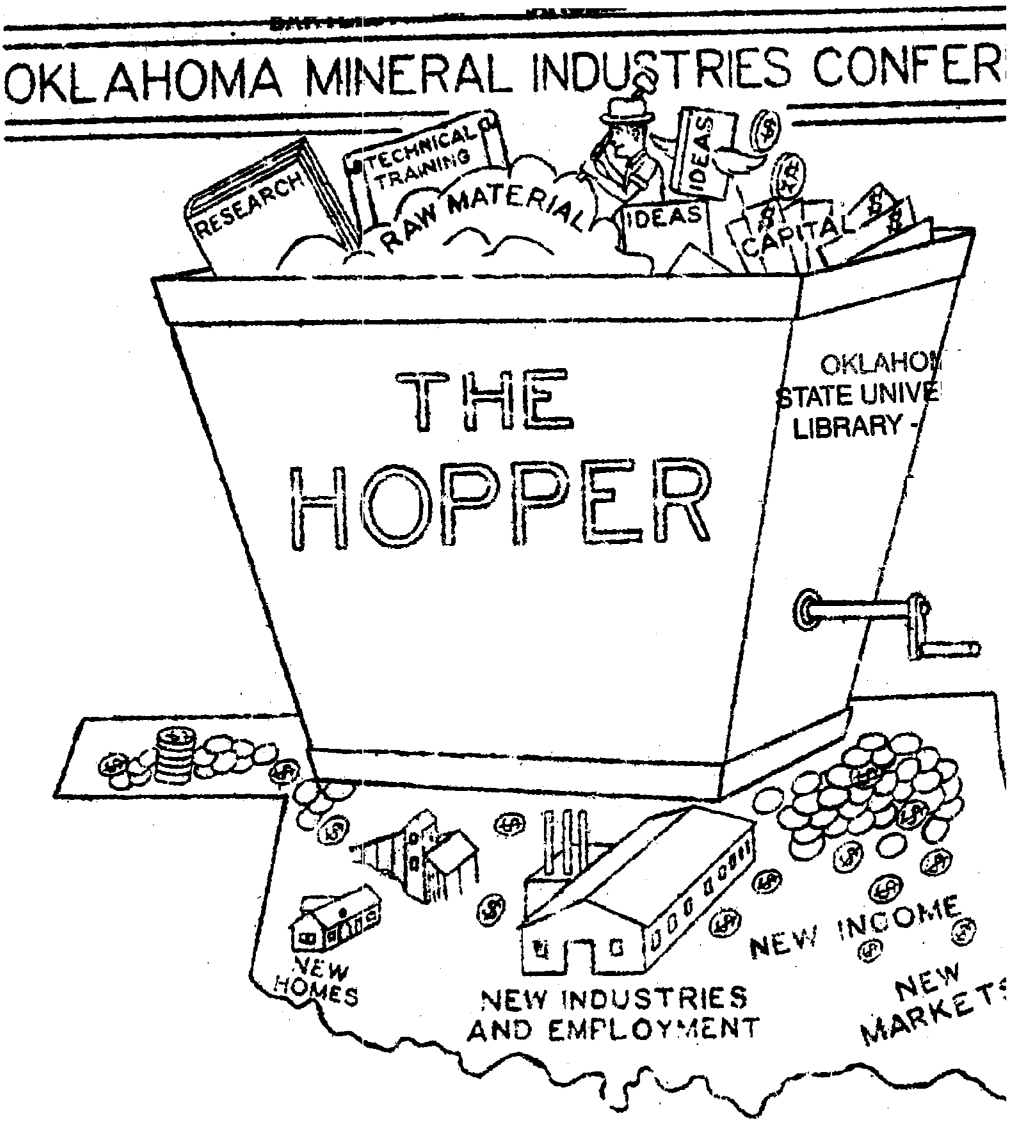

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GROUNDWATER SUPPLIES IN OKLAHOMA AND THEIR DEVELOPMENT

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Part III

Abundance of ground water supplies depends on the presence of aquifers of high permeability—formations that can readily absorb, and give up large quantities of water; and on abundant precipitation in the form of rain and snow. Oklahoma is not too well supplied with either, hence its ground water supplies, and the possibility of developing such supplies are definitely limited.

In some areas aquifers are non-existent, and even farm users are dependent on rainwater collected in cisterns for home use. Over a considerable area of the state, aquifers are too thin or too tight to receive and yield sufficient volumes of water to supply municipal needs; or they contain mineralized water unfit for human consumption. For all these reasons, all large municipalities, and many small ones, are dependent on surface supplies, generally water impounded in artificial reservoirs.

The important aquifers of Oklahoma, which are important because they do, or could produce water supplies adequate for all but the largest cities, may be classified in five general groups: sands and gravels underlying the high plains of the Panhandle (the so-called "Ogallala" formation); river alluvium deposited in the valleys of major rivers; terrace deposits, old alluvium deposited by streams which have later abandoned such channels by downward cutting; sandstones; and limestones.

High plains deposits. Covering all but a small fraction of the three Panhandle counties, and extending a short distance into adjacent counties of northwestern Oklahoma, is a deposit of sand, gravel, and minor amounts of clay, associated with, and capped by a limy rock called caliche. Similar material underlies the entire high plains region from the latitude of Midland, Texas, to northern Nebraska, and is named the Ogallala formation from the county seat of Keith County, Nebraska.

This is probably the best aquifer in Oklahoma because of its area, thickness, and high permeability, despite the fact that it is only partially saturated. Owing to low annual precipitation and high evaporation in this area, insufficient water reaches the aquifer to keep it filled to capacity and offset natural discharge. Even so, because of its great size, this aquifer contains a very large volume of water, and because of the flat surface and the large number of small depressions upon it, there is relatively little run-off and a rather efficient re-charge of the ground water reservoir from such rainfall as the climatic conditions of the area provide.

The ground water conditions of this aquifer may be summarized as follows:

Nature of water-bearing material--sand and gravel, associated caliche (limy rock).

Source of water--precipitation on the high plains surface, not from the Rocky Mountains, except a moderate amount that may percolate downward from streams crossing the high plains.

Quality--hard, 200-300 p.p.m. total hardness, mostly calcium bicarbonate.

Ground water conditions--free or water table.

Capacity of wells--up to 960 g.p.m.; average 250-500 g.p.m.

Pumping lift--70-300 feet, average 200 feet.

Municipal supplies--Most communities in Panhandle counties, Arnett, Ellis County, and Buffalo, Harper County.

River alluvium--Alluvium of the major rivers is most important, though some small cities have developed satisfactory supplies from alluvium of tributary streams, where local conditions are favorable.

Nature of water-bearing material--sand and gravel deposited in the valley.

Source of water-precipitation on valley floor; run-off from adjacent uplands;overflow from stream; from the stream itself.

Quality-depends on minerals in rocks in watershed, more or less like stream flow; contains gypsum in western Oklahoma; salt in valleys of Cimarron River, Salt Fork of Arkansas, Elm Fork of Red and some others; hard water in limestone areas.

Conditions--free or water table.

Capacity of wells-variable, depends on coarseness of materials, stream flow, and rainfall.

Pumping lift--10-50 feet.

Municipal supplies (examples of larger users)-

Arkansas River--Newkirk, Ponca City (supplemental) Jenks, Bixby, Haskell.

Cimarron River--Kingfisher, Coyle,Perkins.

North Canadian River--Beaver, Canton, El Reno, Oklahoma City (supplemental).

North Fork, Red River--Elk City, Sayre.

Salt Fork, Arkansas River--Pond Creek,Tonkawa.

Washita River--Lindsay, Pauls Valley.

Minor streams--Chandler, Pawhuska,Purcell, Walters, Waurika.

Terrace deposits. These are old alluvium deposited by streams that formerly flowed at higher levels.

Nature of water-bearing materials--sand and gravel; very important in areas where other sources are non-existent;some areas include dunes and blowsand from adjacent rivers.

Source of water--precipitation on outcrop, run-off from adjacent uplands.

Quality--moderately soft, 35-250 p.p.m. total hardness; harder in areas where minerals are picked up by run-off from bed rock.

Conditions--free or water table.

Pumping lift--10-70 feet.

Municipal supplies (examples of larger users)- Alva, Bethany and vicinity, Broken Arrow, Cherokee, Fairview, Frederick, Mangum, Medford, Waynoka, and Woodward.

Sandstone aquifers. Sandstone forms the bed rock in many parts of Oklahoma, representing rocks of many different geologic ages. Sandstone is a sedimentary rock, and though originally laid down in an approximately horizontal position, like all other bed rock formations, sandstones of Oklahoma have been folded or tilted, so that they everywhere lie at angles to the horizontal, ranging from one or two degrees to as much as 60 or 80 degrees. Sandstone aquifers are underlain and overlain by impermeable formations, most commonly shale. Thus, from a water-bearing standpoint, sandstones answer the definition of confined or artesian aquifers--the water is confined within the sandstone between two impermeable formations, and they are generally inclined, so that the weight of the water up-dip, toward the outcrop, creates pressure which causes water to rise in a well when the aquifer is penetrated. In the outcrop area, there is no impermeable cap, and water is free rather than artesian.

Geological formations are named from towns, creeks, and other geographic localities on their outcrops. In the following discussion, for identification, the sandstone aquifers will be considered under their formation names, with the general areas outlined where each formation is being utilized.

Nature of water-bearing materials--consolidated rock made up of cemented sand grains, mostly fine-grained, moderately permeable.

Source of water--precipitation falling on outcrop and water from streams crossing outcrop.

Quality--generally good, soft, but may be high in soda; in western Oklahoma may be hard from associated gypsum, or salty from salt springs; may be contaminated from oil field brine locally. Hardness ranges from 15 to 300 p.p.m.

Conditions--Confined (artesian) or free (water table).

Capacity of wells--average about 150 g.p.m.

Important sandstone aquifers include: Rush Springs sandstone member of Whitehorse formation-- The Rush Springs sandstone which makes a "Y"-shaped outcrop in west-central Oklahoma, extending from south-central Grady County to southeastern Washita County, in an outcrop band 8-10 miles wide; thence to the vicinity of Sayre in an outcrop only three miles wide, owing to the relatively steep north dip. For this same reason, and because the wells to the North are below the intake, several wells that have penetrated the formation flow at the surface. However, the quality is not very good, as the salt content is rather high.

Much the largest area of outcrop of the Rush Springs sandstone covers northern Caddo and southwestern Blaine Counties, extreme eastern Washita and Custer Counties, and eastern Dewey County, an outcrop 20-40 miles wide, crossed diagonally by the Canadian River. Northeast of this river, between Taloga and Bridgeport, part of the outcrop is covered by a large area of terrace deposits and dune sand.

The Rush Springs sandstone ranges up to about 250 feet thick, hence is a ground water reservoir of large capacity. Owing to its being exposed at the surface, water-table conditions prevail in much of the area. The next younger formation, the Cloud Chief gypsum, patches of which occur over parts of the broad outcrop of the Rush Springs sandstone, has contributed soluble minerals, and water in the

Rush Springs sandstone is somewhat harder than is normal for sandstone aquifers in Oklahoma, ranging from 200 to 300 p.p.m. total hardness.

Examples of public supplies from the Rush Springs sandstone are: Binger, Cyril, Fort Cobb, Hinton, and Rush Springs.

"Garber" sandstone, Carter and Stephens Counties--This formation consists of alternating sandstones and shale, with a total thickness of 250 feet, in which sandstone predominates. The formation crops out in eastern Stephens and northwestern Carter Counties, and underlies a triangular area extending from Duncan to Wilson, and northeast to Elmore City. The water is of reasonably good quality, with total hardness of about 100 p.p.m., and like most sandstone waters,is rather high in sodium bicarbonate and sodium sulfate.

This aquifer supplies water to the oil fields in eastern Stephens and northwestern Carter Counties, and to Healdton, Hewitt, Ringling and Wilson. Duncan depended upon this source until the recent change to a surface supply, but is retaining the wells as stand-by.

Garber sandstone, central Oklahoma--This formation is similar to the "Garber" of Stephens and Carter Counties, being an alternation of sandstone and shale, with sandstone predominating. It crops out mainly in Cleveland and Oklahoma Counties, and supplies cities and towns in both counties.

The Trinity sandstone crops out in the southern row of counties from Love County to the Oklahoma-Arkansas state line, and supplies water to several municipalities in that area.

Nelagoney-Vamoosa-is applied to an aggregation of thick sandstones with interbedded shales that includes several different geological formations.

The outcrop and down-dip area from which satisfactory water can be obtained extends from southern Seminole County to the Oklahoma-Kansas state line, northeastern Osage County, in a band 15-20 miles wide. There has been some local contamination of water in this aquifer through infiltration of oil field brine, but in general, this is a satisfactory and important source of water in east-central Oklahoma.

Roubidoux sandstone was named from a town in the Ozark region of Missouri, with which the Oklahoma beds have been correlated. It contains water of satisfactory quality in Ottawa County, and mineralized water farther west and southwest, being used at Claremore and elsewhere for medicinal purposes. In Ottawa County the Roubidoux furnishes a much more satisfactory supply than the shallower Boone limestone, but has been seriously overdeveloped. Records show that 40 years ago, wells in Ottawa County drilled into the Roubidoux flowed at the surface, but at the present times, water levels have declined to 250 feet below the surface.

Among the cities that depend on the Roubidoux are: Afton, Miami, and Quapaw, and in addition, considerably greater amounts are being used for industrial purposes.

Simpson group. This group contains four geological formations that contain thick bodies of permeable sandstone in the Arbuckle Mountains, and in certain areas could provide large supplies of water. The famous Wilcox oil sand belongs to this group, and its fame as an oil sand comes from its high permeability, and its ability to give up oil.

In all parts of the state except close to the outcrop areas, these formations are below the surface, and the waters too highly mineralized to be satisfactory for municipal supplies. The flowing wells in the vicinity of Sulphur are from these formations, evidencing both the large capacity of the aquifers and the mineralization of the water. However, in locations close to the outcrops remote from the larger towns, in areas largely devoted to ranching, abundant supplies of good quality probably could be developed from these aquifers.

Minor sandstone aquifers. The sandstones described above arenot the only ones in Oklahoma that contain ground water, nor are the areas described the only ones from which municipal supplies have been or might be developed. These are the most important, and the ones affording the largest yields. However, throughout the state, especially east of the 98th meridian, there are many areas where sandstones crop out, and can be tapped for municipal supplies. In some local areas, some of these may be as prolific as the ones listed above.

Limestone aquifers. Limestone is the bed rock in the Ozark area of northeastern Oklahoma, in much of the Arbuckle Mountains, the north side of the Wichita Mountains, and in interrupted bands of outcrops in Craig, Nowata, Washington, Tulsa, Pawnee, and western Osage Counties. Porosity in limestone that is effective in making such rock an efficient aquifer is the result of solution and leaching of the calcium carbonate by percolating water. By this process, openings up to the size of caverns may be developed, and such openings are inter-connected, so limestones, under favorable conditions, have both high porosity and permeability, and produce large yields of water through wells and springs. On the other hand, the permeability of un-leached limestone is low, and limestone not so affected yields very little water. Furthermore, leaching follows no regular pattern, and whereas one well in a favorable area may yield large volumes of water, others in the vicinity may yield very little.

to, and move rapidly through the aquifer. Because such waters may be heavily contaminated, waters from limestone aquifers may cause, and many instances are known where they have caused, epidemics of typhoid and other water-borne diseases. For this reason water from this type of aquifer should be used with the same caution as surface water.

Nature of water-bearing materials--consolidated rock, in general low permeability, but where leached, permeability may be very high.

Source of water--precipitation and run-off.

Quality--generally hard, calcium bicarbonate.

Conditions --Free (water table) or confined (artesian)

Capacity of wells--up to 3,000 g.p.m. in mining district, Ottawa County.

Municipal supplies (examples) listed below by formations:

Arbuckle limestone--In the vicinity of Lawton there are a number of private wells, some of which flow, producing water from the Arbuckle limestone. Quality is unusual, in that it is a soft, sodium bicarbonate water, similar to most sandstone water; it also is high in fluoride (up to 10 p.p.m.), and in salt.

Ada obtains its supply from a large spring at Byrd's Mill, near Fittstown in the Arbuckle Mountains. This water is very hard. Roff taps the Arbuckle limestone with a well. Springs that issue from the Arbuckle limestone are common in the Arbuckle Mountains, and there are reports of "underground rivers." Probably a large volume of water could be developed from this aquifer in this region which at present is devoted largely to ranching.

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OKLAHOMA INDUSTRIAL AND MINERAL INDUSTRIES CONFERENCE
October 12 and 13, 1948
Oklahoma City

Program

Tuesday, October 12

8:00 a.m. Registration, Skirvin Tower Hotel. No registration fee.

10:00 a.m. Grand opening, Made-in-Oklahoma Manufacturers' Exposition. Municipal Auditorium

12:15 noon Luncheon.

2:00 p.m. Ninth Annual Oklahoma Mineral Industries Conference.
"Oklahoma Minerals--the Life Blood of Key Industries"
"Why Oklahoma Mineral Industries Prosper"
"Brick and Tile"
"Glass"
"Cement"
"Zinc smelting"
"Stone, sand and gravel"
"Petroleum refining"
"Why not More?" - Possibilities based on Oklahoma minerals not now being utilized.
"Oklahomans Should Carve their Own Future."

4:45 p.m. Adjournment

6:30 p.m. Dinner, Skirvin Tower Hotel.

Wednesday, October 13

9:00 a.m. Oklahoma Industrial Conference.

11:45 a.m. Take buses to Okla. City Air Depot (Tinker Field) for lunch.

1:30-4:30 Tour of Tinker Field.

7:00 p.m. Reunion, Oklahoma Industrial Tour of 1947