

Siting Yoretown's Landfill



OREGON STATE
UNIVERSITY

(Adapted from: Investigating Solid Waste Issues. Ohio Department of Natural Resources)

DESCRIPTION:

Students will use a city map, topographic map, and siting criteria to rank four sites for a city landfill.

PURPOSE/GOALS:

Students will be able to:

- Develop criteria for siting a city landfill
- Use a decision chart to analyze the cost and benefit of each site in relationship to the siting criteria.
- Rank the four sites based on their decision chart analysis

TIME ESTIMATE:

Prep: 10 minutes

Activity: 50-55 minutes

MATERIALS:

Rulers

MATERIAL TO PHOTOCOPY:

1 copy/student of *Siting Yoretown's New Landfill Information Sheet*

1 copy per group of 3-4 students:

- *Map of Yoretown and Buckeye County*
- *Transparency of Topography of Terrain*
- *Site Evaluation Sheets for Sites A, B, C, and D*
- *Landfill Site Comparison worksheet*

BACKGROUND INFORMATION:

Read *Siting Yoretown's New Landfill Information Sheet* along with the students.

TEAM-BUILDING SKILLS:

- Everyone listens to others with care
- Integrating a number of different ideas into a single position
Application: Review T-chart developed in Activity 1. Each team should develop a process that enables all team members to agree on the site ranking.
Assessment: Teacher shares with each team his/her observations of listening skills used. Students record in their Learning Logs the most effective method used to bring group to consensus. What were the factors that created agreement?

NEW WORD LIST:

Topography	Groundwater	Bedrock
Leachate	Subsidence	Terrain
Aquifer	Landfill Liner	

CORRELATION WITH NATIONAL SCIENCE CONTENT STANDARDS:

- Unifying Concepts and Processes: Evidence, models, explanation
Students should use evidence gathered from the maps to support their conclusions about siting the landfill.
- Science in Personal and Social Perspectives: Environmental Quality
Students should analyze the effects on environmental quality of the siting decisions that are made.
- Science in Personal and Social Perspective: Natural and Human-induced Hazards
Students should study the effects of a landfill on human health and the effects of the natural geology and man-made structures on the effects from the site.
- Science in Personal and Social Perspective: Science and Technology in local, national, and global challenges
Students should understand that science and technology could be used to reduce the environmental effects of a hazard such as a landfill.

SUGGESTED LESSON PLAN:**Getting Started**

What Do I Think? Learning Log Prompt: "What information would you need to approve the siting of a landfill in your town?"

Doing the Activity

1. Students should be organized into groups of 3-4. Each team should have a copy of the *Map of Yoretown and Buckeye County* and a transparency of *Topography of Terrain*, so that they can place it over the Yoretown map, and copies of each of the four site evaluation sheets, A-D.
2. Depending upon the time available, the teams can evaluate all of the sites or just one of the sites. If the teams evaluate only one site, they need to designate a spokesperson for the team to present the site evaluation to the class.
3. Students should individually read the criteria (page x) and then as a group decide how to develop the site evaluations.

Wrap-up

1. Have each group place their rankings on the board or overhead under the letters for the site. Do all of the groups agree? If not, have groups defend their order. See if the class can reach consensus on the order. There are pros and cons to all four sites, although two are preferable over the others. Assessment of team responses should be based on the persuasiveness of the student presentations, which should be based upon the facts that they have collected about each site.
2. Hold a mock town meeting. Have teams who have chosen different sites as their first choice present their findings to the town council (the rest of the class) and have the class vote.

ASSESSMENT:

As a member of the technical advisory council, you have been asked to make a presentation to a group of angry neighbors of the site that you are recommending. These folks do not want the landfill in their backyard. Write a persuasive essay to win them over to your point of view.

EXTENSION:

Have students visit the local landfill. Using the criteria in this scenario, how would they assess the location of the landfill?

RESOURCES:

- Investigating Solid Waste Issues, produced by the Ohio Department of Natural Resources, is available through the Ohio Department of Natural Resources. <www.dnr.state.oh.us/odnr/recycling/pages/iswi.htm>.

LANDFILL SITE COMPARISON TEACHER KEY

Goals	Location			
	A	B	C	D
Cost	<i>30.9 mil</i>	<i>23.1 mil</i>	<i>34.2 mil</i>	<i>28.2 mil</i>
Road Access	<i>good</i>	<i>good</i>	<i>good</i>	<i>good</i>
Zoning	<i>rural</i>	<i>farm</i>	<i>industrial</i>	<i>rural</i>
Slope	<i>slight</i>	<i>slight</i>	<i>moderate</i>	<i>moderate slope to river</i>
Soil Depth	<i>4 ft</i>	<i>6 ft</i>	<i>3 ft</i>	<i>1 ft</i>
Soil Type	<i>silty clay</i>	<i>clay</i>	<i>sandy loam</i>	<i>sand</i>
Soil Permeability	<i>low</i>	<i>low</i>	<i>high</i>	<i>high</i>
Bedrock	<i>non-porous</i>	<i>porous</i>	<i>non-porous</i>	<i>porous</i>
Aquifer Depth	<i>65 ft</i>	<i>85 ft</i>	<i>45 ft</i>	<i>35 ft</i>
Danger to Groundwater	<i>moderate</i>	<i>low</i>	<i>low</i>	<i>high</i>
Odors to town	<i>in winter</i>	<i>none</i>	<i>none</i>	<i>in summer</i>
Is the site > 1000 ft from homes?	<i>no</i>	<i>no</i>	<i>no</i>	<i>yes</i>
Is the site > 2000 ft from airport?	<i>yes</i>	<i>no</i>	<i>yes</i>	<i>yes</i>
Is the site >200 ft from river?	<i>yes</i>	<i>yes</i>	<i>yes</i>	<i>no</i>
Is the site > 1000 ft from nature preserve?	<i>yes</i>	<i>yes</i>	<i>yes</i>	<i>no</i>
Distance of Wells or Mines from site	<i>1000 ft</i>	<i>1500 ft</i>	<i>1500 ft</i>	<i>500 ft</i>
Is the site near Public buildings?	<i>no</i>	<i>yes, 2000 ft</i>	<i>no</i>	<i>no</i>

**STUDENT PAGES
FOR
SITING YORETOWN'S LANDFILL
FOLLOW THIS PAGE**

SITING YORETOWN'S NEW LANDFILL INFORMATIONAL SHEET

Yoretown has a solid waste disposal problem. The landfill used for the disposal of its solid waste is near maximum capacity. Since Yoretown is so far from other disposal sites, it would not be cost effective to have the community's waste hauled elsewhere, although this remains an option.

The city council has discussed this problem with the Buckeye Solid Waste Management District Policy Committee. The city council and the solid waste district committee have identified four possible landfill sites for a new county landfill. These are on the outskirts of town. The committee now seeks technical advice on which is the best site. Therefore, the district has established a technical advisory council to investigate these potential sites.

Unless otherwise directed by your instructor, your group, representing the technical advisory council, must evaluate the information on each site. After completing the site evaluation sheets, rank the sites. The best site will meet the most criteria and have the least environmental impact. The number one recommendation must be defended with reasons why the site was selected over the others.

CRITERIA FOR EVALUATION

Geology

1. Slope and terrain – These conditions can be important because they determine how much earth must be moved to prepare the site and which direction the surface water will flow off the site.
2. Soil depth – Shallow soils might not provide enough soil for daily cover of the landfill. (Alternative covers, such as foam or canvas blanket, can be used to cover the landfill day by day when soil is difficult to obtain, but at an additional cost)
3. Soil type and permeability – Soil type will influence the permeability at the landfill site. As a rule of thumb, clay soils will have lower permeability than sandy soils (Table 1). The more permeable the soil, the more chance that rainwater can collect in the landfill and become a carrier for leachate (chemicals from the trash). The more impermeable the soil layer at the bottom of the landfill, the less likely leachate can seep through to the groundwater.

Table 1.

Soil Particle Type	Particle size Diameter (mm)	Permeability
Clay	Below 0.002	Very slow
Silt	0.05 - 0.002	Slow
Very Fine Sand	0.10 - 0.05	Moderately Slow
Fine Sand	0.25 - 0.10	Moderate
Medium Sand	0.5 - 0.25	Moderately Rapid
Coarse Sand	1.0 - 0.5	Rapid
Very Coarse Sand	2.0 - 1.0	Very Rapid

4. Bedrock – Exposed bedrock can have pores or fractures that allow the water to flow through. Bedrock of a less porous nature and, without fractures, lessens the chance for liquids to drain out of the landfill.

Groundwater

Depth of uppermost aquifer system – Many farms and cities rely on groundwater for drinking water. Sites close to an existing water well or well field should be carefully evaluated. There should be at least 15 feet between the bottom of the landfill (landfill liner) and the uppermost aquifer.

Gas Migration

Potential explosive gas migration – Over a period of time as waste decomposes, explosive gases such as methane can develop. Potential pathways for this gas to migrate beyond the landfill include underground utility structures such as sewers, water lines or electric cables, pipelines, oil wells, and gas wells. These should not be within 1000 feet of the landfill.

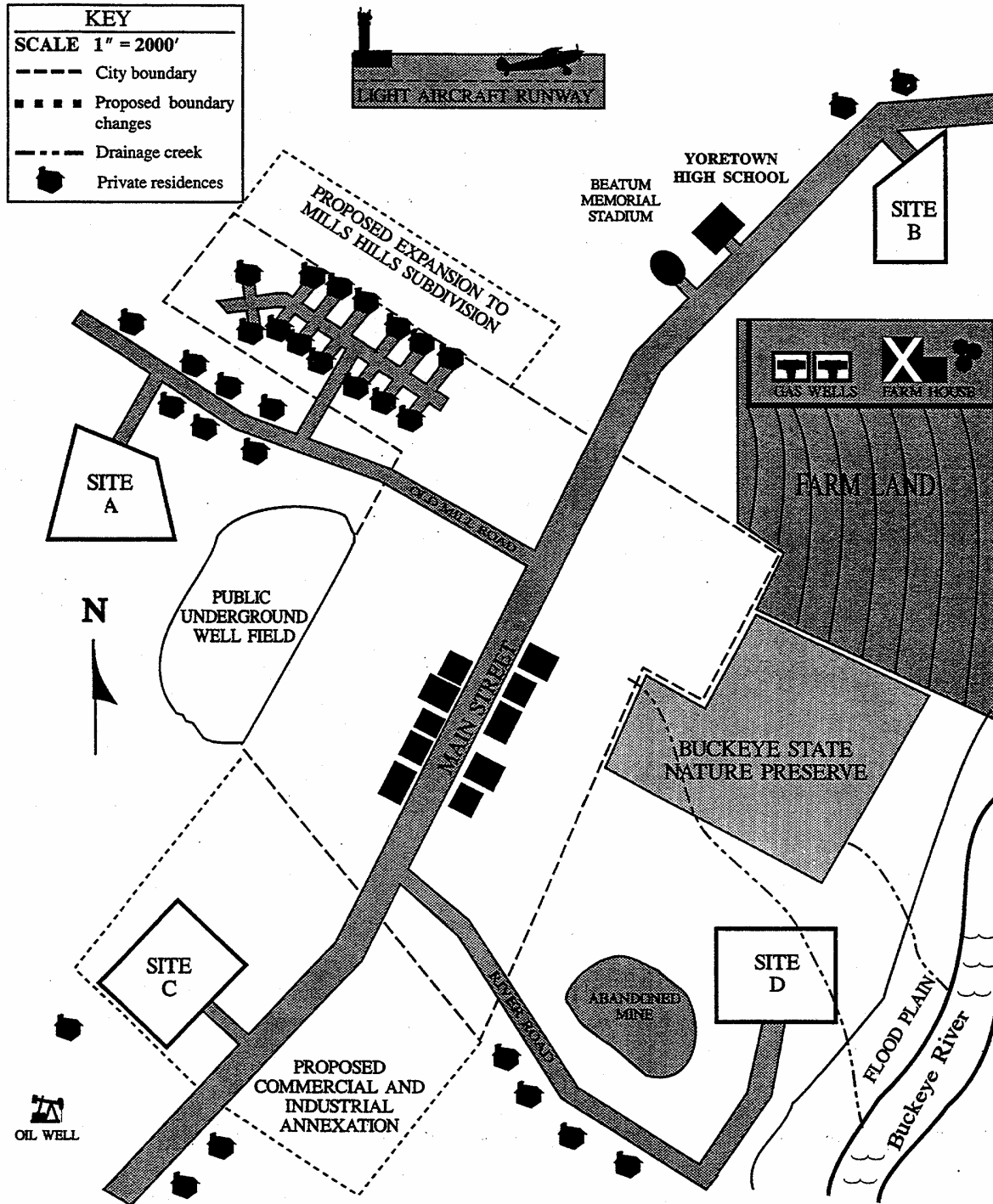
Wells, Mines, and Quarries

Wells, mines, and quarries can be sources of potential subsidence, especially if within 2,000 feet of the buried solid waste. Subsidence can cause rupturing of the liner systems which are designed to contain hazardous liquids that collect at the bottom of landfills.

Other Issues

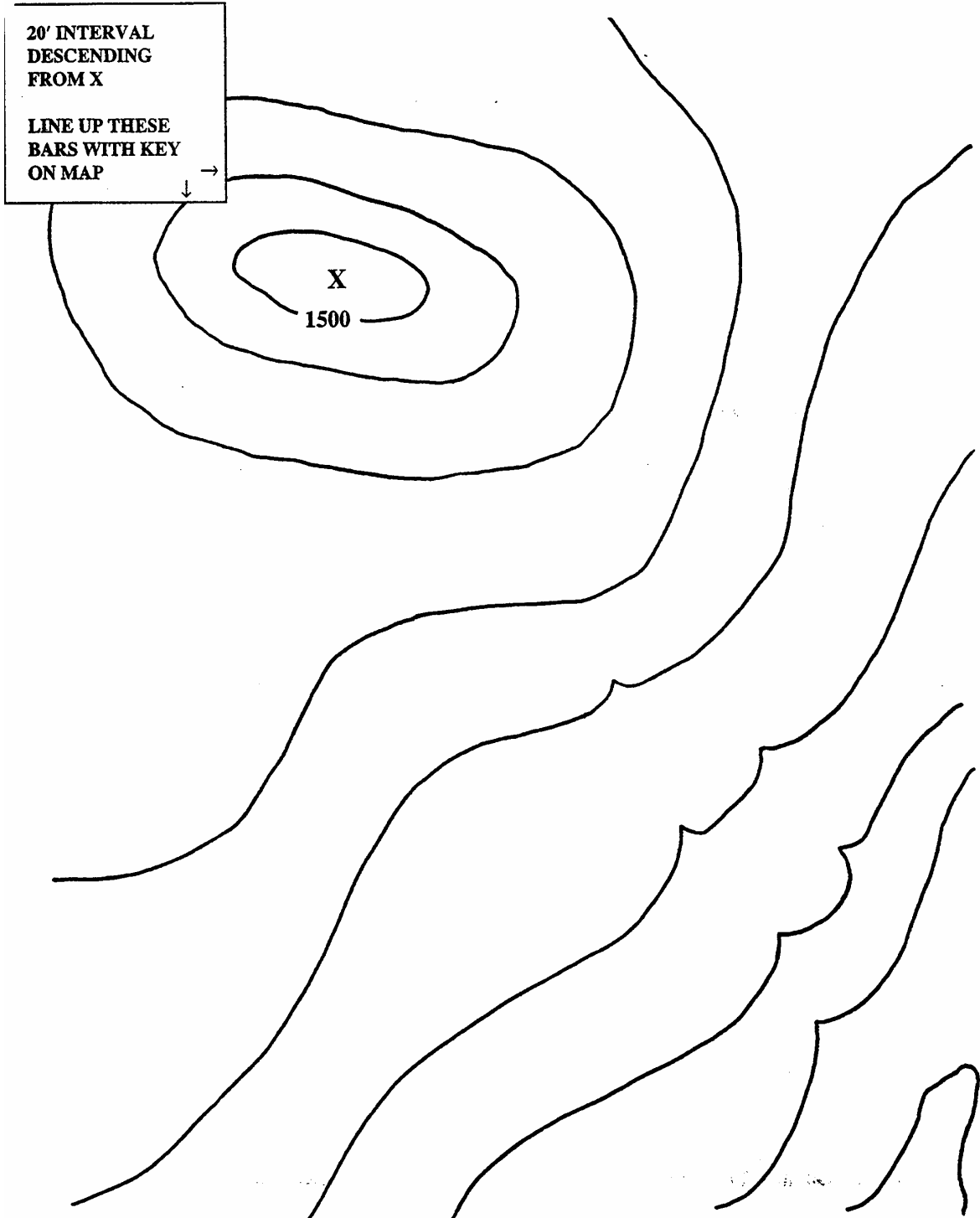
1. Access – Can trucks get to it? Can traffic be managed?
2. Zoning and land use – What is the land currently used for? Is the land more valuable for those uses? How will a landfill affect growth and development in general, and in particular, at this specific site?
3. Location – Would the presence of a landfill cause any detriment to an already established cultural feature?
4. Residence – No solid waste placement can be within 1,000 feet of a home whose owner has not consented to construction of the landfill.
5. Natural features – Generally it is unacceptable to locate solid waste landfill within 200 feet of a stream, lake or natural wetland unless proof of satisfactory diversion of stream or protection of the lake is offered.
6. Airports – If solid waste is placed within 10,000 feet of an airport serving turbine-powered aircraft or within 5,000 feet of an airport serving piston-type aircraft, the permit application must demonstrate that the facility will not pose a bird hazard to aircraft.
7. Nature preserves – A landfill cannot be located within 1000 ft of nature preserves.

MAP OF YORETOWN AND BUCKEYE COUNTY



Investigating Solid Waste Issues, Ohio Department of Natural Resources

TOPOGRAPHY OF TERRAIN



Investigating Solid Waste Issues: Ohio Department of Natural Resource

Name _____

Site A Evaluation

Location:

N NE E SE S SW W NW of Town

Prevailing Wind Direction: from NW in winter and SE in summer.

Description of Site: zoning and land use (residential, farming, industrial, etc.), location relative to other features (buildings, parks, etc.).

Number of Acres: 100

Cost Appraisal of Property: \$900,000

Landfill Development Costs: \$300,000/ acre

Soil Depth: 4'

Soil Type: Silty clay

Bedrock: Shale

Uppermost Aquifer: 65'

Total Cost: _____

Access: _____

Slope and Terrain: _____

Soil Characteristics: _____

Soil Permeability: _____

Danger to Water Table: _____

Potential Direction of Odors: _____

Suitability of the Site:

Pros: _____

Cons: _____

Conclusion: _____

Name _____

Site B Evaluation

Location:

N NE E SE S SW W NW of Town

Prevailing Wind Direction: from NW in winter and SE in summer.

Description of Site: zoning and land use (residential, farming, industrial, etc.), location relative to other features (buildings, parks, etc.).

Number of Acres: 80

Cost Appraisal of Property: \$700,000

Landfill Development Costs: \$280,000/ acre

Soil Depth: 6'

Soil Type: Clay

Bedrock: Fractured limestone

Uppermost Aquifer: 85'

Total Cost: _____

Access: _____

Slope and Terrain: _____

Soil Characteristics: _____

Soil Permeability: _____

Danger to Water Table: _____

Potential Direction of Odors: _____

Suitability of the Site:

Pros: _____

Cons: _____

Conclusion: _____

Name _____

Site C Evaluation

Location:

N NE E SE S SW W NW of Town

Prevailing Wind Direction: from NW in winter and SE in summer.

Description of Site: zoning and land use (residential, farming, industrial, etc.), location relative to other features (buildings, parks, etc.).

Number of Acres: 110

Cost Appraisal of Property: \$1,200,000

Landfill Development Costs: \$300,000/ acre

Soil Depth: 3'

Soil Type: Sandy loam

Bedrock: Clay

Uppermost Aquifer: 45'

Total Cost: _____

Access: _____

Slope and Terrain: _____

Soil Characteristics: _____

Soil Permeability: _____

Danger to Water Table: _____

Potential Direction of Odors: _____

Suitability of the Site:

Pros: _____

Cons: _____

Conclusion: _____

Name _____

Site D Evaluation

Location:

N NE E SE S SW W NW of Town

Prevailing Wind Direction: from NW in winter and SE in summer.

Description of Site: zoning and land use (residential, farming, industrial, etc.), location relative to other features (buildings, parks, etc.).

Number of Acres: 90

Cost Appraisal of Property: \$300,000

Landfill Development Costs: \$310,000/ acre

Soil Depth: 1'

Soil Type: Sand

Bedrock: Fractured limestone

Uppermost Aquifer: 35'

Total Cost: _____

Access: _____

Slope and Terrain: _____

Soil Characteristics: _____

Soil Permeability: _____

Danger to Water Table: _____

Potential Direction of Odors: _____

Suitability of the Site:

Pros: _____

Cons: _____

Conclusion: _____

Name _____

LANDFILL SITE COMPARISON

Goals	Location			
	A	B	C	D
Cost				
Road Access				
Zoning				
Slope				
Soil Depth				
Soil Type				
Soil Permeability				
Bedrock				
Aquifer Depth				
Danger to Groundwater				
Odors to town				
Is the site > 1000 ft from homes?				
Is the site > 2000 ft from airport?				
Is the site >200 ft from river?				
Is the site > 1000 ft from nature preserve?				
Distance of Wells or Mines from site				
Is the site near Public buildings?				