

Quickwrite Mind Map: War

War

Background: The Manhattan Project

"The effects could well be called unprecedented, magnificent, beautiful, stupendous and terrifying. No man-made phenomenon of such tremendous power had ever occurred before. The lighting effects beggared description. The whole country was lighted by a searing light with the intensity many times that of the midday sun. It was golden, purple, violet, gray and blue. It lighted every peak, crevasse and ridge of the nearby mountain range with a clarity and beauty that cannot be described but must be seen to be imagined. It was the beauty the great poets dream about but describe most poorly and inadequately." -- Brigadier General Thomas F. Farrell, Deputy Commander to General Leslie R Groves

"We knew the world would not be the same. A few people laughed, a few people cried, most people were silent. I remembered the line from the Hindu scripture, the Bhagavad-Gita. Vishnu is trying to persuade the Prince that he should do his duty and to impress him takes on his multi-armed form and says, 'Now, I am become Death, the destroyer of worlds.' I suppose we all felt that one way or another." -- J. Robert Oppenheimer, Scientific Director of the Manhattan Project

1 The United States **detonated** the world's first atomic bomb at Trinity Site in the southern New Mexico desert at 5:29:45 AM mountain time on July 16, 1945. The **detonation** was the key test of a top secret effort, code named the Manhattan Project, to build and deploy atomic weapons in time to affect the outcome of World War II. Carried out by the Army under the direction of General Leslie R. Groves, it was the largest and boldest combined scientific and industrial effort ever attempted.

2 The project was conceived in 1939 when Albert Einstein wrote to President Franklin Roosevelt of the need to develop nuclear weapons before the Germans, who were known to have begun research on an atomic bomb. The atom had been split for the first time in a Berlin laboratory in 1938, and the **principle of nuclear fission** was generally understood by the world's scientific community. Prewar atomic research was limited in the United States, but in December 1942 under the auspices of the Manhattan Project, Enrico Fermi and his colleagues at the University of Chicago's **Metallurgical** Laboratory produced the world's first **sustained nuclear reaction**.

3 While the construction of an atomic bomb was considered scientifically **feasible**, the

technology for producing fissionable material on anything greater than a laboratory scale was unknown, and methods for using the material to make a bomb were largely unexplored by American scientists. Two fissionable materials for the bomb were considered: uranium-235 and plutonium-239. Scientists at the University of California at Berkeley, at Columbia University, and at a specially formed secret organization in New York called Kellogg carried out research on separating the **isotope** U-235 from the naturally occurring element U-238. Concurrently, the University of Chicago conducted research on plutonium.

detonated/detonation - exploded/explosion

principle of nuclear fission - the process in which uranium breaks up into two lighter atoms and emits radioactive products, 2-3 neutrons, and releases large quantities of energy.

Metallurgical – expertise with the science and technology of metals

sustained nuclear reaction - the chain reaction effect of fission observed with "pure" uranium

feasible – able to be done successfully

isotope - the forms of an element that differ in the number of neutrons in an atom

4 In 1943 and 1944, a huge **facility** for the separation of U-235 was constructed at Oak Ridge, Tennessee. It had two sites, one for separation by the electromagnetic process, and one for the separation by gaseous (and later thermal) diffusion. The Oak Ridge facility covered 54,000 acres and, at its peak in May 1945, employed 82,000 people. Concurrently, another giant **industrial complex** was built at Hanford, Washington, for plutonium production. It occupied a 600 square mile site and employed over 45,000 people.

5 Major industrial and engineering firms involved in building and operating the **electromagnetic separation** plant at Oak Ridge were Allis-Chalmers, General Electric, Stone and Webster, Tennessee Eastman, and Westinghouse. Those involved in the **gaseous and thermal diffusion processes** were Allis-Chalmers, Houdaille-Hershey, Chrysler Corporation, Kellogg, Union Carbide, H.K. Ferguson, and J.A. Jones Construction. The Dupont Corporation built and managed the Hanford Plutonium plant.

6 Meanwhile, a secret scientific laboratory under the direction of **J. Robert Oppenheimer** was established at Los Alamos, New Mexico, to design and assemble the actual uranium- and plutonium-based atomic weapons. The laboratory site was selected in late 1942 and the first **contingent** of scientists arrived in March 1943. By June, 250 scientific personnel were at work on the physical, chemical, and

metallurgical aspects of the bomb's development. Two dozen scientists who had been performing related work in Britain, including Neils Bohr, later joined the Los Alamos effort under a secret agreement between Roosevelt and Churchill. At war's end, the work force at Los Alamos numbered over 2,500.

facility – building

industrial complex – a group of buildings that house production plants, labs and offices

electromagnetic separation – process that uses magnetic fields to separate out the more fissionable U-235 isotope from the U-238

gaseous and thermal diffusion processes – two methods used to separate out the fissionable U-235 isotope. (One process forced gaseous uranium through membranes while the other used heat transfer to force separation.)

J. Robert Oppenheimer – Theoretical physicist who was the highly respected scientific director of the Manhattan Project. Under his guidance, the Los Alamos site was constructed, top scientists collaborated to create the atomic bomb, and all manner of theoretical, mechanical, and day to day problems were managed.

contingent – group

This reading contains excerpts from the “Written Historical and Descriptive Data” section of the Trinity Site Report, HAER No. NM-1A. by Historian William A. Brenner, AIA, in November 1985.

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, D.C. 20013-7127

<http://lcweb2.loc.gov/pnp/habshaer/nm/nm0100/nm0139/data/nm0139data.pdf>

Background: The Manhattan Project **Key to Highlighting**

"The effects could well be called unprecedented, magnificent, beautiful, stupendous and terrifying. No man-made phenomenon of such tremendous power had ever occurred before. The lighting effects beggared description. The whole country was lighted by a searing light with the intensity many times that of the midday sun. It was golden, purple, violet, gray and blue. It lighted every peak, crevasse and ridge of the nearby mountain range with a clarity and beauty that cannot be described but must be seen to be imagined. It was the beauty the great poets dream about but describe most poorly and inadequately." -- Brigadier General Thomas F. Farrell, Deputy Commander to General Leslie R Groves

"We knew the world would not be the same. A few people laughed, a few people cried, most people were silent. I remembered the line from the Hindu scripture, the Bhagavad-Gita. Vishnu is trying to persuade the Prince that he should do his duty and to impress him takes on his multi-armed form and says, 'Now, I am become Death, the destroyer of worlds.' I suppose we all felt that one way or another." -- J. Robert Oppenheimer, Scientific Director of the Manhattan Project

1 The **[United States]** detonated the world's first atomic bomb at **[Trinity Site]** in the southern **[New Mexico desert]** at 5:29:45 AM mountain time on July 16, 1945. The detonation was the key test of a top secret effort, code named the Manhattan Project, to build and deploy atomic weapons in time to affect the outcome of World War II. Carried out by the Army under the direction of **General Leslie R. Groves**, it was the largest and boldest combined scientific and industrial effort ever attempted.

2 The project was conceived in 1939 when **Albert Einstein** wrote to **President Franklin Roosevelt** of the need to develop nuclear weapons before the Germans, who were known to have begun research on an atomic bomb. The atom had been split for the first time in a **[Berlin]** laboratory in 1938, and the principle of nuclear fission was generally understood by the world's scientific community. Prewar atomic research was limited in the **[United States]**, but in December 1942 under the auspices of the Manhattan Project, **Enrico Fermi** and his colleagues at the **[University of Chicago's]** **Metallurgical** Laboratory produced the world's first sustained nuclear reaction.

3 While the construction of an atomic bomb was considered scientifically feasible, the technology for producing fissionable material on anything greater than a laboratory scale was unknown, and methods for using the material to make a bomb were largely unexplored by American scientists. Two fissionable materials for the bomb were considered: uranium-235 and plutonium-239. Scientists at the **[University of California at Berkeley]**, at **[Columbia University]**, and at a specially formed secret organization in **[New York]** called Kellogg carried out research on separating the isotope U-235 from the naturally occurring element U-238. Concurrently, the **[University of Chicago]** conducted research on plutonium.

detonated/detonation - exploded/explosion

principle of nuclear fission - the process in which uranium breaks up into two lighter atoms and emits radioactive products, 2-3 neutrons, and releases large quantities of energy.

Metallurgical – expertise with the science and technology of metals

sustained nuclear reaction - the chain reaction effect of fission observed with "pure" uranium

feasible – able to be done successfully

isotope - the forms of an element that differ in the number of neutrons in an atom

4 In 1943 and 1944, a huge **facility** for the separation of U-235 was constructed at **[Oak Ridge, Tennessee]**. It had two sites, one for separation by the electromagnetic process, and one for the separation by gaseous (and later thermal) diffusion. The **[Oak Ridge]** facility covered 54,000 acres and, at its peak in May 1945, employed 82,000 people. Concurrently, another giant **industrial complex** was built at **[Hanford, Washington]**, for plutonium production. It occupied a 600 square mile site and employed over 45,000 people.

5 Major industrial and engineering firms involved in building and operating the **electromagnetic separation** plant at **[Oak Ridge]** were Allis-Chalmers, General Electric, Stone and Webster, Tennessee Eastman, and Westinghouse. Those involved in the **gaseous and thermal diffusion processes** were Allis-Chalmers, Houdaille-Hershey, Chrysler Corporation, Kellogg, Union Carbide, H.K. Ferguson, and J.A. Jones Construction. The Dupont Corporation built and managed the **[Hanford]** Plutonium plant.

6 Meanwhile, a secret scientific laboratory under the direction of **J. Robert Oppenheimer** was established at **[Los Alamos, New Mexico]**, to design and assemble the actual uranium- and plutonium-based atomic weapons. The laboratory site was selected in late 1942 and the first **contingent** of scientists arrived in March 1943. By June, 250 scientific personnel were at work on the physical, chemical, and

metallurgical aspects of the bomb's development. Two dozen scientists who had been performing related work in **[Britain]**, including **Neils Bohr**, later joined the **[Los Alamos]** effort under a secret agreement between **Roosevelt** and **Churchill**. At war's end, the work force at **[Los Alamos]** numbered over 2,500.

facility – building

industrial complex – a group of buildings that house production plants, labs and offices

electromagnetic separation – process that uses magnetic fields to separate out the more fissionable U-235 isotope from the U-238

gaseous and thermal diffusion processes – two methods used to separate out the fissionable U-235 isotope. (One process forced gaseous uranium through membranes while the other used heat transfer to force separation.)

J. Robert Oppenheimer – Theoretical physicist who was the highly respected scientific director of the Manhattan Project. Under his guidance, the Los Alamos site was constructed, top scientists collaborated to create the atomic bomb, and all manner of theoretical, mechanical, and day to day problems were managed.

contingent – group

This reading contains excerpts from the “Written Historical and Descriptive Data” section of the Trinity Site Report, HAER No. NM-1A. by Historian William A. Brenner, AIA, in November 1985.

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, D.C. 20013-7127

<http://lcweb2.loc.gov/pnp/habshaer/nm/nm0100/nm0139/data/nm0139data.pdf>

Manhattan Project Worksheet

Before reading the article, read the quotes by Brigadier General Thomas F. Farrell General and J. Robert Oppenheimer.

- What event are the two men describing?

- In what manner are their descriptions similar?

- In what manner are their descriptions different?

- 1) What was the overall mission of the Manhattan Project?

- 2) Why did Einstein advise FDR that atomic research needed to be urgently “fast-tracked?”

- 3) What was significant about Fermi’s work at the Metallurgical Lab in Chicago?

- 4) Although construction of an atomic bomb was scientifically feasible, what two major challenges needed to be resolved before one could be built?

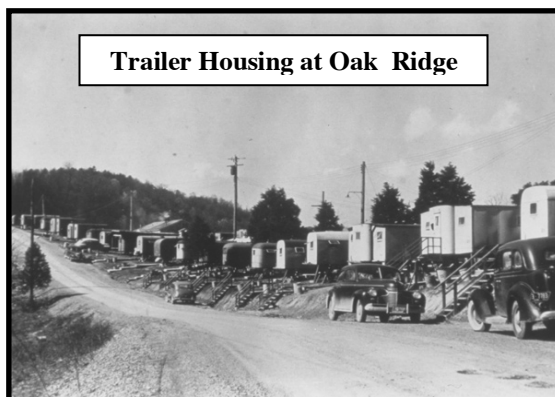
- ---

- ---

- 5) What two isotopes were identified as the best fissionable materials?

- ---

- ---



6) To produce enough fissionable material for the research and development of the atomic bomb, two major industrial complexes were constructed. Refer back to the reading (paragraphs #4 & #5) to help fill in the missing information below.

Site Name	State	Size	Workforce	Fissionable Material Produced
	TN			
			45,000+	

7) How was the Los Alamos site different from the Oak Ridge and Hanford sites?

8) What were some of the responsibilities J. Robert Oppenheimer had as scientific director of the Manhattan Project?

- ---
- ---

9) For purposes of national security, the three “secret cities” of Oak Ridge, Hanford and Los Alamos had to be constructed and operated under a total veil of secrecy.

What precautions and measures do you infer were put in place to maintain secrecy?

(Think-Pair-Share with a partner to come up with three rules or procedures.)

- ---
- ---
- ---

The Manhattan Project Worksheet **Answer Key**

Before reading the article, read the quotes by Brigadier General Thomas F. Farrell General and J. Robert Oppenheimer.

- What event are the two men describing?

Both are describing their witnessing of the first atomic test explosion.

- In what manner are their descriptions similar?

Both describe the atomic blast as otherworldly and of great unspeakable power.

- In what manner are their descriptions different?

Farrell describes the unbelievable intensity and changing colors of the light while Oppenheimer describes the various reactions of the people who witnessed the blast.

- 1) What was the overall mission of the Manhattan Project?

The mission was to build and detonate an atomic weapon in time to affect the direction of WWII.

- 2) Why did Einstein advise FDR that atomic research needed to be urgently “fast-tracked?”

Einstein felt atomic research was needed because the Germans had already begun nuclear fission research in their labs and the danger existed that they could very well develop nuclear weapons first.

- 3) What was significant about Fermi’s work at the Metallurgical Lab in Chicago?

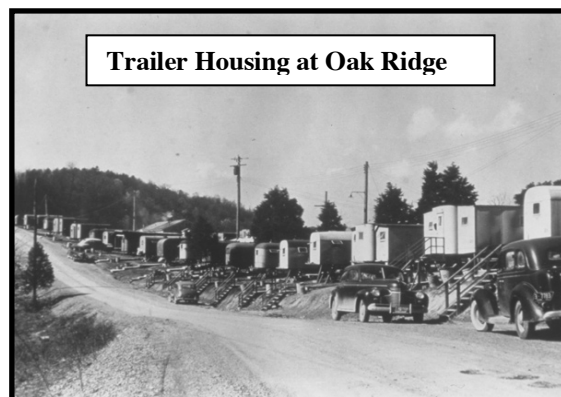
Fermi had produced the first ever sustained nuclear reaction, or chain reaction of uranium, which if controlled could lead to the creation of an atomic bomb.

- 4) Although construction of an atomic bomb was scientifically feasible, what two major challenges needed to be resolved before one could be built?

- *The technology for producing large enough quantities of fissionable materials was needed.*
- *The methods for using the fissionable materials to make a bomb were needed.*

- 5) What two isotopes were identified as the best fissionable materials?

- *Uranium-235*
- *Plutonium-239*



6) To produce enough fissionable material for the research and development of the atomic bomb, two major industrial complexes were constructed. Refer back to the reading (paragraphs #4 & #5) to help fill in the missing information below.

Site Name	State	Size	Workforce	Fissionable Material Produced
<i>Oak Ridge</i>	TN	<i>54,000 acres</i>	<i>82,000 people</i>	<i>Produced U-235</i>
<i>Hanford</i>	WA	<i>600 sq mi</i>	<i>45,000+</i>	<i>Produced Plutonium</i>

7) How was the Los Alamos site different from the Oak Ridge and Hanford sites?

The purpose of the Los Alamos site was to function as a scientific laboratory for the R & D (research and development) of atomic weapons. Oak Ridge and Hanford were the sites needed to produce the uranium and plutonium needed to construct the bomb.

8) What were some of the responsibilities J. Robert Oppenheimer had as scientific director of the Manhattan Project?

- *He directed the construction of the lab site & guided the scientific team's collaborative efforts.*
- *He managed all problems that arose at the lab: theoretical, mechanical, and day to day issues.*

9) For purposes of national security, the three "secret cities" of Oak Ridge, Hanford and Los Alamos had to be constructed and operated under a total veil of secrecy.

What precautions and measures do you infer were put in place to maintain secrecy?

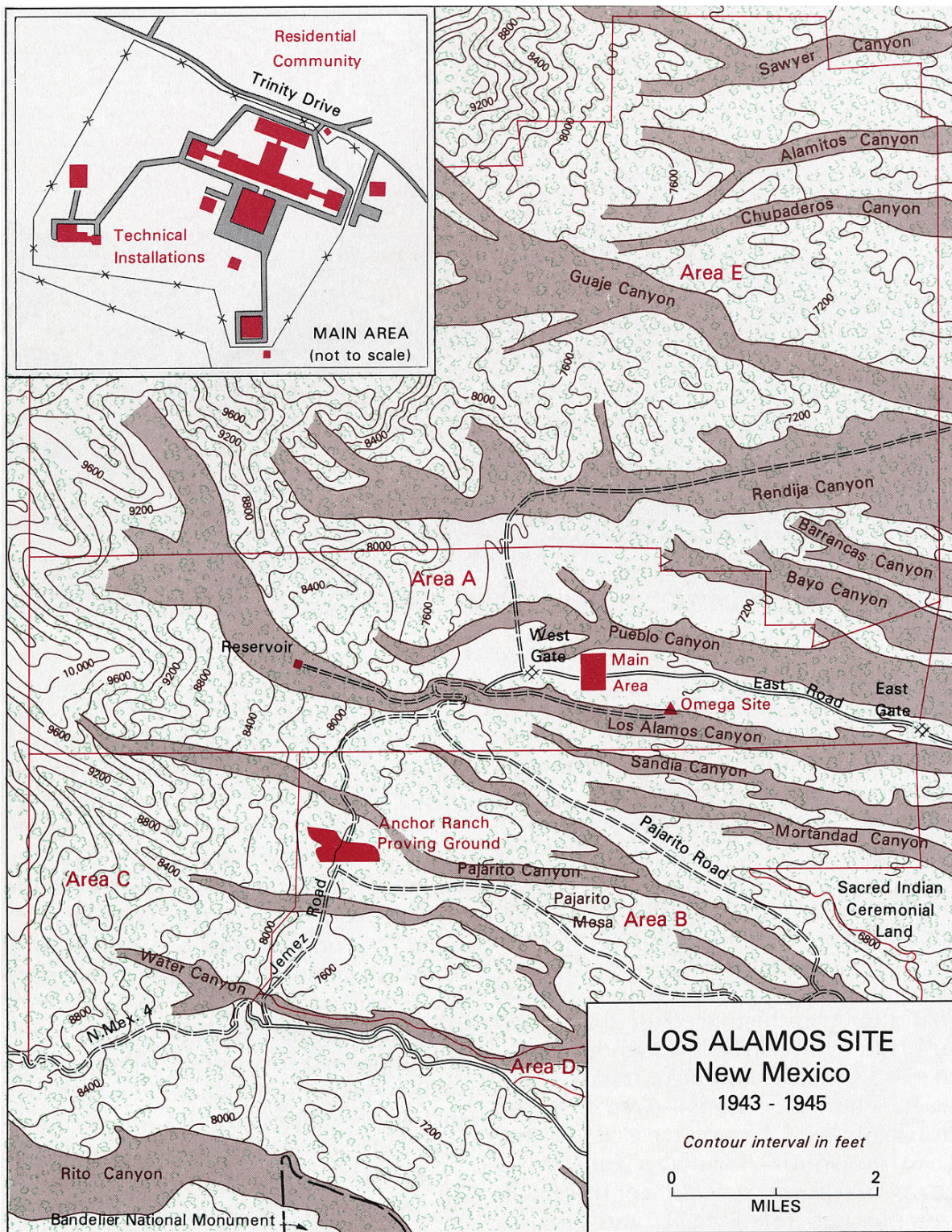
(Think-Pair-Share with a partner to come up with three rules or procedures.)

- *The sites were probably located in isolated locations and were heavily guarded.*
- *There were probably restrictions about what you could talk about in letters & on the phone.*
- *People were probably only given minimal information about the purpose of their work.*

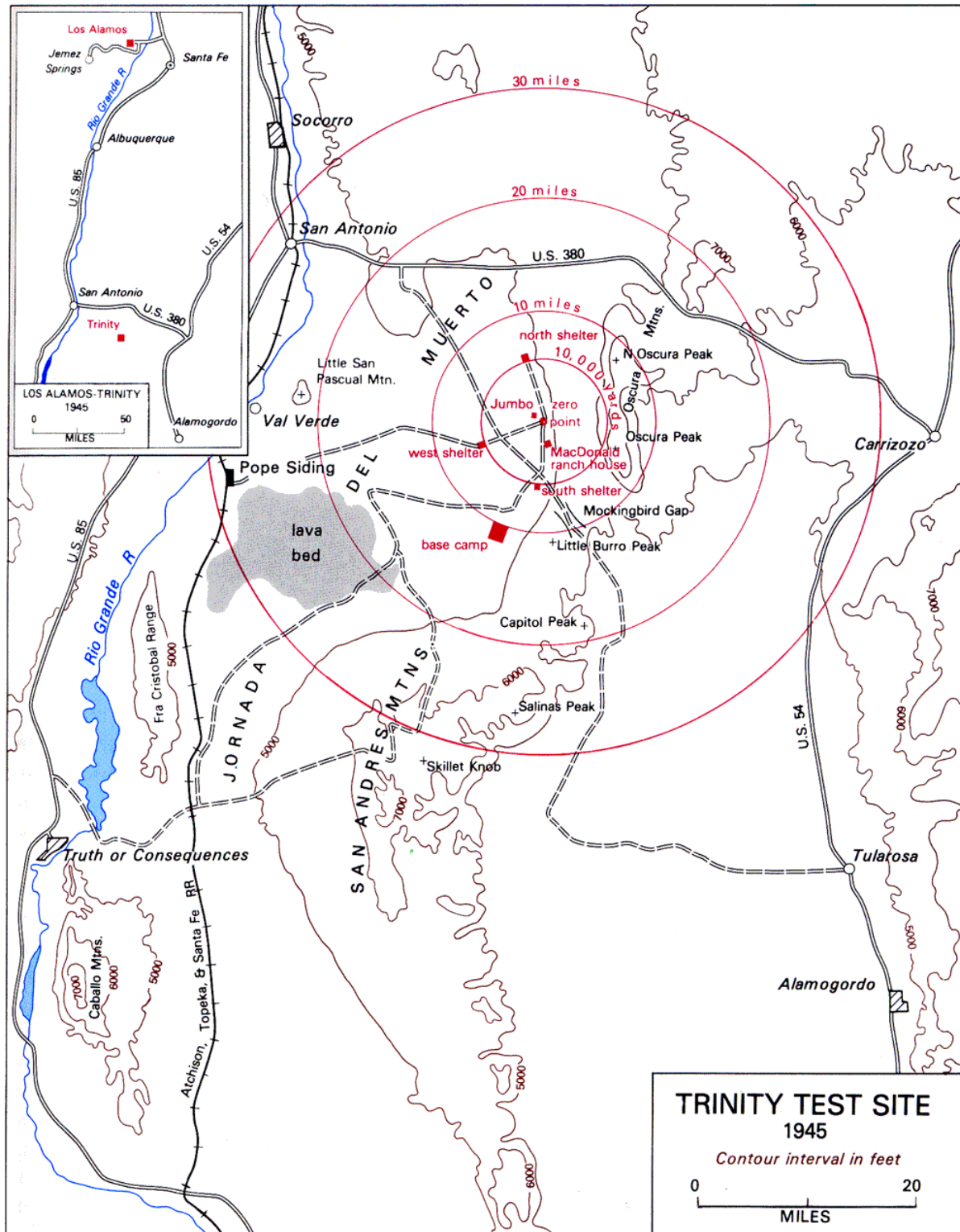




Clinton Engineering Works. Reprinted from Vincent C. Jones, Manhattan: The Army and the Atomic Bomb (Washington, D.C.: U.S. Government Printing Office, 1985)



Los Alamos. Reprinted from Vincent C. Jones, Manhattan: The Army and the Atomic Bomb (Washington, D.C.: U.S. Government Printing Office, 1985)



Trinity Test Site. Reprinted from Vincent C. Jones, *Manhattan: The Army and the Atomic Bomb* (Washington, D.C.: U.S. Government Printing Office, 1985)

Map Analysis Worksheet: _____

(Name of Manhattan Project site)

Analyze: Look at your assigned Manhattan Project map, then work with your group to analyze it.

1. What do you notice first? _____
2. Complete the following chart based upon the features you see in the map.

List the colors used.	Describe the shapes used.	Describe the lines used.	List labels used.
What do the different colors symbolize?	What do the different shapes symbolize?	What do the different lines symbolize?	What do the different label styles symbolize?

3. Describe anything on the map that appears strange, unfamiliar, or that you do not understand.

4. What is the **title** of this historical map?

Historical maps show how a location looked during a specific time period. According to the title, what time period does this map show? _____

5. When was the map **made**? _____ What clues on the map indicate this **date**?

6. This map is missing a **legend**. Create a legend below for the most important symbols & colors used.

<p style="text-align: center;">Legend</p>
--

7. Does the map contain an **inset map**, a small map inside a larger one? ☐ Yes ☐ No

If “yes,” what additional information does the **inset map** reveal about this place?

8. How is **scale**, or actual distance, measured on the map? _____

Contour lines are lines on a map that join points of equal elevation (height) above sea level. You will see the elevations marked on the contour lines. The change in elevation between one **contour line** and the next is the **contour** interval. To determine elevations, pay attention to the amount of space in between lines. If the contours are close together, you're looking at a steep slope. If the contours have wide spaces in between -- or aren't there at all -- the terrain is relatively flat.

9. What information do the **contour lines** reveal about the terrain (landforms) of this Manhattan Project site?

10. Are there any bodies of water on the map? ☐ Yes ☐ No If “yes,” describe the type of water featured:

11. Based upon your answers to Questions #9 & #10, explain how the natural geography features (land & water) may have influenced the decision to establish this location as a Manhattan Project site.

12. How might human geography features (roads, highways, railroads) have influenced the decision to establish this location as a Manhattan Project site?

Map Analysis Worksheet: Hanford, Washington Answer Key

(Name of Manhattan Project site)

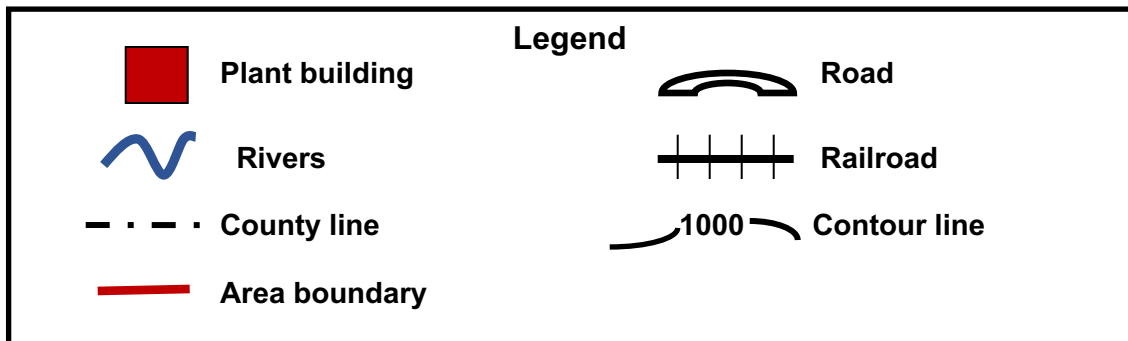
Analyze: Look at your assigned Manhattan Project map, then work with your group to analyze it.

1. What do you notice first? Answers will vary
2. Complete the following chart based upon the features you see in the map.

List the colors used.	Describe the shapes used.	Describe the lines used.	List labels used.
<p>Blue</p> <p>Red</p> <p>Black</p>	<p>Rectangles</p> <p>Polygons</p> <p>Curvy shapes</p>	<p>Straight</p> <p>Squiggly</p> <p>Diagonal</p> <p>Zig-zag</p> <p>Dashed</p> <p>Tracks</p>	<p>Numbers</p> <p><u>Area:</u> A / B / C / D / E</p> <p><u>County:</u> Franklin, Adams, Benton, Yakima, Kittitas</p> <p><u>City:</u> Beverly, White Bluffs, Hanford, Richland, Pasco, Benton City, Kennewick</p> <p><u>RR:</u> Chicago, Milwaukee, St. Paul, & Pacific, Union Pacific, Northern Pacific</p> <p><u>River:</u> Columbia, Yakima</p> <p><u>Road:</u> Wash 11A, US 410, Richland Hanford, Wash 3</p> <p><u>Mountains:</u> Saddle, Gable, Rattlesnake Hills</p> <p><u>Human-made Features:</u> Priest Rapids Irrigation District & Riverland Yard</p>
What do the different colors symbolize?	What do the different shapes symbolize?	What do the different lines symbolize?	What do the different label styles symbolize?
<p>Blue = Water</p> <p>Red = Buildings + Boundaries</p> <p>Black = Boundaries Roads, Railroads & Contour Lines</p>	<p>Rectangles = Buildings</p> <p>Polygons = Counties & Areas</p> <p>Curvy shapes = Rivers. Contour Intervals</p>	<p>Straight = Roads</p> <p>Squiggly = Contour, rivers, & roads</p> <p>Diagonal = Roads</p> <p>Zig-zag = Area Boundaries</p> <p>Dashed = County boundaries</p> <p>Tracks = Railroads</p>	<p><i>Bold Italics</i> = Cities</p> <p>Blue Text = Rivers</p> <p>Red Text = Areas</p> <p>Smaller Font Size = RR, Roads, Counties, Mountains, Human-made Features</p>

3. Describe anything on the map that appears strange, unfamiliar, or that you do not understand.
Answers will vary
4. What is the **title** of this historical map? Hanford Engineer Works, Washington 1943-1945
Historical maps show how a location looked during a specific time period. According to the title, what time period does this map show? 1943-1945, During WWII
5. When was the map **made**? 1985 What clues on the map indicate this **date**?
In the citation (or caption) at the bottom of the map

6. This map is missing a **legend**. Create a legend below for the most important symbols & colors used.



7. Does the map contain an **inset map**, a small map inside a larger one? ☒ Yes ☐ No
If "yes," what additional information does the **inset map** reveal about this place?

It shows the Hanford site is located in the SW region of the state of Washington.

8. How is **scale**, or actual distance, measured on the map? One inch = 7 miles

Contour lines are lines on a map that join points of equal elevation (height) above sea level. You will see the elevations marked on the contour lines. The change in elevation between one **contour line** and the next is the **contour interval**. To determine elevations, pay attention to the amount of space in between lines. If the contours are close together, you're looking at a steep slope. If the contours have wide spaces in between -- or aren't there at all -- the terrain is relatively flat.

9. What information do the **contour lines** reveal about the terrain (landforms) of this Manhattan Project site?
Hanford and all the cities are located within 5 miles of the rivers on flat land. Area A And Area D, where the majority of plant buildings are located are all on flat land. About 5 miles north of the river, the land rises from 1000 to 2000 ft (Saddle Mts). Likewise, 5 miles south of the river, the land rises to 2000 ft (Rattlesnake Hills).

10. Are there any bodies of water on the map? ☒ Yes ☐ No If "yes," describe the type of water featured:
Columbia River & Yakima River

11. Based upon your answers to Questions #9 & #10, explain how the natural geography features (land & water) may have influenced the decision to establish this location as a Manhattan Project site.

The Hanford site needed a location that was relatively flat for construction of its plant buildings as well as a location close to a river for water needed to cool the plants and drinking water for the residents.

12. How might human geography features (roads, highways, railroads) have influenced the decision to establish this location as a Manhattan Project site?

The Hanford site needed a location that was accessible by road for transportation and to receive supplies once established. Hanford is located directly next to Wash 11A with US 410 about 20 miles south. The Union Pacific RR runs directly through Area C making delivery of industrial equipment possible.

Map Analysis Worksheet: Oak Ridge, Tennessee Answer Key

(Name of Manhattan Project site)

Analyze: Look at your assigned Manhattan Project map, then work with your group to analyze it.

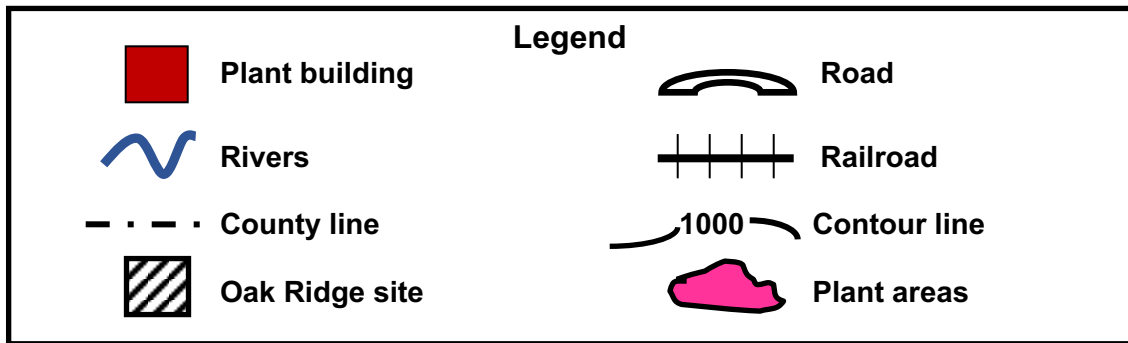
1. What do you notice first? Answers will vary
2. Complete the following chart based upon the features you see in the map.

List the colors used.	Describe the shapes used.	Describe the lines used.	List labels used.
<p>Blue</p> <p>Red</p> <p>Pink</p> <p>Black</p> <p>Green</p>	<p>Rectangles</p> <p>Polygons</p> <p>Curvy shapes</p>	<p>Straight</p> <p>Squiggly</p> <p>Diagonal</p> <p>Dashed</p> <p>Tracks</p>	<p>Numbers</p> <p><u>Buildings:</u> Power Plant, S-50, K-25, K-27, X-10, Y-12</p> <p><u>County:</u> Anderson, Roane</p> <p><u>City:</u> Oak Ridge</p> <p><u>Water:</u> Clinch River, Poplar Creek</p> <p><u>Road:</u> Oak Ridge Turnpike, Bear Creek Rd, Bethel Valley Rd, Old Tenn 61, Scaboro Rd, White Wing Rd</p> <p><u>Valley:</u> East Fork, Gamble, Bethel, Bear Creek</p> <p><u>Ridge:</u> Black Oak, Pine</p> <p><u>Gate:</u> Gallaher, Blair, White Wing, Oliver Springs, Elsa, Edgemoor, Solway</p> <p><u>Human-made Features:</u> Happy Valley Housing Area</p>
What do the different colors symbolize?	What do the different shapes symbolize?	What do the different lines symbolize?	What do the different label styles symbolize?
<p>Blue = Water</p> <p>Red = Buildings</p> <p>Pink = Plant Areas</p> <p>Black = Boundaries, Roads, Railroads & Contour Lines</p> <p>Green = Forest areas</p>	<p>Rectangles = Buildings</p> <p>Polygons = Counties & Areas</p> <p>Curvy shapes = Rivers. Contour Intervals</p>	<p>Straight = Roads</p> <p>Squiggly = Contour, rivers, & roads</p> <p>Diagonal = Oak Ridge site</p> <p>Dashed = Housing area & County boundary</p> <p>Tracks = Railroads</p>	<p><i>Bold Italics</i> = Oak Ridge site</p> <p>Blue Text = Water</p> <p>Red Text = Plant bldgs</p> <p>Smaller Bold Font = Roads, Counties, Gates, Ridges, Valleys, Housing Area</p>

3. Describe anything on the map that appears strange, unfamiliar, or that you do not understand.
Answers will vary
4. What is the **title** of this historical map? Clinton Engineer Works, Tennessee 1943-1945
Historical maps show how a location looked during a specific time period. According to the title, what time period does this map show? 1943-1945, During WWII
5. When was the map **made**? 1985 What clues on the map indicate this **date**?

In the citation (or caption) at the side of the map

6. This map is missing a **legend**. Create a legend below for the most important symbols & colors used.



7. Does the map contain an **inset map**, a small map inside a larger one? ☐ Yes ☒ No
If “yes,” what additional information does the **inset map** reveal about this place?

8. How is **scale**, or actual distance, measured on the map? One inch = 2.5 miles

Contour lines are lines on a map that join points of equal elevation (height) above sea level. You will see the elevations marked on the contour lines. The change in elevation between one **contour line** and the next is the **contour** interval. To determine elevations, pay attention to the amount of space in between lines. If the contours are close together, you're looking at a steep slope. If the contours have wide spaces in between -- or aren't there at all -- the terrain is relatively flat.

9. What information do the **contour lines** reveal about the terrain (landforms) of this Manhattan Project site?
The contour lines on this map indicate that the Oak Ridge site is located on land that is full of ridges and valleys, with few flat areas. The various plant buildings are located on small flat areas either in a valley or a flat area atop a ridge.

10. Are there any bodies of water on the map? ☒ Yes ☐ No If “yes,” describe the type of water featured:
Clinch River forms the southern boundary of the site & Poplar Creek in the NW area

11. Based upon your answers to Questions #9 & #10, explain how the natural geography features (land & water) may have influenced the decision to establish this location as a Manhattan Project site.

The Oak Ridge site is far from flat, so its selection must not have been based upon this feature. The various plant buildings had to be built in flat areas in separate areas of the site. The Power Plant, S-50, K-25, & K-27 buildings were all built directly next to the river so their operation must be dependent upon a running supply of water.

12. How might human geography features (roads, highways, railroads) have influenced the decision to establish this location as a Manhattan Project site?

The Oak Ridge site needed a location that was accessible by road for transportation and to receive supplies once established. Oak Ridge is located directly next to Old Tenn 61 & Oak Ridge Turnpike. In the NE corner, one can see a RR line (unlabeled) making delivery of industrial equipment possible. There are 7 gates to enter/exit and connect to lead to 5 other cities.

Map Analysis Worksheet: Los Alamos, New Mexico **Answer Key**

(Name of Manhattan Project site)

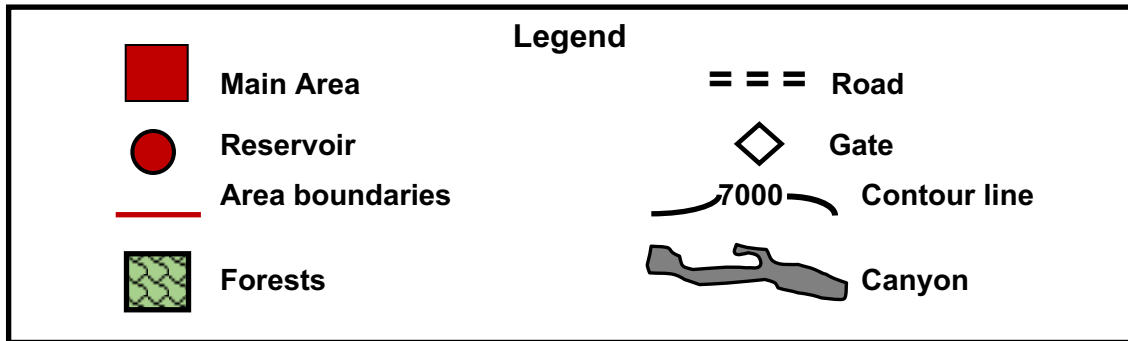
Analyze: Look at your assigned Manhattan Project map, then work with your group to analyze it.

1. What do you notice first? Answers will vary
2. Complete the following chart based upon the features you see in the map.

List the colors used.	Describe the shapes used.	Describe the lines used.	List labels used.
Red Black Gray Green	Rectangles Polygons Curvy shapes	Straight Squiggly Diagonal Dashed Tracks	Numbers <u>Area:</u> A / B / C / D / E <u>Buildings:</u> Main Area, Omega Site, Anchor Ranch Proving Ground, Technical Installations, Reservoir <u>Road:</u> East, Pajarito, Jemez, Trinity Drive <u>Canyon:</u> Sawyer, Alamos, Chupaderos, Guaje, Rendija, Barrancas, Bayo, Pueblo, Los Alamos, Sandia, Mortandad, Pajarito, Water, Rito <u>Gate:</u> East, West <u>Other:</u> Sacred Indian Ceremonial Land, Pajarito Mesa, Bandelier National Mounment
What do the different colors symbolize?	What do the different shapes symbolize?	What do the different lines symbolize?	What do the different label styles symbolize?
Red = Buildings & Area boundaries Black = Boundaries, Roads, & Contour Lines Gray = Canyons Green = Forest areas	Rectangles = Buildings Polygons = Areas Curvy shapes = Contour Intervals, Canyons Diamonds = Gates Triangle = Omega Site	Straight = Area boundaries Squiggly = Contour Lines Dashed = Roads	Gray Text = Canyons Red Text = Bldgs, Areas Smaller Bold Font = Roads, Gates, Mesa, Indian Land, National Monument

3. Describe anything on the map that appears strange, unfamiliar, or that you do not understand.
Answers will vary
4. What is the **title** of this historical map? Los Alamos Site, New Mexico 1943-1945
Historical maps show how a location looked during a specific time period. According to the title, what time period does this map show? 1943-1945, During WWII
5. When was the map **made**? 1985 What clues on the map indicate this **date**?
In the citation (or caption) at the bottom of the map

6. This map is missing a **legend**. Create a legend below for the most important symbols & colors used.



7. Does the map contain an **inset map**, a small map inside a larger one? ☒ Yes ☐ No

If "yes," what additional information does the **inset map** reveal about this place?

It shows details of the Technical installations (labs) and the residential community areas.

8. How is **scale**, or actual distance, measured on the map? One inch = 1.5 miles

Contour lines are lines on a map that join points of equal elevation (height) above sea level. You will see the elevations marked on the contour lines. The change in elevation between one **contour line** and the next is the **contour interval**. To determine elevations, pay attention to the amount of space in between lines. If the contours are close together, you're looking at a steep slope. If the contours have wide spaces in between -- or aren't there at all -- the terrain is relatively flat.

9. What information do the **contour lines** reveal about the terrain (landforms) of this Manhattan Project site?

The contour lines on this map indicate that the Los Alamos Ridge site is located on land at high elevations of 7000-8000 feet. The site has numerous steep-sided canyons and mesas, with few flat areas.

10. Are there any bodies of water on the map? ☐ Yes ☒ No If "yes," describe the type of water featured:

11. Based upon your answers to Questions #9 & #10, explain how the natural geography features (land & water) may have influenced the decision to establish this location as a Manhattan Project site.

The Los Alamos site is set up on a high mesa area and seems quite isolated from any cities or nearby towns. It has NO natural bodies of water shown on the map so a reservoir had to be used for residents' drinking water.

12. How might human geography features (roads, highways, railroads) have influenced the decision to establish this location as a Manhattan Project site?

There are NO railroads or nearby cities visible in the map. There is only one main road with two gates for entering/exiting the Main Area. Since it was the site of the top secret laboratory, it was probably chosen because of its isolated location to keep it out of the public's eye.

Checklist: Manhattan Project “Secret City” Digital Poster or Infographic

Directions: You are a member of a museum team creating a digital exhibit on the Manhattan Project. Your task is to collaborate with your partner/s to create a poster of your Manhattan Project “secret city” site. Use the information gathered from investigating your site and the checklist below as a guide for creating the poster or infographic.

- ☐ **Title:** The name and a historic photo of the “secret city” site and names of co-authors are clearly displayed in a prominent position on the poster or the top page of the infographic.
- ☐ **Appearance:** Poster or infographic has a visually attractive layout and design. Information is well organized with fonts style and sizes that are easy to read. Graphics are relevant to the topic and enhance the project.
- ☐ **Major Thematic Components:** Poster or infographic addresses each of the following thematic questions accurately and coherently with both images and text.
 - 1) **Geography:** What geographic features influenced the “secret city” site’s selection?
 - ☐ **Map:** The Manhattan Project “secret city” site map with the addition of a **legend** that clearly interprets the map’s symbols, lines, and colors.
 - ☐ **Images:** A minimum of three geographic photos with descriptive captions
 - ☐ **Text:** Written summary interpreting the geographic features on the site map and an explanation regarding how these features influenced the site’s selection. Geographic features include physical (natural) and human (man-made) characteristics of the site.
 - 2) **Contributions:** What was the “secret city” site’s major contribution(s) to the Manhattan Project?
 - ☐ **Images:** A minimum of three historic photos with descriptive captions.
 - ☐ **Text:** Information written in bullet point format describing the site’s significant contribution(s) to the overall mission of the Manhattan Project. Address the role these contributions played in the overall success of the Manhattan Project.
 - 3) **Past to Present:** To what extent did the development of this “secret city” site produce lasting changes to the region?
 - ☐ **Images:** A minimum of three photos with descriptive captions.
 - ☐ **Text:** Information written in bullet point format describing the degree to which development of the “secret city” site produced lasting changes to the region. Topics could include a discussion of “before and after” settlement patterns, land use, population changes, and what the site is like today.
- ☐ **Citations:** Give credit to the print & image sources used in your project. Cite weblinks or print resources used.

Suggested Tools for creating Digital Posters or Infographics:

- Popplet <http://popplet.com/> (Poster only)
- Canva <https://www.canva.com/> (Poster or Infographic)

Each student will need to create a FREE account first. One student will need to initiate the poster or infographic, then SHARE it both with one’s partner and teacher.

Investigation Guide: Manhattan Project “Secret Cities”

Hanford, Washington

Hanford Engineer Works (HEW) / Code Name: Project W

http://www.history.army.mil/html/books/011/11-10/CMH_Pub_11-10.pdf

US Army Center of Military History Publications

E-Book “Manhattan: The Army and the Atomic Bomb” Vincent C. Jones, 1985

* Chapter XV Land Acquisition: Hanford Engineer Works (p 331-342)

* Chapter XXII The Atomic Communities in Washington State (p 450-464)

* Check Table of Contents: Illustrations for Hanford Engineer Works (HEW) Photos

https://energy.gov/sites/prod/files/Manhattan_Project_2010.pdf

United States Department of Energy

E-Book “The Manhattan Project: Making the Atomic Bomb” F.G. Gosling, 2010

* Part IV: The Manhattan Engineer District in Operation, Hanford (p 31-35 + 75-77)

* Photo Gallery: Hanford (p 52-63)

<https://energy.gov/management/office-management/operational-management/history/manhattan-project/manhattan-project-1>

US Department of Energy, Manhattan Project Signature Facilities

Click on “B Reactor”

Click on “T Plant Chemical Separations Building”

<http://www.atomicheritage.org/tour-site/life-hanford>

Atomic Heritage Foundation, Hanford Site

<http://www.atomicheritage.org/tours>

Atomic Heritage Foundation, Ranger in Your Pocket Tours

Click on Hanford Tours

<https://www.ci.richland.wa.us/i-want-to-/tourism/richland-road-trip>

City of Richland, WA (Richland was the company residential town for Hanford)

Explore Richland

<https://www.nps.gov/mapr/hanford.htm>

National Park Service, Manhattan Project National Historical Park at Hanford

<http://www.hanford.gov/c.cfm/photogallery/index.cfm/1>

US Department of Energy, Office of River Protection, Richland Operations Office

Hanford Photo Gallery

Check “Settlers” for Historical Photos

Investigation Guide: Manhattan Project “Secret Cities”

Oak Ridge, Tennessee

Clinton Engineer Works (CEW) / Code Name: Project X

http://www.history.army.mil/html/books/011/11-10/CMH_Pub_11-10.pdf

US Army Center of Military History Publications

E-Book “Manhattan: The Army and the Atomic Bomb” Vincent C. Jones, 1985

* Chapter XV Land Acquisition: Clinton Engineer Works (p 319-328)

* Chapter XXI The Atomic Communities in Tennessee (p 432-449)

* Check Table of Contents: Illustrations for Clinton Engineer Works (CEW) Photos

https://energy.gov/sites/prod/files/Manhattan_Project_2010.pdf

United States Department of Energy

E-Book “The Manhattan Project: Making the Atomic Bomb” F.G. Gosling, 2010

* Part IV: The Manhattan Engineer District in Operation, Clinton Engineer Works (p 20-29)

* Photo Gallery: Oak Ridge (p 36-51)

<https://energy.gov/management/office-management/operational-management/history/manhattan-project/manhattan-project-1>

US Department of Energy, Manhattan Project Signature Facilities

Click on “Y-12 Beta-3 Racetracks”

Click on “K-25 Gaseous Diffusion Process Building”

Click on “X-10 Graphite Reactor”

<http://www.atomicheritage.org/location/oak-ridge-tn>

Atomic Heritage Foundation, Oak Ridge Site

<http://www.atomicheritage.org/tours>

Atomic Heritage Foundation, Ranger in Your Pocket Tours

Click on Oak Ridge Tours

<https://www.archives.gov/atlanta/exhibits/rq326.html>

National Archives at Atlanta

Atomic Energy Commission [AEC], Record Group 326

<https://www.nps.gov/mapr/oakridge.htm>

National Park Service, Manhattan Project National Historical Park at Oak Ridge

<http://www.oakridgetn.gov/>

City of Oak Ridge

<http://exploreoakridge.com/>

Oak Ridge Convention and Visitors Bureau

Investigation Guide: Manhattan Project “Secret Cities”

Los Alamos, New Mexico
Los Alamos / Code Name: Project Y

http://www.history.army.mil/html/books/011/11-10/CMH_Pub_11-10.pdf

US Army Center of Military History Publications

E-Book “Manhattan: The Army and the Atomic Bomb” Vincent C. Jones, 1985

- * Chapter XV Land Acquisition: Los Alamos (p 328-331)
- * Chapter XXI The Atomic Communities in New Mexico (p 465-478)
- * Check Table of Contents: Illustrations for Los Alamos Photos

https://energy.gov/sites/prod/files/Manhattan_Project_2010.pdf

United States Department of Energy

E-Book “The Manhattan Project: Making the Atomic Bomb” F.G. Gosling, 2010

- * Part IV: The Manhattan Engineer District in Operation, Los Alamos (p 77-81)
- * Photo Gallery: Los Alamos (p 64-69)

<https://energy.gov/management/office-management/operational-management/history/manhattan-project/manhattan-project-1>

US Department of Energy, Manhattan Project Signature Facilities
Click on “V-Site Assembly Building and Gun Site”

<http://www.atomicheritage.org/location/los-alamos-nm>

Atomic Heritage Foundation, Los Alamos

<http://www.atomicheritage.org/tours>

Atomic Heritage Foundation, Ranger in Your Pocket Tours
Click on New Mexico Tours

<https://www.nps.gov/mapr/manhattan-project-los-alamos.htm>

National Park Service, Manhattan Project National Historical Park at Los Alamos

<http://www.visitlosalamos.org/>

Los Alamos Chamber of Commerce

Rubric: Manhattan Project Poster or Infographic

(Manhattan Project site)

Score	Category	4	3	2	1	0			
____/4	Title	All three required elements (co-author names, "secret city" name and historic photo) are clearly and prominently displayed	All three required elements (co-author names, "secret city" name and historic photo) are present & adequately displayed	Two of the three required elements are present but may be improperly displayed	One of the three required elements are present but may be improperly displayed	None of the three required elements are present			
____/4	Appearance	Exceptionally attractive layout & design; clear font style & size; exemplary organization of information; relevant graphics that enhance the project	Attractive layout & design; clear font style & size; well-organized information; relevant graphics used	Adequate layout, & design, font style & size; average organization of information; partially relevant graphics used or detract from project	Haphazard or confusing layout & design; font style & size difficult to read; deficient organization of information; irrelevant graphics used or missing	Sloppy lay-out & design; font style & size difficult to read; organization lacking; graphics missing			
____/4	Map	Correct site map presented with a legend that is 90-100% accurate	Correct site map presented with a legend that is 80-89% accurate	Correct site map presented with a legend that is 70-79% accurate	Correct site map presented with a legend that is 60-69% accurate	Correct site map missing OR legend that is <60% accurate or missing			
____/4	Images Geography Photos	All 3 photos accurately relate to the topic & have exceptional captions	All 3 photos adequately relate to the topic & have applicable captions	At least 2 photos adequately relate to the topic & have adequate captions	At least one photo adequately relates to the topic OR photos have inadequate or missing captions	All 3 photos inadequately relate to the topic OR are missing			
____/4	Contributions Photos								
____/4	Past-Present Photos								
____/4	Text Geography Summary	90-100% of ideas & content are accurate; exceptional paragraph structure	80-89% of ideas & content are accurate; cohesive paragraph structure	70-79% of ideas & content are accurate; adequate paragraph structure	60-69% of ideas & content are accurate; weak paragraph structure	<60% of ideas & content are accurate; deficient paragraph structure			
____/4	Text Contributions Bullet Points	90-100% of ideas & content are in-depth & accurate; attractive bullet point formatting	80-89% of ideas & content are accurate; attractive bullet point formatting	70-79% of ideas & content are accurate; adequate bullet point formatting	60-69% of ideas & content are accurate; bullet point formatting is deficient or absent	<60% of ideas & content are accurate; bullet point formatting is deficient or absent			
____/4	Past-Present Bullet Points								
____/4	Citations	All print & image sources properly cited.	Majority of print & image sources are properly cited.	Significant print & image sources are adequately cited.	Moderate amount of print & image sources are cited.	Minimal to none print & image sources cited.			
____/40	Total Score	<u>Comments</u>							
40 = 100%	38 = 95%	36 = 90%	34 = 85%	32 = 80%	30 = 75%	28 = 70%	26 = 65%	24 = 60%	22 = 55%