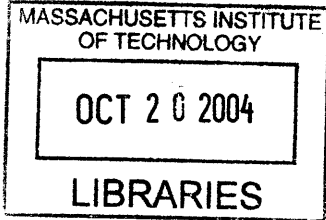


Constructing the Aesthetic Sense: Traversing Scales of Habitation in the Bingham Canyon Mine

Matthew W. Pierce
Bachelor of Environmental Design
Miami University, Oxford, OH, May 1996



Submitted to the Department of Architecture in Partial Fulfilment of the Requirements for the Degree of Master of Architecture at the Massachusetts Institute of Technology
September 2004

ROTCH

The author hereby grants to MIT permission to reproduce and to distribute publicly paper and electronic copies of this thesis document in whole or in part.

Signature of Author: _____
Department of Architecture
July 19 2004

Certified by: _____
Fernando Domeyko
Senior Lecturer
Thesis Supervisor

Accepted by: _____
Bill Hubbard Jr.
Adjunct Associate Professor
Chairman, Architecture Department
Committee on Graduate Students

© 2004 Matthew W. Pierce. All rights reserved

The author hereby grants to MIT permission to reproduce and to distribute publicly paper and electronic copies of this thesis document in whole or in part

**CONSTRUCTING THE AESTHETIC SENSE:
Traversing Scales Of Habitation In The Bingham Canyon Mine**

by

Matthew W. Pierce

**Submitted to the Department of Architecture in Partial Fulfilment of the Requirements
for the Degree of
Master of Architecture at the Massachusetts Institute of Technology
September 2004**

ABSTRACT

The activities of mining and mine reclamation in the American West raise questions of how we perceive, value, and differentiate between 'natural' and man-made landscapes, as they produce radical alterations of the land on a magnitude seldom seen. To many, the appearance of these sites is undesirable, but aesthetic perceptions of landscape that are based solely on visual appearance are incomplete. Through the accumulation of physical experiences and a deeper understanding of the forces that continually shape the land, there lies the opportunity to develop a more complex understanding of man's place in nature, and a more comprehensive aesthetic sense.

Mine reclamation typically involves the reworking of topography and development of open ended ecological systems that intend to stabilize and visually 'naturalize' the altered landscape, thus making it more acceptable to the general public.

However, these landscapes are most often seen from a distance, and are rarely engaged by human occupation. The Bingham Canyon Copper Mine near Salt Lake City, Utah is one of the largest man-made excavations on earth, and has been in production for over 100 years. It is a place with a rich cultural, technological, and natural history, and a place of dynamic change and movement. The project proposes a cultural reclamation of this mining landscape in the form of a science school as a means of supporting human experience in this place over time, providing opportunities to challenge the aesthetic sense.

Thesis Supervisor: Fernando Domeyko Title: Senior Lecturer

Readers: Tim Eliassen, TriPyramid Structures, Inc.

Michael Boucher, Michael Boucher Landscape Architecture

I would like to thank:

the Ann M. Beha Travel Fellowship for enabling me to spend so much time at the Bingham Canyon Mine and other copper mines in Utah and Arizona as well as Robert Smithson's *Spiral Jetty* and Michael Heizer's *Double Negative*,

Jon Callendar of Kennecott Utah Copper and Gary Jones of Phelps Dodge for enthusiastically sharing so much of their time and knowledge,

my parents Donna and Warren and my sisters Shannon and Katie for supporting everything I do,

Nancy Jones for helping me work through some complications..

Nancy Turnquist for her optimism,

Andrew Marcus for his insight and friendship,

my good friend and mentor Fernando Domeyko for sharing his poetic view of the world and for helping me uncover the foundation for my work,

and most importantly my wife Esther for her patience, support, faith, understanding, and love.
and for making me laugh.

BIOGRAPHICAL NOTES:

previous degree:

bachelor of environmental design: miami university
oxford, ohio: department of architecture, may 1996

professional experience:

renzo piano building workshop paris, france february - august 2003
tobler duncker architects jackson, wyoming april 1998 - august 2001
dubbe-moulder architects jackson, wyoming july 1997- april 1998
meacham and apel architects dublin, ohio 1997, 95, 94

research and teaching experience:

the temple sagrada familia, barcelona, spain june - august 2002 student initiated research project under professor mark burry (the royal melbourne institute of technology/ architect: temple sagrada familia), and in cooperation with jordi fauli (la oficina tecnica de la sagrada familia). investigated use of new digital photogrammetric survey tools for architects.
teaching assistant- level 1 graduate studio- spring 2004- professor fernando domeyko
teaching assistant- introductory undergraduate studio fall 2002- professor bill hubbard jr.

published work:

“nature in a middle state: a library on the east boston waterfront” in *Thresholds 26: denatured*. cambridge, massachusetts: MIT, 2003

awards:

francis ward chandler prize for achievement in architectural design: MIT, 2004
ann m. beha travel fellowship: MIT, 2004 support for student travel proposal to visit active and reclaimed copper mines in the american west and speculate on their theoretical and practical interest to designers, as well as to visit the works of influential landscape artists michael heizer and robert smithson.
the renzo piano workshop foundation internship: MIT, 2002-2003
harold horowitz student research award: MIT, 2002
monetary support for student-initiated research at the temple sagrada familia, barcelona, spain
award of merit: wyoming AIA, 2000 sage meadows affordable housing- tobler duncker architects project team
citation: western region AIA, 2001 sage meadows affordable housing- tobler duncker architects project team
faculty award for design excellence: miami university, 1996



...no mode of writing was more artificial than that which set out to give the most accurate description of nature.

-Richard Poulsen from *Landscape of the Mind* pg 2

And above all, one should not wish to divest existence of its rich ambiguity.

-Friedrich Nietzsche as quoted in *Landscape of the Mind* pg 12

1: interpreting place

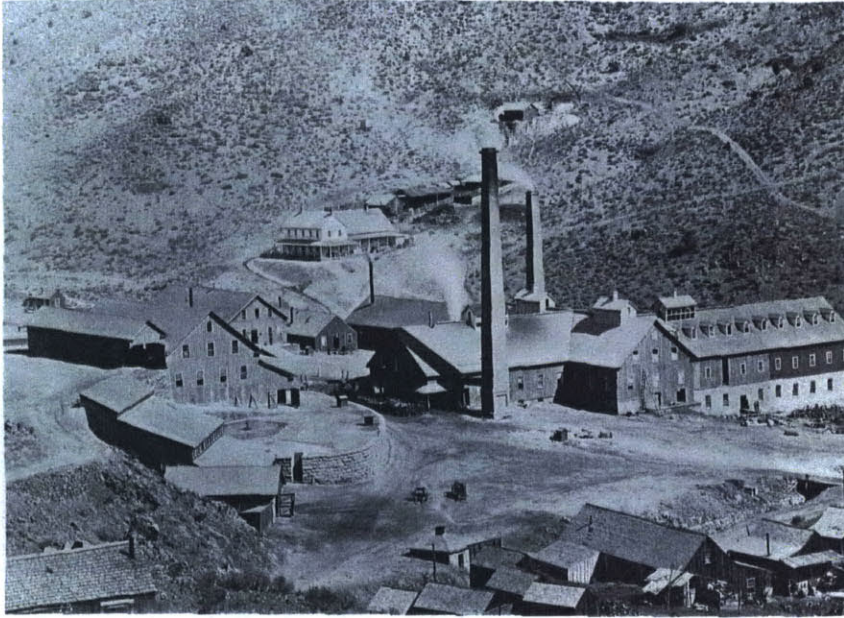


231. Timothy O'Sullivan, 1868. Gold Hill on Comstock Lode, Virginia City, Nev. (United States Geological Survey.)



232. Gordon Bushaw and Mark Klett for the Rephotographic Survey Project, 1979. Gold Hill Ravine (left side), Virginia City, Nev.

images from "second view: the rephotographic survey project", in which photographers in the 1960's and 1970's precisely re-shot photographs taken by William Henry Jackson during his survey of the western United States in the mid 1800's.



12. Timothy O'Sullivan, 1868. Quartz Mill near Virginia City. (United States Geological Survey.)



13. Mark Klett for the Rephotographic Survey Project, 1979. Site of the Gould and Curry Mine, Virginia City, Nev.

"second view: the rephotographic survey project". one might assume that revisiting the sites of jackson's iconic photographs would confirm that once "pristine" western lands show increasing signs of occupation and alteration, while in fact many of these photographs show land that was once intensely inhabited bearing less trace of its history than one might expect.



past occupations of bingham canyon when mining operations first began.

This project is about scales of time, or at least this is where it begins. It is about the ways in which places change over time naturally and willfully, and how our perceptions of them change as well. It is about the movement of the sun and shadows and our movements across the earth. It is about the instability of natural forces that are geologic, climatic, hydraulic, economic, and cultural. It is about instability, and it is about making meaningful places within that instability. And it is about trying to develop a more positive view of the role mankind plays in actively and passively shaping the earth.

The fascination I have with the mountains comes in part from realizing that from any given point of view there is as much shown as is hidden, that the landscape can never be seen in its entirety, and can never be fully understood optically. Mountainous terrain evades a holistic comprehension. Any attempt at an understanding of the whole is a composite, a collage of what is seen and sights that are remembered, combined with photos, maps, stories, and experiences. This is the aesthetic experience that Frederick Turner speaks of, and in the continual building of this collage I am propelled. Its construction comes through movement; changing perspective, the continual shifting of planes and masses, and the changing depth of the terrain that come with the movement of the sun.

The Bingham Canyon Mine cannot be fully understood as a snapshot in time, it has been evolving for more than 1 million years. Just as in any landscape, appearances and readings change throughout the day and throughout the year. Relief is revealed and disguised by the movement of the sun and shadows, and changing vantage points lead to different associations and juxtapositions. A landscape of this magnitude can never be understood from one point of view; it is a collage of what is seen before you and sights and stories that are remembered, histories that have been read and personal experience, maps and satellite photographs, and the complex interplay of natural forces that are geologic, atmospheric, hydraulic, cultural, and technological. This is a place that one can only begin to understand over time.

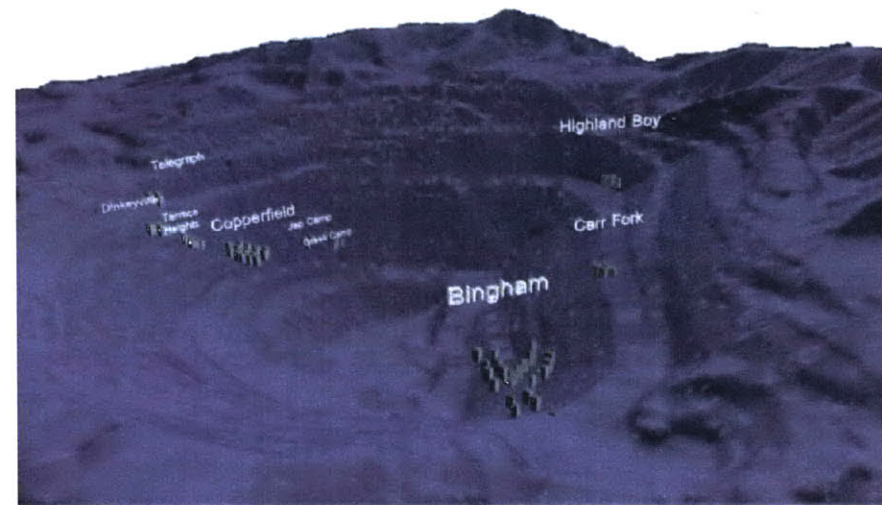
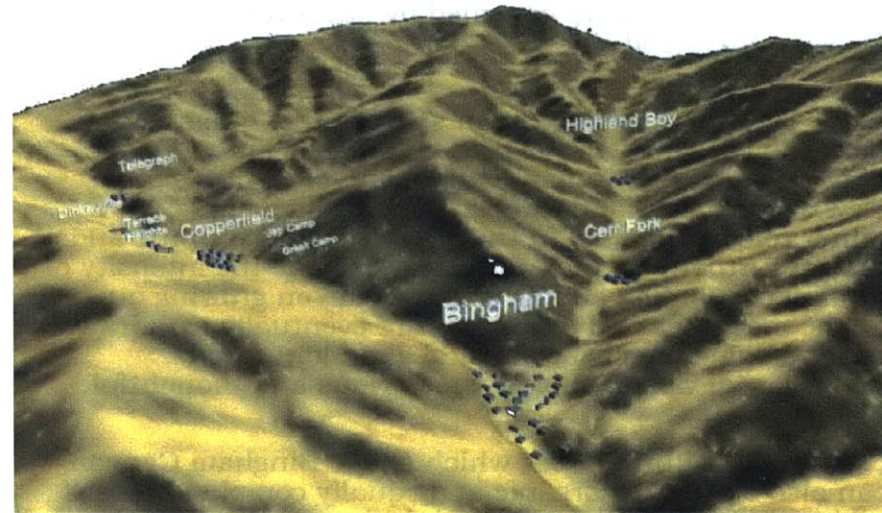
Bingham Canyon is located about 15 miles southwest of Salt Lake City, Utah on the eastern slope of the Oquirrh Mountains. These mountains were formed in the Mesozoic Era about 40 million years ago by the faulting and folding of massive blocks of the earth's surface. Through fissures in these blocks percolated mineral bearing liquids which vaporized and subsequently crystallized near the surface. It was these mineral deposits that caught the attention of Brigadier-General Patrick Connor millions of years later in 1863, and which has brought the canyon into the cultural consciousness.

Early mining in the canyon was undertaken underground by men following veins of high-grade gold, silver, and lead via tunnels which they constructed. Ore bearing rock was hauled in carts by men and horses. The potential wealth offered by this land drew men from all over the country and overseas, making the towns of Bingham Canyon, Highland Boy, Carr Fork, and Copperfield the most diverse and international towns in predominantly Mormon Utah as it became home to significant populations of English, French, Greeks, Chinese, and Mexicans. Towns grew up around the claims and the work complete with saloons, post offices, schools,

and churches. These towns were scattered throughout the canyons near water and were separated by ridges thousands of feet high.

By the end of the 1800's the easy high-grade deposits began to dry up. There was still ore to be recovered, but the poor ratio of waste to ore made its removal uneconomical. However, demand for copper increased with the expansion of telegraph lines and a rising need for copper wire, and companies began to connect the mines and the valley via railroad making it easier to transport large amounts of rock. As mining progressed the quality of the ore continually dropped, but as the high-grade material became increasingly scarce new methods of recovery were also developed to economically recover disproportionately smaller percentages of ore. Correspondingly, more and more earth was moved faster and faster, and eventually it became more efficient to simply remove the surface rather than dig under it. In the early 1900's steam shovels were mounted on train tracks to excavate the mountain and load the waste and ore-bearing bodies into railcars. As terraces were dug more than 1,000 men worked each day to reconfigure the train tracks to access new benches.

The movement of tectonic plates and the friction between them created the Oquirrh Mountains and the mineral deposits within them, while the fertile valley to the east is the product of the alluvial deposition of the prehistoric Lake Bonneville that once covered the entire Salt Lake Valley. The other forces that have been actively shaping Bingham Canyon over millions of years are incomprehensibly complex and impossible to separate: the interaction of water with the rock guided by gravity, and eroding the softer layers more quickly than those which are hard, the deposition of the resulting sediment and its ability to host vegetation, and the movements of animals drawn to these plants. Water intrudes into cracks in the rock and sometimes freezes and expands, gradually expanding the cracks and eventually breaking the rock until it falls and is slowly crushed over hundreds of years



topographic change in bingham canyon over the last century showing the locations of towns that were abandoned and then erased by excavation.

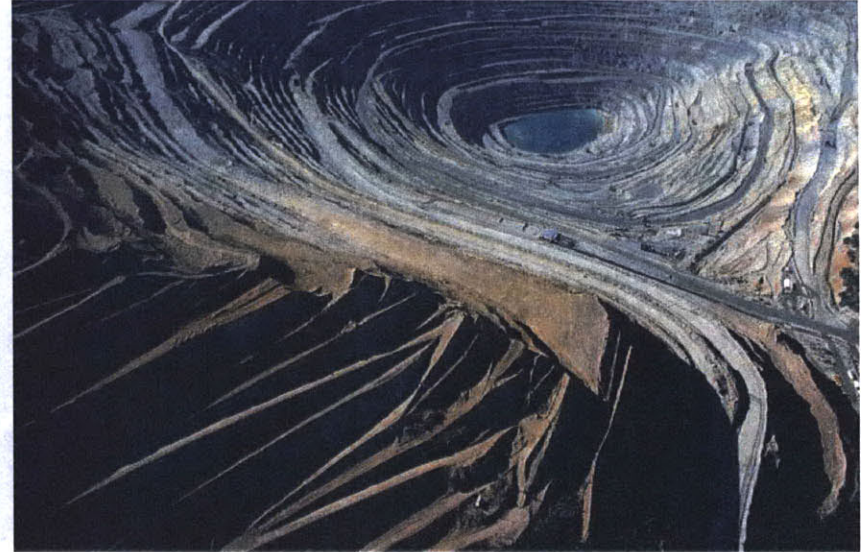
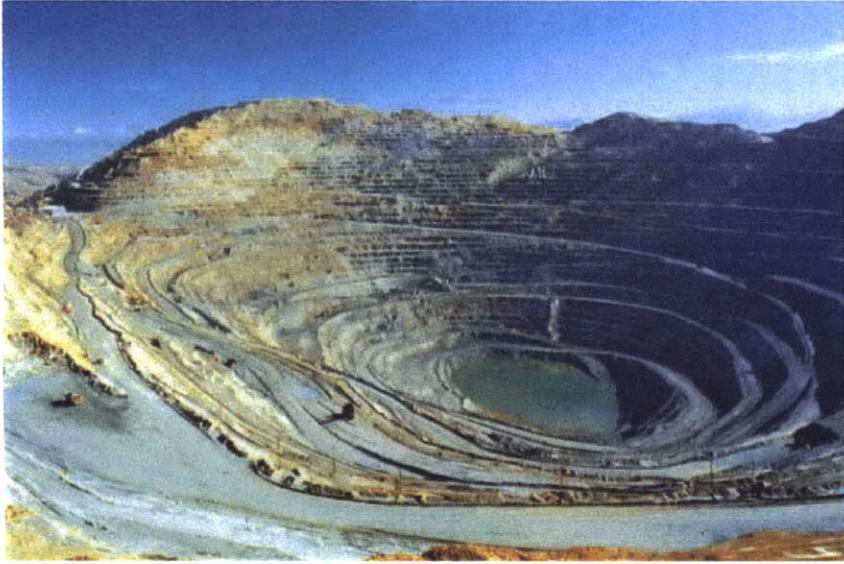
in a slowly sliding slope of talus. As these slopes move over time they may block and divert a stream, causing it to cut through softer banks, or dam up and create a pond. These interactions are governed by natural laws which are widely understood.

A distant vantage point such as this removes one from the specificity of the present and the limitations of the scale of the human lifetime and offers a dynamic view an unstable landscape in which humans play a minor role in shaping. In this view one can continue and project further into the future and imagine the intensity of human occupation ebbing and the canyon growing quiet as the machines and explosives are eventually withdrawn. I can imagine the silence of land abandoned and unmanaged, visited only by the curious and thoughtful.

The cultural forces which shape Bingham Canyon can also be seen as organic and equally complex in their interactions. Human needs and desires create demand for materials and economic and technological parameters shape the ways and rates in which those materials are removed and the surrounding lands are reordered. The deposition of wasterock is a function of labor and fuel costs as well as topography and is rarely directed with intention as to what new features are created and how they might be used or valued culturally. On a macro scale, the traces of human activity on the land can be seen as similar to those we commonly consider natural: a force acting on and in response to the terrain, topography, and climate. One may look at the sheer amount of material that is rearranged and wonder how it could be redirected with intention for human occupation, whether this landscape could be designed on a large scale? This was an important question I considered throughout the project: to what degree does one accept the site as it is found when there lies the potential to significantly modify the terrain?

the time line ranges from the almost incomprehensible processes of geologic transformation to the relics of ancient cultures, to almost instant landscape changes. Historical processes of growth—development—decay seem to be accelerated. The contemporary landscape is one of future shock, where instead of the gradual accretion of generations, we find a quickened pace.

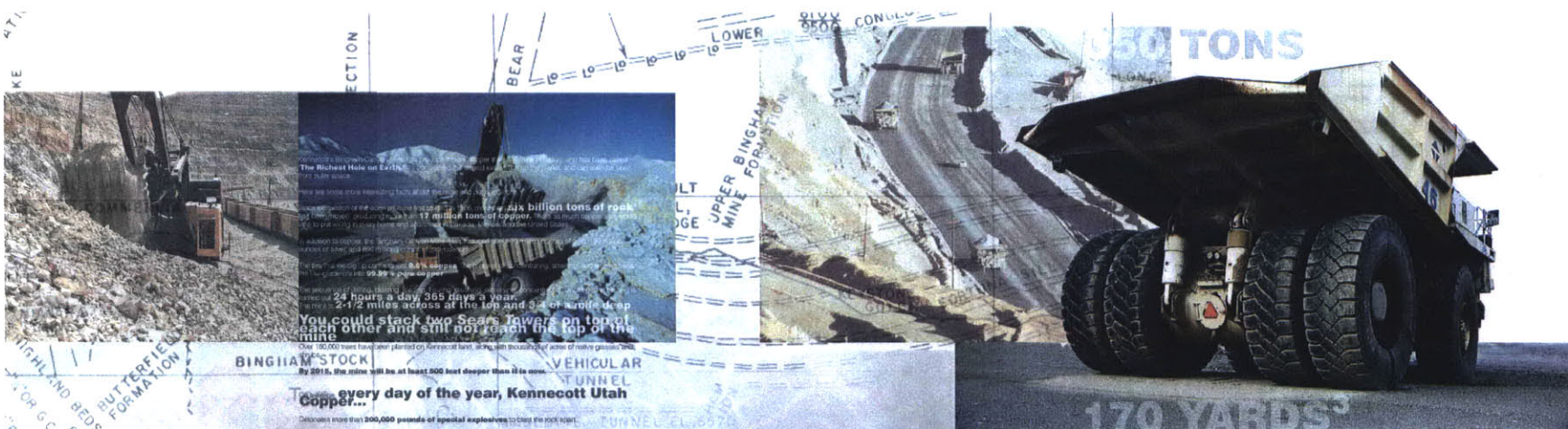
from "Colorado: Visions of an American Landscape" pg 53



satellite photo of salt lake city and surrounding area. a small portion of the great salt lake is seen at the top left, while the city and its suburbs stretch for over 20 miles north to south in the center. the open pit of the bingham canyon mine, 2 1/2 miles wide, is the yellow area at the lower left. more than half of what is visible is wasterock that has been dumped over the sides of the pit, filling valleys and streams.

kennecott utah copper's operations are strung along the 10 miles at the foot of the oquirrh mountains between the mine and the lake to the north. at the edge of the lake directly north of the pit one can see the tailings impoundments where liquified, sandy waste from copper production is deposited. this is just one of the byproducts that is reshaping the topography, ecosystem, and appearance of this area.





The richest hole on Earth...
 Six billion tons of rock...
 24 hours a day, 365 days a year...
 You could stack two Sears towers on top of each other and still not reach the top of the mine.

BINGHAM STOCK **VEHICULAR TUNNEL**

every day of the year, Kennecott Utah Copper...

Delivers more than 300,000 pounds of special explosives to blast the rock apart.

Copper's biggest electric shovels, the largest of which can scoop up to 98 tons of material in a single bite - about the weight of 20 pickup trucks.

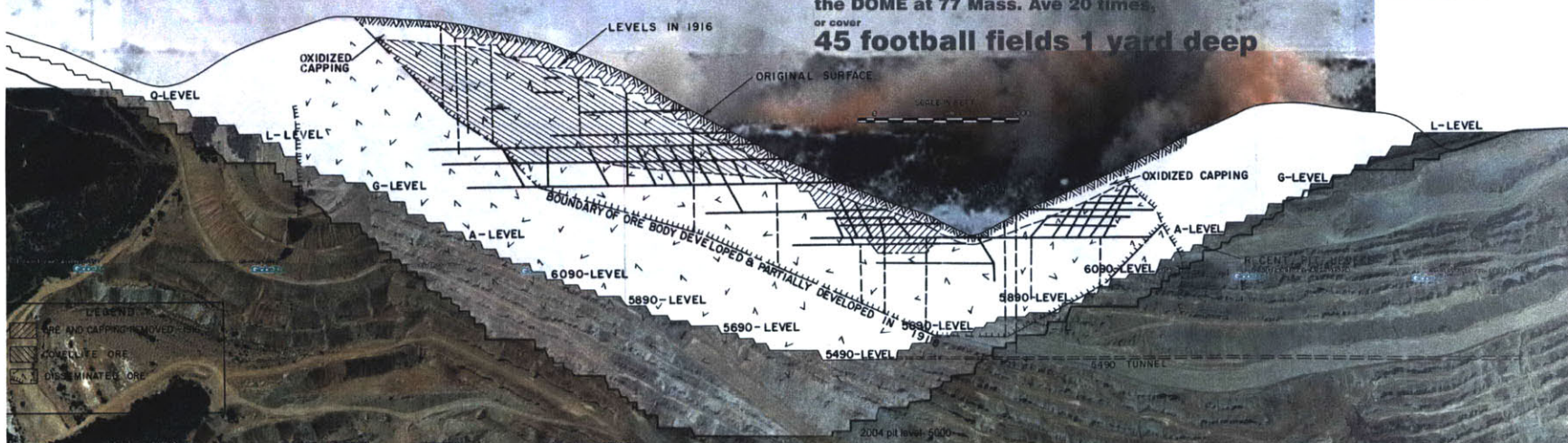
Runs a fleet of 64 monstrous haulage trucks, which can carry 240 - 350 tons per load.

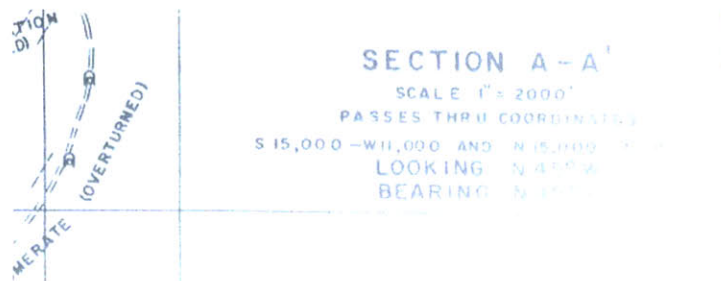
Removes 500,000 tons of material from the mine.

The crusher in the pit takes in about 140,000 tons of ore every day and grinds it into chunks smaller than the size of a basketball.

Produces 870 tons of copper, 1,000 ounces of gold, 8.5 million ounces of silver, up to 97,000 pounds of molybdenum, and over 3,000 tons of sulfuric acid.

=243,000 cubic yards/ day
 would fill:
the AVT 363 times,
the DOME at 77 Mass. Ave 20 times,
 or cover
45 football fields 1 yard deep





SECTION A-A'

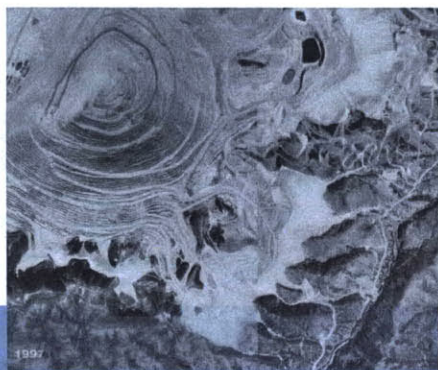
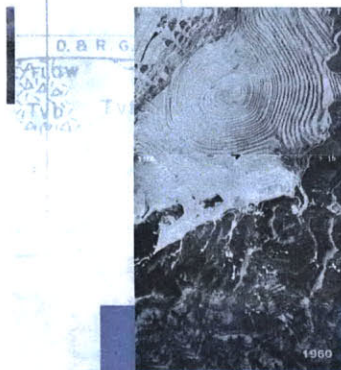
SCALE 1" = 2000'

PASSES THRU COORDINATES

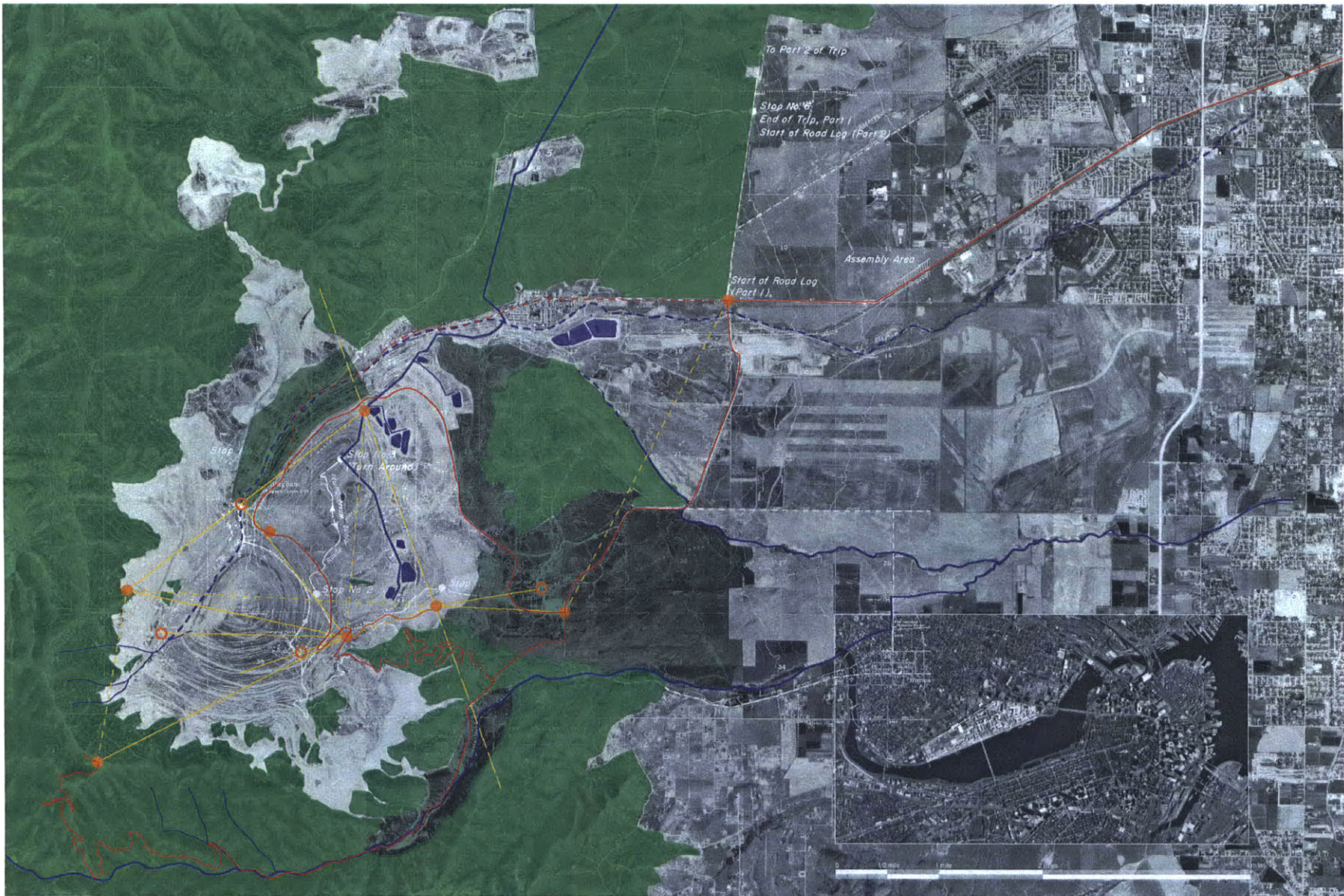
S 15,000 -W11,000 AND N 15,000

LOOKING N 41° W

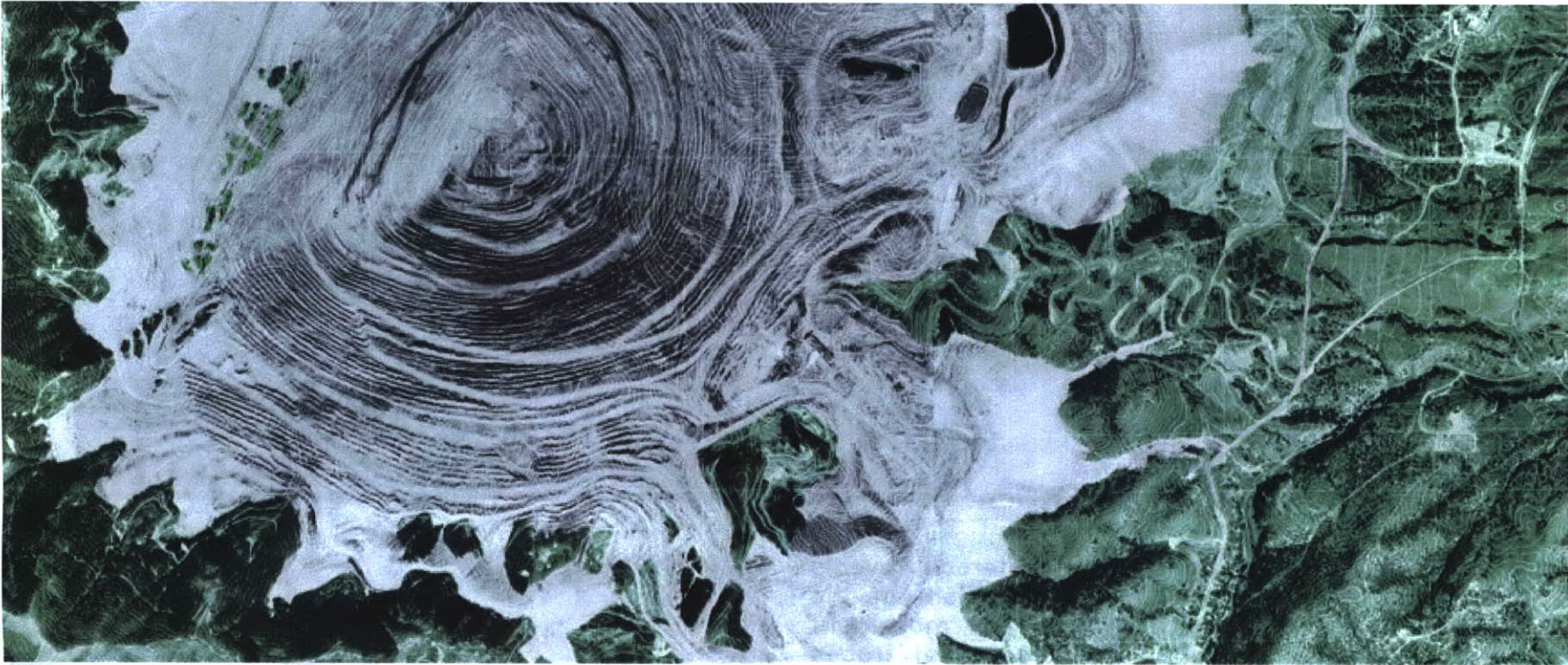
BEARING N 15° W



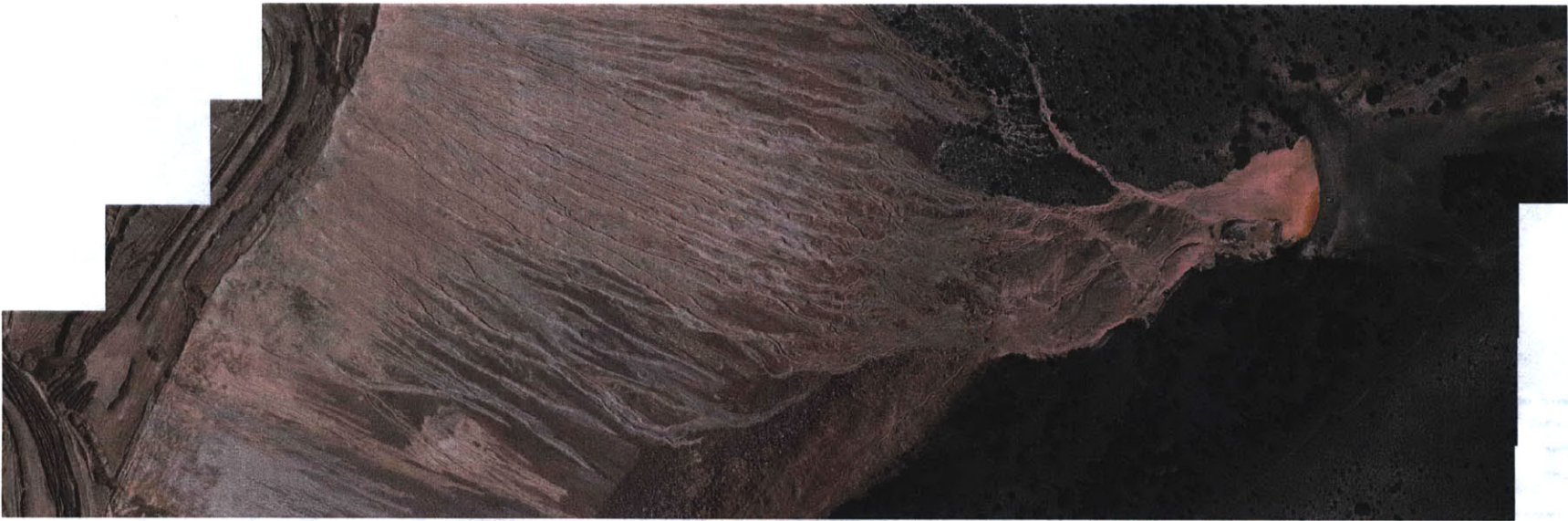
In his book "Reclaiming the American West", Alan Berger says that "aesthetic experiences change over time, either through direct contact or cognitive processing. For example, as we learn about the environment, what was once considered pristine might eventually be considered artificial...Reclamation is attached to cultural systems. It involves and potentially offers more complex phenomena beyond those related to visual response or ocular judgment... judging reclamation solely by its visual surface appearance is incomplete." pg 143



site diagram showing undisturbed land (bright green), reclaimed land (dark green), water supplies, access routes (red), and points of interest such as erased towns and vantage points (orange). the yellow lines sketch relationships between these points. the city of boston is shown scale.

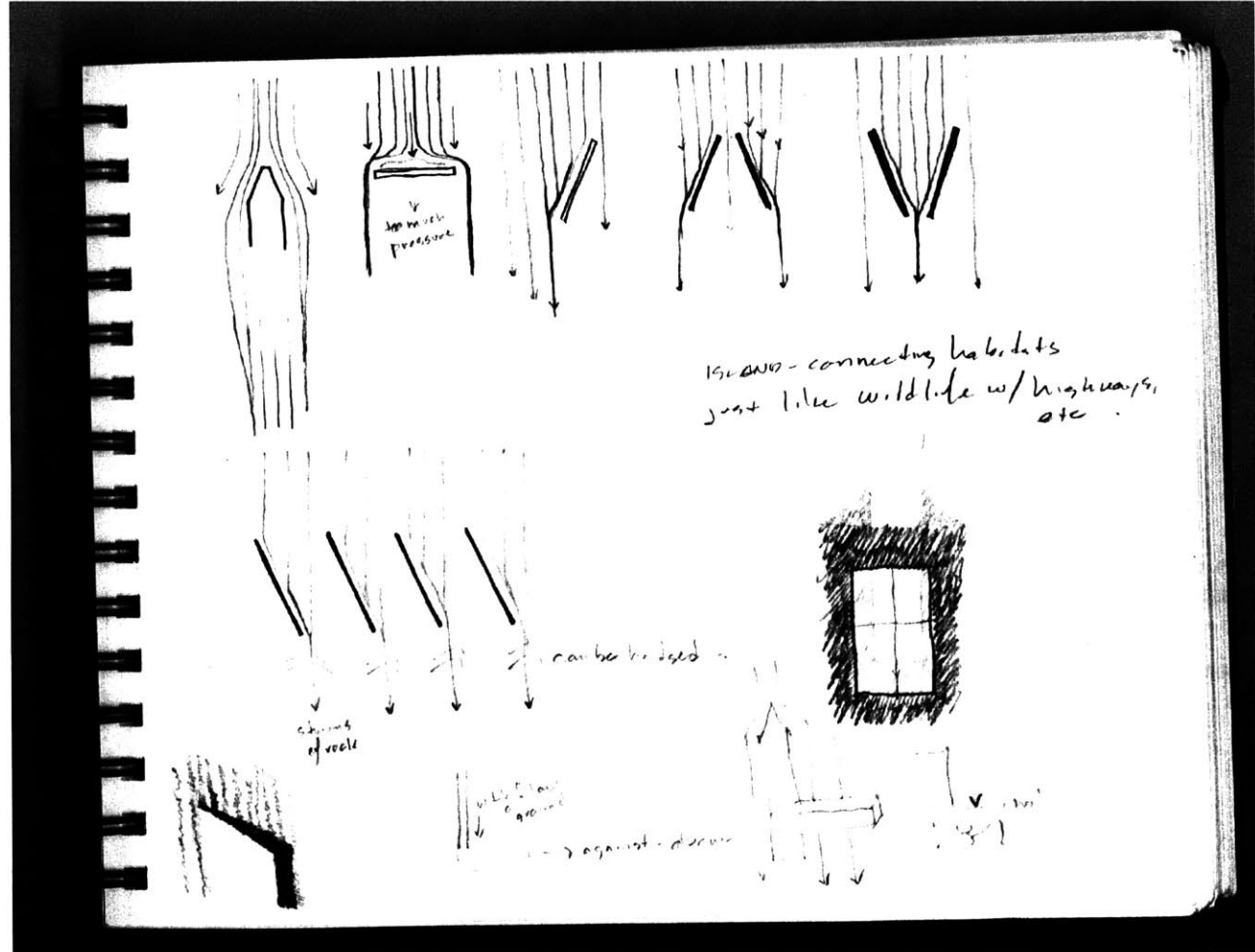


peninsulas and islands of vegetation around the rim of the pit. some of this vegetation has grown on its own, some has been radically reordered along with the topography. some is farmland. sometimes a distinction may be detected, sometimes not. as such it presents the question, what is natural? perhaps clearer questions are what do we value and why? is it a perceived pristine quality, or rather is it distance or wildness (a lack of control or management)?



the instability and texture of the wasterock reveals
the forces of gravity and the dynamism of the
site. the rock flows like a glacier— its movement
not witnessed directly, but in the reading of traces
on the surface and its reaction to obstacles.



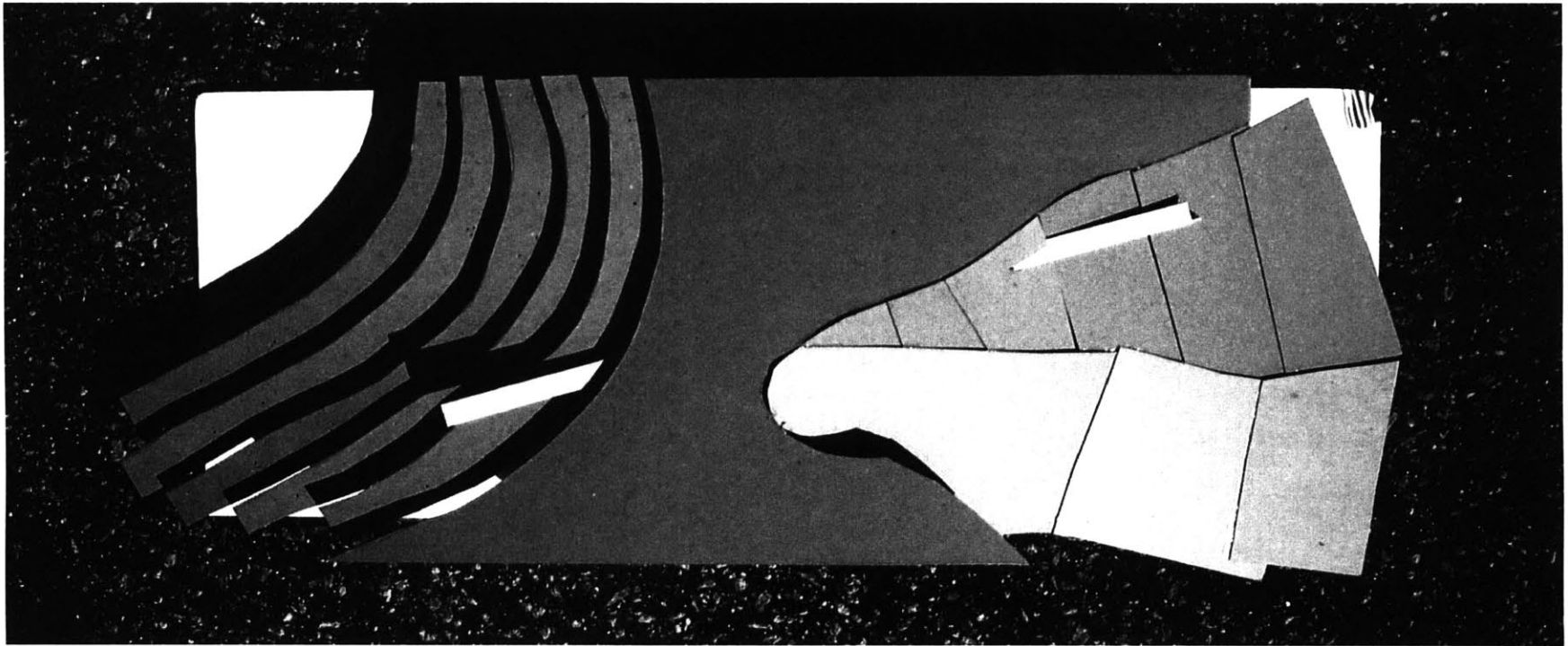


strategies for building in the wasterock flow, diverting the flow much like the piers of a bridge or diverters of a dam.

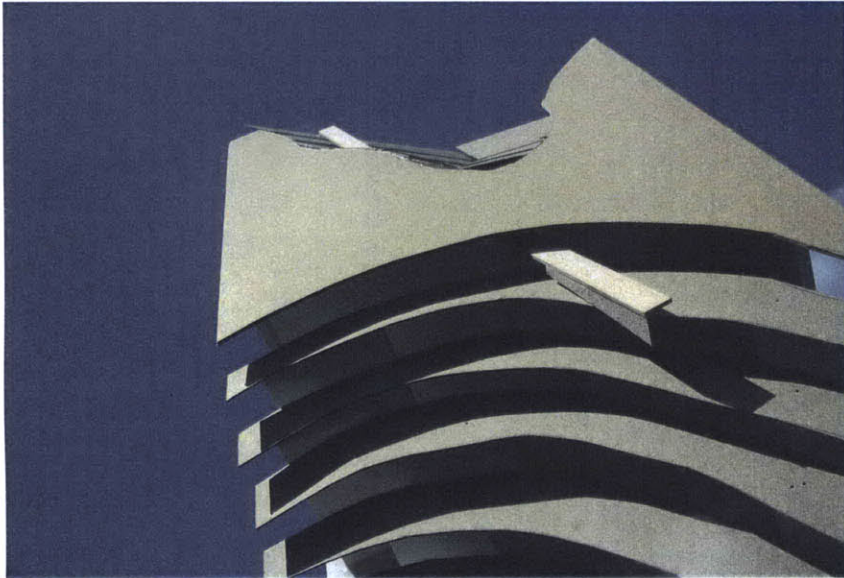
His imagination was always stirred by the thought that he was standing in ancient rain spattering on mud before it became rocks.

-from *A River Runs Through It* by Norman Maclean, pg 96

2: conceptual studies



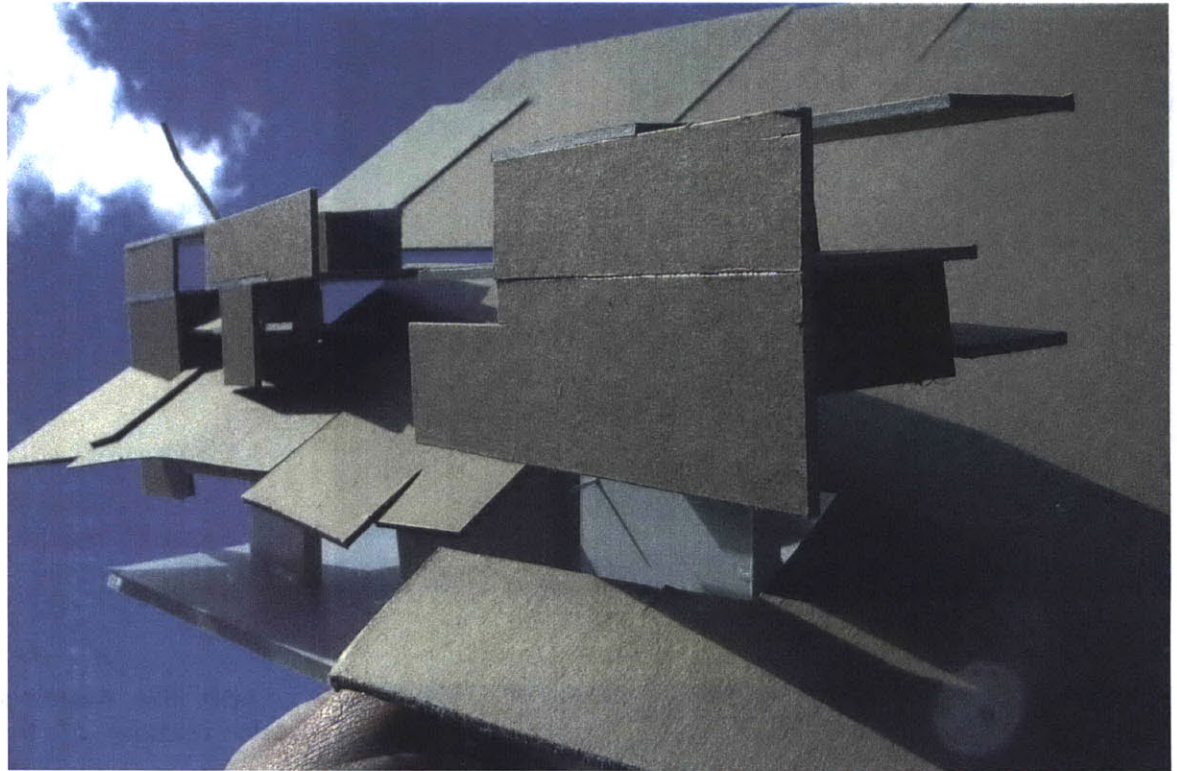
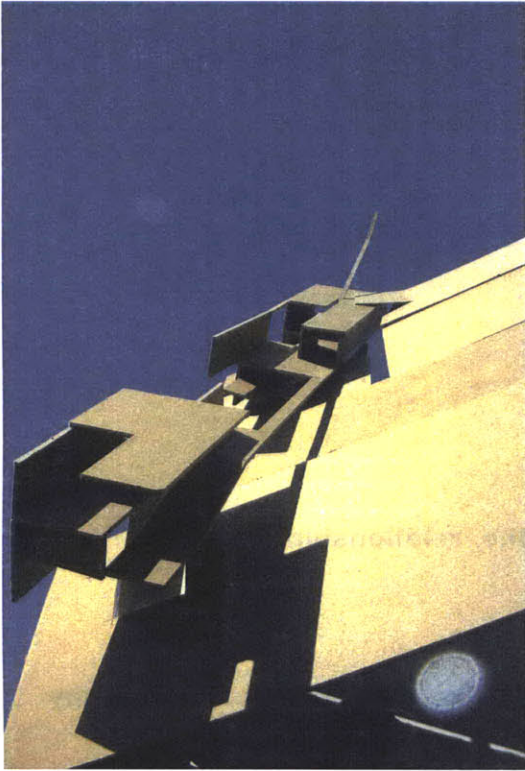
the school (left) is located inside the space of the pit, tangent to the rim. it overlooks the terraces of the pit and the continuing excavation. the housing (right) is located outside of the pit between two prominent wasterock "buttes" which are separated by a ridge, or peninsula of vegetated bedrock. students traverse this saddle from outside to inside each day along the narrowest path that bridges these two worlds, providing the opportunity to measure the magnitude of operations at a human scale. the time passed between these two points in the landscape is regarded as equally valuable and complimentary to other formal periods of study.



conceptual model of the relationship between the school...

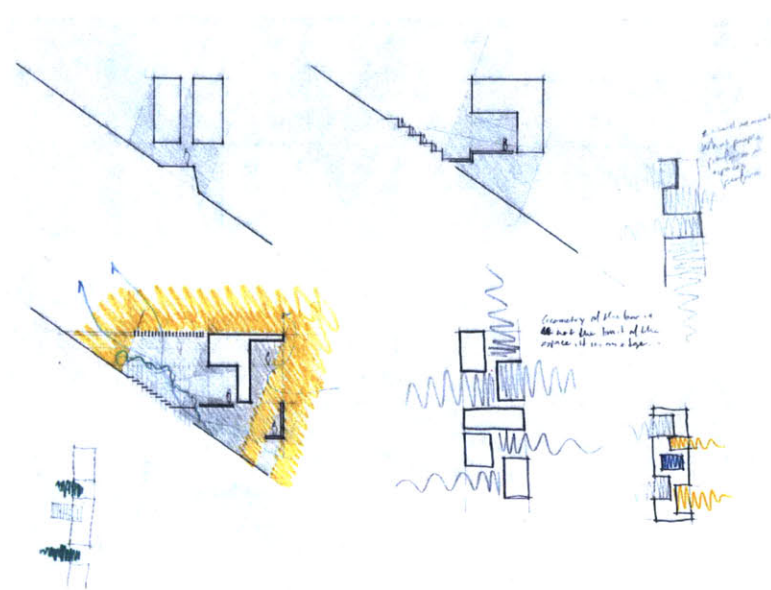


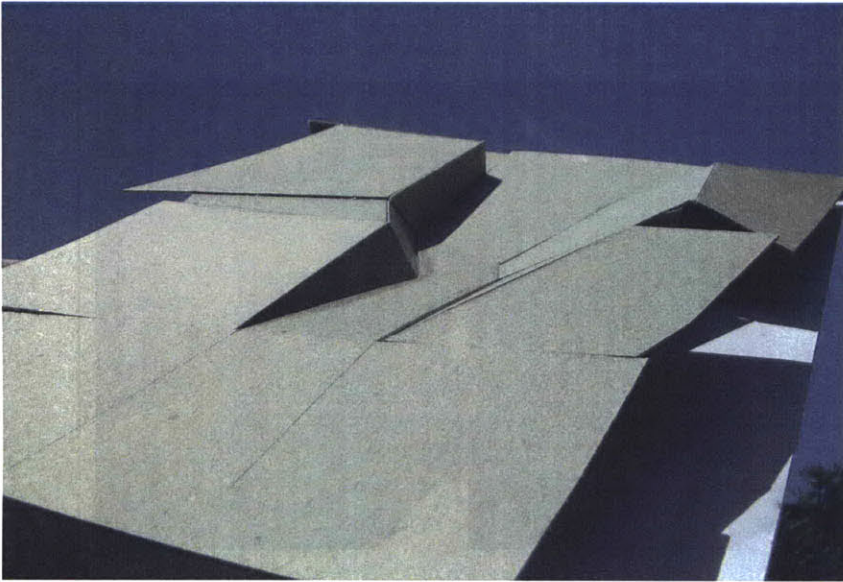
...and the housing with respect to the topography and texture of the land.



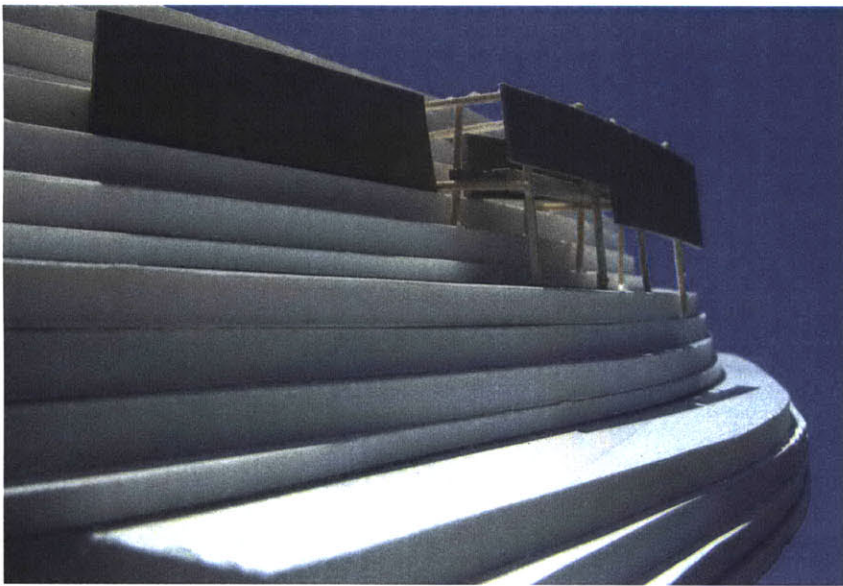
conceptual model of a strategy for building along a steep slope.

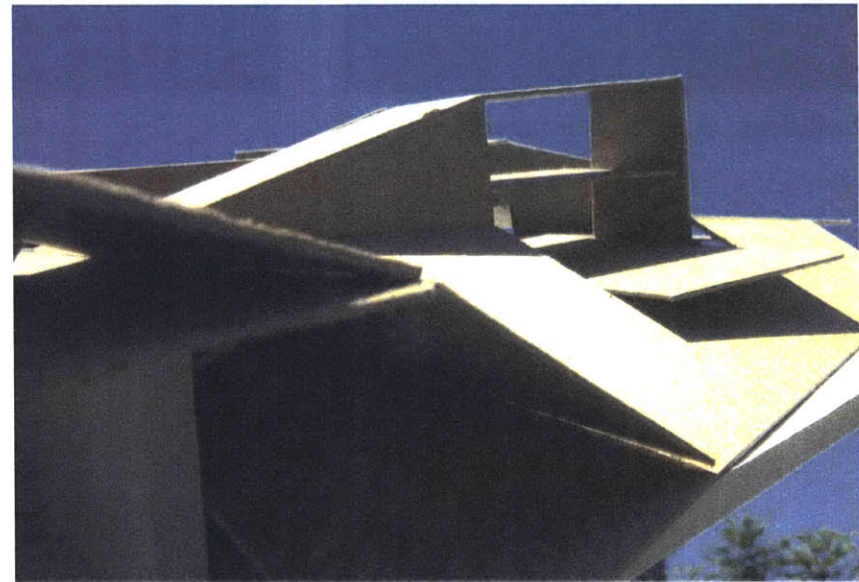
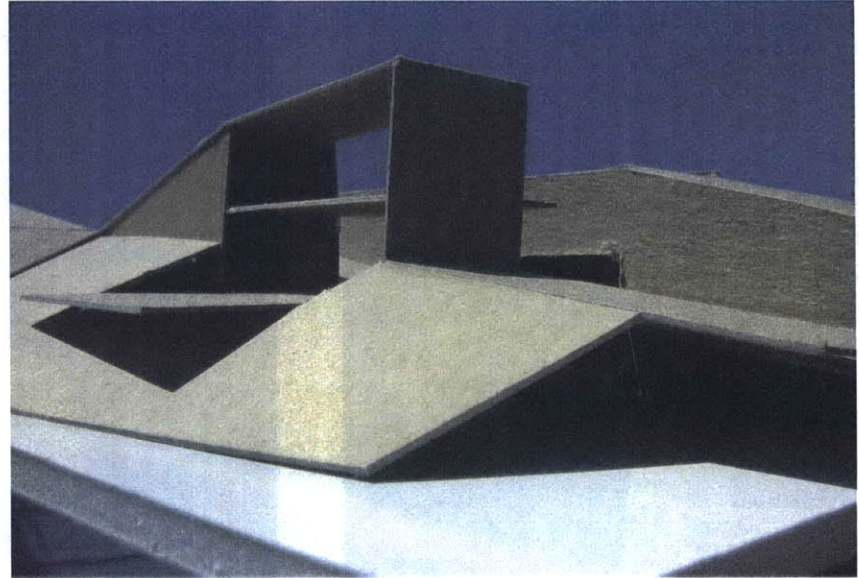
studies for the housing on the wasterock slope
focusing on the importance of shade, both to
make a comfortable space and to define space
beyond the skin of the building. the slope defines
the northern boundary of inhabitation.



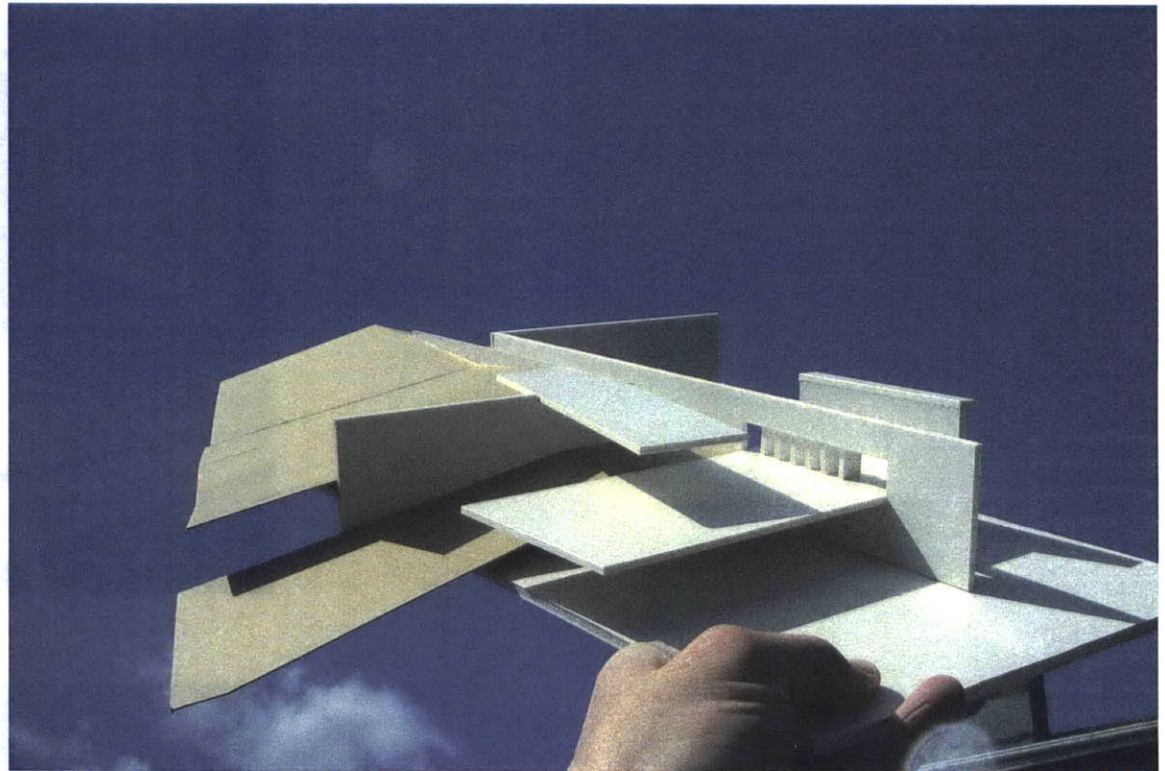
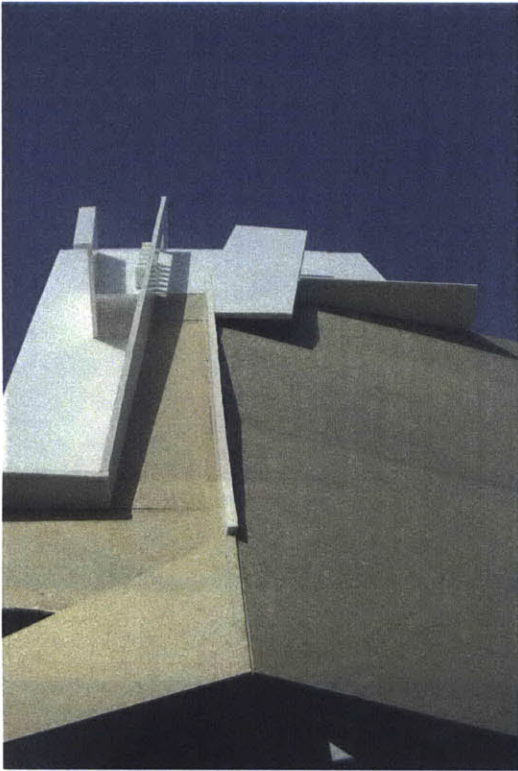


conceptual models of ways of working with the deposited wasterock and building on the terraces.

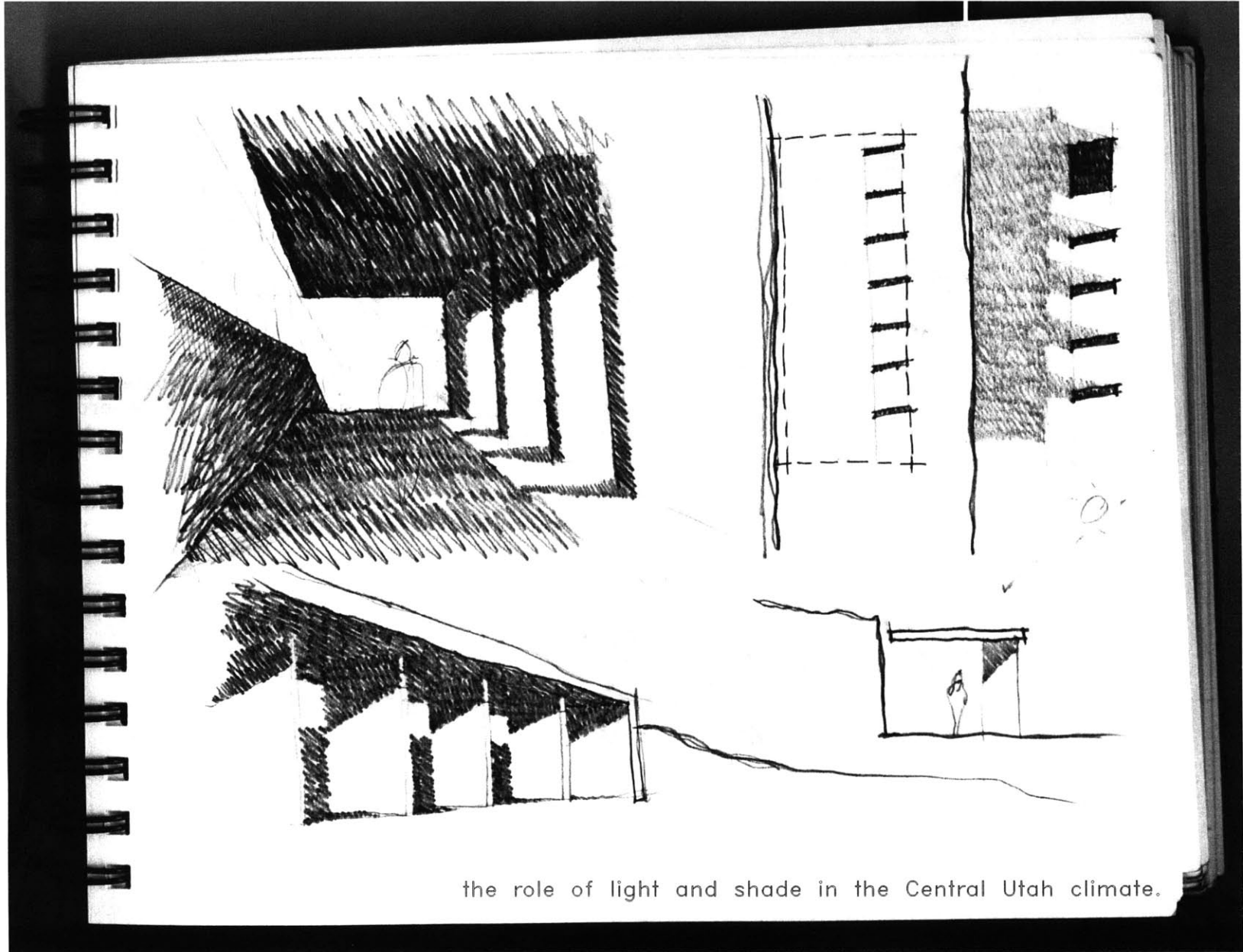




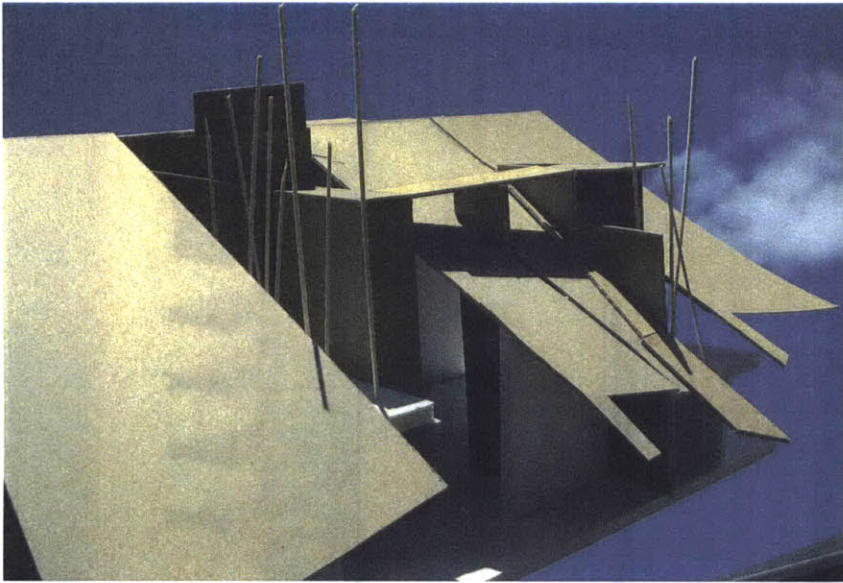
excavating and adding to create space. in the wasterock dump it might make sense to add earth rather than excavate, as the material needs to be deposited somewhere anyway.. perhaps it could be deposited toward some purpose, rather than simply dumped where economy dictates.



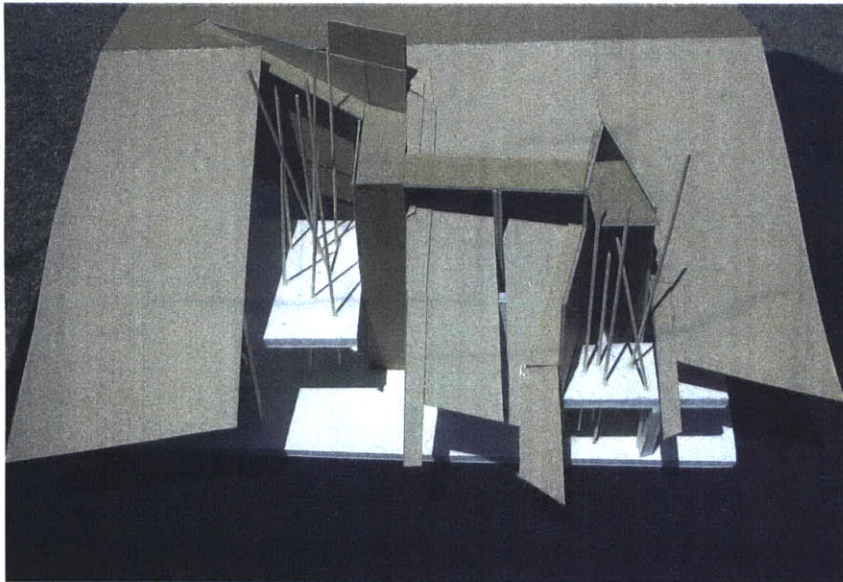
building in the wasteland.

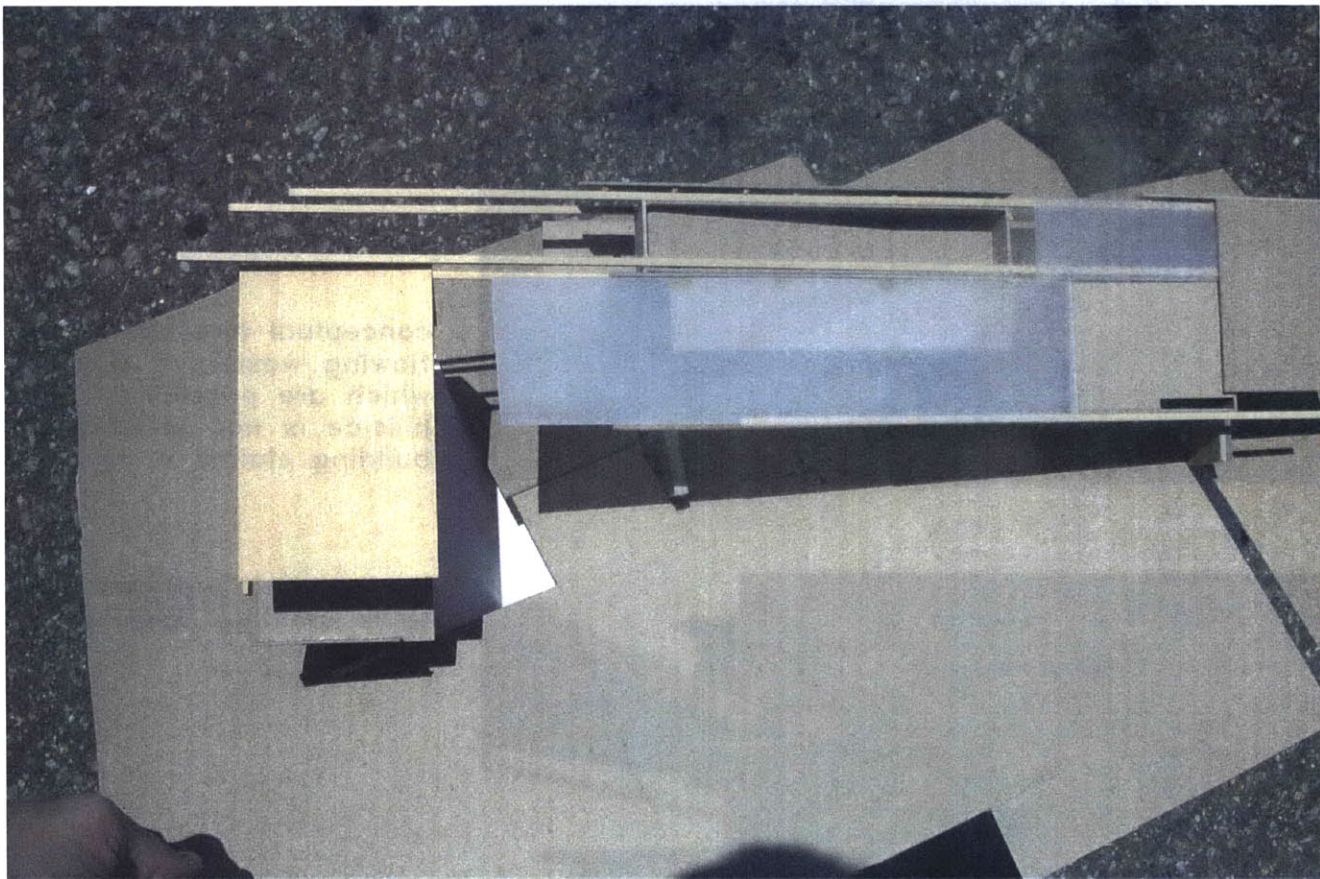


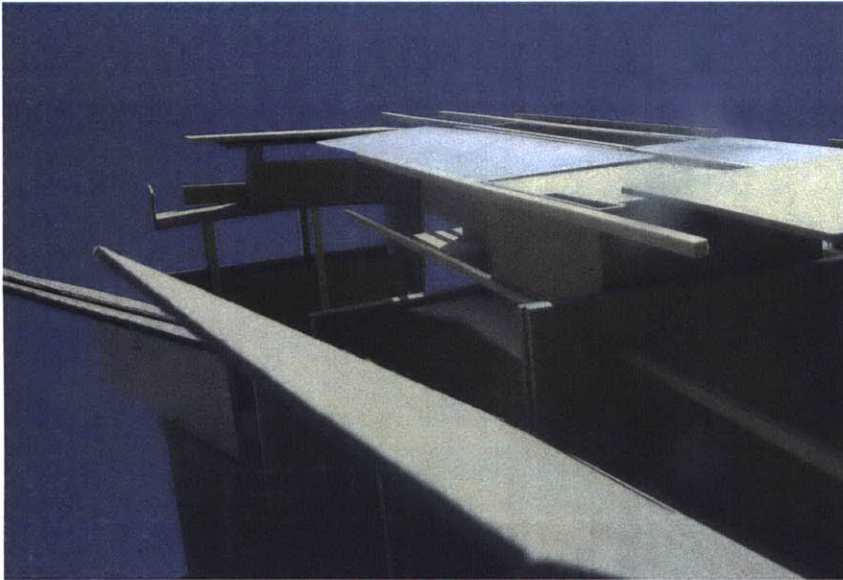
the role of light and shade in the Central Utah climate.



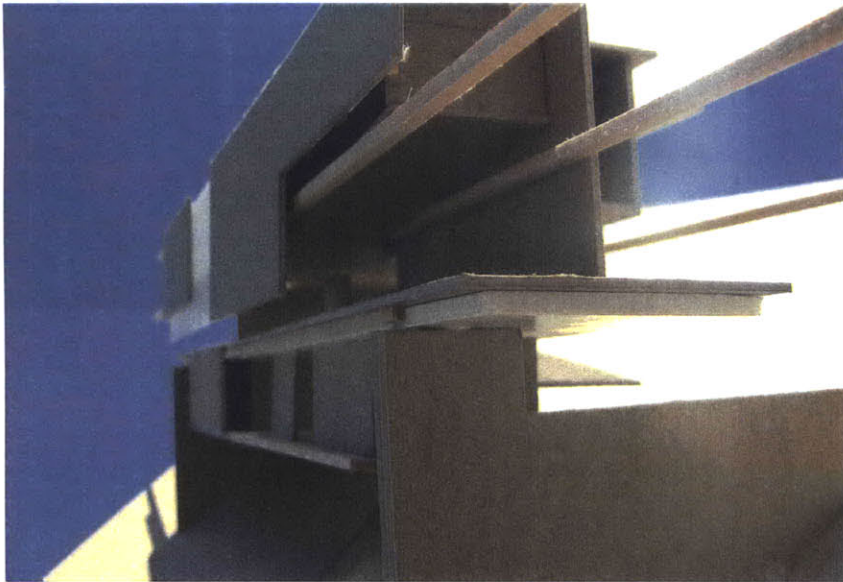
a strategy of building on the wasteland slope,
diverting the flowing rock to create protected
spaces for inhabitation.



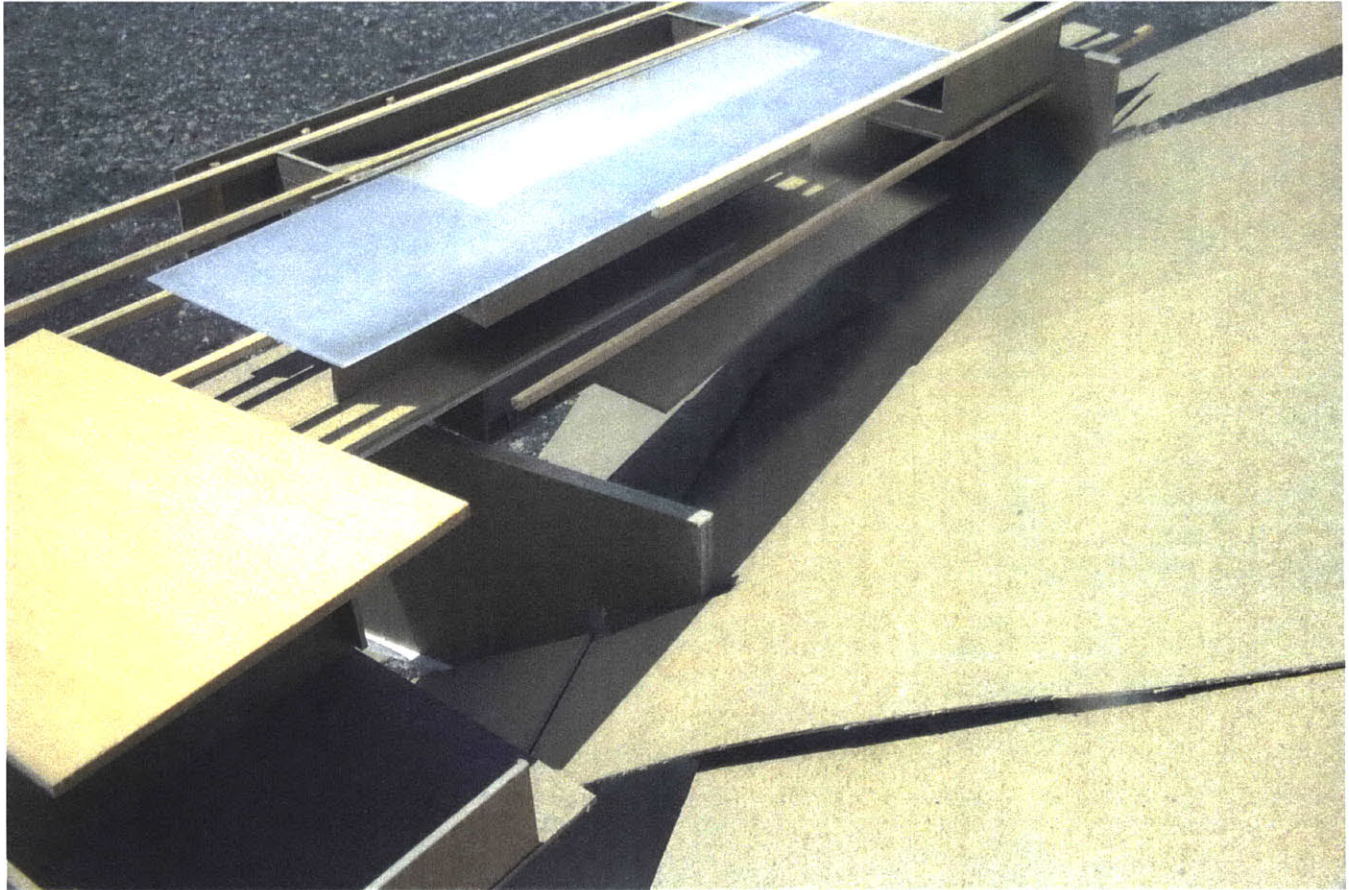




conceptual housing model. building along the flowing wasterock slope by bridging from piers which are paralell to the fall line. although the hillside is not occupiable, the shadow of the building claims it as part of the space.



the building presents a shell to the harsh sun, while creating open-air spaces which open to the hillside.



nature is always valueless, but has been given value at some time, as at present- and it was we who gave and bestowed it.

-Richard Poulsen in *Landscape of the Mind*

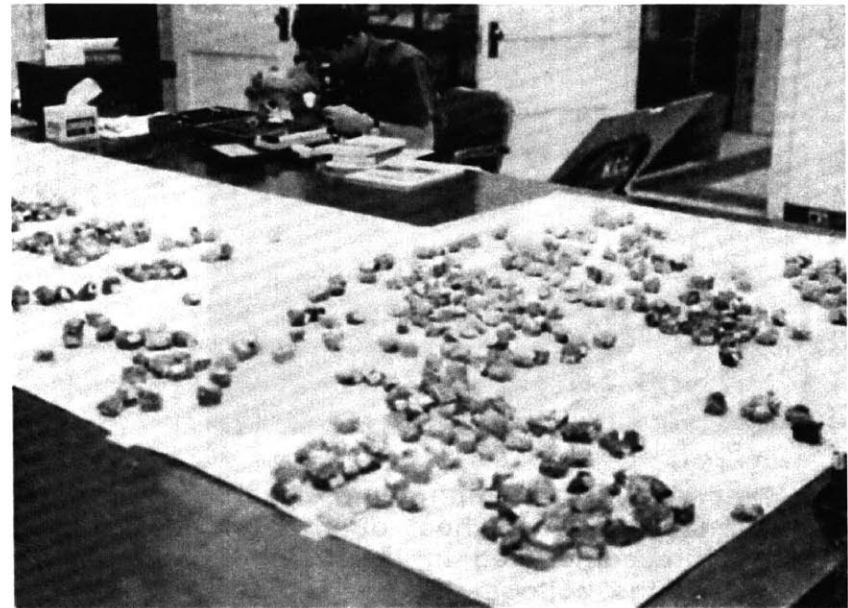
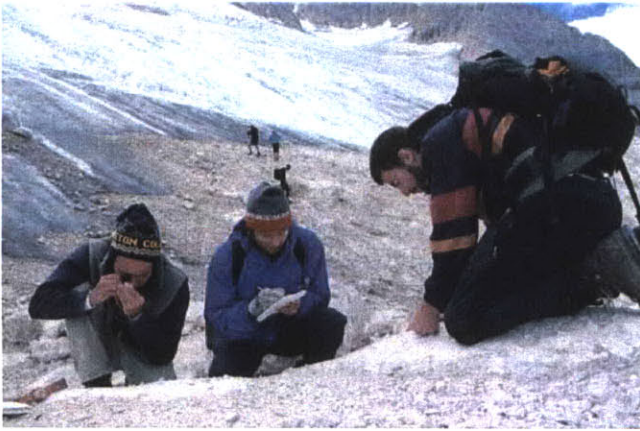


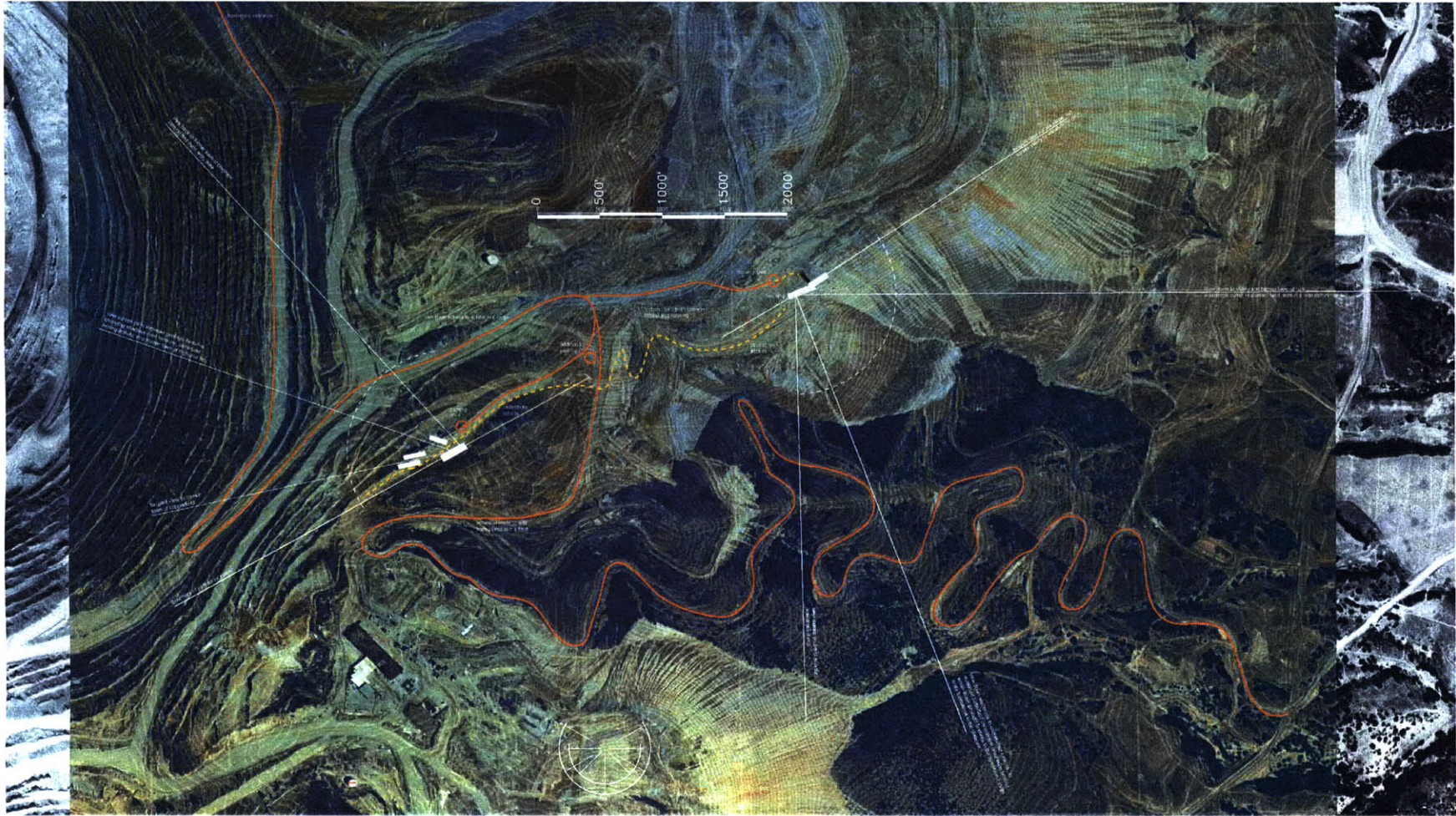
Fig. 26 "Instant Geology" petrologic method, and arrangement for petrographic studies.

3: proposal

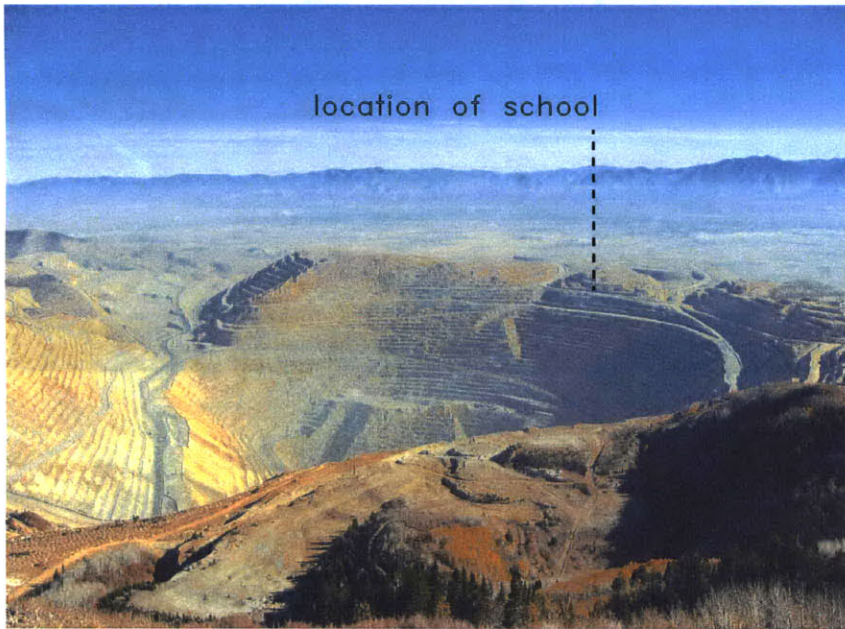
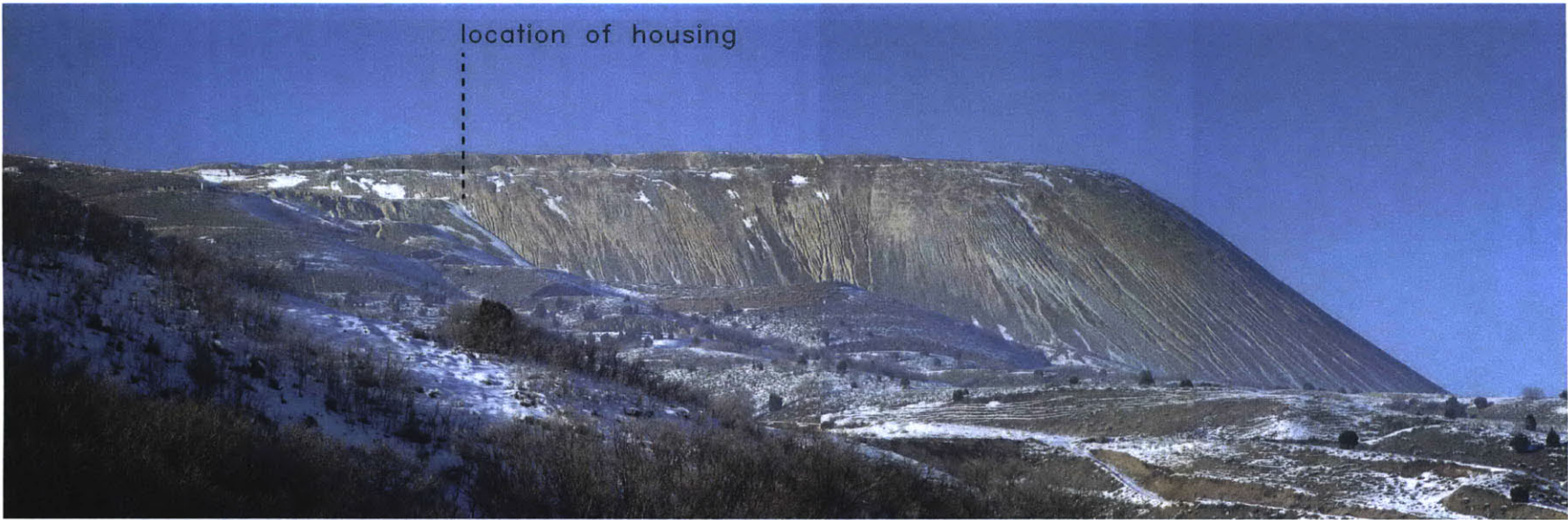


The mine and surrounding land are the primary classroom, while the school augments needs that cannot be accommodated in the field. It is at the school that the collage of experiences is first reassembled to create an understanding of the whole through maps, photographs, satellite images, samples from the field, and historical references. A broad range of possible interpretations is supported in the school and the housing with spaces for reading, writing, painting, and meditating.

The objective of the science school is to challenge preconceptions about what is natural, and to take advantage of this unique setting as a place to study the interconnectedness of natural systems, including those which are human. The Bingham Canyon Mine is a place that currently receives 170,000 visitors per year, 25% of which are students and teachers³. While Kennecott Utah Copper appreciates the educational value of the mine, their current facilities are limited to a small visitor center on the edge of the pit with a picture window where an informational video is shown. Busses pull up in the large asphalt parking lot, the people get out and look down in awe, and then they get back in the bus and drive away. This experience is very superficial and promotes a cursory judgment based primarily on visual impressions. Sometimes we see things in an instant and our lasting understanding comes from that first impression. I prefer to think of the land or a building as a person whose depth is revealed over time.



site map showing locations of school (west) and housing (east), orientations toward important points such as exposed geologic features and locations of removed towns, and access routes. vehicle routes are shown in orange and pedestrian/ bicycle routes are shown in yellow.



The proposed science school seeks to do more than simply teach science. It is an infrastructure that supports immersion in this unique environment over time. Time and exposure are essential to developing a deeper aesthetic sense, as the accumulation of experience and knowledge over time allows for the possibility of reconsideration and recursive thought. Time provides room to grow beyond initial assumptions. Movement through the changing landscape is a facilitator of reflection. The mine and surrounding land is the primary classroom, while the school complements needs that cannot be accommodated in the field. It is at the school that the collage of experiences is first reassembled to create an understanding of the whole through maps, photographs, satellite images, samples from the field, and historical references. However, a broad range of possible interpretations is encouraged by the school and the housing with spaces for reading, writing, painting, playing music and meditating in solitude or as a group.

The school is strung across the saddle with the labs and classrooms anchoring one end and housing pulling on the other. The 4,000 feet strung between them is traversed as a bridge of reflection, and it is the narrowest traverse between the interior of the pit. It occurs along the boundaries of lands that are commonly distinguished between as natural and man-made, though there are more shades of gray between than one may immediately suspect. The magnitude of operations that shape the mine have created a landscape scaled by machines and this is the way it is typically engaged. It was created by the economy of enormous trucks, shovels, and trains, and is not comfortably crossed by unprotected humans. By splitting the two components of the school along this saddle, people may now occupy a territory within this immense landscape, rather than just points. This pedestrian traverse also makes it possible to relate the magnitude of operations to the human scale, not just the vehicle. This traverse is a period of reflection and exploration.

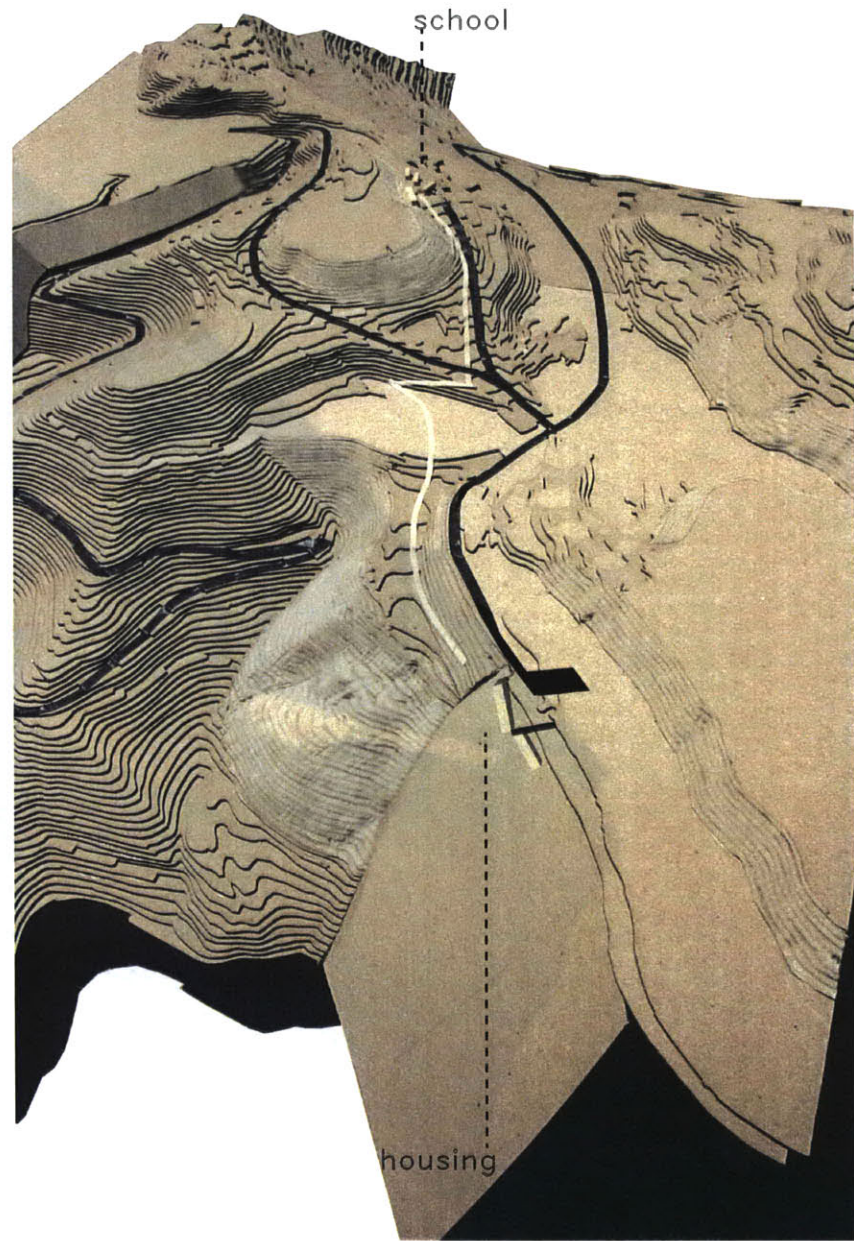
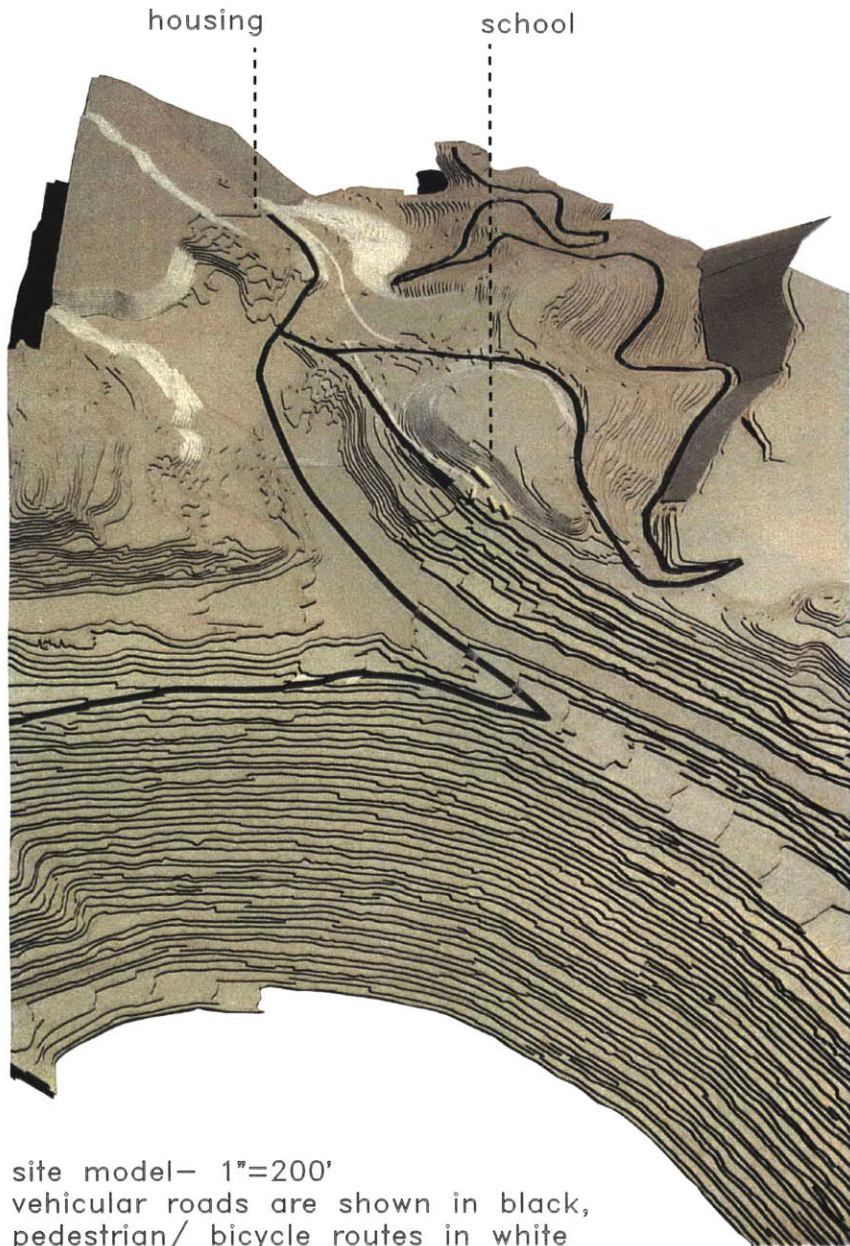
The path between the school and the housing bridge a saddle between the inside and outside of the pit. On the inside is the site of extraction. It is exposed rock cut calculatingly in terraces. Explosives are methodically planted in rows blanketing the target area. The explosives rupture a pad of earth which will be carried away by enormous trucks to be separated and processed into copper or dumped as waste. This methodical process continues 24 hours a day for nearly every day of the year, continually advancing terraces even deeper and subsequently filling a nearby valley hundreds of feet deep with wasterock. The cutting progressively exposes more of the geologic features which have been interpolated in geologic maps. It is slowly progressing section of the earth. Nothing grows here. The terraces are constantly monitored by computers to detect movement and instability, and fertile soil fails to accumulate. Most terraces are relatively narrow, their dimensions governed by the reach of the railroad mounted steam shovels that cut them in the early 1900's. The larger terraces in the pit have been cut since the introduction of the truck. In the pit there is no sign of the towns that once thrived there, that were burnt down and rebuilt several times. Their foundations have been undercut by hundreds of feet of excavation.

The school sits on one of the highest terraces cut since the introduction of the truck. It shears this wide thru-way out into the pit, creating several scales of spaces between the hill and the rim of the pit. The classrooms, labs, and museum shore up the edge of the pit like teeth or giant rocks which have sat heavily as the softer earth has eroded between them. Cuts are made between them that break the boundary of the road and step out into the space of the 2 ½ mile wide bowl. These deep spaces are oriented toward the locations of two of the erased towns, the only markers of their location in the air above the terraces. The school is an observatory overlooking the excavation that may continue for 10 to 30 years, following which the pit may be left dormant, its rate of



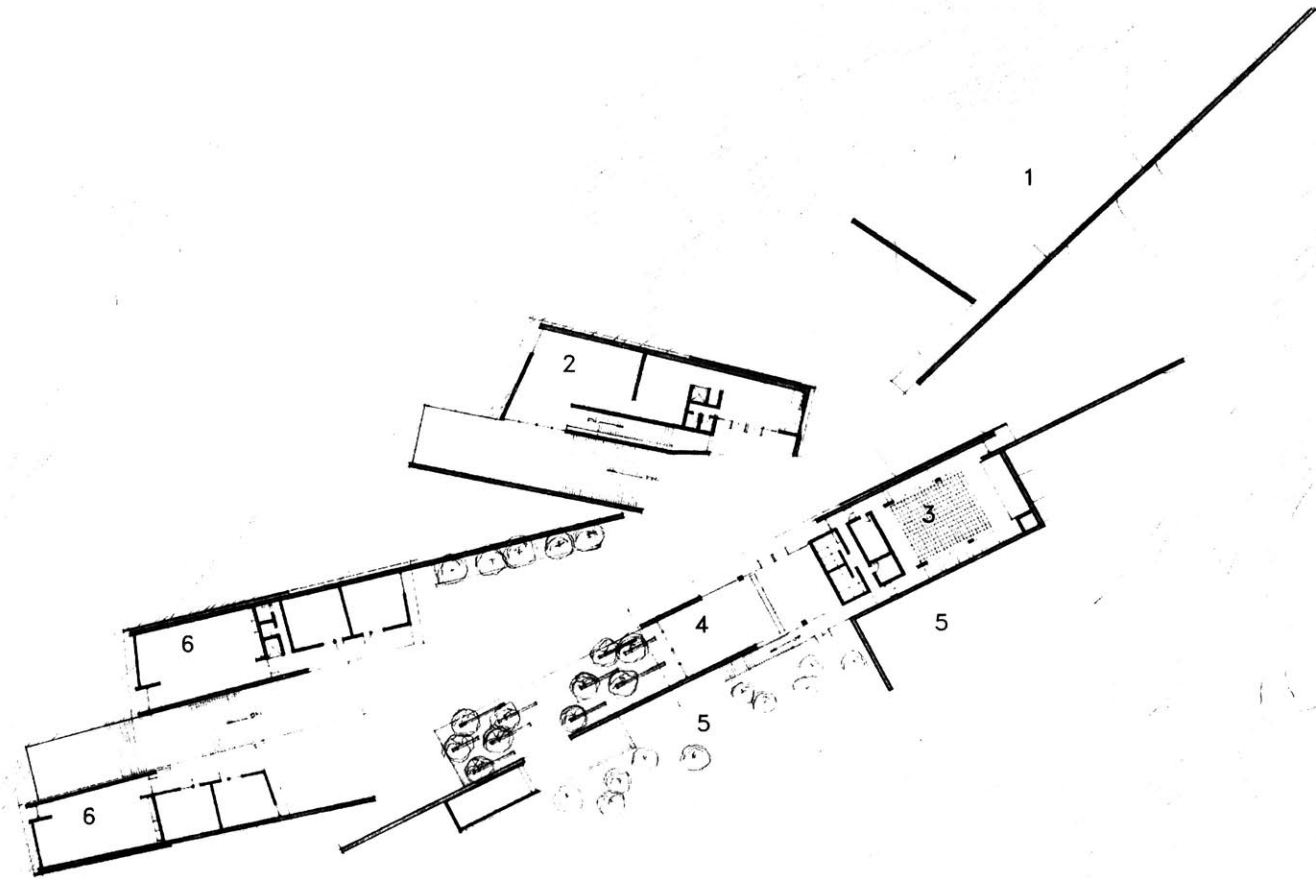
change again slowing down to a geologic scale of change. Or it may be further changed by men as its lower 500 feet are filled with waste from the Rocky Mountain West. Regardless, most of the pit below will eventually become uninhabitable as its stability ceases to be monitored and managed.

The saddle that separates the school and the housing is also crossed by 2 routes leading in and out of the mine pit. These roads take students out into the field for hands on study. It also brings in technical experts from Kennecott Utah Copper who may meet with the students to collaborate on projects or simply share their specialized knowledge. The land claimed by the school and the housing is the inhabited territory in which people may meet. As Kennecott's surrounding lands are developed these routes may also become recreational, with nearby residents passing through on foot or by bike.

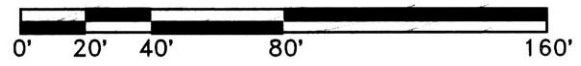




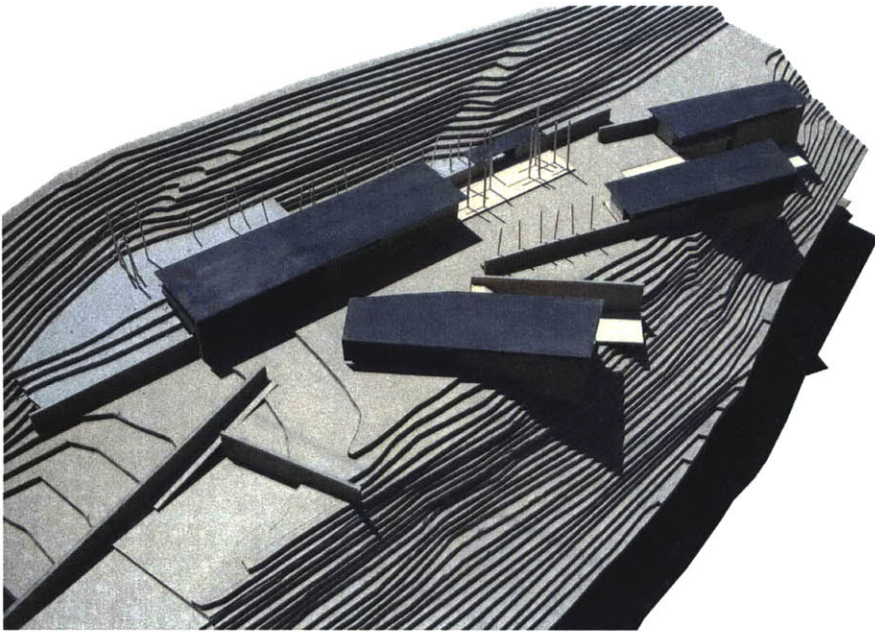
school model- 1"=20'



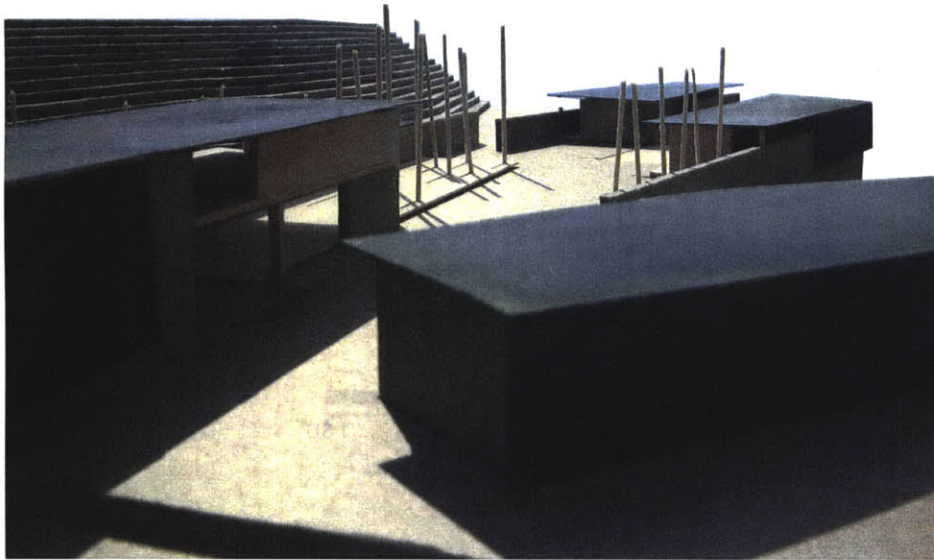
- 1. parking
- 2. museum
- 3. lecture hall (offices above)
- 4. reception (archives above)
- 5. garden
- 6. classrooms (labs below)



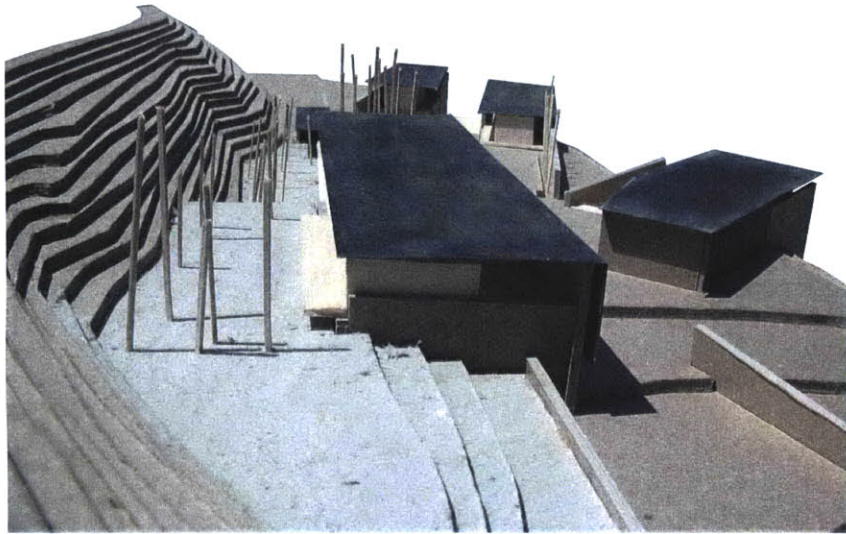
school plan



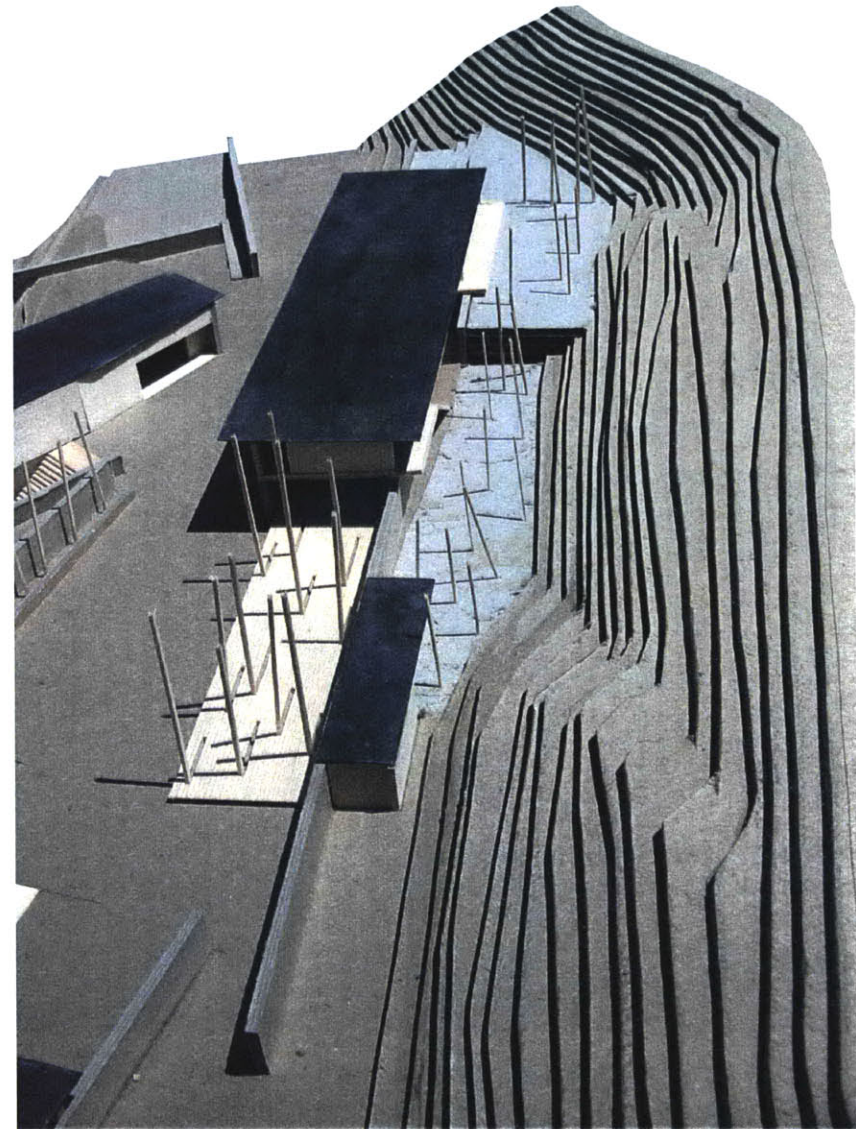
overview of the school from the northwest.



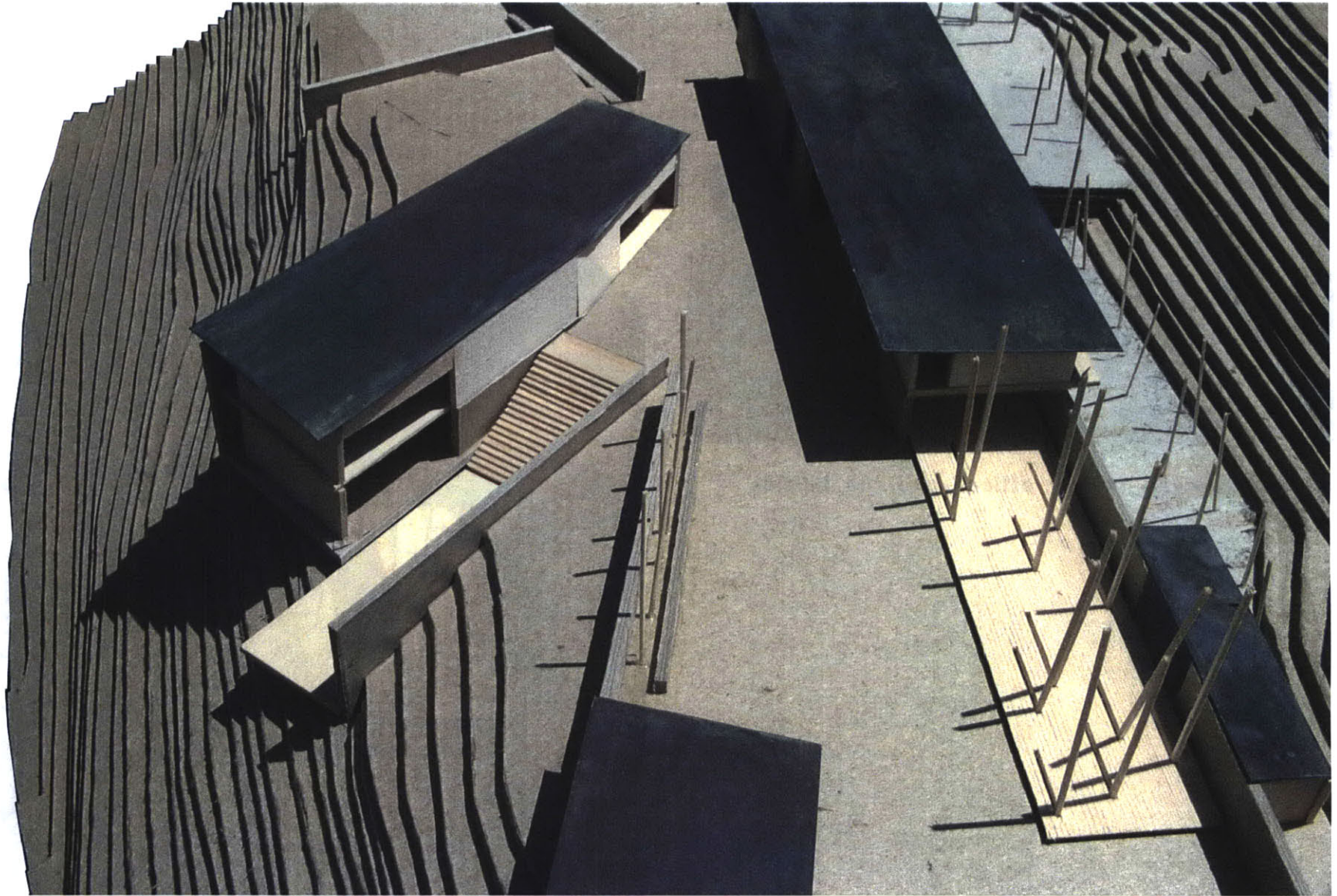
view of entry between museum and
main building



garden between faculty offices and the hillside



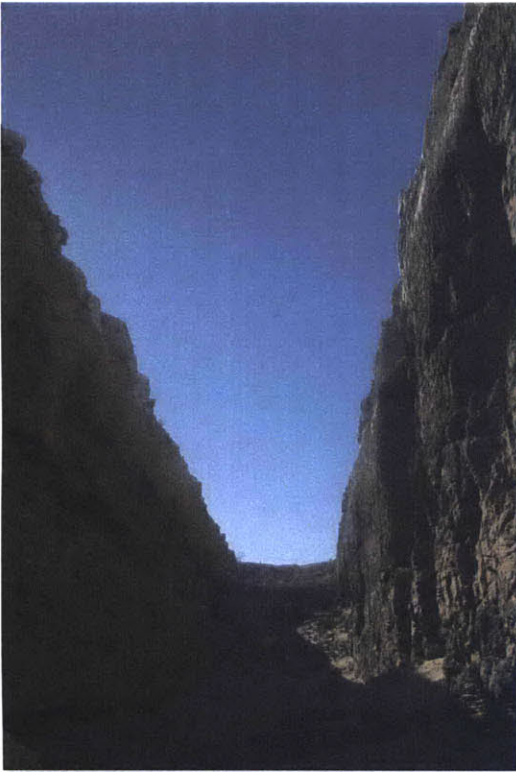
gardens between faculty offices and entry lobby
and the hillside, and main meeting garden at the
"focus" of the campus.



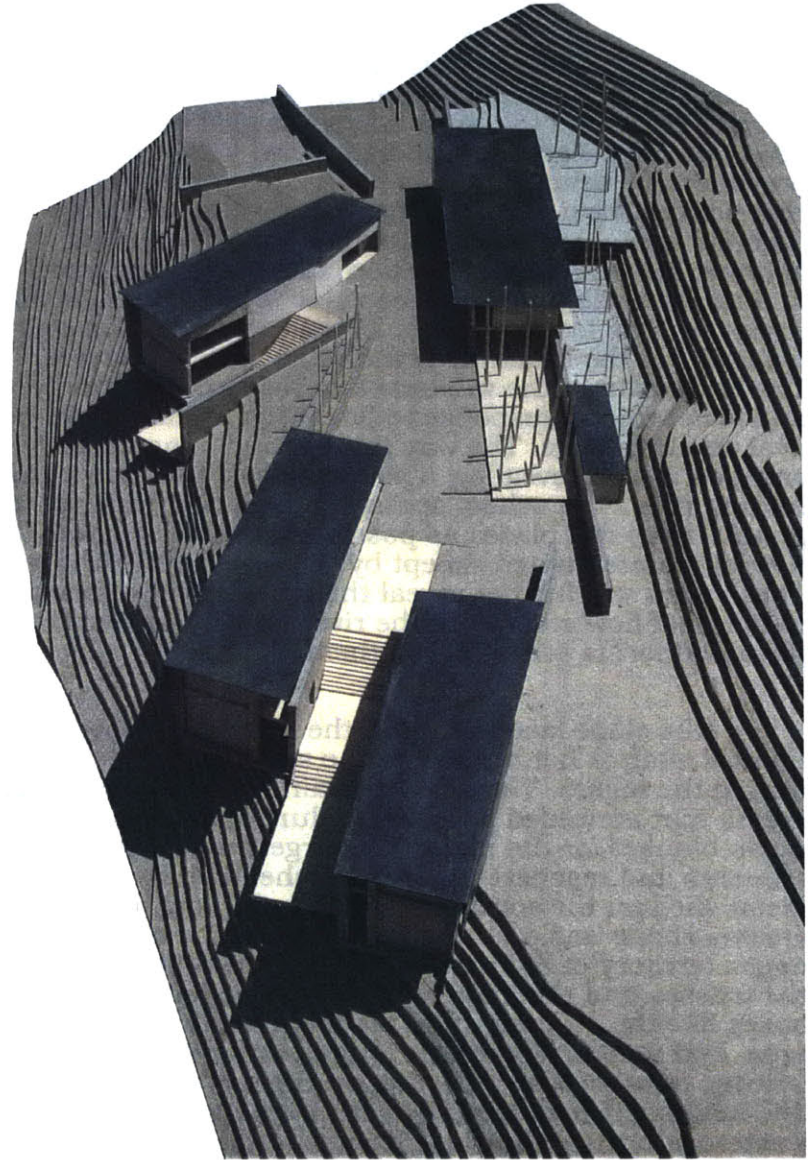
the museum (left) and lecture hall and offices (right).



slot of space between classrooms (above) and labs (at mid-level)

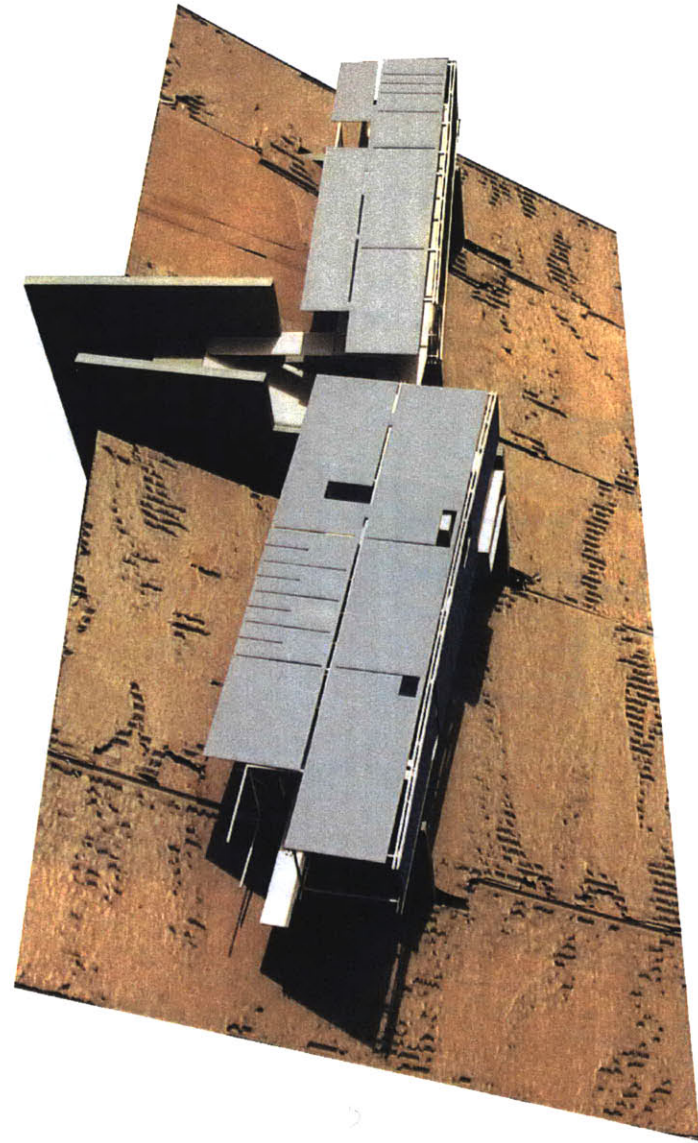


michael heizer's "double negative" near overton, nevada. the trenches primitively introduce an intermediate scale of space to this vast landscape. they become a meter for the movements of the sky and sun and allow one to step into the space of the wash between.



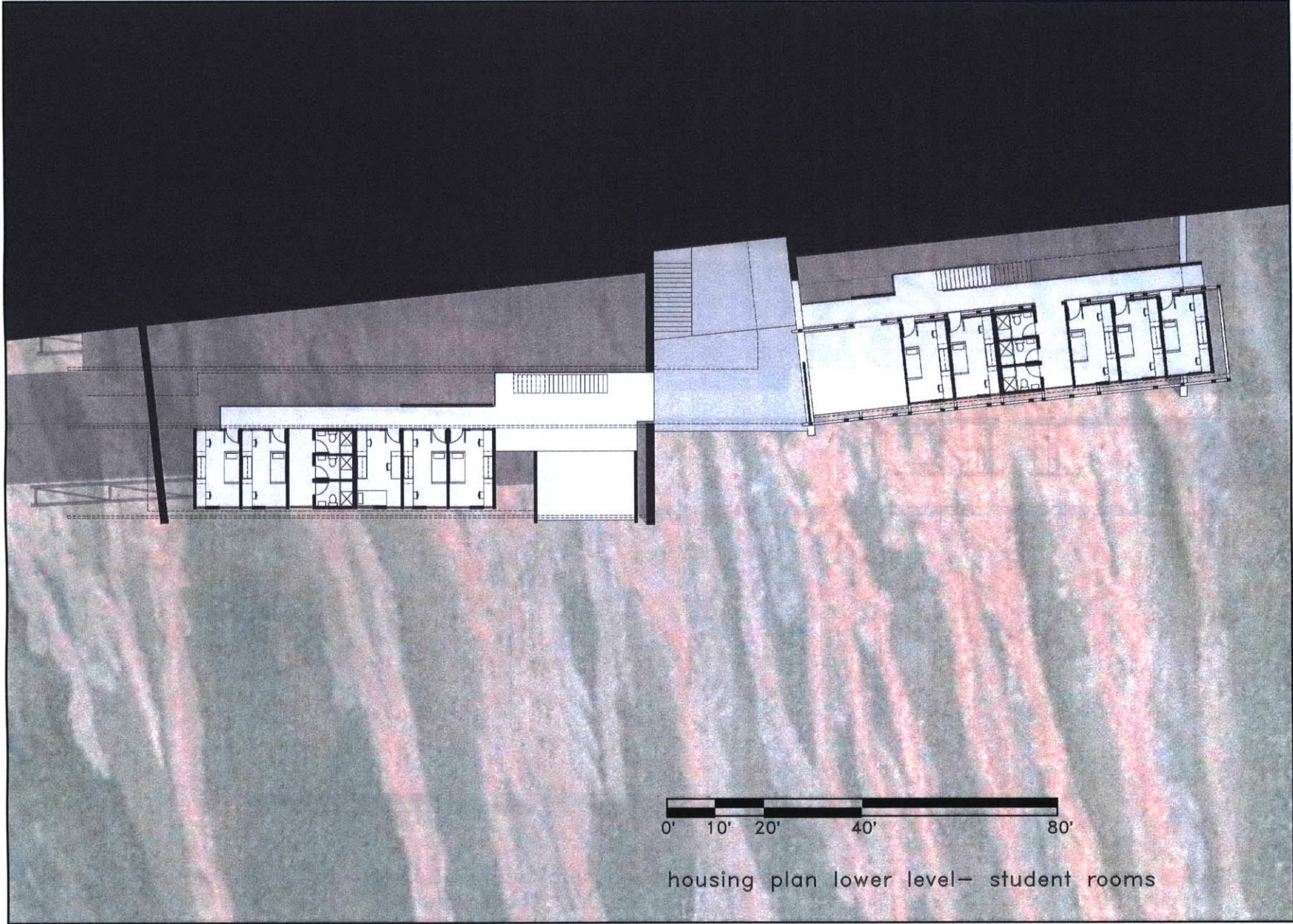
The housing is situated near the top of the most prominent wasterock butte as seen from the valley, and its orientation mirrors that of the school on an east-west axis. It is placed in tension near the edge of the butte with the tallest and longest sweep of the 35 degree face beyond in profile. Another butte is seen across a ridge of bedrock, creating a steeply angled valley. This adjacent ridge was once the high point as the wasterock on which the school sits has filled a deep valley. From this point of view one sees the juxtaposition of many different surface conditions: wasterock fill, exposed bedrock features and vegetation, cultivated vegetation, and the sprawling neighborhoods of West Jordan in the distance. This location is one of the most unstable and dynamic on the humanly perceivable scale of change. The movement of the wasterock in response to gravity and water and in response to obstacles reveals a great deal about the site. The way this ground is necessarily engaged is also revealing. The slope is treated like a slow-moving river. The school spans the river and touches the ground in as few places as possible, allowing the rock to flow by uninterrupted except by the piers of the bridge. These piers will further reveal the grounds movement as patterns of flow emerge as the river breaks around the piers and forms eddies below them.

The slope faces south in the intense summer sun. Central Utah is hot but dry in the summer days, cool during the nights. There is little rain. Shade and a breeze are all that is needed for comfort during the day and a warm blanket for the night. The large trusses that the students and teachers inhabit are sheathed by a light metal shell on the south side and on the roof. This shell creates shade and a strong spatial envelope defining the major territory of habitation between the outside face of the trusses and the hillside. Within this shell are enclosed boxes like the students' and teachers' rooms and dining area, and more open spaces for gathering, reading, writing, or otherwise reflecting on the day's experiences. The housing is accessed via a cut in the top of the wasterock butte or a bridge from the adjacent shoulder.



overview of housing on the wasterock slope. 1/8"=1'-0" model





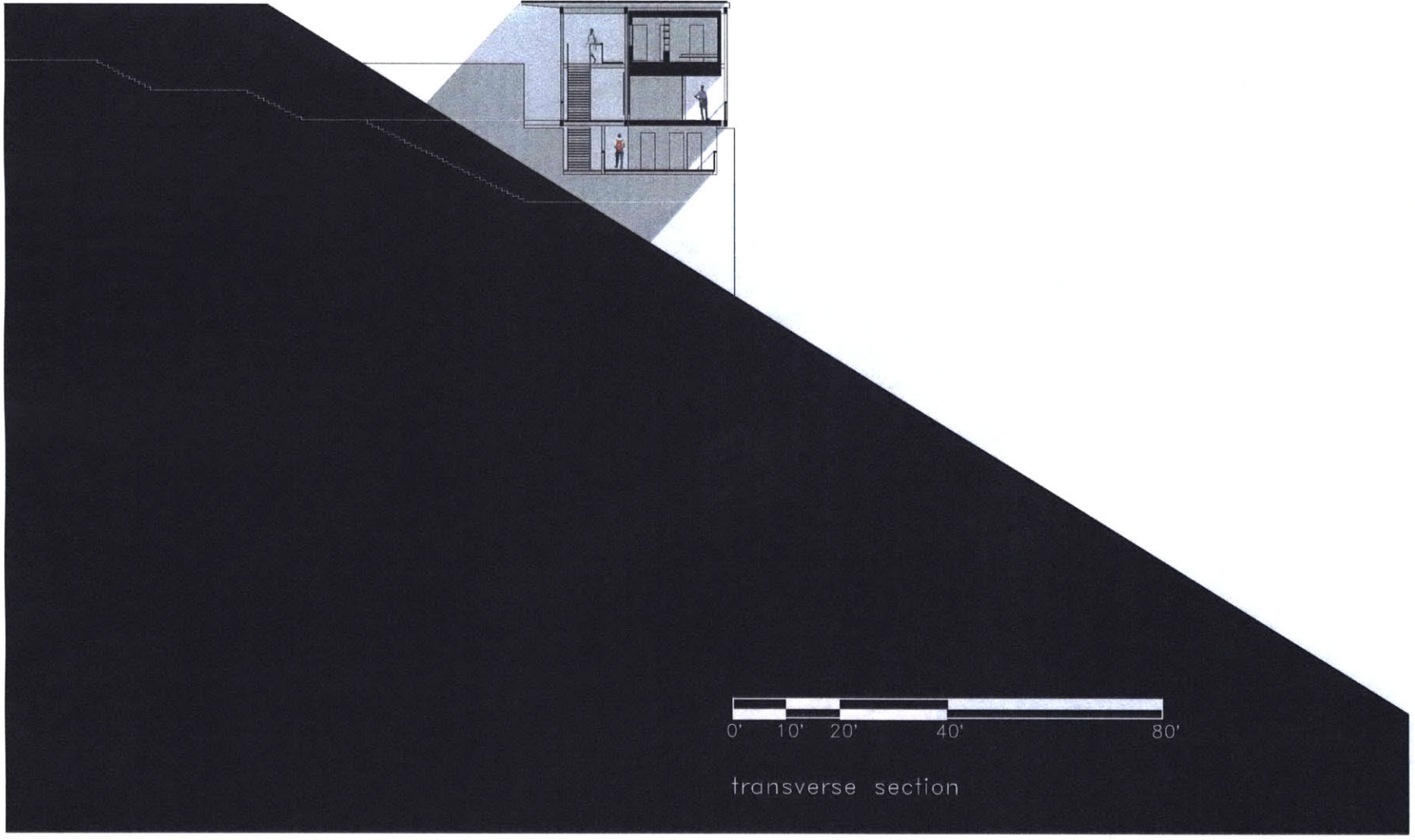


0' 10' 20' 40' 80'

housing plan middle level— living, dining, and studio/ "observatory"







transverse section

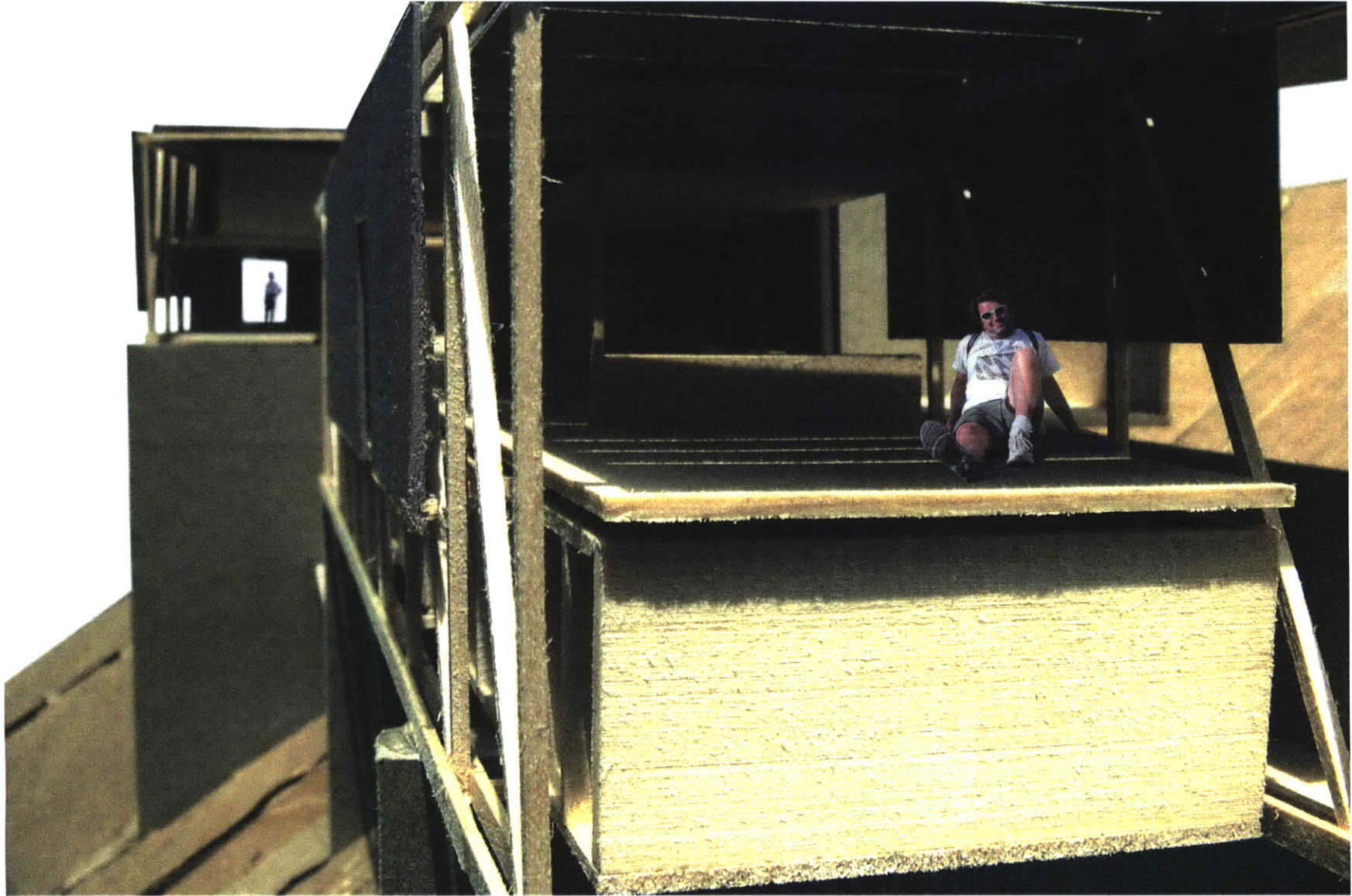


space between the rooms and the slope.



Every landscape appears first of all as a vast chaos, which leaves one free to choose the meaning one wants to give it.

Claude Levi-Strauss from *Tristes Tropiques* as quoted in *Landscape of the Mind* pg 0



BIBLIOGRAPHY

Active Statics, <http://acg.media.mit.edu/people/simong/statics/Start.html>

Baily, Lynn R. *Old Reliable - A History of Bingham Canyon, Utah*. Westernlore Press; 1990

Baldwin, A Dwight, De Luce, Judith, Pletsch, Carl. *Beyond Preservation: Restoring and Inventing Landscapes*, Minneapolis: University of Minnesota Press, 1994.

Berger, Alan. *Reclaiming the American West*. Princeton Architectural Press, New York 2002

Callender, Jon. Vice President of Development Services, Kennecott Land Company. Personal interviews. January 15 and 23, 2004.

Carleton College Geology Department, <http://www.acad.carleton.edu/curricular/GEOL/>

Cook, D.R., editor. *Guidebook to Geology of Utah: Geology of the Bingham Mining District and Northern Oquirrh Mountains*. Utah Geological Society Guidebook, 1961

Corner, James. *Recovering Landscape: Essays in Contemporary Landscape Architecture*, New York: Princeton Architectural Press, c1999.

Earth System Science Online, <http://www.usra.edu/esse/essonline/>

Helphand, Kenneth I. *Colorado: Visions of an American Landscape*, Niwot, Colo.: Roberts Rinehart Publishers in cooperation with the Colorado Chapter of the American Society of Landscape Architects, c1991.

Jones, Gary L. Project Engineer, Phelps Dodge Miami, Inc. Personal interview January 21, 2004

Kennecott Utah Copper, <http://www.kennecott.com>

Kittredge, William. *Who Owns the West?* San Francisco, Mercury House, 1996

Klett, Mark, Manchester, Ellen, Verburg, JoAnn *Second View: The Rephotographic Survey Project*, Albuquerque: University of New Mexico Press, c1984.

KUED 7- *Copper Canyon, American Dream- The Story of Bingham Canyon*, <http://www.kued.org/coppercanyon/explore/index.html>

Limerick, Patricia Nelson, *The Legacy of Conquest : The Unbroken Past of the American West*, New York: Norton, c1987.

Maclean, Norman, *A River Runs Through It, and Other Stories* , Chicago University of Chicago Press, 1976

Nash, Roderick. *Wilderness and the American Mind*, New Haven: Yale University Press, 2001.

Penning, Rowsell, Edmund, Lowenthal, David *Landscape Meanings and Values*, London; Boston: Allen and Unwin, 1986

Poulsen, Richard C. *The Landscape of the Mind: Cultural Transformations of the American West*, New York : P. Lang, c1992.

Smith, Duane A. *Rocky Mountain Mining Camps: The Urban Frontier*, Bloomington, Indiana University Press 1967

Smith, Henry Nash. *Virgin Land: The American West as Symbol and Myth*, Cambridge, Mass. : Harvard University Press, 1970, c1950.

The Teton Science School, <http://www.tetonscience.org>

To Move a Mountain, Utah's Bingham Canyon, <http://www.utahrails.net/ingham/ingham-index.htm>

Treasure House: The Utah Mining Story director Lee B. Groberg, A Utah Statehood Centennial Production, PBS Televised by KUED Television. 1995

Utah Climate Center, <http://climate.usu.edu/>

Utah State Historical Society, Shipler Commercial Photographers Collection. <http://history.utah.gov/Photos/C275/indexform.htm>

Worster, Donald. *Under Western Skies: Nature and History in the American West*, New York: Oxford University Press, 1994.

IMAGE CREDITS

all photographs and graphics by the author unless otherwise noted.

images on pgs 8 and 9 from Second View: The Rephotographic Survey Project.

images on pg 10 from the Utah State Historical Society Shipler Commercial Photographers Collection

computer graphics on pg 13 obtained from <http://www.kued.org/coppercanyon/explore/index.html>

images on pg 15 obtained from Corbis Stock Photography <http://www.corbis.com>

LANDSAT satellite photograph on pg 14 obtained from http://earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=4694

geologic map used on pg. 17 from The Guidebook to the Geology of Utah number 16: Geology of the Bingham Mining District and Northern Oquirrh Mountains. Aerial photograph from <http://www.globeXplorer.com>

pgs 18 and 19- geologic section from The Guidebook to the Geology of Utah number 16. color aerial photographs from globeXplorer, black and white aerial photographs from the U.S. Geologic Survey. additional images from corbis stock photography and the author.

aerial photographs on pgs 20 and 21 from USGS

pg 22- aerial photograph from globeXplorer, detail of slope from Reclaiming the American West.

photo on pg. 39 from The Guidebook to the Geology of Utah number 16

images on pg 40 from the Carleton College Geology Department web site <http://www.acad.carleton.edu/curricular/GEOL/>

aerial photo on pg 41 from globeXplorer.com

Image on pg. 44 from Reclaiming the American West