

The Delta Project: Utah's Successful Carey Act Project

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In the late nineteenth century, there was a growing interest in western land reclamation. An important contributor to this interest was the "hype" generated by the Irrigation Congress, an organization which held its first session at Salt Lake City in 1891. Sponsors of the Congress sought to channel western public opinion into pressure for the Federal government to aid development.

One consequence of this agitation was the passage of the Carey Act of 1894, which authorized the transfer of Federal land to arid-region states. The transfer was conditional on the states arranging for settlement and insuring that the proper irrigation facilities were constructed. Under the Carey Act, several geographically diverse Utah projects were envisioned (State Engineer, 1913). Of all the Carey Act projects, the one located near the modern-day town of Delta was the first to make application and ultimately the only successful attempt. Despite the Delta project's unique position among Utah irrigation developments, it has been largely ignored in scholarly studies.

The general premise of past historical studies of the Delta area is that successful settlement would not have occurred without substantial government (Avery and Singer, 1982) and church (Arrington, 1951) assistance. However, as this paper will demonstrate, irrigation projects in the Delta area succeeded only after private entrepreneurship took over. It was the strong will of the local inhabitants, combined with outside private capital, which made development in the area possible. That is not to say that at times they were not assisted by church and government sources; but the drive and the desire which allowed the projects to succeed was always provided from within the area and not from without. In fact, on at least one occasion, Federal assistance hindered more than it helped. Delta does not fit into the standard mold for Utah developments and it should not be forced into it.

Early Settlement of the Lower Sevier River

The Sevier Desert in west-central Utah ranges from semi-arid to outright desert. On the edge of this desert is the Great Pahvant valley named after the primitive locust-eating Pahvant Indians. For many years explorers regarded the valley, located in the lower Sevier River Basin, as inhospitable and uncultivable. But with a great deal of struggle, the area has been transformed from a barren desert into a productive agricultural settlement.

The several accounts of the colonization of the lower Sevier River Basin are in general agreement. The first area to be settled was the low lands southwest of the present-day community of Delta. In May 1858 a group of Mormons visited the area; they returned to settle the next year. A small community was established at Deseret and an adobe fort was constructed to protect the settlers from Indians.

The difficulties associated with maintaining the early irrigation diversion structures on the Sevier River have been chronicled elsewhere (Arrington, 1951; King, 1947). The location, however, of the diversion structures has not been adequately addressed. Dudley Crafts (a lifetime resident of the Delta area, noted water attorney, and local historian) stated in unpublished notes that the first earthen dam was placed approximately three miles downstream from the present-day town of Deseret. Several irrigation efforts were made below Deseret but pioneer statements and archeological remains locate the major effort upstream.

The original town of Deseret was located on the south side of the Sevier River near where the old fort is located. The settlers built homes, cleared farms of brush, and constructed irrigation systems. An old river channel served as the principal canal. By tracing the old river channel back to its junction with the present Sevier River channel, the old diversion site can be located. It was at this site, located northeast of present-day Deseret, that the major dam building efforts occurred. The site mentioned by Crafts was a diversion dam in the old channel to regulate into irrigation ditches. In all, five separate attempts at diverting the river were made during this period. These efforts were typical of Mormon pioneer efforts elsewhere in Utah (Peterson, 1985): "pioneers had to learn by trial and error. Diversion dams were installed almost annually."

The flooding which occurred along the lower Sevier River in 1863, exposed at least two dams at the upper site. Many of the rocks, cribs, and pilings are still in place. The fifth dam constructed at this site in 1864 withstood spring runoff for three years and the dam was "deemed very secure." But in the summer of 1868 unusually high water caused this dam to fail. The settlers left the Deseret area with many moving a few miles east to Oak Creek.

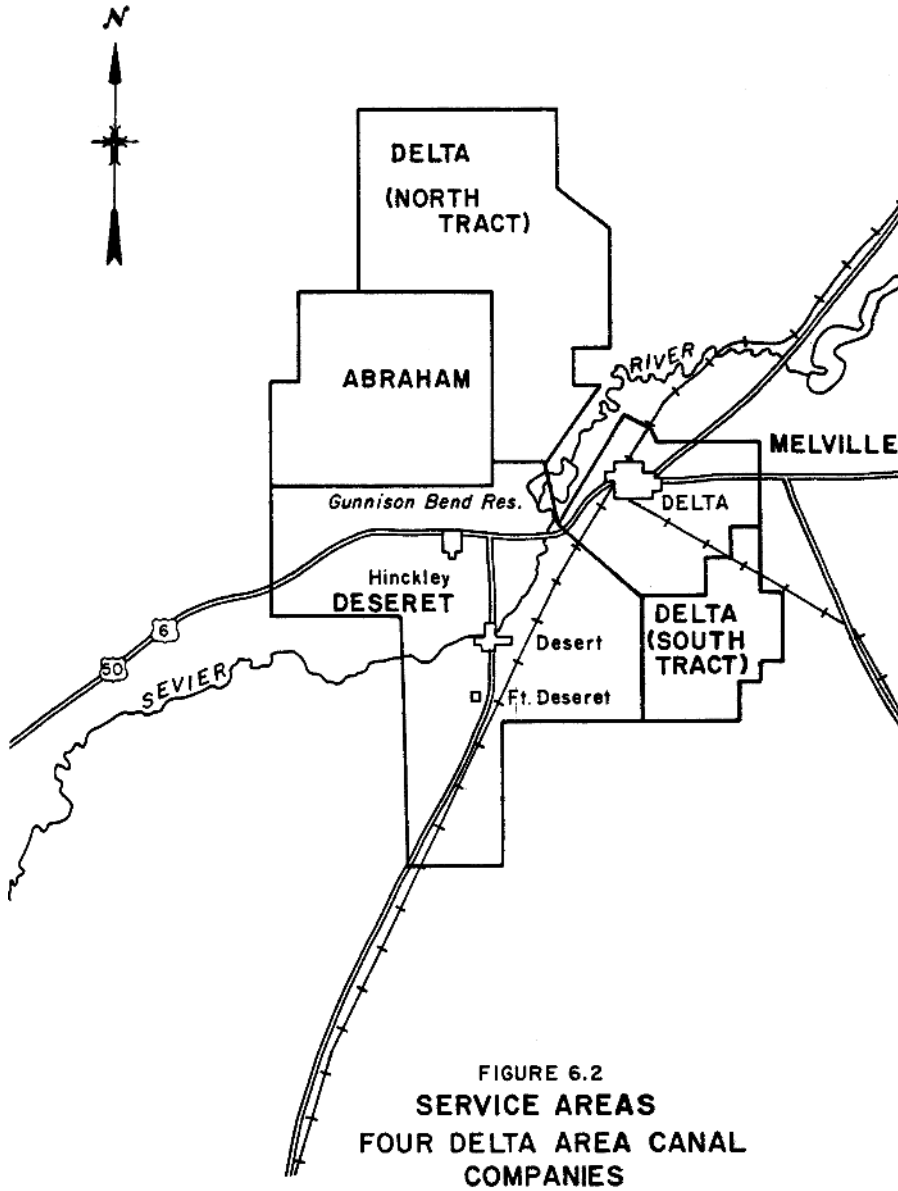


Figure 1.

Table 1. List of Dams Constructed to Serve the Delta Area

Dam	Construction Year	Use*	Alignment**	Comments
Old Deseret Site	1860	D	A-A	Diversion from the old Sevier River channel
Lower Sevier Site	1860-68 and 1874-84	D	B-B	Diversion from Sevier River into old channel
Gunnison Bend	1880-90	D	C-C	Constructed by Gunnison Bend Company; later purchased by Deseret Irrigation Company

Dam	Construction Year	Use*	Alignment**	Comments
Gunnison Bend Enlargement	1895-98	D,S	C-C	Constructed by Deseret and Salt Lake A&M companies; the dam at this site is still in use; it has never failed but was breached in 1910 and 1983 when upstream dams failed; Cropper Cut washed out in 1909.
Delta Site 1	1909-10	D	D-D	Spillways on this structure failed in both 1909 and 1910.
Delta Site 2	1911	D	E-E	This was the diversion structure for the Delta and Melville companies until 1960 when DMAD dam was built; it was then converted into a drop structure; in 1983 the structure washed out causing the DMAD failure.
Sevier Bridge	1903-08	S	G-G	The dam impounded approximately 100,000 acre-feet of water; it was probably unsafe.
Sevier Bridge Enlargement	1914-16	S	G-G	This dam is an enlargement of the earlier reservoir; it impounds approximately 236,000 acre-feet of water and is still in use.
DMAD	1960	D,S	F-F	The dam impounds approximately 11,000 acre-feet; its spillway failed in 1983 and was subsequently rebuilt.

Note:

- * D = Diversion structure with little or no storage
- S = Dam to impound enough water to provide storage
- ** for location refer to Figure 1

The next group to attempt settlement in the area came from the Tintic Mining District. This group, headed by C. Gilbert Webb, chose for the site of its irrigation diversion a gooseneck in the Sevier River referred to as Gunnison Bend. This site is in a very unique section of the river. The flood plain is broad, more than one-half mile wide. The meander of the river has left a large parcel of land some 15 feet above the flood plain that would have been an island except for a narrow neck of land connecting it to the eastern lands. To create a diversion point required a 600 foot dike connecting the "island" to the western edge of the flood plain. An emergency by-pass, known as Cropper Cut, was eventually made by cutting the eastern narrow neck of land.

In the spring of 1874, Brigham Young called a group to resettle the Deseret area. When they arrived, they found Webb's party already there. The Tintic group had located upstream from the old Deseret diversion, so the Mormon settlers reconstructed the old dam. Although the site served as a diversion point for a few more years, the settlers had the same difficulties holding the dam as had the earlier group.

To stay in business, the Tintic group, organized as the Gunnison Bend Company, had to mortgage its diversion works and claimed land. Unable to make the necessary payments, the mortgage was eventually foreclosed. The Deseret Irrigation Company, organized as a private corporation by the Mormon settlers living downstream, voted to purchase the partially completed dam and diversion works of the Gunnison Bend Company. This they did at a sheriff's sale in 1880. Between 1880 and 1890 a ten-foot high diversion dam, low line canal, and flume across the Sevier River above Cropper Lane were completed. This dam, unlike previous attempts downstream, never did fail of natural causes and by 1890 all the water diverted into the Deseret Irrigation Company system was from the Gunnison Bend site. Some 20,000 acres were being irrigated on both sides of the river around Oasis, Deseret and south Hinckley.

Meanwhile, Mormon church officials in Salt Lake City were becoming increasingly interested in the possibilities for expanding settlements in the Pahvant Valley. A farmer himself, church president Wilford Woodruff had a strong interest in building up new farming areas. In 1889 the Salt Lake Agricultural and Manufacturing (A&M) Company was organized. The company acquired land under the Desert Land Act and disposed of it at cost to settlers. Most of the stockholders had plural wives, and "oldtimers" in the Delta area feel that some of them had in mind establishing one or more of their families in Deseret. It was an isolated place which could be used to advantage during the days of the antipolygamy raids.

The leaders of the Deseret and Salt Lake A&M companies were aware of the need for a storage reservoir and the possibilities at the Gunnison Bend site. A partnership between the two companies was formed to enlarge the dam at the Gunnison Bend site. The Deseret Irrigation Company assumed four-sevenths and Salt Lake A&M Company three-sevenths. This division of water rights and responsibilities is still in force, with the Abraham Irrigation Company heir to the Salt Lake faction. Between 1895 and 1898, the dam was raised to a height of approximately 15 feet and a spillway constructed. The Salt Lake A&M Canal Company constructed a from the enlarged Gunnison Bend Reservoir to divert irrigation water to lands north and west of Hinckley. Arrington (1951, p. 402) inaccurately assumed that the enlargement of Gunnison Bend was the construction at Sevier Bridge Reservoir. The latter reservoir, however, was not constructed until the early twentieth century. Avery and Singer (1982, p. 30) allege that Gunnison Bend Reservoir was built with Federal funds. It most definitely was not. Gunnison Bend Reservoir still services the Deseret and Abraham companies and is located approximately two miles west of Delta. The dam has never failed; it has been breached twice when upstream dams failed, once in 1910 and again in 1983.

Irrigation development occurred almost simultaneously along the Sevier River. By 1890 all the land, which could be served by direct river flow, was under cultivation. A series of dry years in the late 1890s resulted in little water reaching the town of Deseret. The farmers were unable to mature their crops. As a consequence, the Deseret people hired a posse to remove diversion dams above Pahvant Valley. There are several folktales regarding the resulting water wars. One "oldtimer" related how the farmers at Suckertown--near the present-day community of Mills--reacted when they heard of the posse's arrival. The Suckertown group organized and constructed "cover" at their diversion site. When the Deseret posse arrived, guns were cocked. The two armed groups stood, eyeball to eyeball, each afraid to make the first move. According to the tale, they confronted each other for more than thirty minutes with no one daring to speak, afraid of starting a shootout.

Recognizing that vigilante law was not going to work, a lawsuit was filed by the Deseret Irrigation Company to establish their right under law. The claims of the users were so conflicting" that Judge Higgins his 1901 Decree put the users in the lower Sevier River Basin on a common priority, recognizing all claims. In the event of a water shortage, all claims would be prorated from the available supply.

During later 1890s, the Abraham area lost many of its settlers. Arrington (1951, p. 406) attributed this decline to waterlogging of the farmlands. The physical evidence suggests otherwise. The lands in the Abraham area did not at that time have serious drainage problems. (The drainage problems were caused by irrigation on the higher lands developed later.) The problem was the area's water right; this was a period of extreme drought. Abraham's share of the primary river flow and Gunnison Bend storage was not enough to maintain even a

fraction of the land under development. Drought was the primary cause of so many leaving the Abraham area. There are, however, many farms in the area that have been continuously farmed from the 1890s to the present.

The drought period from 1895 to 1905 resulted in the "Hawley Filing," a water right application to impound sufficient water to irrigate 70,000 acres. In 1902, the Deseret Irrigation Company hired a surveyor to investigate potential damsites. After field studies, he recommended a site at Sevier Bridge, downstream from Fayette. The president of the irrigation company, Jacob C. Hawley, posted notice at that site on August 26, 1902, stating the intention of the Deseret Irrigation Company to impound 1,500 cfs of unappropriated Sevier River water. To do this, Hawley took the train to Nephi and pedaled his bicycle 25 miles to Sevier Bridge, posted his notice, and then returned to Deseret. Recorded at the Juab County Recorder's Office on September 15, this act in accordance with existing law is known as the "Hawley Filing."

The people of Deseret, Oasis, and Hinckley were entirely without cash resources. The Deseret Irrigation Company undoubtedly sought a loan from the church and other sources only to be turned down. One story tells that the company went to the State Engineer, A. F. Doremus, seeking only a letter of recommendation to be used in seeking a loan. This minimal request was denied with the statement that there was no water available for this reservoir and there would probably never be any.

In December 1903, the State Engineer approved plans and specification for a 60-foot dam to be constructed at Sevier Bridge. A unique plan was devised to get Sevier Bridge Dam (Yuba Dam) built. Each fall an assessment of \$5 per share was levied against the stock of the Deseret Irrigation Company. This could be worked out at the rate of \$2.50 per day for a man and team of horses. Consequently, each stockholder spent nearly all fall and winter working off his assessment. Needless to say there was very little land and water speculation during these years.

The dam was earth-fill, placed in layers, and compacted with wagon wheels. The construction process caused some concern with residents in Juab County. In 1904 a county commissioner wrote the State Engineer (Utah Division of Water Rights, 1979):

From a personal inspection within the last few days we doubt that it is being constructed in a way that insures strength and safety and we think it to your interests as well as the interest of a number of our citizens that you know for yourself just what means of construction are being used--in the way of soil, sprinkling and tamping, rolling, etc.

The exact motivations of the Juab County officials are not known. However, they had a right to be concerned. In 1906, the runoff on the Sevier River was more than ample and nearly washed out the incomplete Sevier Bridge Dam.

Cutoff trenches were included in the design approved by the State Engineer. During construction, however, the trenches were not sunk deep enough and fell well short of bedrock. This allowed water from the reservoir to percolate underneath the dam causing seepage problems. A report by a consulting engineer in 1911 made the following assessment of the dam (Utah Division of Water Rights, 1979):

Considering the nature of the materials on which the dam rests ...it seems remarkable that the structure has not failed before now. The weight of the embankment has evidently compressed the material of the streambed on which it rests, and sunk into it sufficiently to reduce percolation to a minimum.

There seems little doubt that the dam was unsafe and because of the size of the reservoir (maximum capacity of 104,00 acre-feet of water) any failure would have been devastating to downstream landowners. The dam, however, held until it was enlarged in 1916. With the dam complete, the Deseret Irrigation Company was able to secure a loan from the State Land Board.

With the dry cycle ending and ample runoff returning, there was a renewed interest in land and water development in Pahvant valley. The Mormon Church called a group in the Fillmore Stake on a mission to determine the feasibility of constructing an additional irrigation project in the Deseret area. As a result, a group of individuals, with the free enterprise system in mind, formed the Melville Irrigation company. The Deseret Irrigation Company strapped for cash and seemingly having plenty of water was receptive to selling a part of its Sevier Bridge enterprise. The Melville company purchased a one-half interest in the Sevier Bridge facilities and water rights for \$25,000.

Carey Act Project

All the ingredients were in place to change the face of Millard County: surplus water in the river; a large storage reservoir on the Sevier River; desert lands available at little cost; and entrepreneurs who quickly calculated returns versus estimated costs of dams and waterways. Adding to the euphoria was the example of good crops and blossoming agricultural industry under the Deseret and Abraham systems. The fact that most of the lands under cultivation were loamy and well drained (and that most of the remaining land had potential drainage problems) was a very significant factor, which would not be realized until later.

The Oasis Land and Water Company was formed to acquire land, resell it to settlers, and to construct an irrigation system. The company was different from the other projects in that nearly all the area was desert land assigned by the State under the Carey Act. The Oasis group purchased as a water right one-sixth of the Sevier Bridge right from the Melville Irrigation Company and two-sixths from the Deseret Irrigation Company. In addition, the Oasis group joined with the Melville Irrigation Company to construct a diversion dam north of Burtner (present-day Delta). Of the 43,000 acres planned for development, most of the land was in the North Tract, located northwest across the river from the Melville area (refer to Figure 6.2). The rest, the South Tract, was south of the Melville area. The Oasis Land and Water Company thought they had a firm contract with the State of Utah for the right to develop additional water sufficiently above that purchased to give a full irrigation right for the 43,000 acres.

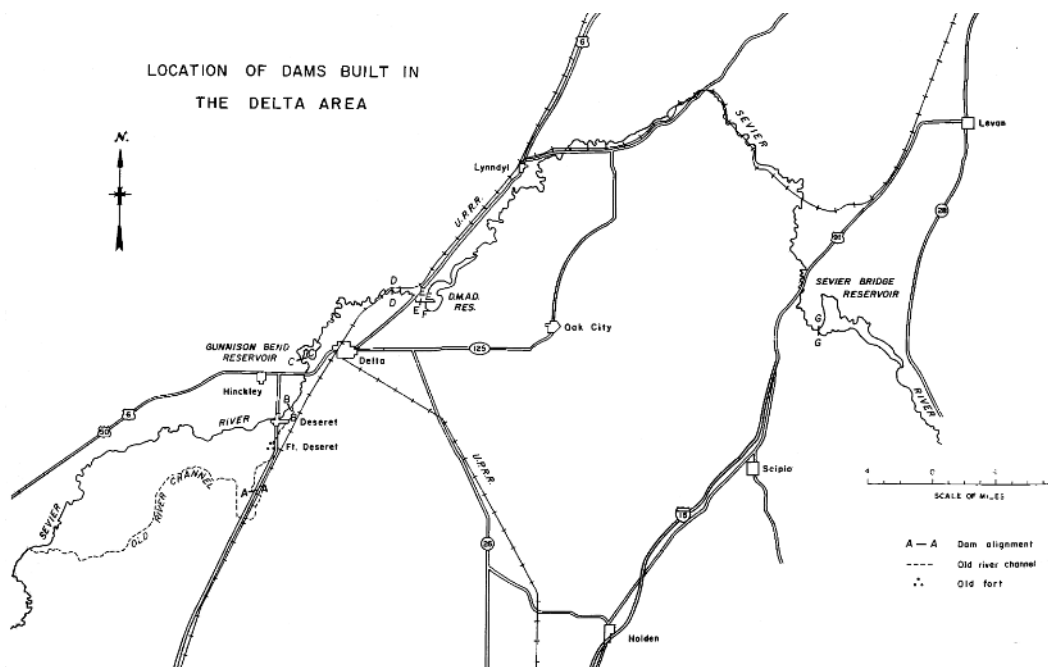


Figure 2.

Some water was turned into the Melville system in 1908. At the beginning of the 1909 irrigation season one flume had been completed to deliver irrigation water to the Oasis project's North Tract. The Carey Act segregation caused rapid growth in the Burtner (Delta) area for about ten years. Settlers were arriving daily. The railhead at Burtner became a boomtown; for a short period of time the town was a tent city. The first 15,000 acres offered were "snapped up," mostly by people from the Midwest.

The project's initial diversion dam was earth-fill with concrete diversion and spillway structures. The one unusual condition was that to put the water into the canal required a considerable back-up. During the night of June 14, 1909, the spillway, constructed on sand, was undermined, leaving the canal high and dry. The flood wave resulting from the dam failure reached Gunnison Bend Reservoir, washing out the Cropper Cut. A regenerated flood wave went on down the river through Deseret causing considerable damage. The John Avery Bishop account printed in the Millard County Chronicle, March 1911, chronicled the event. One folktale told by "oldtimers" in Deseret serves to highlight one memorable event. A local citizen of stature who was known to drink a little was on the roof of his chicken coop watching the flood go by. As the saloon building collapsed he was heard to cry out "Oh my God! I'm ruined."

The efforts to restore the diversion dam were frantic and heroic. E. L. Abbott (1949), an early settler, wrote of the period:

I will never forget the first few days at the dam site, where the people had gathered to begin reconstruction. It was hoped, at first, that the dam could be replaced in time to save the crops so the people came, men with their wives and children rushed to the scene. The men went to work on preliminary work on the dam, leaving the women and larger children to set up the tents and establish camp. Not all of them had tents, but used wagon covers and other materials to shelter them from the blistering sun and elements; none of these, not even the tents were adequate to give them the proper protection under the conditions, and there was considerable discomfort and even suffering.

The first night will always remain a nightmare to me. After a grueling hot and busy day, night came on with none of the camp fully established and most of their belongings still lying where they had been unloaded from the wagons. The campfires were built, over which a meager supper was prepared and eaten. The animals were taken care of for the night and folks went to work untangling their belongings and getting ready to retire and get some rest through the night. The heat dust and flies had been a menace all day, but at night there by the river, where the reservoir had been, the mosquitoes nearly devoured us. Babies and small children were crying, mothers and older children trying to comfort them and get them tucked away in the improvised beds on the ground.

It was all heart sickening, and I wondered if it could be long endured. Some of them couldn't endure it and in a few days pulled out for more pleasant places. Most of them, however, stayed and by persistent and intelligent efforts improved the living conditions in the camp, and fought on determinedly, until the dam was completely replaced, but not early enough to save any of the crops on the project and there was but very little fall grain put in.

Many of the people had planned on working on the canals and clearing more land that winter, but the winter of 1909-1910 was a severe one, and there was no work done. Many of the people were quite hard up by spring, but when spring finally came, they all went to work planting crops, working on canals and many other things that had to be done to build a country.

These activities, however, were soon brought to a halt, for again in the spring of 1910, the dam went out. That year was almost a complete repetition of the year before. A few more people gave up and left but for the most part, the same people that had so heroically fought it out the year before, again went back and gave the Old Sevier a whipping
...

After the second failure, it was decided that the canal head would be extended upstream until it intersected the river channel. A new diversion dam was completed at this site in 1911. The spillway structure served until 1960, at which time it was refurbished to be used as a drop structure in conjunction with the new DMAD Dam located three-fourths of a mile upstream.

The lawsuits and claims resulting from the two dam failures of 1909 and 1910 threw the Oasis Land and Water Company into receivership. A corporation organized in Nevada, the Delta Land and Water Company, took over the project. The money came from prominent Salt Lake City investors.

The newly formed Delta company was able to get the project back on its feet. The State Engineer (1913) described the formidable list of features completed:

The diversion canal has a capacity of 750 second-feet for the first seven miles and carries water for both the Delta Land and Water Company and the Melville Irrigation Company. When it emerges from the canyon it is divided, with one part, called the North Canal, crossing Sevier River to irrigate lands on the right bank, and the other, called the South Canal, continuing down the left side of the river.

The North Canal crosses the river by means of two flumes; one built of steel and is about 10 feet in diameter, and the other is of wood and four feet deep by six feet wide. These flumes are 600 feet long and rest on a trestle that is 35 feet above the bed of the river. Their combined capacity is 300 second feet, all belonging to the Delta Land and Water Company. The total length of this main canal is thirteen miles and it will irrigate lands lying five to ten miles northwest of the new town of Delta on the San Pedro, Los Angeles and Salt Lake R.R.

The other branch continued as an earthen canal down the left side of the river, with a capacity of 450 second-feet for four miles when it divides, about 150 second-feet going to the Melville Irrigation Company, and the remaining 300 second-feet goes into a canal of the Delta Land and Water Company which has a length of about seven miles, not counting lateral, and irrigates lands southeasterly of the town of Delta.

The Delta project is the first of the Carey Act projects to be completed in Utah, and 30,00 acres of the 43,000 acres segregated have already been sold. It is estimated that 12,000 acres were cropped in 1912. The old company sold 14,000 acres of land and water rights at \$40 to \$45 per acre, with ten annual payments and six per cent interest on deferred payments. The Delta Land & Water Company since taking over the project has sold 16,000 acres at \$50, with twelve years to complete payment, and six per cent interest on deferred payments. It has spent \$150,000 for construction of the new diversion dam, for canals and other betterments, and it is to spend about \$30,000 more for its share of the cost of increasing the storage capacity of the Sevier Bridge Reservoir. The sales have been made to Utah people, to farmers from the Mississippi Valley, especially Oklahoma, and a large amount to residents of southern California. The contracts for water calls for 1.5 acre-feet per acre per annum measured at the point of delivery to the settler and within one half mile of each quarter-section of land.

The Land Rush

The land promotions of the Oasis Land and Water Company and its successor the Delta Land and Water Company were typical of Utah land promotions. Although speculation in Delta was in water rather than land, the methods used to attract settlers was basically the same as those used for other speculative projects. Brochures were an important component. Since they were to be distributed in the Midwest, the brochures were designed to touch a vital nerve. One of the short comings of our nation's bread basket is that on occasion rainfall does not come at critical times. The almost ideal climate and soil do not always deliver the maximum crop. What an opportunity to go where the missing ingredient could be applied at will. That the soil and climate might not be ideal was glossed over. One brochure explained the secret to the project's assured success:

The secret of it all is virgin soil--inexhaustible in depth--and WATER, no floods, no droughts; just a steady crop growing climate.

Although no orchards had been planted, the possibility of raising fruit was not overlooked. "While no effort has yet been made to raise fruit around Burtner, apples, pears, and plums will undoubtedly do well." Another crop, which was mentioned frequently in promotions, was alfalfa for seed.

The brochures promised that settlers could expect to live the good life in Delta:

The value of farm and farm products is increasing every year, and the farmer has the most independent life of any class. He is the most contented, worries the least, lives the best and most farmers in Utah have a bank account.

and:

Now if you are a farmer Delta would give back to you tenfold--yes, twentyfold--more than you put into it. But you must work! You must come with enough to make a start--and that need not be much.

After making their claims, the Delta company challenged prospective buyers to come to Delta and look around:

Farmers who drove out onto their land in prairie schooners two years ago are today living in modest houses, their stock well covered. While around them fields of rye, wheat, alfalfa, barley and oats are waving a promise of a third crop that will put money in the bank for every man who has properly farmed!

All this in little more than a round of seasons!

Does it seem possible? Does it seem probable? Come to Delta and see for yourself. Drive over the land and talk with the men who have brought about this transformation. Ask them what they'll sell for.

Potential settlers from the Midwest were given the hard sell. One of the early settlers was Fred Baker from Illinois.

Before buying, he visited the project. His wife described the impression Delta made on her husband (Baker, undated):

The project was alive with activity, men from many states were taking up land, and after only a day or two of looking it over, he decided on an 80 acres in what was known as the South Tract. He returned with fabulous tales of the wonderful climate, the soil, "just like an ash bank" (under the greasewoods), the vast stretches of alfalfa fields. They took him through Oasis and Deseret--and best of all, "no waiting for rain."

As a man from Illinois, it not difficult to see why he was favorably impressed with the Delta area. Baker lived in an area where the rain did not always come at the right time to properly mature crops. In Delta, he would not have to wait for water, but merely open a headgate and let water pour over the land.

The difference between what was promised in brochures and during tours, and the eventual reality in Delta, left Mrs. Baker bitter: "Nothing of course was said about the wind, the dust, the periodic drouths, the unyielding

soil, the alkali and numerous other disadvantages, but then they were salesmen." And perhaps she had a right to be bitter. Folktales abound of questionable sales practices.

Fred Rock, one of the early settlers in the North Tract, had some of the area's only trees. Agents of the Delta Land and Water Company would intimate that the country would produce fruit. As they zipped past Fred Rock's place prospective buyers could observe some nice looking apples on one of his trees. The tree was probably a small poplar. Rock had been hired to keep the fresh apples tied to his tree.

Another "oldtimer," Bill Bassett described some creative photography in grain field. He had seen a great deal of activity there. The barley patch was a little less than typical, about one foot high, thin and struggling, but not so unusual, as most farmers had experienced a similar crop. However, it had headed out. His horses needed a rest and being curious he tied the team to the fence and walked out into the field to see what was going on. A group consisting of three men digging a hole, a farmer, and a photographer. When the hole was deep enough, the farmer jumped in the hole and the photographer took some nice photos showing barley reaching to the farmer's nose.

Enlargement of Sevier Bridge Reservoir

As already noted, several projects had a need for upstream storage. The Sevier Land and Water Company, a new venture formed to develop and irrigate lands in eastern Pahvant Valley, was considering a site which would have backed up water to the toe of Sevier Bridge Reservoir. The owners of the "Hawley Filing" were considering an enlargement of Sevier Bridge Reservoir to impound their full water right.

To further complicate matters, three individuals filed an application for a proposed damsite at Painted Rocks, northwest of Fayette. The location of this latter would have precluded any enlargement of Sevier Bridge Reservoir. This latter filing was ultimately transferred to the Sevier Land and Water Company and the company settled on this filing for its proposed project.

Litigation followed between the Sevier Land and Water Company and the Delta, Melville, and Deseret companies. Realizing the futility of litigation, the four companies entered into negotiations. With an agreement near, the Sevier Land and Water Company filed water rights application #4562. On April 9, 1913 a "Four Party Contract" was signed by Delta Land and Water Company, Sevier Land and Water Company, Deseret Irrigation Company, and the Melville Irrigation Company. This contract gave a "first, absolute, unquestioned, prior and preferred right to all waters which are now or may be impounded in said reservoir up to the capacity above mentioned" to the Delta Land and Water Company (1/2), Melville Irrigation Company (1/3), and the Deseret Irrigation Company (1/6). The enlarged capacity was then divided as follows:

Table 2.

Sevier Land and Water Company	41%
Deseret Irrigation Company	26%
Delta Land and Water Company	17%
Melville Irrigation Company	16%

Plans were submitted for the enlargement of Sevier Bridge Reservoir to the State Engineer in the Fall of 1912. After being returned several times for modification, these plans were finally approved a year later. The approved plans called for a structure 90 feet in height and with a positive cutoff. This latter feature was to rectify some problems with the existing dam. The conclusions of one consulting engineer were (Utah Division of Water Rights, 1979):

The results to be achieved in the way of water storage will be greater for the money expended than any other storage reservoir project in the West. The cost need not exceed seventy-five cents per acre-foot of reservoir capacity, which is far below the average of Western reservoirs.

He concluded the dam height could be increased by 20 feet and proposed a design consistent with the "state of the art" in 1911. The addition to the embankment in 1916 was keyed into the old embankment using a series of steps constructed on both the upstream and downstream faces. Seepage was a problem with the old dam and, consequently, a combination sheet metal, sheet pile, and concrete cutoff wall was constructed to prevent stored water from moving under the dam. The State Engineer (1915) described the difficulties with the damsite:

While the reservoir site is an ideal one, the damsite is a poor one, on account of a lack of suitable foundation. It will require careful and conservative engineering to enlarge this structure to a height of 90 feet and make it safe.

Despite the difficulties associated with the damsite, the dam was successfully enlarged. The design consisted of relatively flat outer slopes and a 26 foot wide crest. The fill was placed using hydraulic fill methods, that is monitors were used in the borrow area to wash soil laden water down a flume to the embankment where the water was ponded and the sediments allowed to settle out. This was Utah's largest effort at constructing a dam using hydraulic methods. The work was completed June 17, 1916. Most of the work was done by stockholders of the Deseret Irrigation, Melville Irrigation, Delta Land and Water, and the Sevier River Land and Water Companies under the direction of various consulting engineers. The enlarged reservoir which stands today has a capacity of 236,0000 acre-feet, one of Utah's larger storage reservoirs.

While Yuba Dam was being constructed, negotiations on water rights continued resulting in following ownership agreement:

Table 3.

Up to 104,000 acre-feet:

Delta Canal Company	50%
Melville Irr. Co.	28 1/3%
Deseret Irr. Co.	16 2/3%
Central Utah (heir to Sevier Land and Water)	5%

Over 104,000 acre-feet:

Central Utah	57%
Delta Canal Company	17%
Deseret Irrigation Company	20.55%
Abraham Irrigation Company	5.45%

Avery and Singer (1982) in their history of Utah water developments, appear to have confused the effort to enlarge Sevier Bridge Reservoir with DMAD Reservoir. Because of the relatively late construction date of DMAD, it seems likely that Avery and Singer (p. 30) are referring to the efforts to enlarge Sevier Bridge Reservoir:

Aided by Federal reclamation funds, these companies built several small dams on the Sevier River, including the Gunnison Bend and D.M.A.D. reservoirs. The D.M.A.D. is among the most interesting because stockholders of Deseret, Abraham, and Melville Irrigation Companies joined the Delta Irrigation Company to build the dam, a precursor to water management in other areas of Utah during the 20th century.

It should be noted that Sevier Bridge Reservoir is by no means a "small dam. and was in no way aided by Federal reclamation funds. It does, however, represent a "precursor to water management in other areas of Utah during the 20th century

Drainage

The prospect of rich irrigated valleys turning into salty deserts or marshes, like the once productive plains of the Tigris and Euphrates valleys of ancient Mesopotamia, did not concern the developers of the Delta Carey Act project. The early settlers of the Deseret and Abraham districts were aware of water table problems on the low-lying, tight-clay soils on the western fringe of the irrigated area. Most of the early developed land, however, lay in close proximity to the river. These soils are generally of Oasis loam which are quite permeable, and the river channel provided good drainage. Crop production in these areas had always been high. The river channel unfortunately gave adequate drainage to only a small percentage of the Pahvant valley. The wet years commencing in 1906 brought a large increase in irrigated acreage, much of which did not have natural drainage.

By 1909, the Deseret Irrigation Company had asked the U.S. Department of Agriculture to survey and plan a systematic drainage system. A report was presented to the stockholders of the Deseret Irrigation Company on

July 30, 1910. It was recommended that open drains be dug one-half mile apart and five to six feet deep. The alternative would be the abandonment of some of the lands. The only drainage activity over the next few years was by the Deseret Irrigation Company.

Even after lands became waterlogged, it was difficult convincing farmers of the need for drains. Many felt that with drains in place that nutrients would be removed with the drainage water. It was decided that a public information program was necessary. The U.S. Department of Agriculture, in cooperation with Utah State Agricultural College, conducted an active educational program for nearly eight years before four drainage districts were finally formed. When county commissioners, boards of supervisors, irrigation companies, and the more prominent farmers all urgently recommended drainage, success was assured.

M. A. Abbott of Sutherland was appointed as one of the first three men on the board of supervisors for Drainage District No.3. Mr. Abbott's account would probably be a representative view.

Our high hopes for good times and big crops were soon to be shattered. We were using large quantities of irrigation water and in 1917 there were several places indicating water-logging with a strong content of alkali on the surface which prevented germination of seed and killed established plants. This condition spread rapidly and by 1918 we all knew something must be done or else everybody would be financially ruined and would have to move away.

In Mr. Abbott's personal history there was another very significant statement.

By 1920 we had fully demonstrated that the lands could be drained and reclaimed. But the dense growth of tumbleweeds and thistles and other weeds during the water-logged period were a great nuisance to us, blowing around and filling up our open drains and open trenches.

Because of the problems with open drains, it was decided to use a system of closed drains. The only open drains were those serving as collectors for the tile drainage system.

Over the next eight years nearly three million dollars was spent installing a drainage system for some eighty thousand acres of land. This money was nearly all raised by selling bonds which obligated every farmer in the districts to repay the costs of drainage at a unit cost per acre of the lands benefited.

Much hindsight analysis has indicated reasons for the failure of this expensive project. Most of the drainage was by tile lines laid from six to seven feet deep and then back-filled. Unfortunately, the tile used was simply straight sections butted together with no structural shapes to form joints and no enveloping material to stabilize the alignment. The end space between sections provided the inlet to the tile line for the excess groundwater.

The drought of the 1930s brought more problems than could be solved. Having been constructed with inflated dollars, the repayment was being made with deflated depression dollars. Instead of 80,000 producing acres, there was a water supply barely sufficient for 35,000. In addition, many farmers now believed the drains were taking away needed water and nutrients. There were many instances of the drains being blocked, and to this writer's personal knowledge dead animals were put into inspection boxes to prevent cleaning or observation.

This time of stress resulted in two very important events. The deficient water supply was further aggravated by the water rights structure. For example, the operating procedure of Sevier Bridge Reservoir required that at the beginning of each irrigation season the stored water was allocated as to the first 104,000 acre-feet allocation provided in the "Four Party Contract" and other decrees. Thus, those irrigation companies with direct flow, or primary water in Sevier Bridge Reservoir either used it or lost it to the storage companies. As a result some canals ran water all winter simply because the companies did not want to lose their water to another company. This wasteful practice could not be tolerated by pioneers who had worked so hard for their projects. These conditions led to what is known as the "1938 Agreement" which allowed each and every user to hold over any unused credits. The allocation between piute and Sevier Bridge as well as between the various companies would be based on the new water accruing after October 1 of each year. This agreement made it possible for Piute, Sevier Bridge, and Otter Creek Reservoirs to become long term carry-over reservoirs. The result was a much more efficient use of the Sevier River for irrigation.

The second major event resulted from the depressed economy. Most farmers had difficulty paying their taxes. As the law required, Millard County sold the delinquent tax lands for back taxes. After going through the court system, the U.S. Supreme Court ruled that the county could sell and deliver a clear title with a tax deed. Many landowners advocated allowing the taxes to become delinquent thus relieving the drainage bond obligation. Others disapproved of this procedure, considering it little more than a device to cheat the bondholders. Much of the farm land became tax delinquent, was sold, and title acquired by tax deed. The important fact, however,

was that the drainage lien did not last forever on land that could not pay. Ultimately a settlement with the bondholders was made by those who did not let their land be sold for taxes. Some lands were redeemed by the bondholders for back taxes and later sold to farmers. Thus, the indebtedness incurred to construct the drainage system was eventually all retired.

An adequate water supply returned in the 1940s. AS the drainage system now became important, it began to fail. As the water table rose, it created a "head" at the seam where two tile sections came together. The high water velocities moved the fine material and when a large enough cavity was created a section of tile would drop to a vertical alignment thereby plugging the drain. The drainage district board, consisting of appointed farmers, reacted promptly and effectively to this crisis. Dragline excavators were purchased and the open drain system which now exists was started.

The Utah Agricultural Experiment Station Bulletin (Israelson, 1935) gives a comprehensive detailed account of the history and drainage conditions as of 1935. However, water quality, one of the most important considerations affecting drainage was not even mentioned. The salinity of the lower Sevier River increased with the development of the upper basin. Before reservoir construction, salinity was only a problem in the late irrigation season. After the reservoir system was completed, and particularly after the 1938 Agreement, return flows constituted a significant amount of water diverted in some sections of the Sevier River. For example, in a dry year when the only water available to the lower Sevier River is from return flows, the water contains high levels of salt. High levels of salinity in irrigation water can be injurious to crops. It is the water moving from the upper Basin to Sevier Bridge that keeps the water quality viable. When the administration of water rights is such that the return flows are more than a small part of the diversion available, disaster results. A fact not understood in early drainage efforts is that the salinity of the Sevier River at Delta is such that if applied to tight soils without adequate drainage, the land is rendered useless by salt in about three years.

Conclusions

Avery and Singer (1982) correctly note that the Deseret and Abraham developments were fostered by the cooperative spirit infused in the area by the Mormon Church. However, in general, the role of the church in getting the Pahvant Valley settled is exaggerated. To quote Arrington (1951, p. 393):

While the founding of these settlements was not the result of a direct "call" from general authorities of the Mormon Church, as was true of many Great Basin colonies, their successful establishment proved to be impossible without extensive organizational and financial assistance from the Mormon Church.

While the Mormon Church was certainly at times at least very interested in Pahvant Valley, it was not the church per se which kept the developments going, it was the grit of the local settlers. The organizational role of the local Mormon community was important; the financial role of the Mormon Church was less so.

While the above arguments may be semantic in nature, the alleged role of the Federal government is not. Avery and Singer state that the Delta and Melville projects "relied on Federal reclamation funds to construct their water systems, which reflects the crucial role Federal policies played in the 20th century."

This is not true. While the Federal Carey Act was the inspiration behind the Delta project, it was not the financial support. The capital to build the project was raised from private individuals; the "spunk" to keep the project going was provided by the settlers themselves. Avery and Singer continue: "The unique cooperation between the early Mormon companies, and the later canal companies is a valuable case study as it foreshadowed other, similar arrangements in Utah." Cooperation began with the joint facilities of the Abraham (a church inspired project) and the Deseret Gunnison Bend project. Delta and Melville, privately owned and operated irrigation companies, also cooperated to share a diversion dam and canal system. But the real cooperative effort began with the enlarging of Sevier Bridge Reservoir. Furthermore, the enlargement of Sevier Bridge was not a Federal Project and not a State project; it was a development by and for the local people, who, strapped for finances, did much of the work themselves. Dudley Crafts (1965) in a discussion at a special water development meeting of the Millard Water Conservancy District stated:

Except for the land leveling and some canal improvements which taken place in the last few years, our entire development has been through private enterprise without the assistance of any governmental agency whatsoever.

The Delta Carey Act project ultimately developed approximately 30% of the Delta area agriculture. There are three primary reasons why this project succeeded where other Carey Act projects failed. First and most im-

portantly, the Oasis Land and Water Company bought a basic, prior water right. Second, the developers were private investors who started with the hopes of making substantial profits. The tenacity of good businessmen determined to protect their investments was an important factor in staying the course. Finally the third reason, the settlers demonstrated a great deal of tenacity of their own during some very difficult times. Such will to succeed assured the successful development of water resources in the Delta area.

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