MARKING BOUNDARY: *A Didactic Base Camp Facility between Desert and Mountain, along the Los Angeles Aqueduct in Owens Valley, California*

by **Christopher Aaron Johns**

Bachelor of Design with Honors
University of Florida, 1999

Submitted to the Department of Architecture in Partial Fulfillment of the Requirements for the Degree of Master of Architecture at the Massachusetts Institute of Technology, February 2004

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ABSTRACT

No problem for the future holds so great a potential for changing the quality of life in California as water and its supportive infrastructure. An obsession with water, which began with the infamous five words "there it is, take it," has shaped the patterns of settlement within California and laid the basis for the modern prosperity of the nation's most populous state.

The purpose of this thesis is to restore lost environmental values by creating an understanding of what is involved in bringing an adequate supply of water to Los Angeles, in order that the general public is more aware of the importance to conserve and use water wisely.

The execution of the design of an environmentally sensitive base camp facility near the trail head of Mount Whitney in Lone Pine, California is intended to educate the public by identifying the price of progress yet responding to the immediate environment in a sensitive way, promoting new attitudes of conservation and sustainability. The base camp provides communal spaces that allow people to convalesce while didactically engaging the aqueduct. The relationship between the visitors and their surroundings is paramount, as the architecture acts as a mediator in the landscape between the desert and mountains, the wilderness and civilization as well as the aqueduct and visitors.

Owens Lake is currently dry due to L.A. taking water from the valley.

ACKNOWLEDGEMENTS

Earning the Masters of Architecture degree has been one of the most arduous tasks I have ever undertaken. This book represents my thesis, the theoretical capstone of my graduate studies, but it cannot pretend to represent the personal effort necessary to complete this academic program. Every sliver of time, every spare thought, tremendous discipline and physical effort as well as going into major financial debt has been required in the past two and a half years.

I would like to thank all the excellent professors and teachers who have greatly influenced and inspired me over the years at every level. For the advising, mentoring and your poignant criticism I am forever in your debt.

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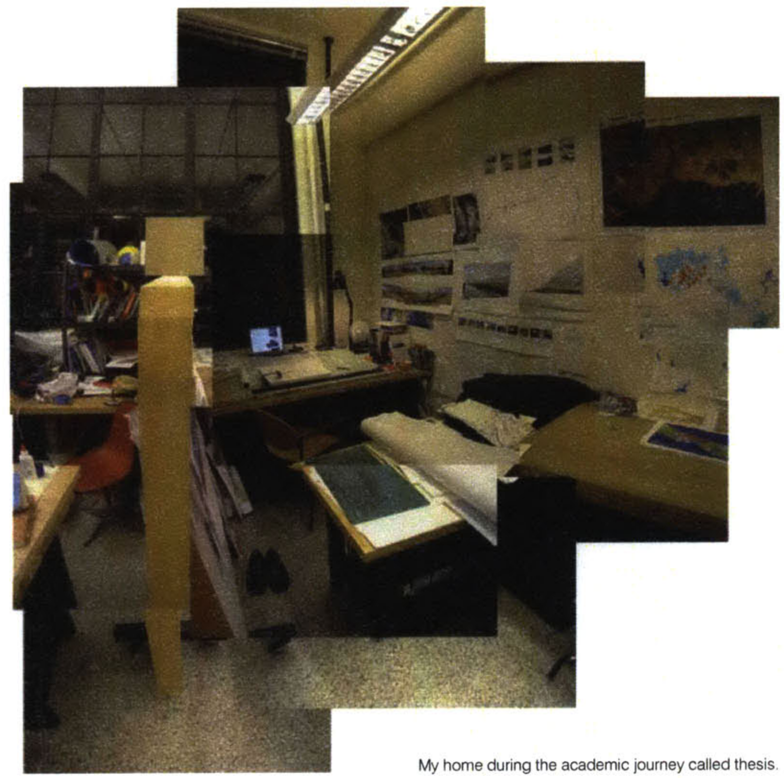
Many thanks to the following people who helped me producing this thesis: Phillip Kelleher, thanks for constructing the model base, it saved me a ton of time; Michael Spinello, this experience would have certainly been less humorous without you around, thanks for all your insight and stay off the floor; Tony Su, thanks for cleaning up my scans, the plans received many compliments; and Amy Watson, your compassionate love, support and patience were amazing through this rigorous process. I hope someday I can repay you. This academic endeavor would not have been possible without the kind of quiet support provided by my family, girlfriend and closest friends that, if called upon, would have turned into a raging flood. Thank you for encouraging me to go after my architectural explorations.

It is thrilling to be done.



My home during the academic journey called thesis.

CONTENTS

A COMPELLING INTEREST

I like to think the origins of this thesis began in the wooded area behind my grandparent's house as a young boy. The Florida landscape, as flat as it may be, is dynamic with geologic conditions such as the sink holes which open up the earth's skin to the limestone cavities below. I often found myself hanging around one particular sink-hole formed sand pit constructing "forts" which my brother and friends would inhabit. These "forts" were usually sited on the edge of the sand pit just as the woods ended; we enjoyed looking over this vast and foreign landscape. As I grew older, I became excited each time we took family trips north into the Appalachian Mountains as I would get to see the collision of dynamic mountain landscapes and massive infrastructure such as steel bridges. The contrast of scale between the tectonically formed mountain ranges and delicate man-made infrastructure intrigued me more and more. I was fascinated by almost everything I saw.

During my undergraduate studies in architecture at the University of Florida, I was always most interested in the role landscape played in architecture, from geology to water. Continued interest of the natural environment followed me through my graduate studies in building construction as I learned about sustainable design practices. I returned to all these interests upon starting the theoretical capstone to my academic journey at MIT. Thanks to many discussions with very insightful colleagues, I realized that my interests were encapsulated in a type of resource providing infrastructure such as the aqueduct systems of Los Angeles. The design process as well as the program would take on a didactic approach to the Los Angeles Aqueduct (LAA) affording me the opportunity to design and build in an unstable rugged landscape where water is the essence of life.

Before commencing the design, I traveled across the country to fully experience the entire 223 miles of the LAA. This was very difficult due to the road infrastructure coming much later than the LAA; I found myself exiting the highway, weaving in and out of neighborhoods and traveling down many dirt roads to get any glimpse I could of the aqueduct. After this arduous experience, I began to understand the lack of opportunities for the general public to engage the LAA. It is inconceivable. This thesis is an attempt to make explicable what is involved in bringing an adequate supply of water to Los Angeles.

INTRODUCTION

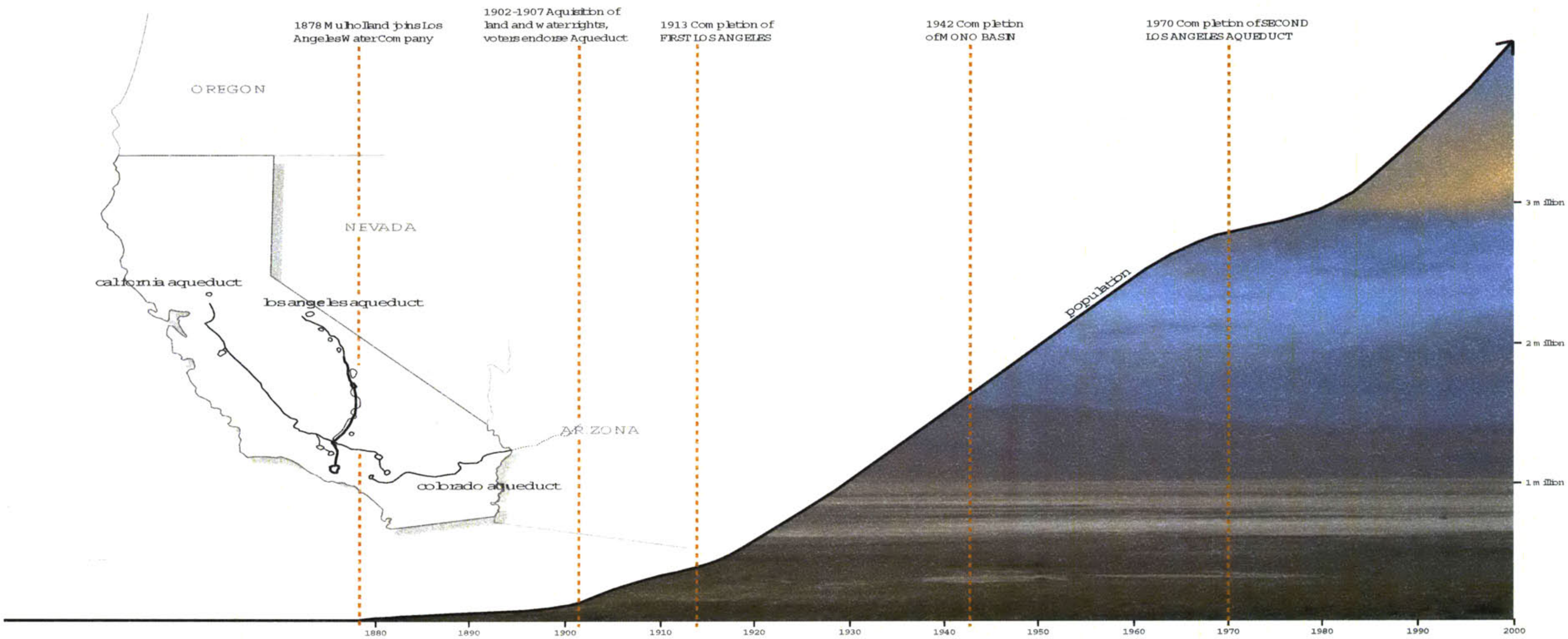
Los Angeles faces rapid, continuous growth in the new century. Already, the estimated population of the city's five-county area – 16.2 million – is the second in the United States only to the New York City region. During the past century, the population of the Los Angeles area grew by an average of two million people per decade, or over 500 people every day for the past 100 years. Even as today's vital infrastructure appears to be pushed beyond capacity, the greater metropolis will receive an additional two million people by 2005.

No problem for the future holds so great a potential for changing the quality of life in California as the current controversies over water and its supportive infrastructure. In the landscape that is Southern California, the possibility of a future water shortage is nothing less than an obsession. Water is so important to the southland that the history of Southern California is the record of its eternal quest for water, and more water, and still more water. The infamous five words, "there it is, take it," voiced by William Mulholland, who presided over the creation of the Los Angeles Owens River Aqueduct System, changed Southern California's history forever. It has shaped the patterns of settlement within California and laid the basis for the modern prosperity of the nation's richest and most populous state. Of all the major cities of the world, Los Angeles has one of the most complex systems to collect and distribute water to its citizens. The water is transported over long distances, and is distributed over a larger, more varying geographical area than any other major city in the United States.

The Los Angeles Department of Water and Power (DWP), established at the beginning of the twentieth century, is currently the largest municipally-owned utility in the nation. DWP developed and continues to operate the Los Angeles water works system as well as manage the 307,000 acres of land purchased by the city of Los Angeles in 1905. These lands are used for recreation and grazing purposes in a manner compatible with the protection of the city's water supply. In describing the many features of historical and scenic interest on the Eastern slopes of the Sierra Nevada and the Los Angeles Owens River Aqueduct System, it is the DWP's goal to create an understanding of what is involved in bringing an adequate supply of water to Los Angeles, in order that the citizens of Los Angeles are more aware of the importance to conserve and use water wisely. However, the DWP has to compete with the unfortunate necessities required by urbanization.

Straightened into concrete, bounded by railroad tracks and concealed by barbed wire and "no trespassing" signs, the Los Angeles aqueduct system is alienated from the public. Sprawl's tract housing, gridded infrastructure and super-sized malls slowly engulf what was once considered natural, the lights of the city obscure starry nights and automobiles and airplanes allow people to traverse the landscape without ever feeling its presence. The lack of a landscape presence in the city, inability to escape the downfalls of urbanization along with the minimal opportunities for the public to interface the Los Angeles Owens River Aqueduct System limit the achievability of genuinely making citizens aware of the role the infrastructure plays in providing the most critical resource, water.

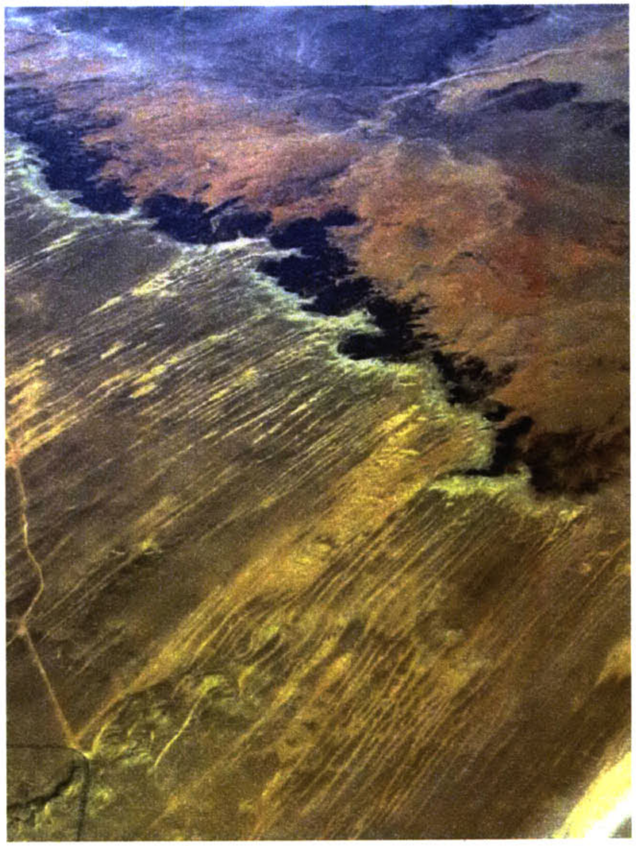
Provided above is the basis for the thesis and following is the process of investigation and discovery.

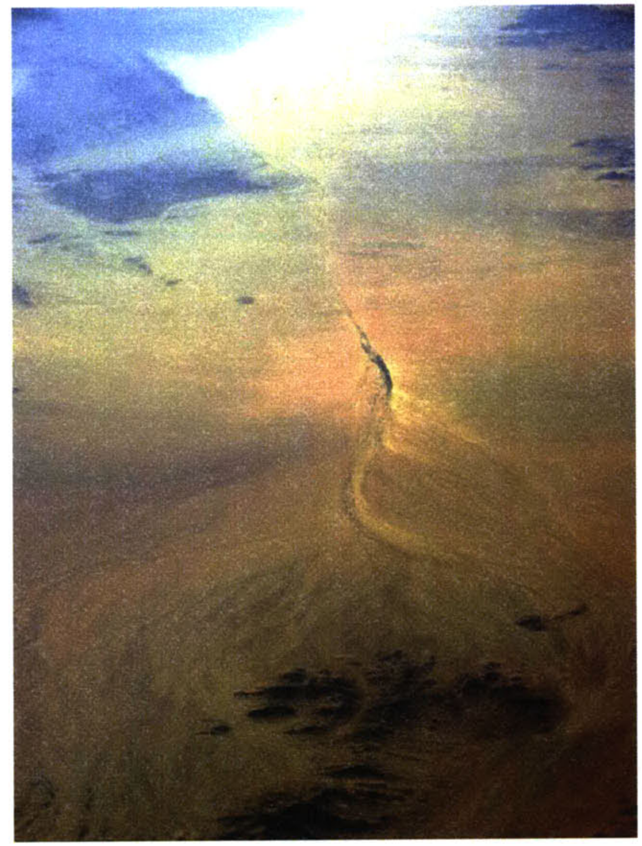


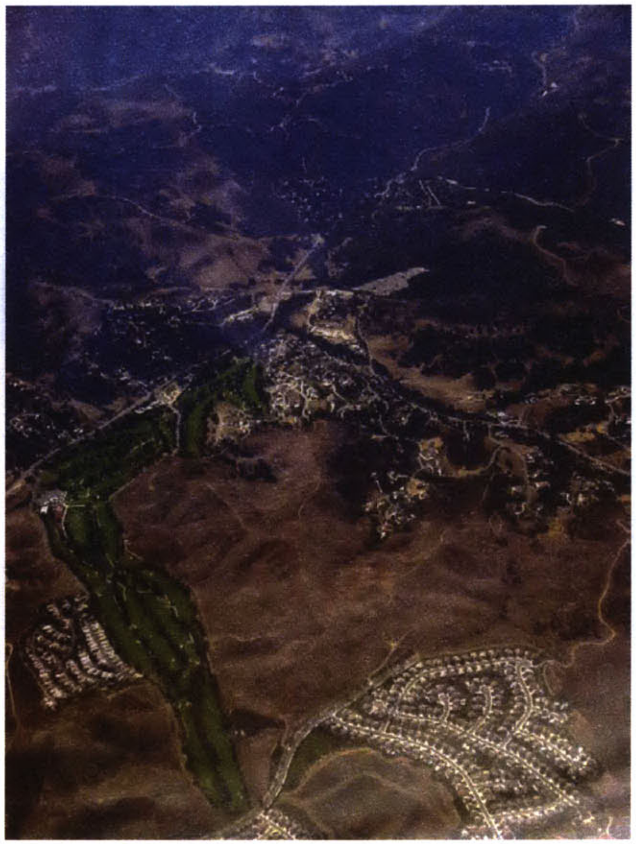
Graphic chart describing the growth of population in relationship to the major points in time in which development of water resources occurred.

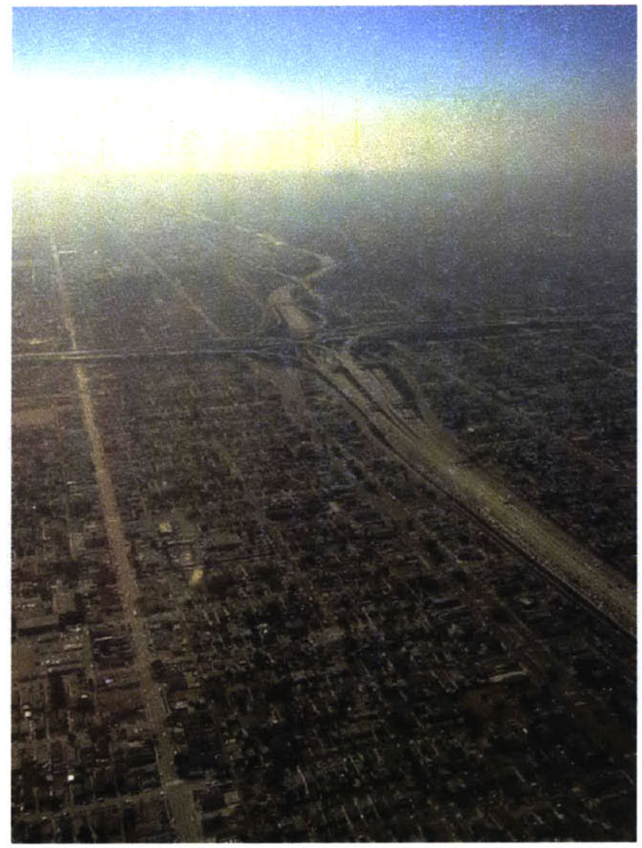
S T A R T I N G   P O I N T S

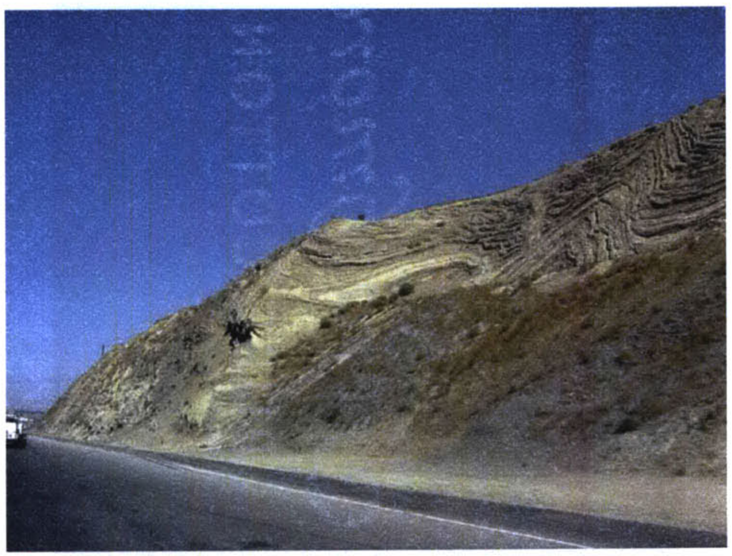
Following is a series of photographs taken during my pilgrimage west to see the Los Angeles Aqueduct. These images represent the way I experienced the dynamic landscape of California related to the aqueduct and specifically water. Beginning with images taken from the airplane during my descend into L.A. and ending with those images from my road trip north through Owens Valley to the head of the aqueduct.

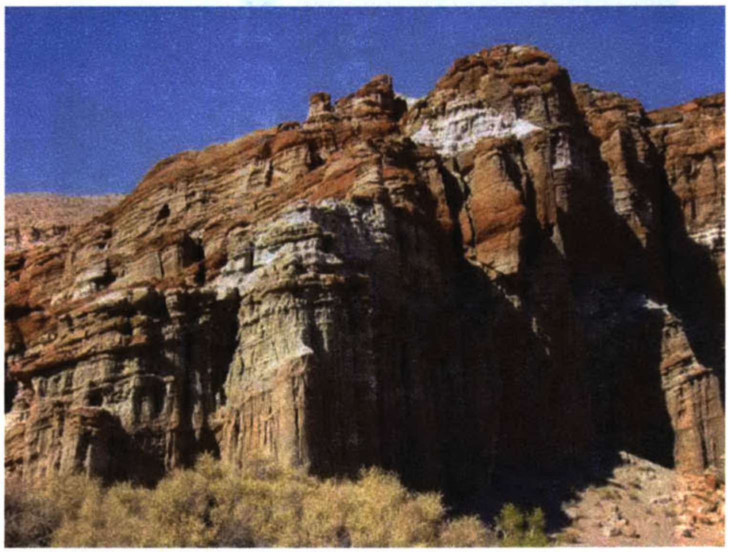


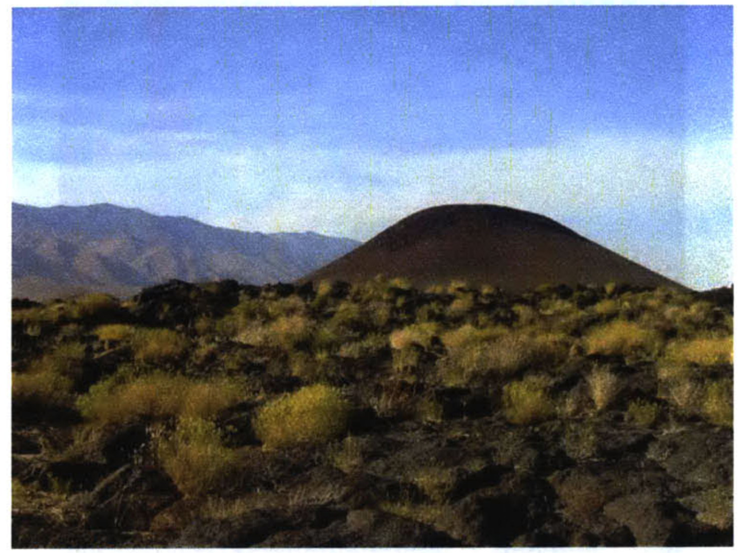


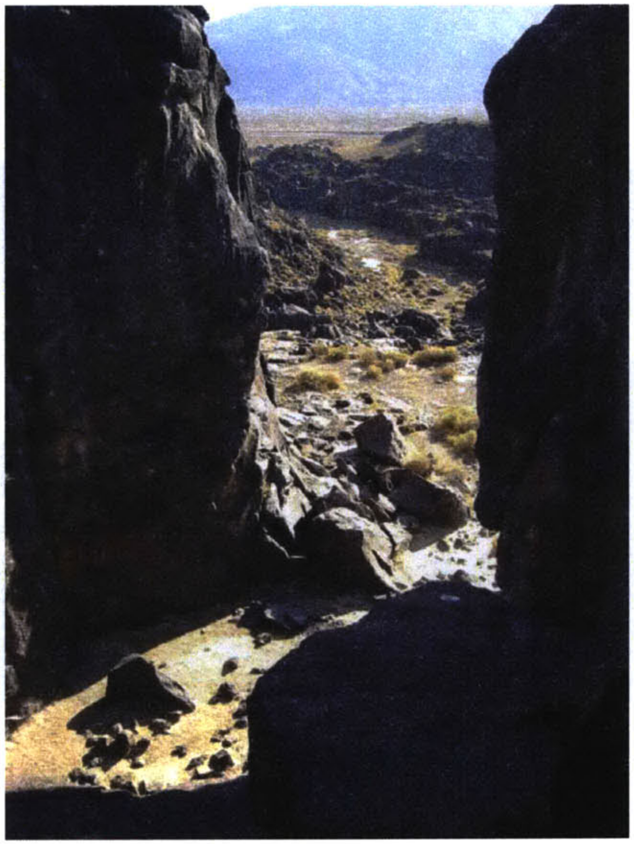


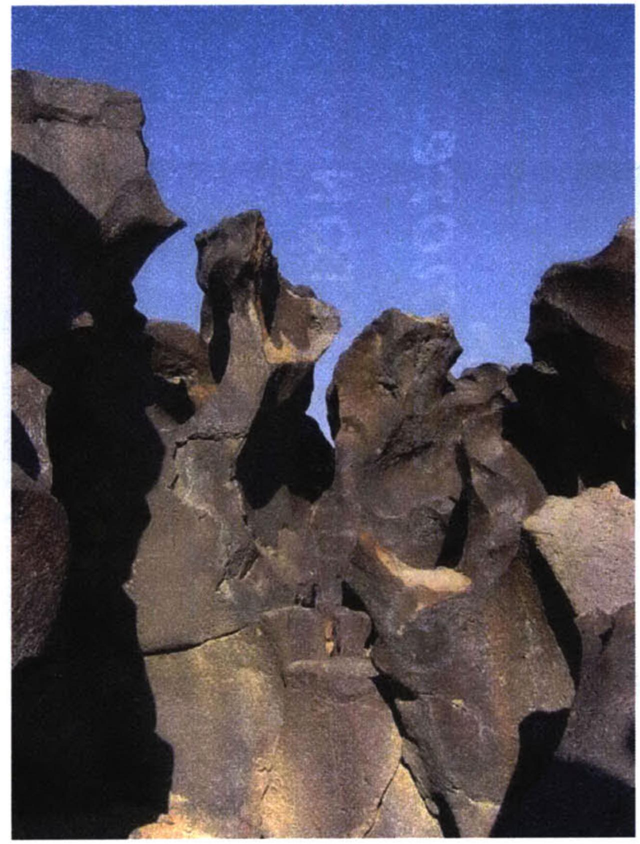


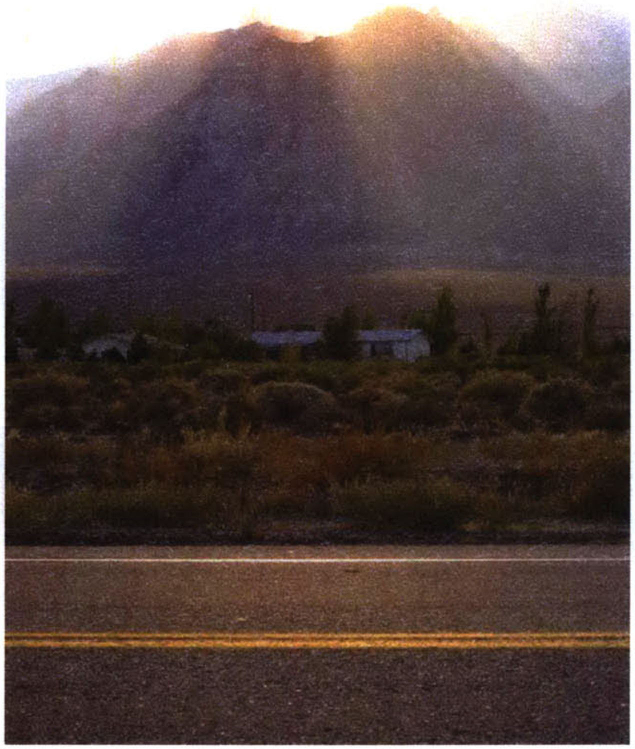


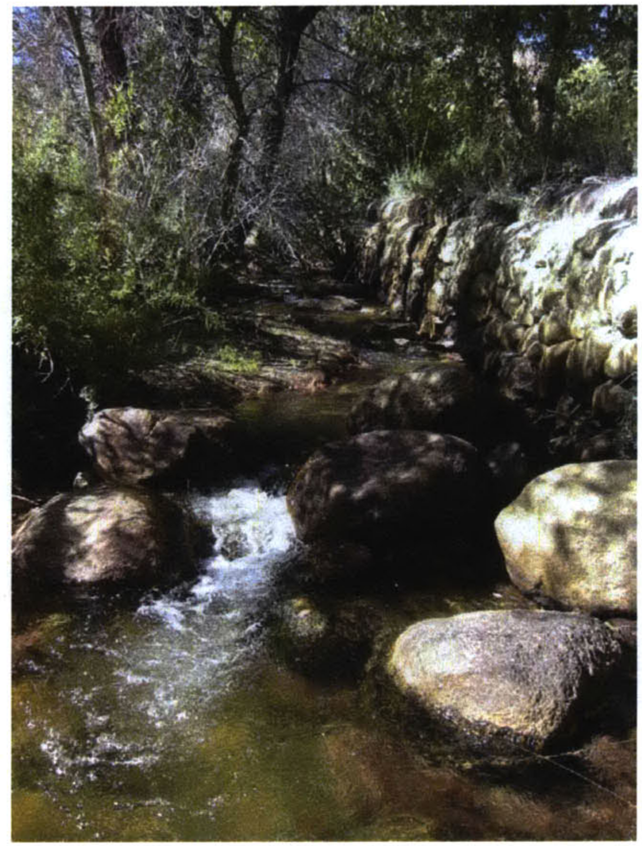


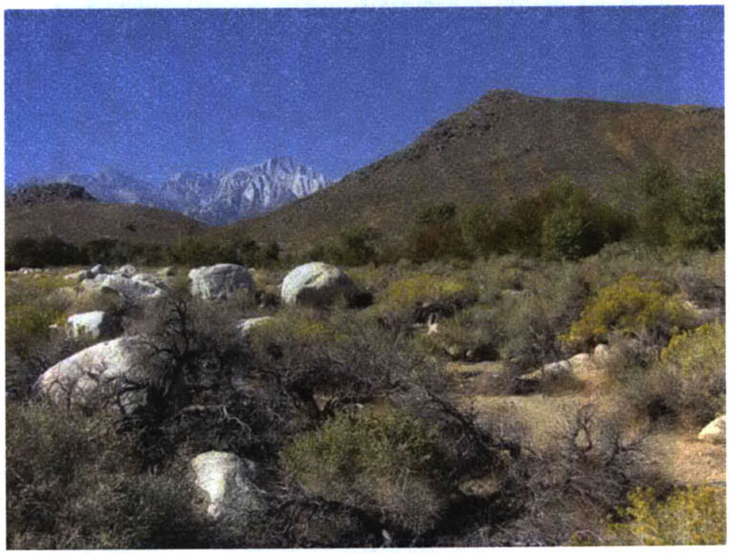


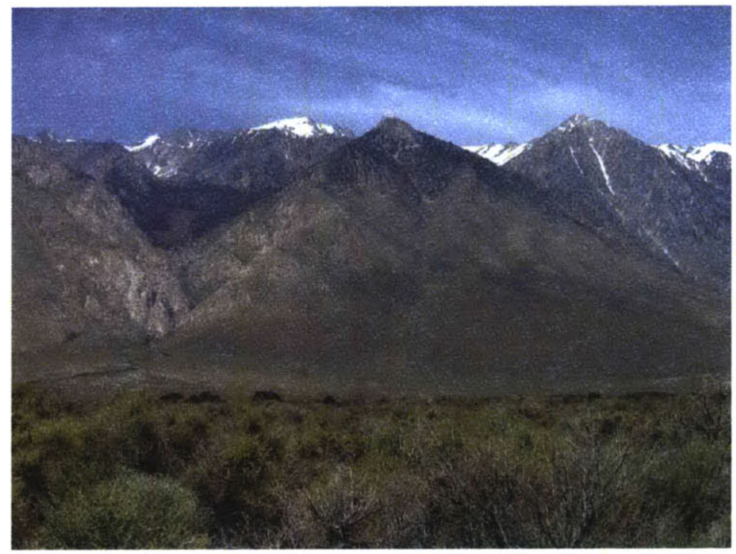












In 1913 the City of Los Angeles completed construction of the first Los Angeles Aqueduct. This is the story of how the dream of a few far-sighted people at the turn of the 20th Century became a reality as the Los Angeles Aqueduct was conceived and built.

Construction of the LAA open concrete-lined channel east of the Alabama Hills. *Photo from LADWP archives.*

H I S T O R Y :
Story of the Los Angeles Aqueduct

Downtown Los Angeles in the early 1900's. *Photo from http://web.ladwp.com.*

CITY OWNS ITS WATER

In 1902, the City of Los Angeles purchased the Los Angeles City Water Company for $2 million, protecting the City's lifeline in the face of tremendous growth. With a population of more than 100,000, the City had doubled more than four times in 30 years.

At the time though, the Board of Water Commissioners was unaware that it had also set in motion the means for Los Angeles' future. As part of the purchase of the Los Angeles City Water Company, the Commissioners had become the employers of its superintendent, William Mulholland. The City would turn to Mulholland again and again to solve the problems created by a burgeoning population in a semi-arid region.

The preconditions for Los Angeles' progression were there from the beginning. When Gaspar de Portola discovered and named the Rio Porciuncula on his mission of exploration from San Diego to Monterey in 1769, he recognized the site as ideal for settlement because of the ample water supply in the river.

The 11 families who founded El Pueblo de Nuestra Senora La Reina de Los Angeles constructed the city's first water system, a brush "toma" or dam across the river. This dam diverted water to the Zanja Madre, or mother ditch, which fed irrigation canals in their adjacent fields. Ownership of the water in the river was granted in perpetuity to the Pueblo at its founding by King Carlos III of Spain. When the City of Los Angeles incorporated 69 years later, the population of 1,610 was vested with all of the rights of the Pueblo, including these rights to the water of the Los Angeles River.

By 1854 this primitive water system was large enough to become a city department. The first person in charge was given the title "zanjero" or water overseer. One year later, William Mulholland, the man who would shape the future of Los Angeles through its water system, was born in Belfast, Ireland. When Mulholland came to work for the Los Angeles City Water Company in 1878, the system had been leased to a private company. He was a ditch tender, a zanjero himself, though the system had progressed from ditches and hollowed logs to include a domestic service system with reservoirs and water mains. The zanjas served the city for 35 more years, carrying water to water wheels which lifted the water for gravity flow to homes and fields.

At 31, William Mulholland became superintendent of the company. The system he oversaw included 300 miles of mains, six major reservoirs, infiltration galleries, and pumping plants. Three years later, in 1889, the company installed its first water meter at Mulholland's instigation.

A NEW SUPPLY

William Mulholland, an immigrant from Ireland, went to work for the Los Angeles City Water Company as a ditch tender. When he became superintendent of the water company at the age of 31, Mulholland began to search for a new water supply. For 16 years Mulholland had watched the effect of Los Angeles' growth. The city, flourishing in a semi-desert environment, had already prompted initial concerns about conservation.

In the 1902 Annual Report he stated, "with a closely estimated population of 85,000...we reached the astounding consumption of over 26 million gallons per day, or about 306 gallons per capita...By the application of a few hundred meters the consumption was cut down nearly three million gallons per day." Metering led to reduced consumption, but growth itself proved to be the pivotal issue. Mulholland began to feel the pressures of growth as head of the new Bureau of Water Works and Supply.

Mulholland's constant reflections on the City's needs were divided between conservation and additional supply. In 1902, he estimated that water metering could reduce per capita consumption to 150 gallons per day. By 1903, per capita consumption was actually reduced to 200 gallons per day from the previous high of 306. In the same period, however, Los Angeles had grown to a population of 175,000.

Mulholland's concerns about the inadequacy of Los Angeles' supply

William Mulholland. *Photo from http://web.ladwp.com.*

were realized during ten days in July 1904. For two years the Los Angeles River had been about 30% below normal. Water demands created by the city's breakneck growth overtook the river's supply and for those ten days the daily consumption exceeded inflow into the reservoirs by nearly four million gallons.

Mulholland began efforts to determine what the City's actual needs would be. He used a per capita demand of 150 gallons per day and estimated population growth based on the previous 10 years. He foresaw a city of 390,000 people using more than 58 million gallons per day by 1925. The required volume was more than double the minimum flow of the Los Angeles River. Even the maximum recorded flow would fall ten percent short of meeting the city's needs. Only later would the superintendent learn that the actual growth of Los Angeles during the 20-year period would exceed his estimate by more than four times.

He began to search for a new supply. The local area yielded nothing. In his search for a new source, he surveyed all of the rivers and groundwater basins south of Tehachapi. He found groundwater limited and gradually being depleted by agriculture. Additional groundwater use would limit the development of the surrounding countryside, the source of wealth of the area. Mulholland concluded Los Angeles would have to look elsewhere.

Owens Valley looking east from the Sierra Nevadas.

THE OWENS RIVER VALLEY

"The constant purpose of the government in connection with the Reclamation Service has been to use the water resources of the public lands for the ultimate greatest good of the greatest number."

President Theodore Roosevelt
Annual Message to Congress, 1907

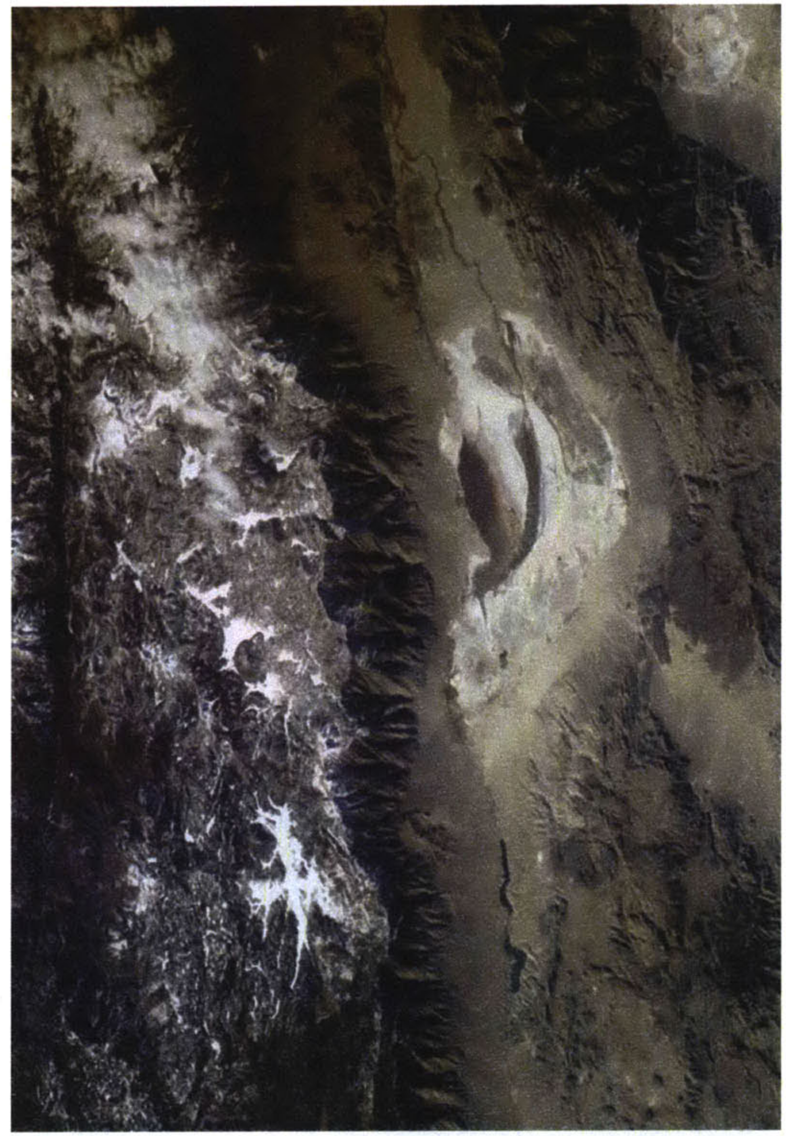
Fred Eaton looked west to the sun setting behind the ragged escarpment of the Eastern Sierra Nevada. It was the summer of 1904. His friend, J.B. Lippincott had invited him, among other guests, on a family camping trip to the Sierras. They had begun in the Yosemite Valley. When they reached Tioga Pass, they had decided to descend to the other side of the mountains to the Mono Lake area. At Mono Lake, a smaller group had decided to go on to Bishop for supplies. Eaton and Lippincott were among them.

Eaton had first come to the valley twelve years earlier in 1892. He had ridden up on horseback to evaluate an irrigation project for a client. His engineer's eye took in the swollen streams of the Sierra snowmelt, bursting their banks in their plunging descent onto the dry plain of the Owens Valley. He also noticed that the lower end of the valley had been blocked by a recent lava flow, but that previous to the eruptions the river had flowed in a channel straight south to the mountains just north of Los Angeles.

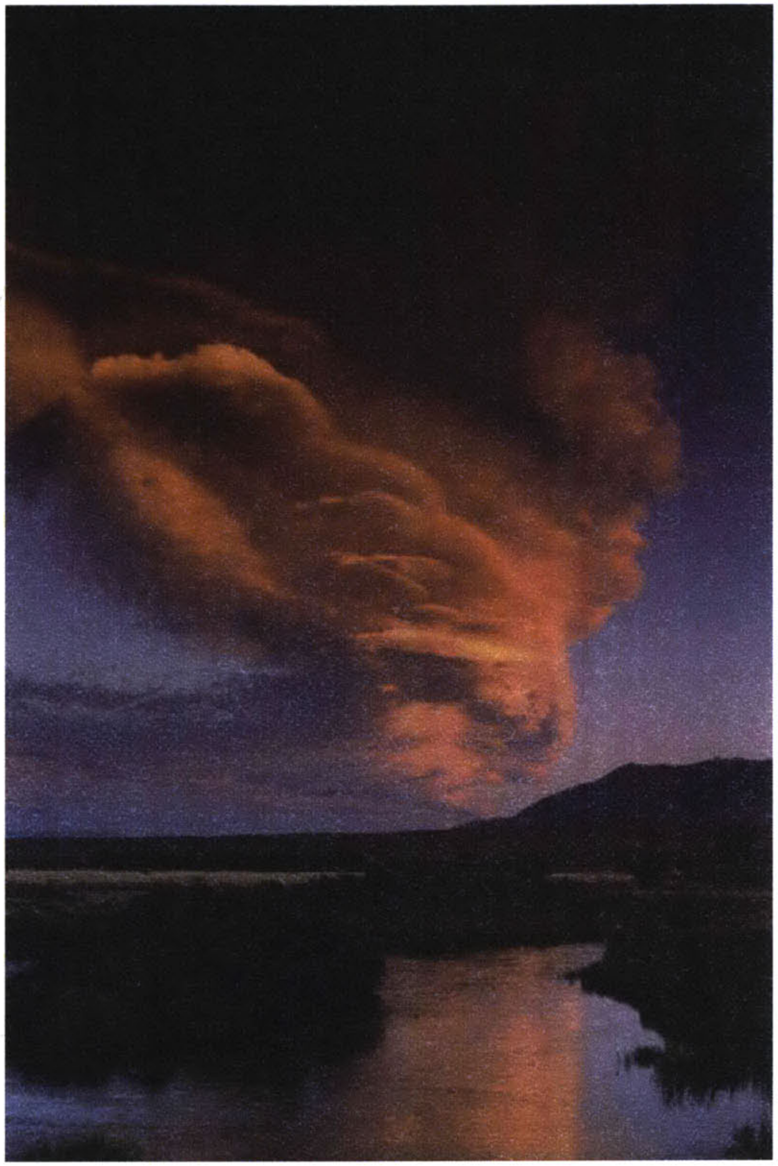
Owens Lake had become a basin from which there was no outlet. Once the water from the Sierras reached the lake Eaton believed it was useless, contaminated by the salt of the enclosed basin. Eaton had begun to plan for this water rather than see it wasted, and now, in 1904 he was on the verge of acting on his plans.

Joseph Barlow Lippincott was also an engineer. The two men shared similar backgrounds and specialties. Eaton's public works experience had led him to become involved with irrigation projects while Lippincott's work as a topographer and hydrographer had led him to the Reclamation Service. Eaton's public service began with his election as City Engineer in 1886, while Lippincott had joined the United States Geological Survey in 1889. Both men were civic minded. Eaton had been mayor of Los Angeles in 1898 when the lease of the Los Angeles City Water Company had expired. He had promoted the purchase of the system by the City, and Lippincott had been a volunteer in the bond drive that had financed the purchase.

The members of the camping party who went to Bishop for supplies encountered many residents of the Owens Valley along the way. Traveling through the valley they discussed the area's potential for a reclamation project, including places of interest such as the reservoir site at Long Valley. To all observers, it was a group of friends on an outing, but Eaton's plans for the water would launch a long conflict.



Owens Valley with the Sierra Nevada escarpment running vertaically through the image.
Photo from http://www.nasa.gov.



Looking south as the Owens River carves through the valley. *Photo by Galen Rowell.*

THE ONLY SOURCE

Upon his return to Los Angeles, Eaton began to act quickly. Aware that Mulholland was searching for a new source of supply for Los Angeles, Eaton persuaded Mulholland to return to the valley with him.

Eaton was confident. He was sure the Owens River was the source Los Angeles needed for the future. Draining the eastern slope of the great mountains for more than 150 miles, the river followed a natural course south toward Los Angeles. Below the small lava flow at the southern end of the basin, Eaton pointed out the old river course, left over from the last ice age. Mulholland saw that the course of the old river was a direct route to the mountains north of Los Angeles and that these mountains were the last barrier to delivering a new supply to the thirsty city.

Eaton's proposal to Mulholland was a joint venture. Eaton would undertake to purchase the land and water rights and the City of Los Angeles would build the aqueduct. Once constructed, the aqueduct would supply the city with the water it required, but surplus water would also be exported from the valley. Eaton proposed that he export this water, paying the City a toll for its transportation, and selling it for irrigation purposes at the other end.

Mulholland agreed with Eaton, the project was viable. He strongly disagreed, however, about the joint venture. However, Mulholland began to plot an alignment, devising a system of aqueducts and reservoirs to transport the water entirely by gravity flow.

Mulholland, like Eaton, knew that the U.S. Reclamation Service was evaluating the potential for a reclamation project in the Owens Valley. Mulholland realized that lands withdrawn from settlement for this purpose by the federal government could never be used for a venture that was not 100% public.

Eaton remained unconvinced. In the 1800s and early 1900s, the American entrepreneur was a hero. Men of great vision pursued great ventures, transcontinental railways, canals, and steamship lines among them. Eaton clung to his ambitions for the project, but by November 1904 Mulholland had convinced him that there could be no joint venture.

Mulholland contacted Lippincott. He requested that Lippincott provide him with a copy of the Reclamation Service report so that he could evaluate stream flows and the potential of the Owens River as a source of water. Lippincott deferred to Newell in this matter. Newell gave the report to Mulholland as a courtesy, but it only served to confirm Mulholland's conviction that the Owens River was the only viable option for Los Angeles.

DRIVNG THE LAST SPIKE

"The last spike is driven...the options are secured."
William Mulholland
July 29, 1905

In March 1905, Fred Eaton went to the Owens Valley to buy land options and water rights. The major acquisition of this trip was the Long Valley Reservoir site. Eaton paid $450,000 for a two month option on ranch lands and 4,000 head of cattle. All in all, he acquired the rights to more than 50 miles of riparian land, basically all parcels of any importance not controlled by the Reclamation Service.

On March 22nd, Mulholland reported to the Board of Water Commissioners. He had surveyed all the water sources available in Southern California and he recommended the Owens River as the only viable source. Immediately following Mulholland's presentation, Fred Eaton made his proposal that the City acquire from him whatever water rights and options he had been able to secure to further the project.

While in the valley, Eaton had conducted some business for Lippincott as well. The bulk of Lippincott's staff had been diverted to the lower Colorado River. The floodwaters of the Colorado River had broken through temporary irrigation barriers and had carved a new channel southeast to the Salton Sink.

Looking north into Owens Valley from the Alabama Hills.

Lippincott knew Eaton was headed to the Owens Valley. Several power applications were pending for projects on the Owens River. Lippincott required information about who the owners were, the use to which the power would be put, and the potential of these projects to interfere with the Reclamation Service's activities. Lippincott asked Eaton to do this work.

This trip became the source of conflict between the Owens Valley and the City of Los Angeles.

Eaton visited the Independence Land Office to do Lippincott's research. There he met Stafford Wallace Austin, the Land Register. The impression Eaton left was that he was there to do work for the Reclamation Service, and his subsequent land acquisition activities were interpreted in that light. Whether deliberate or not, this impression caused anger among residents of the area, most notably Austin, when they discovered that Eaton was not acting on behalf of the Reclamation Service. To the people of the Owens Valley, selling water rights and land for a desired federal project was far different from selling land to Eaton and water rights to the City of Los Angeles.

Austin embodied the people's feelings of betrayal and anger. They were afraid that the Reclamation Service intended to abandon them, serving the interests of the City of Los Angeles instead. Austin wrote to the Commissioner of the U.S. General Land Office and to President Theodore Roosevelt to protest.

Meanwhile a serious decision faced the Reclamation Service. It was required to make a recommendation to the Secretary of the Interior regarding the feasibility of a project in the Owens Valley. The Board of Engineers who were to make that recommendation met on July 27, 1905. From an engineering standpoint, the project was viable. One of the commissioners had previously met with Austin and made sure discussions about the project gave serious consideration to his protest. However, the economic feasibility of the project was in question. The Board saw Los Angeles' ownership of the Long Valley Reservoir site and 50 miles along the river as a great impediment to proceeding with a Reclamation Service project. The Secretary of the Interior, the cabinet member responsible for the

Reclamation Service, made no decision until much later.

Mulholland returned from a car trip to the Owens Valley not two days after the Board of Engineers had met. His statement, "The last spike is driven...the options are secure." Was the City's verdict on the project. It seemed irrelevant that the Reclamation Service had made no decision when on July 29, 1905 the Los Angeles Times headlines bannered "Titanic Project to Give City a River."

ACQUIRING FUNDS

Austin's protest to Theodore Roosevelt in August prompted the appointment of a special investigator to examine the role of the Reclamation Service, and specifically Lippincott. The special investigator found fault with both Lippincott and the City. He blamed the City for not at once presenting their claims to the Secretary of the Interior so that the situation might have been determined on its merits in the beginning. Lippincott's failure was his inability to recognize his primary obligation to the Reclamation Service. Lippincott's defense echoed the sentiments of his president, "I firmly believe that I have acted for the greatest benefit of the greatest number, and for the best building up of this section of the country." Lippincott was absolved of any blame that he assisted Eaton in securing options; however, the investigator's evaluation of Lippincott's behavior ranged from "peculiarly unfortunate (the camping trip to the Sierras)" to "Ill advised...improper...farcical (Eaton's research for Lippincott)."

Mulholland's preliminary estimate for the cost of the project, including water rights and land, was $25 million. Upon his recommendation, the Board of Water Commissioners chose to undertake the project, using its own resources to purchase Fred Eaton's options. In order to finance the project though, they needed community support. They began by enlisting the help of the community's leaders. Among the first people the Board took into their confidence were the President of the Chamber of Commerce, J.O. Koepfli, and Los Angeles Times publisher, Harrison Gray Otis. Through publicity generated both by the Times' editorial position

J.B. Lippincott, Fred Eaton and William Mulholland.
Photograph appeared in the Los Angeles Times, August 6, 1906.

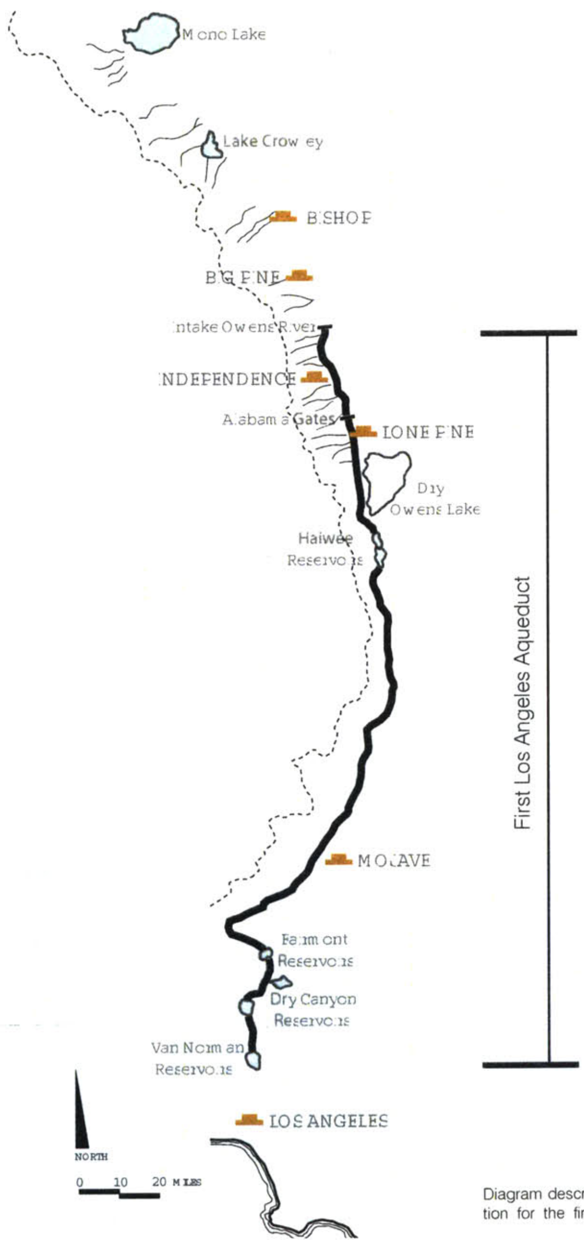


Diagram describing the plan of construction for the first Los Angeles Aqueduct completed in 1913.

and investigations conducted by the Chamber of Commerce, the community rallied to support the initial bond issue to purchase land and begin preliminary construction. The $1.5 million bond issue was approved by more than 10 to 1.

The City hired a prestigious team of engineers to examine the feasibility of the project. Their report states, "We find the project admirable in conception and outline and full of promise for the continued prosperity of Los Angeles." The Board of Water Commissioners appointed William Mulholland, Chief Engineer, Bureau of the Los Angeles Aqueduct. That same year, 1906, the final verdict on the Los Angeles Aqueduct was rendered by the highest authority.

On May 13th, the City submitted an application for rights of way across federal lands for the purpose of constructing the aqueduct. In June, California Senator Frank Flint proposed a bill to grant these rights of way. It easily passed the Senate but ran into trouble in the House of Representatives where Congressman Sylvester Smith of Inyo County had organized an opposition to the bill. His argument was that Los Angeles did not require the water now, but was seeking to acquire it for future needs.

The City planned to include power plants in the project. These power plants would require a constant flow of water. This water would be transmitted by the City but was not required for domestic use. The City's plan was to sell the water for irrigation. Smith argued that irrigation in Southern California should not take place at the expense of irrigation in the Owens Valley. While Smith negotiated a "no irrigation" compromise, Flint went directly to a higher authority.

His appeal to Theodore Roosevelt met with a sympathetic hearing. Roosevelt, on June 25th, called a meeting of Flint, Secretary of the Interior Ethan A. Hitchcock, Bureau of Forests Commissioner Gifford Pinchot, and Director of the Geological Survey Charles D. Walcott. At the end of that meeting Roosevelt dictated the letter which would end the debate,"...yet it is a hundred or a thousand fold more important to the state and more valuable to the people as a whole if used by the city than if used by the people of the Owens Valley."

In 1907, the voters of Los Angeles again gave their overwhelming endorsement to this project, approving a $23 million bond issue for aqueduct construction. The only task that remained was to build it.

CONSTRUCTION BEGINS

The word spread that there were heavy construction jobs near Los Angeles. An itinerant army of "bindle stiffs", named for the bundles of bedding they carried on their backs, descended on the Mojave and spread out to the work camps up the line. It was fall, 1908.

Drawn by the promise of a long, good paying job, they were a tough, hard-drinking mix of nationalities: Greeks, Bulgarians, Serbs, Montenegrins, Swiss, and Mexicans. They worked hard, many of them saving their wages against their eventual return to their homelands. In one situation, the loyalty of these men to their homelands actually caused a labor shortage in the 1912 aqueduct work force. When war began to seem imminent in the Balkan states, some 1500 Serbs, Bulgarians, and Montenegrins left Mulholland's ditch and their $2.25 per day jobs to return home to fight.

The work was hard and the conditions were rugged, but the men were provided with shelter, food, and medical care. Before compensation benefits were a condition of employment, the Bureau of the Los Angeles Aqueduct instituted a medical care plan for its workers at a fee of one dollar per month for those making $40 per month and fifty cents for those making less. Benefits included medical, hospital and surgical service when needed, except for venereal disease, intemperance, vicious habits, injuries received in fights, or chronic diseases acquired before employment.

Dr. Raymond C. Taylor, the aqueduct's medical director, described life on the line. "In the winter, it was just as windy and bitter cold as it was hot in the summer. However, we had practically no heat prostration, although I think I have seen in places in some of the big ditches in the lower Owens Valley that were 15 feet deep and 30 feet across the top, where the temperature in the bottom of the ditch

The earth was excavated with a dipper dredge then discharged away from the channel. *Photo from the LADWP archives.*

The box-shaped concrete form, called a conduit, continued down to Los Angeles interspersed with tunnels and siphons. *Photo from the LADWP archives.*

Formwork being installed for the open concrete-lined channel. *Photo from the LADWP archives.*

Placing concrete in the open channel. *Photo from the LADWP archives.*

must have been close to 130 degrees."

Accident and death figures for the project differ slightly from one account to another. However, the most authoritative summary appears in the Complete Report of 1916. The total number of accidents resulting in death were 43, and miscellaneous accidents of a trivial nature, 1,282.

When Dr. Taylor met his counterpart for the New York Aqueduct, under construction at the same time, the two compared notes. Taylor said he lost about ten men per year to fatalities. The New York doctor said he lost one man per week.

DEDICATION CEREMONIES

A carnival atmosphere prevailed for the dedication ceremonies at the "Cascades" on November 5, 1913. The San Fernando Valley Chamber of Commerce distributed bottles of Owens River water to the 30,000 celebrants who arrived by car, wagon, and buggy. The Southern Pacific charged $1 for a round trip ticket from Los Angeles to the site of the San Fernando Reservoir near Newhall. Pennants proclaiming the event sold for 10 cents.

Mulholland rose to begin the ceremonies. He thanked his assistants and the City of Los Angeles for their loyal support. His address to the crowd was brief, "This rude platform is an altar, and on it we are here consecrating this water supply and dedicating the Aqueduct to you and your children and your children's children-for all time." He paused for a moment as if contemplating his words. Appearing satisfied, he abruptly said, "That's all," and returned to his seat amid a tremendous roar from the crowd.

When the din subsided he was recalled to bring forth the water. The good natured but noisy crowd grew quiet as Mulholland unfurled the American flag from the speaker's stand flagstaff. This was the signal to General Adna R. Chaffee, President of the Board of Public Works during the Aqueduct period, to perform the honored task of opening the gate valves.

At Chaffee's command five men atop the concrete gatehouse put their weight to the great wheels that would lift the gates and release the water into the canal. With the first trickle the crowd broke and ran to the canal. Hundreds of cups were dipped to the sparkling water. Horses reared in fright as the crowds cheered and horns blared. The band played "Yankee Doodle Dandy".

The program had called for Mulholland to formally turn the Aqueduct over to the Mayor, J.J. Rose, who would accept it on behalf of the people. However, all semblance of order had been lost. Mulholland turned to Rose, next to him on the platform, and said, "There it is Mr. Mayor. Take it."

Mulholland had predicted that Los Angeles would have a population of almost 260,000 the day the aqueduct opened. But in 1913 Los Angeles had reached the dizzying figure of 485,000 residents. Within ten years Mulholland and others would be looking for water again.

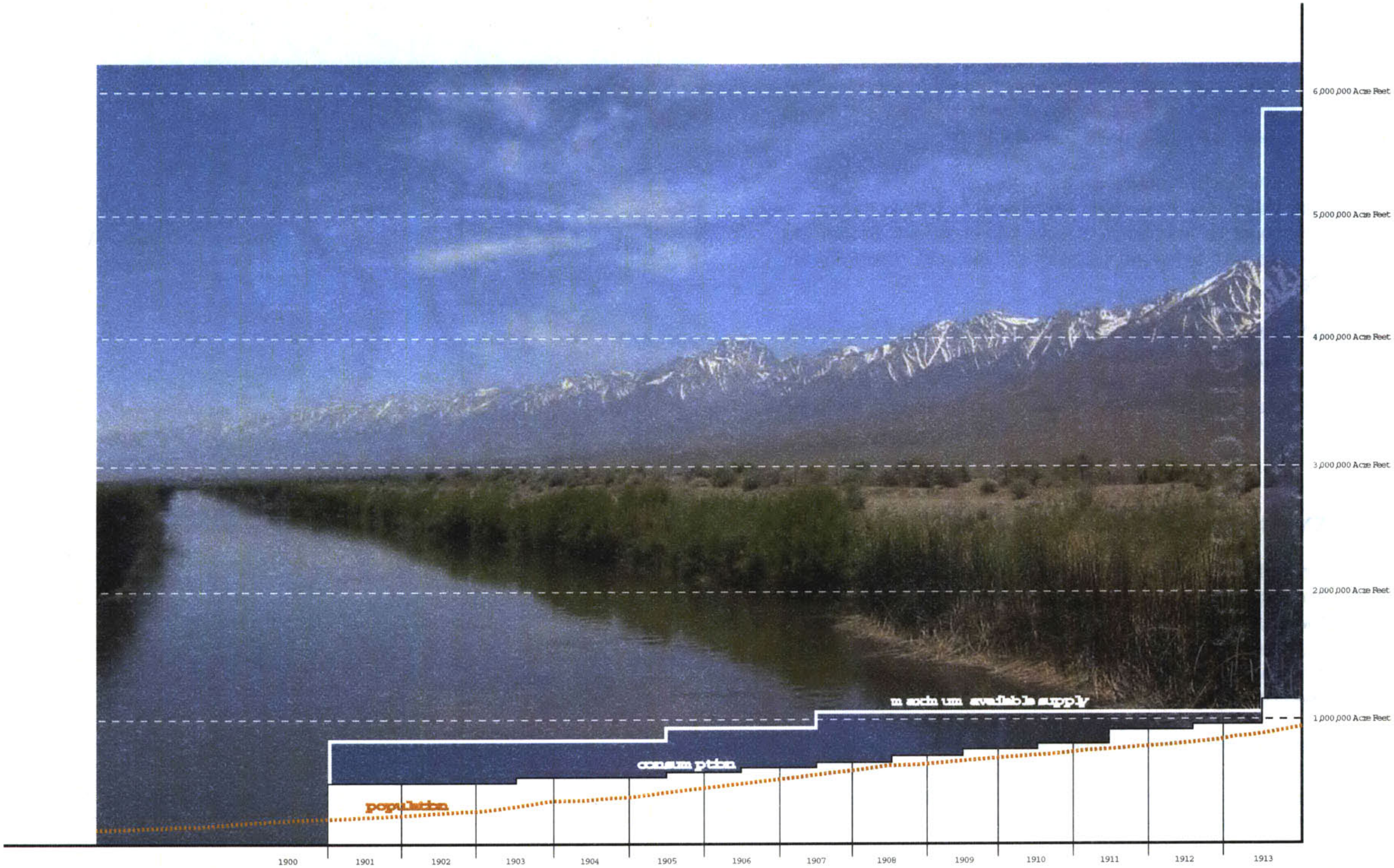
Some 260,000 people gathered at the Cascades for the opening of the first Los Angeles Aqueduct on November 5, 1913. *Photo from the LADWP archives.*

WHOEVER BRINGS WATER BRINGS PEOPLE

By delivering the Owens River water to Los Angeles, Mulholland had made it possible for the city to prosper. Mulholland said, "Whoever brings the water brings the people." But as Los Angeles grew, it was the demand of the people that brought the water. The 1920s brought unprecedented growth, and homes and businesses spread across the Los Angeles basin.

There were several years of lower than normal snowfall in the Eastern Sierra. Local water use on privately owned land in the Owens Valley was increasing. By the spring of 1923 both the City and the Owens Valley were facing water shortages.

Mulholland turned east to the Colorado River as a new source of water. He began a four-year series of surveys in 1923 to find an alignment that would bring the water of the Colorado River to Los Angeles. In 1925 the Department of Water and Power (DWP) was established and the voters of Los Angeles approved a $2 million



Graphic chart describing the growth of population in relationship to the supply and demand of water per year. Note the dramatic increase of supply upon completing the LAA allowing for tremendous growth in L.A.

bond issue to perform the engineering for the Colorado River Aqueduct. The DWP brought the cities of the region together with Los Angeles in 1928 to form a state special district. An act of the State Legislature created the Metropolitan Water District of Southern California (MWD). Its original purpose was to construct the Colorado River Aqueduct to supply supplemental water to Southern California. In 1931, voters approved a $220 million bond issue for construction, and work began on the ten-year project that would bring the water 300 miles to the coast.

Part of the success of the project was the spectacular Boulder Canyon project, now known as Hoover Dam. The DWP, manager of its own hydroelectric power facilities along the Los Angeles Aqueduct, was instrumental in the struggle to gain federal approval for the project which combined flood control, water supply, and energy production for the three states that form the lower Colorado River basin.

As the country emerged from the Great Depression and entered World War II, Los Angeles voters continued to approve financing for water projects. The Mono Basin Project was a construction program to obtain a larger and more dependable flow of water to the Los Angeles Aqueduct. The DWP planned to extend the Los Angeles Aqueduct 105 miles further north, 338 miles from Los Angeles, to take water diverted from the four creeks it had applied for permits for in 1923. By taking water from Parker, Walker, Lee Vining and Rush creeks, the City would obtain a high quality water supply for 500,000 people.

By the time the United States entered World War II, the Mono Basin Project was complete. Los Angeles swiftly became one of the country's most important war production centers. Its heavy manufacturing base continued to diversify, and the population grew with the war effort.

When the war ended, the stage was set for an economic boom with Los Angeles as prime beneficiary. By 1950, Los Angeles had a population of two million people and had become the fourth largest city in the United States.

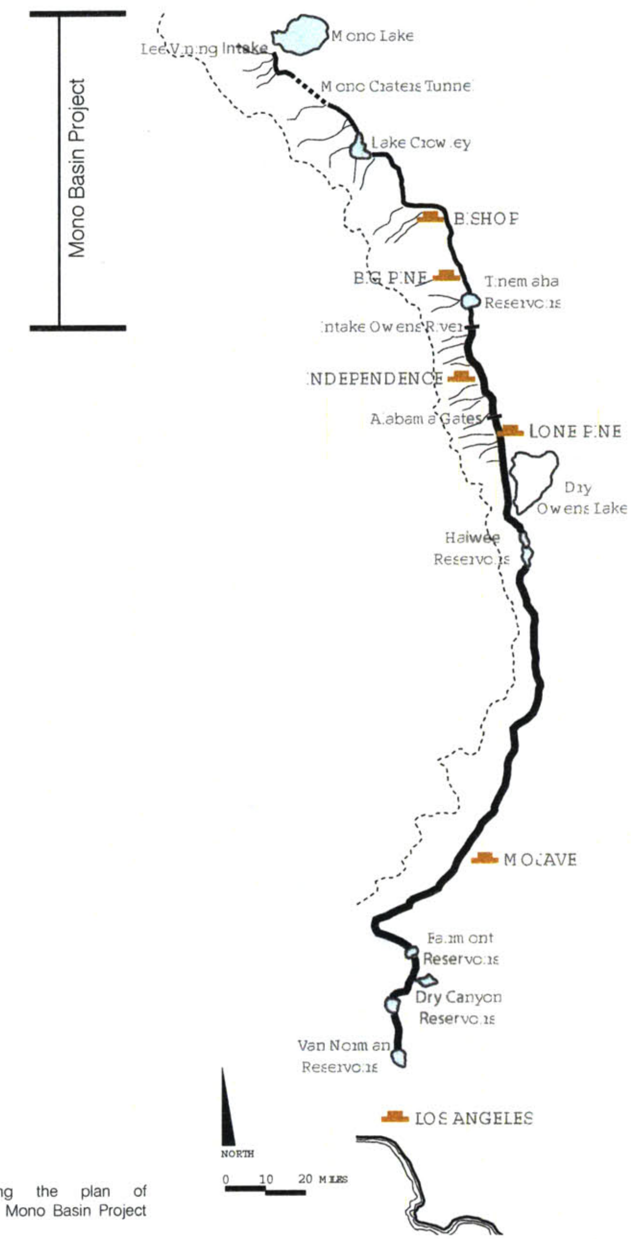


Diagram describing the plan of construction for the Mono Basin Project completed in 1942.

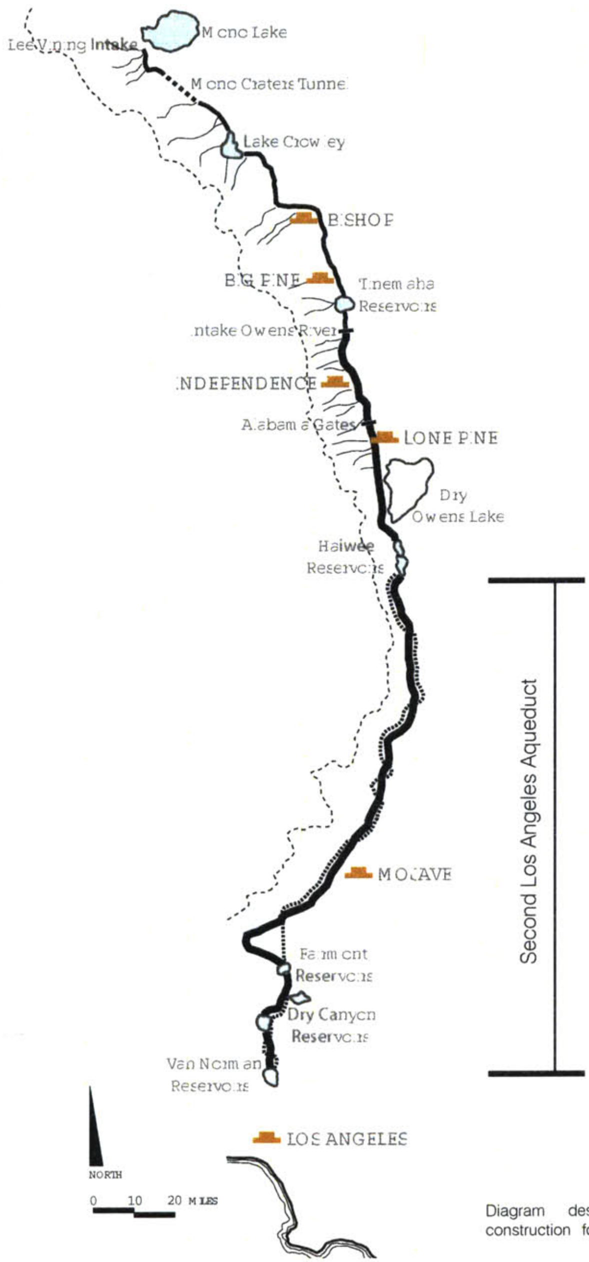
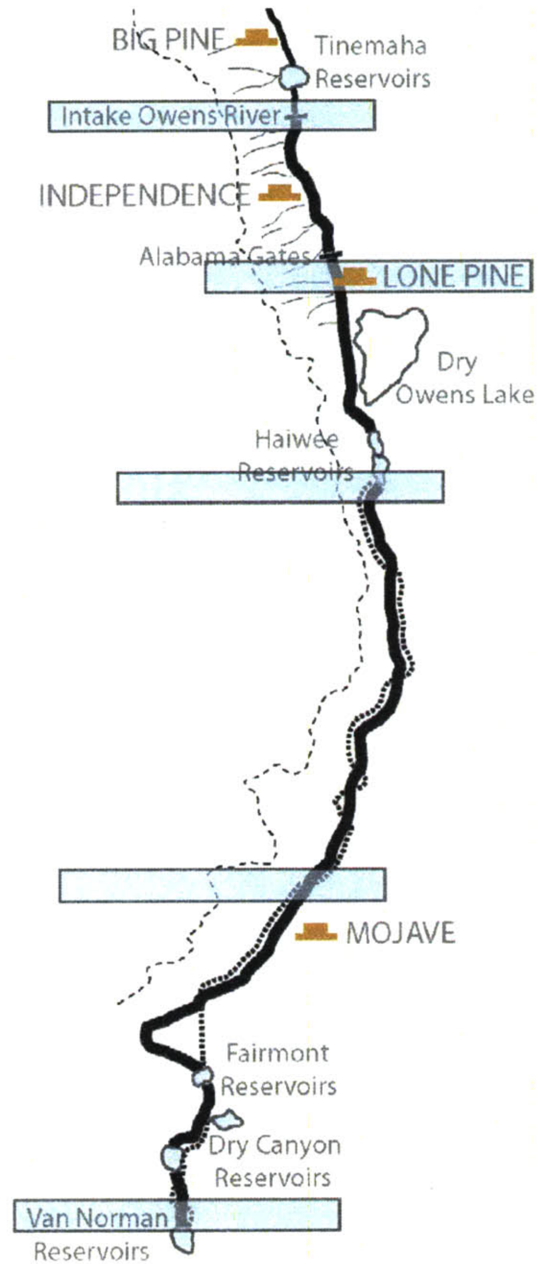


Diagram describing the plan of construction for the Second Aqueduct completed in 1970.

The development of a series of hydroelectric power projects was a natural result of the engineering design of the Los Angeles Aqueduct. The aqueduct had been designed to deliver water to Los Angeles entirely by gravity, requiring no power for the pumping of water along the route. Using this natural gravity flow, engineers designed a series of penstocks that dripped the water to power plants located at the bottom of the Gorge. The force of the water was used to move turbines and create electricity.

During the 1960s there were certain years where the population of California grew as much as 1,500 persons a day. By the end of the decade one in ten persons in the U.S. lived in California. Los Angeles was the premier city in the country's most populous state.

The challenge of water supply continued to press. While the City had taken virtually its full Mono Basin entitlement for several years between 1941 and 1970, therefore the Second Los Angeles Aqueduct, an $89 million dollar facility, was constructed and completed in 1970. Beginning at Haiwee Reservoir, just south of the Owens dry lake bed, this project was shorter and half as wide as Mulholland's "ditch," and was easier to build as a result if improved construction equipment and the lower cost of steel pipe. The new aqueduct added another 50% capacity to the water system. The two Los Angeles Aqueducts now deliver an average of 430 million gallons a day to the city. Under normal circumstances, 70% of the city's water comes from the Eastern Sierra. Wells in the San Fernando Valley and other local groundwater basins supply 15%, and purchases from MWD furnish the last 15%. From a system of ditches and waterwheels in the 1780s, the system has grown to 105 reservoirs, including four major reservoirs along the aqueduct system.



D E S T I N A T I O N S

This thesis attempts to design a didactic pilgrimage of the Los Angeles Aqueduct (LAA), similar to that of the Appalachian Trail, while exploring the dynamic variation in the California landscape in order to gain a better understanding of what is required to transport water to Los Angeles. This pilgrimage follows the LAA with the intent to educate the public by identifying the price of progress related to the natural environment yet responding to the immediate environment in a sensitive way promoting new attitudes of conservation and sustainability. The journey responds to people traveling by land modes of transportation such as automobile, bicycle and on foot.

Currently, the LAA can be encountered primarily by automobile or bicycle in many distinct areas of the California landscape related to transitions in the aqueduct. These locations of engagement are intended to be marked by major intervention in the form of a wilderness base camp or hut in order to address all travelers in a communal way. The base camp will be described in more detail later in this chapter. Each of these camps are reachable by automobile and bicycle but not by foot. Therefore, it is intended that these base camps would be connected over time with a trail like infrastructure for those who travel by foot and are willing to take on the hiking endeavor. However, this thesis only addresses the design of one of these base camps as a case study while tackling issues that would be common to all the base camps.

GENERAL ANALYSIS

During my own discovery of the LAA, I found myself weaving in and out of neighborhoods to capture glimpses of the aqueduct. This proved to be quite difficult which led me to take a step back and review the overall aqueduct. I determined it would be most important if one could travel the length of the aqueduct engaging it at strategic points that began to clearly describe the various conditions of the aqueduct. Determining the locations for the venues or mediators in the landscape to allow the passersby to engage the aqueduct is the basis of this analysis.

It was determined by countless hours of driving in the not so off-road rental car that the following locations were appropriate for the siting of base camps along the first Los Angeles Aqueduct. This is based on ease of finding the location, being situated in an extreme landscape environment and occurring at a unique feature of the aqueduct.

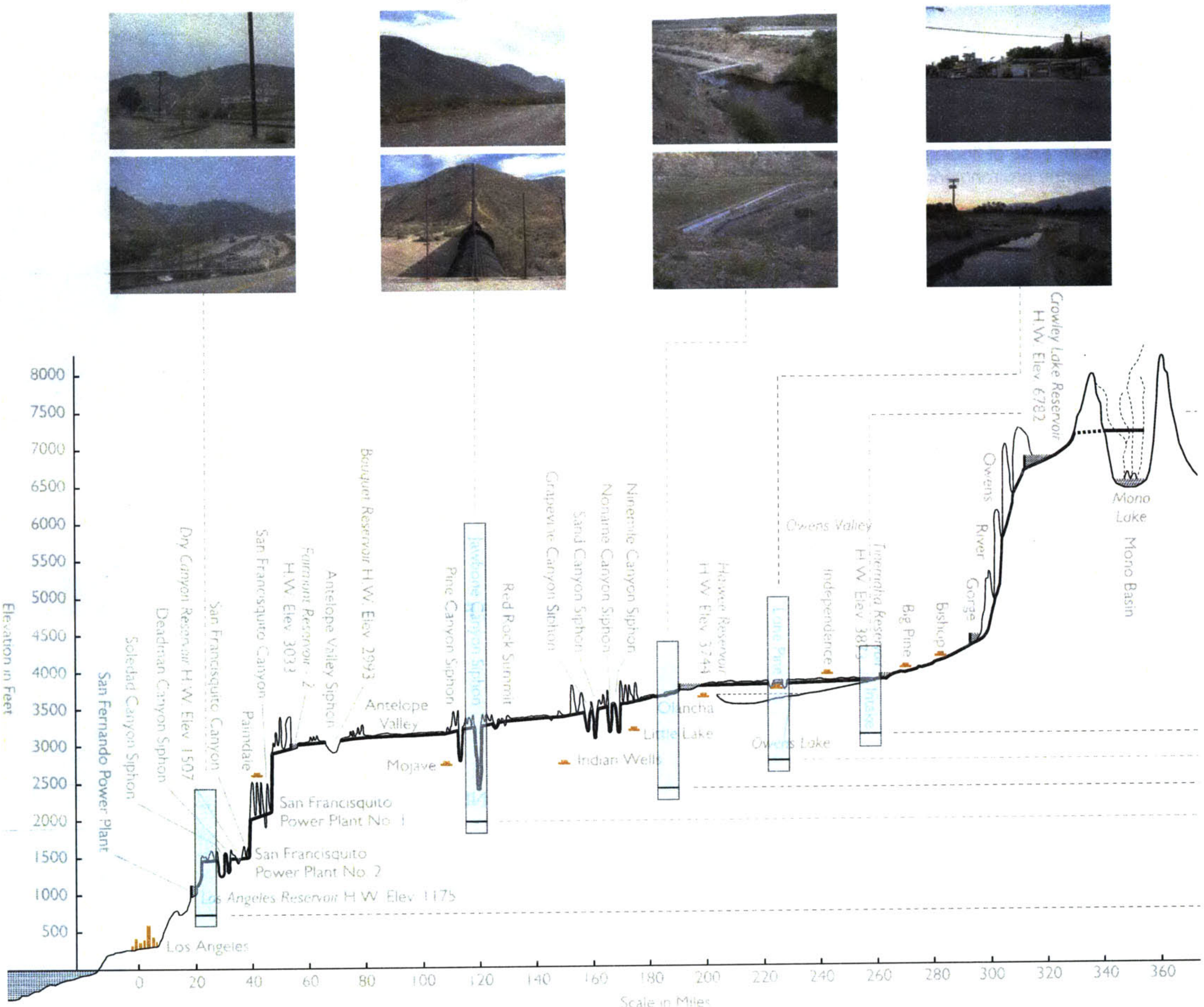
OWENS RIVER INTAKE..............................

LONE PINE..

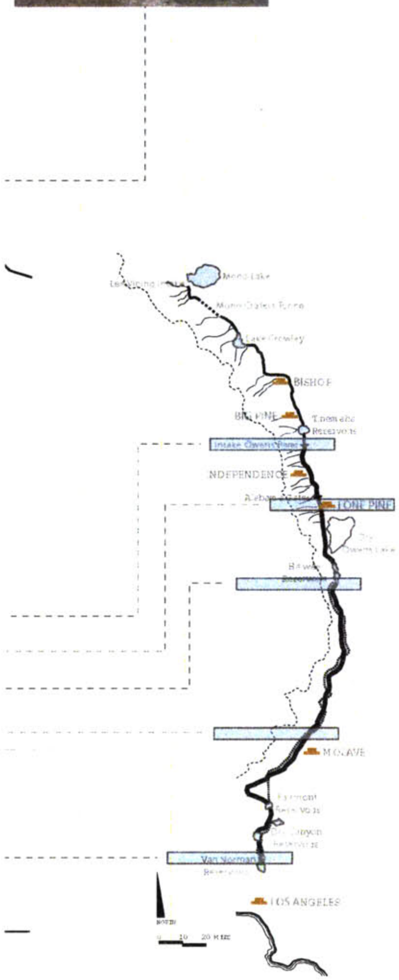
HAIWEE RESERVOIR................................

JAWBONE CANYON.................................

CASCADES..



Elevation in Feet
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
Scale in Miles
Los Angeles
San Fernando Power Plant
Soledad Canyon Siphon
Deadman Canyon Siphon
Dry Canyon Reservoir H.W. Elev. 1507
San Francisquito Canyon
Los Angeles Reservoir H.W. Elev. 1175
San Francisquito Power Plant No. 2
San Francisquito Power Plant No. 1
Palmdale
San Francisquito Canyon
Fairmont Reservoir 2 H.W. Elev. 3033
Antelope Valley Siphon
Bouquet Reservoir H.W. Elev. 2993
Antelope Valley
Mojave
Pine Canyon Siphon
Jawbone Canyon Siphon
Red Rock Summit
Grapevine Canyon Siphon
Sand Canyon Siphon
Noname Canyon Siphon
Ninemile Canyon Siphon
Indian Wells
Little Lake
Olancha
Haiwee Reservoir H.W. Elev. 3744
Owens Lake
Lone Pine
Owens Valley
Independence
Tinemaha Reservoir H.W. Elev. 38..
Intake
Big Pine
bishop
Owens River Gorge
Crowley Lake Reservoir H.W. Elev. 6782
Mono Lake
Mono Basin



In an effort to grasp the Los Angeles Aqueduct system in its entirety, this graphic was created to describe the relationship between distance and elevation as the aqueduct forces its way through the California landscape.

The light blue swaths correlate the determined locations stated on page 43 to the plan and section diagram of the aqueduct.

LONE PINE
A Case Study

Lone Pine is highlighted above on the aerial of southern California. *Basemap from http://www.395.com.*

A 180-degree panorama of Owens Valley taken from the Alabama Hills looking from north to south, left to right respectively. The town of Lone Pine consists of development embraced by the wooded area on the preceding page. The Los Angeles Aqueduct can be seen closer to the foreground running perpendicular to the strands of green trees.

The town of Lone Pine was chosen as the case location for the base camp because it offered multiple constraints, such as extreme geologic conditions, geographical importance as well as for the ancillary activites which occur there. Also, it represents the typical condition of towns that exist within the valley. These communities remain to be stagnant in terms of growth and development due to the presence of the Los Angeles Aqueduct. Because of the aqueduct and the rights of the water belonging to Los Angeles, the majority of the land cannot be developed. The land is to remain undeveloped but open to the public for recreational use. From what I gathered during research, many of the people living in the valley remain bitter toward Los Angeles and especially the bureaucrats who control the situation.

Main Street in Lone Pine which is Highway 395 running straight through town.

Lone Pine is the gateway to Death Valley, in the shadow of Mount Whitney, and in the heart of Owens Valley. The diversity of geography in this unique area also affords a variety of activities throughout the year. Hikers, campers, and visitors to the region can travel from the lowest elevation in the United States at Death Valley to the highest mountain peak in one day. Located just over 200 miles N.E of Los Angeles on Highway 395, Lone Pine is just 100 miles west of Death Valley and 235 miles south of Reno, NV. There is an abundance of recreation opportunities due to 92% of land being open to the public. The town has primarily tourism-based businesses.

Population 2000: 1655
Precipitation: Avg. 5 inches annually
Snow Fall: Avg. 6 inches annually
Elevation: 3700' in Town, Alabama Hills 3900'-5000'

HISTORY

Before the White Man arrived, the Owens Valley was inhabited by the Southern Paiute Indians of the Mono Tribe, who occupied the cooler mountain valleys in the summers and retreated to the warmer Owens Valley floor during the winter months.

The town of Lone Pine is named after the lonely pine tree that was found at the mouth of Lone Pine Canyon. The town was founded during the 1860's to provide supplies to the local gold and silver mining communities of Kearsarge, Cerro Gordo and Darwin, and later to farmers and ranchers. The pine tree has long since vanished, destroyed in flood.

Mount Whitney was first discovered by a California Geological Survey team in 1864, who named the peak after Josiah Whitney, a Professor at the California Academy of Sciences. Members of the survey team, William Brewer and Clarence King attempted to climb the peak but were unsuccessful. Whitney was first climbed on August 18, 1873, by three Lone Pine locals; Charley Begole, Johnny Lucas, and Al Johnson.

Over the years the town has endured an Earthquake the magnitude of the "Big One" in San Francisco in 1906, it has been home to a transient mining population, was home to the construction workers building the LA Aqueduct, and has hosted the crews responsible for many classic feature films. During World War II Japanese American were confined in the Manzanar relocation camp.

Mining

During the 1870's Lone Pine was an active supply town, furnishing goods and services to the surrounding mining communities of Kearsarge, Cerro Gordo, Keeler, Swansea, and Darwin. The large mine at Cerro Gordo, 9,000 feet high in the Inyo Mountains, was one of the greatest silver mines in California. Silver, lead and zinc were carried in ore buckets on a strong cable to the town of Keeler. From Keeler, the ore was transported 4 miles northwest to Swansea's smelter oven. To fulfill the need for building materials and fuel a sawmill was built near Horseshoe Meadows to provide wood for the smelters and the mines, by Colonel Sherman Stevens.

Lumber was transported by flume to the valley, burned in adobe

An open mine at the base of the Alabama Hills in Lone Pine.

kilns to make charcoal, which was then shipped across the 30 foot deep Owens Lake by steamships to the smelters at Swansea. After the metal was extracted from its matrix, silver ingots were loaded aboard steamships and transported to Cartago, on the west side of Owens Lake. From there the silver was carried across land by mule train to the then small city of Los Angeles.

Railroad

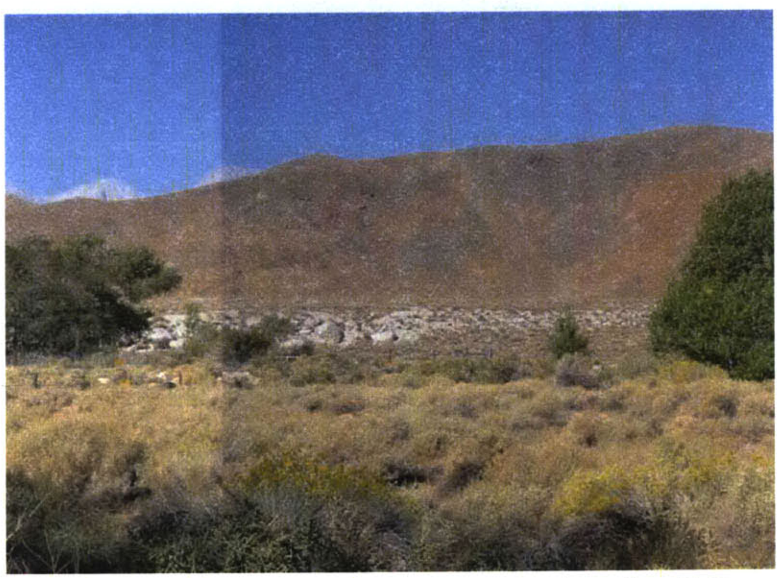
In 1883 the Carson and Colorado Railroad was built from Belleville, Nevada, across the White Mountains to Benton and down into the Owens Valley where the rail line ended in Keeler. The engine was nicknamed "The Slim Princess". The arrival of the rail line and stagecoach in Keller was a great event. Passengers came in on the evening train twice a week to take the stage on the following day to Mojave. Passengers spent the layover at the Lake View Hotel, later the name changed to the Hotel Keeler.

To the north, the short line connected with the Virginia & Truckee Line at Mound House, Nevada. A portion of Keeler's railroad history is still visible in the old railroad station, stationmaster's house, and remnants of passenger coaches that are now converted into residences.

North of Lone Pine is the Lone Pine Station Road, which goes east to the abandoned Southern Pacific depot (now a private residence). With the building of the LA aqueduct, large quantities of freight were needed in the Owens Valley, and the railroad was extended from Mojave to Lone Pine for this purpose.

Earthquake of 1872

On March 16, 1872 at 2:30 A.M. the small community of Lone Pine, California was violently awakened by an earthquake. The magnitude of the quake was about the same as the "Big One" in San Francisco in 1906. It literally leveled the town of Lone Pine. Of the 80 buildings, built of mud and adobe, only 20 structures were left standing. Diaz Lake was formed by this quake. Twenty-six people lost their lives that day in the disaster. A mass grave, located just north of Lone Pine, on the upthrust block of the main fault that caused the quake



Remnants of the Earthquake of 1872 can be seen as this escarpment permanently scared the earth's skin.

commemorates the site.

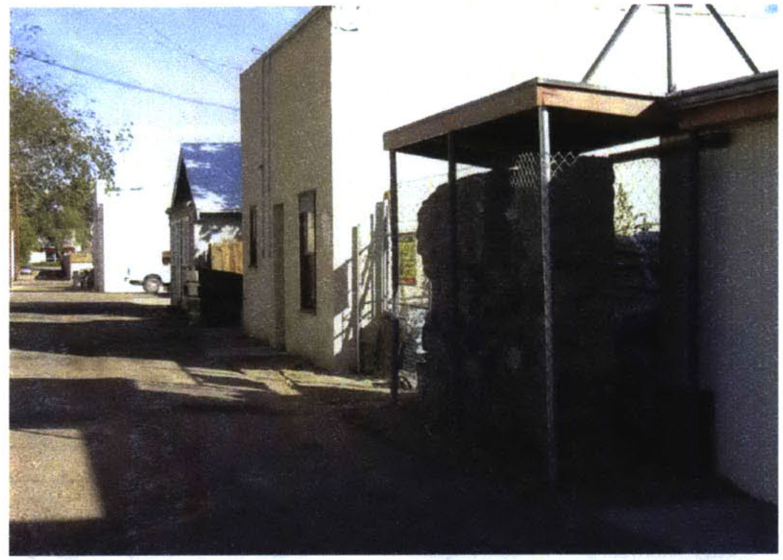
The landscape bears the scars of the 1872 earthquake. From Lone Pine to Big Pine remnants of the disaster are still in evidence. In the alley way behind La Florista, the local flower shop and nursery stands "The Old Adobe Wall," as seen to the left, the only known remaining example of pre-earthquake architecture in Lone Pine. The bottom layer of the wall is three foot thick and built of heavy stone, the rest of the structure is adobe brick and rubble with brick mortar.

The wall is what is left of a general merchandising store and living quarters that was owned by Charles and Madeleine Meysan who came to Lone Pine in 1869 from a French Camp near Columbia. It is believed that the building was near 100 feet long, with the store in front and living area in the back. Shortly afterward, Meysan constructed a new building made of wood. La Florista now occupies this building. The wall remained in the possession of various members of the Meysan family until September 30, 1921 when Eugenie Dunn sold it to O.W. Dolph. On December 22, 1931 the City of Los Angeles purchased the property. On August 6, 1971 the protection for the wall erected by the City of Los Angeles, Department of Water and Power was finished.

Mount Whitney

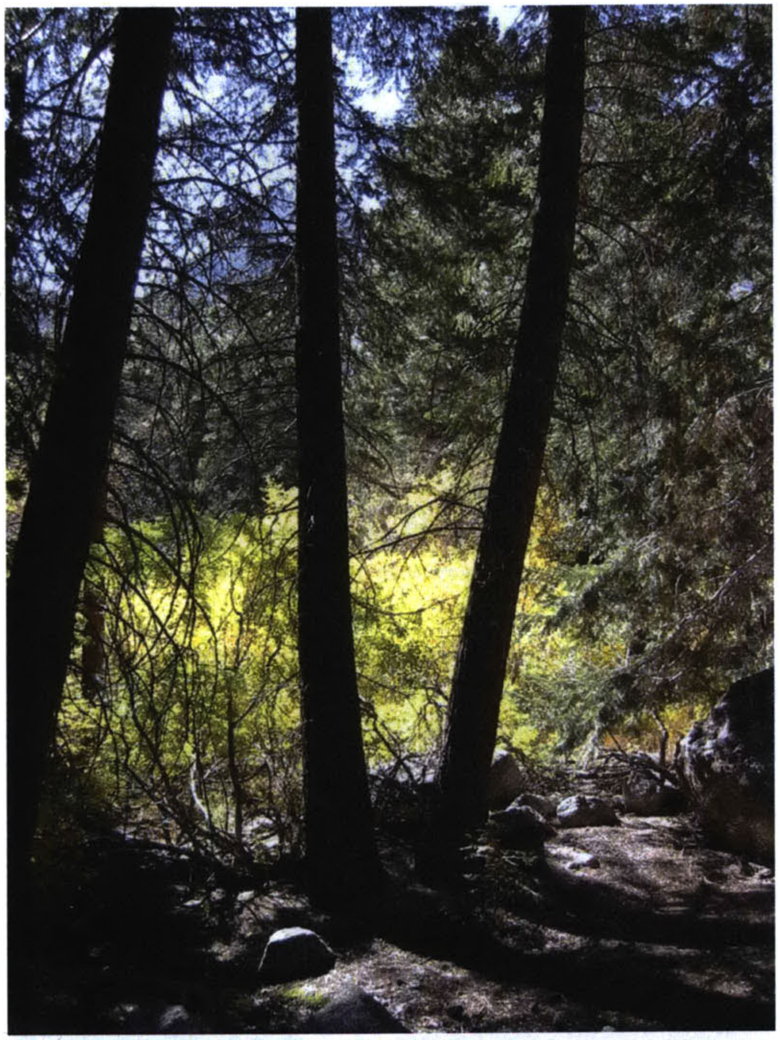
The culminating peak of the Sierra was discovered in 1864, by a California Geological Survey team, and named "Mt. Whitney" after the teams leader, Josiah Whitney. A member of the survey team, Clarence King, attempted to climb Whitney twice during their trip but was not successful. He returned in 1871 and successfully summated -- or so he and everyone else believed for some time. In reality he had accidentally climbed what today is known as Mt. Langley. When his error was discovered two years later, he returned to California to try again. He did summit Whitney on September 19, but was the fourth person to do so. The first ascent was made by three local fishermen, Charley Begole, Johnny Lucas, and Al Johnson. These three friends reached the summit at noon on August 18, 1873.

Residents of the Owens Valley wanted to name the mountain



The Old Adobe Wall, known as the only remaining piece of pre-earthquake architecture in Lone Pine.

The summit of Mount Whitney in the background.


The western sun is filtered by the large pine trees near the Mt. Whitney trailhead.

"Fisherman's Peak" to pay homage to the first summiters. When this name was challenged they proposed the name "Dome of Inyo". Over the next two years, the local newspaper published many articles arguing this issue. Finally a bill which would make "Fisherman's Peak" the official name was introduced in the State Legislature. A strange twist of fate bought the bill before the Senate on April Fools Day, 1881, where they frivolously amended it to read "Fowler's Peak." The Governor ended the silliness by vetoing the bill, and so today the original name stands: Mount Whitney.

John Muir made his first ascent of Whitney on October 21, 1873. Muir was the first person to climb Whitney from the east via what is today known as the Mountaineers Route. He had attempted to summit via the southwest, as those before him, but had retreated to Independence after a cold night out, returning to summit by this new route.

In time the residents of Lone Pine began to realize the demand for a trail to the summit of their mountain, and through local fundraising efforts they financed a pack-train route up the east side. This trail was completed on July 22, 1904.

Lone Pine's own Mr. Gustave F. Marsh engineered the trail, much of which is still in use today. The lower portion, from Lone Pine up to Whitney Portal, is now a National Historic Trail of the Smithsonian Institute.

Early explorers and mountaineers on their way up the slope camped at Hunter's Flat, a clearing at the lower end of what is now Whitney Portal, below the Whitney Portal Road.

The idea to construct a hut on the summit of Whitney was formed after the first recorded death on the mountain on July 26, 1904, of Bryd Surby. Three men from the U.S. Bureau of Fisheries had climbed up the brand new trail and while on top eating lunch, were struck by lightening. Plans for the hut were drawn by Dr. William Campbell in 1908. The original trail builder, Gustave F. Marsh was again contracted to rebuild the trail, and to construct the stone shelter at its end.

The summit shelter was completed in the summer of 1909 with funding from the Smithsonian Institute. Modern day visitors may not be impressed by the sight of this humble house. Some assume its parts were flown in by helicopter. In reality wood was hauled up by mules, stone was broken, shaped, riveted and cemented with hand tools. Amazingly the whole project was completed in a little over one month.

Gustave Marsh worked tirelessly day and night, staying on the summit while others descended to rest or retreat from storms. He is credited with making Mt. Whitney available to science. Several scientific expeditions soon took advantage of the stone hut. In 1909, Dr Campbell visited the summit, bringing a 16" horizontal reflective telescope and a spectroscope. They were able to end a significant controversy by determining that no water existed on Mars. Other parties have studied nocturnal radiation and the earth's cosmic rays.

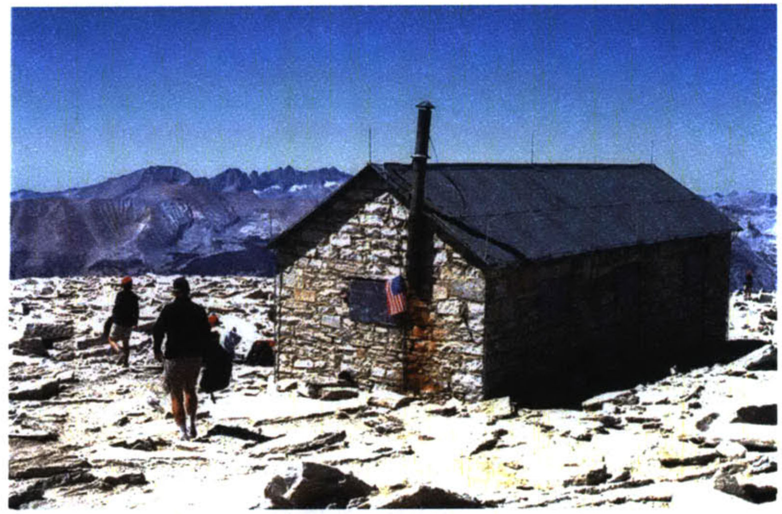
As more people came to visit Mt. Whitney, more accommodations were built. The original Whitney Portal Road was constructed in 1933-35, making it possible for tourists to drive their automobiles up from Lone Pine. Public campgrounds, picnic areas, a store, a tract of summer homes, a pond, and a potable water system were all built in the 30s. During this period the summit shelter was restored by the National Park Service.

Today's emphasis is not on improving the facilities at Whitney Portal, but on preserving them. Overuse of the fragile environment has made it necessary to limit the number of visitors through a quota system of permits.

Manzanar

Located 7 miles north of Line Pine on Highway 395, the Manzanar National Historic Site contains evidence of several historical eras. The Paiute and Shoshone people occupied the Manzanar area for centuries. American Indian archeological sites are important parts of the Manzanar story.

In the late nineteenth century, a cattle ranching homestead



The summit shelter of Mount Whitney. *Photo from http://www.myownlittleworld.com.*

flourished here. In the early 1900's the town of Manzanar grew to be a thriving pear and apple orchard community. By 1913, the city of Los Angeles completed its aqueduct and owned 95% of the Owens Valley. The town of Manzanar was then abandoned and the land remained vacant until March 1942.

Two months after Pearl Harbor was bombed, President Roosevelt signed an Executive Order calling for all those of Japanese ancestry to be placed into relocation camps. Manzanar was one of those relocation centers, built initially as a temporary center it became the first permanent relocation center in the United States.

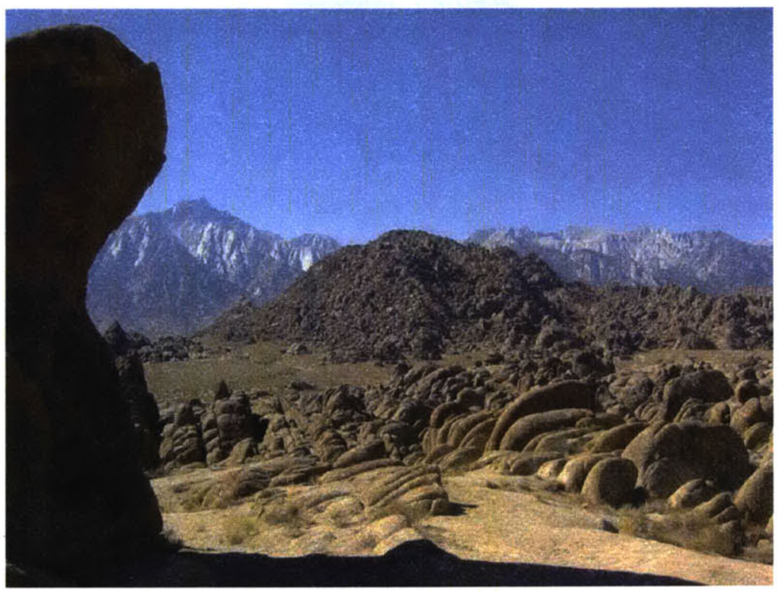
Film Industry

In 1920, Lone Pine was changed forever when a silent movie, "The Roundup," was filmed in the Alabama Hills. Since then, over 250 movies, TV episodes, and commercials have been shot in location in the area, immortalizing the striking rock formations and taking advantage of the picture-perfect weather.

From "Gunga Din" to "Maverick," movie stars, sets and cameras, and equipment have rolled in and out of Lone Pine. A partial list of stars who have visited Lone Pine includes: Hopalong Cassidy, Roy Rogers, Humphrey Bogart, Susan Hayward, Spencer Tracy, Natalie Wood, Clint Eastwood, Kirk Douglas, John Wayne, Steve McQueen, Shelly Winters, Luci and Desi Arnaz, Willie Nelson, Mel Gibson, and many others.

Elephants, horses, and jeeps have all thundered across the rugged backdrops of rock and sky.

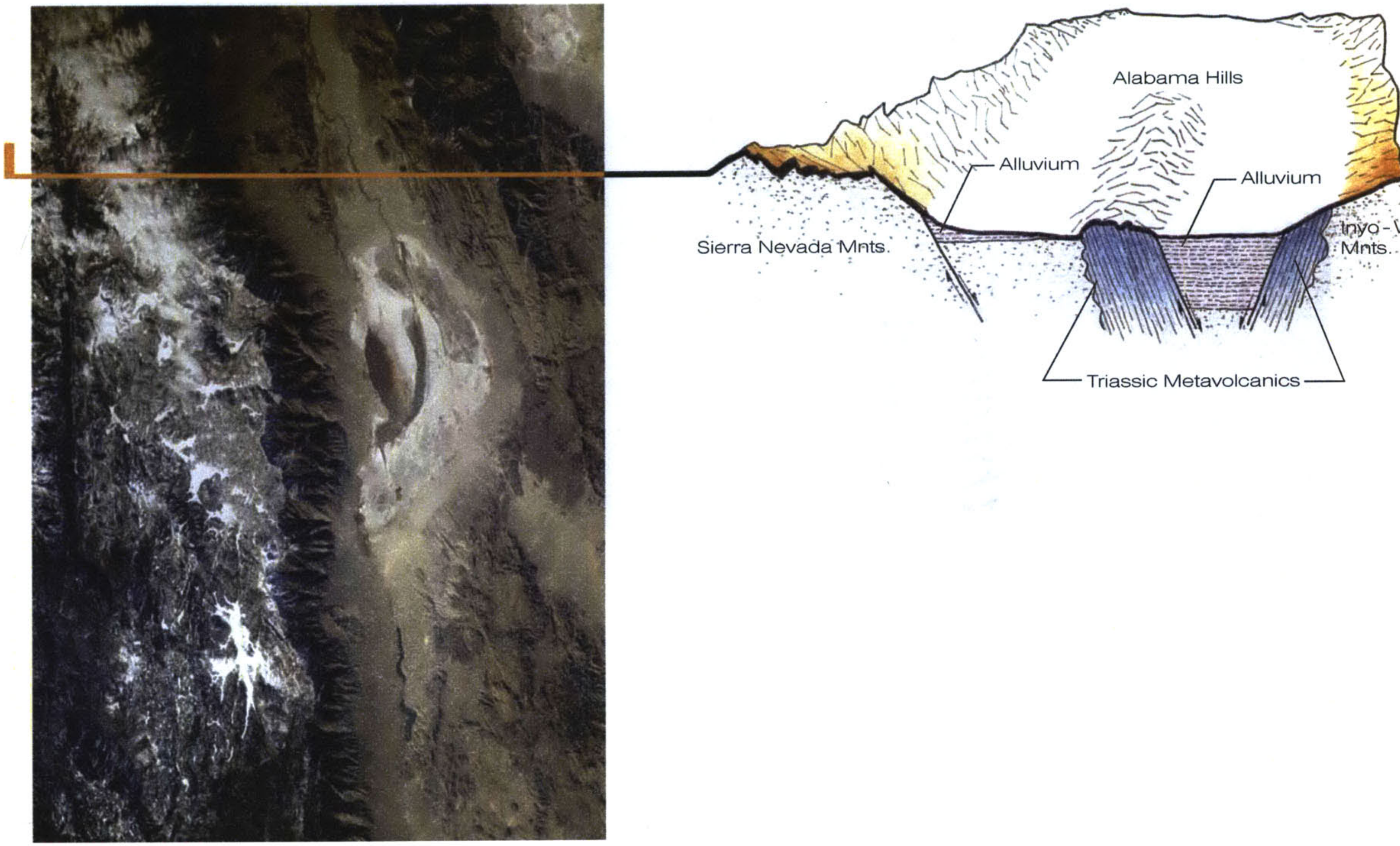
The Movie Room, located at 126 S. Main Street in the Lone Pine Chamber of Commerce courtyard is dedicated to preserving the magical time of cowboys and indians. Every October, the annual Lone Pine Film Festival celebrates film making in the Lone Pine area.



The Alabama Hills, where many western movies were filmed.

LANDSCAPE ANALYSIS

Upon my arrival in Lone Pine, I instantly became awed by the geologic forces that were so evident in this place. Over many years, the active tectonic plates below the earth's skin were very active creating a dynamic and unstable landscape.



Diagramatic Cross-section of Owens Valley at Lone Pine.

Aerial Photograph from http://www.nasa.gov.

PROGRAM HISTORY

The idea of the mountain hut or base camp flows from the European concept of a wilderness structure providing communal overnight shelter. The term mountain hut is applied to structures with typically shared sleeping and toilet facilities. The concept for this building type was developed in the 19th century. Mountain huts are now widely used throughout the world.

North American approaches to mountaineering and wilderness recreation have developed as a less structured, less communal activity typically involving tent camping. With increased recreational activities in wilderness areas, temporary campsites create problems of pollution and degradation of the pristine natural experience sought. A new paradigm is required for the wilderness base camp and for the wilderness experience itself.

These issues are becoming important in all regions of the world, with the worldwide growth in adventure travel. Simultaneous with new approaches to wilderness recreation, new approaches to the mountain hut must move beyond the 19th century models toward more technologically advanced structures better able to preserve and sustain the natural areas surrounding them.

At the same time increasing numbers of people wish to experience endangered wilderness areas, advances in technology offer ideas, products and systems that may promote more harmonious interaction between human beings and natural environments. The hut condenses issues of social interaction, and individual experience of nature. Ideas developed for this small structure may be extrapolated to broader issues in the relationship between human society, nature and technology.

The goal of this thesis is to produce a new pedagogy for the education of the public on issues related to preservation and sustainability by incorporating technological solutions within the desert and mountain huts that will minimize resource consumption and pollution, while maintaining a rich human experience of the natural environment and the Los Angeles Aqueduct.

Mountain huts are typically integrated into the landscape with minimal impact.
Photo from http://www.cetneva.spb.ru.

Shared sleeping arrangements promote a communal atmosphere.
Photo from http://www.sunplus.com.

SUSTAINABLE DESIGN CRITERIA

The basic idea is to provide and use self-sufficient energy supply systems for such isolated places of difficult access, high ecological sensibility and greater solar exposure. This building shows a general overall design that connects and optimizes all available technical possibilities and providing ecological and sustainable building maintenance.

The goal for any building is to attain almost self-sufficient building maintenance, meaning that most of the electric energy should be produced by solar panels. In terms of heating and warm water supply, as well as design and insulation the building follows the guidelines of passive design.

Comfort standard should not be higher than basic, according to the limiting conditions of the special geographic and ecological situation. The building's use requires flexibility. According to weather and seasons the building's frequentation will not be a constant one.

In general this thesis intends to increase the "environmental consciousness" of people enjoying an intact nature and also work as a signal for future building concepts. Though it seems to be a very special building concept for very special locations it could be an outstanding representative for "island buildings" and a demo-project for other buildings with various forms of use.

Ethel M. Chocolate's industrial wastewater treatment living machine in Henderson, Nevada.

Water Conservation

In order to establish an awareness about the importance of water in this extreme climate as well as an understanding of the process of water treament and conservation, a living machine is provide on site to treat wastewater. Water is taken from showers and laundry facilities to be treated in the living machine. This gray water is reused for flushing toilets and watering needs for landscape.

It is possible to achieve water savings of around 55 percent with the incorporation of the living machine along with other strategies such as installation of low flow utilities, a water management plan and rainwater harvesting.

On the following pages, the process of the living machine is described.

Step 1 of the Living Machine

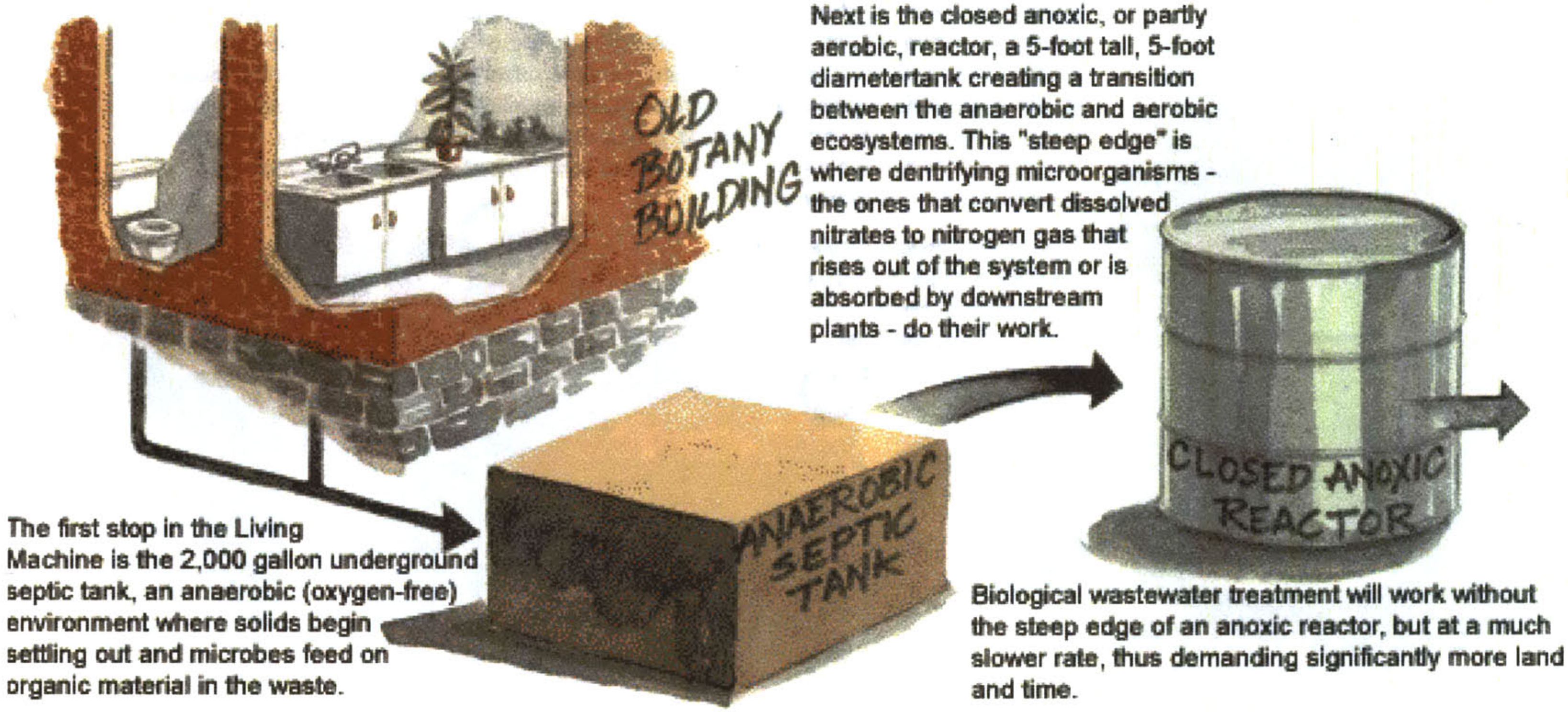


Diagram from http://www.rps.psu.edu.

Step 2 of the Living Machine

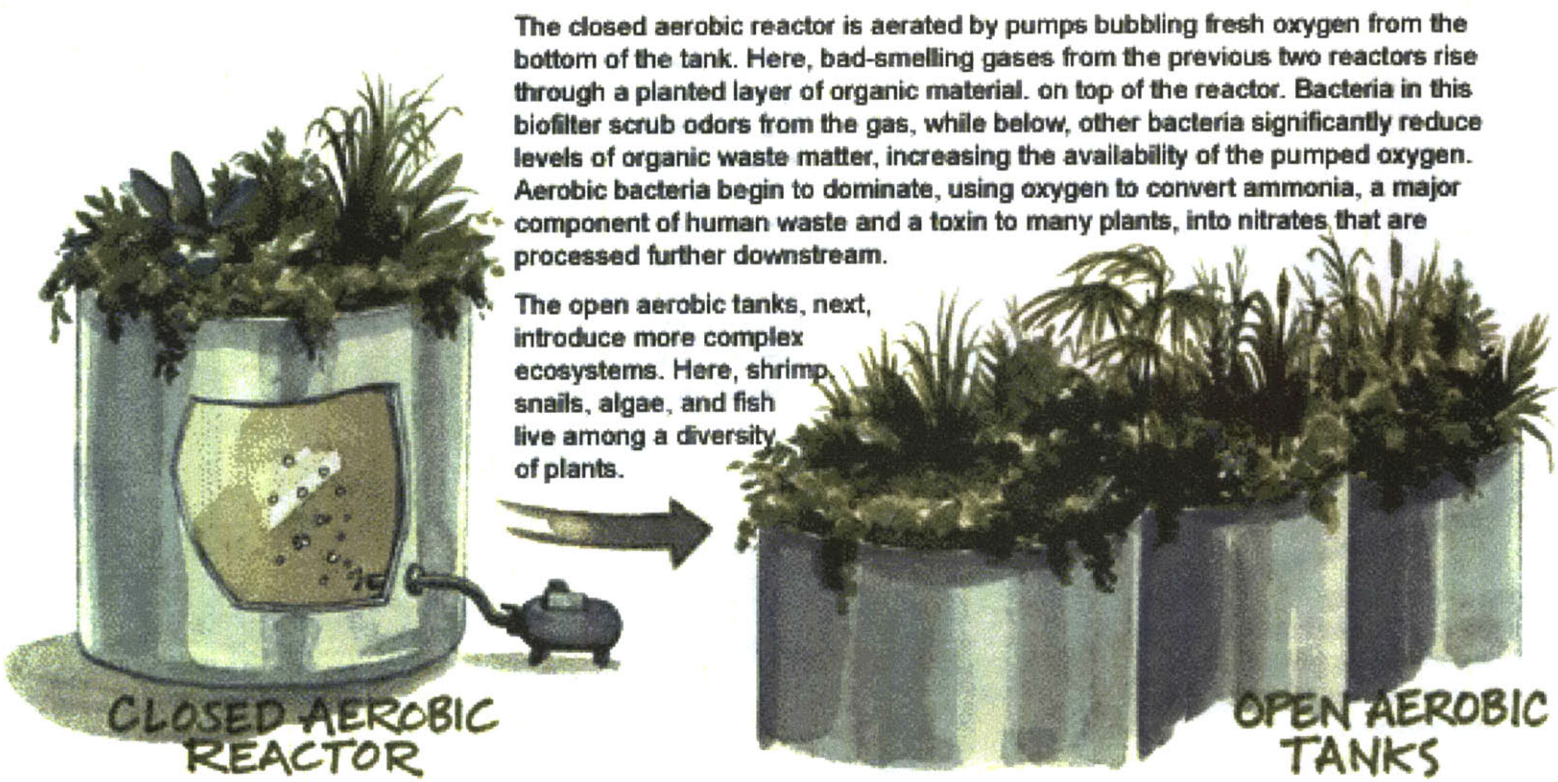


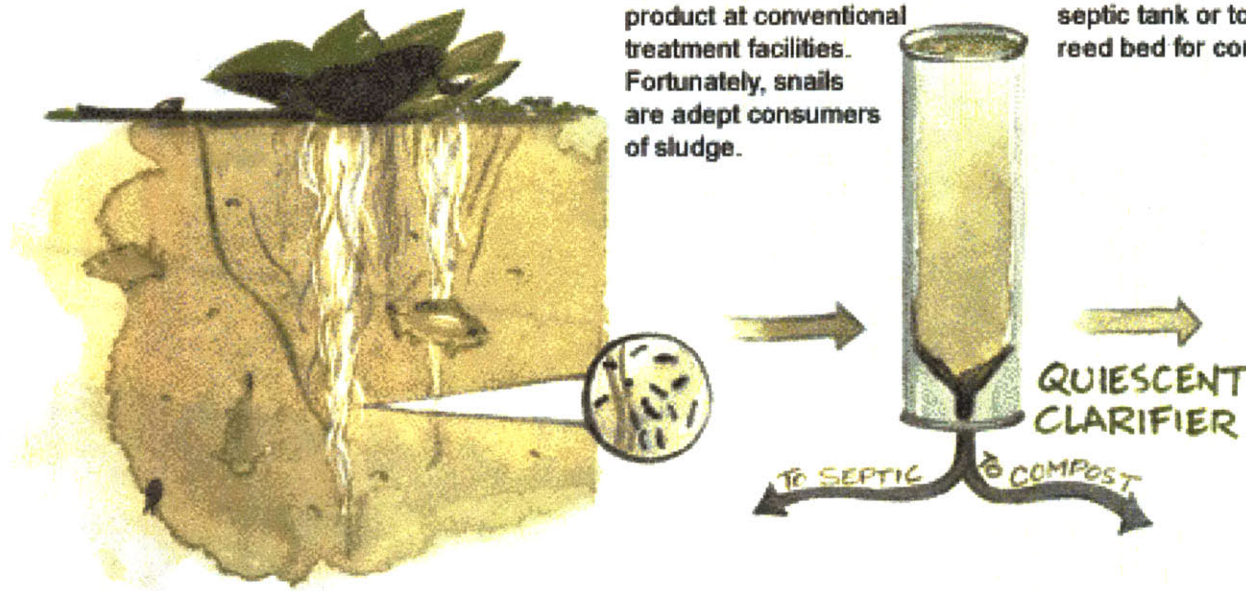
Diagram from http://www.rps.psu.edu.

Step 3 of the Living Machine

The Penn State machine will have three aerobic tanks. By the third tank, bacteria will have completed nitrifying ammonia into nitrates.

Also in these three tanks, algae settle out more of the organic matter in the form of sludge - an infamous waste product at conventional treatment facilities. Fortunately, snails are adept consumers of sludge.

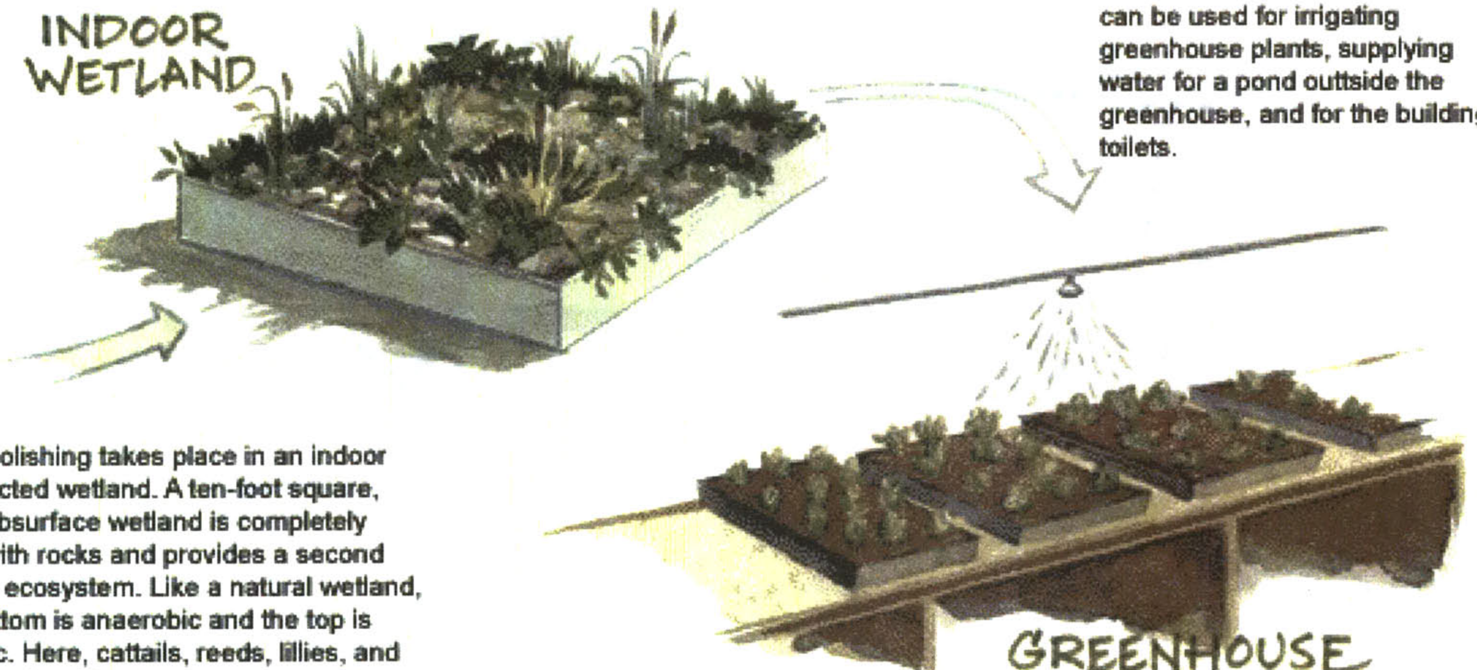
In the quiescent clarifier, gravity pulls dead bacteria and any remaining solids to a funnel-shaped bottom of the calm, non-aerated tank. The solids are recycled to the anaerobic septic tank or to an outdoor reed bed for composting.



The plants' biggest contribution to the system is their roots. The root balls provide a massive platform - better than anything we can make - on which microbial communities can live. These microbes digest the bulk of the remaining waste.

Diagram from http://www.rps.psu.edu.

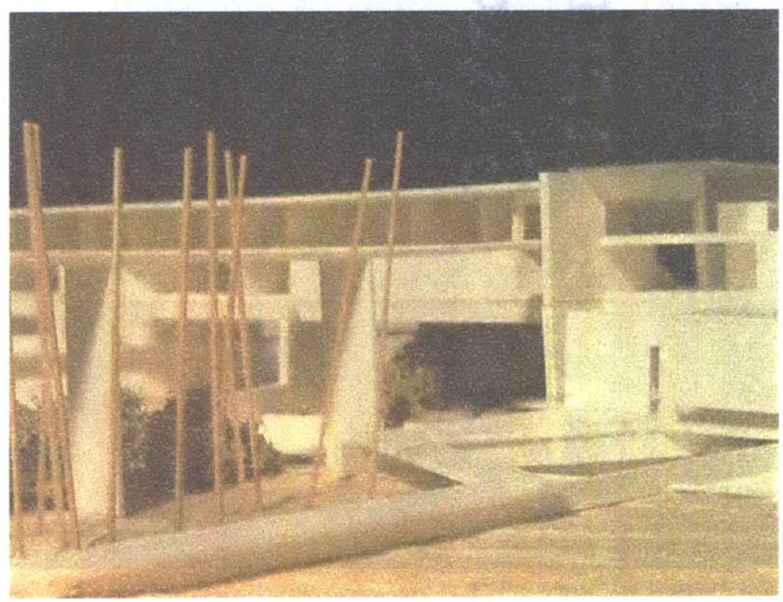
Step 4 of the Living Machine



The clean water coming out of the wetland, while not potable, can be used for irrigating greenhouse plants, supplying water for a pond outside the greenhouse, and for the building's toilets.

Final polishing takes place in an indoor constucted wetland. A ten-foot square, this subsurface wetland is completely filled with rocks and provides a second anoxic ecosystem. Like a natural wetland, the bottom is anaerobic and the top is aerobic. Here, cattails, reeds, lillies, and papyrus live. The key to a successful wetland is rapid circulation.

Diagram from http://www.rps.psu.edu.



A DIDACTIC BASE CAMP FOR LONE PINE

Aerial Photographs from http://www.nasa.gov.

PROGRAM

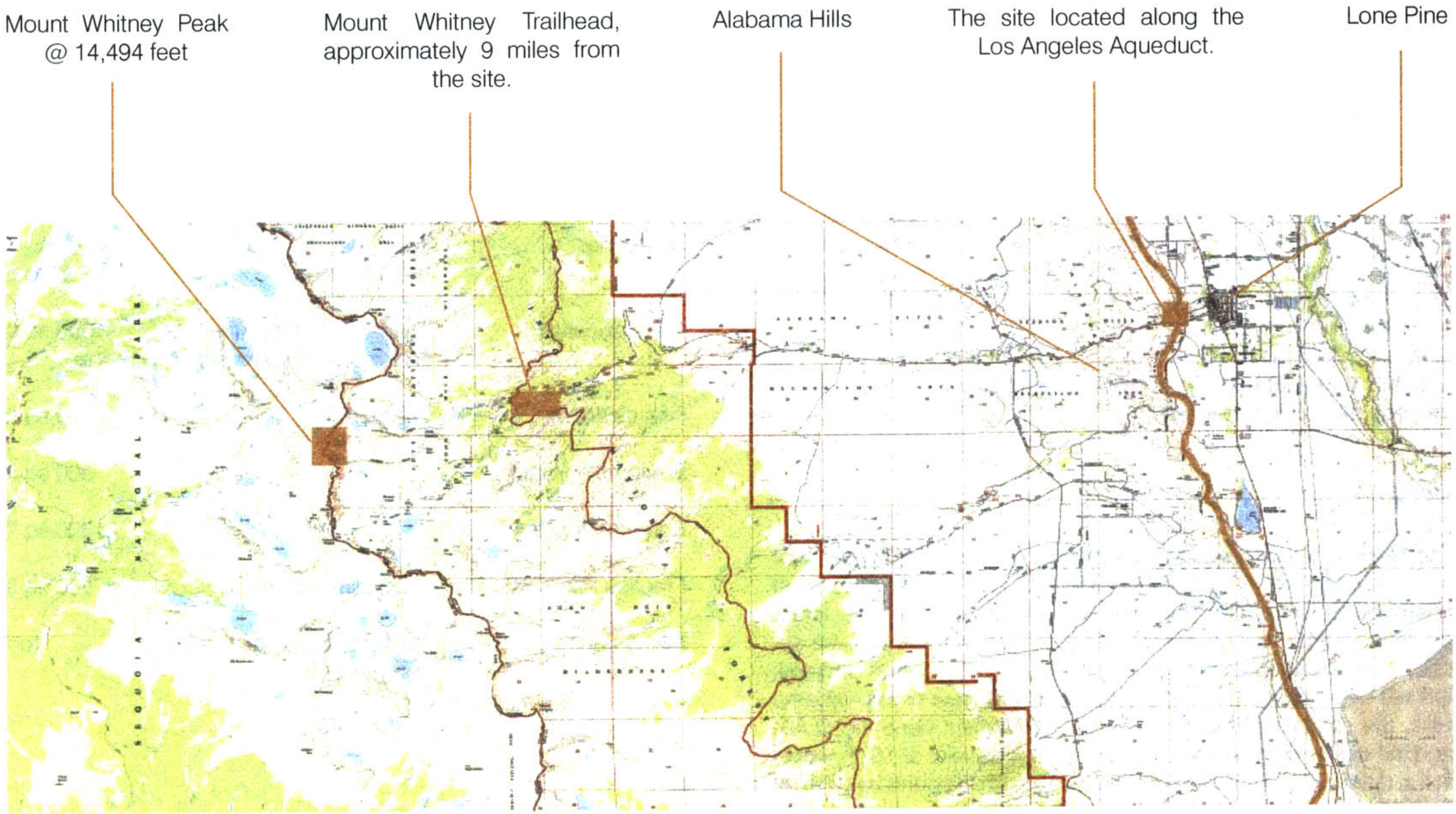
A mountain hut or base camp is the program of choice for this thesis. It will serve as a didactic facility as it will educate those who visit by restoring lost environmental values and creating an understanding of what is involved in bringing an adequate supply of water to Los Angeles. Focusing on a particular audience such as the hiking and rock climbing community gives the best opportunity for this investigation because these people are more environmentally aware to begin with. Also, they provide a larger audience in terms of amount and diversity.

Hiking and rocking climbing interests have long existed in the community of Lone Pine. Approximately fifteen years ago, a base camp existed in the region before being swept away by a surge in Lone Pine Creek due to a large snow-melt. According to locals, the camp was constantly used prior to this minor tragedy especially during the more extreme weather months of the year. Many hikers and climbers come to the region to try their skills at climbing the highest peak in the continental United States, Mt. Whitney. To learn more about Mt. Whitney refer to the preceding chapter. For the purposes of this thesis a program similar to that of the pre-existing camp was adapted and expanded with ideas generated through the design process. See list on the right.

SITE

The site is located along the aqueduct approximately 1/2 mile west of the town center of Lone Pine. The land is owned by the city of Los Angeles and is open to the public for recreational use. It can be accessed by multiple roads but the building proper is to be accessed in a particular fashion based on the site design strategy; this will be discussed in a later section. At the base of the Alabama Hills, the site is situated next to the Los Angeles Aqueduct (LAA) and the escarpment left behind from the earthquake of 1872, visible in the diagram on the preceding page. The site is bound by Whitney Portal Road, the only access route to the Mt. Whitney trail head, to

FUNCTION			SIZE
Sleeping Rooms:	2	12-bed rooms	1200 sq ft
	6	8-bed rooms	800 sq ft
	4	4-bed rooms	400 sq ft
	*each with locked storage for gear and full bathing facilities		
Staff Rooms:	2	1-bed rooms	150 sq ft
	*each with full bathroom		
Day Rooms:	5	1-bed rooms	100 sq ft
	*shared bathroom facility		
Registration:			200 sq ft
	*small front desk area, minor bookkeeping and administration		
Dining Hall:	Food prep & storage		200 sq ft
	Eating space		400 sq ft
LAA Education:	Display & Multimedia		1000 sq ft
	*additional outdoor space possible		
Fish cleaning:	outdoors		50 sq ft
Equipment Repair:			300 sq ft
Equipment Sales:			500 sq ft
Practice Facilities:	Rock climbing walls		500 sq ft
Maintenance:	Trash, solar power, wastewater treatment, etc.		tbd



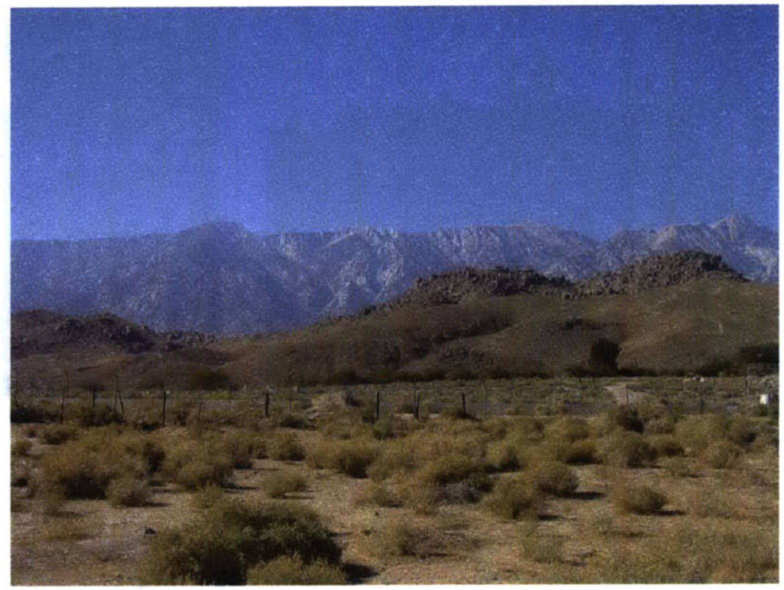
Map from USGS.

the south, sparse residential development to the east, the Alabama Hills to the west and open land to the north. See map on previous page. The immediate area of the site is relatively flat desert terrain as seen in the upper right photograph.

The landscape on the site is very dynamic and reveals much about the natural processes that take place on the site. First of all, the presence of water and its location is obvious. The process of erosion is evident in the hills west of the site as the dry earth is washed away during rainfall. Running through the site, Lone Pine Creek is ever-present as it plays a vital role in supplying water to Los Angeles. As Lone Pine Creek winds its way out of the mountains and flows east toward town and the aqueduct, it clearly affects the ground cover as the plant life is larger and greener the closer it is to the creek beds. The creek is split off into four separate streams before reaching the aqueduct where it supplies water. The two northern most streams are permitted to pass over the aqueduct while the most southern stream is captured in a small reservoir and fed into the aqueduct. The last of the streams has minimal flow and is basically dry during the summer and fall months of the year. Photographs of these conditions can be seen on the following page.

The power of water makes this an ever changing place but more so the force of shifting tectonic plates have had a greater impact on the site. The earthquake of 1872 left a scar on the earth's skin which appears as a plateau in the background of the lower right photograph. Fortunately, the LAA was constructed long after the earthquake though it was constructed parallel to the escarpment as they both run in a north/south direction.

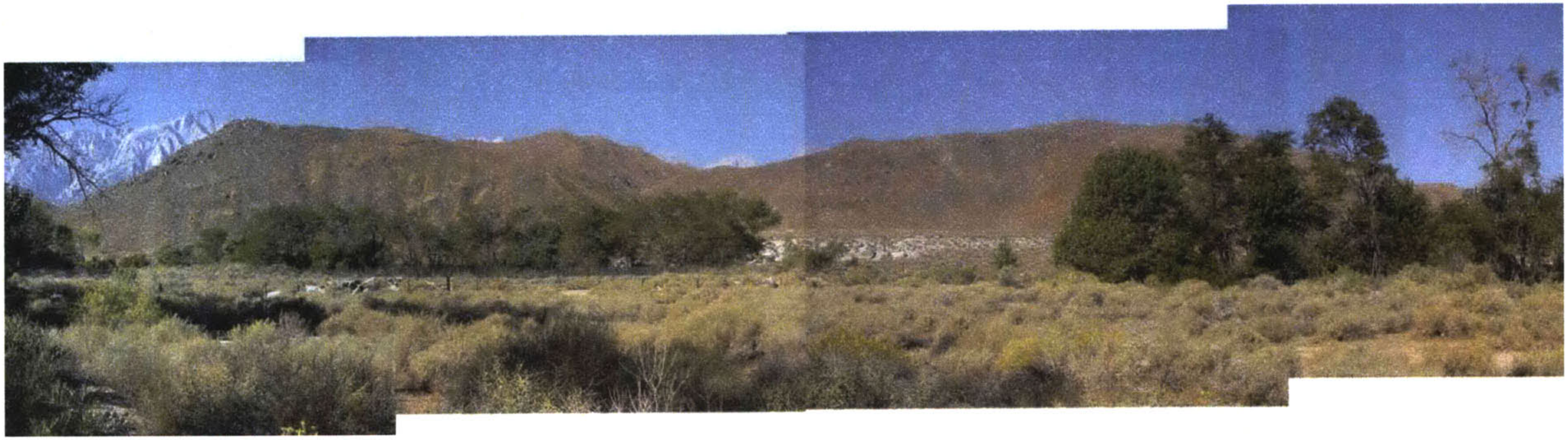
Heading west from town, the area is intensely layered visually as the Sierra Nevada mountain range dominates the background, Alabama Hills the middle ground and the lush green strips of green the foreground. However, the presence of the aqueduct on the site is less apparent than one would presume. It is easy to crossover the LAA without ever realizing its there while driving in or out on Whitney Portal Road. Therefore, the siting of the building and the approach to the building both play key roles in calling attention to the water transporting infrastructure.

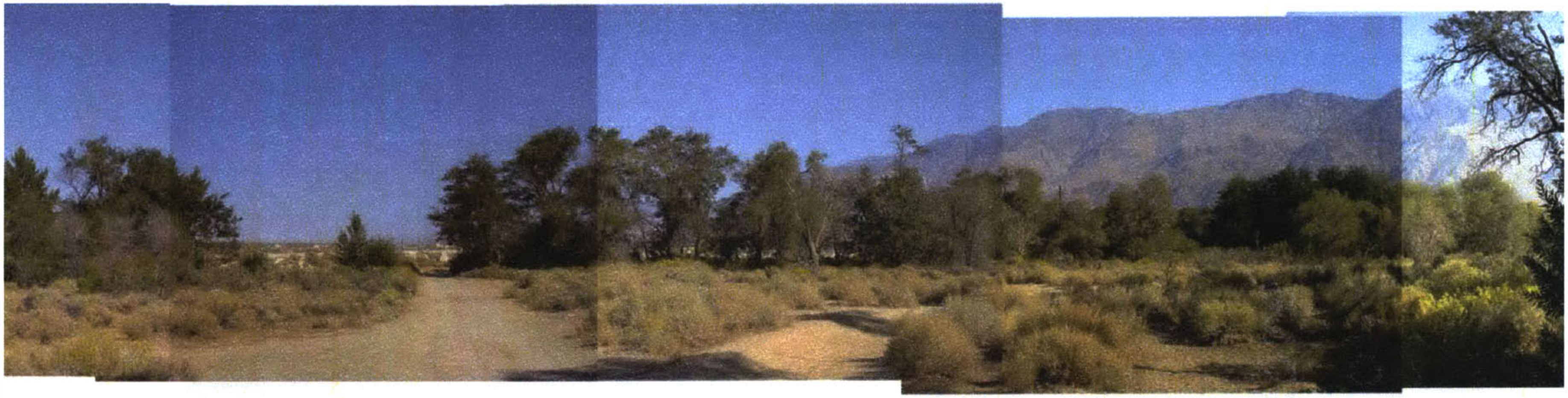


CONCEPTUAL / SITE STRATEGIES

To reiterate the strategy of this thesis, I would like to point out that the development of the base camp at Lone Pine is intended to be one response to this particular location. The overall strategy includes similar programs to be deployed at the other four locations of public engagement along the aqueduct as discussed in the second chapter titled *DESTINATIONS*.

Infrastructural technologies provide strong ties between urban and rural areas, forging a permanent link between development and population growth in cites and the natural resources that support them. As in the case of the Los Angeles Aqueduct, it is the sole factor that allowed the city of Los Angeles to prosper while connecting the city to rural communities such as Lone Pine. However, the aqueduct represents multiple disconnects as well. People in these rural communities view the aqueduct in a negative light. By constructing the aqueduct, control of the land was seized untruthfully and the people of the valley remain bitter about that. It has caused people to be disinterested in the process of the aqueduct, water conservation and other environmentally sensitive ideas. The fact that over 90% of the land is control by L.A. has caused these rural communities to freeze in time as they have had no land to expand on. Also, the aqueduct represents a physical disconnect in that it

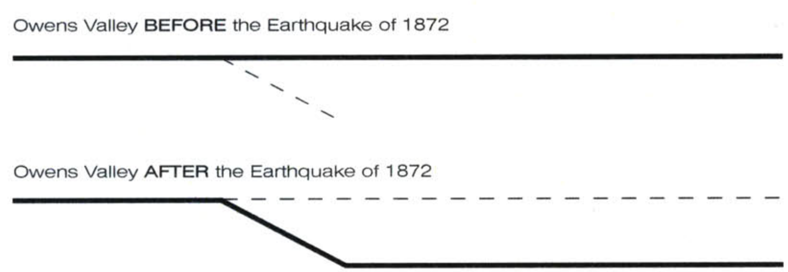


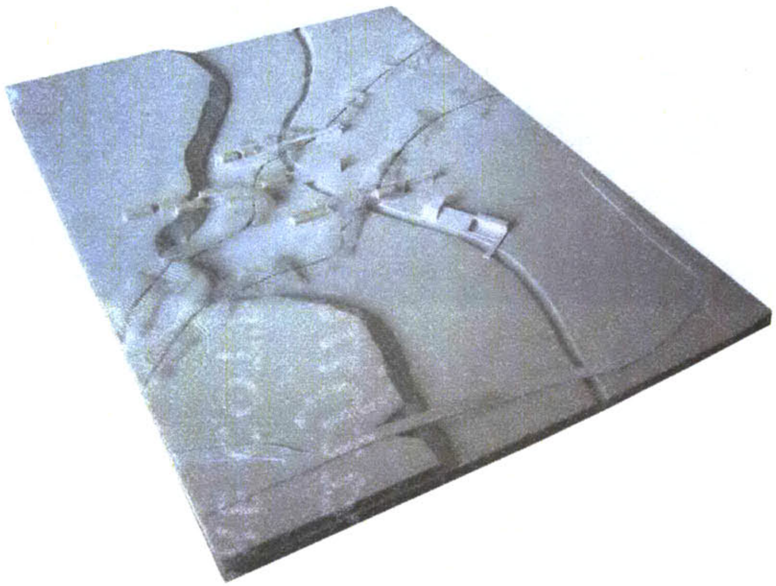


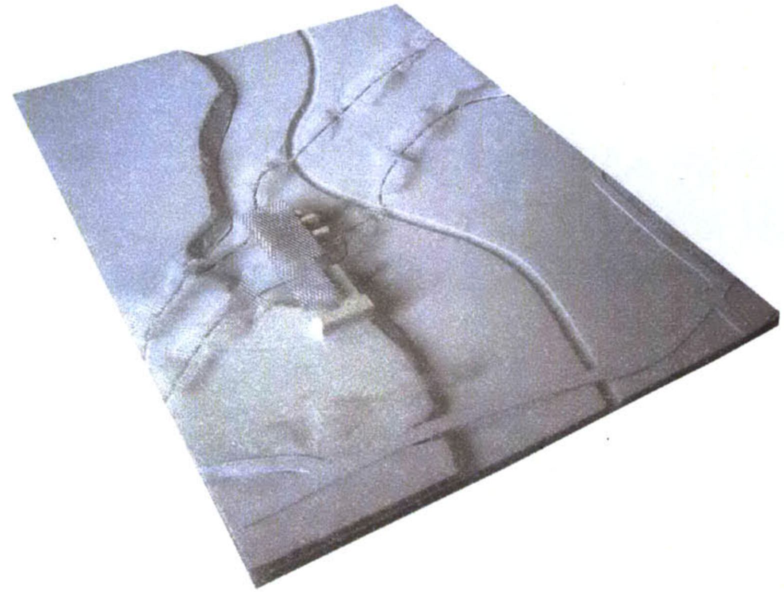
creates a boundary between developed or civilized regions of the valley and the wild undeveloped area of the Sierra Nevadas. It is the goal of this thesis to begin bridging these disconnects. By providing a program, such as the base camp, the proposal will engage the local community as well as the larger public while educating them about environmentally sensitive design, water conservation and an understanding of what is involved in bringing water to L.A.

The major site specific strategy that informed the process of placing the program on the site is based on the notion that the flat desert floor once existed twenty feet higher than it does now. The earthquake scarp reveals the shift that occurred in the ground plane one hundred thirty years ago. Basically the desert floor dropped twenty feet at the time of the earthquake.

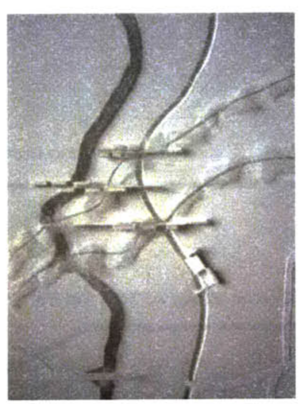
This strategy is deployed by executing four studies on how to introduce or place program on the site. Each investigation elevates or floats the program over the desert floor in order to reestablish the once existing desert floor and, more importantly, to minimize the building footprint. On the following two pages are these studies.



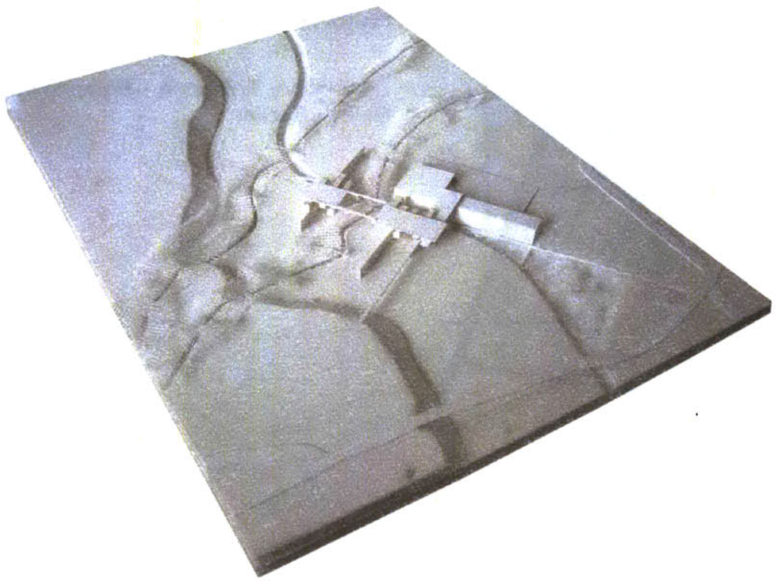


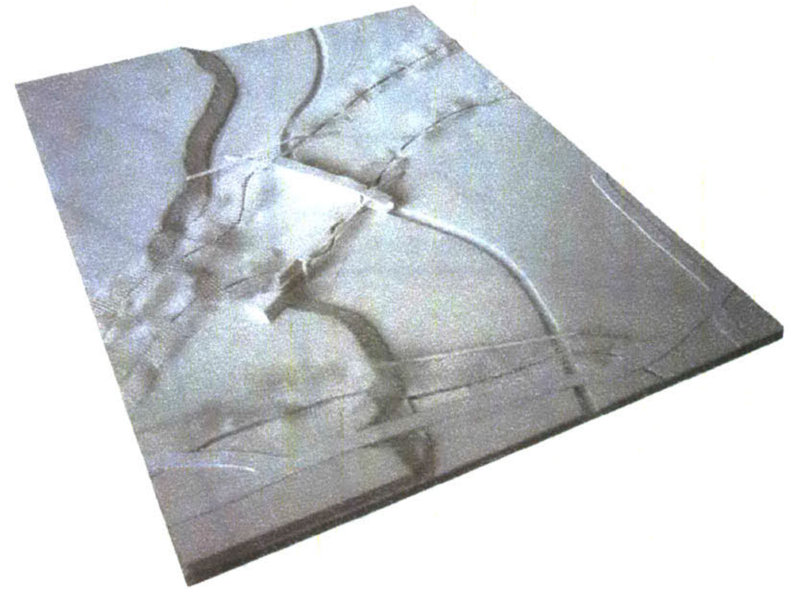


This study attempts to densify the program on linear organizing circulation elements in an east / west direction bridging the aqueduct. Groupings of sleeping room types are separated from the remainder of the program.

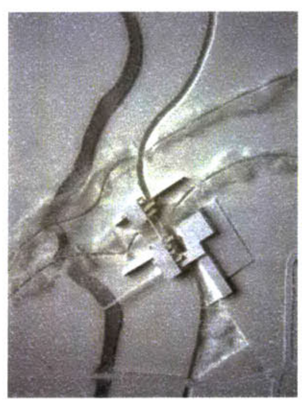


Using a similar strategy, this study attempts to densify the program again on a linear organizing circulation element. In this case, the administrative functions are located at grade of the upper level of the earthquake scarp. The remainder of the program is elevated above the desert in one large multi-story grouping.

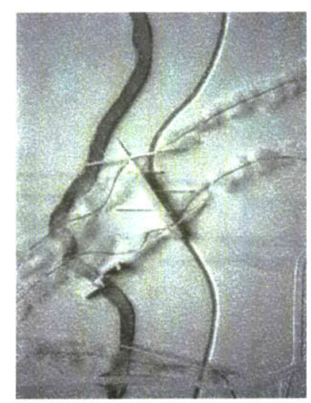


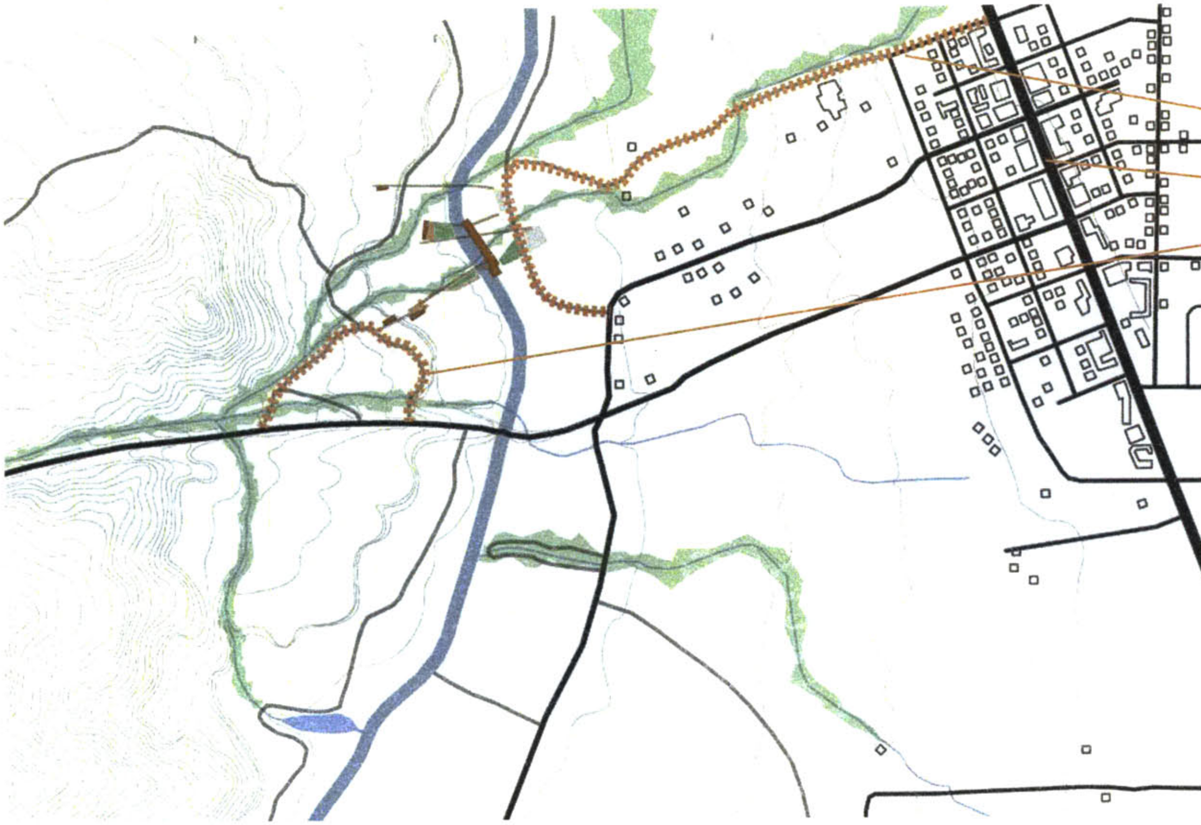


This study is intentionally heavy-handed in that it engages the infrastructure and makes modifications to the surrounding landscape. The primary organizing elements are the aqueduct itself and views to the mountain landscapes beyond.



This study borrows successful traits from each of the previous three investigations. The majority of the program including sleeping, dining and administrative functions are densely placed along side the aqueduct. Separate from the building proper are the equipment repair / sales and the rock climbing facility. This allows the general public to visit these programmatic components while not distrurbing those who convalesce. Land bridges provide the organization as well as the connective tissue to the dispersed program. **This study was chosen for further development.**



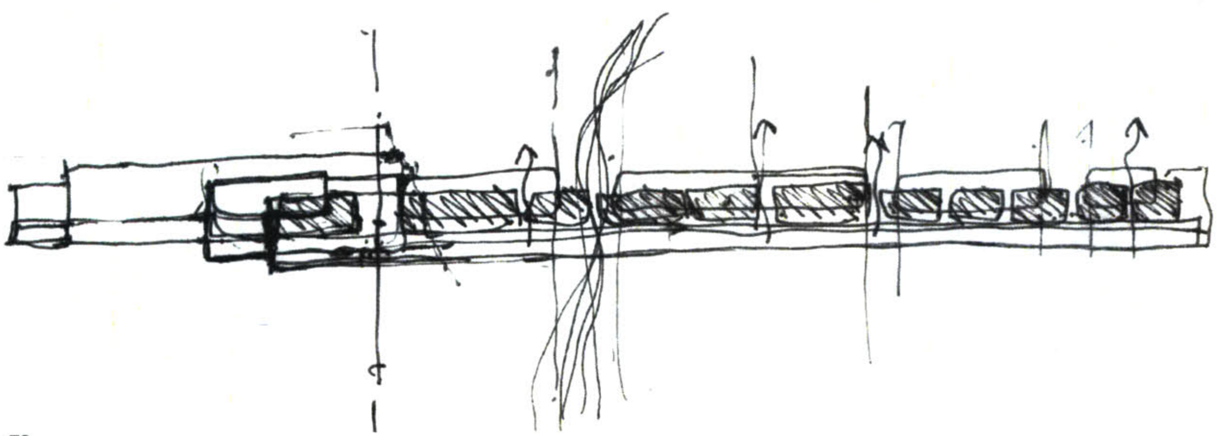


Main Approach and Entrance

Highway 395 / Main Street

Secondary Entrance - Equipment Sales / Repair

SITE PLAN @ 1" = 1000'



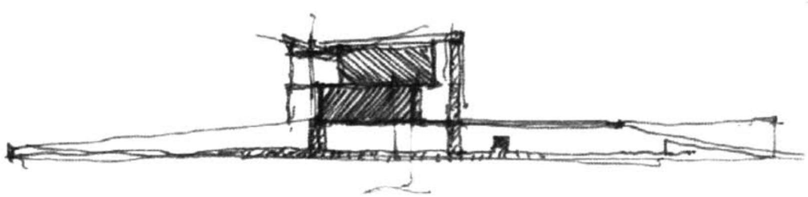
Process sketch of plan diagram.

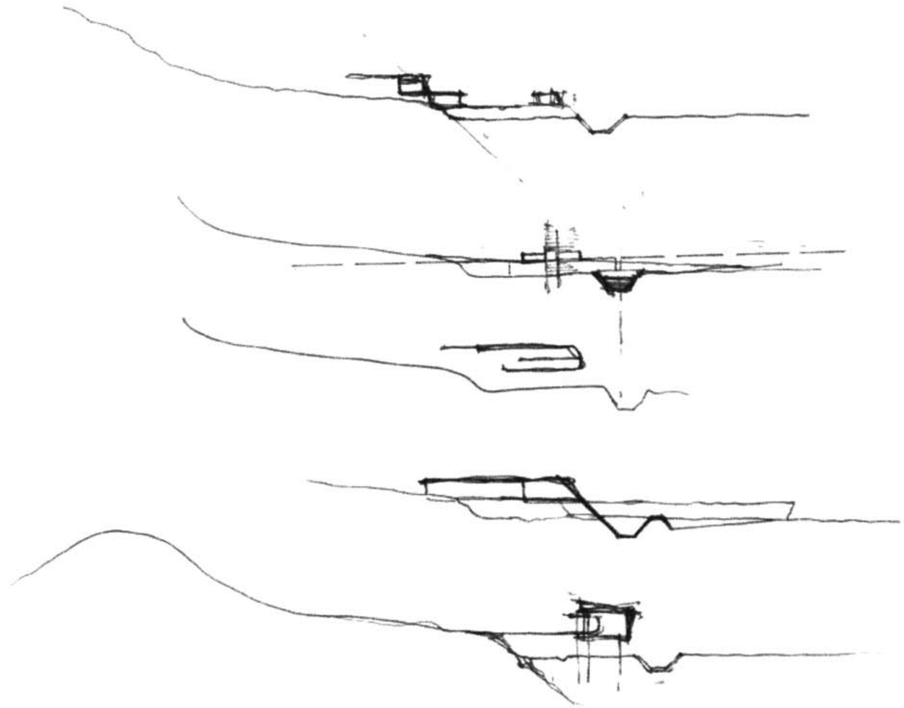
ARCHITECTURAL DESIGN

The Site Plan drawing on the preceding page illustrates the basic layout of the program on the site. The bulk of the program is oriented toward Mt. Whitney maximizing views of the mountain landscape while engaging the aqueduct in close proximity. A series of land bridges provide connectivity to all programmatic elements.

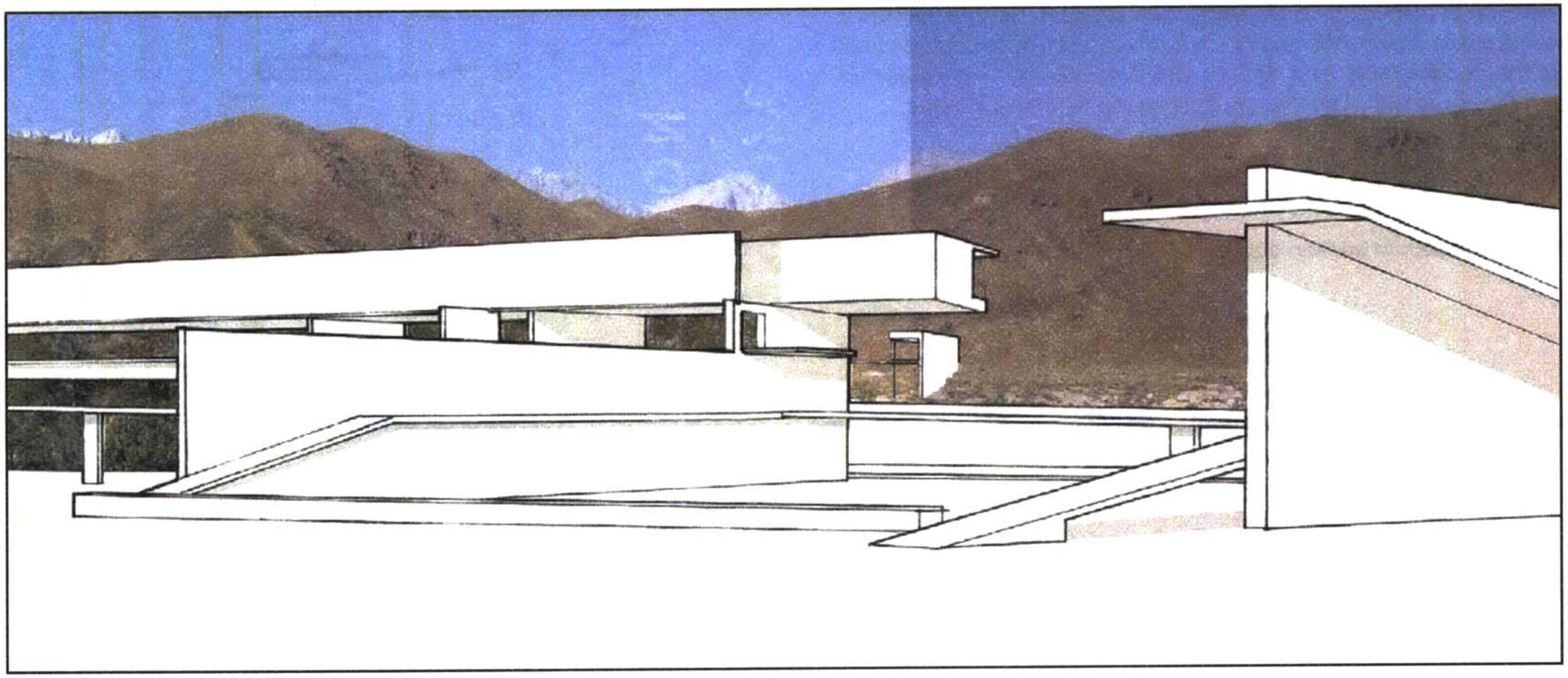
The approach to the building entrance is important so that an experience of discovery takes place. The arrival to the site intends to reveal views and conditions of the landscape by way of procession as the *building acts as a filter or mediator between the landscape and the occupant*. This can be seen in the following images.

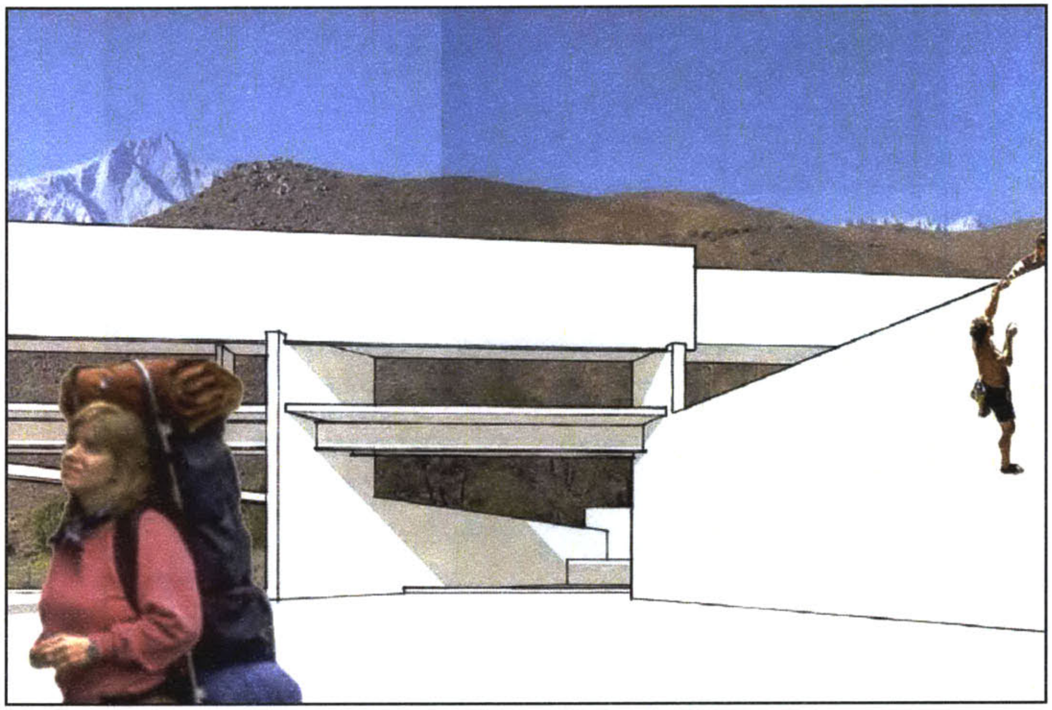
Process sketch of section diagram.

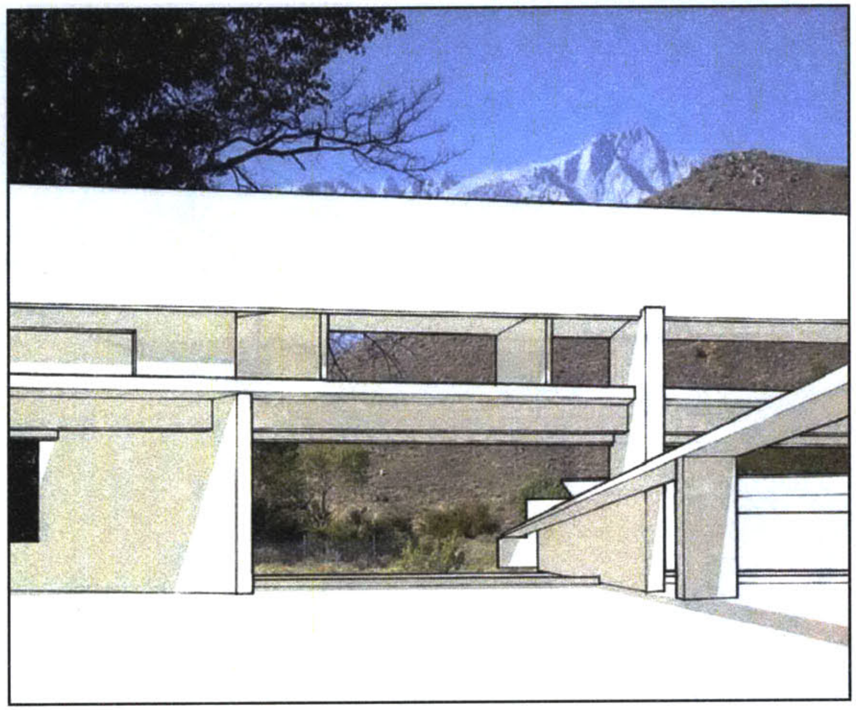


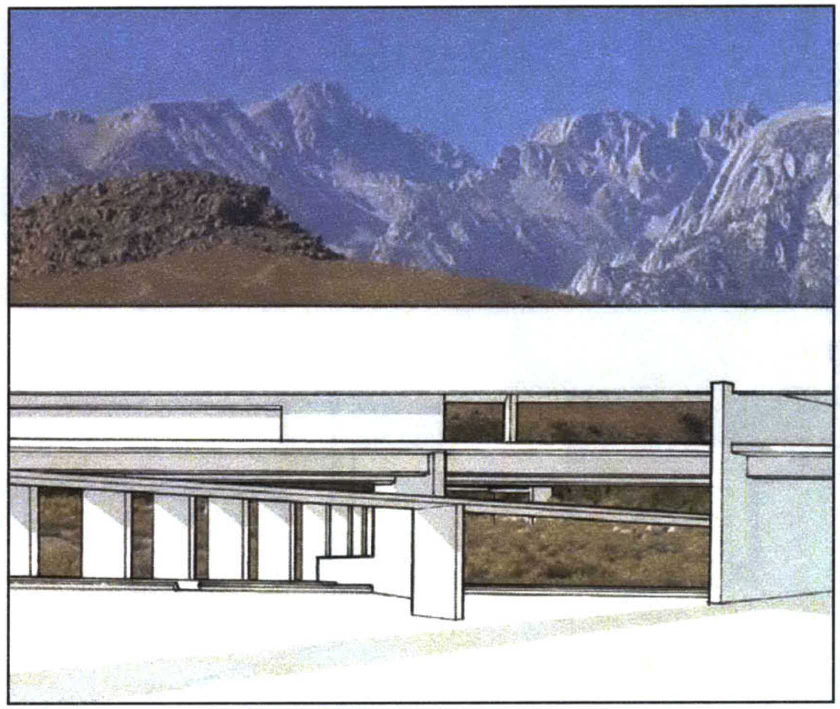


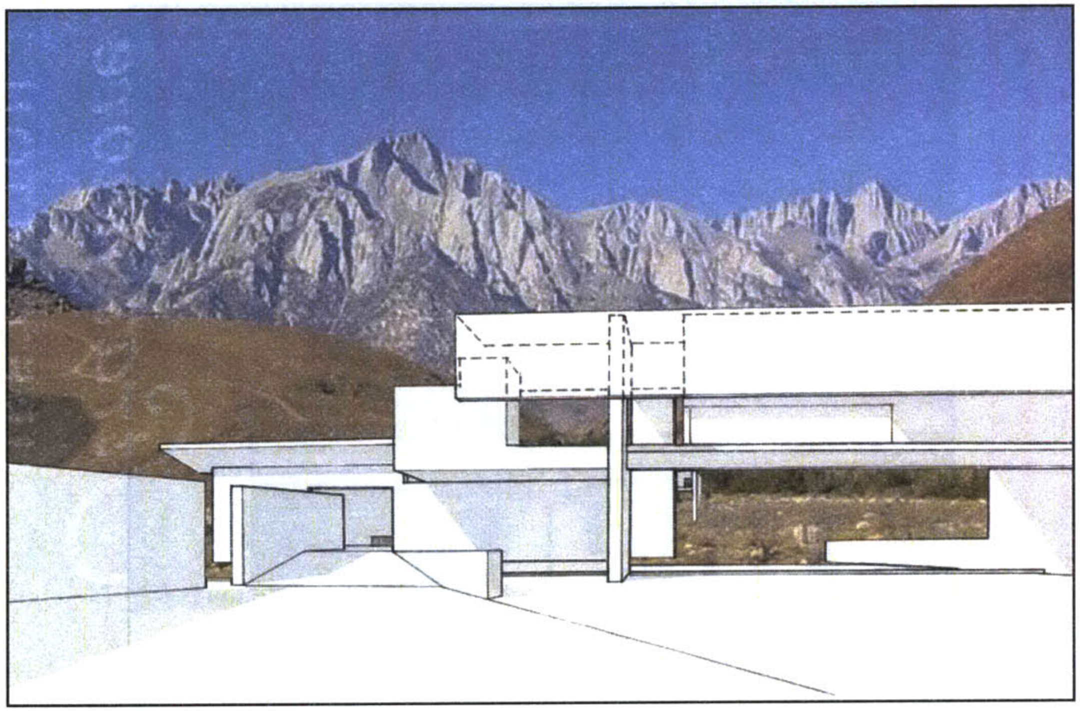
A series of process sketches of the section diagram.

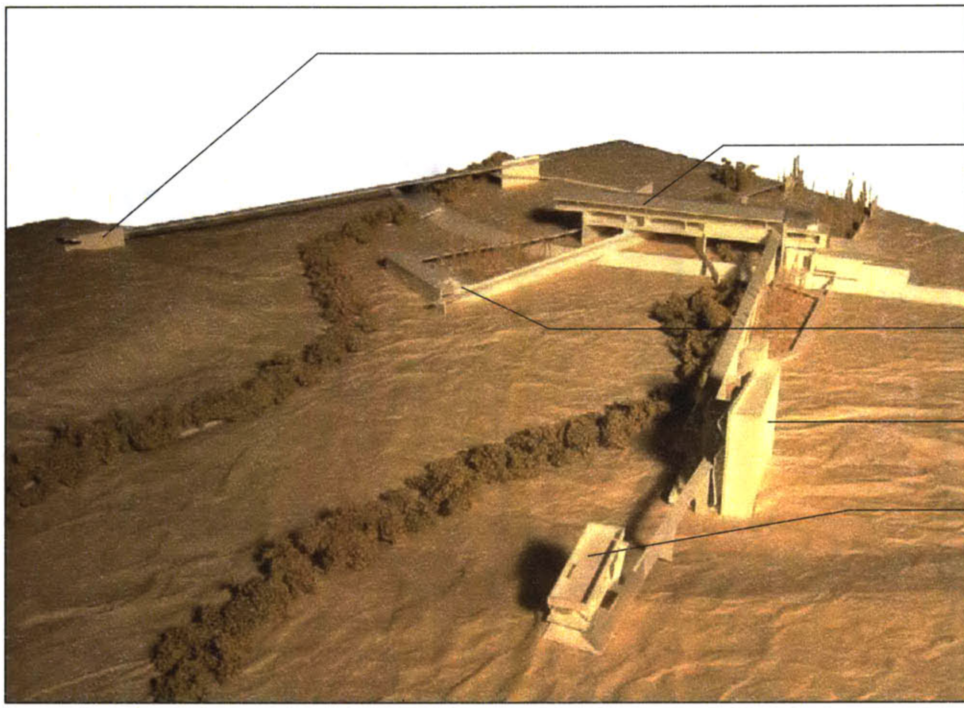






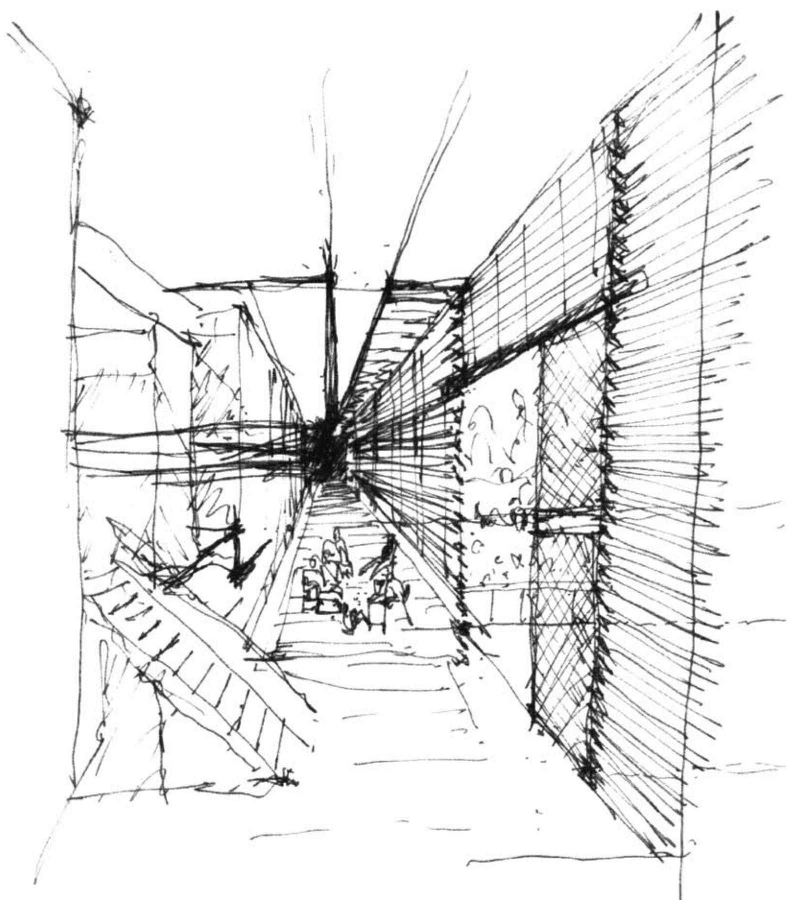




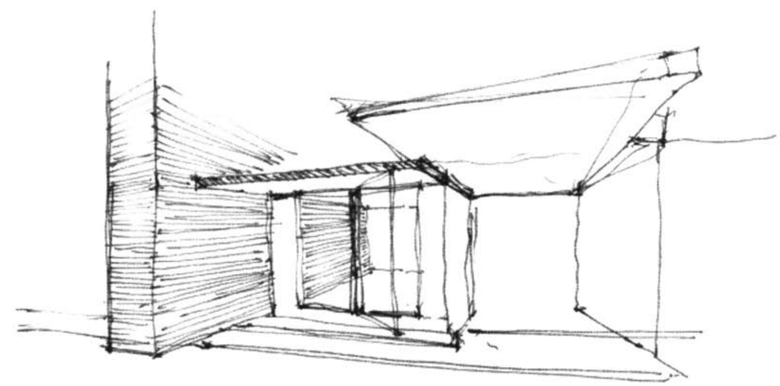


PROGRAMMATIC DESIGN

The programmatic components are separated in order to draw the occupants to various conditions on the site to create an intimacy and understanding of the natural process and the aqueduct. Additional program such as the mountain biking trail, is added in response to the park which exists in town as well as the potential for

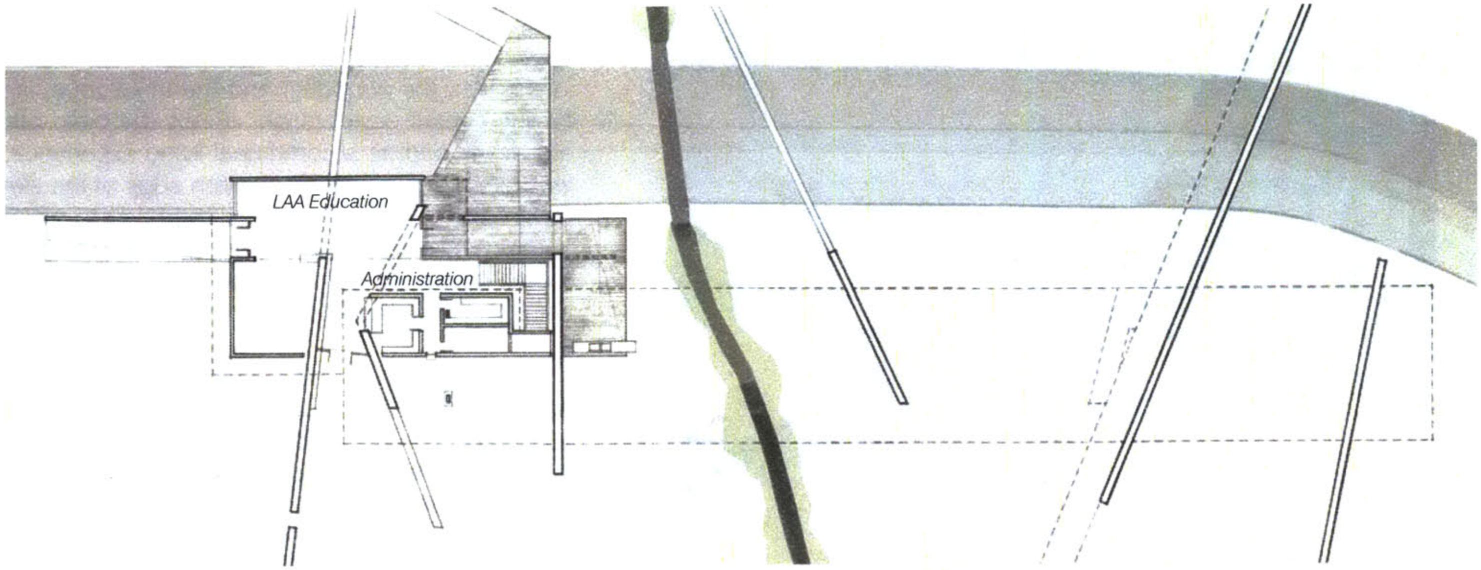


Process sketch of the main communal space or "porch".

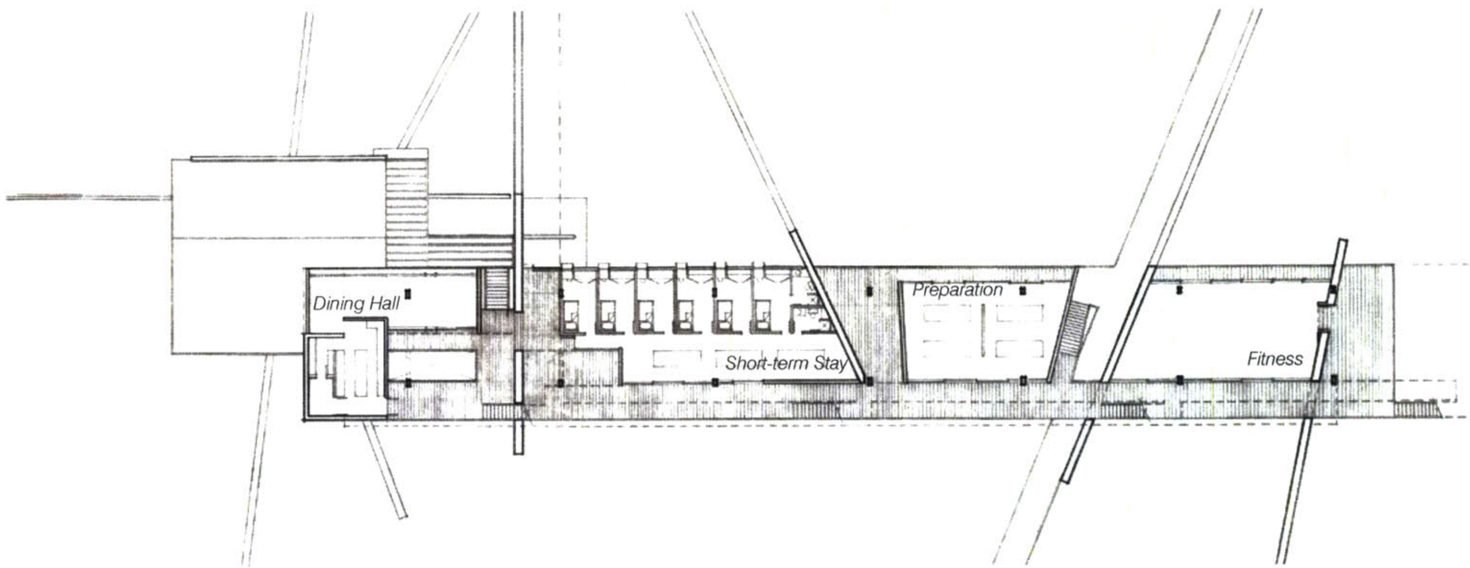


hikers to be accompanied by their bicycles. Many people meander through town on their bicycles never engaging the landscape or the aqueduct. The addition of a new bicycle trail will allow people to ride up in the tree tops twenty feet off the desert floor while overlooking the aqueduct. Similarly, pedestrians are afforded an experience of discovery of and intimacy with the diverse landscape on the site provided by the land bridges. One moment occupants could be walking in the hot dry desert with the sun piercing their eyes and before they know it they are moving through a cool lush green canopy of trees while listening to the creek below their feet.

The building proper is organized primarily into one large elevated mass which consists of all the functions related to the hikers accommodations. This mass is anchored to the desert floor by



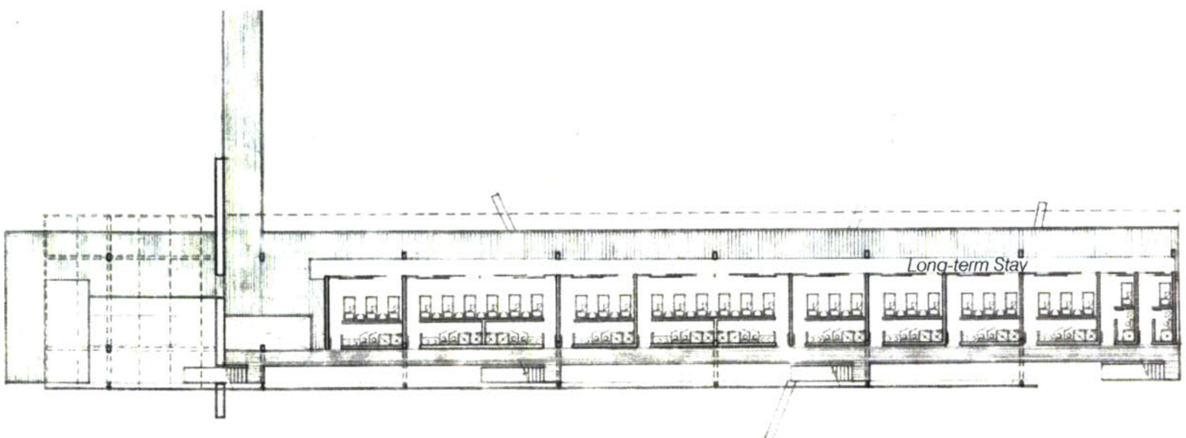
GROUND FLOOR PLAN @ 1" = 40'



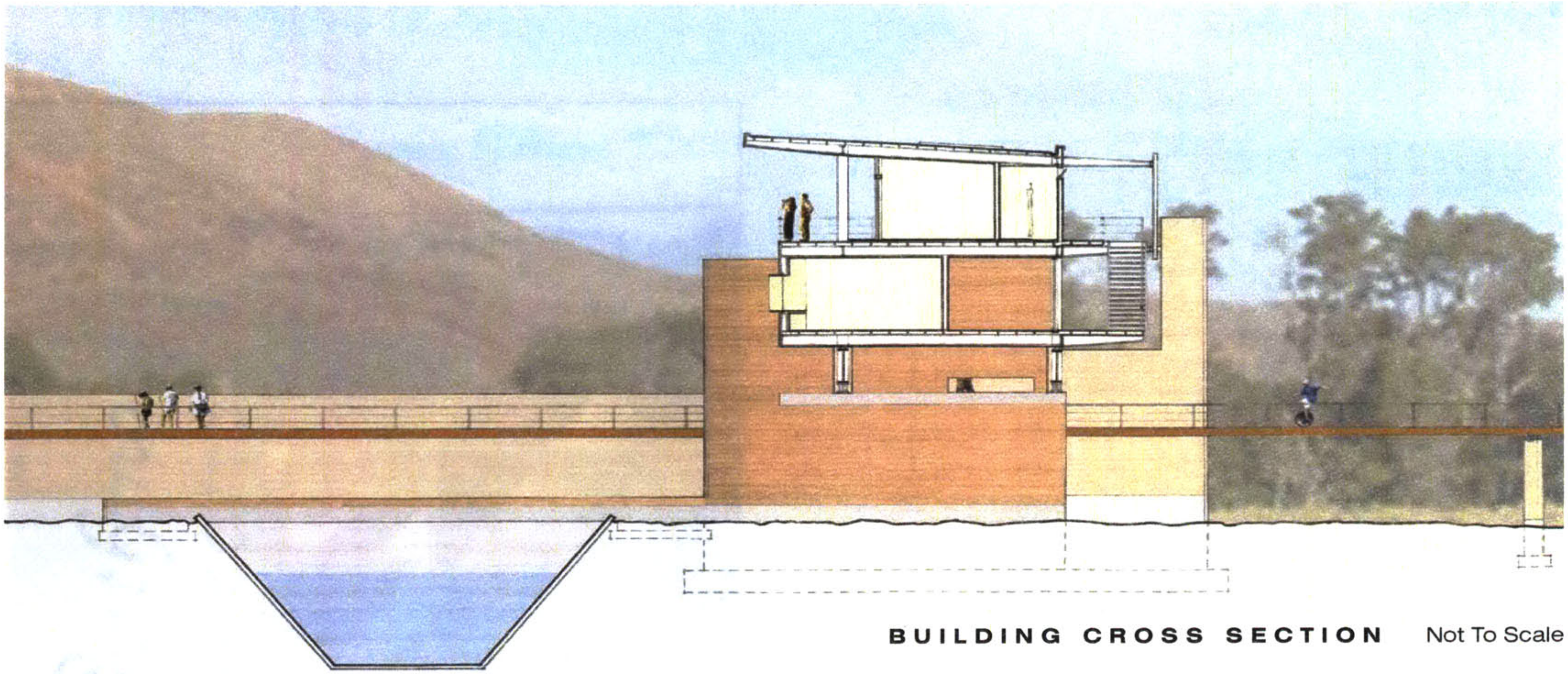
SECOND FLOOR PLAN @ 1" = 40'

a more fragmented mass, the administration and educational functions of the program. Circulation, in relation to views, social interaction, the aqueduct and the landscape, is the driving factor for the overall organization. Since the base camp was traditionally developed as a communal living experience, a social "porch" was integrated along the western edge of the elevated mass. This covered area provides a large overhang to mitigate the sun in the summer and allows for the sun to shine directly into the sleeping rooms during the winter. It also provides a large space to socialize while preparing for a hike, hanging clothing out to dry or dining.

The elevated mass is supported by a series of rammed earth or adobe walls. Rammed earth is used because it is made up of soil, an abundant and sustainable material, and it is an indigenous method of construction. The building envelope is primarilty clad in Korten™ steel revealing the additional affects of water as the building skin will rust over time. Non-native eucalyptus trees are introduced at the entrance, near the living machine and along the main land bridge in order to increase the sensual qualities of the intervention. Also, this tree type makes a connection back to southern California since this non-native species can be found all over that region.



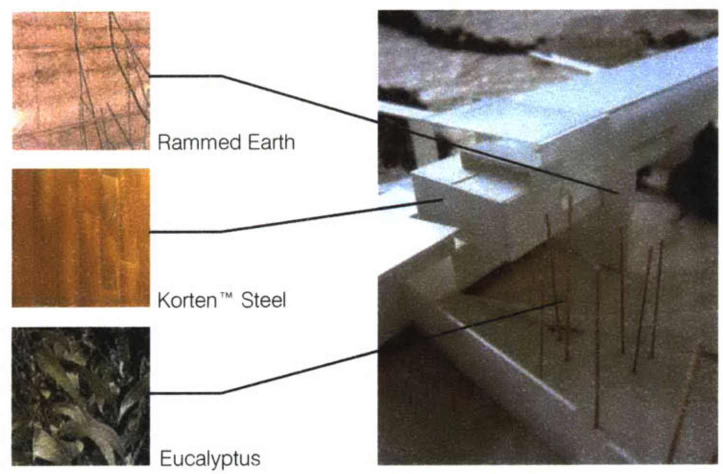
THIRD FLOOR PLAN @ 1" = 40'



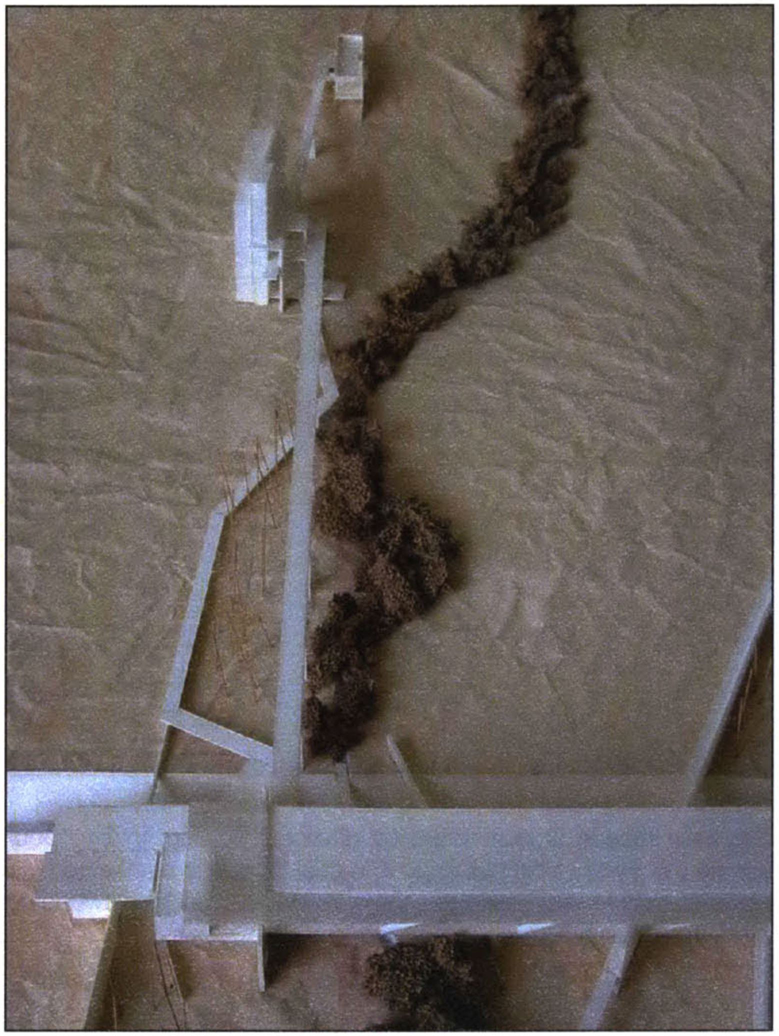
BUILDING CROSS SECTION Not To Scale

The building is articulated into two floors spanning from earthen wall to earthen wall. These spans are supported by large steel beams. As described in the material palette on the right, Korten steel clads the exterior while wood planking makes up the exterior floors. A wood-slat screen wall mitigates early day sun to the east as well as sweeping winds from the valley. For the most part, glazing dominates the west facade allowing for panoramic views and warming sunlight in the winter. The roof is sloped to capture rain water for harvesting and photovoltaics gather energy from the sun for heating and electricity.

Material Palette



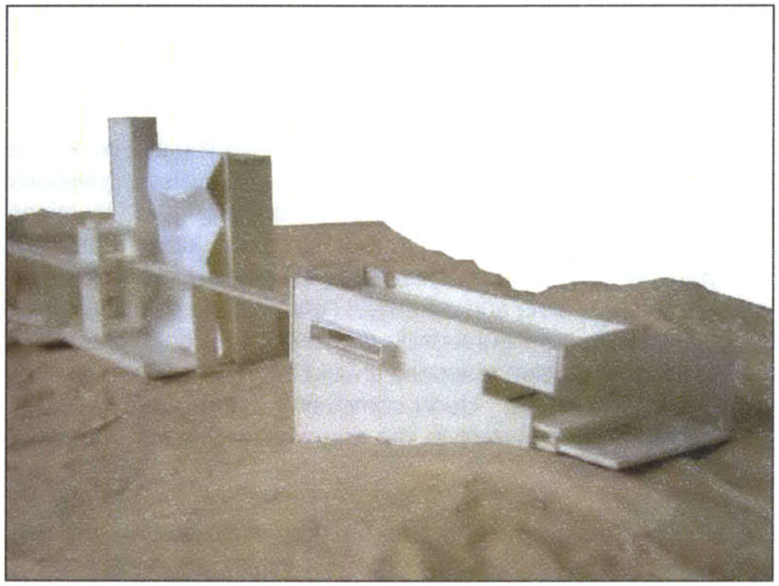
The administration and eduction components of the program lightly rest on the edge of the aquect while grounding the elevated mass of sleeping rooms floating over the aqueduct.



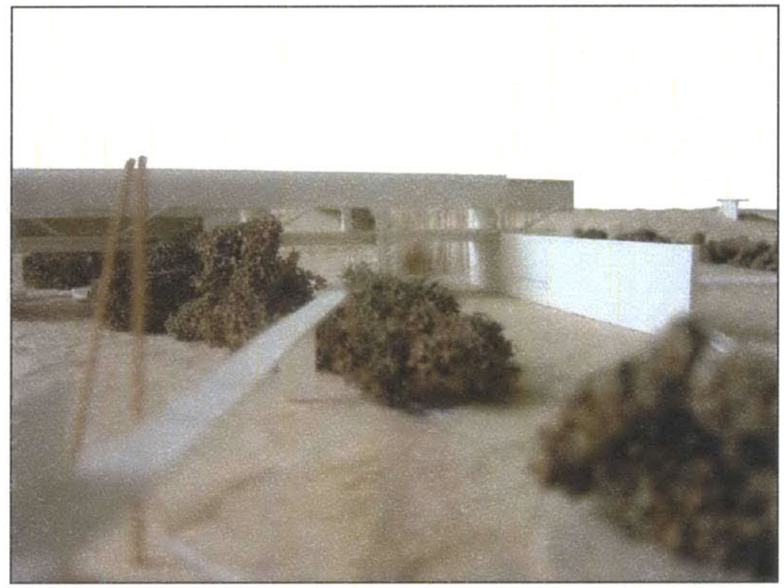
The main land bridge between the sleeping accommodations and the practice rock-climbing wall and equipment sales and repair runs along a stream of Lone Pine Creek on axis with Mt. Whitney.

Floating above the desert floor, the sleeping accommodations rest on the earthen walls. A pedestrian bridge leads from the parking to the living machine.

The west facade is dominated by glazing, allowing light to pour across the width of the building. The east facade is blanketed by a wood-slat screen that mitigates the early day sun and the sweeping winds from the valley.



In the background sits the practice facilities for rock climbing. The equipment sales and repair shop is located in the foreground embedded in the earthquake scarp.



Looking west down the pedestrian land bridge that connects the parking to the fitness facilities and the living machine, occupants are given the opportunity to engage the unique lush landscape of the desert.

CONCLUSIONS

The ideas expressed in this thesis are an investigation into an area of architecture that has been minimally explored. Neither entirely architecture nor landscape, there is a realm between the two which can aid in the harmonious understanding of our resource providing infrastructure. The Los Angeles Aqueduct was an amazing engineering feat for our country and it was constructed in a fascinating place with extreme shifts in landscape. Like the uniqueness of the site in Lone Pine, there is the potential for this type of intervention to be revolutionary in restoring lost environmental values in other communities across the world.

As I designed the base camp at Lone Pine, intending it to be a case study of sorts even though it would be part of a system, questions regarding other types of infrastructure, time periods and locations arose. How might these ideas be applied to an ancient aqueduct in Rome? What would be achieved by intervening in a landscape that was less revealing and extreme? I came to the conclusion that each site has its own personality and processes occurring within it. Any sensitive design response should take into account the site specific circumstances. Upon completing this arduous process, I learned what is important to me and what highly influences my approach to design.

Hopefully, I at least scratched the surface on presenting one particular way to restore lost environmental values by identifying the price of progress yet responding to the immediate environment of Lone Pine in a sensitive way, promoting new attitudes of conservation and sustainability. Most importantly I grew from this experience and I certainly have a better understanding of what is involved in bringing an adequate supply of water to Los Angeles.

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