The Wood Screw Pump:
A Study of the Drainage Development of New Orleans

by Jennifer Haydel

It would be difficult to find a location where the natural drainage is worse than that of New Orleans, owing to a want of declivity in the land, and the tenacious nature of the soil; yet, the problem is easy of solution and presents few difficulties, when we come to apply artificial means, aided by the science and practical knowledge of modern times. <1>

This report In 1869 prefigured the installation of one of the most significant technological designs in flood control for the city of New Orleans. The Wood Screw Pump, engineered in 1913 by Albert Baldwin Wood, effectively revolutionized the urban geography of a sprawling New Orleans in the early twentieth century.

New Orleans at the turn of the century developed as one of many burgeoning American urban centers. However, the low-lying topography of New Orleans offered a unique challenge to city developers. Plagued by problems arising from the wet, swampy conditions, city residents sought measures which would alleviate the topographical hindrances to the expansion of the city. Following the creation of the Sewerage and Water Board in 1899, city engineers instituted various drainage systems which assisted urban development. A.B. Wood's Screw Pump would outperform these systems, offering opportunities for reclamation of the city's backswamps. The success of the pump extensively contributed to the improvement of the city's physical layout. With newly opened lands, the city underwent a drastic demographic shift with its population enjoying greater mobility. Thus, the engineering feat of Albert Bladwin Wood in the construction of the screw pump represented a milestone in the urban development of New Orleans.

The impressive development following the introduction of Wood's pump must be considered in terms of the city's unique topography. Squeezed in between Ponchartrain to the north and the Mississippi River to the south, New Orleans has historically suffered many deluges. Its highest elevations, rising approximately five to fifteen feet above sea level, exist along surrounding waterfronts. Inland areas not built up by the sedimentary deposits of natural wateerways rest on lands two feet below sea level. Two higher level ridges, approximately two feet above sea level, separate these low areas. These ridges are the Metarie Ridge, extending east to west parallel to the river, and Esplanade Ridge, stretching from Bayou St. John in the north to the river in the south. Together with the high banks of Lake Ponchartrain and the Mississippi River, these two ridges divide the city's interior into two bowl-like deppressions. Prior to the construction of a proper drainage system, these low-lying inland areas remained as nothing more than undeveloped swamplands. The peripheral higher regions along the ridges and waterways spawned the only commercial and residential growth possible. Any development near the swampy interior would be washed away either by rainfall or overflowing of the surrounding waterways. <2> Thus, New Orleans prior to the installation of the Wood Screw Pump subsisted in an extremely precarious physical state.

Various social and physical burdens reflected this precariousness prior to the implementation of the efficient Wood pump design. The following account of eighteenth-century New Orleans described the city most accurately:

At high tide, the river flows through the street. The subsoil is swampy. New Orleans becomes famous for its tombs; buried coffins must have holes so that they do not float to the surface when the land is flooded. Dikes have to be built along the river, and the houses can be constructed only on piles. Those living in the city dedicated to the Duke of Orleans feel as if they were living on an island in the middle of a mud puddle. <3>

An overabundance of water due to inadequate natural drainage clearly wreaked the most havoc on the city. As gauged in 1894, an accumulation of 15.10 inches of rainfall in 17 hours was not an anomalous occurrence. Those living furthest from the peripheral areas were continually plagued by flooding. <4> This inhibited development and threatened the well-being of city residents.

In addition to the incessant flooding, the overabundance of water further endangered city residents by threatening their health condition. Rudimentary drainage facilities, conslating of mainly open canals, did exist to control the excessive water. However, they often posed a greater danger to the city's residents. The stagnant waters of the open drainage canals offered ideal breeding grounds for hazardous mosquitoes carrying the yellow fever virus. With inadequate drainage, gutters also remained filled with torpid rain water, further complicating the city's mosquito infestation. Yellow fever endangered the city's residents in the late 1800s by contributing to an average death rate of twenty-seven per one thousand residents. This threat of disease contraction, related to the drainage dilemma, inhibited not only residential growth but also financial development. Foreign businesses shunned New Orleans as too great a health risk for commercial investment. <5> Therefore, oversaturation and the lack of effective drainage techniques jeopardized the sanitation of the city and restricted its expansion.

Oversaturation further endangered the city and its residents by affecting the streets of New Orleans. Improper drainage prohibited city maintenance workers from adequately paving roadways. Without proper pavement, firefighters could hardly maneuver their gear through the city's quagmire to stop a threatening blaze. Fires often exacted heavy damages to city structures prior to a solution to the drainage dilemma. <6> Thus, the growing city lost to fire many distinguishing landmarks, such as the St. Charles Hotel in 1895, because of substandard fire fighting techniques, a problem significantly enhanced by the lack of efficient drainage. <7>

Without efficient drainage, yet another social burden existed--the limitation of building construction. Only those areas of relatively high elevations along the waterways provided a foundation sturdy enough to support construction. Within the interior, the soil was a thick gruel unsuitable for residential growth. Thus, as the city expanded in population, the demand for living space surpassed the city's supply of available land sites. A curious pattern of tightly compacted construction emerged. Houses, erected on land parcels as small as thirty feet, were crowded side by side along the waterfronts. <8> Suitable land sites near the city's commercial hub, however, were quickly exhausted. The only option to accommodate this expansion was to move construction further outward along the narrow, elevated ridges. Because of the city's shoddy roads and transportation still reliant on horse and buggy, this extended span between homes and businesses proved extremely troublesome. This dilemma, prompted by the lack of drainage, further contributed to the compact construction of residences. <9> The soggy ground also prohibited residents from erecting cellars to compensate for the restricted living space. In the topographical environment of New Orleans before sufficient drainage, such underground facilities remained overly damp and useless. <10> Together these difficulties reflected the precariousness of life in New Orleans.

With such pressing problems threatening their livelihood, the residents of New Orleans vigorously sought a solution to the city's drainage dilemma. As early as 1725, initial plans emerged to conquer the city's foe--excessive water. The French governor Etienne Perier ordered each property owner along the river bank to construct a levee six feet wide and two feet high. Each property owner was further responsible for all maintenance of the constructed levees. <11> This plan may have offered protection from water coming into the city. However, levees could compound the problem by preventing rain water from naturally running off into the river. A plan for the actual removal of water overflow would remain a solution for future residents.

Several plans emerged in the nineteenth century to tackle the overflow problem by providing for a system of drainage canals. The first plan, proposed by Louis H. Pille in 1857, called for the completion of both levees and open drainage canals. Through such a design, the city could be spared from the rising waters of the river and the lake. Furthermore, the deluges that did occur from either rainfall or overflow could be redirected into the open canals rather than remain do the city's interior. Pilie's plan, however, was abandon by city officials because it lacked explicit details concerning the required engineering of the proposed system. The the Civil War also delayed comprehensive construction of a drainage plan. <12>

Once the war subsided, L. Surgi, the city surveyor, offered a second drainage plan to city officials in 1868. Like his predecessor, Surgi suggested that the construction of open canal would suffice as adequate drainage. Surgi's report also included a scheme to employ Bayou Bienvenue as an outlet for the excess water to be deposited in Lake Borgne. City officials hoped to include in Surgi's plan a system of underground sewerage pipes to further deposit excess water into the Mississippi River. However, this proposal was abandoned by city officials because of an apparent lack of technological innovation for such an engineering feat. <13> The removal of water continued to depend upon a rudimentary system of surface drainage canals. New Orleans remained plagued by too much moisture and the dangers that ensued under such conditions.

With the intent of successfully countering these conditions, city officials appointed a Board of Engineers in 1869. Its task was to formulate a comprehensive and feasible drainage protection program for the city. After examining the conditions that existed, the Board reported that

The present imperfect system of surface drairage is only a slight improvement on that which nature originally established, and is entirely inadequate to the demands imposed by a dense population. . . . the number and dimensions of ditches and canals were made to correspond, until they have become an eyesore and a nuisance. <14>

The open drainage canals, in failing to efficiently remove excess water, had degenerated into holdings of garbage and fecal matter. Sewage contaminated the canals because the existing system did not separate the function of removing water from that of removing wastes. All rain water and foreign materials were deposited through the same outlets. After consulting various European engineers, the Board formulated their recommendations based on designs from other densely populated cities. Clearly the Board hoped to avoid the pitfall of previous drainage plans--a lack of engineering expertise. The Board's proposal included the construction of covered underground drainage canals. Sewerage and drainage functions were to remain incorporated with a single system. However, the rain water and sewage would no longer be exposed to endanger the city's inhabitants; both would be transferred through a system of subsurface drainage canals. <15> W.H. Bell, the city surveyor, formalized the Board's proposal for subsurface drainage into a comprehensive plan. The "Bell Plan" of 1871 outlined that the storm water and other foreign materials transported through the underground drainage canals should ultimately be delivered into Lake Ponchartrain and Lake Borgne. Bell further recommended the utilization of "drainage machines" which would pump the water collected out into the lakes. These machines were deemed necessary because the land between the higher water banks and ridges was relatively level for approximately three to four miles. Extremely powerful pumping machines would be needed in order to generate a strong enough current to propel the water forward through the canals and finally out into the lake depositories. Without such machines strategically placed at the beginning of the canals as well as along the lake shore, heavy storms would result in water backup within the canals, culminating in an overflow into the city. <16> However, the "Bell Plan" initially failed to garner enough support from city officials. In fact, a report of the Advisory Board of Engineers in 1895 stated that "there is no complete description of the system as proposed by Mr. Bell to be found..." <17> Thus, city officials made little progress toward the confirmation of a practical and efficient drainage system.

The same dilemma continually recurred to hinder this progress toward the realization of an efficient drainage plan--a lack of resources and knowledge. No reliable information existed to aid officials in the development of such an extensive and untested engineering feat. In fact, New Orleans officials did not install automatic rain gauges until 1894. <18> Therefore, such fundamental information as annual rainfall amounts remained imprecise data for most of the nineteenth century. To compensate for this deficiency of knowledge, the Legislature proposed an act in 1888 authorizing an official probe into the city's topography and hydrography. However, the New Orleans City Council rejected the required appropriation of funds for such an investigation. Entreaties directed at private firms also failed to generate the necessary resources to acquire adequate data. Thus, any drainage plans that were developed languished without any hard data upon which to base a comprehensive system. This was the fate of several plans presented to city officials in 1890. In desperation, the Orleans Levee Board advertised a $2500 reward for anyone offering the worthiest drainage plan for New Orleans. Several competitors formulated plans with the aid of only a scant outline of the city. Yet again, the city's rejection of these proposals reflected the recurring problem of a deficiency in basic technical information. <19>

In the 1890s, officials vigorously fought to eradicate this problem of deficient information in order to overcome the barriers to efficient drainage. City leaders, realizing the urgency of the dilemma, pressed the City Council to appropriate funds for drainage research. Their campaign was met with success in 1893 as the Council approved $17,500 to finance topographical and hydrographical studies within New Orleans. <20> With the infusion of sound engineering data, the progression toward an adequate plan advanced rapidly. By 1895, L.W. Brown, City Engineer, devised a workable plan that gained the approval of the Advisory Board of Engineers. The creation of a Drainage Commission followed a year later in order to manage the construction of Brown's plan and address any further drainage issues. <21>

Construction of this newly devised plan remained a major undertaking to be organized by the Drainage Cornmission, requiring extensive oversight and resources. The drainage system, largely adapted from the ideas of W.H. Bell, included both canals to collect excess water as well as pumping machinery to propel the water into the lake depositories. However, even as construction of the system began in 1897, the commission lacked the funds to bring Brown's plan to its fruition. A need for a higher body, armed with technical expertise and a steady source of financial resources, arose as yet another barrier to establishing adequate drainage in New Orleans. <22>

In order to fulfill this goal of adequate drainage and complete the initial project, the city officials worked to establish a financially secure and separate entity responsible for maintenance of public utilities. The General Assembly of the Louisiana Legislature awarded their efforts by approving a bill to create a distinct body known as the Sewerage and Water Board. Act Six was established "to make effective the vote and levy of the special tax by the property taxpayers of the city of New Orleans for water, sewerage, and drainage purposes. . . " <23> In order to the construction projects of the board, the act legislated a special two-mill tax, in effect for a period of forty-three years, to be paid by all property holders of New Orleans. The proceeds from this tax, together with one half of the surplus from a one per cent debt tax, were intended to fund the interest on bonds sold by the city for public improvement projects. These projects, conducted by the Sewerage and Water Board, included the completion of the drainage plan initiated by the Drainage Commission in 1897. This proposed tax required the approval of the city's taxpayers before its implementation.

Taxpayers immediately expressed opposition to this proposed tax on their property. However, several prominent women of the Sewerage and Drainage League initiated a vigorous public, awareness campaign in order to arouse support for the special tax. These women targeted other women property owners who shared their views regarding the tax but were leery to exercise their newly acquired voting rights in the immediate wake of a successful suffrage movement. Through such tactics, approximately 800 votes by proxy were gathered and deposited at the ballot box in favor of the special tax. The diligence of the women leaders inspired others to take up the cause for adequate drainage. Property taxpayers expressed a favorable sentiment for the completion of a drainage plan as well as other utility projects by over-whelmingly approving the two-mill tax measure on June 6, 1899. Passage of the tax was hailed as a glorious and patriotic measure that would induce economic development through public improvements. <24> The Sewerage and Water Board, along with the Drainage Commission, assumed operations the following year to further the progress begun on drainage.

The organization of the Sewerage and Water Board significantly influenced this progress toward effective drainage. Following the enactment of the 1899 legislation, the terms of organization of the Board maintained that the Drainage Commission was to remain a separate entity. Work resumed on the comprehensive drainage plan. However, such a massive undertaking required an immense coordination of resources, far too extensive to be handled singly by the Drainage Commission. Thus, in order to consolidate operations and maximize efficiency, the Sewerage and Water Board merged with the Drainage Commission in 1903. <25> With this consolidation, the Board was further empowered to install the proposed system and continually look forward toward future improvements.

Following the consolidation of the Sewerage and Water Board, New Orleans rapidly advanced toward a modern drainage facility. City officials empowered the Board to construct adequate pumping machinery to lift the excess water collected in the canals into Lake Ponchartrain. After various unsuccessful trials, Board engineers determined that the pumps initially installed were completely inadequate for the immense task of draining the city. Generated by windmills, these archaic pumps lacked the capacity demanded by such a large quantity of water. Thus, in 1903, the Board removed the pumps and installed electrically powered machinery known as centrifugal pumps. <26> A.B. Wood, a mechanical engineer employed by the Sewerage and Water Board, devised a superior six foot centrifugal pump in 1906 which extended the city's pumping capacity even further. <27> However, this invention was only a mere hint of Wood's future engineering genius. As the project reached completion, New Orleans was equipped with a powerful system to conquer Its foe. By 1913, seventeen large Pumps, generated by eight pumping stations, managed 4,140 cubic feet of water per second. The amount actually removed represented a total capacity of 2,810 cubic feet of water each second. <28> The following year the pumps exhibited the continual improvements with an increased combined capacity of 4,600 cubic feet of water per second. Total water removal capability equaled 2,500,000,000 gallons of water every twenty-four hours. Officials lauded the system for its merits in improving the health condition of the city, draining the backswamps, and providing protection from floods. <29> Finally, it appeared as if New Orleans had attained its dream of constructing an effective drainage system.

Despite the impressive improvements, members of the Sewerage and Water Board were well aware of the incompleteness of the existing system. Heavy rainfalls continued to exact heavy tolls on the city, even as the drainage pumps were pushed to their capacities. The inadequacies of the system were revealed in 1913 as twenty-two storms left in their wake a total of 59.4 inches of precipitation. This amount surpassed a twenty-year average of total rainfall by 4.54 Inches. Areas fully supported by the drainage pumps were largely spared from destructive flooding. However, those regions in which construction works were just beginning suffered heavy damages. The existing pumps lacked the capacity to reach those areas that were still dependent upon simple canals for water removal. With no pumping machinery, the canals quickly overflowed with heavy rains. Therefore, the Board urgently sought improvements to their existing drainage in order to increase the pumping capacity needed by the expanding city.

A.B. Wood provided the solution to this need for greater pumping capacity with his specially designed twelve-foot screw pump. As an employee of the Sewerage and Water Board, Wood understood the hurdles involved in providing the city with adequate drainage. He volunteered his engineering mastery and presented plans for the Wood Screw Pump to the Board in 1913. Wood's electric screw pump consisted of a large pipe within which a steel blade operated as a sort of propeller. The pipe acted as a siphon which transferred the water from the main canals into discharge canals. Wood's pump controlled the the inflow and outflow of water into the pipe through the manipulation of air pressure rather than through the use of gates or valves within the interior. The Wood Screw Pump represented the largest and most powerful drainage machinery of its kind. <31>

Before approving such a huge piece of machinery, the Board devised a a twelve-inch model of Wood's original design in order to confirm the effectiveness of the full sized pump. The Board also contructed a thrity-inch screw pump for further corroboration of Wood's preposed estimates. Tests on both models verified the adequacy on Wood's suggested design. <32> Estimations derived from the tests presented staggering increases in pumping capacity. Based upon estimations of eleven total screw pumps, the combined capacity was assumed to be 5,500 cubic feet of water per second. Officials further asserted that the pumps' total removal capacity would range from 3,500 cubic feet per second during moderate storms to 7,900 during heavy downpours, culminating in an unprecedented discharge of 213,000,000 gallons of water per hour. <33> Such remarkable results of the Wood Screw Pump's initial tests primpted a quick response from the Sewerage and Water Board.

The Board soon began its inquiry to determine the acceptance of rejection of Wood's proposed design. Armed with such impressive test statistics, member of the Boad urged that Wood's pump be implemented in future drainage works. However, some city residents questioned the Board's procedure in accepting Wood's plan. These residents asserted that extensive improvement plans tothe drainage system shoudl arise from an open bidding process. Because Wood was an employee of the Sewerage and Water Board, opponents feared his design had been given a favorable status. Yet supporters on the Board could bot be swayed by such criticisms. They deemed the Wood Screw Pump far too superior to reject. Thus the Sewerage and Water Board accepted Wood's design and offered a construction contract to the lowest bidder, Nordberg Manufacturing of Milwaukee. Nordberg's contract stipulated that eleven screw pumps were to be built at a price of $159,042.00 and installed by 1915. <34> Thus, officials awaited the true test of the effectiveness of such a massive investment.

The Board's investment ultimately proved sound as officials conducted tests on the first pumps installed in 1915. One such official, W.H. Creighton, attested to the pump's effletency and claimed

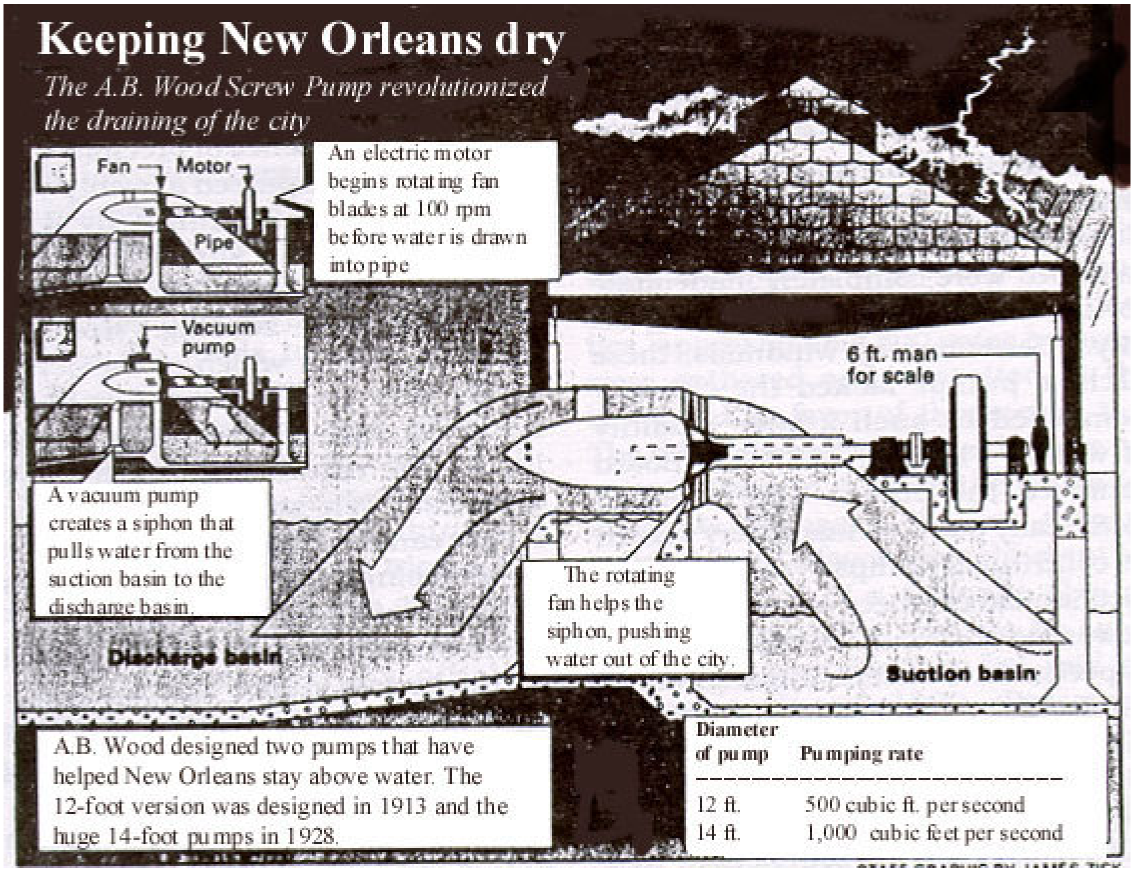
... while the Wood Screw Pump surpasses in efficiency, under normal conditions, those of previous installations, the superiority is much greater just when the greatest service is required. Emergency service is probably the weak point of the old pimps. It is the forte of the new... results show that the pumps easily answered all requirements and that they are the largest and most efficient low lift pumps in the world. <35>

Utilization of the screw pumps resulted in efficiencies reaching a maximum of eighty-four percent in total lifts as hish as eighty-seven feet. In fact, the supreme test and affirmation of the pump's effectiveness occurred on September 29, 1915 as a hurricane threatened the city of New Orleans. A Sewerage and Water Board report claimed that even a storm of such magnitude was handled with the utmost efficiency by the newly installed Wood Screw Pumps. <36> In the following year, installation of the pumps expanded to other pumping stations in order to service more regions of the city. All stations serviced by the Wood Screw Pump reported increased pumping capacities and satisfactory operations. when compared to the pumping capacity provided in 1915, the expanded installation of screw pumps offered a sixty-five percent increase in total capacity. <37> Apparently, New Orleans had discovered a viable and successful solution to its drainage dilemma.

As a successful solution, the Wood Screw Pump relieved many of the pressuures that had previously plagued the residents of New Orleans. Flooding, an incessant problem with rudimentary drainage, became less of a threat to the areas serviced by the screw pumps. As previously stated, even the rainfalls incurred through a hurricane became more manageable witht he outstanding pumping capacity of Wood's invention. Canals, once breeding grounds for dangerous mosquitoes, were no longer filled with stagnant water. The screw pump provided a quick transport of water through canals into the proper depositories. Thus, the death rate from mosquito-related diseases declined evn further in responses to Wood's creation. <38> Roadways, previously only swampy and almost impassable footpats, could now be paved upon sturdier grounds with the increased drainage. Thus, as early as 1915, officials anticipated the development of approximately five hundred miles of paved streets. In addition to improved roadways, the overall drainage provided by the Wood Screw Pump afforded city residents more land in which to settle through the reclamation of the surrounding swamplands. Thus, the total amount of land reclaimed as early as 1915 amounted to 25,000 acres. <39> Wood's accomplishment in improving the conditions of the city gained international acclaim, affirming the screw pump's effectiveness in public improvements. For example, Dutch engineers were so enamored of Wood's design that they employed the screw pump to reclaim lands overtaken by the Zuyder Zee. <40> Statistics provided by the Sewerage and Water Board (see chart below) in 1938 best reflected the general improvements and overall effects offered by the increased rainage of the Wood Screw Pump. <41>

Throughout its urban history, New Orleans was plagued by an overabundance of water. Every facet of the city's urban development was influenced by this topographical fact. At the turn of the century, drainage as a refuge from the hazards of too much water emerged from a highly difficult process of trial and error. Drainage plans were instituted, but the water remained. Yet one form of drainage clearly developed as an unprecedented savior of urban New Orleans in the early 1900s--the Wood Screw Pump. It enabled a burgeoning city to continue its growth in defiance of its environmental barriers.

General:	**End of 1899**	**End of 1925**	**End of 1937**
Population	280,000	420,000	516,000
Population Area (Acres)	16,000	30,000	33,000
Approx. Number of Premises	67,000	103,000	125,000
Death Rate:			
from Malaria (per 100,000 pop.)	70	5	2.32
Drainage:			
Miles of Low Level Canals and Drains	100	560	940
Combined Drainage Pumping Capacity	1,200	13,000	25,478
Number of Drainage Stations	7	8	9
Area Drained in Acres	13,000	40,000	50,000



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