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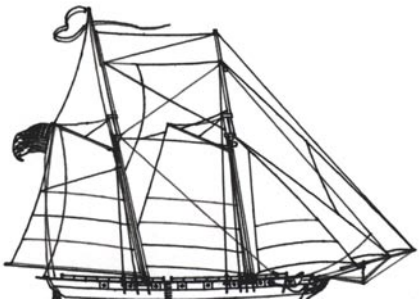

USS SHARK

Florida Keys
Sea Heritage Journal

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OFFICIAL QUARTERLY PUBLICATION OF THE KEY WEST MARITIME HISTORICAL SOCIETY

Key West Search for Fresh Water

Part Three

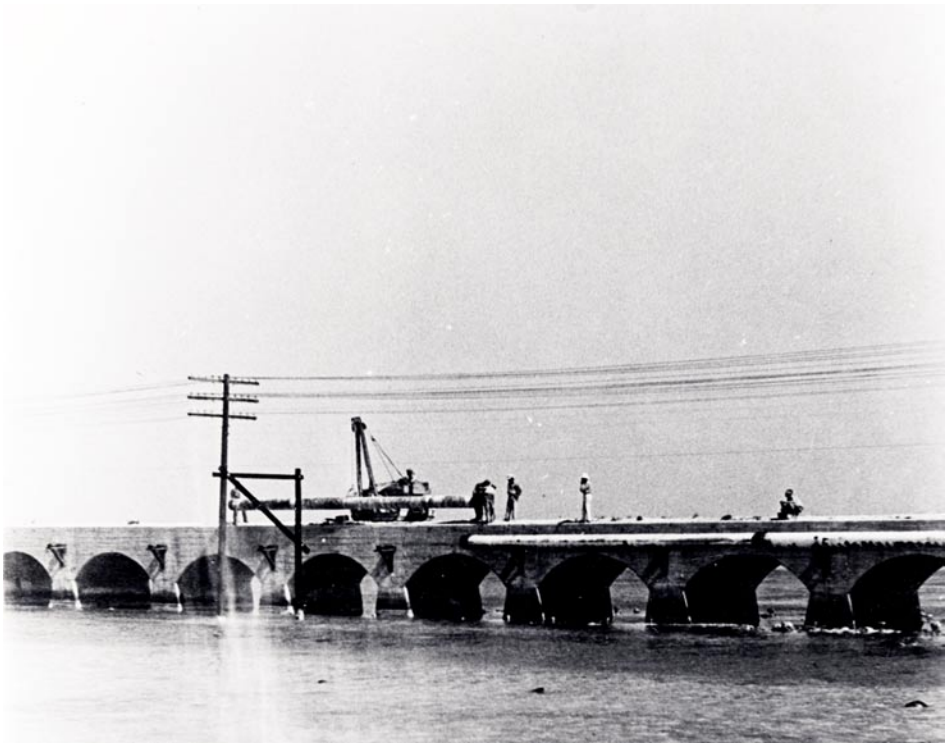
By Carston R. Heinlein

This is part three of a continuing story that may or may not have an ending. As long as there are inhabitants on the island an adequate supply of fresh water is essential, it can make or break an economy. Its abundance, a deep water harbor and the strategic position of the island made it ideal for a pioneering settlement and a rendezvous for the United States Navy in the early eighteen hundreds.

Part One of "Search" was in the Winter 1998/99 issue of the "Florida Keys Sea Heritage Journal" and Part Two appeared in the Fall 2000 Issue.

We must remember that Key West is near the end of a chain of islands extending south and westward 122 miles from the peninsular of Florida, that for more than a century the inhabitants only transportation was by sea. There were no roads or bridges connecting the islands to the mainland. They knew more about business transactions in major seaports from New Orleans to New York than proceeding in Tallahassee the state capital until the railroad was completed in 1912.

Key West was never a port of origin but was considered one of the twelve important seaports in the country. It's rich products of sponge, cigars, salvaged goods from wrecks, fish, salt and pineapples the island grew to wealth and prosperity. Miami never had a natural deep water harbor, only a small unorganized village occupied the banks at the mouth of the Miami River where schooners and other sailing craft made port to trade and take on fresh water until 1892. In that year Julia Tuttle a visitor purchased a square mile of land on the banks of the Miami River and encouraged Henry Flagler to extend his railroad from Palm Beach to her property with a promise of land to build one of his hotels, which he did. But Henry Flagler wanted a deep water port for his ships which he achieved when he extended his railroad to Key West. After the railroad arrived in 1912 it became



Water pipeline being installed on a railroad bridge. Photo credit: Monroe County Library.

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NEWS AND NOTES FROM THE "PRESIDENT'S DESK"

By Ed Little

We are now well into the summer of 2006. And, as has been the case for several years past, this is the season when the Society normally goes "dormant". That's because so many of our Directors and Members are out of town, that we find it ad visible not to hold the free public lectures (and other events) that have proved popular during the "winter season".

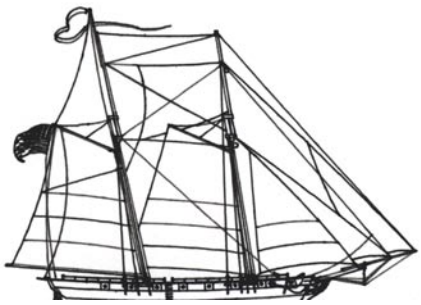
But, that doesn't mean that we are completely idle. Your Directors continue to meet monthly to conduct Society business, and to plan coming events. Then too, Lynda Hambright, the Editor of our quarterly "Florida Keys Sea Heritage Journal, seldom has a respite from getting out new issues.

Lastly, even your President (me) always has something on his plate. This time it is wrapping up efforts to provide (at no cost to the City) interpretive "historical" markers for placement along the harborwalk at the municipally owned Key West Historic Seaport. This initiative has been underway (in fits and starts) for over ten years, and it is the logical outgrowth of the Society's mission to increase public awareness and appreciation of Keys maritime history. It was only recently however, that I was able to acquire, research, and produce the graphic and text materials needed for those markers. Last month, I completed a full scale mock-up of the marker that will be used at the three primary entrances to the harborwalk.. As I explained to the Board that manages the Seaport, each marker will provide a "capsule history" of the maritime activities that were centered at Key West Bight in years past.

Because the markers will be on permanent display out of doors, they have to made of especially durable and weather-proof materials. The accompanying photo shows a representative portion of the mock-up of a marker. A vendor that has long experience at producing such markers has at last been found, and we will soon be working with him to finalize the project.

New Members

George Born, Key West; Richard and Polly Crise, Summerland Key; Connie and Terry Ganzd, Dade City, FL; Eric Langley, Peachtree City, Georgia; Philip McGann, Cudjoe Key; Mile Zero Publishing, Key West; Edmund Schmelzle, Key West.



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Editor: Lynda Hambright
Production:Tom Hambright

Letters and articles are welcome. Please write to: Editor, Florida Keys Sea Heritage Journal, KWMHS, P.O. Box 695, Key West, FL 33041.

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the principal method of travel to the mainland. In 1917 Monroe County issued roadway bonds for bridges to link the islands to the mainland, trails were made wider and existing roads lengthened to meet the wood bridges, a steel swing bridge across Card Sound connected Key Largo with the mainland. Dade County cooperated by building a road from Florida City to meet the Monroe County road. Unbridged gaps were covered by ferry boats from Lower Matecumbe to Grassy Key and from the Southern part of Key Vaca (Marathon) to No Name Key. Elevated fresh water tanks were part of the ferry landing for the ferry boat supply as well as people waiting in line for the next one. The highway was completed in 1928 without any federal financing.

The loss of the railroad when miles of track and roadbed was destroyed by the tidal wave of the Hurricane of 1935, ending the most convenient method of travel for locals, plus tank car of water to alleviate the shortages during the dry months of November through April. Ironically most tourist and visitors were present during the dry months and few during the wet months of July through October and never enough to support a tourist economy. The highway with its ferries and narrow fourteen-foot wide wood bridges was now the only land route to travel from Key West to the mainland. More adventuresome travelers not discouraged by Miamians descriptions of poor conditions on the Keys would bring provisions of water, picnic lunches and a spare can of gasoline.

Hauling water by truck would have been cost prohibited, reports of $3,000 per million gallons on the Upper Keys have been found and the use highly restricted. Small quantities by tank trucks on Upper Keys were priced at ½ to 2 cents per gallon $15 dollars per 1,000 gallon $15,000 per million. Four cents a gallon in emergency cases, or $40,000 per million gallon on Matecumbe have been reported at the Veterans camp that were building a bridge to close the water gap on the highway. A ten-ton load is equivalent to only 2,400 gallons.

A haard hat diver working on the pipeline. Photo credit: Monroe County Library.

In 1933 the Overseas Road and Toll Bridge Commission was created by the Florida State Legislator to build bridges to span the water gaps between the islands from Lower Matecumbe Key to Big Pine Key to eliminate the slow inconvenient and expensive ferries. The bridges were to be financed by the sale of bonds to be paid for by tolls. This project suffered the same fate as the railroad with their equipment, camps, workers lives and what little progress they had made were destroyed by the Hurricane of 1935.

The railroad was beyond

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economical repair due to extensive damage over thirty-six miles of track. The Reconstruction Finance Corporation financed the Overseas Road and Toll Bridge Commission's purchase of the abandoned railroad right-of-way and the stout unharmed concrete bridges for $3,600,000, including the conversion of the bridges into twenty-two foot wide highway, using twenty-two foot long steel I-beams across the fourteen foot wide railroad foundations and adding a poured concrete slab for the twenty foot wide roadbed. Work began November 28, 1936, within a week approximately 800 men were on the job, rebuilding the landfill causeways over the low wide stretches of water were ocean and gulf meet, while other crews worked on the bridges. Sixteen months later the highway was completed and officially opened July 4, 1938. Toll booths were placed at Lower Matecumbe and Big Pine Key, rates were one dollar for car and driver, twenty five cents for each passenger and four dollars for trucks.

Meanwhile, the idea of a water pipe line from the mainland would surface and pass with no action taken. George W. Allen, president of the First National Bank of Key West, wrote in 1914, "It will not be long, however until a water system will be installed, the water being piped from the mainland in pipes that will run parallel to and alongside the East Coast Extension [railroad]." In the same year Mayor J.M. Fogarty wrote in his article "What Key West Needs, "A water supply, to the company or individual that would install a fresh water supply in Key West, the most liberal franchise would be given and in addition, every possible co-operation would be extended."

During the month of August 1935 Mayor William H. Malone was authorized by members of the city council to file with the Federal authorities an application for a loan and grant to aid in financing construction of a water pipe line from Key West to a source of supply on the mainland. The application was delivered to H.S. Biddle, consultant engineer with the Federal Emergency Relief Administration (FERA) and A.C. Bogart, sanitary engineer, and directed to furnish information that may reasonably requested in connection with the application to the United States Government through the FERA. On the fourth of September 1935, Bogart and F.H. McKinly, attached to the P.W.A. Engineering Branch, left by steamship to Tampa and then by railroad enroute to Tallahassee with the application.

One year before the highway was completed, the Florida State Legislature created the Florida Keys Aqueduct Commission that was signed into law June 11, 1937 by Governor Frederick P. Cone. Monroe County Representative Bernie C. Papy recommended William T. Daughtry, William M. Arnold and Earl R. Adams to the Governor to serve on the Aqueduct Commission. The engineering firms of L.L. Lee and Associates, public works consultants of Miami and Elson T. Killman, hydraulic and sanitary engineer of New York City, were selected to make a preliminary report upon the cost of an adequate and sanitary water supply for the city of Key West and the Florida Keys. No real funding was in sight except that attainable from the Federal Government for a project of this dimension.

Long fresh water lines 75 to 500 miles in length serving 10,000 population was nothing new, there were at least 25 works in this country, none applicable to the Florida Keys situation. All study and evaluation must be based on local conditions. The report stated that the water would be obtained from the vicinity of Homestead where it had been demonstrated by long term operations of the railraod and municipal supplies. A yield of 500,000 to 850,000 gallons per day was taken from the wells at Homestead and railroad wells and a draft as high as 2,500,000 gallons per day for short periods had been reported.

A supply line from this source to the existing distribution in Key West would have a maximum length of 130 miles and will essentially follow the old Florida East Coast Railroad right-of-way. A major step in construction conditions and lower cost, more favorable now that the right-of-way is under the control of the state highway. All though the northern part of Key Largo was entitled to water and may require substantial qualities in the future the highway route running farther north is six and one half miles longer than the railroad and would be of substantial additional cost to run the pipe line along the highway. Not only the extra miles but special problems due to the long crossing at the old Card Sound wooden bridge where the pipe line would be required to go under the channel at the swing bridge and road practically at sea level on the east end of the bridge rising to a higher elevation on Key Largo . Constructing the main line around this longer route would exceed the cost of providing a lateral feeder off the main line by approximately $60,000. This is one example where in all probability it best to follow the most direct route. The cost of every major item, structural or mechanical was considered as well as its serviceability.

Anticipated water consumption,

important to the determination of the capacity of the water system for present and future periods could not properly be considered by the usual rates of an average city of the same size because of the ingrained habit of the local people to conserve water. A survey showed 2,241 resident cisterns in the city with a total capacity of 11,670,000 gallon storage, an average capacity of 5,200 gallon per cistern., or an estimated seven gallons per person per day, supplemented by shallow brackish wells for washing, flushing and watering, an essential provision for some homes but unfit for human consumption. There were 131 commercial cisterns with a total capacity of 4,730,000, averaging 36,000 gallons per cistern and eight government, totaling 4,200,000 gallons with an average of 525,000 per cistern. The city had a grand total of 20,200,000 gallons of water stowage, none interconnected or to the distribution system, except those in the Navy Yard.

While Key West had approximately 94 per cent of the total population of the Keys, it comprised only 3 per cent of the 103 square miles of the main Keys from Key Largo south and westerly. A Work Projects Administration survey showed the population of Key West as 12,317 and 934 people living in the area from Stock Island to Key Largo.

It was apparent that with the new overseas highway the city is intimately bound to the future of the Keys and must be included in the overall capacity development of a consumption rate included several other factors such as population growth, irrigation along the Upper Keys, boats of various classes and the necessity of rate structure with adequate minimum charge that would encourage reasonable liberal use and a reversal of past economy. The consumption rates estimated for a base of selecting the capacity of the aquaduct was 50 gallons per capita per day for 1939, 56 per capita per day for 1944, 62 for 1949 and 86 gallons for 1969. The consumption was based on a thirty year period before possible upgrading the system.

Pipes at Florida City for the water pipeline. Photo credit: Monroe County Library.

The pipe was the first major item, numerous quotations had accordingly been obtained from cast iron founders and steel mills in respect to suitable classes of materials in regards to a reasonable cost of installation in order to keep fixed charges down with the ability to pay, the most favorable quotation was on the use of steel pipe. The final selection must be made between cost and the comparative compliance with (A) maximum strength (B) permanence (C) minimum leakage (D) flexibility (E) high sustained carrying capacity, higher pressure than normal working pressure of 60 to 100 pound per square inch would be required due to the long supply line on the Keys.

In selecting a required sized pipe, attention should be given to one which could be conveniently and economically duplicated or enlarged. Pumping stations, including prime movers, pumps, and supporting equipment, plus storage tanks can be readily enlarged, compared to a parallel pipe lines involving large expenditures. Increasing the diameter of the pipe by one or two inches greatly exceeds the added increase in cost. For example, increasing the diameter of the pipe from 16 to 18 inches is equal to running an additional parallel line of approximately 11 ½ inches in diameter.

Leakage was of great importance due to its great length and high value of water. While leakage from 100 to 150 gallons per inch diameter, per mile, per day may be acceptable in some type of water works of shorter pipe line constructions, in the case of a 16 inch line, 130 miles long as comparison, the total loss of water per day with the foregoing average allowable rate would amount to 260,000 gallons daily. If the water were valved at $200 per million gallons this cost capitalized at 6 per cent would amount to $300,000.

Flexibility is important to offset contraction and expansion due to temperature changes and to

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afford movement primarily to avoid rupture of the pipe section and interruption of service. The pipeline would be subject to tropical storms and hurricanes. The entire length should be designed with a very high safety facture to minimize damage from any or all conditions which might occur. A protective coating for exterior protection against corrosion is recommended. As well as provision of liberal storage at various point's along the Keys for possible temporary interruptions of service in a catastrophy. Joint operation with the city of Homestead or Florida City's pumping facilities or for the purchase of electric power for the pumping station would appear feasible due to the small load during the early years to minimize the cost should be considered. The construction, superintendence and labor for operation of single inline booster station would nvolve an annual expenditure of $150,000 to $180,000. Based on the initial rate of consumption would not be warranted.

The essential features of the proposed plan as being the most economical in developing an adequate and sanitary supply of water for the Florida Keys and Key West includes the following (1) A supply of water on the mainland in the vicinity of Florida City or Homestead of approximately 1.23 million gallons per day capacity, designed for the future enlargement to provide capacity of not less 2.75 million gallons per day. (2) A main pumping station at the site of the well, designed and equipped for an average daily capacity of 1.25 million gallons per day, with provisions for future enlargement to provide an average daily capacity of 2.75 million gallons.. (3) A supply line approximately 16 inch average diameter with minor changes in size through special sections to meet varying requirements, with a total maximum length of 685,000 feet - 130 miles - extending from the source of supply on the mainland to a point of connection with the existing distribution system in the city of Key West. (4) Storage facilities in the City of Key West with a capacity equivalent to one weeks consumption at the estimated initial rate or approximately 3,700,000 gallons. (5) An emergency booster station at Key West with a capacity of approximately 3 million gallons per day.

The preliminary report was completed in May 1938, giving the estimated cost using 16" diameter pipe at $2,494,000. Progress was slow. Financing was not forthcoming from the Federal government as in previous years. While President Roosevelt was trying to draw the country out of the Great Depression (there were as many people unemployed in 1937 as in 1932) an armament was being assembled in Germany at an alarming rate that could be a threat to any country. Although far from the United States our defense was becoming outdated. The passage of the Naval Expansion Act on May 17, 1938, the same month the Florida Keys Aqueduct report was filed, had little effect on the island. On January 5, 1939, President Roosevelt asked Congress to increase the national defense budget, Federal funding was shifting from the domestic progams to military and national defense. A futile attempt to secure a loan from the Reconstruction Finance Corporation for the estimated cost of the complete water distribution system was made on May 20, 1938. More than a year passed when on September 11, 1939 war came to Europe. The gates to the Navy Yard were closed to visitors and the Sub Base to visiting yachts, by order of the Secretary of the Navy. This was a blow to the city trying to build an economy on tourism.

On September 19, 1939, Mr. S. Pierre Robineau of Miami was employed to act as attorney for the Commission. The citizens of Key West took it all in stride, worked all week (if they had a job), congregated on Duval Street Saturday nights with friends and relatives, went to church on Sunday morning, supplemented government food rations with grits and Grunts, (a small fish easily caught near shore) and kept their rain barrels clean.

Thompson Enterprises continued to draw water for their ice plant on Caroline Street from 32 wells in the neighborhood, there were at least 3 in the Poorhouse area at the intersection of William Street, Galveston and Poorhouse Lanes, some on Solares Hill, two on Higgs Lane and several on Fleming Street, when one section would turn brackish they would switch to another section. In the center of the island windmills, vulnerable to storm winds had given way to electric powered pumps to slow pump fresh well water into above ground supply tanks for the dairy herds. The Overseas Hotel, 919 Fleming Street, advertised 100 rooms, each with a private bath or semi-private bath and shower, hot and cold running water in every room. At 1015 Fleming Street the Gibson Hotel advertised 40 cool clean outside rooms with Simmons innerspring mattresses on every bed. Each room has a private or connecting bath showers with hot and cold running water.

After seven years on a bare maintenance status, the Naval Station reopened November the first 1939, Commander E.G. Hoey Commanding. A Marine detachment reported for duty and Navy

Water pipeline installed on a railroad bridge. Photo credit: Monroe County Library.

personnel and shipments of supplies arrived daily. A contingent of naval vessels replaced the yachts in the submarine base. Sixty three civil service workers were rehired to join the 12 regular employees in making the existing buildings habitable. Lee M. Pierce, a Quarterman Shipfitter senior civilian employee, remained in charge as he was during the years the stations was closed and with his many years of service in the yard was a unlimited source of information and help to Lieutenant Commander T.J. Brady the new Public Workers Officer. Aviation personnel were arriving occupying the Seamen's Barracks Building 66, until living quarters were completed at the Naval Air Station (temporarily under command of the Navy Yard). Preparation for a new air station was underway on the site of the World War One seaplane and dirigible base on Trumbo Point. Contracts were let in early 1940 for temporary type buildings to provide emergency aviation patrols, hangers, barracks, dispensary, fire house, water storage, ect. Contractors desperate to complete their obligations were buying fresh water for their concrete work from the Navy at $3.00 per 1,000 gallons until they were lead to a well on Grinnell Street.

The well was a backup for two large cisterns on the grounds of the Casa Marina, a large hotel on the southern shore built by the Florida East Coast Railroad Company.

The entire Naval Station was dependent on the rain-water collection system, distillation plant and 1,500,000 gallon reservoir assembled before World War I until March 1940 when contractors began moving in with contracts, blue prints and construction equipment to start an expansion of the 50 acre naval station not envisioned by local naval personnel or anyone else, newer contract continued, acres of land was acquired by purchase, lease or dredging and fill, fresh water became crucial, to alleviate the demands arrangements were made to barge water from Miami and to have merchant marine ship the American Seamen to ship it in from Tampa, with an estimated cost of $1.93 per 1,000 gallons, including labor and equipment. Even at this date the Navy realized the present water facilities would be inadequate if there was a great expansion in the future. A survey indicated that 1,000,000 gallons of water per day would be needed for the Naval Station, forces afloat, Naval Air Station, construction in progress and facilities still in the planning stage. It was estimated that $2,000,000 would cover the expenses for the development of a water supply from the mainland, using 10 inch pipe.

The Navy did continue to expand its facilities, not only within the bounds of the station but in several areas of the island city, for each new activity commenced orders for two

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more seemed to follow, land to build on was acquired by judgement of a declaration of taking, the valuation of the property determined and paid the owner, the Navy was becoming more involved in the city and the city was feeling the effects of a growing population due to the arrival of civil service employees, construction workers and families, an urgent economic and sanitary problem was apparent.

It was determined that while the $2,000,000 procurable through the federal appropriation for a pipe line from the mainland would be adequate for the fresh water needs of naval and other federal government activities it would not also furnish the needs of the present and prospective civil population of he City of Key West and the Florida Keys without additional funding.

Meanwhile, on September 30, 1940 the Florida Keys Aqueduct Commission with no tangible financing passed a resolution to petition the United States Navy and Bureau of Yards and Docks to begin all preparations and operations necessary for the earliest possible construction and completion of a water line to Key West with the Florida Keys Aqueduct Commission participating in the cost up to the sum of $1,000,000.

Just how far the resolution went is rather vague in available records, however the United States Navy and the Bureau of Yards and Docks avoided joint adventures with civil industries and state agencies for various reasons, it literally took an act of Congress to formulate an agreement, which it did. Taking into consideration that the fresh water distribution system to their various Naval and Federal activities would be in the City of Key West and the Florida Keys Aqueduct Commission is a state agency, the Congress of the United States did appropriate $2,000,000 therefore by and under the first supplemental National Defense Appropriation Act 1941 which appropriation provided the that such water supply system might be built in cooperation with an agency of the State of Florida.

The distribution system would extend throughout the city, connecting all neighborhoods, Navy, Army and other Federal properties including housing. The main pipe line, pumping station and supply tanks. Making it undoubtably part of national defense program, there by entitled to defense appropriations of $1,000,000 in negotiable bonds. (The arrangement of Government bonds relieved the city and residences the burden of taxation. Paying back the bonds would be through the sale of water to consumers.)

On March 18,1941 an agreement was entered into by the United States of American acting through the Navy Department and the Florida Keys Aqueduct Commission an agency of the State of Florida for the development of a water supply line from the mainland of Florida extending along the Florida Keys to Key West. The commission was authorized to issue $1,000,000 in water revenue bonds to pay one-third of the cost of construction the water supply system and in return the Navy Department agreed to supply to this commission at least one-third of the total quantity of water available in each twenty-four hours from the pipeline aqueduct when operating under normally designed conditions, by proviso, in the event of military emergency the Navy may shut off the supply of water completely to the commission. The commission likewise will reimburse the department in full for the commission's proportionate share of all costs incurred in the operation, maintenance and major repairs.

Frank Knox, Secretary of the Navy, during a special trip to Key West, signed the agreement for the Navy Department, William T. Doughtry and attorney S.P. Robineau signed for the Aqueduct Commission.

An indenture of lease was made and entered into in September 1941, between the City of Key West a municipal corporation and the Florida Keys Aqueduct Commission, an agency of the State to construct, equip, operate and maintain a water distribution system as a means of providing an adequate fresh water supply to the inhabitants of the City of Key West. The lease included the existing water distribution system comprising all property, equipment and facilities now owned by the city and now formerly installed or used for the purpose of distribution of potable, fire protection sanitation or domestic or industrial uses including all main feeders and distribution gridirons gate valves and valve boxes, hydrants, runs and services, the pumping station on Jackson Square, piping and storage tanks, the city will pay $50.00 per annum per hydrant which service shall include water required by the city for fire protection, street cleaning and flushing of sewer mains. The commission also agrees to furnish the city with water required for parks and playgrounds, public schools, administrative buildings and libraries, charitable institutions and hospitals, cemeteries and municipal markets at an rate not to exceed 40 cents per thousand gallons, provided however the rate to the city for water for such municipal uses shall not be in excess of the standard rate charged by the commission.

Trailer for carrying pipe. Photo credit: Monroe County Library.

When the distribution system in the city (Installed by the WPA during the depression years) was inspected, it was discovered that it was "not now sufficient to meet the cities requirements because of lack of fresh water, only useable for sea water." Apparently they believed the building of the aqueduct would correspond to their progress of the system, in addition the system was incomplete in its extensions, equipment, meters, valves, storage facilities, pumping stations and other incidental equipment. Major rebuilding and improvement was required to adequately and properly complete the system.

Ralph A. Bard, acting Secretary of the Navy was the expediter in finding land suitable for a well site, his search took him to a 353.17 acre tract of land one mile west of Florida City, Dade County, a development laid out in lots partly sold with only one house The title taken under the authority of Congress August 18, 1941, which is specified by the law of "eminent domain" the right of government to take or to authorize the taking of property for public use, just compensation being given to the owner. The development was called Stanford Park and each lot owner plus the developer had to be located, transaction made and paid individually bring the total to $12,644.00 for the property.

The construction of the pipeline finally became a reality when contract number Noy-5012 was signed with the Fairbanks Morse and Company for two 500 H.P. diesel-driven centrifugal pumps with an average capacity of 1.25 millions gallons of water a day each, including all accessories and proper installation at the well site west of Florida City. They could not have made a better selection by ordering from this company. It was a large company with the reputation of manufacturing heavy duty diesel engines, hydraulic pumps, air compressors and large freight scales. The aqueduct engine was a medium speed, two cycle, water cooled engine with individual large bore cylinders setting upright on the engine base with compressed air starting system, which accounts for the accessories in the contract. A self contained air compressor was required plus a small electric power plant. Centrifugal pumps as the name implies was also manufactured by Fairbanks Morse, depend for their operation on centrifugal force which imparts a high velocity to the water pumped. The high velocity is converted to static pressure in the pump casing, it has only one moving part, an impeller mounted on a rotating shaft directly attached to the end of the diesel engine's crankshaft. The casing is circular and short in length designed to accommodate the impeller with a suction chamber to the center of "eye" of impeller creates a radial and rotary motion to the water resulting in centrifugal force, as the speed increases the water is pushed out the discharge developing suction in the center drawing more water from its source. It has only one draw back the pump is not self priming, in other words the casing must be completely flooded before it will function. This is corrected by suppling the pump with water from an exterior supply. Priming systems are standard equipment on this type installations. Work on the contract started April 15, 1942 and completed August 22, 1943.

A second contract Noy-5196 was awarded to the Williams Brothers Corporation to construct a building for the pumping equipment, the digging of three 10-inch wells, each capable of being pumped for an average of one million gallons of water daily and the laying of approximately 130 miles of 18 inch diameter pipe from the well site at Florida City down the Florida Keys following the old railroad

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right-of-way ending at Key West. The pipeline originally estimated to be 10 inches in diameter by the Navy and 16 inches recommended by the Florida Keys Aqueduct Commission's preliminary report is now 18 inches. Construction finally started November 28, 1941, 11 days before World War II was declared by the United States.

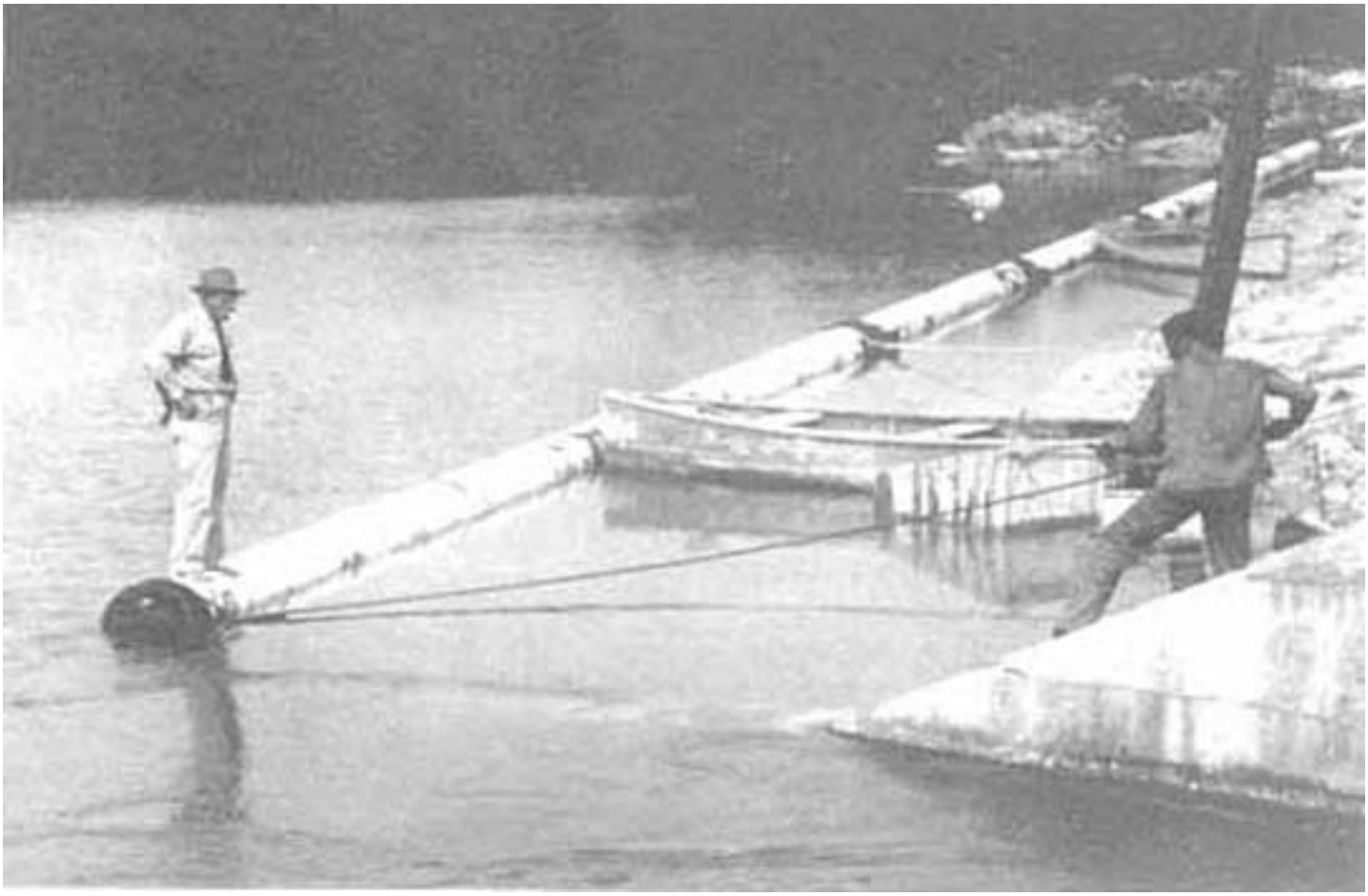
There was a sudden increase of activity in Homestead when a long freight train hauling thousands of 18 inch diameter steel pipes, each one 42 feet long, weighing a ton and a half arrived and began unloading, days later they were lined up in good order completely covering 10 acres of ground. Special open air sheds were constructed where workmen prepared the pipe before instillation. They were first cleaned inside and out in one shed under sprays of a large stationary pressurized water and chemicals system, then rolled to another shed where an electric detector was passed inside the length of each pipe that would pin point the slightest leak by recording the drop of voltage at the hole, repaired, if necessary recleaned and tested. They were all specially treated inside and out to protect them from the corrosive effects of salt water and air, next was a covering of heavy fabric shield of asbestos and tar to prevent scarring enroute to the job site and puncturing of rocks during installation. Gleaming aluminum paint was applied for protection from rays of the hot Florida sun, when dried were transported to the job site on a pole type semi-trailer which merely consisted of a single 4 inch diameter steel pole, rear axal assembly a set of dual wheels, a cross member on each end formed to accommodate the four pipes and attached to a truck.

They were loaded and unloaded by crawler tractors specially designed with a short heavy duty boom fitted on one side with cables for hoisting heavy objects. A little ingenuity in placing the lifting sling in the proper place provided perfect balance of the long heavy steel section making it easier and safer for the workmen lowering thousands of pipes into the trench dug by a huge ditching machine.

Stretching east, south and westerly 130 miles 685,460 feet the pipeline designed by Elson T. Killam of New York enters it's final stage. They will encounter 43 water ways between the islands, some with channels of surging currents forced though by tidal changes that would race 5 hours one way, pause then 7 hours of its powerful surg from the opposite direction. The 106 miles from Jewfish Creek to Key West included 37 miles of open water most in the open sea, 17 miles of concrete viaducts, concrete and steel miles long, 20 miles of earth filled causeways. Areas of tough hard rock that would make the ditching machines shudder, vibrating, both machine and operator. Snakes, swamps and the sawgrass plant with its long blades armed with three rows of sharp teeth, but the most vexing was the horse flies, sand flies and gnats in their seasons, the aggravating mosquitos seemed to have open season year around.

It was desolate country, of the 934 inhabitants during the railroad days, the population dwindled to less than 600 on the Keys including Key Largo and Stock Island, no one lived in the 27 miles from Florida City to the small settlement of Rock Harbor except for a few homesteaders on Upper Key Largo. It was about this time the State Road Department realized improvements should be made on the highway to accommodate the increasing traffic due to the military expansion in the Lower Keys. The state road department and the Public Works Administration agreed to finance the improvements. Extending the highway straight through from Florida City to Key Largo on the remains of the railroad bed, passing Card Sound road and bridge. In addition to building a new road on the abandoned railroad bed from Sugarloaf Key, south to the end of the line in Key West. Instead of trying to improve the 19.8 miles of the narrow, winding state road and wooden bridges following the eastern shoreline ending in Key West by way of the eastern tip of Stock Island, would trim 17 miles off the roadway. Lowering the overall milage to Miami from 174 to 156 miles. The bridges converted to a highway in 1938 and the fact that the original bridges existed at this time was an advantage to the Florida Keys Aqueduct's pipeline in man hours, work time and cost.

Records show the tides raise and lower sea levels as much as one to one half feet daily and are responsible for the strong currents through the waterways between the Keys. Wind speed from different directions can pile sea water on the shore line, while windstorms bring waves washing ashore, seasonal changes and phases of moon add their greater level of the sea. The railroad engineers felt safe in building the railroad bed at 7 to 10 feet level above mean low tide. To do this soil and rocks were excavated from both sides of the proposed road bed and cut through higher elevations. One exception, however was the land area from Florida City to Key Largo. The subtropical marsh land along the eastern edge of the Florida Everglades barely above sea level. Draglines brought out a sticky moist soil called muck and left water resulting in one road



Water pipeline being installed underwater alongside a bridge. Photo credit: Monroe County Library.

bed, two ditches and no land area for an unforeseen pipe line built in later years on an abandoned right away. An area approximately 200 feet wide.

The pipeline was designed to be supported by a series of wooden stanchions to maintain an equivalent elevation in lower areas and waterways and buried in trenches in the earth of higher elevations to keep rise and decent to the lowest degree.

The pressing of war having its effect after Japan's attack, people would become tense when scouting planes from the Naval Air Station would fly over head, strangers were looked on with suspicions, fishermen out in their small boats were reported to naval intelligence as would be saboteurs, strange lights at night sending signals was also reported which turned out to be navigation lights that were there for years. People where expecting something to happen. The highway and bridges were a vital link to the navy and other military components in the Lower Keys would be vulnerable as well as the new water line. The military set up road patrols to search for any form of sabotage device and report any suspicious damage to road, bridges or pipeline.

The week of December 8, 1944 S. Pierre Robineau, attorney for the Aqueduct Commission was on his way to the Nations capital to inquire into the delay of $1,750,000 water bonds. County Clerk Ross Sawyer and two members of the Florida Keys Aqueduct Commission, William Daughtry and William Arnold were waiting to affix their signatures on the bonds along with S.R. Robineau. Back on May 10, 1938 the Aqueduct Commission resolved to prepare the proper application to secure a loan from the Reconstruction Finance Corporation (Established in 1932 to stimulate banking and business.). On September 4, 1941 the Aqueduct received from the RFC an executed copy of the resolution of commitment to buy $1,500,000 of bonds at an interest rate of four percent and on September 9, 1941, a resolution providing the issuance of $1,750,000 Aqueduct bonds was signed with the First National Bank of Miami as trustee.

The war also had its effect on the pipeline construction, supplying the Lower Keys with a greater supply of water was essential. Building the stanchions and installing them in perfect alignment was time

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consuming. (A stanchion is an upright bar, beem or post used to support.) In this case two uprights were used with a cross member on top to carry the pipe secured by a "U" shaped iron bar over the pipe and into the wood cross member. To save time and security the pipeline was laid submerged in the westerly side canal for nearly 20 miles between Florida City and Jewfish Creek. More men were employed, day and night crews worked ahead building and mounting stanchions in lower elevation, across short water ways and land fills, while others were installing triangular medal intermediate hangers on concrete spandral bridges at proper spans or welded to steel girders or cross beams, others were operating ditch digging machines digging trenches to avoid a delay of the pipe fitters work when they arrive. Nearly a thousand men were working on various places from Jewfish Creek to Key West. Jewfish Creek was the first challenge, it was more than a creek it forms the boundary between the main land and the Florida Keys, the only passage for many miles, also a channel for the intercoastal waterway coming down the eastern seaboard connecting the Atlantic with the Gulf and Florida Bay. Well traveled by medium and small boats and a new Bascule bridge. With the service of a drill-barge a trench was cut into the bottom of the channel, the pipes were assembled to conform to the trench and floated into place with the assistance of a crane, line handlers and hard hat driver, to prevent damage to the new pipeline.

Local men were also employed building the aqueduct. Art McKee worked as a diver and Alonzo Cothron operated a ditch digger, Otis Curry worked as rigger.

Past Jewfish Creek there was 106 miles to go from Key Largo the largest of the Florida Keys which also provided the longest straight away of the entire pipeline running parallel to the highway and some of the most difficult surface to break thru with ditching machinery..

Blasting with dynamite was the best way to break the surface of tough coral rock composed largely of coral and shells called Key Largo Lime Stone also described as exposed bedrock. This formation of rock is present as far south as Big Pine Key where it dips below sea level at the New Found Harbor Keys. From there to Key West the formation of Miami Oolite overlays the Key Largo limestone with a thin layer of cap rock.

A two mile line of tall stanchions were installed in the shallow water running parallel to the highway, bridges and filled causeways between Upper and Lower Matecumbes. A forty-foot Bascule bridge extended over the Teatable Key Channel near the east side where the pipeline was laid into the bottom of the channel. The most demanding engineering problem included the area from Lower Matecumbe to Long Key a stretch of open water where the Gulf of Mexico meets the open sea, nearly four miles wide before Flagler's Railroad, built two and half miles of land filled causeways, a mile and a half of bridges and a fifty foot Bascule Bridge. Funneling a vast area of water through the only passage creating strong tidal currents. The low draw spans beneath which strong current pass prevented placing the pipeline on the bridge work. Large drill barges failed to dig a trench into the bottom, only blasting a path with dynamite into the hard rock bottom was the drill barges able to dig a trench to lay the pipe under water for a distance of nearly a mile.

The Long Key Viaduct an abandoned railroad bridge was 11,969 feet long concrete multiple spandrel arch structure convert to an automobile highway by adding a concrete roadway deck which extended four feet on each side of the substructure, installation of the pipeline was accomplished with the service of a mobile crane with an attachment shaped to lower the pipe, and under the four foot overhang of the highway deck on to the hangers. Pipe fitters worked from a small platform suspended from another mobile unit. (A spandrel is either of the triangular spaces between the exterior curve of the arch and a rectangular frame or molding enclosing.) The Seven Mile Bridge a 35,716 foot long structure named for the seven miles of open water from Knight Key to Pacet Key, steel deck plates on giant concrete piers supported the railroad two-thirds of the way to Pacet Key, two hundred and ten 53 foot concrete spandrel arches completed the bridge. The roadway on top was the same as described for Long Key with one exception, a 253-foot swing bridge over Moser Channel, not only did the pipeline go under the 16 foot swift channel but around a 125 foot bulwark extending 90 degrees from the swing bridge foundation. Last of the three great bridges, the single-lane steel truss bridge 5,356 foot long on giant concrete piers over the Bahia Honda Channel, to narrow for a two lane highway. Building the same type roadway decking over the 65 foot high top of the truss solved the problem. The builders of the aqueduct were more fortunate by placing the pipeline through the vacant interior of the truss 30 feet above the channel. A long landfill made the approach. The terrain makes a change beginning near Big Pine Key, the second largest key including an elevation

Trench for the water pipeline. Photo credit: Monroe County Library.

of 8 to 10 feet above sea level. Sufficient for burying, the pipes in trenches. The concrete arch bridges continue, none so massive or long mostly 6 to 7 feet clearance over more waterways of shallow milder currents. Across Big Pine Channel is Little Torch Key primarily good elevation railroad bed only raised to maintain seven foot as was Ramrod, Summerland, Cudjoe and Upper Sugarloaf Keys turning into Lower Sugarloaf an assortment of small low laying islands, shallow water, mud tidal flats, mangrove islands and swamps approximately four miles wide ridged on the oceanside with reasonably high ground and state highway, nothing suitable for a railroad with a preference of a straight line regardless of what it takes, this time numerous land fills and concrete arched bridges, the pipeline was carried on stanchions most of the way including Big Coppit Key, Boca Chica Key, Stock Island and finally two thirds the way through Key West then down Eaton Street and over to existing pump station, storage tanks and distribution center on the southwest corner of Jackson Square, corner of Thomas and Southard Streets and court house.

The Key West Citizen of September 2, 1942 reported Captain C.E. Reordan, Commandant of the Naval Operation Base, issued a memorandum that requested all Naval personal to "Exercise the upmost economy in the use of water in as much as the Operating Base is not receiving fresh water from the Homestead pipeline contrary to published reports." The water reached Key West September 22, 1942. First pumping was to flush out the line, however no water was for human consumption since engineering difficulties had developed that would probably delay operation of the line for an indefinite period. Lieutenant K.M. Fenwick, Public Works Officer for the Naval Base, said "Initial technical difficulties are to be expected in a project as complicated as this."

Indefinite time it was, search and correcting problems over so large a territory was no easy task. When the two pumps at Florida City were not in operation air pockets formed as the water would settle in the low areas creating vacuum above which drew air in holes to small for a water leak to be noticeable. Air pockets were also formed by small users along the Florida Keys, when pumps started up again they had to run slowly for approximately two hours until the pressure built up to avoid a hammering effect which strained the line, caused by air pockets built up to excessive air pressure. (Air can be compressed, reduced in volume, pure water can not.). The Navy report also stated "The water while potable was extremely hard and contained considerable suspended matter, a high degree of color and was not suitable for steaming." Extremely hard would be high content of minerals that under high heat of the boiler and its circuits tends to carry some moisture of insoluble matter that may form heat resisting scale on

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Navy water plant at Florida City. Photo credit: Monroe County Library.

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the turbine blades causing corrosion and unbalance of ships propulsion steam turbines. Complaints were coming from Navy and some civilian housewives with little success in making soapy water for laundry and dishes. Bathing wasn't much better, with the new water. The Navy Hospital was experiencing the same problem, not suitable for hospital use, resorted back to their original rain water collection system of two large cisterns and a large water tank in the tower on the roof. It was years before they returned to the aqueduct for the fresh water supply.

On October 16, 1943 a recommendation was made to the Bureau of Yards and Docks for the instillation of a filtration and treatment plant. The news media showed interest when the Aqueduct reported "Major project of the Navy, a 135 mile aqueduct bringing water from wells at Florida City acclaimed one of Engineering marvels of all time." Justly so by many people but the statement "The water line to Key West is the longest single force aqueduct in the world." Was short lived the project that started with limited funds and expectations of operating a minimum capacity is now under strain to meet the demand. A recommendation was made to the Bureau to install a booster pumping station at Marathon. On May 9, 1944 the two recommendations were authorized, giving Charles Toppino and Sons contract NOY-11096 for $112,135 for a pumping station at Marathon and Gabel Construction Company $180,000 for a water treatment plant at Florida City. Both jobs were still under construction in October 1945. In April 1944 Hunter Harden chief electrician and electrical engineer for the Naval Base was provided with funds up to $200,000 to build and install certain electrical equipment to prevent corrosion of the pipeline. A cathodic survey had just been completed to determine the amount of corrosion in the line. After meeting and overcoming many difficulties, on October 1944 the aqueduct was finally accepted. Williams Brothers was paid $1,719,017.95 for digging wells and laying he pipes and Fairbanks Morse and Company for two diesel-driven centrifugal pumps and installation was paid $44,862.35.

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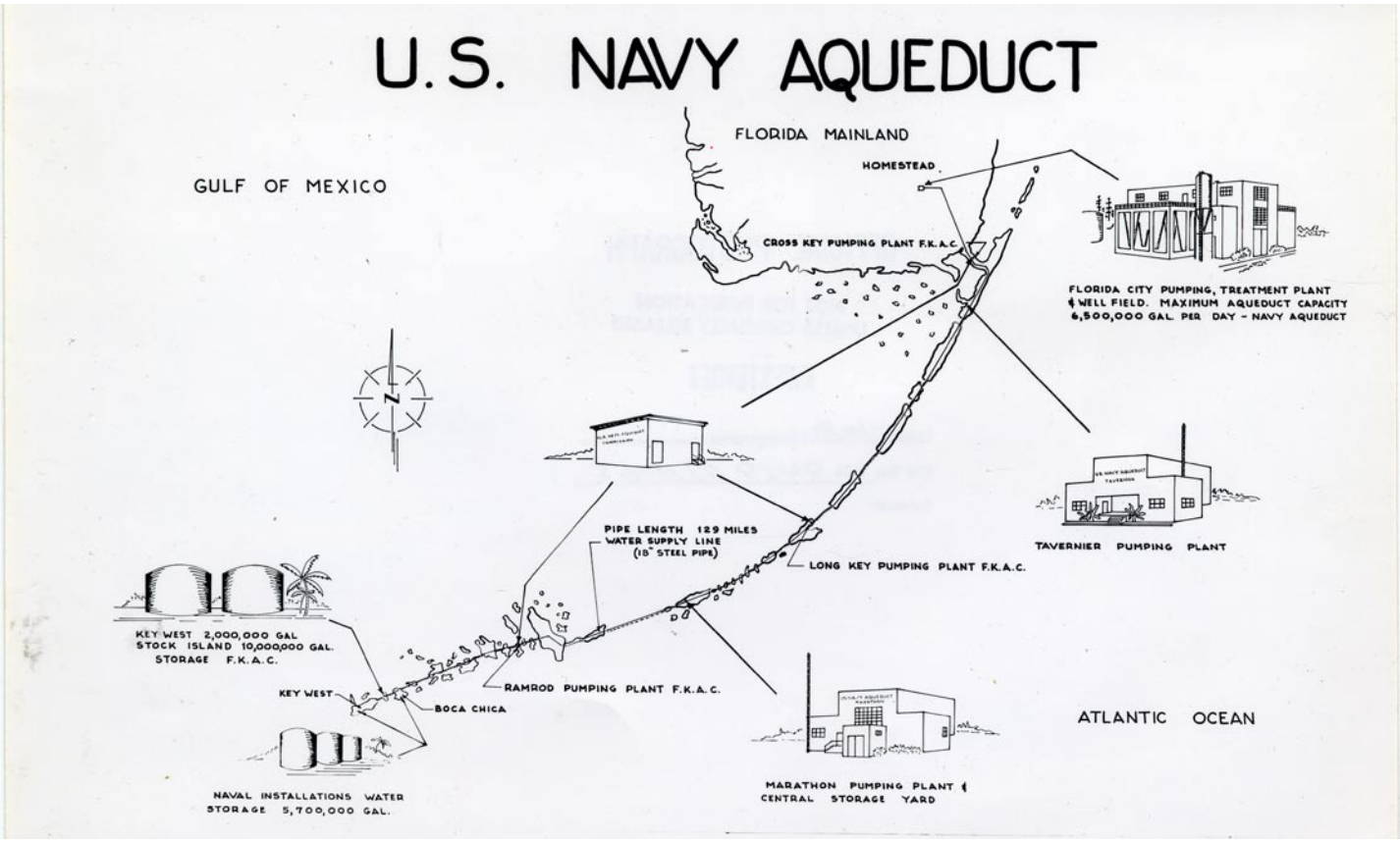
On a normal running day the pumps provided three-million gallons a day, 10,000,000 gallons of water filled the line and an average of six days traveling time for the water to reach the island base in Key West from Florida City. There was mixed reaction by the residences and customers. The majority accepted it as the best thing that could happen to the island, but due to reasons previous mentioned were hesitant to use it even after the treatment plant reduced the hardness and cleared the suspended matter. The old ingrained habit of conserving water was still there and had a lot to do with their monthly bills. Consumption was not up to original estimate 56 gallons per capita per day. Elderly people were still on welfare from depression days. The director of the aqueduct offered to demolish cisterns and haul it away to entice them to use more water, monthly payments from customers were short of making full payment on the bonds. In the late 1940's an arrangement was worked out through legislation where the government would buy out the Florida Keys Aqueduct Commission's share of the pipeline and then sell Navy water to residents as needed. Contracts took effect December 1951. The arrangement was suitable until the growing civilian population's demand for water surpassed the Navy's. To increase supply a pump station was built on Tavernieer. The war in the past, Key West Naval operation base made a reduction in force while civilian population grew. The Navy demand for water was less and the civilian more, in effect it was not the Navy's responsibility to operate a civilian utility. Resulting in negotiations for a contract in an agreement with the Florida Keys Aqueduct Commission a water system to operate independent of the Government on their own property no later than December 1, 1957. Plans, design and financing to construct a new pipeline started immediately. No plans or estimate could put the completion before or by the time limit. Attention turned to the feasibility of a desalination plant. Consulting engineers were employed, loan applications were requested for $4,436,000. Westinghouse Electric's bid met all specifications and built their plant on Stock Island, producing two and six-tenths million gallons a day for a thirty day test period and went on line in the fall of 1967. Westinghouse Corporation was awarded $3,360,000. In the meantime the military was making a world wide review of all base and commands for cutbacks and base closings and the Key West Naval Station was on the list. Rear Admiral F.J. Brush in preparing for cutback made known his intention to transfer the pipeline back to the aqueduct. Going through government legislation and both houses of Congress would be time consuming. He simplified the matter by transferring through existing legislation for surplus property. After four months transition period on June 1, 1976 the Florida Keys Aqueduct, now "Authority" took over full ownership and operations of all existing pipeline and facilities, well field and treatment plants. Surplus transfer price was $2,100,000.

Carston R. Heinlein, originally from Ohio, enlisted in the U.S. Marine Corps before WW II. He was stationed in Key West during the early days of the war before joining the First Marine Division in which he served in the Pacific Theater and North China. He married Camille Louise Pierce of Key West and settled here after the war.



The Navy Aqueduct in 1963. Photo credit: Monroe County Library.

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