

IN THE SHADOW
OF THE DAM(MED)

by

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

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in

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Joshua David Cuthbertson

April 2008

TABLE OF CONTENTS

1. CONTEXT

Current conditions.....	7
History.....	12

2. THE BENEFITS OF DAMMING A RIVER

The River is not a Switch.....	15
Point of no return.....	20
Water Law.....	22
Wildlife along the river.....	24

3. LAND USE STRATEGY

Setup.....	28
Power, the new crop.....	32
Wind farming techniques.....	38
Reservoir recreation.....	44

4. PROGRAMMING A BUILDING OF MEASURE

Qualitative program.....	48
Quantitative program.....	57
Code Review.....	60

5. PRECEDENTS

Randall Ott; The Salt Chapel.....	63
Antoine Predock: Rio Grande Nature Center.....	67
Andy Goldsworthy: Various Works.....	71
D. B. Young Assoc.....	74

6. DESIGN PROCESS.....77

7. BIBLIOGRAPHY.....102

8. END NOTES.....104

LIST OF FIGURES

FIGURE:

- 1 Wyoming Water Map. http://www.lib.utexas.edu/maps/united_states/wyoming_90.jpg
- 2 Compilation. Edited by author. Wyoming, Colorado, Nebraska water maps.
http://www.lib.utexas.edu/maps/united_states/wyoming_90.jpg
- 3 Guernsey Reservoir. Guernsey, Wyoming. Google Earth Image.
- 4 Reclamation Web Site. Reclamation Data Page
<http://www.usbr.gov/dataweb/html/gpnplprjdata.html>
- 5 Nebraska crop sources. National Agricultural Statistics Service.
<http://www.nass.usda.gov/research/cdl/NEall.htm>
- 6 Nebraska Farm and Non-Farm Population, 1930-2000
<http://www.neded.org/files/research/stathand/esecc7.gif>
- 7 Guernsey Power Plant. Reclamation Website.
<http://www.usbr.gov/power/data/sites/guernsey/guernsey.html>
- 8 Sandhill Whooping Crane Spring Staging Area
<http://www.nacwg.org/sandhill.htm>
- 9 Migratory Patter of Sandhill Whooping Cranes
<http://www.nacwg.org/sandhill.htm>
- 10 Wyoming Wind
http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp
- 11 Nebraska Wind
http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp
- 12 Turbines at Sunset <http://www.jsonline.com/story/index.aspx?id=306847>
- 13 Turbines at Sunset
http://www.bbc.co.uk/cumbria/content/image_galleries/january_2007_gallery.shtml?38
- 14 Turbines at Sunset <http://flickr.com/photos/stuartyeates/93821358/>

LIST OF FIGURES (cont.)

15 Current Installed Wind Power Capacity

http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_installed_capacity.asp

16 Turbines in the Landscape <http://www.tribes.com/blog/27389/archives/2006/10>

17 Farms Demand on the North Platte River. Google Earth Image, modified by author.

18. Google Earth Image, modifications by author.

19. Google Earth Image, modifications by author.

20 Farms Demand on the North Platte River after implementing wind turbines.

Google Earth Image modified by author.

21 Transmission Lines <http://www.nationaltrust.org/11Most/05.html>

22 Transmission Lines

<http://www.nationaleminentdomain.com/articles/national-eminent-domain/>

23 Transmission Lines at Sunset

http://cheatseekingmissiles.blogspot.com/2007_04_01_archive.html

24 Hiroshima. <http://www.lewrockwell.com/orig8/hiroshima1.jpg>

25 Sequoyah. <http://www.cleanenergy.org/Code%20Red/seqouyah.jpg>

26 Action at the Nuclear Power Plant.

<http://www.macalester.edu/environmentalstudies/students/projects/nuclearpowerwebsite/home.html>

27 “The Castle,” Guernsey Reservoir. Photo by Author.

28 Guernsey Dam. Google Earth Image.

29 Student and Teacher reviewing propeller.

<http://gtresearchnews.gatech.edu/newsrelease/WATER.html>

30 Ibid

31 Proposed site for recreation. Google Earth Image.

LIST OF FIGURES (cont.)

32 All Images came from

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33 Ibid

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44 Matt Thomas' Cyber-English Class

<http://easthollywoodenglish.wordpress.com/2007/08/>

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http://www.acme.com/jef/photos/31may2004_stanford/mvc-7746.html

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ABSTRACT

Settlers developed the American West by controlling and subduing the processes of nature. This thesis explores architecture that reveals those processes, not subdues them. A prime example of this is the area along the North Platte River in southeastern Wyoming. The area's quick settlement has resulted in poor land development that threatens the area's current, agriculture-dependant, livelihood. Reservoirs developed to support the agricultural industry have reached the end of their useful lives, and now threaten the water supply. Once such reservoir, located in Guernsey, Wyoming, is silting and must be removed.

In the early 1900's, society built whatever was necessary to maintain its livelihood. It was about building quickly and controlling the forces of nature. But that approach caused problems that need to be repaired. With a new land use strategy for the river, and strategic localized site planning, architecture will be a solution. Rather than spending millions of dollars dredging the reservoir, architecture can ignite a series of positive land development.

Architecture provides mankind with historical insight. It is a way for people to interact with nature and visualize an environment's effect over time. In order for people to integrate with nature, they must be aware of the processes that shape a place. To fully integrate architecture into the landscape, four points must be considered: the current conditions, the history, a new use for the land, and the implementation and integration of all these aspects.

CONTEXT

Conservation is getting nowhere because it is incompatible with our Abrahamic concept of land. We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it the esthetic harvest it is capable, under science, of contributing to culture.¹

The town of Guernsey, in southeastern Wyoming, exists because of settlers migrating west along the Oregon Trail. As a result of the migration and the agricultural industry that followed, large scale water projects were needed. A reservoir near Guernsey was created through the North Platte River Project, initiated by the Bureau of Reclamation in 1902. Guernsey Reservoir was commissioned, designed, and constructed by the government, and its construction is an example of what taxpayers' dollars can do to help change the environment. Or at least it was in the early 1900's. Nebraska thrived after the creation of the reservoir and benefitted a great deal from the wealth of crops that grow because of it.² But today the reservoir serves a small number of people, and its condition is in constant decline. The small number is going to get smaller.

In the 1900's, reservoirs provided ways for farmers to irrigate the lands they settled. Water could be diverted and brought directly to the farm. It allowed an easier lifestyle. But because farmers needed water immediately, developers overlooked the implications of their

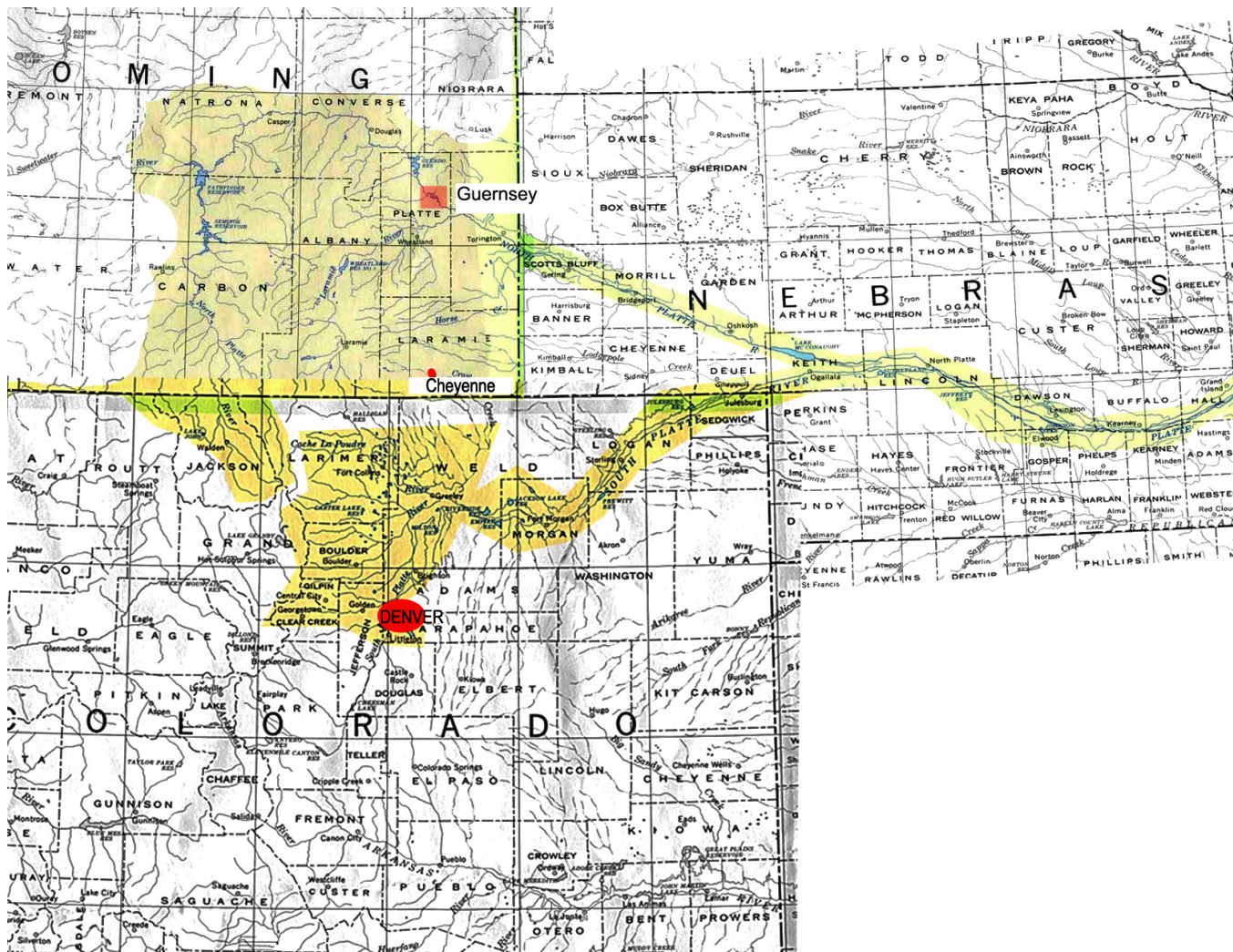


fig. 2 North Platte River Basin

fig. 3 (Right) Guernsey Reservoir. Guernsey, Wyoming.

constructions. Current Conditions, explores the facts surrounding the degrading conditions at Guernsey reservoir. History, looks into the history behind these conditions. The question today is, how long do reservoirs actually last?

Reservoirs last as long as their benefits. Chapter 2 shows that the benefits Guernsey Reservoir are limited and, therefore, that the reservoir is no longer necessary. Chapter 3, Land Use Strategy, looks for ways to develop the land. Solutions that serve both the farmers, and the public, are explored. Chapter 4 is significant because it looks for solutions architecturally, through site planning, and programming of a series of building constructions.



North Platte Project Project Data

[North Platte Project - Main Page](#)

Land Areas (1992)

Irrigable area:

Full Irrigation Service	226,237 acres
Supplemental Service	107,224 acres
Temporary Irrigation Service	0 acres
Number of Irrigated Farms	2,660
Total Irrigable Lands	333,461 acres

Population Served:

Farm Population Served	10,096
Non-Farm Population Served	74
Total Population Served	10,170

Area Irrigated and Crop Value

There is no information on area irrigated and crop value currently available for the North Platte Project.

fig. 4. Reclamation Data Sheet

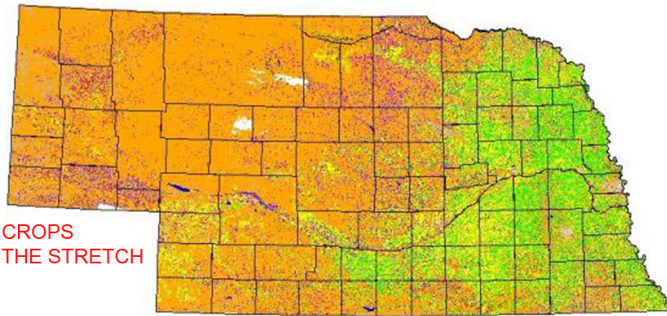
Current Conditions

Guernsey Reservoir serves a small number of people. The acreage that the N.P.R.P. covers, from Guernsey, Wyoming, to Bridgeport, Nebraska, is not as large as one might think. The river's water spreads out over 335,000 acres of land, but in the end only serves 10,170 people.³ This number represents the farming and non-farming populations. For such a small population served, the reservoir delivers water along 2,000 miles of canals and other transportation methods. The dam generates power and transports it over 160 miles of transmission lines.⁴

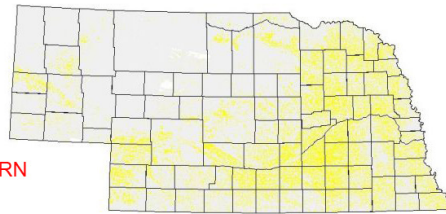
Along with all the infrastructure that followed the building of the dam came the upkeep costs. Maintaining the reservoir factors in how many people successfully receive water each year, but the physical conditions of the reservoir are on a steady decline. This not only threatens the people who benefit from the reservoir; it threatens the land, the water, and the environment the reservoir sits upon.

Guernsey Reservoir controls the flow of the river. With the river subdued by man, irregular flows of the new North Platte River bring sediment that is slowly filling the lakebed, decreasing the reservoir's ability to store water. Dan G. Batuca, a Romanian engineer studying reservoir sedimentation, and Jan M. Jordaan, a retired civil servant, study the silting of reservoirs in their book, Silting and Desilting of Reservoirs. They explain the ineffective nature of reservoir construction.

MAJOR CROPS
ALONG THE STRETCH



CORN



FALLOW-IDLE CROP LANDS



WINTER WHEAT

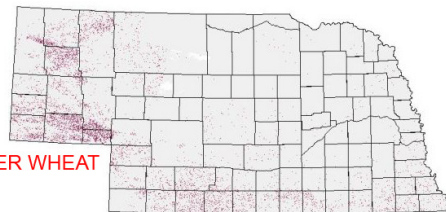


fig. 5 Nebraska Crop Sources.

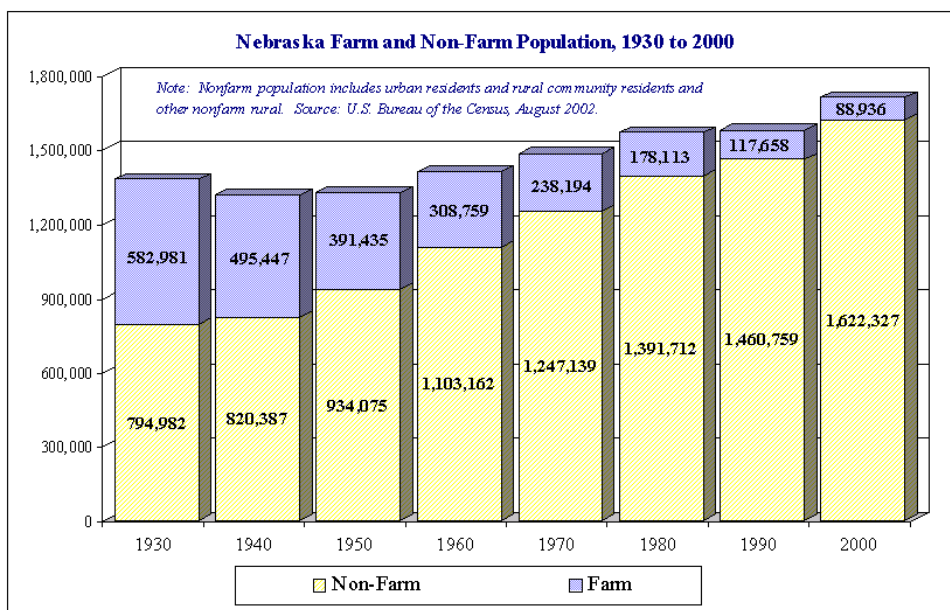
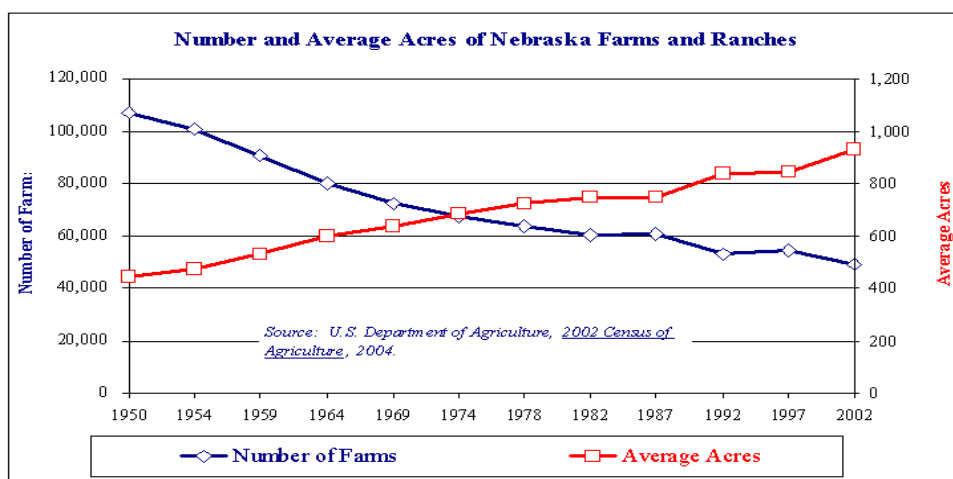


fig. 6 (Top) Number of Farms vs. Farm Size.
(Bottom) Farm and Non-Farm Population

This inexorable process of reduction in effectivity of reservoirs worldwide due to sediment accrual represents a loss of capital investment in dams and related water conveyance works, as these could eventually become obsolescent if nothing can be done to restore lost capacity or to reduce generation, conveyance and deposition of sediment into reservoirs.⁵

Once the river has completely filled the lakebed with sediment, it will be expensive to remove all of the silt. And this is not a new problem. Guernsey Reservoir lost 40% of its storage capacity in its first 30 years of operation.⁶ Over time siltation will overtake the lakebed completely. The only way to stop the siltation is the take down the dam, which would allow nature to reclaim her presence and continue the “Cradle-to-Cradle” design that will forever sustain life, not the “Cradle-to-Grave”⁷ designs of modern mankind.

Nebraska farmers have tapped every drop of water in the North Platte River. But the infrastructure created to distribute water to the farms is drying up, and this is beginning to affect the farms downstream. By diverting water from its natural course, the river cannot replenish itself and will eventually disappear. No water, no farms.

Over the years, the number of farms has plummeted as large farms buy out small farms; as a result, the average acreage on these farms has dramatically increased. Small farms, with their limited resources, cannot compete in a large-farm market. However, large farms demand more from the river and drain its resources on a larger scale. The health of a landscape that keeps us alive is threatened.

The federal government, however, puts millions of dollars into this failing agricultural system. The value of land in western Nebraska is closely related to the land's crop yield. As water becomes scarcer, so do crops. Yet farmland values are constantly on the rise in Nebraska. That's because the Federal government takes action to ensure the success of farms using government-provided subsidies.⁸ Today a farm's success is based on government subsidies, not the efficiency of the reservoir. This money, generated by taxpayers, ensures the farms will succeed during droughts and even during natural disasters.

Over the past 80 years Wyoming, Colorado, and Nebraska have been battling a series of Supreme Court cases for water rights in the North Platte River.⁹ Of the three states, Wyoming has suffered the most from these battles because Nebraska has higher irrigation demands. And since Nebraska has access to the water during July, Guernsey suffers economically with the drainage of the reservoir. This brings reservoir tourism to a halt. Combined with siltation and the continuing degradation of Guernsey reservoir, this will end the area's tourism and agricultural industries. Why did our society succumb to such devastating techniques of development? History holds the answer.

History

As settlers moved west along the Oregon Trail, the lands became familiar. More and more farmers settled western Nebraska and eastern Wyoming. This eventually brought the railroad, which rapidly increased the number of people in the area. People including the founder of Guernsey, Wyoming.

Guernsey, as the city's Web site states, was founded by Charles A. Guernsey, who moved from New York to settle in the West. He purchased land in what was then known as the "emigrant's wash tub."¹⁰ But the area's history is rooted with early settlers and the need for water in this naturally arid region. The North Platte River offered solace.

The North Platte River Valley, located mainly in Wyoming and western Nebraska, developed into a rural community dependant on agriculture for revenue. The agricultural industry provided the area with added benefits like more jobs, yet farms were still failing; Western Nebraska's economy needed infrastructure to provide for the growing population. Finally, in 1895, Nebraska created districts that could analyze the land with the goal of developing irrigation improvements because projects along the river were dying. These policies and plans considered nature as a hindering force that interfered with the works of human development. With this in mind, the river had to be modified.

In 1902, the federal government passed the Reclamation Act, which required that farmers pay the construction costs of all future government actions modifying the river. Anyone who benefitted economically from using the water had to abide by a repayment program.¹¹ The

Bureau investigated multiple sites for river control projects. One of the sites developed was Guernsey, Wyoming. Begun in 1925 and completed in 1927, Guernsey reservoir provided river flow control to meet irrigation demands and it also generated electricity. Irrigation and power were the two main design considerations; everything else was secondary: flood control, recreation, and the town of Guernsey, Wyoming.¹²

The Bureau of Reclamation was formed because the farmers needed water. The attitude of early Americans in this region is reflected in the name of the Bureau. The Bureau of Reclamation's Web site states, "The name Reclamation stuck because the purpose was to reclaim arid lands (by irrigation) to make them suitable for settlement."¹³ The Bureau's benefits, in 1902, were provided by conquering naturally occurring processes and bring them to a halt. The river shall always be full! Man will decide when the flows occur. The reservoir construction was to reclaim nature for society, not to integrate with the naturally occurring processes.

Reservoirs are not integrated within the environment. Such structures intrude upon the landscape and cannot provide the benefits that integration can. As stated earlier the benefits of a reservoir determine the lifespan. So what are the benefits of Guernsey Reservoir?



fig. 7 Guernsey Power Plant

THE BENEFITS OF DAMMING A RIVER

The River is not a Switch

Land development, in the 1900's, was fresh and the visions were of conquering nature. Allowing society to inject itself into the environment and rapidly take all the resources it could. The water problems were easy to solve. Society could construct machines to control the environment.

Problems with a water solution did not matter. What mattered was getting the water now. At the time of the dam's construction, designers were concerned with the amount of water storage needed to fulfill the demand. But storing water centralizes its position. The water then had to be delivered to spread out farmers along 2000 miles of canals. Centralizing a river's water restricts its natural flow.

The reservoir in Guernsey, Wyoming, is a single-purpose project that only fulfills the needs of a few. These "single-purpose projects,"¹⁴ were what the economy of the time needed, but the lifespan of the project was overlooked. Pressing issues needed to be handled: farmers needed *their* water. Their crops needed water. Instead of farmers building farms that relied on the river's position in the land, the government changed the fluvial navigation of the river's flow. But to fund such a modification to the landscape, its benefits had to be re-evaluated.

The Reclamation service re-evaluated the benefits reservoirs provide so as to change

the disbursement of the incoming funds. Flood control was considered a major benefit of reservoirs.¹⁵ Secondary benefits, such as a pseudo belief in controlling natural disasters, became major recipients of funding. The Bureau's Web site states that, "limiting damage was seen as in the national interest."¹⁶ Benefits overlooked in the initial consideration of the reservoirs construction were providing income.

Reservoirs are extreme feats of engineering but are extremely harmful to a river's future. As Dan Batuca, and Jan Jordaan explain, building a reservoir on a riverbed is a major deterrent to the river's naturally occurring hydrologic and hydraulic functions. Inserting a man-made object, "strongly affects[s] the natural regime of the flow, sediment transport and river morphology, as well as the environment in all its aspects,"¹⁷ and disrupts earth's natural systems. Are the benefits of constructing a reservoir worth sacrificing the water for future generations? They were in the early 1900's.

In the opening chapters of their book, Silting and Desilting of Reservoirs, the authors look at reservoirs around the world. The beginning provides a look into the actual functions of reservoirs. They specifically list all of the reasons why a reservoir would need to be constructed.

In general, reservoirs are designed, constructed and operated to perform one or more of the following functions, *often counter-effective in their requirements*:

- Flood control, when an empty reservoir is required,

- Power generation, when sufficient storage and head are required,

- Water supply, when a filled reservoir with water of good quality is required,

- Discharge regulation, when a reservoir operates to provide water storage during flood and water releases during dry seasons.

- Level Regulation, when a reservoir operates to provide acceptable conditions for fluvial navigation, especially during dry seasons.

- Fishing, when a deep reservoir with water of good quality is required,

- Recreation, when a reservoir of near constant level is required.¹⁸

Flood control was not an initial design consideration when Guernsey was built. But when income was needed, benefits were re-evaluated to entice funds. Guernsey was recast, this time with flood control as one of its functions. “Guernsey Reservoir has no allocated flood control or surcharge capacity; however, it has prevented \$439.0 thousand in flood damage

since its construction.”¹⁹ It did provide minimal flood control, but tell this number to an investor. Would they invest in a project of this magnitude?

In power generation, we see the second most important factor of modern reservoirs: clean energy. But, a reservoir is a finite construction and will not last forever and neither will its energy source. Guernsey Reservoir’s power generation capacity is 6,400 kW, thanks to a generator upgrade in 1992-1994.²⁰ So how much electricity does this project generate? The average American home uses approximately 830 kWh per month.²¹ This means the power plant at Guernsey Reservoir has the capacity to support about 8 homes per month.

Water supply was the primary purpose of Guernsey. The farming economy relied on water management, but the counter-productive methods of river diversion depleted the original water source. In the end the reservoir destroys its own water supply. This is not an integrated practice.

Discharge regulation disrupts the natural flows of the North Platte River and provides water to farmers on demand. The river is not allowed to flow as nature intended. Society now exerts control over the river’s flow. But controlling the river is difficult. The level of water in the reservoir must be controlled as well.

Level regulation states that a reservoir is built to provide, “fluvial navigation,” for river waters. The reservoir is a guide for the water during dry seasons. This permits the stored water a path directly to crops any time of the year. However, if the reservoir was never built, the water still had its’ own path.

Reservoirs provide social benefits as well. The last two points on Batuca and Jordaan's list deal with outdoor recreation. Recreation on reservoirs provides communities with a market for tourism. It also provides people with a way to interact with nature. Today, the best benefit Guernsey Reservoir provides is outdoor recreation. Fishing, for example, is on the list of a reservoir's design purposes. Reservoirs also provide other invaluable experiences, such as camping, hiking, and boating.

Camping sites are located along the Guernsey lake shore and are full of tourists every summer.²² Hiking is provided throughout the state park, and a visitor center with historical information is placed near spectacular views. The early architectural designs that were added to the reservoir's state park were integrated with the landscape, but the reservoir itself was not.

The early life of the reservoir provided a wealth of opportunities. Guernsey was an opportunity for the Civilian Conservation Corps to showcase its talent and provide the newly created park with architecture. "[T]he park soon became the showplace of state park design in Wyoming."²³ Lakeshore drives with majestic views of the landscape and a visitor center all went into the design of the park. All things considered, the design was a success, but it overlooked the reservoir's long-term effects on farming communities and the river's hydrologic and hydraulic functions. This led to unethical building unsuited for the environment or long-term sustainability. The underdeveloped benefits of reservoir construction are proving disastrous, leading our nation to a point of no return.

Point of No Return

The reservoir will dry up if sediment is not removed. “The unavoidable sediment trapping and silting process will occur within the reservoir and all these changes will aggravate in time.”²⁴ A reservoir’s lake bed will inevitably silt. This causes the federal government millions of dollars in repair work. When will reservoir benefits begin to outweigh the negative impacts? “Consequently, multiple direct and/or indirect negative morphological, technical, environmental, economical and social effects would be expected both in the upstream and downstream reaches of reservoir, and in its basin and at its dam structure as well.”²⁵ The time for change is now. The lifespan of Guernsey Reservoir has ended.

The loss of storage capacity disrupts the economic life of services that depend on the delivery of the reservoir’s water. The benefits that come with reservoir construction have dissipated. Batuca and Jordaan list what the current effects are:

1. The reduction of useful and economic life of reservoirs by excessive, rapid or premature loss of storage capacity and the services that depend on it.
2. The reduction of hydro-power generation, water supply or discharge regulation capacity, where the reservoirs have been designed and completed to achieve these functions.
3. The obstruction of main river and tributaries’ mouths by formation of back-water deposits and sand bars, which hinder or even stop the normal water-sediment inflow into the basin of the reservoir. The Gui Shui tributary’s mouth at the Guanting Reservoir in China was almost completely blocked by a very large sand bar formation of 5m height, affecting the fluvial navigation in this region.²⁶

As the river bed rises, so does the water. Once it reaches height of the dam wall, the Federal government must raise the dam wall or dredge the river bed. Silt deposits and obstructions provide the river's water an alternate path. The path the water will choose is highly unpredictable and could severely damage infrastructure.

The Union Pacific Railroad carries loads of coal, 24 hours a day, 7 days a week, adjacent to a portion of Guernsey Reservoir. The city of Guernsey would also be at risk, as would the park itself, which the Federal government has listed on the National Register of Historic Places.²⁷ A change in fluvial navigation would lead to the destruction of a *Historic Place*.

The reservoir is destroying the environment it initially supported. What is happening in the reservoir's basin will create a chain reaction that not only affects the agricultural community but also the wildlife downstream. Future generations should not have to deal with the consequences of irresponsible past developments. They should look forward to reaping the benefits of our current developments. Treat the land well, and be treated well. Theodore Roosevelt once said, "The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased, and not impaired, in value."²⁸ Today, however, the water laws created in the 1900's are strict and impair the chance for future development of the area.

WATER LAW

No fewer than 14 additional federal, state, and private water development projects had been planned or are under construction in the Platte River system. If completed, the total withdrawal from the system would be about 799,318 acre-feet annually, or over 80 percent of the remaining mean-yearly flow would be depleted. The greatest depletion would occur in Nebraska where about 566,200 acre-feet (72.8 percent) of flow would be removed annually.²⁹

Wyoming has a majority of the physical water in the North Platte Basin, but because of water law, the state cannot use 75% of the in-stream flows. The first surface water laws in Wyoming were enacted in 1875. Later more comprehensive laws became necessary and were adopted in 1890. These early laws were based on the, “doctrine of prior appropriation,”³⁰ meaning the person to successfully benefit from the water was its proper owner. Wyoming’s water is regulated by priority.

Later, as river modifications increased, so did conflicting interests regarding ownership. In the mid-1930’s, Nebraska took Wyoming and Colorado to the Supreme Court of the United States to settle disputes about the ownership of water in the arid West and along the North Platte River. In 1945 the court passed a decree that apportioned the water and distributed it “equitably” among the states. This resulted in the current ratios: 25% of the natural flow to Wyoming and 75% to Nebraska.³¹ The decision handed down by the Supreme Court are modi-

fied as needs change, as it was on March 13, 2001.³² As we have seen from the beginning, water is an environmental concern. Even the laws that distribute the water in the area prevent future development

Wildlife along the River

The entire North Platte River Basin supports a wide variety of species. Human beings are one example, but other living creatures share the river and are struggling to deal with the man's unnatural constructions. Constructions that are not integrated destroy life.

Nebraska's agricultural economy and Guernsey Reservoir are depleting the wildlife habitats of Sandhill Whooping Cranes. These birds fly through both hemispheres, nearly pole to pole.

Water battles between people can destroy wildlife habitats. With communities so focused on the success of crops, people often turn a blind eye to the management and conservation of not only the water but also the life along the water. The diversity of species on our planet is something to be cherished. We need species diversity.

The Sandhill Whooping Cranes, an endangered species, will provide the solution for water ownership.

Nearly 25 percent of birds occurring in Nebraska are included in the treaties with Japan and the former Soviet Union. Some of the Sandhill cranes which stage along the Platte nest in Siberia. International treaties are the highest law in the nation, superseding state and local laws. Given the extraordinary concentration of cranes along the Platte, new impetus should be given to conservation along the Platte in order to fulfill treaty obligations.³³

With the demand for the river's flow growing every day, the river's capacity and natural



© ICF

Sandhill Cranes at spring staging area on the Platte River,
Nebraska, USA

fig. 8 Sandhill Crane Spring
Staging Area

flow decrease, degrading the wildlife refuge for Sandhill Whooping Cranes. The Federal government will need to take action to fulfill international laws that are in place to protect these birds. Doing so, carries the possibility of cutting off current water rights.

Sandhill Crane *Grus canadensis* (migratory subspecies)

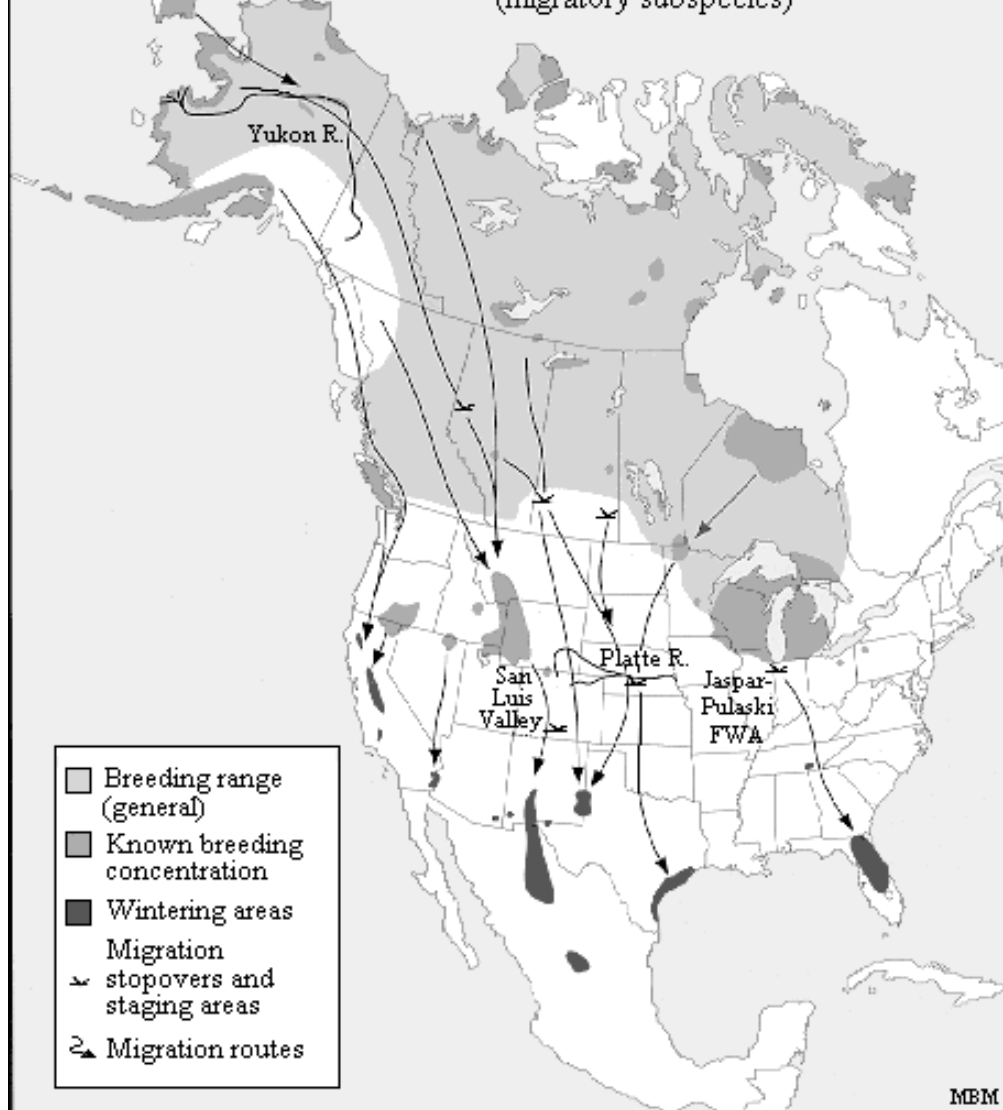


fig. 9 Migratory
Pattern of Sandhill
Whooping Cranes

LAND USE STRATEGY

Setup

Farming takes vital resources from the land, but it is also an important part of life in the American West. Profits from farming sustain communities, and farming also provides people with food. But we do not sustain these resources very well. As a result, the federal government acts to protect the people by providing subsidies.

A subsidy is a monetary grant given by the government to industries supporting public interest.³⁴ Farm subsidies are given to farms during drought conditions. This supplies America's farming communities a substantial corporate welfare program.³⁵ By using farm subsidies—for development not recovery—new farming techniques in eastern Nebraska can be developed in a way that supports a larger population while reducing the demand on the river's water. The land use strategy here is to implement a new crop that does not require water to grow—energy.

The United States awaits a large-scale demonstration of a beautiful landscape developed with wisdom, skill and taste—the evolution of a process that can produce a noble and ennobling physical environment: A step towards the American dream.³⁶

Large amounts of subsidy money poured into an agricultural community can be used to fund large-scale environmental recovery programs and to create clean energy. This can be done most effectively when the land is used to determine what development happens. This can also lead us to beneficial discoveries. If we look to the land for answers, we see a plethora of opportunities.

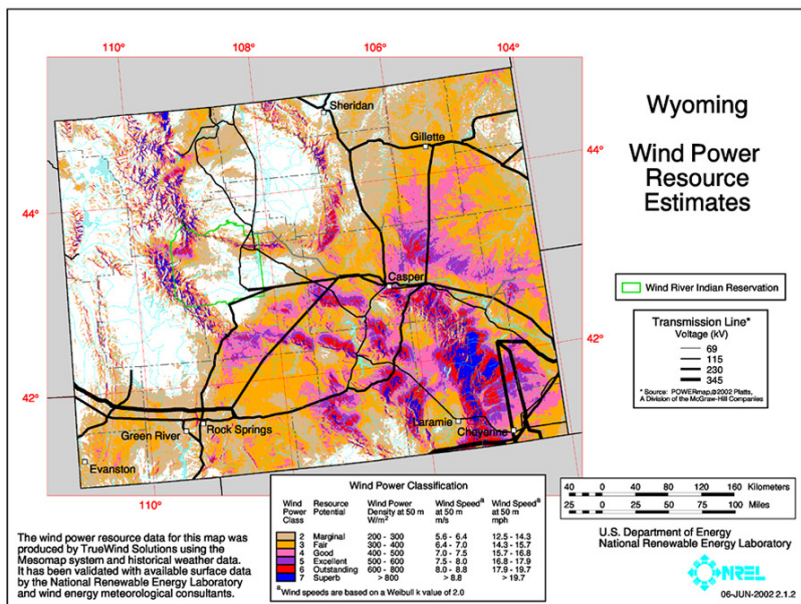


fig. 10 Wyoming Wind Map

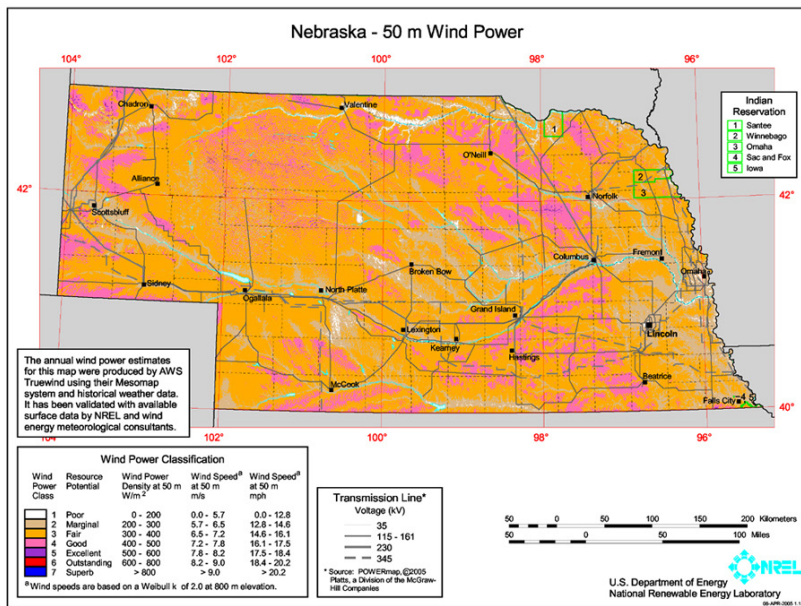


fig. 11 Nebraska Wind Map



fig. 12 Turbines at Sunset



fig. 13 Turbines at Sunset

fig. 14 Turbines at Sunset



fig. 16 Turbines in the Landscape.

Power, The New Crop

Looking to the environment for help reveals a free crop ready to harvest, one that will last as long as the planet does: wind. Wind is a clean and renewable source of energy. Electricity generated by wind in the area around the North Platte River could support a large population. Plus, wind can be harvested as a crop.

If one thing is certain, the river basin will need as much electricity as it can get. Colorado's population alone is projected to grow to 4.8 million by 2010. It is projected to have an average of 41.5 people per square mile. Nebraska is growing as well, with an average of 22.26 people per square mile and a population of 1.7 million expected by 2010. The least populated state is Wyoming. By 2010 the statewide population, with five people per square mile, is projected to be 519,886.³⁷

The challenge is to supply a majority of the 7 million people living in the area with clean energy. First, the land must be reviewed to consider what sources of natural energy lie there. The U.S. Department of Energy, through the National Renewable Energy Laboratory, has extensively measured Wyoming and Nebraska for potential wind installations. The stretch of river from Scottsbluff to Ogallala, Nebraska, averages winds of 12.8 to 16.1 mph. (This stretch utilized the majority of water released from Guernsey.) This wind measurement was taken at 150 ft or 50 m, the height of the rotation point for turbines. Wind Turbines need an average wind of 7 mph to generate electricity and shut off at approximately 56 mph. The farms along

the river are prime lands for wind farming. Even the area along the stretch of river in Wyoming averages wind speeds of 14.3 to 16.8 mph. Wyoming and Nebraska alike have the potential for wind farming.³⁸ To take advantage of that potential, wind turbines could be placed along the river from Guernsey to Bridgeport, Nebraska.

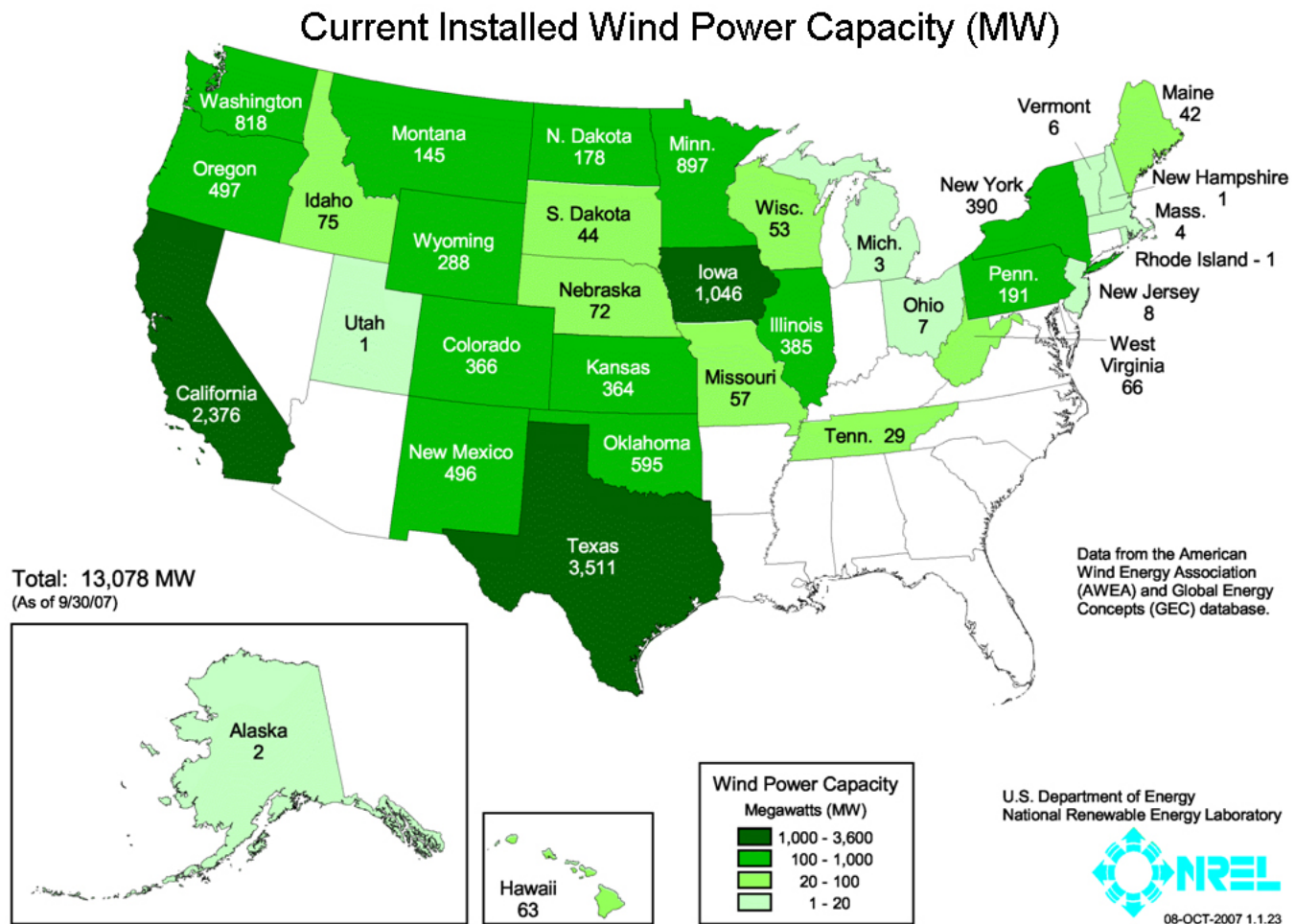


fig. 15 Current Installed Wind Power Capacity

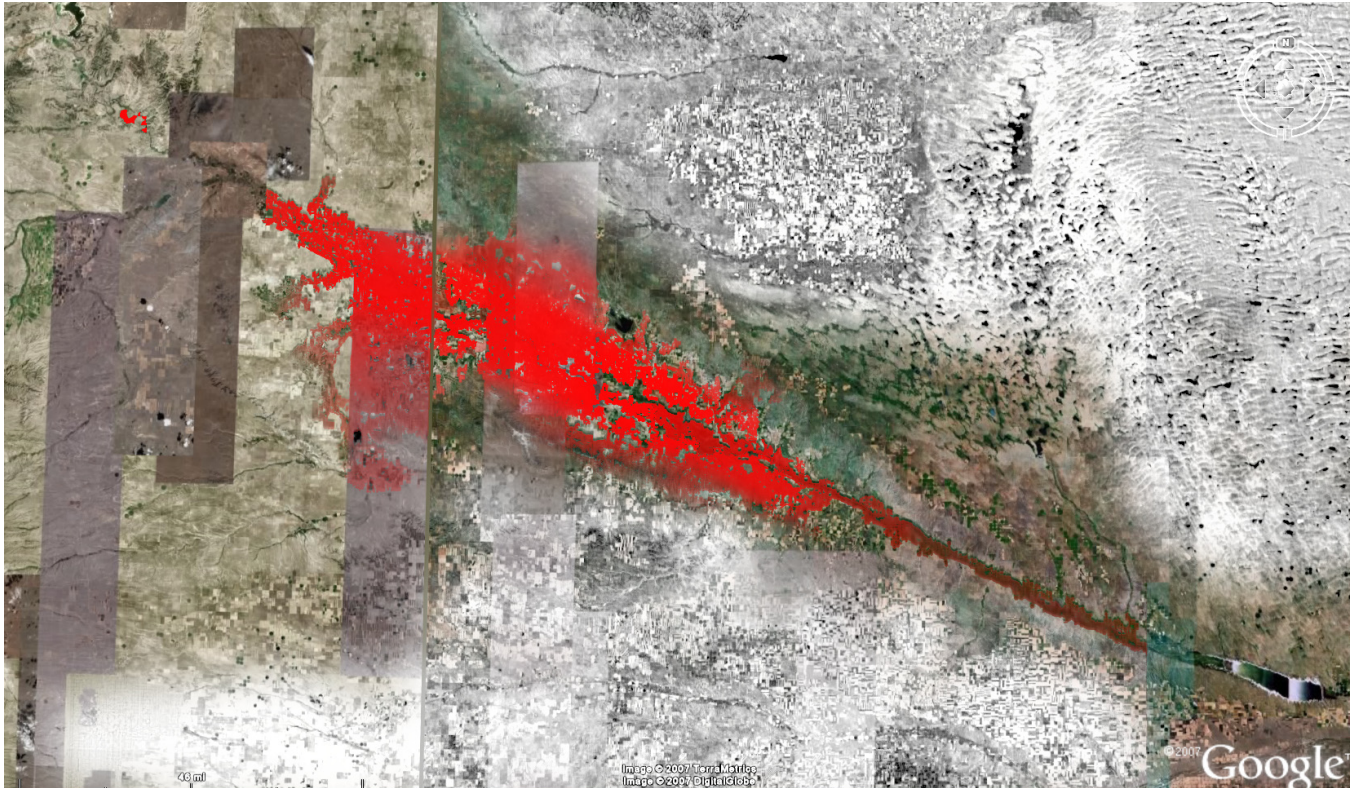


fig. 17 Farms Demand on the North Platte River Water.

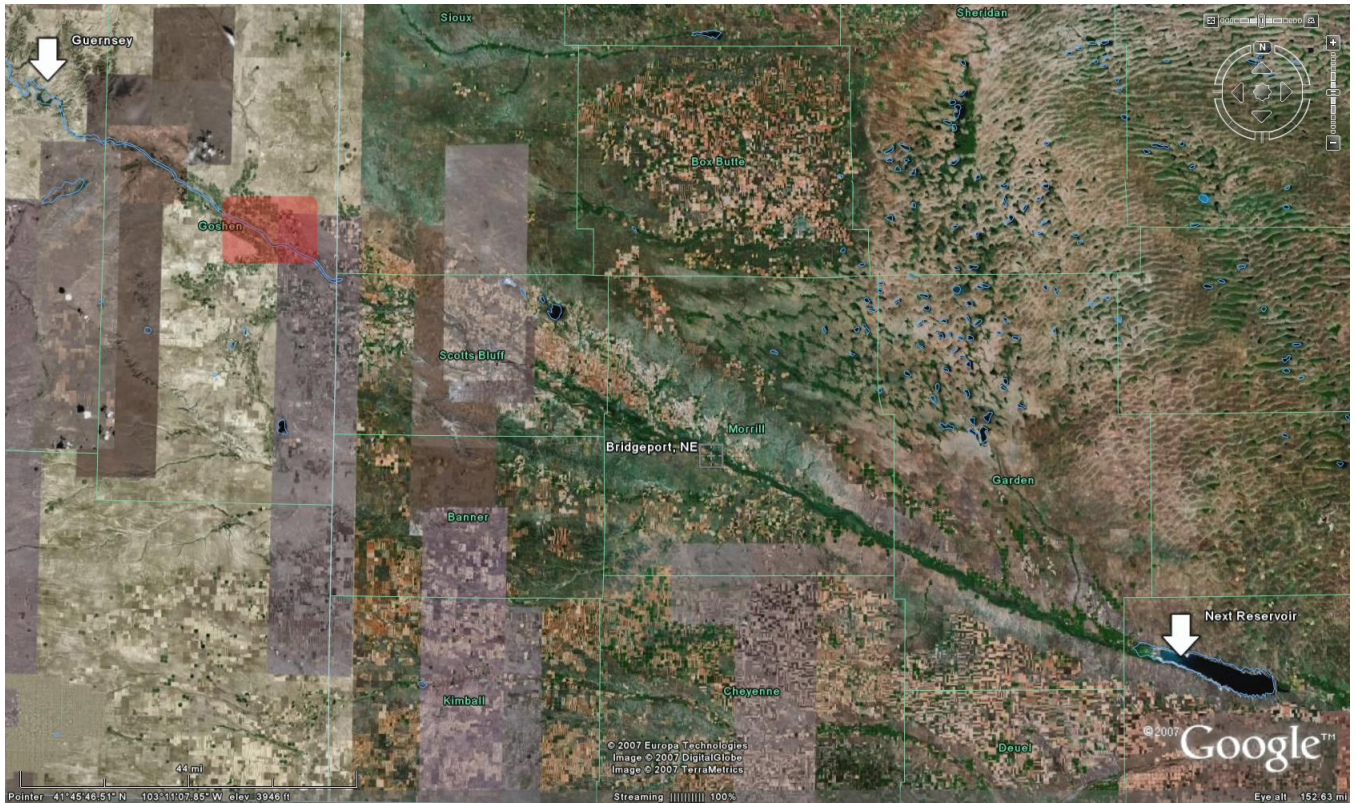


fig. 18 “The Stretch.” Farmland from Guernsey Reservoir to Bridgeport, Nebraska, is 111 miles. A portion of this 111 miles is shown in red.

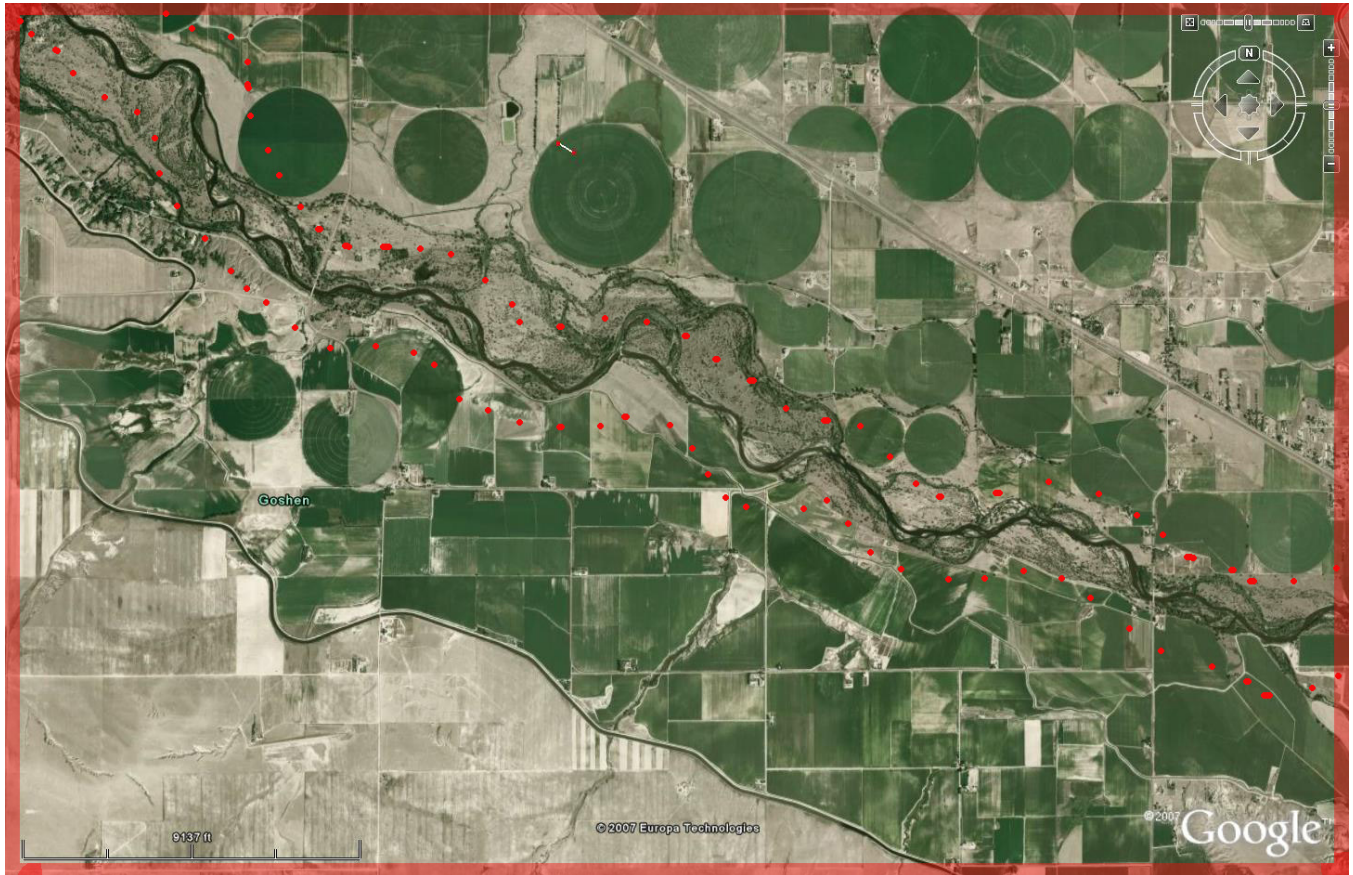


fig. 19 Wind turbines will provide electricity, a development barrier, income for the farmers, and a reduction in the demand for the river water.

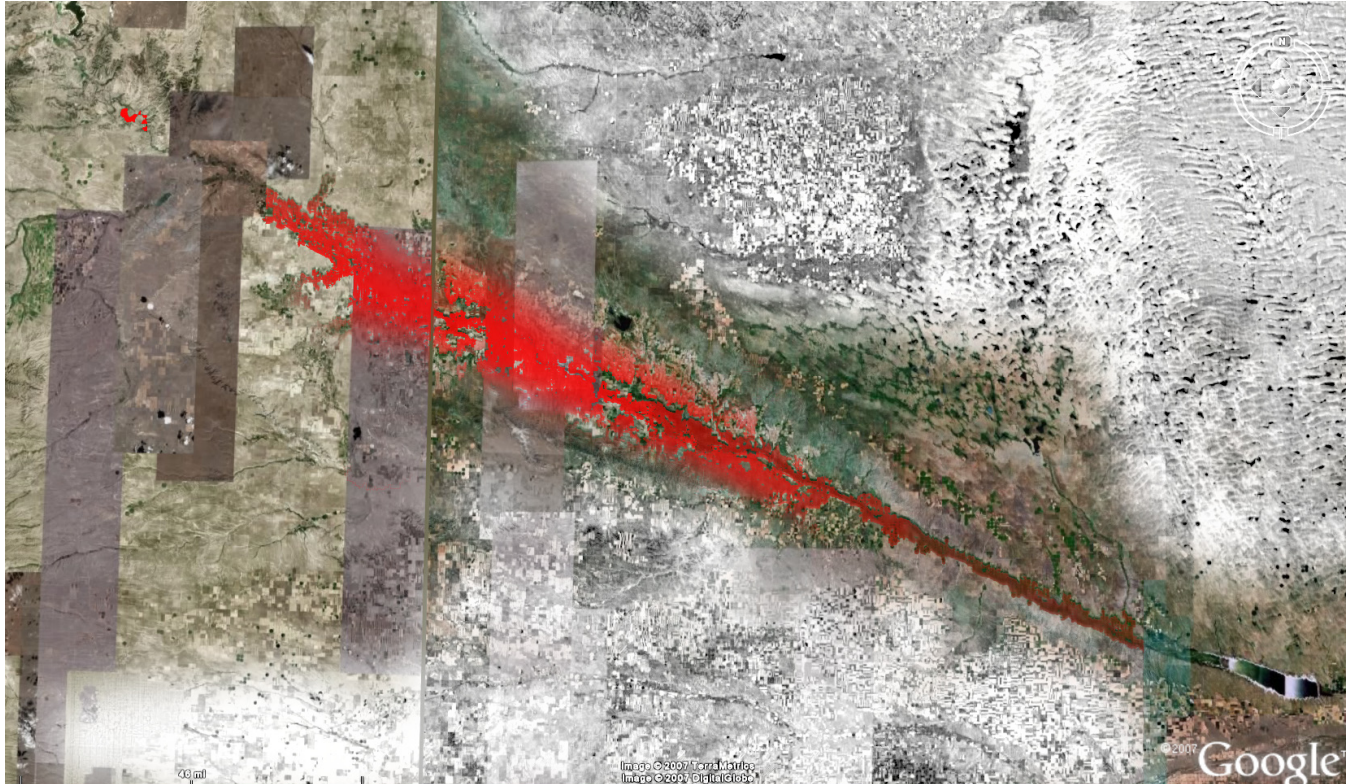


fig. 20 Farms demand on the North Platte River
after implementing wind turbines.

Power Farming Techniques

America is producing more and more green energy. Wyoming (288), Nebraska (72), and Colorado (366) currently generate 726 Megawatts of electricity combined.³⁹ Wind farming is available, but investors in the wind market, such as the federal government, are needed. As investments in the wind market increase, farmers will have the opportunity to develop new types of harvests. Other farmers around the world are already taking advantage of power farming.

Farming power is nothing new. It has been extremely successful in Germany. There, wind farmer Heinrich Gartner relies on power farming to support his family. He raises pigs and produces a cash crop, but Heinrich also provides power to 1,500 homes. He added 10,000 solar panels to his farmland. Those panels produce 1,000,000 kilowatt-hours of electricity. The incentives have a far greater potential than pig farming. Heinrich states, "I am still a farmer. I'm still breeding pigs. But the hunger for electricity is even bigger than for food at the moment, in Germany."⁴⁰

Back at the Platte river in Wyoming and Nebraska, we see the demand for water rising. As the river dries up, farmers will need a new source of income. Placing wind turbines along the river is a solid solution.

The turbines will be placed on both sides of the river approximately 500 ft from the water's edge. The turbines will be on farmers' land but will be placed far enough from one another that they only minimally intrude on crops. Crops can still be grown using river water, but as the demand for energy becomes stronger, the farmers will have the opportunity to shift to

harvesting more power and fewer crops. In this fashion, food crop farming in this area could be phased out. This strengthens the demand for other farms around the state that utilize stronger, more capable rivers.

Under this plan, with the growing energy crisis, the farmer can draw a more profitable income from the turbines and keep the open land. The turbines would also create a development barrier. Cities will not want to build directly next to them. However, something as simple as bike trails could easily be placed near turbines. The land becomes multi-functional: Creating a line with the turbines will create a line between farming and recreation. So on the river side of the turbines, recreation is abundant, and on the farming side of the turbines, open land is abundant.



fig. 21 Transmission Lines

fig. 22 Tansmission Lines

Wind turbines bring criticism that concludes with their intrusive visual effect on the landscape. But are turbines that much different from common landscapes that we see today?



fig. 23 Transmission Lines at Sunset



fig. 24 Effect of Nuclear Products



fig. 25 Nuclear Power plant

Other energy markets are a dead end. These markets, however, are the leading argument to wind energy as a renewable resource. But the by products produced from nuclear energy can NEVER be disposed of. They can NEVER disappear from our planet's ecosystems, EVER.

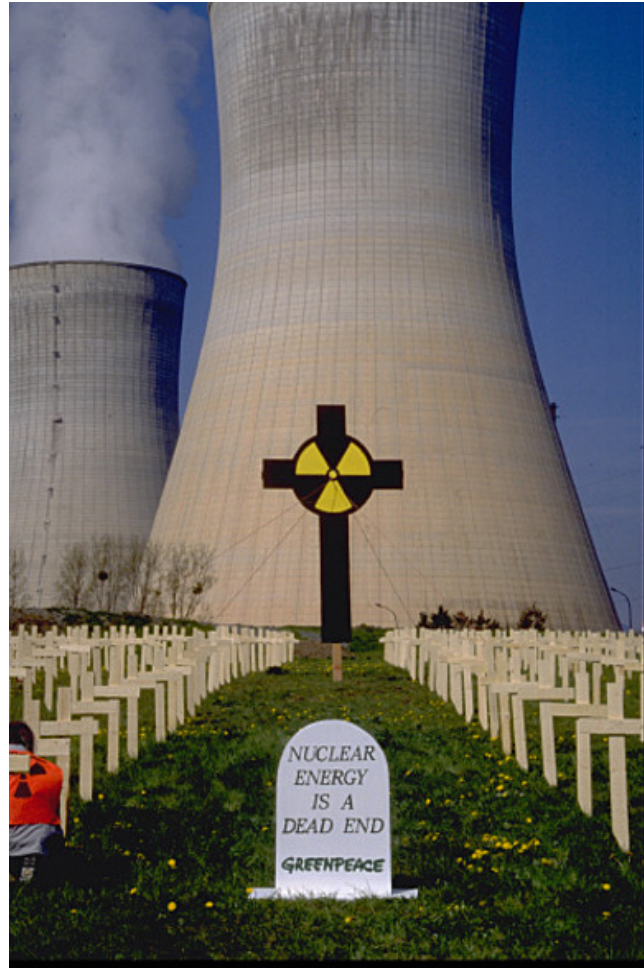


fig. 26 Green Peace Protest

Reservoir Recreation

Increasing the demand for wind-farming means less water would be needed, and the reservoir could be torn down. However, this would destroy the recreational opportunities provided by the reservoir, and recreation is something Wyoming cannot afford to lose. Architecture allows multiple circumstances to come together and maintain recreational opportunities around the reservoir.

Outdoor recreational opportunities provide society with green space and a chance to interact with nature. Facilities placed at the dam site and along the river will provide the public new forms of recreation while keeping most of the current recreation. The Guernsey Reservoir currently provides six types of recreation.

1. Boating
2. Jet/Water skiing
3. Camping
4. Hiking
5. Fishing
6. Swimming

Two of these activities require fossil fuels. Boating requires fossil fuels and, with the removal of the dam, will no longer be available. Because we are losing activities like boating and jet-skiing, fewer tourists will come. Camping, hiking, swimming, and fishing will still be available, but the loss of fossil fuel activities will result in a greater loss of tourists at the reservoir. Other activities offering the same experiences will be designed. Bike paths along the river, designed for electric motorcycles, will provide tourists a sustainable journey through the land. Building bike paths along the river will protect the river's edge from development.

The main exploration of this thesis, however, is to explore the architectural possibilities created from dam removal. Architecture shows us history, and the building will mark the water's multiple levels in time.



fig. 27 "The Castle,"
Guernsey Reservoir.

PROGRAMMING A BUILDING OF MEASURE

Qualitative Programming

Data points to the silting and eventual depletion of Guernsey Reservoir, and that depletion will affect a wide range of ecological, economic, and capital-driven interests. Predicting land evolution, especially with human-driven parameters, is a complex process. Ian L. Mcharg, a landscape designer and founding chairman of the Center for Ecological Research in Planning and Design, insists on educating modern designers and landscape architects who are competent in the natural sciences, especially those integrated by ecology.

To learn of the evolution of physical and biological processes is an indispensable step towards the knowledge one needs before making changes to the land: but it is far from enough. It is as necessary to know how the world works. Who are the actors and how do they respond to the environment, to physical processes and to other creatures?⁴¹

Architecture must be designed to sustain man and the systems that surround him, for those systems are the key to combining people with nature and the survival of people's processes within.

Yet, the step forward is a reluctant one. We look back enviously to those fewer, earlier men who, with smaller powers, built slowly, a little at a time, without harm and could change with less thought.⁴²

The construction of a building adds a historical marker in time, a marker for the accomplishments of people. Remembering the history of Guernsey is important for future development.

It is as the centralisation and protectress of this sacred influence, that Architecture is to be regarded by us with the most serious thought. We may live without her, and worship without her, but we cannot remember without her.⁴³

To look toward the future, we need to remember the past. Society must confront the conquest of nature that occurred in subduing the North Platte River. Ian Mcharg states this very clearly.

If one accepts the simple proposition that nature is the arena of life and that a modicum of knowledge of her processes is indispensable for survival and rather more for existence, health and delight, it is amazing how many apparently difficult problems present ready resolution.⁴⁴

To completely integrate architecture into the landscape, many things need to be considered. History being the most important, and current conditions being the second. Strategies that offer hope for the land well into the future must be examined, but one building could not achieve these tasks alone. But a series of constructions over time could, and they will be carried out in three phases.



fig. 28 Guernsey Dam

PHASE 1: Destruction of the dam at Guernsey Reservoir.

Once the dam is removed, a water research center will be designed to replace it. The facility will allow scientists from around the world to study a former dam site and the effect of that dam's removal. The building's function will benefit the river's future; the architecture will address the area's historical value.

Water ecology and watershed research are vital for recovering the nation's natural watersheds. Labs to study the watershed, water ecology, and river hydraulic and hydrology will provide scientists and researchers an area with a unique, and still developing, river. The center will provide an in-house, rotation style environment housing individual scientists from around the world. The facilities will help measure the naturally occurring systems such as river flow, sedimentation, and energy production.

Parallel to the workings of the scientists, university students will be provided with live-in research labs to assist the scientists and experience firsthand the human science behind nature. This will offer future generations insight into nature that can only be understood through immersion. Phase one will be the major factor explored.

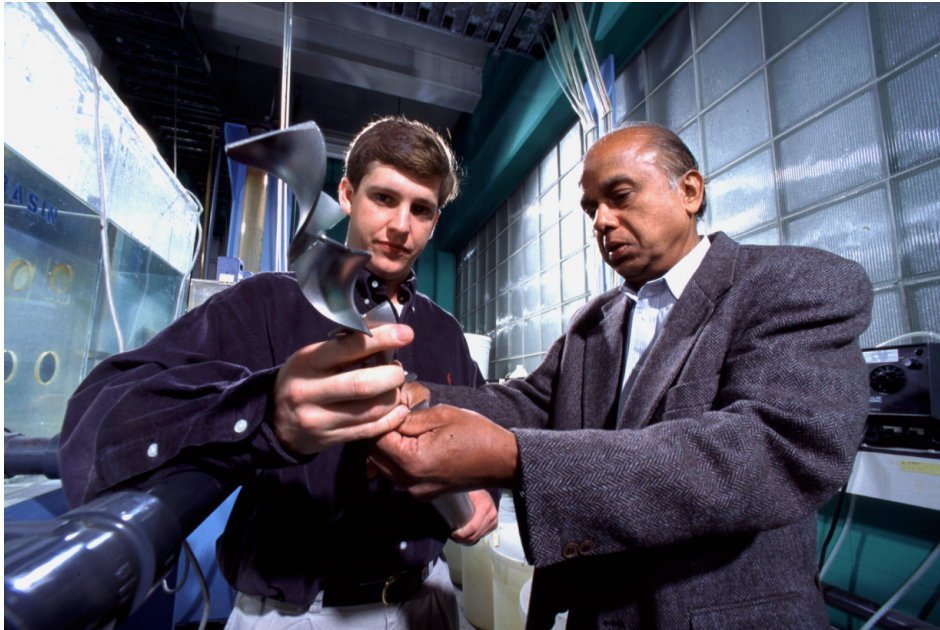


fig. 29 Student and teacher re-viewing propeller.

PHASE 2: Implementation of Recreational nodes.

In order to maintain the tourism Guernsey currently uses, new systems must be designed that adhere to certain qualities of the previous ones. Boats provide the feeling of speed, and keeping water present during or near such an activity is crucial. Sustainable products, such as electric motorcycles, will satisfy the need for speed. Nodes will be established along the stretch of river from Guernsey, Wyoming, to Bridgeport, Nebraska. These will provide people different recreational opportunities along the river: biking, kayaking, swimming, inner tubing, and riding motorcycles. All offer ways to experience the landscape, and these recreational nodes will be run by the students. State workers, whose jobs would otherwise be eliminated with the removal of the dam, would keep the same jobs they did running the reservoir. Groundskeepers still maintain the landscape; park rangers still patrol the grounds. To integrate this component with the research facility, a studio will be provided for students to help the scientists while managing the business of keeping the recreation open and running. This provides students multiple educational opportunities. The nodes along the river will be explored through mapping, merely placement. The focus will be on the integration of a facility at the dam site.

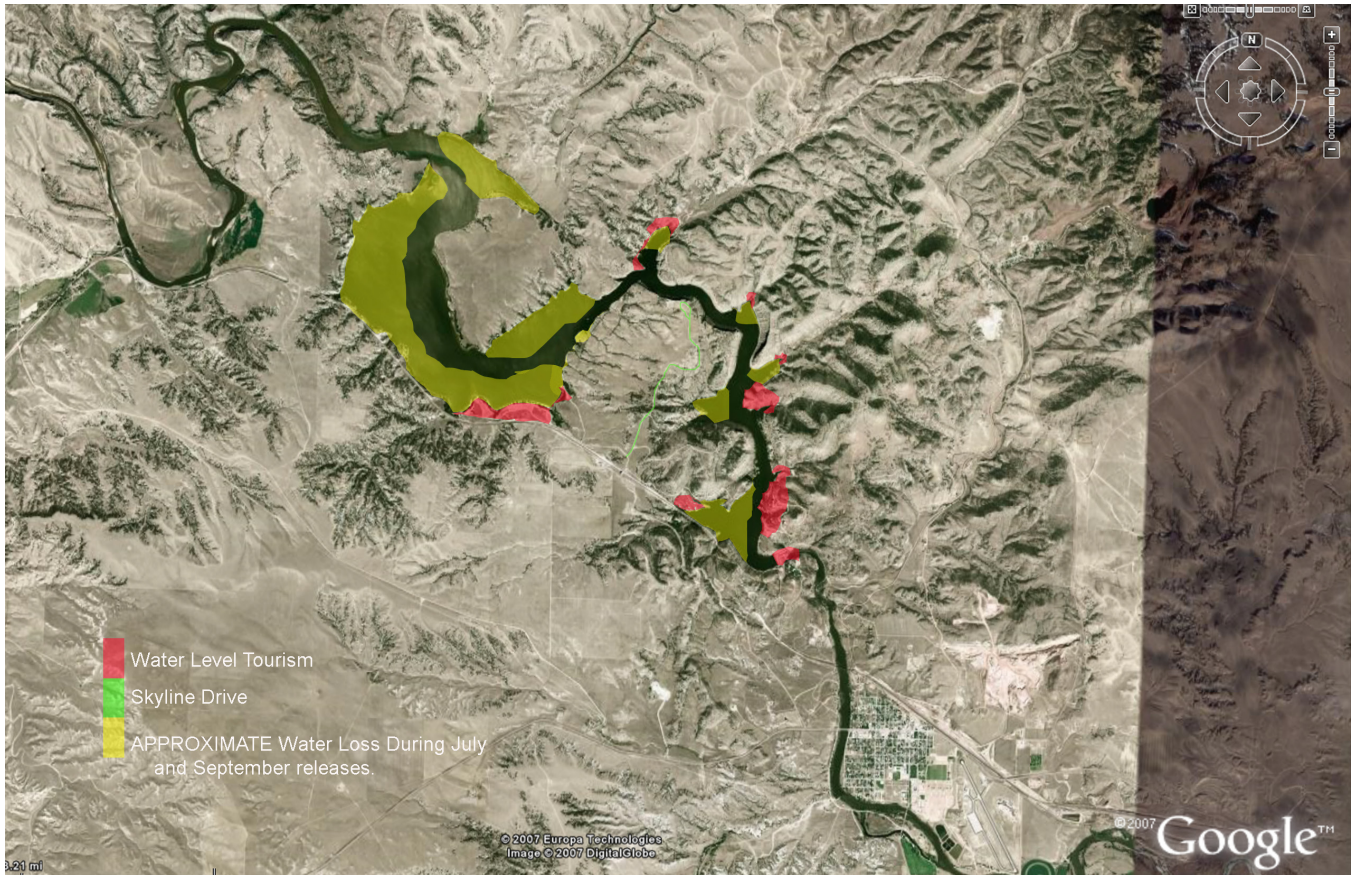


fig. 30 Guernsey Reservoir

PHASE 3: Design of secondary systems

- Bike Paths
- Landscaped Campgrounds
- River accessibility

Extended bike trails will provide transport, and landscape barriers will hinder any future development of the water's edge. Also these trails will serve as an educational guide, providing awareness of a landscape's ability to sustain life.

As the water in Guernsey Lake recedes, the silt is revealed, and so are opportunities to create unique camping experiences along the old lake bed. Architectural elements installed along with the bike paths offer the opportunity to show the effects of a silting river. Sculptural elements will be explored to act as silt catches. A silt catch will be explored to measure the river's ability to transport aggregates and fertile soil with the hopes of developing a permanent system. These silt catches need to be designed to juxtapose function, research, and recreation, especially to provide camping along the river as well as recreational accessibility to the river. The silt catches will be explored at the dam site where the building meets the river. It is thought that over time the silt catches designed at the dam site can spread over the reservoir. This will be explored through abstract imagery and placement mapping.

Exploring these aspects of an integrated design within nature require a specific program relevant to the issues explored within this study. The quantitative program will be as follows.



fig. 31 Proposed site for recreation development

QUANTITATIVE PROGRAM

Research Facility:

LABS:

Wet Research Lab	1250sq. ft.
Dry Research Lab	1250sq. ft.
Exhibit	200sq. ft.
Auditorium	1200sq. ft.

ADMINISTRATION:

4 Administration Offices	400sq. ft.
6 Research Offices	600 sq. ft.
Public Restrooms	300sq. ft.

PRIVATE SECTOR:

6 Research Living Units	1350sq ft.
Cafeteria/Commons	400sq. ft.
6 Facility Restrooms	300sq. ft.
Equipment/Data Storage	2000sq. ft.

EXTERIOR:

Water Dock	300sq. ft.
Entry Pavilion	300sq. ft.

Education Facility:

LABS:

2 Classrooms	800sq. ft.
Student Lab	800sq. ft.

LIVE IN AREA:

6 Girls Rooms	600sq. ft.
6 Boys Rooms	600sq. ft.

Girls Locker Room	450sq. ft.
Boys Locker Room	450sq. ft.

EXTERIOR:

Amphitheater	1200sq. ft.
Recreation Module	800sq. ft.

Mechanical (15% of Interior)	1942sq. ft.
------------------------------	-------------

Circulation (15% of Interior)	1942sq. ft.
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Recreation Component:

FACILITIES:

3 Exchange Modules	1600sq. ft.
20mi Bike Trail	
Landscaping	

Program Total (Interior)	12950sq. ft.
Program Total (Exterior)	2600sq. ft.

TOTAL BUILDING AREA	15550sq. ft.
----------------------------	---------------------

Code Review- International Building Code 2006

OCCUPANCY TYPE

303.1 Assembly Group A. Assembly Group A occupancy includes, among others, the use of a building or structure, or a portion thereof, for the gathering of persons for purposes such as civic, social or religious functions; recreation, food or drink consumption; or awaiting transportation.

A-1 Assembly uses, usually with fixed seating, intended for the production and viewing of the performing arts or motion pictures.

A-3 Assembly uses intended for worship, recreation or amusement and other assembly uses not classified elsewhere in Group A including, Exhibition halls and Museums.

304.1 Business Group B. Business Group B occupancy includes, among others, the use of a building or structure, or a portion thereof, for office, professional or service-type transactions, including storage of records and accounts. Business occupancies shall include, but not be limited to, the following:

Educational occupancies for students above the 12th grade Electronic data processing

Laboratories: testing and research

310.1 Residential Group R. Residential Group R includes, among others, the use of a building or structure, or a portion thereof, for sleeping purposes when not classified as an Institutional Group I or when not regulated by the *International Residential Code* in accordance with Section [101.2](#).

R-1 Residential occupancies containing sleeping units where the occupants are primarily transient in nature, including: Boarding houses (transient) Hotels (transient)

311.1 Storage Group S. Storage Group S occupancy includes, among others, the use of a building or structure, or a portion thereof, for storage that is not classified as a hazardous occupancy.

CONSTRUCTION TYPE

602.3 Type III. Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. Fire-retardant-treated wood framing complying with Section [2303.2](#) shall be permitted within exterior wall assemblies of a 2-hour rating or less.

ALLOWABLE BUILDING HEIGHTS AND AREAS

503.1 General. The height and area for buildings of different construction types shall be governed by the intended use of the building and shall not exceed the limits in Table [503](#) except as modified hereafter. Each part of a building included within the exterior walls or the exterior walls and fire walls where provided shall be permitted to be a separate building.

Allowable building height in stories (3)

Allowable building height in feet (3)

Allowable building area in square feet (14,000)

FIRE RESTRICTIVE RATINGS

Load Bearing Walls

Interior: Type III B=0

Exterior: Type III B=0

Non-Load Bearing Walls

Interior: Type III B=1

Exterior: Type III B=1

Structural Frame: Type III B =0; steel

Floor Construction: Type III B=0

Roof Construction: Type III B=0

MEANS OF EGRESS

1003.2 Ceiling Height: The means of egress shall have a ceiling height of not less than 7 feet (2134mm)

1004.12 Occupant Load: The number of occupants computed at the rate of one occupant per unit of area as prescribed in Table 1004.1.2 Maximum floor area allowances per occupant assembly

Concentrated (no fixed seats)	7 net
Standing space	5 net
Unconcentrated	15 net

1005.1 Exit Width Corridors: Stairways .2 inches per occupant other components .15 inches per occupant.

1005.1 Exit Width Ramps: Other components .15 inches per occupant.

1005.2 Exit Width Doors: .5 Inches during swing. 7 inches when open

1008.1.1 Minimum Width Doors: 32 inches

1008.1.1 Minimum Height Doors: 80 inches

1014.2.1 Exit Remoteness: 1/2 Length of max overall diagonal dimensions or area to be saved.

1015.1 Length of Exit Access Travel: 200 feet without sprinklers. 250 feet with sprinklers.

1016.2 Minimum Required Width Corridor: 44 inches

1016.3 Dead End Corridor Maximum: 20 feet

1018.1 Number of Exits

1 for areas with less than 50 occupants

2 for areas with less than 500 occupants

3 for areas with 500 to 1000 occupants

ACCESSIBILITY

The entire building must meet ADA accessibility requirements including but not limited to:

36 inch wide accessible routes

60 inch by 60 inch passing space

80 inch head room

1:20 maximum slope

4 inch minimum horizontal protrusion

32 inch minimum clear door opening

PRECEDENTS

Randall Ott

Salt Chapel
Salt Lake City, Utah
The Great Salt Lake, 2004

The Salt Chapel, a hypothetical project, is on the Great Salt Lake in Utah. The areas current design typologies, and history led to the mechanized form. This project was formed from the historical references that surround it. Current technology is used to measure natural events within our environment. The chapel roams the Lake by adjusting its position with regard to the tidal flux of the Lake. This is an example of architecture that measures naturally occurring events and reacts to them. The project was developed through a historical study, localized conditions, and the environment.

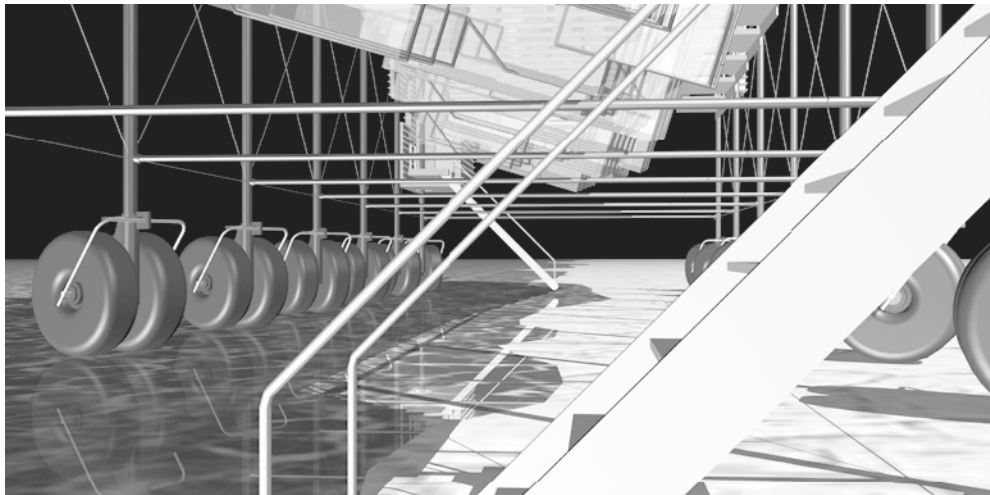


fig. 32

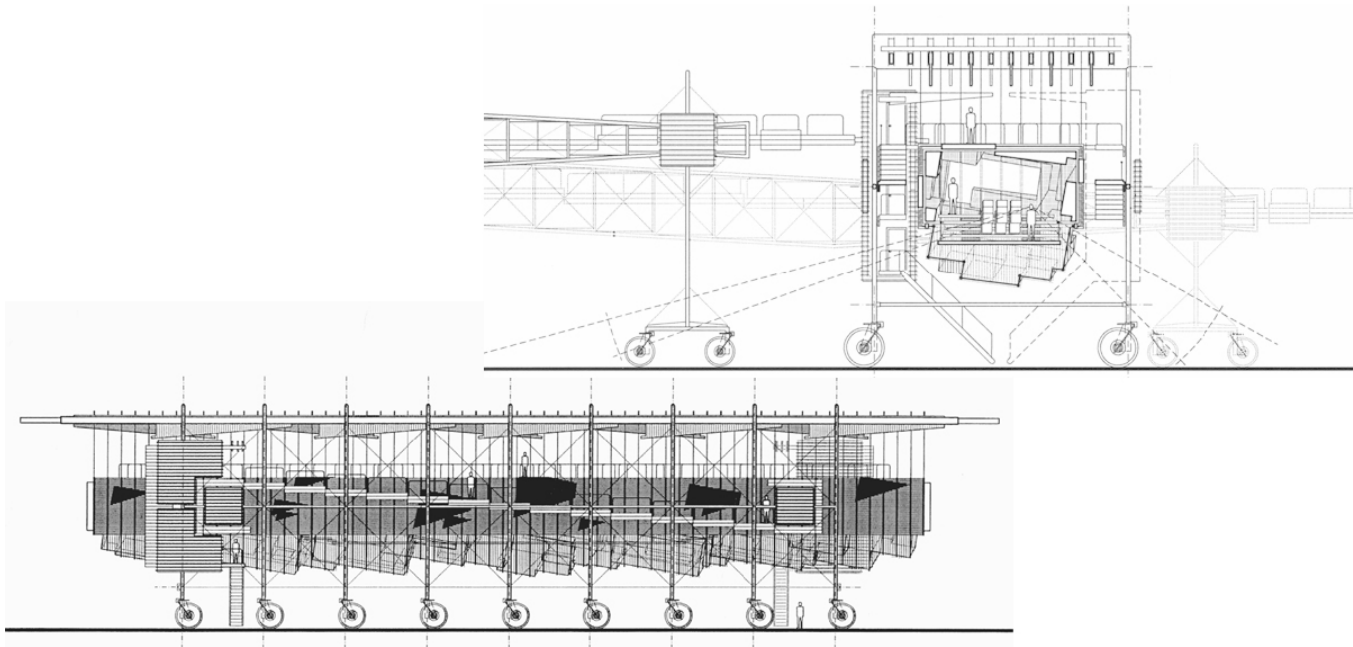
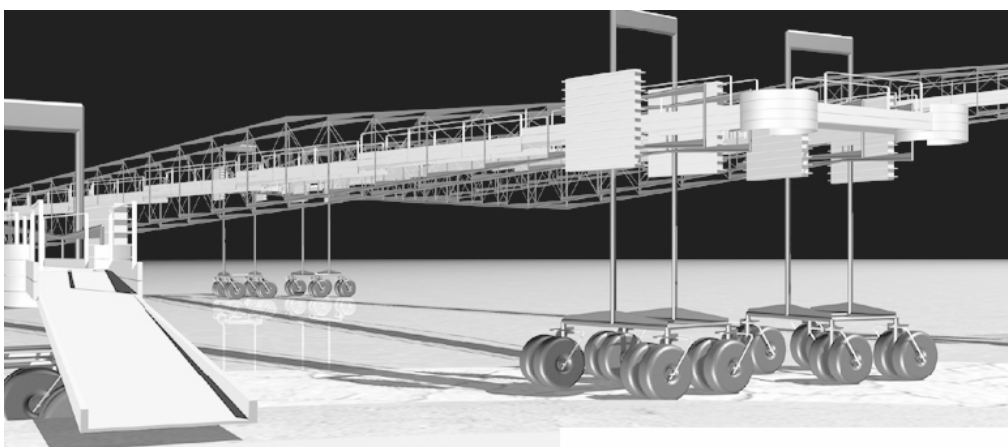


fig. 33
fig. 34
fig. 35

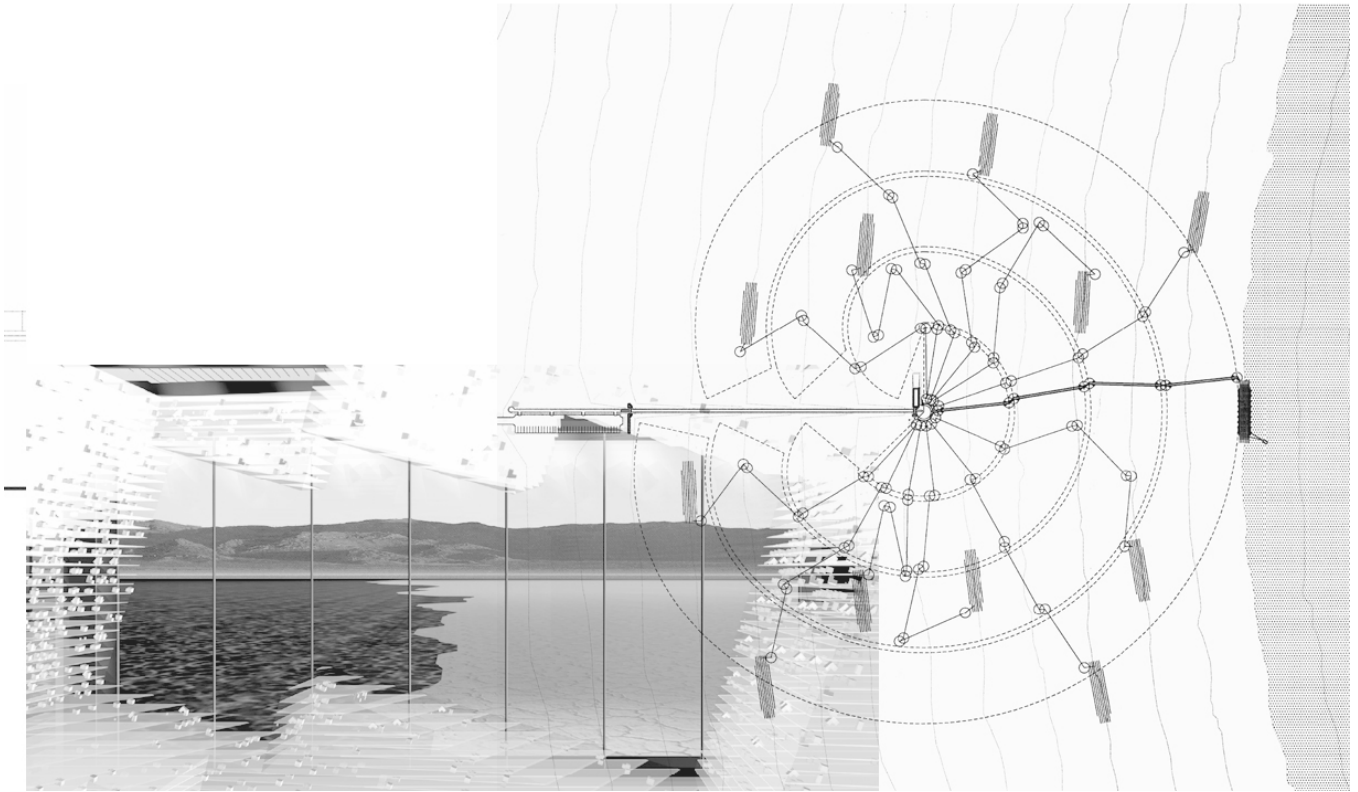


fig. 36

fig. 37

fig.38



fig. 39

Antoine Predock

Rio Grande Nature Center
Albuquerque, New Mexico
1982

This Nature Conservatory designed by Antoine Predock exemplifies building within the natural surroundings of a specific environment. It was realized in 1982 with the unnatural events of a whooping crane habitat in an urban surround.

The simplistic forms allow the building to integrate within the landscape. The land becomes the focus. With this in mind apertures are specifically placed to frame events that occur outside. Events that allow a controlled view to natural processes, such as the nesting routines of rare birds. This allows people to see birds nesting within their natural habitat and allows the building to connect with the land.

The conservation workers within the building can be integrated into the environment that they are researching allowing a broad range of research opportunity.

Predock's construction exemplifies techniques to integrate architecture into the landscape. The Nature center is a border condition that emphasizes land and water. Routes to and from the building are taken back by the landscape and minimize the buildings presence. The facility is an example of a facility that provides research, recreation, and conservation of the environment, a key strategy of this thesis.



fig. 40
fig. 41





fig. 42

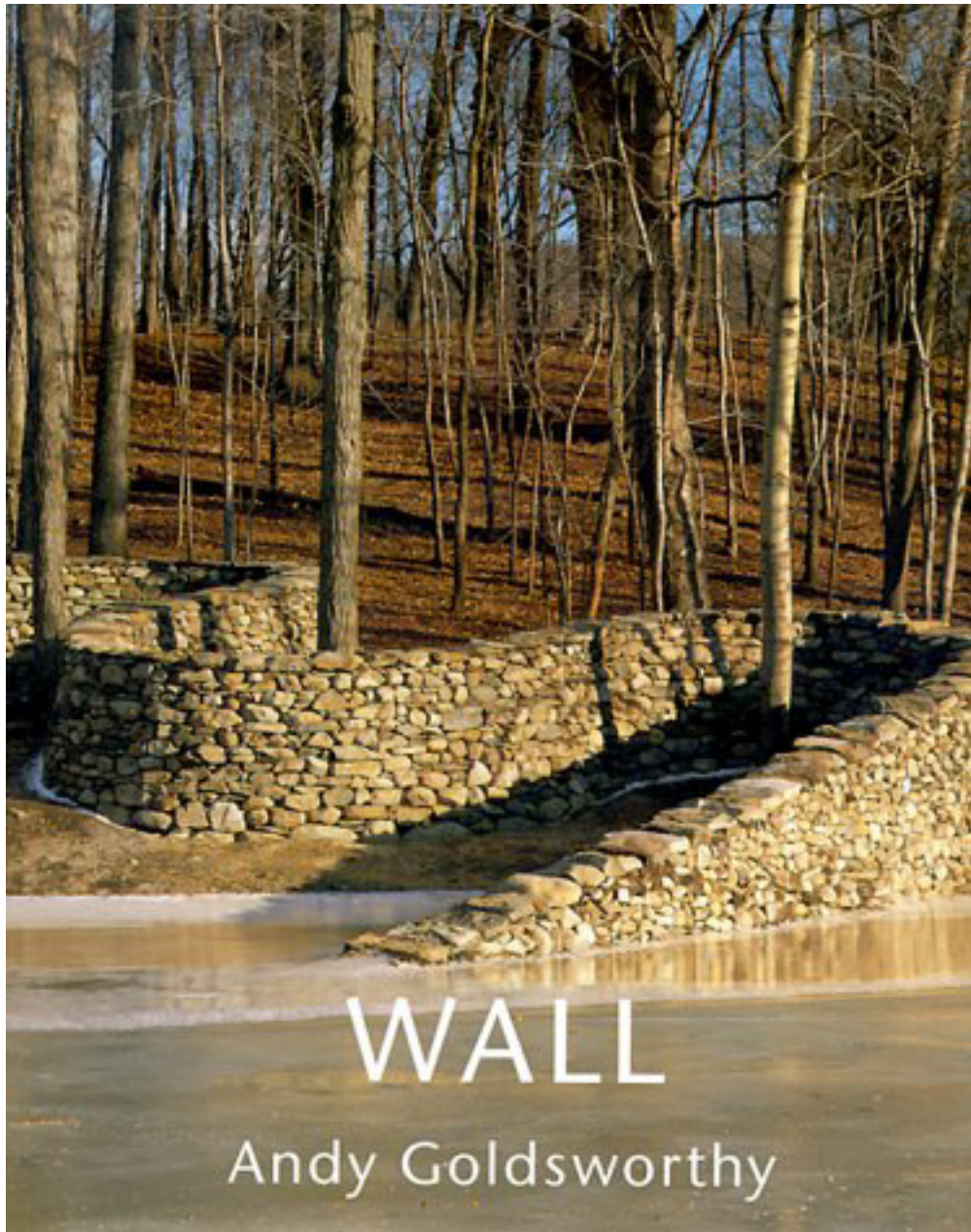


fig. 43

Andy Goldsworthy

Various Works

The various works of Andy Goldsworthy provide the world with a look into how man can successfully integrate himself with the natural world. Though these are mere sculptures the examples these beautiful pieces of art provide, allow an insight into how the formation of architecture can react to an environment over time.

Using actual landscape and systems that are found within the environment Andy Goldsworthy's sculptures use nature to elevate the essence of the areas place character to the minds mankind.

These techniques are relevant as the formation of the architectural forms will rely heavily on localized material conditions. This will allow the architecture to evolve right alongside the landscape.



fig. 44



fig. 45

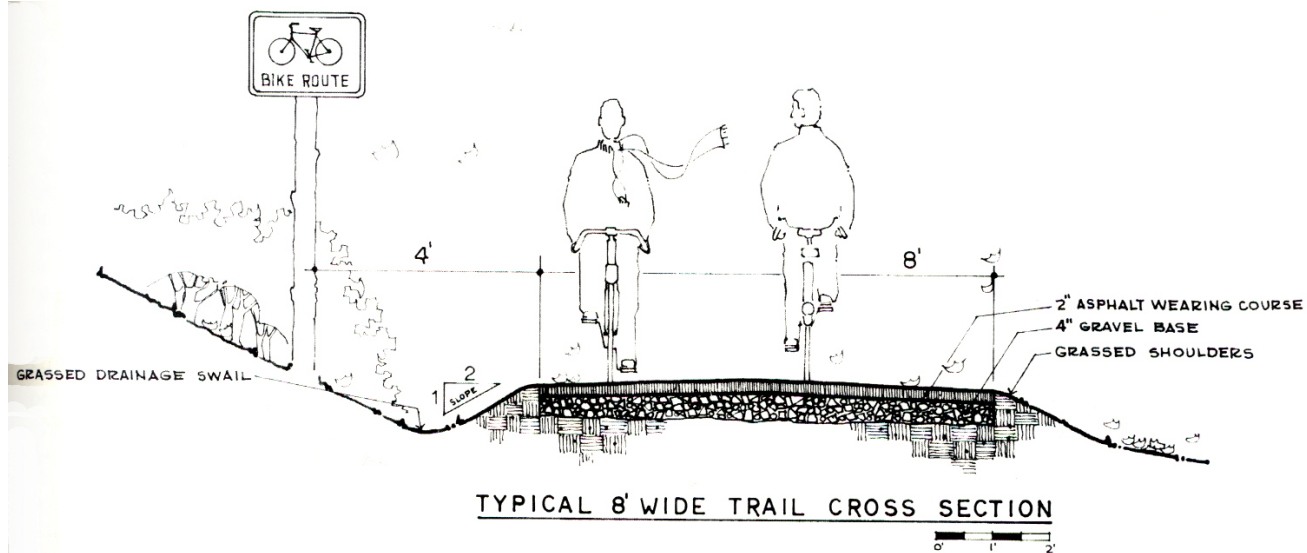
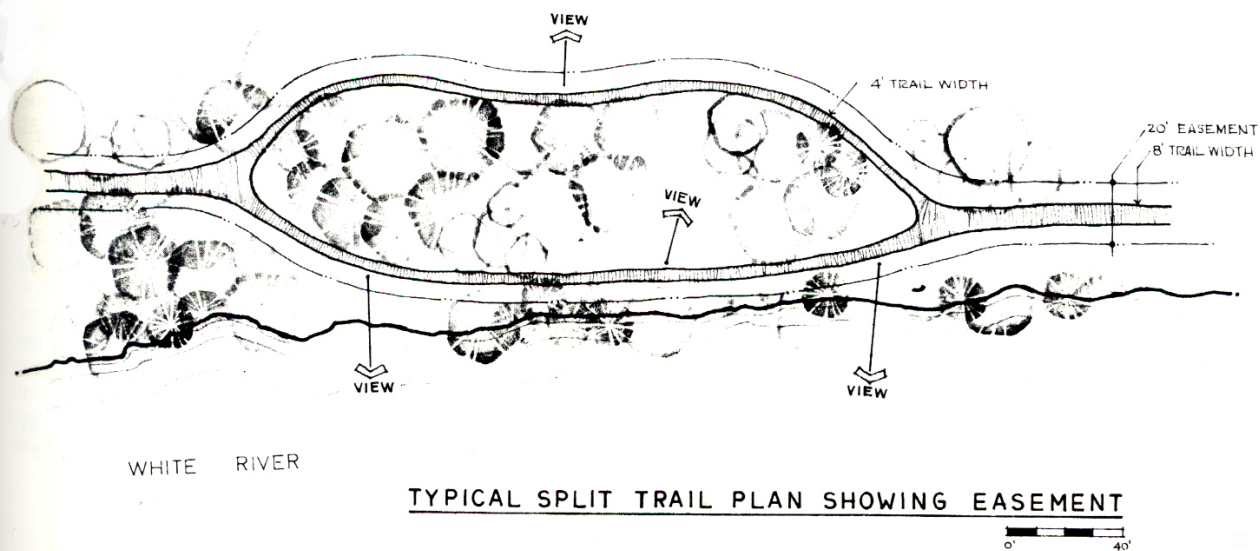
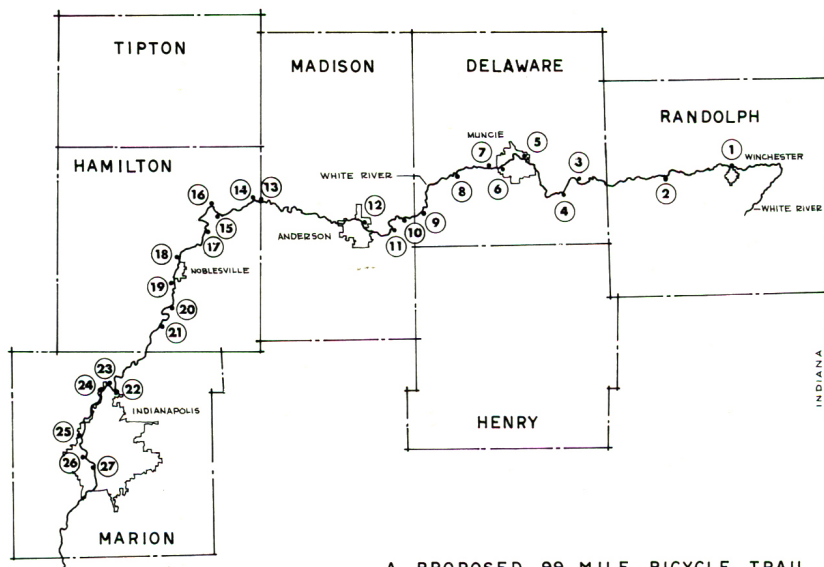


fig. 46



A PROPOSED 99 MILE BICYCLE TRAIL
FROM WINCHESTER TO INDIANAPOLIS

0 MILES 0

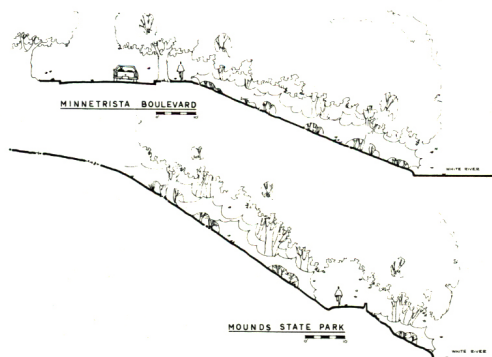


fig. 47



D.B. Young &
Assoc., Inc.

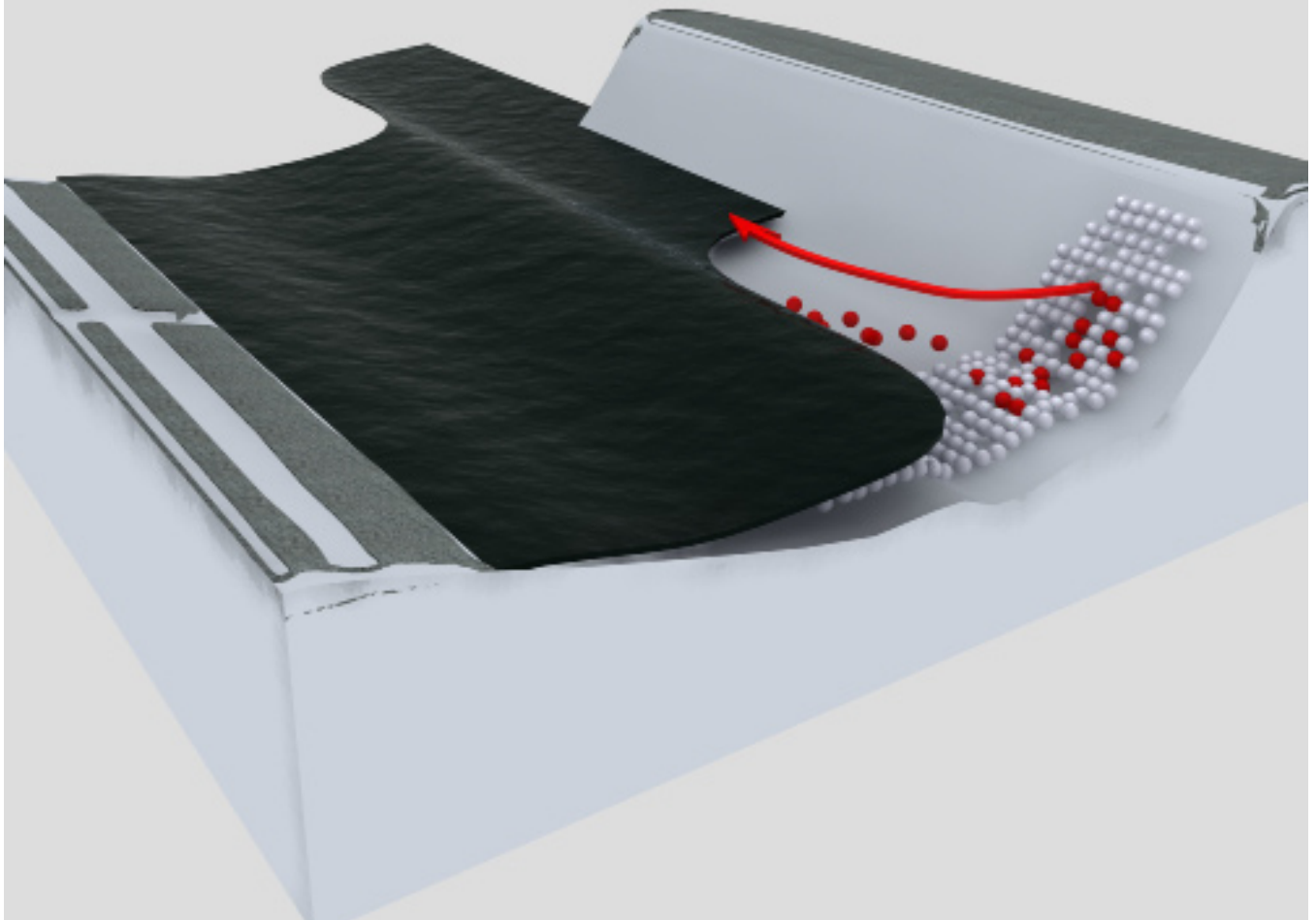
Landscape Architect.

A 99 mi. bike trail that
crosses 5 counties.
1971

Design Process:

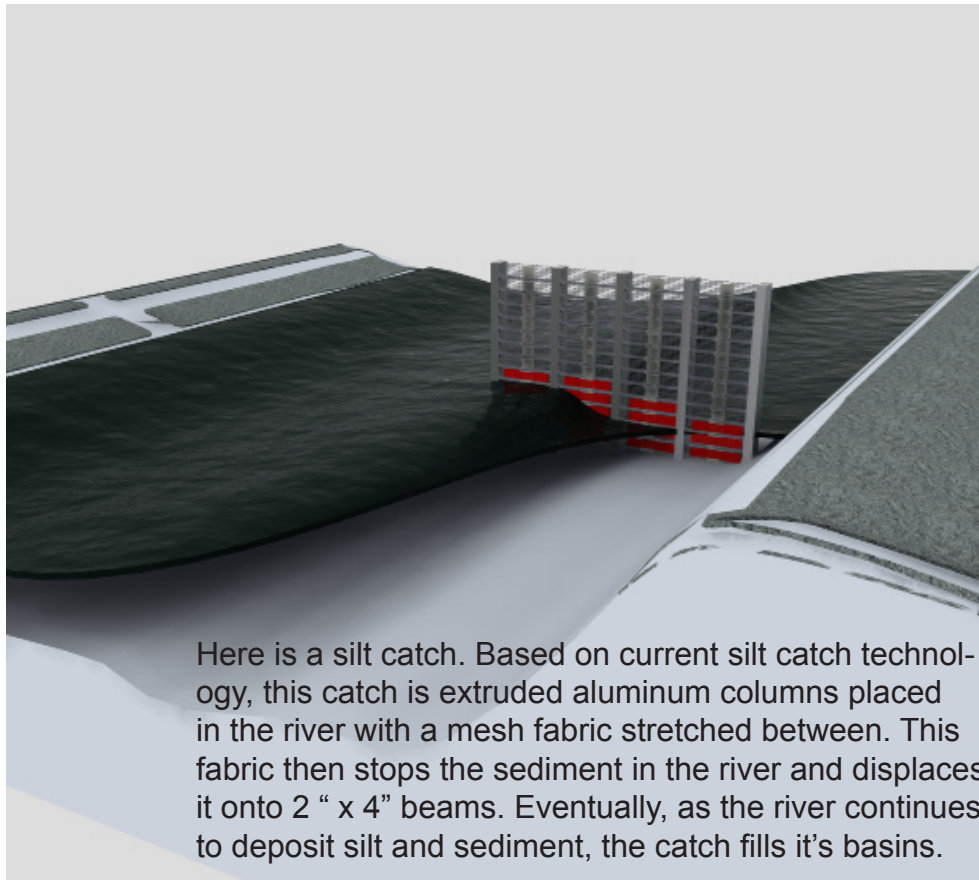
The Problem

The process began here. This is a diagram of the problem facing many of today's reservoirs, river siltation. This diagram shows particles detaching from the river bed and being transported downstream.

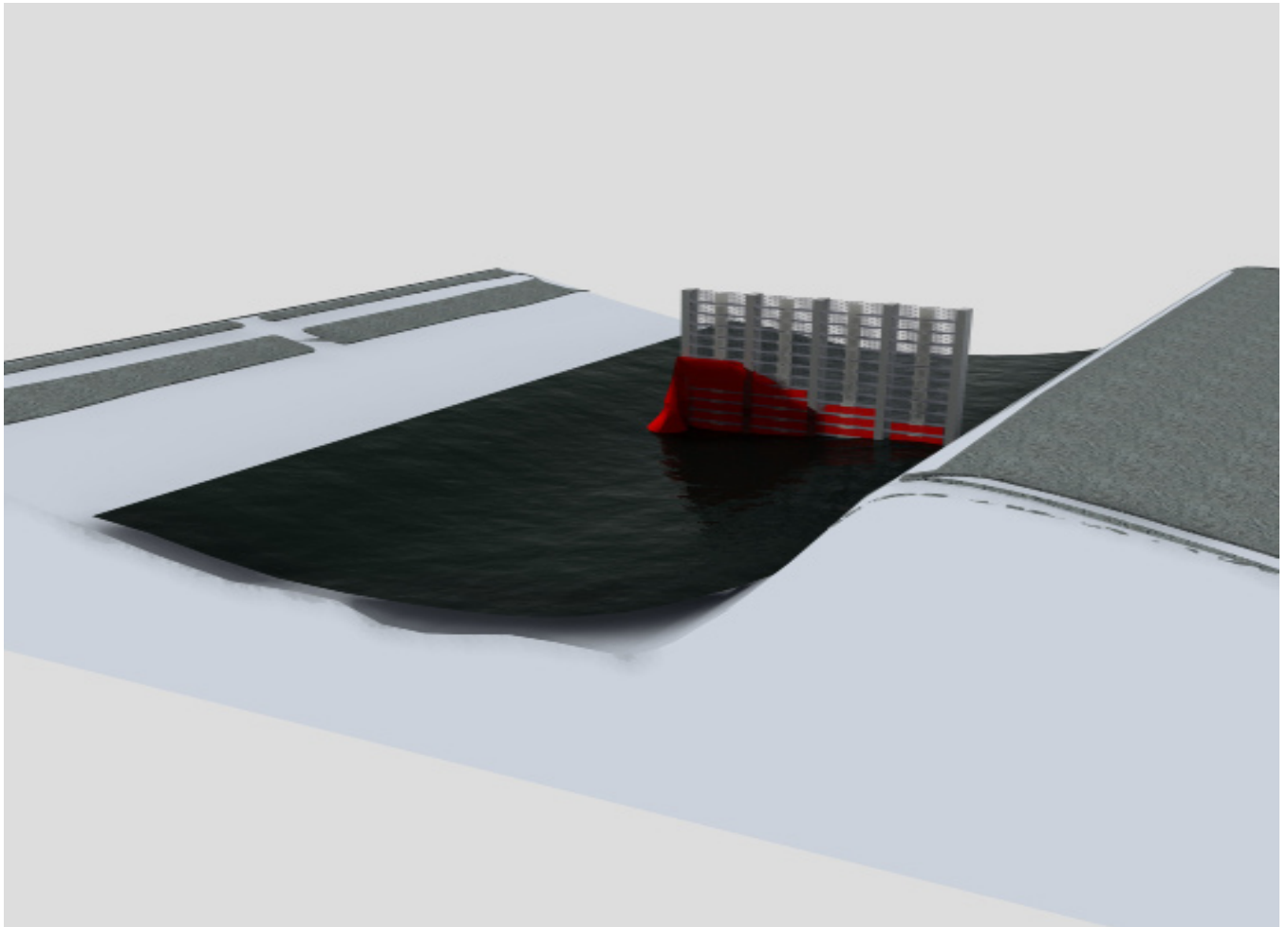


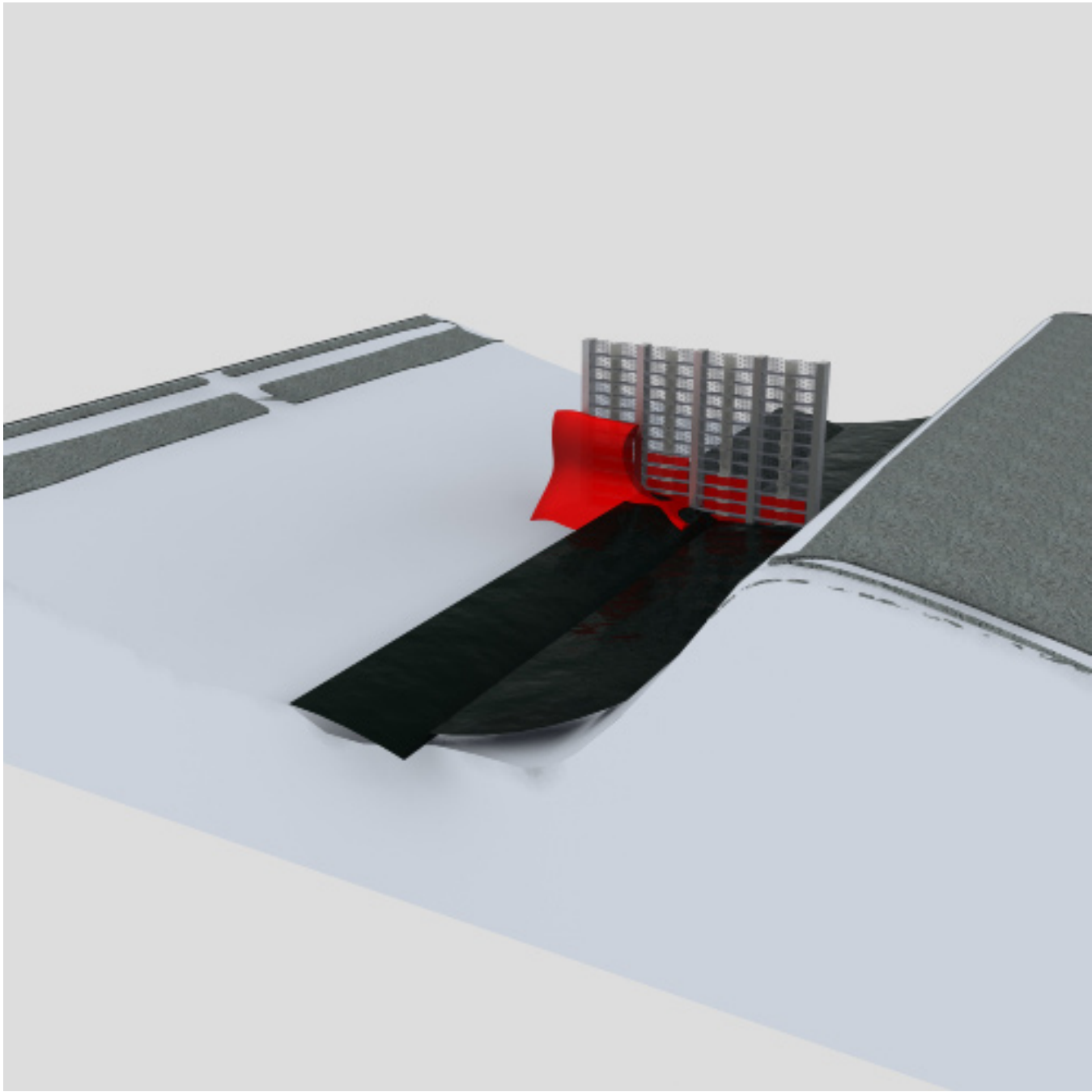
The silt that is transported downstream has negative impacts on many things: wildlife refuges, a river's fluvial navigation, and communication between the river and an area's aquifer.

To reveal a process within nature is to allow mankind to interact with that process. The design encompasses river siltation, and acts as a filter to deal with the silt in new ways.

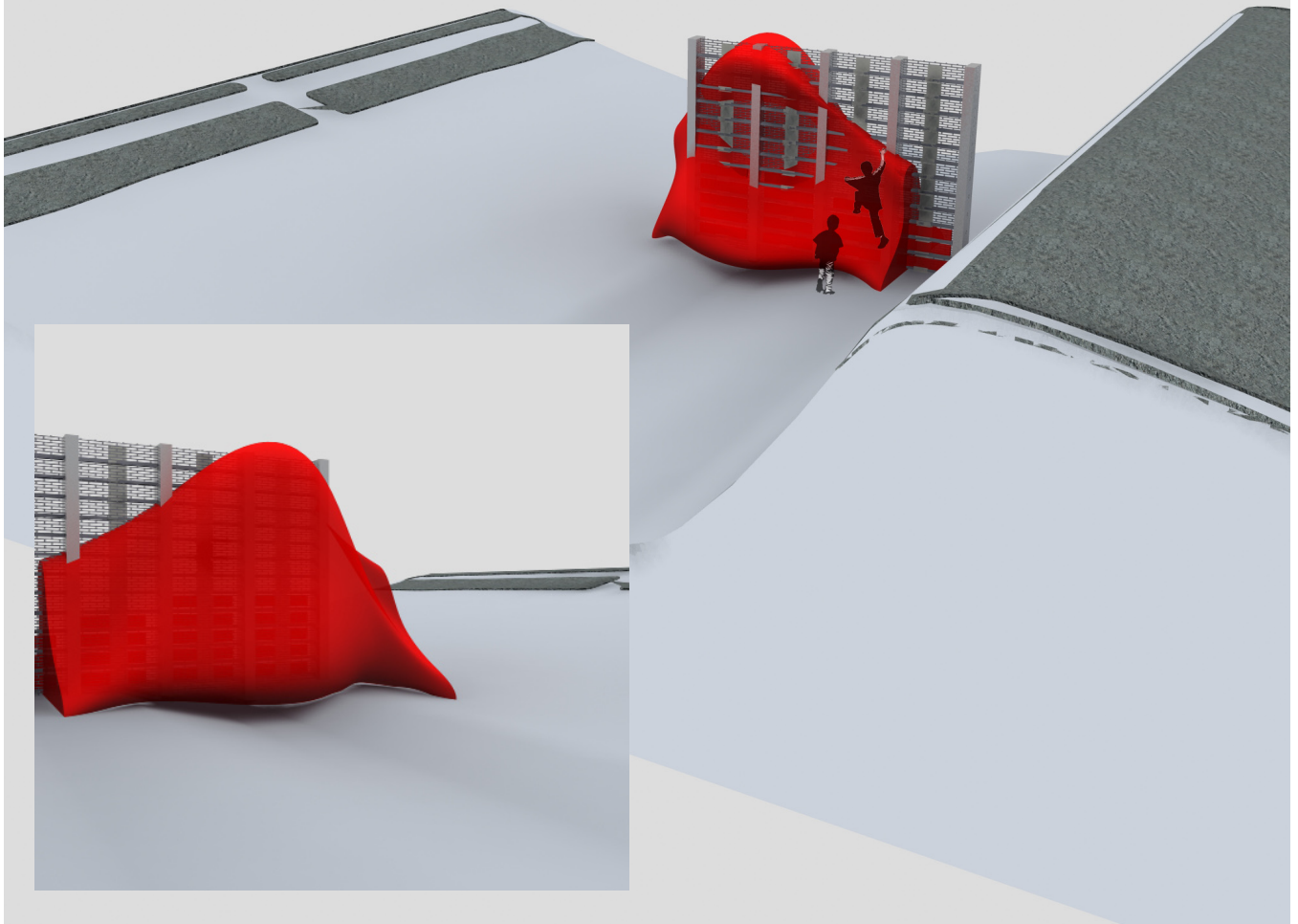


The river's water level constantly changes. If the silt and sediment build up, and then the river drops below the sediment level, the sun begins to constantly hit the exposed silt and sediment. Because of the varying degree of particle sizes, the mixture of dirt begins to act like mud brick. The larger particles become an aggregate, and the smaller particles act like cement, bonding the two together. This forms a solidified form grafted to the silt catch.

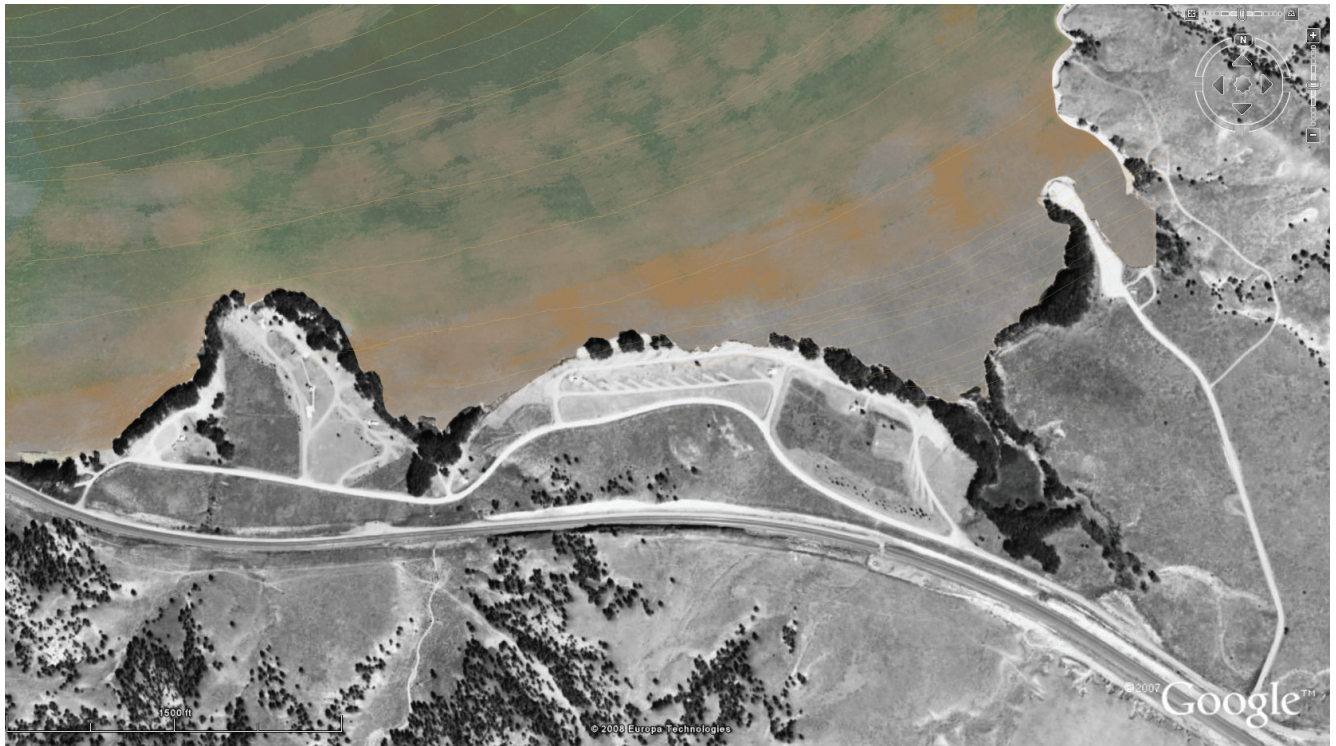


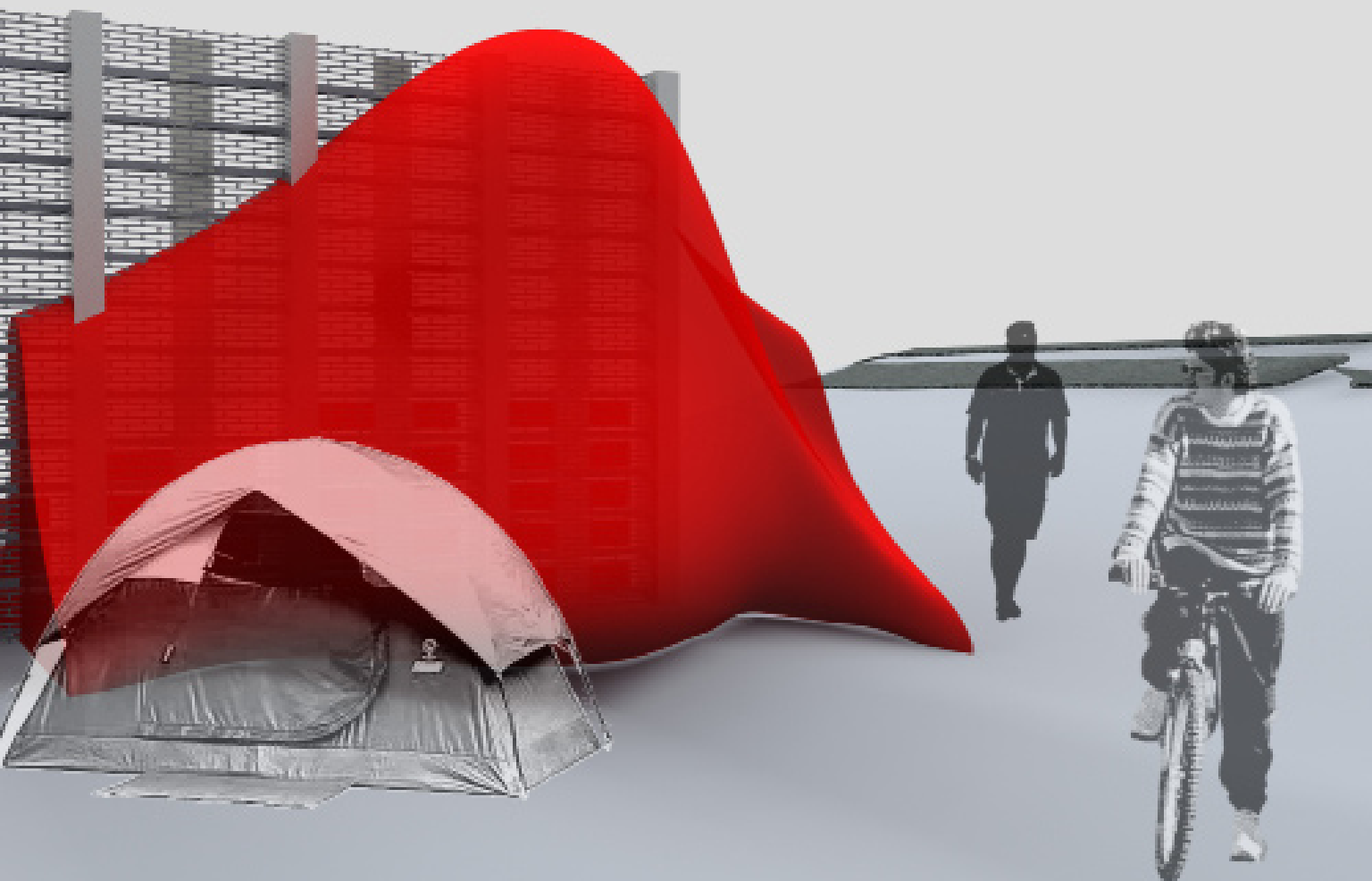


The rise, fall, and constantly changing nature of the water will affect the solidified form over time. Erosion will then occur as another parameter to the river's flow and begin to carve away at the solidified silt forms.



The water will recede once the dam is removed. The campgrounds will become desolate and unoccupied if water is not present. However, if the silt catches are placed periodically new spatial conditions for camping emerge. Below is a diagram of the water receding from Sandy Beach, Guernsey Reservoir. The gradient of color mark the water's position at periods of the recession.

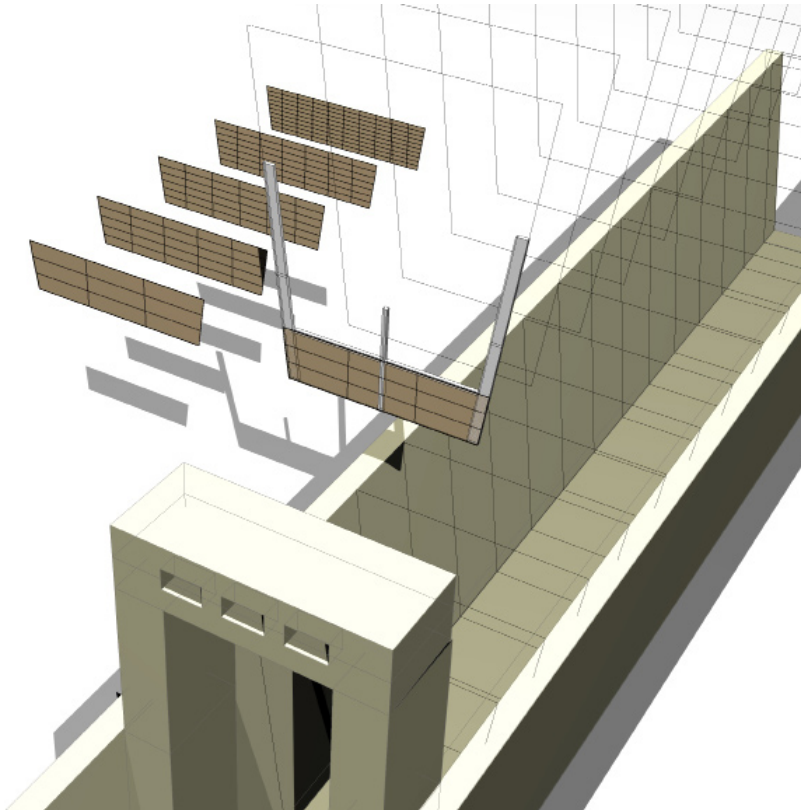




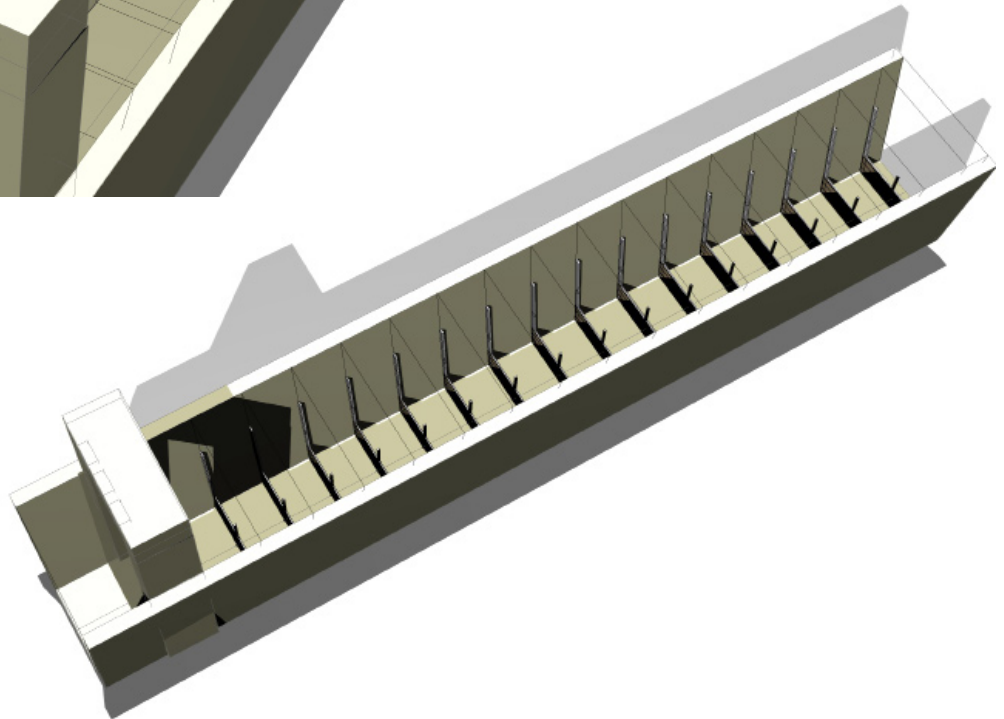
REMOVING THE DAM

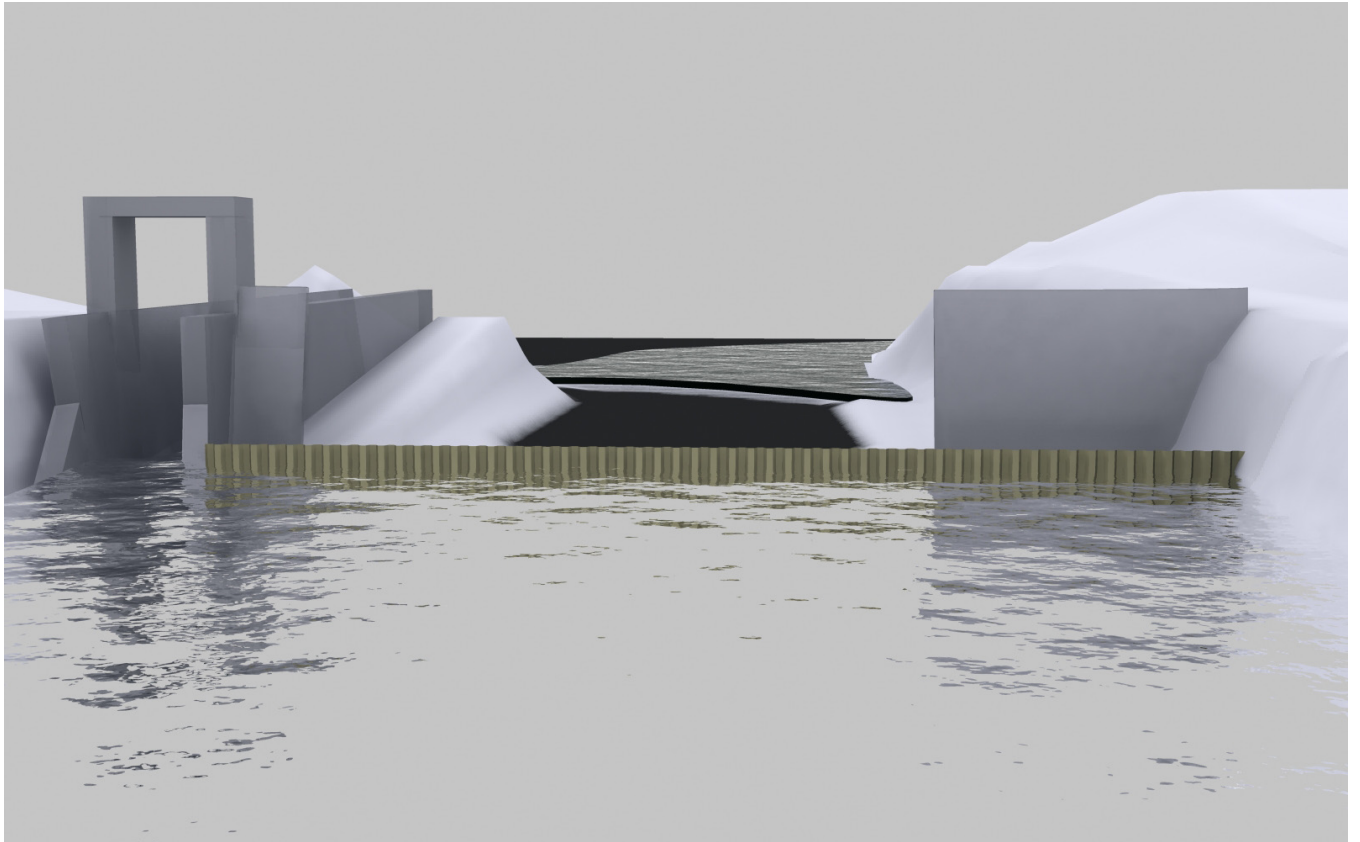


Many issues were explored as to how to remove the dam. The best fit solution is as follows:

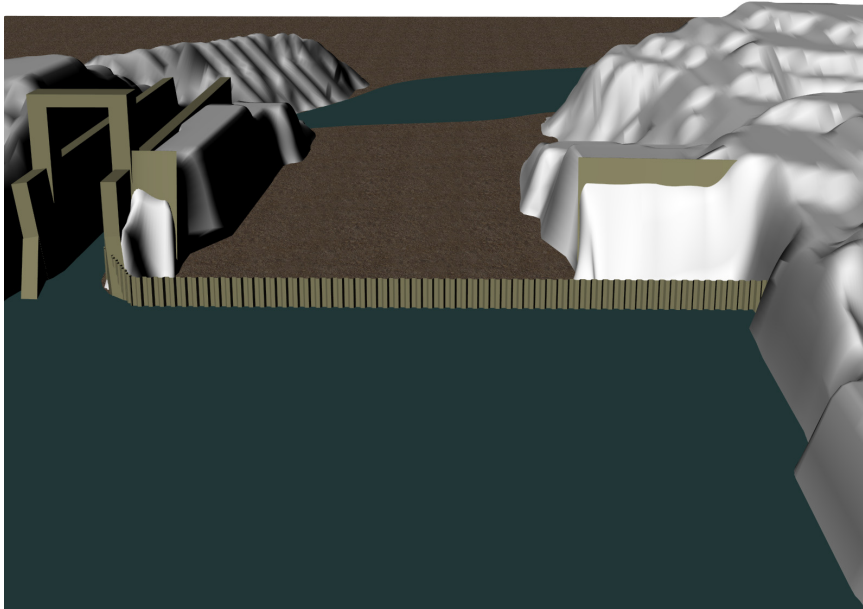


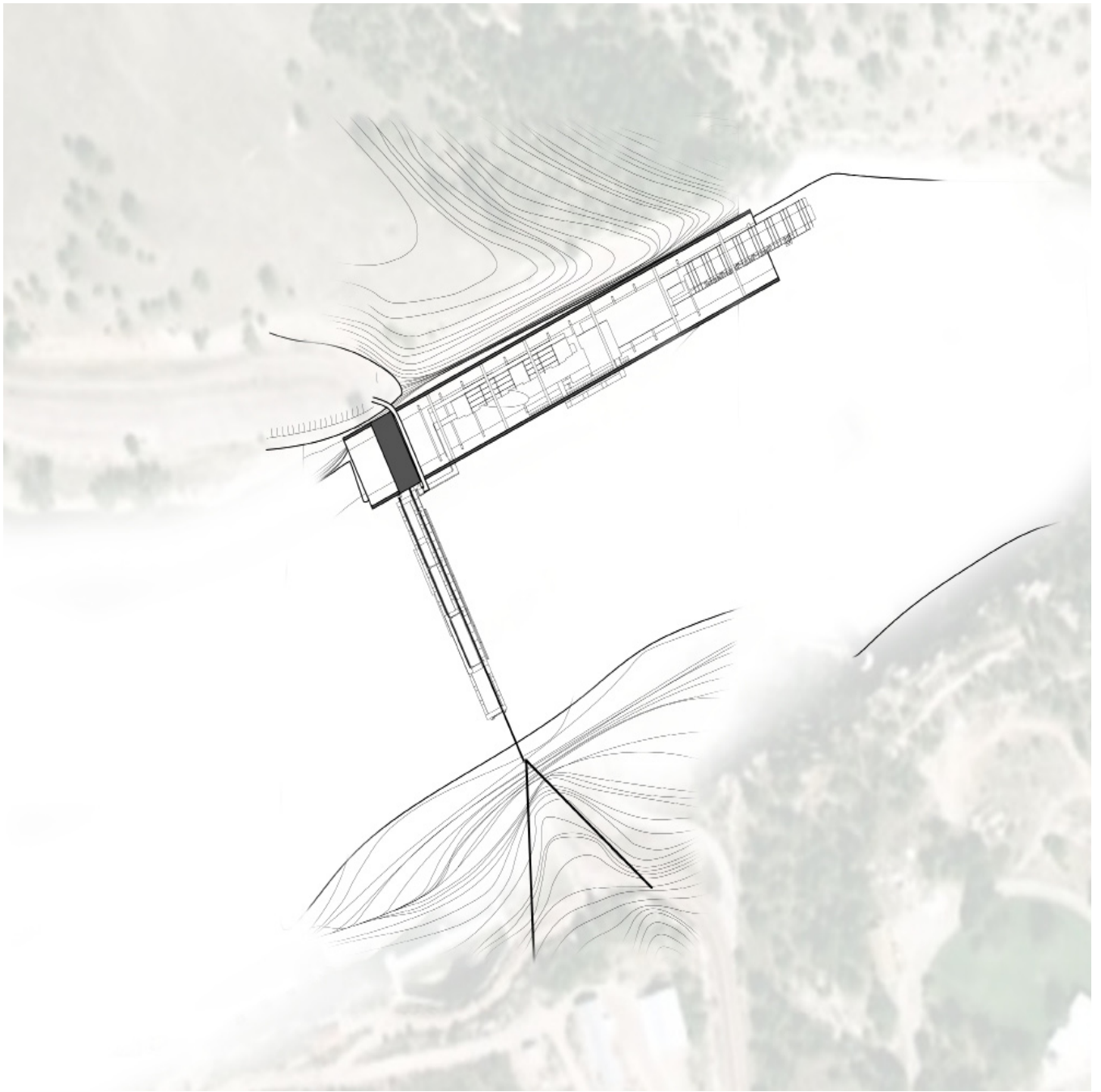
1. A series of filters are put into the existing spillway. These filters all have different mesh sizes to catch a variety of silt particle sizes.

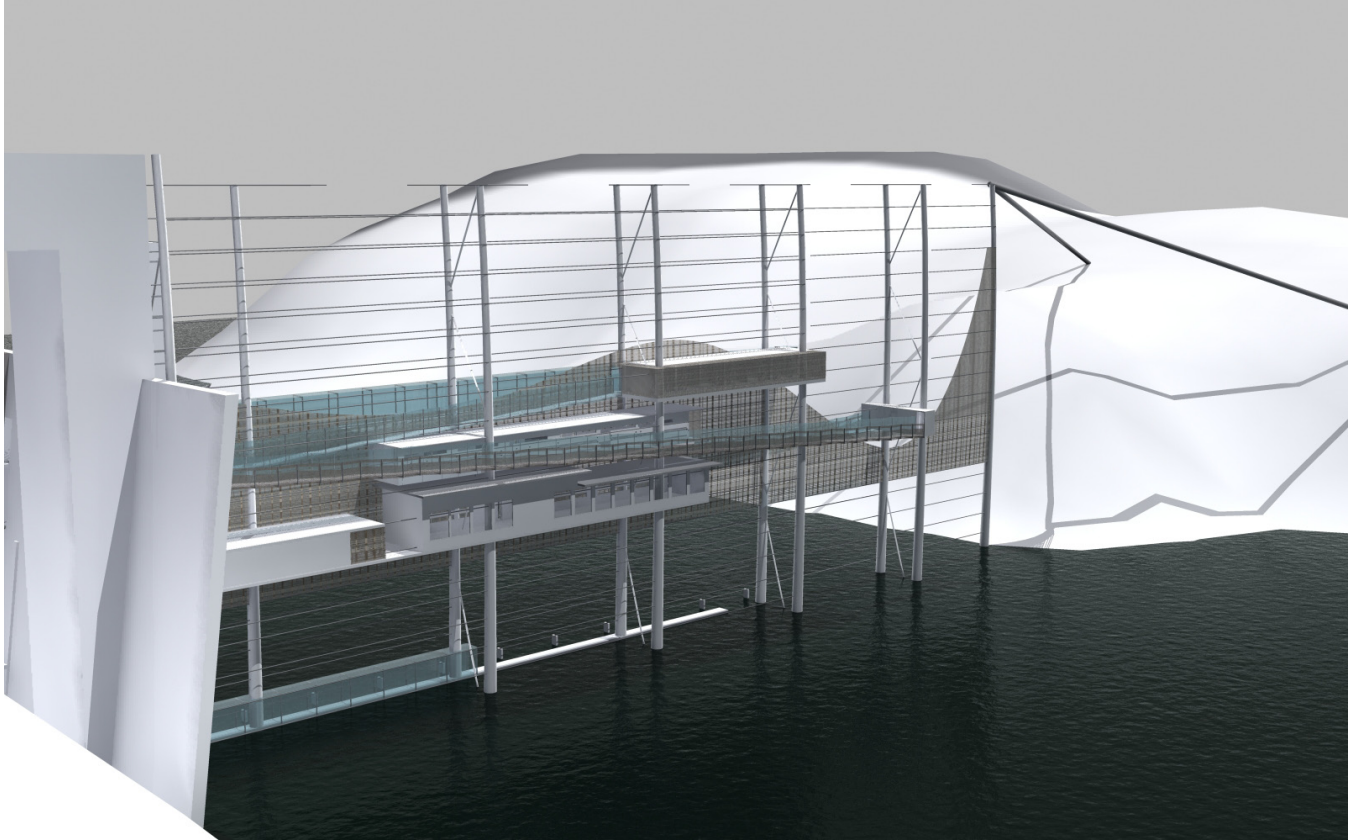


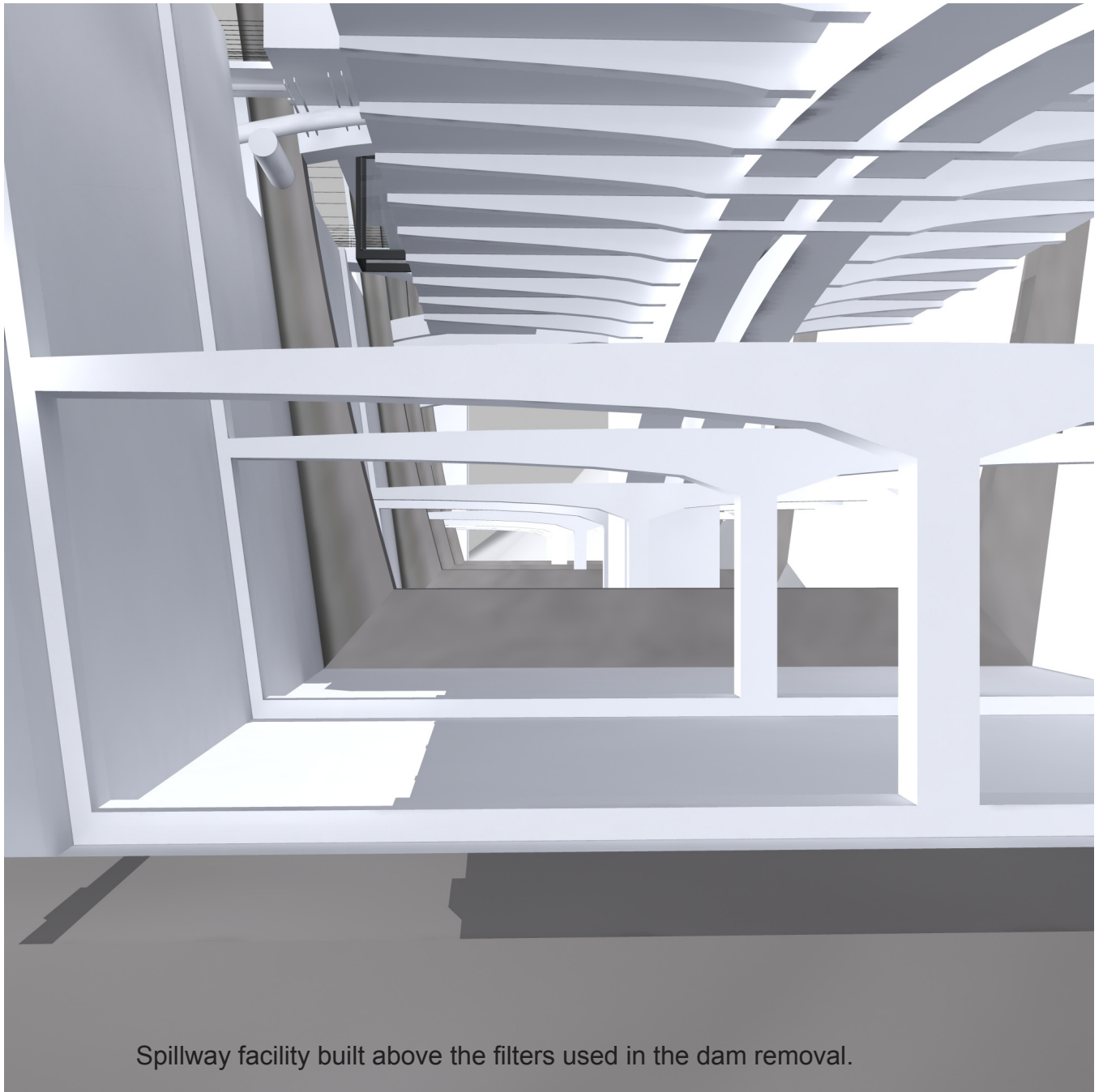


2. Sheet piles are driven to divert the river's water directly into the spillway at all times. The piles allow the flow of the water to continue while the research labs can be inserted. This insertion mimics the "wall" like nature of the dam. The design will rise over the river as a wall, as the shadow of the previous dam.





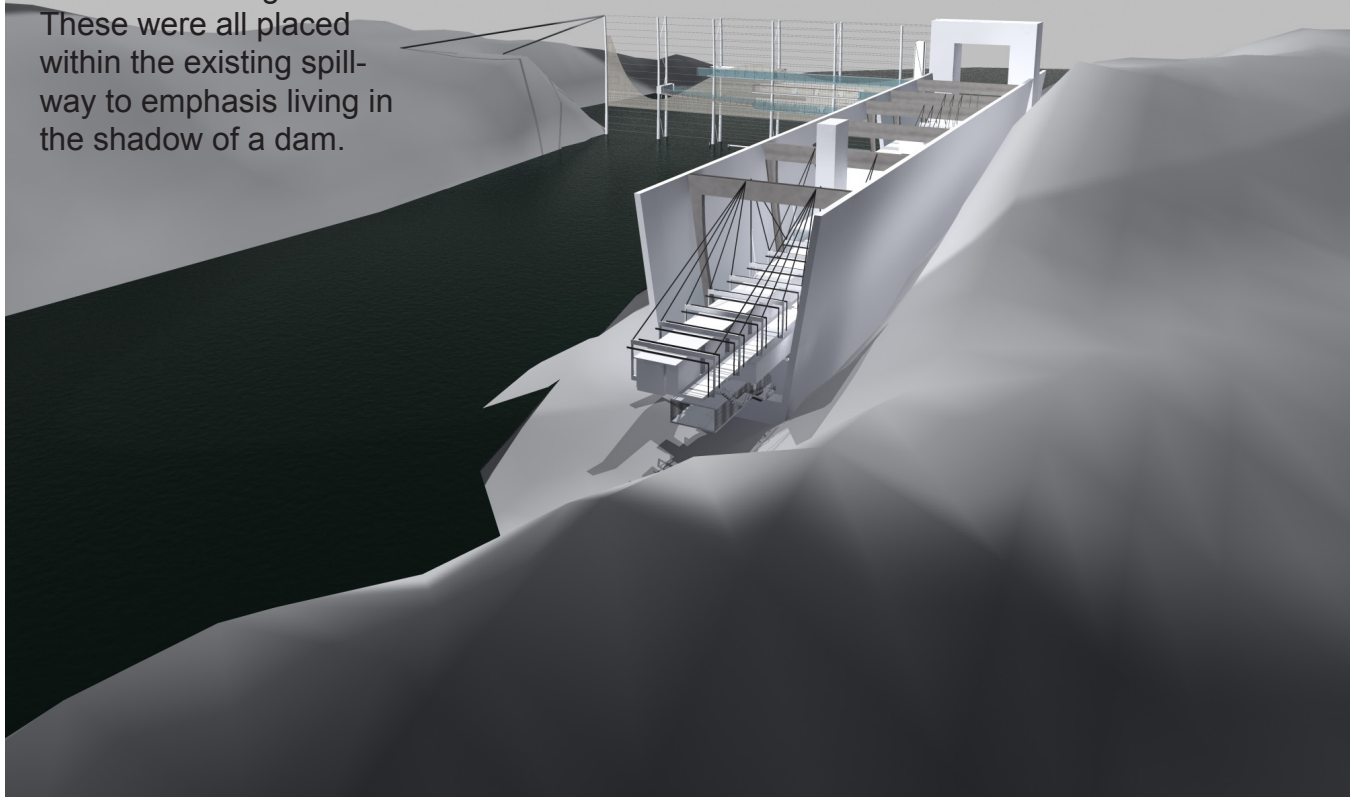




Spillway facility built above the filters used in the dam removal.

After the labs are constructed the sheet pilings are removed. The river then flows through and over the silt catches that were built below the lowest level.

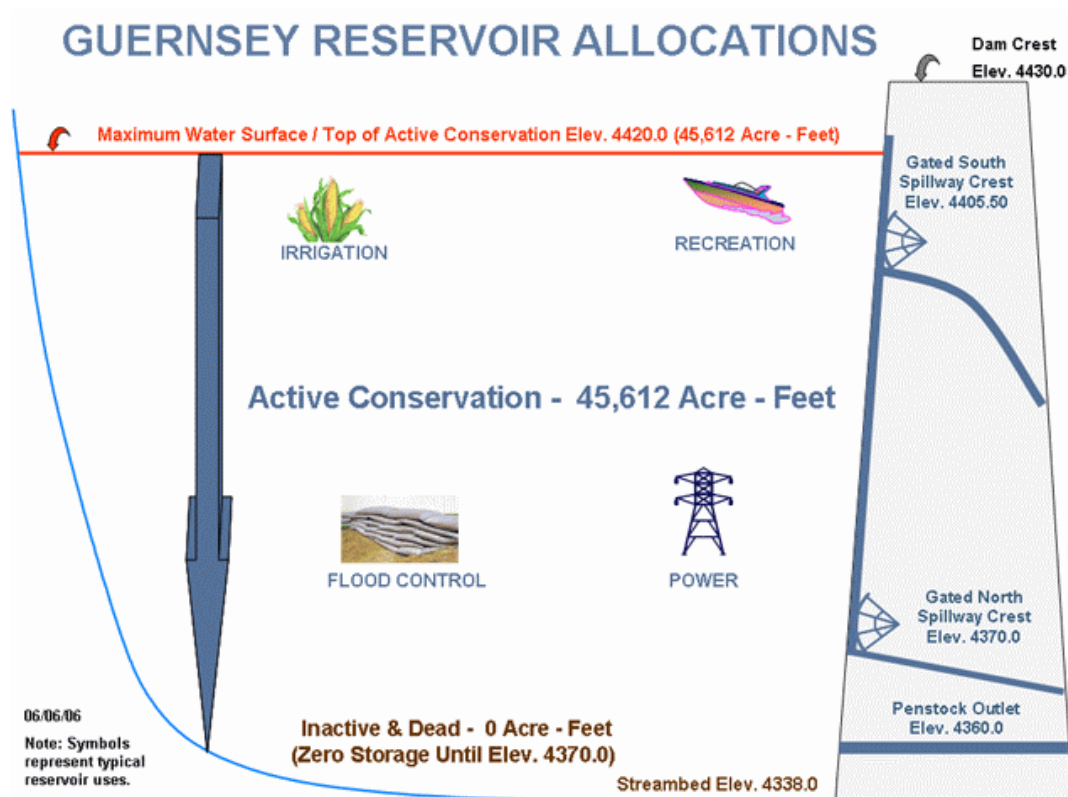
The next construction was the research living units, the school, and the student living units. These were all placed within the existing spillway to emphasis living in the shadow of a dam.



A MEASURE OF TIME AND HISTORY

To make the building shadow the history of the area, historical markers were needed.

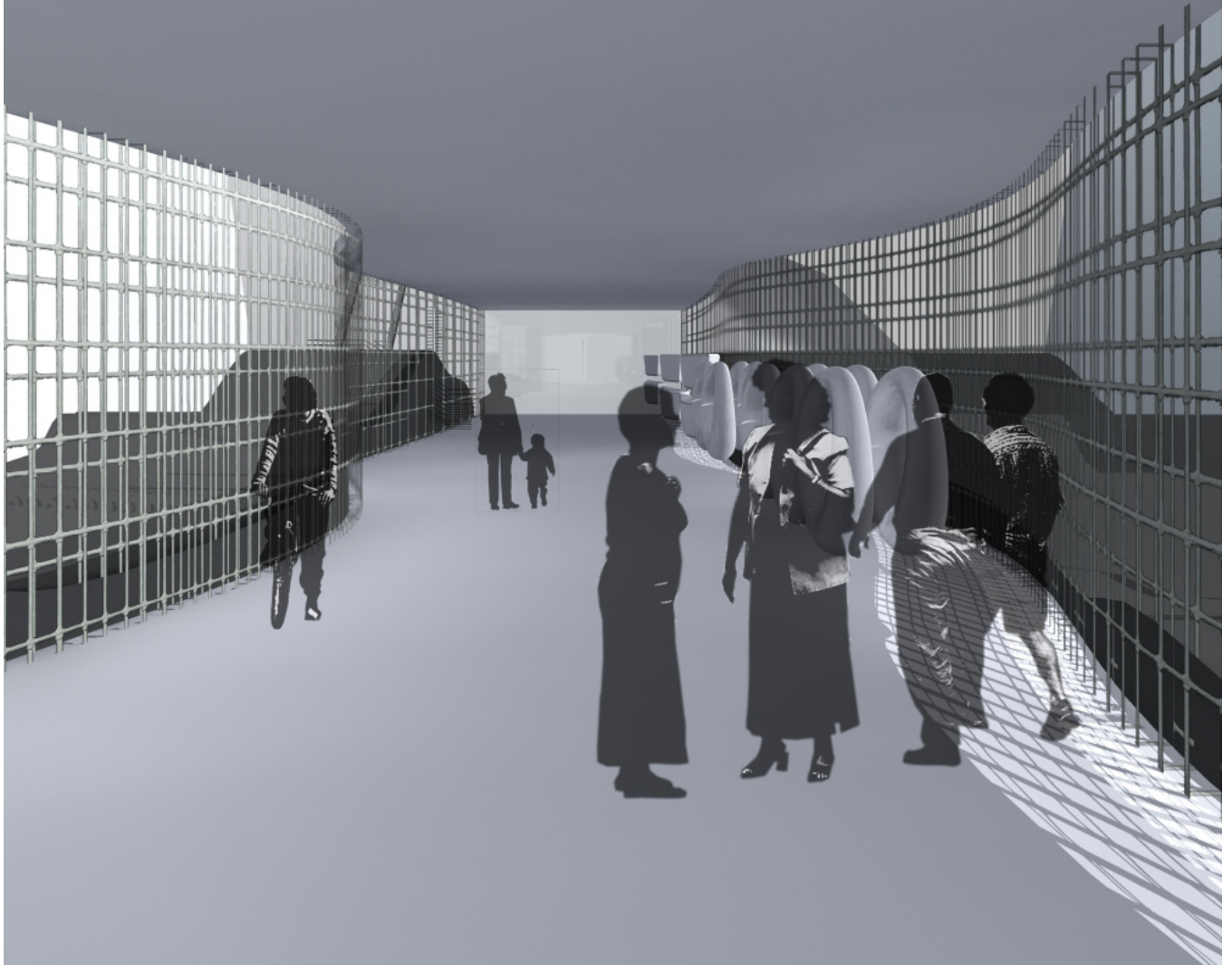
The water level behind the old dam was always kept at certain elevations.

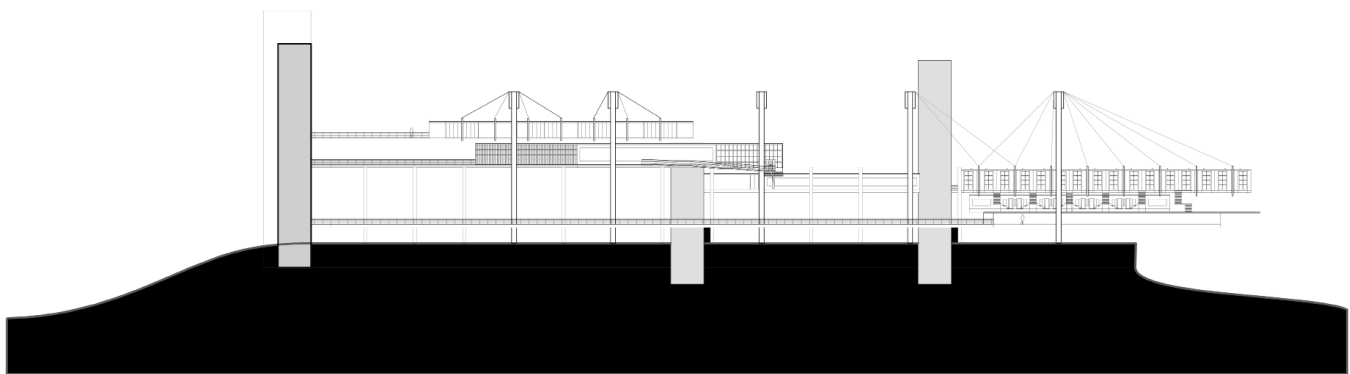
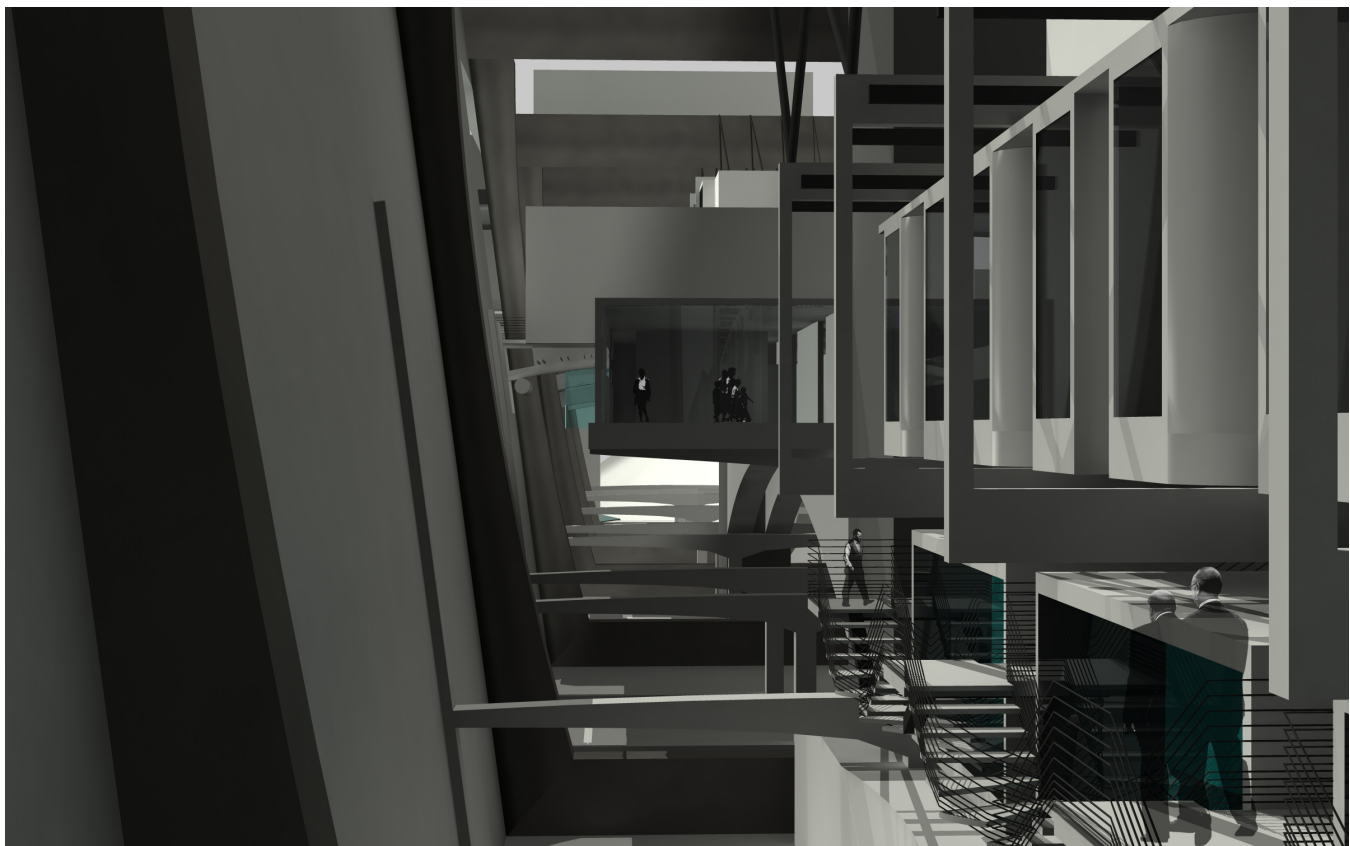


The building components align with the previous water levels.



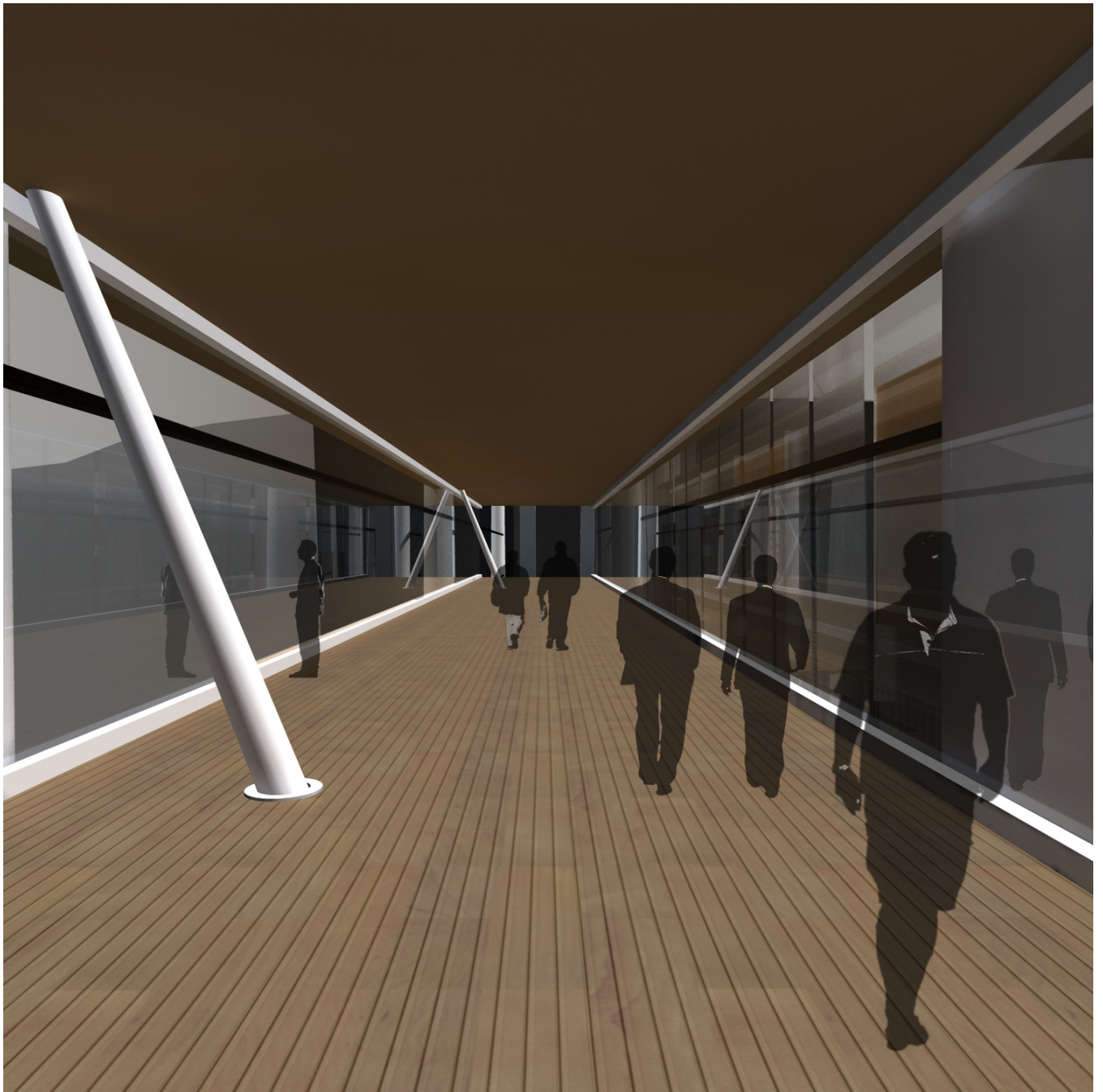
The lowest level in the spillway is the students recreation center. The center is placed in the silt that is caught when dam is being removed.



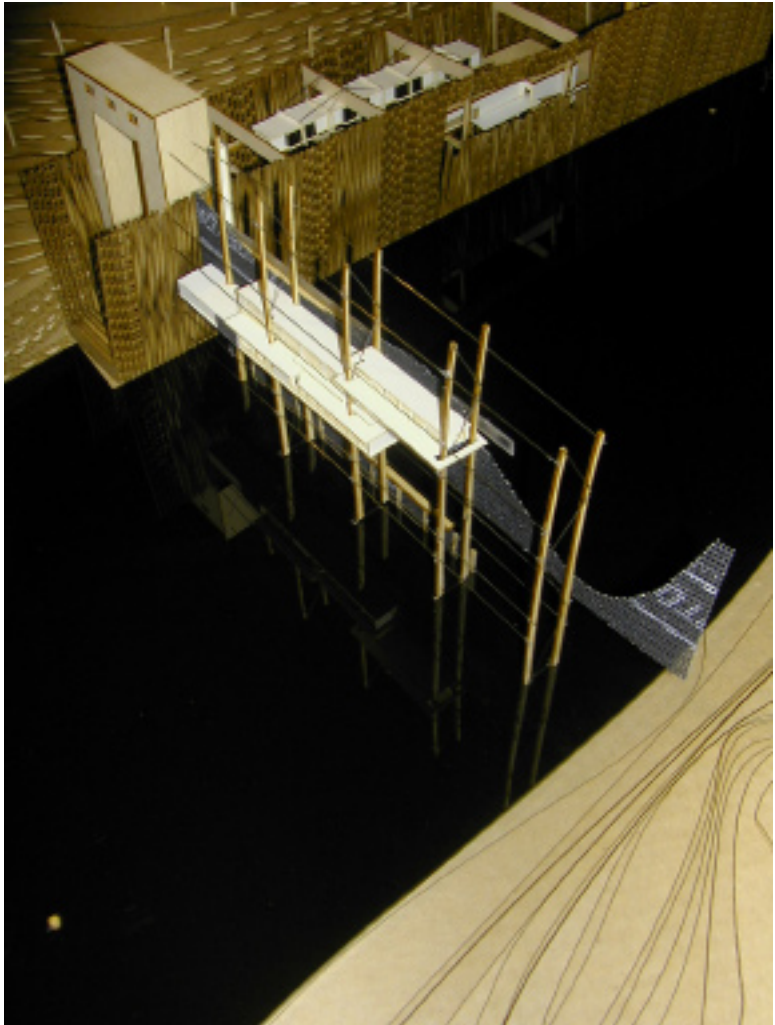


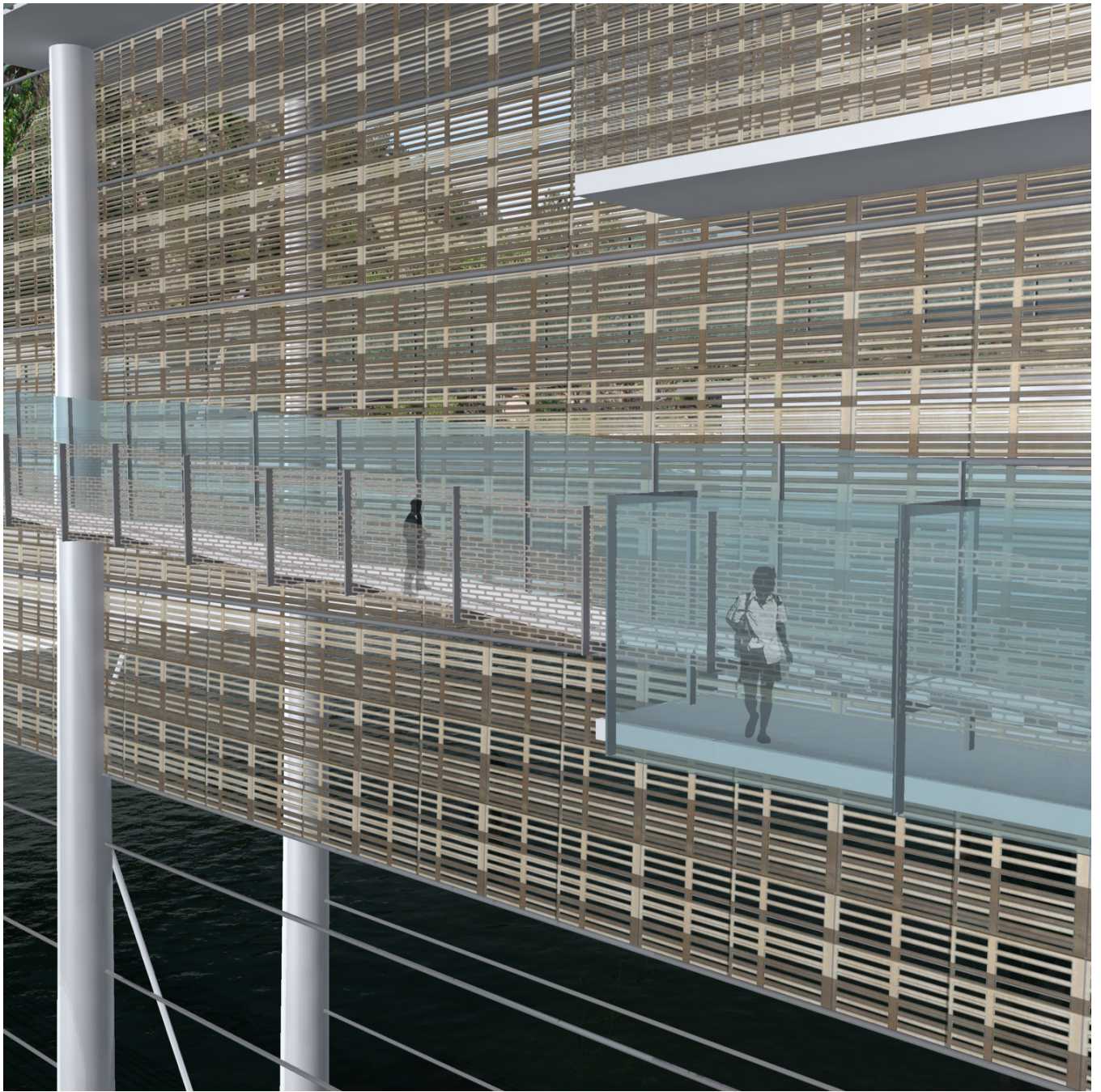


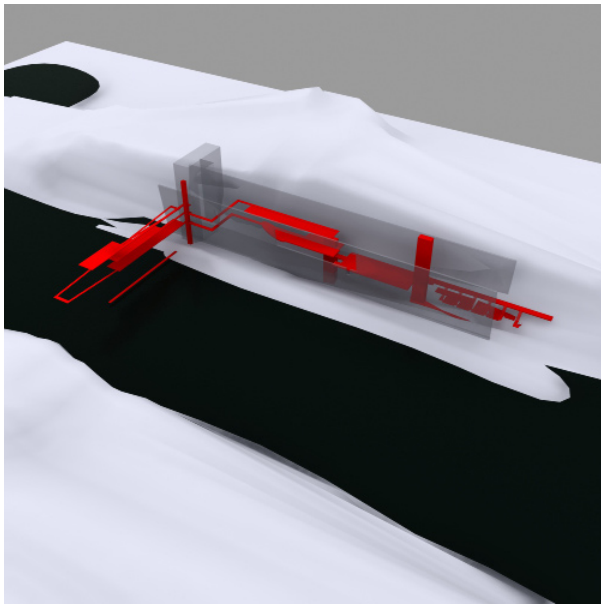
Experiences within the wall.



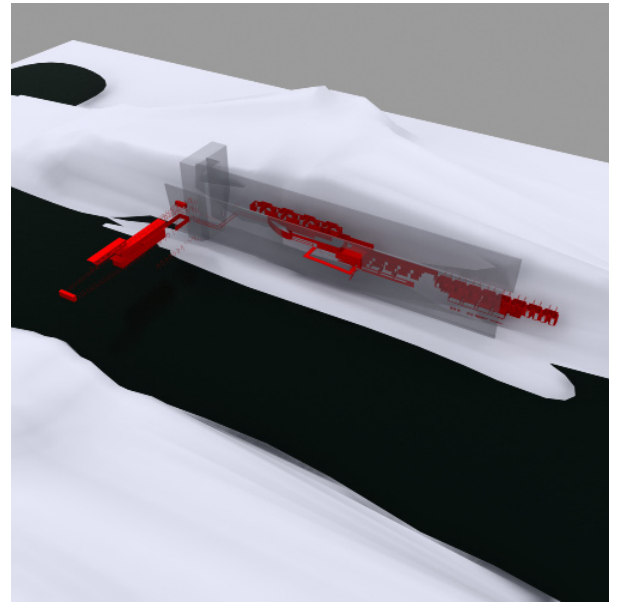
Visual Screening



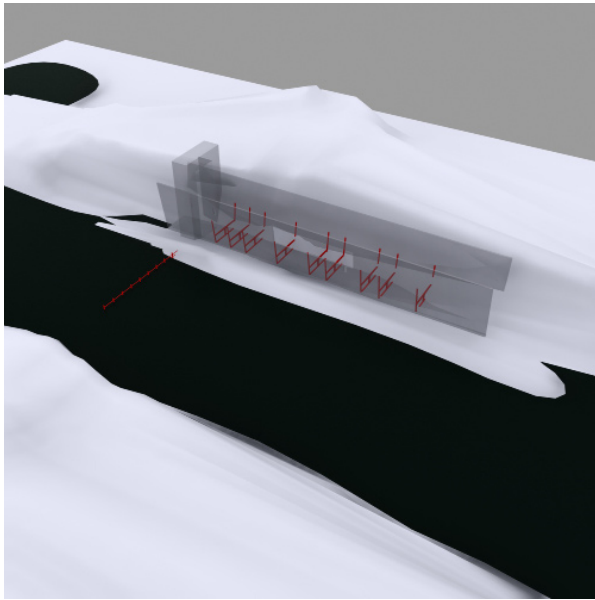




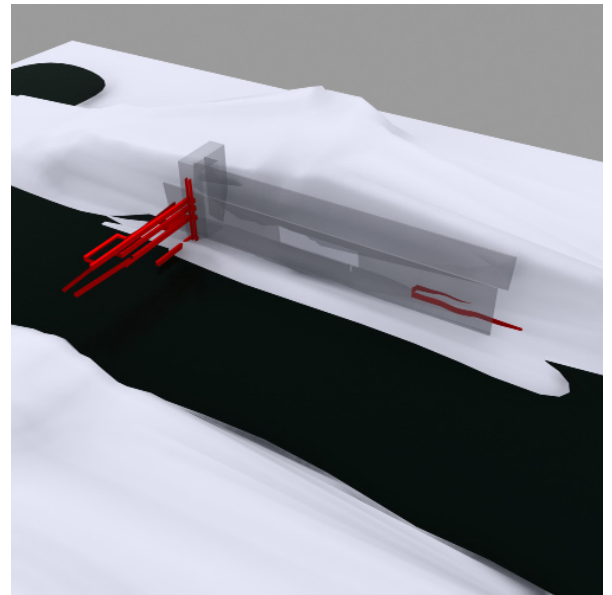
Circulation



Program

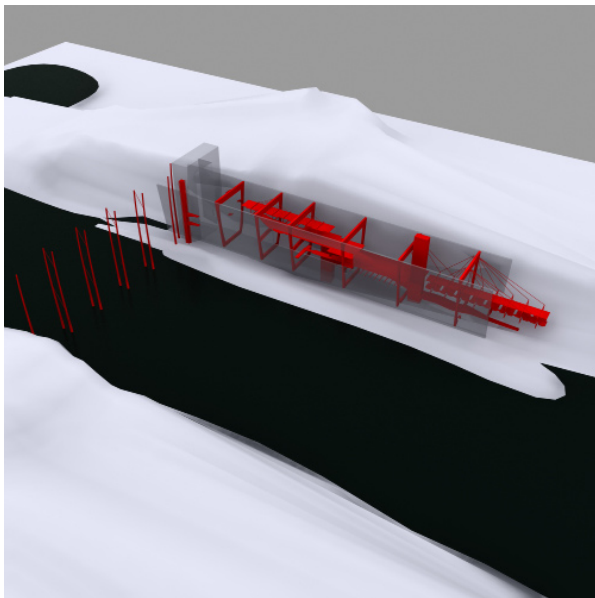
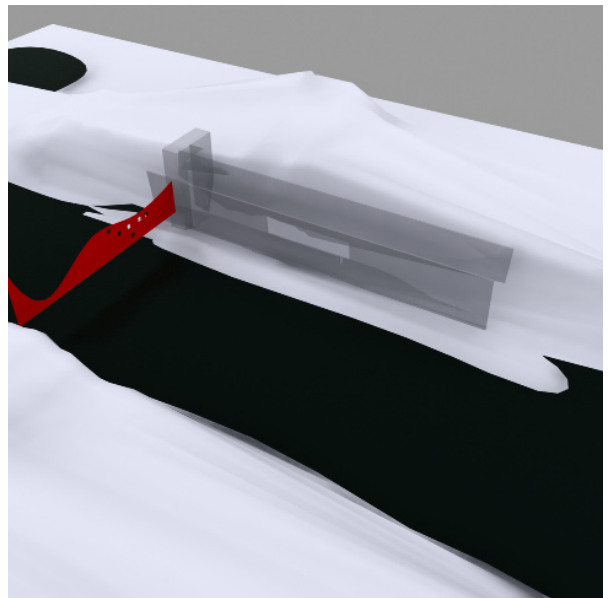


Spillway Filters

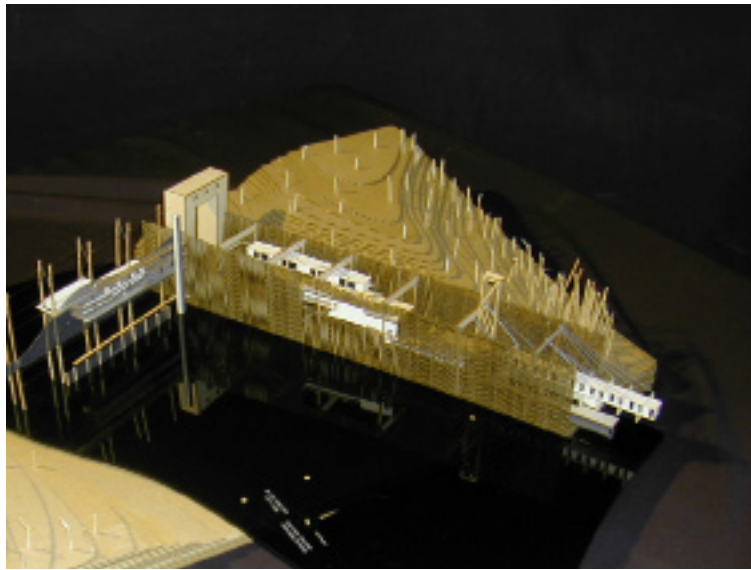
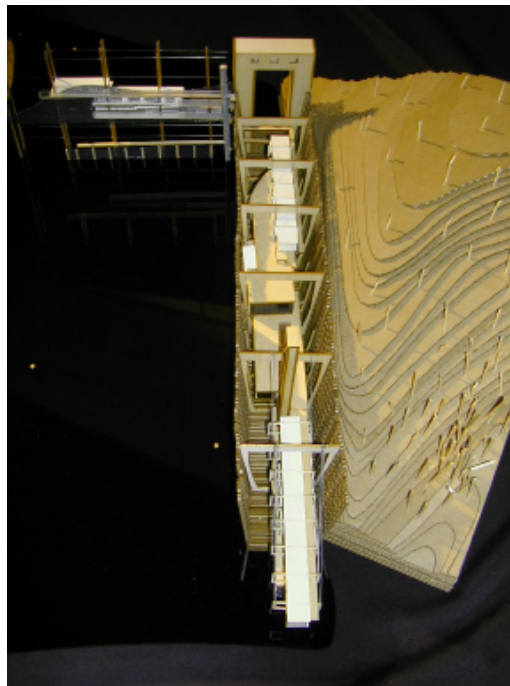


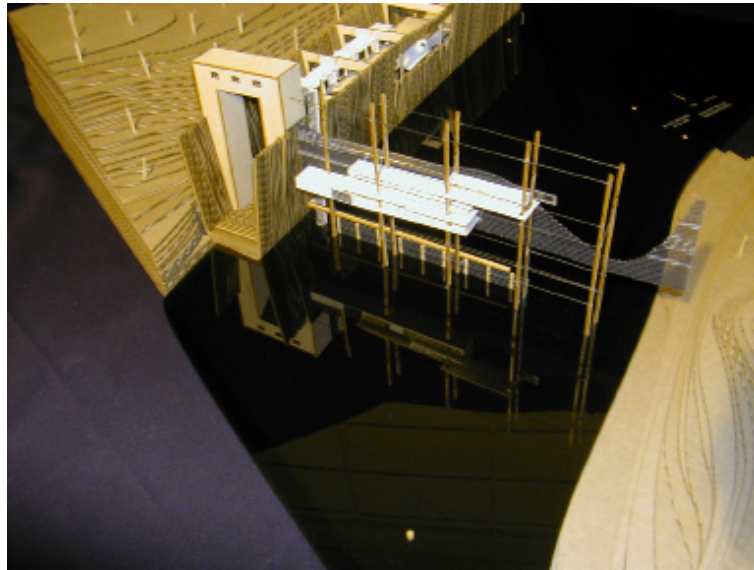
Visual Screening

Structure



Primary Screen, mimics profile curve of silt before dam removal





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