

TABLE 5.—Maximum free-air wind velocities, (M. P. S.), for different sections of the United States based on pilot-balloon observations during June 1937

Section	Surface to 2,500 meters (m. s. l.)				Between 2,500 and 5,000 meters (m. s. l.)				Above 5,000 meters (m. s. l.)						
	Maximum velocity	Direction	Altitude (m) M. S. L.	Date	Station	Maximum velocity	Direction	Altitude (m) M. S. L.	Date	Station	Maximum velocity	Direction	Altitude (m) M. S. L.	Date	Station
Northeast ¹	45.5	SW	1,000	14	Pittsburgh	39.2	W	4,130	14	Columbus	43.2	NNE	9,000	24	Albany.
East-Central ²	28.4	W	2,180	10	Knoxville	28.0	W	3,059	10	Murfreesboro	40.0	NW	10,080	8	Greensboro.
Southeast ³	26.3	NW	1,960	28	Spartanburg	26.7	NNW	2,640	22	Atlanta	34.4	NNW	5,740	22	Spartanburg.
North-Central ⁴	27.9	SSE	1,688	17	Bismarck	51.2	NNW	2,070	21	Fargo	40.8	W	10,010	15	Detroit
Central ⁵	47.3	WSW	2,200	5	Omaha	46.8	WSW	2,500	5	Omaha	34.0	SW	6,822	7	Indianapolis.
South-Central ⁶	33.8	SW	1,530	9	Abilene	35.0	SSW	4,270	5	Amarillo	38.0	NW	9,960	7	Dallas.
Northwest ⁷	30.8	NNE	670	7	Pendleton	25.4	SSW	4,293	21	Spokane	34.6	N	7,733	4	Spokane.
West-Central ⁸	34.8	SSW	633	16	Redding	42.6	SSW	3,735	16	Modena	47.7	WNV	6,975	4	Modena.
Southwest ⁹	35.8	WSW	1,704	9	Winslow	40.6	WSW	3,018	4	Winslow	37.4	WSW	5,960	9	Albuquerque.

¹ Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.
² Delaware, Maryland, Virginia, West Virginia, Southern Ohio, Kentucky, Eastern Tennessee, and North Carolina.
³ South Carolina, Georgia, Florida and Alabama.
⁴ Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
⁵ Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
⁶ Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.
⁷ Montana, Idaho, Washington, and Oregon.
⁸ Wyoming, Colorado, Utah, northern Nevada, and Northern California.
⁹ Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

RIVERS AND FLOODS

[River and Flood Division, MERRILL BERNARD in charge]

By BENNETT SWENSON

The precipitation during June was normal or considerably above normal over most sections of the country while limited areas received only scanty amounts. The principal areas of above-normal precipitation were from Oklahoma northeastward to lower Michigan and New York, the Middle Atlantic Coastal Plains, New Mexico, northeastern Colorado, Washington, and in portions of Wyoming, Idaho, Oregon, and northern California. In portions of Washington the amounts were more than four times normal.

The floods resulting from excessive precipitation during the month are discussed below with a table of gage heights appearing at the end of the text.

Great Lakes drainage.—Floods in this section occurred from June 21 to 30 in the Red Cedar and Grand Rivers in Michigan, the St. Joseph River in Ohio and Indiana, and the Sandusky River in Ohio. These floods were the result of ample rains during the entire month with excessive rains occurring in the form of thunderstorms on the 20-21st and again on the 25th. The losses due to the floods were not extensive, except along the Sandusky River in Ohio, where damages amounting to \$690,000 were reported, mostly to growing crops.

Atlantic slope drainage.—Minor floods occurred during the month in the Santee and Savannah Rivers in South Carolina. No damage was reported.

Upper Mississippi Basin.—Heavy local rains over northern Illinois on June 20-21 resulted in local floods in the Rock River from June 22-29. The flat character of the country permitted the overflow to spread out and the losses suffered were mainly damage to crops. Approximately 3,500 acres of growing crops were inundated with a loss of \$200,000.

Minor flooding occurred in the Bourbeuse and Meramec Rivers in Missouri on June 10-12, but no losses of consequence were reported.

Missouri Basin.—Several local floods occurred in Montana during June but the most disastrous occurred at Billings, Mont., on the night of June 11-12. Among other localities flooded were Roundup, Klein, and Hinsdale, Mont. It is believed to be the first flood experienced

at Billings in the 54 years of its history. The damage that occurred in the city and the immediate vicinity is conservatively estimated to be over \$750,000.

Less severe floods in the Missouri Basin occurred in the upper Solomon River at Beloit, Kans., and in the lower Osage River in Missouri. The damage from the Solomon River was estimated at \$12,000, most of which was to growing crops, and the Osage River, \$45,500.

The greater portion of the Missouri River has been unusually low for a number of years as the result of deficient precipitation over much of the watershed. Sand bars and islands in the river that have not been inundated in the last few years are being used by farmers to an increasing extent to pasture cattle and some good crops have been produced of late on the bars that would, in most years, be flooded. For that reason, moderately high stages in the river after several years of low stages are of more than ordinary interest.

The unusually heavy rains from June 5-14 over Montana, Wyoming, North Dakota, and northern South Dakota resulted in a pronounced rise in the upper and middle Missouri River. Although the river exceeded flood stage only at Nebraska City, Nebr., it was necessary to issue warnings that the highest stage for several years during June would be reached from Bismarck, N. Dak., to St. Joseph, Mo., in order to protect livestock interests.

The high stages in the Missouri River resulted in damages amounting to about \$285,000, mostly to growing crops. Heavy local rains on June 17 in the southern Black Hills region (Cheyenne River watershed) of South Dakota caused damages amounting to about \$140,000 in the vicinity of Hot Springs, S. Dak.

Ohio Basin.—Floods in the Muskingum and Scioto Rivers in Ohio were caused by exceptionally heavy thunderstorms on June 21, together with abundant precipitation throughout the month, which left the ground in a saturated condition. The losses in the Muskingum River amounted to \$712,000 and in the Scioto River, \$100,000. The principal damage in each case was to growing crops.

Excessive rains occurred between 4 and 6 p. m. of the 21st over Gilmer and Lewis Counties in West Virginia and

parts of five adjoining counties. Glenville, W. Va., recorded 3.75 inches within a 2½-hour period. As a result of this storm the Little Kanawha rose rapidly, the stage at Glenville rising from 3.4 feet at 6 p. m. of the 21st, passing the flood stage of 23 feet at 10:30 p. m., and reaching a crest of 27.8 feet at 8 a. m. of the 22d. This flood was the third highest of record at Glenville and was very destructive in that vicinity, with losses estimated at \$20,000.

Minor flooding occurred on the West Fork of the White River at Anderson, Ind., but no damage resulted.

Arkansas Basin.—During the first half of the month heavy rains fell over much of the Arkansas Basin. These rains resulted in light to moderate floods in the Cimarron, Neosho, and North and South Canadian Rivers and a general rise in the Arkansas River.

The Cimarron River reached a stage of 12.1 feet at Perkins, Okla. (flood stage 11 feet) on the 16th as the result of a heavy rain on the 9th followed by additional heavy rains on the 14th and 15th. About 1,200 acres of wheat were damaged with a loss estimated at \$15,000.

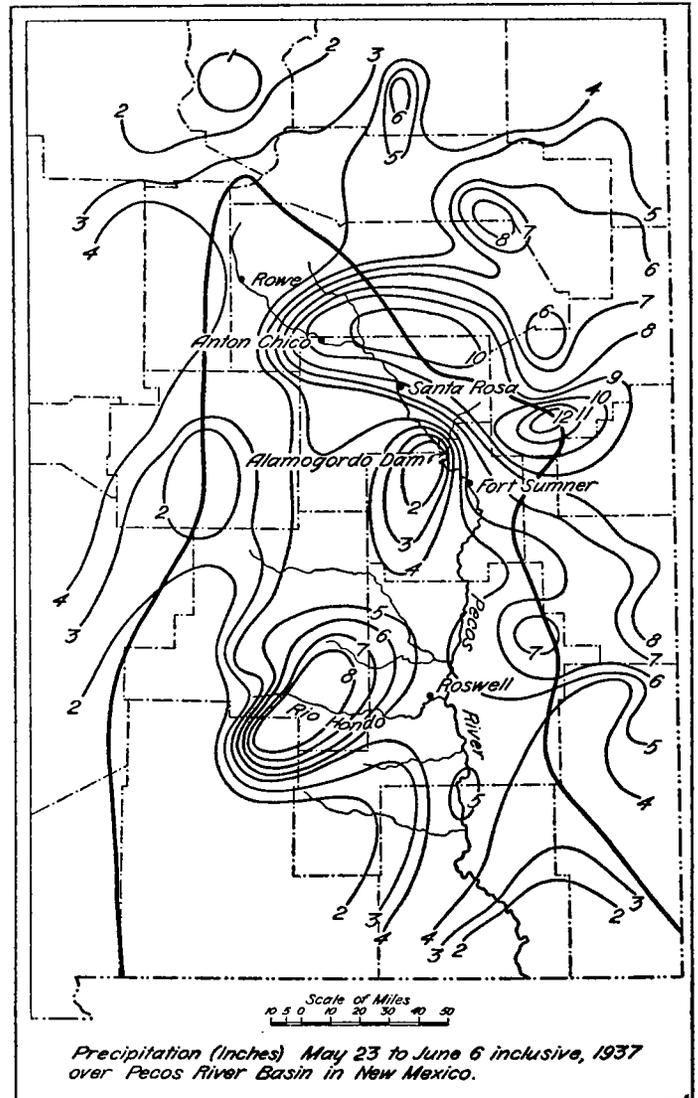
There were two moderate overflows in the lower Neosho River, one on June 10–11 and the other on June 15–17. The first overflow reached a stage of 20.5 feet at Oswego, Kans., on the 10th (flood stage 17 feet) and the second overflow resulted in a stage of 22.6 feet on the 16th. The total loss was estimated at \$66,000.

Excessive rains over the upper reaches of the Canadian River watershed at the close of May followed by frequent, heavy rains over much of the watershed during the first half of June resulted in a series of overflows along the North and South Canadian Rivers from May 31–June 26. The total losses incurred are estimated as follows: North Canadian in Oklahoma, \$330,600; South Canadian in Oklahoma, \$818,800; and North and South Canadian in New Mexico, \$6,800.

West Gulf of Mexico drainage.—Exceptionally heavy and general rains occurred over much of eastern New Mexico beginning on May 23 and continuing at frequent intervals until June 6. The total precipitation during this period, particularly over the Pecos drainage is shown in the accompanying chart. A total amount slightly in excess of 12 inches (see table) was recorded at Ragland, N. Mex., and much greater amounts probably occurred at some points where no rain gages were located.

Another center of heavy precipitation was located a short distance north of Santa Rosa where more than 10

inches were recorded. However, an airplane pilot reported on the afternoon of June 1 that extremely heavy rain was



falling over the upper Pecos River between Rowe and Anton Chico of which no actual measurement is available.

Daily precipitation, May 23–June 6, inclusive, 1937, at a few selected stations in the Pecos River drainage in New Mexico

Station	May										June						Total
	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6		
Alamogordo Dam	0.14	0.14				0.54	0.57									1.39	
Artesia	.90	1.00				3.14										5.04	
Boaz	2.20	.93							3.75		0.43	0.23				7.59	
Capitan		.88	0.18		0.31	2.16	.87			.17						4.57	
Corona	.01	1.31			.25	.18	1.68									3.43	
Cuervo		.78	.25	0.35	1.70	3.11	1.23			1.22		.83			0.15	9.02	
Doretta	.25	.75	.60	1.47	.23	.40	.42	0.04			.15	.10	0.08			4.49	
Fort Sumner	.47	.15		.34	.35	3.05	1.26	.18			.02	.25	.03			6.70	
Palma		.50	.25	1.20	.10	.50	.80			.28	.28	.65	1.76		0.09	8.66	
Ragland	.34	1.03		1.78	2.02	2.45	1.45		.28	.28	.65	1.76				12.13	
Roswell	1.38	.66				1.21	.29		.19			.86				4.04	
Santa Fe	.44	.38			.27	.99	1.86			.36						4.30	
Santa Rosa		.83			.50	2.10	2.20	.07			.80	.80	.15		.15	7.30	
Vaughn		.94		.40	1.10	1.60		.50				.50				5.04	
White Tail	1.20	1.57	.57	2.03	1.80	.33		.56		.67	.20					8.93	

A third area of excessive precipitation was centered over the upper Rio Hondo. This rainfall resulted in the Rio Hondo overflowing its banks and flooding the city of Roswell on May 28-29. The losses suffered in Roswell are estimated at \$13,500.

The excessive rainfall over the upper Pecos watershed gave rise to a serious situation along the Pecos River. The following report by the official in charge at Albuquerque, N. Mex., in regard to the floods in the Pecos River and in the Rio Grande is presented herewith:

Exceptionally heavy and general rains over eastern New Mexico caused much flood damage during May and June.

The most serious conditions were in the Pecos River watershed where record-breaking stages occurred. Extreme excessive rainfall occurred over a rather small area between Rowe and Anton Chico. This rainfall along with general rains over the entire watershed caused a peak stage at Santa Rosa of 29.0 feet, which is believed to be an all-time record.

The most serious problem was the unfinished Alamogordo Dam above Fort Sumner. The dam was nearly full of water from the May 28th rains and every effort possible was required to keep the dirt fill ahead of the water. This office received word of the excessive storm near Rowe from an airplane pilot and issued the warning to the officials at the Dam. Over 8 hours time was saved by issuing the warning when information was received from the pilot, instead of waiting until the water reached the gage at Santa Rosa.

Arrangements were made to warn the people in the Pecos Valley below Fort Sumner in case it was necessary to do so. Radio equipment was obtained and placed in planes ready to be sent to Fort Sumner in case telegraph and telephone lines failed. The Coast Guard was contacted at El Paso and they furnished much help by flying up and down the river and reporting flood conditions. They also stood by for possible help in case it would be necessary to issue flood warnings to the people below Fort Sumner.

Due to exceptionally heavy snowfall in the upper watershed of the Rio Grande the river was near flood stage at Espanola and Albuquerque, N. Mex., from May 1 to 31. No damage occurred at Espanola or Albuquerque, but some damage was reported at Bernalillo, about 20 miles north of Albuquerque, and much damage between Albuquerque and Elephant Butte Dam. The greatest damage occurred between Los Lunas and San Marcial. Much farming land in that section is lower than the normal river bed and is protected by dikes. The main flow of the river shifted, and this along with the continued high water caused many of the dikes to break on May 18, flooding rich farm lands and roads, and washing out tracks, etc.

On May 28 several severe thunderstorms occurred north and west of Socorro, about 3 p. m., causing a severe flood in the Rio Puerco and Rio Salado. Much damage occurred between Socorro and San Marcial, as the added water coming into the Rio Grande caused more dikes to break and added much water to already flooded areas. Much property and probably some lives were saved by advance warnings from this office, based on reports from two pilots that were in the vicinity of the severe rains when they occurred and reported direct by radio to this office. Some 2 hours' advance notice was given, which would have been impossible if the pilots had not reported, as there are no telephones or telegraph stations in that section. Four people in an automobile were trapped in an arroyo and were drowned.

The general rains during the first few days in June caused added trouble in the Rio Grande below Albuquerque, from the 1st to the 6th. Irrigation projects were flooded. The town of Belen was under water, and the low land between Socorro and San Marcial was again flooded. Road and railroad bridges were washed out below Socorro, blocking traffic between El Paso and Albuquerque.

Exceptionally heavy losses resulted from the overflows in the Pecos and Rio Grande in New Mexico during May and June, the greatest item being the damage to growing crops. The total estimated losses are as follows: Pecos River, \$987,600; and Rio Grande, \$787,500. The warnings are believed to have resulted in preventing a much greater loss.

Minor flooding occurred in the Guadalupe River in Texas from June 5-9, but no damage of consequence resulted.

Colorado Basin.—No floods occurred in the Colorado Basin except that an irrigation reservoir dam on the Gunnison River just above Austin, Colo., burst on June 13, resulting in severe local damage to the town of Austin

and to approximately 3,000 acres of land. The estimated losses amounted to about \$211,000.

Pacific Slope drainage.—The overflow in the San Joaquin Basin continued during the first part of June with stages in the Kings River exceeding flood stage at Piedra, Calif., from June 4-7. That portion of the water which could not be diverted for irrigation purposes continued to flow into Tulare Lake Basin until cooler weather during the latter half of the month brought about a more gradual run-off.

Although the precipitation was considerably above normal over the Columbia Basin during June flood stage was exceeded at only two points, Jefferson, Oreg., on the Santiam River and Vancouver, Wash., on the Columbia River. No damage resulted.

Corrections to April Report

Page 164, Table of flood stages.

Oneonta, N. Y., dates above flood stage and crest published as "From April 6, to April 7, crest 13.0 on April 6, 7" should be as follows (all dates in April):

Above flood stage—dates		Crest	
From—	To—	Stage	Date
6	9	14.0	6.7
16	18	12.9	16
23	24	12.4	23

Table of flood stages during June 1937

[All dates in June unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ST. LAWRENCE DRAINAGE					
<i>Lake Michigan</i>					
Red Cedar:	<i>Feet</i>			<i>Feet</i>	
Williamston, Mich.....	7	25	27	7.1	26
East Lansing, Mich.....	8	26	26	8.1	26
Grand:					
Eaton Rapids, Mich.....	5	25	30	7.1	27
Lansing, Mich.....	11	26	27	11.7	27
<i>Lake Erie</i>					
St. Joseph:					
Montpelier, Ohio.....	10	21	29	(1)	22
Fort Wayne, Ind.....	12	25	27	13.2	26
Sandusky: Tiffin, Ohio.....	7	22	24	9.4	22
		25	27	9.6	26
ATLANTIC SLOPE DRAINAGE					
Santee:					
Rimini, S. C.....	12	3	6	12.3	4
Ferguson, S. C.....	12	22	27	12.5	25
		26	27	12.0	26, 27
Savannah: Ellenton, S. C.....	14	22	22	14.2	22
MISSISSIPPI SYSTEM					
<i>Upper Mississippi Basin</i>					
Rock: Moline, Ill.....	10	22	29	11.2	25
Bourbeuse: Union, Mo.....	12	10	12	15.4	12
Meramec: Valley Park, Mo.....	14	10	12	15.0	10
<i>Missouri Basin</i>					
Solomon: Beloit, Kans.....	18	4	7	20.9	6
Osage: St. Thomas, Mo.....	23	16	16	18.0	16
		10	14	27.2	12
Missouri: Nebraska City, Nebr.....	15	21	29	16.5	25, 26
<i>Ohio Basin</i>					
Tuscarawas: Coshocton, Ohio.....	11	22	25	14.2	23
Muskingum:					
Lock No. 10, Zanesville, Ohio.....	25	22	23	27.6	22
Lock No. 7, McConnelsville, Ohio.....	22	22	24	26.6	22
Lock No. 3, Lowell, Ohio.....	25	22	23	25.2	23

1 "Over gage"; gage graduated to 14 feet.
 2 Fell 0.3 foot below flood stage on 28th.