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DEPARTMENT OF PUBLIC WORKS
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GEOLOGICAL SURVEY OF OHIO
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SAND AND GRAVEL RESOURCES IN NORTHERN OHIO

By
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CONTENTS

	Page
Introduction	3
General Considerations	4
Production	4
Transportation	4
Table of Sand and Gravel Production	5
Processing	6
Specifications and Grading of Aggregates	6
Availability of Aggregates with Respect to Size	8
Geology and Distribution of Deposits	9
Discussion of Deposits by Counties	11
Cuyahoga County	11
Medina County	14
Summit County	15
Portage County	16
Wayne County	18
Wyandot County	19
Geauga County	20
Ashtabula County	20
Lake County	22
Sand Resources of the Lake Erie Bottom	22
References	24
Illustrations:	
Glacial Map of Ohio showing location of producers	Opposite Page 24

Page 2 is blank

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WILLIAM H. SMITH

INTRODUCTION

During the past several years the increase in building activity in Northern Ohio has brought about a shortage in the supply of sand and gravel to a number of cities. The cities of Cleveland, Lorain, and Toledo as well as other cities and towns along the south shore of Lake Erie have experienced a most serious shortage in supply for construction purposes.

In order to better understand the factors contributing to this shortage the State Director of Public Works, Colonel George B. Sowers, requested that the writer spend several months studying the problem. During this study the writer visited many of the sand producers in the area, and in addition, spent a considerable amount of time collecting and assembling general information regarding the geological structures in the critical regions that have not been prospected for sand and gravel largely because of lack of knowledge regarding their location and possibilities for commercial production.

Much work remains to be done along these lines, but because of its tedious nature the working out of complete details regarding the geological possibilities for sand in these counties will have to await the completion of a detailed geologic survey of each county and the publication of a bulletin on the general geology and on the sand and gravel deposits together with other economic raw materials.

This report is restricted to a general reconnaissance of the regions which the writer was able to study during the time allotted.

Many details regarding the location and probable extent of the deposits, the nature of the terrain, the ground water level, etc., can only be shown by means of topographic maps, well logs, and other data that cannot be included in this type of report. In the process of conducting this reconnaissance a considerable amount of this type of information was collected. This, together with pre-existing data and details gathered from other sources, is an open file in the offices of the Geological Survey of Ohio in Columbus. Those interested in further details are invited to visit the Columbus office and make use of any such unpublished information as is on file.

Several prospecting trips were also made to the dredging areas in Lake Erie in an effort to determine the possible reserves of sand from this source. This work is still in progress and will be covered by a complete report to be issued later by the Beach Erosion Board of the Corps of Engineers. Therefore, only a brief account of these deposits is included in this report.

A map is included with this report listing the principal producers and showing their location. This map is intended to assist the reader in following the location of sand and gravel deposits and glacial features discussed in the report. In the counties not discussed there are doubtlessly omissions on the map of some pits but all pits for which locations were known are shown. Artificial sand producers are shown on the map by separate symbols. The writer is indebted to Mr. C. H. Wuchter and other members of the Ohio Department of Highways for assistance in the location of these producers, for analysis of samples, and for much other valuable assistance.

GENERAL CONSIDERATIONS

Sand and gravel from Ohio deposits is a mineral product that is rapidly increasing in importance, yet the industry has grown too slowly in many places to keep pace with the demand that was heaped upon it during the war and in the period of rapid construction following the war. A majority of the sand producing plants that are operating today were built fifteen to twenty-five years ago and many of them are still operating in the same pits, a number of which are nearly worked out.

Sand and gravel was first produced from many small pits located throughout the State. The first job with which these producers were faced was getting the people of Ohio out of the mud and onto gravelled roads. Then came the great sweep to concrete roads and bridges, super highways, skyscrapers, and finally, the present day trend to steel and concrete construction in the postwar building program and in all sorts of public works projects.

An inspection of the production figures set forth will indicate the tremendous growth of the industry during the past few years. This basic commodity, though not a glamorous or highly publicized mineral product, is vitally important in all phases of construction and industry and provides an income of millions of dollars within the State.

During the past several years there has been a large development in the use of artificial sand or sand produced from the crushing of rock. The limestone industry in northwestern Ohio is now furnishing crushed limestone sand in any grading desired. The Ohio Department of Highways concrete specifications cover the use of such crushed stone sand.

PRODUCTION

In 1947, the last year for which final figures for value have been compiled, Ohio ranked third among the states in value of sand and gravel produced. Below is given an account of Ohio production for the years 1944 to 1948:[1]

Year	*Quantity of Sand and Gravel Produced*	*Value*
1944	10,327,012 tons	$ 8,866,549
1945	9,420,380 tons	$ 7,985,018
1946	13,266,074 tons	$11,105,652
1947	15,388,990 tons	$14,195,288
1948	13,215,929 tons	.....

The tabulation on the following page lists the county production for 1947 in the northern Ohio counties. These figures compiled by the Ohio Department of Industrial Relations are the only figures available. However, these figures are not complete and this should be taken into account by the readers. It is unfortunate that these statistics which are so vital in the field of mineral economics are not more accurately kept, but this is in a large measure due to incomplete returns of questionnaires and while many mineral industries faithfully answer these questionnaires many do not.[2]

TRANSPORTATION

Inasmuch as sand and gravel is a low value commodity the transportation involved in marketing it is a vital factor. With the recent sharp increase in demand the local pits in many areas are unable to maintain an adequate supply and aggregates must be transported from distant points. As a result of this shortage in supply transportation costs have risen to as much as one and one-half

[1] Figures for 1944-47 are from U. S. Bureau Mines Minerals Yearbook. 1948 figures from Ohio Dept. Ind. Relations Annual Minerals Report.

[2] It would be extremely helpful to many organizations and agencies concerned with the mineral industries if in the future more producers submitted returns so that these important mineral statistics would be more complete.

SAND AND GRAVEL PRODUCTION IN NORTHERN OHIO
BY COUNTY AND DISPOSITION 1947*
(Tons)

County	Total Sand and Gravel	SAND					GRAVEL		
		Foundry Sand	Building	Paving	Engine	Other	Building	Paving	Other
Ashland	7,565						3,782	3,783	
Ashtabula	125,881	23,533	11,658	2,500		1,250	11,607	45,333	30,000
Carroll	9,900	9,900							
Columbiana	16,381	16,381							
Coshocton	126,477	20,735	10,474	2,128		2,500	35,213	54,427	1,000
Cuyahoga	544,855	2,366	335,039	63,952		56,743	79,433		7,322
Erie	1,111,448	112,007	631,162	320,000	48,279				
Fulton	15,500		7,500				8,000		
Geauga	81,178		963			31,366			48,849
Hardin	900		350				150		400
Henry	15,300		12,120	400		980	1,320	480	
Holmes	42,341		10,989					28,512	2,840
Huron	73,021		11,710						61,311
Knox	302,444		78,250	54,567		7,670	54,000	64,107	43,850
Marion	6,267		4,983					1,284	
Medina	34,184							34,184	
Morrow	49,284							42,534	6,750
Portage	152,565	11,600	83,211			4,648	25,941		27,165
Richland	66,500		1,500				3,000	61,000	1,000
Seneca	1,850	50	1,800						
Summit	316,748		186,672	1,100	6,000	20,000	78,176	4,800	20,000
Trumbull	60,000		20,000	5,000			15,000	20,000	
Tuscarawas	243,304	12,855	22,326	18,800	3,600	3,665	21,400	127,823	32,835
Wayne	31,131			152					30,979
Williams	127,259		30,314				40,773	39,203	16,969
Wyandot	44,098		29,640				693	2,194	11,571

* Taken from Ohio Department of Industrial Relations Annual Report 1947.

times the net cost of the commodity in many areas. The lake cities have suffered most in this respect and in Cleveland for instance a very large part of the sand used is transported from Portage, Summit, and Medina counties with a transportation cost of $1.00 to $1.25 per ton. Most of this sand travels a distance of 20 to 30 and occasionally as much as 40 miles. Except in a few instances the sand from these outlying pits is trucked because it can be delivered directly to the point of use and also because many of the pits are not served by railroads. Another factor is that independent truckers undercut the railroad freight rate so that even some of the pits served by railroads are now selling all of their product to truckers who haul it to distant metropolitan areas such as Cleveland at a rate just under the railroad freight rate.

PROCESSING

Nearly all sand and gravel aggregates produced must undergo considerable processing in order to meet specific requirements imposed by state and government agencies and by engineers in charge of private contracts. Engineers have determined that such quality controls are vitally important and that the added life and strength of concrete made from first quality aggregates far outweighs the added cost of properly processing the raw materials.

The quality of material found in the glacial deposits varies considerably from place to place principally as a result of the type of rock over which the ice moved. Soft shales and limestones underly a large part of northern Ohio, and, where a considerable amount of this has been ground out by the ice and incorporated into the sand and gravel, the aggregate is often unsound and will not meet specifications. Methods of beneficiating these deposits to remove the unsound particles have been developed and are used considerably in other states that were not blessed with the enormous quantities of glacial sand that Ohio enjoys. In Ohio such deposits are either left unworked or the material is sold for jobs not requiring specification aggregates. It is quite possible that beneficiation processes will be used in Ohio in the future to make specification aggregates from low grade deposits where an appreciable freight savings can be accomplished.

In general the processing of Ohio's glacial deposits consists of screening the pit run material into various size components, crushing the oversize material, and washing the aggregate to remove excess fines and silt. Some plants are able to produce materials that comply with a wide range of specifications by segregating the various screen size components into different bins during washing and processing and later combining them to meet the customers' specifications. Other plants have screens so arranged that aggregates of different types are produced and stockpiled in one operation.

SPECIFICATIONS AND GRADING OF AGGREGATES

Construction engineers, especially those connected with highway construction, have given a great deal of attention to specifications for mineral aggregates. Highway structures especially are subjected to continuous wear, impact, and exposure to adverse weather conditions and their engineers have continually sought to raise the quality of material in order to increase the strength and durability of highways.

Due to the wide variation in quality and characteristics of natural sands, all aggregates used in Ohio's highway construction projects must pass rigid tests at a central testing laboratory located on the campus of the Ohio State University in Columbus. These tests and specifications are essentially the same as those proposed by the American Society for Testing Materials and are included here as a basis for the soundness and grading qualities which aggregates should possess.

In order to give the reader a better understanding of the principal tests used in these determinations each will be discussed briefly.

The modified abrasion test is used on coarse aggregates to determine their resistance to wear. In this test a weighed sample is subjected to wear and impact by a mechanical device and the percentage loss in weight indicates the degree of resistance to wear. This result not only gives a measure of the wear to be expected of the aggregate, but it also serves as an index to its qualifications for use in concrete work.

The sodium sulphate soundness test is used to determine the resistance of an aggregate to changes in temperature and moisture content and is often referred to as the "freeze test." The sample is subjected to five twenty-four hour cycles of soaking in a saturated solution of sodium sulphate followed by drying in an oven. During each soaking the solution saturates all lines of weakness in the stone and on drying crystallizes and exerts a pressure which splits apart shale and other soft stones. This test is continuously employed as an index to the soundness qualities of various aggregates and to prevent the use of unsound aggregates in concrete construction. The test is used on both fine and coarse aggregates and serves as an index to the quality of the material of which the aggregate is composed. Soundness of the aggregate has a pronounced effect upon the life and wearing qualities of Portland cement concrete, thus the fewer unsound particles in the aggregate the better the concrete.

Screening tests are conducted on all aggregates to determine their fitness as regards particle sizes for the particular type of work for which they are to be used. In this test a weighed quantity of the material is placed on the coarsest of a nest of standard screens and shaken by a mechanical device. The weight of material remaining on each successively finer mesh screen is then weighed and the percentage of particles in each size group computed.

The grading requirements and other specifications for each of the more important types of fine aggregate are as follows.[1]

1. CONCRETE SAND. (Highway Dept. Sec. M-2.1—Sand)

1. *General.* The sand shall be natural sand composed of clean, hard, durable, uncoated particles of stone, well graded from coarse to fine, with the coarse particles predominating, free from lumps of clay and all organic matter.

2. *Grading.* (U. S. Standard Sieve Series). The sand shall be well graded from coarse to fine and when tested by means of laboratory sieves shall conform to the following grading:

Sieve No.	*Total Per Cent Passing*
⅜"	100
No. 4	95-100
No. 8	70- 95
No. 16	45- 80
No. 30	25- 60
No. 50	10- 30
No. 100	1- 10

Fine aggregate failing to pass the minimum requirement for material passing the No. 50 and/or No. 100 sieves may be used provided a satisfactory inorganic material is added to correct the deficiency in grading. The amount of approved fine material to be added shall be as determined by the Laboratory.

The gradation requirements given above represent the extreme limit which shall determine suitability for use from all sources of supply. The gradation from any one source shall be reasonably uniform and not subject to the extreme percentages of gradations specified above. For the purpose of determining the degree of uniformity, a fineness modulus determination shall be made upon a representative sample from each source of supply. Fine aggregate from any one source having a variation in fineness modulus greater than 0.20 either way from the fineness modulus of the representative sample may be rejected.

[1] Construction and Material Specifications: Ohio Dept. of Highways, 1949.

3. *Physical Properties*

Loss on decantation by weight . . . not over . . . 4.0 per cent.

When the sand is used in Portland cement concrete or mortar, the tensile strength of cement sand mortar (1-3) shall be not less than 100 per cent standard when compared with standard Ottawa sand.

4. *Soundness.* When tested in accordance with the Tentative Method of Test for Soundness of Aggregates by use of, Sodium Sulfate, A.S.T.M. Designation C 88, the weighted average loss in five cycles shall not exceed 10 per cent, except for Sec. B-71.04, where the weighted average loss in five cycles shall not exceed 12 per cent.

5. *Sulfur Limitation for Sand Used in Portland Cement Concrete.*

Except as otherwise provided in this section the amount of sulfur from sulfur compounds shall not exceed 0.3 per cent by weight of the fine aggregate when determined in accordance with the Laboratory method of analysis. In accepting or rejecting fine aggregate, principal dependence will be placed on service records of the fine aggregate when exposed, in concrete, to actual weathering conditions. This test will not be used as an arbitrary basis of rejection. It will be used only to furnish information to indicate whether or not the fine aggregate requires further investigation.

II. MASON SAND. (Highway Dept. Sec. M-2.3—Sand (Pneumatically Placed Mortar, Cement Grout and Mason Sand)

1. *General.* The sand shall be either a natural or manufactured product and shall be composed of clean, hard, durable, uncoated particles of stone, and free from lumps of clay and all organic matter.

2. *Grading.*

Passing No. 4 Sieve	100%
Passing No. 16 Sieve, not less than	95%
Passing No. 100 Sieve, not over	10%

3. *Physical Properties.*

Clay and silt, by weight, not over 4%

Tensile strength of cement sand mortar (1-3), shall be not less than 70 per cent standard when compared with standard Ottawa sand mortar.

4. *Soundness.* When tested in accordance with the Tentative Method of Test for Soundness of Aggregates by Use of Sodium Sulfate, A.S.T.M. Designation C 88, the weighted average loss in five cycles shall not exceed 10 per cent.

III. SAND FOR BITUMINOUS MIX. (Highway Dept. Sec. M-2.12—Sand)

1. *General.* The sand shall be a natural or manufactured product composed of clean, hard, durable, uncoated particles of stone or slag, free from clay and organic material.

2. *Grading.*

Passing ⅜" Sieve	100%
Passing No. 4 Sieve from	90 to 100%
Passing No. 8 Sieve from	65 to 100%
Passing No. 16 Sieve from	40 to 85%
Passing No. 30 Sieve from	20 to 60%
Passing No. 50 Sieve from	7 to 40%
Passing No. 100 Sieve from	0 to 15%
Passing No. 200 Sieve from	0 to 7%

The gradation requirements given above represent the extreme limit which shall determine suitability for use from all sources of supply. The gradation from any one source shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. For the purpose of determining the degree of uniformity, a fineness modulus determination shall be made upon a representative sample from each source of supply. Fine aggregate from any one source having a variation in fineness modulus greater than 0.20 either way from the fineness modulus of the representative sample may be rejected.

AVAILABILITY OF AGGREGATES WITH RESPECT TO SIZE

In the areas in and around Cleveland and the other lake cities with which this report deals mainly, the shortage of sand for concrete construction is most pronounced. Coarse aggregate is obtained both from crushed slag obtained from steel industries in the vicinity and from crushed limestone brought in by lake

freighters. Fine sand suitable for mortar work is in general much more abundant than the coarser concrete aggregate sand. Much fine sand for mortar work is obtained from local pits from which no concrete sand can be produced, thus the principal aggregate shortage in the region under consideration is in sand suitable for concrete work, most of which must either come from Lake Erie or from pits located 20 to 40 miles to the south.

GEOLOGY AND DISTRIBUTION OF DEPOSITS

Virtually all of the sand and gravel deposits of Ohio are the result of the transportation and sorting of materials carried by the Pleistocene glaciers which invaded Ohio. These glaciers covered nearly three-fifths of the State and the outwash of water from the ice carried sand and gravel along streams to most of the remainder of the State.

All of the sand and gravel deposits of commercial value have been sorted by the action of water, which concentrated the sand and gravel and washed out the clay and silt. Such stratified deposits include the following glacial features: moraines, kames, eskers, lateral stream terraces, glacial deltas, outwash plains, and valley trains.

Another type of deposits resulted from wave action in the early glacial lakes of the Erie Basin which left high level beaches that are now exploited as a source of both fine and coarse aggregates. Each of these features will be briefly described.

Moraines: A moraine is generally expressed topographically as a group of low hills or ridges formed at the front of the ice sheet. The moraine at the farthest point of advance of the ice was first formed and is called a terminal or end moraine. As the ice melted back it halted several times and remained stationary or oscillated slightly due to seasonal changes, advancing slightly in winter and retreating in summer. There formed along the margin of the ice at these places an accumulation of drift melted out of the ice or pushed up by it and material washed off the ice mass and deposited at the front. The major morainic system in Ohio is shown on the glacial map included with this report. Moraines may be composed almost wholly of till, or they may contain beds of stratified material. The stratified deposits often occur as local beds or lenses of stratified sand or gravel and are often discordant; and considerable investigation should be done before opening them commercially to insure against encountering pockets of till or clay that will disrupt operations.

Kames: Associated with morainic belts there frequently are found areas of sharp conical hills and intervening depressions many of which often contain small lakes. This is referred to as kame and kettle hole topography. The kames are composed of stratified material ranging in size from fine silt to cobbles. The individual beds of different size material are of varying thickness and are often quite discordant with the strata inclined at many different angles. The kames were formed at the ice front by waters issuing from the melting ice laden with debris that was deposited in and around blocks of "rotting ice." When these ice blocks finally melted out of the debris in which they were buried, the deposits slumped to form the present kame and kettlehole topography. Kames are also formed by filling of cavities and crevasses in the ice which later melted and allowed the slumped material to remain in the form of an irregular ridge.

A large number of Ohio producers that do not operate in outwash deposits formed along streams are utilizing kames as their source of material. Kames are abundant throughout much of the interlobate moraine in Portage and Summit counties and are being utilized by several companies with varying degrees of success. Kames are apt to be very deceiving and because of the

many abrupt changes in character of material encountered in them they may be opened in very good quality material and after a short while of digging the deposits may change to undesirable or unusable material. A thorough investigation of a kame deposit should be obtained by borings and by a detailed geologic study of the origin before establishing a large plant on the site.

Lateral Stream Terraces or Kame Terraces: As the ice melted and retreated the highlands were first exposed while the valleys remained filled with a tongue of the ice. Large quantities of meltwater flowing in the valley followed the margins of this ice tongue and deposited strata of sand, gravel, and clay depending upon the velocity of the water as determined by the climatic conditions. As the tongue of ice in the center of the valley melted out these deposits were left as relatively flat topped terraces along both valley walls. Blocks of ice were sometimes buried and later melted to form depressions in the surface of the terrace, and near the ice front at the upper part of the tongue structures very similar to true kames were formed by water cascading from the main ice mass. Such terraces where they contain materials of suitable size range are generally suitable for development since the uniformity of the material is apt to be quite consistent laterally. In Ohio terraces occur most often on the streams flowing southward from the drainage divide but located within the glacial boundary.

Outwash Plains and Valley Trains: As the Wisconsin ice sheet retreated northward across Ohio large volumes of water were carried by all of the south-flowing streams that are tributary to the Ohio River. These streams carried heavy loads of detritus which was in general well sorted as it was deposited along these drainage courses, often to a great depth. These deposits along the valleys of the Muskingum, Scioto, Hocking, and other principal rivers and their tributaries contain the finest commercial sand and gravel in the State and the reserves are essentially unlimited. Most of these deposits, however, are located too far south to be economically transported to the areas of shortage in northern Ohio and so it remains for these areas to prospect and develop the less favorable deposits nearer at hand.

If there was no pre-determined water course for the water issuing from the ice front to be channeled into, it spread out into the flat land in front and dropped its load in the form of an outwash plain or apron in front of the ice border. As these streams had no channel to follow but instead followed an anastomosing or braided network across the plain their velocity rapidly decreased and the resulting deposits are less sorted and have a greater amount of silt and clay mingled with the sand than do those following valleys where the currents were more constant. It is difficult to tell without considerable prospecting by pits or drillings where the best sorted sand in these deposits is to be found, or how large an area might be expected to be covered by a pocket of sand that is of good quality on the outcrop. Although details have not yet been worked out for the area, it appears that much of northern and eastern Portage County contains deposits of this sort..

North of the drainage divide where the drainage is to Lake Erie, outwash deposits of the two types described above are not found because of the existence of lakes in these valleys formed by ice damming the outlet of the streams and causing the formation of slack water and lake deposits.

Glacial Deltas or Sand Plains: As the ice retreated over certain regions the distribution of the ice and the topography was such that temporary lakes were frequently formed. Where streams heavily laden with debris flowed from the ice margin into these quiet waters the load was dropped and deltas were formed. Some of these deltas are large and contain good deposits of well sorted material. These features are more common north of the drainage divide than south of it.

High Level Beach Deposits: As the glacial ice melted back northward lakes formed in the Huron and Erie basins by the melting of the ice from these basins while their northward outlets remained blocked by the main mass of glacial ice. As the ice mass retreated from and readvanced upon various drainage outlets the levels of the lakes underwent many changes. This long and complicated history of the glacial lakes has been worked out to a remarkable degree by Leverett in his lifetime of study of these glacial features.[1]

The material washed into beaches along these old shore lines is used extensively as a source of aggregate in Lake and Ashtabula counties and to a lesser extent westward from Painesville to Toledo. It will suffice to say here that although the quality of material in these deposits is generally poor and the recovery and processing are more difficult than in other deposits, the location and availability of these beach deposits are such that they probably will continue to be an important source of aggregate materials.

DISCUSSION OF DEPOSITS BY COUNTIES

CUYAHOGA COUNTY

The densely populated and rapidly expanding area in and around Metropolitan Cleveland has been suffering an acute shortage of sand suitable for concrete aggregate. This report has therefore been more or less centered on this area and the surrounding areas that serve Cleveland.

It is exceedingly difficult to obtain accurate figures regarding the quantities of sand produced at, or used in various places; however, a few approximate facts and figures are set forth below in order to assist in the understanding of the Cleveland sand situation.

Consumption of Sand in Cleveland: No accurate figures for the amount of sand consumed in the Cleveland area are available. Information obtained from various sources indicates that the annual consumption for the Cleveland area is probably about one and one-half million tons. The best quantitative estimates available indicate a total consumption of approximately 1,328,000 tons subdivided by sources as follows: (1) Sand produced in Cuyahoga County 466,000 tons, (2) Lake sand produced in Ohio waters and sold in Cleveland 220,417 tons, (3) Lake sand from other than Ohio waters 141,858, and (4) Bank or pit sand produced outside of Cuyahoga County and transported to Cleveland 500,000 tons (rough estimate).

Cost of Sand in Cleveland: The lake sand pumped in Ohio waters and sold in Cleveland is priced in the neighborhood of $1.50 to $1.75 per ton unloaded onto the dock. The bank sand produced in Cuyahoga County sells in general at about the same price as the lake sand. Sand transported from without the county is sold for less money per ton, but transportation increases the cost from around $1.80 to as much as $2.50 per ton on the Cleveland market. Some Canadian sand is sold in Cleveland, but the supply is limited, and the amount of this sand probably does not exceed 10,000 tons annually.

Sand and Gravel Deposits in Cuyahoga County: In this study seven sand producers were noted in Cuyahoga County. The location and a directory of these producers are shown on the map accompanying this report.

Favorable sand deposits are, as far as present knowledge extends, fairly well restricted to the areas that are currently developed. Other deposits are present but are inaccessible due to their location under industrial or residen-

[1] Leverett, Frank, Glacial Formations and Drainage Features of the Erie and Ohio Basins: U. S. Geol. Survey Mon. No. 41, pp. 710-774, 1902.

tial sections. Over much of the county such deposits as were formed have been later buried by glacial or lake deposits and are inaccessible.

With the exception of the deposits in the Mill Creek Valley near Garfield Park practically all of the sand that is dug in the Cleveland area runs fine, and although it is suitable for mortar, it does not contain sufficient particles in the minus 4 mesh to 30 mesh range to make it suitable for concrete sand.

Cuyahoga County was invaded by at least two ice sheets. Knowledge of the Illinoian glacial deposits is meager because the advance of the Wisconsin, or second ice sheet, largely obliterated or covered the deposits of the earlier Illinoian glacial period.

The most prominent effects of these glacial invasions were the modification of the drainage and the formation of the Great Lakes. A complete description of the geology of Cuyahoga County, including a very thorough history of the formation of the Great Lakes, may be found in Bulletin 818 of the U. S. Geological Survey, to which the interested reader is referred for a complete treatise. [1]

The streams that drained Cuyahoga County in pre-glacial time were well established streams that flowed in deep, rock carved valleys. The Cuyahoga River follows the largest of these old valleys from Cuyahoga Falls to Lake Erie at Cleveland, a distance of 30 miles. At Cleveland the channel of this pre-glacial Cleveland River whose headwaters were in Belmont County 100 miles to the south was carved in bedrock to a depth slightly below present sea level, and thus the glacial fill in this valley at Cleveland is more than 600 feet deep. As the glacier advanced upon these north-flowing streams, the waters were ponded and lakes formed in the valleys. Little is known of the details of these deposits at depth, but during the existence of the higher levels of Lake Erie thick water-lain deposits were built up in the lower course of the Cuyahoga Valley. With the lowering of the Lake level to its present position the Cuyahoga has cut a sinuous trench 140 to 160 feet deep into these deposits and thus left a broad flat topped terrace with steep fronts that forms a very conspicuous feature all along the lower course of the Cuyahoga Valley.

In the southern part of Cleveland there are several sand pits that operate in the deposits of this terrace. These are: Canal Sand and Gravel Co., Kaiser Nelson Inc., Schaff Road Sand Co., and several others. In all of these pits the principal product is mainly fine sand which is used principally in mortar work and for fill sand. The reserves of sand of this type in these terraces is practically unlimited, but the supply of sand suitable for concrete work is very small. In the lower part of some of these deposits there appears to be some coarser material suitable for concrete work. Some well drilling information indicates a coarser grade of sand and some gravel at depths near and below the level of the Cuyahoga, and it therefore appears that a more intensive study of these deposits should be considered. If pockets of coarser sand could be located in the deposits of this alluvial terrace the removal of overburden would undoubtedly present a considerable problem. However, in consideration of the freight rate necessary to transport sand to this area it seems quite possible that a feasible means of recovery might be accomplished. Time has not permitted more than a very preliminary investigation in this area. Yet with the economic benefits which might arise from it a thorough study of this area would seem advisable since there are several buried channels which cross the Cleveland area about which very little is known. The areal geology set forth in Bulletin 818 of the U. S. Geological Survey furnishes an excellent background and a starting point for such an investigation and a great amount of information beyond the scope of that report could undoubtedly be secured by a more detailed

[1] Cushing, H. P., Leverett, Frank, and Van Horn, F. R., Geology and Mineral Resources of the Cleveland District, Ohio: U. S. Geol. Survey Bull. 818, 1931. (out of print, available in public libraries).

study and by accumulating and correlating information found in past drilling and excavations in the areas where sand or gravel deposits, if present, might be recovered from these alluvial deposits.

The beaches formed by the higher levels of the lake contain abundant gravel, sand, and silt, but where observed in the Cleveland district, the quality of this material is so poor that it is not a practical source for aggregate materials. There are several of these high level beaches which are thoroughly discussed by Carney[1] and by Leverett.[2] One of these high level beach deposits was studied and sampled where exposed in the pit of the Schaff Road Sand Co., located just north of the road at the top of the hill one mile west of the clover leaf at the junction of Schaff Road and U. S. Route 21. The elevation of this beach is from 740 to 760 feet. It has been traced northwestward along the south side of Schaff road to Brooklin and is located on the Brooklin moraine. This beach north of Schaff Road is overlain by three to five feet of lake clays that are stripped off to expose it at the Schaff Road Sand Company pit. In this pit the beach material consists of 3 to 7 feet of "dirty gravel" composed largely of shale and soft sandstone pebbles, fine sand, and silt. Directly beneath this beach material there is an irregular and discontinuous bed of clay a few inches to two feet in thickness, sometimes consisting of one bed, or of several thin streaks interstratified with sand. Below this clay, medium to fine sand is encountered to the bottom of the pit, which exposes 4 to 5 feet of it. The depth of this pit is limited to 12 feet below the surface due to the method of excavating used, but an earlier pit in this area is reported to have worked to a depth of about 30 feet.

A second sand producing area at Cleveland is located in Mill Creek Valley near Garfield Park. These deposits have a very unusual occurrence and appear to have been formed by a stream flowing beneath the glacier under hydrostatic pressure. Both sand and gravel of good quality have been obtained from these pits for many years. No other such deposit is known in this county, and, because of its complicated nature and the fact that it has never been thoroughly studied and traced out, the possible reserves are unknown. The apparent reserves, however, seem to be more or less restricted to the three pits now operating, two of which are nearly worked out. Lytle Brothers' Company and Newberg Sand and Gravel Company both operate in the large wet pit just south of Calvery Cemetery where the sand has been removed to a depth of 30 to 40 feet below water level.

Schmidt Sand and Gravel Company, located 2 miles south of Garfield Park on Broadway, is the largest producer of these Mill Creek Valley deposits. This plant was opened about 1900 and now operates two pits located on opposite sides of McCracken Road. Both are dry pits with faces more than 50 feet high. Several small diggings 30 or more feet below the general working level have failed to reach the bottom of the deposits, and, in fact, the quality of the material apparently increases at depth.

Mill Creek follows the course of a pre-glacial valley that parallels the Wheeling and Lake Erie Railroad and Broadway for a distance of about 3 miles southeast from the Insane Asylum, but on reaching this point, its course is diverted by a part of the Brooklin moraine and the stream follows south along the moraine until it meets the Cuyahoga at Willow. This pre-glacial portion of the Mill Creek Valley must therefore be very deep, and the gravel in the deposits along this part of its course probably extends for a considerable distance in both directions from these pits. This sand and gravel deposit was visited by Leverett[3]

[1] Carney, Frank, the Abandoned Shorelines of the Ashtabula Quadrangle, Ohio: Bull. Sci. Lab., Denison University, Vol. 18, 1916.

[2] Leverett, Frank, and others, Geology and Mineral Resources of the Cleveland District, Ohio: U. S. Geol. Survey Bull. 818, 1931.

[3] Leverett, Frank, and others. *Ibid*, p 65.

who said of it that: "These deposits show remarkable variation in coarseness, ranging from cobbles to fine sand. The bedding is very discordant, some beds having been washed away and filling of material of different texture brought in." With regard to the origin of this deposit, Leverett says that: "Beds of sand and gravel of this sort appear to have been laid down underneath rather than outside the ice, in places where there was sufficient hydrostatic pressure to produce strong currents, with enough difference in strength to determine the many differences that the deposits exhibit." The deposits exposed in the pits are covered with a thin layer of till or lake deposits formed by the melting back of the ice which makes the tracing of the deposit and the location of other possible pit sites difficult without the use of drill holes.

MEDINA COUNTY

The most extensively developed commercial deposits of sand and gravel in Medina County are located three miles southeast of Lodi along Killbuck Creek. The Allied Supply Company and Quillen Brothers Company both have rather large plants operating in this deposit; in addition there is a large abandoned pit once used to obtain railroad ballast and several smaller pits from which bank run material has been taken out at one time. An asphalt pavement hot mix plant is also located within the area of these deposits and obtains its aggregates from the two sand and gravel companies located nearby.

The deposit consists of kames of rather strong topographic expression which are associated with the Fort Wayne moraine. The material making up the deposits consists of sand, pebbles, and cobbles exhibiting various degrees of sorting at different points within the deposits. In general, the percentage of pea gravel in these kames is unusually high, and a large amount of crushed gravel is also produced. The gravel, however, generally contains soft stones which detract from its soundness and make it difficult to pass state specifications for sodium sulphate soundness tests.

The thickness of the sand and gravel in these kames is very favorable. It exceeds fifty feet in many places and apparently lies on sand which constitutes the fill in a buried valley of pre-glacial origin. The indications are that there are large reserves of sand and gravel in this area which appear to be suitable for commercial development. The limits of the area covered by these kame deposits were not determined, but a rapid reconnaissance of the area led the writer to believe that its extent may be conservatively estimated to be several thousand acres.

In northeastern Medina County there are two pits located two miles northeast of Granger that are operated by Allied Supply Company. The two pits are in the same deposit and during the war years closed due to labor shortage. These are, however, being re-opened and should furnish a fair amount of sand and gravel to the market both in this area and in Cleveland.

The deposit appears to be composed of kames, one of which, though only a thousand feet in diameter at the base, rises to a height of one hundred feet and consists entirely of rather well sorted sand and gravel with some cobbles and boulders as large as two feet in diameter. The area of workable deposits is not large, and probably does not exceed one square mile. There are, however, outwash deposits to the east and southeast, and to the west of the deposits currently being worked which might be suitable for future development.

Along Wolf Creek in Sharon Township the Medina County Highway Department operates a pit which supplies a fairly large amount of gravel for highway work. The pit is located just west of the Medina-Summit county line on State Route 162.

The material worked in this pit consists of sand and gravel in about equal

volumes. The deposit has been worked to water level (about fifteen to twenty feet below road level) in the southeast corner of the property. The thickness worked varies from about 10 feet to 40 feet in the deposit. Drilling below the depth reached in the pit shows 20 feet of quicksand underlain by an undetermined thickness of gravel. The overburden, where seen, consisted of a foot or so of topsoil underlain by about a three foot zone of leached sand and gravel. This overburden is not stripped.

In the semi-portable plant through which the gravel is processed at this pit, the bank run material is screened over a three-inch horizontal bar screen and the cobbles and boulders not passing go to a primary crusher and are reduced to minus three inch.

The minus three inch material passes by belt to a one and one-half inch square mesh vibrating screen and the oversize is crushed and returned to the screen. The material passing the one and one-half inch vibrating screen drops onto a three-eighths or five-eighths inch horizontal bar screen and that retained goes by belt to the gravel hopper. The sand passes this screen and goes by belt to a separate bin and is hauled to waste piles. The three-eighths or five-eighths inch screens are interchanged, depending on the dampness of the material. Some of the waste material passing these screens is used by the County highway department for road berms. About 125 to 150 tons of gravel is produced daily in this plant.

Structurally the deposit in which this plant is operating is a very large one. The sand and gravel was transported and deposited by glacial meltwater and apparently fills the valleys of Wolf Creek and Van Hyming Run to an elevation of about 1,040 feet, or about 20 to 40 feet above the general level of these streams. Not a great deal is known about the depth of these deposits below present stream level; however, indications are that they may extend to a considerable depth.

SUMMIT COUNTY

Summit County has a large amount of sand and gravel production, much of which is consumed in the Akron industrial district. A large amount of sand is also transported to Cleveland from Summit County. Almost the entire eastern and southern half of the county lies within the interlobate tract formed between the Killbuck lobe and the Grand River lobe of the ice and the reserves of sand and gravel are therefore large.

The deposits of sand and gravel in the county consists mainly of kames and outwash terraces. West of Akron, in Copley Township, there are undoubtedly large reserves of sand and gravel in the outwash terraces along Wolf Creek and Van Hyming Run although only a small amount of the county's production has come from these deposits. One moderately large kame on the west bank of Wolf Creek about one and one-half mile southeast of Bates Corners on Clarks Mill road has recently been opened by the E. H. Amlin Company. The deposit consists mainly of medium to coarse sand with a lesser amount of gravel. It is rather easily worked into sand for concrete and mortar uses so that the deposit has proved to be very satisfactory. A smaller plant on the east side of Wolf Creek about one mile north of Barberton, which was not visited by the writer, apparently also operates in deposits similar to those on the west side of the valley.

In the Portage Lakes region south of Akron there is a large area of kame topography which consists largely of stratified glacial outwash. This large area which includes virtually all of Coventry, Springfield, Franklin, and Green townships is drained by the headwaters of the Tuscarawas River, and by Nimisila Creek, both of which have large amounts of sand and gravel outwash along their valleys. The Rubber City Sand and Gravel Company which has been op-

erating for over twenty years in the same pit is located in outwash deposits along the south bank of the Tuscarawas River about five miles south of East Akron. Suction dredging has been the principal means of removal in this plant from which a large part of the production is shipped by rail to Cleveland and other distant points.

One mile east of Cuyahoga Falls there is a newly opened pit operated by the J. P. Loomis Company which formerly took their material from a large pit near the race track on the north side of the Cuyahoga River at Akron. Another large pit operated by the Loomis Company is located just south of Darrowville from which a large amount of sand is trucked to Cleveland. The deposit at Darrowville does not extend to a very great depth and appears to be an outwash deposit which may have formed as an apron in front of the retreating ice. This deposit consists dominantly of medium to coarse materials from which concrete sand, pea, gravel and three-quarter inch gravel are produced.

North of Darrowville and throughout the northwestern part of Summit County there are no commercial sand pits and the prospect of finding commercially usable deposits is doubtful due to the accumulation of fine sand, silt, and clay in this region. This was brought about by the ponding of the glacial meltwater in the valley of the Cuyahoga River and the existence of a lake which stood for a long period of time at an elevation of about 960 feet, which is the elevation of the southward outlet over the drainage divide at Akron.

PORTAGE COUNTY

Portage County, like Summit County, has large reserves of sand and gravel. It is a less industrialized county and therefore the local consumption is less but large quantities of sand move by truck to Cleveland from the northwestern part of the county, and to Warren and Youngstown from the eastern half of the county.

Geologically the western third of the county is very similar to southeastern Summit County as it lies within the large interlobate tract formed between the Grand River lobe of the ice, which encroached upon the area from the northeast, and the Killbuck lobe, which moved from the northwest across Summit County. Virtually all of the topography in the western third of Portage County consists of kames and water laid moraine that was deposited by meltwater flowing between these two great lobes of the glacial ice.

A large amount of the material in this interlobate moraine is sand and gravel suitable for commercial purposes and there are quite a number of pits located in the area. The largest of these is the Hugo Sand and Gravel Company pit at Earlville, two miles north of Kent. The deposits at Earlville consists of kames of moderately strong topographic expression. The sand is removed by a suction dredge that operates to a depth of about 40 feet below the water table and breaks down a bank about 40 feet high by a hydraulic jet. The pit was first opened in 1929 near route 43 where coarse sand and a considerable amount of gravel were encountered in rather well stratified deposits. In extending the pit westward pockets of clay and silt were encountered which hampered operations. This wall of clay and silt was left standing and operations commenced to the west of it have encountered more poorly sorted material including some clayey till.

Since this type of lack of uniformity in kames is not uncommon they are often not considered as desirable as other forms of outwash deposits, but with sufficient drilling to prove their uniformity kames often prove to be very good sites for commercial sand production.

North of Earlville, in Streetsboro Township, there are two rather large producers. One is the Hudson Sand and Gravel Company, located one and one-

half miles west of Streetsboro, and the other is the Flescher Sand and Gravel Company, located two miles southeast of Streetsboro.

Both of these producers are operating in what appear to be outwash terraces, and the material in them produces a good grade of sand. The deposit west of Streetsboro is operated to a depth of about 60 feet below the water table and to a height of about 40 feet above the water table. The material consists of about two-fifths gravel and three-fifths sand from which both concrete and masons sand is produced. The depth to which commercially usable sand might extend here is not known, but geologically the trend of the deposit appears to lie within, and to conform to the southeast to northwest course of the buried valley of the old Ravenna River, which was a Deep Stage stream whose bedrock floor lies several hundred feet below the level of Tinkers Creek which now drains the area.

The deposit in which the Flescher Company operates two miles southeast of Streetsboro is also an outwash deposit and has proved to be a very favorable location. The material in this deposit is coarser than that at the Hudson pit and produces about two-thirds gravel and one-third sand. The deposit is quite uniform and is worked by a dragline scraper to a depth of 60 feet below the water table and to a height of about 40 feet above.

Reserves of sand in these deposits near Streetsboro appear to be large and detailed prospecting along the preglacial channel of the Ravenna River and on the broad terraces west of the Cuyahoga River in the eastern part of the township would undoubtedly reveal several locations favorable for the opening of other sand pits in these outwash deposits.

Farther upstream along the Cuyahoga River, in Shalersville and Mantua townships, there are valley fills and terrace deposits that should contain abundant sand and gravel. One moderately large pit operating in these deposits was noted one mile west of Mantua. This is the Brugman Sand and Gravel Company whose pit extends to a depth of about 30 feet below water level and from which concrete sand, number 46 gravel, and number 3 gravel are produced by the use of a dragline scraper.

The western third of Portage County from Kent southward to the Stark County line is much like the northwestern part of the county and the topography is dominantly that of a water laid moraine consisting of many kames and depressions, many of which have lakes or ponds in them. The surface of the whole area is dominantly sand and gravel of various size gradations and exhibiting varying degrees of sorting. In general these deposits lack the necessary uniformity in particle size and do not have a large enough extent where the sorting is good for commercial purposes. There seems to be little doubt, however, that numerous pit locations could be found in this large tract of water laid moraine covering most of Brimfield, Rootstown, Suffield, and Randolph townships.

East of Ravenna the topography becomes much less hummocky as the interlobate moraine passes into a till plain consisting mostly of gently rolling topography. Detailed mapping of the glacial geology of this area has never been done and the time available to the writer did not permit a very thorough reconnaissance of this part of Portage County. The mapping of some of these glacial features is planned during the summer of 1949, and its completion may reveal the presence of a considerable area of deposits worth prospecting for sand and gravel pit locations.

The buried valley of the Ravenna River apparently passes just south of the city of Ravenna and at Campbellsport divides into two headwater branches, one of which follows about the course of the west branch of the Mahoning River eastward to the county line. The other branch passes south of Campbellsport,

follows about one and one-half miles west of Edinburg, and thence southward through the village of Atwater. The depth of fill in this valley is very great as a well 230 feet deep at Campbellsport failed to reach bedrock, and a well one mile north reached a depth of 270 feet without encountering bedrock. Near Atwater bedrock was not reached in a well at a depth of 139 feet. It is, therefore, quite probable that there are some good sand and gravel deposits along the line of this old valley which may be accessible with the removal of only a small amount of overburden.

In eastern Charlestown Township, eight miles east of Ravenna on state route No. 5, the Charlestown Sand and Gravel Company is operating a pit that appears to be a small delta formed by water flowing from the retreating ice sheet. Twenty-five to thirty feet of concrete and mortar sand is exposed, which is overlain by a deposit of gravel about 10 feet thick. Other similar topographic features in this part of the county may contain similar deposits formed in the same way and should be investigated more thoroughly.

A weak moraine which encircles the Grand River Valley enters Portage County one mile east of Hiram Rapids and follows south along the Hiram Township-Nelson Township line to Garrettsville and then southeastward to Windham where it becomes indistinct and cannot be traced farther. This moraine according to Leverett[1] is scarcely a mile wide and consists of a series of ridges and knolls 10 to 25 feet high that probably represented a temporary halt of the ice during which a moraine was formed only along a portion of the ice front.

The Sober Sand and Gravel Company, located about two and one-half miles west of Rootstown on state route 18, has commenced a fairly large operation in what appears to be part of a delta formed at the ice front. This pit has been in operation for about one year and during this time has well exposed the structure of this deposit. The cut exposed extends from a height of 30 to 40 feet above the level of the plant site to a depth of about 25 feet below the plant level. The deposit consists of beds of coarse sand interstratified with beds of sand and gravel which occasionally contain quite a few cobbles up to six or eight inches in diameter. These beds are all quite variable in thickness in different parts of the pit, but there is not a great amount of discordance between the beds. The dip of the beds is persistently to the south throughout the pit. The angle of dip is also fairly uniform and was estimated to be about 10 degrees.

Indications are that the same good quality of deposits may extend to a great depth. A nearby water well encountered sand to a depth of 150 feet and other wells in this part of the county have encountered depths of glacial drift of over 200 feet.

If the assumptions regarding the origin of this deposit are correct, it is quite possible that material of good quality will be encountered underlying several hundred or more acres of an area occupied by this glacial feature. Similar looking structures also lie both to the north and south of this ridge and should warrant further detailed study.

WAYNE COUNTY

The sand and gravel deposits of Wayne County generally are not of very good quality due to the large amount of sandstone and shale particles which they contain. These deposits are also located beyond the economic limit of trucking to the Lake Erie cities and for these reasons the development of the sand and gravel resources in Wayne County has been limited to local demand. The reserves of sand and gravel are fairly large, but as mentioned the quality is generally only fair to poor. Topographically the county is an area of rolling uplands with broad, flat-bottomed valleys. The entire county was overridden

[1] Leverett, Frank, Glacial Formations and Drainage Features of the Erie and Ohio Basins: U. S. Geol. Survey Mon. No. 41, 1902.

by the Wisconsin ice sheet which disrupted the drainage of the pre-glacial streams and deposited a thickness of 10 to 25 feet of drift over the surface. The pre-glacial streams flowed northward and were well established before the glaciation. These are now filled to depths as great as 200 feet with glacial debris. The outwash terraces along these valleys contain large quantities of sand and gravel and are the principal source in which the commercial pits operate.

The geology of Wayne County is well covered in a county report by G. W. Conrey[1]. This report also contains a large glacial geology map of the county to which those interested in this county are referred. The distribution and extent of the outwash deposits are accurately shown on this map together with the location of many small and abandoned pits where ready access to the deposits for examination or sampling may be had.

WYANDOT COUNTY

Only a small amount of time was devoted to Wyandot County during this study. The three pits shown on the map included with this report were visited and are, to the best of the writer's knowledge, the only pits operating within the county.

Wyandot County lies within the relatively smooth and undissected Mississippi Valley plain. The western part of the county is underlain by the Niagara dolomite, the central part by the Monroe group of Devonian age, and the eastern part of the county is underlain by the Columbus limestone of Devonian age which overlies the Monroe group.

The entire county was overridden by both the Illinoian and Wisconsin ice sheets which left a drift covering of clayey till varying from a few feet to a hundred feet or more in thickness but averaging less than 50 feet.

The Fort Wayne moraine enters the county on the west at the town of Forest and loops southward through Brownston and Little Sandusky and from there passes almost straight north for a distance of about eight miles until reaching the center of Eden Township from where it turns sharply eastward and leaves the county at a point about two and one-half miles south of Deunquat.

The Corfman, the Kinsley, and the H & W sand and gravel pits are located about one-half mile apart in almost a straight north-south line in sections 11 and 14 of Crane Township, Wyandot County.

The deposit consists of rather well sorted sand and gravel which seems to have been formed by a stream fronting the glacier at about the time of the formation of the Fort Wayne moraine. There is a definite difference in particle size due to sorting noticeable in these deposits; since the northernmost of the three pits encounters principally gravel, the middle pit of the three produces both coarse sand and small gravel, and the southernmost pit produces only concrete and mortar sand.

The depth of the sand in these pits is said to be in the neighborhood of 100 feet of which 40 to 60 feet is below the water table and is mined by using a dragline scraper with a slackline cableway. The products from these pits is of good quality and because of their location in a region where there are no other pits, their materials are commonly trucked to distances as great as 40 miles.

No detailed maps of the glacial geology in Wyandot County have yet been made and so it is difficult to determine what other possible sand-producing areas in the county there are that may be worthy of prospecting. There are several topographic features fronting the Fort Wayne moraine south of the Eden Township pits that give the suggestion of being outwash deposits and which may contain sand suitable for commercial use.

[1] Conrey, G. W., Geology of Wayne County: Geol. Survey of Ohio, 4th Ser. Bull. 24, 1921.

GEAUGA COUNTY

The interlobate moraine from which large quantities of sand and gravel are taken in Summit and Portage counties extends northward into southcentral Geauga County. There are, however, no producers presently located in this district due to lack of a local market and because of the proximity of several large pits in northern Portage County. Several pits have operated in this part of Geauga County in the past, and others could undoubtedly find suitable locations.

Present production in this county is thus limited to two large plants both of which are engaged in the production of silica sand and silica pebbles from the Sharon conglomerate. This formation is the basal member of the Pennsylvanian system. It is exploited in two areas of the State, one located in western Jackson County, and the other in parts of Summit, Portage, and Geauga counties. Outliers of this northern outcrop area also extend into parts of Medina, Cuyahoga, and Lake counties.

The Sharon is dominantly a medium to coarse-grained sandstone containing occasional thin pebble beds. The parts most extensively worked, however, are zones of true conglomerate containing large quantities of pebbles. These pebble zones form long, narrow north-south bands which represent deposition in channels cut into the underlying Mississippian rocks.

The principal products obtained from the large open pit mines in the Sharon are pebbles over one-half inch in size used in large quantities in steel manufacture, pebbles for use in manufacture of silica brick, and small granules used for manufacture of roofing materials. The fine aggregate is used for molding sand, engine sand, blasting sand, etc.

In addition to these products, and of particular interest in this report, is the growing use of the Sharon as a source of concrete aggregate materials. These uses include mainly the fine aggregate sizes due to the premium price obtained for the pebbles for other industrial uses. The soundness qualities of these aggregates far surpass those of aggregates from any other source and concrete made from Sharon aggregates is generally superior in strength and other desirable qualities.

The Walter C. Best Company, Inc., located just south of Chardon, and the R. W. Sidley Company at South Thompson are both engaged in the mining and processing of Sharon conglomerate including the production of concrete aggregates. At the Chardon plant much of the product is used in the manufacture of high-grade concrete blocks, but at the Thompson plant large quantities of concrete sand is produced and marketed by trucking to Cleveland, Painesville, and other cities within 30 to 40 miles distance.

Reserves of fine aggregates in the Sharon formation in this northern field are enormous, but because of the higher cost of processing only minor amounts of aggregates from this source have been produced. Field work leading to a complete geologic report and mapping of the Sharon conglomerate is in progress by the Geological Survey of Ohio and when completed should be of great value in establishing favorable locations for added production of high quality aggregates from this source.

ASHTABULA COUNTY

Virtually all of the aggregates produced in Ashtabula County are obtained from the high level beaches along Lake Erie. The remainder of the county consists mainly of a relatively flat till plain. One isolated kame near Eaglesville from which road gravel was once dug was visited, but this deposit is very small and has been practically depleted. In the southeastern part of the county near Pymatuming Reservoir some small pits are reported to have been located, and other pits located just across the state line in Pennsylvania produce aggregates

for the local market. Details of the glacial geology in this county have never been adequately mapped; however, the completion of such a project might lead to the development of deposits that heretofore have not been recognized.

The lake plain on which the old shoreline deposits are found extends from three to five miles southward from the lake to the Painesville moraine. The detailed mapping of these beach deposits was done by Frank Carney, whose thorough study of the shorelines of the glacial lakes was carried on over a period of many years.[1]

Deposits left by the highest of the glacial lakes, Lake Maumee, are limited to small patches at an elevation of about 760 feet in this county. The best developed beach deposits of this stage are found in the vicinity of Kingsville. Just east of Kingsville across Conneaut Creek these deposits are worked very extensively in the pit of the Northeast Materials Company where a maximum thickness of 25 or more feet of gravel and sand is dug over a large area.

The Whittlesey stage at an elevation of about 740 feet was the next lower lake stage which left a very pronounced beach along the lake plain in Ashtabula County. State road 84 follows this beach ridge from the west edge of the county eastward to Kingsville, and a number of gravel pits are producing aggregates obtained from these beach deposits.

In general the material in these deposits, where worked, consists of medium and small gravel mixed with coarse to medium sand. Beds of uniformly fine lake sand are often encountered in these deposits and in many of the pits in the Whittlesey beach the beach gravel overlies such fine sand which is not removed but is left as the floor in the pit. The beach gravel is often overlain by deposits of very fine wind blown sand which has been drifted into dunes. These dunes are a conspicuous feature along many parts of the beach ridges where the surface presents a hummocky topography. The beach deposits have been leached to a depth of four or five feet which is responsible for the dark brown earthy appearance of the upper part of the deposits exposed in the pits. Gravel and sand for concrete work, masons sand, and road gravel are the products produced from these deposits. A large percent of the material in these deposits is composed of soft shale, siltstone, and sandstone which is responsible for the poorer quality of these aggregates as compared to aggregates from the glacial outwash deposits from which the bulk of the aggregates used in Ohio are taken.

Large quantities of sand and gravel have been taken from the Whittlesey beach at the Carter Sand and Gravel Company pit just south of Ashtabula, at the N. T. Pinney Construction Company pit on the north bank of the Conneaut Creek three miles east of Kingsville, and at a pit one mile east of the Pinney pit from which the Lake Shore Railway dug large quantities of material.

Along the lake plain northward from the Warren and Whittlesey beaches Carney[2] has also traced out and mapped the beaches of Lake Arkona, which during two different stages formed beaches at 695 and 710 feet above sea level, Lake Warren at an elevation of 680 feet, Lake Wayne at 660 feet, and Lake Lundy with one stage at 640 feet and a lower stage at 620 feet above sea level. No commercial pits operating in the deposits of these lower abandoned beach levels were noted in this county.

As regards the reserves of sand and gravel contained in these beach deposits it appears that there is a great abundance; however, because of so many variations in the thickness and quality of the material and due to the development of cultural features along these old shorelines, a comprehensive survey would be necessary in order to attempt a quantitative estimate of what these deposits might be expected to produce in the future.

[1] For a list of published reports by Frank Carney see bibliography accompanying this report.

[2] Carney, Frank, The Abandoned Shorelines of the Ashtabula Quadrangle, Ohio: Bull. Sci. Lab Denison Univ. Vol. 18, pp 362-369, 1916.

LAKE COUNTY

In Lake County all sand and gravel production noted is, as is the case in Ashtabula County to the east, dug from pits located in the high level beach deposits. The quality and general character of the material in these deposits is, in general, the same as that described for the Ashtabula County deposits located in the same beach ridges.

The beach formed at the 760 foot level of Lake Maumee is fairly well defined in the western part of Lake County where there are two pits operating in these deposits. One is a small operation about three-quarters of a mile south of Wickliffe where the beach material has been removed to a depth of 8 to 10 feet over an area of several acres. Another pit in the western part of the county operating in Maumee beach deposits is the Ridge Gravel Company located 500 yards north of route 84 at a point two and one-half miles east of Wickliffe and about two miles southwest of the center of Willoughby. Fairly large quantities of medium to small gravel and sand have been removed from this deposit which appears to have been worked to a maximum depth of about 15 to 20 feet. This pit is currently being operated in a small way to produce pit run material for gravelling roads, etc.

Just east of Mentor there are two small pits located in the 680 foot level of Lake Warren. One very small bank may be seen just north of the east fork of Marsh Creek and U. S. Route 20 at a point about one and one-half miles east of the center of Mentor. In this bank about 15 feet of clean medium to coarse sand is exposed. The deposit is small and only a few truckloads of sand have been removed. Another pit in the Warren beach deposits is located about 0.6 miles southwest of this point. This is a wet pit worked to a depth of about 10 feet over a small area.

There are two fairly large abandoned pits at Painesville. One is just east of the Grand River and just south of the railroad and U. S. Route 20. Large quantities of coarse sand and small gravel were removed from the Warren beach level here and used by the railroad. Another pit on the west bank of the river just south of Route 84 at Painesville operated in deposits that seem to correlate with Carney's Whittlesey shoreline.

Northeast of Painesville there is a newly opened pit operated by the Perry Sand and Gravel Company. This pit is two and one-half miles west of Perry and one mile south of Route 20. It is located on a flat terrace at an elevation of about 700 feet which corresponds to the level of the Lake Arkona beach. This is a wet pit using a suction dredge which works to a depth of about 8 to 10 feet. The dredged material then goes to an up-to-date processing plant where mason sand, concrete sand, and several gravel sizes are produced.

In Lake County as in Ashtabula County the reserves of sand and gravel in these beach deposits are apparently large and can be expected to furnish aggregate to the local market for an indefinite period of time.

SAND RESOURCES OF THE LAKE ERIE BOTTOM

As mentioned in the introduction, the writer was engaged for several weeks in preliminary reconnaissance to determine the occurrence and extent of sand deposits on the bottom of Lake Erie. More detailed investigations along these lines are currently being conducted by the Ohio Department of Public Works in cooperation with the U. S. Army Engineers. The results of these investigations will subsequently be published and for this reason only a brief discussion of these lake sands will be given here.

Sand has been produced from the bottom of Lake Erie for many years. In the early days of the industry the boats were small and operated in shallow

waters near the shore or on bars along the islands. Later these small dredges gave way to larger boats of 500 to 1,000 cubic yard capacities which are capable of lifting sand by suction from depths of 50 to 75 feet or more.

In spite of the long history of sand production from the lake bottom, very little information is known regarding the occurrence and distribution of this sand. The principal production comes from three areas; namely, one located about five to eight miles offshore at Vermilion, one located about five miles offshore at Fairport, and an area in Pennsylvania waters near Presque Isle at Erie, Pa.

The Kelley Island Lime and Transport Company operates several sand boats and is the principal producer of sand from the Lake Erie bottom. The sand is dredged and transported by the boats from the nearest pumping ground to docks located at Toledo, Sandusky, Lorain, Cleveland, Fairport, Ashtabula, and Conneaut. All of these boats are self unloading, and since the sand has been washed and screened during pumping and loading it can be used directly from these stockpiles without further processing.

Toledo, Sandusky, and Lorain are served principally from the Vermilion deposits where both concrete sand and mortar sand are available. The sand encountered in the area off Fairport is generally only suitable for mortar work because of fineness; and most of the concrete sand for the eastern Ohio ports is brought from the area off Erie, Pennsylvania.

Due to the vast amount of damage created by erosion along the south shore of Lake Erie, and because of lack of information regarding the occurrence, distribution, and movement of sand on the bottom of the lake, the Governor has placed a ban on dredging activities at Vermilion and Fairport after this year and has limited 1949 production to 175,000 tons in these two areas combined.

Because of the erosion problems and the serious problem of understanding the factors which will influence the future supply of sand to the cities along the south shore of Lake Erie, it is necessary that more basic information about the resources on the Lake Erie bottom be known and it is hoped that the studies now in progress will contribute to the solution of these difficult problems.

REFERENCES

Carney, Frank, The raised beaches of the Berea, Cleveland, and Euclid sheets, (quadrangles), Ohio: Bull. Sci. Lab. Denison Univ. Vol. 14, pp. 262-287, 1909.

Carney, Frank, The abandoned shorelines of the Oberlin quadrangle, Ohio: Bull. Sci. Lab. Denison Univ. Vol. 16, pp. 110-117, 1910.

Carney, Frank, The abandoned shorelines of the Vermilion quadrangle, Ohio: Bull. Sci. Lab. Denison Univ. Vol. 16, pp. 233-241, 1911.

Carney, Frank, Some preglacial lake shoreline of the Bellevue quadrangle, Ohio: Bull. Sci. Lab. Denison Univ. Vol. 17, pp. 231-246, 1913.

Carney, Frank, The abandoned shorelines of the Ashtabula quadrangle, Ohio: Bull. Sci. Lab. Denison Univ. Vol. 18, pp. 362-370, 1916.

Conrey, G. W., Geology of Wayne County: Geol. Survey of Ohio. 4th Ser. Bull. 24, 1921.

Cushing, H. P., Leverett Frank, Van Horn, F. R., Geology and Mineral Resources of the Cleveland District, Ohio: U. S. Geol. Survey Bull. 818, 1931.

Flint, R. F., Glacial geology and the Pleistocene epoch: John Wiley & Sons, New York, 1947.

Hutton, Charles W., Geology of the Conneaut and Ashtabula quadrangles, Ohio: Unpublished thesis, M.A., Ohio State University, 1940.

Leverett, Frank, Glacial formations and drainage features of the Erie and Ohio basins: U. S. Geol. Survey Monograph 41, 1902.

Schaefer, E. J., White, G. W., and Van Tuyl, D. W.: The ground water resources of the vicinity of Canton, Ohio: Ohio Water Resources Board, Bull. 3, 1946.

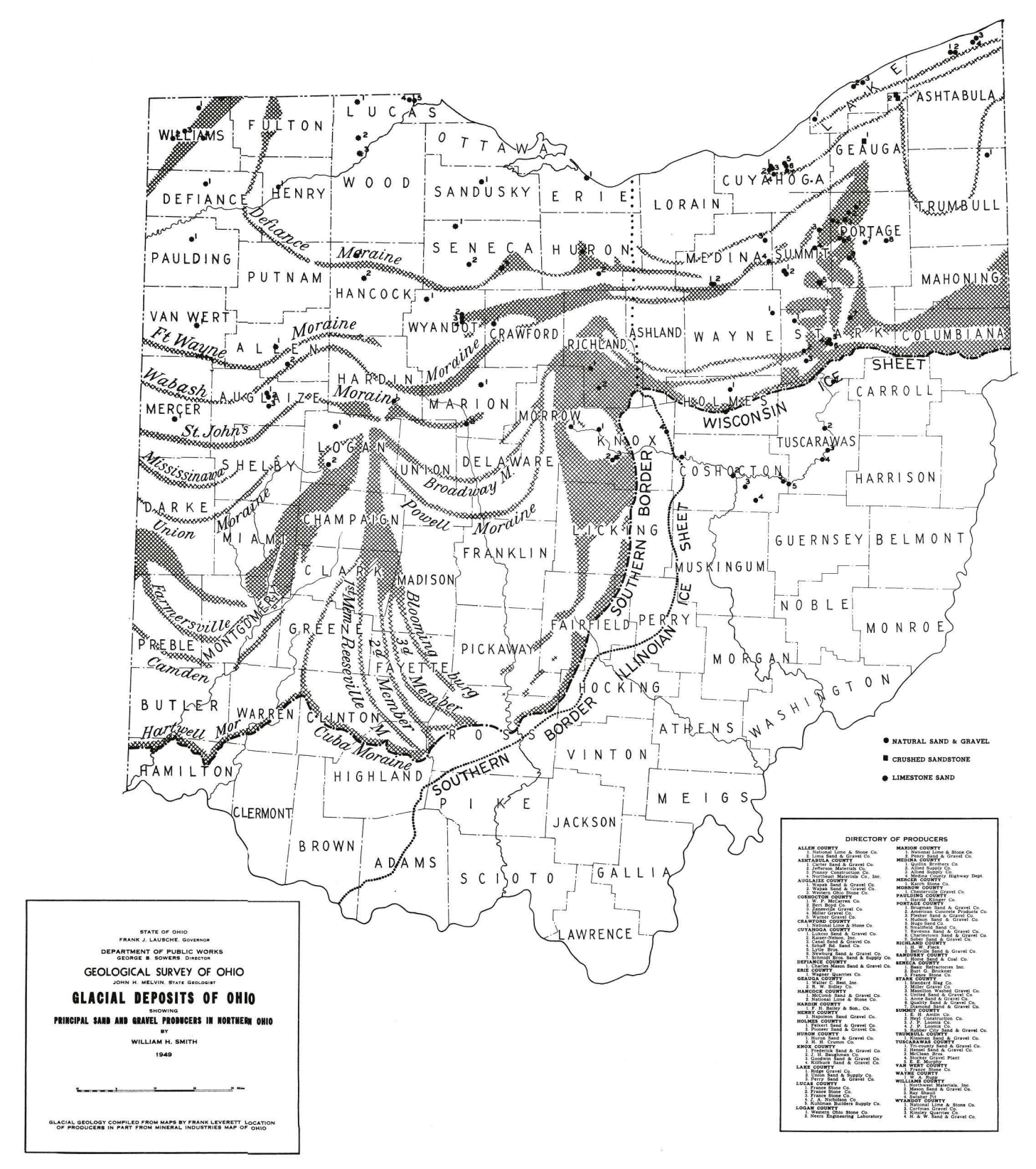
Thoennen, J. R., Industrial Minerals and Rocks; Sand and Gravel, pp. 671-720, published by American Institute of Mining and Metallurgical Engineers, New York, 1937.

Upham, Warren, Preglacial and postglacial valleys of the Cuyahoga and Rocky rivers: Bull. Geol. Soc. Am. Vol. 7, pp. 327-348, 1896.

Upham, Warren, Preglacial gorge in Cleveland, Ohio: Bull. Geol. Soc. Am., Vol. 8, pp. 7-13, 1897.

White, George W., The Pleistocene geology of the region of the reentrant angle in the glacial boundary in north-central Ohio: Unpublished thesis, Ph.D., Ohio State University, 1934.

Whitnall, Harold O., The story of glacial sands and gravels: National Sand and Gravel Association Circular 5, 1930.



STATE OF OHIO
FRANK J. LAUSCHE, GOVERNOR
DEPARTMENT OF PUBLIC WORKS
GEORGE B. SOWERS, DIRECTOR

GEOLOGICAL SURVEY OF OHIO
JOHN H. MELVIN, STATE GEOLOGIST

GLACIAL DEPOSITS OF OHIO

SHOWING
PRINCIPAL SAND AND GRAVEL PRODUCERS IN NORTHERN OHIO

BY
WILLIAM H. SMITH

1949

GLACIAL GEOLOGY COMPILED FROM MAPS BY FRANK LEVERETT. LOCATION OF PRODUCERS IN PART FROM MINERAL INDUSTRIES MAP OF OHIO

DIRECTORY OF PRODUCERS

ALLEN COUNTY
1. National Lime & Stone Co.
2. Neers Engineering Laboratory

ASHTABULA COUNTY
1. Lister Sand & Gravel Co.
2. Jefferson Materials Co.
3. Pinney Construction Co.
4. Morrison Materials Co., Inc.

AUGLAIZE COUNTY
1. Wapak Sand & Gravel Co.
2. Wapak Sand & Gravel Co.
3. Western Ohio Stone Co.

COSHOCTON COUNTY
1. Coshocton Concrete Co.
2. Bert Bond Elev.
3. Zanesville Gravel Co.
4. Miller Gravel Co.
5. Warner Gravel Co.

CRAWFORD COUNTY
1. Nationwide Lime & Stone Co.

CUYAHOGA COUNTY
1. Lukon Sand & Gravel Co.
2. Kaiser-Nelson, Inc.
3. Canal Sand & Gravel Co.
4. Cleveland Rock Co.
5. Lytle Bros.
6. Newburg Sand & Gravel Co.
7. Schmidt Bros. Sand & Supply Co.

DEFIANCE COUNTY
1. Charles Mason Sand & Gravel Co.

ERIE COUNTY
1. Wagner Quarries Co.

GEAUGA COUNTY
1. Walter C. Beil, Inc.
2. R. W. Sidley Co.

HANCOCK COUNTY
1. McCloskey Sand & Gravel Co.
2. National Lime & Stone Co.

HARDIN COUNTY
1. F. H. Bailey & Son., Co.

HENRY COUNTY
1. Napoleon Sand Gravel Co.

HOLMES COUNTY
1. Pioneer Sand & Gravel Co.
2. Pioneer Sand & Gravel Co.

HURON COUNTY
1. Huron Sand & Gravel Co.
2. H. H. Crumm Co.

KNOX COUNTY
1. Fred Sand & Gravel Co.
2. T. H. Baughman Co.
3. Goodwin Sand & Gravel Co.
4. Kilbuck Sand & Gravel Co.

LAKE COUNTY
1. Ridge Gravel Co.
2. Perry Sand & Supply Co.
3. Perry Sand & Gravel Co.

LUCAS COUNTY
1. France Stone Co.
2. France Stone Co.
3. France Stone Co.
4. The Nathanson Co.
5. Kuhlman Builders Supply Co.

LOGAN COUNTY
1. Western Ohio Stone Co.
2. Neers Engineering Laboratory

MARION COUNTY
1. National Lime & Stone Co.
2. Marion Sand & Gravel Co.

MEDINA COUNTY
1. Quality Brothers Co.
2. Allied Supply Co.
3. Allied Supply Co.
4. Medina County Highway Dept.

MERCER COUNTY
1. Karch Stone Co.

MORROW COUNTY
1. Mount Gilead Gravel Co.

PAULDING COUNTY
1. Harold Klinger Co.

PORTAGE COUNTY
1. Brugman Sand & Gravel Co.
2. Portage Concrete Products Co.
3. Pinney Sand & Gravel Co.
4. Hudson Sand & Gravel Co.
5. Hugo Sand Co.
6. Smallfield Sand Co.
7. Kent Sand & Gravel Co.
8. Charlemichael Sand & Gravel Co.
9. Sober Sand & Gravel Co.

RICHLAND COUNTY
1. H. W. Fleck
2. Mansfield Sand & Gravel Co.

SANDUSKY COUNTY
1. Howe Sand & Coal Co.

SENECA COUNTY
1. Basic Refractories Inc.
2. Pyle Stone Co.
3. Pyle Stone Co.

STARK COUNTY
1. Standard Slag Co.
2. Miller Gravel Co.
3. Miller Sand & Gravel Co.
4. United Sand & Gravel Co.
5. Anne Sand & Gravel Co.
6. Quality Sand & Gravel Co.
7. Diamond Sand & Gravel Co.

SUMMIT COUNTY
1. E. B. Austin Co.
2. Heyl Construction Co.
3. J. P. Loomis Co.
4. J. P. Loomis Co.
5. Kuhlman Sand & Gravel Co.

TRUMBULL COUNTY
1. Klaasman Sand & Gravel Co.

TUSCARAWAS COUNTY
1. Tri-county Sand & Gravel Co.
2. Warner Sand & Gravel Co.
3. McClean Bros.
4. Stockey Gravel Plant
5. E. E. Murphy

VAN WERT COUNTY
1. Van Wert Stone Co.

WAYNE COUNTY
1. H. A. Rupp

WILLIAMS COUNTY
1. Ammann Materials, Inc.
2. Mason Sand & Gravel Co.
3. Ray Shaull
4. Swisher Pit

WYANDOT COUNTY
1. Nationwide Lime & Stone Co.
2. Corfman Gravel Co.
3. Kinsley Quarries Co.
4. H. & W. Sand & Gravel Co.