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**Appendix D**  
**“Waterway and Flood-Control Activity”**  
*The Military Engineer*

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# Waterway and Flood-Control Activity

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RECENT years have witnessed a tremendous increase in river and harbor and flood-control activity throughout our country. A review thereof will show not only to what great extent the Federal Government, through the Corps of Engineers and the Engineer Department, has assisted in relief to unemployment during the present depression, but also the economies that have been achieved and the progress that has been made in these public improvements.

In the years just prior to 1928, the annual appropriations for maintenance and improvement of river and harbor works had ranged generally from \$40,000,000 to \$50,000,000 per year. Operating and

\$7,500,000 to \$8,000,000 per year. Flood-control appropriations have jumped to between \$30,000,000 and \$35,000,000 per year for Mississippi River and tributaries and \$1,000,000 per year for Sacramento River, these resulting from the flood-control projects adopted by the Act approved May 15, 1928. Mississippi River flood control has similarly benefited by emergency appropriations for the relief of unemployment, having received \$3,000,000 in the Emergency Act of December, 1930, and \$15,500,000 in the recent Emergency Relief and Construction Act of July 21, 1932. In the past 5 years, total appropriations for river and harbor and flood-control activities were about \$100,000,000 to \$150,000,000 per year.

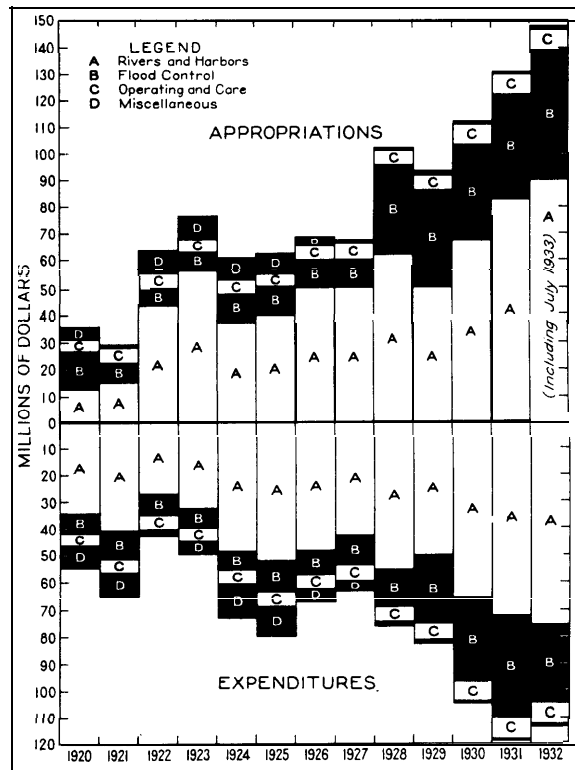
The increased appropriations during this critical period have helped the country in many ways.

### Relief to Unemployment

In the first place, they have provided a vast amount of employment during a most critical period in the construction industry, when private work had been markedly decreased. It is difficult, however, to determine accurately the amount of additional employment so afforded. Some of the jobs were of short duration, while others extended through the year or longer. In general, for the same expenditure, a larger number of men are provided employment on a greater number of short jobs rather than on a few long jobs, even though the total man-days of labor may be the same.

Some jobs employed directly a much greater number of men per \$1,000 expended than did others. The difference between the direct employment on two jobs costing the same total is, however, no measure of the relative employment provided. The job where a large portion of the money went toward the purchase of cement, steel, and such may have been even more efficient than otherwise by providing relief to unemployment in the industrial centers where these basic products are produced and where conditions may have been even more critical than at the site of construction. The portion of each construction dollar applied to the purchase of materials therefore served equally as well as that paid to the labor employed directly on the job.

Figures kept on a great number of river and harbor and flood-control jobs giving the ratio of one man-year of direct employment per dollar expended ranged generally from \$2,000 to \$6,000, with a scattering above and below these sums in some jobs. It is believed that on a conservative basis about one man-year of direct employment can be provided for \$4,000 of river and harbor expenditure and for \$3,500 of flood-control expenditure, assuming the usual cross-section of such work, including lock and dam construction, dredging, jetties and breakwaters, dikes, revetments, and levee construction. It is also conservatively estimated that at least one man is employed indirectly for every man directly employed. Based on these assumptions and taking into consideration that much of the work is seasonal in char-



Rivers and Harbors and Flood Control Appropriations and Expenditures, 1920-1932

care of completed locks and dams averaged about \$5,000,000. Appropriations for flood control were about \$10,000,000 per year.

In recent years, particularly since the authorization of the Mississippi River Flood Control Project in 1928 and during the present emergency, the picture has completely changed. Appropriations for maintenance and improvement of rivers and harbors have ranged about \$60,000,000 per year with additional emergency appropriations since 1930 of \$12,000,000, \$22,500,000, and \$30,000,000. Operation and care of completed locks and dams now cost about

acter and does not extend throughout the year, it is estimated that the Federal Government, through the Corps of Engineers, has provided employment, direct and indirect, to from 75,000 to 100,000 men per year, during the present emergency.

The provision for a 30-hour week for work being prosecuted under the \$30,000,000 appropriation for rivers and harbors under the Emergency Relief and Construction Act of 1932 will materially increase the total direct employment for the money expended, as it will require, in direct labor, 1.6 men per week for each man on the present 48-hour week.

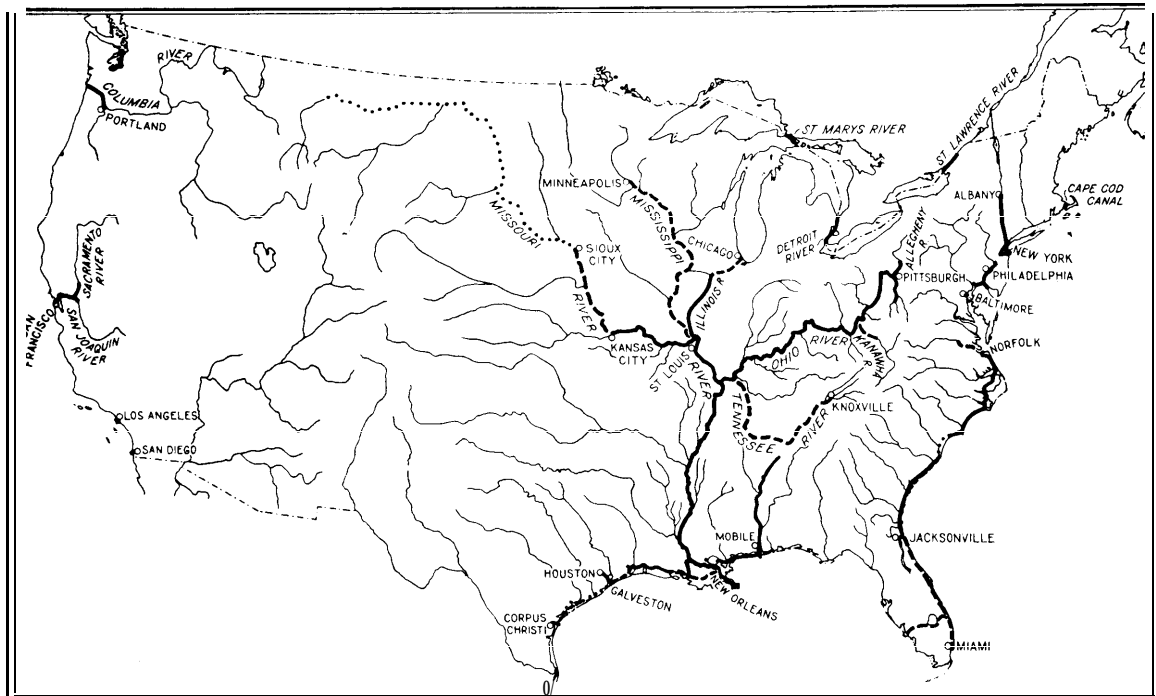
**Economies Effected**

In addition to providing relief to unemployment at a critical period when such relief has been of material assistance, the expanded program of activity has achieved material economies to the government by the prosecution, during a period of low prices, of authorized work, which, it has been previously determined, will effect savings in excess of their costs and which must some day be done anyway. To defer them to a period of high industrial activity would require a much greater total expenditure by reason of higher costs, put the government into competition with private industry in seeking construction forces and plant at a time when these are otherwise engaged on private work, and defer the anticipated savings accruing from projects which have previously been determined to be economic even on a higher normal cost basis.

By reason of the surplus of plant, labor, and materials now available, work can be done currently at prices much lower than any attained in recent years of industrial activity. This is illustrated by the following extreme examples, in which bids, materially

below the engineering estimate, have been received. Figures are round numbers in units of \$1,000.

Item	Estimated Cost	Low Bid
<b>Atlantic Coast:</b>		
Dredging Miami River, Fla.....	1,058	517
Construction of jetty, East Rockway Inlet .....	488	312
<b>St. Lawrence River:</b>		
Dredging, Ogdensburg to Lake Ontario	550	321
<b>Great Lakes:</b>		
Dredging Oswego Harbor.....	575	270
Dredging (rock removal) Livingstone Channel, Detroit River.....	6,097	3,426
Dredging, Lake Nicolet, St. Marys River	630	318
Dredging, West Neebish Channel, St. Marys River .....	1,200	790
Dredging, Vidal Shoals, St. Marys River	600	322
Dredging, Vidal Shoals, St. Marys River	1,100	595
<b>Illinois Waterway:</b>		
Dredging, Marseilles Pool.....	1,395	886
Dredging, Dresden Island Pool.....	752	536
Dredging, Starved Rock Pool.....	701	380
Construction, Marseilles Dam.....	860	497
<b>Ohio River System:</b>		
Construction of Locks, Montgomery Island, Ohio River.....	3,065	1,554
Construction, Lock A, Marmet, Kanawha River .....	1,285	800
<b>Upper Mississippi River:</b>		
Lock in Twin City Dam, Minneapolis..	950	684
<b>Mississippi River Flood Control:</b>		
Levee, East Atchafalaya Basin.....	336	232
Levee, West Atchafalaya Basin.....	444	304
Levee, Lower Tensas Levee District...	1,467	1,139
Levee, White River District.....	951	781
Levee, White River District.....	475	326
<b>Gulf Coast:</b>		
Dredging, Houston Ship Channel....	800	427
Louisiana-Texas Intracoastal Waterway	1,100	394



Location of Important Waterway Projects

Material benefits will accrue to the Federal Government and to our industries, consumers, and taxpayers as a result of these savings. These Federal improvements will show even greater dividends than were anticipated when they were originally authorized as economic improvements, even under the higher unit costs then estimated. The savings achieved on individual projects have been applied to the prosecution of other authorized works not otherwise possible of execution at this time with the funds available, thereby resulting in additional employment and economies. The nation has been benefited by the provision of low-cost water-transportation facilities earlier than could normally have been anticipated. The protection afforded those affected by the flood-control projects is being advanced with resultant decrease in flood losses. Finally, the total bill for all these improvements will be less to the taxpayer than originally authorized and expected.

It is of interest here to note the progress made on the major projects.

#### Atlantic Coast

As we come down the Atlantic coast, the first large project we encounter on which there has been major activity in the past few years is the Cape Cod Canal, which was purchased by the Federal Government in 1928 at a cost of \$11,500,000 and which has been maintained since as a free waterway. Tonnage has jumped from less than 1,000,000 tons to about 2,500,000 tons annually, valued at close to \$150,000,000. Plans have been prepared and recommended to Congress for deepening and widening the channel and approaches, including the provision of a tidal lock 110 feet by 1,000 feet, which with improved highway and railroad crossings, is estimated to cost \$23,250,000, to provide a safe waterway 30 feet deep for ocean shipping.

As we approach New York Harbor we find a recently completed 30-foot channel through Staten Island Sound, a deepened 30-foot channel in Newark Bay, extension of a similar channel in Jamaica Bay, a jetty at Rockaway Point nearing completion, and one at East Rockaway Inlet under construction. The major channels of New York Harbor, including the Anchorage channel, Bay Ridge and Red Hook Channels, the Hudson River, all 40 feet, and the rock-bottomed channel of the East River, 35 feet, have recently been deepened, widened, and extended. Work is about to commence on the 40-foot Buttermilk Channel project. These improvements have been pushed to take care of the large and valuable commerce of this port, which, during the past two years, has ranged between 106,000,000 and 120,000,000 tons, valued at approximately \$10,000,000,000.

Extending north from New York we see the 27-foot channel project to Albany now practically completed, providing deep-draft ocean navigation to this new interior port. Commerce is growing rapidly, having reached 3,500,000 tons valued at \$160,000,000 over the past year.

Further south, we find another major port, Philadelphia, on which the annual commerce ranges from 37,000,000 to 41,000,000 tons valued at \$936,000,000 to \$1,700,000,000. Here the Corps of Engineers has about completed and is actively maintaining the 35-foot channel in the Delaware River from the sea to Philadelphia, over a distance of 63 miles, and has

extended a 20-foot channel to Trenton, New Jersey, 30.5 miles upstream.

On Chesapeake Bay are located two other large ports, Norfolk and Baltimore, on which major activity has been carried on during this period. Forty-foot channels of ample width have been provided in the entrance channel and at Thimble Shoals to Norfolk and Newport News, with adequate interior channels of 12- to 35-foot depth, to take care of the large and valuable commerce of this port, totalling 30,000,000 tons, valued at over \$1,250,000,000. The main channel to Baltimore has been deepened to 37 feet over part of its width up to Sparrows Point and to 35 feet above. The remainder of the 37-foot channel has been advertised for contract so that Baltimore's heavy commerce, aggregating about 15,000,000 tons, valued at over \$500,000,000, will be well cared for.

One of the largest projects on the Atlantic coast, in addition to these important harbors, is the inland waterway paralleling the coast. Cape Cod Canal and Long Island Sound provide a sheltered reach in the New England Area. A survey is actively under way for a canal across the state of New Jersey, to connect the Raritan and Delaware Rivers. The Chesapeake and Delaware Canal, the connecting link between the Delaware and Chesapeake Bay, has recently been completed to a 12-foot depth. At the mouth of Chesapeake Bay, the Norfolk-Beaufort section of the Intracoastal Waterway, including a large tidal lock in the Albemarle and Chesapeake Canal, has been completed, also providing a 12-foot depth. The section from Beaufort to Cape Fear River has been recently completed to 12-foot depth, excepting certain small rock areas of 9-foot depth. The link from Cape Fear River to Winyah Bay has been completed in part, and work on the uncompleted section is being advertised. The section from Winyah Bay, thence south to Saint Johns River, Florida, has been completed, providing depths of from 4 to 7 feet. Extensive work is under way on the reach from Jacksonville to Miami, where the project depth is 8 feet. The entire reach has been restored to the original depth of 5 feet, in this, the old Florida East Coast Canal, which was transferred to the Federal Government in 1929. The new project depth of 8 feet has been secured over 190 miles. Extension of the waterway south to Florida Bay has been recommended to Congress. A major project for navigation and flood control on the Caloosahatchee River and Lake Okeechobee drainage areas estimated to cost over \$9,000,000, which will provide a light-draft waterway across Florida and flood protection to the Okeechobee Drainage Area, was adopted in 1930, and work thereon is actively under way.

A very extensive survey is actively in progress for a ship and barge canal across the Florida Peninsula. It is hoped that this survey will be completed by next year, and report thereon submitted to Congress at that time.

#### Gulf Coast

The important harbors of our Gulf coast, including Mobile, New Orleans, Sabine-Neches Waterway, Galveston, Houston, and Corpus Christi, have been improved and maintained. At Mobile, the new 32-foot project is well advanced, and all the work thereunder will shortly be under contract. The Passes of the Mississippi River, providing 30- and 35-foot

channels to New Orleans and Baton Rouge, have been actively maintained to handle the commerce of 14,000,000 tons, valued at \$500,000,000, which is now passing through these channels. The Sabine-Neches Waterway, providing 25-, 30-, and 33-foot depths, is practically completed and the 32-foot project to Galveston is nearly so. Widening of the 30-foot channel to Houston has been pushed and the Aransas Pass-Corpus Christi 30-foot channel was completed last year.

The Intracoastal Waterway skirting the Gulf coast has witnessed great activity over the past few years. The eastern portion of the section between Pensacola Bay and Mobile Bay has been completed to a depth of 9 feet, and the western portion is under contract. The 9-foot section between Mobile Bay and New Orleans has been completed. There has been a great amount of dredging activity on the section extending from New Orleans to Galveston, the work west of Galveston being dependent on fulfillment of conditions of cooperation requiring local interests to furnish rights of way. Construction of the Harvey Lock at the eastern terminus connecting with the Mississippi River is well advanced.

In every respect, the past three or four years have witnessed the greatest advance of any comparable period in the improvement of our Atlantic Coast and Gulf Coast waterways.

#### Pacific Coast

Maintenance and improvement of the major harbors on the Pacific coast has been most active in recent years. The project for San Francisco harbor has been enlarged to provide for an entrance channel of 45 feet in depth. At San Diego harbor, the depth has been increased to 40 feet, and work is actively under way on the enlargement of the channel facilities within the harbor. At Los Angeles and Long Beach harbors, California, construction of an outer breakwater 12,500 feet in length and estimated to cost in excess of \$7,000,000 has been begun to provide additional shelter to this important harbor. The 26-foot channel in the San Joaquin River to Stockton is nearing completion. At Crescent City harbor, California, a rubble mound breakwater 3,000 feet long has been constructed. At Richmond harbor, a channel 30 feet deep and a training wall for the protection of the harbor have been completed. Construction of the rubble mound breakwater 1,300 feet long at Monterey harbor is well advanced. In the Columbia and Lower Willamette Rivers, through which important commerce totalling 7,000,000 tons of ocean traffic valued at over \$300,000,000, in addition to an equal tonnage of inland river traffic valued at about \$60,000,000, is carried, the channel has been deepened to 35 feet up to Portland, and major repairs in the raising and strengthening of the south jetty at an estimated cost of about \$3,000,000 are under way.

#### Great Lakes

The major project in connection with the improvement of Great Lakes waterways has been that for deepening the downbound connecting channels to secure channels suitable for vessels of 24-foot draft, at an estimated cost approaching \$30,000,000. The Great Lakes system is by far the major inland-waterway development of our country, with a commerce

averaging annually for the past 10 years over 125,000,000 tons, valued at close to \$2,000,000,000, and effecting transportation savings of hundreds of millions of dollars per year. Its improvement to provide a draft of 24 feet for the heavy laden ore carriers will effect large additional savings to our important steel industry. Work on this project is well advanced. On St. Mary's River, the project is practically completed and the work remaining to be done is under contract. Work has recently been started on the St. Clair River. Work on the Detroit River is actively under way, a contract having recently been let for deepening the rock bottom of Livingstone Channel, upon which a most favorable price, \$2,500,000 below the estimate, was secured.

Our major lake ports have been actively maintained and many of them have been deepened and enlarged. Surveys have recently been made of all the large harbors with a view to their deepening to the extent required for the increased draft to be made available in the downbound connecting channels. New breakwaters have been completed, or nearly so, at Oswego, New York; Fairport, Ohio; Muskegon and Frankfort, Michigan; and Milwaukee, Wisconsin.

An important event materially affecting the Great Lakes system was the signing on July 18, 1932, of a treaty by representatives of the Canadian and American Governments for the construction of the Great Lakes-St. Lawrence Deep Waterway, based on the final report of April 9, 1932, of the Joint Board of Engineers. Subject to ratification of the treaty by the legislative branches of both governments and subsequent appropriation of funds, work will then be prosecuted for a joint navigation and power project, providing a channel 27 feet in depth in the St. Lawrence River to the Lakes. A section of this waterway was authorized in the river and harbor act of 1930, to provide a 27-foot depth between Ogdensburg and Lake Ontario, and work thereon has been actively under way and is expected to be completed this year.

#### Inland Waterways

The past three or four years have witnessed a remarkable advance in the improvement of our interior waterways. A connection between the Mississippi River System and the Great Lakes was authorized in 1930, at a cost of \$7,500,000, by the extension of the 9-foot project on the Illinois River to include completion of the Illinois State Waterway, then under construction by the State of Illinois. The former Federal project to provide a 9-foot channel up to Utica, 230 miles above the mouth, has been practically completed, and the work on the completion of the five locks and dams in the Illinois Waterway section is well advanced, being scheduled for completion this coming spring. Through navigation between the Great Lakes and the Mississippi River system will shortly be dependent only upon the alteration by the state of Illinois of the bridges crossing the waterway, the alterations of which are also in progress.

#### Upper Mississippi River

The 9-foot project for the Upper Mississippi River from the mouth of the Illinois River to Minneapolis, at an estimated cost of \$124,000,000, by the canaliza-

tion of this river, was authorized in 1930. Work on this project has been actively under way. New locks have been constructed at the Twin City Dam, a lock and dam have been completed at Hastings, Locks Numbers 4, 5, and 20, located at Alma, Wisconsin, Fountain City, Wisconsin, and Canton, Missouri, respectively, are being advertised, and the construction of new locks and a dam at Rock Island is well advanced.

#### Ohio River

In October, 1929, the completion of the canalization of the Ohio River providing a 9-foot depth from Pittsburgh to the Mississippi, over a distance of 981 miles, at a cost approaching \$118,000,000, was formally celebrated. This river is now carrying a commerce ranging from 18,000,000 to 22,000,000 tons, valued at close to \$200,000,000.

A number of feeders to the Ohio River have also been the scene of great construction activity. On the Allegheny, locks and dams Numbers 4, 5, 6, 7, and 8, extending navigation of 9-foot depth up to Rimerton, Pennsylvania, at Mile 61 have been completed. New locks at 2 and 3, with a new dam at 3 have also been advertised. On the Monongahela River, the lock at Dam Number 4 has been replaced by a new structure, of large capacity adequate to handle the heavy and valuable commerce, totalling 25,000,000 to 30,000,000 tons, valued at \$150,000,000 to \$175,000,000, passing over this important stream, which, through provision of low-cost water transportation for coal and other basic materials used in steel, is one of the major factors in the Pittsburgh steel industry.

On the Kanawha River, another important feeder of the Ohio, construction of new locks and dams at London and Marmet is under way, to replace the old and inadequate locks and dams Numbers 2 to 5, inclusive.

A major project for improvement on the Tennessee River at an estimated cost of \$75,000,000 to provide 9-foot navigation, over a distance of 652 miles to Knoxville, was adopted in 1930, and work on the first of these structures, the lock at Dam Number 3, has just been advertised. This project is a joint power and navigation project authorizing the Federal Government to contribute to the cost of any high dam constructed as a power development the estimated cost of the navigation structures replaced. For this reason, the construction of low dams at locations where power development appears feasible under the terms of the authorization, has been deferred pending receipt of applications under the Federal Water Power Act, for such power development.

#### Missouri River

The project for 6-foot navigation on the Missouri River from its mouth to Sioux City has been actively pushed. Contraction and stabilization works on the Missouri up to Kansas City are practically completed, and a 6-foot navigable depth over this reach will be available shortly. The reach above Kansas City to St. Joseph is the scene of present major activity. It is expected that, with the completion of the work now under contract, this reach will be about 85 per cent completed. As an index of the recent activity on the Missouri River, it should be noted that, of the \$75,000,000 expended on the Mis-

souri River project to Sioux City, two-thirds have been expended during the past 4 years. The work is therefore obviously being rapidly advanced.

#### Flood Control

The two important projects for flood control committed to the Engineer Department are those on the Sacramento River, California, and on the Mississippi River and tributaries. The present projects for both of these streams were authorized in the flood-control act approved May 15, 1928, and work has been carried on as fast as funds were made available.

The flood-control project for the Sacramento River is estimated to cost the Federal Government \$17,600,000, including the refund to the State of California of the amount previously expended thereon by the state. This project provides for the enlargement of the river channel, for the construction of two cut-offs, and for the construction of auxiliary flood ways including necessary weirs and levees. Work thereon is being actively prosecuted with funds appropriated at the rate of \$1,000,000 annually.

#### Mississippi River and Tributaries

The project for flood control on the Mississippi River and tributaries is the major single project of the Department. Its authorized cost is \$325,000,000. Its principal features consist of raising and strengthening the main river levees below Cape Girardeau, Missouri, construction of a set-back levee in the vicinity of New Madrid to provide additional channel capacity during periods of flood, the raising and strengthening of levees on the south bank of the Arkansas and Red Rivers, the construction of protection levees through the natural overflow areas in the Boeuf and Atchafalaya basins in order to limit the area heretofore subjected to overflow in extreme high waters, and the construction of a spillway located just above New Orleans bypassing water into Lake Pontchartrain. Work on this project has been prosecuted at a high rate. The New Madrid Floodway and Bonnet Carré Spillway are about completed. On September 1, 1932, over 250,000,000 cubic yards of levee had been completed under the main river project, and an additional 15,000,000 cubic yards on tributaries and above Cape Girardeau. During the month of August alone, over 17,500,000 cubic yards of earthwork was placed in the levees. In this connection it is interesting to note that the total excavation by the French, useful in the construction of the Panama Canal, was less than 30,000,000 cubic yards and the total of the United States to the end of the past fiscal year, about 370,000,000 cubic yards in the construction and maintenance of the canal. Dirt is being moved on the Mississippi River at a rate never previously attained.

By every measure, in so far as river and harbor and flood control improvements are concerned, the past 4 years have loomed far and large as the greatest in our national history in new projects authorized, in total appropriations and expenditures made, in relief to unemployment and industry during a critical period, and in results achieved in advancement of our national program to provide coordinated systems of low cost waterway transportation and relief from national flood damage. The vast army of workers who have been engaged on this program have reason to feel a pride in their accomplishments.

