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# Water Resources Development in Santa Clara Valley, California: Insights into the Human-Hydrologic Relationship

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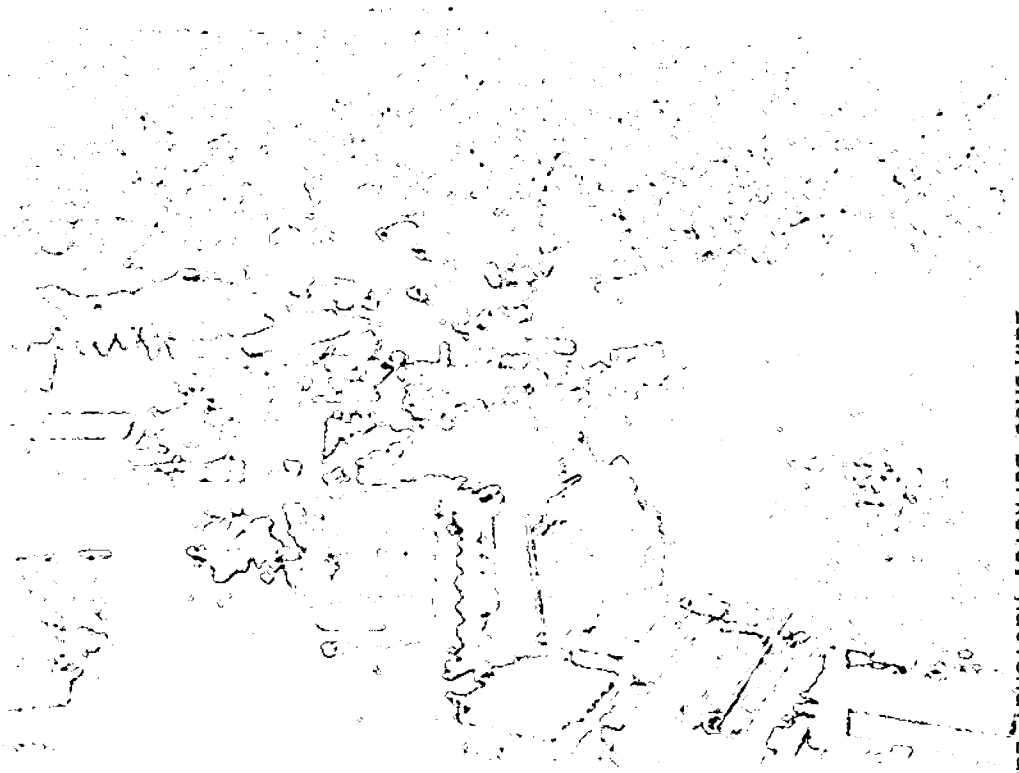
**Earth Sciences Division**

June 2000

[1]Master's Thesis



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Abstract

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by

Jesse L. Reynolds and T. N. Narasimhan

Groundwater irrigation is critical to food production and, in turn, to humankind's relationship with its environment. The development of groundwater in Santa Clara Valley, California during the early twentieth century is instructive because (1) responses to unsustainable resource use were largely successful; (2) the proposals for the physical management of the water, although not entirely novel, incorporated new approaches which reveal an evolving relationship between humans and the hydrologic cycle; and (3) the valley serves as a natural laboratory where natural (groundwater basin, surface watershed) and human (county, water district) boundaries generally coincide. Here, I investigate how water resources development and management in Santa Clara Valley was influenced by, and reflective of, a broad understanding of water as a natural resource, including scientific and technological innovations, new management approaches, and changing perceptions of the hydrologic cycle.

Market demands and technological advances engendered reliance on groundwater. This, coupled with a series of dry years and *laissez faire* government policies, led to overdraft. Faith in centralized management and objective engineering offered a solution to concerns over resource depletion, and a group dominated by orchardists soon organized, fought for a water conservation district, and funded an investigation to halt the decline of well levels. Engineer Fred Tibbetts authored an

elaborate water salvage and recharge plan that optimized the local water resources by integrating multiple components of the hydrologic cycle. Informed by government investigations, groundwater development in Southern California, and local water law cases, it recognized the limited surface storage possibilities, the spatial and temporal variability, the relatively closed local hydrology, the interconnection of surface and subsurface waters, and the value of the groundwater basin for its storage, transportation, and treatment abilities. The proposal was typically described as complementing an already generous nature, not simply subduing it. Its implementation was limited by political tensions, and fifteen years later, a scaled-down version was constructed. Well levels recovered, but within a decade were declining due to increasing withdrawals. I assert that the approach in Santa Clara Valley was a forerunner to more recent innovations in natural resource management in California and beyond.

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**Table 1. Timeline of events in the Santa Clara Valley**

| | |
|---|---|
| 1897-98 | Dry winter leads to a six-fold increase in irrigation |
| 1904 | USDA OES report on valley irrigation is published |
| 1904-05 | Bay Cities plans are defeated in *Miller* Superior Court case |
| 1908-10 | Bay Cities offers recharge plan, but is defeated in *Miller* Supreme Court case |
| 1910-13 | Using the recharge plan, Bay Cities wins *Hayes* Superior Court case |
| 1912 | Conservation Commission report details local irrigation and water resources |
| 1912-13 | Dry winter leads to increase in irrigation with groundwater |
| 1913 | First community meeting calling for a water conservation plan |
| 1917 | Preliminary USGS Water Supply Paper for Coyote Valley area is published |
| | Consistent overdraft and decline in water table begins |
| 1920 | Water Conservation Committee forms |
| | Salt water intrusion is first reported |
| 1921 | Comprehensive Tibbetts and Kieffer plan is released |
| | Voters narrowly reject a proposed district |
| 1924 | Complete USGS Water Supply Paper for entire valley is published |
| 1925 | Voters overwhelmingly reject a proposed district |
| 1926 | Water Conservation Association forms and begins demonstration projects |
| 1929 | Voters overwhelmingly approve the Water Conservation District |
| 1931 | Dramatically scaled-down conservation plan is presented by Tibbetts |
| | $6 million in bonds is rejected by voters |
| 1932 | Land subsidence is discovered |
| 1933 | DWR publishes report on the valley's groundwater |
| 1934 | Tibbetts offers an even smaller conservation plan |
| | Voters approve $2 million in bonds |
| 1936 | $600,000 in supplementary bonds is approved by voters |
| | Water conservation works completed |
| 1943 | Water table peaks before resuming decline |

"What is needed is a fundamentally new approach to the challenge of how to extract a farm living from the hydrological cycle, both in humid and in arid regions. That requires vision more than technique: a way of perceiving, a set of mental images, an ethic controlling agricultural policy and practice." – Donald Worster[1]

# I. INTRODUCTION

The foundation of how a society interacts with its natural environment is its methods of food production. For hundreds of years these methods have generally intensified due to the pressures of increased food demand and economic gain. This has been manifested not only as a regime of physical and energetic manipulations radically unlike those of previous eras, but also as profoundly new cognitive perspectives of the environment. How water, an essential component of food production, is used and understood has undergone a dramatic evolution through this process.

Water resources maintain ecosystems, human life and health, economies, and cultures. Their importance has increased with agriculture intensification, especially through irrigation. Groundwater, in particular, plays a critical role in this by helping to produce one-third of the world's food.[2] Groundwater has several benefits over surface water. The occurrence of groundwater is more consistent spatially and temporally, reducing risks, costs, and transmission losses. Throughout the world, reliance on groundwater is increasing as available surface water of adequate quality dwindles.

California has a history of rapid agricultural intensification, irrigation development, and groundwater extraction, yielding immense economic benefits but also

[1] Worster, 1993, p. 131
[2] Serageldin, 1995

significant environmental and social costs. Santa Clara Valley, at the southern end of San Francisco Bay, offers a remarkable case of the development of groundwater for irrigation and, later, for urban uses. Increased reliance on groundwater and a series of dry years led to consistent overdraft beginning in 1917. Within four years, a group dominated by orchardists organized and funded an engineering investigation to halt the decline of well levels, producing an elaborate water salvage and recharge plan. Once a scaled-down version of the plan was implemented nearly fifteen years later, well levels were stabilized and even partially restored for a number of years.

This story is instructive because responses to this unsustainable resource use were, to a large degree, successful. Moreover, when placed in the context of its time, place, and the common understanding of the hydrologic cycle, it becomes illuminating from geographical, engineering, and historical perspectives. Geographically, the Santa Clara Valley serves as an uncommon natural laboratory where the boundaries of surface water hydrology, groundwater hydrology, county, and water districts generally coincide. Although they were not entirely novel, the proposals for how to physically manage the water resources incorporated several new approaches which, when evaluated as a whole, reveal significant evolution in the relationship between humans and the hydrologic cycle. In fact, Santa Clara Valley was later recognized by the American Society of Civil Engineers as:

> the first and only instance of a major water supply being developed in a single groundwater basin involving control of numerous independent

> tributaries to effectuate almost optimal conservation of practically all of the sources of water flowing into the basin.[3]

Another reason this case is of interest is that the valley experienced many of the major economic and social trends of California. At the time of this development, it was in transition from a pastoral and extensive agriculture regime to a hydraulic and intensive mode of agricultural production. In fact, one report claimed it was the largest area in the world irrigated exclusively by wells. Furthermore, this occurred during the era of the development of many of California's major water projects such as San Francisco's Hetch Hetchy, Easy Bay Municipal Utility District, Los Angeles' Owens River and Colorado River Aqueducts, and the Central Valley Project. However, the historiography of the water resources development in Santa Clara Valley is less robust than those of the others.[4]

The overall goal of this thesis is to investigate how water resources development and management in the Santa Clara Valley was influenced by, and was reflective of, a broad understanding of water as a natural resource, including scientific and technological innovations, new management approaches, and changing perceptions of the hydrologic cycle. At the least, this includes explaining how the water resources program originated and was implemented. More importantly, I will use the 1921 plan as a centerpiece, placing it within the context of ideas of the hydrologic cycle, new technologies, innovations in institutional arrangements, market forces, and political ideologies.

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[3] Statement by Robert L. Morris, President of the San Francisco Section of ASCE, in American Society of Civil Engineers, 1976

[4] Pillsbury, 1930. I have clearly borrowed the modes from Worster, 1990. The only sources which attempt a comprehensive history are McArthur, 1981; Martin, 1950; Walker and Williams, 1982; and Smith, 1962. (continued...)

## *Methodological framework*

This task clearly has an interdisciplinary foundation. The questions presented here are informed by fields such as regional and historical geography, which address how people have perceived and modified landscapes, and by environmental anthropology, which contributes an analysis of the cultural politics of meaning.[5] However, environmental history provides the best framework because of its emphasis on the use of the narrative form to "explore the ways in which the biophysical world has influenced the course of human history, and the ways in which people have thought about their natural surroundings."[6] Although this may initially seem conceptually awkward or amorphous, this approach can help us recognize the threads that connect people, cultures, technologies, and the environment.

In the most cited explanation of environmental history, Donald Worster details three general themes of the field. First, it traces the ecological history of past natural environments. The second avenue of research is the history of how societies produced what was needed and wanted, and how nature was manipulated and reorganized in the process. Finally, it examines the perception and value of the environment. This acknowledges that ideas themselves are ecological agents, and they are the products of location, time, culture, and individual personality. Of course, these are not isolated, since the environment, technological and social institutions of production, and ideology are dynamically and mutually interactive.[7]

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The latter two used only aspects of the development to support a more general assertion. In contrast, the other projects have been examined in numerous books, articles, and theses.

[5] For geography and anthropology, see Glacken, 1967, Nir, 1987; Powell, 1996; and Milton, 1993.

[6] Worster, 1996, p. 5

[7] Worster, 1990

The environmental history of water development has thus far been generally limited to the first two themes, yet water clearly carries powerful cultural precepts of its behavior, nature, and potential uses. These are apparent in myth, allegory, and religion, often with sacred roles of birth, cleansing, transformation, and death. Also, the occurrence of water is a fundamental influence on the course of human cultures and civilizations. Moreover, water management has political messages, such as a British dam in India as a symbol of either progressive development or imperial exploitation. In some communities, the collection and distribution of water act as vital social and political forums. It is "as vital to our minds as to our bodies" and is "the most widely used metaphor."[8] And the metaphors we employ help construct our understanding of reality. For example, "reclamation" implies not only a task left unfinished by nature, but that the resources must be saved from some detrimental fate. Alternatively, the "duty of water," a term for the optimal amount of irrigation water for a crop, suggests some sort of hydrologic imperative.[9]

The ultimate purpose of environmental history is to explain why societies often have problems interacting with their natural environment. All humans impact their environment, yet they have chosen (however unconsciously) to do so in a wide variety of ways. This body of past choices and experiences can inform present difficult decisions. By considering local environments, social norms and structure, ideologies, economic

[8] Worster, 1994b. For examples, see Tuan, 1968 and Moore, 1998.
[9] Back, 1981; Cosgove, 1990; Igler, 1996; Opie, 1993

conditions, and technologies, we can learn how to minimize the risk of unsustainable practices and environmental destruction.[10]

A realization stemming from exploring these past decisions is that of the historical contingency of knowledge. William Cronon advises that, "recognizing [this] helps us guard against the danger of decontextualized 'laws' or 'truths' which can all too easily obscure the diversity and subtlety of environments and cultures alike."[11] Modern science presently reigns as the body of the most powerful "universal truths," and the recognition of its constructed nature is profound. Yet when examining past decisions, historians all too often ignore the possibility of variations in the cultural understanding of natural systems and resources. Consequently, historians:

> must contend with the cultural rooted dimensions of knowledge, rather than relying entirely upon the "truth" of modern science to explain everything. We need to make sense of the often dramatic difference in past versus present claims about the physical world, rather than simply dismissing the old assumptions and understandings as incorrect.[12]

Because of the reliance placed on science to guide our interactions with the natural environment, it is critical that environmental history investigate the context and development of science, as well as how it has been manifested in engineering practices, regulation, and institutional arrangements.

Using the decline of California fisheries from 1850 to 1980, Arthur McEvoy has provided a compelling example of the historical contingency of science, its influence on management, and the sometimes disastrous results. Moreover, this example presents a striking parallel with groundwater development. During the nineteenth century, the

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[10] Cronon, 1993; Bird, 1987
[11] Cronon, 1993, p. 16

natural environment and economic forces were understood to be outside the sphere of human affairs. Consequently, the depletion of natural resources was seen as an inevitable part of progress, any conflicts were simply the result of competition among users, and regulation was minimal in this *laissez faire* climate. By the Progressive era of the early twentieth century, the reduced abundance of natural resources was evident. The prevalent belief was that centralized regulation based on impartial scientific evidence would result in ideal resource consumption. Although these models were congruent with Progressive ideas of nature and the market, they ignored climatic variation, ecological interactions, technological developments, and the political economy of legislation. Consequently, the populations of several fish species crashed. After World War II, these simplifications were criticized, and the narrative of the "Tragedy of the Commons" implied that external costs must be internalized, or that common property resources must be placed under one owner or regulator. More recently, attempts have been made to incorporate non-monetary values, ecosystem noise and interrelations, and culture into this approach. It is now apparent that regulation is as much a social endeavor as a biological one.[13]

Although Joseph Petulla asserts that environmental history has a "freedom from hang-ups about traditional methodologies," the primary device is clearly the narrative, which is subject to what the author chooses to include and exclude, and when to begin and end. Many of the narratives of this field have focused on environmental degradation and the failures of people to prevent them. In contrast, the story presented here is one of

[12] Rosen and Sellers, 1999

adaptation and temporary success, congruous with Marvin Harris's theory of cultural materialism. In this, the "techno-environment" is the core of a society's production. Due to population growth and a desire for greater consumption, production increases, creating pressures on natural systems. The techno-environment must be revised, or natural resource systems may collapse. Here, I focus on how one society harnessed the local hydrologic cycle and reorganized it as part of an agroecosystem and of market systems. When this resource was evidently in decline, the society utilized collective action and political leverage to mobilize science and engineering to revise their relationship with the hydrologic cycle. Success was brief, however, because of the limited actions taken and the continued rapid increase in use of the resource.[14]

### *Water resources development in California*

Understanding the importance and difficulty of water resources development in California reveals the relevance of the case of groundwater exploitation and conservation in the Santa Clara Valley. California is not a truly arid state, but instead is characterized by great temporal and spatial variation of precipitation. Most precipitation occurs in the north and during winter, whereas the bulk of demand is in the southern part of the state and during the summer. The use of 80% of the state's developed water supply to irrigate 10 million acres[15] has helped produce an exceptional agricultural regime, characterized by intensive and specialized production, large farms, and corporate control. Indeed, since

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[13] McEvoy, 1986. A concise summary can be found in McEvoy, 1988. Another example of changing attitudes toward a resource is Prince, 1997.
[14] Petulla, 1985; Cronon, 1992; Harris, 1979
[15] The standard American units are used in most sources for this thesis, and are retained here. Abbreviations and conversions can be found in the appendix.

the 1940s California has led the United States in the dollar value of agricultural production.

Frequently, difficult decisions must be made regarding the acquisition, distribution, and impacts of water resources. A source of frequent and contentious debate, this management involves competing users and uses, as well as environmental and social impacts. Water development is typically promoted by land speculation and urban growth interests. Moreover, it has resulted in technocratic elites and powerful hidden agencies with little oversight that produce policy based on maximizing exploitive gain but hindered by political fragmentation. Therefore, political scientist David Feldman argues that, "Water problems are the result of misguided and misdirected human actions. They are not the product of physical or technical limitations."[16]

Most histories of water resources development in California have focused on political economy. Instead, I propose a general narrative of water management that is more materialist and less critical of social institutions and power relations. Due to technological advances, increasing consumption, and rising population, regions typically experience an increase in the demand, and subsequently the cost, for water. Overlain on this are additional concerns regarding the impacts of water use, such as endangered fish species. The typical result is some combination of the acquisition of new supplies, technological innovation, and refined management institutions. Less frequently, the response may include a cultural component, such as the previously unconsidered notion of demand reduction. When examined on a broader scale, these responses reveal an

[16] Karhl, 1983; White, 1985; Gottlieb and FitzSimmons, 1991. The quote is from Feldman, 1991, p. 26.

evolution in the relationship between humans and the hydrologic cycle. We increasingly manage greater spatial and temporal scales, as well as more components of the hydrologic cycle, other natural systems, and human systems. Yet the results of these innovative approaches have been inconsistent, and sometimes leading to clearly unsustainable practices and alienated parties. An understanding of how scientific and technological innovations, new management approaches, and changing cultural perceptions of water as a resource have been incorporated into policies in the past will aid in the future formation of sustainable water policies.

A major shortcoming of existing studies of California water resources development is the lack of attention given to groundwater. Although it has less romantic appeal than the legends of surface water conflicts, groundwater is critical to understanding past and future water management. Groundwater is estimated to comprise 98% of the world's fresh water and presently provides an average of one-third of California's developed water supply. Moreover, this average conceals the value of groundwater as a buffer to variable and uncertain surface supplies. In addition, groundwater depletion has been the catalyst behind the growth of the state's agricultural economy and many of the state's major surface water projects:

> It is common knowledge that the great economy California enjoys today took root and germinated primarily on groundwater supplies which have been naturally available when needed and, generally, where needed. This bountiful resource has required only the drilling of a well and installation of a pump.... The low capital cost has favored such development by individuals as well as by public agencies. Most of the large surface

> systems that serve our great cities and irrigated areas have been made possible by the economy that developed on groundwater supplies.[17]

In general, groundwater is typically available when and where it is needed, at a uniform temperature, and often at a high quality. Its greatest advantage may lie in the properties of aquifers, which provide storage at little cost, with no evaporation or flooded reservoir sites, and the ability to purify and transport the water.

Yet there is evidence that California is squandering its groundwater resources. The average annual overdraft of groundwater is 1.5 million acre feet (af), and there is widespread contamination and salinization. Despite these facts, California lacks a statewide groundwater management structure. Instead, it relies on a variety of local districts and court-ordered adjudications. These institutions often cross traditional political boundaries, and are "incremental, sequential, and self-transforming" in order to account for local conditions and the dynamic nature of water cycling. Thus, there are aspects inherent to groundwater which make it difficult to manage. Not only does groundwater behave much differently than the surface water with which people are accustomed, but also its dimensions and movements are difficult to observe. Moreover, the vast size of aquifers can give the illusion of abundance. Because aquifers tend to underlie the flat valley floors attractive to development, groundwater is especially susceptible to contamination. Perhaps the most difficult facet of groundwater management is its "common pool" nature. In a common pool resource, the consequences of use are shared by all users. These reciprocal externalities engender the problem of the free rider. This, coupled with America's tradition of minimal governance, has made the

[17] From a talk by Albert J. Dolcini, water resources engineer, given at Berkeley, CA, June 26, 1963, quoted (continued...)

efficient and equitable distribution of the costs and benefits of groundwater management among present and future users a very elusive task. Yet these difficulties make groundwater management imperative, as well as a tool for social justice.[18]

There are relatively few histories of groundwater development. The Ogallala aquifer of America's High Plains is the best studied, and helps illuminate the case of Santa Clara Valley. The first attempts at settling this "Great American Desert" failed, despite the faith that the rain would follow the plow. Irrigation, although largely promoted by speculators, was eventually admitted to be necessary, but surface water supplies were inadequate. Groundwater was perceived as mysterious, inexhaustible "sheet water" or underground rivers, and this belief in abundance was supported by government investigations. Pumping remained problematic until a set of events changed irrigation from an expensive backup supply to the primary source of water. These events were natural (drought), social (more knowledge of groundwater, better lines of credit), and technological (improved drilling techniques, superior pumps, and center pivot irrigation). Intensive groundwater use revolutionized agriculture on the High Plains, and furthered the faith in unlimited progress. Soon, the water table declined, and management districts were formed in response. However, their goal was not to restore the aquifer, but to promote efficient resource exploitation and to preserve property rights. Although the common belief remains that technology will soon find the solution to the depleted aquifers, some researchers assert that technology has merely delayed reaching natural limits. These themes of an early reluctance to irrigate and the mysterious nature of

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in Cooper, 1968

groundwater, giving way to confidence in progress through irrigation and engineering is present in the Santa Clara Valley.[19]

[18] California Department of Water Resources, 1998; Blomquist, 1992; Fiege, 1999; Bittinger and Green, 1980; Tarlock, 1985; Gottlieb and FitzSimmons, 1991; Ostrom, 1990; Opie, 1993

[19] Green, 1973; Bittinger and Green, 1980; Opie, 1993; Blomquist, 1992; Chapelle, 1997. The first three detail the Ogallala aquifer.

## II. PRELUDE: EVOLVING APPROACHES TO NATURAL RESOURCES

The historical context of changing approaches to natural resources is required to understand the innovations of the water development project in Santa Clara Valley. Nineteenth century California experienced an overwhelming influx of Anglo peoples, technologies, and culture. In this climate, unparalleled resource exploitation and faith in progress led to new concerns over the limits of natural resources. Coupled with a newfound confidence in the objective reasoning of engineers, California was fully engaged in the Progressive revolution at the start of the twentieth century. Increased use and management of water produced not only new scientific understanding and legal institutions, but also a novel relationship with the hydrologic cycle.

### *Natural resources, engineering, and the rise of a conservation ethic*

The Anglo-Americans who arrived in California possessed a similar view of natural resources akin to the Spanish and Mexican people in one regard: God had designed an orderly and definable nature for humans to exploit. The new Americans added a belief in inexhaustible natural resources, and consequently followed a different management strategy. Unlike the Spanish systems of community resource regulation, the Americans adopted a *laissez faire* approach. Furthermore, they felt a duty to make natural resources productive, and to improve and bring order to a chaotic Earth.[1]

However, seeds of concern were germinating. Charles Darwin challenged the assumptions of a static planet designed for humans, and the theme of humans modifying,

[1] Koppes, 1988; Hundley, 1992

or even defiling, nature appeared in the works of several writers. In particular, George Perkins Marsh's *Man and Nature* described the limits of natural resources and the need to conserve. Although the world was now seen as more dynamic, undermining the absolute faith in progress required evidence of resource depletion, and California scientists were on the vanguard of perceiving these limits. The collapse of the salmon fishery led to the 1870 formation of the California State Board of Fish Commissioners, the first government agency to regulate natural resource use. Furthermore, the official closing of the frontier following the 1890 census had a profound effect on the belief of limitless nature. For the first time, Americans had to consider the intensive use of available land instead of simply "moving on to better pastures," and publicly debated which uses and communities would be best for the limited supply of land. Paralleling this were an increasing concerns for the power of monopolies and the development of a Romantic appreciation of nature, such as in the writings of John Muir. Although still squarely within the paradigm of economic growth, Americans had developed a discontent with unbridled capitalism and a redefinition of their relationship with nature, setting the tone of conservation politics in the next century.[2]

Another development in the late nineteenth century that contributed to the conservation ethic was the rise of the engineer. Engineering was an established career, but by the 1890s a professional ethic developed in which, "engineers saw a united and dedicated profession providing society with enlightened leadership in its dealings with the harmful effects of technology" in order to produce abundance and wealth.[3] Some

[2] Marsh, 1864; Huth, 1957; Glacken, 1967; Smith, 1987; Koppes, 1988; Stoll, 1998
[3] Layton, 1971, p. viii

carried a broader zeal, believing that the objective engineering professionalism gave them an imperative to reform society. At the same time, the emerging Progressive view envisioned an efficient, non-partisan, and machinelike society, with a faith in the human capacity for improvement. Coupled with widespread concerns over the limits of natural resource extraction, the public placed faith in engineers to manage resources objectively and efficiently. For example, conservationists believed that the maximum sustained yield, the rate of resource extraction that equals the rate of replenishment, could be easily found through objective science. By the turn of the century, engineers were essential to resource and city management.[4]

Thus, the confluence of concern over a dwindling supply of limited resources, the Progressive ideal of a managed society, and faith in the applied science of the engineer established a conservation movement. Although there were anti-monopoly sentiments, it was not anti-capitalism. In fact, large industries fully supported the transition from uncoordinated to scientifically optimized resource utilization. By working with industry, the focus of conservation was kept on the patterns of resource use, not the distribution of benefits. This "gospel of efficiency" overwhelmed concomitant movements for equity and aesthetic appreciation of nature. One fervent proponent asserted that, "It is a sin and a crime to allow a drop of water that can possibly be restrained to get away into the ocean and not be made to work."[5] However, the focus on optimization was not a call to dominate nature, but instead was often seen as improving or finishing its work. For example, another conservationist wrote, "Nature has done all that it can for us. We must

[4] Layton, 1971; Pursell, 1985; Clements, 1980; Cosgove, 1990
[5] Anonymous, 1926, p. 123

do the rest."[6] Furthermore, conservationists were beginning to consider the interdependence of natural systems, especially the relationships between forest cover and the hydrologic cycle, particularly in California.[7]

Despite its emphasis on the capacity of objective applied science to optimize resource use, conservation remained a political issue because it is inherently a distribution of costs and benefits. Thus, a social conflict had been redefined as a technical problem. Consequently, technical experts were entrusted to implement, legitimize, and even promote a conservation political agenda. Although conservation was typically cast as a democratic movement, it was in tension with American ideals of individualism and local control as power shifted to a centralized and technocratic elite. Cadres of developers and managers grew around resource issues, but they were largely hidden from the public. Conservation historian Samuel Hays has written, "A vigorous and purposeful government became the vehicle by which ideals derived from an individualist society became adjusted to a new collective age."[8]

Therefore, by the early twentieth century, a sense of resource scarcity and the Progressive faith in social improvement engendered a conservationist philosophy. By strengthening that faith and responsibility placed in engineers, this did more than centralize power. It also established supply development through physical means as the dominant paradigm of water management and empowered a powerful but largely hidden community of water managers. These are epitomized in the 1902 passage of the federal Reclamation Act. The phalanx of engineers of the new Reclamation Service was to

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[6] Thomas, 1901, p. 85

[7] Hays, 1959; Smith, 1987; Koppes, 1988. Cronau, 1908 is an exemplary conservation piece.

objectively optimize water resources for the landless and small farmers. But like most visions, this one fell short of the ideal. Reclamation was co-opted by industrial agriculture, which soon was subsidized through federal water.

### *Changing perceptions and management of water*

Water permeates human culture, particularly in arid areas. Native Americans explained hydrologic phenomena through myths, and water was central in many stories of creation, regeneration, and death. Their settlement patterns were strongly influenced by the availability of water. Although they did manipulate the hydrologic cycle, such as in the irrigation practiced by some California groups, later groups were more aggressive. For example, their Spanish irrigation systems was a central priority for the Missions. Yet like the Native Americans, individuals held no water rights, and ownership of the water resided with the Spanish King. Under the Plan of Pitic, water systems were managed and maintained by the community, although Native American neophytes contributed most of the labor at the Missions. All users would proportionally reduce diversions in times of shortage, and disputes were resolved by a *mayordomo*. These traditions generally continued under Mexican rule.[9]

Although the understanding of water and the hydrologic cycle among the Anglo-American settlers was undergoing rapid change in the nineteenth century, it derived from a rich cultural heritage. Water was central to Christianity's vision of transformation, and it was seen as a divine gift, making the world fertile for humans. Even with the rise of modern science, some Enlightenment philosophers asserted that the

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[8] Hays, 1959; Koppes, 1985. The quote is from Hays, 1959, p. 271.
[9] Adams, 1946; Back, 1981; Dunbar, 1983; Hundley, 1992

balance of the hydrologic cycle was evidence of God's wisdom. In addition, water, and groundwater in particular, were informed by other myths. For example, springs were thought to have healing powers, and offering gifts to a well would grant wishes. In the end, however, the rise of capitalism, technology, and the Darwinian concept of a dynamic world transformed water from a sacred gift to an instrument of secular materialism. This "conquest of water" was central to the increase in the standard of living in Europe, and the control of water, as a commodity for prosperity and comfort, became a sign of social status. This revolution was not entirely spontaneous, but instead was guided by engineers and the government who funded their studies. Soon, the engineers' vision of water was imposed on the landscape, in the straight aqueduct and the levied river. More than anywhere else, this vision was evident in California.[10]

The European heritage and the commodification of water help explain the origins of the California water doctrines. Among the first acts of the new California legislature was the adoption of English common law, which included the riparian doctrine for surface water. In this, water could be diverted to land adjacent to a flowing watercourse for nonconsumptive uses, and riparian rights were correlative, or equal among themselves. The English common law included a separate doctrine of groundwater rights, which gave absolute rights to the overlying landowner. The California Supreme Court upheld this in 1871, ruling that, "Water filtrating or percolating in the soil belongs to the owner of the freehold – like the rocks and minerals found there."[11] This was not mere tradition: groundwater behavior remained largely mysterious, and the courts were

[10] Tuan, 1968; Goubert, 1986; Guilerme, 1988; Cosgove, 1990; Worster, 1994b; Chapelle, 1997
[11] *Hanson v. McCue* 42 *Cal.* 303, 1871.

reluctant to administer it. One Ohio court said that groundwater is "so secret, occult, and concealed that an attempt to administer any set of legal rules in respect to [it] would be involved in hopeless uncertainty," and a Vermont court asserted that it has "secret, changeable and uncontrollable character."[12]

Meanwhile, the miners of California developed an alternative doctrine of prior appropriation for surface waters. Unlike riparian and groundwater rights, these are prioritized by the date they were established, and are separate from land ownership. California's appropriative rights embodied the increasing commodification of water for productive advantage and personal gain. A contemporary observed that, "The water, instead of remaining appurtenant to the land, becomes alien to it; it is a thing apart which one can own, though he does not possess the soil."[13] It is not surprising that in this individualistic and *laissez faire* era, government regulations were minimal. Most water suppliers were private companies, and state water policy was limited to support for flood control and swamp reclamation.[14]

Although Anglo-American irrigation was pioneered in Utah and the Columbia basin, California soon became the leader. To many engineers, farmers, journalists, social reformers, and even speculators, irrigation embodied a moral, economic, and aesthetic vision. It would preserve the small farm, redistribute income, master nature, diversify crops, develop agriculture into an exact science, relieve urban tensions, and preserve the Anglo-Saxon race.[15] Furthermore, the common use of the metaphor "Make the desert

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[12] Frazier *v.* Brown 12 Ohio St. 294; 1861; Quoted in Dunbar, 1983, pp. 154-155.
[13] Bennett, 1897, reprinted in Merchant, 1998, p. 216
[14] Harding, 1936; Hutchins, 1956; Dunbar, 1977; Dunbar, 1983; Tarlock, 1985; Kelley, 1989
[15] Tyrrell, 1999; Fiege, 1999. See Thomas, 1901 as an example.

bloom like a rose" reveals the Christian roots of turning an unfinished nature into an Edenic garden through applied science. Nonetheless, there was a great deal of resistance to irrigation, generally based on self-interest and misconceptions. For example, regional boosters and real estate speculators were concerned that the adoption of irrigation would ruin California's image as a paradise, whereas many farmers viewed it as an inferior method, practiced only by Mexicans and land speculators. Also, there was a widespread belief that the moisture from irrigation would increase malaria.[16]

Despite this resistance and many failed projects, irrigation took hold in the 1870s and 1880s, primarily in southern California and the San Joaquin Valley. Much of this was accomplished by large private endeavors, such as the San Joaquin and Kings River Canal. These were initially surface water projects, but the use of groundwater followed. The dream of orderly development through irrigation hid reality of the natural risks, speculation, and monopoly that remained a part of agriculture. Although its proponents espoused the independence achieved by irrigation, in fact it engendered a centralized society of large corporations and powerful district governance. If the result was an Edenic garden, it was an "industrial Eden."[17]

Nevertheless, the crusade for irrigation gained momentum in the 1890s. Developers, scientists, journalists, and politicians called for increased irrigation, and especially for its federal support. They linked irrigation with economic development, social reform, and Progressive conservation. The propaganda for this movement emphasized the control of nature through science and idealized suburban-like farming

[16] Adams, 1946; Thompson, 1969; Dunbar, 1983; Pisani, 1984; Igler, 1996
[17] Pisani, 1984; Fiege, 1999

lifestyles. The economic Panic of 1893 led to concern over poverty, urban overpopulation, and social unrest, and irrigation was consequently further heralded as a social tool to reclaim both wasted lands and wasted humans. The crusade was largely successful after the California drought of 1898 and after advances in well drilling, pump, and power technologies made using groundwater more practical. By the turn of the century, California led the nation in irrigation.[18]

Two other catalysts to the growth of California's groundwater irrigation are worth exploring: an active government which revised archaic water policy, established irrigation districts, and supported water resource surveys; and the development of a basic understanding of groundwater behavior. Water law had evolved as an improvised patchwork, ignoring the reality of California's hydrology. Riparian surface rights came under criticism as favoring large land holdings, and often conflicted with the prior appropriations doctrine. The systems came to a head in 1886, when the California Supreme Court in *Lux v. Haggin* established the California doctrine, under which the riparian and prior appropriations systems both operate. Non-riparian California irrigators reacted by pumping more groundwater and by forming irrigation districts. Increased utilization of groundwater basins soon led to conflict, particularly in southern California, which revealed the shortcomings of the absolute groundwater ownership principle. In *Katz v. Walkinshaw* in 1903, the Supreme Court established a new groundwater doctrine in which all groundwater users overlying a basin entitled to a "fair and just" portion; have correlative, mutual, and reciprocal rights; and are limited to reasonable and beneficial

[18] Freeman, 1968; Pisani, 1984; Pisani, 1996; Tyrrell, 1999. Smythe, 1899 is an essential example of the irrigation crusade.

uses. In times of shortage, all users must reduce pumping proportionally. If there is a surplus after all overlying users are satisfied, groundwater can be appropriated for export, although this assumes that a basin somehow produces groundwater, independent of interactions with the surface water hydrology. Historian Walter Rusinek notes that, "As western states and territories began framing groundwater laws, they adopted legal systems that ignored the hydrologic connection between surface and groundwater, and incorporated into their codes absurd notions such as underground streams in definable banks."[19] The *Katz* ruling maintained this distinction and only applied to general percolating waters. Supposed "defined and known" underground streams were, like surface streams, covered by appropriation. Although such underground streams are a hydrologic fallacy, the doctrine remained and perpetuated myths of inexhaustible groundwater.[20]

The irrigation district was a policy attempt to fill an authority vacuum while considering local human and natural geography. Although California made a few earlier attempts at irrigation districts, it was the 1887 Wright Act, as a response to the *Lux* ruling, which achieved success, albeit limited. Albert Henley, attorney for the Santa Clara Valley Water Conservation District, asserted that, "There can be no doubt that the discovery of the legal formulae for these organizations was of infinitely greater value to California than the discovery of gold a generation before. They are an extraordinary

[19] Rusinek, 1987, p. 32

[20] *Lux v. Haggin* 69 *Cal.* 255, 1886; *Katz v. Walkinshaw* 141 *Cal.* 116, 1903; Shaw, 1922; Hutchins, 1956; Dunbar, 1977; Dunbar, 1983; Pisani, 1984; Tarlock, 1985. Igler, 1996 describes how the arguments in *Lux v. Haggin* essentially depicted alternative views of the hydrologic cycle.

potent engine for the creation of wealth."[21] Based on swamp reclamation laws but reminiscent of Spanish community governance, districts recognized the local nature of hydrologic management, addressed fears of monopolistic businesses and overbearing government, fused development interests and democratic participation, a guaranteed a steady flow of tax revenues. They allowed residents to form and fund a district that could acquire water rights and build physical works. This centralization improved credit, allowed for risks to be spread, increased the time and financial horizons of feasible projects, minimized wasteful expenditures, lowered costs by removing profiteering, enabled the hiring of law and engineering expertise, and isolated water management from the often corrupt local government. Despite the idealism of democracy, irrigation districts engendered conflicts of power and cost. Indeed, Worster describes districts as quasi-public corporations devised by a majority of the landowners but coercing the remaining minority into sharing the financial burden. Many residents felt that benefits and taxes were not distributed in proportion, and these hidden governments easily came under the influence of powerful private interests. Although most Wright Act irrigation districts failed, after subsequent revisions the number of successful districts increased dramatically.[22]

The government also spurred irrigation through water resource investigations. Within California, these increasingly called for the spatial and temporal coordination of water resources, an idea realized in the following century in Santa Clara Valley and in the Central Valley Project. As early as 1856, the California Surveyor General called for a

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[21] Henley, 1957, p. 665
[22] Worster, 1982; Hope and Sheehan, 1983; Dunbar, 1983; Pisani, 1984; Elkind, 1998

comprehensive system of reclamation. The 1874 report of a federal commission led by Col. B. S. Alexander outlined a scheme for coordinated irrigation development of California's Central Valley, with a major canal on the west side of the valley and a series of canals on the east. Although it did not emphasize the need for water storage, it can be considered the first prototype of the Central Valley Project. In 1879, John Wesley Powell submitted to Congress his *Report on the Lands of the Arid Region of the United States*, which suggested a fundamentally new approach to natural resources. By recognizing the geographic diversity of the west, noting that value in an arid region is derived from water, and integrating other natural resource, he called for the efficient, equitable, and objective classification and management of western lands and water based on local hydrographic districts. Clearly an early Progressive conservationist, he espoused the interdependence of natural and human systems. Later, as chief of the new U.S. Geological Survey (USGS), Powell worked to expand the view of the hydrologic cycle from the narrow focus of the Army Corps of Engineers to one that considered variable precipitation, floods, percolation, and multiple uses. His work virtually ignored groundwater, however, and consequently Richard Hinton was directed by Congress to investigate the potential of groundwater resources. Coinciding with a national boom in the utilization of artesian wells, his 1887 and 1892 reports attempted to clarify the occurrence and behavior of groundwater, and concluded that it was a finite but underutilized resource limited by well and pump technology.[23]

[23] Powell, 1879; Hinton, 1887; Hinton, 1892; Montgomery and Clawson, 1946; Harding, 1960; Pisani, 1983; Rusinek, 1987; Hundley, 1992; Manley, 1993; Worster, 1994a

### *The understanding of groundwater occurrence and behavior*

Throughout the nineteenth century, the utilization of groundwater was limited by poor understanding of the hydrologic cycle, which was in turn hindered by a European heritage of misconception and speculation. For centuries, natural philosophers debated the origins of rivers and springs, generally believing that precipitation was not abundant enough for this supply and that sea water migrates uphill as groundwater to become springs and headwaters. This was grounded in the biblical passage of Ecclesiastes 1:7, which says, "All the rivers run into the sea; yet the sea is not full; unto the place from whence the rivers come, thither they return again." Although experiments in the seventeenth and eighteenth centuries indicated that rain was sufficient to supply rivers, these beliefs lingered throughout the 1800s, and as late as 1921 a respected hydrologist opposed the precipitation infiltration theory in favor of underground condensation. There were other myths of groundwater, especially those of "sheet water" and underground rivers, which persisted into the 1950s. By envisioning groundwater as immense, rapidly-moving bodies of water, the users came to believe that the supply was inexhaustible.[24]

By the middle of the nineteenth century, the emerging geologic sciences had established the foundations of stratigraphy, and early hydrologic investigations developed the basic principles of groundwater occurrence and flow. After Powell's 1879 report on the arid lands, the American government recognized the importance of water resources to national interests, and enlisted the "global engineering priesthood" to explicate the

[24] Meinzer, 1934; Baker and Horton, 1936; Adams, 1938; Parizek, 1963; Biswas, 1965; Green, 1973

behavior and availability of water. The water resource surveys increasingly addressed the behavior of the hydrologic cycle. For example, in an early USGS report, Thomas Chamberlain established the principles of artesian wells, and even suggested the regional flow of groundwater. Furthermore, Hinton's publications attempted to demystify the arcane understanding of groundwater, and he attacked the myth of underflow.[25]

Scientists generally understood the fundamentals of groundwater occurrence and motion, and its generally pluvial origin was widely accepted by the turn of the century. Although the basic principles were established, the field had yet to be synthesized into a comprehensive, holistic, three dimensional dynamic model. Government water resource investigations became institutionalized in the U.S. Department of Agriculture Office of Experiment Stations (OES), and in later the USGS Groundwater Division. These offices quantified resources and examined the technologies, methods, and legal institutions of irrigation. An outgrowth of their work was that groundwater was transformed from an alien, unknown force into a resource which can be scientifically studied but whose use must be regulated. Groundwater hydrology progressed rapidly, and soon recognized the three-dimensional and heterogeneous nature of subsurface materials, hydrostatic pressure, and groundwater movement. Investigators soon developed conceptual tools such as flow nets and recognized the regional flow of groundwater as strongly influenced by surface topography.[26]

Although the number of reports increased dramatically, a handful of influential early twentieth century studies reveal the understanding and methodology of groundwater

[25] Chamberlain, 1885; Hinton, 1892; Meinzer, 1934; Worster, 1994b
[26] Meinzer, 1934; Parizek, 1963; Bredehoeft, Back, and Hanshaw, 1982

hydrology as well as the new practice of artificial recharge in California. For example, a 1902 USGS Water Supply Paper by Charles Slichter summarized the American and European knowledge of groundwater movement. He described the saturated zone as approximating surface topography, and having distinct areas of "receiving" and "returning," now referred to as recharge and discharge areas. Slichter referred to underground rivers and the underflow of streams, but noted that the latter tends to diffuse once the stream leaves its canyon. He asserted that confined aquifers, or "deep zones," are not recharged locally, and his seven prerequisites for artesian wells would be acceptable today. Finally, he recognized connections between surface and groundwater by noting that irrigation can raise the local water table, and that aquifers are like "inexpensive and indestructible reservoirs for the storage of storm waters."[27]

A number of influential publications focused on southern California's San Bernardino groundwater basin. In the same year as Slichter's report, an OES report by University of California soil scientist Eugene Hilgard discussed the alluvial geology, and described the debris fans at the canyon mouths as containing "stringers," the buried gravel beds of the itinerant streams. What is most notable is his recommendation for the falling water table, which he attributed to an increasing number of wells. Because there were no good sites for surface reservoirs, he suggested that by spreading the stream waters over their alluvial fans, the water would percolate into the "stringers" and raise both deep and shallow well levels. His language is consistent with the belief that such hydrologic manipulation was finishing nature's work: "[I]f nature's work were

[27] Slichter, 1902

supplemented by some surface work carefully planned so as to produce the widest spread of the water over the gravel beds, absorption and water storage might be materially increased at comparatively light cost."[28] Two years later, Walter Mendenhall of the USGS used another common motif, that of ideal conditions provided by a generous nature, when describing how the basin was favorable to storing water underground, whether naturally or artificially:

> These [geologic] conditions give rise to certain peculiarities in the habits of the rivers, peculiarities which it happens adapt them in a wonderful way to man's needs as an irrigationist.... These basins are, therefore, not only storage reservoirs, but are most effective regulators as well, and go far to bring about that most important desideratum in irrigation practice, uniformity of supply.[29]

In 1912, Charles Lee published studies on the groundwater of both the San Bernardino basin and the Owens River Valley. The former focused solely on the practice of artificially recharging the groundwater. In these reports, he emphasized that groundwater basins are subterranean reservoirs with a mass budget. If withdrawals are greater than the sum of natural and artificial recharge, then the water table will fall. Furthermore, Lee asserted that most percolation occurs via the exposed gravels of present or old stream beds. He described these concepts and his methodology in an influential 1915 journal article, which focused on the safe yield, defined as "the limit to the quantity of water which can be withdrawn regularly and permanently without dangerous depletion of the storage reserve," an amount that he asserts can be measured. This was the first use of this phrase in groundwater hydrology, borrowed from forestry. It would haunt the fields throughout the century, often as "sustainable yield." This yield can be increased by

[28] Hilgard, 1902, p. 133

reducing residual losses such as evaporation, eliminating waste from uncapped flowing wells, and increasing percolation through artificial recharge. However, he diverged from Hilgard by suggesting that some surface storage is needed in order to absorb even ordinary floods.[30]

Despite these strides in understanding the hydrologic cycle, popular misconceptions persisted at the turn of the century. Some of these concerned the existence of large, swiftly moving underground streams or sheets of water. One European engineer wrote, "It is now a well-known fact, that ground-water streams are running under the surface of the earth, and their course can be followed, their direction and inclination determined and their capacity calculated with an accuracy, which excludes all risk of water-works, based thereon, being unsuccessful."[31] Such beliefs typically led to the conclusion that the potential yield was immense.[32]

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[29] Mendenhall, 1904, pp. 152-153
[30] Lee, 1912a; Lee, 1912b; Lee, 1915
[31] Richert, 1900, p. 8
[32] Van Dyke, 1899; Ames, 1901

# III. SANTA CLARA VALLEY, BAY CITIES WATER COMPANY, AND THE DECLINE OF PRIVATE INERESTS

At the end of the nineteenth century, Santa Clara Valley, at the forefront of California's agricultural intensification, developed an economy based on the growth and processing of deciduous fruits, particularly prunes. Irrigation was a recently established practice, and many orchards were then turning to groundwater. Residents commonly believed that the valley was a distinctive place, blessed with an abundant supply of groundwater that was transforming it into a garden. When outside corporations threatened to export this resource, a coalition of insurgent Progressives and local business interests rose and prevented such expropriation. In the process, the seeds were planted for a more intricate understanding of local hydrologic cycle, and the insurgents established themselves as the new leadership of the valley.

## *Natural setting*

Santa Clara Valley is the southern end of the larger valley surrounding San Francisco Bay (Figure 1). The amphitheater-shaped main northern portion is up to thirteen miles wide and twenty miles long. To the south, it rises into the Coyote Valley, which is separated by the Lower Gorge of Coyote Creek. This valley, in turn, leads south to the valley of the Pajaro River. Although writers have referred to various delineations of Santa Clara Valley, here it indicates the main north valley.

Two contrasting mountain ranges border Santa Clara Valley, each reaching about 4000 feet above sea level. On the west are the moist, forested Santa Cruz Mountains, and to the east is the dry and open Diablo Range, or Mount Hamilton Range. The bedrock of the mountains and beneath the valley is poorly water-bearing metamorphosed

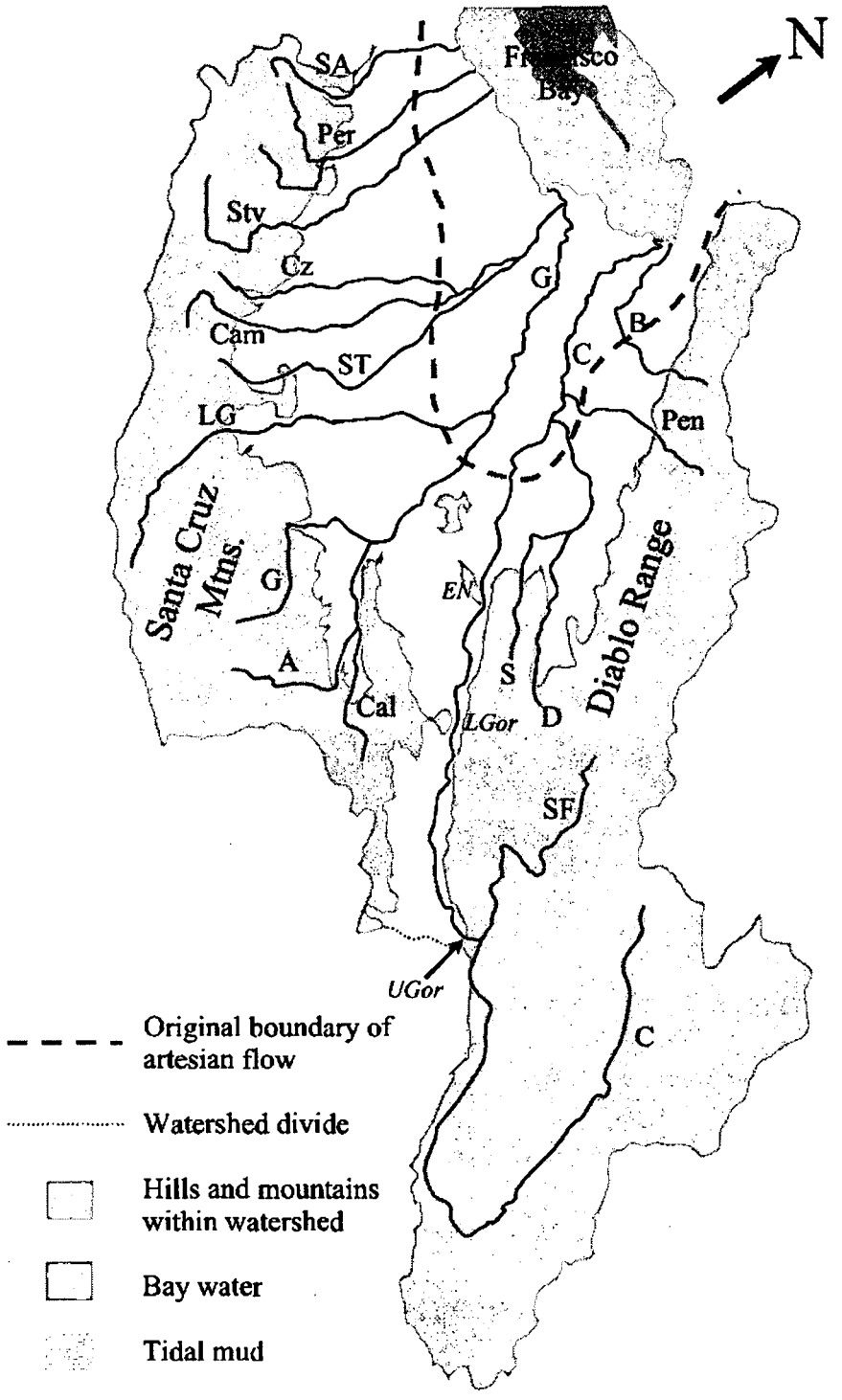


**Figure 1. Hydrology of the Santa Clara Valley.**
The outline of the mountains (shaded) and the divide (dotted) delineate the watershed. The creeks are San Antonio (SA), Permanente (Per), Stevens (Stv), Calabazas (Cz), Campbell (Cam), San Tomas Aquinas (ST), Los Gatos (LG), Guadalupe (G), Los Alamitos (A), Calero (Cal), Coyote (C), San Felipe (SF), Silver (S), Dry (D), Penitencia (Pen), and Berryessa (B). Also shown are the Upper Gorge (*UGor*), Lower Gorge (*LGor*), and Edenvale Narrows (*EN*) of Coyote Creek.

sediments. The valley itself is a down-dropped block bordered by two major faults, the San Andreas to the west and the Hayward on the east. The bowl thus formed is filled with thousands of feet of alluvial sediments. The lower part of these sediments are composed of a partially consolidated, which is overlain by about 1000 feet of unconsolidated material. This water-bearing upper layer is a complex array of lenses and channels of gravel, sand, silt, and clay. Gravel and clay dominate the upper reaches of the valley, especially in the alluvial fans at the mouths of the stream canyons. Clay layers, deposited when the level of the bay was higher, become more prominent in the lower valley, and is ubiquitous at the bay tidelands. Intermingled with the clay are lenses and channels of gravel and sand formed by old river channels and flood plain deposits. These are discontinuous due to changing depositional conditions and faulting.[1]

The climate of Santa Clara Valley is moderate Mediterranean, with warm dry summers and cool moist winters. Almost all precipitation occurs between November and March and as rain, except for the occasional snow on the mountain peaks. The amount of precipitation varies widely among years and with location. Seasons with half or double the average rainfall are not uncommon. That average is about 14 inches per year at San Jose, and increases with elevation to 29 at Los Gatos, 44 on the peaks of the Santa Cruz Mountains, and twenty-seven on Mt. Hamilton. This hydrologic distribution results in dense forests of redwood, fir, and oak trees on the western mountains, but open grasses and brush with clusters of oak on the East. The vegetation of the dry valley floor

[1] State Water Resources Board, 1955; Poland and Ireland, 1985; Todd (David Keith) Consulting Engineers, 1987

**Table 2. Average hydrologic budget of Santa Clara Valley Streams.**
All values are in thousands of acre feet per year (taf/y). Tributaries have separate inflows but combined outflow and losses. Losses include evaporation and percolation. Source: State Water Resources Board, 1955.

| | Surface inflow | Surface outflow | Losses |
|---|---|---|---|
| San Francisquito Creek | 14.3 | 12.2 | 2.1 |
| Permanente Creek | 3.1 | 2.4 | 0.7 |
| Stevens Creek | 9.8 | 3.7 | 6.1 |
| Calabazas Creek | 2.2 | 1.1 | 1.1 |
| Campbell Creek | 6.5 | 4.0 | 2.5 |
| San Tomas Aquinas Creek | 3.6 | 1.9 | 1.7 |
| Los Gatos Creek | 35.8 | | |
| Los Alamitos Creek | 18.1 | | |
| Guadalupe Creek | 8.7 | | |
| Guadalupe River | | 32.3 | 30.3 |
| Fisher Creek | 4.6 | | |
| Coyote Creek | 61.7 | | |
| Coyote River | | 41.1 | 25.2 |
| Silver and Dry Creeks | 3.6 | 0.7 | 2.9 |
| Penitencia Creek | 6.0 | 2.4 | 3.6 |
| Other | 25.2 | 8.2 | 17.0 |
| Total | 203.2 | 110.0 | 93.2 |

originally resembled this open park of grasslands and oaks. In the lower reaches of the valley were willow thickets, and at the bay is an amphibious salt marsh.[2]

The hydrology of the valley (Table 2) largely determines the sediment deposition, topography, and soils. The streams originate in the mountains, deposit gravel and sand when they first reach the valley, and become broad and shallow as they lose momentum and cross the valley floor. They generally flow only during the rainy winter season, and have brief, torrential discharge immediately following a storm. Indeed, the bulk of the annual stream flow occurs during these floods. Much of the normal flow of the streams percolates into the gravel beds, and they typically disappear into the alluvium, although Guadalupe and Coyote Creeks are perennial north of San Jose due to additions from the shallow water table. The rainy Santa Cruz Mountains produce the majority of runoff, but

the largest stream in the valley is Coyote Creek, which originates in the Diablo Range above Coyote Valley.

The alluvial fill of Santa Clara Valley contains an immense reservoir of groundwater. Not including the Coyote Valley subbasin, 3225 thousand acre-feet (taf) of generally high quality groundwater lies between the land surface and a depth of 310 feet, and the natural rate of turnover is 58.2 thousand acre-feet per year (taf/y). The upper half of the valley floor overlies unconfined aquifers, but the region from the bay to four miles southeast of San Jose is underlain by confined groundwater. Although this consists of a complex of partially interconnected aquifers and confining clay layers, a major clay zone at 150 feet deep generally separates the upper unconfined from the lower confined groundwater. Moreover, most of the wells tapping confined aquifers were originally artesian, or flowing, wells. The groundwater basin is almost completely isolated. Recharge occurs in the upper areas of the valley floor, especially in the gravel riverbeds, and the regional flow pattern is thus toward the center of the valley and northward. In contrast, Coyote Valley is essentially unconfined, with 76 taf of stored groundwater and 4.4 taf/y natural recharge. The groundwater in Coyote Valley north of the divide flows northward, and is pushed near the surface as it passes through the narrow Lower Gorge and into the main Santa Clara Valley.[3]

### *Human settlement, agricultural, and water use*

The hydrology of Santa Clara Valley has always been central to the lives of its inhabitants. The Native Americans would move seasonally with the availability of water.

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[2] State Water Resources Board, 1955

In 1777 both the Pueblo de San Jose and Mission Santa Clara were established along the Guadalupe River, although the latter had to be moved twice due to floods. Building ditches, or *acequias*, for irrigation and stock were among the highest priorities of the Spanish colonists. They quickly adapted to the climate, which was similar to that of Spain, and soon had irrigated gardens and wheat farms.[4]

Although California's Native American, Spanish, and Mexican populations all farmed, American occupation engendered dramatic changes in agricultural practices and institutions. The first Anglo-Americans arrived in 1814, before Mexican independence, and many more later settled on farms to support the miners of the Gold Rush. American California inherited the cattle economy of Mexico, but by 1865, cattle ranching gave way to wheat, more permanent settlement, and the establishment of a number of small communities in the Santa Clara Valley (Figure 2). Furthermore, the wheat economy set the tone of Californian agriculture with large farms, corporate agriculture, and mechanization.[5]

The open acequias were inadequate and unhealthy for the growing Santa Clara Valley towns. Hundreds of flowing artesian wells, first discovered in 1854 in San Jose, were drilled for domestic purposes, and windmills were used outside the artesian area to lift groundwater. The dry season of 1864-65 and subsequent decrease in well yields led to the first calls for water conservation:

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[3] State Water Resources Board, 1955; Santa Clara Valley Water District, 1981; Poland and Ireland, 1985; Todd (David Keith) Consulting Engineers, 1987
[4] Broek, 1932; Rickman, 1981
[5] Adams, 1946; Jelinek, 1982

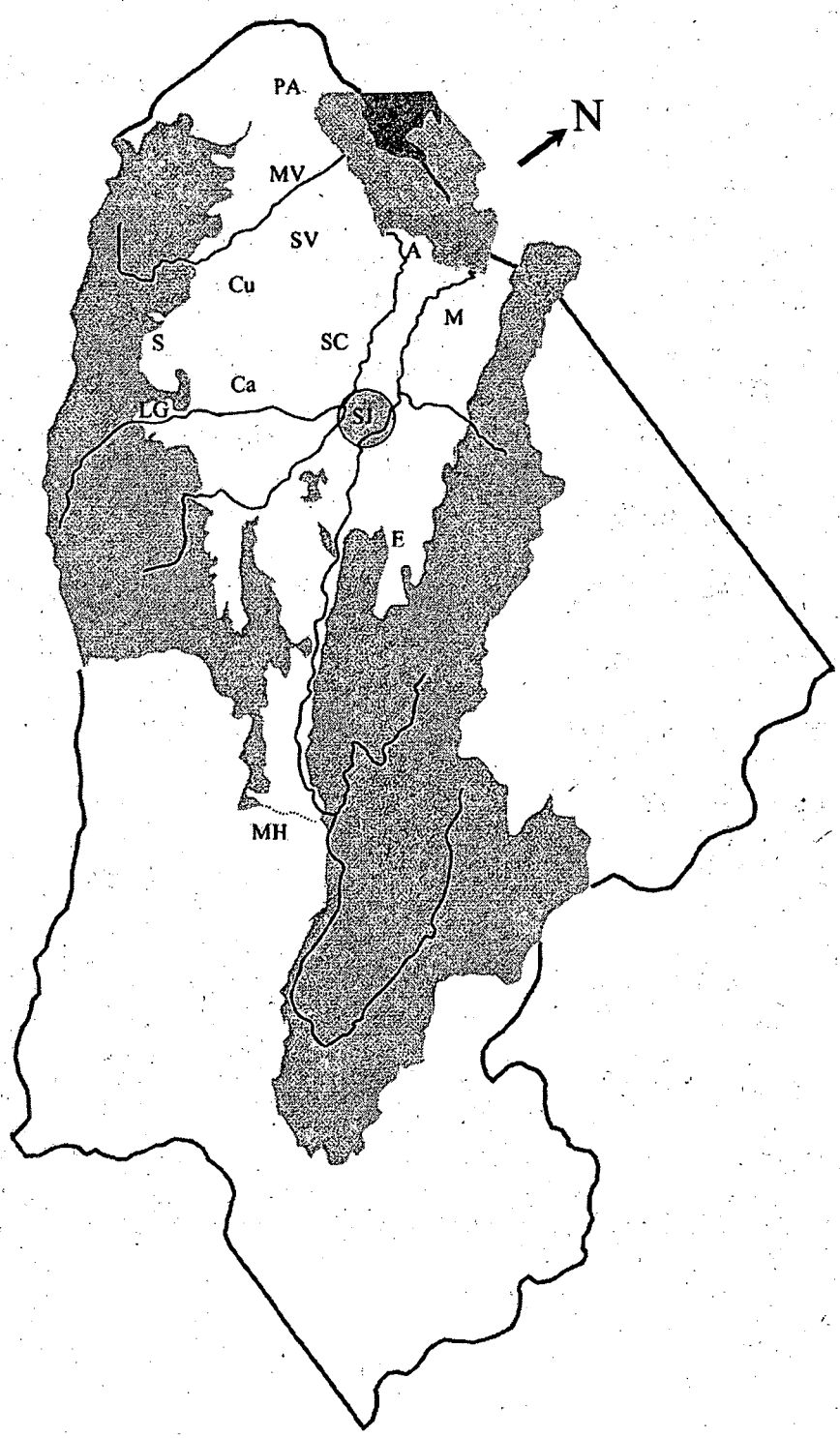


**Figure 2. Towns and boundary of Santa Clara County.**
Note the relative coincidence of the watershed and county boundary (solid outline). The towns are Palo Alto (PA), Mountain View (MV), Sunnyvale (SV), Cupertino (Cu), Saratoga (S), Campbell (Ca), Los Gatos (LG), Santa Clara (SC), San Jose (SJ), Alviso (A), Milpitas (M), Evergreen (E), and Morgan Hill (MH).

> Artesian wells do not now give out more than one-third the quantity of water which they have heretofore done, and orchards, nurseries and gardens would now be parched and arid but for the rattling and squeaking of the numerous Quixotian giants that with their long and brawny arms pump incessantly, still more reducing said scanty fountains. What shall be done if this exhaustion of our supply of water continues much longer? Shall we supinely wait, while it is vanishing before our eyes, until we are made miserable, and our beautiful valley is rendered sterile?[6]

The waste from uncapped flowing wells was soon outlawed.[7]

Many natural resources in nineteenth century California were developed by private companies, and groundwater in Santa Clara Valley was not an exception. In 1864, Donald McKenzie dug wells, built storage tanks, and acquired exclusive rights to supply water for San Jose and Santa Clara. With the infusion of $100,000 from John Bonner and East Bay water magnate Anthony Chabot, the San Jose Water Company was formed. The company expanded its pumps, purchased much of the watershed of Los Gatos Creek, and built a series of storage reservoirs, and by the end of the nineteenth century it had eleven reservoirs, five large pumping stations, and fifty-six miles of pipeline. The company recognized the high water quality and storage benefits of the immense groundwater basin, and espoused them in its promotional material. Its power grew as it acquired rival water companies, and its owners became a crucial component of the region's political establishment. One president of the Water Works (as it was called after 1913) was so candid as to say, "Whoever controls water in Santa Clara County controls Santa Clara County."[8] By successfully fending off several attempts at

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[6] Thompson, R.P. *San Jose Mercury*, June 23, 1864, quoted in Martin, 1950
[7] Broek, 1932; Arbuckle, 1986
[8] Elsman, Ralph, July 24, 1961, quoted in Parks, 1983

municipalization, it today remains the oldest utility and largest private water retailer in California.[9]

Statewide, the wheat economy experienced a rapid decline in the 1880s, and was replaced by specialty crops. The best agricultural lands had been settled, and the resulting sense of scarcity contributed to innovation and intensification. Although such specialization was grounded in the heterogeneity of the landscape and resulted in some smaller farms, it was also tied to dependence on national markets, transportation networks, mobile labor, chemical inputs, government-sponsored research, processing, and irrigation. This increasingly complex – and expensive – agricultural network led many smaller farms to consolidate. The small farms that did remain formed marketing cooperatives to navigate this web of dependence. The owners began to see themselves not as traditional farmers, but as innovative businessmen, and preferred the label "grower." Many were professionals and farmed only part-time. Furthermore, they were often able to enjoy urban comforts, and came to idealize the suburban, garden landscape.[10]

Santa Clara Valley was at the vanguard of these trends. It led the state in production during the era of wheat, which peaked at 175,000 acres countywide in 1874. However, the connection of the railroad in 1869 had opened eastern markets for fruit and would thus drastically alter the economy and landscape of the valley. Orchard land in the valley grew rapidly, and prunes, introduced to the valley in 1856, became the leading crop. By 1880, there were 4.5 million fruit trees in Santa Clara Valley. This was nearly

[9] Thompson and West, 1876; Herrmann and Elliott, 1913; James and McMurry, 1933; San Jose Water Works, 1938?; Parks, 1983; California Department of Water Resources, 1998

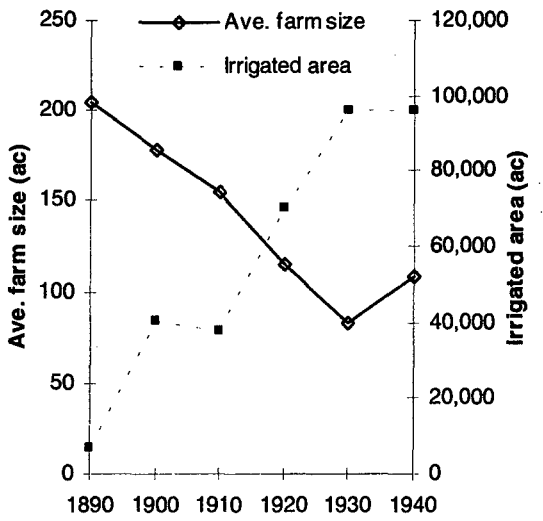


**Figure 3. Average farm size and total irrigated area, Santa Clara County, 1890-1940.**
Source: United States Bureau of the Census, 1892, 1902, 1912, 1922, 1932, 1943

double from the previous decade, and one-third of these trees were prunes. In 1890, the county produced three-quarters of the national prune crop.[11]

This transformation dramatically increased irrigation in the valley (Figure 3). Although some irrigation had been attempted during the 1850s, the results were disappointing due to the lack of proper techniques. Many farmers, though, continued to recognize the available resources, and an 1876 local atlas optimistically stated that, "One of the greatest blessings that Santa Clara County enjoys is its abundant supply of wholesome water, drawn from the subterranean streams by means of artesian wells. This supply is inexhaustible and would, with the inauguration of the proper system, be sufficient to irrigate the entire valley."[12] However, irrigation remained uncommon. Most growers believed it was an unneeded expense, unnatural, and produced inferior crops, and thus only irrigated in dry years, if at all. In the 1890s, increased demands on

[10] Tufts, 1946; Pisani, 1984; Stoll, 1998
[11] Thompson and West, 1876; Broek, 1932; Tufts, 1946; Arbuckle, 1986

orchards, new technologies, more open attitudes toward irrigation, and the dry season of 1897-98 caused a six-fold increase in irrigated acreage. Much of irrigation occurred near Campbell, where a network of private ditches was built on Los Gatos Creek. But surface irrigation was limited, primarily because it is most available when it is least needed. Logically, the early groundwater endeavors were concentrated in the artesian belt. In a dry year, many farmers would install pumps to save their orchards in a drought. But once this initial expenditure was made, using groundwater was relatively inexpensive. Consequently, groundwater irrigation increased more rapidly than its surface counterpart, particularly after the extremely dry winter of 1912-13. By 1909, 42% of irrigation in Santa Clara County was by pumped wells, 20% was by flowing wells, and 38% was with surface water.[13]

The intensification of agriculture through irrigation and horticulture catalyzed changes in the landscape, economy, demography, and politics. The population was doubling every twenty-five years, a trend that would continue throughout the twentieth century. Furthermore, after 1890, the rate of urban population growth exceeded that of the rural population. Villages such as Mountain View and Campbell developed into larger agricultural service centers, and San Jose changed from a small town into a burgeoning city. Food processing, particularly drying and canning, was the foundation for a growing manufacturing sector, which doubled in size from 1910 to 1915. Electric lines and suburban railroads spread throughout the valley. Unlike in most of the Central Valley, farms were subdivided into small orchards (Figure 3). Indeed, there were three

[12] Thompson and West, 1876, p. 13
[13] Newell, 1894; United States Bureau of the Census, 1912; Sawyer, 1922; Broek, 1932; Watson, 1989

times as many farms of less than 50 acres in 1909 as there were in 1889. In this atmosphere of agricultural prosperity, blooming orchards, and suburban amenities, residents and boosters praised the valley as a modern Garden of Eden, "a terrestrial paradise like Adam before the Fall."[14] Rapid economic growth and urban expansion also fueled city machine politics. By the turn of the century, the socially conservative and politically progressive Good Government League, led by the wealthy newspaper owners E. A. and J. O. Hayes, was gaining strength.[15]

### *The Bay Cities Water Company*

The nineteenth century was an era of private water companies. But as cities accumulated the necessary financial and political resources, and as the emerging Progressive movement called for ending institutionalized support of corrupt and profiteering companies, they were displaced by large municipal projects. Los Angeles tapped the Owens River, and San Francisco and Oakland set their sights on the Sierra Nevada. Before the cities of the Bay Area undertook these interbasin transfers, however, private water companies attempted to maintain their position by meeting the increasing demands of the cities. One such company repeatedly attempted to export the water of the Coyote and Santa Clara Valleys. Although it never succeeded, it brought the hydrologic cycle and water resources into the public's mind.[16]

The Bay Cities Water Company was incorporated in the fall of 1902 with $10 million in capital from San Francisco financiers led by William Tevis of the Kern County

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[14] Sawyer, 1922, p. 138. Other praise can be found in Gage, 1904; Field, 1911; and even Tibbetts and Kieffer, 1921.

[15] United States Bureau of the Census, 1892, 1902, 1912, 1932, 1943; Tibbetts and Kieffer, 1921; Broek, 1932; James and McMurry, 1933; Arbuckle, 1986

Land Company. It assumed the extensive land and water rights of one of its founders, E. G. Wheeler, in the Diablo Range above Santa Clara Valley. Although its ostensible goal was to supply water and power for the towns and orchards of the valley, in truth the company focused on delivering water to the more lucrative markets of San Francisco and Oakland. Its intentions were soon made clear when the City Engineer of San Francisco investigated and rejected the Bay Cities offer in 1904, and the voters of Oakland defeated a similar proposal by referendum in 1905. Moreover, its properties included the upper watershed of Calaveras Creek, which flows northward into Alameda County and was utilized at lower elevations by the Spring Valley Water Company, the monopolistic supplier for San Francisco. Although Bay Cities threatened to cut off the supply of Spring Valley, they were merely superficial rivals, for Tevis and William Sharon of Spring Valley were not only part of the same allied elite of San Francisco capitalists, but also in-laws.[17]

The Bay Cities Water Company developed an elaborate water development scheme. It had already purchased 1500 acres of riparian lands and appropriated all the remaining flow of Coyote Creek. It planned to divert 20 taf/y of Calaveras Creek through a tunnel to the upper Coyote Creek, which would have 150 taf in storage reservoirs. The supply was to be augmented by 18 taf/y of groundwater pumped from Coyote Valley where the river passes through the Lower Gorge, where a proposed subsurface dam to bedrock would capture all groundwater. Indeed, half of the pumping capacity had

[16] Karhl, 1983; Elkind, 1998

[17] "Form new water company." *San Francisco Chronicle*, October 21, 1902, p. 14; "To impound waters of Coyote Creek." *The Evening News*, October 21, 1902, p. 5; Clements, 1980; Elkind, 1998; Brechin, 1999

already been installed. Finally, the plans called for the total 55 taf/y to be delivered to San Francisco or Oakland via a canal that would be elevated by electric pumps.[18]

The residents of Santa Clara Valley did not wait for San Francisco to reject Bay Cities' offer. Supposedly, in January 1904 while on a train to Washington, E. A. Hayes, by then a Congressman, learned from the crown prince of Poland of the company's plans to sell water to the orchardists at a high rate. Upon returning, he organized over 200 other valley orchardists as the Home Protective Association. They had the support of the San Jose Water Company, which had begun pumping groundwater in Coyote Valley in 1903. The Association retained civil engineer A. T. Herrman and attorneys John E. Richards and S. F. Leib, the latter a former lawyer for the San Jose Water Company but now a judge in the Santa Clara County Superior Court. With the help of the Hayes' *San Jose Mercury* and *Herald*, the group was portrayed as small farmers uniting to defend the interests of the entire valley from an invasive, profiteering corporation. For example, the *Mercury* editorialized that the Bay Cities Water Company will "take from the rancher and the fruit grower the element that makes the county a garden and without which it would speedily become a desert," and Leib told a newspaper, "No individual grower can successfully fight a combination that has millions in money behind it; but the growers, the merchants, and the community as a whole can fight it."[19]

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[18] "May cut city water supply." *San Francisco Chronicle*, April 3, 1903, p. 14; *Miller v. Bay Cities Water Company et al.* 157 *Cal.* 256, 1910

[19] "Supply of water is scarce." *San Jose Mercury Herald*, January 20, 1920, p. 1, 8; Sawyer, 1922; James and McMurry, 1933; Parks, 1983; Arbuckle, 1986; San Jose Water Company, 1991. The quotes are in "Basic principle in litigation with Bay Cities Water Company." *San Jose Mercury*, June 8, 1905, p. 6; San Jose Water Company, 1991.

In January 1904, members of the Home Protective Association filed six suits against the Bay Cities Water Company in Santa Clara County Superior Court. The plaintiffs were fifty-eight farmers who irrigated by groundwater between the Lower Gorge and the Edenvale Hills, including a handful of wealthy and powerful parties such as the Imperial Prune Orchard Company, the Hayes-Chynoweth Company, and orchardist George E. Nicholson. The lawsuits claimed that the diversion of Coyote Creek would dramatically reduce the recharge of the aquifers upon which the farmers depended for irrigation and the maintenance of land values. Bay Cities spared no expense in the case, and hired renown Bay Area lawyers such as Garret McEnerney and Judge John Garber. In December, the court chose the case filed by orchardist Charles Miller as a test for all six. Witnesses included many local farmers, well borers, business owners, employees of the Bay Cities, Spring Valley, and San Jose Water Companies, and nationally recognized geologists.[20]

Although some debate concerned the true nature and benefits of Bay Cities' plans, much revolved around alternate representations of the hydrology of Coyote and Santa Clara Valleys. Whereas the orchardists described the surface and groundwater as interconnected components of a single hydrological cycle, the company maintained that they were essentially distinct. All agreed that the Coyote is a torrential stream, with most

[20] "Suit to restrain water company." *San Jose Mercury*, January 10, 1904, p. 5; "Causes affecting rise of well water levels." *San Jose Mercury*, May 5, 1905, p. 5; "Company's consulting engineer on the stand." *San Jose Mercury*, May 10, 1905, p. 4; *Kocher v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15228, 1904; *Ballou v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15229, 1904; *Lewis v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15181, 1904; *Miller v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15183, 1904 (ruling 1905); *Wiltz v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15184, 1904; *Hayes-Chynoweth Co. et al v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15181, 1904 (ruling 1913); Sawyer, 1922. "Chynoweth" is spelled "Chenoweth" in some documents.

discharge occurring during floods, and that water percolates into its gravel bed. The plaintiffs contended that these gravels connect to aquifers that sink beneath clay layers to the north of the Lower Gorge. Because the percolation of Coyote Creek recharges these confined aquifers, the plaintiffs and hundreds of other well owners relied on the continued flow of the stream. Consequently, their lawyers argued that the company could not divert any water south of San Jose without unjustly harming the farmers. The Bay Cities Water Company, however, said that the gravel strata, percolation, and groundwater movement were not clearly defined, and that, "The underground flow of water is devious and uncertain."[21] Moreover, according to the company, the gravel bed of Coyote Creek is not connected to the confined aquifers of the valley, which instead are recharged by the streams on the west side of the valley. Finally, it contended that because the deeper groundwater of Coyote Valley is naturally prevented from flowing north by the shallow bedrock at the Lower Gorge, its wells would tap only "stored" groundwater. Thus, the Company planned only to divert wasted floodwaters and trapped groundwater.[22]

In his decision of July 1905, Judge Rhodes agreed with the plaintiff's vision of the valleys' hydrology. His findings of fact and opinion described how Coyote Creek percolates into its gravel bed, which is continuous with a complex of interconnected gravel strata, as far north as San Jose but mostly just below the Lower Gorge. Moreover,

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[21] "Judge Leib closes for plaintiff in Bay Cities Case." *San Jose Mercury*, June 7, 1905, p. 3

[22] *Miller v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15183, 1904; "Regional faults found in district south of the bay." *San Jose Mercury*, April 26, 1905, p. 9.; "Testimony continues in Bay Cities trial." *San Jose Mercury*, May 3, 1905, p. 7; "Coyote Flood waters measured by company." *San Jose Mercury*, May 4, 1905, p. 4; "Company's consulting engineer on the stand." *San Jose Mercury*, May 10, 1905, p. 4; "Judge Leib closes for plaintiff in Bay Cities Case." *San Jose Mercury*, June 7, 1905, p. 3

Rhodes ruled that the Coyote supplies essentially all of the underground water of the plaintiffs, and the bulk of that for the entire Santa Clara Valley. Thus, the utility and economic viability of these lands were dependent upon the percolation from the Coyote, which he claimed is simply proportional to the volume of stream flow. Although there may have been wasted floodwater, the company failed to establish the amount of such waste. Furthermore, Rhodes concluded that no groundwater lies dormant in Coyote Valley, and even the present pump capacity would dramatically lower the plaintiff's wells within two years. Consequently, because the company's plans would significantly harm the plaintiffs, the judge ruled that the plaintiffs were entitled to the maintenance of their well levels, and perpetually enjoined the company from diverting the surface or underground waters of Coyote Creek above the Lower Gorge. After the decision, Richards asserted it was the most important case ever in the county based on the number of people and value of property threatened.[23]

Nevertheless, Bay Cities persisted with its plans, and continued to buy land in the Coyote Creek watershed to the chagrin of Spring Valley Water Company. And once again, while claiming to be intent on supplying Santa Clara Valley, it kept an eye on San Francisco. Rumors circulated that the San Jose Water Company had ceased the payments to Bay Cities that had kept it out of the San Jose market, or that the Coyote Creek plans were just a distraction from its massive purchases of land and water on the American River in the Sierra Nevada. Furthermore, when a committee of San Francisco engineers resigned after they disapproved of a proposed purchase of Bay Cities and its assets,

[23] *Miller v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15183, 1904; "Decision handed down in Bay Cities Water case." *San Jose Mercury*, July 29, 1905, p. 3

former Mayor James Phelan called for an investigation. It was soon revealed that the $10 million price included $1 million in kickbacks for the Mayor and the Board of Supervisors, and led to a broader graft investigation of the city government, business power, and wealthy elite.[24]

The Bay Cities Water Company appealed the ruling, and by 1908 *Miller v. Bay Cities* was in the California Supreme Court. The company argued that the decree of the lower court was too broad, legally unfounded, unsubstantiated by the evidence, and would actually harm the valley residents by continuing the waste of water. Maintaining that the surface water and underflow of Coyote Creek are physically and legally distinct from the percolating groundwater beneath, Bay Cities asserted that the plaintiffs had no legal riparian or appropriative rights to the stream. Furthermore, the company denied any plans to expand their pumping facilities, and claimed the existing facilities would not significantly affect the plaintiffs' wells. A just decree consistent with the *Katz* doctrine, according to Bay Cities' attorneys, would merely restrict its diversions and pumping to levels that would not harm the plaintiffs. Based on a pumping test in which the pumps were operated at full capacity, the company's engineers estimated a two foot drop in Miller's well. However, during the test, the immense withdrawals were simply returned to the stream bed, and the rapid absorption by the Coyote's gravel bed provided grounds for a novel proposal. The company offered to build a dam and divert surface water, but

[24] "Claims water co. is a monopoly." *The Evening News*, August 21, 1906, p. 1, 4; "Bay Cities ready to bring water here." *The Evening News*, August 22, 1906, p. 1; "Suing to disrupt water combine." *San Francisco Call*, August 22, 1906, p. 3; "Storm precedes the approval by supervisors of the Bay Cities Water project." *San Francisco Call*, October 9, 1906, p. 16; "Municipal water supply and its involved scandals." *San Francisco Call*, October 18, 1906, p. 5; "Water company may have competition." *The* (continued...)

to release the stored water in a manner that would maintain the plaintiff's well levels. Because the amount of time water is in a stream – not the volume of flow – is the primary determinant of percolation, the company argued it could slowly release and sink into the gravel 13.5 taf/y, an amount even greater than the recent measurements of natural percolation.[25]

The plaintiffs presented themselves as simple yet noble peasants following divine intentions, and the Bay Cities Water Company as a thieving, untrustworthy speculator who would defy nature:

> On the one side are these hundreds upon hundreds of orchardists, seeking only to be allowed to have and to use that which God gave to their lands... and, without which, their orchards would be valueless – the mere threatened loss of which will impair their value. On the other side is a mere speculator... without the slightest regard for the rights of others, and all for the mere gain that may arise out of the speculation.[26]

They argued that the company would not conform to any decree and any reduction in the surface flows of Coyote Creek would lower their wells. The "[p]roposed generosity" of Bay Cities "so startles the conscience that one can hardly consider it with an even pulse," and amounts to "substituting for nature's plan, another plan altogether."[27] Regarding this proposal, the orchardists' attorneys claimed that more than 13.5 taf/y naturally percolates, that any such decree would be impossible to monitor, and that the proposal is simply not an issue before the court.

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*Evening News*, October 20, 1906, p. 5; "Plans for big steal forced from Tevis aid." *San Francisco Call*, March 7, 1908, p. 1; Clements, 1980; Brechin, 1999

[25] *Miller v. Bay Cities Water Company et al.* 157 *Cal.* 256, 1910; "Scores of orchardists seek to preserve rights." *San Jose Mercury*, January 20, 1910, p. 3

[26] *Miller v. Bay Cities Water Company et al.* 157 *Cal.* 256, 1910, Reply Brief of Respondent, p. 69-70

[27] *Miller v. Bay Cities Water Company et al.* 157 *Cal.* 256, 1910, Brief of Respondent, p. 190; Reply Brief of Respondent, p. 8

Once again, the legal arguments were framed by a debate on the behavior of water. The Bay Cities Water Company tried to segregate from an interconnected reality distinct spatial and hydrological compartments, such as regular versus flood flows and surface versus underground water. However, as a prerequisite for the feasibility of its proposal, the company now admitted that Coyote Creek is connected to the plaintiffs' wells by gravel, but as only one of many sources. Moreover, the defendant called in experts to testify that percolation is not proportional to total flow and driven only by the weight of the water, but instead is controlled by the amount of time water is present, the rate of flow, and the area covered. In contrast, the plaintiffs maintained that the Coyote is the sole supply for their wells via buried gravel "pipes" which flow like underground streams, and that percolation is proportional to the weight of the floodwater. Finally, water table depression created by Bay Cities' pumps would not be a symmetrical cone, the plaintiffs testified, but instead would produce a water table to the north of the pumps which would be horizontal and level with the bottom of the pumps.

In 1910, the Court ruled in favor of the plaintiffs and upheld the decision of the lower court, concluding that users of an aquifer clearly recharged by a river are of similar legal standing as riparian users. As in Judge Rhodes' decision, Bay Cities could theoretically export waste water, but the floods were not considered waste because their weight and width helps recharge the aquifer. Furthermore, the company's proposal to artificially maintain the well levels was not an issue before the trial court nor part of the suit, and thus could not be considered. Justice Lorigan's opinion described the superiority of groundwater as an irrigation supply, and the "natural advantage" it bestows on the overlying land. In a concurring opinion, Justice Shaw noted that, "[t]he Santa

Clara Valley presents conditions not paralleled elsewhere in the state, except it may be in the San Fernando Valley, in which is found similar gravel beds kept supplied by similar flood waters and rainfall." In addition, he argued that the community values supported by the farms outweighed the proprietary interests of the Bay Cities Water Company.[28]

The ruling had a significant impact on California water law by establishing a legal link between the physically connected surface and groundwater systems. This eventually lead to "a high degree of coordination of rights in surface and groundwaters that constitute a common source of water supply."[29] However, it also bypassed the principle of reasonable use, and was cited for many years as interfering with viable surface storage projects.[30]

Despite defeat in the Supreme Court and rejection by San Francisco and Oakland, Bay Cities persisted. President Will Tevis allied himself with transit magnate Francis "Borax" Smith and continued a publicized drive to supply the East Bay while battling the rival Spring Valley and People's Water Companies. Furthermore, because the court implied that the proposal was unacceptable merely because it had not been presented to the trial court, the company resurrected one of the five cases held in abeyance.[31]

*Hayes-Chynoweth et al. v. Bay Cities Water Company et al.* resumed in the Superior Court in July 1910, and incorporated all the evidence from the *Miller* trials. In

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[28] *Miller v. Bay Cities Water Company et al.* 157 *Cal.* 256, 1910; "Decision against Bay Cities Co." *San Jose Mercury*, February 5, 1910, p. 1
[29] Hutchins, 1956, p. 519
[30] Fortier, 1924; Hutchins, 1956
[31] "Tevis ready to submit definite proposals." *San Francisco Call*, March 31, 1910, p. 10; "Water companies in bitter war." *San Francisco Call*, April 25, 1910, p. 5; "Tevis water to run beside trolley line." *San Francisco Chronicle*, May 17, 1910, p. 1; "Borax king to acquire stock in Bay Cities Co." *San Jose Mercury and Herald*, November 27, 1910, p. 8; "Big water fight on across the bay." *San Francisco Chronicle*, March 30, 1911, p. 13

this trial, Bay Cities adopted a new strategy. Instead of arguing that the plaintiff's wells would not be harmed by the water exports, it admitted that if its activities would lower the plaintiffs' wells, then the injunction was justified. Furthermore, the defendant placed its proposal, which would now keep water within Santa Clara Valley, at the center of its argument. The conservation of "waste" water had recently received much attention nationwide, and the company appropriated the conservation rhetoric. Also, the additional benefits, such as storage during droughts and flood control, were espoused. The company's proposal included several variations, such as letting a constant volume of water percolate, or guaranteeing to maintain the plaintiffs' wells at certain levels. The lawyers also presented more convincing evidence, such as quantifying the amount of waste in terms of the irrigated acreage or urban population it could supply, as well as citing recent federal reports on artificially recharging groundwater in Southern California. Bay Cities concluded its brief by noting that large-scale water conservation requires the centralization of capital and authority, and if the court maintains the injunction, an opportunity to conserve would be lost:

> When the valley has been built up, when more railroads have crossed its territory, when its cities have increased in population, when the agricultural and manufacturing industries of the county have grown to dimensions justified by the natural resources of the country... the demand for water will become insistent. The people will then turn their attention to the vast waste of water in the sea; and they will be met with the adverse decision in this case. The farmers themselves, the very plaintiffs in this case, will not then be able to combine to protect against this loss, for the very principle which lies at the foundation of that decision will preclude the conservation of this waste.[32]

[32] *Hayes-Chynoweth Co. et al v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15181, 1904, Opening Brief for Defendents, p. 258

The plaintiffs countered that a court does not have the authority to interfere with "nature's plan." Furthermore, they asserted that relying on averages is hazardous, the hydrologic measurements were inaccurate, and the plan would fail because silt would clog the stream bed gravels.[33]

Judge J. W. Welch's eloquent ruling and decree of November 1913 is worth quoting at length. It praised the virtues of groundwater and conservation, revealing a belief that water is a divine gift, provided for economic production:

> The great demand for life-giving water for man, beast, and annual crops, necessitates the conservation of every gallon of rain falling upon the floor of the valley and the generous watersheds of the County.... [Aquifers] afford pure, sparkling, wholesome water to man and beast everywhere. They bring forth the crops in season and in abundance to the inhabitants; they are ever present and ever ready to serve the uses of man; never stagnant or polluted; for many, if not all purposes they are superior to the surface waters.... I have no inclination to take one drop of this life-giving water from the dwellers of the valley. It is Nature's gift to the urban and suburban inhabitants therein. But on the other hand, if there are vast quantities of pure, life-sustaining water wasting itself in the sea, it would be equally wrong to forbid its conservation and use....

Although the plaintiffs warned against the altering "Nature's plan," such modifications were necessary, and engineers could be trusted to improve nature:

> Without modifying nature's destructive way in disposing of the waters of the Colorado river, the fruitful, beautiful Imperial Valley would not now exist, but would today be a desert waste.... Without retaining dams and the engineer's skill, running waters could not be arrested and controlled and put to use and work for man's benefit and convenience.

Thus, he ruled that Bay Cities' plan would not only be harmless to the plaintiffs, but would also benefit them and the greater public though conservation, flood control, and

[33] *Hayes-Chynoweth Co. et al v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15181, 1904; "Bay Cities Co. wants Coyote River water." *San Francisco Call*, July 2, 1910, p. 8; "Water rights case argued by attorney." *The Evening News*, May 31, 1911, p. 1

drought mitigation. Preventing such an endeavor would be contrary to the paradigm of economic growth. Indeed, he said, "Let private capital be free to develop the resources of the County.... This is true conservation which can not be accomplished by Courts' prohibitory injunction, or by governmental arbitrariness." Consequently, the judge allowed the company to develop the surface and groundwater of the Coyote valley under the restrictions that it export no water, limit pumping to 7 taf/y, and release water from the reservoir so that the first 19 taf/y of flow plus 6.6% beyond that percolate into the stream bed.[34]

The Bay Cities Water Company was able to win the final case because it presented a proposal that agreed with the popular ethic of natural resource conservation while avoiding the resentment typically generated by the expropriation of natural resources. Furthermore, its artificial recharge plan was studied and modified by over 150 farmers in the Coyote Valley who filed a Friend of the Court brief, weakening the accusation that the company was stealing form the local residents. In addition, Santa Clara Valley suffered from flood damages in 1910-11, during which the case was argued and the defendant emphasized the flood control values of its project. Although the plaintiffs filed an appeal, Bay Cities was unable to proceed with its plans. The accusations of graft in San Francisco damaged the viability of a "paper company" which had never actually produced a product. By 1918 it failed to make bond payments, and was soon purchased by the expanding People's Water Company. Later, Spring Valley

[34] *Hayes-Chynoweth Co. et al v. Bay Cities Water Company et al.* Santa Clara County Superior Court 15181, 1904; "Ranchers win suit for water in Santa Clara." *San Francisco Call*, September 21, 1912, 1, p. 10

Water Company, Bay Cities' old rival, explored the option of a water project on Coyote Creek and even began construction of a dam.[35]

The Bay Cities cases both reflected and influenced the understanding of the region's hydrology. Although they involved competing claims to this understanding, the trials also revealed concepts which were more broadly accepted. Of course, these images were seen through the lenses of the observers, many of whom adopted rhetoric to advance pecuniary interests. In the era of the rapid expansion of profitable irrigated orchards, Santa Clara Valley was the beneficiary of nature's anthropocentric plan. A nature this generous was not to be subdued, but instead assisted or complemented. Although faith was widely placed in the engineer, there lacked a consensus on what magnitude of manipulation was appropriate. Consistent with the dominant thinking of the early twentieth century, the court asserted that dams provided the solution to conflicts over water. In addition, the trials opened a publicized dialogue on the geology and hydrologic behavior of Santa Clara Valley. Specifically, the cases popularized the ideas of an interconnected hydrologic cycle, groundwater recharge through stream bed percolation, and the artificial augmentation of this finite resource through slow releases from surface storage. Furthermore, they cited the inland valleys of southern California as an exemplar of this practice. Finally, the Bay Cities cases coincided with a shift in power from the San Jose city machine and boss, essentially defeated in the 1916 elections, to a

[35] "Ranchers win suit for water in Santa Clara." *San Francisco Call*, September 21, 1912, 1, p. 10; "Water suit to go up to Supreme Court." *The Evening News*, November 28, 1913, p. 8; "Millions involved in suit." *San Jose Mercury Herald*, January 25, 1919, p. 1; "Report water survey now well under way." *San Jose Mercury Herald*, October 7, 1920, p. 11; unpublished Spring Valley Water Company documents in the Water Resources Center Archive, University of California, Berkeley (Herrmann, F. C. 1913. *Alviso* (continued...)

new Progressive Republican regime derived from the Good Government League and Home Protective Association. In particular, E. A. Hayes was in Congress from 1905 through 1916; S. F. Leib – already a judge – was later vice-president and director of the First National Bank; and John Richards took the judicial bench in 1906.[36]

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*Lands: Water Possibilities*; Schussler, Hermann. 1914. *Outline for the Development of the Water Resources of the Coyote River*; Spring Valley Water Comany. 1914. *Coyote Creek Diversion*)

[36] "Water company is beaten in tussle." *San Jose Mercury*, October 29, 1904, p. 1; "Water question in this valley." *San Jose Mercury Herald*, January 8, 1905, 1; "Gives exhaustive review of notable cause." *San Jose Mercury*, June 6, 1905, p. 3, 5; Sawyer, 1922

# IV. CALLS FOR CONSERVATION AND THE TIBBETTS-KIEFFER PLAN

At the time the Bay Cities cases concluded, the valley was in the midst of prosperity. The booming farm market furthered agricultural intensification and changes in demographics and landscape. Increased use of groundwater soon diminished the artesian area and lowered the water table. Residents voiced concern, and within a few years organized to fund an investigation. The results included a comprehensive plan to conserve the wasting flood water of the valley and store it underground. Drawing on ideas from the Bay Cities cases and reports from southern California, it integrated multiple components of the hydrologic cycle, as well as its spatial and temporal variability.

## *The changing Santa Clara Valley*

In the early twentieth century, a prosperous farm economy, underwritten by new technologies and institutions, fueled rapid groundwater depletion in Santa Clara Valley. Indeed, the agriculture economy before World War I was among the strongest in American history. Improvements in transportation and processing techniques catalyzed fruit production. Furthermore, marketing cooperatives, particularly the California Prune and Apricot Growers' Association, soon increased profits for growers in Santa Clara Valley. In addition, farmers' political groups grew throughout the state. Although the agribusiness-oriented Farm Bureau was the largest such organization in California, the Grange, which favored small scale growers, was most prominent in Santa Clara County. Agricultural intensification was both fuel for, and a result of, the booming market. It led to greater productivity, yield, and revenue. But at the same time, increasing competition

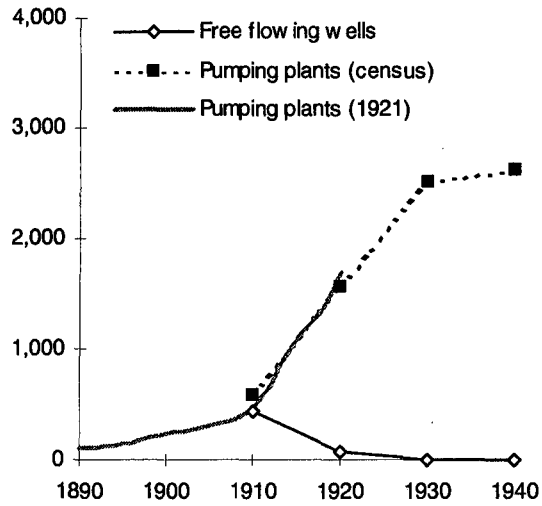


**Figure 4. Number of wells, Santa Clara County, 1890-1940.**
Source: Tibbetts and Kieffer, 1921 United States Bureau of the Census, 1892, 1902, 1912, 1922, 1932, 1943

forced growers to adopt higher standards and new – often expensive – technologies. The farms thus became caught in the cycle of needing greater yields to finance the means of increasing output.[1]

Economic growth and agricultural intensification engendered other changes. For example, the use of technology, smaller farm sizes, and improved transportation led to an intermingling of urban and rural lifestyles. Farm residents enjoyed a quasi-suburban lifestyle. Many farmers owned many small plots, scattered throughout the town and country (Figure 3, page 41). In addition, the valley's demographics changed as an increasing number of farms relied on migrant labor, most of whom came from Asia or eastern Europe. Furthermore, food processing spurred rapid urban growth and the development of other industries. In fact, manufacturing in San Jose doubled from 1910 to 1915. The Progressive movement gained strength statewide, and local politics came

under the influence of the Progressive, socially conservative Republicans of the Good Government and Lincoln-Roosevelt Leagues. In 1915 a new town charter was adopted in San Jose, with the executive in the hands of a city manager.[2]

Although the amount of orchard land increased little, irrigation and groundwater pumping accelerated. Statewide, irrigated agriculture became increasingly profitable and competitive, and its benefits were now widely accepted. Furthermore, nearly half of the newly irrigated land used groundwater. During the 1910s in Santa Clara County, the irrigated acreage nearly doubled (Figure 3, page 41 and Figure 15, page 100), and an increasing share of this was by groundwater as farmers drilled wells in response to short-term dry spells (Figure 4). In that decade, the number of pumping plants in the county almost tripled as groundwater draft approach 70 taf/y. New technologies catalyzed this by decreasing the startup and operation costs of groundwater pumping. Two-thirds of existing pumps in the valley were powered by steam in 1904, but soon the spread of electric lines offered a superior power source. This increased groundwater withdrawals not only through convenience and affordability, but also by the electricity price structure. Farmers were billed based not on electricity consumption but on the installed capacity. Consequently, once a pump was installed there was little incentive to moderate its use. Furthermore, the development and improvement of the vertical centrifugal pump and the new rotary method of well drilling decreased costs and maintenance, and increased the depth of accessible water. By the mid-1910s, most wells used vertical centrifugal pumps and electric power. The accelerated withdrawal of

[1] Sawyer, 1922; McWilliams, 1949; Chambers, 1952; Ackerman and Lof, 1959; Arbuckle, 1986; Malone and Etulain, 1989

groundwater reduced the area of flowing artesian wells to 7000 acres and lowered the water table. Even though new technologies lowered costs per foot of lift, the lower water levels caused a net increase. Specifically, in 1920 the average cost of groundwater was double that of 1904.[3]

The alarming groundwater conditions spurred consideration of a conservation project. In the summer of 1913, only a few months before the *Hayes* ruling, the first meeting discussing a valley-wide conservation project was held. A false statement to the *Mercury* implied that federal funds were available for water conservation, and subsequently prominent Santa Clara Valley Progressives led a forum in Campbell on potential projects. Although the rumor of aid was dispelled by Congressman E. A. Hayes, the attendees, who included both growers and urban businessmen, recognized that the problems of winter floods and summer drought could remedy one another. The consensus was to conserve wasted water, and to aim for a surface storage project in the Santa Cruz Mountains to ensure against dry years. Strategies to achieve this varied, with some calling for an irrigation district and others seeking a study of available water resources. L. Woodward, chairman of a committee formed to investigate the options, attributed the decreasing artesian supplies to dry years, and asserted that conservation is necessary to maintain a productive landscape:

> [W]e have really had only one rainy season in four. That is reducing the supply of water in our wells. It seems to me that we would be putting up a good argument for federal aid if we pointed out that assistance was needed

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[2] Sawyer, 1922; Broek, 1932; James and McMurry, 1933; Bohnett, 1968

[3] Fortier, 1905; United States Bureau of the Census, 1912, 1922; Adams, 1913; Adams, 1920; Tibbetts and Kieffer, 1921; Clark, 1924; Fortier, 1924; Martin, 1950; Bittinger and Green, 1980; Parks, 1983. Indeed, Donald Green largely attributes the exploitation of the Ogallala aquifer to such technological advances (Green, 1973).

> to prevent this Garden of Eden [from] reverting to a desert.... We wish to prevent land reclaimed from returning to a desert.[4]

The committee took no action, believing the groundwater would replenish itself, and that conservation was too expensive.[5]

The meeting had been called by state Senator Herbert C. Jones and Assemblyman L. D. Bohnett, local Progressive Republicans who would play prominent roles in the valley's conservation movement. Jones (Figure 5) was drawn into the conservation movement as a San Jose youth through his mother's involvement in the Sempervirens Club, which worked to establish Big Basin Redwoods state park. After education at Stanford, he was elected to the California Senate, where he served from 1913 until 1934. As a member of the Lincoln-Roosevelt and Progressive Voters' Leagues, he sought to maintain progressivism in the Republican party. In the Senate, he maintained liberal stances in economic affairs, but supported conservative social policy. Furthermore, he balanced his alliances with the valley's urban growth and its farming interests. An avid proponent of an active government in water conservation, Jones supported the municipalization of the San Jose Water Works, helped draft the 1928 constitutional amendment on water, and even became known as the "Father of the Central Valley Project."[6]

Lewis Dan Bohnett (Figure 6) was born into a large, modest family with a prune orchard in Campbell. As a young lawyer, he represented one of the plaintiffs in the

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[4] "Orchardists to investigate big irrigation project." *San Jose Herald*, June 13, 1913, p. 9, 11

[5] "Orchardists to investigate big irrigation project." *San Jose Herald*, June 13, 1913, p. 9, 11; Smith, 1962; Rickman, 1981

[6] Posner, 1957; Jones, 1958; Walker and Williams, 1982; Matthews, 1999; Willie Yaryan, personal communication

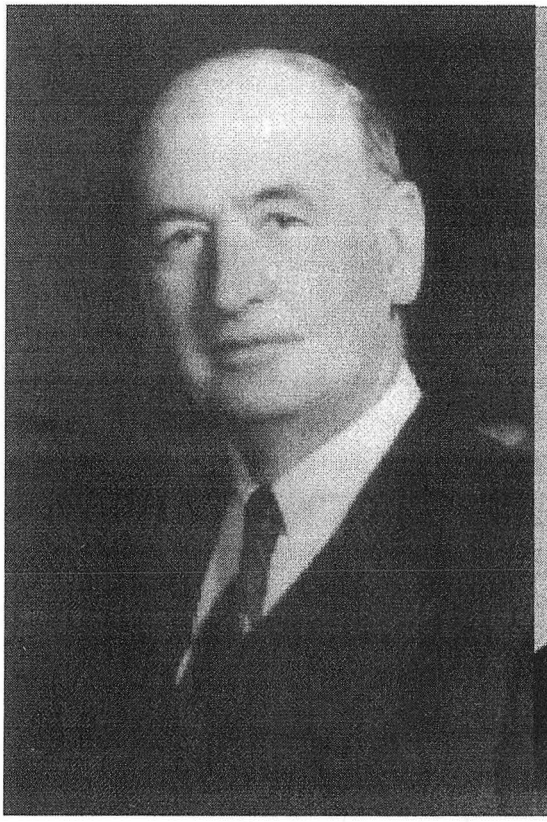

**Figure 5. Sen. Herbert C. Jones.**
Image source: Martin, 1950.

**Figure 6. L. D. Bohnett.**
Image source: Bohnett, 1968.

*Hayes* case. Elected to the Assembly as a Republican in 1908, he led a bipartisan Progressive coalition, and sponsored the Railroad Commission and Water Commission Acts. By cross-listing as a Democrat and Progressive, in 1914 he challenged E. A. Hayes for his Congressional seat, accusing him of entrenchment in the San Jose political machine and failure to be truly progressive. After losing the election, Bohnett maintained a law practice in San Jose for several decades.[7]

The continued lowering of the water table in Santa Clara Valley and throughout California catalyzed legislative reform and government investigations in water resources.

[7] Sawyer, 1922; Jones, 1958; Bohnett, 1968; "Bohnett is logical candidate for Congress." *Gilroy Advocate*, October 24, 1914

Several studies recommended the reform of water law and comprehensive, multiple-use planning. After revision in 1897, 1913, and 1917, the Wright Act rapidly increased the land in irrigation districts, and other legislation permitted the formation of other types of water districts with varying powers. The State Water Commission, established in 1914, began oversight of appropriations. Also, the federal government increased the output of water resource investigations through the USDA OES and the USGS, including some studies of Santa Clara Valley. In 1904, the OES published the first such local report, which focused on the irrigation techniques and duty of water in the valley. It noted the uneven temporal and spatial distribution of water availability, but emphasized the ability of winter irrigation to reduce wasted water and store moisture in the soil. The report of the California Conservation Commission of 1912 explored the use and conservation of natural resources throughout the state, and broadened the definition of conservation to accommodate the Progressive fears of monopolistic control. In it, a chapter on Santa Clara Valley emphasized the potential of water conservation projects in the area. Finally, to assist in the potential formation of an irrigation district in the Coyote Valley, the USGS released in 1917 a preliminary report from an ongoing investigation that described the geography and geology of the valley and compiled precipitation, stream discharge, and pumping data, including data and exhibits from the Bay Cities Water Company trials.[8]

### *The Water Conservation Commission*

Higher pumping costs from the falling water level motivated Santa Clara Valley residents to investigate forming an irrigation district and implementing large-scale water

[8] Fortier, 1905; Conservation Commission of California, 1912; Adams, 1913; Clark, 1917; Fortier, 1924; United States Bureau of the Census, 1912, 1922, 1932; Montgomery and Clawson, 1946; Smith, 1962

conservation projects. Although the water table temporarily declined after the dry winter of 1912-1913, consistent overdraft began in 1917. The San Jose Chamber of Commerce voiced concern, and at a November 1919 meeting it recommended storing the winter floods behind dams, especially on Coyote Creek, and using the water not for direct irrigation but instead to "to act as a continual source of supply to the underground streams which are fed by [Coyote] during the summer."[9] Speakers attributed the falling water levels to dry years and more farmers using groundwater, and felt that such a plan would act as insurance against uncertain water supplies. However, they recalled the difficulties faced by Bay Cities in its plans to dam the stream.

Over the following months, the recently-formed Farm Owners and Operators' Association, met in the Chamber of Commerce offices, usually with Jones and Bohnett, to discuss the importance of conservation and consider potential solutions. Speakers noted the high stakes, asserting that the farming economy relied on the water supply: "Water is absolutely necessary. Water is King. Stop the water supply of our great Santa Clara Valley orchards and this valley will be one of the driest spots in California.... We will be dead."[10] In addition, the first reports appeared of salt water intrusion from the bay into wells near Mountain View. The association did not place responsibility for the falling water table on the increased number of wells, but instead on the natural phenomena of recent dry years, high evaporation rates, and the wasting of winter floods. Some noted that the deforestation of the Santa Cruz Mountains increased the magnitude

[9] "Dam Coyote Creek to raise water levels." *San Jose Mercury Herald*, November 4, 1919, p. 9, 11
[10] "Water is vital to valley." *San Jose Mercury Herald*, January 22, 1920, p. 1

of the floods, and Jones even asserted that the loss of the forests had caused precipitation to fall to one-third. Furthermore, it was imperative to correct nature's shortcomings:

> If left uncorrected this natural state of affairs would practicall[y] prohibit the proper and most effective utilization of the water.... In order to therefore correct, adjust and regulate the volume of water that a stream produces to the greatest advantage, the best and practically the only remedy consists in the construction of storage reservoirs of ample capacity.[11]

The group considered importing water from the Calaveras Creek watershed, or even pumping all groundwater from near the bay to higher elevations, but deemed these impractical. Instead, most participants agreed that surface storage was needed, generally for groundwater recharge. Specifics for two reservoirs on Coyote Creek totaling 115 taf were given, and one suggestion called for a 20 mile conduit from the reservoirs to the Los Gatos region, where irrigation and the water table decline were most intense.[12]

Conflicts between rural and urban constituencies plagued the conservation movement from the start, but compromise was generally attained. Although Bohnett recognized these potential conflicts and the need for unity, under the chairmanship of J. J. McDonald the Association remained dominated by farm interests. This caused the conservation interests to reorganize in February 1920 as the Water Conservation Committee, with more town and business representation. Charles E. Warren of the Farm Owners and Operators' Association was elected president, E. A. Hayes its chairman, and Bohnett retained as attorney. The committee planned to establish one or more irrigation

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[11] "Seek plan for water supply." *San Jose Mercury News*, January 25, 1920, p. 1, 3, 24

[12] "Conservation of water imperative." *San Jose Mercury Herald*, December 20, 1919, p. 1; "Water situation told at meeting." *San Jose Mercury Herald*, December 21, 1919, p. 1, 12; "Water is vital to valley." *San Jose Mercury Herald*, January 22, 1920, p. 1; "Seek plan for water supply." *San Jose Mercury* (continued...)

districts in the county, and to build dams to store floodwater to recharge the aquifers. Its chief task was to raise funds for a comprehensive survey of the valley's water resources. Emphasizing the connection between the water supply and general economic prosperity, the committee raised $25,000 from the county Board of Supervisors, the Chamber of Commerce, and local farming organizations.[13]

Throughout the meetings of the association and the committee, the plans remained in the shadow of the Bay Cities Water Company trials. The *Mercury Herald* brought this to the forefront of discussion in a January 1920 front page article that recounted the history of the cases and described the valley's surface and subsurface hydrology in detail. Like the plaintiffs in the Bay Cities cases, the new conservation movement was generally led by successful, Progressive Republican orchardists, most notably Hayes, Bohnett, and Frank Leib, a Stanford classmate of Jones and son of the plaintiff's lead attorney in the Bay Cities cases. Moreover, their plan for surface storage of winter rains and controlled groundwater recharge was clearly informed by the proposal of the company. Jones pointed this out at the first water conservation meeting of the association, but did not expect the present plans to face the same difficulties.[14]

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*News*, January 25, 1920, p. 1, 3, 24; "Irrigation drive is started." *San Jose Mercury Herald*, February 1, 1920, p. 1, 16

[13] "Irrigation drive is started." *San Jose Mercury Herald*, February 1, 1920, p. 1, 16; "Famers discuss the problem of water." *San Jose Mercury News*, February 15, 1920, p. 7, 9; "Committe on irrigation elects permanent officers." *San Jose Mercury Herald*, February 29, 1920, p. 25; "County aid asked in survey." *San Jose Mercury News*, March 16, 1920, p. 1, 2; "Fruit growers, merchants, C. of C. to aid water fund." *San Jose Mercury News*, April 28, 1920, p. 1; Martin, 1950; Fish, 1994?

[14] "Water situation told at meeting." *San Jose Mercury Herald*, December 21, 1919, p. 1, 12; "Supply of water is scarce." *San Jose Mercury Herald*, January 20, 1920, p. 1, 8;

**Figure 7. Fred H. Tibbetts**
Image source: Martin, 1950.

For the survey of the valley's water resources, the Water Conservation Committee considered several engineers, including the former engineer of the Bay Cities Water Company, Harry Haehl. It settled on Frederick H. Tibbetts (Figure 7), who would guide the plans for comprehensive water conservation for the next two decades. Born in Wisconsin in 1882, Tibbetts moved to a Campbell orchard at the age of ten. He obtained degrees in civil engineering at College of the Pacific in San Jose and the University of California, Berkeley. While at Berkeley, he studied with the most prominent authorities on irrigation, such as Frank Adams and Samuel Fortier. For his senior thesis, he conducted the field work and wrote much of the text for the 1904 USDA OES investigation of Santa Clara Valley. During that project, he became acquainted with more of the California engineering elite such as Elwood Mead, and developed many of the ideas for later proposals. By 1919, he had taught at Berkeley, worked in private

consulting, led investigations into artesian conditions in Pleasanton and Livermore Valley, and supervised massive reclamation and flood control projects in the Sacramento Valley.

Fred Tibbetts's career continued to advance in the 1920s. He became chief engineer of several water districts; worked on highways, sanitation, land division, bridges, harbors, hydropower, and railroads; and was employed in projects in Arizona, Nevada, California, Oregon, and Alaska. Tibbetts was chairman of the Commonwealth Club section on irrigation, a member of the advisory board for the California Water Resources Investigations, and chairman of the Executive Committee of the Irrigation Division of the American Society for Civil Engineering. In addition, he had a reputation as an effective communicator, particularly conveying technical subjects to lay audiences. Tibbetts' writings reveal that he envisioned engineering and irrigation as critical to developing California's economic potential, although this would require the coordination of resources and regional planning. To that end, he considered it necessary for engineers to develop a "broad, sympathetic understanding," including the economics and politics of a project.[15]

### *The Tibbetts-Kieffer report*

Tibbetts and his associate Stephen Kieffer, assisted by seventeen employees, began field work in August 1920. Within seven months, they prepared a topographic

[15] "County aid asked in survey." *San Jose Mercury News*, March 16, 1920, p. 1, 2; Frederick Horace Tibbetts papers, Bancroft Library, U.C. Berkeley; Wadsworth, 1940; Downs, 1931; Anonymous, 1928; Anonymous, 1930; Records of the Office of Experiment Stations Relating to Irrigation and Drainage Investigations, 1898-1915, National Archives, Pacific Station, San Bruno, California, "Tibbetts biography – 1882-1938," anonymous manuscript in the Santa Clara Valley Water District Archives; Tibbetts, 1925; Tibbetts, 1931a

map of the valley, conducted a crop census, studied the past and present water use, surveyed water prices, delineated and analyzed watersheds for precipitation and runoff, calculated absorption in the stream beds, located and measured the depth to water in 600 wells, mapped the water table, analyzed groundwater movement, surveyed potential reservoir sites, and drafted preliminary designs and costs of proposed facilities. Furthermore, the project was completed under budget.[16]

The contents of the March 1921 report shed light on the authors' biases, sources of ideas, and conceptualization of the hydrologic cycle. Tibbetts and Kieffer approached the valley favorably, calling it:

> one of the garden spots of the state.... Its favorable geographical location, topography, climate and general productivity have combined to produce a community of the highest type with resulting high property values... a veritable edition de luxe of horticultural and agricultural development.[17]

First, a geographic overview described the topography, geology, climate, watersheds, and vegetation of the valley. The economic study detailed the historical and present demographics, agricultural practices, land valuation, and even the business, transportation, and educational facilities. The crop survey and estimates of the average duty of water and per capita residential consumption revealed that 137 taf/y of water was used, of which 90% was for irrigation. The authors attributed the water table decline to the increase in pumping during recent decades, which in turn was due to inexpensive pumps and electricity and to a series of dry years. They concluded that withdrawals had exceeded natural replenishment since 1917. Furthermore, they extrapolated agricultural

[16] "Water survey in full swing now." *The Evening News*, August 12, 1920, p. 8; "Water survey now fairly under way." *San Jose Mercury Herald*, September 19, 1920, p. 1; "Report water survey now well under way." *San Jose Mercury Herald*, October 7, 1920, p. 11; Tibbetts and Kieffer, 1921

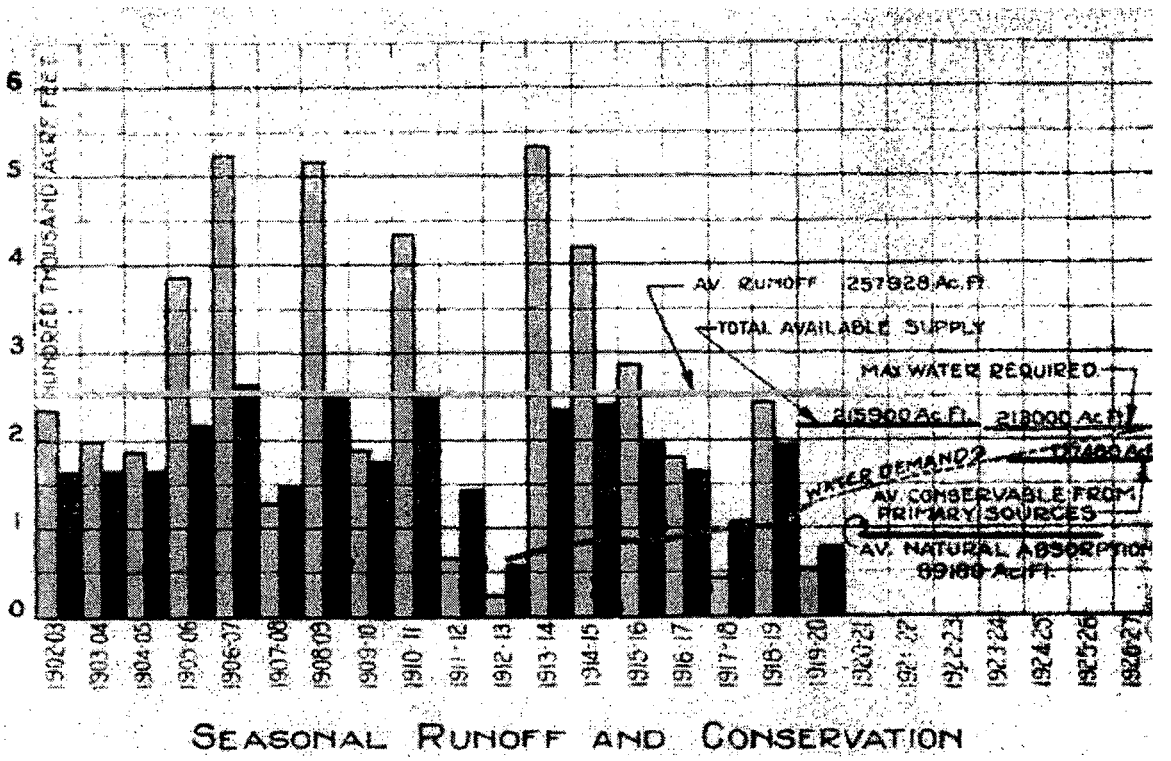


**Figure 8. The Tibbetts and Kieffer prediction of maximum conservation and demand.** For each year, the left bar is the runoff, the lower right bar is the natural absorption, and the upper right bar is the conservable supply from primary sources. Each of this is averaged into a line on the right, and the water demand is extrapolated to its predicted maximum. Conservable secondary sources are added to the primary sources, producing a total available supply just 1% above the maximum demand. Source: Tibbetts and Kieffer, 1921.

and demographic trends, and predicted that all irrigable land would actually be utilized as such within a decade (Figure 8). Because Tibbetts and Kieffer assumed that the growing cities would use no more water than the irrigated farms they replaced, a maximum water demand of 213 taf/y would be reached and "will then be steadily sustained and practically uniform...."[18] Nevertheless, the report expressed concern the increasing overdraft would stifle economic growth.

The heart of the field work was the hydrographic survey. Using a handful of rain gauges in the county and correlating the sparse data with the longer record from San

[17] Tibbetts and Kieffer, 1921, p. 20
[18] Tibbetts and Kieffer, 1921, p. 67

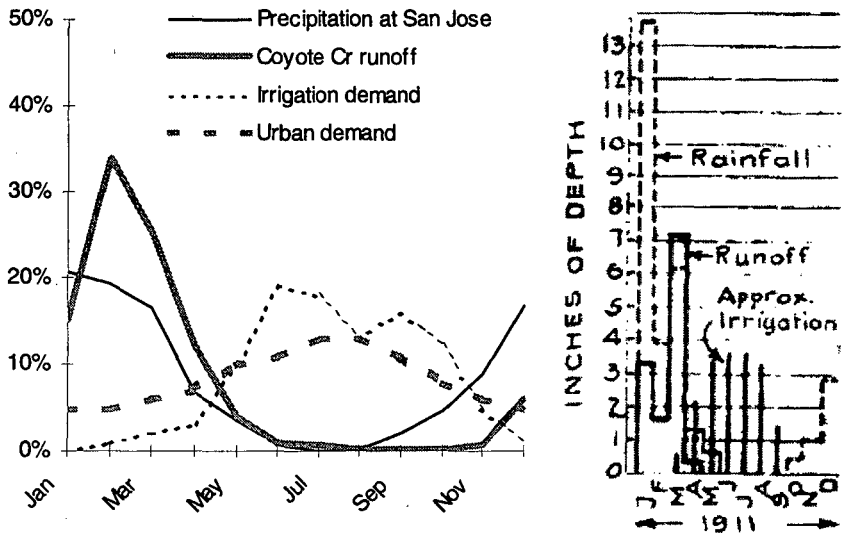


**Figure 9. Annual distribution of water supply and demand, Santa Clara Valley.**
In the report, Tibbetts and Kieffer acknowledged this temporal distribution. Source: State Water Resources Board, 1955; Tibbetts and Kieffer, 1921.

Francisco, Tibbetts and Kieffer drew a map of average annual precipitation and determined the hydrologic contribution of twenty-eight watersheds. Runoff and absorption functions of precipitation were produced for each stream. Actual absorption data were available for only a handful of streams, most notably from Bay Cities Water Company's records of Coyote Creek, but in most cases these were estimated based on watershed and stream characteristics. The authors concluded, as did the courts in the Bay Cities cases, that the rate of natural absorption rapidly levels off as stream discharge increases. The report assumed that percolation in gravel stream beds is the only significant source of groundwater recharge.

The hydrologic model of Tibbetts and Kieffer is a fundamentally interconnected local system whose heterogeneous spatial and temporal distribution was incongruous with the demands of the irrigated economy (Figure 9). In this model, hydrologic processes have influenced topography, soils, and crops through the alluvial deposition of

the valley streams, and the streams have left old gravel beds that form irregular connections between the larger aquifers. The gravel is more abundant, connected, and accessible along the margins of the valley, with clay becoming more prominent toward the bay. Recharged through the stream channels, the groundwater itself was considered as a vast reservoir that slowly and irregularly moves toward the bay, supplying both the surface and confined aquifers. Thus, the basin serves both water storage and distribution functions. Tibbetts and Kieffer claimed that one of their most important observations was the water table forms large ridges underneath the streams each spring, implying that prolonging their flow in these percolation areas would increase recharge. The engineers extended this integrated hydrologic model to include human uses. Thus, "The wells through which water is drawn upward from the gravel reservoir to the orchard trees should be considered as an alternate portion of the distributing system connecting the streams with orchards."[19] Furthermore, applied irrigation water recharges the aquifers, and this water can subsequently be reused at lower elevations. However, the strongest emphasis was on the waste of water caused by the incongruity of the natural supply and human demands. Because most surface flow occurs outside of the irrigating season, two-thirds of the water supply was unused. Even groundwater flowing into the bay was considered as waste.

Tibbetts and Kieffer proposed a physical network of facilities that would build upon those provided by nature, and store and redistribute the water to better match the spatial and temporal distribution of supply and demand (Figure 10). Maximum storage

[19] Tibbetts and Kieffer, 1921, p. 45

was considered essential because of the torrential nature of the streams of Santa Clara Valley, and the construction of seventeen surface reservoirs with 194 taf of surface storage was recommended. However, because some streams lacked storage sites or were distant from the demand, a distribution system would also needed. The excess supply of Coyote Creek, with nearly two-thirds of the surface storage would be the primary source of diverted water. Some would be diverted for direct surface irrigation, and the project would follow the *Hayes* ruling by allowing the first 19 taf/y plus 6.6% beyond that to sink below the Lower Gorge. Furthermore, the investigators proposed a cement canal through the Coyote Valley in order to prevent excessive recharge there. After meeting these local needs, via a series of canals and pumps 7 taf/y would be pumped to the east side and 30 taf/y would be transferred to the depleted west side as far as Stevens Creek. The low areas of Milpitas and Palo Alto would be supplied by pumps that would capture and reuse the groundwater returning from irrigated plots before it seeped into the bay. Because percolation is largely a function of the length of time that a stream contains water, releases from the reservoirs would be at a rate which would entirely sink into the stream beds and a handful of off-stream percolation ponds. This recharge would be augmented by low, broad dams at the gravely areas of the streams that lack reservoir sites, especially Los Gatos Creek. Tibbetts and Kieffer concluded that the supply from such maximum conservation of the valley's water resources could average 177 taf/y from primary sources, and including secondary groundwater from irrigation, 216 taf/y – only 1.5% greater than the estimated maximum water demand. The cost for this system would exceed $11 million, or $4.16 / acre each year in amortized bonds. A final chapter by Bohnett proposed the organization of an irrigation district that, as Tibbetts and Kieffer

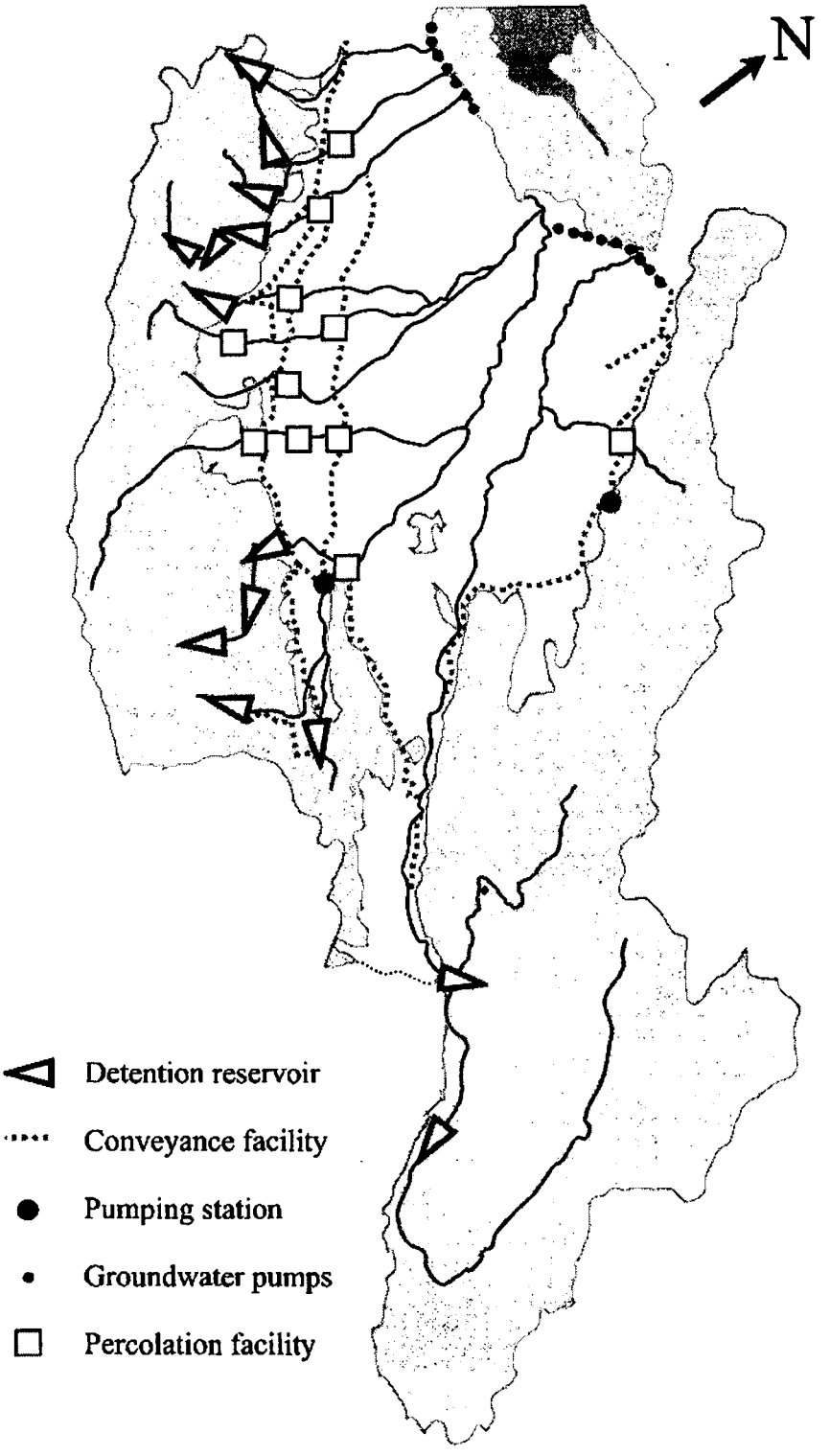


**Figure 10. Schematic of the 1921 Tibbetts and Kieffer plan.**

noted, conformed to the natural infrastructure. The borders of the district essentially coincided with the groundwater basin, and it would have seven divisions based on the sources of groundwater. Finally, existing laws required that districts rely on a single source, and consequently this proposal to integrate an entire hydrologic network required a special law that had been written by Bohnett and submitted to the Senate by Jones.[20]

The Tibbetts and Kieffer report integrated several innovative trends in water management. The authors were clearly aware of previous work in the valley, as they incorporated data from private water companies, the Bay Cities cases, the 1904 USDA report, the Conservation Commission study, and the 1917 USGS Water Supply Paper. More importantly, the authors developed a "hydrologic paradigm" which holistically considered the local hydrologic cycle, including precipitation, runoff, percolation, recharge, aquifer storage, and groundwater movement; the variable nature of these components; and their relationship with other natural and human systems. The local focus was highlighted by the lack of consideration given to importing water.

The core of this paradigm was the practice of artificial recharge. Storing water underground buffers an irregular supply of water so that it can be used whenever needed. In addition, aquifers can act as a distribution system. Using these underground reservoirs avoids many of the shortcomings of surface facilities, such as evaporation, flooded land, costs, and susceptibility to earthquakes. In his oral history, Jones said that the benefits depend on the local conditions:

> But we have no place for vast surface storage that can carry over a series of dry years.... If we have plenty in a wet year and store the surplus

[20] "Water report is made for county." *San Jose Mercury Herald*, March 24, 1921, p. 1, 14; Tibbetts and Kieffer, 1921; Smith, 1962

> underground, we'll have enough [left] over to carry us through a dry year. If you depend just on a surface reservoir, there comes a dry year and you're sunk; orchards die.[21]

Artificial recharge rests on the notion that humans, through a scientific understanding of the hydrologic cycle, can improve the functioning of nature. Writing on the similar artificial enhancement of fish populations, McEvoy states such an approach offered

> simple, technical, intuitive solutions to the complex problems of fishery depletion.... [T]hey seemed to fulfill the very great promise... that applied science could revive and sustain the productivity of a ravaged environment without requiring any fundamental changes in the ways in which people used it.[22]

This is consistent with the turn of the century engineering philosophy, as well as the views expressed by Santa Clara Valley residents.[23]

Although the connection between the surface streams and the aquifers and the possibility of managing the former to recharge the latter were publicized in the Bay Cities trials, the source of this approach was largely federal reports detailing the experiences of water development in the valleys of southern California. These were cited throughout the Tibbetts and Kieffer report, as well as the during the court trials. However, artificial recharge of groundwater appears to have been first used for municipal supplies in Europe at the end of the nineteenth century. These systems were small scale, in which a well field near a river was enhanced by diverting some of the surface water into an infiltration gallery or pond near the wells. Outside of the California, there was little artificial

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[21] Jones, 1958, p. 275
[22] McEvoy, 1986, p. 108
[23] Cooper, 1968

recharge practiced in the United States, although there are reports of simple municipal systems such as those in Europe being implemented in Denver as early as 1890.[24]

The most extensive and frequently-cited artificial recharge project in America during the early twentieth century was in the San Bernardino Valley of southern California, where conditions are similar to Santa Clara Valley. In the center of the groundwater basin was an artesian area supplied by a handful of torrential streams passing over alluvial cones. It was utilized by irrigators and a handful of private water companies which exported to nearby towns. Although reports vary, as early as 1884 local residents may have suggested saturating the ground with surface water to recharge the artesian source, and the water companies may have spread excess waters of the streams over permeable areas before 1900. Because the mountains lack good surface reservoir sites, Eugene Hilgard of the University of California suggested artificial recharge in a 1902 USDA report. On this advice, farmers, companies, and county governments contributed to the Tri-County Water Conservation Association, which began an extensive recharge program in 1911, and the portion of annual precipitation which escaped the valley decreased from 54% to 30%. Due to different hydrological and geological conditions, the methods were different than those proposed by Tibbetts and Kieffer. There, the streams are even more torrential, and they empty onto steeper gravel cones. Consequently, the Association built a series of temporary embankments that

[24] For European cases, see DeRance, 1884; Richert, 1900; Richert, 1904; Barrows and Wills, 1913; Scheelhaase and Fair, 1924. For Denver, see Anonymous, 1894; Tait, 1917.

spread the water into smaller and smaller channels. Furthermore, the percolation was nearer to the pumping area, and thus the aquifer was not utilized for long term storage.[25]

Tibbetts and Kieffer cited groundwater studies of southern California not only for the engineering practices, but also for the hydrologic framework and methods. The authors of the earlier reports, notably Charles Lee and Walter Mendenhall, described the valleys using concepts and language much like those later used by Tibbetts and Kieffer. They emphasized the temporal and spatial variability of precipitation, the torrential character of the streams, stream bed percolation as the primary source of recharge, groundwater movement through buried gravel channels, and the value of the aquifers as natural underground reservoirs. In particular, Lee presented a methodology for determining the hydrologic budget of a closed groundwater basin, which was largely adopted in the Santa Clara Valley study.[26]

Nonetheless, Tibbetts and Kieffer did not merely transplant these ideas from southern California to Santa Clara Valley. Their proposal was more fully integrated: instead of simple flood spreading and percolation facilities on individual streams, they sought to spatially coordinate areas of excessive supply, lowered water table, and high percolation rates though a system of canals and pipes. Furthermore, the Santa Clara Valley plan utilized surface and underground storage in order to incorporate temporal dynamics. The recharge and pumping areas were significantly further apart in Santa

[25] Hilgard, 1902; Tait, 1911 ; Lee, 1912b; Tait, 1917; State Water Commission of California, 1917; Sonderegger, 1918; Forbes, 1921; Anonymous, 1926; Beattie, 1951
[26] See Mendenhall, 1908; Lee, 1912a; Lee, 1912b; Lee, 1915; Sonderegger, 1918

Clara Valley than in San Bernardino Valley, and thus the aquifers acted as transportation and storage facilities to a greater degree.[27]

[27] Stivers, 1938

# V. STRUGGLE FOR A DISTRICT: 1921-1929

Although a small group of conservation proponents in Santa Clara Valley had developed a vision of water management, they still had to organize themselves better and to convince the voters to form a water district. These were not light tasks, and required three attempts over the course of the 1920s to succeed. The greatest barriers were balancing the interests of the towns with those of the growers', and balancing the need for a strong district with the voters' fears of taxes and unaccountable government. Throughout this process, views of the behavior and natural providence of the local hydrologic cycle permeated the public debate.

## *Defeat in 1921 and 1925*

During the 1920s, Santa Clara Valley continued the trends of population increase, urbanization, agricultural intensification, and groundwater overdraft seen in the previous decades. Growth was increasingly urban and suburban, largely due to the expansion of fruit processing industries (Figure 11). Despite a nationwide agricultural depression, the valley's horticultural market continued to grow to become the state's strongest fruit growing and processing region. Although farm acreage peaked in the middle of the decade, the horticultural portion continued to expand. Indeed, the area in prunes increased by about 50% in the 1920s. During this decade of below-average precipitation, new wells were installed at an accelerating rate (Figure 12 and Figure 4, page 59). The water table declined an average of five feet each year, but technological advances such as the deep well turbine pump were able to keep pace to wells level of 400 feet deep (Figure

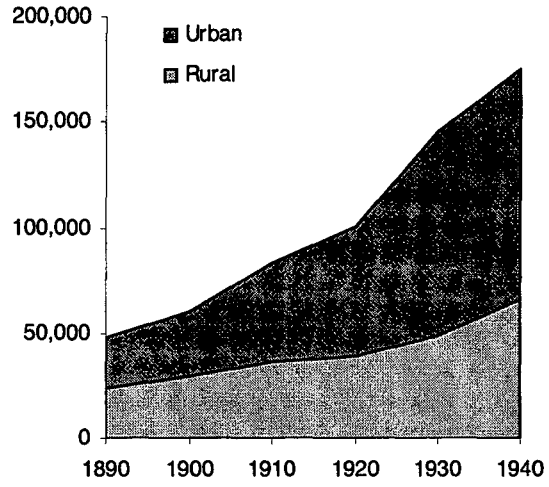


**Figure 11. Population, Santa Clara County, 1890-1940.**
Source: United States Bureau of the Census, 1892, 1902, 1912, 1922, 1932, 1943

14). These large lifts and expensive pumps led USDA irrigation expert Samuel Fortier to claim that the valley had the highest irrigation costs of anywhere in the world.[1]

In 1921, the leaders of the water conservation movement in Santa Clara Valley attempted to establish an irrigation district. Groundwater depletion and other water scarcity problems throughout the state were often addressed through water districts. Recent laws enabled the formation of several distinct varieties, and these were used to fill a vacuum in the government's ability to regulate natural resources. The districts embodied Progressive ideals to overcome obstacles of traditional political boundaries, monopoly power, and government corruption in order to efficiently manage resources. The Wright Act irrigation districts were unsuitable to the valley for two reasons. First, they were limited to utilizing a single water source, and the Tibbetts and Kieffer plan

[1] "Failure of coming election death blow to conservation." *San Jose Mercury Herald*, September 13, 1921,p. 9, 11; "Forum members enthusiasitc for conservation of water." *San Jose Mercury Herald*, September 16, 1921, p. 13, 14; "Well expert gives discussion of local water misconceptions." *The Evening News*, March 9, 1925, p. 14; United States Bureau of the Census, 1922, 1932; Sawyer, 1922; Broek, 1932; James and McMurry, 1933; Jelinek, 1982; Arbuckle, 1986

called for the coordination of many streams and aquifers. Second, they could levy taxes on total property value, which would have been unacceptable to city residents. Consequently, Bohnett drafted a special law in order to "To enable the complete and harmonious development of all the land of the valley by conserving water from all the valley's available sources,"[2] which Jones pushed through the Legislature. In addition to permitting the conservation of multiple sources, it taxed land only, excluding any improvements, as a compromise between the city and the farm. Furthermore, it contained a special funding mechanism by which initial district-wide voting would form the district and simple taxes fund its overhead costs, after which . Then, any specific projects would require an assessment of the amount of benefits each voter would receive, and both voting and taxes for the project would be proportional to these expected benefits. The proposed irrigation district included all the valley floor land in the county, and was split into six divisions of equal population.[3]

A publicity drive led up to the September 27, 1921 vote for district approval. The prospective board of directors of the district was on the same ballot, and included Charles Warren and E. A. Hayes of the Water Conservation Committee. The committee undertook an intense public education campaign by hosting forums for many civic groups and business organizations, many of which were attended by over 100 people. In these the speakers, primarily Bohnett, Tibbetts, and Kieffer, emphasized that higher pumping costs would stifle economic growth, that the vote was to merely create a district

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[2] "Special law demanded to conserve valley's water." *San Jose Mercury News*, September 19, 1921, p. 2
[3] "Water conservation bill is subject of discussion." *San Jose Mercury Herald*, April 7, 1921, p. 9, 12; "Special law demanded to conserve valley's water." *San Jose Mercury News*, September 19, 1921, p. 2; (continued...)

mechanism for conservation, and that any projects would be financed in proportion to benefits received. Furthermore, they asserted that there was enough conservable water to meet future needs, but these proposals were necessary to continue economic expansion. Even though no specific facilities were before the voters, the forum speakers often described the dams, surface reservoirs, and diversions from the 1921 report.[4]

Nearly all groups that received a presentation by the committee endorsed the district proposal, many by unanimous consent. These included farming organizations, civic groups, labor unions, Chambers of Commerce, Realtors, merchants' associations, and banks. Because the San Jose Water Works stood to benefit greatly, it quietly approved of the committee's actions. Perhaps the most effective source of support were the valley's newspapers, especially the *Mercury Herald*, owned by the Hayes brothers. It provided extensive coverage of the Water Conservation Committee's campaign, often with two or more pieces each day, written in extremely favorable tones.[5]

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"Explains how conservation projects can be initiated." *San Jose Mercury News*, September 20, 1921, p. 9, 10; Tufts, 1946; Henley, 1957; Smith, 1962; Elkind, 1994

[4] "Water engineers address Chamber of Commerce forum." *San Jose Mercury Herald*, April 15, 1921, p. 2; "Water district's tax, 2 1-3 cents." *San Jose Mercury Herald*, September 6, 1921, p. 1; "Conservation proposals to be explained at meetings." *San Jose Mercury Herald*, September 12, 1921, p. 1; "Construction works to save flood waters are described." *San Jose Mercury Herald*, September 17, 1921, p. 9, 10; "'Election of Sept. 27 not bond election' - Bohnett." *San Jose Mercury Herald*, September 18, 1921, p. 2; "Whether progress or retrogression for valley, to be decided by voters today." *San Jose Mercury Herald*, September 27, 1921, p, 1, 2. Typical reports of meetings include "Evergreen audience given facts about conservation." *San Jose Mercury Herald*, September 20, 1921, p. 13; "Conservation plan Sunnyvale subject." *San Jose Mercury Herald*, September 21, 1921, p. 4; "No conservation work to be approved at election." *San Jose Mercury Herald*, September 22, 1921, p. 14

[5] Parks, 1983; "Famers in favor of district." *San Jose Mercury Herald*, September 11, 1921, p. 1, 2; "More impetus given move to resure water." *The Evening News*, September 14, 1921, p. 4; "Labor men back movement for water salvage." *The Evening News*, September 16, 1921, p. 6; "Water conservation favored by Grange." *San Jose Mercury Herald*, September 15, 1921, p.12; "Farmers, labor, merchants back of water saving." *The Evening News*, September 21, 1921, p. 1; "Adopt irrigation district, advice of W. S. Clayton." *San Jose Mercury Herald*, September 24, 1921, p. 1; "Whether progress or retrogression for valley, to be decided by voters today." *San Jose Mercury Herald*, September 27, 1921, p. 1, 2. Examples of biased pieces include "Failure of coming election death blow to conservation." *San Jose Mercury Herald*, September 13, 1921, p. 9, 11; "Fear oe [sic] shortage of water leads to demand for action." *San*

(continued...)

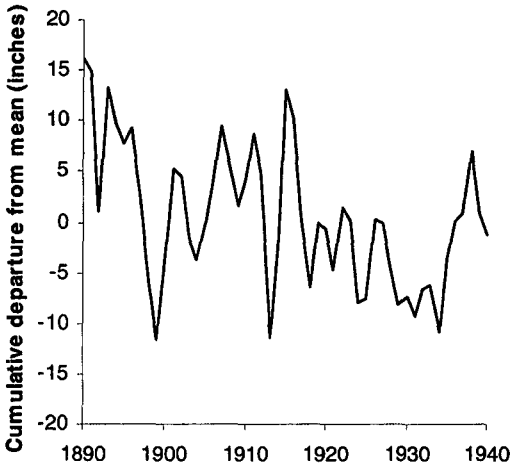


**Figure 12. Precipitation, San Jose, 1890-1940.** The values are the cumulative departures from the mean of 14.2 inches per year. Thus, a downward sloping line represents a dry year. The mid-1920s began a ten year dry period. Source: State Water Resources Board, 1955.

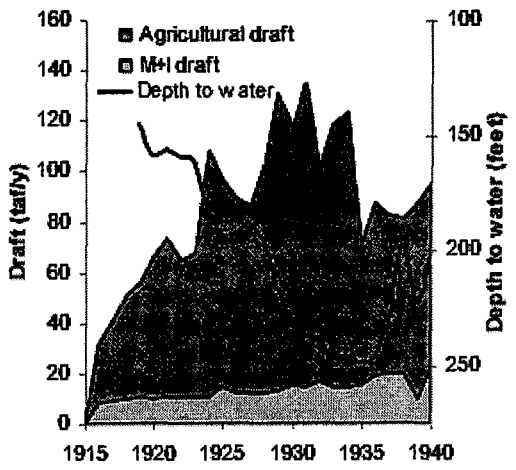


**Figure 14. Groundwater draft, Santa Clara County, 1916-1940.** M+I is the municipal and industrial (urban) draft. The depth to water is at a reference well four miles southwest of Sunnyvale, and was measured in the fall. In the early 1920s and again in the late 1920s, the agricultural draft greatly increased and the water table fell. Source: Poland and Ireland, 1985; State Water Resources Board, 1955.

Although the committee garnered support from many organizations, a vocal opposition arose from the beginning. Organized as the Taxpayers' Committee, its primary arguments were that the organization of the district placed too much power within the towns while taxing the farmers' land, and that the Tibbetts and Kieffer plan was expensive and impractical. In fact, capitalizing on the Water Conservation Committee's emphasis on surface storage and diversion, the opposition recalled the Bay Cities cases and claimed the plan would actually deprive the aquifers of their replenishment. The Taxpayers' Committee placed advertisements in the newspapers, and the Water Conservation Committee was forced to counter the charges and rumors. In

*Jose Mercury News*, September 15, 1921, p. 11, 13; "Explains how conservation projects can be initiated." (continued...)

contrast to the Taxpayers' Committee, some city residents were worried that the farmers would impose a heavy tax burden on them.[6]

The initiative to create an irrigation district lost by a 2% margin. Despite the attention given to the issue in the newspaper and in meetings, voter turnout was only 10%. Opposition was strongest in the farming districts, whereas Palo Alto and parts of San Jose were the most favorable. Bohnett claimed this spelled the death of water conservation in Santa Clara Valley for the present generation.[7]

Bohnett's claim aside, the Water Conservation Committee repeated its attempt for a district four years later, with similar results. In 1923, Senator Jones again passed a bill written by Bohnett that enabled a conservation district in the "peculiar" conditions of the valley. The only significant difference with the 1921 law was the exclusion of Palo Alto and the Pajaro Valley. However, conservation proponents did not act immediately after the law's passage, and in the meantime, the USGS report on Santa Clara Valley's groundwater was published. Using measurements from the mid 1910s and from the Bay Cities cases, it concluded that the presence of groundwater increases the value of overlying land by three to six times. In addition, according to the report the best method to conserve this resource would be to prolong the period of flow in Coyote Creek.

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*San Jose Mercury News*, September 20, 1921, p. 9, 10

[6] "Water meeting to be at Campbell Tuesday." *San Jose Mercury Herald*, March 28, 1921, p. 7; "Water conservation bill is subject of discussion." *San Jose Mercury Herald*, April 7, 1921, p. 9, 12; "Free hurls lie at water conservation heckler." *The Evening News*, September 23, 1921, p. 10; "F. C. Malkmes objects to move to save water." *The Evening News*, September 21, 1921, p. 8; "Vote intelligently - vote NO - Tuesday." *The Evening News*, September 25, 1921, p. 5

[7] "Failure of coming election death blow to conservation." *San Jose Mercury Herald*, September 13, 1921, p. 9, 11; "Unofficial returns show irrigation district lost by less than 100 votes." *San Jose Mercury Herald*, September 28, 1921, p. 1; "Water conservation lost by 109 margin." *The Evening News*, September 28, 1921, p. 1

Finally, it asserted that developing surface irrigation projects on the Coyote would engender conflicts over complicated issues of water rights.[8]

Compared to the first attempt, the conservation movement now roused only lethargic endorsement. With the assistance of committee chairman Charles Warren, businessman Max Watson, and successful orchardist S. N. Hedegard, Bohnett spearheaded another educational campaign for the March 1925 election. This time, proponents stressed the limits to the district's power and that no particular plan would be adopted, although their efforts were largely spent dispelling rumors, such as the belief that water district bonds would cause property mortgages to instantly mature. Furthermore, the relatively recent defeat led to a lack of enthusiasm, and only a handful of organizations, such as the San Jose Realty Board, the *Evening News*, and the *Mercury Herald*, expressed support. What is more revealing is who failed to support the committee. All service clubs and even the San Jose Chamber of Commerce were unable to take positive stances.[9]

Moreover, this time the opponents of the conservation initiative were better organized and more outspoken. Some of 1921's Taxpayers' Committee organized as the explicitly agricultural Growers' Protective Association. Its members used essentially the

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[8] Clark, 1924; Smith, 1962; "Water issue fully described for first time in Jones article." *The Evening News*, February 19, 1925, p. 1, 4

[9] "Water saving is debated." *The Evening News*, February 24, 1925, p. 6; "S. C. Chamber favors water district here." *The Evening News*, February 25, 1925, p. 1; "Service clubs dodge water saving issue." *The Evening News*, February 26, 1925, p. 1; "Water plan abandoned by Papa." *The Evening News*, February 27, 1925, p. 1; "Water move is endorsed by city Realtors." *The Evening News*, February 28, 1925, p. 3; "Explains water act provisions." *San Jose Mercury Herald*, March 4, 1925, p. 15; "Conservation question discussed at Sunnyvale." *San Jose Mercury Herald*, March 6, 1925, p. 17, 18; "Irrigation lien rumor is denied." *San Jose Mercury Herald*, March 7, 1925, p. 13; "16 things to remember at polls Tuesday." *The Evening News*, March 9, 1925, p. 1; "Conservation step imperative need, says Hon. E. A. Hayes." *San Jose Mercury Herald*, March 10, 1925, p. 1

same arguments: that the plan was expensive, unworkable, and would disproportionately burden farmers. In addition, they stressed that the voters had already rejected the proposal, and claimed that the proponents had ulterior motives to enrich a handful of lawyers and engineers through indefinite appointments on a powerful board. The association advertised extensively before the election and attended many of the Committee's forums, some of which became contentious debates. In letters to the newspaper, some farmers claimed that there was no conservable water within the valley, whereas others expressed faith that the dry spell would end soon:

> Is there no God? Do you suppose that this valley with all its beauty, sunshine, and fertility is going to dry up and blow away?... Just because we have had some dry weather is no sign we will always have it.[10]

Finally, the county Board of Supervisors, who merely failed to endorse the 1921 proposal, now explicitly denounced the plan.[11]

The 1925 initiative to create a water district in Santa Clara Valley was rejected by an overwhelming 87% majority. Voter turnout was very low, and the strongest opposition was in the northwest valley. After the crushing loss, the Water Conservation Committee dissolved.[12]

The 1921 and 1925 movements for a water district failed because they were unable to generate widespread support among the farmers of the valley. Although they

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[10] "Says Growers not in favor of water act." *The Evening News*, March 6, 1925, p. 12

[11] "Water saving is debated." *The Evening News*, February 24, 1925, p. 6; "L. D. unable swing bangals." *The Evening News*, March 5, 1925, p. 1; "Conservation question discussed at Sunnyvale." *San Jose Mercury Herald*, March 6, 1925, p. 17, 18; "Water conservation is discussed pro and con." *San Jose Mercury Herald*, March 8, 1925, p. 25; "Water meeting lively affair." *San Jose Mercury Herald*, March 8, 1925, p. 21, 31; "Citizens - electors of Santa Clara county - vote no!" *San Jose Mercury Herald*, March 9, 1925, p. 4; Martin, 1950

[12] "Small interest in water election." *The Evening News*, March 10, 1925, p. 1; "Proposed water district loses by 960 to 6084." *San Jose Mercury Herald*, March 11, 1925, p. 1, 8

were worried about the falling water table, many were more concerned that the structure of district governance and assessment would have placed control with the towns while the rural areas shouldered most of the tax burden. Although this fear was unfounded, it was evident in the lack of endorsement in 1921 and outright opposition in 1925, by the county Board of Supervisors. Other sources of voter apprehension were present in both urban and rural areas. In an era of reduced farm incomes and calls for efficient government, many were reluctant to create an entirely new political entity with powers to issue bonds, tax, and condemn. Furthermore, despite the extensive coverage by the supportive newspapers, Jones later asserted that most valley residents remained unaware of the magnitude of the groundwater depletion, and that many – observing the dry stream beds ten months of each year – believed there was simply no water to conserve. In addition, the surface water facilities appeared to others unlikely to raise well levels, while the principles of groundwater percolation remained unfamiliar to the layman.[13]

The voting results, however, do not support the assertion of political scientist Stephen Smith's that the proposed district was simply too big. It is true that between 1921 and 1925, Palo Alto and the Pajaro Valley were removed. Despite the facts that the former was densely populated and strongly in favor while the latter was only lightly populated, the margin of loss greatly increased. The 1925 drive for a conservation project lacked the enthusiasm of the 1921 Water Conservation Committee, including the presence of the respected engineers Tibbetts and Kieffer, while it faced a better organized and funded opposition. In addition, the weather may have played a role in the results.

[13] Martin, 1950; Smith, 1962; Jones, 1958; Walker and Williams, 1982; Albert Henley, personal communication

**Figure 15. Leroy Anderson.**
Image source: Martin, 1950.

The first vote took place on a day of record high temperatures at the end the dry summer, whereas the latter voting day was a chilly, humid day after a relatively wet winter.[14]

### *Success in 1929*

After the crushing defeat in 1925, few in the water conservation movement had the energy to continue the crusade. Nonetheless, within a year another organization was formed under a new leader, Leroy Anderson (Figure 15). A graduate of Cornell University and a former professor at California State Polytechnic University and the University of California at Davis, Anderson was later elected to the American

[14] "Water conservation lost by 109 margin." *The Evening News*, September 28, 1921, p. 1; "Proposed water district loses by 960 to 6084." *San Jose Mercury Herald*, March 11, 1925, p. 1, 8; Smith, 1962

Association for the Advancement of Science. Anderson also helped found the effective California Prune and Apricot Growers' Association, and was president of the county Farmers' Educational and Cooperative Union.[15]

The new movement was catalyzed by a February 1926 talk by a state engineer to the valley community on the importance of conservation. Soon, about fifty concerned members of the Grange, Farm Bureau, Farmers' Educational and Cooperative Union, and Chambers of Commerce organized initially as the West Side Water Conservation Committee. Based on the experiences of the Tri-County Water Conservation Association in San Bernardino Valley, the group, dominated by the valley's most prominent growers, decided to demonstrate the effectiveness of artificial recharge with modest facilities. In November the committee reorganized as the Water Conservation Association, and adopted the motto "No community can become greater than its water supply." The directors, which included some activists from the 1925 election, elected Anderson as president and Watson as treasurer-secretary.[16]

The association funded its projects through voluntary contributions. Soliciting from farm and commercial organizations, such as the Grange and the San Jose Realty Board, it raised almost $10,000 within two years. Most support was from farmers, who were asked to contribute 50¢ per acre. With sack dams and "sausage" dams, composed

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[15] "Death summons Leroy Anderson." *San Jose Mercury News*, April 24, 1949, p. 1; "A salute to reservoir visionary." *San Jose News*, March 14, 1980

[16] "State expert gives view of need of water conservation in valley." *The Evening News*, February 15, 1926, p. 1; "Water engineer advocates cheap irrigation plan." *San Jose Mercury Herald*, February 16, 1926, p. 1; "Water engineer approves plans." *San Jose Mercury Herald*, November 20, 1926, p. 15; "New association is organized to conserve water." *San Jose Mercury Herald*, November 23, 1926, p. 1, 11; Santa Clara Valley Water Conservation Association, 1926; Anderson, 1931. A set of correspondence between the Santa Clara Valley residents and the Tri- County Water Conservation Association is in the Santa Clara Water District archives.

of rocks rolled in wire fencing, spreading ponds were created on gravely areas of several west side streams. Other small dams diverted water into absorptive abandoned gravel quarries and surface ditches. In addition, an experimental "inverted well," in which Coyote Creek water was diverted into an unused well, was tested on the east side of the valley. These projects were remarkably successful, raising the nearby water table to its highest level in over a decade.[17]

The intention of the association was to increase support for the formation of a district. During the summer of 1928, Anderson and Jones led open meetings, attended by growers and businessmen, throughout the valley in order to assess the public sentiment. Support was very strong at all locations, except in Coyote Valley where there was concern about raising the already shallow groundwater. In addition, two events greatly increased support for a district. In December, the Federal Land Bank announced that it would refuse loans in areas of overdraft, a policy it first considered in 1921. Furthermore, because the water table had been lowered below sea level, in August 1929, wells around Palo Alto began to yield salty water.[18]

At first, the association considered forming a district under the 1927 Duvall Act, which permitted districts to store water underground. However, like the Wright Act, this was unacceptable to urban residents because it would have assessed improvements on

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[17] "Water engineer approves plans." *San Jose Mercury Herald*, November 20, 1926, p. 15; "Almaden dams to replenish valley wells." *San Jose Mercury Herald*, January 13, 1927, p. 7; "Diversion dams declared success." *San Jose Mercury News*, July 8, 1927, p. 7; "East side water saving program is inaugurated." *San Jose Mercury Herald*, November 22, 1928, p. 1; "Diversion dams store rainfall." *San Jose Mercury News*, February 5, 1929, p. 1, 10; "Status today of valley water conservation is interestingly shown in report of directors." *The Evening News*, June 10, 1929, p. 2; Anderson, 1931

[18] "Farms may be refused loans." *San Jose Mercury Herald*, September 25, 1921, p. 1, 2; "First of water saving series at Coyote tonight." *San Jose Mercury Herald*, July 11, 1928, p. 15, 16; "City advised to assist (continued...)

land. Consequently, Jones pushed through the legislature a bill that was much weaker than the 1921 and 1923 district enabling acts. Under this law, the district would be accountable to the county government: the Board of Supervisors would approve the district's budget, and the usual county offices would be responsible for assessments and tax collection. In addition, the division of the district for representation on its board of directors was based on area instead of population, which increased growers' representation. More importantly, the district did not have the power to issue bonds. The Board of Supervisors approved the proposed boundaries, which now excluded Coyote Valley, and a petition drive quickly placed an initiative on the ballot.[19]

Once again, district proponents undertook a voter education and publicity drive. This time, the San Jose Chamber of Commerce took the lead, and its various committee members were each assigned an industry to lobby for support. Public presentations to agricultural, business, fraternal, and civic groups were led by Anderson, Jones, and J. Fred Holthouse, a well-borer who was running for the district board of directors. They argued that water conservation was important to all valley residents, whose higher pumping costs were already greater than the proposed taxes. But unlike in the previous campaigns, the speakers could rely on proven the success of the demonstration recharge projects of the Water Conservation Association. The association published

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county conserve water." *San Jose Mercury Herald*, July 17, 1928, p. 13; "Salt water is peril to P.A., board is told." *The Evening News*, August 5, 1929, p. 6; Anderson, 1931

[19] "Conservation district will be mapped." *The Evening News*, July 30, 1928, p. 2; Anderson, 1931; Henley, 1957; Smith, 1962

advertisements, including a series in two Italian-language newspapers, and even sponsored a water conservation essay contest in the eight grade class.[20]

The water conservation initiative was endorsed by more organizations than ever before, including several Chambers of Commerce, Grange locals and other farming groups, well contractors, and even the Taxpayers and Voters League. Additionally, a local radio station gave fifteen minutes each week for the association and San Jose Chamber of Commerce to promote the initiative. The two large San Jose newspapers still supported conservation. The *Evening News* contained some coverage and a mild endorsement, but the Hayes' *Mercury Herald* ran two or three pieces on the issue each day, including editorials on the front page and extended profiles of each candidate for the board of directors. In contrast to 1925, the county Board of Supervisors, with its largely rural constituency, strongly supported the initiative. There was no significant organized opposition to the district proposal.[21]

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[20] "C. of C. assumes conservation of water promotion." *San Jose Mercury Herald*, July 26, 1929, p. 1, 10; "Water storage district election petitions issues." *San Jose Mercury Herald*, August 25, 1929; "Need for water district to be told on radio." *San Jose Mercury Herald*, August 27, 1929, p. 13; "Conservation of valley's water urged." *San Jose Mercury Herald*, October 5, 1929, p. 28; "Need of water conservation is told by essayists." *San Jose Mercury Herald*, October 15, 1929, p. 15, 17; "Water saving of vital concern to all, experts say." *San Jose Mercury Herald*, October 16, 1929, p. 15; "Santa Clarans endorse water saving project." *San Jose Mercury News*, October 19, 1929, p. 21; "Water district nominations are officially filed." *San Jose Mercury Herald*, October 25, 1929, p. 1; "Water election campaign mapped by C. of C. group." *San Jose Mercury Herald*, October 29, 1929, p. 17, 22; "La question della irrigazione." *La Voce del Popolo*, October 31, 1929; "La vallata di S. Clara necessita d'un distretto irrigatorio." *L'Italia*, October 31, 1929

[21] "Water District plans endorsed by Consolidated." *San Jose Mercury Herald*, August 7, 1929; "Santa Clarans endorse water saving project." *San Jose Mercury News*, October 19, 1929, p. 21; "Water saving tax would be small group declares." *San Jose Mercury Herald*, October 20, 1929, p. 21; "We must conserve flood waters." *San Jose Mercury Herald*, October 22, 1929; "Grange OK's bond for water saving." *San Jose Mercury Herald*, October 24, 1929, p. 1; "Conserving water supply is urged by Farmers' Union." *San Jose Mercury Herald*, October 28, 1929, p. 3; "Formation of valley water district asked." *The Evening News*, October 28, 1929, p. 19; "Conservation of water endorsed by S.J. Realtors." *San Jose Mercury News*, November 2, 1929, p. 12; "Mountain View Grange favors water district." *San Jose Mercury Herald*, November 4, 1929, p. 12; "Water conserving victory predicted on election eve." *The Evening News*, November 4, 1929, p. 1; "Unqualified endorsement of water conservation plans expected at election (continued...)

On November 5, 1929, an amazing 90% of voters approved the formation of the Santa Clara Valley Water Conservation District. Turnout remained low, especially in San Jose, and the results were slightly more favorable outside of that city. The weakest support was 62% in Milpitas, whereas Agnew approved unanimously. The Water Conservation Association disbanded within two weeks, but its property was transferred to the new district and many of its leaders were now on the district's board of directors.[22]

The lopsided success in 1929 is remarkable, coming only four years after the overwhelming loss in 1925. This is evident in the lack of organized opposition, the new support in rural areas, and the reversed position of the Board of Supervisors. There are several reasons for this dramatic turn. First, conditions were much more severe, with lower water tables and salt water intrusion. Second, the threat by the Federal Land Bank to refuse loans had a powerful impact on the opinions of voters. Third, the proponents of the district were much better organized under the Water Conservation Association. Fourth, the enabling act won the support of conservative and rural voters by forbidding bonded debt, increasing the rural representation, and empowering the Board of Supervisors. Fifth, the district advocates called for simple artificial recharge facilities instead of massive surface water projects. Not only did this carry a more modest price tag, it preserved the usefulness of growers' deep wells. Finally, groundwater behavior

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today." *San Jose Mercury Herald*, November 5, 1929, p. 1, 19; Martin, 1950. The candidate profiles ran October 28 through November 3, 1929.

[22] "Formation of valley water conservation district is approved by huge majority." *San Jose Mercury Herald*, November 6, 1929, p. 1, 10; "Water election vote is light in each district." *San Jose Mercury Herald*, November 7, 1929, p. 17; "Committee on water saving disbands here." *The Evening News*, November 20, 1929, p. 3; "Water district campaign group disbands here." *San Jose Merucry Herald*, November 20, 1929, p. 17, 22

was better understood, the practice of artificial recharge was more widely accepted, and the utility of the proposed works had been demonstrated by the association.[23]

### *Reflections on water and nature*

The statements of conservation proponents, opponents, and journalists reveal certain widespread perceptions of nature, water, and engineering. Although confidence was placed in the engineer's ability to objectively determine the optimal course of action, nature in general and the hydrologic cycle in particular were usually described as bountiful divine gifts that merely needed assistance or completion by humans in order to maximize their benefits.

There was consensus on the understanding of most aspects of the local water resources. The groundwater basin was often referred to as an underground reservoir, and several people emphasized its ability to distribute water effectively. Most speakers and writers described the subterranean hydrology of the valley much as in the Bay Cities cases, in which creeks had built up debris cones with buried stream beds that connect to larger aquifers in the valley. Although a couple of residents asserted that the groundwater originates in the Sierra Nevada, most believed the groundwater came from the mixed recharge in local stream beds. Several quotations recalled the supposed abundance of water in the past. However, some statements were simply false, such as "when there was a lake in the Guadalupe creek near West San Jose even in midsummer

[23] "Petition for election on conservation plan up today." *San Jose Mercury Herald*, October 7, 1929, p. 1, 5; "Yesterday's election." *San Jose Mercury Herald*, November 6, 1929; Henley, 1957; Smith, 1962; Walker and Williams, 1982; Albert Henley, personal communication. For examples of the increased understanding of groundwater behavior and artificial recharge, see Meinzer, 1923; Lee, 1928; and Weil, 1929.

and when this stream flowed the year round,"[24] or the assertion that rainfall had dramatically decreased during recent decades. Perhaps the most consistent belief was that water was the source of wealth, prosperity, and life in the valley. After the Tibbetts and Kieffer report, however, nearly everyone in the conservation movement attributed the decline of the water table to the increase in the number of wells, as opposed to the recent dry years.[25]

Another widespread notion was that the immense groundwater reservoir was an endowment from nature. Consequently, overdraft would be abusing such a gift, and large diversion works were unnecessary. A 1929 *Mercury Herald* editorial provides an excellent example:

> Experimental work done on a relatively small scale along some of the creeks of the valley has proved that Santa Clara Valley has been favored by nature. Million dollar dams in the hill canyons are not necessary in order to impound the winter flood waters. Beneath the floor of the valley lies a strata of gravel, a natural reservoir of unestimated capacity, providing by its very extent a natural distribution system. That the use of this water supply system provided by nature is practical has been demonstrated.... No expensive structures or difficult engineering problems are involved – merely assistance by means of diversion dams in spreading the water over percolation areas.[26]

Based on this logic, the conservation proposals worked with – not against – nature to merely complete or assist its work. A candidate for the district board of directors said:

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[24] "Farmer Feder'n is behind plan to save water." *The Evening News*, September 12, 1921, p. 4

[25] Examples include "Water saving to benefit high and lowland regions." *San Jose Mercury Herald*, October 31, 1929, p. 17; "Whys and wherefores of conservation." *San Jose Mercury Herald*, March 7, 1925, p. 6; "Ample supply of water essential to prosperity." *San Jose Mercury Herald*, February 27, 1927, p. 19; "Well expert gives discussion of local water misconceptions." *The Evening News*, March 9, 1925, p. 14; "Constant fall in water level spells disaster." *San Jose Mercury Herald*, June 10, 1929, p. 11; "Ample supply of water essential to prosperity." *San Jose Mercury Herald*, February 27, 1927, p. 19; "Water saving common sense, stated." *The Evening News*, March 5, 1925, p. 4; "Driller warns valley of water supply depletion." *San Jose Mercury Herald*, October 28, 1929, p. 1, 3; "Candidate writes of water matter." *San Jose Mercury Herald*, March 7, 1925, p. 8.

> Nature has provided the valley with about everything else and it is not strange that it provided its own facilities for water conservation, leaving but a very small part of the job to be completed by those who enjoy the prosperity and beauty of the valley.[27]

More than sixteen years after it was first proposed, the advocates of water conservation in Santa Clara Valley finally formed a district. Smith asserts that this length of time and number of sequential decisions are typical in natural resources development in order to integrate conflicting interests, educate the public, and refine proposals. In fact, the conservationists had to abandon the vision of the Tibbetts and Kieffer proposal, and ended up bound by a law that prevented the district from raising adequate funds for comprehensive conservation. In the following decade, the district sought to undo these restrictions and implement a grand project to integrate surface and groundwater resources.[28]

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[26] "We must conserve flood waters." *San Jose Mercury Herald*, October 22, 1929
[27] "Saving of water expense held to negligible sum." *San Jose Mercury News*, November 1, 1929, p. 1, 16
[28] Smith, 1962

# VI. IMPLEMENTATION: 1929-1936

A number of obstacles remained for the new Santa Clara Valley Water Conservation District. Under the motto "There is no substitute for water," it began by developing small artificial recharge projects on a limited budget. It continued to strive for a comprehensive conservation system, but the political authority and budget required to complete the task would be compromised by the apprehension of voters. The eventual result was a valley-wide detention, diversion, and groundwater recharge system, but one that had lost much of Tibbetts' original integrated vision. As in the struggle to form a district, initial failure allowed conservation proponents to refine their strategies and later attain success.

## *Defeat in 1931*

In the 1930s, agricultural intensification in Santa Clara Valley climaxed. By 1934, the maximum extent of irrigated farming in the valley had been reached (Figure 15). Most of the farm land was in fruit production, which generated over 70% of the value of the county's agricultural products. Orchards were most plentiful on the west side of the valley, where they encroached on the foothills of the Santa Cruz Mountains. Although the valley was a leading region in the state of greatest fruit production, it was severely impacted by the national depression as the demand for specialty crops collapsed. In 1931 alone, prune prices declined from eleven to four cents per pound. By the end of decade, total farm acreage was decreasing, although that remained offset by increases in yields, and average farm size began to increase.[1]

[1] Broek, 1932; Hunt, 1940; Tufts, 1946; Matthews, 1999

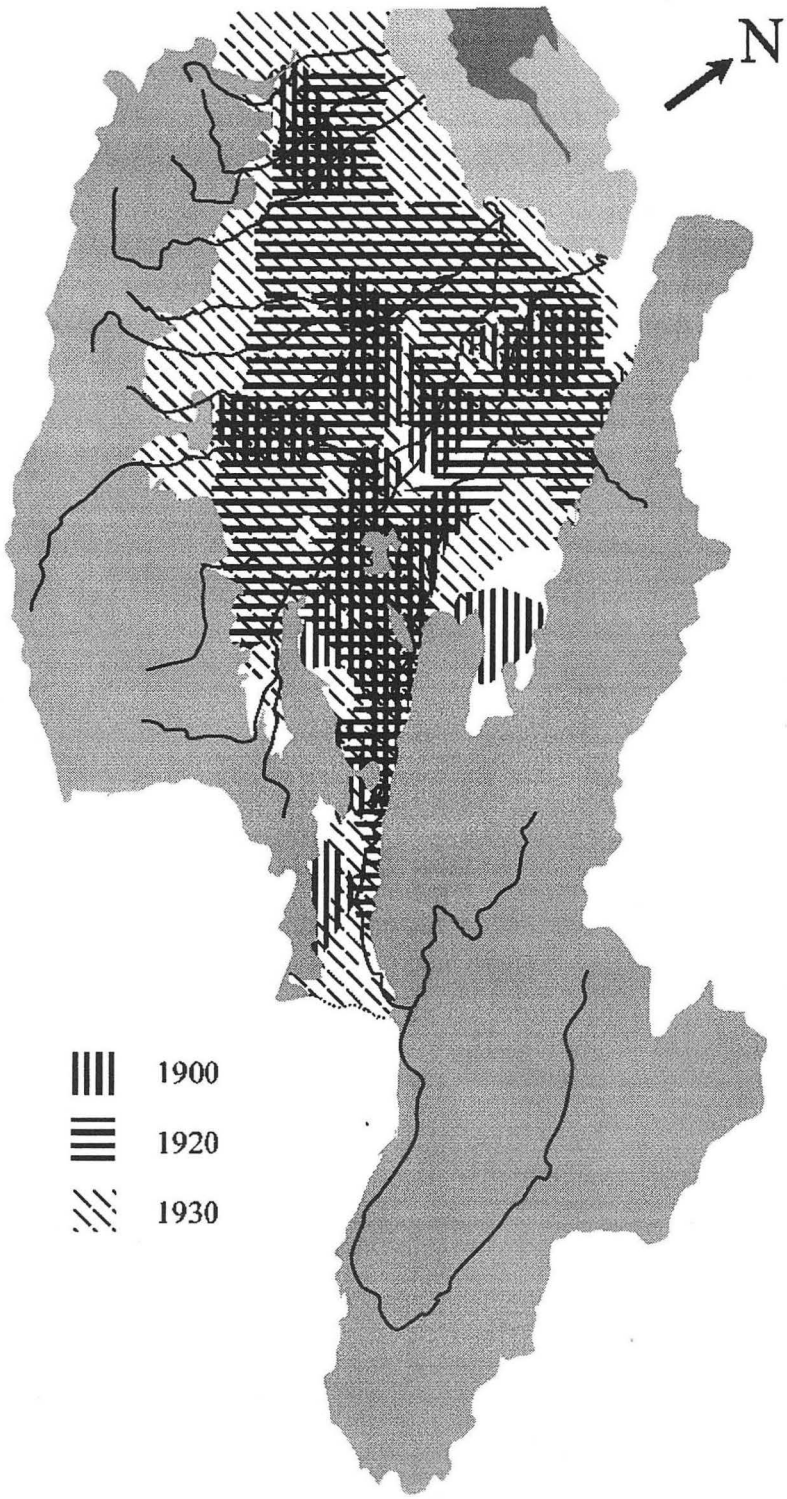


**Figure 15. Growth of irrigated land in Santa Clara Valley, 1900-1930.**
Source: United States Bureau of the Census, 1902, 1922, 1932.

The rates of groundwater pumping and water table decline both accelerated. The region experienced subnormal rainfall from 1927 to 1934, and the annual overdraft reached 44 taf/y (see Figure 12 and Figure 14). The average rate of water table decline doubled in the early 1930s, with the most depleted areas on the west side near Campbell and Mountain View. By the middle of the decade, the water table of half the valley floor was below sea level, inviting extensive salt water intrusion. Compared to 1915, pumping a given volume of groundwater now required fifteen times as much power, and valley growers had spent approximately $17 million since then on new pumps and deepened wells. Indeed, the farmers were caught in a vicious cycle of competition for this common resource. Deeper wells and new technologies, such as the common but expensive deep well turbine pump, were required to reach the lower groundwater, while also contributing to that drop.[2]

The nascent Santa Clara Valley Water Conservation District began work immediately. On its limited budget, the district, under the presidency of Leroy Anderson, ordered the construction of modest projects before the onset of the first winter rains. These included digging a percolation trench in the bed of Coyote Creek, the diversion of part of Los Gatos Creek into the pits of the Santa Clara Gravel company, and the construction of many small check dams to slow floods. When the district lacked the funds to hire workers, 100 volunteers helped build a percolation dam on Coyote Creek. In addition, with the assistance of the state Division of Water Resources (DWR) and the USGS, the district gathered hydrologic data. Based on the initial results, a committee of

[2] "Engineer urges joint valley water storage system." *San Jose Mercury Herald*, September 2, 1931; Tibbetts, 1931b; Jones, 1931; Bryan, 1933; Tibbetts, 1936c

local engineers, including Tibbetts, estimated that the groundwater was being pumped at three times the rate of natural recharge. These small-scale activities were continued the following year.[3]

The directors of the district maintained the grander visions of earlier proposals, but legal, political, and engineering hurdles remained. Anderson and Senator Jones, who had been retained as district attorney, soon made public statements that the district would have to resort to surface storage facilities. Because the district was still unable to issue the necessary bonds, however, Jones risked his political career by quietly pushing through the legislature a bill that empowered the district to float bonds, levy special assessments, and add territory. Soon, it considered Harry Haehl and Fred Tibbetts for the job of district engineer, more than eleven years after they first competed for the task of designing a water conservation plan. On June 21, 1931 – within a week of the bill's signing – Tibbetts was officially employed as chief engineer for the district.[4]

Tibbetts quickly produced a revised conservation plan. In August, he described the plan in an informal presentation, by which time the district had already applied to use the surplus water on Coyote, Almaden, Guadalupe, Los Gatos, and Stevens Creeks.

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[3] "Water conservation district established by heavy majority." *The Evening News*, November 6, 1929, p. 1; "Temporary dams ordered at once by water board." *San Jose Mercury Herald*, November 19, 1929, p. 15, 28; "Workmen rase on big construction job to beat rain." *San Jose Mercury Herald*, December 9, 1929; "Engineers to make report on water data." *Palo Alto Times*, February 8, 1930; "Huge amount of water saved by valley project." *San Jose Mercury Herald*, March 8, 1930; "U. S. Geological Survey records water wastage." *San Jose Mercury Herald*, March 20, 1930; "Storage check dams adopted." *San Jose Mercury Herald*, July 2, 1930; "Dropping water level in county bared by survey." *San Jose Mercury Herald*, October 9, 1930, p. 15; "One percolation dam completed in Coyote Creek." *San Jose Mercury Herald*, December 7, 1930, p. 15, 17; Tesche, 1930

[4] "Replenishment of undergroundwater difficult." *San Jose Mercury Herald*, June 3, 1930, p. 11; "Gilroy district begins move to conserve water." *San Jose Mercury Herald*, June 3, 1930, p. 1, 11; "Expert will map plan for valley water conservation." *San Jose Mercury Herald*, June 21, 1931; "Tibbetts is chosen to do vital survey." *The Evening News*, June 23, 1931; Martin, 1950; Jones, 1954; Bohnett, 1968; Fish, 1981

Tibbetts presented the proposal to seventy-five farm and civic groups in September, and the official report was published in October. It essentially recommended the construction of a scaled-down version of the 1921 plan. Unlike the earlier report, though, this one was did not systematically examine the valley's history, economy, and infrastructure, and instead was restricted to a discussion of present and future groundwater conditions, and the proposed facilities.[5]

The report recommended a conceptually similar system of surface detention reservoirs, conveyance facilities, and percolation areas (Figure 17). After reexamining all the original reservoir sites, Tibbetts selected the five most economical, which would be managed to maximize the length of time the streams below them would flow. The centerpiece was a single reservoir on Coyote Creek that would have three-quarters of the system's 80 taf total storage. Recognizing from the *Hayes* decision "a general feeling, not necessarily founded on a sound legal basis, but nevertheless firmly asserted, that preferential rights to water percolating from stream beds are vested in the valley of that stream,"[6] Tibbetts suggested that Coyote Creek water beyond this local requirement set forth in the 1913 ruling be transferred to the more depleted areas on the east and – especially – west sides. Instead of only open canals, this was now to be accomplished also with pressurized closed conduits, pumps, and hydropower generators at the Coyote Dam. The major reservoirs were to be supplemented by low percolation dams on the streams of the valley floor, which would spread the water over porous areas.

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[5] "First move to build valley water storage system begun." *San Jose Mercury Herald*, August 18, 1931; "Engineer urges joint valley water storage system." *San Jose Mercury Herald*, September 2, 1931; Tibbetts, 1931b

[6] Tibbetts, 1931b, p. 42

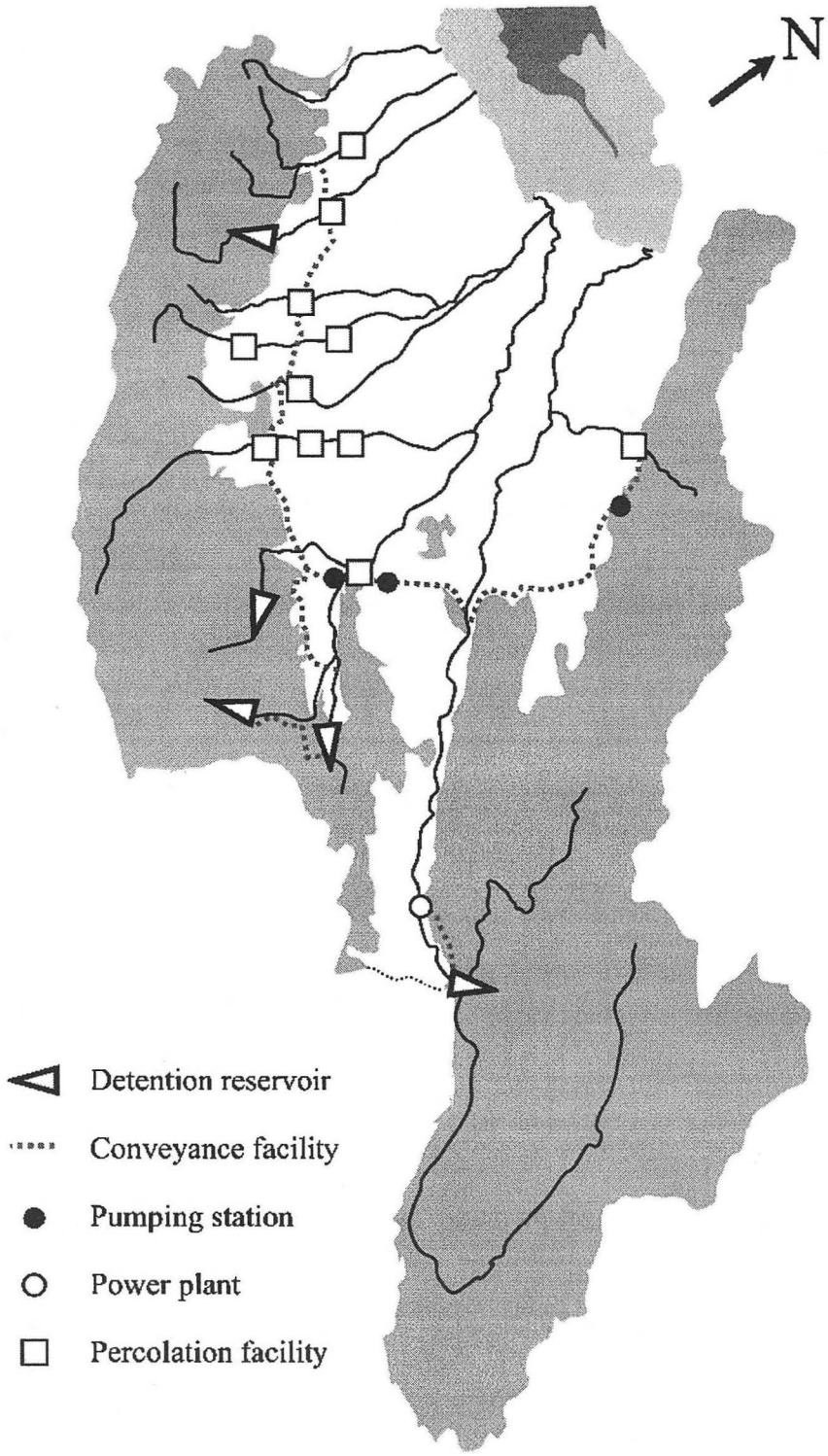


**Figure 17. Schematic of the 1931 Tibbetts plan.**

Furthermore, many small check dams in the mountain canyons would retard the passage of flood waters. Tibbetts predicted that this system would increase average recharge from 76 taf/y to 131 taf/y. At the present rate of pumping, this would reverse the average decline of 4.8 ft/y to a rise of 1.6 ft/y. The estimated cost for the project was $5.5 million.

Despite the lack of a more thorough portrait of the valley's socioeconomic and physiographic conditions, the 1931 report is in the same hydraulic paradigm as the 1921 one. Specifically, it continued to propose to regulate systematically the temporal and spatial heterogeneity of the local hydrologic cycle in order to make it more compatible with human demands. This was still to be achieved through a system of surface reservoirs to regulate runoff, and conduits to transfer and integrate the many supplies. Furthermore, most data and some text passages were simply reused from the first report. The report did note, however, that it incorporated data from the ongoing investigation by DWR, and it credited the new Colorado River Aqueduct as the inspiration for the hydropower and pumping conveyance system.

The new report continued to reject water importation schemes, and Tibbetts maintained that local supplies would be able to satisfy the ultimate water demand. This is remarkable in light of contemporary developments throughout the state. The state began to examine seriously a comprehensive, integrated water project after Col. Robert Bradford Marshall, former Chief Geographer for the USGS, published such a proposal in 1919. Throughout the 1920s, the state Division of Engineering and Irrigation conducted investigations and drafted plans. A specific proposal was adopted in 1931, and it was assumed by the federal government a few years later. The Central Valley Project, as it

became known, used storage reservoirs and interbasin water transfers to integrate the location and timing of supply and demand. Clearly, this is similar to the approach of Tibbetts, who served on the project's advisory board in the 1920s. In addition, Jones later noted the similar water management frameworks, albeit on much different scales, of the Central and Santa Clara Valleys.[7]

Why did the Santa Clara Valley Water Conservation District not seek an outside supply of water in the era of statewide water planning and transfers? With Jones' position in the Senate and Tibbetts involved in the project's planning, it was not a matter of political clout. The *Mercury Herald* asserted that the valley simply had an adequate local supply, and state authorities would thus not approve of a transfer: "Santa Clara county must have more water and must get that water from its own water sheds and must proceed alone in the development of its water resources."[8] However, it also remained in the valley's best interest not to seek an outside supply. The time and finances required to deliver water from the Carquinez Straits to Santa Clara Valley were uncertain, but were bound to be great. Additionally, relying on importation would further increase uncertainty by making the valley's economy subject to the control of state and federal politics, and could engender interregional conflicts as well. Finally, prematurely seeking an external water source was inconsistent with the Progressive engineering philosophy of optimizing available resources.[9]

A referendum was required to issue the bonds to fund the project. The county Board of Supervisors scheduled the vote on November 17, 1931, and the Water

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[7] Marshall, 1920; Marshall, 1920; Downs, 1931; de Roos, 1948; Jones, 1958
[8] "Editorial analysis." *San Jose Mercury Herald*, August 18, 1931

Conservation District formed Citizens' and Farmers' Committees to campaign for four weeks (Figure 18). The proponents held open forums and spoke to community groups, although the newspapers reported fewer such meetings than for the previous elections. Anderson, Jones, and Tibbetts led these meetings, with support from other district directors, especially S. N. Hedegard. The district's bond initiative received endorsements from many of these groups, whose composition of business, engineering, and labor groups reflected the urbanizing face of Santa Clara Valley. In addition, statements of support were issued by several authorities, including U.S. Interior Secretary Ray Wilbur, Berkeley irrigation professor Frank Adams, and State Engineer Edward Hyatt. The *Evening News* backed the proposal, but the *Mercury Herald* went to new lengths to advance the district's agenda. Although it did include advertisements and letters opposing the initiative, the paper placed a supportive editorial on the front page of every paper for three weeks before the vote, and ran a daily profile of a conservation project supporter.[10]

Under the new demographic and economic conditions, the district, the *Mercury Herald*, and other project proponents utilized new strategies in their arguments. Their most consistent assertion was that the bonds were a sound investment. The initiative

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[9] Kennedy, 1926; Jones, 1958; Elkind, 1998

[10] *Water Conservation District advertisement, San Jose Mercury Herald*, November 12, 1931; "Secretary Wilbur urges passage of waste water salvage bonds; terms project vital to safety." *San Jose Mercury Herald*, November 12, 1931, 1; "Grower gives clearcut sidelights on water." *San Jose Evening News*, November 14, 1931, p. 5; "Project benefit to exceed cost, declares expert." *San Jose Mercury Herald*, November 15, 1931, p. 4; "We Submit." *San Jose Mercury Herald*, November 17, 1931; "Citizens vote on water." *San Jose Evening News*, November 17, 1931, 1. Examples of front page editorials are "Why should valley bond itself for $6,000,000 water salvage project." *San Jose Mercury Herald*, October 28, 1931, p. 1; "Federal, state, district, local engineer reports all back salvage plans." *San Jose Mercury Herald*, November 8, 1931, p. 1; and exmaples of the daily profile are "Nursery owner supports water (continued...)

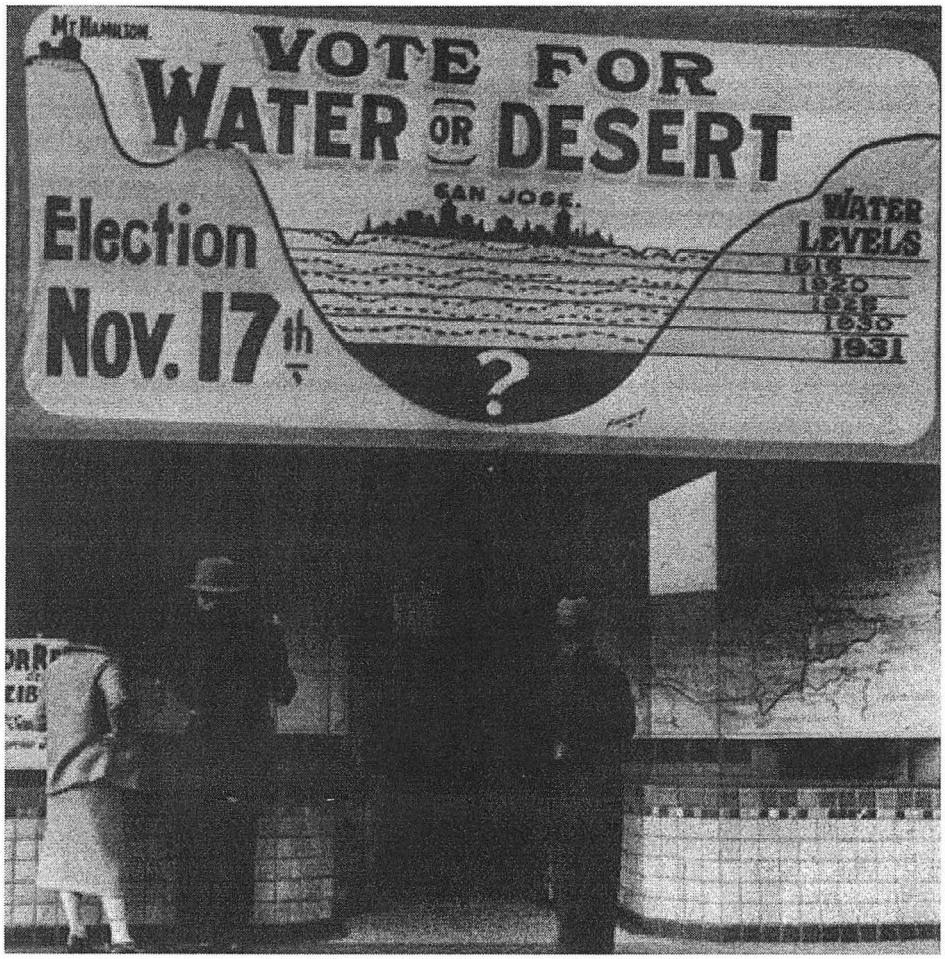


**Figure 18. Conservation propaganda at the district headquarters.**
Source: *San Jose Mercury Herald*, November 5, 1931, p. 10.

called for $6 million in bonds to be repaid over 25 years. The district estimated this would average, for a typical orchard, under three dollars per year per acre, whereas increased well replacement and pumping costs already exceeded seven dollars. Within nine years, the savings from the predicted rise in the water table would surpass the project's cost. Furthermore, citing the Federal Land Bank's decision, the proponents emphasized that higher groundwater levels were necessary to maintain economic productivity and property values for both the farm and urban sectors. This was especially

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conservation plan." *San Jose Mercury Herald*, November 10, 1931, p. 8; "Water salvage to save money, grower claims." *San Jose Mercury Herald*, November 11, 1931, p. 4.

critical in the depressed economy of the 1930s, and it was quickly noted that construction would potentially create thousands of jobs. Supporters also highlighted the accelerating lowering of the water table, and made dire predictions: farms would be abandoned, the entire groundwater basin would soon be empty, and the valley would become a desert. As a solution, they recommended placing faith in the expertise of engineers. An enthusiastic San Jose State College professor said:

> The very best engineering talent available has been hired to make these plans. Then what right has any layman to say they are no good and will not accomplish the desired end?[11]

In addition to Tibbetts and other prominent engineers who endorsed the proposal, the San Jose Chamber of Commerce requested that Harry Haehl review the report. He declared the plan sound, and suggested only minor changes. Moreover, artificial recharge by stream bed percolation was now a proven method, and the *Herald* noted that the proposals were much like the recommendations of the 1924 USGS groundwater study.[12]

As during the 1925 campaign, an effective and aggressive opposition organized to defeat the water conservation movement. The Farmers' and Home Owners' Protective League was led by San Jose attorneys and businessmen, and had the support of Louis Oneal, the boss of the city machine. The League held meetings and advertised as much, if not more than, the project supporters, and used a wide range of arguments to discredit the bond proposal (Figure 19). Chief among these was that it amounted to a mortgage on

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[11] "Bond opponents overlook facts, professor says." *San Jose Mercury Herald*, November 13, 1931, p. 9

[12] ""Engineer urges joint valley water storage system." *San Jose Mercury Herald*, September 2, 1931; Federal, state, district, local engineer reports all back salvage plans." *San Jose Mercury Herald*, November 8, 1931, p. 1; "U.S. government warned valley on water in '24, suggested present plan." *San Jose Mercury Herald*, November 9, 1931, p. 1; "Large scale percolation only hope of refilling underground reservoir." *San Jose Mercury Herald*, November 14, 1931, p. 1; "How much is your land worh as loan security if you (continued...)

**VOTE NO**

**Today**

**Now is the time to protect your homes and farms from a 25-year blanket mortgage of more than $10,000,000.00**

**Note NO for Safety Now!**
**Tomorrow Is Too Late!**

**Soaring tax bills will drive money from the Santa Clara Valley unless**

**YOU VOTE NO**

**Don't expect your neighbor's vote to protect you from this dangerous project. Every vote is needed.**

**Locate your Pole and**

**VOTE NO**

**If you don't know where to vote call Ballard 1701**

**VOTE NO**

**Farmers and Home Owners Protective League**

**Figure 19. Anti-conservation newspaper advertisement.**
Source: *San Jose Mercury Herald*, November 17, 1931, p. 6.

all property in the valley. They claimed to support conservation but said this elaborate scheme was unnecessary, especially since the district's existing modest percolation facilities had not been in operation long enough. The taxes would the make valley uncompetitive in fruit markets, and would be levied on all residents regardless of how much they benefited.

Furthermore, the League members accused the lawyers and engineers of seeking financial windfall. They also cited the 1926 *Herminghaus v. Southern California Edison* ruling of

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cannot get water?" *San Jose Mercury Herald*, November 15, 1931, p. 1; Jones, 1931; Haehl, 1931; Martin, 1950

the California Supreme Court (which was written by Justice John Richards, a lawyer for the orchardist plaintiffs in the Bay Cities cases) as granting downstream riparian owners the right to enjoin upstream storage projects, which would result in extensive litigation. In addition, the League attacked the validity of basing the proposals on decade-old data, and it criticized Jones for surreptitiously passing the bonding authority law. Other assertions were based on their interpretation of the local hydrology. Some critics insisted there was simply no water to conserve, others that years of high rain were imminent, and a couple that the valley's groundwater originates in the Sierra Nevada.[13]

Such an array of criticism put the district and its allies on the defensive, and many of their resources were spent countering these attacks. They frequently accused the League of pursuing its narrow self-interest, while the project supporters claimed to have the greater public in mind. Also, they published the details of payments to Jones and Tibbetts, although these revealed that they both stood to reap a financial windfall if the bonds passed. Furthermore, the district glossed over the clandestine nature of the passage of the 1931 amendments. Judging by the attention given the issue, it appears that the *Herminghaus* argument was quite effective. Project proponents used a number of counter

[13] "Water district opponents ask further survey." *San Jose Mercury Herald*, November 7, 1931, p. 10; "Riparian rights decision stands." *San Jose Mercury Herald*, November 7, 1931, p. 4; "Water engineers figures attacked by orchardist." *San Jose Mercury Herald*, November 7, 1931, p. 11; "A protest against the proposed Santa Clara Valley Water Conservation District $6,000,000.00 bond issue." *San Jose Mercury Herald*, November 7, 1931; "Riparian rights threaten district lawayers declare." *San Jose Mercury Herald*, November 8, 1931, p. 8; "Bond oppenent hits legal fee." *San Jose Mercury Herald*, November 12, 1931, p. 13; "Present system of conservation held adequate." *San Jose Mercury Herald*, November 12, 1931, p. 13; "Objections aired on water conservation." *San Jose Evening News*, November 13, 1931, p. 16; "Group opposing water district deny benefits." *San Jose Mercury Herald*, November 15, 1931, p. 4; "Bond opponent urges 'no' vote." *San Jose Mercury Herald*, November 17, 1931, 11; *Herminghaus v. Southern California Edison Co.*, 200 *Cal.* 81, 1926; Fish, 1976?

claims, but only a few times did they bring up the 1928 state constitutional amendment (which Jones helped write) that largely invalidated the *Herminghaus* decision.[14]

The results of the election were a disaster for the young water district. Passage of the bonds required a two-thirds majority, but only 13% of voters supported the initiative. This time opposition was strongest in San Jose, where a majority of votes were cast. At 40%, the turnout was nearly a record for a special election. The fears of the project's costs and the ensuing debts were the strongest concerns of the opponents. Jones later attributed this apprehension to the depressed economy. In contrast, political scientist Stephen Smith describes a constituency that remembered supporting a district without the authority to bond and consequently was resentful over the amendments to the law.[15]

### Success in 1934

Putting the overwhelming defeat aside, the Santa Clara Valley Water Conservation District continued its limited projects, but soon planned another bond initiative. However, it had to address conflicts and limits to its budget and authority. Restricted by the budget, it made arrangements to percolate water using existing ditches and pits on private property. Other residents of the district, however, were unhappy with the tax burden and petitioned to be removed from the district. In addition, there was internal strife among the board of directors. When Anderson was up for reelection in 1933, an "underhanded opponent" on the board engineered a successful eleventh hour

[14] "Questions on water storage plan answered." *San Jose Mercury Herald*, November 6, 1931, p. 3; "Questions and answers on the water project." *San Jose Mercury Herald*, November 7, 1931, p. 11; "Vast expense denied in water project." *San Jose Evening News*, November 13, 1931, p. 32; Water Conservation District advertisement, *San Jose Evening News*, November 14, 1931, p. 5; "We submit." *San Jose Evening News*, November 17, 1931, p. 11

campaign to unseat him. His supporters on the board immediately appointed him as the district's secretary. Finally, the district sought to further increase its authority. Looking toward the future, Jones got an amendment passed that gave water conservation districts the power of eminent domain.[16]

Major publications in 1933 highlighted the severity of the groundwater situation in Santa Clara Valley. First, DWR issued the report from its recent hydrologic monitoring. Done at the request of, and with financial support from, the Water Conservation District, it noted that since 1915 groundwater withdrawals had increased over six-fold, resulting in a 95 foot drop in the water level and a net groundwater loss of 729 taf. These years were drier than average, however, and the author emphasized that overdraft would not occur with normal precipitation. The report also presented the measured waste of surface water, and estimated the amount that could be salvaged under different regimes of surface storage. It is remarkable that after twenty-three years, the Bay Cities cases were still informing the understanding of the valley's hydrology, as exhibits from them were figures in the report. Most importantly, it concluded that internal water conservation was ideal and importation unnecessary. In a series of front-page articles, the *Mercury Herald* presented an in-depth summary of the state's

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[15] "Landslide beats water project." *San Jose Evening News*, November 18, 1931, p. 1; "Waste wate salvage bonds defeated by vote of 7 to 1." *San Jose Mercury Herald*, November 18, 1931, p. 1; Martin, 1950; Jones, 1958; Smith, 1962

[16] "Water district pact on creek diverstion signed." *San Jose Mercury Herald*, January 15, 1932; "Dairyman gets $9234 in suit over dam land." *San Jose Mercury Herald*, August 13, 1936; Tibbetts, 1932; Fish, 1981; Jones, 1958; Martin, 1950

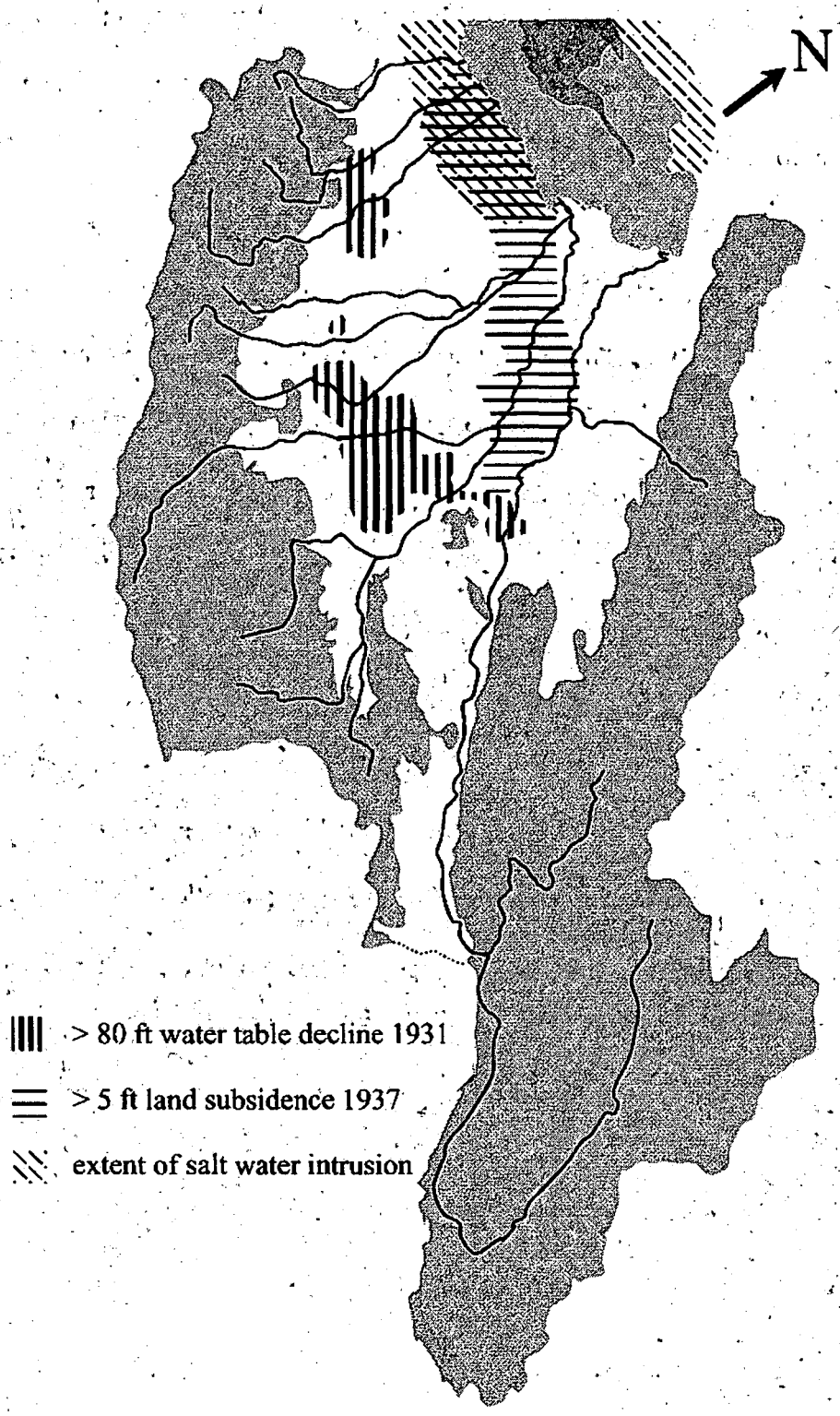


**Figure 20. Extent of groundwater-related problems in the 1930s.**
Source: Tibbetts, 1931b; Bryan, 1933; Hunt, 1940.

results.[17]

Second, a series of articles disclosed the first observations of land subsidence in the valley, which was eventually attributed to groundwater overdraft (Figure 20). Although it had been suspected as early as 1912, it was not accurately detected until a 1932 U.S. Coast and Geodetic Survey leveling. Subsidence results when saturated clays are drained, and the particles irreversibly compress. Thus, there was much less subsidence at Campbell, where the lowering of the water table was greatest, because of the lack of clays there. Santa Clara Valley was the first published report of land subsidence due to groundwater withdrawals, and within a few years, over 200 square miles were affected, with a maximum sinking of 5.5 feet at San Jose. That city eventually fell nearly 13 feet, resulting in $40 million in damages to infrastructure. The bay shore town of Alviso had to build levees as it sank below sea level, and these were breached in 1937 during a heavy storm.[18]

Finally, in 1933 Berkeley civil engineering professor Sidney Harding released a investigation for the Federal Land Bank. Using data from DWR, he claimed that years of low rain were largely to blame for the depressed water table. This study was more spatially refined, though, and disaggregated groundwater conditions and predictions into thirty-seven areas. Harding's bank report was not widely circulated.[19]

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[17] "Water import in Santa Clara held needless." *San Francisco Chronicle*, September 21, 1933, p. 8; "State advises valley to plug up water leak." *San Jose Mercury Herald*, October 6, 1933, p. 1, 2; "Long dry spell drains valley's water supply." *San Jose Mercury Herald*, October 7, 1933, p. 1, 4; "Valley's farming future perilled by salt water." *San Jose Mercury Herald*, October 8, 1933, p. 1, 4; Bryan, 1933

[18] "Alviso flooded as WPA levees go in reverse." *San Jose Mercury Herald*, February 15, 1937; Rappleye, 1933; Tibbetts, 1933; Tolman and Poland, 1940; Smith, 1962; Poland and Ireland, 1985

[19] Harding, 1933

In the fall of 1933, the Santa Clara Valley Water Conservation District began to prepare for another bond issue by requesting federal assistance. The national economic depression of the 1930s had reinvigorated an active government with a new emphasis on equity and ethics, embodied in the Franklin Roosevelt's natural resource policies and his New Deal. The district applied for a grant from the new Works Progress Administration, and John Crummey, chair of the district's Citizens General Water Advisory Committee, went to Washington to lobby. He successfully secured $688,000 just days before the election the following year.[20]

Tibbetts again revised his plan for comprehensive water conservation. He categorized the proposals into the three components of detention reservoirs, diversion dams, and spreading areas. Nonetheless, the May 1934 plan was little more than an appendix to the 1931 one, detailing the modifications (Figure 21). Most significantly, the Coyote reservoir was moved upstream and reduced to half the capacity, and the conveyance facilities on both sides of the valley were removed entirely. In addition, based on Haehl's recommendation, the Coyote Valley bypass canal returned from the 1921 report. Tibbetts predicted that these limited facilities would still be able to reverse the declining well levels, but he no longer claimed they would meet all future demands in the valley. Although it retained the basic principle of the gradual release of stored floodwaters in order to percolate through the stream beds, the lack of trans-valley conveyance undermined the spatial integration of the plan. Instead of accounting for

[20] "County water plan under NRA backed at Campbell meet." *San Jose Mercury Herald*, October 7, 1933, p. 1, 4; "Water district approved by all PWA bureaus." *San Jose Mercury Herald*, March 23, 1934, p. 1; "Public apathy to water loss puzzle in east." *San Jose Mercury Herald*, June 1, 1934, p. 15; Koppes, 1985

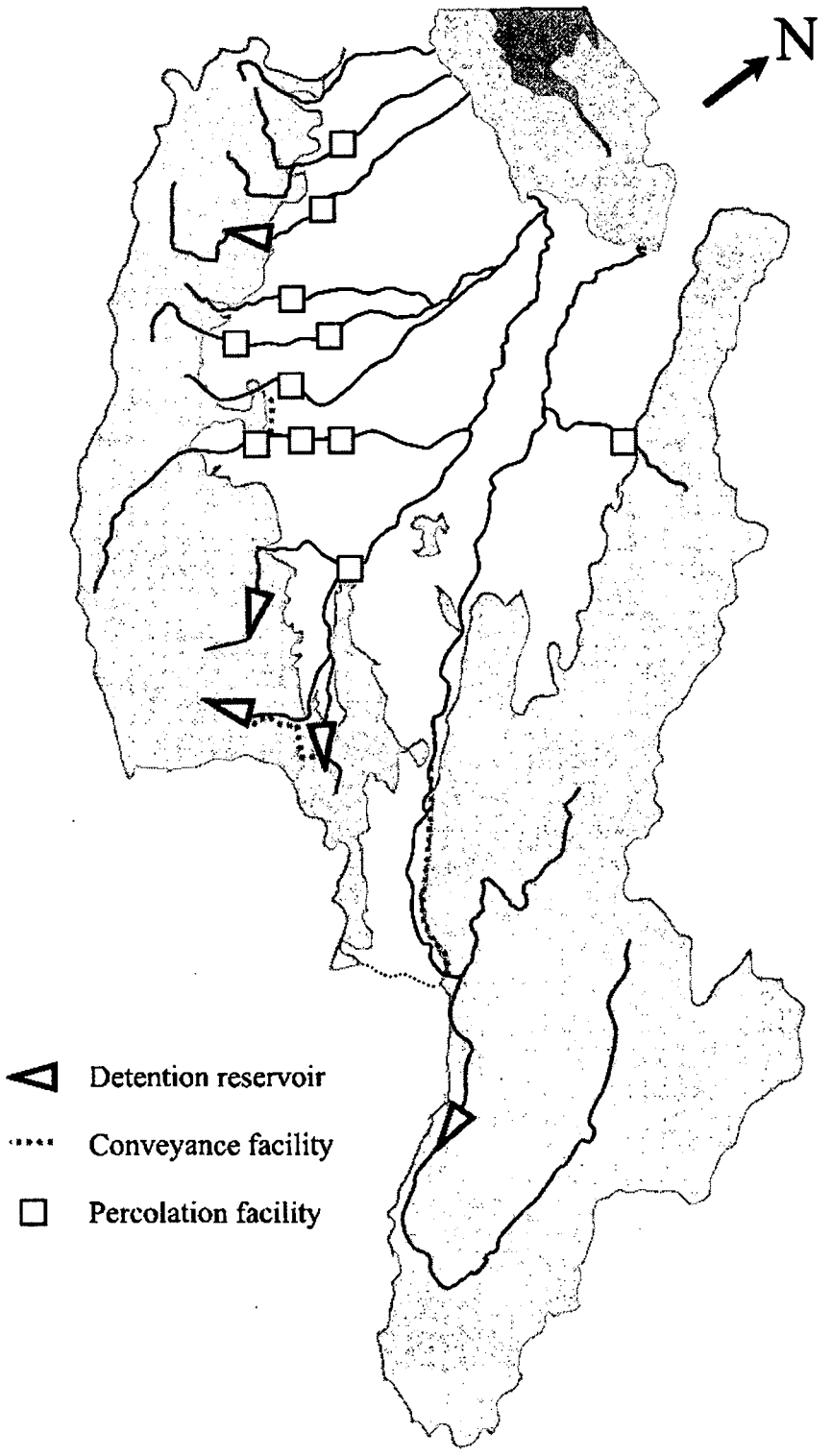


**Figure 21. Schematic of the 1934 Tibbetts plan.**

local variability in water supply and groundwater overdraft, comprehensive resource conservation had essentially been reduced to a set of individual stream facilities.[21]

The $2 million bond election was set by the county Board of Supervisors for June 19, 1934. The Citizens' and Farmers' Committees again led the campaign, focusing on the bonds as a logical investment. As before, they emphasized that irrigation was the foundation of the valley's economy, and that the falling water table was costing voters four times as much as the bonds would. Now, the proponents could emphasize the new circumstances engendered by the national depression. The federal government was offering a gift to cover one-fourth the costs, and promised to buy the bonds at a low interest rate. In addition, the need for job creation was greater than ever, and half the costs would be spent on local labor.[22]

Of course, bond proponents made arguments based on the hydrological conditions, as well. For example, they emphasized that the annual amount of water wasted to the bay was 2.5 times the rate of groundwater depletion, and enough to supply San Jose for seventeen years. Furthermore, the water table had dropped 21 feet during the previous year, and half of the valley's water level was now below sea level. In fact, much of their warnings focused on the threat to wells posed by salt water intrusion. Compared to the previous elections, the conservation propaganda was stronger and more dismal:

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[21] "Conservation of water based on three-way plan." *San Jose Mercury Herald*, June 5, 1934, p. 11, 17; Tibbetts, 1934; Smith, 1962

[22] "Flash bulletin: Future of valley is at stake now!" *San Jose Mercury Herald*, June 14, 1934, p. 4; "Valley water bonds up to voters Tuesday." *San Jose Mercury Herald*, June 17, 1934, p. 1, 2; "Local jobless will get water project work." *San Jose Mercury Herald*, June 9, 1934, p. 13; San Jose Citizens' and Farmers' Committees, 1934

> [Y]ou need but think of the Valley's present beauties and contrast it with the dismal, monotonous, arid land which will be our valley twenty years from now if water is not conserved. Think, too, of your children. How better can you safeguard their future in the Santa Clara Valley than by protecting now their rights to enjoy Nature's gift of water as you have enjoyed it during the past years?... [Imagine] an arid desert waste, devoid of human habitation, productive of nothing but scrawny desert vegetation and cacti, where neither man nor beast can exist. The only difference between this valley and our Santa Clara Valley is WATER.[23]

In addition, project supporters reminded voters of the possibility of completely exhausting the aquifers, of the success of the recharge facilities already in place, and above all, to place trust in the experts. The *Mercury Herald* likened the faith in engineering to that in medicine:

> When civic leaders of this region became aware of the seriousness of Santa Clara Valley's ailment, they likewise called a 'doctor,' the most capable and best qualified engineer available... [but] few of these voters will have sufficient technical engineering knowledge to determine for themselves the soundness of the remedy.[24]

Responding to criticism from the 1931 election, the district had a team of five "disinterested" engineers review the proposal. This advisory committee concluded that the plan was the only feasible alternative, and was essential to the valley's prosperity.[25]

Although the district's Citizens' and Farmers' Committee again spearheaded a publicity campaign, it did not reach the intensity of the 1931 or 1929 elections. Meetings, fewer in number, were held with the usual civic, business, and farm groups, and project supporters were granted radio time. This time, they were not led by leaders such as Anderson, Tibbetts, or Jones (who in April made a brief attempt at the governor's

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[23] "Flash bulletin: Future of valley is at stake now!" *San Jose Mercury Herald*, June 14, 1934, p. 4
[24] "Water fundamental to prosperity of valley." *San Jose Mercury Herald*, June 16, 1934, p. 1
[25] "Water project value outlined by N. J. Menard." *San Jose Mercury Herald*, June 6, 1934, p. 17; "Water in valley dropped 20 feet since March 15." *San Jose Mercury Herald*, June 12, 1934, p. 11; "Five (continued...)

office), but instead by the prominent businessmen and farmers of the committees. Nevertheless, the bonds were endorsed by many groups. The *Mercury Herald* described the proposal in glowing terms, and ran front-page editorials during the week before the election. Although the Grange locals, the Farm Bureau, and other agricultural associations were among the supporting organizations, the bulk were urban, business, and labor groups. T. J. Henderson, a water conservation opponent for twelve years, even supported the bonds. There is no evidence of any organized opposition.[26]

The $2 million bonds were approved by a seven to one majority. Support was relatively uniform throughout the valley. Jones later called it, "One of the most remarkable reversal of public opinion in such a limited space of time."[27] There are plenty of reasons for the change, however. The initiative called for one-third the debt, the water table was much lower, and the previous year had been exceptionally dry. In addition, the public had largely accepted the premise of unemployment relief through large public works projects, and the PWA grant appeared to sway many opinions. Finally, there was no significant opposition to counteract the district's publicity, which had been coordinated by a public relations specialist.[28]

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engineers, geologist back water project." *San Jose Mercury Herald*, June 14, 1934, p. 1, 5; San Jose Citizens' and Farmers' Committees, 1934

[26] "County water plan under NRA backed at Campbell meet." *San Jose Mercury Herald*, October 7, 1933, 1, 4; "Jones, governor candidate, talks." *San Francisco Chronicle*, April 11, 1934, p. 2; "Water project value outlined by N. J. Menard." *San Jose Mercury Herald*, June 6, 1934, p. 17; "Valley Shrine club supports water project." *San Jose Mercury Herald*, June 8, 1934, 17; "Local jobless will get water project work." *San Jose Mercury Herald*, June 9, 1934, p. 13; "Indifference may cause defeat of water bond issue." *San Jose Mercury Herald*, June 18, 1934, 1, 2; "We endorse water conservation." *San Jose Mercury Herald*, June 18, 1934, p. 4. An example of a front-page editorial is "What price water?" *San Jose Mercury Herald*, June 13 1934, p. 1.

[27] Jones, 1958, p. 266

[28] "$2,683,000 water project approved by vote of 7 to 1." *San Jose Mercury Herald*, June 20, 1934, p. 1, 4; Jones, 1958; Martin, 1950

Fourteen years after comprehensive water conservation was first seriously considered, the district began construction of the facilities. In 1935, all but two of the dams were rushed to completion before the winter rains. Almaden Dam was completed the following winter, but the construction of Coyote Dam, by far the largest, was delayed when the Hayward fault was found to run immediately under the dam site. Consequently, the dam had to be four times larger than planned. Tibbetts later declared it "earthquake-proof." Furthermore, planning for the future, the district asked the state to relocate the Santa Cruz Highway so that it could eventually build a large detention reservoir in the only adequate site on Los Gatos Creek.[29]

The project was a success. In the first year of operation using the incomplete facilities, 100 taf was artificially recharged and the amount of water flowing into the bay was halved. After the 1936 rains, the water table was on average 32 feet higher and up 100 feet in some locations, although the net rise was only 21 feet by the end of the summer. Moreover, without the distribution canals, much recharge was confined to distinct groundwater "mounds," particularly under Coyote and Los Gatos Creeks, which required many months to distribute naturally. The area of the valley with a water table below sea level was reduced from one-half to one-third. In addition, a study by the University of California at Davis estimated $150,000 in immediate savings. Artesian conditions even returned in the Laguna Seca section of Coyote Valley. This area, though, already had a shallow groundwater problem, and the owner of the land, engineer Harry

[29] "Water project will begin in fall months." *San Jose Mercury Herald*, June 21, 1934, p. 13; "Construction of dams rushed for finish by winter." *San Jose Mercury Herald*, July 10, 1935, p. 1, 2; "PWA grants plea for Coyote Dam work extension." *San Jose Mercury Herald*, December 10, 1935, p. 17; "Why Coyote (continued...)

Haehl, was forced to cap the well. Writing in *Western Construction News*, Tibbetts justified the project by noting that the cost of deeper pumps was two to three times greater than the capital outlays for the dams, and the annual price of energy for greater pumping lifts was ten times the interest on the bonds. Tibbetts' success attracted the attention of the federal government, as he was among the final contenders to lead the Bureau of Reclamation.[30]

Construction costs ran over, however, and the district had to ask the voters to approve more bonds. This was attributed to the complications in constructing Coyote Dam, greater than expected costs in acquiring rights-of-way, and a small reduction in the PWA grant. The district had the county Board of Supervisors call one more election for May 12, 1936 for $400,000 in bonds. Promotional material and newspaper articles recalled the success of the facilities, and voters were invited to tour them. Moreover, the district warned that if the bonds failed, the PWA would withhold half of its grant and the district would be forced to levy a special assessment. Thus, it asserted that passage of the bonds would actually prevent a tax increase. Although there were no promotional forums, the initiative was endorsed by a large number of valley agricultural, business, and civic groups. There was no significant opposition. It is not surprising that the additional bonds carried by a 77% majority. Throughout the valley, the degree of support was fairly

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Dam is held quake proof." *San Jose Mercury Herald*, August 2, 1936; Tibbetts, 1936a; Tibbetts, 1936b; Tibbetts, 1936c

[30] "Then – water recovery – April, 1935... Now – water recovery – April, 1936." map, Santa Clara Valley Water Conservation District, in the John Galloway papers, Water Resources Center Archive, University of California, Berkeley. "3 State Men for Mead Job." *San Francisco Examiner*, February 2, 1936; "Water district votes today on $400,000 bond issue." *San Jose Mercury Herald*, May 12, 1936, p. 1, 9; "Storage district revives artesian flow in valley." *San Jose Mercury Herald*, May 14, 1936, p. 1, 3; Tibbetts, 1936a; Tibbetts, 1936b; Tibbetts, 1936c; Martin, 1950

consistent. By December, construction of the project was complete, including five major detention dams, two small canals, and fifty-two spreading dams.[31]

Groundwater conditions improved almost immediately after the completion of Coyote Reservoir. Floods in February 1937 filled the surface storage early, and later that year land subsidence halted after the project had doubled the natural rate of groundwater recharge. The water table rose more rapidly than in its recorded history, and Professor J. F. Tolman of Stanford praised the system as innovative and an immediate success. Although the return of normal precipitation rates contributed to the rise in well levels, by 1940 the valley's water table was 75 feet higher with the facilities than without. Consequently, the district had saved the valley $715,000 in pumping costs alone.[32]

The perceptions of nature and the hydrologic cycle expressed during these elections were much like those during the 1920s. The aquifers were described as "irregular and frequently discontinuous" bodies formed as streams deposited gravels and moved over their debris cones. Although most residents understood that the groundwater was from local recharge, the myth of a Sierran origin occasionally appeared. To warn of the imminent and total depletion of the groundwater, the district and its supports

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[31] "District plans bonds election to finish dams." *San Jose Mercury Herald*, March 1, 1936, p. 1, 2; "Water district explains how funds ran short." *San Jose Mercury Herald*, March 18, 1936, p. 1, 2; "Water project raises valley well levels in wide area." *San Jose Mercury Herald*, May 7, 1936, p. 1, 3; "The Water Election." *San Jose Mercury Herald*, May 8, 1936, p. 16; "Voters urged to see dams today for background on Tuesday vote." *San Jose Mercury Herald*, May 10, 1936, p. 1, 2; "Grangers pass resolutions to aid water bonds." *San Jose Mercury Herald*, May 11, 1936, p. 9; "Water district votes today on $400,000 bond issue." *San Jose Mercury Herald*, May 12, 1936, p. 1, 9; "Water district voters attention!!" *San Jose Mercury Herald*, May 12, 1936, p. 4; "Water district bonds carried; margin over three to one." *San Jose Mercury Herald*, May 13, 1936, p. 1, 2; "Fifty of valley groups endorse storage project." *San Jose Mercury News*, June 15, 1936, 17; Santa Clara Valley Conservation Water District, 1936; Tibbetts, 1938a; Tibbetts, 1938b; Martin, 1950

[32] "Subsidence grows less, water storage stops sinking." *San Jose Mercury Herald*, September 14, 1936; "Water rising fast in dams around valley." *San Jose Mercury Herald*, February 15, 1937; "Valley water (continued...)

frequently asserted that the basin is narrower towards the bottom, and consequently the rate of the water table drop would accelerate. The goal remained to capture the "waste" water and put it to "beneficial" use, but after the 1931 DWR report, the water table decline was increasingly attributed to insufficient rain instead of greater withdrawals. Of course, the water supply was still the "life blood" of the valley, and nature had provided an adequate supply and a groundwater basin that offered storage, transportation, and treatment. Humankind, however, must assist in the task:

> I[t] is a plan carefully and efficiently designed to save for our valley water which is ours and which Nature supplies to us in bountiful amounts each year.... [The plan will] aid nature in extending over months the percolation which now occurs only a few days or weeks.[33]

As a consequence, Tibbetts' plan of water conservation was recognized as working with nature's facilities. It was further praised for:

> The fact that the entire water supply is obtained from sources immediately adjoining [the valley, which] makes for a compact, closely coordinated system, much more economical to operate than one that sprawls over a wide territory and obtains water from widely separated sources.[34]

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savings told by professor." *San Jose Mercury Herald*, March 3, 1937; "Santa Clara Valley water table rising." *San Francisco Chronicle*, November 6, 1938, p. 6; Hunt, 1940

[33] "Flash bulletin: Future of valley is at stake now!" *San Jose Mercury Herald*, June 14, 1934, p. 4

[34] "First move to build valley water storage system begun." *San Jose Mercury Herald*, August 18, 1931; "Objections aired on water conservation." *San Jose Evening News*, November 13, 1931, p. 16; "Water shortage perils walnuts, manager says." *San Jose Mercury Herald*, June 8, 1934, p. 17; Tibbetts, 1931b; San Jose Water Works, 1938?; Tibbetts, 1938a. The final quote is from San Jose Water Works, 1938?, p. 23.

# VII. CONCLUSION

Although Santa Clara Valley's scaled-down water conservation system produced immediate improvements in groundwater conditions, the district still faced many challenges. Some valley residents challenged the district, while it addressed internal struggles. Moreover, contrary to Tibbetts' predictions, water demand continued to grow, and more facilities had to be built. Eventually, the valley had to import water, but this development engendered county-wide conflicts among rival institutions.

In its first few years of operation, the Santa Clara Valley Water Conservation District encountered significant resistance. It had to file suits for several rights-of-way and land condemnations, and its applications for water diversion were protested. Moreover, by 1938 it was the target of at least nineteen lawsuits, including two by familiar faces. First, the district had awarded some construction contracts to Floyd Bohnett, who argued he was underpaid for his work. With his brother L. D. Bohnett as his attorney, he sued the district, although the conflict was settled out of court. Second, the already shallow water table rose to the surface on the land of several Coyote Valley residents. Among these was Harry Haehl, who had acquired his land from his former employer, the Bay Cities Water Company. Also represented by L. D. Bohnett, Haehl led a lawsuit against the district to force it to build the Coyote Creek bypass canal that he recommended in his review of the 1931 proposals. After the district agreed to flow limitations in Coyote Creek and traded Haehl's land for a plot near Calero Reservoir, he dropped the suit. However, another group of Coyote Valley residents were suspicious of

the canal and protested the diversion. The water rights hearings favored the district, and the canal was built.[1]

The leadership of the district changed significantly in these first few years. Although in 1935 an attempt to remove Anderson as district secretary failed, such a move succeeded in 1937. In its public statement, the board of directors said they no longer needed a person of such caliber, but it is clear that significant internal disagreements divided the board. The following year, Fred Tibbetts, distraught over the recent death of his wife and his increasing eyesight troubles, took his own life. The district had developed an innovative conservation scheme under the guidance of visionaries, but after the construction and the change in leadership, it became institutionalized.[2]

Urbanization soon created the demand for more facilities. Tibbetts had optimistically assumed that urban water consumption per acre would remain less than the orchards' duty of water. Consequently, he optimistically predicted that the maximum water demand would be reached when all possible land was irrigated. Higher urban densities, and especially greater per capita water use, invalidated this forecast. Although irrigated land peaked in the 1930s, investment and industrialization after World War II led to a tripling of the valley's population the following decade. By 1943, the water table

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[1] "Water district bonds carried; margin over three to one." *San Jose Mercury Herald*, May 13, 1936, p. 1, 2; "Coyote protective body forms." *San Jose News*, September 4, 1936; "Water board in suits for lands." *San Jose News*, September 16, 1936; "Protests on water rights to be heard." *San Jose Mercury Herald*, September 18, 1936; "Coyote water right assured ranch owners." *San Jose Mercury Herald*, September 24, 1936; "Diversion of Coyote is protested." *Morgan Hill Times*, November 6, 1936; "Almaden reservoir abatement sought; man asks $10,000." *San Jose News*, March 2, 1937; *H. L. Haehl et al. vs. Santa Clara Valley Water Conservation District*, Superior Court of Santa Clara County 50103, 1939; Santa Clara Valley Water District memo by Kimberly Linser, 1997

[2] "Reorganized water district directors." *San Jose News*, March 2, 1937; "Fred Tibbets, noted engineers, ends own life." *San Jose Mercury Herald*, August 3, 1938, p. 1, 4; "F. H. Tibbetts ends own life." *San Francisco Chronicle*, August 3, 1938, p. 12; Martin, 1950

was again declining, reaching an all time low in 1950, and land subsidence resumed. Two major bond issues funded the construction of Anderson Dam, forming a mammoth reservoir at the upper gorge of Coyote Creek, and Lexington Reservoir on Los Gatos Creek, after much wrangling to move the state highway. Furthermore, the district finally built conveyance facilities to transport excess water supply from Coyote and Los Gatos Creeks to the flanks of the valley.[3]

As the burgeoning electronics industry took hold and the Valley of Heart's Delight became Silicon Valley, municipal and industrial water demands continued to mount. A 1955 state report predicted the ultimate water needs, based on the complete urbanization of the valley, at 405 taf/y, nearly double Tibbetts' values. Although after 1952 a few cities in the northern valley received water from Hetch Hetchy, it was clear that greater importation was required. However, this led to conflict between the Water Conservation District and the county Board of Supervisors. The district favored importation from the federal Central Valley Project via Pacheco Pass because it would better serve its agricultural constituency. In contrast, the Supervisors allied themselves with urban interests and called for linking to the proposed State Water Project to the north. To further these goals, the county had the state legislature form the Santa Clara County Flood Control and Water Conservation District (usually simply called the Flood Control District), which served the entire county and clearly had overlapping responsibilities as the original district. The Flood Control District began to receive imports from the state in 1968, a year after the Water Conservation District signed a

[3] "San Jose: Worried city in a thirsty valley." *San Francisco Chronicle*, July 17, 1950; Martin, 1950; State Water Resources Board, 1955; Clarke, 1959; Fish, 1981

contract for federal imports. Once again, land subsidence ceased and the water table began to climb. The older district also pushed for bonds to build treatment plans for the expected water, and in 1964 imposed a pumping tax, which not only created an incentive to reduce groundwater withdrawals but also made water imports relatively cheaper. After nearly two decades of struggles for authority, the two districts merged in 1968, and eventually settled on the simple moniker of the Santa Clara Valley Water District.[4]

Like many natural resource agencies, the district had to adjust to the new management paradigm of the 1970s. In the past, it had focused nearly exclusively on the quantity of water supply. The riparian and aquatic ecosystems that were affected by preventing surface water from reaching the bay were ignored, save for a few fish ladders on the smaller diversion and percolation dams. Water quality was also not a concern. In the post-Earth Day era, however, the district initiated programs of water quality, riparian health, aesthetics, and recreation. Furthermore, the district added hydropower facilities to Anderson Dam in 1980. The integration of these multiple goals, in addition to those of flood control and urban water supply from previous decades, often led to conflicting priorities and management difficulties.[5]

Recent years have seen continued growth and problematic issues. The valley's reliance upon its groundwater basin for nearly all its water needs was highlighted by the discovery of significant contamination by the supposedly clean industries of Silicon Valley. Such groundwater contamination is extremely difficult to remediate, and the valley now contains many Superfund sites. Moreover, by 1984, water use had reached

[4] State Water Resources Board, 1955; Clarke, 1959; Smith, 1962; Ford, 1978; McArthur, 1981; Walker and Williams, 1982; Matthews, 1999

the "ultimate requirement" prediction of the 1955 state report, although demand reduction programs have generally kept the annual usage by the valley's 1.6 million residents to less than 400 taf/y. Of this, slightly over half is from local supplies, 30% from the federal Central Valley Project, and 18% from the State Water Project.[6]

The Santa Clara Valley Water Conservation District and its various successors established an innovative and dynamic political and physical water supply infrastructure that has, to varying degrees, retained Tibbetts' vision of a spatially and temporally integrated system which optimizes the available local resources. Although no single component of the project was entirely revolutionary, its comprehensive hydraulic paradigm of utilizing the entire hydrologic cycle is remarkable. To repeat an earlier quotation, this was best described by the American Society of Civil Engineers:

> the first and only instance of a major water supply being developed in a single groundwater basin involving control of numerous independent tributaries to effectuate almost optimal conservation of practically all of the sources of water flowing into the basin.[7]

The result was a system that utilized the local facilities of an immense groundwater basin for its storage, transportation, and treatment properties, and the limited availability for surface storage. The drawback is a necessity for tight management. Tibbetts' approach was simply overwhelmed by the massive urban demand which he did not (or chose not to) foresee. The need for water imports compromised the project at not only an abstract level, but from a pragmatic perspective as well. The reliance on external supplies has

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[5] State Water Resources Board, 1955; Smith, 1962; Ford, 1978; McArthur, 1981
[6] Todd (David Keith) Consulting Engineers, 1987; Santa Clara Valley Water District, 1999
[7] Statement by Robert L. Morris, President of the San Francisco Section of ASCE, in American Society of Civil Engineers, 1976

drawn the valley into statewide water conflicts, and made it vulnerable to the politics of Sacramento and Washington.[8]

This approach to water resources management was built upon an understanding of the hydrologic cycle that, although most evident in Tibbetts' proposals, is present throughout the public dialogue in the valley. Although the valley's hydrology was occasionally an issue in the nineteenth century, the Bay Cities trials of 1904 to 1913 launched the modern concern for groundwater management. The most common components of this understanding were the recognition of local precipitation as the source of all water in the valley; an acknowledgment of the uneven spatial and temporal distribution of precipitation; the torrential character of the streams; the interconnection of surface and groundwater via recharge in the stream beds, particularly on the alluvial cones; and the transmission of groundwater through a network of interconnected buried stream beds and larger aquifers. Inherent to this was the consideration of the valley as a hydrologically closed unit. These beliefs were not universal, however, and myths such as sheet water and the Sierran origin of groundwater persisted as the perception of water dynamics evolved. The myths were gradually debunked, and practices such as irrigation, the use of groundwater, and artificial recharge became more accepted. These trends eventually resulted in the recognition of the immense value of the groundwater basin for its abilities to store, transport, and purify water.

[8] An interview with Jerry Garrett of the Santa Clara Valley Water District on October 16, 1976 on the California History Center, de Anza College, Cupertino highlights the need for "tight" control of the supply and conservation system. Worster, 1990 notes the instability and vulnerability which results from reliance on water importation.

The application of this understanding to water resources engineering and management reveals other ideologies. Citizens, district officials, and engineers repeatedly described the various proposals as complementing an already generous nature, not simply subduing it. Thus, Richard White's description of the Columbia River projects as an "organic machine" in which human-made and natural facilities are intertwined to improve nature can be applied to Santa Clara Valley. The creation of this intricate machine was driven by faith in the ability of engineering and in the progress of capitalism. Although science is now recognized as a constructed product of culture and engineering is often criticized as overzealous, in early twentieth century America engineers were revered as the objective analysts who could impose order on a chaotic nature and navigate the road to prosperity. To a degree, this faith was justified, since many issues of natural resource management that appear to be only political are in fact questions of understanding the nature of the resource. For example, the appropriate strategy in Santa Clara Valley depended on whether the water table decline was solely caused by a period of low precipitation, or on the extent of connection between the alluvial cones and the deeper aquifers. Nonetheless, the ultimate engine for the groundwater crisis was the unwavering belief in the market to foster unending development and the subsequent commodification and exploitation of the natural resource. The maximization of individual profit drove the more apparent causes of the water table decline such as agricultural intensification, urban growth, and technological advances.[9]

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[9] White, 1995

The implementation of this vision of a better nature through engineering was limited by political tensions. The incongruity of the pursuit of self interest with the spatially shared nature of groundwater engendered the management dilemma of the common pool resource. Consistent with the arguments of Elinor Ostrom, both the pure market and the proposal for a strong district, such as in 1921, failed. An appropriate compromise between the fears of voters and the necessary authority of a governing entity was essential to muster support. The resulting district did not, however, maintain enough legitimacy to construct the proposed facilities immediately, and was challenged by a rival district within two decades. In the end, the district evolved and accreted enough power to manage the water supply of the entire county, as well as import from two major statewide projects. Its development of the water supply was critical to the astounding landscape and demographic transformation of the valley.[10]

I assert that the approach in Santa Clara Valley was a forerunner to more recent innovations in natural resource management in California and beyond. In particular, water policies in recent decades have integrated larger spatial and temporal scales, more components of the hydrologic cycle, and other natural and human systems:

> The story of water, engineering, and landscape is about the progressive and continuing human ambition to control the spatial and temporal pattern of water availability.... This story is as much as social history as a technological one, and the theme is particularly timely as we are currently witnessing a dramatic change of our fundamental attitudes to both water development and environmental protection.[11]

At the very least, district governance, integrated management, conjunctive use, and artificial recharge are all now common. Moreover, water resources management is

[10] Ostrom, 1990; Matthews, 1999

undergoing a profound transformation from simple physical solutions in order to increase supply to comprehensive demand reduction programs, multiple resource integration, and multilateral stakeholder negotiations. This is best exemplified in the ongoing CALFED negotiations, which seek to integrate more of California's hydrologic cycle under one management umbrella.[12]

Modern policy makers can learn from this narrative of water in Santa Clara Valley. The understanding of nature, including science, is shaped by culture, is dynamic, and thus is historically contingent. At the present time, persistent throughout modern capitalism has been the vicious cycle of exploiting inexpensive, readily available resources in order to generate enough wealth to afford scarcer, more expensive resources. Such a paradigm lacks a sustainable foundation. Present laws and management schemes have failed to reconcile the shared and uncertain nature of groundwater with its social patterns of use. Alternate approaches should rest on principles of ethics, equity, sustainability, and adaptability. Moreover, such approaches must be informed by histories which reveal the complex arrangements not just among humans, but between humans and nature, and which also highlight the critical role but constructed underpinnings of scientific knowledge.

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[11] Petts, 1990, p. 188
[12] Owens-Viani, Wong, and Gleick, 1999

# APPENDIX: UNIT CONVERSIONS AND ABBREVIATIONS

- 1 acre = 0.0015625 square miles = 0.405 hectares
- 1 acre-foot (af) = 43560 cubic feet = 325900 gallons = 1233.5 cubic meters
- 1 thousand acre-feet per year (taf/y) = 0.89 million gallons per day = 1.38 cubic feet per second = 1,233,500 cubic meters per year = 3377 cubic meters per day = 39 liters per second
- 1 foot (ft) = 30.7 centimeters
- 1 mile (mi) = 1.62 kilometers

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