

PART I
GENERAL DISCUSSION

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Introduction.—Each summary table for the United States is preceded by a discussion of the statistics there shown, but a further discussion will serve to present some facts more clearly and emphasize important comparisons. Most of the data presented in the summary tables for the United States are also shown by geographic divisions and States so that comparisons between divisions and States can be easily made.

Drainage on farms.—State Table XI, page 46, shows the number of farms reporting drainage and the acreage provided with drainage, by geographic divisions and States. This land may be either within or without an organized drainage enterprise. The land within a drainage enterprise may be drained either entirely by the works of the enterprise or by these works supplemented by ditches or tile constructed by the farm owners. The works reported by an enterprise, however, do not include supplemental drains constructed by the farm owner. No attempt was made to determine the sizes or types of drains which the owners installed, but generally the farm drains consisted of small ditches and tile. These doubtless were meandered lines draining the low swales in the fields. The acreage drained in a particular farm is largely a matter of opinion of the owner or tenant as to the area actually benefited. Both the number of farms reporting drainage and the acreage drained are doubtless too low, due to the fact that some enumerators failed to secure answers to the farm drainage questions on the general farm schedule.

The statistics on State Table XI, relative to all farms, all land in farms, crop land, and woodland, were taken from the general farm schedule; and are also published in Volume II, Agriculture, 1930. The questions concerning these items were consistently answered and the data shown are substantially accurate.

Land and area in drainage enterprises.—Land, area, and number of drainage enterprises are shown by size and by geographic divisions and States in State Table II, page 28. As stated in the section on definitions and explanation of terms, the land in drainage enterprises is the acreage covered by enterprises, regardless of the number of projects in which the acreage may have been included.

The area of drainage enterprises in a State or county is the sum of the areas of all individual enterprises. The difference between this sum and the land actually covered within a State, or county, is the total overlap. It therefore follows that where no land is covered by more than one enterprise, the area of enterprises and the land in enterprises are the same. In some counties, particularly in the States of Ohio, Indiana, and Michigan, the same land has been covered several times, due to the fact that much repair, enlargement, and extension work was done by forming new enterprises and apportioning the costs as though they were original

projects. Overlapping from this source is confined almost entirely to the States in which enterprises are largely under the control of county officials. However, in States in which the enterprises are drainage districts under their own officials, some overlapping is due to the formation of subdistricts to provide for more intensive drainage or of outlet districts formed primarily to enlarge or improve the joint outlets of several original districts.

More than any other single factor this overlapping has complicated the problem of presenting the drainage statistics in an entirely satisfactory manner. However, overlapping was found principally in certain counties of Ohio, Indiana, and Michigan. In Ohio, the area of drainage enterprises was nearly three times as great as the land in enterprises; for Indiana, this ratio of area to land was 2.26; and for Michigan, 1.64.

The 67,927 organized drainage enterprises cover 84,408,093 acres of land. Of this total, 39.7 per cent is in the East North Central States; 28.1 per cent, in the West North Central States; 8.2 per cent, in the South Atlantic States; 5 per cent, in the East South Central States; 13.4 per cent, in the West South Central States; 2.3 per cent, in the Mountain States; and 3.3 per cent, in the Pacific States. The 4 States having the largest amount of land in enterprises are, first, Minnesota, with 11,474,683 acres; second, Indiana, with 10,214,014 acres; third, Michigan, with 9,180,851 acres; and fourth, Ohio, with 8,165,494 acres.

The average area of enterprises of the 35 drainage States is 1,892 acres; of the East North Central States, 1,196 acres; of the West North Central States, 3,863 acres; of the South Atlantic States, 22,682 acres; of the East South Central States, 5,840 acres; of the West South Central States, 10,971 acres; of the Mountain States, 9,051 acres; and of the Pacific States, 7,533 acres. The high average for the South Atlantic States is due largely to the Everglades Drainage District. If the unreclaimed part of this district were excluded, leaving only the subdistricts within that area, the average for the South Atlantic States would be 14,710 acres.

By far the greater proportion of small enterprises is in the East North Central States. Out of a total of 6,077 enterprises of less than 100 acres, 5,859, or 96.4 per cent, are in this division, and out of a total of 7,099 enterprises of 100 to 199 acres, 6,704, or 94.4 per cent, are also in this division.

Table 4 of the summary, on page 20, shows 71.4 per cent of the 84,408,093 acres in enterprises as in projects drained by ditches and levees; 9.9 per cent is in projects drained by tile only; 14.4 per cent is in projects drained by ditches, tile drains, and levees; while the remainder is in enterprises served entirely or partly by pumps. It should here be noted that a considerable amount of tile drains is installed by individual farmers or land-owners and that only drains installed by or belonging to

the enterprises were reported on the drainage schedule. For this reason, land shown as drained by ditches only may also have privately installed tile drains.

Enterprises reporting either all or part of their acreage as served by pumps covered 3,642,495 acres or 4.3 per cent of the total land in organized projects. Of this amount, 2,174,803 acres, or 2.6 per cent of all land in enterprises, were reported as served by pumps on January 1, 1930, while the remaining 1,467,692 acres were provided with gravity drainage only. There were 1,608,433 acres in enterprises served entirely by pumps and 566,370 acres served by pumps in enterprises reporting both gravity and pump drainage. State Table III, page 33, shows land served by type of drainage according to States and State Table VII, page 41, shows the acreage served by pumps in each geographic division and State.

Nearly half of the total area served by pumps is in enterprises in California, most of which are located in the Great Valley of the San Joaquin and Sacramento Rivers. Illinois has the second largest acreage served by pumps.

The land in enterprises according to completion of works is classified by geographic divisions and States in State Table VIII, page 42. Almost 97 per cent of the acreage is in enterprises with completed works. Many of these enterprises later may extend or improve their drainage systems, but on the drainage census date such work was not officially authorized or under construction. Enterprises reporting works under construction included both new enterprises constructing their original works and old enterprises extending or improving works previously constructed. The census of 1920 showed a much larger acreage in enterprises under construction than did the census of 1930. The abnormal prices following the World War resulted in the organization of a large number of drainage enterprises, many of which were under construction on January 1, 1920. The subsequent fall in the values of agricultural land and products left many of these projects with a large amount of unimproved land.

Character of enterprises.—All drainage enterprises have been classified according to their type of organization and the results are shown in Table 3, page 20, of the summary. The earliest ditches were dug by individual owners in an effort to drain their lands, but in many cases it became evident that satisfactory results could be secured only by extending the outlets through adjoining lands. Such outlet ditches were often more expensive than a single owner could afford. These considerations gradually led the great majority of the States to adopt comprehensive drainage laws so that a large number of landowners could drain their land cooperatively and distribute the cost in proportion to benefits. All State drainage laws are based on the general principle of public welfare such as the improvement of public health, the improvement of public roads, and the increase in the taxable wealth of the State. A general discussion of drainage laws and a summary for each of the 35 drainage States are given in the special section on laws on page 355 of this volume. The drainage enterprises fall into two general classes, corporate enterprises under the control of their own officers selected either by the landowners or appointed by public authority, and public enterprises, such as State, county, and township drains, which in common with others of their type are under the control of public officials. The classi-

fication of land in enterprises according to the several types of organization is shown for each of the 35 drainage States in State Table 3 of each State.

Drainage districts include all drainage enterprises having executive officers exclusively their own, chosen according to the State drainage laws. Districts organized under special State laws have been included with those organized under the general State drainage laws. As shown in Table 3, page 20, 32,544,972 acres, or 38.6 per cent of all land in enterprises, are covered by drainage districts. The following amounts and proportions of the land in enterprises of each geographic division are included in drainage districts: South Atlantic, 6,770,776 acres, or 97.5 per cent; West South Central, 10,558,534 acres, or 93.1 per cent; East South Central, 3,553,496 acres, or 85.2 per cent; Pacific, 1,457,121 acres, or 51.8 per cent; Mountain, 811,151 acres, or 41.2 per cent; East North Central, 5,507,762 acres, or 16.5 per cent; and West North Central, 3,886,132 acres, or 16.4 per cent.

The above geographic divisions are arranged according to the proportion of their lands in enterprises included in drainage districts. It is evident that this type of organization predominates in the South Atlantic, West South Central, East South Central, and Pacific divisions. Probably the district type of organization is best adapted to the larger enterprises requiring a long period of years for repayment of the construction loans. As these projects are under the control of their own officers, complicated drainage problems can be more readily handled than would be the case if, in common with others, they were under the control of public officers.

County drains include all enterprises which are under the control of county officials. Of all land in enterprises of the 35 drainage States, 47,547,137 acres, or 56.3 per cent, are covered by county drains. The following amounts and proportions of the land in enterprises of each geographic division are included in such projects: East North Central, 27,783,720 acres, or 83 per cent; West North Central, 18,883,941 acres, or 79.7 per cent; East South Central, 582,125 acres, or 14 per cent; Pacific, 106,462 acres, or 3.8 per cent; West South Central, 170,248 acres, or 1.5 per cent; and South Atlantic, 20,641 acres, or 0.3 per cent. No county drains were reported in the Mountain division. It is thus evident that the county drain type of enterprise predominates in the East North Central and the West North Central divisions. Generally speaking, this type of organization seems most adaptable to enterprises of rather small size, having simple drainage problems and is most common in the older States which first began organized drainage.

Township drains comprise those enterprises which are under the control of township officials. Only 193,929 acres, or 0.2 per cent of the land in enterprises of the 35 drainage States, are covered by such projects. The acreage and proportion of the land in township drains for each geographic division are as follows: East North Central, 134,984 acres, or 0.4 per cent; West South Central, 48,225 acres, or 0.4 per cent; and West North Central, 10,720 acres, or less than one-tenth of 1 per cent. The remaining divisions reported no land in this type of enterprise.

Township drains are almost exclusively confined to small enterprises with simple drainage problems. The largest acreage in such enterprises was reported from

Illinois, but the proportion there was only 2.2 per cent of the land in enterprises.

State projects include those enterprises which are under the exclusive control of State officials. Of all land in enterprises of the 35 drainage States, only 608,309 acres, or 0.7 per cent, are covered by such projects. The West North Central States reported a total of 606,173 acres, or 2.6 per cent of its land in enterprises, as in State projects. This acreage is located entirely in northern Minnesota. The East North Central States have 600 acres; the East South Central, 560 acres; and the Pacific, 976 acres. In each of these three divisions the land in State projects is less than one-tenth of 1 per cent of the land in drainage enterprises.

Irrigation enterprises comprise those drainage projects which are under the control of the officers of an irrigation organization. Such enterprises are coextensive in area with the irrigation project and the drainage and irrigation operations are functions of the same enterprise. Much of the drainage of irrigated lands in the West is done by separate drainage districts rather than directly by irrigation enterprises.

Although it is not possible to give the exact acreage in drainage enterprises located on the irrigated lands of the arid West, an estimate made from the drainage schedules is 4,500,000 acres. Of this amount, 2,644,674 acres, or 3.1 per cent of all land in enterprises, are included in irrigation enterprises as defined above, but approximately 1,037,000 acres of this land are not yet served by drainage works. Much of this land, however, will ultimately be served if damage from seepage and alkali makes it necessary.

The following acreage and proportion of the land in enterprises of each geographic division are located in irrigation enterprises: Mountain, 1,120,118 acres, or 56.9 per cent; Pacific, 1,177,303 acres, or 41.8 per cent; West North Central, 259,974 acres, or 1.1 per cent; and West South Central, 87,279 acres, or 0.8 per cent.

When drainage is done directly by the irrigation enterprise, all the irrigable land, including that not yet drained, is usually assessed for the drainage works. The reason for assessing all irrigable lands is doubtless based on the assumption that the remaining lands will either finally be drained or be indirectly benefited by the drainage of the damaged portion. A further discussion of the drainage of irrigated land is contained in the irrigation volume of the Fifteenth Census reports.

Commercial developments include all drainage enterprises under the control of individuals or organizations engaged in the draining of land for purposes of development, subdivision, and sale. Of all land in enterprises of the 35 drainage States, 72,457 acres, or 0.1 per cent, are included in such developments. The following acreage and proportion of the land in each geographic division are located in commercial developments: South Atlantic, 40,927 acres, or 0.6 per cent; Mountain, 9,100 acres, or 0.4 per cent; West South Central, 8,710 acres, or 0.1 per cent; and Pacific, 2,550 acres, or 0.1 per cent. Of the remaining portion, the West North Central division contains 8,270 acres, and the East North Central, 2,900 acres, but each amount is less than one-tenth of 1 per cent of the land in its respective division.

Individually owned projects include all drainage enterprises without legal organization, as such, belonging to individuals, partnerships, or agricultural companies.

Projects of this type are included only when the area drained is 500 acres or more.

Of all land in enterprises of the 35 drainage States, 782,423 acres, or 0.9 per cent, are in projects of this type, and the following amounts and proportions of the land in enterprises in each geographic division are located in such projects: West South Central, 467,156 acres, or 4.1 per cent; Pacific, 53,534 acres, or 1.9 per cent; South Atlantic, 109,372 acres, or 1.6 per cent; Mountain, 29,401 acres, or 1.5 per cent; East South Central, 31,500 acres, or 0.7 per cent; East North Central, 55,788 acres, or 0.1 per cent; and West North Central, 35,672 acres, or 0.1 per cent. The largest acreage in individually owned projects was reported by States in the cotton belt where many plantations have privately drained tracts of land of 500 acres or more. Louisiana, with 393,786 acres, or 10.8 per cent of its land in enterprises, reported the largest acreage in individually owned projects.

Other.—In addition to the land classified under the several types of projects mentioned, the Pacific division reported 14,192 acres, or 0.5 per cent of all land in enterprises as "Other." This includes 3 enterprises under the control of the United States Bureau of Indian Affairs and 2 under a city commission.

CONDITION AND USE OF LAND IN ENTERPRISES

Drainage condition in 1929.—The statistics relative to land as fit or unfit to raise a normal crop in 1929 or fit only for a partial crop, refer to the condition of wetness in that year, regardless of the use of the land. As the usual purpose of an enterprise is to provide outlet drainage for the lands assessed, the fact that some land is still unfit to raise a crop or fit only to raise a partial crop, does not necessarily mean that the works are inadequate. The accessory ditches or tile drains required to fully drain the farms are usually installed by the individual owners. In a few cases the reports indicated that the unfitness or only partial fitness of the lands was due to excessive rainfall or flood conditions in 1929 and that the works would have provided satisfactory drainage in a normal year. Such cases were more often reported by enterprises located in stream valleys subject to overflows causing complete loss of crops. The average rainfall in 1929, by months, for each of the 35 drainage States, and the departures from normal, are shown in the table on page 16.

Land unfit to raise any crop.—A total of 7,396,078 acres, or 8.8 per cent of all land in enterprises of the 35 drainage States, was reported as unfit for crops because of lack of drainage. (See State Table I, p. 24.)

The results show, by geographic divisions, for the East North Central division, 1,288,906 acres, or 3.8 per cent of the land in enterprises, as unfit; for the West North Central, 2,412,875 acres, or 10.2 per cent; for the South Atlantic, 1,516,966 acres, or 21.9 per cent; for the East South Central, 466,687 acres, or 11.2 per cent; for the West South Central, 1,597,904 acres, or 14.1 per cent; for the Mountain, 59,667 acres, or 3 per cent; and for the Pacific, 53,073 acres, or 1.9 per cent. The remaining lands in each of these divisions were either fit for a normal or a partial crop. The land fit for a partial crop may be land originally unfit and only partially drained by the works of the enterprise.

The largest proportional acreage of unfit land is found in the South Atlantic division which reported

almost 22 per cent of its land in enterprises as unfit. Approximately 1,000,000 acres of unfit land are located within the Everglades Drainage District of Florida, but if this district were omitted from the total the resulting proportion would be little changed. The largest proportion of unfit land is usually found in those enterprises organized principally to reclaim swampy land not previously in farms. Many enterprises covering such land provide only outlet drainage, and much of the land will not be fit for crops until lateral or farm drains are constructed.

Improved land.—The statistics for the 35 drainage States (see State Table I, p. 24) show 63,514,081 acres, or 75.2 per cent of the land in enterprises, as improved.

The results, by geographic divisions, follow: For the East North Central division, 29,906,796 acres, or 89.3 per cent, as improved; for the West North Central, 18,485,847 acres, or 78 per cent; for the South Atlantic, 1,215,239 acres, or 17.5 per cent; for the East South Central, 2,681,977 acres, or 64.4 per cent; for the West South Central, 7,035,974 acres, or 62 per cent; for the Mountain, 1,703,743 acres, or 86.5 per cent; and for the Pacific, 2,484,505 acres, or 88.4 per cent.

The low percentage of improved land in the South Atlantic division is partly due to the condition in the Everglades Drainage District. Excluding all land within this district, the result for this division would show 26.8 per cent of the land as improved. The highest proportion of improved land is in the East North Central division. Much of this land was already in farms before drainage. In the three States of Ohio, Indiana, and Illinois, approximately 93 per cent of the combined acreage in enterprises is improved.

Woodland.—There were 11,310,402 acres, or 13.4 per cent of all land in enterprises, reported as woodland. By far the larger portion of this acreage was cut-over timber lands. The remaining acreage was covered either by virgin timber or a scrub growth of trees of little or no commercial value. Lands with chaparral, sagebrush, or other woody shrubs were not classified as woodland.

By geographic divisions, the results for the East North Central division show 2,440,540 acres, or 7.3 per cent of the land in enterprises, as woodland; for the West North Central, 2,723,026 acres, or 11.5 per cent; for the South Atlantic, 2,188,439 acres, or 31.5 per cent; for the East South Central, 1,226,931 acres, or 29.4 per cent; for the West South Central, 2,687,952 acres, or 23.7 per cent; for the Mountain, 6,571 acres, or 0.3 per cent; and for the Pacific, 36,943 acres, or 1.3 per cent. It is thus evident that the South Atlantic, East South Central, and West South Central divisions, in the order mentioned, have the largest proportion of their land in enterprises covered by woodland. These are also the divisions which reported the largest proportion of their lands in enterprises as swampy prior to drainage. These three divisions combined, contain 26.6 per cent of all land and 54 per cent of all woodland within the enterprises of the 35 drainage States.

The Mountain and Pacific divisions have a very small percentage of woodland since the enterprises mainly cover irrigated lands. Most of the woodland reported in these divisions was in enterprises located in the humid western portions of Washington and Oregon. The remaining woodland probably consisted principally of strips of cottonwood along the streams in the irrigated areas.

Doubtless nearly all the woodland in the drainage enterprises of the 35 drainage States is included in the 20,003,315 acres of idle land. A very small acreage may have been intensively used as farm wood lots and some land covered by scattered woods was probably considered to be in use for pasturage. With the data available it was not possible to determine accurately the acreage of woodland in such use.

Land in occupied farms.—A total of 68,640,109 acres, or 81.3 per cent of all land in enterprises of the 35 drainage States, was in occupied farms. Approximately 79 per cent of the acreage in farms was also in cultivated crops in 1929. The remaining portion included land used for barnyards, buildings, roads, idle and unimproved lands, and doubtless some pasture land which was classified as improved.

The total acreage in improved land was 92.5 per cent of the land in occupied farms, but a small portion of this acreage was doubtless in farms temporarily idle. The land in occupied farms is distributed among the geographic divisions and States in about the same proportion as the improved lands.

Land idle in 1929.—Approximately 20,000,000 acres, or 23.7 per cent of all land in enterprises, were reported as idle. This acreage includes all woodland and other unimproved land not intensively used for pasture or farm wood lots, idle crop land, and land in unoccupied farms. Practically all land reported as unfit to raise any crop for lack of drainage was also idle and unimproved. The relation of idle land to the arrearage of enterprises and to the area delinquent in drainage taxes is discussed on page 15 of this volume.

The acreage of idle land by geographic divisions is as follows: The East North Central, 2,498,332 acres, or 7.5 per cent of its land in enterprises; the West North Central, 4,910,444 acres, or 20.7 per cent; the South Atlantic, 6,040,396 acres, or 87 per cent; the East South Central, 1,523,503 acres, or 36.6 per cent; the West South Central, 4,226,453 acres, or 37.3 per cent; the Mountain, 357,568 acres, or 18.2 per cent; and the Pacific, 446,619 acres, or 15.9 per cent.

The highest proportion of idle land is found in the South Atlantic States and is due in part to the large amount of unimproved land in the Everglades Drainage District. If this district were omitted the results for this division would show 71.2 per cent idle instead of 87 per cent. In Florida the improved land reported was nearly double that in occupied farms which indicates that a considerable acreage of the idle land was in farms temporarily out of use. The remaining idle land in the South Atlantic division was mainly cut-over woodland and land unfit for crops for lack of adequate drainage. This division also reported the highest per cent of land unfit for crops and the lowest per cent of improved lands.

The East South Central and West South Central divisions showed the next highest proportion of idle lands, with approximately 37 per cent in each. These divisions also had a high proportion of cut-over timber lands, practically all of which are doubtless idle.

It is thus seen that the South Atlantic, East South Central, and West South Central divisions each contained a larger proportion of idle land, woodland, and land unfit for crops in organized enterprises than any of the other divisions. Much of the land in enterprises of these divisions was originally swampy and covered with cut-over timber. Nearly 57 per cent of the land was reported as unfit to raise any crop prior to drain-

age. The high percentage of idle land is due largely to the fact that much remains to be done after outlet drainage is provided; much expensive clearing is often necessary; farm or lateral ditches must be built; roads opened, and schools and other social agencies established before desirable settlers can be secured. However, the high fertility of most of these lands, their flat topography favorable to machine farming in large units, and their accessibility to rail and water outlets, make it probable that settlement will proceed steadily when farm products again command favorable prices.

In the East North Central, West North Central, Mountain, and Pacific divisions, a large portion of the land now in enterprises was in farms prior to drainage; therefore, a low percentage of idle land was to be expected for these groups. However, Minnesota, Wisconsin, and Missouri showed a high proportion of idle land. Most of the idle land in Minnesota is in enterprises in the northern part of the State where much of the land is still unfit for crops due to incomplete drainage.

Utah, with 30.1 per cent, reported the highest proportion of idle land of any State in the Mountain or Pacific divisions. A study of the statistics indicates that a large part of the idle land in enterprises of this State is improved land of unoccupied farms.

Land available for settlement. The drained land in enterprises held for sale was considered as available for settlement. Land in occupied farms was not included unless there were large holdings intended for future subdivision or unless the farms were developed by a company for the purpose of sale. Land reported as unfit to raise any crop for lack of drainage was not considered available, if the reports indicated that this unfitness was due to the inadequacy of the works of the enterprise rather than to a lack of farm drains to supplement these works. By far the greater portion of the acreage available for new farms is unimproved land not included in farms. Probably the larger portion of this available land is cut-over timber land.

DRAINAGE WORKS OF ENTERPRISES

Drains and levees. State Table 1, page 24, gives the total mileage of ditches, tile drains, and levees by geographic divisions and States, and State Table IX, page 44, shows the acreage served per mile of drain by geographic divisions and States.

The statistics for ditches show 138,673 miles completed and 1,423 miles under construction; those for tile drains, 55,932 miles completed and 2,204 miles under construction; and those for levees, 6,540 miles completed and 126 miles under construction. The amount of work under construction was quite small as compared with that of the 1920 census. In the 10-year census period (1920-1930), the length of completed ditches increased approximately 29 per cent, the length of tile, 30 per cent; and the length of levees, 86 per cent. The drainage schedule called only for lengths of ditches, tile drains, and levees. No data were secured relative to the size of ditches or levees, nor to the diameter of tile used. However, the average size of ditches constructed during the past 15 years is considerably larger than the average for earlier enterprises. The earlier enterprises usually covered smaller and more easily drained areas than did later ones. Later enterprises have generally constructed

the larger outlet ditches, leaving the smaller ditches to be dug by subdistricts, as the demand for new land develops; likewise, in tile the sizes have been increased. Many later enterprises use a minimum size of 5 inches, in Iowa, however, outlet pipes of 4 feet in diameter have been constructed by several enterprises.

Of the total length of ditches completed, 51.2 per cent is in the East North Central States; 19.8 per cent, in the West North Central States; 22.2 per cent, in the East South Central, West South Central, and South Atlantic States; and 6.8 per cent, in the Mountain and Pacific States.

Of the total length of tile drains completed, 49.8 per cent is in the East North Central States; 42.9 per cent, in the West North Central States; 0.6 per cent, in the East South Central, West South Central, and South Atlantic States; and 6.7 per cent, in the Mountain and Pacific States.

A comparison of the land served per mile of drain is shown by States and geographic divisions in State Table IX, page 44. In this table, all land has been classified according to type of drain making no distinction between gravity and pumping enterprises; therefore, the division of land by type of drain will be different from that in Table 4, page 20, and State Table III, page 33, where a separate division is shown for land in enterprises served entirely or partly by pumps. The lengths of drains shown in State Table IX include those under construction as well as those completed, and the following discussion of ditch lengths applies to this combined total. As previously stated, the drains shown are those belonging to the enterprises and do not include supplemental drains constructed by the landowners to drain their farms more effectively. Particularly in the case of tile drains, it is probable that considerable additional mileage has been laid by individual owners. Hence, some of the land reported as drained exclusively by ditches may include land drained by private tile systems.

In a few of the older drainage States, such as Ohio and Indiana, it is probable that little private supplementary drainage has been necessary as the enterprise drains are sufficiently close together to serve directly nearly every farm. The total lengths of ditches reported for Ohio and Indiana are probably a little in excess of the actual lengths. This is due to overlapping and consequent duplication in the length of some ditches.

The combined length of all ditches and tile drains, including that completed and authorized, for the 35 drainage States is 197,332 miles, or an average, per mile of drain, of 427 acres, while the 1920 census showed 417 acres per mile. Considering enterprises having ditches only, an average of 524 acres was served per mile of ditch, while the 1920 census shows 529 acres per mile. The results for tile drains only, in 1930, indicate an average of 280 acres per mile, while the 1920 census shows 214 acres per mile.

Land having both ditches and tile drains averaged 278 acres per mile of drain as compared with 277 acres per mile in 1920. For land drained by ditches only, the acreage served per mile of ditch decreased slightly. This small decrease is due partly to the fact that some drainage districts established since 1920 provide chiefly outlet drainage which will be supplemented by other drains, probably built by subdistricts, as the need arises.

A further reason for this small decrease is the fact that approximately 4,000,000 acres, not yet served by drains, are included in the enterprises reporting in 1930. This acreage, located in the Everglades Drainage District of Florida and in irrigation districts directly doing their own drainage, was not included in the 1920 totals. If this acreage were deducted the land served per mile by all types of drains would be 407 acres for 1930 and 417 acres for 1920.

If no deductions were made for the necessary connecting drains, the mileage cited for the 35 drainage States in 1930 would provide parallel drains for the land in enterprises the following distances apart: All types, 0.67 mile; ditches only, 0.82 mile; tile only, 0.44 mile; and ditches and tile, 0.43 mile.

Probably the acreage per mile, for land drained by ditches only, constitutes the best basis of comparison of one geographic division or State with another. For land so drained in the 35 drainage States, the average is 524 acres per mile of ditch. By geographic divisions the results show an average of 368 acres per mile in the East North Central; 712 acres in the West North Central; 862 acres in the South Atlantic; 627 acres in the East South Central; 668 acres in the West South Central; 441 acres in the Mountain; and 356 acres in the Pacific. The small acreage per mile for the first division is due largely to the intensive drainage found in Ohio and Indiana, where the public drains provide both outlet and lateral drains for most of the farms. The Mountain division also has a relatively low acreage per mile of ditch. This drainage is primarily to protect irrigated lands from damage by seepage and alkali and necessarily is a more intensive type of drainage than that usually required in the humid regions.

The smallest proportion of acreage to ditch length is found in Georgia with an average of 172 acres per mile. This is to be expected since the enterprises in Georgia are located almost entirely along the narrow bottoms of the Piedmont streams. The highest ratio of acreage to ditch is found in North Dakota, with an average of 1,329 acres per mile; the second highest, in Arizona, with 1,084 acres per mile; and the third highest, in Florida, with 1,068 acres per mile. This high ratio for Florida is due to the fact that about two-thirds of the Everglades Drainage District has not yet been reclaimed. The rather high ratio of acreage to ditch in Arizona and several of the other Mountain States is due to the fact that a few irrigation enterprises, while assessing all their irrigable lands for drainage work, have built drains for only a portion of these lands.

Drainage by pumping.—The statistics relative to pumping are shown in Tables 5 and 6, page 21, and State Table VII, page 41, and a discussion of the results on page 20. However, further discussion of the data in State Table VII is desirable.

Both the engine or motor capacity and the pump capacity for the Pacific States are much larger than those for any other group. This condition is due principally to the large pumping development in California. The Mountain States show the third largest engine or motor capacity but the second lowest pump capacity, due to the fact that much of the pumping is from drainage wells with relatively high lift. The drainage wells also account in part for the more than average lift shown for the Pacific division.

The total pump capacity in relation to land served is presented in State Table VII, both in gallons per minute per acre and in depth in inches which the pumps operating at the reported capacities could remove from the land served in a day of 24 hours. The greater number of pumping plants of Iowa, Missouri, and Illinois are located near the Mississippi River between Rock Island, Ill. and the mouth of the Missouri River, and along the Illinois River below Peoria. These plants constitute a group operating under rather similar conditions of lift and rainfall. The pump capacity of this group is approximately 0.50 inch in 24 hours, and the average lift is about 10 feet. With the exception of Wisconsin which reported only 50 acres served by pumps, Louisiana has the highest pump capacity with 1.27 inches in 24 hours and Georgia is next with 1.06 inches in 24 hours. These two States also have a greater annual rainfall than any other States reporting pumps, as shown by the table on page 16. Arizona with 0.08 inch, and Texas with 0.09 inch in 24 hours, reported the lowest pump capacities. However, the pumps of these States served irrigated lands only and much of the pumping was from drainage wells, which accounts for the rather high average lifts.

The plant ratio for all States reporting averaged 2.05. This is determined by dividing the total engine or motor capacity, by the product of the total pump capacity and average lift reduced to horsepower. Based on the combined engine and pump capacities and the average lift for all pumps, the plant efficiency or reciprocal of this ratio is almost 50 per cent.

There were 444 wells pumped for drainage. All of these wells were located on irrigated land and served a total of 224,411 acres. The total capacity of their pumps was 632,080 gallons per minute, and the average capacity was 2.8 gallons per minute per acre.

COST AND FINANCING OF DRAINAGE ENTERPRISES

The investment in a drainage enterprise includes primarily the cost of constructing the drainage works, together with engineering, legal, and organization expenses. It does not include the value of land. The cost of operation and maintenance has been excluded as far as possible. However, when enterprises do not have a continued separate existence but are superseded by new enterprises organized to repair or improve the works of older ones, some costs of maintenance have been unavoidably included in the invested capital. The great majority of enterprises of this type are in Ohio, Indiana, and Michigan. For such enterprises it was impossible to separate repair costs from construction costs, but even in the States mentioned it is not probable that the invested capital has been greatly increased by the inclusion of such repair costs, for the major portion of maintenance is done directly without forming new enterprises.

In comparing costs in the several tables it should be remembered that these costs are the actual investments made at various times rather than those which would have been required to replace the existing works on January 1, 1930. The dollar unit for measuring invested capital has been a variable one and has fluctuated widely between the years 1900 and 1920. The results obtained are, however, acceptable as a basis for comparing costs according to the different classifications.

It should also be noted that many of the older enterprises were constructed largely by the direct labor of landowners, who thus paid their portion of the cost by labor instead of money. However, these were usually small enterprises served by small drains and the work so done does not greatly affect the State totals. The States in which the direct labor of owners has been used mostly are Ohio, Indiana, Michigan, and Louisiana. In the last-named State a great deal of the work in individually owned enterprises was done by slave labor prior to the Civil War and the small costs reported are much below contract costs for similar work.

Nearly all the tables showing cost refer to the capital invested to January 1, 1930, but in a few tables the additional capital authorized to complete the works under construction and the total investment when completed are also given. A total of only \$9,346,099 was required to complete enterprises under construction in 1930 as compared with \$62,321,412 in 1920. The capital required for completion was, therefore, 1.4 per cent of the investment on January 1, 1930, and 16.7 per cent of the investment on January 1, 1920. This large difference is due principally to the high agricultural prices and increase in farm-land values resulting from the World War which, up to 1920, encouraged the organization of reclamation enterprises, whereas the subsequent fall in prices and decline in values which preceded the date of the 1930 census discouraged development of enterprises.

As indicated in State Table VIII, page 42, nearly \$3,000,000 of the total amount required for completion was reported by Florida; over \$1,000,000 by Illinois; and nearly \$800,000 by California. Thus, these three States accounted for over half the sum required for completion of works under construction.

Cost according to location.—The capital invested in enterprises is shown by geographic divisions and States in State Table I, page 24, of the summary. The total investment both in the East North Central and in the West North Central divisions is far greater than that of any other division and, combined, accounts for approximately 61 per cent of the invested capital in the 35 drainage States. The South Atlantic, East South Central, and West South Central divisions, combined, have 24 per cent, the Mountain division 4 per cent, and the Pacific division 11 per cent of the total invested capital.

State Table III, page 33, shows the average cost of drainage per acre for each of the 35 drainage States, the average being \$8.06 per acre. By geographic divisions, arranged in order of cost, the average cost per acre was as follows: Pacific, \$26.76; Mountain, \$14.15; West North Central, \$8.70; East South Central, \$8.48; South Atlantic, \$7.72; West South Central, \$6.40; and East North Central, \$6.27. These figures include both gravity and pump drainage.

The drainage of irrigated land is generally of a more intensive type and hence, more costly than that required in humid regions. The purpose is to prevent damage from seepage and alkali by controlling the water table, rather than the removal of surface run-off resulting from heavy rainfall. This is accomplished by the use of rather deep drains at close intervals. A large proportion of these drains is tile, laid deeper than is customary in humid regions. There are also 224,441 acres of irrigated land now drained by pumping

from wells. This difference in purpose and type of drainage accounts for the higher cost in the Mountain division. Drainage in the Pacific division includes both that of irrigated land and land with ample rainfall for crop purposes. This division has the highest cost per acre with an average of \$26.76. The principal reason for this high figure is the large amount of pumping, especially in the Great Valley of California. Land served by pumps requires extensive levees as well as interior drains.

The East North Central division reported the lowest cost per acre with an average of \$6.27. This low average is due largely to the fact that the lands of Ohio, Indiana, and Michigan are served by rather small ditches, many of which were built directly by the landowners, or at a time when prices were much lower than those prevailing in recent years.

Costs considered by individual States show a wide divergence. Utah, with \$30.58, has the highest average cost which is accounted for by the large amount of tile used for draining irrigated land. Nearly 88 per cent of the land in enterprises in this State is drained by tile or by ditches and tile, and only 12 per cent is drained exclusively by ditches. California, with a cost of \$29.75 per acre, is the next highest. As previously mentioned, this high investment is due to the large amount of drainage pumping done in this State. Some enterprises in the Great Valley have reported as much as \$200 per acre invested in drainage works, but the value of truck crops raised on some of these lands justifies a very high investment. The third highest investment in drainage enterprises was reported by Georgia, with an average of \$22.77 per acre. Most of the drained lands of this State are located in the rather narrow valleys of the Piedmont streams, resulting in a high ratio of ditch length to area served. The average area served per mile of ditch is 172 acres, which is lower than that of any other State.

North Dakota, with an average of \$2.88, shows the lowest cost per acre of any of the States. By far the greater part of the land in enterprises of this State is located in the flat plain of the Red River Valley. As the mean annual rainfall is approximately 20 inches, the rate of run-off is comparatively low, and rather small ditches widely spaced can provide the necessary drainage. A mile of ditch serves an average of 1,329 acres in North Dakota. This is a larger acreage per mile than that of any other State.

Michigan, with an average of \$4.10, reported the next lowest cost per acre. This low cost is due partly to the fact that ditches constructed by landowners were doubtless not estimated at equivalent contract prices. Money spent for drainage prior to 1897 is not included in the total invested, since only enterprises organized since January 1, 1897—the year of the general drainage law—were included in the canvass for the 1930 census. The exclusion of these enterprises further reduced the total investment shown for this State.

Cost by type of drainage.—The total investment in drainage enterprises of the 35 drainage States was \$680,732,880. Approximately 84 per cent of this amount is invested in enterprises drained entirely by gravity, and 16 per cent is in enterprises served entirely or partly by pumps.

The cost of drainage according to type is shown in State Table III, page 33. The cost of accessory levees is included in the totals which represent the invested capital. State Table I, page 24, also gives the cost

of drainage according to type of works. These costs, however, include the amounts necessary to complete the works under construction and are a little higher than those showing the actual investment.

Cost of gravity drainage only.—The average cost per acre, when completed, for gravity enterprises having ditches only, is \$5.35, and if accessory levees are included the cost is \$6.20 per acre; for enterprises reporting ditches and tile only, the cost is \$10.63 per acre, and if those having accessory levees are included, the cost is \$10.71; for enterprises having tile only, the cost is \$8.51 per acre, and if those reporting accessory levees are included, the cost remains substantially the same. It is evident, therefore, that the cost per acre of gravity drainage is not much higher if enterprises with accessory levees are included with those without levees. Enterprises drained entirely or partly by pumping have proportionally even more levees than those gravity enterprises which reported some levees. Such gravity enterprises reported 3,866 miles of levees, an average of 2,232 acres per mile, while enterprises drained entirely or partly by pumping reported 2,799 miles of levees, an average of 1,301 acres per mile. The above figures include 126 miles of levees under construction on the census date.

Considering enterprises reporting gravity drainage only, the average investment was \$6.20 per acre for those having ditches and levees; \$8.50 per acre for those having tile drains and levees; and \$10.62 per acre for those having ditches, tile drains, and levees. The investment per acre for enterprises having ditches and levees (see State Table III, p. 33) varied from \$22.95 in Georgia to \$2.85 in North Dakota. As shown in State Table IX, page 44, a mile of ditch served an average of 172 acres in Georgia and 1,329 acres in North Dakota. The above cost and acreage served indicate that the average cost per mile of ditch is almost the same for each of these States. It should here be noted that the totals for the several types of drains shown in State Table III include enterprises both with and without accessory levees.

The statistics in State Table III give only a very general idea of the extent and cost of tile drainage. Only tile drains installed by organized enterprises were reported on the drainage schedule, and these doubtless consisted principally of meandered lines draining low wet sections of the fields rather than parallel lines providing more complete field drainage. It is probable that most of the intensive tile drainage was installed by the individual landowners, using the enterprise drains as their outlets. In the Pacific and Mountain divisions tile drainage costs more per acre than in the other divisions. This is due to the fact that the greater part of tile drains in the Western States has been installed on irrigated lands, where more expensive drainage is required to prevent damage from seepage and alkali. All States, except Nebraska, showing an average cost of over \$20 per acre for tile drainage, are located in the Pacific and Mountain divisions.

The cost of drainage by ditches, tile drains, and levees is subject to certain limitations, as an enterprise having 1 mile of ditch and 100 miles of tile would be classified in the same group as one having 100 miles of ditches and 1 mile of tile. This, however, is an extreme case but illustrates the nature of the statistics for this type of drainage. No more definite classification was possible for this type.

The low cost of tile drainage in Ohio and Indiana is due, at least in part, to excessive overlapping. Thus an original enterprise, having ditches only, may be lapped by one extending and repairing these ditches; again lapped by one installing tile in half of these ditches and repairing the other half; and again lapped by an enterprise installing tile in the remaining ditches. In such a case the cost of the first two enterprises would be credited to ditch drainage; the cost of the third to drainage by ditches and tile; and the cost of the last only to drainage entirely by tile. However, no other method of classifying costs was practicable; thus the results affect only counties in which there was considerable overlapping of enterprises.

Drainage, all or part by pumping.—State Table III, page 33, shows the investment per acre in enterprises reporting all their land served by pumps and also in those reporting part of their drainage by gravity and part by pumping. For enterprises reporting only a part of their lands served by pumps it was not possible to separate the investment for the portion served by pumps from the total. For this reason, the cost per acre for enterprises drained partly by gravity and partly by pumping does not provide a satisfactory basis for conclusions relative to investment by type of drainage.

Drainage by pumping from wells is confined entirely to certain irrigated lands in California, Arizona, Texas, Oregon, Idaho, and Nebraska. There are 12 enterprises, covering 679,918 acres, with a total investment of \$4,089,196, that reported either all or a part of their lands as drained by pumping from wells. These pumps served a total of 224,411 acres; only 2 of the 12 enterprises, covering 28,279 acres, and with an investment of \$441,127, reported all of their land as served by pumps. Pumping from wells to prevent damage from seepage and alkali requires a much lower investment per acre than that necessary in humid regions where a single plant pumps from collecting ditches and serves an area also protected by levees. However, the 2 enterprises mentioned, 1 located in California and 1 in Texas, have such a small proportion of the total land and capital reported by the all-pumping enterprises that the average cost for that group is not materially affected by their inclusion. The average lift for pumps in drainage wells was 47 feet in 1930.

Enterprises having all their land served by pumps reported a total investment of \$79,894,531, and averaged \$49.67 per acre. This is more than six times the average of \$8.06 for all types of drainage; about seven times the average of \$7.10 for gravity only; and nearly four times the average of \$13.31 for part gravity and part pumping enterprises. California, Illinois, and Louisiana reported by far the largest investment in pumping enterprises. The average cost per acre for drainage entirely by pumping was \$58.13 for California; \$60.93 for Illinois; and \$51.47 for Louisiana. In California nearly all the land served was in enterprises using electric power; in Illinois about half the land served was in such enterprises; and in Louisiana, less than 3 per cent of the land served was in such enterprises. The average lifts reported were approximately 13 feet for California, 11 feet for Illinois, and 6 feet for Louisiana. Average lifts are shown in State Table VII, page 41. The lowest investment per acre served was reported for North Carolina, but the drainage works there could not be replaced for the costs shown.

The rather high investment per acre for pumping enterprises as compared with gravity enterprises is not entirely due to the cost of the pumping plants but is partly occasioned by the greater lengths of levees necessary in such enterprises. Not only the additional investment in works but also the cost of operation and maintenance of the pumps should be considered in comparing the cost of gravity drainage with drainage by pumping.

Cost of operation and maintenance.—This item includes all expenditures for the year 1929, except payments of principal and interest on indebtedness of the enterprises, and charges to capital investment. It includes administrative charges, such as the salaries of employees and all items chargeable to the repair and operation of drains, levees, pumping plants, and other accessory works. The expenditures for maintenance of ditches and tile drains for any year depends largely on the financial condition of the landowners within the enterprise. If the prices of farm produce are low, much needed maintenance work will be deferred until better times. Therefore, the cost of maintenance for a particular year may not represent the average amount required to keep the works in good repair. A discussion of this cost precedes Table 12, page 23, but the cost relative to pumping deserves further consideration.

For enterprises having part of the land served by gravity and part by pumping, it was not possible to separate the costs of operation and maintenance between the parts. In some cases the area served by pumps was by far the larger portion in the enterprise and in others the reverse was true. The average cost reported for such enterprises in 1929 was 56 cents per acre. The operating cost incurred in a given year depends largely on the length of time that the pumps operate; this in turn depends upon the amount of rainfall during the growing season and the stage of water in the streams or other outlets. However, this condition as to rainfall and outlets does not materially affect the costs reported by enterprises located on irrigated lands.

The mean rainfall for 1929 and the departures from normal are shown by States on page 16.

Considering only enterprises that reported all of their land as served by pumps, the average cost of operation and maintenance was \$1.18 per acre. This cost, by geographic divisions, was as follows: The East North Central, \$1.88; the West North Central, \$2.09; the South Atlantic, \$0.59; the West South Central, \$1.62; the Mountain, \$0.60; and the Pacific, \$1.01. On account of the larger number of enterprises reporting, it is probable that the results shown for the East North Central, West North Central, West South Central, and Pacific divisions are the most representative. The lands served in the combined East North Central and West North Central divisions are located almost entirely in Illinois, Iowa, and Missouri, and the average for this combined group is \$1.94 per acre. Approximately 83 per cent of the land reporting on cost, with all its drainage by pumping, in the West South Central division is in Louisiana, and the pumping lift there is less than that reported in the East North Central and West North Central divisions. In the Pacific division by far the greater portion of the land served is in the San Joaquin and Sacramento River Valleys and the power used is almost entirely electric.

A number of enterprises, pumping entirely from wells to prevent damage from seepage and alkali, reported that the cost of operation was fully offset by the value of the drainage water used again for irrigation.

The cost for operation and maintenance of drainage works is necessarily only approximate and in particular cases has varied considerably from the averages.

Arrearage and delinquency.—Arrearage of enterprises and delinquent land is shown in State Table IV, page 34, and idle land according to arrearage, in State Table X, page 45.

In the 35 drainage States, enterprises comprising 9,812,578 acres, or 11.6 per cent of the total lands in enterprises, were reported in arrears; 10,050,800 acres, or 11.9 per cent, were reported delinquent; and 20,003,315 acres, or 23.7 per cent, were reported idle. The acreage of delinquent land contains some duplication due to overlapping which could not be accurately determined, but a rough estimate is 833,000 acres, of which 83,000 acres are in Minnesota; 50,000 acres in Arkansas; 65,000 acres in Missouri; and 635,000 acres in the Everglades Drainage District of Florida.

The statistics for the South Atlantic States show 21.4 per cent of the land in enterprises as in arrears; 46.7 per cent, delinquent in drainage taxes; and 87 per cent idle. The figures for delinquency include some duplication occasioned by overlapping in the Everglades Drainage District; even if a correction were made for this area, the delinquency would be 37.5 per cent and would still remain the highest of any group.

Of the land in enterprises, there was reported for the East South Central States 18.9 per cent in arrears, 9.5 per cent delinquent, and 36.6 per cent idle; for the West South Central States, 16.3 per cent in arrears, 12.6 per cent delinquent, and 37.3 per cent idle; for the West North Central States, 15.3 per cent in arrears, 15.9 per cent delinquent, and 20.7 per cent idle; for the Pacific States, 13.5 per cent in arrears, 9.7 per cent delinquent, and 15.9 per cent idle; for the Mountain States, 13.2 per cent in arrears, 9.6 per cent delinquent, and 18.2 per cent idle; and for the East North Central States, 4.2 per cent in arrears, 2.2 per cent delinquent, and 7.5 per cent idle.

This comparison indicates that the East North Central States have the lowest proportion of land in arrears, land delinquent, and land idle; and the South Atlantic States, the highest proportion for all three items. This difference is primarily due to the much higher development of the lands of the former group as compared with those of the latter.

The four States reporting the greatest area delinquent, which is due to the large area of cut-over or other unimproved lands in enterprises, are Florida, Minnesota, Arkansas, and Missouri, in the order named.

Of all States having irrigated lands, Utah reported the highest proportion of both arrearage and delinquency, with 65.8 per cent in arrears and 61.2 per cent, delinquent. This State also had the highest drainage cost per acre, due to the large amount of tile used. A shortage of water in certain sections of the State caused a large reduction in crop yields and accounted to some extent for the high proportion of arrearage and delinquency.

GENERAL DISCUSSION

PRECIPITATION,¹ BY MONTHS, FOR THE YEAR 1929, WITH DEPARTURE² FROM NORMAL, FOR THE 35 DRAINAGE STATES

STATE	ANNUAL		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
	Precipitation	Departure										
	Inches	Inches										
Arizona.....	11.14	-2.65	0.93	-0.29	0.80	-0.38	0.46	-0.65	0.62	-0.02	0.15	-0.17
Arkansas.....	46.10	-1.02	5.08	+0.98	4.01	+0.66	3.77	-0.97	5.69	+0.81	6.31	+1.29
California.....	15.00	-10.62	1.82	-3.64	2.24	-2.20	2.35	-1.50	2.07	+0.36	0.60	-1.00
Colorado.....	18.16	+0.96	0.70	-0.04	0.96	-0.02	1.48	+0.15	1.61	-0.23	1.61	-0.19
Florida.....	59.04	+6.38	3.19	+0.41	2.14	-1.00	3.21	+0.26	3.40	+0.74	4.98	+1.00
Georgia.....	69.83	+20.24	4.04	+0.70	8.63	+3.63	10.17	+5.38	4.02	+0.44	5.48	+1.98
Idaho.....	13.06	-4.04	2.15	+0.05	0.90	-0.84	1.37	-0.18	1.83	+0.42	0.54	-0.99
Illinois.....	41.94	+5.59	3.98	+1.72	1.27	-0.68	3.38	+0.17	5.21	+1.80	5.80	+1.80
Indiana.....	47.04	+7.75	4.92	+1.87	1.88	-0.66	3.11	-0.75	5.02	+1.53	7.23	+3.22
Iowa.....	30.20	-1.95	2.06	+0.90	1.31	+0.10	1.44	-0.33	4.62	+1.66	2.47	-2.11
Kansas.....	27.96	+1.18	1.13	+0.46	0.83	-0.33	0.94	-0.54	3.33	+0.82	4.76	+1.01
Kentucky.....	48.40	+2.62	4.54	+0.19	3.58	+0.13	4.17	-0.52	3.57	-0.46	7.37	+3.37
Louisiana.....	63.65	+8.32	6.53	+1.80	6.46	+1.97	6.06	+1.99	3.22	-1.48	6.08	+1.65
Michigan.....	31.22	+0.60	3.05	+1.23	0.94	-0.75	2.07	-0.15	5.34	+2.84	3.69	+0.57
Minnesota.....	20.56	-4.25	1.25	+0.58	0.52	-0.18	1.00	-0.11	1.96	+0.02	2.01	-1.02
Mississippi.....	60.03	+6.07	5.24	+0.25	6.16	+1.41	8.65	+2.92	4.53	-0.85	4.70	+0.30
Missouri.....	46.61	+7.09	3.47	+1.43	1.92	-0.10	3.30	+0.23	6.15	+2.34	7.52	+2.82
Montana.....	13.08	-2.36	0.91	-0.03	0.64	-0.09	1.20	+0.29	0.94	-0.21	1.71	-0.52
Nebraska.....	23.09	-0.47	0.37	-0.18	1.01	+0.20	0.80	-0.30	3.27	+0.83	2.73	-0.82
Nevada.....	5.83	-2.35	0.80	-0.18	0.57	-0.35	0.84	+0.03	0.74	0.00	0.14	-0.66
New Mexico.....	16.48	+1.62	0.29	-0.26	0.74	+0.03	0.94	+0.03	0.20	-0.82	2.60	+1.33
North Carolina.....	62.00	+12.54	3.71	-0.23	6.38	+2.22	5.94	+1.06	3.12	-0.57	0.33	+2.30
North Dakota.....	14.32	-3.62	0.63	+0.09	0.29	-0.20	0.78	-0.05	1.31	-0.07	2.90	+0.44
Ohio.....	45.83	+7.92	4.36	+1.48	2.37	-0.02	2.83	-0.60	4.88	+1.64	5.33	+1.74
Oklahoma.....	35.30	+1.94	2.09	+0.46	1.49	+0.08	3.42	+1.25	2.90	-0.86	7.67	+3.30
Oregon.....	23.72	-7.69	3.88	-0.75	1.02	-2.61	2.64	-0.73	3.11	+0.60	0.98	-0.85
South Carolina.....	66.13	+17.82	4.01	+0.46	7.85	+3.44	7.59	+3.01	4.30	+1.20	6.46	+2.81
South Dakota.....	20.93	+0.71	0.95	+0.40	0.66	+0.04	1.78	+0.07	2.49	+0.40	2.63	-0.37
Tennessee.....	59.78	+9.71	4.80	+0.66	5.00	+0.65	7.75	+2.40	5.26	+0.72	7.67	+3.47
Texas.....	31.17	+0.10	2.11	+0.28	1.30	-0.60	2.68	+0.52	2.42	-0.83	7.70	+1.04
Utah.....	13.60	-0.10	1.36	+0.13	1.36	+0.26	1.62	+0.12	1.92	+0.53	0.47	-0.74
Virginia.....	45.92	+3.50	2.49	-0.80	4.10	+1.05	3.84	+0.23	4.02	+0.66	4.74	+0.93
Washington.....	23.74	-12.44	2.65	-2.66	1.40	-2.63	3.39	-0.17	2.89	+0.39	1.51	-0.62
Wisconsin.....	28.00	-2.58	2.61	+1.39	1.18	+0.05	1.65	-0.00	3.94	+1.53	2.40	+1.49
Wyoming.....	15.06	+0.58	0.74	-0.00	0.83	-0.04	1.75	+0.68	2.03	+0.53	2.04	-0.10

STATE	JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Precipitation	Departure												
	Inches	Inches												
Arizona.....	0.08	-0.29	2.79	+0.53	2.74	+0.41	1.88	+0.64	0.42	-0.46	0.13	-0.72	0.14	-1.25
Arkansas.....	3.08	-0.34	3.07	-0.75	1.29	-2.40	2.46	-0.97	4.20	+1.32	2.61	-1.04	3.84	-0.21
California.....	1.39	+1.08	0.01	-0.08	0.10	0.00	0.19	-0.35	0.13	-0.09	(3)	-2.47	4.61	+0.37
Colorado.....	0.59	-0.98	3.07	+0.70	3.17	+1.03	2.60	+1.20	1.25	+0.01	0.86	+0.11	0.20	-0.83
Florida.....	7.88	+1.26	8.23	+0.97	6.40	-0.69	10.98	+4.21	4.15	-0.21	1.64	-0.55	2.84	-0.02
Georgia.....	5.27	+0.86	4.57	-1.14	3.24	-1.98	0.62	+6.15	5.24	+2.48	4.95	+2.30	3.70	-0.56
Idaho.....	1.53	+0.30	0.13	-0.44	0.37	-0.24	0.54	-0.42	0.74	-0.65	0.15	-1.84	2.81	+0.79
Illinois.....	4.82	+0.95	4.57	+1.27	2.46	-1.00	2.93	-0.69	3.39	+0.76	1.81	-0.59	2.32	+0.08
Indiana.....	4.38	+0.55	4.22	+0.82	2.70	-0.55	3.05	-0.07	3.83	+1.14	2.71	-0.38	3.93	+1.03
Iowa.....	3.08	-1.42	4.31	+0.48	2.44	-1.00	3.74	+0.07	3.10	+0.67	1.24	-0.31	0.39	-0.75
Kansas.....	3.00	+0.15	3.54	+0.10	2.14	-0.95	1.01	-0.88	3.59	+1.62	1.61	+0.47	0.19	-0.75
Kentucky.....	4.11	-0.14	3.97	-0.17	2.09	-1.67	4.09	+1.86	3.65	+0.88	4.03	+0.46	2.72	-1.31
Louisiana.....	3.41	-1.40	5.87	-0.35	3.30	-1.80	4.28	+0.32	4.07	+0.77	10.10	+8.52	4.27	-0.98
Michigan.....	3.03	+0.02	2.30	-0.65	1.28	-1.54	1.76	-1.45	3.67	+0.97	1.74	-0.64	2.30	+0.15
Minnesota.....	2.02	-2.08	2.02	-0.83	1.98	-1.32	3.50	+0.93	2.27	+0.44	0.55	-0.50	0.58	-0.18
Mississippi.....	3.40	-0.91	4.47	-0.34	2.24	-2.07	4.22	+1.23	4.00	+1.40	8.61	+5.19	3.66	-1.01
Missouri.....	5.77	+0.90	4.12	+0.12	2.50	-1.25	3.20	-0.64	5.54	+2.65	1.46	-0.96	1.66	-0.41
Montana.....	2.14	-0.47	0.59	-0.95	0.34	-0.81	1.35	-0.03	0.86	-0.15	0.58	-0.32	1.82	+0.93
Nebraska.....	3.81	-0.49	3.17	-0.23	1.48	-1.33	2.82	+0.69	3.07	+1.51	0.98	+0.24	0.93	-0.68
Nevada.....	0.73	+0.19	0.14	-0.25	0.68	+0.29	0.34	-0.08	0.00	-0.55	0.02	-0.62	0.74	-0.17
New Mexico.....	0.46	-0.88	3.50	+1.00	3.57	+1.09	2.10	+0.51	1.20	+0.04	0.76	+0.13	0.12	-0.63
North Carolina.....	6.02	+1.27	5.83	-0.22	4.05	-1.40	5.82	+2.07	7.36	+4.30	4.47	+2.15	3.00	-0.95
North Dakota.....	1.44	-2.06	1.27	-1.84	0.77	-1.61	1.65	+0.01	1.85	+0.85	0.53	-0.05	0.81	+0.27
Ohio.....	4.01	+0.12	4.84	+1.04	2.79	-0.59	3.02	+0.01	4.18	+1.47	3.81	+1.05	3.41	+0.53
Oklahoma.....	3.44	-0.50	2.79	-0.03	0.78	-2.21	3.93	+0.48	3.93	+0.05	2.05	+0.03	0.90	-0.76
Oregon.....	2.15	+0.83	0.04	-0.39	0.14	-0.36	0.28	-1.12	0.97	-1.18	0.38	-4.02	8.13	+2.89
South Carolina.....	5.73	+0.88	4.35	-1.55	3.18	-2.65	7.36	+3.18	7.31	+4.27	3.85	+1.56	4.14	+0.61
South Dakota.....	2.12	-1.35	2.47	-0.21	1.35	-0.98	3.22	+1.53	2.41	+1.02	0.61	-0.06	0.24	-0.38
Tennessee.....	4.62	+0.24	4.42	0.00	2.40	-1.64	4.82	+1.70	3.75	+0.91	6.18	+2.56	3.11	-1.42
Texas.....	1.49	-1.78	2.62	+0.01	0.87	-1.69	2.74	-0.14	2.55	-0.04	3.10	+0.76	1.69	-0.47
Utah.....	0.71	+0.06	1.23	+0.27	1.53	+0.43	2.23	+1.09	0.65	-0.64	0.14	-0.80	0.38	-0.80
Virginia.....	5.31	+0.81	3.87	-0.70	2.67	-1.85	2.54	-0.82	6.89	+4.18	3.34	+0.98	2.11	-1.08
Washington.....	2.29	+0.71	0.29	-0.40	0.41	-0.53	0.45	-0.54	1.50	-1.80	0.85	-3.61	6.11	+0.42
Wisconsin.....	3.87	-0.07	3.30	-0.33	1.87	-1.42	3.55	-0.66	2.02	-0.61	0.88	-0.91	0.73	-0.60
Wyoming.....	1.08	-0.57	1.09	-0.31	0.98	-0.12	2.03	+0.69	1.00	-0.13	0.95	+0.28	0.49	-0.27

¹ Data compiled from records of United States Weather Bureau.
² A plus sign (+) denotes excess; a minus sign (-) denotes deficiency.
³ Precipitation less than one-hundredth inch of rain or melted snow.