REPORT

ON THE

WATER SUPPLIES OF SARASOTA COUNTY

FOR THE

BOARD OF COUNTY COMMISSIONERS

COUNTY OF SARASOTA

FLORIDA

APRIL, 1963

SMALLY, WELLFORD and NALVEN

CONSULTING ENGINEERS

SARASOTA, FLORIDA

SMALLY-WELLFORD & NALVEN • CONSULTING ENGINEERS
133 South McIntosh Road, Sarasota, Florida • P. O. Box 4341 • Phone RIngling 7-3175

April 25, 1963

Board of County Commissioners
Sarasota County Court House
Sarasota, Florida

Subject: Water Supplies of Sarasota County

Gentlemen:

We are pleased to submit our report on the Water Supplies of Sarasota County, in accordance with your authorization.

This report is intended to be a general reference. Unlike a report for a specific project, which can apply established criteria to a particular problem, the need at this time is to provide sufficient information and knowledge of fundamental principles for planning which may lead to criteria suitable for Sarasota County. We have therefore tended toward thoroughness rather than brevity.

The water supplies of Sarasota County are not in a state of crisis. However, the time is ripe for planning among affected interests so that the future well-being of all residents will not be endangered. Inaction in the face of rapid urban growth would be a form of gambling.

We hope that this report will serve as a platform for extending common sense into a technical field with connotations involving political boundaries and other complex aspects, so that all the public bodies, together with private interests, may reach agreements and compromises in the public interest.

The cooperation that we received from many individuals, public agencies and private organizations is gratefully acknowledged.

Respectfully submitted,

SMALLY, WELLFORD & NALVEN
Consulting Engineers

Robert M. Nalven, P.E.

RMN/lt

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SARASOTA COUNTY, FLORIDA

Board of County Commissioners

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County Health Officer	R. H. Veldhouse, M.D.
County Attorney	Richard E. Nelson

April, 1963

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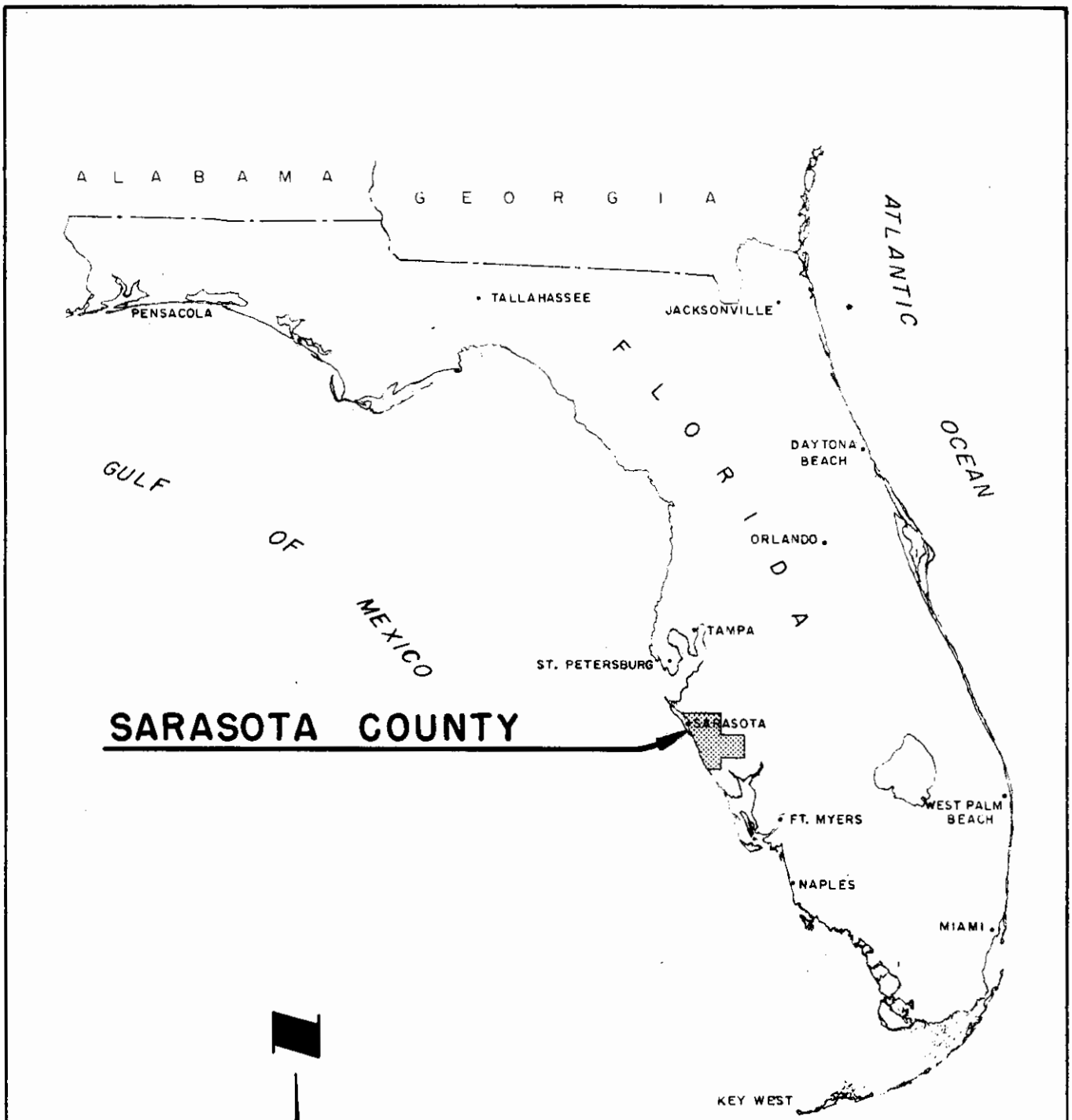


LOCATION MAP

SARASOTA COUNTY, FLORIDA

SMALLY·WELLFORD & NALVEN CONSULTING ENGINEERS

SARASOTA, FLORIDA

JOB NO. 783

EXHIBIT

I. INTRODUCTION

The water supplies are the water resources that can be used. The purpose of this study and report is to gather in useful form information related to the water resources of Sarasota County, and to explore the needs of the county that will have to be served by these resources. Supplying sufficient quantity of water of good quality is a complex problem involving not only the water supply itself but the present and future requirements of a rapidly increasing population.

Actions to be taken by Sarasota County, and the municipalities and other jurisdictions within it, can be no better than the information available to those who hold the responsibility. Likewise, support for such actions depends upon an informed public.

Much information that is available is in compartmented and fragmentary form. Other data is held by various interests for their own uses. Therefore it has been difficult even to plan intelligently, and the various public bodies involved with county and municipal affairs have been severely handicapped in evaluating the needs of particular areas against the background of total county resources.

Recognizing their responsibility to the entire county, the Board of County Commissioners has authorized this report as a significant step. Additional information will be needed and an interchange of viewpoints among the many interests involved, before even a preliminary county master plan that would have real meaning can be developed.

This report is intended to assist in the achievement of long-range planning that will be acceptable to all responsible interests and that will serve the public without infringing on the prerogatives of any group. Because of the interrelationship of resources and usage, which do not recognize boundary lines, and also because these aspects are integral components of overall water management, it is essential

that the actions of any interests be coordinated to avoid unreasonable interferences with the present and future needs and rights of others as to any water-related aspects.

The economic stakes would be difficult to overstate. In the long run the least costly water systems to the users and taxpayers will be those that are planned and coordinated with an eye to the future. The broad picture is in bold relief: a community cannot prosper which neglects or unwittingly handicaps its water resources. No property values can escape an index as fundamental as this.

The foundation of all progress is the obtaining and refinement of information. The planning which may follow this report should remain flexible enough to be adjusted from time to time as more refined data becomes available. This is a necessity in a rapidly growing community where unregimented Americans ignore the most carefully developed projections of future population and usage.

II. SCOPE

As a correlation of water supply and distribution requirements of a growing population, the scope of this report is as follows:

A. All available data and reports on water resources in the part of Florida within which Sarasota County lies have been reviewed.

B. All municipalities, water districts and franchise holders have been contacted, and pertinent data has been obtained related to the purpose of this report.

C. Population projections have been developed for the various areas of the county.

D. A preliminary analysis of all of the above has been made, leading to a generalized pattern of maturing stages related to geographical areas of the county.

E. Because of the intimate interrelationship with other aspects of water management, it is necessary to refer to some of these. Such peripheral discussions are minimized, but are covered in sufficient detail to permit this report to outline the principles involved.

F. A list of pertinent references has been compiled and appears as an appendix.

III. GENERAL ASPECTS OF SARASOTA COUNTY

Note: The following is essentially a condensation of Sections IV and VI of the engineering report dated September 1961, prepared by this firm for the Board of County Commissioners under the title "Sarasota County Coastal Basins Flood Control Study."

A. General

Exhibit "B," on the following page shows the outlines of the county and its principal cultural features. The county has achieved a national image as an attractive community with a cosmopolitan environment that appeals to new residents and visitors alike.

Transportation facilities of almost every type are available, Sarasota being served by land, sea and air. Highways include two federal routes and a number of state routes. Two railroads serve the county.

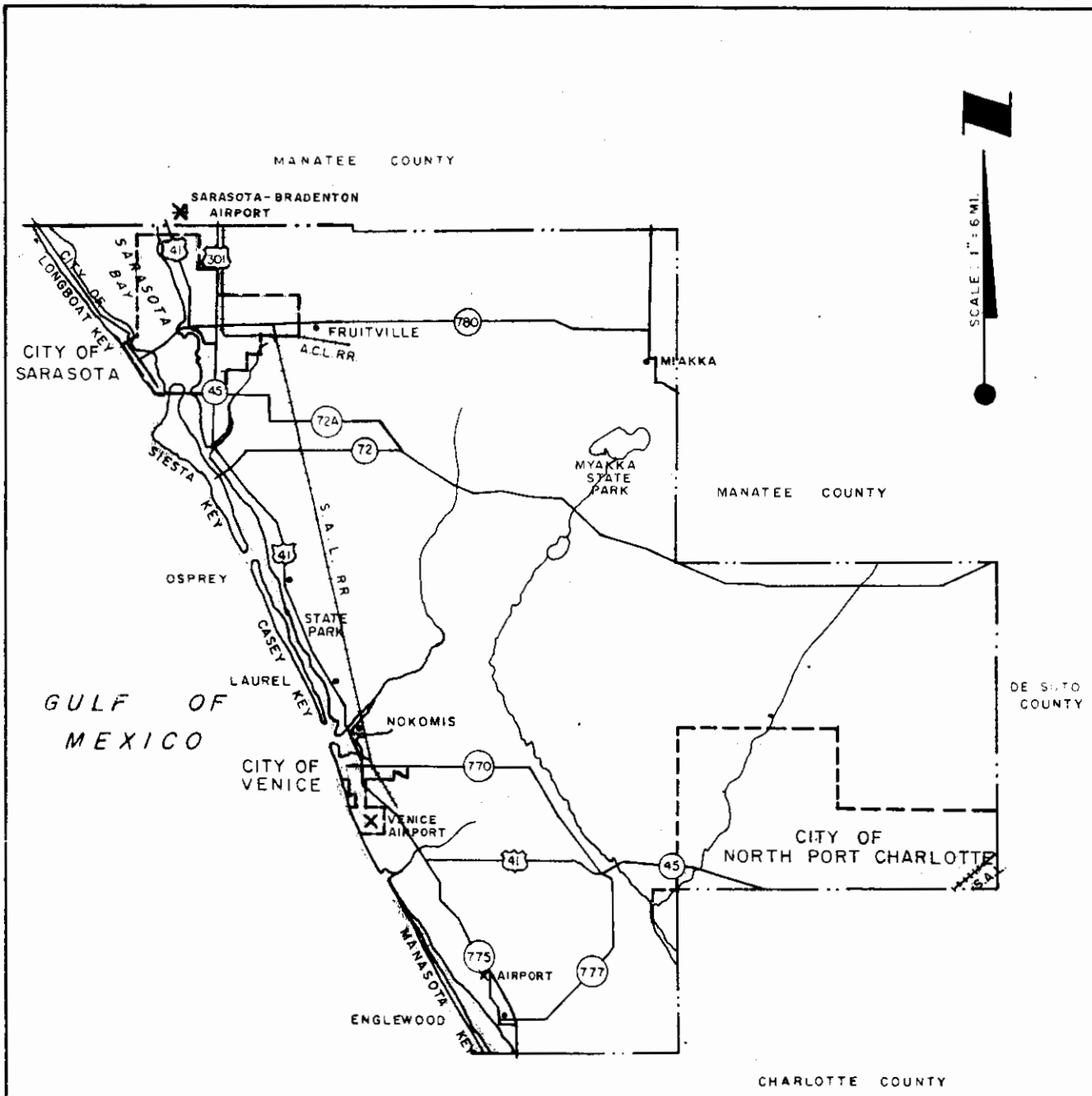
The great deep-water port of Tampa is 50 miles to the north. Sarasota is bordered by part of the federal waterway system. The channel is now being deepened to 9 feet to better serve boat and barge traffic.

Sarasota County has two large airports, both in active use. Sarasota-Bradenton Airport is served by two major airlines.

B. Economy of County

The county economy is not only a matter of local commerce and industry, but is rooted also in the independent income and wealth of the population.

Starting from an agricultural base the economy has become resort-oriented. Growth of a permanent population, at first strongly represented by retired persons, has spread information as to Sarasota's natural advantages, and new industry has been established at a quickening rate. The growth of population has of itself developed industry and services to supply local demands.



SARASOTA COUNTY

SARASOTA COUNTY, FLORIDA

APRIL, 1963

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EXHIBIT 'B'

The building construction industry is the largest because it reflects directly the growth of the area. Industries include building products, electronics, plastic and rubber products, chemicals, wire products, boats and accessories, fishing equipment, trailers and accessories, dairy and other consumer products, furniture and others.

Agriculture was for many years the original backbone of the economy. In general, agriculture is prosperous, subject to setbacks due to bad weather conditions, and is relatively stable in size.

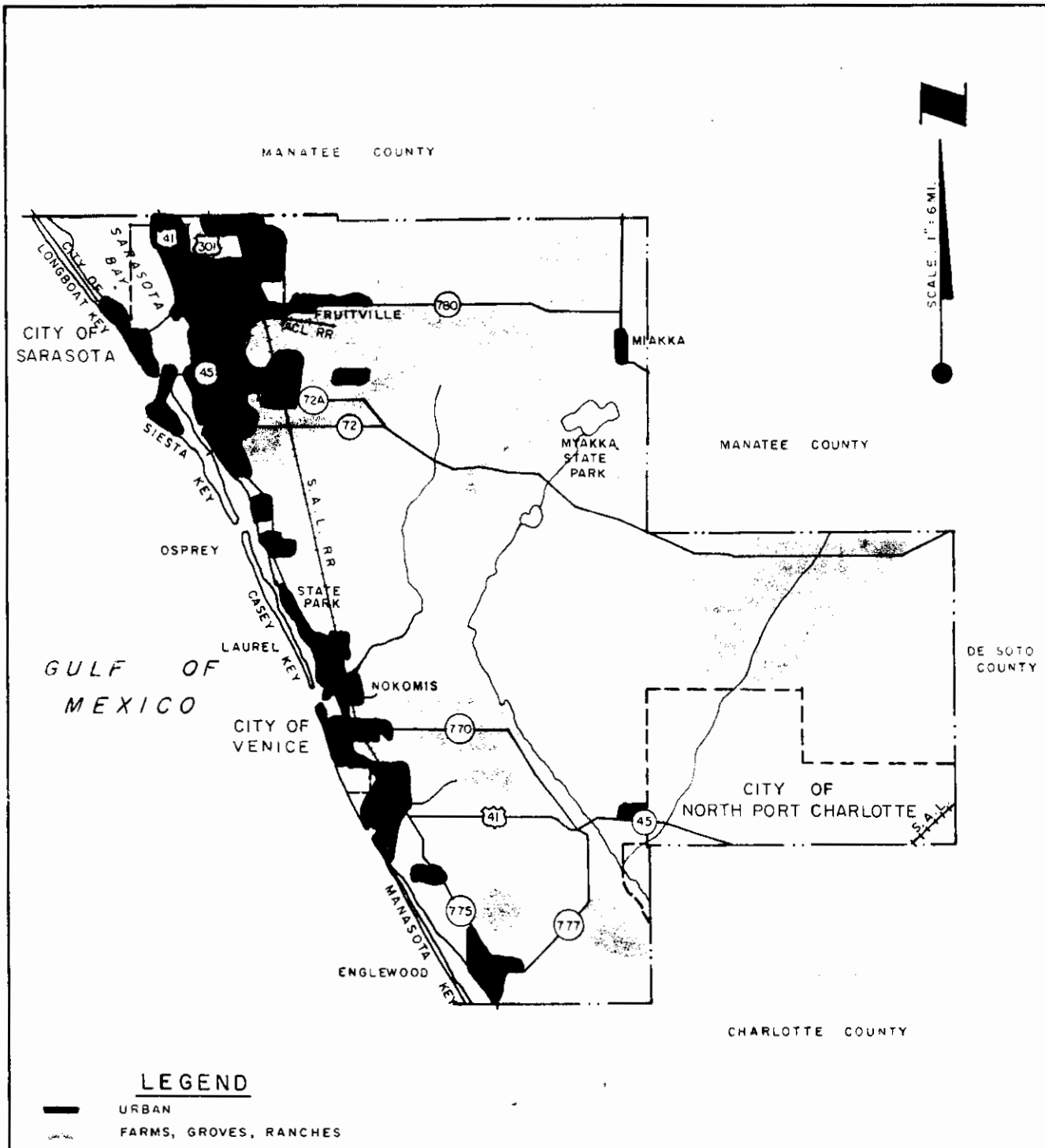
C. Land Use

Land use is the culmination of the relationship of man to nature. Exhibit "C" on the following page, maps the existing land use in a generalized manner.

Much of the presently undeveloped land, which covers a major portion of the county, contains numerous shallow wet-weather ponds. It is believed that ranching will gradually move into these areas, rather than cultivation of crops.

Because financial pressures usually guide events in our economy, when not controlled otherwise, the sequence of usage usually moves toward higher dollar values. For instance, today's farms and groves adjacent to urban areas will give way to tomorrow's urban development, when the demand arises.

Freedom to grow in this manner stems from the rights of people in this nation to use their property as they see fit. In many respects it is a self-regulating system that amalgamates a number of strong forces. On the other hand, completely haphazard growth is not always in the public interest, and many methods have been established to control the features deemed important. Road right-of-way and public parks are examples of the many interests of the public that have been recognized and have been upheld by the courts provided proper procedures are followed. Planning and zoning are modern tools to lend an organized approach to these community needs.



LEGEND

URBAN

FARMS, GROVES, RANCHES

EXISTING GENERALIZED LAND USE

SARASOTA COUNTY, FLORIDA

APRIL, 1963

SMALLY-WELLFORD & NALVEN CONSULTING ENGINEERS

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EXHIBIT "C"

D. Population

Because the population of the county and its growth rate are so closely interrelated with the jurisdictions of municipalities, water districts and franchises, the population aspects of the county will follow the next section of the report, which reviews these jurisdictions.

IV. LOCAL WATER SYSTEM JURISDICTIONS

A. General

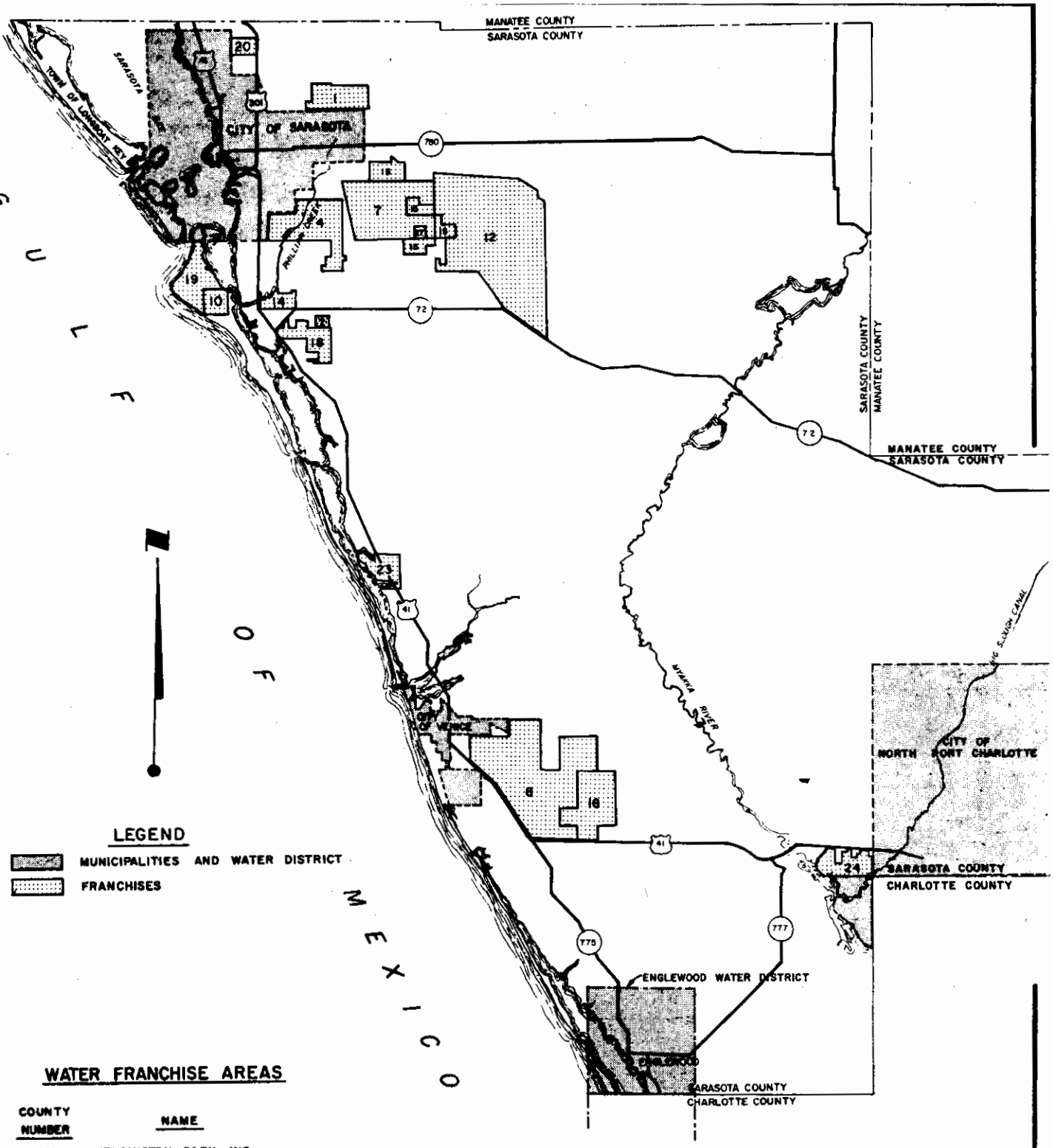
About 60 percent of the total county population is now supplied with water by public utilities, which have a total capacity of about 10 million gallons per day. There are three basic types of local water system ownerships at this time:

1. Municipal
2. District
3. Franchise

Exhibit "D" on the following page shows the boundaries of all municipalities, districts and franchises now existing in Sarasota County. There are 18 water utilities, three being municipalities, one a district and the remaining 14 franchised systems. These classifications probably encompass the future as well, unless the county should set up a public water system not within the legal framework of a district, which seems unlikely.

The fundamental role of any local system is the distribution of water to consumers, and almost invariably the system will have exclusive jurisdiction over distribution within its boundaries. The source of a water supply, however, need not be located within these boundaries, although it usually starts out that way. Once outside of its own boundaries, the system's special rights become limited, and such procedures as purchase of land and use of right-of-way must follow patterns acceptable to other jurisdictions. Many local water distribution systems elsewhere purchase their water from others, whether raw or treated, and this kind of arrangement appears likely to commence soon in Sarasota County, probably starting with smaller franchised systems.

Municipal and district systems are forms of public ownership, and are sanctioned by the state legislature either directly or indirectly. Franchised systems



WATER FRANCHISE AREAS

COUNTY NUMBER	NAME
1	KENSINGTON PARK, INC.
2	DOUBLE TEN (SHADOW LAKES)
4	SOUTH GATE WATER & SEWER CO., INC.
7-15-17	SOUTHERN GULF UTILITIES, INC. (BRENTWOOD, RIDGEWOOD)
6	VENICE GARDENS UTILITIES CORP.
10	SIESTA GULF CORP. (SIESTA ISLES & VICINITY)
12	SOUTHEASTERN DEVELOPMENT & UTILITIES, INC. (LAKE SARASOTA, BERKSHIRE ESTATES)
14	PHILLIPPI GARDENS UTILITY CORP.
16	EAST WATER CORP. (VENICE EAST)
18	GULF GATE UTILITIES, INC.
19	SARASOTA BEACH WATER SYSTEM, INC. (SIESTA KEY MISC.)
20	CONSUMERS UTILITIES CORP. (TRI-PAR TRAILER PARK)
23	C.E. PITTS (SORRENTO SHORES & VICINITY)
24	B & B UTILITIES, INC. (TRAILER ACRES)

BOUNDARIES OF PUBLIC WATER UTILITIES

SARASOTA COUNTY, FLORIDA

SMALLY · WELLFORD & NALVEN SARASOTA, FLORIDA

APRIL, 1963

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EXHIBIT "D"

on the other hand, are privately owned, and usually are circumscribed in many ways to protect the rights of the public whom they serve. The publicly owned systems may be considered to be perpetual in nature, whereas the franchised ownerships are for a fixed period, may change hands privately or may be acquired by the public.

B. Boundaries of Systems - General

Of the main elements of this investigation, the most difficult to come to grips with is the future of the distribution systems.

Nature does not have a voice in the jurisdiction and legal modifications of society, whereas under our system of government the public retains the ultimate power, and exerts continued pressures upon the office holders who are temporary custodians of the power. This political system places a great handicap upon forecasts of the future, which contain inherent inaccuracies under any circumstances. Yet attempts must be made, or else intelligent planning becomes impossible.

C. Municipalities - General

The classical pattern of the past in the United States has been that municipal services are supplied by cities, whether or not a particular system might be owned by the city or franchised by the city. A city was established when a population center reached a reasonable size and density. As the surrounding areas grew in population they were annexed. This is a logical sequence, and if the pattern applied to Sarasota County, the water supply problems would be greatly simplified, along with the tasks of the engineers and planners who must attempt to look ahead.

There have always been exceptions to this rule, such as the artificial expansion of the City of Sarasota far beyond its present limits in the boom days of the 1920's, which has been repeated recently by the City of North Port Charlotte. Today's trend is mainly the reverse. Urbanized areas fringe the boundaries of cities to a depth of many miles, but are not annexed. South Gate subdivision is an example.

Resistance often comes from people outside the cities, but sometimes cities do not wish to expand, like San Francisco. A tendency toward the status quo develops to avoid public heat and friction which would end in futility.

Sometimes an urbanized area will incorporate as a separate city or town if the people feel they need to protect their own interests. This is a common event in Florida. Greater Miami contains 19 cities, some of them almost surrounded by others, and the problems produced by this fragmentation probably are more responsible for the controversial Metro government of Dade County than anything else.

Reality must be faced. Therefore it is assumed that any expansion of the boundaries of the Cities of Sarasota and Venice and the Town of Longboat Key will be limited. If the future brings a change in the attitude of the public, corresponding adjustments will have to be made in planning. Judicious engineering and planning can apply sufficient advance flexibility in the design of public works to minimize modifications that may become necessary.

D. Water Districts - General

If the municipalities do not provide water distribution to urbanized areas in unincorporated parts of the county, who will? Generally services of this nature will be supplied by a special district or by a franchised public utility.

A special district is either created by a separate statute of the state legislature or else under general procedures established by a more comprehensive act. The Englewood Water District is an example of the former, which was particularly appropriate because the district covers lands in both Sarasota and Charlotte Counties.

A proposed special district for the lower Phillippi Creek area, to provide both water and sanitary sewer services, was studied at the request of the Board of County Commissioners, and a comprehensive engineering report was issued in

December 1958. Upon the Board's engaging of a financial adviser, a supplementary report was issued in April, 1960. A planning loan for the preparation of plans and specifications was approved by the Housing and Home Finance Agency, but a change in county policy caused postponement. These reports remain pertinent to this day, and should be reviewed.

The state legislature undoubtedly could pass a general or special act which would permit the formation of water distribution districts under the guidance of the Board of County Commissioners, similar to the existing special acts covering water conservation districts. An act of this nature invariably contains safeguards to protect the interests of the people within the district and the county at large. Water districts are generally self-financing, and hence are no burden to taxpayers not residing within them.

E. Franchises - General

Although municipalities often grant franchises for utilities, they usually operate their own water systems. The franchises discussed herein are all in unincorporated areas of the county.

Privately owned and operated water and sewerage systems have existed for many years in Florida, but only recently has it been possible to establish franchises as a means to define and protect legitimate public and private interests. The 1957 state legislative passed House Bill 1833 which authorizes Boards of County Commissioners to issue franchises.

Sarasota County began issuing franchises in 1958. Exhibit "D" previously cited delineates all existing franchises. There are 16 of these under 14 utilities, three contiguous franchises being operated by one firm. The franchises run for 20 years.

Most franchises are established by land developers, although usually as a separate corporation, who are required to furnish water and sanitary sewerage systems under the subdivision regulations. A number were initiated prior to this requirement. The economic feasibility of the utilities may be secondary to the overall development feasibility. A lot-type subdivision operates under a financial handicap for many years if expensive water lines (and sewer lines) are installed when houses fill in gradually, whereas a builder-development or a lot development which controls the sequence of house construction would operate in the black much sooner.

Size is a problem in most cases. A small water system suffers from disproportionate overhead expense, and even the larger franchised areas start small and expand by stages. This problem is especially severe as to plant facilities, the cost per person served increasing rapidly as the size is reduced. For this reason a source of treated water available at wholesale rates to the franchise holder could be an attractive arrangement. He could forget his plant problems and costs, and concentrate on the operation of a retail distribution system.

The utility corporation may be built or owned initially by other interests with whom the developer negotiates a mutually acceptable arrangement. In many other cases, the utilities are sold after they have gained sufficient maturity to make them more attractive financially.

Such sales may be at such a price that it could be uneconomic for a public utility to purchase the system at a later date. This is particularly so if a water system is sold separately from a sanitary sewerage system, because often the profits of the former carry the losses of the latter. The county should discourage or prohibit such separate sales, under its franchise regulations, especially considering that the county could be left with a white elephant on its hands if a sewerage system were abandoned, as has happened elsewhere.

The attractive features of franchises are that they provide water (and sewerage) facilities without burdening the taxpayers at large, and they permit the initiative of the free enterprise system to promote growth of the community. However, unless they are guided wisely from the start they can create a haphazard situation that would serve neither their operators nor consumers well, and could blockade orderly growth of an area both physically and economically. Comprehensive plans of a generalized nature are required for the orderly integration of separate systems at some future date.

A franchise usually grants an exclusive right to private interests, and the people that live within the area become the captives of a natural monopoly, usually willingly under county procedures. In return, the franchise owner must accept obligations to the public. The franchise regulations provide for reviews of the rates charged. A more difficult public right to protect, without unfairly burdening a franchised utility in some instances, is the right to be served.

Considering financing problems and other disadvantages, and the recommended public policy of not issuing a water franchise without a concurrent sanitary sewer franchise, it is unlikely that private franchised systems will represent large consolidations of the future. Municipalities and public districts are probably the means to this end.

F. Review of Local Water Systems

A brief review of each local water system follows. The anticipated population growths of the areas served by these systems are outlined under Section V.

Exhibit "T" at the end of the report collates comparative data which has been assembled concerning all the water systems in Sarasota County. This information has been collected from a number of sources, largely from the utilities themselves, and is believed to be sufficiently accurate and comprehensive for the purposes of this preliminary report.

1. City of Sarasota

The City now serves most of its residents, who number some 40,000 persons. Although it is the most mature urban community in the county, about half of its 17 square miles remains to be developed.

The City utilizes the deepest wells used by any existing public water facility, ranging from 550 ft. to 850 ft. deep. These are high capacity units in the upper Floridan aquifer or lower Hawthorn, and the 21 wells range in size from 6" to 12". The water is aerated, softened by the zeolite process, blended with raw water to the desired hardness, and chlorinated. As set out in Section VII, the raw and treated water is excessively high in sulfate (672 ppm) and total dissolved solids (1690 ppm) being by far the most mineralized of any water used for a public supply in this county.

It is also the hardest of the hard, 1,000 to 1,400 ppm, but is reduced by treatment to the order of a soft 85 ppm.

Because of its mineral content, the water is corrosive, scale-forming and unpalatable. It has laxative effects for the unacclimated, represented in large numbers by tourists, and may not be healthful for persons with high blood pressure and heart conditions. Its availability, finished softness and clear appearance are its only known virtues. A detailed comparison between the raw and finished product appears in Section VII.

The present capacity of the plant is 6 million gallons per day to serve an average usage of 4 MGPD. The City's consulting engineers estimate that an anticipated improved raw water supply from the northeast county area might have the effect of increasing the plant capacity to 10 MGPD. This would approach the ultimate needs of the City within its present boundaries.

The St. Armands-Lido Key auxiliary plant and Bay Island on Siesta Key will undoubtedly be served by the mainland plant in the future.

Fire protection is furnished, hydrants being spaced at about 1,000 ft.

2. City of Venice

Venice was laid out by professional planners about 35 years ago, and is an attractive community that is now growing rapidly. About 3,900 persons are served out of an ultimate 20,200, which might be even greater if the city serves water to areas outside its limits as it has done before.

The wells tap a relatively shallow field, being 65 ft. to 140 ft. deep. Because of the limited capacity of this aquifer, multiple wells of small unit capacity are employed, 32 wells of 2 ins. to 4 in. size. Imminent construction of the intracoastal waterway through Venice will jeopardize the quality of these wells, and the cost of relocation would be paid by the waterway district.

The raw water supply meets most of the U.S.P.H.S. standards, marginally so in some respects, except for the total dissolved solids being 770 ppm as compared to 500 ppm recommended. The color is a little high, but this is undoubtedly reduced by aeration. The water is excessively hard, 594 ppm.

The only treatment is aeration, sedimentation-storage and chlorination. It would appear that the addition of softening would make this water suitable for some years to come. The present plant capacity is 0.6 MGPD compared to an average daily demand estimated at 0.4 MGPD. Fire protection is supplied by hydrants spaced at about 1,000 ft.

3. City of North Port Charlotte

The existing water system serves a population of 1,100 persons, which is the nucleus of a conceivable 284,000 in the distant future, based on the huge land holdings of the developers who incorporated this city.

Very shallow wells are employed, 45 to 50 ft. deep. There are 14 of these wells, all 2 inch. A salinity dam in the stream near the water plant impounds fresh water. The color of the water is a dark 55, which probably reflects its local recharge from surface waters and the wisdom of constructing the dam to protect them. High iron content is not surprising for this source.

Fluoride has been reported as low as a good 0.5 to as high as 1.86 ppm, which exceeds the permissible limit. The water is hard at 429 ppm. Total dissolved solids are a little high, 650 ppm. Sulfate and chloride do not appear to be problems.

All of the unacceptable qualities of the raw water are susceptible to treatment, and owners have met their responsibility by installing the most complete treatment in Sarasota County. The treatment includes lime, soda-ash, alum, calgon, chlorine and filtration. The analysis of finished water, as reported, is clear and soft, fully meeting U.S.P.H.S. standards, except apparently marginal in fluoride at times. This appears to be one of the best waters now supplied by any system in the county. A comparative analysis between the raw and finished product is tabulated in Section VII.

The future supply for this city hinges on future sales by the developer. It cannot be assumed that the ultimate supply will represent an enlargement of the present source and treatment, because this shallow well source may be limited. The present capacity is 0.216 MGPD.

There is no provision for fire protection.

4. Englewood Water District

This district straddles the Sarasota-Charlotte County line, and serves an important although unincorporated population center. The system is under construction, and limited available information permits only preliminary generalizations.

Englewood has been a particularly difficult area in which to obtain water of even marginally acceptable quality. Salt water contamination is common, and many residents depend on very shallow wells which may be vulnerable to pollution and seasonal fluctuations.

The State Board of Health advises that an apparently acceptable source has been obtained from a shallow aquifer provided suitable treatment is applied. The analysis from one test well meets U.S.P.H.S. standards in all respects except for an extreme color problem represented by a very high index of 100 and described as a tea color. It is believed that a lime and alum treatment will be applied, with supplementary measures as needed. The raw water appears to be fairly hard, 330 ppm, but the above treatment should soften it adequately.

Because the population is thinly concentrated in some parts of the district, not all areas will be served initially, and the water rates will be comparatively high in order to finance the installation. As the population fills in the open spaces, the rates should come down and the system will be expanded to serve the entire district.

5. Kensington Park, Inc. No. 1
(County Franchise No. 1)

This franchise is the first one granted by the Board of County Commissioners, in 1958. The subdivision served is rapidly nearing completion, which will probably take place within the next two or three years. The present population is 3,100, the ultimate about 4,800 persons.

The water source is shallow to medium depth wells, from 73 ft. to 220 ft. deep. There are 24 wells, 3", 4" and 6". The quality of the raw water meets U.S.P.H.S. standards except for fluoride, which reaches about 1.9 ppm. Hardness is moderate, 288 ppm. Review of successive analyses over the years indicates that there may be some progressive deterioration in quality, especially in fluoride increase. This might be caused by uncontrolled irrigation wells installed by many residents.

Like all other franchised systems, treatment includes only aeration, sedimentation-storage and chlorination. Fluoride and hardness are not affected by this treatment. Plant capacity is now 0.42 MGPD.

Fire protection is provided by a hydrant system with 1,000 ft. spacing.

6. Double Ten (County Franchise No. 2)

This system serves the small Shadow Lakes subdivision. 130 persons are served out of an ultimate 500. Gulf Gate, which adjoins, recently acquired the franchise, but the systems have not yet been integrated physically.

One 4 inch shallow well, 65 ft. deep, furnishes water acceptably within reach of the U.S.P.H.S. standards. Hardness is moderate, 299 ppm.

Treatment is the usual aeration and chlorination. Plant capacity is 0.045 MGPD. There is no provision for fire protection.

7. South Gate Water & Sewer Co. Inc. (Franchise No. 4)

South Gate serves the most people of any existing franchise, 4,500. The ultimate population is about 12,400 and steady growth toward this level in the high growth area is anticipated for the immediate years to come.

Medium depth wells are used for supply, from 280 to 350 ft. deep. There are 8 of these in service, all 6 inch, and another is ready.

The raw water analysis reveals a quality that meets U.S.P.H.S. standards. The water is hard at 389 ppm.

Aeration, sedimentation-storage and chlorination are applied. Hardness is not reduced. The present plant capacity is 1.0 MGPD.

Fire protection is provided by hydrants spaced at 1,000 ft.

8. Southern Gulf Utilities Corp. (Franchise No. 7, 15 & 17)

This utility holds three franchises, as captioned, serving Brentwood and Ridgewood subdivisions. The population served is 1,050 out of an ultimate 22,800, which will not be reached for some years.

Two relatively shallow 6 inch wells, 100 ft. deep, presently supply the system. An analysis furnished for Well #2 indicates that the quality meets U.S.P.H.S. standards (barely for fluoride) except that the total dissolved solids are moderately high at 639 ppm. The water is hard, 351 ppm. Aeration, sedimentation-storage and chlorination constitute treatment. Capacity is 0.35 MGPD.

Fire protection applies in some areas, not everywhere. Hydrants are spaced at 1,000 ft.

9. Venice Gardens Utilities Corp. (Franchise No. 8)

780 persons are now served out of an ultimate 36,800 in this large franchise which covers 4,600 acres. Although this is an actively growing subdivision, saturation is obviously some years in the future.

The water source is relatively shallow, 100 ft. to 140 ft. There are 10 wells, all 4 inch. Analyses from a number of these wells indicates that the composite meets U.S.P.H.S. standards in all respects. The water is moderately hard, 289 ppm.

The aeration-sedimentation-storage-chlorination plant has a capacity of 0.129 MGPD.

The operator of this utility has filed complaints with the county that irrigation wells drilled for individual lot owners interfere with the wells supplying the water system.

10. Siesta Gulf Corp. (Franchise No. 10)

This franchise is essentially for Siesta Isles subdivision, but serves a number of nearby facilities, including Twin Oak Ponds subdivision, and may expand further. It is located on Siesta Key, and presently serves 240 people out of a potential 1,900. Growth in this subdivision will continue steadily in this desirable location.

The wells are 110 ft. to 150 ft. deep, there being 5 of these, 2 in. and 3 in.

The water quality meets U.S.P.H.S. standards except for a slightly high total dissolved solids content, 620 ppm. It is hard at 455 ppm.

Capacity of the aeration-sedimentation-storage-chlorination plant is 0.150 MGPD.

There is no provision for fire protection.

11. Southeastern Development & Utilities Inc. (Franchise No. 12)

This is the largest franchise in the county, 6,600 acres, covering the original Lake Sarasota subdivision holdings, now being developed under the name of Berkshire Estates. A small population of 140 is now served, and population growth will take many years to fill out this area.

The water source is fairly deep, 390 ft. and is tapped by one six inch well. A 1959 chemical analyses meets U.S.P.H.S. standards in all respects, but is hard at 448 ppm.

The water plant has a capacity of 0.096 MGPD. Hydrants for fire protection are spaced at 1,000 ft.

12. Phillippi Gardens Utility Corp. (Franchise No. 14)

This 210 acre subdivision is surrounded by urbanizing areas and its growth should continue steadily to completion. 400 persons are now served out of an ultimate 1,700.

There are three wells, 4" and 6", of medium depth, 112 ft. to 160 ft.

Except for high total dissolved solids, 929 ppm, the quality of the raw water appears to meet U.S.P.H.S. standards. The water is hard at 376 ppm.

Plant capacity is now 0.150 MGPD. Five hydrants are spaced at 1,000 ft. for fire protection.

13. East Water Corp. (Franchise No. 16)

This utility supplies Venice East subdivision, the holdings of which cover 1,400 acres. There are now 120 persons, and full development will take a number of years.

Three 4 inch wells supply water from a relatively shallow depth, 100 ft. to 110 ft.

Review of analyses of these wells indicate that the composite meets U.S.P.H.S. standards in all respects. The water is fairly hard at 314 ppm.

The treatment plant has a capacity of 0.054 MGPD. No fire protection is provided.

14. Gulf Gate Utilities, Inc. (Franchise No. 18)

This utility was established primarily to serve Gulf Gate subdivision, but its franchise or service arrangements have been expanded to include Siesta Heights Manor, Gulf Gate Manor, and Cedar Cove Trailer Park. The Double-Ten franchise, serving Shadow Lakes, has been purchased as noted above.

About 720 acres ultimately will be provided for. The population now served is 500, which can be expected to grow steadily in this urbanizing area to about 5,800 persons.

Three wells of 4 in. and 6 in. size are of medium depth, 102 to 170 ft. The raw-water analyses reveal moderately high, although not excessive, total dissolved solids (654 ppm) and a water which is hard at 430 ppm. Fluoride exceeds U.S.P.H.S. standards, being 1.65 ppm compared to a maximum of 1.4 ppm.

The usual aeration-sedimentation-storage-chlorination treatment has a capacity of 0.131 MGPD.

Hydrants are spaced at 1,000 ft. for fire protection.

15. Sarasota Beach Water System Inc. (Franchise No. 19)

This utility existed long before the franchising regulations. Its franchise area begins at the City of Sarasota limits and covers 1,072 acres, being the largest water franchise on Siesta Key.

Established areas that are within the franchise include: Sarasota Beach; Sara Sands; Siesta Manor; Mira Mar Beach; Sandy Hook; Ocean Beach; Siesta Beach; Revised Siesta; Miscellaneous.

700 people are now served compared to a potential of about 8,600 which will fill in steadily in this desirable area.

The water source is moderately deep, 215 to 315 feet, and is tapped by three wells, 4 in. and 6 in. The raw water is high in total dissolved solids (1,140 ppm) and sulfate (506). It is very hard at 660 ppm.

The usual aeration-sedimentation-storage-chlorination treatment does not affect the above characteristics, and only hardness reduction could be accomplished by additional conventional treatment.

Plant capacity is 0.446 MGPD. There is no provision for fire protection.

16. Consumer Utilities Corp. (Franchise No. 20)

This utility serves Tri-Par Estates subdivision for trailers. Its 94 acres will concentrate about 1,300 persons, of whom 300 now reside there. The plans call for increasing their development and franchise to a total of 167 acres, corresponding to about 2,400 or more persons.

Two fairly deep 6 inch wells reach 350 and 460 ft. The analysis of Well #1 reveals that it is somewhat high in total dissolved solids (820 ppm) and moderately exceeds the recommended sulfate limit (298 ppm). The water is hard at 404 ppm.

The plant capacity is 0.288 MGPD. Fire protection is furnished by hydrants spaced at 500 ft.

17. C. E. Pitts (Franchise No. 23)

This franchise, owned by the developer of Sorrento Shores, includes the following subdivisions: Sorrento Shores; Venetian Gardens; Spring Hill Park; Havanna Heights.

The area covered is 640 acres with a potential of 5,100 persons.

The water system is under construction and technical data is not available. Initial plant capacity is to be 0.315 MGPD and ultimate capacity 0.613 MGPD.

18. B & B Utilities, Inc. (Franchise No. 24)

This utility will serve the new Trailer Acres development which is now under construction near Warm Mineral Springs. The 710 acres could provide for an ultimate 10,000 trailer population.

The future intention is to provide for a surface water supply by impoundment behind a salinity dam. Meanwhile four 2 inch wells have been drilled as an initial stage. These are exceedingly shallow, 22 to 29 feet deep, and therefore are exposed to seasonal variations and contamination like the surface water that will recharge them. Proper operation under the health authorities should control any such condition.

The quality of the water when drilled, as revealed by chemical analyses, is slightly high in total dissolved solids (659 ppm), but otherwise meets U.S.P.H.S. standards. However it is very hard at 555 ppm.

Complete information will not be available until the system is placed in operation. It is understood that there are no provisions for fire protection.

G. Geographical Distribution

The geographical distribution of the water systems follows the pattern of population growth discussed elsewhere in the report, as would be expected. However, this correlation is only approximate because certain franchises have been granted, such as the huge one at Lake Sarasota (County Franchise No. 12) which may be well ahead of prospective population growths. Everywhere the jurisdictional outlines are irregular, reflecting complex legal, developmental and public considerations.

The ultimate pattern of an urbanized area along the coast but stretching deep inland, and turning east with U. S. 41 becomes apparent. Future projections developed in the report reflect this pattern.

V. POPULATION GROWTH

A. General

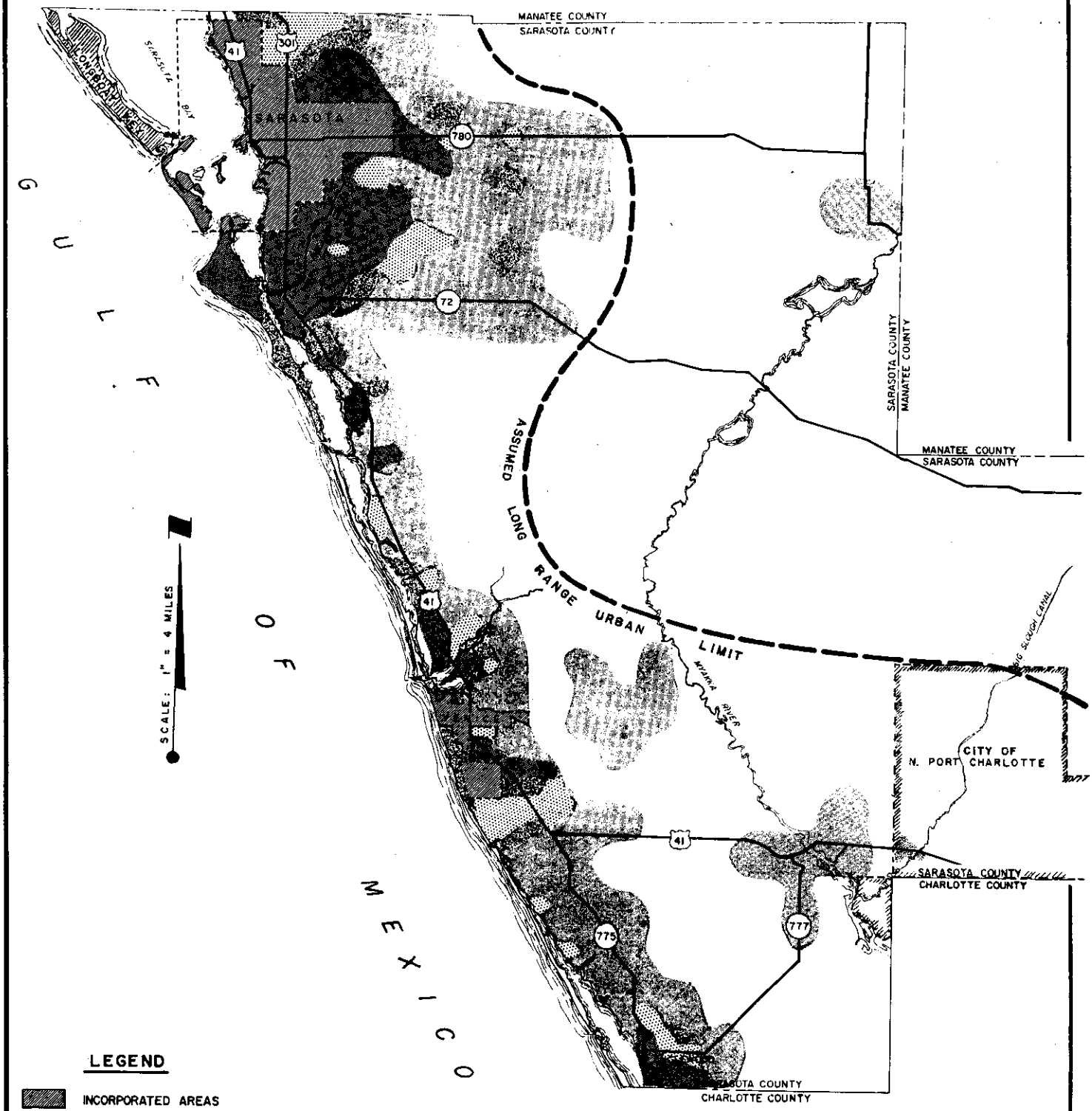
The objective of this study is to relate the water resources to the people to be served. This part of Florida grows so rapidly that problems of the future cross the threshhold even before accumulated problems of the present can be solved. There is no more important aspect of this study than an analysis of population characteristics and distributions projected into the future.

The migration and procreation of a free people is not readily predicted. Even as to the total national population, which is not affected by internal migration, the capable U. S. Census Bureau has been inaccurate in its projections. Demography is part art, not all science. However, for the purpose of this preliminary report a high degree of accuracy is not necessary, and reasonable approximations of future events will suffice. Adjustments and refinements to planning are both necessary and desirable as time goes by.

Exhibit "E" on the following page graphically portrays the existing population distributions in Sarasota County. The population densities are shown by different shadings, in terms of numbers of homes per square mile.

It will be noted that the largest city in the County, North Port Charlotte has no population over most of its 55.5 square miles. The great area relates to advance incorporation of the land holdings of the development corporation, and the present population of 1159 persons is concentrated in the first units platted, near U.S. 41.

Before analyzing the growth areas in detail, the following tabulations computed from Census Bureau statistics reveal significant general trends.



LEGEND

- INCORPORATED AREAS
- OVER 200 HOMES PER SQ. MI.
- OVER 100 HOMES PER SQ. MI.
- OVER 50 HOMES PER SQ. MI.
- LESS THAN 50 HOMES PER SQ. MI.
- ASSUMED LONG RANGE URBAN LIMIT (300 SQ. MI.)

SHADED AREAS = 120 SQ. MI.

PRESENT POPULATION DISTRIBUTION

SARASOTA COUNTY, FLORIDA

SMALLY · WELLFORD & NALVEN SARASOTA, FLA.
APRIL , 1963

JOB NO. 783

EXHIBIT "F"

1960 RESIDENT POPULATION

	Number of Persons	Percent of Total
City of Sarasota	34,083	44.5
City of Venice	3,444	4.5
Englewood	2,877	3.7
Balance of County	36,491	47.3
Sarasota County (Total)	76,895	100.0

The trend to outside the City of Sarasota is revealed by the above 44.5 percent in the city in 1960 as compared to 66.2 percent in 1950.

POPULATION GROWTH RATES 1950 to 1960

	Annual Rate of Increase
Sarasota County -- Overall	10.3
Unincorporated Sarasota County	15.6
City of Sarasota	6.1
City of Venice	16.9
Dade County	6.1
State of Florida	6.0
United States	2.3

The U. S. growth rate represents the net gain of total births over total deaths, and the differences between this rate and the other rates reveal approximately the effects of the population moving to Florida.

At the 1950-1960 growth rate, the population of the county would double in seven years. The Sarasota County growth rate is impressive by any standard, and ranks 14th of all the counties in the United States for this period. This growth reflects the explosive trend of the coastal areas of peninsular Florida. Waterfront, white sandy beaches and a favorable climate have proven to be a magnetic combination,

and the available raw supply is rapidly dwindling. To this is added a way of life favored by many and the growing power of a regional commercial and industrial hub.

The overall growth characteristic for a large urban area is actually a summation of many different growth factors, which have distinctive features of their own. These may be described as follows:

1. Expansion of metropolitan areas.
2. Establishment of subdivisions some distance from metropolitan areas, the large subdivisions usually being farther away because of land costs and the need for virgin tracts.
3. Small satellite subdivisions near or in between metropolitan areas and large subdivisions.
4. Gradual filling-in of the open areas between metropolitan areas and all of the other subdivisions.
5. Settlement on or near desirable land features, especially coasts, bayous, rivers and lakes.
6. Growth along major highways, such as U.S. 41.

The most unpredictable factor is the growth of large subdivisions. Unlike the established communities, whether incorporated or unincorporated, which have a history and will grow naturally, the large subdivisions have a kind of forced growth that is fertilized by advertising, promotion and the inducements of pre-planned facilities which ordinarily would follow growth instead of leading it.

If a long national recession does not intervene and the developers maintain their momentum they will have a tremendous total impact on the area population. On the other hand, if either condition is reversed, there could be a leveling off.

Whether any subdivision development will be an asset or a liability to the county depends on many factors. Control and guidance may be provided by county

planning, subdivision regulations, zoning and other tools and approaches. The overall public interest is not served solely by land development, but also by ultimate land use for many purposes, including those of the public at large.

Another factor that can have a potential effect on development is the extent and locations of large land holdings that are kept off the market. Whether these holdings will have a restraining influence will depend on future policies and events.

It is not surprising that the urban areas outside the boundaries of the City of Sarasota are increasing in population faster than the city itself. The classic pattern is that a young suburban community, considered separately from its urban core, will grow rapidly until it too becomes mature and begins to approach saturation.

B. Projections - General

There is little about the history of Florida's post-World War II growth to inhibit optimism, and many studies continue to reflect high growth rates. However, a certain amount of caution should be injected as to future projections.

Florida's phenomenal growth has leaned heavily on migration. Even if this migration should continue at a constant high level, each year's influx will become a smaller percentage of the larger existing population. In addition, it is well to assume that the migration wave itself will reach a peak and gradually decline, reaching a steady level at some future date.

In addition, the limitations of saturation will itself tend to reduce the rate of increase in future years. The pattern in California, which Florida seems to be following, is a good example. Despite Los Angeles' great numerical increase since 1950, the annual rate of increase of this city has been only about 2.5% since 1950.

On the other hand, it can be assumed that in the residential suburbs of the California cities the growth rates have been much greater, as they are for suburbs of Florida cities.

For these reasons long-range projections should be tempered with conservatism, to avoid planning for events that might not transpire. Growth rates for the distant future must ultimately taper off toward the national projection which is expected to be 1.5% per year.

C. Urbanizing Areas of Sarasota County

The domestic water requirements of the urbanizing areas are represented by population, and the population studies summarized herein have been confined to these areas in order to clearly outline the scope of the problems. Rural area water requirements are often overshadowed by irrigation usage, and in any event the rural domestic demand can be satisfied indefinitely by individual wells that are widely separated.

Exhibit "E" previously cited shows two significant regional boundaries. The total shaded area, which generalizes the present populated areas, covers about 120 square miles, and the main growth to come in the next 20 years will be concentrated in and around this area. Based on a potential of 8 persons per acre by present county residential standards, the saturation population would be about 615,000 persons, which might be approached before the year 2,000. The 1980 population is estimated at about 380,000, compared to a present population of about 95,000.

Also on Exhibit "E" is a dashed line further inland, which represents the assumed long range urban limit. This must be an approximation of blending into a predominately rural area. 300 square miles are included, which is more than half the county's 586 square miles. The saturation population could reach 1,500,000 or more, but this potential is so far off in the future that it is noted here not as a prediction but as a conception for the next generation.

Accordingly, the orientation of the population study has been toward the 120 square miles shaded on Exhibit "E." Pertinent county-wide observations appear in the report as generalizations only.

D. Populated Areas Studied

The growth potential in this area is revealed by comparing population densities. The most mature community is the City of Sarasota, which now has about 40,000 people, or 3.7 persons per acre, compared to a potential saturation of about 87,000 at 8 per acre.

Unincorporated County areas within the 120 square miles also contain about 40,000 people at a density of 0.4 persons per acre, compared to potential saturation of 320,000 persons. The overall averages for the entire area are 0.8 persons per acre for the present 95,000 against a potential of 615,000 persons at 8 persons per acre.

Exhibit "F" on the following page tabulates the areas and populations for the area studied, with each water system jurisdiction listed separately. Existing conditions, projections for 1970 and 1980, and ultimate conditions are set out.

Exhibit "G", following Exhibit "F" graphically summarizes the population projections. Exhibits "H," "I," and "J" following Exhibit "G" are detailed projections curves. Every utility system area, as now delineated, is shown separately, and the rate of each approach to its saturation ceiling should be of particular interest.

SUMMARY OF POPULATION PROJECTIONS

WITHIN 120 SQUARE MILE URBAN AREA

SARASOTA COUNTY

Location	Area (acres)		POPULATION Served		Projected Year	
	Ultimate	Present Served	Ultimate	Present	1970	1980
MUNICIPALITIES						
City of Sarasota	10,900	5,000	87,000	40,000	60,000	84,000
City of Venice	2,400	440	20,200	3,900	10,500	19,000
City of North Port Charlotte (see below)	———	———	———	———	———	———
Totals - Municipalities	13,300	5,440	107,200	43,900	70,500	103,000
WATER DISTRICT						
Englewood Water District (Sarasota County portion)	4,300	—	34,500	—	5,800	13,000
FRANCHISES						
County Franchise Number						
1 Kensington Park Inc.	500	330	4,800	3,100	4,800	4,800
2 Double Ten (Shadow Lakes) Purchased by Gulf Gate	67	16	500	130	260	500
4 South Gate Water & Sewer Co., Inc.	1,550	560	12,400	4,500	8,700	12,400
7-15-17 Southern Gulf Utilities, Inc. (Brentwood, Ridgewood)	2,850	120	22,800	1,050	2,000	4,600
8 Venice Gardens Utilities Corp.	4,600	96	36,800	780	1,500	3,500
10 Siesta Gulf Corp. (Siesta Isles & Vicinity)	239	30	1,900	240	460	1,050
12 Southeastern Development & Utilities Inc. (Lake Sarasota - Berkshire Estates)	6,600	17	53,000	140	200	300
14 Phillippi Gardens Utilities Corp.	210	50	1,700	400	780	1,600
16 East Water Corp. (Venice East)	1,400	15	11,200	120	230	520
18 Gulf Gate Utilities, Inc.	720	63	5,800	500	980	2,200
19 Sara[redacted] Beach Water System, Inc. (Siesta Key Misc.)	1,072	167	8,600	700	1,400	3,100
20 Consumers Utilities Corp. (Tri-Par Estates Trailer Park)	94	21	1,300	300	1,300	1,300
23 C. E. Pitts (Sorrento Shores & Vicinity)	640	—	5,100	—	150	330
24 B & B Utilities (Trailer Acres)	710	—	10,000	—	260	1,900
Totals - Franchise Areas	21,252	1,485	175,900	11,960	23,020	38,100
Totals - Within Public Water Utility Areas	38,852	6,925	317,600	55,860	99,320	154,100
UNINCORPORATED AREAS NOT ASSIGNED TO UTILITIES (including Town of Longboat Key)	37,948	—	303,600	39,140	90,680	221,100
Grand Totals - 120 Square Mile Urban Area	76,800	6,925	621,200	95,000	190,000	380,000
MUNICIPALITY - City of North Port Charlotte (See Note)	35,500	159	284,000	1,100	2,100	4,800

Note: This City is listed separately because it represents a 55 square mile inventory for a single subdivision development that will grow at a rate and in a manner corresponding to national promotion and other non-local factors, and the potential population corresponding to its huge size would tend to obscure evaluation of the locally urbanizing areas outlined above. The geographical separation of the North Port Charlotte tract permits this separate consideration.

URBAN AREA POPULATION PROJECTION

EXHIBIT "F"

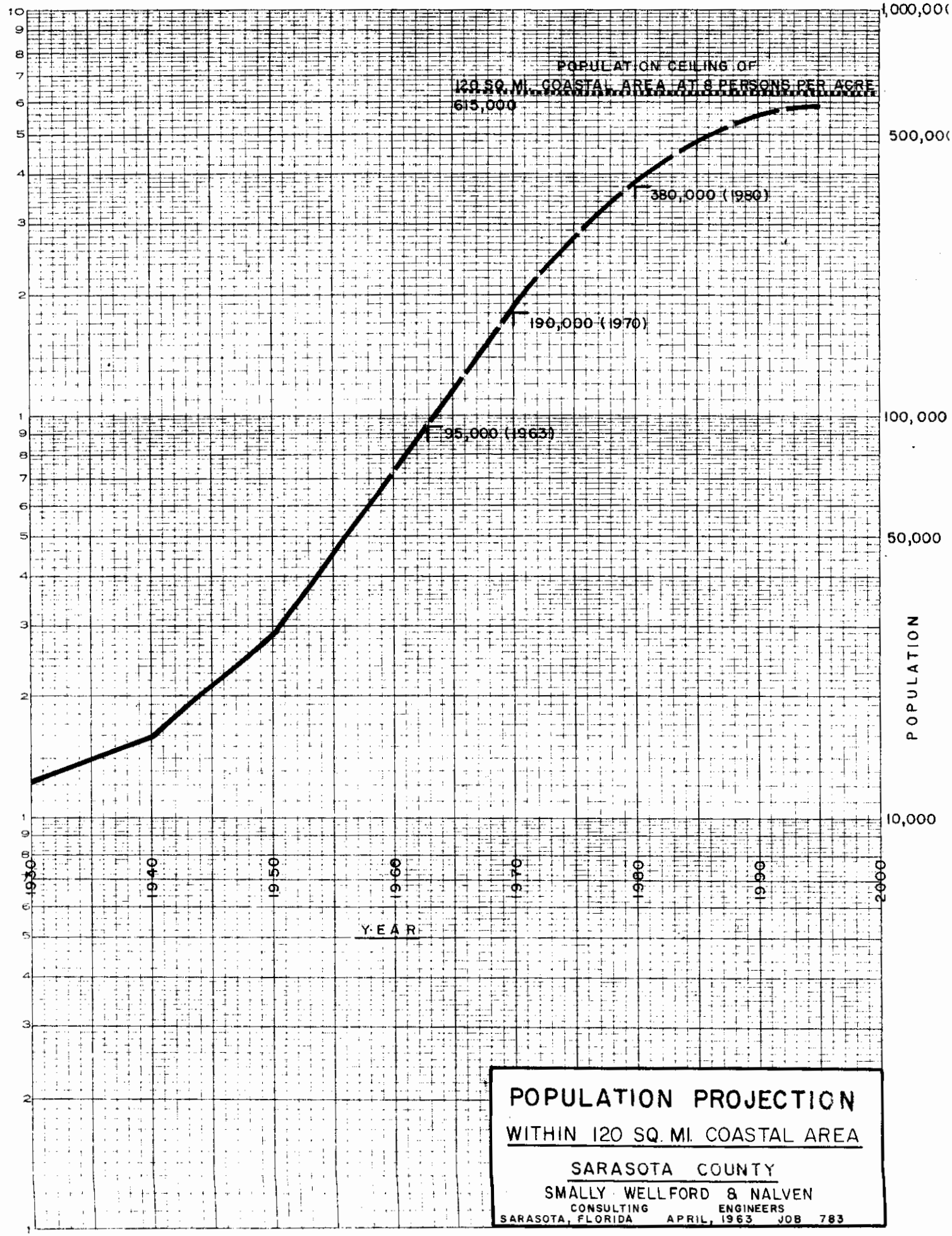

POPULATION CEILING OF
120 SQ. MI. COASTAL AREA AT 8 PERSONS PER ACRE
615,000
380,000 (1980)
190,000 (1970)
95,000 (1963)
1,000,000
500,000
100,000
50,000
10,000
POPULATION
1940
1950
1960
1970
1980
1990
2000
YEAR
POPULATION PROJECTION
WITHIN 120 SQ. MI. COASTAL AREA
SARASOTA COUNTY
SMALLY WELLFORD & NALVEN
CONSULTING ENGINEERS
SARASOTA, FLORIDA APRIL, 1963 JOB 783

EXHIBIT "G"

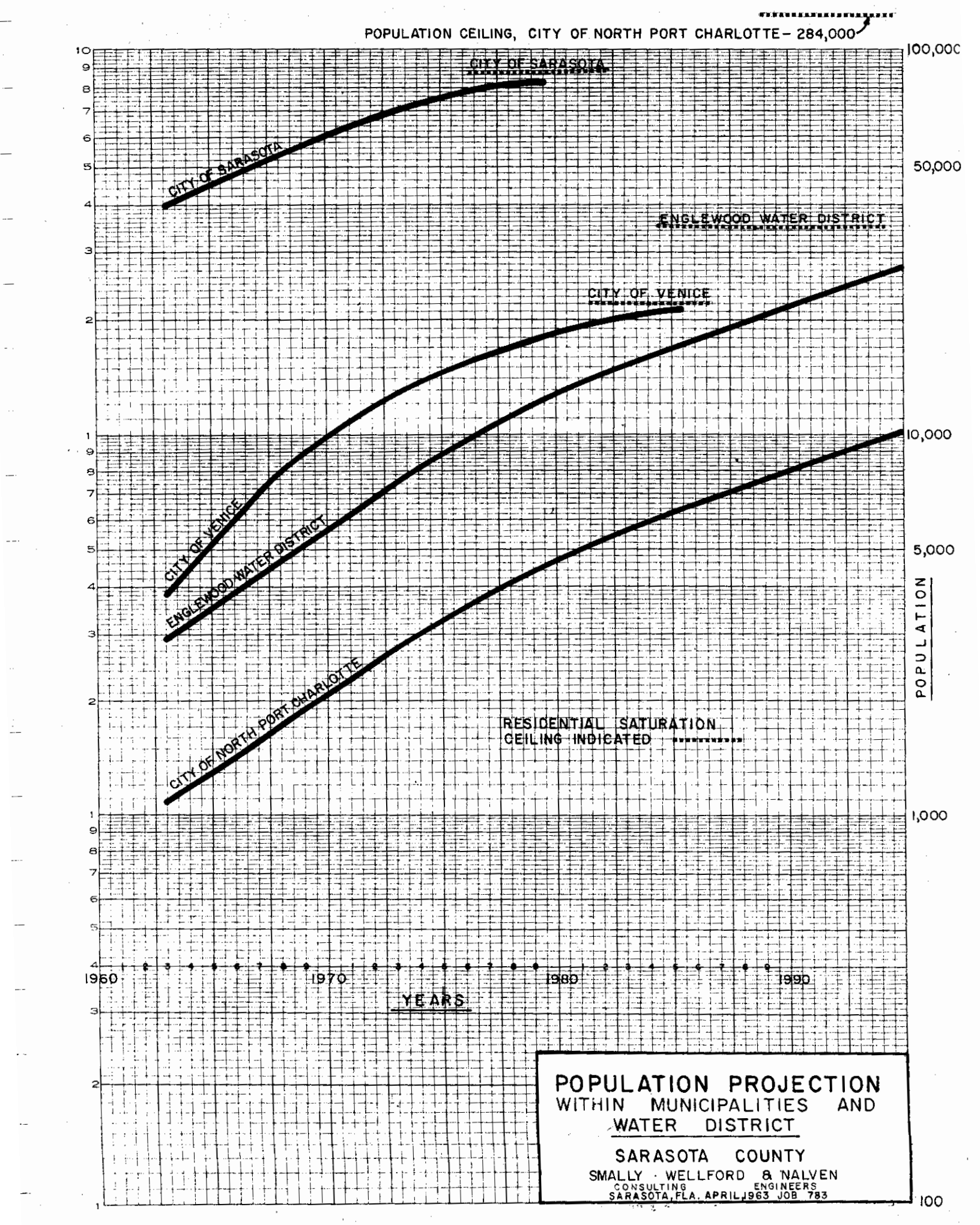

POPULATION CEILING, CITY OF NORTH PORT CHARLOTTE – 284,000
CITY OF SARASOTA
CITY OF SARASOTA
ENGLEWOOD WATER DISTRICT
CITY OF VENICE
CITY OF VENICE
ENGLEWOOD WATER DISTRICT
CITY OF NORTH PORT CHARLOTTE
RESIDENTIAL SATURATION CEILING INDICATED
100,000
50,000
10,000
5,000
1,000
100
POPULATION
1960
1970
1980
1990
YEARS
POPULATION PROJECTION
WITHIN MUNICIPALITIES AND WATER DISTRICT
SARASOTA COUNTY
SMALLY · WELLFORD & NALVEN
CONSULTING ENGINEERS
SARASOTA, FLA. APRIL 1963 JOB 783

EXHIBIT "H"

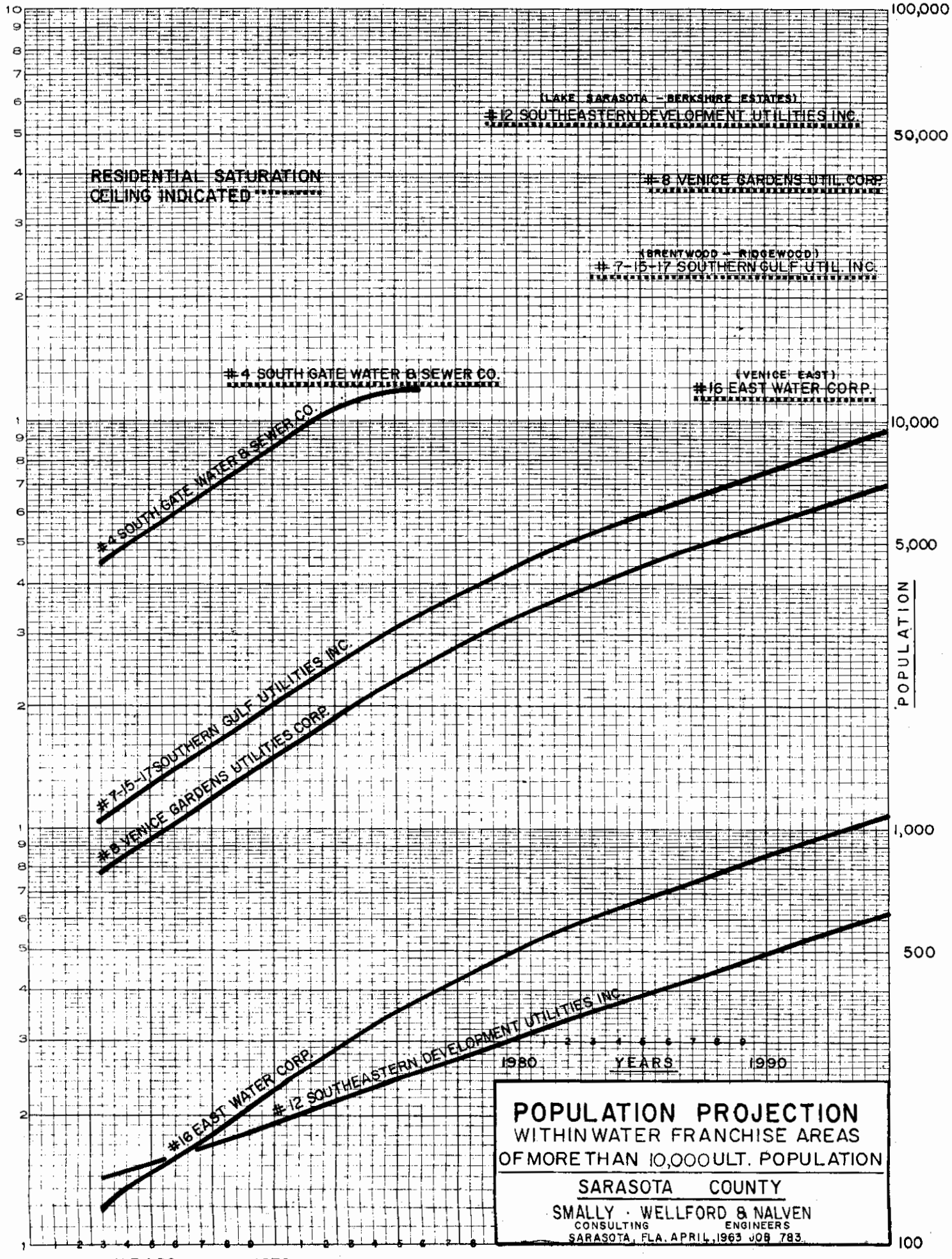

(LAKE SARASOTA - BERKSHIRE ESTATES)
#12 SOUTHEASTERN DEVELOPMENT UTILITIES INC.
RESIDENTIAL SATURATION CEILING INDICATED
#8 VENICE GARDENS UTIL. CORP.
(BRENTWOOD - RIDGEWOOD)
#7-15-17 SOUTHERN GULF UTIL. INC.
#4 SOUTH GATE WATER & SEWER CO.
(VENICE EAST)
#16 EAST WATER CORP.
#4 SOUTH GATE WATER & SEWER CO.
#7-15-17 SOUTHERN GULF UTILITIES INC.
#8 VENICE GARDENS UTILITIES CORP.
#16 EAST WATER CORP.
#12 SOUTHEASTERN DEVELOPMENT UTILITIES INC.
100,000
50,000
10,000
5,000
1,000
500
100
POPULATION
1960
YEARS
1970
1980
YEARS
1990
POPULATION PROJECTION
WITHIN WATER FRANCHISE AREAS
OF MORE THAN 10,000 ULT. POPULATION
SARASOTA COUNTY
SMALLY · WELLFORD & NALVEN
CONSULTING ENGINEERS
SARASOTA, FLA. APRIL, 1963 JOB 783

EXHIBIT "I"

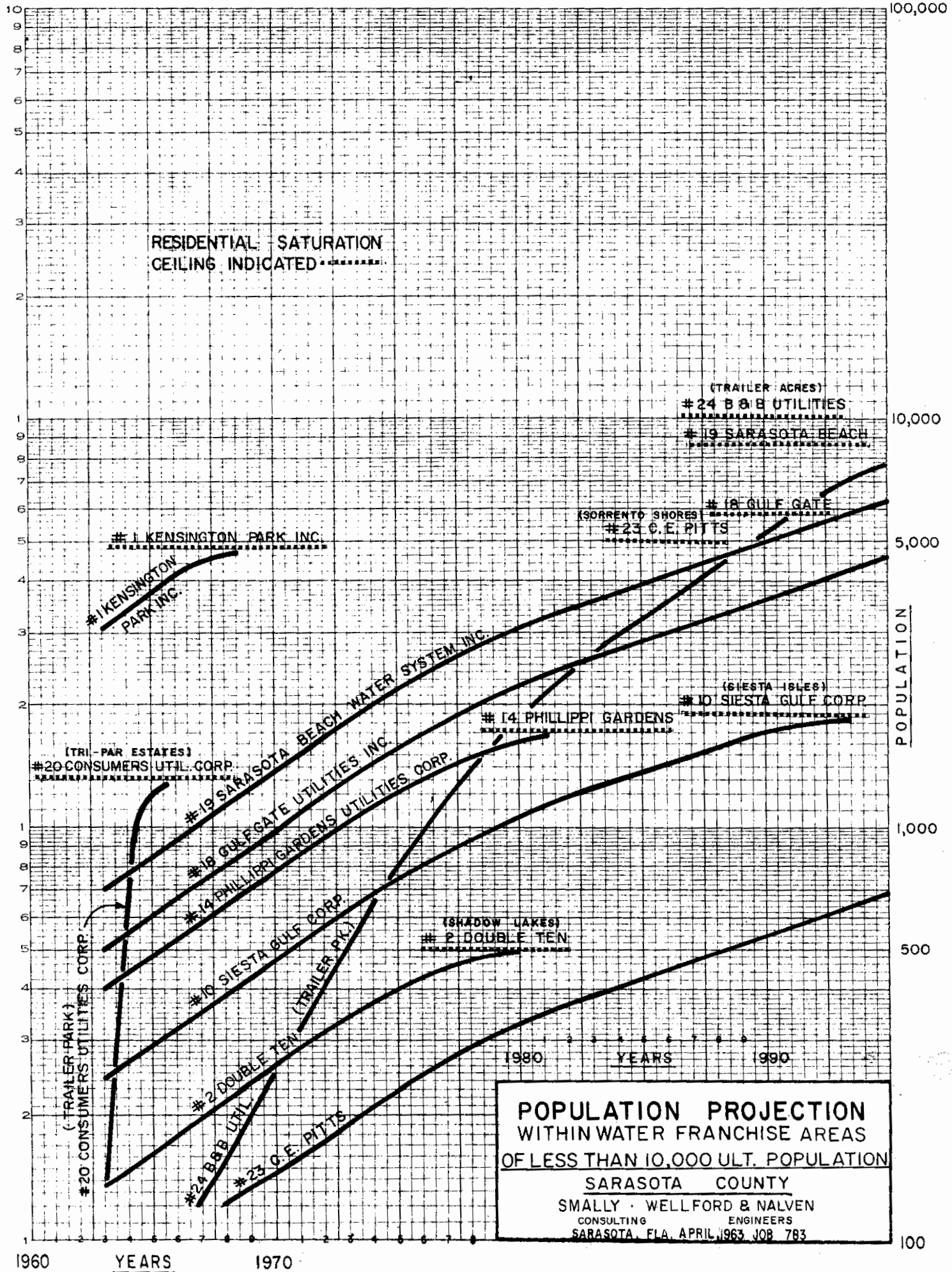

RESIDENTIAL SATURATION CEILING INDICATED
(TRAILER ACRES)
#24 B & B UTILITIES
#19 SARASOTA BEACH
#18 GULF GATE
(SORRENTO SHORES)
#23 C.E. PITTS
#1 KENSINGTON PARK INC.
#1 KENSINGTON PARK INC.
#19 SARASOTA BEACH WATER SYSTEM, INC.
#18 GULFGATE UTILITIES, INC.
#14 PHILLIPPI GARDENS UTILITIES, CORP.
(SIESTA ISLES)
#10 SIESTA GULF CORP.
#14 PHILLIPPI GARDENS
(TRI-PAR ESTATES)
#20 CONSUMERS UTIL. CORP.
#10 SIESTA GULF CORP.
(TRAILER PK.)
(SHADOW LAKES)
2 DOUBLE TEN
#2 DOUBLE TEN (TRAILER PK.)
#24 B & B UTIL.
#23 C.E. PITTS
#20 CONSUMERS UTILITIES CORP. (TRAILER PARK)
100,000
10,000
5,000
1,000
500
100
POPULATION
1960
YEARS
1970
1980
YEARS
1990
POPULATION PROJECTION
WITHIN WATER FRANCHISE AREAS
OF LESS THAN 10,000 ULT. POPULATION
SARASOTA COUNTY
SMALLY · WELLFORD & NALVEN
CONSULTING ENGINEERS
SARASOTA, FLA. APRIL 1963 JOB 783

EXHIBIT "J"

VI. INTRODUCTION TO WATER RESOURCES ASPECTS

The water needed by people must be supplied from the available resources. Fresh water resources originate from rainfall, but not necessarily upon the area being supplied or even upon the county. Nature ignores political boundaries, and the water being tapped locally may travel overland or underground a considerable distance.

The water resources are affected by a complex interplay among the physical features of the region and the hydrologic cycle. The principles of these conditions and forces as they relate to the purpose of this study will be reviewed in the sections of the report which follow.

From puny beginnings in number, knowledge and physical strength, mankind has almost suddenly harnessed tremendous forces and has acquired a staggering appetite for water, along with other natural resources. A population explosion simultaneous with an industrial and scientific revolution results in a demand for far greater water per person, directly and indirectly. Pressed by need, mankind now has the power to interfere with nature and thus create a "feedback" effect on the natural resources that he never had before.

The increasing pressures for more water and the capability to do something about it has taken many courses. They have influenced the law by which man lives, which is not surprising considering that law must relate to the needs of society. Eastern water law historically has reflected sufficient water, but is undergoing evolution in the direction of western water law which from the start corresponded to the water deficiency of its largely arid areas. Laws related to human and industrial pollution reflect new knowledge of the dangers created by our expanding civilization.

VII. QUALITY OF FRESH WATER

A. General

Water is abundant in this area, but only water of acceptable quality which can be treated economically by available methods has value as a source of supply. Before exploring where the resources are it would be wise to determine what we are looking for.

Although the requirements of people, animals and plants are not identical, not even among themselves, most waters that are totally unsuitable for one are usually unsuitable for all. The raw water used directly for farm purposes usually must be treated for people. For the purposes of this report, reference will be made to the standards of the U.S. Public Health Service.

There are no permanently fixed and exact criteria for water quality. Scientists are learning more all the time about the effects of organic and inorganic chemicals in the water supply. Simultaneously, changes in the water available are occurring: The increase in population and industries add pollutants and require the re-use of waste water. New factors such as radiation fallout from nuclear bomb testing are appearing. Esthetic factors such as color require public acceptance, and must be re-evaluated.

With the assistance of a special advisory committee, the U.S. Public Health Service revised the U.S.P.H.S. Drinking Water Standards in 1962, the previous revision being in 1946. The characteristics considered may be grouped as follows:

1. Bacteriological safety.
2. Physical characteristics affecting sight, taste and smell.
3. Previously established standards for chemical substances such as chlorides.
4. New household chemicals, such as the synthetic detergents.
5. Industrial chemicals such as chromium.

Note: An excellent discussion of possibly ideal water characteristics appears in AWWA Journal, Nov. 1963 as "Progress Report on Water Quality Criteria" by E.L. Bean.

6. Radioactive materials.

7. Consideration of intake of toxic substances from food and air, in evaluating the above.

8. Corrosiveness

B. Bacteriological Quality

Public Health specialists equate bacteriological quality to organisms of the coliform group, although other organisms are the disease carriers. Coliform count and control provide a simple yardstick which has been found effective, except for some evidence in recent years that viruses may escape detection by the routine tests.

Local pollution of this type is usually the result of an accidental condition, such as seepage from septic tank effluent. In general the closer the water supply to the surface the greater the possibility of exposure. Surface water supplies and shallow wells are thus the most susceptible, and deep well supplies are more likely to be safe in this county, although this cannot be taken for granted.

Public water supplies are checked routinely under requirements established by the State Board of Health, and therefore the potential hazard is not as great for central systems as for the thousands of individual wells, which are usually fairly shallow, especially in urban areas of concentrated population which also have septic tanks.

C. Physical Characteristics

Impurities that could offend the sight, smell and taste may not be harmful in themselves, but can cause people to turn to alternative supplies that may be unsafe. Public acceptance is a requisite for success.

Comparative test units have been established to serve as an approximately consistent measurement for certain of the factors involved:

RECOMMENDED LIMITS FOR PHYSICAL CHARACTERISTICS

	Limit
Turbidity	5 Units
Color	15 Units
Threshhold Odor Number	3 Units

Local water can usually be treated economically to reduce the above to acceptable limits. Chemicals causing unpleasant taste are more variable and certain ones cannot be removed economically at this time.

D. Chemical Substances

After consideration of the new information on old chemicals and reviewing available data on new chemicals, the following revised standards have been established:

RECOMMENDED MAXIMUM CONCENTRATION

Substances	Parts Per Million (mg/liter)
*Alkyl Benzene Sulfonate (ABS)	0.5
Arsenic (As)	0.01
Chloride (Cl)	250.
Copper (Cu)	1.
Carbon Chloroform Extract (CCE)	0.2
Cyanide (CN)	0.01
**Fluoride (F)	0.8
Iron (Fe)	0.3
Manganese (Mn)	0.05
***Nitrate (No_a)	45.
Phenols	0.001

Sulfate (SO_4)	250.
Total Dissolved Solids (TDS)	500.
Zinc (Zn)	5.

*This surfactant is an index for the effect of household detergents.

**Adjusted for warm climate, because of greater water intake. See next table for rejection maximum

***In areas in which the nitrate content of water is known to be in excess of the listed concentration, the public should be warned of the potential dangers of using the water for infant feeding.

These maximums are recommended, and are not necessarily grounds for rejection. Many water supplies in the county exceed one or more of these values. However, substantial excesses are obviously good reason for obtaining alternative supplies or treatment. It is noteworthy that although the same maximum of 500 ppm total dissolved solids is recommended as formerly, the revised standards eliminate a permissible maximum of 1000 ppm where alternative supplies are not available, although neither is an automatic rejection maximum.

The following table sets limits which are considered to be grounds for rejection.

MAXIMUM CONCENTRATIONS (FOR REJECTION)

Substances	Parts per Million (mg/liter)
Arsenic (As)	0.05
Barium (Ba)	1.0
Cadmium (Cd)	0.01
Chromium (Hexavalent) Cr^{46})	0.05
Cyanide (CN)	0.2
*Fluoride (F)	1.4
Lead (Pb)	0.05
Selenium (Se)	0.01
Silver (Ag)	0.05

*Adjusted for warm climate.

A number of common chemicals occur frequently in natural water, but do not appear in the above tables. Excessive quantities of these chemicals are limited automatically in the U.S.P.H.S. standards by the total dissolved solids ceiling, of which they are components. The chemicals affecting local waters are reviewed later in this section.

E. Radioactivity

The increase in radioactivity caused by nuclear bomb testing in the atmosphere has received considerable attention. Many people do not realize that man has always been subject to natural radiation every moment of his existence, and undoubtedl is built for this exposure. Atmospheric bomb explosions have had two effects: first to increase the total exposure, and second to produce exotic radioactive substances, such as Strontium 90, which tends to enter the bone structure because of its similarity to calcium.

Although there is scientific dissent (sometimes, it would appear, coupled with unscientific emotion) the majority of the qualified investigators in this field do not consider the changes alarming. The U. S. Public Health Service relies on the Federal Radiation Council for advice, but must relate the total environmental exposures to drinking water.

The interest in radiation engendered by the bomb tests has resulted in focusing attention also on naturally occurring and industrial sources which might be locally excessive. Radium 226 has been selected as a guide for this purpose, whereas Strontium 90 is used as a measure of fallout radiation.

For practical purposes in this part of Florida, it is sufficient to note that surveillance has been undertaken nationally and will continue. Maximum limits have been established tentatively, and for exposed areas tests will be made for Radium 226 and Strontium 90. Supplementary measures undoubtedly will be taken if found necessary.

F. Corrosiveness and Scale Forming

A water supply should not be corrosive nor excessively scale forming. The costs of replacing system piping and equipment plus similar costs to homeowners and other consumers can become excessive. Pipes, heaters and boilers can become plugged or damaged in other ways by scale deposits.

The pH scale is an index of acidity and alkalinity. A pH of 7.0 is neutral, corresponding to pure distilled water. Lower values are acid, higher are alkaline. Acid waters are generally corrosive, and a pH slightly on the alkaline side is desirable. However, corrosion is not automatically eliminated by a suitable pH, because other chemical reactions may be involved.

Scale formation is sometimes associated with corrosion, but not always. Scale that forms in boilers is accelerated by the heating process, but total elimination of this property would probably be incompatible with other qualities desired of a general purpose water supply.

G. Other Characteristics Reviewed by U.S.P.H.S.

The U. S. Public Health Service recognized and considered many other chemical and bacteriological substances and situations, such as the buildup of insecticides. However, without confirmation of particular hazards it was not possible to incorporate specific criteria in the 1961 revision. The advisory committee recommended strongly that means be established for continued appraisal and appropriate revisions, and that U.S.P.H.S. studies be intensified for this purpose.

H. Local Water Quality - General

Sarasota County starts with an advantage over many U. S. communities. There is no need to re-use water, as inland cities on rivers must do, each taking its water upstream and discharging its sewage downstream for the next city.

Sarasota's re-use is via clean rainfall. However even Florida's abundant sources can be polluted; Orlando unwittingly has endangered an excellent supply by past practices.

Of the U.S.P.H.S. items cited above, only the following are typical local problems:

Color
Odor
Iron (Fe)
Fluoride (F)
Chloride (Cl)
Suflate (SO_4)
Total Dissolved Solids (TDS)

In addition, the following chemicals are of considerable significance to local waters:

Sodium (Na)
Potassium (K)
Calcium (Ca)
Magnesium (Mg)
Bicarbonate (HCO_3)
Hydrogen Sulfide (H_2S)
Hardness (As a function of chemicals named)
Taste

These characteristics are discussed below, but not entirely in the above order:

1. Color. Color may be due to the presence of matter leached from organic soils, affecting mainly surface waters and shallow wells, and is usually harmless. Color from iron, on the other hand, develops upon standing, and is undesirable in that it can stain bathroom fixtures, utensils and fabrics. Both sources of color can be treated economically.

2. Odor. Some local well waters contain hydrogen sulfide, which causes a rotten egg odor. Iron can also produce an offensive odor. These causes can be treated economically.

3. Taste. Hydrogen sulfide and iron also adversely affect the taste of water. Most people desire some taste derived from chemicals, but chemicals in excess can produce unpleasant tastes. Sodium chloride (table salt) can be detected by most people at about 350 ppm, which supports the U.S.P.H.S. standard of 250 ppm. None of the public supplies exceed these limits, but many irrigation wells do and probably a number of individual wells. 500 ppm of magnesium sulfate can be detected, and this level is likewise exceeded by some local well waters. Coffee is adversely affected by 400 to 500 ppm chlorides or 800 ppm sulfate. Chloride and sulfate cannot be removed economically.

4. Iron. The disadvantages of iron as to color, odor and taste, have been noted above. Treatment of local supplies does not appear to be a major problem.

5. Fluoride. Fluoride in excess of a very slow concentration is believed to mottle the enamel of children's teeth, whereas a desirable minimum is believed to reduce tooth decay. The optimum range is remarkably narrow, 0.6 to 0.8 ppm for this area, with a ceiling of 1.4 ppm. The limits depend on the local climate because people drink more water in warm places. Some wells in the county contain 2.0 ppm or more. Fluoride can be reduced to a limited degree by one standard treatment (lime) which might be sufficient in some cases, but substantial reduction beyond this is costly.

6. Chloride. Chloride is present in excessive concentrations in many well waters, and probably occurs as a residue of ancient sea water, although there is also some recent salt water intrusion. Salty water underlies the entire county at great depths, a 1955 oil-well probe recording 100,000 ppm just north of the county line, compared to about 20,000 ppm for modern sea water. Common readings have ranged from 20 ppm to 3500 ppm or more, the latter being too salty for drinking. Chloride also promotes corrosive qualities. This element cannot be removed economically.

7. Sulfate. Sulfate is particularly high in some deeper aquifers, ranging up to 700 ppm or more, as compared to the 250 ppm recommended maximum. Surface and shallow supplies usually contain acceptable amounts. Sulfate salts are common laxatives and impart a bitter taste. They contribute to scale-forming qualities. Sulfate cannot be removed economically.

8. Sodium and Potassium. These elements may be present in limited amounts except where sea water contamination occurs. The concentration ranges from 5 ppm to as high as 2,000 ppm and more. Sodium is believed to be unsuited to persons suffering from heart trouble and high blood pressure. Softening treatment increases the sodium content.

9. Calcium and Magnesium. Limestone consists largely of calcium carbonate with varying amounts of magnesium carbonate, and other rocks contain these elements. Consequently almost all ground waters pick up appreciable amounts. Calcium and magnesium salts are the major causes of hardness. Hardness and its treatment is discussed separately.

10. Bicarbonate. This is the soluble form of the carbonate found in limestone and other carbonate rocks. The solutions of calcium and magnesium are largely in the form of bicarbonates and hence they are widespread in ground waters.

11. Hardness. Hardness is a property that is measured in secondary effects but commonly receives the most attention. In Florida waters, it is caused by calcium and magnesium compounds. Carbonate hardness results from the carbonates and bicarbonates of calcium and magnesium, and non-carbonate hardness from the sulfates, chlorides and nitrates of the same elements. Total hardness is their sum.

The effects of hardness are felt in the difficulty of forming a lather from soap, which used to be the standard test. Not only does it cost more money to wash in hard water, but the curds interfere with working operations and the life of

fabrics is said to be reduced. Introduction of detergents have reduced this problem, but have not eliminated it. Older estimates indicated that a family of four might save more than $10 per year in soap alone, if the hardness of their water was reduced from 300 to 70 ppm total hardness, but with detergents this savings may now be of the order of perhaps half this amount.

Industrial usage of water is also affected by hardness, which is an indication of harmful scale-forming and other undesirable effects. These could preclude certain processes or damage expensive equipment.

Economical treatment is available to soften water. Sodium, the salts of which do not cause hardness, is substituted for calcium and magnesium. The total dissolved solids do not change greatly and will actually increase for the zeolite treatment employed by the City of Sarasota.

National statistics and community evaluations indicate that a hardness of 85 to 120 ppm is considered to be satisfactory for most public supply uses. Many communities find 200 ppm acceptable. Public reaction to hardness higher than this is revealed by one survey of those people who had assumed the considerable expense of providing their own home softening equipment, as follows:

Hardness of water Supplied by Utility	Percentage of consumers Installing their own Softeners
Up to 125 ppm	Negligible
200 ppm	30%
250 ppm	60%
350 ppm	70%

It costs about 5 to 10 times as much to soften water individually than if the water system provided this treatment. Although local statistics of the above type are not available, it would appear that potential savings may be possible where water is suitably softened.

12. Health Aspect of Hardness. Hardness is considered an enemy, and most water treatment is in terms of softening water. Yet statistics seem to indicate that longevity may be greater where drinking waters are hard than where they are soft. The sodium substituted for calcium and magnesium may not be as good for people as the latter.

13. Total Dissolved Solids. The total solids are a summation of all the minerals in the water. A reasonable limit is advisable to keep all possible constituents at suitable levels. As to personal reactions, acclimatization is important. More than 100 public supplies in the U.S. provide water with more than 2,000 ppm, which the City of Sarasota water approaches.

I. Specific Local Quality

A great amount of detailed data is available in the published references listed in the appendix and from other sources, and no need is seen for burdening the report with it. Exhibit "T" at the end of the report lists comparative data for all of the public water systems in the county. Typical analyses have been selected for illustrative purposes and are tabulated on the following page.

It is emphasized that a far greater range of chemical content has been found in other wells which are not used for drinking water, except perhaps by individual well owners. Some of these wells are too mineralized for irrigation or any other purpose.

Unfortunately only meager data is available for the easterly county regions, and especially the northeast where the best water potential may be located. In effect, the mass of data reveals our problem but not its solution.

TYPICAL ANALYSES OF RAW WELL WATERS USED BY PUBLIC WATER SYSTEMS

	Lake Sarasota (Berkshire Est.)	City of Sarasota	City of Venice	No. Port Char-lotte	Kensington Park	South Gate	Phillippi Gardens	Venice Gardens	Tri-Par Estates	U.S.P.H.S. Standards (Max)
Depth of Wells, in feet	390	550 to 850	65 to 140	45 to 50	73 to 270	280 to 350	112 to 160	100 to 140	350 to 460	
Total Dissolved Solids (TDS) ppm	312	1,690	770	650	515	510	929	358	820	500
Hardness, ppm	448	1,200	594	428	288	389	376	289	404	--
Chloride, ppm	87	200	102	140	64	63	192	51	65	250
Sulfate, ppm	48	672	220	0.0	89	120	74	6	298	250
Fluoride, ppm	0.8	1.1	0.8	0.5	1.9	1.07	0.90	0.77	0.70	1.4
Iron, ppm	0.08	0	0.3	0.7	0.25	0.09	0.04	0.07	0.06	0.3
Color cobalt scale	5	5	20	55	5	9		7	15	15

The effects of treatment of raw water for the two systems that have softening processes, the City of Sarasota and the City of North Port Charlotte, are illustrated by comparisons between the raw and finished waters, which also follow. In a sense these are both special cases and do not involve raw water that is likely to be representative of the future quality to be obtained, and for this reason only limited conclusions should be drawn. These analyses are for a typical day and do not coincide exactly with the averages reported for the other tabulations in the report.

CITY OF SARASOTA WATER DEPARTMENT

Date Tested: February 13, 1962 Tested by: PML Laboratory

	Raw	Finished
Total Dissolved Solids	1295	1690
Total Hardness, Versonate	1215	52
Alkalinity as Ca CO_3	140	140
Non-Carbonate Hardness	1075	-88
Bicarbonate HCO_3	170	170
Iron Fe	0.02	0.02
Sulfate SO_4	720	800
Chloride Cl	177	220
Sodium Na	55	391
Calcium Ca	250	21
Magnesium Mg	142	0
Fluoride (F (distillate)	1.48	1.48
Carbondioxide CO_2	6	10
Bicarbonate as Ca CO_3	140	140
Carbonate as Ca Co_3	0	0
Hydroxide as Ca Co_3	0	0
Color (Std. Cobalt Scale)	5	5

	Raw	Finished
Odor	None	None
pH field	N.D.	N.D.
pH Lab.	7.6	7.4
pHs	7.1	8.1
Stability index	6.6	8.8
Corrosive	Maybe	Yes
Scale Forming	Maybe	No
Appearance	Satisfactory	Satisfactory

NORTH PORT CHARLOTTE WATER PLANT
(Partial Test)

Date Tested: 22 April 1963

	Raw	Finished
Hardness	490	120
Chloride	186	
Fluoride	1.86	1.0/1.5
Iron	0.1	0.0
Color	60	5
pH	7.1	8.3

J. Changes in Quality

It can not be assumed that the quality of water sources will remain unchanged. The water analyses presented in this report are only accurate for the times that the samples were taken. Some of the older analyses may no longer be completely accurate.

The local wet and dry seasonal cycle often will cause corresponding fluctuations in quality. Surface and shallow well supplies are obviously the most vulnerable because runoff and underground percolation will be quickly affected by rainwater. Both bacteriological and chemical quality must be monitored.

The peak annual population occurs in the dry season which also coincides with heavy demand for lawn watering. Agricultural irrigation likewise increases greatly. The heavy pumping that results can affect every aquifer and its quality. Wells tapping the Hawthorn formation, at medium depth of perhaps 100 to 400 ft. may be expected to be affected by the variety of deposits in this unhomogeneous formation.

Individual wells that are closely spaced may interfere with each other. Wells that are drilled and cased carelessly can contaminate good wells that are nearby, including those supplying a water utility.

The seasonal cycle will not fully restore conditions for concentrating urban areas with close spaced individual wells. The heavy pumping action may improve the quality by flushing out old chemicals or may cause deterioration by introducing new ones from surrounding areas or by inducing salt water intrusion. Present evidence points toward deterioration. Pollution may also become dangerous where septic tanks are concentrated, depending on other local conditions.

K. Water Treatment

In many respects treated water reflects raw water quality, and certain undesirable characteristics can not be altered sufficiently by economical methods. The first step must be to find an adequate water source. After we have done so what do we want to do with it?

Any water treatment for the general public represents three compromises:

1. The water must be used for many purposes. For instance, zero softness may be ideal for laundering but the sodium substituted for calcium and magnesium probably is not as healthful. Removal of all minerals can be accomplished, but the water no longer is a source for nutritional elements but becomes unpalatably flat-tasting for most people. Where special needs apply, individual consumers may provide

suitable treatment facilities of their own. A laundry may install its own softener. An industrial plant (e.g. EMR) may provide its own demineralizer.

2. Cost is an important factor, and there must be a compromise between the ideal target and an economical treatment of whatever acceptable water source is found.

3. It is usually necessary to proceed with the above principles by stages, especially in a rapidly growing area. Early stages may fall short because of the need to use a local water supply that may be marginal, and the treatment may be limited by the financial burden of getting a water system started.

What constitutes good water? This is an involved and technical matter subject to the above compromises, but may be summarized by stating that the water delivered to consumers should be bacteriologically safe, clear and pleasing in appearance, free from objectionable tastes and odors, within the recommended standards established by the U.S.P.H.S. standards, reasonably soft for general purposes but containing minerals of long-accepted character and in sufficient quantity to avoid radical departure from the usual norms of taste and nutrition.

This appears to be a big and broad package, but it is not as difficult a matter as it may seem. Public officials are well advised to support a position that is conservative within a broadly permissive band, avoiding extremes in any direction. A flexible approach to particular applications is both necessary and desirable.

No purpose would be served by developing in detail the methods that can be employed to treat water economically in this area, and these will be reviewed generally. Except for the City of Sarasota the usual method of treatment consists only of aeration, sedimentation-storage and chlorination. This usually removes hydrogen sulfide and carbon dioxide, and reduces iron and color. The chlorine tends to kill microorganisms that may be present.

The major chemical constituents are unchanged. Hardness remains practically the same.

More sophisticated treatment is necessary for softening or more effective removal of iron and other objectionable chemicals. Two long-established and reasonably economical methods are available.

1. Lime, or Lime and Soda Ash.

This is the oldest and still the most widely used method, and remains the best for many water sources. It cannot soften the water to zero hardness, but this is not desirable for public supplies anyway. Lime is used for carbonate hardness and usually soda ash is applied for non-carbonate hardness. Disposal of sludge is sometimes a problem.

2. Ion Exchange (Zeolite)

This is more commonly called the zeolite process, as applied to public water supply treatment. The water can be totally demineralized by putting it through successive cation and anion exchanges, but this is neither desirable nor economical except for special purposes.

The common zeolites used have the property of removing calcium and magnesium hardness of waters that pass through them. Home softeners also apply this principle. Hardness can be reduced to zero, and as a practical matter the water leaving the plant is usually a controlled blend of treated and untreated water. The zeolites are regenerated by the use of common salt, which can be an expensive procedure in some locations. The City of Sarasota and many other places economize by utilizing sea water for this purpose.

The quality of water softened by the two processes is not the same. Lime alone will reduce the total dissolved solids, whereas zeolite will end up with more minerals. The zeolite process will yield any residual hardness desired down to

zero, whereas lime-soda has a lower limit for hardness of 35 to 40 ppm. Both softening processes involve substitution of sodium for calcium and magnesium, and the finished hardness will reflect the amount of the latter retained.

Lime softening may lower the fluoride content, whereas zeolite will not. This can be an important consideration for the marginally-high fluoride content in some local waters.

Other standard procedures are available as required for the treatment of particular problems. Filtration and stabilization with carbon dioxide are commonly employed.

Coagulation of impurities such as color may be applied particularly for surface and shallow well water. Addition of a coagulant such as aluminum sulfate (alum) forms flocs which separate and absorb many impurities, and are settled in a basin prior to filtration.

Activated carbon may be used to remove organic odors and tastes, as part of the coagulant process.

No advance generalization can be made as to a universally applicable treatment. The particular raw water supply, alternative costs and staging considerations all must be considered. It may be noted, however, that small plants obviously will be more heavily burdened by successively more complex treatment procedures, and centralized supply and treatment serving large numbers of people is an advantage.

Of all the public water facilities in the county only the City of Sarasota and the City of Port Charlotte apply treatment beyond the basic aeration and chlorination.

L. Governmental Jurisdiction as to Quality

The State Board of Health, working both directly and through the County Health Department, has legal jurisdiction over the public water supplies. Plans must be prepared by an engineer registered in the state, but the environmental, health and functional aspects must be approved by the Board of Health.

Before a new water source is considered it must be tested for chemical quality. Departures from U.S.P.H.S. standards must be justified by reasons deemed to be sufficient, and factors outlined previously are given consideration.

Procedures are prescribed for construction of facilities, and after the system goes into service it must be operated by a qualified personnel. Periodic tests must be performed, including bacteriological tests to assure public safety. A complete review of the State Sanitary Code and its local application is beyond the scope of the report.

The county well drilling regulations are enforced under the authority of the Board of County Commissioners. Well drilling practices are intimately related to water quality, and indiscriminate drilling can ruin the supply of a considerable area. Further steps are needed to firm up procedure for the future, and measures to rectify the past also must be developed as necessary to protect ground water quality.

The Florida Geological Survey and the U. S. Geological Survey are basically research agencies for the gathering and analysis of data, most of which relates to water resources and their qualities. Other state and federal agencies participate in related aspects. There are a number of local organizations that are interested in this field.

VIII. PHYSICAL FEATURES OF SARASOTA COUNTY

A. Geology

The peninsula of Florida lying above sea level rests upon a much wider continental peninsula rising from the depths of the Gulf of Mexico and the Atlantic Ocean, known as the Floridian Plateau. Geological investigations reveal that at times far more of this plateau has been exposed when the sea level was lower, whereas at other times the sea covered most of the present state area, including all of Sarasota County. About half of this plateau is now submerged by relatively shallow waters, mainly under the Gulf. The edge of this plateau is about 100 miles west of Sarasota, where the water is about 300 feet deep.

The geologic formations that constitute peninsular Florida have been classified and re-classified a number of times, but may be described as thick sedimentary limestone deposits lying on core rocks about 12,000 ft. or more deep. The limestones are generally covered by the unhomogeneous Hawthorn formation, which in turn is mantled by surface soils, mainly sands.

Avon Park Limestone:

The deepest limestone formation that appears to be of interest as a possible fresh water source is the Avon Park limestone. This is a thick formation, the top of which is probably more than 1,100 ft. below the surface. Little is known about its character under Sarasota County.

Ocala Group:

Lying above the Avon Park is the Ocala group, which is perhaps 300 ft. thick. The formations that constitute the Ocala group are, from the bottom, the Inglis formation, the Williston formation and the Crystal River formation. The Crystal River formation has been penetrated by a number of wells in Sarasota County.

The Suwanee limestone overlies the Ocala group, and is about 150 to 250 ft. thick.

The Tampa limestone is the uppermost limestone formation (although beds of limestone appear in the Hawthorn) and is about 100 to 250 ft. thick.

The limestones are permeable to water to a considerable degree, and in various ways. Taken together they are called the Floridan Aquifer, which is one of the most productive water sources in the world.

The Hawthorn formation overlies the limestones. It consists of deposits of clay, marl, shells, limestone, dolomite and sand. Because of its considerable thickness, about 300 to 550 ft., and beds of clay and other impermeable materials, the Hawthorn acts as a confining layer above the limestones, as a result of which they are under artesian pressure. Various beds in the Hawthorn itself are under artesian pressure for the same reason.

The upper formations lying above the Hawthorn, which are classified as surface materials, consist mainly of sands and shells with some clay. They range in thickness from 5 to as much as 100 feet. This layer produces the least mineralized ground water in the county, being recharged and flushed out by local rainfall.

The water bearing features of these formations are discussed in greater detail in Section XI.

B. Topography

Sarasota County is covered by parts of several marine terraces that were constructed by ocean waters during the Ice Age. Invasions by the sea left successive shores over the coastal lowlands of Sarasota County at elevations of approximately 70, 42 and 25 feet. Changes from one marine terrace to another, for the

most part, are indefinite. The most apparent terrace escarpments are in the northeastern part of the county. The entire county was twice entirely submerged.

The lands consist of nearly level plains separated by low flat ridges. Changes in elevation are very gradual, and the rise is barely perceptible over long stretches of landscape.

Elevations in the county range from sea level to about 95 feet. The highest points are in the northeast, several miles north of Old Myakka. The highest measured elevation, 95.5 feet, is near the Manatee County line, a short distance south of Verna. Other elevations are Bee Ridge, 36 feet; Laurel, 13 feet; Osprey, 17 feet; Sarasota, about 10 to 31 feet, and Venice, about 7 to 15 feet.

Numerous slight depressions of shallow wet areas and sloughs about one to three feet deep are common. They range from less than an acre to many acres in size, but their total area is considerable. In the rainy season, the water levels are a few feet higher than in dry periods. Many of the depressions are shallow intermittent ponds without natural outlets.

Surface runoff in the flatlands is characterized by shallow, indistinctly defined drainageways with sluggish flows. Heavy rainfall tends to become impounded in sheets which move overland slowly along the flat slopes, impeded by the frictional resistance of land and vegetation, until they gradually work their way into the drainageways or else remain impounded in the wet weather ponds and other natural depressions.

Tidewaters extend inland for several miles into some of the embayments and streams along the coastal section and up the Myakka River about 10 miles to a point east of Venice. The change from salt to fresh water is gradual and is usually accompanied by changes in the kinds of vegetation.

In land as flat as much of Sarasota County, relatively small adjustments in elevations may shift contours and ridge lines considerable distances, and man-made structures such as built-up roadways may superimpose new ridges.

C. Soils and Vegetation

Most of the county has a mantle of marine quartz sand deposited during sea stages of the Ice Age. Details relative to the surface soils and their characteristics are covered comprehensively in the excellent "Soil Survey of Sarasota County" issued in 1959 by the U. S. Department of Agriculture in cooperation with the University of Florida Agricultural Experiment Stations.

Except for certain mucklands, most of the soils are low in natural fertility. Their agricultural value lies in their susceptibility to specialized soil and water management, and their location in an area favored by climate for the winter market.

The sub-tropical climate produces a great variety of natural vegetation of tropical and temperate species. Even minor elevation differentials, such as pine islands compared to swamps and sloughs, provide sufficient variation in soil moisture and aeration for the root structures of many different kinds of plants.

IX. HYDROLOGY

A. The Hydrologic Cycle

The behavior of water as it relates to the earth is encompassed by the science of hydrology. Nature's unending re-use of water is termed the hydrologic cycle. This cycle is pictured on the following page, as Exhibit "K."

Water condenses from the moisture in the atmosphere and falls as rain. Then it moves over and beneath the land surface to the sea. This cycle is completed by returning moisture to the atmosphere through evaporation, from the oceans, from the lands, and from vegetation. Much of the rainfall falls on the seas, abbreviating its span in the hydrological cycle.

Evaporation from surface water and wet soil, with transpiration from the foliage of plants, returns the greater proportion of the total rainfall to the air. The amount of water infiltrating directly into the ground is limited. Underground lateral movement is slow, and after the water table rises during the wet season surplus water will move or lie upon the surface, or evaporate.

The amount that remains after evaporation and infiltration will be surface water. This will approximate 20 percent of rainfall in Sarasota County, and represents surplus water potentially available for additional use.

The foregoing is a simplified description of an exceedingly complex, inter-related and variable series of processes. To complicate matters, the works of man are now beginning to exert influence in many ways. Urbanization reduces infiltration and accelerates surface runoff. Drainage and flood control improvements collect sheet surface water into channels. Pumping water out of the ground affects the movement, quantity and quality of the ground water storage. Effects on evaporation and transpiration result from land use for agriculture. All of these are inter-related.

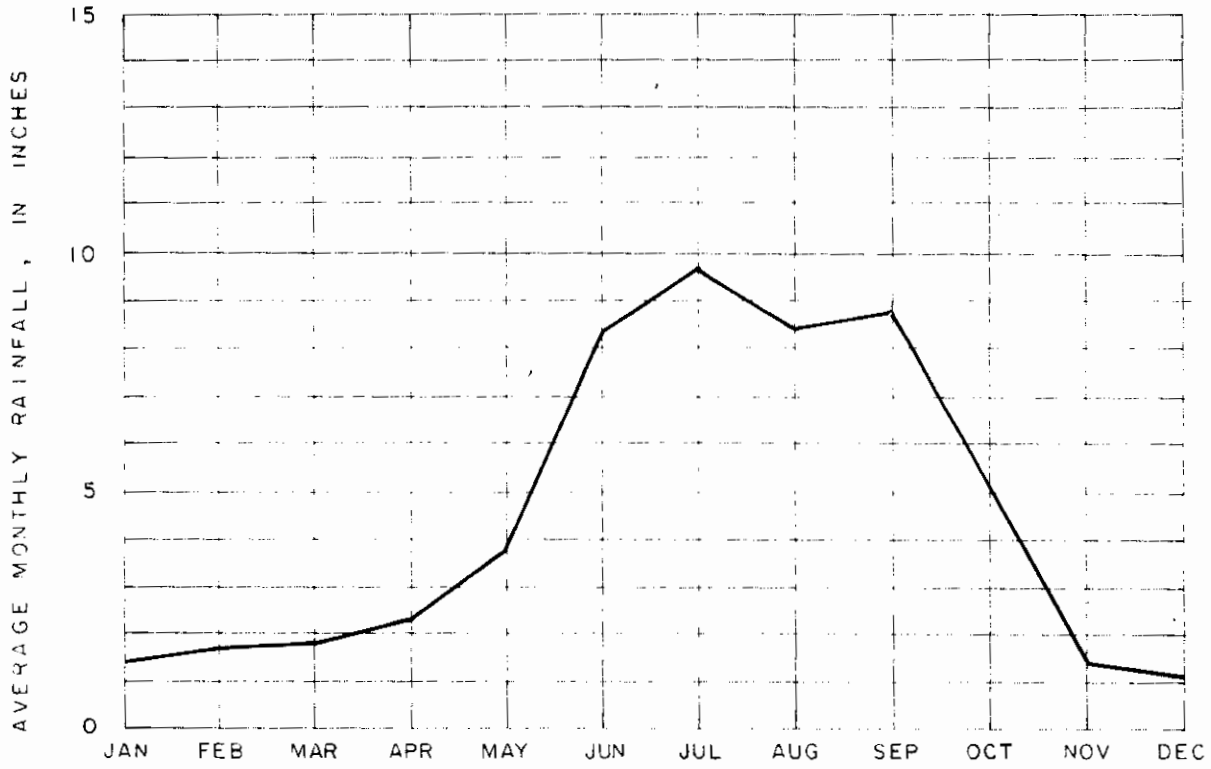
B. Climate and Rainfall

Southern Florida lies nearer to the equator than any other part of continental United States and is surrounded on three sides by great seas. These, together with other factors, create a unique climate characterized by warm weather, usually ample rainfall, and normally light and persistent winds. The climate may be termed a state resource, in that it attracts residents and tourists, permits growing of off-season crops, encourages certain industries and military installations, and in many other ways offers advantages found nowhere else in the nation to the same degree.

The total annual rainfall upon Sarasota County averages 54 inches per year. There are two striking aspects to this rainfall. First is the fixed seasonal pattern; more than half of the total falls in the four to five month summer period, as shown on Exhibit "L" on the following page. Second is the uneven geographical distribution of local rainfall, for the reason that summer rains, unlike the rains in the dry season are produced by local heavy rainshowers. A striking example of this uneven distribution is offered by Miami's three stations within 10 miles of each other, which report average annual rainfalls of 42.9, 47.2 and 56.4 inches; monthly totals there have been known to differ by more than 11 inches.

C. Evaporation and Transpiration

Evaporation from water surfaces and the moist ground, together with evaporation from vegetation, which is called transpiration, remove far more rainfall than surface runoff and infiltration combined. Indeed, in places evaporation may exceed rainfall, the difference being made up by surface inflow from higher elevations. Great evaporation is induced in southern Florida where water lies available on or near the surface under a hot sun for long periods of time.



Average total annual rainfall = 54"

Source: U. S. Weather Bureau

SARASOTA COUNTY

AVERAGE MONTHLY RAINFALL

SMALLY-WELLFORD & NALVEN CONSULTING ENGINEERS
SARASOTA, FLORIDA

JOB NO. 783

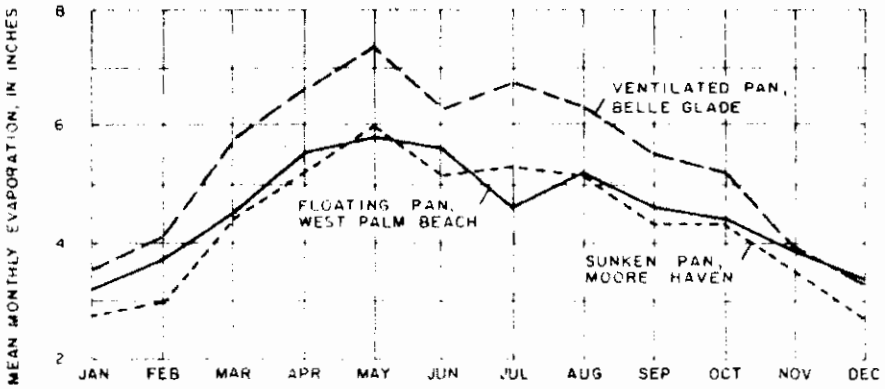
EXHIBIT "L"

Measurements of evaporation have been made for some time, since 1925 in Belle Glade, for instance. The correlation of these measurements with the actual natural conditions remains a technical problem. Exhibit "M," on the following page, indicates comparative results for various types of evaporation pans in southeast Florida.

Transpiration is the process by which a plant pumps water out of the soil. Most of the water does not enter into tissue building, but is used to assist the life processes, and reaches the leaves where it is evaporated in huge quantities. Farmers have reported sharply increased demands on their irrigation pumps when nearby Cypress trees blossom into new foliage.

Tremendous quantities of water are transpired. This is significant in Sarasota County not only as to forests and undeveloped areas, but as to the irrigation needs of agriculture.

Since evaporation is the biggest water loss in the county, it is of interest to note that man can influence evaporation and transpiration, but this has been done unknowingly for the most part, and not always in a beneficial manner. The drainage works in the Everglades are an example of man-made changes affecting evaporation.



Source: Florida Geological Survey, "Water Resources of Southeastern Florida", paper number 1255

TOTAL ANNUAL EVAPORATION AT BELLE GLADE, IN INCHES

1925	59.04	1934	65.27	1943	63.95	1952	65.95
1926	63.24	1935	70.60	1944	64.29	1953	65.40
1927	65.29	1936	66.63	1945	63.51	1954	62.95
1928	*	1937	64.44	1946	63.48	1955	66.52
1929	*	1938	65.79	1947	61.76	1956	66.42
1930	63.01	1939	66.87	1948	59.32	1957	63.12
1931	60.69	1940	64.86	1949	62.95	1958	60.74
1932	62.85	1941	64.32	1950	62.37	1959	58.56
1933	62.21	1942	64.19	1951	62.42	1960	62.44

Mean Annual Evaporation - 63.69 inches

*Not Available

Source. U.S. Weather Bureau

EVAPORATION IN SOUTHERN FLORIDA

SMALLEY WELSFORD & NAEVEN CONSULTING ENGINEERS
SARASOTA, FLORIDA

JOB NO 783

EXHIBIT "M"

X. SURFACE WATER SOURCES

The report dated September 1961 prepared by this firm under the title "Sarasota County Coastal Basin Flood Control Study" reviews in detail the surface water aspects, both as to principles (Section X) and applications to basins (Section XI). Only those features most directly related to the water supply will be touched upon herein.

A. General

Surface water is the water that lies or moves above the ground. Surface and ground water are especially interrelated in the low, flat relief and porous soils of Florida, and water may change its habitat, so to speak, several times before reaching the sea or evaporating into the air.

Out of annual rainfalls of about 45 to 65 inches only about 8 to 10 inches may be defined as surface runoff. Most of the difference passes to the air as evaporation and plant transpiration.

This runoff is a tremendous total quantity. Totals and averages, however, are misleading. The problem is that there is too much of it when not needed, and too little when needed. Geographical distribution even in the wet season may be a local problem because of the point nature of the summer rainstorms which supply most of the water. Conservation practices will help to offset these distribution problems of time-cycle and geography.

Surface waters within the county arising from the general rainfall distribution have superimposed upon them the flow of water from higher elevations. Nature does not recognize political boundaries, and runoff crosses all county lines to some degree.

Sarasota County is a flatlands area, where overland flow generally moves sluggishly through ill-defined drainageways. A number of streams, all of them relatively short except for the Myakka River, may be called rivers and creeks. These are supplemented by canals, notably in the Phillippi Creek basin. Ridge lines are low and may even be temporarily submerged by flood runoff. This terrain means that man's works, such as a built-up roadway, may readily modify nature's basins. This characteristic can be used to advantage, but causes problems where construction ignores it.

Although relatively flat, the gradual land slopes would permit flood runoff in most areas by natural flow if adequate channels are provided. In rural areas pasture grasslands might need no further protection than open drainage systems, but vegetable crops and citrus cannot tolerate long submergence, and may require water table control in certain areas beyond the economic feasibility of such a system. It is anticipated that, where needed, the practice of diking and pumping of farms will be applied. However, ultimate concentration of agricultural acreage will demand rural canal systems to supplement the major drainageways which are delineated by plans officially adopted by the Board of County Commissioners.

B. Available Water Potential

Although the wet-weather ponds and other natural depressions impound or attenuate a considerable volume of surface water in the wet season, these generally dry up during the dry season. There are few deep lakes to provide year-round storage, the only significant ones being upper and lower Myakka Lakes totaling about 2 square miles. Developers sometimes provide small lakes deep enough for year-round stability (6 ft. or greater), and there probably will be many more of these in the future.

The Myakka River drains a large basin, about 235 square miles. Peak monthly flows exceed a billion gallons per day, with instantaneous maximums still higher. Annual averages are also impressive, ranging from a wet year high of 375 million gallons per day to a dry year low of 48 million gallons per day. However, during the annual dry season there are months when the flow is zero or close to it.

This would be a splendid water source for a large population if there were some place to store the surplus water during the wet season. Unfortunately the valley is too shallow for great impoundment, and the shallow depth would also be vulnerable to severe evaporation loss.

Observations of other streams and canals all reveal similar periods of little or no flow. The shallow stream and valley depths limit the effect of lateral seepage from the ground water to maintain dry-season flow, and provide potential storage capacity that is very limited.

During low stages these drainageways are also subject to salt water encroachment by tidal action, the effects of which penetrate the Myakka River more than 10 miles. This threat may be controlled by the placement of salinity dams.

The lack of year-round flow does not encourage the use of surface water sources for either urban water supply or rural irrigation, especially considering that the demand for both is at a peak during the period of lowest flows in the dry season. Perhaps this condition is aggravated by overdrainage which could be mitigated by the placement of weirs to assist in stabilizing the water table. The county's comprehensive water management plan calls for the eventual placement of stepped weirs in all drainageways, terminating in salinity dams at tidewater.

Although its direct large scale usage is unlikely in this county, surface water impoundment may play a significant role as to water resources in the following ways:

1. A source of supply for a limited number of people. This could be an early stage for a system which might later have to obtain a supplementary or alternative supply.

2. Protection and storage for an adjacent shallow well system. North Port Charlotte's supply is an example.

3. Natural recharge and conservation of available ground water.

4. Artificial recharge of the ground water, by pumping during the wet season surplus, for areas that are over-pumped by wells.

C. Improvement Programs

Construction of major drainage and conservation improvements under the control and support of the U. S. Soil Conservation Service in the 90 square-mile Cowpen Slough - Shakett Creek basin is about to begin. The upper area of the 58 square-mile Phillippi Creek basin is benefitting from features of the former and from emergency measures in the downstream urban area, which will lead into a planned program of significant proportions, perhaps under the control and support of the U. S. Army Corps of Engineers.

Elements of the county comprehensive plan have been completed and others are in process. The efforts in the county probably will be accelerated in order to avoid repetition of disastrous flooding problems, and far-sighted planning will provide for corollary benefits affecting fresh water resources. The formation of a conservation district is being considered at this time in the urbanized Phillippi Creek basin and possibly adjacent areas.

Observations of the effects of the improvements after construction will provide more refined information for subsequent planning and actions related to water

resources. Stream and water level gages are deficient now and additional gages will be needed as improved channels are completed. Assistance may be available from the U. S. Geological survey.

D. Manatee County Surface Waters

Unlike Sarasota County, the topography of Manatee County would permit impoundment of much surface water. For many years the City of Bradenton's supply has been taken from the Braden River, which flows westerly a short distance north of the Sarasota County line. The storage capacity of this river is limited however, and during especially dry times the fresh water level behind the salinity dam has stood below tidewater.

The real potential lies in the Manatee River valley. The Manatee County Board of County Commissioners sponsored an engineering study, the report on which was issued in 1958. An addendum appeared in 1960.

The Board later engaged another engineering firm to review the proposed project. A report has been issued recently which is not yet available for distribution.

All reports have supported the eventual feasibility of damming the Manatee River, but the stumbling block is the cost. A major portion of this is in transporting the water many miles from the reservoir to the urban communities, and the intention is to reduce this cost by utilizing the Braden River as an aqueduct.

The first proposal was to have the costs shared by both Manatee and Sarasota Counties and the major municipalities therein, without which the financial feasibility would be questionable. Sarasota County and the City of Sarasota have held off, and the City of Bradenton has not shown enthusiasm.

The present approach would exclude Sarasota County. The initial stage would supply water to the Braden River by deep wells in the east county area near the Braden's headwaters. Damming the Manatee River would come later, perhaps in five years, although land wisely would be acquired now for the ultimate reservoir.

The first stage is proposed for 8 million gallons per day, supplied by the well field. The cost would be about $8 million, which includes a 12 MGPD treatment plant and land acquisition for the future reservoir.

The next stage, at a cost of about $7 million, would provide a dam in the vicinity of Rutland that would yield about 24 million gallons per day. Additional dams in the upper Manatee River and the Little Manatee River could augment the capacity as required in years to come.

The proposal is to supply treated water of high finished quality and suitable softness. Whatever distribution arrangements might come later, initially the major flow would be piped to existing distribution systems, presumably at wholesale rates.

The previous engineering studies proposed that the pipeline extend into Sarasota County to serve the City of Sarasota and other local distribution systems. The cost of the finished water did not appear attractive enough at that time. Because of the economics of the pipe line and pumping equipment, the water would be supplied at average daily flow rates. Consequently peak demand would have to be provided by each local system, using elevated or ground storage, and possibly with supplementary water supply being required for support.

Financial feasibility apparently remains as the obstacle. Even with staging and other proposed economies the feasibility is marginal if the project is to be self-supporting. It is understood that various alternatives are being explored. Accordingly, if the program is undertaken it may differ to some degree from the present proposals. In particular, the first stage may be reduced further.

Aspects of the proposed Manatee County system related to the ultimate Sarasota supply are discussed in Section XII.

F. Surface Water Quality

The quality of surface waters tends to be less mineralized than most ground water tapped by wells, because rain water contains no minerals and the ground water that seeps into the streams passes through an upper soil mantle that has been leached out by many years of flushing action.

However, a color problem usually exists because the water picks up organic coloring and sometimes iron as it passes through the vegetation and topsoil. This is often a matter of esthetics rather than health, and economical water treatment methods are available to reduce the color to acceptable levels.

Because of its exposure both directly and to shallow ground water containing septic tank effluent, surface waters are more susceptible to pollution than deep well water. Competent vigilance and regular bacteriological testing in conjunction with treatment should preclude any hazard in a public water supply utilizing this source.

XI. GROUND WATER RESOURCES

A. General

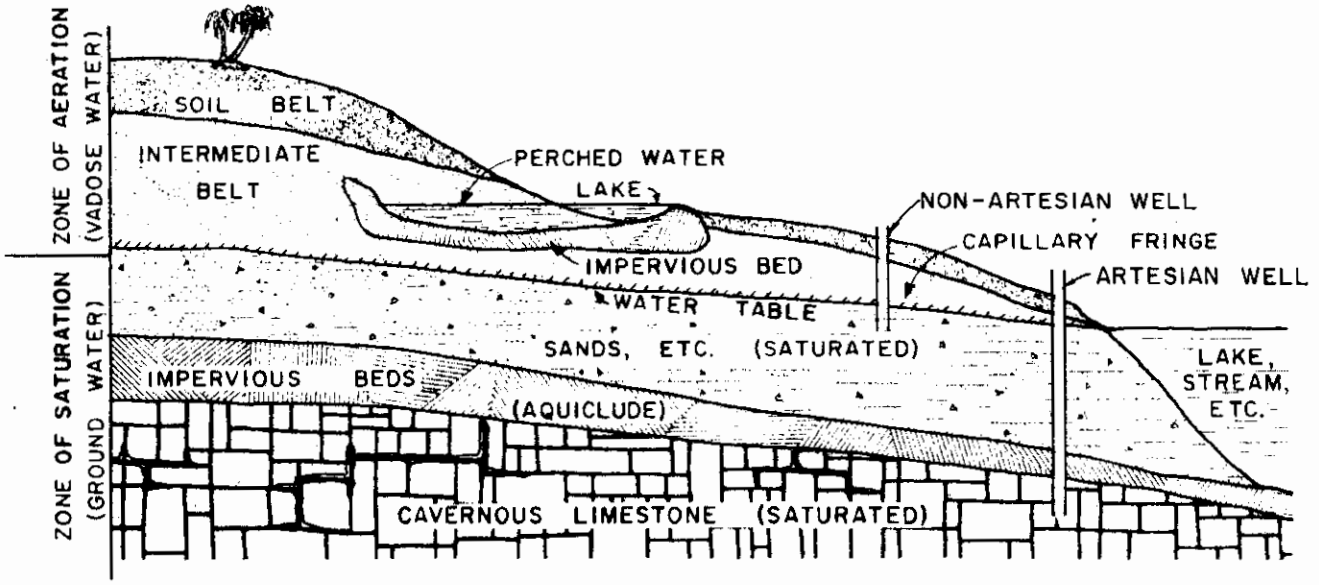
The classifications of water lying beneath the surface of the ground are illustrated by the figure on the next page, Exhibit "N." There are two major zones. The term "ground water" applies to the lower levels which are saturated, the water table being the upper surface of the ground water. Moisture above the water table is in the "zone of aeration," at least part of which is available to the roots of plants.

Sometimes saturated water is held above the overall water table by local impervious beds of rock or hardpan. This localized ground water is known as "perched water," and may be of considerable importance to certain areas.

Ground water is stored in the openings available, which may range from tiny voids between soil particles to large cavities in rocks. The ability to absorb water, "porosity," is not identical with the property of transmission, "permeability." Clay is highly porous and yet low in permeability; therefore it yields low flows to wells. The limestones, sands and shells of Florida are generally highly permeable and are therefore favored as high-volume aquifers where they are not excessively mineralized.

Ground water may be viewed as a huge covered water reservoir. The total amount in storage is tremendous. It is covered by the upper soil layer, which in dry weather retards evaporation, a feature that surface water storage lacks. This reservoir may be tapped as needed, but replenishment must ultimately balance use or the deficit will cause major problems, and in extreme instances could lead to a kind of bankruptcy.

Rainfall replenishes the ground water. It may infiltrate directly into the soil it falls upon, or indirectly from surface runoff flowing from higher elevations overland or through channels.



CLASSIFICATION OF SUBSURFACE WATER

ADAPTED FROM VERNON

SMALLY-WELLFORD & NALVEN CONSULTING ENGINEERS
SARASOTA, FLORIDA

JOB NO. 783

EXHIBIT 'N'

Rainfall infiltrating into one area may recharge ground water elsewhere by percolating laterally through the ground. Lateral percolation of ground water is a slow movement that originates at higher elevations and continues to the sea, where it seeps out and is lost. The water table slopes like a river surface and this hidden hydraulic gradient is a measure of the gravity force that causes the underground flow. When the downward slope moves under an impervious layer, the confined water becomes artesian.

Ground water may seep out of as well as into streams and lakes, before reaching the sea. Drainage and irrigation canals are examples of water table control exercised by farmers. Wells tap the ground water reservoir for drinking and irrigation water. Plants pump out huge quantities as part of their transpiration process.

During former invasions of the sea over southern Florida, salty water permeated the limestone formations. Saline residues remained after the sea retreated. Fresh water from rainfall has been diluting and flushing out the ancient salts for some 10,000 years, but the process is still incomplete.

This flushing action means that as the rainwater percolates through the ground it picks up minerals in solution, depending on the character of the materials it passes through. Soft, fresh water tends to remain apart from harder waters unless acted upon by forces which cause mixing. Wells and pumps are one of these causes.

The geologist enters the picture because water in the ground is a resource, like minerals, - oil or other deposits, and is intimately related to the rocks and their geological history. He tries to map the various underground materials so that the knowledge gained will aid in obtaining the best of what is available at the least cost. Constant refinement is necessary because of the hidden nature of the subject, and the cost of drilling. Well drillers' logs are used for economy and are required by Florida law. Sometimes underground areas remain unknown frontiers for many years until the economic values at stake justify adequate geological investigations.

B. Data Sources

Although there is no up-to-date definitive geological report covering Sarasota County, much useful information is available and additional data is added every year in one way or another.

The most intensive analysis is V.T. Stringfellow's 1933 report which covers investigations made in 1930 by the U. S. Geological Survey in cooperation with the Florida Geological Survey. E. W. Bishop made a supplementary report in 1960 for the Board of County Commissioners.

Investigations and test wells have been sponsored by the City of Sarasota in recent years to develop a new water supply of better quality. Horace Sutcliffe of the U. S. Geological Survey has been conducting well investigations in the County, the results of which should be informative and useful. Miscellaneous data, often unpublished, can be obtained from various sources.

References listed in the appendix contain much detailed data, including chemical analyses of water from many parts of Sarasota County and surrounding areas. However, most of the information covers aquifers that are along or near to the populated coastal region, whereas there is a paucity of data in the northeasterly part of the county which appears to be the most promising source for a future water supply.

C. Artesian vs. Non-artesian Wells.

The principle of an artesian well is a simple matter of water seeking its own level. A permeable layer underground may be confined above by an impervious bed of rock or clay. If water penetrates into this permeable layer from an opening in the confining bed in a location at higher elevation, the head of ground water at the source may be such that the confined water some distance away is under pressure.

A well drilled through the confining bed will release the water, which will rise to a level corresponding to the pressure. Whether or not the pressure is sufficient to force the water to the ground surface, the well is artesian; in the latter event the well is called a free-flowing artesian well. The water must be pumped for most purposes.

The pressure at any point depends on the elevation below the water source and the frictional effect resulting from percolation through the ground. The piezometric surface is a fictitious surface corresponding to the heights to which columns of water would rise if encased. This surface is about 50 ft. above mean sea level in the northeast county, sloping to about 20 ft. at the coast. Artesian wells tapping the Floridan aquifer at the coast are thus free-flowing, but the land surface slopes more steeply than the piezometric surface and overtakes it at the northeast corner, where artesian wells will not flow freely at the land surface.

What is usually called a spring may be described as nature's artesian well, a passageway through the confining bed to the surface. The upper Hawthorn formation supplies the drinking water of Pinehurst spring, and the lower Hawthorn the highly mineralized water of Warm Salt Spring (Warm Mineral Springs).

Non-artesian wells are those that tap the ground water lying above the uppermost impervious layer. Thus they are shallower than the artesian wells in this particular location, although fairly shallow artesian conditions can and do exist even at 100 ft. deep or less, because of local beds of hardpan, clay and limestone above them.

The most important aspects of these two groupings is their re-charge function; a water source is no better than its replenishment. An artesian aquifer is recharged by rainfall some distance away, whereas a non-artesian aquifer is recharged by

local rainfall. Considering the possible effects of urbanization on recharge features, pollution and expanding demand, one reason for tapping a deep artesian aquifer is its non-local recharge.

D. Hawthorn Aquifer

These are the principles, but what is the actual situation applying to Sarasota County? The truly non-artesian wells are those that are very shallow, in the surficial sands.

The underlying Hawthorn formation previously described is not homogeneous. This aquifer supplies most local wells, and its quality is as variable as its geological composition. The shallower wells are usually of limited capacity.

Within the great thickness of the Hawthorn formation are beds of both permeable materials such as sand and shell, and impermeable materials such as clay and limerock. All of these beds are discontinuous. Wells in this formation may be non-artesian, semi-artesian or artesian, as the depth increases. It is reasonable to assume that the potential recharge radius increases with depth.

Stringfield reported in 1933 that the principal ground water supply for the deep wells in Sarasota are from the Hawthorn formation and not from the underlying Ocala limestone, as had previously been thought. The wells that he tested penetrated the Ocala limestone, which was the reason for the latter supposition, but the heavy flow into these wells came from the deep Hawthorn formation.

Stringfield also found little evidence of leakage between one water-bearing stratum and another. This is not surprising if the deep limestones that the tested wells penetrated were relatively impermeable.

Bishop's 1960 report for Sarasota County concluded also that the Hawthorn formation is the most important water source, and further that it receives recharge

from northeastern Sarasota County through parts of Manatee, Hardee, Hillsborough and Polk Counties. Bishop's study represents an up-dating review of Stringfield's work with a limited amount of new data. It may be assumed that Stringfield's major premises are permitted to stand. One of these is that there is little leakage upward from the Floridan aquifer. Bishop also concluded, however, that the Floridan aquifer contains large quantities of usable water in the northeastern part of the county.

Adjacent Manatee County has received an intensive modern investigation, the report of which, by H. M. Peek of the U. S. Geological Survey, was issued in 1958 as Florida Geological Survey Report No. 18. Peek's conclusions are that the Suwanee limestone and the Tampa formation, which form the upper part of the Floridan aquifer, are the principal sources of ground water in Manatee County. He also found that there is upward leakage from these formations into the Hawthorn formation, because the artesian head is greater below, through wells that are open to both levels.

Manatee County is so close to Sarasota County that one would expect that generalizations would not differ this sharply. We believe that due consideration should be given to the possibility that the Hawthorn formation may be recharged to a considerable degree by the underlying Floridan aquifer. Although it is true that aquifers tend to maintain their own integrity rather than disperse at random, water will flow in response to a difference in pressure, which is upward in this case.

If the Hawthorn formation is not homogeneous, as reported, one could expect discontinuities in the confining beds, which would permit water to work its way upward, even where wells were not drilled, although at a slower rate. A zig-zagging upward flow through a semi-permeable medium would account for a gradually lower piezometric pressure nearer the surface, without the necessity for recharge effects from above.

Again based on the low permeability of the Hawthorn formation taken as a whole, it appears to be unlikely that it would be adequately recharged from a long distance away. It seems logical that water would more readily percolate upward a few hundred feet than laterally 30 miles or more.

The evidence of the tests on local wells is not conclusive, because the discontinuities in the Hawthorn formation could not be expected to conveniently line up for each well. As to the limited flow out of the Floridan aquifer, the overall permeability of this huge formation has been cited by many authorities, and areas of permeability could be in random contact with corresponding areas of the Hawthorn formation.

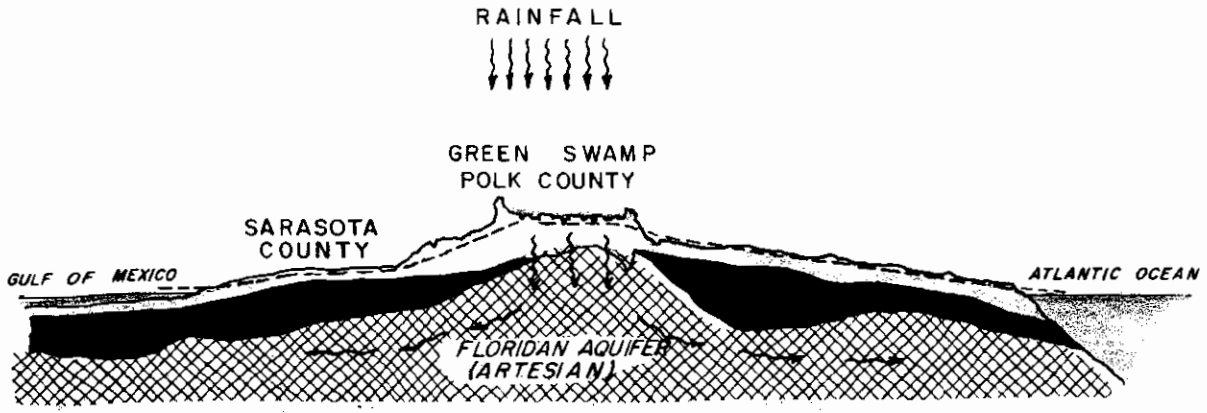
E. Floridan Aquifer

The foregoing serves as an introduction to perhaps the most important ultimate source of water for Sarasota County, the Floridan aquifer. The deep limestones are generally highly permeable on the one hand, and have a huge recharge area on the other.

This aquifer is supplied by rainfall on Polk County and parts of surrounding counties. The core is a huge lake and marshy region known as the Green Swamp. Exhibit "O" on the following page illustrates a generalized cross-section of the state showing the Floridan aquifer. Because almost all of central Florida depends on this source, attempts are being made toward its protection.

Rainwater that percolates downward in Polk County and nearby, through lakes and sinkholes penetrating the Hawthorn formation, travels laterally in all directions. The tremendous flow of Silver Springs arises from the Floridan aquifer. The water moves outward toward the sea under the Floridian plateau, and over thousands of years has flushed out sea-water residues and other soluble minerals over a large radius. This radius of good fresh water may reach into Sarasota County, but progressively deteriorates as it moves toward the coast.

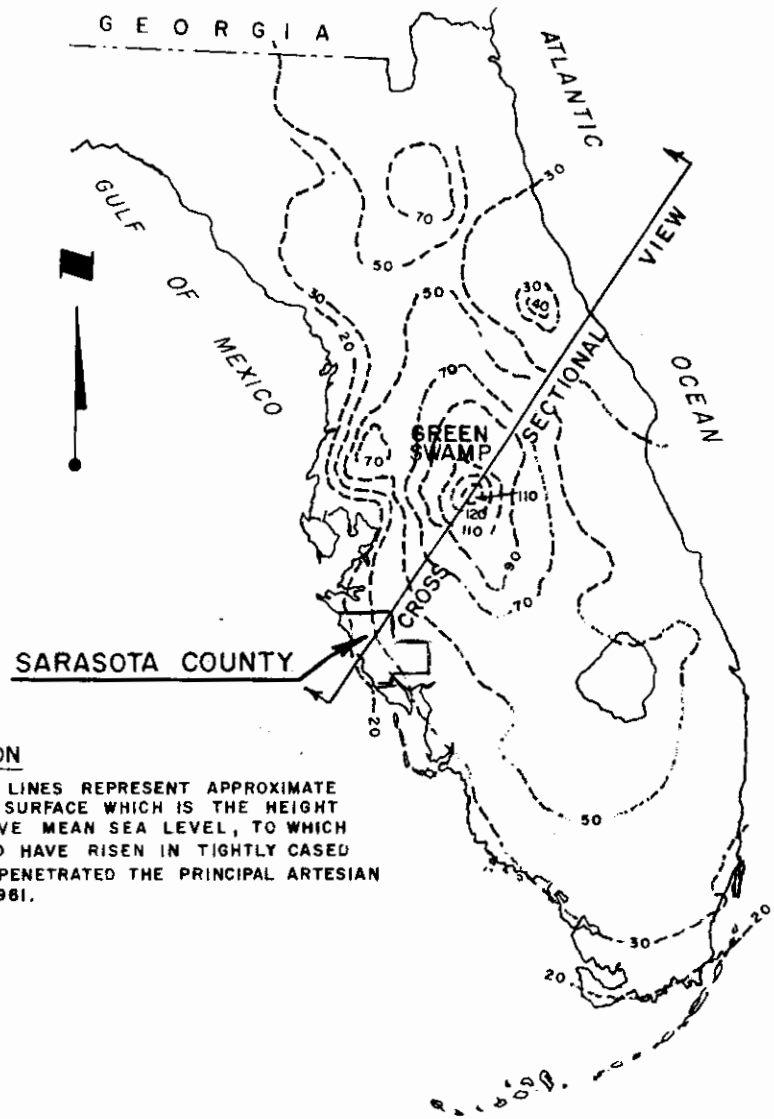
JOB NO. 783



LEGEND

- PERMEABLE SURFACE SOILS
- CONFINING LAYER (Hawthorn Formation)
- FLORIDAN AQUIFER
- PIEZOMETRIC SURFACE

CROSS SECTIONAL VIEW



EXPLANATION

CONTOUR LINES REPRESENT APPROXIMATE PIEZOMETRIC SURFACE WHICH IS THE HEIGHT IN FEET ABOVE MEAN SEA LEVEL, TO WHICH WATER WOULD HAVE RISEN IN TIGHTLY CASED WELLS THAT PENETRATED THE PRINCIPAL ARTESIAN AQUIFER IN 1961.

PIEZOMETRIC SURFACE

GENERALIZED CROSS SECTION THROUGH GREEN SWAMP AND SARASOTA SHOWING FLORIDAN AQUIFER

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SARASOTA, FLORIDA

- 55 -

EXHIBIT "O"

The long distance to the continental shelf and the probable great depth there of the limestone outcropping, which backs up a hydrostatic pressure, may have combined to slow down the flow, and thus the flushing action, which would then cumulatively favor the easy way out. The huge solution channels that supply Silver Springs may deprive Sarasota County of its full share of the underground flow. This would explain why Stringfield did not find the cavernous solution channels here which supply tremendous flows to wells in a number of other counties. However as long as the Green Swamp is "topped off" by annual recharge, the pressure available for artesian flow beneath Sarasota county will remain fairly constant.

Exhibit "P" on the following page shows the approximate extent of the U.S.P.H.S limits of two critical chemicals in the Floridan aquifer, as speculated by Bishop from very limited information:

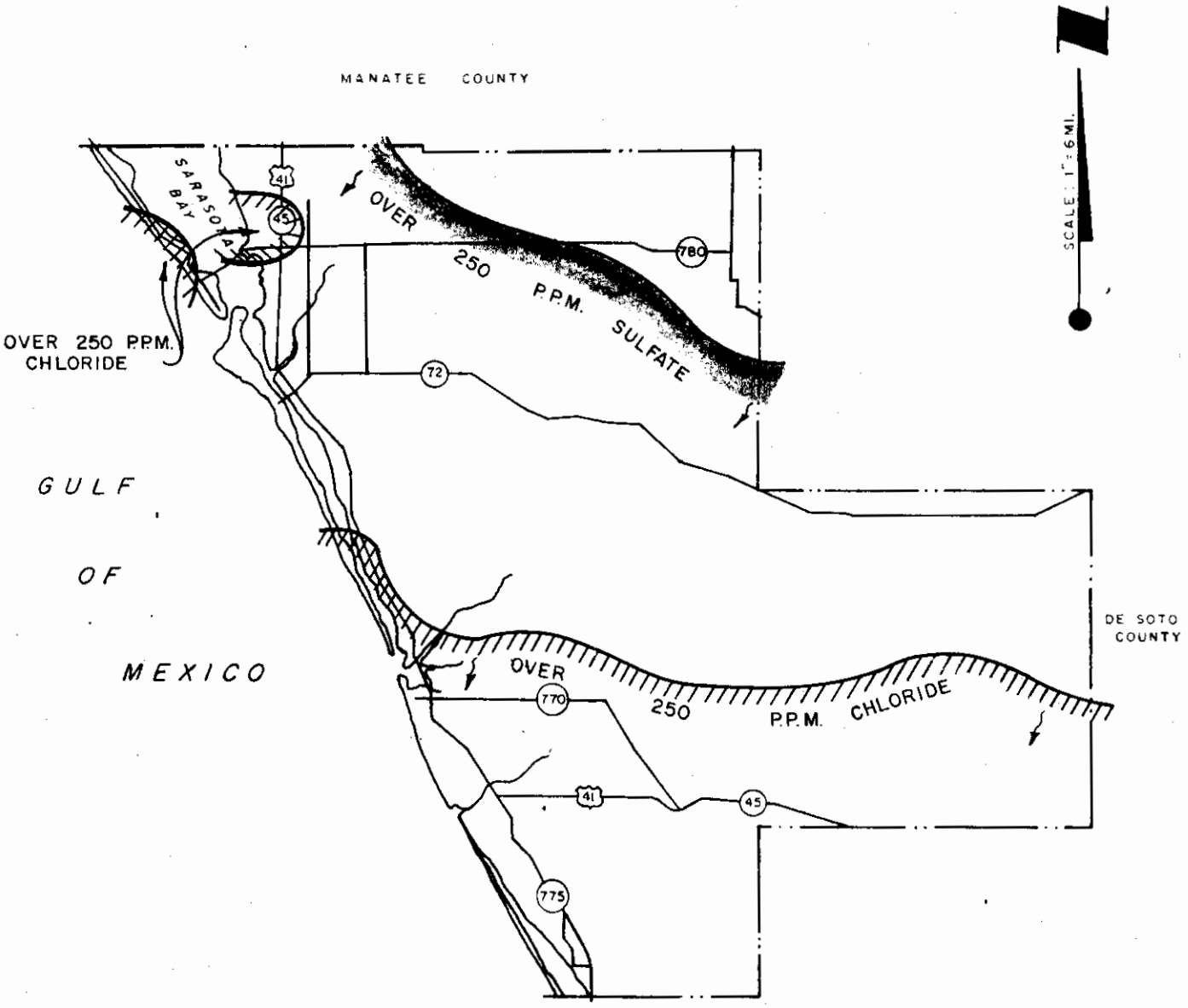
Sulfates	250 ppm
Chlorides	250 ppm

These delineations must be considered as generalized for lack of sufficient data. The City of Sarasota test well now being drilled in this area has revealed sulfate double this amount at one level, but it is hoped that the condition is localized considering evidence of low sulfate from the few other wells in the region. Ultimately a refined map should be possible, which would become a most valuable tool, although the invisible underground will always produce localized surprises.

The existing wells within the boundaries of the City of Sarasota tap the upper part of the Floridan aquifer, and it will be noted that the city area is high in both sulfate and chloride.

F. Offshore Keys

The offshore island keys present a special case. The sandy surface soil contains a non-artesian lens of fresh water which floats on underlying denser salt water, where rock or other impermeable layers do not intervene. During the dry season, and especially in drought years, this limited upper supply becomes salty,



From Bishop (1960)

Note:
U.S. Public Health Service standards specify maximum 250 p.p.m. for chloride or sulfate.

APPROXIMATE LIMITS OF PERMISSIBLE CHLORIDE AND SULFATE IN DEEP WELLS

SARASOTA COUNTY

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SARASOTA, FLORIDA

JOB NO. 783

EXHIBIT " P "

especially as pumping by a growing population increases the demand. The mechanics of salt water intrusion is discussed elsewhere in the report.

Local artesian conditions exist under areas of the keys and the bays, such that fresh water flows seaward under rock layers. Careful well drilling can tap this source. However the local recharge feature and seasonal aspects appear to make this source vulnerable to salt water and other undesirable effects, and the future supply of the keys, as the population builds up, probably must rely on a dependable source piped from the mainland.

G. Inherent Quality and Quantity of Sources

It is apparent from the above review of the various sources that water of adequate quality may be obtained in most urbanized areas from relatively shallow wells, which tap the surficial soils and the upper Hawthorn formation. These wells are relatively low in capacity, and a public water system must develop a network of multiple wells. For a major system the physical limitations and economics eventually justify an alternative source.

It would be difficult to estimate the ultimate potential of the locally recharged aquifer. As long as the ground water tops off regularly, whether every year or every few years, there would not be a permanent deficit, no matter how severe or dangerous are the problems caused by dry-weather overpumping.
Local observations in urban as well as rural areas over many years, as reported by Mr. Ken Clark, the County Agricultural Agent, have not revealed any tendency away from the usual wet-season surplus. The surface soils are highly permeable and readily permit infiltration in all but completely paved downtown areas. It is possible that factors other than depletion will play a major part in turning from local aquifers to other sources. However, heavy pumping of thousands of wells concentrated near the coast could well invite salt water intrusion.

Bishop's 1960 report suggested the establishment of specific conservation areas in various parts of the county, for the purpose of protecting the local recharge and preventing salt water intrusion. Considering the insufficient knowledge of the actual recharge mechanism and its quantitative aspects, and the observations of the County Agent cited above, the main significance of Bishop's suggestion is that it dramatizes the importance of learning more about the local recharge function. Many areas of the county will depend on ground water which is probably recharged locally for years to come, under any circumstances, and it might be dangerous to wait until after any damage is done.

The lower Hawthorn formation and the Floridan aquifer, both artesian, have plenty of capacity, but are unacceptably mineralized under the coastal urbanized areas. The northeastern part of the county, or some miles beyond toward Polk County, should rectify this situation if no alternative acceptable source is obtainable nearby.

The effects of heavy pumping even in a productive aquifer are revealed dramatically by the multiple irrigation wells in the celery growing area east of the City of Sarasota, known as the Palmer Farms. These deep wells were estimated by Stringfield in 1930 to pump as much as 7.5 million gallons per day, which approaches the 10 million gallons per day required by the entire 1963 county population. Present consumption of water in this agricultural area is unknown, but allowing for seasonal fluctuations there is a local depression in the piezometric surface of about 6 ft. Another local depression in the City of Sarasota is caused by the City's deep wells, and amounts to about 3 ft.

H. Salt Water Intrusion

Salt water not only meets fresh water at the coast and tidal inlets, but also underlies much of the county. The salt water near the coast is modern sea water whereas inland the salt water beneath the fresh water represents the residues from ancient ice-age seas which have never been flushed out.

Fresh water is slightly lighter than sea water and will tend to float upon it. Near the coast the theoretical Ghyben-Herzberg principle generally applies, which is that for every foot of fresh water above sea level there will be about 40 feet below. It is analogous to an iceberg, most of which lies below the water surface.

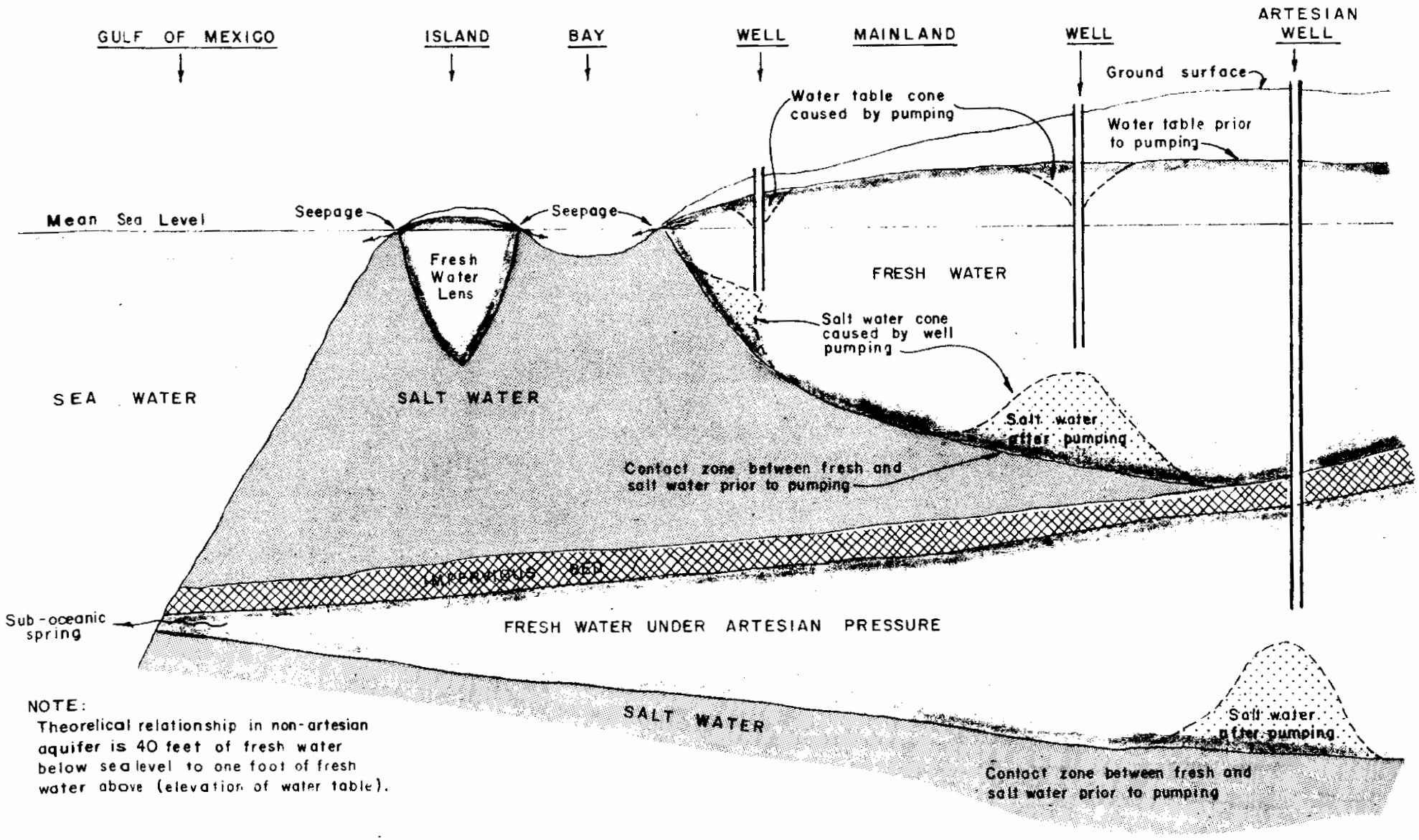
The significance of the water table immediately becomes evident; if the water table is, say, 5 feet above sea level, fresh water will extend about 200 feet below, and a well tapping this zone will, at least initially, obtain fresh water. The actual shape of the zone of contact is a curve, as shown on Exhibit "Q" on the following page. This exhibit illustrates the classical principles, and also the effects of pumping.

The relationship shown on Exhibit "Q" is for shallow non-artesian wells in a permeable aquifer. This description fits the main source of fresh ground water in coastal Sarasota County, and salty shallow wells near the coast such as in Englewood, appear to confirm the condition.

Salt water intrusion immediately adjacent to land may move laterally inland, as well as vertically upward. A "salinity" dam placed in tidewater channels helps resist salt water intrusion by barring tidal flow inland, as well as by pooling fresh water above it.

The 40 to 1 ratio principle does not apply inland, for various reasons, but the basic situation is similar in that a head of fresh water floats on a bed of salty water. At deeper levels than the shallow surface soils, the pressure effects of artesian aquifers and the influence of the impervious layers that confine these aquifers alter the relationship.

The placement, construction and operation of wells have a great influence on contamination of the fresh water aquifers. Drawdown of the well by pumping lowers the water table locally, as an inverted cone, which in turn permits the underlying



NOTE:
Theorelical relationship in non-artesian aquifer is 40 feet of fresh water below sea level to one foot of fresh water above (elevation of water table).

GENERAL RELATION OF FRESH WATER TO SEA WATER IN COASTAL AREAS

Not to scale

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SARASOTA, FLORIDA

salt water to move upward in an opposite cone effect. Where the wells are close to the coast, the bottom cone may be warped sideways toward the sea, with consequent movement of sea water laterally toward the well. In either case, contamination from salt water may result. The harder the pumping and the closer the spacing of the well field, the greater will be the potential intrusion.

I. Other Contamination

Artesian wells of poor quality can create problems. Over most of Sarasota county water will flow freely, or "wild," out of an open artesian well. Capped wells that have corroded casings can be contaminating adjacent shallow aquifers. For the latter reason, capping is insufficient and may even accelerate hidden underground contamination. Plugging of the wells is the best solution for either situation, but is relatively expensive.

The wildly flowing well problem is so common in Florida that a special inventory was published by the Florida Geological Survey in 1957. The State Division of Water Resources and Conservation has initiated a plugging program, the progress of which is limited by costs.

There are other sources of ground water contamination in Sarasota County. Irrigation water, unlike rainfall, contains dissolved salts. The quantity may be minor enough for ordinary usage, but may build up over a period of time. Sea spray and unusually high tides add to the problem in coastal areas. Where natural rainfall flushes out these salts, the problem may be transferred to the lower areas of the basin. The importance of agriculture and the value of irrigation to Sarasota County is such that this aspect merits further study to preclude or minimize the problem, rather than attempt to solve it after it might reach major proportions.

Overall, a majority of the population outside of the cities use private wells for water supply, and septic tanks with drainfields for sewage disposal. Failures of septic tank systems are widespread when the water table rises to the ground level, and the County Health Department reports that many complaints are received of sewage standing in yards and open ditches.

Pollution by industrial wastes will become a problem as the county attracts more industry, unless suitable treatment is required. Such treatment has been installed at the local EMR plant. Nature may also add undesirable pollutants at times.

A long range program should incorporate procedures for coping with pollution before it becomes a hazard or excessively costly to correct after the fact. Sarasota County has already taken important steps in this direction under its overall water management controls.

J. Well Drilling

The well driller plays a key role in the county's water supplies. The placement and construction of wells is a critical matter. For instance, an uncased well penetrating a mineralized aquifer confined between rock layers can permit this poor water to penetrate adjoining aquifers and ruin the quality of neighboring wells.

The leakage of well water between aquifers and upon the ground may become of increasing importance, although some evaluation of nature's own leaks through discontinuities in confining beds is needed to determine whether the problems are local or general.

Future wells should have longer casings properly seated to seal out undesirable layers, and wells drilled too deep should be plugged back to the level that provides the desirable water, or if abandoned, plugged to the ground surface.

Older wells may require a program of plugging, renewal and re-seating of casings, and extension of seated casings to deeper levels. This could be an expensive undertaking, and therefore a program of this nature requires additional data, analysis and planning. It would be necessary to determine which wells actually need corrective measures and to develop an equitable policy as to the costs.

The county has wisely initiated a program of well drilling regulations. These will require refinement as they are implemented.

Other aspects of well drilling are discussed elsewhere in the report, but a detailed and complete review of this subject is beyond the scope of the report. A comprehensive review of this nature would be of great value to public and private interests, and would be a worthwhile project for the county.

XII. WATER SUPPLIES

A. General

In previous sections of the report, jurisdictions, population and resources have been analyzed. An assessment of the water supplies of Sarasota County must relate these factors to each other, as a kind of supply and demand situation.

A realistic correlation could be made of these complex factors if we were dealing with the present or even the near future. However, the most important purpose is to look far enough into the future to plan for orderly and economical growth which would avoid creating problems that might be exceedingly painful and prohibitively costly to cope with later.

No one can predict the future with accuracy or lay down a mandatory blueprint in our free society. In this case there are several public agencies having independent jurisdiction, as well as the quasi-public features of franchises.

No pretense is made that the projections in this report will apply literally. Instead, they should be considered as an attempt to outline reasonable concepts of the future, suitable for discussions and negotiations among the various interested parties, and leading to preliminary planning steps in the countywide public interest.

The data that has been assembled has been reduced to common denominators, and a summary appears at the end of the report as Exhibit "T." In connection with the population projections, reference should be made also to Exhibit "F" in Section V of the text.

B. Demand

The demand for fresh water is the summation of the individual requirements of every consumer. The uses of water may be classified as follows:

1. Domestic, including lawn watering
2. Agricultural
3. Industrial and Commercial

For many years the agricultural demand was by far the greatest. Irrigation water for winter crops in the Palmer Farms area was estimated at about 7.5 million gallons per day in 1930 compared to total domestic usage probably of the order of one million gallons per day.

Present domestic usage is probably about 10 million gallons per day and will continue to increase with the influx of population. Industrial and commercial use is beginning to become significant, and will also increase in the future, although Sarasota County does not appear likely to require the staggering quantity of industrial water that must be supplied in other parts of the United States.

The quality of the water supply is also of importance, and need not be the same for all purposes. Drinking water standards are not identical with agricultural specifications. Budgeting of the available supply may take this into consideration when a shortage arises.

Of the total domestic usage of about 10 million gallons per day (MGPD) the public water utiliites now supply about 6 MGPD, or 60 percent. The remaining 4 MGPD, or 40 percent, is supplied by individual wells operated by homeowners and other users.

Individual needs very widely and seasonally. It has been found by experience elsewhere that the per capita requirement for domestic uses has been approaching 100 gallons per person per day. Analysis of meter records for county water systems tends to confirm this as a conservative average figure for estimating purposes. This per capita demand may be broken down as follows:

AVERAGE PER CAPITA DAILY DEMAND

Personal needs, cooking, bathing, sanitary	50 gallons
Laundering and lawn watering	25 gallons
Leakage and unaccounted for losses	25 gallons
Total Daily	100 gallons

On this basis the total domestic requirements of the near future are estimated as follows:

TOTAL DOMESTIC DEMAND	
1963	10 MGPD
1970	19 MGPD
1980	38 MGPD

It is reasonable to expect that the great majority of this demand will be supplied by public utilities. A major share of the appreciable industrial and commercial demand will also be supplied by these public utilities.

Agricultural requirements will undoubtedly continue to be handled by privately owned wells. The amount of water they consume must be reckoned as a substantial addition to the total demand upon the county's water resources.

All of the above are average computations. A seasonal peak occurs in the dry season, and daily peaks during certain hours of each day. The effects of these peak demands are reflected all the way back to the water sources, although an adequately designed distribution system can attenuate at least the daily peaks. Design criteria is available for this purpose.

C. Existing Situation

The City of Sarasota is committed to the obtaining of raw water from the northeast part of Sarasota County, having negotiated a purchase option for a 2 square mile well field site 10 miles east of the City limits. Private interests have proposed that they handle this project, as the first phase of a county wholesale supply system, and of course the Board of County Commissioners could interest themselves in it for the same reason. In any event, if water of good quality is confirmed by test, the supply will become reality within the next few years, and the City will finally replace its substandard water with a high quality supply.

Englewood has formed its own Water District, which should provide for its needs for some years to come. The City of Venice well field will be moved easterly if required by deterioration caused by construction of the adjacent tidewater inland waterway, at the expense of the waterway district.

Although the above pressing needs will be fulfilled, the future has a way of catching up with the present with dismaying rapidity in this part of Florida. Many water supply systems for franchised areas are already marginal as to quality or quantity or both, especially in the dry season, and the economic factors do not always encourage expansion of the water supply or the development of new sources. Therefore the present is none too soon for preliminary planning.

It has been noted that the agricultural demand in the Palmer Farms area has caused a permanent depression of about 6 ft. in the piezometric surface. The potential effects on the aquifer of the future demands outlined above will be greater and more widespread.

No generally dangerous condition appears to be imminent as to the existing total demand, but local problems are occurring which inevitably will become more acute unless corrective measures are taken. At times it is certain that everywhere the water table has been lowered and the piezometric pressure in every aquifer reduced by heavy dry weather pumping.

D. Planning for the Future

Acknowledging the complexities and jurisdictional aspects, the most reasonable approach in behalf of all of the people in the County of Sarasota would appear to plan for the following steps:

1. Groupings of urban areas as distribution systems around cores, over a period of time.

2. Exploration of local sources of supply for the distribution systems until alternative sources become economically available.

3. Development of a limited number, perhaps only one, ultimate source of supply which would serve the distribution systems from centralized treatment facilities in core locations within the urban area groupings.

4. Alternatively, consideration as the main source of supply of the Manatee River impoundment project being explored by Manatee County's Board of County Commissioners.

E. Grouping of Urban Areas

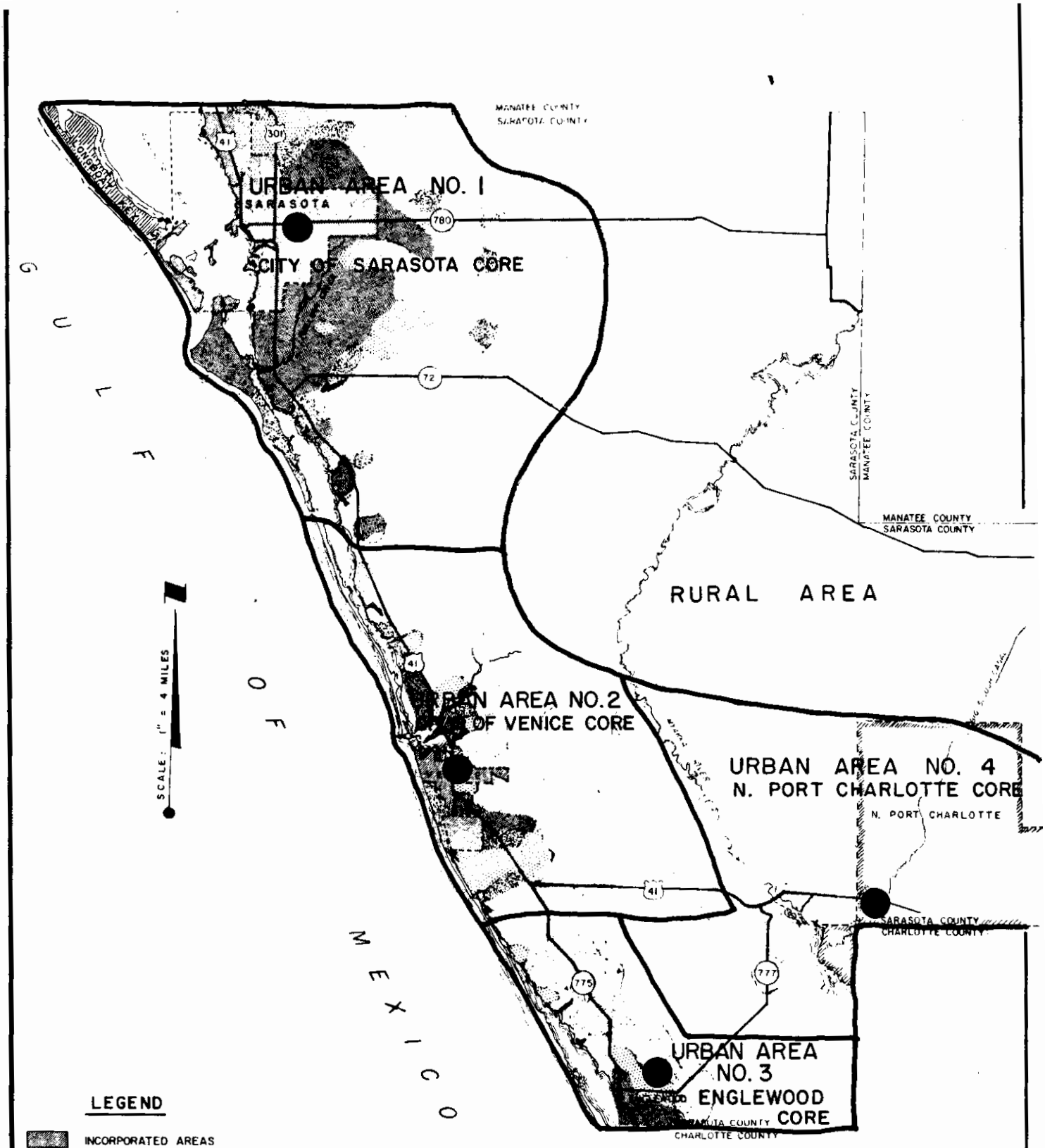
Exhibit "R" on the following page outlines a grouping of urban areas that appears to be reasonable. There are three coastal areas shown:

URBAN AREA GROUPINGS

Area Number	Location	Core
1	North Coastal	City of Sarasota
2	Central Coastal	City of Venice
3	South Coastal	Englewood
4	Southeast	City of North Port Charlotte

It would be premature and futile to attempt to outline herein the procedures for lending effect to these groupings, or alternative groupings if found to be more feasible for various possible reasons. Jurisdictional aspects, state statutes, property rights, economic considerations and the will of the people are deeply involved, and there are many potential inter-reactions.

Exploratory discussions among all concerned and the creation of public awareness should lead toward succeeding steps which may evolve toward an ultimate solution. Even if the first agreement is only a generalized and loose understanding,



ANTICIPATED
URBAN AREAS AND CORES

SARASOTA COUNTY, FLORIDA

SMALLY · WELLFORD & NALVEN SARASOTA, FLA.

APRIL, 1963

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EXHIBIT "R"

this meeting of minds will have justified the initiative that has been taken in the public behalf by the Board of County Commissioners. Informed public opinion will support or perhaps even demand implementing measures.

It is important to note that the overall success of a program of this nature does not depend on uniform acceptance of every detail by every party. Voluntary cooperative actions can go a long way.

F. Future Water Supply System

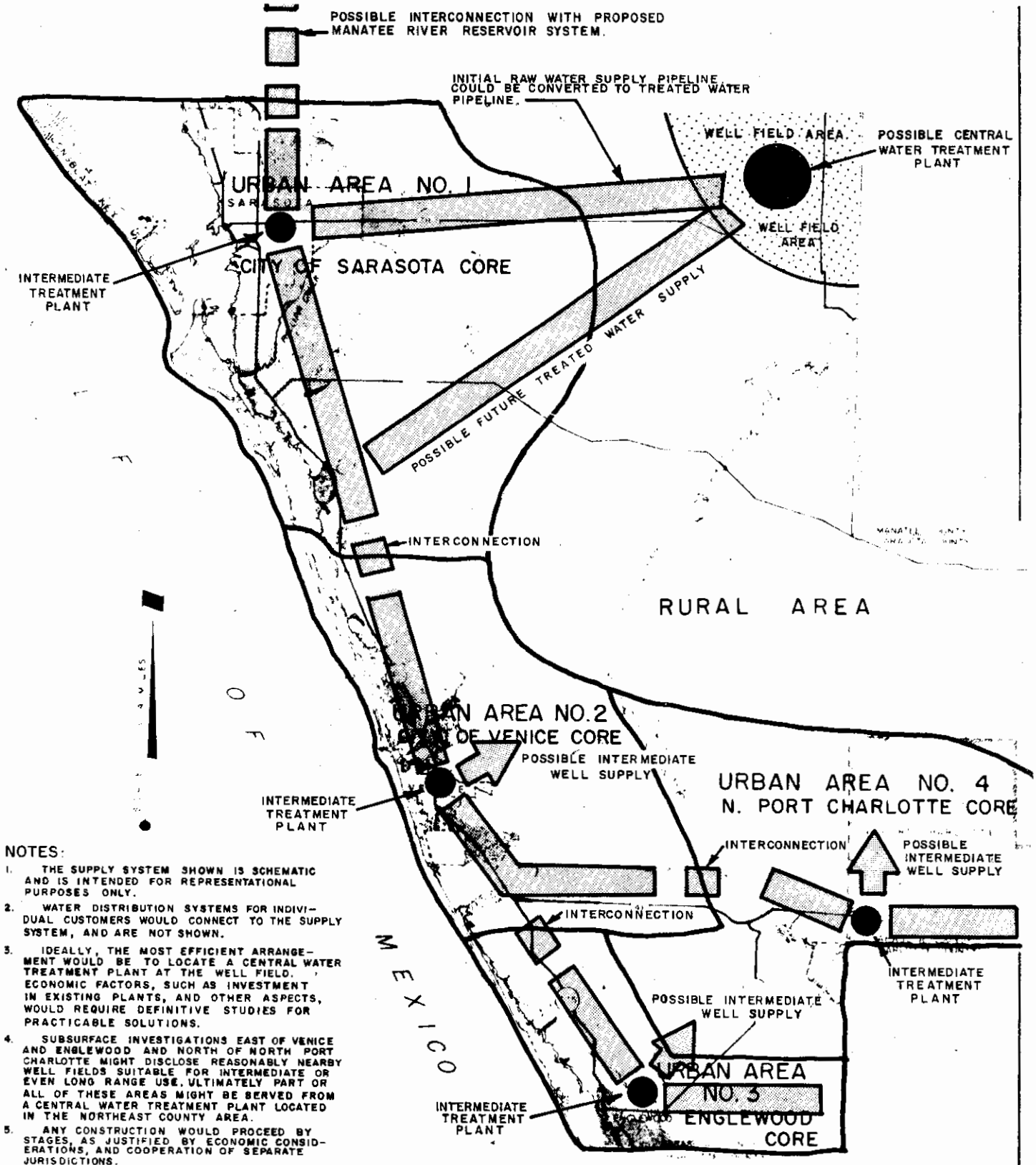
Exhibit "S" on the following page outlines schematically a possible water supply system for the long-term requirements of Sarasota County. This preliminary outline is intended to convey concepts only. The distribution systems that would be served by the supply system are not shown.

Treated water of high quality, meeting U. S. Public Health Service standards in every respect, would be carried by one or more large pipelines passing through the urban areas. The local distribution systems would purchase the water at wholesale rates for distribution to their consumers at retail rates.

Because of the economics of pipeline and treatment capacity, the water would be supplied at average daily flow rates, and peak demand would have to be provided by each distribution system in the form of adequate ground or elevated storage tanks. Existing plant components could be utilized for this purpose, and even the old well fields could serve as standby equipment for emergencies. In all other respects the retail distribution systems would be relieved of the burden of supply and plant treatment.

The water supply would come from one or more of the following sources:

1. The north coastal urban grouping, Area No. 1, would receive a supply from the northeast part of the county. The water would be treated by a plant located in



NOTES:

1. THE SUPPLY SYSTEM SHOWN IS SCHEMATIC AND IS INTENDED FOR REPRESENTATIONAL PURPOSES ONLY.
2. WATER DISTRIBUTION SYSTEMS FOR INDIVIDUAL CUSTOMERS WOULD CONNECT TO THE SUPPLY SYSTEM, AND ARE NOT SHOWN.
3. IDEALLY, THE MOST EFFICIENT ARRANGEMENT WOULD BE TO LOCATE A CENTRAL WATER TREATMENT PLANT AT THE WELL FIELD. ECONOMIC FACTORS, SUCH AS INVESTMENT IN EXISTING PLANTS, AND OTHER ASPECTS, WOULD REQUIRE DEFINITIVE STUDIES FOR PRACTICABLE SOLUTIONS.
4. SUBSURFACE INVESTIGATIONS EAST OF VENICE AND ENGLEWOOD AND NORTH OF NORTH PORT CHARLOTTE MIGHT DISCLOSE REASONABLY NEARBY WELL FIELDS SUITABLE FOR INTERMEDIATE OR EVEN LONG RANGE USE. ULTIMATELY PART OR ALL OF THESE AREAS MIGHT BE SERVED FROM A CENTRAL WATER TREATMENT PLANT LOCATED IN THE NORTHEAST COUNTY AREA.
5. ANY CONSTRUCTION WOULD PROCEED BY STAGES, AS JUSTIFIED BY ECONOMIC CONSIDERATIONS, AND COOPERATION OF SEPARATE JURISDICTIONS.

WATER SUPPLY PIPELINE

SCHEMATIC
FUTURE WATER SUPPY SYSTEM

SARASOTA COUNTY, FLORIDA

SMITH, WETHERBY & NAIMAN SARASOTA, FLA.

APRIL, 1963

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EXHIBIT "S"

or near the area core, the City of Sarasota. Considering that this source may become reality soon for the City of Sarasota, other areas might be initially served through the Sarasota core.

2. Ideally, the most efficient arrangement would be to locate a central water treatment plant at the well field. This would save pipeline construction and operating costs, and avoid parallel raw water and treated water pipelines. It is well known that pipeline and plant capacity can be more economically increased than providing the same capacity with separate supply facilities.

However, other economic factors such as investment in existing coastal plants will apply, and many other aspects require consideration. A definitive study would be needed for the most practicable solution.

3. The central coastal urban grouping, Area No. 2, would be served by its Venice core, whether or not the City of Venice operated the treatment plant. Local and intermediate well fields, as might be revealed by subsurface investigations, might be exploited fully, until at some later stage it might be expedient to connect to the central supply source discussed above.

Economics would largely dictate the choice and timing. If a nearby long range source is not found and the ultimate source depends on the same northeast well field as the City of Sarasota, it would be better to receive a treated supply than to construct a long and expensive raw water line.

4. A similar procedure would be followed for the Englewood core of the south coastal urban grouping, Area No. 3, and for the southeast urban grouping, Area No. 4 whose core is North Port Charlotte.

5. No matter what the final arrangements may be, the supply pipelines for all urban groups should be connected to each other. An interconnected system has financial and operational benefits of considerable potential, and could be ideal for expanding the supply systems by stages.

6. If the proposed Manatee River impoundment system which is being planned by the Manatee County Board of County Commissioners becomes reality, a definitive study should be sponsored by the Sarasota County Board to evaluate and compare the cost factors and other considerations involved in utilizing this source, provided that the Manatee County Board would be agreeable.

Since the Manatee system would provide treated water like the supply system proposed for Sarasota County, a cross-connection between the two systems would appear to be compatible, and might be advantageous to both counties. This is analogous to the common practice of interconnecting hydro and steam powered electric systems. Manatee County could economically supply Sarasota County with surplus water during the rainy season that would otherwise run off, and Sarasota could make up possible dry-weather deficits in Manatee. The concept will move beyond the theoretical as soon as the City of Sarasota's new supply goes into service and the Manatee system gets under way.

G. Initial Action

All of the existing water systems are now served by supplies essentially within their own boundaries, and with the need for alternative sources clearly in view the time is ripe for the county to initiate long range planning for the best interests of all. The flaw in this timing is that the City of Sarasota cannot wait.

The city is committed to obtain good water now, not later. As noted above, it is conceivable that arrangements could be made by the county or private interests to undertake this well development and pipeline, but the city is pressing forward independently.

This well field is located far outside the city in the area which probably will be called upon to serve much of the rest of the county. It would appear to be a reasonable approach for the city and county to explore a mutually agreeable

arrangement, toward establishing for the future a maximum degree of flexibility as to ownership and its transfer, either to each other or to a franchise, the possibility of enlarging the system to serve others, and whatever arrangements are necessary to provide appropriate financing and charges for any of these steps. Special legislation should be obtained if necessary.

This is not a proposal for any governing body to surrender its prerogatives or to reduce its momentum. The objective is to avoid any possibility of prejudicing the future of all the people of Sarasota County by procedures that would tend to freeze forever an initial approach which might not be ideal in the long run.

H. Other Actions

The planning measures proposed herein should provide for exploring various procedures outlined in Sections X and XI, which cover surface and ground water resources. Once a policy is established for a program of continuing data collection and analysis, and for periodic reviews of the developing supply and demand situation, the implementation of the plans should follow on an orderly basis. Adjustments to meet changing events should be relatively painless in the future if an effective working framework can be established now.

I. The Distant Horizons

It would be presumptuous to attempt to plan for the far distant future. That is the prerogative of generations to come, who will have the benefit of knowledge far beyond what we have today. However, it may be of value to those shaping the near future to glimpse the possible shape of things to come.

Some day enough information will be available to treat the hydrological cycle quantitatively in all respects, by regions, states and even continents. Engineers and geologists will know where all the water goes and what happens to it, instead

of groping for pieces of the puzzle as we do now. The surface runoff will be accurately charted. Subsurface flows in every aquifer will be computed with reasonable accuracy, from points of origin to points of usage, or to losses to the sea and the air.

Consumption will be tremendous, and losses will have to be controlled, even considering Florida's abundant rainfall. The Floridan aquifer will be drawn upon so heavily that it is conceivable in the distant future Silver Springs may cease flowing. This great spring is a natural artesian well, and if the piezometric surface should fall below the elevation of its mouth that would be the end. Its 500 million gallons per day might be captured by wells for use elsewhere.

Sarasota County might have to return to its local sources for supplementary capacity. Induced recharge using surplus surface water, in impoundment areas or behind weirs in streams, could help replenish various selected aquifers by natural means or pumping.

Re-use of sewage might be required, the processes for which would have been perfected by then to a degree that no one could know the difference. Public acceptance would long have been an accomplished fact.

If salt water conversion is ever necessary, Florida's long coast line would provide an economically available source. The cost has already been reduced to reportedly about $1.00 per 1000 gallons, but probably $1.50 to $2.50 considering all factors, which is lower than some arid places pay now, and the target for the current national research program is 50¢ per 1000 gallons, corresponding to $1.00, considering the same factors. Great additional strides in this process are inevitable, because of the need in many locations less fortunate than Florida. Brackish water can be treated at less cost than sea water, and some of Sarasota's mineralized wells might be suitable for this purpose.

The state of man's knowledge even today, and certainly tomorrow, is such that with intelligent planning and action Sarasota County should never have a water shortage so long as an energy source is available to provide the necessary power.

J. Fire Insurance

Although it is beyond the scope of this study to evaluate economic factors, it should be noted that potential savings in fire insurance premiums exist when the following conditions are both met:

1. A water system with fire hydrants to supply water of sufficient quantity at sufficient pressure, and operated in a reliable manner.

2. A fire department meeting prescribed standards. Most municipalities and fire districts are rated, but volunteer fire departments are usually marginal.

There are rating criteria for water systems and fire departments, and other factors enter into the overall rating of a community, including the fire alarm system, the cooperation of the police department, the adequacy of the building code and local regulations covering fire hazards, and the existing conditions and environments of the buildings.

Of the 18 water utilities in Sarasota County, 10 provide fire protection in the form of hydrants. Exhibit "T" tabulates pertinent data.

XIII. CONCLUSIONS

The future of Sarasota County depends upon the equitable usage of the available water resources. Although the complexities and jurisdictional aspects do not permit setting out a firm program herein, the time is ripe for planning by all interested parties in behalf of all of the people of Sarasota County. As the countywide elected public body, the Board of County Commissioners can best sponsor such planning and establish the framework for cooperation.

Although the most immediately pressing problems are being worked out by the utility systems involved, notably the City of Sarasota and the new Englewood Water District, tremendous demands of the rapidly urbanizing areas superimposed on a large agricultural requirement cannot safely be ignored. The danger signals are already evident. Unilateral actions by local water systems, even though justifiable, may not always be ideally suited for all the people of the county or even for the water systems that must initiate the actions under present conditions.

In the populated coastal areas, relatively shallow wells yield the best quality but are limited in volume. The deep wells in these areas deliver ample volume but are excessively mineralized.

Meager data in the northeast part of the county indicates that deep wells there may provide a plentiful supply of good quality water. The City of Sarasota has embarked upon test well drilling in this area.

The Myakka River does not provide the year-round flow or impoundment area that would be needed to warrant its use for a water supply. The only surface water source of significance in the region is the Manatee River. If the Manatee Board of County Commissioners proceeds to develop this source, mutually advantageous arrangements between the two counties might be possible.

Sarasota County must continue to look underground for its water sources. With the benefit of the information assembled by this report, the Board of County Commissioners will be in a position to negotiate with the Florida Geological Survey and the U. S. Geological Survey for a mutually agreeable program of investigations which may channel the budgeted funds where they are most needed. Time is available for a prudent decision. However inaction in obtaining the knowledge required to protect future needs is a form of gambling, and in this case the stakes are high.

It would appear that at the present time the highest priorities from the county's point of view for assistance from these capable agencies are as follows:

A. Ground Water

1. A comprehensive review of available data and test wells. In effect this would be an up-dating of Stringfield's excellent 1933 report, and in keeping with Peek's 1958 report covering Manatee County.

2. Initiation of a program to chart ground water characteristics, especially in high-volume aquifers, in the easterly and northeasterly areas of the county. Test wells may have to be drilled, the high cost of which require judicious planning.

3. Development of knowledge of the recharge mechanism of the shallow aquifers in coastal areas, sufficient to determine whether protective measures, such as impoundment zones, are needed. Shallow wells will be depended upon for many years to come, in many parts of the county.

B. Surface Water

A number of stream gages and water level gages should be installed. Provision should be made for adding to these as major drainageways are improved under the county's comprehensive plan. A number of years of

collected data would be necessary for further investigations of surface water characteristics. At that time a review can be made of the investigations that may then be justifiable.

The present water treatment systems distribute water that is safe but hard in varying degrees, with the exception of the City of Sarasota and the City of North Port Charlotte, which supply softened water. Some supplies fail to meet U.S. Public Health Service standards in a number of respects but not dangerously so. With the exceptions noted, the basic treatment is aeration, sedimentation-storage and chlorination.

The future can be expected to demand not only great increases in system capacities, but more sophisticated treatment. The financing, economical operation and other factors do not favor such increases, especially in plant capacity for softened water, within a fragmented complex of many separate systems depending on local well sources. Certainly these smaller systems cannot be expected to separately pipe raw water from long distances.

Consideration should be given to consolidation of systems in various ways. Even if all or many continue as separate distribution systems for many years, urban area groupings could be supplied with high quality treated water from plants in the cores of these areas.

It is anticipated, however, that economics and other forces will tend to reduce the number of small systems in favor of water districts and large franchises. The need for parallel sanitary sewerage systems will influence this trend, because sewer systems are usually less profitable than water systems.

Ideally, the most efficient arrangement would be to locate a limited number of central water treatment plants at the well fields, perhaps only one if there might be one ultimate well field remote from the populated areas. Many aspects would enter a study of actual feasibility, including the accumulated plant investment at that time.

XIV. RECOMMENDATIONS

1. Copies of this report should be distributed to the municipalities, the Englewood Water District, and other parties of interest.

2. As the elected public body representing the entire county, the Board of County Commissioners should sponsor and volunteer to coordinate long range planning among all parties of interest.

3. In consideration of the City of Sarasota's urgent and legitimate need to develop a well field far beyond the City limits, in the heart of the area that may also serve much of the balance of the County, the City and County should negotiate a mutually acceptable arrangement to provide sufficient flexibility for the present and future, as to ownership, financing, costs, charges and other considerations, so that any action undertaken now will not tend to prejudice the future best interest of all of the people of Sarasota County.

4. Negotiations should be initiated with the Florida Geological Survey and the U. S. Geological Survey for a mutually agreeable program of investigations, on a selective basis.

5. The status of the proposed Lower Phillippi Creek Utility District for water supply and sanitary sewerage should be reviewed.

6. Regular annual supplements to this report should be prepared, in order to provide continuing knowledge of the latest developments. Studies that are filed and not refreshed tend to be wasted. Future supplements could consider costs and other additional factors as they become pertinent.

7. The disposal of sewage is a closely related health problem involving both public utilities and individual facilities. A parallel investigation should be considered, so that the Board of County Commissioners may act as countywide coordinators in this field also.

8. The water (and sewer) franchise regulations and amendments thereto, as well as the negotiation of each franchise, should give due consideration to consolidation aspects that would be desirable in the future.

9. A comprehensive review of well drilling practices, including past history, existing regulations and other pertinent data should be made, with arrangements for keeping it continually up to date. Perhaps a county department could undertake this task in keeping with the regulatory function.

10. Any special legislation deemed desirable or necessary for the present and near future should be obtained, so that undue delay will not ensue for lack of power to act. The recommended arrangements with the City of Sarasota should be considered in this light.

11. The subject of this report is one phase of the overall water management needs of Sarasota County, and any planning or actions should be in harmony with other phases.

APPENDIX A

RATES CHARGED BY WATER UTILITIES

The water rates for metered public systems in this area are as follows:

MONTHLY WATER RATES FOR RESIDENCES

City of Sarasota

Minimum for 1,000 gallons	$1.68
Next 1,000 gallons	.55 for 1,000 gallons
Next 3,000 gallons	.45 per 1,000 gallons
Next 15,000 gallons	.38 per 1,000 gallons
Next 10,000 gallons	.34 per 1,000 gallons
Next 20,000 gallons	.33 per 1,000 gallons
Next 50,000 gallons	.28 per 1,000 gallons
Over 100,000 gallons	.22 per 1,000 gallons

City of Bradenton

Minimum, for 3,000 gallons	$2.00 ($.67 per 1,000 gallons)
Next 2,000 gallons	.50 per 1,000 gallons
Next 5,000 gallons	.40 per 1,000 gallons
Next 40,000 gallons	.30 per 1,000 gallons
Over 50,000 gallons	.25 per 1,000 gallons

City of Venice

Minimum for 3,000 gallons	$3.00 ($1.00 per 1,000 gallons)
Next 7,000 gallons	.30 per 1,000 gallons
Over 10,000 gallons	.25 per 1,000 gallons

Englewood Water District

Minimum for 5,000 gallons	$5.00
Next 5,000 gallons	.83 per 1,000 gallons
Next 5,000 gallons	.75 per 1,000 gallons
Next 10,000 gallons	.70 per 1,000 gallons
Over 25,000 gallons	.60 per 1,000 gallons

Bayshore Gardens Subdivision (Manatee County)

Minimum for 6,000 gallons	$3.50 ($.59 per 1,000 gallons)
Next 5,000 gallons	.50 per 1,000 gallons
Next 5,000 gallons	.45 per 1,000 gallons
Over 16,000 gallons	.40 per 1,000 gallons

Kensington Park, South Gate and Gulf Gate Subdivisions

Service Charge	$1.25 flat
First 2,000 gallons	.50 per 1,000 gallons
Next 3,000 gallons	.40 per 1,000 gallons
Next 15,000 gallons	.35 per 1,000 gallons
Next 30,000 gallons	.30 per 1,000 gallons
Over 50,000 gallons	.25 per 1,000 gallons

Phillippi Gardens Utility Corp.

Service Charge	$2.00
Minimum for 6,000 gallons	4.00 ($.67 per 1,000 gallons)
Next 14,000 gallons	.35 per 1,000 gallons
Next 20,000 gallons	.30 per 1,000 gallons

Sarasota Beach Water System

Minimum for 2,000 gallons	$3.00 ($1.50 per 1,000 gallons)
Next 10,000 gallons	.50 per 1,000 gallons
Next 10,000 gallons	.40 per 1,000 gallons
Next 22,000 gallons	.35 per 1,000 gallons

Southern Gulf Utilities, Inc. (Brentwood, et al)

Minimum for 11,000 gallons	$6.00 ($.55 per 1,000 gallons)
Next 20,000 gallons	.35 per 1,000 gallons
Next 20,000 gallons	.30 per 1,000 gallons
Over 51,000 gallons	.25 per 1,000 gallons

Southeastern Development & Utilities, Inc. (Berkshire Estates)

Minumum for 6,500 gallons	$4.50 ($.70 per 1,000 gallons)
Next 20,000 gallons	.35 per 1,000 gallons
Next 20,000 gallons	.30 per 1,000 gallons
Over 46,500 gallons	.25 per 1,000 gallons

Venice Gardens Utilities Corp.

Minimum for 6,000 gallons	$4.65 ($.78 per 1,000 gallons)
Next 2,000 gallons	.65 per 1,000 gallons
Next 2,000 gallons	.55 per 1,000 gallons
Over 10,000 gallons	.45 per 1,000 gallons

East Water Corp. (Venice East)

Minimum for 3,000 gallons	$3.00 ($1.00 per 1,000 gallons)
Next 12,000 gallons	.35 per 1,000 gallons
Next 15,000 gallons	.30 per 1,000 gallons
Over 30,000 gallons	.25 per 1,000 gallons

Double Ten, Inc. (Shadow Lakes)

Service Charge	$1.50 flat
First 2,000 gallons	.60 per 1,000 gallons
Next 3,000 gallons	.50 per 1,000 gallons
Next 15,000 gallons	.40 per 1,000 gallons
Over 20,000 gallons	.30 per 1,000 gallons

Siesta Gulf Corp. (Siesta Isles)

Minimum for 2,000 gallons	$3.00 ($1.50 per 1,000 gallons)
Next 10,000 gallons	.50 per 1,000 gallons
Next 10,000 gallons	.40 per 1,000 gallons
Over 22,000 gallons	.35 per 1,000 gallons

Consumers Utilities Corp. (Tri-Par Estates)

Mobile home users	$4.00 per month flat
Other residential users:	
Minimum for 6,000 gallons	$4.00 ($.67 per 1,000 gallons)
Over 6,000 gallons	.35 per 1,000 gallons

The tabulation of monthly water rates, as listed above, is not as significant as the monthly water bills calculated therefrom as follows:

CUMULATIVE MONTHLY WATER BILLS

Gallons Used	City of Sarasota	City of Bradenton	City of Venice	Englewood Water District	Bayshore Gardens	Kensington Park, Gulf Gate and South Gate	Sarasota Beach Sarasota Beach	Phillippi Gardens
0	$ 1.68	$ 2.00	$ 3.00	$ 5.00	$ 3.50	$ 1.25	$ 3.00	$ 2.00
1,000	1.68	2.00	3.00	5.00	3.50	1.75	3.00	6.00
2,000	2.23	2.00	3.00	5.00	3.50	2.25	3.00	6.00
3,000	2.68	2.00	3.00	5.00	3.50	2.65	3.50	6.00
4,000	3.13	2.50	3.30	5.00	3.50	3.05	4.00	6.00
5,000	3.58	3.00	3.60	5.00	3.50	3.45	4.50	6.00
6,000	3.96	3.40	3.90	5.83	3.50	3.80	5.00	6.00
**7,000	4.34	3.80	4.20	6.66	4.00	4.15	5.50	6.35
8,000	4.72	4.20	4.50	7.49	4.50	4.50	6.00	6.70
9,000	5.10	4.60	4.80	8.32	5.00	4.85	6.50	7.05
10,000	5.48	5.00	5.10	9.15	5.50	5.20	7.00	7.40
15,000	7.38	6.50	6.35	12.90	7.80	6.95	9.20	9.15
20,000	9.28	8.00	7.60	16.40	11.85	8.70	11.20	10.90
30,000	12.68	11.00	10.10	22.90	15.85	11.70	14.80	13.90
40,000	15.98	14.00	12.60	28.90	19.85	14.70	18.30	16.90
50,000	19.28	17.00	15.10	34.90	23.85	17.70		
100,000	33.28	29.50	27.60	64.90	43.85	30.20		

Gallons Used	Southern Gulf Util.	S.E. Devel. & Util.	Venice Gardens	East Water Corp	Double Ten	Siesta Gulf Corp	Consumers Utilities Mobile	Consumers Utilities Others
0	$ 6.00	$4.50	$ 4.65	$ 3.00	$ 1.50	$ 3.00	$ 4.00	$ 4.00
1,000	6.00	4.50	4.65	3.00	2.10	3.00	4.00	4.00
2,000	6.00	4.50	4.65	3.00	2.70	3.00	4.00	4.00
3,000	6.00	4.50	4.65	3.00	3.20	3.50	4.00	4.00
4,000	6.00	4.50	4.65	3.35	3.70	4.00	4.00	4.00
5,000	6.00	4.50	4.65	3.70	4.20	4.50	4.00	4.00
6,000	6.00	4.50	4.65	4.05	4.60	5.00	4.00	4.00
**7,000	6.00	4.68	5.30	4.40	5.00	5.50	4.00	4.35
8,000	6.00	5.03	5.95	4.75	5.40	6.00	4.00	4.70
9,000	6.00	5.38	6.50	5.10	5.80	6.50	4.00	5.05
10,000	6.00	5.73	7.05	5.45	6.20	7.00	4.00	5.40
15,000	7.40	7.48	9.30	7.20	8.20	9.20		7.15
20,000	9.15	9.23	11.55	8.70	10.20	11.20		8.90
30,000	12.65	12.55	16.05	11.70	13.20	14.80		12.40
40,000	15.70	15.55	20.55	14.20	16.20	18.30		15.90
50,000	18.70	18.38	25.05	16.70	19.20	21.80		19.40
100,000	31.25	30.88	47.55	29.20	34.20	39.30		36.90

** Estimated average demand per month

APPENDIX B

General References

The following references are a selected list that apply, directly or indirectly to water supplies and related water management aspects in Sarasota County. Many other references not listed also bear on this subject to some degree. Standard engineering reference works are not included. References marked with an asterisk (*) are a group selected for especial pertinence to water supply aspects in Sarasota County.

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SUMMARY OF PUBLIC WATER UTILITIES - SARASOTA COUNTY - 1962-1963

(1)	AREA (Approx. Acres) Total (2)	AREA (Approx. Acres) Served Presently (3)	POPULATION SERVED Ultimate (4)	POPULATION SERVED Present (5)	WATER QUANTITY Water Required (m.g.p.d.) Ultimate (6)	WATER QUANTITY Water Required (m.g.p.d.) Present (7)	Present Raw Water Supply Number of Wells (8)	Size (9)	Depth (Ft) From (10)	Depth (Ft) To (11)	Present Water Plant Capacity (m.g.p.d.) (12)	Type Treatment (13)	Storage (gals) (14)	Normal Line Pressure (15)	WATER QUALITY Typical or Composite Raw Water Characteristics Parts Per Million Total Dis. Solids (16)	Total Hardness (17)	Chloride (18)	Sulfate (19)	Fluoride (20)	Iron (21)	Corrosive (22)	Color Cobalt Scale (23)	FIRE PROTECTION Special Booster Pump (24)	Fire Hydrant Pressure (25)	Approx. Hydrant Spacing (26)
MUNICIPALITIES																									
City of Sarasota	10,900	5,000	87,000	40,000	8.700	4.000	21	6"-12"	550	850	6.000	See Note 4	2,600,000	50# - 60#	1,690	1,000 1,400	190 210	672	1.1	0	Yes	5	Yes	40#	1,000'
City of Venice	2,400	440	20,200	3,900	1.500	.600	32	2"-4"	65	140	0.600	See Note 5	600,000	52# - 60#	770	594	102	220	0.8	0.3	Maybe	20	No	60#	1,000'
City of North Port Charlotte	35,500	159	284,000	1,100	28.400	.110	14	2"	45	50	0.216	See Note 6	130,000	50# - 60#	650	428	140	0	0.5	0.7	No	55		None	
TOTALS	48,800	5,599	391,200	45,000	38.600	4.710					6.816														
WATER DISTRICT																									
Englewood Water District (Sarasota County Portion) Under Construction	4,300	—	34,500	—	3.450	—			Shallow						378	330	48	28	0.0	0.1		100			
FRANCHISES																									
1	7-7-58	Kensington Park, Inc.	500	330	4,800	3,100	0.480	.310	24	3"-4"-6"	73	270	0.420	Aeration & Chlorination	350,000	40# - 60#	515	288	64	89	1.9	0.25		5	Yes		1,000'
2	11-26-58	Double Ten (Shadow Lakes) Purchased by Gulf Gate	67	16	500	130	0.050	.008	1	4"		65	0.045	"	30,000	40# - 60#	543	299	84	54	0.20	0.10		10		None	
4	8-25-58	South Gate Water & Sewer Co., Inc.	1,550	560	12,400	4,500	1.240	.450	10	6"	280	350	1.000	"	200,000	40# - 60#	510	389	63	120	1.07	0.09		9	Yes	60#	1,000'
7-15-17	8-28-59	Southern Gulf Utilities, Inc. (Brentwood, Ridgewood)	2,850	120	22,800	1,050	2.280	.105	2	6"	100	100	0.350	"	9,600	60#	639	351	180	16	1.4	0.09	Maybe	5	No	60#	1,000'
8	12-22-59	Venice Gardens Utilities Corp.	4,600	96	36,800	780	3.680	.096	10	4"	100	140	0.129	"	26,000	38# - 50#	358	289	51	6	0.77	0.07	Maybe	7	No	25#	1,000'
10	2-14-61	Siesta Gulf Corp. (Siesta Isles & Vicinity)	239	30	1,900	240	0.190	.024	5	2"-3"	110	150	0.150	"	30,000	50# - 65#	620	455	86	181	0.9	0.15		11		None	
12	12-28-60	Southeastern Development & Utilities Inc. (Lake Sarasota-Berkshire Estates)	6,600	17	53,000	140	5.300	.014	1	6"		390	0.096	"	120,000	40# - 60#	312	448	87	48	0.8	0.08	Maybe	5	No	60#	1,000'
14	1-19-60	Phillippi Gardens Utility Corp.	210	50	1,700	400	0.170	.040	3	4"-6"	112	160	0.150	"	18,000	50# - 60#	929	376	192	74	0.90	0.04			No	60#	1,000'
16	8-29-61	East Water Corp. (Venice East)	1,400	15	11,200	120	1.120	.012	3	4"	100	110	0.054	"	70,000	40# - 60#	466	314	81	79	0.49	0.08	Maybe	13		None	
18	12-21-60	Gulf Gate Utilities, Inc.	720	63	5,800	500	0.580	.050	3	4"-6"	102	170	0.131	"	50,000	40# - 60#	654	430	145	108	1.65	0.09	Maybe	13	No	60#	1,000'
19	12-21-60	Sarasota Beach Water System, Inc. (Siesta Key Misc.)	1,072	167	8,600	700	0.860	.070	3	4"-6"	240	315	0.446	"	60,000	50# - 60#	1,140	668	87	506	1.3	0.04		5		None	
20	11-23-60	Consumers Utilities Corp. (Tri-Par Estates Trailer Park)	94	21	1,300	300	0.178	.041	2	6"	350	460	0.288	"	160,000	45# - 55#	820	404	65	298	0.70	0.06		15	No	40#	500'
23	11-27-62	C. E. Pitts (Sorrento Shores & Vicinity) Under Construction	640	—	5,100	—	0.510	—																			
24	2-18-63	B & B Utilities, Inc. (Trailer Acres) Under Construction	710	—	10,000	—	0.750	—	4	2"	22	29	—		26,000	35#	659	555	93	8	0.4	0.61	No	15		None	
TOTALS	21,252	1,485	175,900	11,960	17.388	1.220					3.259														
GRAND TOTALS	74,352	7,084	601,600	56,960	59.438	5.930					10.075														
U. S. PUBLIC HEALTH SERVICE Standards (Maximum)															500		250	250	1.4	0.3		15			

Notes:

1. Franchise numbers omitted are either sanitary sewerage systems only, not issued, or withdrawn.
2. County franchises issued for 20 years. Additional areas would have same expiration date as base franchise.
3. Southern Gulf Utilities, Inc. consists of following Franchises:
   #7 - Brentwood Water Supply Co. (total 2,200 acres), #15 - Southern Gulf Utilities, Inc. (total 570 acres) and #17 Ridgewood Utilities (total 80 acres).
4. City of Sarasota water treatment is by aeration, chlorination and zeolite softening.
5. City of Venice water treatment is by aeration and chlorination.
6. City of North Port Charlotte water treatment is by lime-soda ash, alum and Calgon, with rapid sand filters.
7. Data has been obtained from best available sources. Water quality is subject to both seasonal fluctuations and long-term changes.
8. Where estimated, following criteria was used: approximately 8 persons per acre ultimate, 100 gallons of water per person per day. Trailer Park, franchise No. 20, is based on current actual data. Trailer Park, franchise No. 24, is based on 75 gallons of water per person per day.

SMALLY, WELLFORD & NALVEN, Consulting Engineers

Sarasota, Florida

April, 1963 Job 783

SUMMARY OF PUBLIC WATER UTILITIES

EXHIBIT "T"

PUBLIC AGENCIES IN WATER MANAGEMENT

FUNCTIONS AND MAJOR INTERESTS

FUNCTIONS AND MAJOR INTERESTS	FEDERAL: Weather Bureau	Surface Water Branch of Geological Survey	Ground Water Branch of Geological Survey	Quality of Water Branch of Geological Survey	Topographic Division of Geological Survey	Coast & Geodetic Survey	Corps of Engineers	Soil Conservation Service	Commodity Stabilization Service	Bureau of Land Management	Agricultural Research Service	Agricultural Conservation Program	Farmers Home Administration	Fish & Wildlife Service	National Park Service	Housing & Home Finance Agency	Bureau of Indian Affairs	Bureau of the Census	Public Health Service	Miscellaneous Congressional and Executive Study Bodies	STATE: Board of Conservation	Department of Water Resources	Geological Survey	University of Florida	Coastal Engineering Laboratory (University of Florida)	Agricultural Experiment Station & Extension Service	Bureau of Economic Research (University of Florida)	Florida State University	Oceanographic Institute (Florida State University)	University of Miami	State Road Department	Board of Health	Game & Fresh Water Fish Commission	Soil Conservation Board	Board of Parks & Historic Memorials	Board of Forestry	Trustees of Internal Improvement Fund	Land Use & Control Commission	Florida Development Commission	Attorney General	Legislature Study Committees	LOCAL: Central & Southern Flood Control District	Municipalities	County	County Agent (Local Functions)	Water Management Districts (Drainage, Etc.)	Soil Conservation Districts	Miscellaneous Districts (Mosquito, Road & Bridge, Etc.)
Basic Data, Analysis & Research																																															
Weather & Evaporation Data	●						●				●													●				●		●											●					
Surface Water Data		●					●	●			●			●									●	●																●		●			
Flood Forecasting	●						●																																●					
Ground Water & Geological Data			●								●												●	●															●					
Water Quality Data				●							●								●				●	●									●											
Beach Erosion Data							●																			●											●							
Soil Moisture Data											●																●																	
Tidal Water Data							●														●					●			●	●														
Topographic Mapping					●	●	●	●																●								●									●	●		
Miscellaneous Mapping						●	●	●		●				●										●								●									●	●		
Aerial Photography					●	●	●	●	●																																				
Miscellaneous Data, Analysis, Research	●				●		●	●			●			●					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●	●	●		●	●	●	●	●	●	●
Regulation																																														
Water Consumption																					●		●																	●	●	●	●		●		
Miscellaneous Regulations							●						●		●						●	●	●																	●		●	●		●		●
Pollution Abatement																																														
Municipal & County														●					●		●	●	●	●		●														●	●	●	●		●		
Industrial														●					●		●	●	●	●		●														●	●	●	●		●		
Development of Water Supplies																																														
Municipal & County														●					●		●	●		●																●	●	●	●		●		
Industrial																					●			●																●	●	●	●		●		
Irrigation								●				●	●		●						●			●			●													●	●			●	●		
Recreational														●	●	●					●			●																●	●	●	●		●		
Soil & Water Conservation							●	●			●	●	●	●	●	●					●			●			●													●	●	●	●	●	●	●	●
Flood Control							●	●			●	●	●		●						●			●																●	●	●	●	●	●	●	●
Drainage							●	●			●	●	●		●						●			●			●													●	●	●	●	●	●	●	●
Insect & Weed Control							●	●			●			●							●			●			●													●	●	●	●	●		●	
Navigation							●								●						●			●			●													●	●		●			●	
Beach & Channel Erosion Control							●	●							●						●			●			●													●		●	●			●	
Fire Protection								●						●	●						●			●			●													●	●	●	●	●	●		●
Legal Aspects																					●			●																●	●	●	●				
Financial Assistance & Cooperative Funds																																														
Grants							●					●									●	●					●														●	●	●	●				
Loans													●		●						●																				●							
Program Coordination							●	●			●	●	●	●							●	●	●	●	●	●														●	●	●	●	●	●	●	●
Unclassified							●	●			●	●	●	●	●				●		●	●	●	●	●	●	●														●	●	●	●	●	●	●	●

THE PURPOSE OF THIS CHART IS TO SHOW THE OVERALL CHARACTERIZATION OF PUBLIC AGENCY INVOLVEMENT IN WATER MANAGEMENT. THE DEPTHS OF INTERESTS OF THESE AGENCIES VARY GREATLY, AND THE INTERRELATIONSHIPS OF THE AGENCIES AND THEIR FUNCTIONS ARE OFTEN COMPLEX. FOR CLARITY OF PRESENTATION REASONABLE JUDGEMENT HAS BEEN APPLIED IN ASSIGNING THE FUNCTIONS AND MAJOR INTERESTS. THE FUTURE WILL ALTER SOME OF THESE.

PREPARED BY
SMALLY WELLFORD & NALVEN - CONSULTING ENGINEERS
SARASOTA, FLORIDA
MAY, 1961

PUBLIC AGENCIES IN WATER MANAGEMENT

EXHIBIT "U"