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CHICAGO AREA WATER SUPPLY

A SYMPOSIUM

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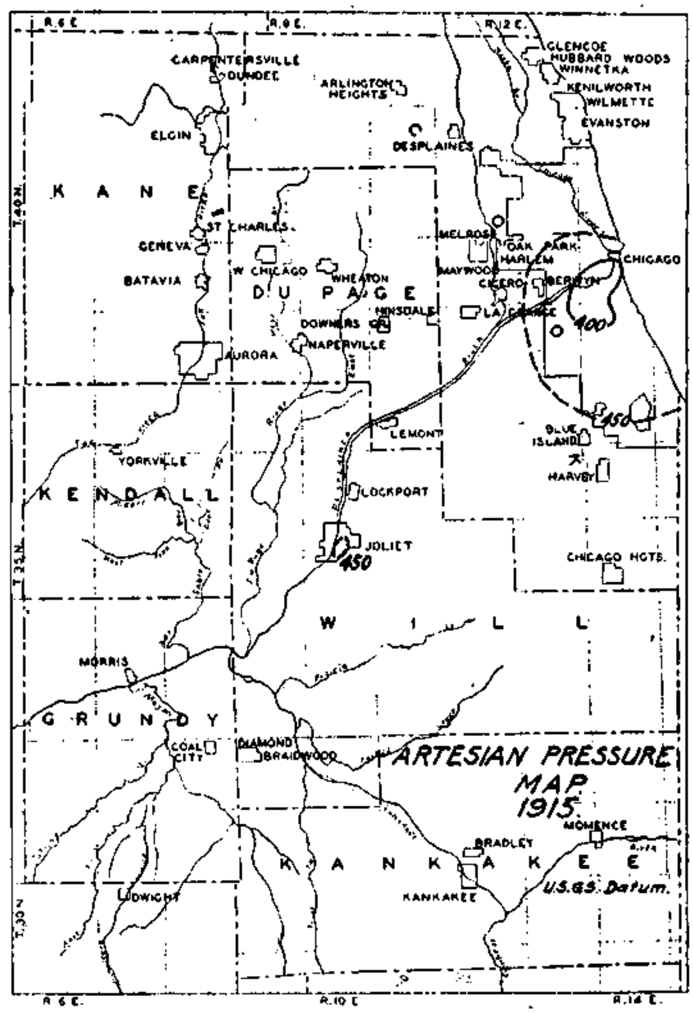


Figure 1

1. The Ground Water Conditions in the Region

Illinois State Water Survey

A. M. Buswell, ***Chief***

Max Suter, ***Head, Engineering Research***

H. E. Hudson, Jr., ***Head, Engineering***

In the Chicago area as in most areas where ground water use is large, the biggest use of the water is for industrial purposes. Table 1 shows the division of uses of water in the area.

This table shows that great quantities of water are used in industry. Table 2 shows the quantities of water required for some individual industrial processes. Some of these uses, such as water used for testing airplane engines, and for generation of electric power, are not water-consumptive processes, inasmuch as they use, as a rule, surface water which is returned almost entirely to the source after being warmed up two or three degrees Fahrenheit. Many operations, however, require extraction of cool ground water which is not returned to the source.

Figures 1, 2, and 3 are maps of the water levels in wells, which are sometimes called piezometric surface maps or artesian pressure maps. Figure 1 illustrates the water levels (expressed in feet above mean sea level) in 1915. Figure 2 shows the artesian pressures in wells drilled in the deep sandstones as of 1944. It will be noted that a considerable lowering has taken place in the levels, with the deepest levels in the vicinity of the western and southern parts of Chicago, Joliet, and an area south of Joliet.

By 1949, as seen in Figure 3, the area of lowest water levels had changed to some degree to correspond to the shift of the Chicago center of pumpage. During the past six years, pumping increased by three million gallons per day

Table 1. 1945 Groundwater Pumpage in the Chicago Area

Use	*Million Gallons Daily*
Public Water Supply	36.3
Air Conditioning	1.6
Steel and Metal Plants	9.3
Food and Packing Plants	24.3
Chemical Plants	6.7
Railroads	1.6
Other	4.7
Total	84.5

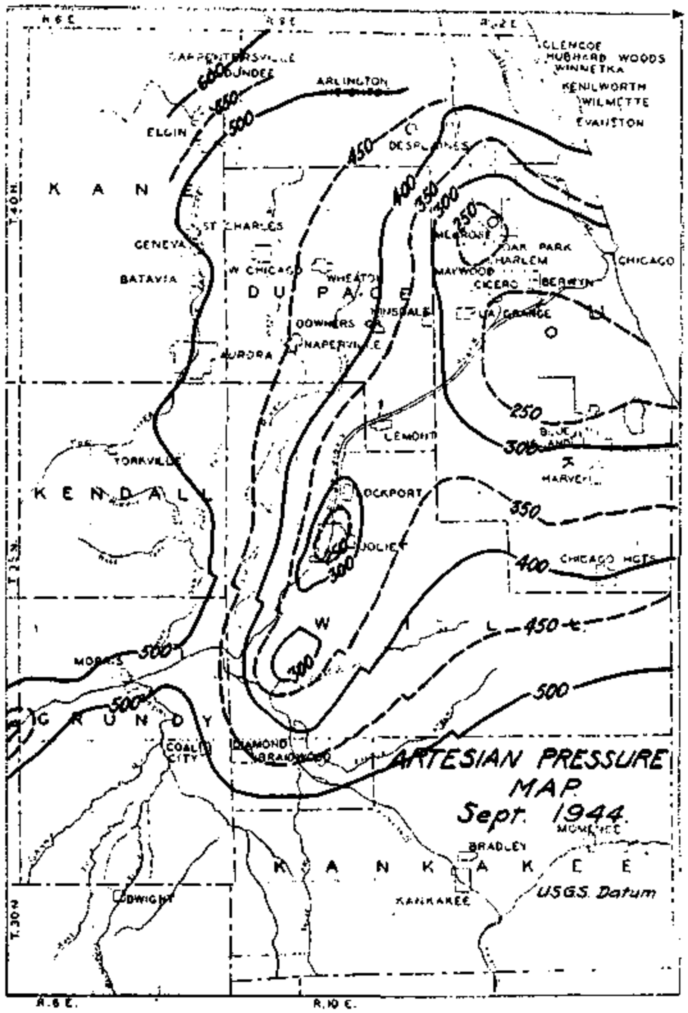


Figure 2

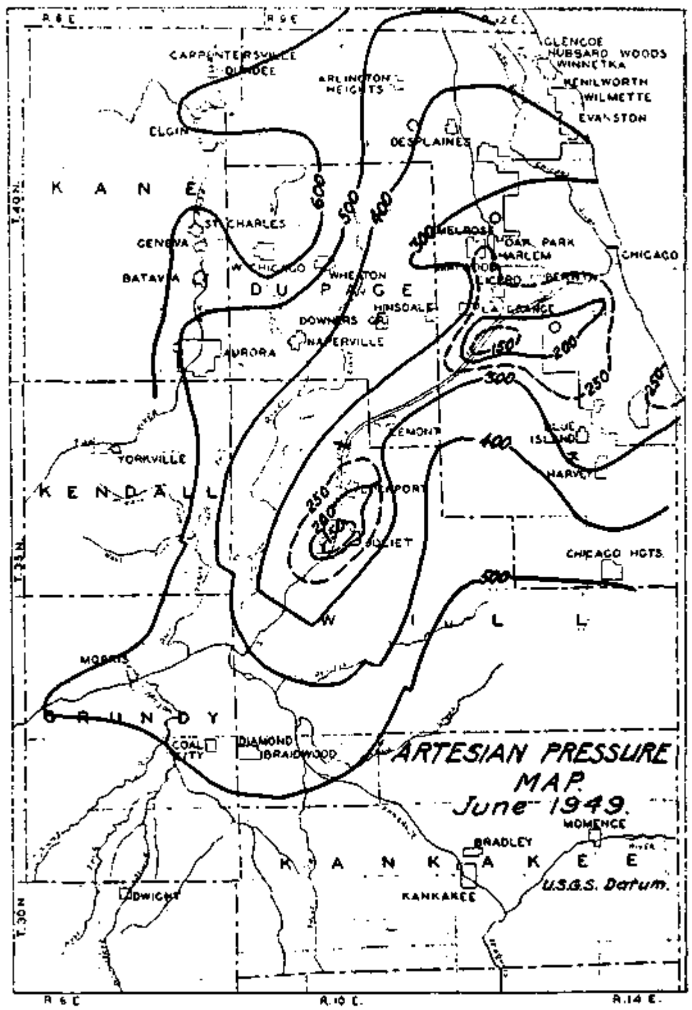


Figure 3

to the west of Chicago, and the water level recession rate increased from eight feet per year to ten feet per year.

Ground water from the deep sandstones has two peculiar virtues. It has nearly constant temperature, which makes it particularly well suited for industrial uses where waters of approximately 60°F. are required. The only substitute for this source of high grade heat-absorbing capacity is mechanical refrigeration which requires much greater investment costs.

The other major virtue of ground water is its freedom from contamination. The waters of the deep sandstone are protected by vast thicknesses of impermeable materials, which safeguard them from chemical and bacteriological pollution. Unrestrained abandonment of bores that penetrate deeper formations yielding salty waters are in certain instances in the Chicago region causing the movement of saline waters from those formations upward into the major producing sandstones. At the present time there is little evidence of contamination from the surface.

Should atomic bombs ever be used to attack municipalities or industrial centers, Chicago would be an important target. Use of atomic bombs for this purpose could very possibly cause a serious contamination of Chicago's drinking water supply taken from Lake Michigan. It is almost beyond the realm of possibility for atomic explosions to cause the contamination of the deep sandstone aquifers. They constitute therefore, a reserve drinking water source adequate to supply any emergency needs of the population of the region, so long as these waters are within reach of reasonable extraction procedures. Possibly this reserve should be earmarked as an emergency supply of National significance.

During the past 60 years there have been nine investigations of the feasibility of distributing Lake Michigan water to the communities surrounding Chicago. Without exception, these investigations have shown that it is economically practicable to make lake water available for municipal systems. The desire for local autonomy and plain inertia have been major forces contributing to the rejection of each of these plans.

The State Water Survey has been conducting a ground water investigation in the Chicago area since 1942. During the last year, water level observations were made on 316 wells of which 31 were equipped with recording instruments. Pumpage data were obtained from 321 wells and special pumping tests were made on 10 wells.

In this territory there are three principal types of wells. (1) The wells in the drift formation consist of dug, driven, or drilled wells at farms and residences. These are the lowest producers. (2) Rock wells drilled in the upper limestone formations are very common, not only for farms and residences, where there is little drift, but also for industrial and municipal supplies. While their yield is sometimes more than 500 gallons per minute, their capacity is not predictable before drilling, and sometimes they furnish water of doubtful sanitary quality. (3) Deep rock wells pentrating the lower sandstones are generally of high capacity. They are therefore the main source of water for industrial, and suburban municipal uses. These wells have a high initial cost but can in most cases be depended on to furnish the desired quantities of water of sanitary quality. About three per cent of the water comes from drift wells, twenty per cent from limestone wells, and the remaining seventy-seven per cent from sandstone wells.

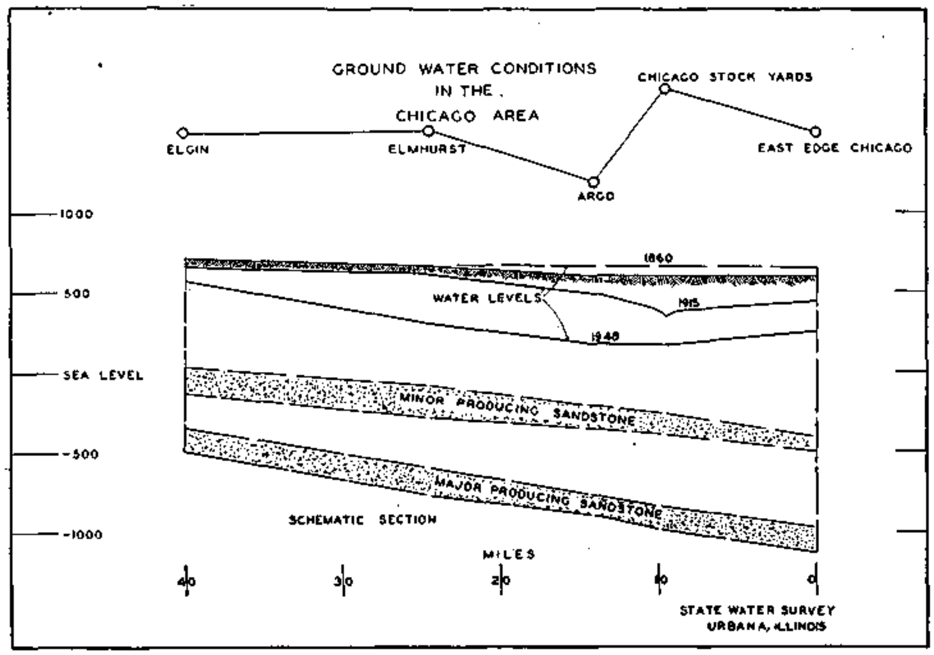


Figure 4

Drift and limestone wells penetrate aquifers which usually receive their water vertically from nearby surface infiltration and vary to some extent in yield and water levels with local rainfall.

The deep sandstone wells are of the artesian type, whose water is from original storage in the formation with a very slow lateral recharge from distant outcrops of the water bearing strata.

How much water can be taken from underground in the Chicago region? No calculations have been made for the drift and limestone wells, but the calculated amount for the sandstone is readily available. Using the contour lines shown in Figure 3, calculations based on the permeability of the formations, and the hydraulic gradient, lead to the following estimates.

The inflow of water into the area within the 400-foot (above MSL) contour was calculated to be 50 M.G.D. The quantity of water being pumped from the sandstones within the same area was 60 M.G.D. during 1949. These data indicate that the Chicago region within the 400 contour is extracting about 20 per cent more water than is moving into the area. This indicates that there is not likely to be any slackening in the recession of water levels unless it be caused by reduction in total pumpage.

Until 1915 the pumpage increased in the area at a rate of about 0.6 million gallons per day every year, but after that the increase in pumpage rose an average of about 1.7 million gallons per day every day every year until about 1940. Since then the total areal pumpage has shown little increase; in fact, since 1946, it has shown a slight decrease. Detailed studies show also that the center of the heavy pumpage has moved west in recent years because in the city of Chicago and the suburbs many ground water uses were replaced by lake water.

Need **Adequate Planning**

Many of the difficulties which have occurred in municipal and industrial ground water supplies in the Chicago region have been due to lack of foresight. Trends in ground water conditions have been ignored, so that adequate planning was not made for conditions that could readily be predicted.

In an area where ground water is being overpumped, as it is in the Chicago region, it is necessary to lower well pumps at intervals, and to provide new equipment to meet the deeper water levels. Work is now proceeding on the installation of some pumps in this area at levels of 800 feet or more below the ground surface. It is not difficult to visualize the mechanical problems involved in such installations, and the great costs of operation and maintenance of units placed further below the ground surface than the height of Chicago's tallest building.

Some industries and municipalities have failed to plan for the lowering levels, thus encountering water shortages. This is a situation very similar to that which faces New York City at the present time, where the shortage was clearly foreseen, but was ignored by the City Administration.

Difficulties due to overpumping do occur with all kinds of wells, but in drift and limestone wells the difficulties are more often due to mechanical defects in the well construction; whereas in the deep sandstone wells they are due to receding levels brought on by the heavy pumpage, wide area of interference between wells, and the slow recharge inflow. Only the latter type of difficulty is of major importance in the Chicago area and it has therefore received concentrated study.

Data found in old records throw an interesting light on the development of the ground water sources. These old records show that the first deep sandstone well was drilled in the Chicago area in 1864. This was a flowing well with pressure 80 feet above ground. As more wells were drilled and pumpage increased, the artesian pressure was lowered and by 1900 most of the deep wells ceased to flow above ground. This did not hinder further development, and levels continued to drop until now the non-pumping water levels in the sandstone wells are 300 to 450 feet below the ground level. In the Chicago area this lowering of the water levels has been at the average rate of about six feet per year since 1900.

It is plain that the Chicago region is using its deep sandstone supplies at a rate greater than their ability to furnish water. The future course of water levels can readily be charted. The expiration date of this resource can be predicted. There are means available to halt the destruction of this resource and to make it available as a reserve for important needs. A problem faces us. We know its solution. When will we apply it?

Table 2. Industrial Requirements for Water

Industry	*Unit*	*Water Required Gals. per Unit*
Airplane engines	To test one engine	50,000 to 125,000
Gasoline	Gallon	7 to 10
Beer	Barrel	470
Whiskey	Gallon	80
Canning vegetables	Case of No. 2 cans	25 to 35
Canning fruits	" " " " "	55 to 65
Canning spinach	" " " " "	160
Coke	Ton	3,600
Fabricated steel	Ton	42,000
Beet sugar	Ton of beets	3,100
Packing house	Hogs, per animal	550
" "	Cattle, " "	2,200
Air conditioning (Freon type)	Ton of refrigeration	50 to 250 for 60°F. to 90°F. water
Pulp and paper mills	Ton of pulp	50,000 to 150,000
Tanneries	Lb. of hide	3 to 8
Dairies	Quart of milk	3
Electric power	Kw. Hr.	80

Chicago Area Water Supply

2. The Critical Situation in the Outlying Sections

Arthur W. Consoer, Consoer, Townsend & Associates, Consulting Engineers

In 1888 a deep rock well was drilled into the Potsdam Sandstone on the site of Tribune Tower. At that time it was a free-flowing artesian well. There is no record of its depth or yield.

The Wanger Company at Harvey, Illinois, in 1891, obtained a free-flowing well with a depth of 2,075 feet.

In Graceland Cemetery in the year 1895 a well was drilled to a depth of 1,540 feet into the Dresbach Sandstone, which 55 years ago discharged a considerable flow of water under pressure without a pump.

No records have been located by the writer regarding free-flowing wells drilled after 1895 in or near Chicago.

A well was drilled in Blue Island in 1896. At a depth of 1,025 feet, static water level in the well was 60 feet below the ground, and at a depth of 1,632 feet, the static level was 61 feet below the ground.

For a well drilled for the Manhattan Brewery Company in Chicago in 1897, it was necessary to install a pump to get a supply of water.

In 1898 the static water level was 32 feet below the ground in a well drilled for the Columbia Malt Company in Chicago.

The same year worse luck was experienced by the American Malting Company on the far northwest side of the City with static level when well was not pumped, at 60 feet below the surface of the ground.

In 1898 too, the Northwest Malt & Grain Company developed a well 1,534 feet deep with static level of 58 feet.

In 1901 the Clearing Industrial District was pleased to get a well at a depth of 1,601 feet which produced 475 gallons per minute with static level of 106 feet.

The static level in 1905 was 120 feet below the ground in a well drilled to a depth of 1,620 feet by the White Eagle Brewing Company, and it was then obvious that static water levels in deep rock wells in the Chicago area were definitely receding.

During the past 40 years the recession has, on an average, been from 7 to 8 feet per year in static water level. Average pump settings today are about as follows:

- In the Bellwood-Elmhurst area—500 feet.
- In the Joliet area—500 to 550 feet.
- In the Kankakee area—530 feet.
- In the vicinity of Argo—825 feet.
- In the vicinity of Chicago airport—680 feet.

Maximum depth of pumping setting must be worked out from the economics of the situation involved. Ordinarily the lower the setting the greater the yield and the higher the operating costs.

For oil wells, settings of 3,000 to 4,000 feet are common but these are low capacity wells, and do not utilize turbine pumps, but use some improved type of plunger pump. The deeper you go with pump settings, the more reserve units you need to provide safety of operation.

An 800 foot setting seems to be entirely feasible from the standpoint of pump manufacture and well-drilling operations and probably will be realized for municipal supplies in the Chicago Metropolitan Area before effective measures are taken to obtain a supply of Chicago water in many of the suburban towns, west and southwest of Chicago.

Some of the railroads have set turbine pumps as low as 900 feet to 1100 feet, but no other similar instances are known to the writer.

Difficulties in following the water on down in a deep rock well are:

Most casings in old wells are too small.

Many old wells were finished 4 to 5 inches at the bottom.

Crooked bores.

Where the alignment is bad, a deep setting for a turbine pump is not possible.

The cost of increasing the bore in an old well can exceed the cost of a new larger well.

Deepening a deep rock well is very apt to produce water with an excessive salt content.

Rehabilitation of old wells will seldom produce economically high capacities of the low-value end product, namely, water.

Much valuable information on this subject is given in a pamphlet entitled, *"Rehabilitation of Sandstone Wells,"* by J. B. Millis. It is issued by the Department of Registration and Education, State Water Survey Division, Urbana, Illinois.

Careful and regular water level readings, plus flow meter readings, are essential so that new wells can be drilled in plenty of time, or old wells rehabilitated in plenty of time.

Opinion is divided as to the results obtained with acid treatment of old wells. Good and bad results are reported.

Where new wells are to be drilled, they should be designed to meet capacity requirements and to provide efficient pumping installations.

New wells should preferably be located outside of present cones of influence where competition from existing industrial wells and municipal wells will be at a minimum.

It is wise to build reservoirs to handle hourly peak demands. Location of water consuming industries in areas where wells are failing should be discouraged.

Large straight wells with large casings down deep to accommodate low settings of turbine pumps are called for when new work is undertaken.

Deep rock wells should be supplemented where possible with gravel-packed gravel wells of good quality to handle peak days. Such wells may produce excessive amounts of iron which should be removed.

In localities where well supplies are deteriorating rapidly, plans should be made now for surface supplies, with a multi-stage construction program and a multi-stage financial plan.

These programs should be designed to complete construction comfortably ahead of demand but not excessively ahead of demand. If this is not done, excessive rates are inevitable. Most careful engineering surveys and studies are needed to form the foundation for multi-stage construction plans and multi-stage financial plans.

In planning now for surface supplies consideration can be given to:

A. Practically inexhaustible Lake Michigan.

B. Impounding reservoirs, where found to be practicable, on the DuPage River, Fox River, Hickory Creek, Kankakee River, etc., etc.

C. Research work is needed on high-velocity pipe lines in order that pipe lines, properly designed for normal day demand, may also be utilized for a few high demand days without excessive increases in annual power costs.

D. Form combinations of large users, municipal and industrial. It would appear that such combinations should follow straight lines from Lake Michigan or Chicago city limits. Belt line pipe lines appear to be uneconomical because of the large mileage involved, with no paying customers adjacent thereto.

Summary

There seems to be no immediate danger of water famine in the Chicago Metropolitan Area providing adequate engineering studies are started at once and recommendations for rehabilitation of old wells and construction of new **wells** are followed promptly, and advance planning for surface water supplies is started soon.

Financial planning should go along simultaneously with physical planning. Open-end bond issues should be used with minimum requirements for surpluses in the rate structures.

Careful records of the performance of all wells in the system should be constantly maintained and studied to note trouble before it starts. An analogy can be drawn between the need for an individual's necessary periodical medical examinations and the equally important periodical examinations of well water supplies, the only difference being that the examinations of well water supplies should come at more frequent intervals than is the case with a healthy man or woman.

Groups of municipalities and industries following straight lines from Lake Michigan or the corporate limits of Chicago should be set up to provide, in the foreseeable future, a supply of Lake Michigan water.

The public must be educated to the necessity of paying higher rates for the Lake Michigan supply. My feeling is that Lake Michigan supplies will be needed as far west as the Fox River towns in 40 to 50 years. All indications point to Lake Michigan as the only dependable water source two to five decades hence, from Chicago to points sixty miles away.

The economical solution in any one case may involve the purchase of water from the City of Chicago, or it may involve the creation of independent Lake Michigan intake filtration plants and pumping stations.

Rehabilitation of existing wells, and the drilling of new wells, could be carried out at reasonable cost pending the development of plans and actual construction of Lake Michigan water supply works.

It is not too early to begin planning now for Lake Michigan water. In many situations the additional cost of getting Lake Michigan water, compared to developing more well supplies; will be justified by the increased safety of supply. For an interlude period the well supplies could be maintained in conjunction with a Lake Michigan supply, using the well supplies to handle peak hours and per-

2. The Critical Situation In the Outlying Sections

haps even peak days. Such an interim system will reduce the cost of the initial Lake Michigan water supply installation.

New York City today is paying the penalty for tardy planning and tardy construction. The towns in the Chicago Metropolitan Area, which are utilizing well supplies today, will be well advised to start their planning now and their construction in the very near future.

The problem in the Chicago area will be intensified rapidly because use of shallow wells contiguous to septic tanks must in the near future be discouraged and prohibited by law in urban and semi-urban areas. County and township health officers must see to it that such situations are controlled. At Joliet 45,000 persons in such outlying areas are rapidly being supplied with city water mains and city sewers.

Naturally such badly needed improvements will add to Joliet's water needs. Most every suburban or satellite town in the Chicago area faces similar problems.

As an example of the action that can be taken, Joliet has been engaged, since February, 1947, in a notable multi-stage program for improving its water supply and sewerage facilities. What Joliet is doing other communities, or groups of communities in Northeastern Illinois can do.

The planning has included not only improvements for the needs of the incorporated City but also for the contiguous areas with a population of 45,000.

It has been determined that eventually Lake Michigan will be Joliet's major source of water supply.

In the meantime three new deep rock wells and five new gravel-packed wells in gravel formations have been drilled in the Hadley Valley easterly from the City limits. Water from these wells will be conducted through a 30-inch reinforced concrete pipe line 17,500 feet long, leading to an Iron Removal Plant, Reservoir and High Lift Pumping Station in the city. The pipe line is a step in the right direction with its easterly terminus 34 miles from Lake Michigan.

In comparing the sources of water supply there is included only the cost of supplying the water to the low pressure distribution system at Elevation 660. The well supply will be cooler than Lake Michigan supply or Chicago supply. The Lake Michigan supply or Chicago supply are much softer than the well supply, and do not contain an objectionable amount of iron. The well supply should have the iron removed from the gravel well water, and also be softened when the well supply has been proven.

The projects compared are as follows:

Project No. 1—Well Supply with Iron Removal.

Project No. 2—Well Supply Softened.

Project No. 3—Lake Michigan Supply.

Project No. 4—Chicago Water Supply.

The comparative costs include the construction cost of the source of supply and getting water to the low pressure distribution system in Joliet; and the annual cost of same. It must be kept in mind that in order to get the total cost of water, the additional cost of reservoirs in Joliet, the distribution system costs, and the present operating costs must be added.

Construction Project Costs (Supply Only)

Project No., Description	Project Cost 12 M.G.D. Capacity	14 M.G.D. Capacity
1 Wells (Iron Removal)	$1,415,000	$1,648,000
2 Wells (Softening)	2,810,000	3,210,000
3 Lake Michigan Supply	5,270,000	5,900,000
4 Chicago Water Supply	3,400,000	3,800,000

Joliet Water Supply

The Joliet planning includes Master Plans for Water Main and Sanitary Sewer Extensions throughout the Joliet Area, both outside of and inside the city limits. $2,000,000 of such extensions were constructed in 1948 and 1949. Connecting property owners, in lieu of paying special assessments, pay $250.00 each in ten monthly installments. Customers outside corporate limits pay rates 50% in excess of City charges.

Other elements in the multi-stage planning include:

For 1950

Intercepting Sewers and Sewage Treatment Plant.

$900,000 for Water Main and Sewer Extensions.

For 1951

Three Deep Rock Wells.

Ten Gravel Wells and 18,000 feet extensions of the 30" pipe line heading toward Lake Michigan.

Water Feeder Mains.

West Side Reservoir.

$900,000 of Water Main and Sewer Extensions.

Beyond 1951

Lake Michigan Supply including Intake, Filtration Plant, Pumping Stations and Completion of 30" Pipe Line.

Secondary stage of Sewage Treatment Plant.

Extensions of Water Mains and Extensions of Sanitary Sewers.

It is planned to accomplish all this in twenty to thirty years with a 95% average increase in old water rates.

★ ★ ★

3. A Proposed System for the Area

Loran D. Gayton, Assistant City Engineer

The Chicago Metropolitan Area, as described in this paper, is the land area circumscribed by a circle with its center at the intersection of State and Madison Streets in Chicago, and with a radius of forty miles. This assumed Metropolitan Area reaches from Waukegan, Illinois on the north to Gary, Indiana on the south; as far west as the cities of Elgin and Aurora; and southwest to the City of Joliet. In this area there were, as of 1940, 168 incorporated cities, towns and villages, and 25 unincorporated villages, making a total of 193 communities.

Occupancy of the Area

The city of Chicago stretches for 20 miles along the Lake Michigan shore line, approximately north and south, and at certain locations it reaches back approximately 10 miles from the shore line. It covers an area of approximately 212 square miles. The main branch of the Chicago River enters Lake Michigan at a point almost exactly midway between the north and the south limits of the city's shore line.

The central business district of the city, or the so-called Loop area, reaches from Chicago Avenue on the north to 12th Street on the south, or a distance of approximately two miles, and from the Lake Shore on the east to the south branch of the Chicago River on the west, a distance of approximately one mile. This central business district is built up almost solidly with commercial and office buildings of the skyscraper type.

From Chicago Avenue northward to the city limits and from the Lake Michigan shore line westward to the city limits, there is a predominately residential area broken here and there by local community business centers. Directly west of the business center of the city is an area made up partly of manufacturing, partly of commercial and partly of residential structures.

Reaching from 12th Street southward along the shore line to 79th Street, a distance of approximately eight miles, and reaching westward from the shore line to the city limits, is an area that is generally residential, although this area is dotted with manufacturing establishments, industries such as the Union Stock Yards, and numerous community business centers.

From 79th Street southward to the city limits at 138th Street, a distance of approximately seven miles, and spreading east and west for a distance of approximately five miles, we find one of the world's greatest industrial areas. This is the great Calumet Industrial District with its huge steel mills, car works and docks. We also have an almost continuous industrial and manufacturing area stretching along both banks of the north branch of the Chicago River, and also on the Chicago Sanitary District Canal reaching across the city to the southwest. The majority of Chicago's industrial and manufacturing areas lie south of Chicago Avenue and reach to 138th Street, and from near the Lake Shore westward to the city limits. This whole area is covered with a network of railroads with numerous terminals and switching yards.

Northward from the Chicago city limits along the shore line to Waukegan are numerous residential communities with practically no industrial occupation, although the city of Waukegan does have some large industries. To the northwest, west, and southwest of Chicago, and lying within a circle 20 miles from the intersection of State and Madison Streets, in Chicago, are numerous small residential communities with little or no industrial occupancy. In these same areas and lying beyond the 20 mile circle, but within the 40 mile circle, we find mostly rich farming land with small community centers widely separated.

From the southern limits of the city of Chicago, and reaching along the Indiana shore line to Gary, we find a continuation of the Calumet Industrial District, with huge steel mills, cement plants and oil refineries. South of the Indiana Industrial area, are a few small residential communities, and beyond these, farming country.

In addition to the foregoing description of the various industrial districts of the area, attention should be called to the city of Joliet, lying to the southwest of Chicago, and approximately 35 miles from the intersection of State and Madison Streets in the city of Chicago. Joliet is an industrial city with a number of large and important plants and is strategically located on the Desplaines River at what is sometimes called the head of the Illinois Waterway, and it is also an important railroad center.

Elgin and Aurora are two other fairly large cities lying to the west of Chicago, and approximately 35 miles from the Loop. Each of these cities is a center of a rich farming area and, no doubt, will continue to be purely residential and commercial.

Population

The 1940 U. S. Census gave the 168 incorporated communities in the assumed Chicago Metropolitan Area a population of 4,607,990 inhabitants. The Census gave no population for the 25 unincorporated villages. We have estimated the rural and unincorporated population as 191,260 and this added to the Census figures for the incorporated communities, gives a total population for the assumed Chicago Metropolitan Area of 4,799,250, as of the year 1940.

The city of Chicago with a population of 3,396,808 in 1940 represents 71% of the population of the entire Metropolitan Area and approximately 90% of the population of the Metropolitan Area was within the limits of a

3. A Proposed System For the Area

circle 25 miles from the intersection of State and Madison Streets in Chicago.

From Waukegan on the north, to Gary, Indiana, on the south, and including these cities, there are 15 municipalities with a population of 3,816,234 as of 1940, taking water through their own intakes from Lake Michigan. The city of Chicago supplies Lake Michigan water either directly or indirectly to 45 towns having a population of 398,215 as of 1940. Therefore, there are 60 towns, or 35% of the municipalities within the 40-mile circle, getting Lake Michigan water.

The above 60 towns have a total population of 4,214,440 as of 1940. Assuming the total population of the 168 incorporated municipalities within the 40-mile circle as 4,607,990, we find that approximately 91% of the incorporated population within the 40-mile circle secures a water supply from Lake Michigan at the present time.

Sanitary District Act

The act creating The Sanitary District of Chicago was passed by the Illinois State Legislature on May 29, 1889. Under this act the city of Chicago was required to furnish water to any municipality in the District at a cost no greater than that charged like large consumers within the city limits.

The first municipality to take advantage of the act was Burnham, which made a connection to the Chicago system in 1909. At the present time there are 34 municipalities, beyond the city limits, but within the Sanitary District, taking water directly from the Chicago system, and 11 more getting water indirectly from the Chicago system, making a total of 45 communities getting Lake Michigan water from Chicago.

Ground Water Supplies

With the exception of the municipalities taking their water supply from Lake Michigan, all the municipalities in the Chicago Metropolitan Area secure their water supplies from wells of varying depths. In the Chicago area the majority of these wells extend either into the St. Peter or Potsdam Sandstones and vary in depth from 500 to 2300 feet.

For many years, the demand for water from these wells has been increasing and the elevation of the water table has been dropping at an average rate of from five to eight feet per year. Due to this rapid lowering of the water level, the cost of pumping water from these wells has greatly increased. Also, many municipalities have been compelled to drill wells to such a great depth that the water is highly unsatisfactory as to its mineral content, and in the majority of cases it is extremely hard. So many new wells have been driven in recent years and the demand for these wells has been so great that, at the present time, the majority of the municipalities in the area find the water supply from these wells absolutely inadequate to serve their purposes now or in the future. The indications are that the conditions outlined above will continue to grow worse and that the time is not far distant when the municipalities, now served by deep wells, must look to Lake Michigan as a new source of supply.

From 1924 to 1948, nine different water supply systems, to supply the Chicago Metropolitan Area, were proposed by various groups. Seven of these systems were to build their own intakes and two proposed to take water from the Chicago system. Up to date no one of these proposed systems has been built.

Suggested System

In August, 1947, Oscar E. Hewitt, Commissioner of Public Works of the city of Chicago, made public a plan showing a possible extension of the Chicago water supply system, to supply Lake Michigan water to 62 municipalities in the Chicago Metropolitan Area, now depending upon ground water supplies. This plan was the result of studies made by the Bureau of Engineering over a period of years.

The municipalities to be served reach from Barrington on the north line of Cook County on the north, to Elgin, St. Charles and Aurora on the west, to Joliet on the south west, and to the south line of Cook County on the south. This system will serve Lake Michigan water to every municipality of any size in the area under consideration, not now supplied with water from Lake Michigan.

The 1940 Census gave these 61 municipalities a population of 320,548, and it is estimated their 1970 population will be 493,000.

Based on a per capita consumption of 150 gallons per day, it is estimated that the maximum day demand in 1970 will be approximately 74,000,000 gallons.

The system is designed to meet the maximum day's demand in 1970, and to deliver water at ground level at the boundary of each municipality. Each municipality is to provide and maintain any necessary reservoirs and pumping equipment and distribute the water to the ultimate consumer. The water is to be metered at the point of delivery to each municipality.

The system has been divided into three major zones, the Northwest, the West or Central, and the South. The required quantity of water for both the Northwest and Central zones will be available from the Chicago Avenue tunnel. A ten-foot-diameter extension of the Chicago Avenue tunnel to 25th Avenue, in Melrose Park, is proposed. Provisions for a reservoir and low lift pumps at the end of the tunnel have been made so that if the peak demand by city consumers should require all the water in the tunnel for several hours the suburban system could continue to pump from the reservoir, which would be refilled during the off-peak demand.

Northwest Zone

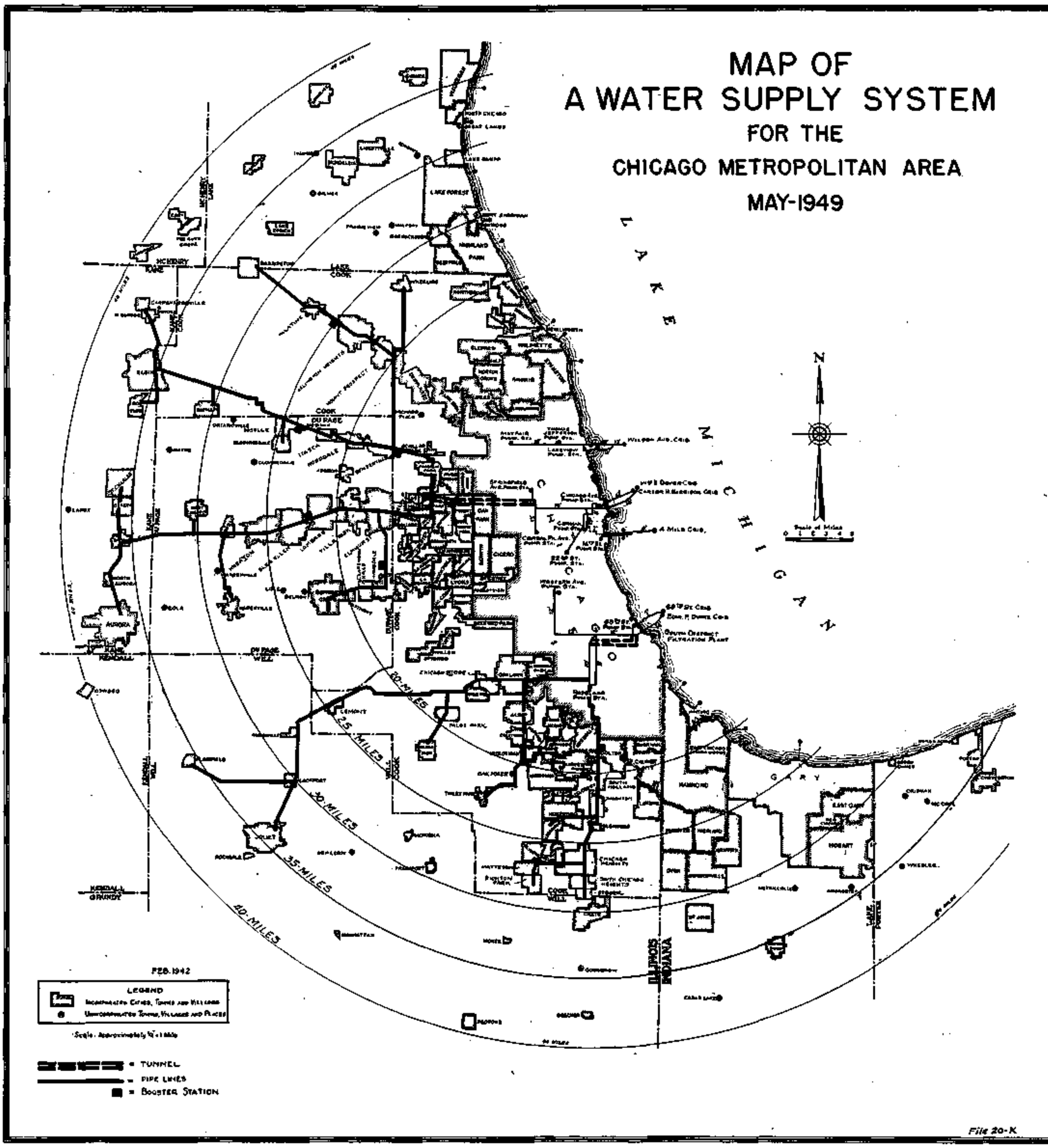
The Northwest Zone, taking water from the Chicago Avenue Tunnel, will serve 19 communities, with an estimated population in 1970 of 111,600; and an estimated maximum day's water demand of 16,740,000 gallons. The Northwest Zone will require three booster pumping stations.

Central Zone

The Central Zone taking water from the Chicago Avenue tunnel, will serve 18 communities, with an estimated population in 1970 of 224,600, and an estimated maximum day's water demand of 33,690,000 gallons. The Central Zone will require two booster pumping stations.

South Zone

The South Zone, taking water from the Roseland Pumping Station, will


MAP OF
A WATER SUPPLY SYSTEM
FOR THE
CHICAGO METROPOLITAN AREA
MAY-1949
LAKE
MICHIGAN
CHICAGO
GARY
N
20-MILES
25-MILES
30-MILES
35-MILES
40-MILES
FEB. 1942
LEGEND
= TUNNEL
= PIPE LINES
= BOOSTER STATION
File 20-K

3. A Proposed System For the Area

serve twenty-five (25) communities, with an estimated population in 1970 of 156,-800, and an estimated maximum day's demand of 23,415,000 gallons.

The South Zone is divided into two projects, both getting water from the Roseland Pumping Station. To increase the capacity of the Roseland Pumping Station, a new twelve-foot tunnel is to be built in 74th Street, from Oglesby Avenue to State Street. This will take its water supply from the existing tunnel at Oglesby Avenue and connect with the ten-foot tunnel running south in State Street to the Roseland Pumping Station.

The Chicago Heights project will require a reservoir and a booster station near 151st Street and Indiana Avenue. If the peak demand by the City consumers should require all the water available from the main, the booster could continue to pump from the reservoir, which would be refilled during the off-peak demand.

The Jpliet project will be exclusively supplied by new pumps at the Roseland Pumping Station, which will deliver the water at sufficient pressure so that no booster station will be needed.

Preliminary cost estimates, made from the drawings, indicate that the Metropolitan Water Supply System outlined, could deliver Lake Michigan water to the municipalities under consideration at reasonable rates. However, new legislation would be required to enable Chicago to extend its water supply system beyond the city limits.

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