REPORT ON CONNECTICUT RIVER, CONNECTICUT, MASSACHUSETTS, VERMONT, NEW HAMPSHIRE AND QUEBEC.

AUTHORIZED BY HOUSE DOCUMENT NO. 308, 69th CONGRESS, FIRST SESSION

APPENDIX

PASSUMPSIC RIVER, VERMONT

(9)

REPORT ON CONNECTICUT RIVER, CONNECTICUT, MASSACHUSETTS
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PASSUMPSIC RIVER, VERMONT

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REPORT ON CONNECTICUT RIVER
under House Document No. 308,
sixty-ninth Congress, first session

APPENDIX

PASSUMPSIC RIVER, VERMONT

S Y L L A B U S

It is the opinion of the district engineer that:-

(a) Improvement of the river for navigation is not justified.
(b) The river is subject to important flood damage which can be relieved by the construction of storage reservoirs. It would not be feasible for flood-control interests alone to finance such construction.
(c) There is potential water power and storage capable of being developed on an economic basis.
(d) Irrigation is not necessary.
(e) Power and flood-control interests might be coordinated to construct 2 specified reservoirs which would provide a large measure of flood protection and be of value to power interests. This project would be feasible for coordinated interests, but not feasible for either interest alone.
(f) Federal interests are not involved except possible flood damage to Federal-aid highways and participation in the cost of improvements for flood control or power development is not recommended.

I. PREVIOUS REPORTS

1. No previous reports have been made by this office.

II. DESCRIPTION OF THE WATERSHED

2. Location.- The Passumpsic River is wholly in Vermont. It rises in Bald Hill Pond in the eastern part of the town of Westmore, Orleans County; flows southeastward about 9 miles across Caledonia County to East Haven, Essex County; southwestward 14 miles to Lyndonville, Caledonia County; thence in a southerly direction, 20 miles through Lyndon, St. Johnsbury and Passumpsic to its junction with the Connecticut River at East Barnet, a total of 43 miles.

3. Area.- The drainage area is 907 square miles as shown in detail in the following table. It is roughly rectangular in shape. Its greatest length northerly from the mouth is 30 miles and its greatest width in an easterly and westerly direction is 25 miles.

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10/28/52

TABLE I. - Drainage areas, Passumpsic River and tributaries.

Miles from mouth		Location	Drainage area in square miles	
Passumpsic River	Tributaries		Tributaries	Passumpsic River
		Passumpsic River at -		
0.0		Mouth		507
0.6		Bridge at East Burnet		507
2.15		Junction with Joes Brook, including Joes Brook		504
		Joes Brook at -		
	0.0	Mouth	58	
	1.0	Mile 1.0 dam site	57	
	1.8	Mile 1.8 dam site	55	
	3.75	Mile 3.75 dam site	49	
	6.15	South Danville dam site	46	
	6.9	Mile 6.9 dam site	37	
	8.2	Mile 8.2 dam site	36	
	8.25	Junction with Keiser Pond Brook, including Keiser Pond Brook	36	
		Keiser Pond Brook at -		
	0.0	Mouth	3	
	0.3	Keiser Pond dam site	2	
	(0.3)	(Keiser Pond dam site including Joes Pond)	(31)	
		Joes Brook at -		
	8.25	Junction with Keiser Pond Brook, excluding Keiser Pond Brook	33	
	9.5	Mile 9.5 dam site	32	
	10.95	Green Mountain Power Corp. Plant No. 15 dam	29	
		Passumpsic River at -		
2.15		Junction with Joes Brook, excluding Joes Brook		446
3.4		Junction with Waterandrick Brook, including Waterandrick Brook		445
		Waterandrick Brook at -		
	0.0	Mouth	17	
	0.1	Waterandrick Brook dam site	17	
		Passumpsic River at -		
3.4		Junction with Waterandrick Brook, excluding Waterandrick Brook		428
4.0		U. S. Geological Survey gaging station at Passumpsic		423
8.1		Junction with Sleepers River, including Sleepers River		419
		Sleepers River and Burrough Brook at -		
	0.0	Mouth	42	
	3.3	Fish Hatchery dam site	41	
	Mileage continued on Burrough Brook			
	8.15	Goss Hollow dam site	11	

TABLE 4 - - Drainage areas, Passumpsic River and tributaries (Continued)

Miles from mouth		Location	Drainage area in square miles	
Passumpsic River	Tributaries		Tributaries	Passumpsic River
		Passumpsic River at -		
8.1		Junction with Sleepers River, excluding Sleepers River		377
9.35		Junction with Moose River, including Moose River		375
		Moose River at -		
	0.0	Mouth	118	
	0.7	St. Johnsbury dam site	118	
	0.9	U. S. Geological Survey gaging station at St. Johnsbury	*117	
	4.75	East St. Johnsbury dam site	105	
	9.5	Bridge at Concord	86	
	10.9	Junction with Kirby Brook, including Kirby Brook	84	
		Kirby Brook at -		
	0.0	Mouth	6	
	0.5	Mile 0.5 dam site	6	
		Moose River at -		
	10.9	Junction with Kirby Brook, excluding Kirby Brook	78	
	11.8	Mile 11.8 dam site	77	
	17.3	Victory dam site	66	
		Passumpsic River at -		
9.35		Junction with Moose River, excluding Moose River		257
11.9		Bridge at St. Johnsbury Center		245
18.4		Bridge at Lyndon		219
21.1		Junction with Millers Run, including Millers Run		202
		Millers Run at -		
	0.0	Mouth	56	
	0.5	Lyndon Center dam site	54	
	7.75	Bridge at Wheelock	32	
	10.0	Bridge at Sheffield	30	
		Passumpsic River at -		
21.1		Junction with Millers Run, excluding Millers Run		146
22.55		Junction with West Branch, Passumpsic River, including West Branch, Passumpsic River		144
		West Branch, Passumpsic River at -		
	0.0	Mouth	74	
	2.95	Junction with Calendar Brook, including Calendar Brook	70	
		Calendar Brook at -		
	0.0	Mouth	26	

* 112 by U. S. Geological Survey

TABLE 1 - Drainage areas, Passumpsic River and tributaries (Continued)

Miles from mouth		Location	Drainage area in square miles	
Passumpsic River	Tributaries		Tributaries	Passumpsic River
		West Branch, Passumpsic River at -		
	2.95	Junction with Calendar Brook, excluding Calendar Brook	44	
	8.5	Bridge at East Burke	8	
	14.1	Clark Pond dam site	3	
		Passumpsic River at -		
22.55		Junction with West Branch, Passumpsic River, excluding West Branch, Passumpsic River		70
23.95		Mile 23.95 dam site		70
27.1		Mile 27.1 dam site		58
32.3		Mile 32.3 dam site		48
34.45		Junction with East Branch, Passumpsic River, including East Branch, Passumpsic River		39
		East Branch, Passumpsic River at -		
	0.0	Mouth	17	
	2.0	Mile 2.0 dam site	13	
		Passumpsic River at -		
34.45		Junction with East Branch, Passumpsic River, excluding East Branch, Passumpsic River		22
Mileage continuous on Center Pond Brook				
38.5		Center Pond dam site		8

4. Topography and profile.- The topography is hilly and much of it is rocky with generally narrow stream valleys and steep wooded slopes. The branches from the west drain the eastern slope of the Green Mountains where elevations along the watershed frequently exceed 2,000 feet. Elevations along the river vary from 1308 at Center Pond (which is about a mile from the main river) to 660 at Lyndonville and 400 at the mouth. The average slope of the river from Center Pond to the mouth is about 22 feet per mile, it being steeper above Lyndonville than below. Graphic and tabular profiles are attached showing the slope of the river and principal branches. Drawing No. 1 is a plan and No. 2 is a profile of the Passumpsic River and several tributaries. Drawing No. 3 is a plan and Drawing No. 5, Sheet No.2 is a profile of Joes Brook, a branch joining the Passumpsic River about 2 miles above its mouth, which is one of the most precipitous streams in the Connecticut River Basin having a fall of 1,960 feet in 11 miles from Joes Pond to the mouth, or 178 feet per mile.

There are no large lakes in the basin and only about eight small ponds. The largest is Joes Pond with an area estimated at 40 to 45 acres. There is a considerable swamp area above Victory on Moose River but the lack of topographic maps in the Passumpsic Basin prevents a reliable estimate of the area of lakes and swamp lands. It is but a very small percentage of the whole.

TABLE 2 .- Profile of Passumpsic River and tributaries.

Location	Miles from mouth	Elevation above mean sea level	Fall in feet	Distance in miles	Slope in feet per mil
	Passumpsic River and Center Pond Brook				
Mouth to mile 0.45,	0.00 to 0.45	456.4 to 460.0	3.6	0.45	8.0
Mile 0.45 to Roy Bros. Mfg. Co. tail-water,	0.45 to 0.5	463.0 to 465.1	5.1	0.05	102.0
Roy Bros. Mfg. Co. dam,	0.5				
Tail-water,		465.1			
Toe,		479.1			
Crest,		487.3	22.2		
Pond,	0.5 to 3.15	487.3		2.65	
Roy Bros. Mfg. Co. pond to U.S. Geological Survey Gaging Station	3.15 to 4.0	487.3 to 491.0	3.7	0.85	4.4

TABLE 2 .- Profile of Passumpsic River and tributaries (Continued).

Location	Miles from mouth	Elevation above mean sea level	Fall in feet	Distance in miles	Slope in feet per mile
U.S. Geological Survey Gaging Station to Canadian Pacific Rwy. bridge,	4.0 to 4.9	491.0 to 493.7	2.7	0.9	0.3
Canadian Pacific Railway bridge to Twin State Gas & Electric Co. Plant #4 tail-water,	4.9 to 5.1	493.7 to 497.1	3.4	0.2	17.5
Twin State Gas & Electric Co. Plant #4 dam,	5.1				
Tail-water,		497.1			
Toe,		513.2			
Crest,		520.2			
Flashboards,		521.2	24.1		
Pond,	5.1 to 7.0	521.2		1.9	
Twin State Gas & Electric Co. Plant #4 pond to Twin State Gas & Electric Co. Plant #3 tail-water,	7.0 to 7.3	521.2 to 522.9	1.7	0.3	5.7
Twin State Gas & Electric Co. Plant #3 dam,	7.3				
Tail-water,		522.9			
Toe,		522.9			
Crest,		533.0			
Flashboards,		539.9	17.0		
Pond,	7.3 to 8.1	539.9		0.8	
Twin State Gas & Electric Co. Plant #3 pond to mile 8.5,	8.1 to 8.5	539.9 to 541.0	1.1	0.4	2.8
Mile 8.5 to Twin State Gas & Electric Co. Plant #2 tail-water,	8.5 to 8.9	541.0 to 545.3	4.3	0.4	10.8
Twin State Gas & Electric Co. Plant #2 dam,	8.9				
Tail-water,		545.3			
Toe,		561.1			
Crest,		554.2			
Flashboards,		554.9	9.6		
Pond,	8.9 to 9.2	554.9		0.3	
Twin State Gas & Electric Co. Plant #2 pond to Twin State Gas & Electric Co. Plant #1-1/2 tail-water,	9.2 to 9.6	554.9 to 555.7	0.8	0.4	2.0
Twin State Gas & Electric Co. Plant #1-1/2 dam,	9.6				
Tail-water,		555.7			
Toe,		560.5			
Crest,		573.0			
Flashboards,		574.8	19.1		
Pond,	9.6 to 12.05	574.8		2.45	
Twin State Gas & Electric Co. Plant #1-1/2 Pond to Twin State Gas & Electric Co. Plant #1 broken dam,	12.05 to 12.1	574.8 to 575.1	0.3	0.05	6.0
Twin State Gas & Electric Co. Plant #1 broken dam,	12.1				
Water elev. below,		575.1			
Water elev. above,		579.2	4.1		

TABLE 2 .- Profile of Passumpsic River and tributaries (Continued).

Location	Miles from mouth	Elevation above mean sea level	Fall in feet	Distance in miles	Slope in feet per mile
Twin State Gas & Electric Co. Plant #1 broken dam to Twin State Gas & Electric Co. Plant #0 tail-water,	12.1 to 15.0	579.2 to 587.8	8.6	2.9	3.0
Twin State Gas & Electric C . Plant #0 dam,	15.0				
Tail-water,		587.8			
Toe,		591.3			
Crest,		604.2			
Flashboards,		605.0	17.2		
Pond,	15.0 to 16.4	605.0		1.4	
Twin State Gas & Electric Co. Plant #0 Pond to Lyndonville Electric Co. tail-water,	16.4 to 16.45	605.0 to 605.6	0.6	0.05	12.0
Lyndonville Electric Co. development,	16.45 to 16.6			0.15	
Tail-water,	16.45	605.6			
Toe,	16.6	626.7			
Crest,		666.7	61.1		
Pond,	16.6 to 17.2	666.7		0.6	
Lyndonville Electric Co. pond to Canadian Pacific Railway bridge,	17.2 to 17.5	666.7 to 667.9	1.2	0.3	4.0
Canadian Pacific Railway bridge to Lyndonville Electric Co. tail-water,	17.5 to 17.65	667.9 to 671.6	3.7	0.15	24.7
Lyndonville Electric Co. dam,	17.65				
Tail-water,		671.6			
Toe,		671.6			
Crest,		686.9	15.3		
Pond,	17.65 to 18.0	686.9		0.36	
Lyndonville Electric Co. Pond to Millers Run,	18.0 to 21.1	686.9 to 691.0	4.1	3.1	1.3
Millers Run to highway bridge,	21.1 to 22.6	691.0 to 702.1	11.1	1.5	7.4
Highway bridge to Mile 23.95 dam site,	22.6 to 23.95	702.1 to 728.0	25.9	1.35	19.2
Mile 23.95 dam site to highway bridge,	23.95 to 24.5	728.0 to 740.1	12.1	0.55	22.0
Highway bridge to mile 25.7,	24.5 to 25.7	740.1 to 775.0	34.9	1.2	29.1
Mile 25.7 to Mile 27.1 power-house site,	25.7 to 26.88	775.0 to 804.0	29.0	1.18	24.6
Mile 27.1 power-house site to E. A. Darling Estate dam,	26.88 to 26.9	804.0 to 804.4	0.4	0.02	20.0
E. A. Darling Estate dam,	26.9				
Water elevation below,		804.4			
Crest,		815.6	11.2		
Pond,	26.9 to 27.15			0.25	
(Mile 27.1 dam site)	27.1	815.6			
E. A. Darling Estate pond to mile 28.65,	27.15 to 28.65	815.6 to 830.0	14.4	1.5	9.6

TABLE 2 .- Profile of Passumpsi River and tributaries (Continued).

Location	Miles from mouth	Elevation above mean sea level	Fall in feet	Distance in miles	Slope in feet per mile
Mil 28.65 to mile 29.15,	28.65 to 29.15	830.0 to 839.0	9.0	0.5	18.0
Mil 29.15 to Mile 32.3 power-house site,	29.15 to 29.8	839.0 to 863.0	24.0	0.65	36.9
Mile 32.3 power-house site to mile 30.15,	29.8 to 30.15	863.0 to 879.0	16.0	0.35	45.7
Mile 30.15 to mile 31.3,	30.15 to 31.3	879.0 to 930.0	51.0	1.15	44.3
Mil 31.3 to Mile 32.3 dam site,	31.3 to 32.3	930.0 to 953.4	23.4	1.0	23.4
Mile 32.3 dam site to broken dam,	32.3 to 33.0	953.4 to 976.2	22.8	0.7	32.6
Broken dam,	33.0				
Water elevation below,		976.2			
Water elevation above,		978.8	2.6		
Broken dam to mile 34.2,	33.0 to 34.2	978.8 to 1003.0	24.2	1.2	20.2
Mil 34.2 to East Branch, Passumpsic River,	34.2 to 34.45	1003.0 to 1011.0	8.0	0.25	32.0
East Branch, Passumpsic River to mile 36.0,	34.45 to 36.0	1011.0 to 1134.0	123.0	1.55	79.4
Mile 36.0 to mile 36.2,	36.0 to 36.2	1134.0 to 1181.0	47.0	0.2	235.0
Mil 36.2 to mile 36.75,	36.2 to 36.75	1181.0 to 1209.0	28.0	0.55	50.9
Mile 36.75 to mile 37.4 Center Pond Brook,	36.75 to 37.4	1209.0 to 1224.0	15.0	0.65	23.1
Profile continued on Center Pond Brook					
Center Pond Brook mile 37.4 to mile 37.8,	37.4 to 37.8	1224.0 to 1239.0	15.0	0.4	37.5
Mile 37.8 to E. A. Donaldson tail-water,	37.8 to 38.0	1239.0 to 1254.0	15.0	0.2	75.0
E. A. Donaldson dam,	38.0 to 38.05			0.05	
Tail-water,	38.0	1254.0			
Toe,	38.05	1256.0			
Crest,		1277.0	23.0		
Pond,	38.05 to 38.1	1277.0		0.05	
E. A. Donaldson pond to Center Pond dam site,	38.1 to 38.45	1277.0 to 1301.5	24.5	0.35	70.0
Center Pond dam site to toe of Center Pond dam,	38.45 to 38.5	1301.5 to 1306.0	4.5	0.05	90.0
Center Pond dam,	38.5				
Toe,		1306.0			
Crest,		1308.5	2.0		
Pond,	38.5 to 39.0	1308.0		0.5	
DOUBLE SPACE → ALL CAPS →	**JOES BROOK AND KEISER POND BROOK**				
Mouth to Mil 1.0 power-house site,	0.0 to 0.37	487.3 to 499.0	10.9	0.37	29.5
Mile 1.0 power-house site to mile 0.7,	0.37 to 0.7	499.0 to 540.0	41.0	0.33	124.2
Mile 0.7 to Mile 1.0 dam site,	0.7 to 1.0	540.0 to 582.0	42.0	0.3	140.0
Mil 1.0 dam site to E. M. Randall broken dam,	1.0 to 1.5	582.0 to 592.6	10.6	0.5	21.2
E. M. Randall broken dam	1.5				
Below dam,		592.6			
Above dam,		596.1	3.5		
Pond,	1.5 to 1.7	596.1		0.2	

TABLE 2 .- Profile of Passumpsic River and tributaries (Continued).

Location	Miles from mouth	Elevation above mean sea level	Fall in feet	Distance in miles	Slope in feet per mile
E. N. Randall broken dam pond to mile 1.9,	1.7 to 1.9	596.1 to 619.8	23.7	0.2	118.5
Mile 1.9 to Warden Brook	1.9 to 2.3	619.8 to 625.8	6.0	0.4	15.0
Warden Brook to Mile 3.75 power-house site,	2.3 to 2.6	625.8 to 640.0	14.2	0.3	47.3
Mile 3.75 power-house site to mile 2.7,	2.6 to 2.7	640.0 to 651.0	11.0	0.1	110.0
Mile 2.7 to Mile 3.75 dam site,	2.7 to 3.75	651.0 to 758.2	107.2	1.05	102.1
Mile 3.75 dam site to mile 4.0,	3.75 to 4.0	758.2 to 775.9	17.7	0.25	70.8
Mile 4.0 to South Danville power-house site,	4.0 to 4.45	775.9 to 813.0	37.1	0.45	82.4
South Danville power-house site to Daniell, Clifford & James broken dam,	4.45 to 4.55	813.0 to 820.0	7.0	0.1	70.0
Daniell, Clifford & James broken dam,	4.55				
Below dam,		820.0			
Above dam,		827.0	7.0		
Daniell, Clifford & James broken dam to Daniell, Clifford & James dam,	4.55 to 4.75	827.0 to 840.5	13.5	0.2	67.5
Daniell, Clifford & James dam,	4.75				
Tail-water,		840.5			
Toe,		845.7			
Crest,		851.5	11.0		
Pond,	4.75 to 4.85	851.5		0.1	
Daniell, Clifford & James pond to mile 5.0,	4.85 to 5.0	851.5 to 890.0	38.5	0.15	256.7
Mile 5.0 to mile 5.6,	5.0 to 5.6	890.0 to 1021.0	131.0	0.6	218.3
Mile 5.6 to South Danville dam site,	5.6 to 6.15	1021.0 to 1121.3	100.3	0.55	182.3
South Danville dam site to Mile 6.9 power-house site,	6.15 to 6.6	1121.3 to 1157.0	35.7	0.55	64.9
Mile 6.9 power-house site to Green Mountain Power Corp. dam,	6.6 to 6.85	1157.0 to 1198.6	41.6	0.2	208.0
Green Mountain Power Corp. dam,	6.85				
Toe,		1198.6			
Crest,		1209.1	10.5		
Pond,	6.85 to 7.1	1209.1		0.2	
(Mile 6.9 dam site)	6.85	1198.6			
Green Mountain Power Corp. pond to highway bridge,	7.1 to 7.4	1209.1 to 1219.2	10.1	0.3	33.7
Highway bridge to mile 8.0,	7.4 to 8.0	1219.2 to 1235.0	15.8	0.6	26.3
Mile 8.0 to Keiser Pond power-house site,	8.0 to 8.2	1235.0 to 1239.5	4.5	0.2	22.5
Keiser Pond power-house site to Keiser Pond Brook,	8.2 to 8.25	1239.5 to 1242.3	2.8	0.05	56.0
Keiser Pond Brook to mile 8.5,	8.25 to 8.5	1242.3 to 1251.0	8.7	0.25	34.8

TABLE 2 .- Profile of Passumpsic River and tributaries (Continued).

Location	Miles from mouth	Elevation above mean sea level	Fall in feet	Distance in mile	Slope in feet per mile
Mil 8.5 to mile 9.25,	8.5 to 9.25	1251.0 to 1302.4	51.4	0.75	68.5
Mile 9.25 to mile 9.5,	9.25 to 9.5	1302.4 to 1343.2	40.8	0.25	163.2
Mile 9.5 to mile 9.7,	9.5 to 9.7	1343.2 to 1352.6	9.4	0.2	47.0
Mil 9.7 to Green Mountain Power Corp. development #15 tail-water,	9.7 to 10.4	1352.6 to 1377.2	24.6	0.7	35.1
Green Mountain Power Corp. development #15 tail-water to broken dam,	10.4 to 10.8	1377.2 to 1471.9	94.7	0.4	236.8
Broken dam,	10.8				
Below dam,		1471.9			
Above dam,		1474.5	2.6		
Broken dam to broken dam,	10.8 to 10.85	1474.5 to 1486.5	12.0	0.05	240.0
Broken dam,	10.85				
Below dam,		1486.5			
Above dam,		1492.5	6.0		
Broken dam to toe of Green Mountain Power Corp. dam #15,	10.85 to 10.95	1492.5 to 1538.0	45.5	0.1	455.0
(Joes Pond development dam site),	10.95	1538.0			
Green Mountain Power Corp. development #15					
(Tail-water)	(10.4)	(1377.2)			
Toe,	10.95	1538.0			
Crest,		1547.0			
Flashboards,		1548.5	10.5		
Pond,	10.95 to 13.5			2.55	
Keiser Pond Brook					
Mouth to Keiser Pond dam site,	0.0 to 0.3	1242.3 to 1289.8	47.5	0.3	158.0
Keiser Pond dam site to Keiser Pond,	0.3 to 0.35	1289.8 to 1292.2	2.4	0.05	48.0
Keiser Pond,	0.35 to 0.85	1292.2		0.5	
Sleepers River and Burrough Brook					
Mouth to Canadian Pacific Railway bridge,	0.0 to 0.3	539.9 to 544.4	4.5	0.3	15.0
Canadian Pacific Railway bridge to highway bridge,	0.3 to 0.5	544.4 to 544.4	0.0	0.2	0.0
Highway bridge to toe of Fairbanks Scale Co. dam,	0.5 to 1.6	544.4 to 564.2	19.8	1.1	18.0
Fairbanks Scale Co. dam,	1.6				
Toe,		564.2			
Crest,		569.4	5.2		
Pond,	1.6 to 2.1	569.4		0.5	
Fairbanks Scale Co. pond to Fish Hatchery power-house site,	2.1 to 3.2	569.4 to 590.0	20.6	1.1	18.7
Fish Hatchery power-house site to toe of U.S. Fish Hatchery dam,	3.2 to 3.25	590.0 to 636.1	46.1	0.05	922.0
U.S. Fish Hatchery dam,	3.25				
Toe,		636.1			
Crest,		640.1	4.0		

TABLE 2 .- Profile of Passumpsic River and tributaries (Continued).

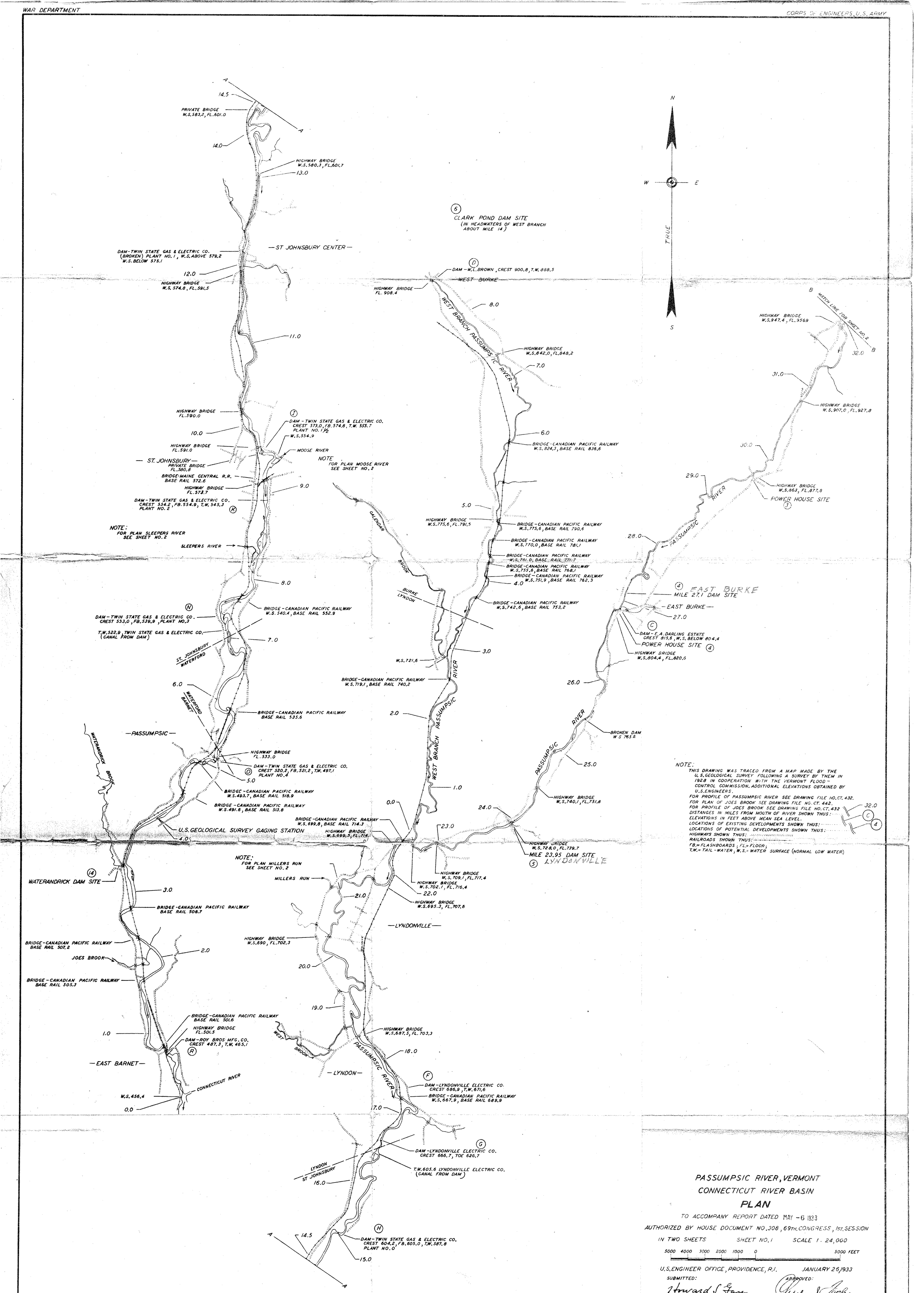
Location	Miles from mouth	Elevation above mean sea level	Fall in feet	Distance in miles	Slope in feet per mile
U.S. Fish Hatchery dam to Fish Hatchery dam site,	3.25 to 3.3	640.1 to 641.5	1.4	0.05	28.0
Fish Hatchery dam site to mile 4.0,	3.3 to 4.0	641.5 to 646.[illegible]	4.5	0.7	6.4
Mile 4.0 to highway bridge,	4.0 to 4.45	646.0 to 665.7	19.7	0.45	43.8
Highway bridge to highway bridge,	4.45 to 4.8	665.7 to 685.3	19.6	0.35	56.0
Highway bridge to Burrough Brook,	4.8 to 5.2	685.3 to 696.4	11.1	0.4	27.8
Profile continued on Burrough Brook					
Burrough Brook to mile 5.35	5.2 to 5.35	696.4 to 7[illegible]5.0	8.6	0.15	57.3
Mile 5.35 to mile 6.0,	5.35 to 6.0	7[illegible]5.0 to 77[illegible].0	65.[illegible]	0.65	100.0
Mile 6.0 to highway bridge,	6.0 to 6.35	77[illegible].0 to 814.1	44.1	0.35	126.0
Highway bridge to mile 7.25	6.35 to 7.25	814.1 to 852.[illegible]	17.9	0.9	19.9
Mile 7.25 to mile 8.0,	7.25 to 8.0	852.[illegible] to 87[illegible].0	38.0	0.75	50.7
Mile 8.0 to Coos Hollow dam site,	8.0 to 8.15	87[illegible].0 to 891.3	21.3	0.15	142.0
Moose River					
Mouth to highway bridge,	0.0 to 0.25	554.9 to 555.4	0.5	0.25	2.0
Highway bridge to St. Johnsbury power-house site,	0.25 to 0.45	555.4 to 56[illegible].0	4.6	0.2	23.0
(St. Johnsbury dam site),	0.7	582.7			
St. Johnsbury power-house site to toe of American Fork & Hoe Co. dam,	0.45 to 0.7	56[illegible].0 to 582.8	22.8	0.25	91.2
American Fork & Hoe Co. dam,	0.7				
Water elev. below,		582.8			
Crest,		591.2	8.4		
American Fork & Hoe Co. dam to toe of J.W. Davies & Co. and Manton Gaylin Mfg. Co. dam,	0.7 to 0.85	591.2 to 592.7	1.5	0.15	10.0
J.W. Davies & Co. and Manton-Gaylin Mfg. Co. dam,	0.85				
Water elev. below,		592.7			
Crest,		606.1	13.4		
J.W. Davies & Co. and Manton-Gaylin Mfg. Co. dam to East St. Johnsbury power-house site,	0.85 to 1.1	606.1 to 615.0	8.9	0.25	35.6
East St. Johnsbury power-house site to highway bridge,	1.1 to 3.0	615.0 to 714.5	99.5	1.9	52.4
Highway bridge to highway bridge,	3.0 to 3.75	714.5 to 740.0	25.5	0.75	34.0
Highway bridge to mile 4.5,	3.75 to 4.5	74[illegible].0 to 759.0	19.0	0.75	25.3
Mile 4.5 to Maine Central Railroad bridge,	4.5 to 4.6	759.0 to 765.9	6.9	0.1	69.0
Maine Central Railroad bridge to broken dam,	4.6 to 4.75	765.9 to 781.3	15.4	0.15	102.7

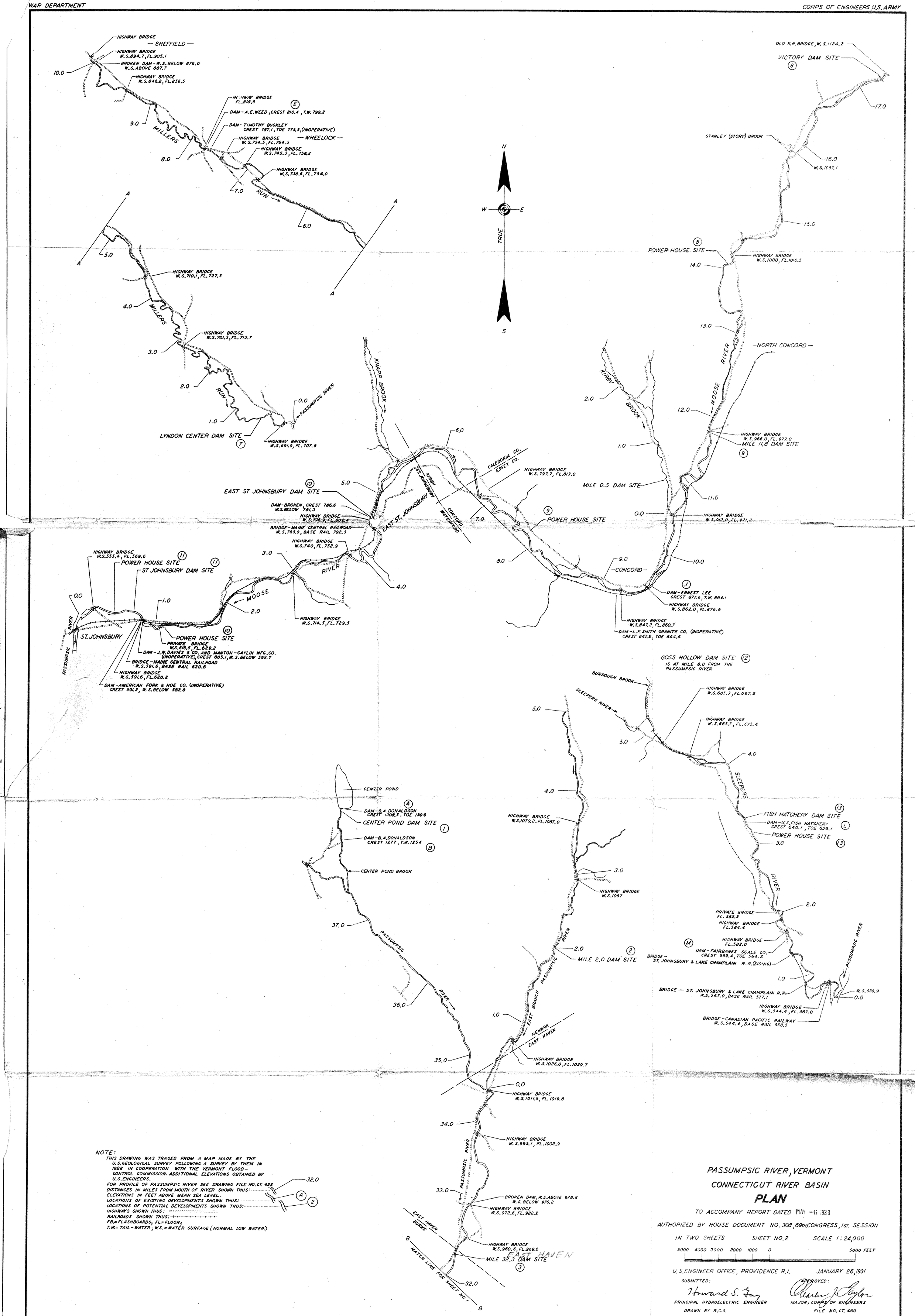
TABLE 2 .- Profile of Passumpsic River and tributaries (Continued).

Location	Miles from mouth	Elevation above mean sea level	Fall in feet	Distance in miles	Slope in feet per mile
(East St. Johnsbury dam site)	4.75	780.2			
Broken dam,	4.75				
Water elev. below,		781.3			
Crest,		786.6	5.3		
Pond,	4.75 to 5.2	786.6		0.45	
Broken dam pond to highway bridge,	5.2 to 6.85	786.6 to 797.7	11.1	1.65	6.7
Highway bridge to Mile 11.8 power-house site,	6.85 to 7.8	797.7 to 800.0	2.3	0.95	2.4
Mil 11.8 power-house site to L.F. Smith Granite Co. tail-water,	7.8 to 9.3	800.0 to 854.3	34.3	1.5	22.9
L.F. Smith Granite Co. development,	9.3 to 9.5			0.2	
Tail-water,	9.3	854.3			
Toe,	9.5	844.4			
Crest,		847.2	12.9		
L.F. Smith Granite Co. dam to Ernest Lee tail-water,	9.5 to 9.65	847.2 to 864.1	16.9	0.15	112.7
Ernest Lee dam,	9.65				
Tail-water,		864.1			
Crest,		877.6	13.5		
Pond,	9.65 to 9.85	877.6		0.2	
Ernest Lee pond to mile 10.5,	9.85 to 10.5	877.6 to 910.0	32.4	0.65	49.8
Mile 10.5 to mile 10.8,	10.5 to 10.8	910.0 to 940.0	30.0	0.3	100.0
Mile 10.8 to mile 11.35,	10.8 to 11.35	940.0 to 960.0	20.0	0.55	36.4
Mile 11.35 to Mile 11.8 dam site,	11.35 to 11.8	960.0 to 966.1	6.1	0.45	13.6
Mile 11.8 dam site to mile 13.9,	11.8 to 13.9	966.1 to 980.0	13.9	2.1	6.6
Mil 13.9 to Victory power-house site,	13.9 to 14.1	980.0 to 990.0	10.0	0.2	50.0
Victory power-house site to mile 14.6,	14.1 to 14.6	990.0 to 1020.0	30.0	0.5	60.0
Mil 14.6 to mile 16.0,	14.6 to 16.0	1020.0 to 1060.0	40.0	1.4	28.6
Mile 16.0 to mile 16.4,	16.0 to 16.4	1060.0 to 1075.0	15.0	0.4	37.5
Mile 16.4 to mile 16.65,	16.4 to 16.65	1075.0 to 1090.0	15.0	0.25	60.0
Mil 16.65 to Victory dam site,	16.65 to 17.3	1090.0 to 1119.5	29.5	0.65	45.4
Victory dam site to mile 17.35,	17.3 to 17.35	1119.5 to 1124.2	4.7	0.05	94.0
Millers Run					
Mouth to mile 3.45	0.0 to 3.5	691.0 to 704.0	13.0	3.5	3.7
(Lyndon Center dam site),	0.5	693.0			
Mile 3.5 to mile 5.6,	3.5 to 5.6	704.0 to 722.0	18.0	2.1	8.6
Mil 5.6 to highway bridge,	5.6 to 6.75	722.0 to 738.6	16.6	1.15	14.4
Highway bridge to mile 6.85	6.75 to 6.85	738.6 to 743.0	4.4	0.1	44.0
Mile 6.85 to highway bridge,	6.85 to 7.5	743.0 to 754.5	11.5	0.65	17.7
Highway bridge to toe of Timothy Buckley dam,	7.5 t 7.7	754.5 t 775.5	21.0	0.2	105.0
Timothy Buckley dam,	7.7				
Toe,		775.5			
Crest		787.1	11.6		
Pond,	7.7 to 7.75	787.1		0.05	

TABLE 2 .- Profile of Passumpsic River and tributaries (Continued).

Location	Miles from mouth	Elevation above mean sea level	Fall in feet	Distance in miles	Slope in feet per mile
Timothy Buckley pond to A. E. Reed tail-water,	7.75 to 7.8	787.1 to 799.2	12.1	0.05	242.0
A. E. Reed dam,	7.8				
Tail-water,		799.2			
Toe,		805.5			
Crest,		81[illegible].4			
Pond,	7.8 to 8.0	81[illegible].4	11.2	[illegible].2	56.0
A. E. Reed pond to mile 9.15,	8.0 to 9.15	81[illegible].4 to 83[illegible].0	19.6	1.15	17.0
Mile 9.15 to highway bridge,	9.15 to 9.3	83[illegible].0 to 846.8	16.8	0.15	112.0
Highway bridge to mile 9.55,	9.3 to 9.55	846.8 to 85[illegible]	3.2	[illegible].25	12.8
Mile 9.55 to mile 9.8,	9.55 to 9.8	85[illegible] to 86[illegible]	1[illegible].0	0.25	4[illegible].0
Mile 9.8 to broken dam,	9.8 to 9.95	86[illegible] to 876.0	16.[illegible]	[illegible].15	106.7
Broken dam,	9.95				
Water elev. below,		876.0			
Water elev. above,		887.7	11.7		
Broken dam to highway bridge at Sheffield,	9.95 to 1[illegible].0	887.7 to 894.7	7.0	[illegible].05	140.0
West Branch					
Mouth to mile 1.0,	[illegible].0 to 1.0	7[illegible]1.0 to 71[illegible].5	9.0	1.0	9.0
Mile 1.0 to Calender Brook,	1.0 to 2.95	71[illegible].0 to 721.6	11.6	1.95	5.9
Calender Brook to mile 3.3,	2.95 to 3.3	721.6 to 73[illegible].0	8.4	[illegible].35	24.0
Mile 3.3 to Canadian Pacific Railway bridge,	3.3 to 3.6	73[illegible].0 to 742.6	12.6	0.3	42.0
Canadian Pacific Railway bridge to Canadian Pacific Railway bridge,	3.6 to 4.4	742.6 to 761.0	18.4	0.8	23.0
Canadian Pacific Railway bridge to Canadian Pacific Railway bridge,	4.4 to 4.85	761.0 to 775.6	14.6	0.45	32.4
Canadian Pacific Railway bridge to highway bridge,	4.85 to 4.9	775.6 to 775.6	0.0	0.05	0.0
Highway bridge to mile 5.0,	4.9 to 5.0	775.6 to 78[illegible].0	4.4	0.1	44.0
Mile 5.0 to mile 5.45,	5.0 to 5.45	78[illegible].0 to 79[illegible].5	1[illegible].0	0.45	22.2
Mile 5.45 to mile 5.7,	5.45 to 5.7	79[illegible].0 to 82[illegible].0	3[illegible].0	0.25	12[illegible].0
Mile 5.7 to mile 7.25,	5.7 to 7.25	82[illegible].0 to 84[illegible].0	2[illegible].0	1.55	12.9
Mile 7.25 to highway bridge,	7.25 to 7.3	84[illegible].0 to 842.0	2.0	[illegible].05	4[illegible].0
Highway bridge to mile 7.7,	7.3 to 7.7	842.0 to 85[illegible].0	8.[illegible]	[illegible].4	2[illegible].0
Mile 7.7 to mile 8.4,	7.7 to 8.4	85[illegible].0 to 879.0	29.0	0.7	41.4
Mile 8.4 to N. L. Brown tail-water,	8.4 to 8.5	879.0 to 888.5	9.5	0.1	95.0
N. L. Brown dam,	8.5				
Tail-water,		888.5			
Toe,		888.8			
Crest,		900.8	12.3		
East Branch					
Mouth to mile [illegible].3,	[illegible].0 to [illegible].3	1011.0 to 1[illegible]	9.[illegible]	[illegible].3	3[illegible].0
Mile 0.3 to mile 1.15,	0.3 to 1.15	1020.0 to 1028.0	8.0	0.85	9.4
Mile 1.15 to mile 2.0 dam site,	1.15 to 2.0	1028.0 to 1047.2	19.2	0.85	22.6
Mile 2.0 dam site to highway bridge,	2.0 to 3.6	1047.2 to 1079.2	32.0	1.6	2[illegible].0
Highway bridge to mile 5.0,	3.6 to 5.0	1079.2 to 1123.0	43.8	1.4	31.3


N
S
E
W
TRUE
A
A
14.5
PRIVATE BRIDGE W.S.583.2, FL.601.0
14.0
HIGHWAY BRIDGE W.S.580.3, FL.601.7
13.0
ST JOHNSBURY CENTER
DAM-TWIN STATE GAS & ELECTRIC CO. (BROKEN) PLANT NO. 1, W.S. ABOVE 579.2 W.S. BELOW 575.1
12.0
HIGHWAY BRIDGE W.S. 574.8, FL. 591.5
11.0
HIGHWAY BRIDGE FL.590.0
10.0
HIGHWAY BRIDGE FL.591.0
ST. JOHNSBURY
PRIVATE BRIDGE FL.580.8
BRIDGE-MAINE CENTRAL R.R. BASE RAIL 572.6
HIGHWAY BRIDGE FL.573.7
9.0
DAM-TWIN STATE GAS & ELECTRIC CO. CREST 554.2, FB.554.9, T.W. 545.3 PLANT NO. 2
K
NOTE: FOR PLAN SLEEPERS RIVER SEE SHEET NO. 2
SLEEPERS RIVER
8.0
N
DAM-TWIN STATE GAS & ELECTRIC CO. CREST 533.0, FB.539.9, PLANT NO.3
T.W.522.9 TWIN STATE GAS & ELECTRIC CO. (CANAL FROM DAM)
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.540.4, BASE RAIL 552.9
7.0
ST. JOHNSBURY
WATERFORD
6.0
WATERFORD
BARNET
BRIDGE-CANADIAN PACIFIC RAILWAY BASE RAIL 535.6
PASSUMPSIC
WATERANDRICK BROOK
HIGHWAY BRIDGE FL.533.0
DAM-TWIN STATE GAS & ELECTRIC CO. CREST 520.2, FB.521.2, T.W. 497.1 PLANT NO.4
O
5.0
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.493.7, BASE RAIL 518.9
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.491.6, BASE RAIL 513.8
U.S. GEOLOGICAL SURVEY GAGING STATION
4.0
14
WATERANDRICK DAM SITE
3.0
BRIDGE-CANADIAN PACIFIC RAILWAY BASE RAIL 508.7
BRIDGE-CANADIAN PACIFIC RAILWAY BASE RAIL 507.2
JOES BROOK
2.0
BRIDGE-CANADIAN PACIFIC RAILWAY BASE RAIL 505.3
BRIDGE-CANADIAN PACIFIC RAILWAY BASE RAIL 501.6
HIGHWAY BRIDGE FL.501.5
1.0
DAM-ROY BROS MFG. CO. CREST 487.3, T.W. 465.1
R
EAST BARNET
CONNECTICUT RIVER
W.S.456.4
0.0
6
CLARK POND DAM SITE (IN HEADWATERS OF WEST BRANCH ABOUT MILE 14)
D
DAM-W.L.BROWN, CREST 900.8, T.W. 888.5
WEST BURKE
HIGHWAY BRIDGE FL. 908.4
8.0
WEST BRANCH PASSUMPSIC RIVER
HIGHWAY BRIDGE W.S.842.0, FL.848.2
7.0
I
DAM-TWIN STATE GAS & ELECTRIC CO. CREST 573.0, FB.574.8, T.W. 555.7 PLANT NO. 1½
W.S.554.9
MOOSE RIVER
NOTE FOR PLAN MOOSE RIVER SEE SHEET NO. 2
6.0
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.824.3, BASE RAIL 836.6
GALENDAR BROOK
5.0
HIGHWAY BRIDGE W.S.775.6, FL.791.5
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.775.6, BASE RAIL 790.6
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.770.0, BASE RAIL 781.1
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.761.0, BASE RAIL 771.7
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.755.6, BASE RAIL 768.1
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.751.9, BASE RAIL 762.3
4.0
BURKE
LYNDON
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.742.6, BASE RAIL 753.2
3.0
W.S.721.6
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.719.1, BASE RAIL 740.2
2.0
WEST BRANCH PASSUMPSIC RIVER
0.0
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.699.8, BASE RAIL 714.3
HIGHWAY BRIDGE W.S.699.5, FL.714.
NOTE: FOR PLAN MILLERS RUN SEE SHEET NO. 2
MILLERS RUN
21.0
HIGHWAY BRIDGE W.S.690, FL.702.3
20.0
LYNDONVILLE
19.0
WEST BROOK
LYNDON
HIGHWAY BRIDGE W.S.687.5, FL.703.3
PASSUMPSIC RIVER
18.0
F
DAM-LYNDONVILLE ELECTRIC CO. CREST 686.9, T.W. 671.6
BRIDGE-CANADIAN PACIFIC RAILWAY W.S.667.9, BASE RAIL 689.9
17.0
G
DAM-LYNDONVILLE ELECTRIC CO. CREST 666.7, TOE 626.7
T.W.605.6 LYNDONVILLE ELECTRIC CO. (CANAL FROM DAM)
LYNDON
ST JOHNSBURY
16.0
H
DAM-TWIN STATE GAS & ELECTRIC CO. CREST 604.2, FB.605.0, T.W.587.8 PLANT NO.0
14.5
15.0
A
A
B
B
MATCH LINE FOR SHEET NO. 2
HIGHWAY BRIDGE W.S.947.4, FL.956.9
32.0
31.0
HIGHWAY BRIDGE W.S.907.0, FL.927.8
30.0
29.0
HIGHWAY BRIDGE W.S.863, FL.877.8
POWER HOUSE SITE
3
PASSUMPSIC RIVER
28.0
4
EAST BURKE
MILE 27.1 DAM SITE
EAST BURKE
27.0
C
DAM-E.A.DARLING ESTATE CREST 815.6, W.S. BELOW 804.4
POWER HOUSE SITE
4
HIGHWAY BRIDGE W.S.804.4, FL.820.6
26.0
BROKEN DAM W.S. 765±
PASSUMPSIC RIVER
25.0
HIGHWAY BRIDGE W.S.740.1, FL.751.8
24.0
HIGHWAY BRIDGE W.S.728.0, FL.739.7
MILE 23.95 DAM SITE
5
LYNDONVILLE
23.0
HIGHWAY BRIDGE W.S.709.1, FL.717.4
HIGHWAY BRIDGE W.S.702.1, FL.716.4
22.0
HIGHWAY BRIDGE W.S.695.3, FL.707.6
NOTE:
THIS DRAWING WAS TRACED FROM A MAP MADE BY THE U.S.GEOLOGICAL SURVEY FOLLOWING A SURVEY BY THEM IN 1928 IN COOPERATION WITH THE VERMONT FLOOD-CONTROL COMMISSION. ADDITIONAL ELEVATIONS OBTAINED BY U.S.ENGINEERS.
FOR PROFILE OF PASSUMPSIC RIVER SEE DRAWING FILE NO.CT. 432.
FOR PLAN OF JOES BROOK SEE DRAWING FILE NO.CT. 462.
FOR PROFILE OF JOES BROOK SEE DRAWING FILE NO.CT. 432
DISTANCES IN MILES FROM MOUTH OF RIVER SHOWN THUS:
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL.
LOCATIONS OF EXISTING DEVELOPMENTS SHOWN THUS:
LOCATIONS OF POTENTIAL DEVELOPMENTS SHOWN THUS:
HIGHWAYS SHOWN THUS:
RAILROADS SHOWN THUS:
FB.= FLASHBOARDS; FL.= FLOOR;
T.W.= TAIL-WATER; W.S.= WATER SURFACE (NORMAL LOW WATER)
32.0
C
4
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
PLAN
TO ACCOMPANY REPORT DATED MAY -6 1933
AUTHORIZED BY HOUSE DOCUMENT NO.308, 69TH. CONGRESS, 1ST. SESSION
IN TWO SHEETS
SHEET NO. 1
SCALE 1. 24,000
5000 4000 3000 2000 1000 0 5000 FEET
U.S. ENGINEER OFFICE, PROVIDENCE, R.I.
JANUARY 26, 1933
SUBMITTED:
Howard S. Fay
PRINCIPAL HYDROELECTRIC ENGINEER
DRAWN BY R.C.S.
APPROVED:
Charles L. Tyler
MAJOR, CORPS OF ENGINEERS
FILE NO.CT. 460


HIGHWAY BRIDGE
— SHEFFIELD —
HIGHWAY BRIDGE W.S.894.7, FL.905.1
BROKEN DAM - W.S. BELOW 876.0 W.S. ABOVE 887.7
HIGHWAY BRIDGE W.S.846.8, FL.856.5
HIGHWAY BRIDGE FL.818.6
DAM - A.E. WEED; CREST 810.4, T.W. 799.2
DAM - TIMOTHY BUCKLEY CREST 787.1, TOE 775.5, (INOPERATIVE)
— WHEELOCK —
HIGHWAY BRIDGE W.S.754.5, FL.764.5
HIGHWAY BRIDGE W.S.745.3, FL.758.2
HIGHWAY BRIDGE W.S.738.6, FL.754.0
MILLERS RUN
HIGHWAY BRIDGE W.S.710.1, FL.727.5
HIGHWAY BRIDGE W.S.701.3, FL.713.7
HIGHWAY BRIDGE W.S.691.9, FL.707.8
PASSUMPSIC RIVER
LYNDON CENTER DAM SITE
N
W
E
S
TRUE
OLD R.R. BRIDGE, W.S. 1124.2
VICTORY DAM SITE
STANLEY (STORY) BROOK
W.S. 1057.1
POWER HOUSE SITE
HIGHWAY BRIDGE W.S.1000, FL.1010.5
KNAPP BROOK
KIRBY BROOK
MOOSE RIVER
—NORTH CONCORD—
HIGHWAY BRIDGE W.S.966.0, FL.977.0
MILE 11.8 DAM SITE
CALEDONIA CO.
ESSEX CO.
HIGHWAY BRIDGE W.S.797.7, FL.813.0
MILE 0.5 DAM SITE
EAST ST JOHNSBURY DAM SITE
DAM - BROKEN, CREST 786.6 W.S. BELOW 781.3
HIGHWAY BRIDGE W.S.776.9, FL.802.4
BRIDGE - MAINE CENTRAL RAILROAD W.S.765.9, BASE RAIL 792.5
HIGHWAY BRIDGE W.S.740, FL.752.9
EAST ST. JOHNSBURY
ST. JOHNSBURY
KIRBY
CONCORD
WATERFORD
POWER HOUSE SITE
HIGHWAY BRIDGE W.S.912.0, FL.921.2
—CONCORD—
DAM - ERNEST LEE CREST 877.6, T.W. 864.1
HIGHWAY BRIDGE W.S.862.0, FL.876.6
HIGHWAY BRIDGE W.S.847.2, FL.860.7
DAM - L.F. SMITH GRANITE CO. (INOPERATIVE) CREST 847.2, TOE 844.4
HIGHWAY BRIDGE W.S.555.4, FL.569.6
POWER HOUSE SITE
ST JOHNSBURY DAM SITE
MOOSE RIVER
HIGHWAY BRIDGE W.S.714.5, FL.729.5
ST. JOHNSBURY
PASSUMPSIC RIVER
POWER HOUSE SITE
PRIVATE BRIDGE W.S.616.5, FL.629.2
DAM - J.W. DAVIES & CO. AND MANTON - GAYLIN MFG. CO. (INOPERATIVE), CREST 605.1, W.S. BELOW 592.7
BRIDGE - MAINE CENTRAL RAILROAD W.S.591.6, BASE RAIL 620.6
HIGHWAY BRIDGE W.S.591.6, FL.620.2
DAM - AMERICAN FORK & HOE CO. (INOPERATIVE) CREST 591.2, W.S. BELOW 582.8
GOSS HOLLOW DAM SITE
IS AT MILE 8.0 FROM THE PASSUMPSIC RIVER
BURROUGH BROOK
SLEEPERS RIVER
HIGHWAY BRIDGE W.S.685.3, FL.697.2
HIGHWAY BRIDGE W.S.665.7, FL.675.4
SLEEPERS RIVER
FISH HATCHERY DAM SITE
DAM - U.S. FISH HATCHERY CREST 640.1, TOE 636.1
POWER HOUSE SITE
CENTER POND
DAM - B.A. DONALDSON CREST 1308.5, TOE 1306
CENTER POND DAM SITE
DAM - B.A. DONALDSON CREST 1277, T.W. 1254
CENTER POND BROOK
PASSUMPSIC RIVER
HIGHWAY BRIDGE W.S.1079.2, FL.1087.0
HIGHWAY BRIDGE W.S.1067
MILE 2.0 DAM SITE
PRIVATE BRIDGE FL.582.5
HIGHWAY BRIDGE FL.584.4
HIGHWAY BRIDGE FL.582.0
DAM - FAIRBANKS SCALE CO. CREST 569.4, TOE 564.2
BRIDGE - ST. JOHNSBURY & LAKE CHAMPLAIN R.R. (SIDING)
BRIDGE — ST. JOHNSBURY & LAKE CHAMPLAIN R.R. W.S. 547.0, BASE RAIL 577.1
HIGHWAY BRIDGE W.S.544.4, FL. 567.0
BRIDGE - CANADIAN PACIFIC RAILWAY W.S.544.4, BASE RAIL 558.5
W.S. 539.9
EAST BRANCH PASSUMPSIC RIVER
NEWARK
EAST HAVEN
HIGHWAY BRIDGE W.S.1026.0, FL.1039.7
HIGHWAY BRIDGE W.S.1011.5, FL.1019.8
HIGHWAY BRIDGE W.S.995.1, FL.1002.9
BROKEN DAM, W.S. ABOVE 978.8 W.S. BELOW 976.2
HIGHWAY BRIDGE W.S.972.6, FL.982.2
HIGHWAY BRIDGE W.S.960.6, FL.969.6
MILE 32.3 DAM SITE
EAST HAVEN
EAST HAVEN
BURKE
MATCH LINE FOR SHEET NO 1
NOTE:
THIS DRAWING WAS TRACED FROM A MAP MADE BY THE U.S. GEOLOGICAL SURVEY FOLLOWING A SURVEY BY THEM IN 1928 IN COOPERATION WITH THE VERMONT FLOOD-CONTROL COMMISSION. ADDITIONAL ELEVATIONS OBTAINED BY U.S. ENGINEERS.
FOR PROFILE OF PASSUMPSIC RIVER SEE DRAWING FILE NO. CT. 432
DISTANCES IN MILES FROM MOUTH OF RIVER SHOWN THUS:
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL.
LOCATIONS OF EXISTING DEVELOPMENTS SHOWN THUS:
LOCATIONS OF POTENTIAL DEVELOPMENTS SHOWN THUS:
HIGHWAYS SHOWN THUS:
RAILROADS SHOWN THUS:
FB. = FLASHBOARDS; FL. = FLOOR;
T.W. = TAIL-WATER; W.S. = WATER SURFACE (NORMAL LOW WATER.)
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
PLAN
TO ACCOMPANY REPORT DATED MAY -6 1933
AUTHORIZED BY HOUSE DOCUMENT NO. 308, 69TH CONGRESS, 1ST. SESSION
IN TWO SHEETS
SHEET NO. 2
SCALE 1:24,000
5000 4000 3000 2000 1000 0 5000 FEET
U.S. ENGINEER OFFICE, PROVIDENCE R.I.
JANUARY 26, 1931
SUBMITTED:
Howard S. Fay
PRINCIPAL HYDROELECTRIC ENGINEER
DRAWN BY R.C.S.
APPROVED:
Charles J. Taylor
MAJOR, CORPS OF ENGINEERS
FILE NO. CT. 460

NOTE:
FOR PLAN OF PASSUMPSIC RIVER SEE DRAWING FILE No. CT. 460
ELEVATIONS PRINCIPALY BY U.S. ENGINEERS.
CIRCLES "O" INDICATE HIGH WATERMARKS IN NOVEMBER 1927.
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL.
DISTANCES IN MILES FROM THE CONNECTICUT AND PASSUMPSIC RIVERS.
SURVEYED IN 1928 BY THE U.S. GEOLOGICAL SURVEY IN COOPERATION WITH THE VERMONT FLOOD-CONTROL COMMISSION.
F.B.= FLASHBOARDS; FL.= FLOOR; T.W.= TAIL-WATER; W.S.= WATER SURFACE.

PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
PROFILE

TO ACCOMPANY REPORT DATED MAY -6 1933
AUTHORIZED BY HOUSE DOCUMENT No. 308, 69TH. CONGRESS, 1ST. SESSION

IN TWO SHEETS SHEET NO. 1 SCALE AS SHOWN

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. FEBRUARY 21, 1931

SUBMITTED: Howard S. Gray, PRINCIPAL HYDROELECTRIC ENGINEER
DRAWN BY S.W.T.

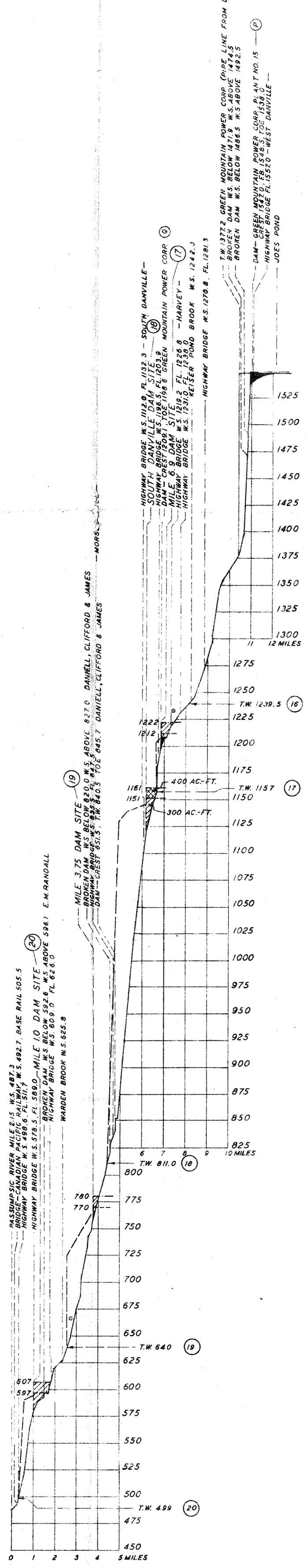
APPROVED: Charles D. Taylor, MAJOR, CORPS OF ENGINEERS
FILE No. CT-432

— LEGEND —

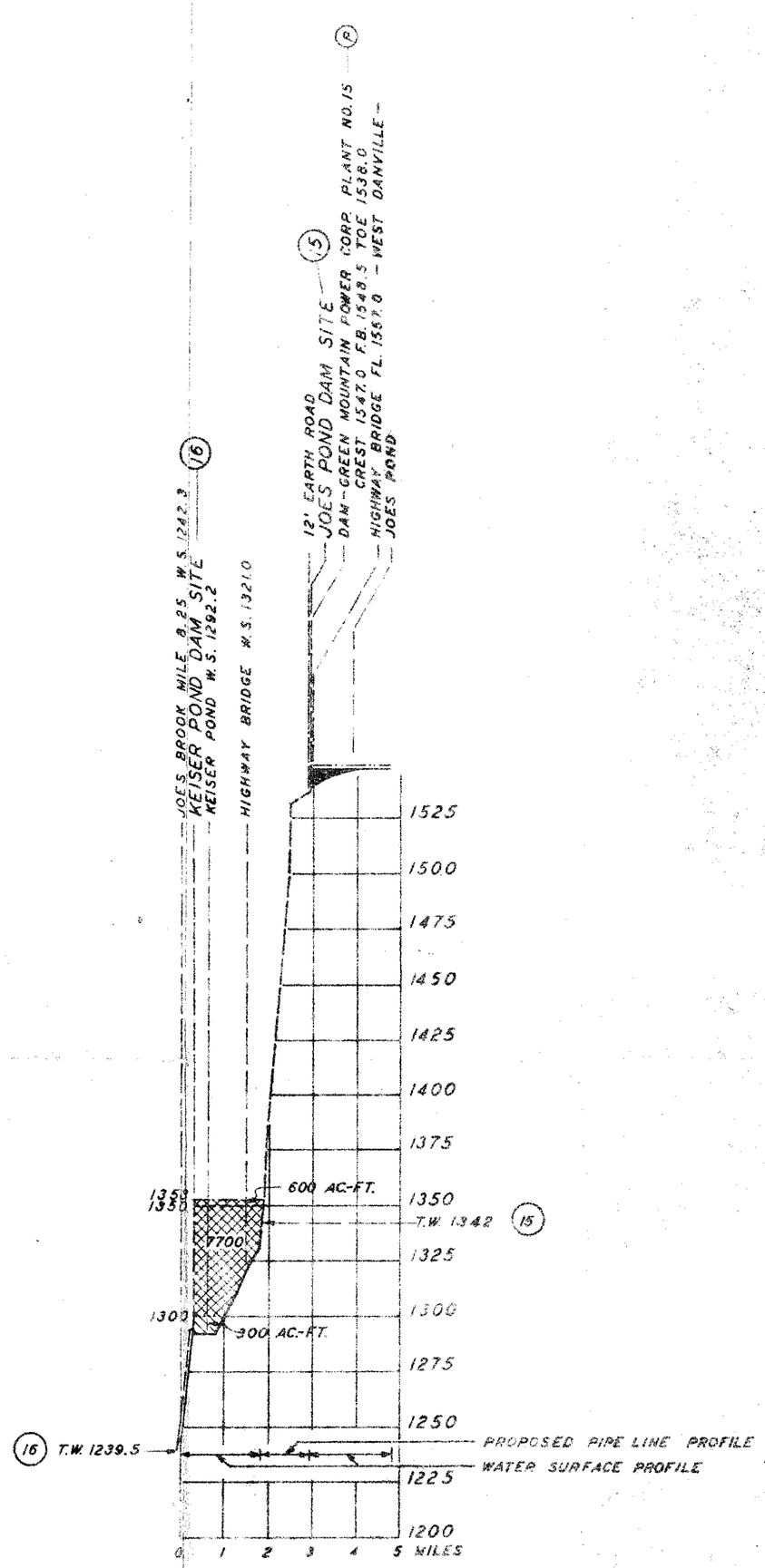
- ELEVATION OF HIGH WATER AT DAM.
- ELEVATION OF FLASHBOARDS.
- ELEVATION OF FLASHBOARDS AND HIGH WATER AT DAM.
- ELEVATION OF CREST.
- ELEVATION OF LOWEST DRAFT FOR POWER.
- FLOOD STORAGE
- POWER AND FLOOD STORAGE
- EXISTING DEVELOPMENT.
- PIPE LINE
- RECOMMENDED DEVELOPMENT.
- REJECTED DEVELOPMENT.

NOTE:

CIRCLES "G" INDICATE HIGH WATERMARKS IN NOVEMBER 1927.
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL.
DISTANCES IN MILES FROM THE PASSUMPSIC RIVER.
FOR PLAN OF JOES BROOK SEE DRAWING FILE No. CT. 442.
FB. = FLASHBOARDS ; FL. = FLOOR ;
T.W. = TAIL-WATER ; W.S. = WATER SURFACE.



JOES BROOK



PROFILE OF KEISER POND BROOK; POND AND PROPOSED PIPE LINE FROM JOES POND

JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
PROFILE

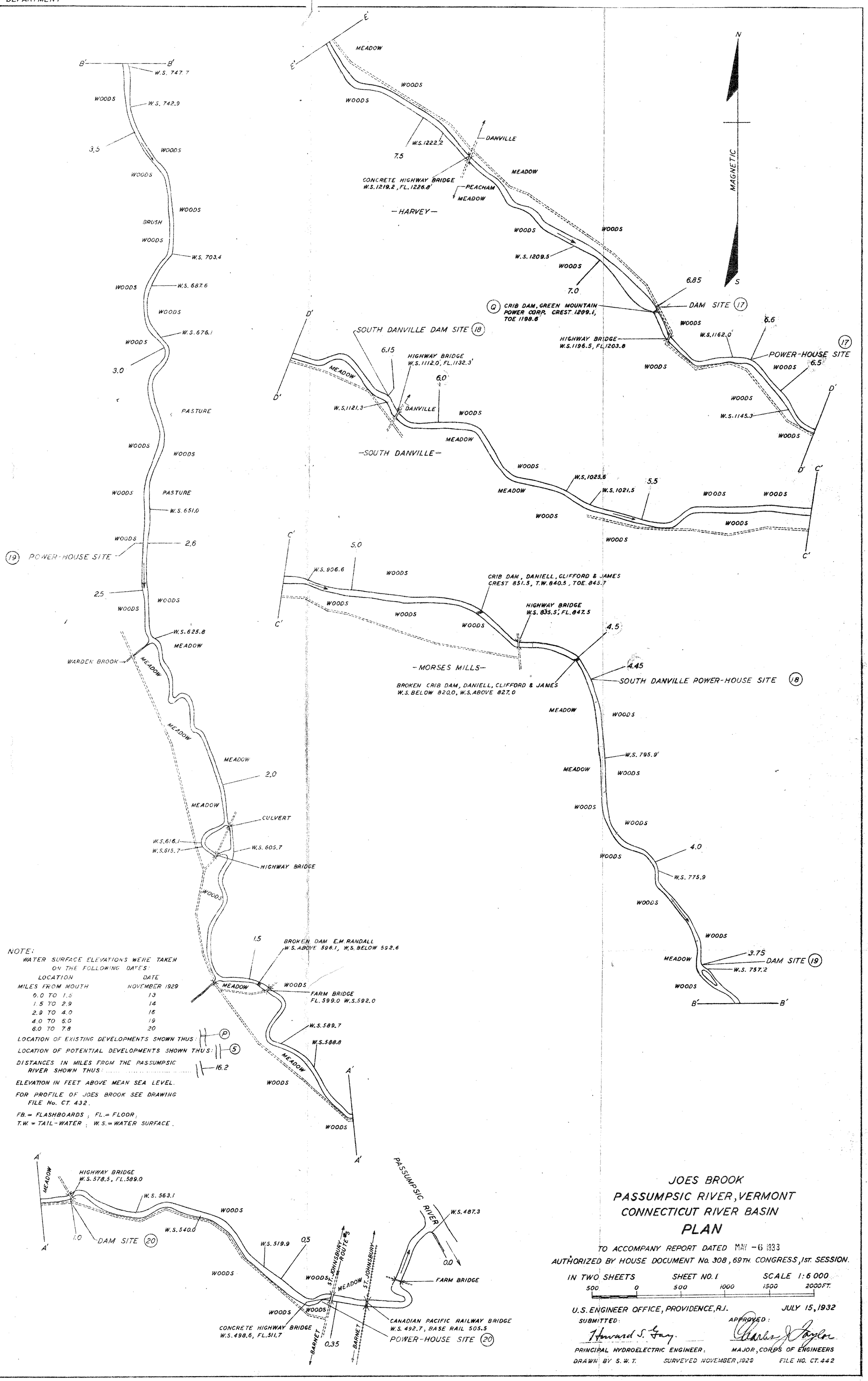
TO ACCOMPANY REPORT DATED MAY - 6 1933
AUTHORIZED BY HOUSE DOCUMENT No. 308, 69TH. CONGRESS, 1ST. SESSION

IN TWO SHEETS — SHEET NO. 2 — SCALE AS SHOWN

U. S. ENGINEER OFFICE, PROVIDENCE, R.I. — FEBRUARY 14, 1931.

SUBMITTED: Howard S. Gray — PRINCIPAL HYDROELECTRIC ENGINEER
APPROVED: Charles J. Taylor — MAJOR, CORPS OF ENGINEERS

DRAWN BY S.W.T. — SURVEYED NOVEMBER 1929 — FILE NO. CT. 492



JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
PLAN

TO ACCOMPANY REPORT DATED MAY -6 1933
AUTHORIZED BY HOUSE DOCUMENT No. 308, 69TH. CONGRESS, 1ST. SESSION.

IN TWO SHEETS — SHEET NO. 1 — SCALE 1:6 000

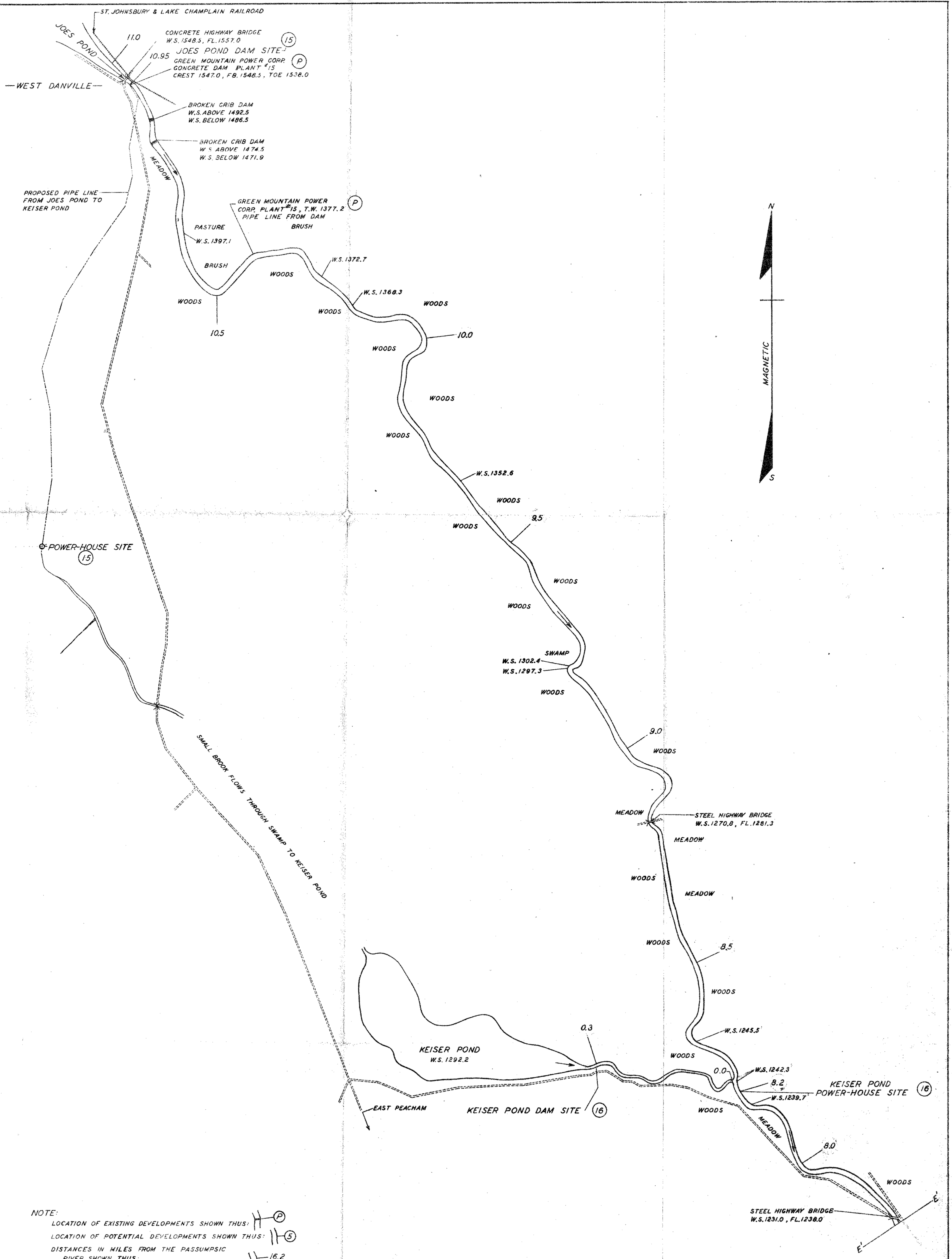
500 0 500 1000 1500 2000 FT.

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — JULY 15, 1932

SUBMITTED: Howard S. Fay — PRINCIPAL HYDROELECTRIC ENGINEER.

APPROVED: Charles J. Taylor — MAJOR, CORPS OF ENGINEERS

DRAWN BY S. W. T. — SURVEYED NOVEMBER, 1929 — FILE NO. CT. 442



NOTE:

LOCATION OF EXISTING DEVELOPMENTS SHOWN THUS: —(P)

LOCATION OF POTENTIAL DEVELOPMENTS SHOWN THUS: —(5)

DISTANCES IN MILES FROM THE PASSUMPSIC RIVER SHOWN THUS: ..... —16.2

ELEVATION IN FEET ABOVE MEAN SEA LEVEL.

FOR PROFILE OF JOES BROOK SEE DRAWING FILE No. CT. 432.

FB. = FLASHBOARDS ; FL. = FLOOR ;
T.W. = TAIL-WATER ; W.S. = WATER SURFACE.

WATER SURFACE ELEVATIONS WERE TAKEN ON THE FOLLOWING DATES:

LOCATION	DATE
MILES FROM MOUTH OF JOES BROOK	NOVEMBER, 1929
7.8 TO 8.9	21
8.9 TO 10.0	22
10.0 TO 11.0	23

JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
PLAN

TO ACCOMPANY REPORT DATED MAY -6 1933

AUTHORIZED BY HOUSE DOCUMENT NO. 308, 69TH. CONGRESS, 1ST. SESSION

IN TWO SHEETS — SHEET NO. 2 — SCALE 1:6000

500 0 500 1000 1500 2000 FT.

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — JULY 15, 1932

SUBMITTED: Howard S. Gay — PRINCIPAL HYDROELECTRIC ENGINEER

APPROVED: Charles J. Taylor — MAJOR, CORPS OF ENGINEERS

DRAWN BY S.W.T. — SURVEYED NOVEMBER, 1929 — FILE NO. CT. 442

5. Geology.- See this title in the Connecticut River section of this report. The Passumpsic valley is in effect a continuation of the Connecticut Valley below Fifteen Mile Falls. At its mouth and as far as St. Johnsbury it falls over a succession of rock ledges. The rocks are mainly limestone and schist. The overburden is calcareous soil well suited for agriculture. The valley is terraced and modified drift is in evidence. Probings at many sites showed sand or gravel with occasional evidence of clay.

6. Climate.- St. Johnsbury at an elevation of 711 in the south central part of the basin has a mean annual temperature of 4[illegible].1 degrees Fahrenheit (58 years record) compared with 45.9 degrees for New England (44 years record). The mean monthly temperature is as follows:

Station	Elevation	January	February	March	April	May	June
St. Johnsbury	711	15.6	16.7	28.7	42.1	54.5	63.5

Station	July	August	September	October	November	December	Annual
St. Johnsbury	69.1	65.8	58.3	47.6	34.1	2[illegible].5	43.1

Data regarding mean minimum and mean maximum temperature, and snowfall may be estimated from the records at [illegible]nsburg Falls, Vt., 51 miles to the northwest from St. Johnsbury, and at Northfield, Vt., 37 miles to the southwest as follows:

Station	Elevation	Temperature in degrees Fahrenheit			Snowfall in inches
		Mean	Mean maximum	Mean minimum	
		(1)	(2)	(2)	(2)
St. Johnsbury	711	45.1			
[illegible]nsburg Falls	601	42.5	53.2	31.[illegible]	99.6
Northfield	876	41.4	51.8	3[illegible].5	85.2

(1) Record to 1931 inclusive.
(2) Record to 192[illegible] inclusive.

The river is generally frozen throughout the winter.

7. Population.- The populations (1930) of the principal villages are as follows: St. Johnsbury, 7,92 ; Lyndonville, 1,559; East Burke, 559. The populations of the principal towns are as follows: St. Johnsbury, 9,690; Lyndon, 3,285; Danville, 1,600; Burke, 1,[illegible]16. The total population of the 12 towns which practically comprise the drainage area is 19,290 or 38 per square mile on the 507 square miles of drainage area. This is 5.4 per cent of the population of Vermont. The population of Caledonia County which is composed principally of the drainage areas of the Passumpsic, Stevens and Wells Rivers, is 27,253, or 44.1 per square mile on 618 square miles.

8. Roads.- All communities of any importance are served by improved roads including a considerable mileage of concrete road running north, south and west from St. Johnsbury. Highway facilities seem to be sufficient for the needs of the basin.

9. Railroads.- The Canadian Pacific Railway running northward from its connection with the Boston and Maine Railroad at Woodsville, N. H. traverses the length of the basin, passing through the principal communities and connecting with the Maine Central Railroad which runs easterly from St. Johnsbury to Portland, Me., and with the St. Johnsbury and Lake Champlain Railroad which runs westerly from St. Johnsbury to a connection with the Central Vermont Railway near Lake Champlain. Railroad facilities seem to be sufficient for the needs of the basin.

10. Navigation.- There is no boat service in the basin.

11. Activities.- The rural activity is largely dairy farming. The 193 census states there are 1,397 farms in the 12 towns comprising the basin, totaling 2[illegible]5,597 acres and valued at $6,699,240.

The following statistics refer to Caledonia County which has an area of 618 square miles, as compared with 5[illegible]7 square miles for the Passumpsic River Basin:

Agricultural statistics

	Census of 192[illegible]	Census of 193[illegible]	Ratio of 193[illegible] to 192[illegible] in per cent
Number of farms	2,313	2,[illegible]85	90
Acreage in farms	339,548	3[illegible],927	89
Value of farms, land and buildings	$12,356,[illegible]97	$1[illegible],2[illegible]4,[illegible]45	85
Value of live stock on farms	3,651,264	2,897,124	79
Value of dairy products sold	[illegible],442,185	2,449,778	100
Value of crops	3,525,767	1,66[illegible],334	47
Value of forest products cut	-	4[illegible]8,162	-
Value of chickens and chicken eggs produced	349,[illegible]84	490,[illegible]62	14[illegible]

Industrial activities are located in communities along the river. The largest center is St. Johnsbury.

Industrial statistics

	Census of 1919	Census of 1929	Ratio of 1929 to 1919 in per cent
Number of manufacturing establishments	(1) 155	(1) 74	-
Value of output	$1[illegible],671,868	$ 9,682,187	90
Number of wage earners	2,[illegible]37	1,897	78
Annual wages	$ 2,225,432	$ 2,[illegible]06,571	90
Rated capacity in horsepower of installed mechanical and electrical power	12,509	10,75[illegible]	86

(1) Figures are not comparable. The figures for 1919 refer to all establishments having products valued at $500 or more, whereas figures for 1929 refer to establishments having products valued at $5,000 or more. This change has very little effect on the other items in the table.

The 193[illegible] census states there are 9,[illegible]64 males and 1,88[illegible] females, or a total of 10,944 gainfully employed in all industries. Those industries employing the greatest number are as follows:

Agriculture	2,929
Building	1,475
Iron and steel	966
Clay, glass, and stone industry	299
Food and allied products	207
Saw and planing mills	114
Other manufacturing industries	729
Wholesale and retail trade, except automobiles	931
Steam and street railroads,	347
Professional and semi-professional service	619
Domestic and personal service	689
Other non-manufacturing industries or service	1,659
	10,944

12. Use of electrical power.- The principal use for electric power is for industrial power, heat and light in the villages and for use on the farms in rural districts.

13. Progress of the community.- The population decreased 1 per cent from 1910 to 1920 and increased 5.8 per cent from 1920 to 1930. Rural activities, as measured by the acreage in farm lands, decreased about 11 per cent from 1920 to 1930. Industrial activities, as measured by the number of wage earners, decreased about 22 per cent from 1919 to 1929. While the previous tabulation shows relative values over a decade, it is thought that these values are not a measure of progress.

III. WATER RESOURCES

14. Rainfall.- St. Johnsbury is the only precipitation gaging station in the basin. Fifty-one per cent of the drainage area is tributary to the stream at this point and above Moose River. The record covers 38 years to 1931 inclusive. The mean yearly precipitation at this station is 34.67 inches. The average for the basin is probably about 35 inches. The average for New England is 41.68 inches. The mean monthly precipitation in inches at St. Johnsbury is as follows:

Station	Elevation	January	February	March	April	May	June
St. Johnsbury	711	2.18	2.10	2.63	2.51	2.82	3.39

Station	July	August	September	October	November	December	Annual
St. Johnsbury	3.86	3.86	3.72	2.77	2.62	2.38	34.67

15. Storms.- Reference is made to this title in the Connecticut River section. Data assembled by the District Engineer of New York (Winooski River Report) indicates that the intensity and frequency of rainstorms at St. Johnsbury, based on a record from 1890 to October, 1929, is as follows:

Storm intensity in inches	Frequency in years
3.60	10
5.02	20
6.32	50
7.12	100

The rainfall during the November, 1927 storm as recorded at St. Johnsbury was as follows:

November	3	1.00 inch
do.	4	5.39 inches
do.	5	.17 inch
Total		6.56 inches

The total run-off is not recorded.

Owing to the storage capacity of the soil in the valleys, not all excessive rainstorms produce excessive run-off; for instance, it is reported that 4.99 inches of rain fell at St. Johnsbury on July 28, 1913, of which 2 inches fell in 45 minutes. This is remarkable precipitation for this basin, but the effect on the stream gage at Pierces Mills, 5 miles above St. Johnsbury, was not over 1-foot rise.

All floods are not necessarily produced by rainstorms, as melting snow with or without rain may produce excessive run-off.

16. Run-off.- This is estimated by consideration of the records at the gage at Pierces Mill. It varies according to drainage area. For Pierces Mill the figure adopted is 1.7[illegible] second-feet per square mile or 403 second-feet based on 237 square miles. This is equivalent to 23 inches annually on the drainage area compared with an average rainfall for the same period of 35.2 inches at St. Johnsbury. This is a ratio of run-off to rainfall of 65.4 per cent.

The record of mean monthly discharges of the Passumpsic River in second-feet per square mile is as follows:

(See following page for table)

Mean monthly discharge of Pascagoula River
(second-feet per square mile)

MONTH	Pierces Mills (237 square miles)											Pascagoula (423 square miles)		
	1908-1909	1909-1910	1910-1911	1911-1912	1912-1913	1913-1914	1914-1915	1915-1916	1916-1917	1917-1918	1918-1919	1928-1929	1929-1930	1930-1931 (1)
October		.734	.734	1.21	1.35	.882	.443	.995	1.27	2.35	3.50		.579	.624
November		.781	.840	1.38	1.89	.878	.616	1.01	1.72	1.78	2.74		1.22	1.01
December		.658	.591	2.38	1.68	.868	.612	1.54	1.75	.899	2.02	1.28	.830	.714
January		1.91	.802				.717	2.30	1.07	.527	1.88	1.23	1.97	.310
February		1.16	.422				1.14	1.92	.916	.790	.872	.558	1.36	.355
March		4.19	.781				1.26	2.16	1.98	1.73	3.15	2.67	2.65	1.06
April		3.89	5.78	6.88	3.76	5.40	3.03	4.81	5.23	5.32	4.56	6.34	4.49	3.62
May		2.68	2.62	3.35	1.57	2.74	1.32	2.70	2.90	2.89	2.51	4.44	2.67	2.00
June	1.15	1.81	.844	2.36	1.01	.679	.751	2.32	2.62	1.76	1.14	1.48	1.61	1.49
July	.536	.654	.570	.477	.692	.561	2.03	1.56	1.56	1.03		.896	1.25	1.03
August	.456	.684	.629	.616	.422	.443	1.84	1.29	2.03	.774		.589	.664	.574
September	.650	.708	.344	1.27	.355	.481	1.11	1.10	1.09	1.59		.421	.898	1.80
The Year		1.74	1.29				1.24	1.97	2.01	1.79			1.65	1.22

(1) Provisional record, subject to correction.

The record of mean monthly discharges of the Moose River in second-feet per square mile is as follows:

MONTH	St. Johnsbury (112 square miles)			
	1927-28	1928-29	1929-30	1930-31
				(1)
October		1.51	.387	.495
November		1.84	1.04	.804
December		1.12	.629	.491
January		1.58	1.84	.352
February		.616	.954	.357
March		3.69	1.70	1.00
April		11.3	6.27	4.59
May		6.58	3.47	2.04
June		.938	1.90	1.71
July		.588	1.68	.574
August		.377	.724	.320
September	1.46	.252	.558	1.25
The Year		2.55	1.76	1.16

(1) Provisional record, subject to correction.

17. Storage. The only storage of any importance used for stream-flow regulation is at Joes Pond in the headwaters of Joes Brook. The estimated usable capacity is 1,200 acre-feet. Limitations imposed by abutting property owners make the usable storage considerably less than the actual. This storage benefits any plant on Joes Brook and the lowest plant (Hoy Bros.) on the Passumpsic River.

Lyford Pond is a small natural pond without a dam about 2 miles northwest of Joes Pond and tributary to it.

Coles Pond on Joes Brook, 6 miles north of Joes Pond, is a natural pond with a 10-foot timber dam, 150 feet long, which is used for storage. The area is about 100 acres when full and the draft is about 6 feet.

Center Pond is in the central part of the town of Newark. There is concrete dam at the outlet about 2 feet high on the average and 150 feet

long. The draft is about 2.6 feet and the area when full, 85 acres. The storage is used to run a small bobbin mill. The outlet is about a mile long and joins the Passumpsic River at mile 37.4.

Clark Pond is 3 miles west of Center Pond in the headwaters of West Branch about 14 miles from the south. It is an uncontrolled natural pond of 102 acres.

Chandler Pond, about 5 miles west of Lyndonville, is a 40-acre pond whose outlet flows into West Brook, tributary to the Passumpsic River near Lyndonville. It is on a private sheep farm owned by C. E. Goss. There is an earth dam, 400 feet long by 12 feet average height, with concrete spillway, with 16.5 feet clear opening. Its original use was for fire protection on a private estate.

Cow Mountain Pond is a small pond, in the southern part of the Town of Granby, tributary to Moose River through Pond Brook and Granby Stream.

18. Tributary streams.- The principal tributaries are Joes Brook, 58 square miles, Sleepers River, 42 square miles, and Moose River, 118 square miles, Millers Run, 56 square miles, and West Branch, 74 square miles. No gaging stations have been operated on these branches except at St. Johnsbury on Moose River which gage was established in 1928 and has not been operating a sufficient time to determine the normal mean discharge. A comparison of the discharge of the Moose River with that of the Passumpsic River may be made by consideration of the hydrographs (Fig. 11 and 10) for a period of simultaneous gagings at St. Johnsbury and Passumpsic from December 1928 to September 1931. The mean discharge for the Moose River was 1.52 second-feet per square mile while that of the Passumpsic River was 1.60. It is to be noted that the run-off for this period at Passumpsic is normal.

IV. NAVIGATION

19. Description of general features.- The Passumpsic River is a series of ponds at hydroelectric developments for the first 18 miles from the mouth. Navigation facilities are not provided at the dams. Beyond the ponds the river is too shallow and slope too steep for navigation. By nature the river was unsuitable for navigation and there is no means of access to it from

the Connecticut River since there is no commercial navigation above Holyoke, Mass.

20. Improvement desired by local interests.- None.

21. Commerce.- If navigation were possible the commerce to be expected from 15,000 to 20,000 people centered near St. Johnsbury and Lyndonville would not be large.

22. Volume of water-borne commerce.- None.

23. Federal project now effective.- None.

24. Conclusion.- Navigation facilities are impracticable, not wanted by local interests, and should receive no further consideration at this time.

V. FLOOD CONTROL

25. General.- Conditions condusive to excessive peak discharge are as follows: Experience shows that the basin is subject to rainfall of sufficient intensity and duration to produce floods; at St. Johnsbury in Nov. 1927, 1.00 inch fell on the 3rd, 5.39 inches on the 4th and .17 inches on the 5th. The depth of snow cover is large, averaging 85.2 inches at Northfield, Vt., which lies southwest of the basin, and 99.6 inches at Knosburg Falls, which is northwest of the basin. The drainage area is wide compared with its length being roughly square in shape permitting syncronization of discharge from branches. The watershed is in the mountains at elevations generally over 1,000 feet whereas the water surface at St. Johnsbury is less than 575; the topography of the basin, as well as the grade of the main stream and its branches, is one of steep slopes. There are no important lakes nor swamps, with the exception of Joes Pond, and the swamp above Victory on Moose River, which might retard flood discharge. The steep mountain slopes are generally rocky or boulder clay possessing but little ground storage capacity and producing a rapid run-off.

Conditions tending to reduce peak discharge are: A swamp area above Victory on the Moose River and Joes Pond on Joes Brook. Large storage capacity of the soil in the valley bottoms which probings at many sites indicated to be largely sand and gravel although clay was found at various places. From Lyndonville to the mouth, the slope is largely concentrated at falls at various places

with comparatively level stretches between, now developed as ponds. The flood coeffi ient adopted by th Committee on Floods, Boston Society of Civil Engineers, for use in their formula for peak flood flow is 500 to 600.

26. Records of past floods.- Rainfall data of the storm of 1869 and subsequent storms are fairly complete and accurate but for earlier torms no data are available. No run-off records are available prior to 1903. Data regarding early floods is largely limited to statements of flood heights and the most important items of damage. Prior to the flood of 1927 no detailed estimate of flood damage has been found available for either railroad, highway, industrial or agricultural property. The following storms undoubtedly caused extraordinary highwater and either did cause damage or would have under present conditions:

November	3 - 4, 1927	January	8 - 9, 1841
October	3 - 4, 1869	July	24 -25, 1830
April	25, 1866	September	3 - 5, 1828
April	18 -19, 1862	March	24 -25, 1826
April 27 - May 1, 1854		October	20 -22, 1785
January 7 - 8, 1770			

Description of these storms is to be found in the Connecticut River section of this report.

The maximum discharge reported by the U. S. Geological Survey for the 1927 flood is 35,000 second-feet at Pierce's Mills, on the Passumpsic River about five miles above St. Johnsbury, or 159 second-feet per square mile on an ffective drainage area of 237 square miles. The maximum gage height recorded during the period 1909 to 1919 when the gaging station was being maintained is 14.8 feet, which occurred during the night of March 27, 1913. The corresponding discharge is not computed, but is very much less than that of 1927.

Partial data regarding the 1927 flood hydrograph from the log sheet of Plant No. 2, Twin State Gas & Electric Co. at St. Johnsbury are as follows:

Nov. 3,	12:01	A.M.	Headwater -14"	Tailwater +2"
	6	A.M.	-10"	+2"
	12	Noon	+ 3"	+7"
	6	P.M.	+19 1/2"	+24"
	9	P.M.	+26"	+30"
	12	MN	+36"	+49"
Nov. 4,	3	A.M.	+68"	+65"

last reading before vacating plant.

Crest of dam Headwater 0"

Normal tailwater Tailwater 0"

with unit shut down and normal river flow.

The time of the peak of the 1927 flood at various places was as follows:

East Burke, Friday, Nov. 4 -			11 A. M. to 12 Noon
Lyndonville, "	"	"	12 Noon to 1 P. M.
St. Johnsbury, "	"	"	2 P. M.
East Barnet, "	"	"	3 P. M.

During the field survey, the elevations of various high-water marks indicated by natives were obtained as shown in Table 3.

(See following page for table)

TABLE 3 .- High-water marks, November, 1927.

Miles from mouth of river	Elevation		Location
	High water	Normal low water	
PASSUMPSIC RIVER			
10.2	586.8	573.0	Highway bridge
20.3	707.9	690.	Highway bridge
21.7	708.2	695.3	Highway bridge
22.3	714.1	699.5	Highway bridge
23.0	717.6	709.1	Highway bridge
24.0	737.8	728.0	Highway bridge
26.9	819.6	-	Floor of feed store
32.0	958.3	947.4	Highway bridge
32.5	971.6	960.6	Highway bridge
32.9	987.2	972.6	Highway bridge
JOHN BROOK			
2.75	666.3	651.0	Trash on bank
7.4	1232.3	1222.2	Mark on bank shown by resident
ELEMPKES RIVER			
1.6	574.6	569.4	Dam Fairbanks Scales
MOOSE RIVER			
0.2	568.2	555.4	Highway bridge
0.9	608.0	592.7	Below dam of J. E. Davies & Co.
4.8	796.4	776.9	Highway bridge
9.8	883.2	877.6	On saw mill. Dam of H. Lee
WILLIAMS RUN			
7.8	814.8	810.4	Dam A. A. Wood
WEST BRANCH			
8.5	906.8	900.8	Highway bridge

27. Reports.- See bibliography in the Connecticut River section of this report. The 1930 Report of the Advisory Committee of Engineers on Flood Control, Vermont, includes a summary of the results of its investigation on this river.

28. Existing flood-control laws.- See this title in the Connecticut River section of this report. There are no laws known to me relating specifically to the Passumpsic River.

29. Predictions of future floods and frequency.- The 1927 flood is the record flood for the Passumpsic River so far as I have been able to determine. The record may be said to extend back to 1770. Probably greater floods can and will occur at some future time and a possible cause is the location of a great storm center in the Passumpsic Basin or a combination of warm rain and melting snow. However, there is not sufficient data to indicate the size of such a flood. History indicates that a flood great enough to cause damage has occurred once in about every 15 years, and floods comparable with that of 1927, once in about every 54 years. These are average figures and do not preclude the possibility of a flood in two successive years.

30. Present channel capacity.- The lower 20-mile section of the river from Lyndonville to the mouth is practically a succession of ponds separated by dams and falls. This is the only section where channel capacity is of any importance for the annual submergence of abutting meadows is a good thing for the land unless it occurs in the growing season which is a rare occasion. At St. Johnsbury Center and Lyndonville, places selected for investigation, the river banks are fairly low, the land adjoining being mostly hay meadows; the river has a fairly flat gradient and winding course; the channel is through gravel and bowlders with clayey top-soil, the river being very muddy in high water.

Dams located below the sections of river investigated control the discharge; the discharge capacity of the channel was calculated by the slope-area method and checked by computing the discharge over the spillway of the

dam below, with its pond at the stage corresponding to that upstream.

The channel capacity as determined is as follows:

At St. Johnsbury,

12,000 cfs, or 47 second-feet per square mile.
(With no flashboards on dam below section of river investigated).

9,000 cfs, or 35 second-feet per square mile.
(With 1.8 feet of flashboards on dam below).

At Lyndonville,

3,300 cfs, or 16 second-feet per square mile.
(With no flashboards on dam below; the Lyndonville meadows are quite low with respect to the river, and are often flooded).

The waterway at bridges is shown in the following table.

(see following page for table)

TABLE 4 .- Data on bridges in Passumpsic River Basin.

Location	Miles from mouth	Use	Elevation of normal low water	Average elevation of floor or base of rail	Minimum clearance at normal low water (feet)	Total length between abutments (feet)	Number of piers	Clear waterway to lowest member (square feet)	Approximate drainage area (square miles)	Capacity of waterway based on velocity of 10 ft. per second (second-feet per square mile)	Kind	Remarks
PASSUMPSIC RIVER												
East Barnet	0.6	Highway	(a) 487.3	501.5	10.9	91	0	1,635	507	32	Steel truss	(Built 1928) (a) Crest of Roy Bros., Dam
do.	0.6	Railroad	(a) 487.3	501.6	10.8	180	1	3,465	507	68	do.	(a) Do.
do.	1.6	do.	(a) 487.3	505.3	14.0	149	0	3,625	504	72	do.	(a) Do.
do.	2.3	do.	(a) 487.3	507.2	16.4	148	0	3,415	446	76	do.	(a) Do.
do.	2.75	do.	(a) 487.3	508.7	17.2	144	0	3,360	446	75	do.	(a) Do.
Passumpsic	4.4	do.	491.6	513.8	16.7	165	0	3,505	423	83	do.	-
do.	4.9	do.	493.7	518.9	20.7	147	0	3,500	423	83	do.	-
do.	5.10	Highway	(b) 521.2	533.0	8.7	200	1	2,990	422	71	do.	(b) Flashboards of Twin State Dam No. 4
do.	5.75	Railroad	(b) 521.2	535.6	10.9	150	0	3,980	421	95	do.	(b) Do.
St. Johnsbury	7.75	do.	540.4	552.9	9.3	230	1	3,870	418	93	do.	-
do.	9.15	Highway	(c) 554.9	573.7	15.7	149	0	3,590	376	95	do.	(c) Flashboards of Twin State Dam No. 2
do.	9.2	Railroad	(c) 554.9	572.6	13.4	161	0	3,540	375	94	do.	(c) Do.
do.	9.7	Private	(d) 574.6	580.8	-	100	0	-	254	-	Wooden	(d) Flashboards of Twin State Dam No.1-1/2
do.	9.75	Highway	(d) 574.6	591.0	13.0	136	1	3,040	254	120	Concrete	(d) Do.(at elev. 574.8)
do.	10.2	do.	(d) 574.6	590.0	11.1	156	0	2,590	252	103	Steel truss	(d) Do.
St. Johnsbury Center	11.9	do.	(d) 574.6	591.5	14.2	98	0	1,700	245	69	do.	(d) Do.
do.	13.0	do.	580.3	601.7	16.3	150	0	2,760	237	116	do.	-
do.	14.4	Private	583.2	601.0	14.1	66	0	1,160	232	50	Steelgirder	-
Lyndon	17.5	Railroad	667.9	689.9	18.8	97	0	2,010	218	92	Steel truss	-
do.	18.4	Highway	687.5	703.3	12.3	111	0	1,525	218	70	Wooden	Covered bridge
Lyndonville	20.3	do.	690.0	702.3	9.2	100	0	1,150	199	58	Wooden	Do.
do.	21.7	do.	695.3	707.6	9.1	140	2	1,060	143	74	Concrete	(Built in 1931)
do.	22.3	do.	699.5	714.3	10.3	199	3	1,800	142	127	do.	(On curve)
do.	22.4	Railroad	699.8	714.3	11.5	74	0	995	142	67	Steelgirder	-
do.	22.6	Highway	702.1	716.4	11.0	51	0	680	70	97	Steel truss	-

TABLE 4 .- Data on bridges in Passumpsic River Basin (Continued).

Location	Miles from mouth	Use	Elevation of normal low water	Average elevation of floor or base of rail	Minimum clearance at normal low water (feet)	Total length between abutments (feet)	No. of piers	Clear waterway to lowest member (square feet)	Approximate drainage area (square miles)	Capacity of waterway based on velocity of 10 ft. per second (second-feet per square mile)	Kind	Remarks
Lyndonville	23.0	Highway	709.1	717.4	5.3	50	0	335	75	76	Wooden	Covered
do.	23.95	do.	723.0	730.7	9.7	56	0	555	75	85	do.	Do.
do.	24.5	do.	740.1	751.5	8.7	56	0	625	64	92	Concrete	
East Burke	26.8	do.	804.4	820.6	13.6	46	0	695	58	120	Wooden	Covered
do.	29.7	do.	863.0	877.8	11.9	65	0	850	52	163	Steel	
do.	30.8	do.	907.0	927.8	17.2	57	0	990	49	202	Concrete	(Built 1929)
do.	32.0	do.	947.4	956.9	6.6	50	0	325	47	69	Wooden truss	
East Haven	32.5	do.	960.6	965.6	7.4	37	0	335	47	71	Steel girder	
do.	33.95	do.	972.6	982.2	7.2	63	1	520	45	115	Concrete	(Built in 1926)
do.	33.3	do.	998.1	1002.9	6.0	37	0	260	39	67	Wooden	
do.	34.4	do.	1011.5	1019.8	5.2	50	0	310	39	79	Concrete	(Built in 1929)
JOHN BROOK												
East Barnet	0.3	Railroad	492.7	505.5	11.	61	0	755	50	138	Steel plate girder	
do.	0.35	Highway	498.5	511.7	11.	40	0	556	50	52	Concrete	
do.	1.0	do.	578.5	589.0	9.5	34	0	394	57	67	Wooden	
do.	1.3	do.	609.0	626.0	16.2	40	0	560	55	106	do.	
Morses Mill	4.7	do.	838.5	847.5	10.	30	0	437	42	51	Steel truss	
South Danville	6.15	do.	1112.0	1122.3	18.9	70	0	1,379	45	299	Wooden	
do.	6.7	do.	1196.5	1205.9	6.5	32	0	246	37	65	Steel truss	
Harvey	7.4	do.	1219.8	1226.8	6.5	38	0	193	37	73	Concrete	
do.	7.7	do.	1231.0	1239.0	5.4	31	0	203	38	57	Steel truss	
Danville	9.8	do.	1270.8	1281.3	8.5	26	0	252	32	79	do.	
West Danville	11.1	do.	(e) 1548.5	1557.0	6.	30	0	365	29	126	Concrete	(e) Crest of flashboards, dam at Joes Pond
SLEEPERS RIVER												
St. Johnsbury	0.3	Railroad	544.4	559.5	11.9	40	0	510	42	121	Steel girder	
do.	0.5	Highway	544.4	557.0	15.9	126	2	1,075	42	256	Concrete	
do.	0.8	Railroad	547.0	577.1	25.9	196	(f) 2	2,225	42	524	Wooden, Riding	Maine Central Railroad (f) Pile bents
do.	1.3	do.	556.0	580.9	-	-	-	-	41	-	Riding	Do.
do.	1.3	Private	556.0	569.4	13.5	43	0	460	41	112	-	Owned by Fairbanks Scale Company.

TABLE 4 --Data on bridges in Passumpsic River Basin (Continued).

Location	Miles from mouth	Use	Elevation of normal low water	Average elevation of floor or base of rail	Minimum clearance at normal low water (feet)	Total length between abutments (feet)	Number of piers	Clear waterway to lowest member (square feet)	Approximate drainage area (square miles)	Capacity of waterway based on velocity of 10 ft. per second (second-foot per square mile)	Kind	Remarks
St. Johnsbury	1.7	Highway	569.4	582.0	9.1	81	0	670	41	139	Steel truss	
do.	1.9	do.	569.4	584.4	10.6	106	2	835	41	203	Concrete	
do.	2.0	Private	-	582.5	-	-	-	-	41	-	-	
do.	4.45	Highway	665.7	675.4	6.7	69	0	450	29	123	Concrete	(Built in 1929)
do.	4.8	do.	685.2	697.2	9.4	62	0	615	39	162	Wooden	Covered
do.	5.5	do.	708.7	720.0	11.6	34	0	415	23	180	Wooden truss	
BURROUGH BROOK, Branch of PASSUMPSIC RIVER												
St. Johnsbury	(1)5.2	Private	793.4	807.5	13.5	17	0	250	15	192	Wooden	Town bridge (1) Mileage continued on Burrough Brook.
do.	6.55	Highway	814.1	825.4	9.2	29	0	350	13	269	do.	Do.
do.	8.1	do.	892.8	902.0	7.7	23	0	195	9	217	do.	
MOSES RIVER												
St. Johnsbury	0.25	Highway	556.4	569.6	9.9	70	0	725	118	67	Wooden	Covered
do.	0.8	do.	591.5	620.2	24.6	89	0	1,398	117	119	Concrete	
do.	0.8	Railroad	591.5	620.6	21.7	69	0	1,320	117	113	Steel girder	
do.	1.1	Private	616.5	629.2	11.0	69	2	1,055	117	91	do.	
do.	3.0	Highway	714.5	729.5	12.0	87	0	820	110	74	Concrete	
do.	3.75	do.	740.0	752.9	9.4	95	2	700	109	64	do.	
East St. Johnsbury	4.6	Railroad	765.9	792.5	16.9	125	1	1,715	108	159	Steel girder	
do.	4.7	Highway	776.9	802.4	18.9	73	1	860	108	80	Concrete	
Concord	6.85	do.	797.7	813.0	12.3	76	0	930	100	93	Steel truss	
do.	9.5	do.	847.2	860.7	10.0	90	1	670	86	78	Concrete	
do.	9.6	do.	862.0	876.6	10.8	83	0	585	86	68	do.	
do.	10.8	do.	912.0	921.2	8.2	46	0	435	84	52	Wooden	Town bridge
do.	11.8	do.	966.0	977.0	8.7	49	0	565	77	73	Steel truss	
do.	14.2	do.	1000.0	1010.5	-	-	-	-	-	-	-	
do.	17.35	Railroad	1124.2	-	-	-	-	-	-	-	Old bridge	

TABLE 4 .- Data on bridges in Passumpsic River Basin (Continued).

Location	Miles from mouth	Use	Elevation of normal low water	Average elevation of floor or base of rail	Minimum clearance at normal low water (feet)	Total length between abutments (feet)	Number of piers	Clear waterway to lowest member (square feet)	Approximate drainage area (square miles)	Capacity of waterway based on velocity of 10 ft. per second (second-feet per square mile)	Kind	Remarks
MILLERS RUN												
Lyndon	0.1	Highway	691.9	707.6	12.5	47	0	590	56	105	Wooden	Covered
do.	2.8	do.	701.5	713.7	10.3	52	0	540	49	110	Wooden truss	
do.	4.2	do.	710.1	727.9	14.6	41	0	600	46	130	Concrete	
Wheelock	6.75	do.	738.6	754.0	11.0	37	0	490	40	122	do.	
do.	7.1	do.	746.5	758.2	9.8	36	0	360	39	92	do.	
do.	7.3	do.	754.0	764.5	7.4	44	0	330	38	87	Steel girder	
do.	7.8	do.	810.4	813.6	5.7	39	0	550	32	109	Concrete	(Built in 1927)
Sheffield	9.3	do.	845.8	852.5	6.2	44	0	340	27	126	Steel girder	
do.	10.0	do.	894.7	906.1	9.3	52	0	515	20	257	Steel truss	
do.	10.1	do.	900.3	912.9	9.8	40	0	565	20	282	Concrete	
WEST BRANCH												
Lyndonville	2.7	Railroad	719.1	740.2	14.5	41	0	685	71	96	Steel girder	
Burke	3.6	do.	742.6	753.2	7.0	29	0	555	44	60	do.	
do.	4.0	do.	751.5	762.3	6.9	25.5	0	270	42	86	do.	
do.	4.2	do.	755.6	768.1	8.0	28.5	0	250	40	72	do.	
do.	4.4	do.	761.0	771.7	7.1	30	0	200	38	74	do.	
do.	4.75	do.	770.0	781.1	7.6	30	0	230	36	75	do.	
do.	4.85	do.	775.6	790.6	10.9	28	0	385	35	104	do.	
do.	4.9	Highway	775.6	791.5	13.0	25	0	340	35	97	Concrete	
do.	5.3	Railroad	824.3	833.5	9.3	23.5	0	190	28	68	Concrete arch	
do.	7.3	Highway	842.0	848.2	3.7	38	0	170	18	94	Wooden	
West Burke	8.5	do.	902.1	906.4	2.6	74	0	325	8	407	Steel girder	Concrete floor
EAST BRANCH OF PASSUMPSIC RIVER												
Newark	0.8	Highway	1065.0	1039.7	10.4	48	0	605	17	297	Concrete	(Built in 1929)
do.	2.9	do.	1067.0	-	-	-	-	-	11	-	-	
do.	3.6	do.	1079.2	1087.0	6.2	10	0	115	10	115	Concrete	(Built in 1931

31. Value of damages due to floods.- The data available refer to damage caused by the flood of November, 1927 as follows:

Municipal (Property within towns and villages except industrial establishments.)

East Barnet	$8,600
East Burke	43,400
West Burke	4,600
Lyndon Center	5,100
Lyndonville	72,500
Passumpsic	10,000
St. Johnsbury (including St. Johnsbury Center)	410,400
Sheffield	1,700
Walden	2,900
Wheelock	3,800
	$563,000

Industrial

Passumpsic	45,000
St. Johnsbury	140,000
	$185,000
Lyndonville (included in municipal damages)	

Rural

Loss of land, buildings, and stock from farms in this drainage area on basis of comparison with total farm loss in Vermont is estimated at $50,000.	$ 50,000

Notwithstanding flood damage to farm land, which was large in the case of some individual farms unfortunately located, comparatively few property assessments on the towns' rolls were reduced on account of the flood.

Railroads.- The Canadian Pacific Railway lost one bridge near East Burke and considerable of the track and road-bed were washed out between Lyndonville and East Barnet; the railroad station at Passumpsic was undermined; from St. Johnsbury to East Barnet hardly any safe track remained and railroad service was not resumed for over a month. The company has reported its damage in a lump sum but I estimate that about one-third of the total damage to the Canadian Pacific Railway in Vermont was caused in this drainage area, or about $400,000.

The Maine Central Railroad Company had a total loss of $75,000 as follows:

Loss of bridge at St. Johnsbury which was burned to save the highway bridge just below,	$60,000
Damage to track in the Moose River valley,	$15,000

Highways and bridges.- Cost of repairs and replacement of highways and bridges, segregated as far as possible among towns, is reported approximately as follows:

Town	Roads	Bridges	Total
Barnet	$275,500.	$20,500.	$306,000.
Burke	34,000.	85,600.	119,600.
Concord	11,100.	2,400.	13,500.
Danville	4,900.	10,600.	15,500.
East Haven	300.	14,800.	15,100.
Lyndon	199,300.	79,400.	278,700.
Newark	3,300.	12,200.	15,500.
Sheffield	10,000.	15,800.	25,800.
St. Johnsbury	279,200.	121,100.	400,300.
Sutton	13,600.	21,000.	34,600.
Victory	600.	3,400.	4,000.
Waterford	72,400.	10,900.	83,300.
Totals	$904,200.	$406,700.	$1,310,900.

Dams.- No dams of modern construction were damaged by the 1927 flood; several dams, old and of crib construction, were washed out or partly destroyed as listed below:

West Burke	3 small dams partly destroyed.
	1 dam dynamited during the flood to relieve conditions.
East Burke	2 dams washed out.
Lyndon	1 dam washed out.
St. Johnsbury	1 dam washed out.
	1 dam partially destroyed.
Passumpsic	1 dam washed out.
East Barnet	1 dam weakened and required repairs.

Deaths.- None.

Summary.- The above estimates of damages due to the 1927 flood are largely replacement costs, and especially in the case of highway and railroad damage, includes the cost of a better type of construction than was destroyed. On the other hand, the indirect losses due to interruption of transportation facilities, etc. were large but difficult to estimate, so that the following summary may be considered reasonably conservative:

Summary of damages due to 1927 flood

1.	Municipal	$563,000
2.	Industrial	180,000
3.	Rural	50,000
4.	Railroad	475,000
5.	Highway	1,311,000
	Totals	$2,584,000

Considering that a major flood such as 1927 may occur once in 54 years, the average yearly loss in the Passumpsic Basin due to great floods is about $48,000.

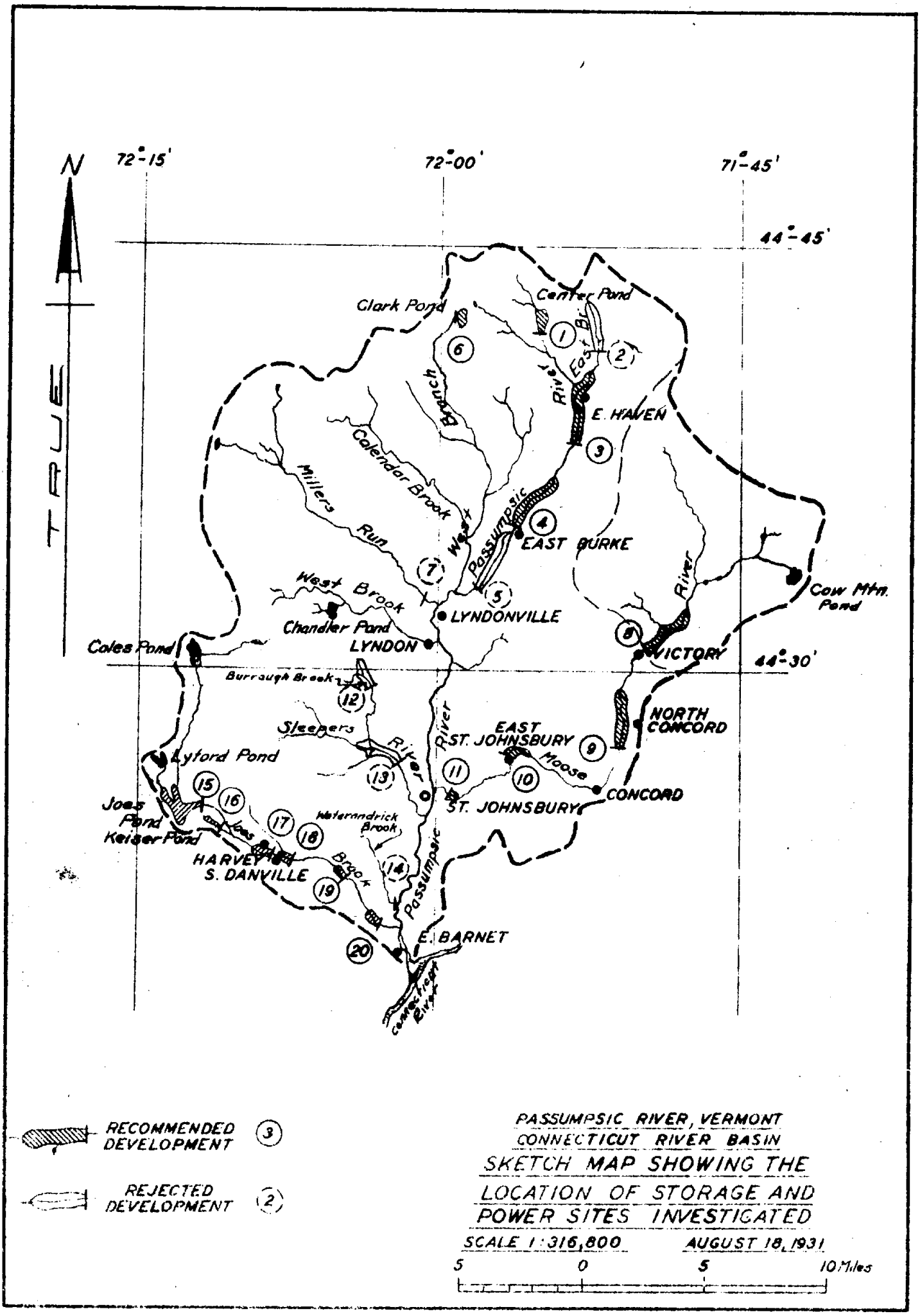
The value to be assigned to damages which might occur from the eight minor floods is a mere estimate. It is not a matter of public record. For the purpose of this estimate, the loss from such a flood has been assumed to be 10 per cent of the loss from a great flood. The average yearly loss from eight minor floods over 162 years would be about $13,000. There is no data available as to the annual losses from ordinary freshets but it is thought that the amount assumed for the minor floods is sufficient to include yearly freshets.

The total average annual loss in the Passumpsic Basin due to all floods is therefore estimated at $61,000.

The peak flood on the Connecticut River between East Barnet and White River Junction is largely due to the discharges from the Passumpsic and Ammonoosuc Rivers. The damage on the Connecticut River which might be allocated to the Passumpsic River is estimated at $76,000 above the Ammonoosuc River and $215,000 below; total, $291,000. This gives an average annual loss, computed on the same basis as for the Passumpsic River, of about $7,000.

The total average annual loss in the Passumpsic and Connecticut Basins due to the Passumpsic River floods may be estimated at $68,000.

52. Possibility of flood protection.- Field surveys have been made to determine the facts. The location of the sites investigated is shown on Figure 1. It is physically possible by means of reservoirs to reduce flood heights and velocities of known floods to a point which would cause no important damage in the basin below the reservoirs. The reservoir sites investigated and the probable effect of each, and the total effect of all, on a flood similar



RECOMMENDED DEVELOPMENT (3)

REJECTED DEVELOPMENT (2)

PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
SKETCH MAP SHOWING THE LOCATION OF STORAGE AND POWER SITES INVESTIGATED

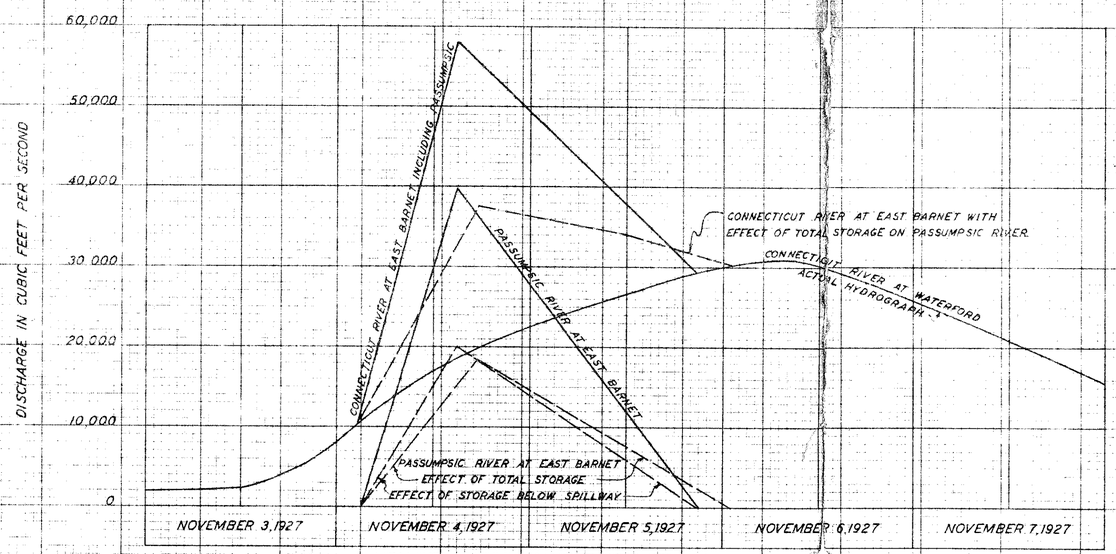
SCALE 1:316,800 AUGUST 18, 1931

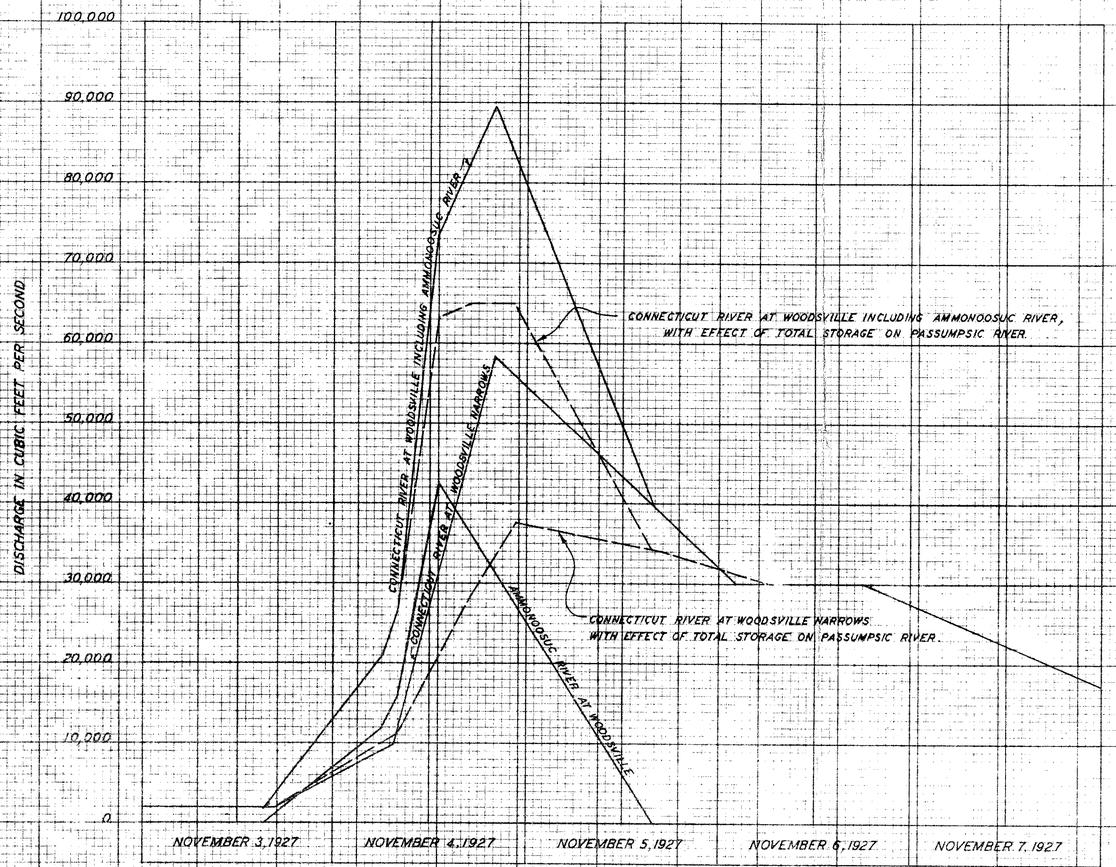
5 0 5 10 Miles

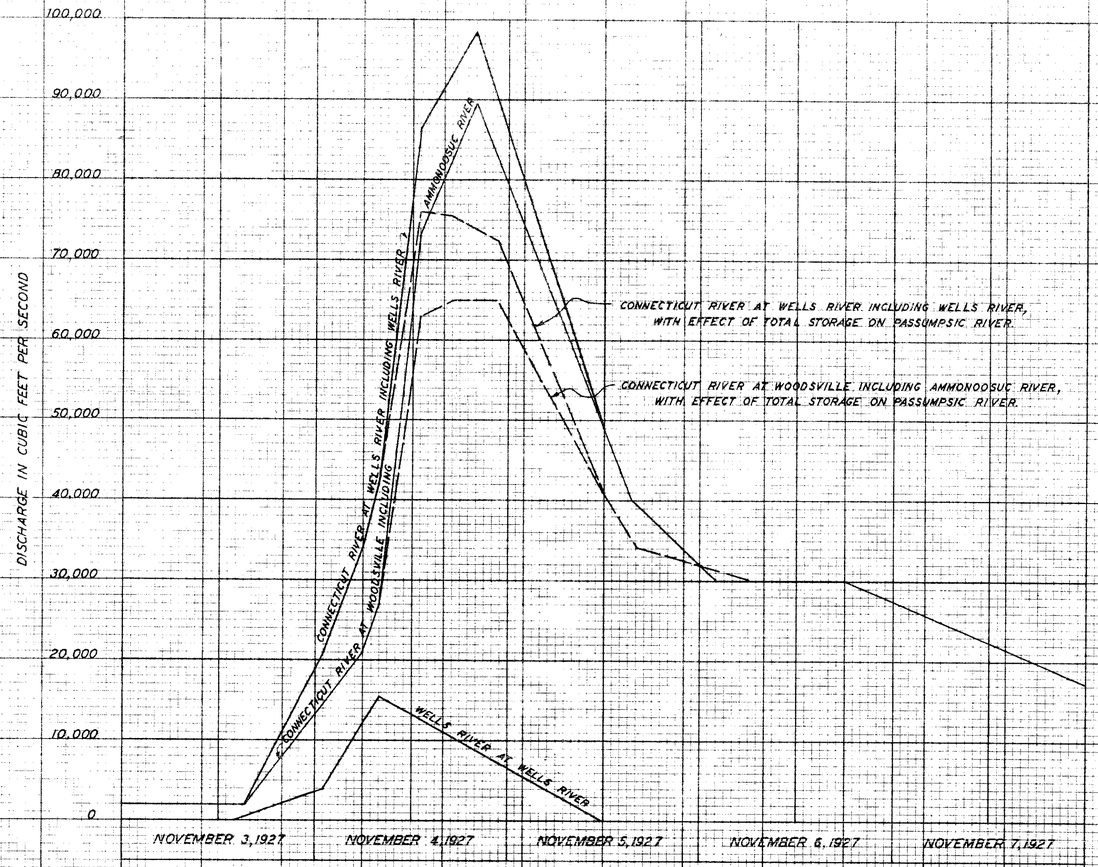
Figure 1

to that of November, 1927 at various places on the river, are shown on Table 6 and are shown graphically on Figure 2. The computation is based on an assumed standard hydrograph as the actual is not known to me. If the capacity of each reservoir were available at the time of flood, the effect is estimated to be a reduction in peak discharge of 54 per cent at the mouth of the river, 55 per cent at St. Johnsbury above Moose River and 72 per cent at Lyndonville. On the Connecticut River between West Fernot and White River Junction the reduction would be 28 per cent at Woodsville Narrows and 11 per cent at Wilder. The effect of eliminating certain reservoirs is readily determined by inspection of the table. The relative importance of each is also apparent, mile 32.3 being the most effective and mile 25.95 and 27.1 following in this order. The remaining reservoirs would have been of no great importance for control of the 1927 flood.

(See following page for table)







COMPUTED HYDROGRAPH FOR FLOOD OF NOVEMBER, 1927 SHOWN THUS: ———

COMPUTED EFFECT OF STORAGE ON FLOOD HYDROGRAPH SHOWN THUS: — — —

PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
GRAPHS SHOWING EFFECT OF PASSUMPSIC RIVER STORAGE ON FLOOD HYDROGRAPHS OF PASSUMPSIC RIVER AT EAST BARNET AND OF CONNECTICUT RIVER AT EAST BARNET, WOODSVILLE AND WELLS RIVER

FIGURE No. 2

TABLE 5.- Effect of storage on peak discharge.

Potential storage site		Center Pond	Clark Pond	Keiser Pond	Victory	Mile 27.1	Mile 32.3	Mile 2, East Branch	Mile 25.55	
Drainage area at site (square miles)		3.2	3.2	2.4	66	58	47.5	12.9	70	
Flood-storage capacity (acre-feet)		1,150	1,900	3,600	61,000	7,200	12,500	10,400	10,000	
Below spillway (acre-feet)		930	(1) 1,720	(1) 3,000	(1) 42,000	7,100	(2) 11,000	(1) 7,400	8,400	
Above spillway (acre-feet)		220	180	600	18,000	700	1,500	2,000	2,400	
Location	Drainage area (square miles)	Reduction in discharge in per cent of peak flow								
		Effect of individual reservoirs								Total effect of all reservoirs
PASSUMPSIC RIVER BASIN										
East Burke	98	6	-	-	-	56	52	22	-	100
West Burke (West Branch)	3	-	40	-	-	-	-	-	-	40
Lyndonville	202	2	2	-	-	16	24	6	22	72
Lyndon	218	2	1	-	-	16	22	6	21	67
Pierce's Mills	227	1	1	-	-	14	20	5	19	60
St. Johnsbury (above Moose River)	257	1	1	-	-	13	18	5	17	55
St. Johnsbury (below Moose River	575	1	1	-	3	12	17	5	17	56
Passumpsic	423	1	1	-	3	12	17	5	16	55
East Barnet	507	1	1	-	3	11	17	5	16	54
CONNECTICUT RIVER										
Woodsville Narrows (above Ammonoosuc River)	2,265	1	-	-	2	7	12	3	10	35
Wells River (below Wells River)	2,765	-	-	-	2	5	7	2	7	23
South Newbury	2,865	-	-	-	1	2	4	1	4	12
Wilder	3,422	-	-	-	1	2	4	1	3	11

Note:--- The total flood storage capacity is considered effective if it does not exceed the flood run-off.
(1) This capacity exceeds flood run-off.
(2) This capacity considered equal to flood run-off.

Flood control by storage reservoirs is to be preferred to detention reservoirs because the latter serves no useful purpose, except flood control while the former is of benefit to water-power developments as well. A later discussion of feasibility will indicate that it would not be economically sound for flood control interests alone to finance the necessary construction, but coordinated power and flood-control interests might. This precludes the use of detention reservoirs.

Flood control by channel correction, if possible, is local in effect and offers no general relief. No plan of channel correction appears to warrant discussion here. If applied to the river below Lyndonville, where industrial activities are mainly centered, such a discussion must inevitably be directed to the location of control points with and without existing dams and the relative elevations of the resultant flood profiles. This would be a very controversial subject and requires much more data than is available to me.

Levees in farming districts are not desirable because there are no extensive bottom lands of high value to protect and the yearly flooding of the land by fall or spring freshets is a good thing for the soil.

33. Feasibility of flood protection.- The interests which might be benefited by storage reservoirs in the Passumpsic Basin are the users of water power on the river below the reservoirs and on the Connecticut River below East Barnet; and those who suffer flood damage on the river and on the Connecticut River from East Barnet to White River Junction. No Passumpsic River flood is likely to cause damage below White River Junction where the peak discharge is caused by the White River peak and the flow contributed by the Passumpsic River to the White River peak at White River Junction is too small to be the subject of possible reduction. The funds which might feasibly be spent on the Passumpsic reservoirs for flood protection are measured by the average flood damage mentioned in a previous section, totalling $60,000 annually. This amount, based on the present worth of the flood damages to occur in the future over the periods of flood frequencies, is estimated at $535,000 for losses in the Passumpsic River Basin and $65,000 for losses on the Connecticut River, or a total of $599,000, say $600,000 in round figures. Reference is

made to Table 6 giving a summary of estimates of potential storage and to Table 5 showing the effect of storage on peak discharge. It will be noted that the amount is insufficient to provide complete protection. It may be considered therefore, the measure of a reasonable contribution by flood-control interests to the cost of a coordinated plan of development involving power interests, if the plan assured the desired flood protection.

(See following page for table)

TABLE 6 .- Summary of estimates of potential storage developments in Passumpsic River Basin.

Serial No.	Location: Miles from mouth	Location: Site	Drainage area (square miles)	Cost of storage development exclusive of power (dollars)	Storage available for power development: Capacity to proposed lowest draft for power (acre-feet)	Storage available for power development: Cost per acre-foot (dollars)	Storage available for flood control: Above spillway to high water (acre-feet)	Storage available for flood control: Below spillway to proposed lowest draft for flood control (acre-feet)	Storage available for flood control: Total capacity for flood control (acre-feet)	Storage available for flood control: Cost per acre-foot of total capacity (dollars)	Effect of power storage: Developed head through which used (feet)	Effect of power storage: Cost per foot of developed head per acre-foot of storage (cents)	Effect of power storage: Increase in minimum discharge at site (second-feet)
		CENTER POND BROOK											
1		Center Pond	8.2	32,000	850	38.00	320	830	1,150	27.80	542	7.1	4
		EAST BRANCH											
2	2.0	Mile 2.0	12.9	746,000	7,400	101.00	3,000	7,400	10,400	72.00	519	19.4	16
		PASSUMPSIC RIVER											
3	32.5	Mile 32.3	47.6	1,035,000	11,000	94.00	4,800	7,700	12,500	83.00	519	18.2	39
4	27.1	Mile 27.1	58.	652,000	7,100	92.00	2,300	5,000	7,300	84.00	519	17.7	35
5	23.95	Mile 23.95	70.	990,000	8,400	119.00	2,800	8,000	10,800	92.00	519	22.9	42
		EAST BRANCH											
6		Clark Pond	3.2	47,000	1,720	27.40	180	1,720	1,900	24.70	551	5.1	4
		MOOSE RIVER											
8	17.3	Victory	66.	410,000	38,000	10.80	15,500	42,500	61,000	6.70	420	2.6	80
9	11.2	Mile 11.2	77.	323,000	3,200	92.00	3,100	3,200	6,300	51.00	406	15.5	35
		BUSHNOCK BROOK											
12		Gose Hollow	10.6	296,000	4,000	74.00	900	4,000	4,900	60.00	397	18.6	11
		CAMPBELL RIVER											
13	3.5	Fish Hatchery	40.8	1,041,000	6,500	160.00	1,100	6,000	7,100	147.00	397	40.4	28
		JOES BROOK											
16		Keiser Pond	(1) 2.4	223,000	7,700	29.00	600	8,000	8,600	26.00	355	8.1	22
		Total development		5,808,000	97,850	59.	38,100	94,350	132,450	44.			

(1) 21.8 square miles by including Joes Pond drainage area.

34. Estimate of capital outlay justified by ability to pay.- If flood control were attempted by a "River Regulating District", the district here involved might include Caledonia and Orange Counties in Vermont and Grafton County in New Hampshire, assuming that a county is the smallest political sub-division which might engage in the enterprise. Data regarding assessed valuation and taxes in these counties for the year 1931 are as follows:

County	Assessed valuation	Property taxes	Property rate (per cent)	Total taxes
Caledonia, Vt.	$ 29,802,204			
Orange, Vt.	16,645,833			
Grafton, N.H.	67,737,333	$ 1,943,097	2.87	1,991,279
Total	$113,183,750			

An investment of $600,000 in flood control would result in annual charges for money of $21,000 based on 3.5 per cent. The investment would equal about 0.53 per cent of the assessed valuation of the three counties and the annual charges would add about 2 cents per $100 to the tax rate, whereas the average annual losses, as estimated, are three times this amount, or 0.05 per cent of the assessed valuation. It should be noted, however, that probably 90 per cent or more of the yearly charges would equitably be assessed against Caledonia County beneficiaries or say $19,000 annually. This is about .07 per cent of the valuation of the county.

35. Conclusion.- There is a flood problem on the Passumpsic River causing a loss in a single recent occurrence estimated at $2,875,000 and an average loss of $68,000 per year. An adequate protection is obtainable by the construction of storage reservoirs. The construction of the reservoirs cannot be economically financed wholly by flood-control interests. Such reservoirs would have a real value to power interests. Federal interests are involved only to the extent of possible damage to Federal-aid highways.

36. Description of existing water-power plants.- Table 7 gives a list of existing developments. Their locations are shown on Drawings Nos. 1 and 3. About 427 feet of fall on the river or its tributaries is developed for power at 14 plants with an installed capacity of about 6,400 horsepower. Excluding five small mill powers under 50 horsepower capacity, the plants, with the single exception of a woodworking mill, are hydroelectric developments distributing electric power to the public. Two are owned by Lyndonville for town lighting and power; five by Twin State Gas and Electric Co; and two on Joes Brook by the Green Mountain Power Corp., now a part of the New England Power Association.

(See following page for table)

TABLE 7 -- Existing water-power developments in Passumpsic River Basin.

Serial letter	Location	Miles from mouth	Owner or operator	Purpose for which installed	Kind of dam	Gross head (feet)	Installed capacity	Remarks
	Center Pond Brook							
A	Center Pond		R. A. Donaldson	Storage	Concrete	-	-	Dam 2.0 feet high with 2.5-foot draft.
B			do.	Shingle and bobbin mill	Wooden	23.0	40 hp. (est.)	Wood-stave penstock about 250 feet long.
	Passumpsic River							
C	East Burke	26.9	E. A. Darling Estate	Storage for domestic purposes and fire protection	Concrete	-	-	Dam is 11.2 feet high.
	West Branch							
D	West Burke	5.5	W. L. Brown	Gristmill	Wood-crib	12.5	20 hp. (est.)	
	Millers Run							
E	Wheelock	7.75	A. E. Reed	Sawmill	do.	11.2	20 hp.	
	Passumpsic River							
F	Lyndon	17.55	Lyndonville Electric Co.	Electric power	Concrete	15.5	60 kw.	Two steel penstocks about 50 feet long.
G	do.	16.6	do.	do.	do.	61.1	600 kw.	Headrace and penstock about 500 feet long.
H		15.0	Twin State Gas & Electric Co.	do.	do.	17.2	280 kw.	Wood-stave pipe-line 250 feet long. Plant #2.
I	St. Johnsbury	9.6	do.	Electric power, fire protection, street cleaning	Wood-crib	19.1	375 kw.	Plant #1-1/2.
	Moose River							
J	Concord	9.65	Ernest Lee	Sawmill	do.	13.5	20 hp. (est.)	
	Passumpsic River							
K	St. Johnsbury	8.9	Twin State Gas & Electric Co.	Electric power	Wooden	2.6	150 kw.	Plant #2. 500 kw. auxiliary steam turbine.
	Sleepers River							
L		3.25	U. S. Fish Hatchery	Storage for fish hatchery	Wood-crib	-	-	Dam 4.0 feet high.
M	St. Johnsbury	1.6	Fairbanks Scale Co.	Storage for fire protection	do.	-	-	Dam 5.2 feet high.
	Passumpsic River							
N	Near St. Johnsbury	7.3	Twin State Gas & Electric Co.	Electric power	Concrete	17.0	700 kw.	Plant #3.
O	Passumpsic	5.1	do.	do.	do.	24.1	700 kw.	Headrace 100 feet long. Plant #4.
	Joes Brook							
P	West Danville	10.95	Green Mountain Power Corporation	Electric power	Stone-concrete	171.5	1750 hp.	1600 feet of pipe line. Plant #15.
Q	South Danville	6.65	do.	Sawmill	Crib	10.5	20 hp. (est.)	Not used much
	Passumpsic River							
R	East Barnet	0.5	Roy Bros. Mfg. Co.	Woodworking mill	Concrete and wood-crib	22.2	310 hp.	

37. Sources of auxiliary power.- The public utility plants are either a part of a large power system or tied in with one, as shown on a drawing accompanying the Connecticut River section of this report, showing the location of transmission lines in the Connecticut River Valley and vicinity. No 2 plant of the Twin State Gas and Electric Co. has a steam-turbine driven generator of 500-kilowatt capacity for auxiliary service.

38. Value of present installations. - All of the Twin State Gas and Electric Co. plants with the exception of No. 2 at Ft. Johnsbury have been rebuilt since the 1927 flood and are modern plants. No. 2 is an older plant with wood-crib dam. The assessed valuation of the five plants is $351,000.

The two Lyndonville plants are not assessed for taxes but the value for rate-making purposes was fixed at $250,000 or $379 per kilowatt of installed capacity compared with $131 per kilowatt for the Twin State plants. As the appraisals were made for different purposes, I do not think the values are comparable.

The West Danville plant, formerly owned by the Green Mountain Power Co. was 1760 horsepower and has changed ownership at least twice and is a fairly old plant. The value placed on it at the recent sale is not known to me. The dam controls Joes Pond storage and the power house is some 1500 feet distant, the conduit being a wood-stave pipe.

Roy Bros. dam near the mouth of the river is part log crib and part concrete, about 8 feet high and 295 feet long. The installation is 310 horsepower and the assessed valuation of $25,000 includes the wood-working mill.

The remaining mill powers do not represent large investments in power development.

39. Potential water power.- A reconnaissance of the basin was made and 20 sites selected for consideration and the cost of development of storage or power estimated for 18 sites. The location of the sites is shown on Figure 1. Table 8 shows that there is 2,010 feet of head available for development of power at 14 sites on the Passumpsic River and tributaries with a potential capacity of 16,220 horsepower and a potential output of 84,024,000 kilowatt-hours. Data regarding the potential capacity at each site are shown in the table. A description of each potential development follows at the end of this appendix.

TABLE 8 .- Summary of estimates of potential hydroelectric-power and storage developments in Passumpsic River Basin.

Serial No.	Location: Miles from mouth of river	Location: Site	Drainage area (square miles)	Head: Gross (feet)	Head: Maximum draft for power (feet)	Head: Average net at full load (feet)	Maximum usable flow: Second-feet	Maximum usable flow: Approximate second-feet per square mile	Potential capacity 80% efficiency (horsepower)	Average yearly output (1,000 kilowatt-hours)	Primary power (per cent)	Cost of development (dollars): Storage only	Cost of development (dollars): Power only	Cost of development (dollars): Total storage and power	Cost of development (dollars): Per horsepower based on power cost only	Cost of development (dollars): Per horsepower based on total cost	Fixed and operating charges (dollars per year): Based on power cost only	Fixed and operating charges (dollars per year): Based on total cost	Cost of power production (mills per kilowatt-hour): Based on power cost only	Cost of power production (mills per kilowatt-hour): Based on total cost
		CENTER POND BROOK																		
1		Center Pond	8.2	—	—	—	—	—	—	—	—	35,000	—	32,000	—	—	—	—	—	—
		EAST BRANCH																		
2	2.0	Mile 2.0	12.9	—	—	—	—	—	—	—	—	748,000	—	748,000	—	—	—	—	—	—
		PASSUMPSIC RIVER																		
3	32.3	Mile 32.3 - East Haven	47.5	167.	40.	127.	142.5	3.0	1650	6,139	91.	1,035,000	411,000	1,446,000	249	876	57,300	168,000	9.5	27.5
4	27.1	Mile 27.1	88.	64.	38.	46.4	174.	2.0	730	2,894	80.	652,000	113,000	765,000	165	1,048	21,600	90,100	8.7	36.1
5	23.95	Mile 23.95	70.	85.	40.	57.	315.	4.5	1920	4,476	43.	998,000	166,000	1,164,000	86	606	30,000	134,800	6.7	30.1
		WEST BRANCH																		
6		Clark Pond	3.2	—	—	—	—	—	—	—	—	47,000	—	47,000	—	—	—	—	—	—
		MILLERS RUN																		
7		Lyndon Center																		
		BARTON RIVER																		
8	17.5	Victory	66.	108.5	22.5	128.6	198.	3.0	2300	8290	48.	414,000	615,000	1,020,000	265	443	80,000	128,000	9.7	14.8
9	11.8	Mile 11.8	77.	231.5	80.	147.	231.	3.0	3140	11100	48.	325,000	717,000	1,040,000	231	335	98,600	127,000	8.3	11.4
10	4.75	East St. Johnsbury	108.	176.	4.	138.	324.	3.0	4100	13[illegible]	17.	—	766,000	766,000	—	187	—	98,500	—	7.3
11	0.7	St. Johnsbury	118.	40.	2.	43.5	354	3.0	1400	4949	17.	—	243,000	243,000	—	174	—	38,000	—	8.7
		SUTTON BROOK																		
12		Cone Hollow	10.8	—	—	—	—	—	—	—	—	296,000	—	296,000	—	—	—	—	—	—
		PASSUMPSIC RIVER																		
13	3.3	Fish Hatchery	40.8	120.	48.	100.	122.	3.0	1110	3815	54.	1,041,000	99,000	1,140,000	89	1,027	22,200	131,500	6.8	34.4
		WATERANDRICK BROOK																		
14		Waterandrick																		
		JOES BROOK																		
15	10.95	Joes Pond	28.9	206.5	1.5	198.	58.	2.0	1720	4630	7.	—	203,000	203,000	—	200	—	34,000	—	7.5
16		Keiser Pond	(1) 2.4	110.5	50.	55.5	93.9	3.0	740	1256	48.	228,000	104,000	332,000	141	449	21,700	45,600	8.9	14.5
17	6.9	Mile 6.5	37.	85.	2.5	80.	111.	3.0	600	1172	5.	—	126,000	126,000	—	210	—	22,600	—	10.4
18	6.15	South Danville	45.7	380.	10.	303.4	91.	2.0	2500	1[illegible]00	14.	—	385,000	385,000	—	154	—	57,800	—	5.0
19	3.75	Mile 3.75	49.	140.	4.	120.	98.	2.0	1070	940	7.	—	232,000	232,000	—	217	—	57,000	—	7.5
20	1.0	Mile 1.0	57.	108.	4.	94.8	114.	2.0	980	460	7.	—	217,000	217,000	—	221	—	35,400	—	7.9
		(1) Not including Joes Pond.		2,010.					23,220	8924		5,808,000	4,392,000	10,200,000		391	325,400	1,141,300		13.4

The existing plants do not fully develop the potential power at their sites. Table 9 shows that the present capacity at ~~8~~ eight plants is about 4,530 horsepower. The potential capacity at these sites based on a nominal draft of pond and turbine capacity of ~~two~~ 2 second-feet per square mile of drainage area totals 9,760 horsepower or an increase of 5,230 horsepower over the present installation.

TABLE 9.- Potential power at existing developments.

Serial letter	Location	Present capacity (horsepower)	Potential capacity based on a turbine capacity of 2 second-feet per square mile: Additional (horsepower)	Total (horsepower)
F	Lyndonville Electric Co.	90	450	540
G	do.	900	1,550	2,450
H	Twin State Gas and Electric Co.	370	300	670
I	do.	560	250	810
K	do.	220	340	560
M	do.	1,040	130	1,170
O	do.	1,040	660	1,700
R	Roy Bros.	310	1,550	1,860
Total		4,530	5,230	9,760

40. Stream-flow gaging stations.- The following gaging stations have been operated by the United States Geological Survey for the periods stated.

Station	Drainage area in square miles used by U.S.G.S.	Period
Passumpsic River:		
St. Johnsbury Center	244	1903
Pierces Mills	237	1909 to 1919
Passumpsic	423	Nov.15, 1928 to date
Moose River:		
St. Johnsbury	112	Aug. 7, 1928 to date

The record of mean monthly discharges of the Passumpsic River at Pierces Mills and Passumpsic, and the Moose River at St. Johnsbury is given in Paragraph 16.

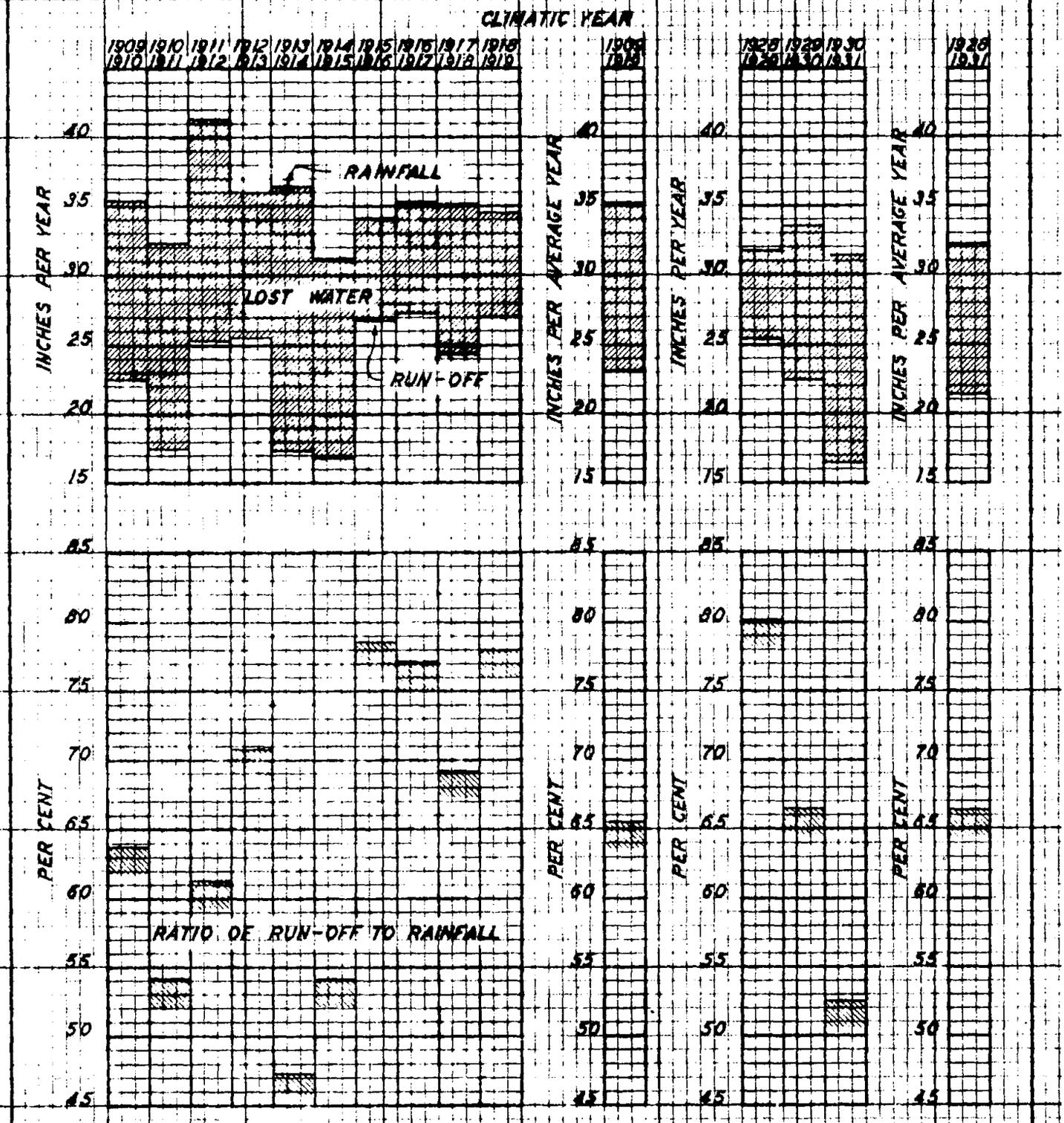
41. Hydraulic graphs.- The following graphs are attached which are based on the records at the above gaging stations:

Figure 3 - Rainfall and run-off
4 - Hydrograph of mean monthly discharges at Pierces Mills showing effect of storage.
5 - Hydrograph of mean monthly discharges of Moose River at St. Johnsbury.
6 - Flow-duration curve based on daily discharges at Pierces Mills.
7 - Assumed mean discharge according to drainage area.
8 - Effect of storage on mean usable discharge at Pierces Mills.
9 - Effect of storage on mean usable discharges, percentage basis.
10 - Effect of storage on minimum flow at Pierces Mills.
11 - Effect of storage on minimum flow, percentage basis.
12 - Mass curve of mean monthly discharges at Pierces Mills and Passumpsic.
13 - Flow-duration curve as modified by storage based on mean monthly discharges at Pierces Mills.

42. Precipitation.- The mean monthly precipitation at St. Johnsbury is shown in Paragraph 14. The record extending over 38 years shows the average annual precipitation to be 34.87 inches. The average for the basin is probably about 36 inches. In order to determine whether the period covered by the gagings at Pierces Mills was a normal period, the precipitation for the period was compared with the 38-year record at St. Johnsbury. The average precipitation for the period of gaging was 35.31 inches as compared with a normal of 34.87.

The ratio of run-off to rainfall is shown on Figure 3 and Table 10. The general average is about 69 per cent.

(See following page for table)



PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
RAINFALL AND RUN-OFF GRAPHS
OCTOBER 1, 1909 TO SEPTEMBER 30, 1919
RUN-OFF RECORD AT PIERCE'S MILLS
OCTOBER 1, 1928 TO SEPTEMBER 30, 1931
RUN-OFF RECORD AT PASSUMPSIC.
RAINFALL RECORD AT ST. JOHNSBURY

Figure 3

TABLE 10.- Ratio of run-off to rainfall.

Climatic Year ending Sept. 30-	Run-off (inches)	Rainfall at St. Johnsbury (inches)	Ratio of run-off to rainfall (per cent)
	At St. Johnsbury		
1910	22.60	35.42	63.9
1911	17.47	32.33	54.1
1912	25.42	41.35	61.2
1913	25.51	36.07	70.9
1914	17.29	36.68	47.1
1915	16.82	31.15	54.1
1916	26.86	34.05	78.8
1917	27.32	35.38	77.1
1918	24.24	36.12	69.1
1919	27.0	34.59	78.0
Average for 10 years	23.04	35.21	65.4
	At Passumpsic		
1929	25.55	31.86	80.1
1930	22.49	38.63	58.5
1931	16.49	31.48	52.5
Average for 3 years	21.51	32.32	66.4

Note: Where there are no records Orford record was used.

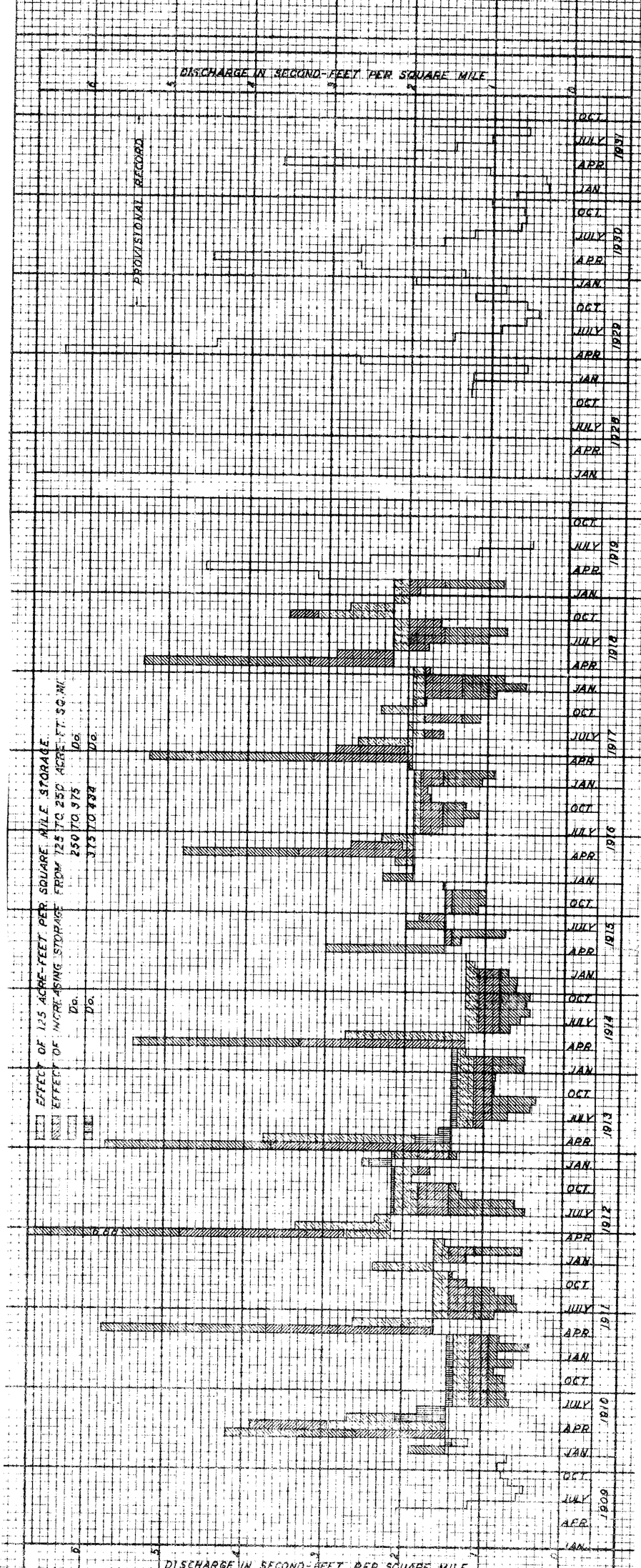
43. Stream flow.- Figure 4 is a hydrograph of the Passumpsic River showing mean monthly discharges at Pierces Mills. Figure 5 shows the same data for the Moose River at St. Johnsbury. Figure 6 shows the duration of stream flow at Pierces Mills based on daily discharges.

44. Mean stream flow.- Figure 7 shows the unmarked mean discharge according to drainage area. (For Joes Brook, the Ottauquechee River graph of mean discharge was used). The mean discharge at Pierces Mills based on the record from October 1, 1909 to September 30, 1919 is 1.70 second-feet per square mile on 237 square miles of drainage area or a total of 403 second-feet.

45. Mean usable stream flow.- Figure 8 shows the mean usable discharge at Pierces Mills for various turbine capacities. Figure 9 is designed to show the same data in per cent of mean discharge and in addition it is applicable to various drainage areas since the mean discharge varies with drainage area as shown on Figure 7. For Joes Brook, the Knightville (Westfield River) graphs of mean usable stream flow were used herein.

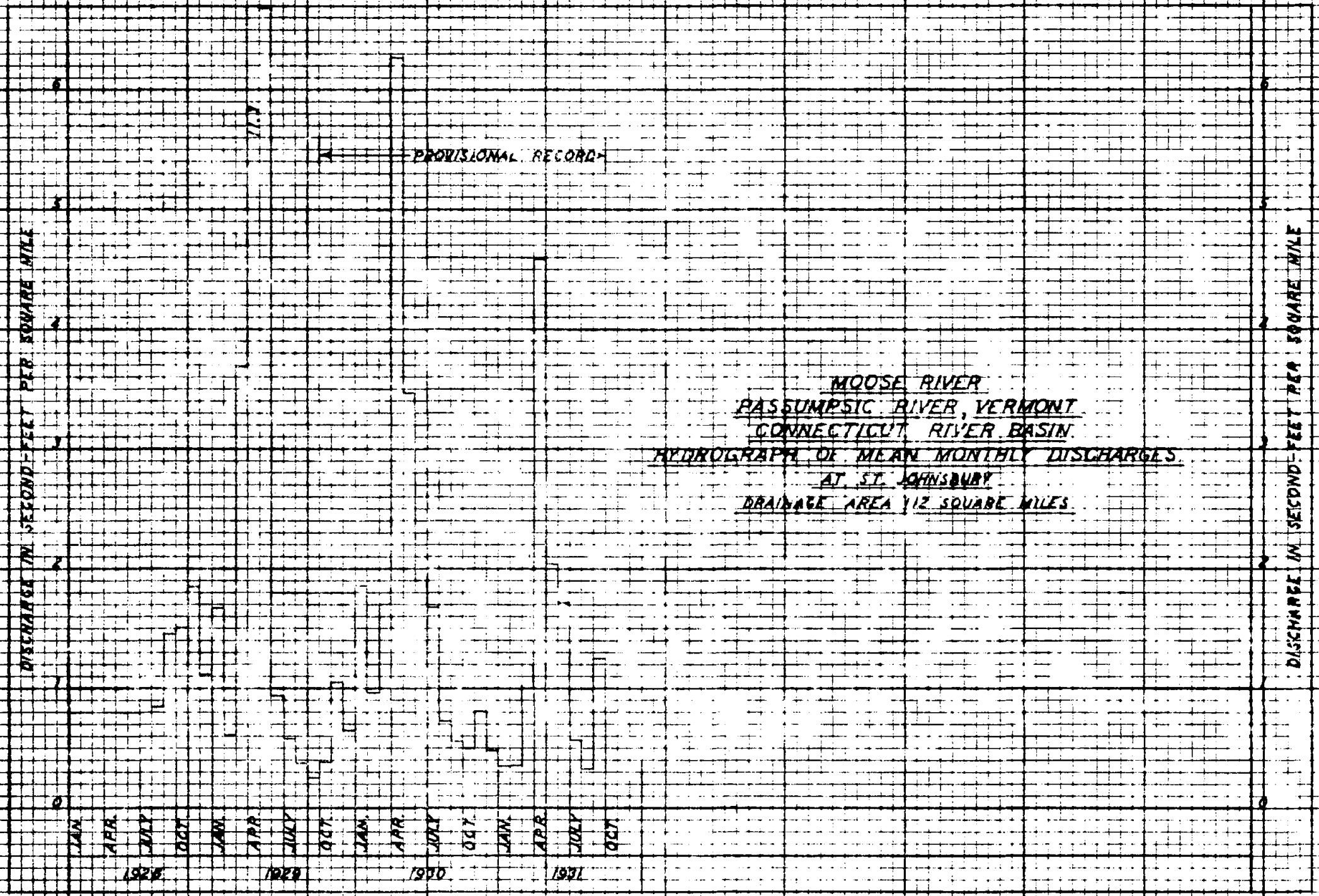
The mean usable discharge at Pierces Mills with no storage is as follows:

(See following page for table)



PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
HYDROGRAPH OF MEAN MONTHLY DISCHARGES
AT PIERCE'S MILLS FOR PERIOD MAY 1909 - JULY 1919 AND
AT PASSUMPSIC FOR PERIOD NOVEMBER 1928 - SEPT 1931
SHOWING THE EFFECT OF STORAGE
DRAINAGE AREA AT PASSUMPSIC 423 SQUARE MILES
DRAINAGE AREA AT PIERCE'S MILLS 237 SQUARE MILES

Figure 4


MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
HYDROGRAPH OF MEAN MONTHLY DISCHARGES
AT ST. JOHNSBURY
DRAINAGE AREA 112 SQUARE MILES
PROVISIONAL RECORD
DISCHARGE IN SECOND-FEET PER SQUARE MILE
DISCHARGE IN SECOND-FEET PER SQUARE MILE
0
1
2
3
4
5
6
JAN.
APR.
JULY
OCT.
1928
1929
1930
1931

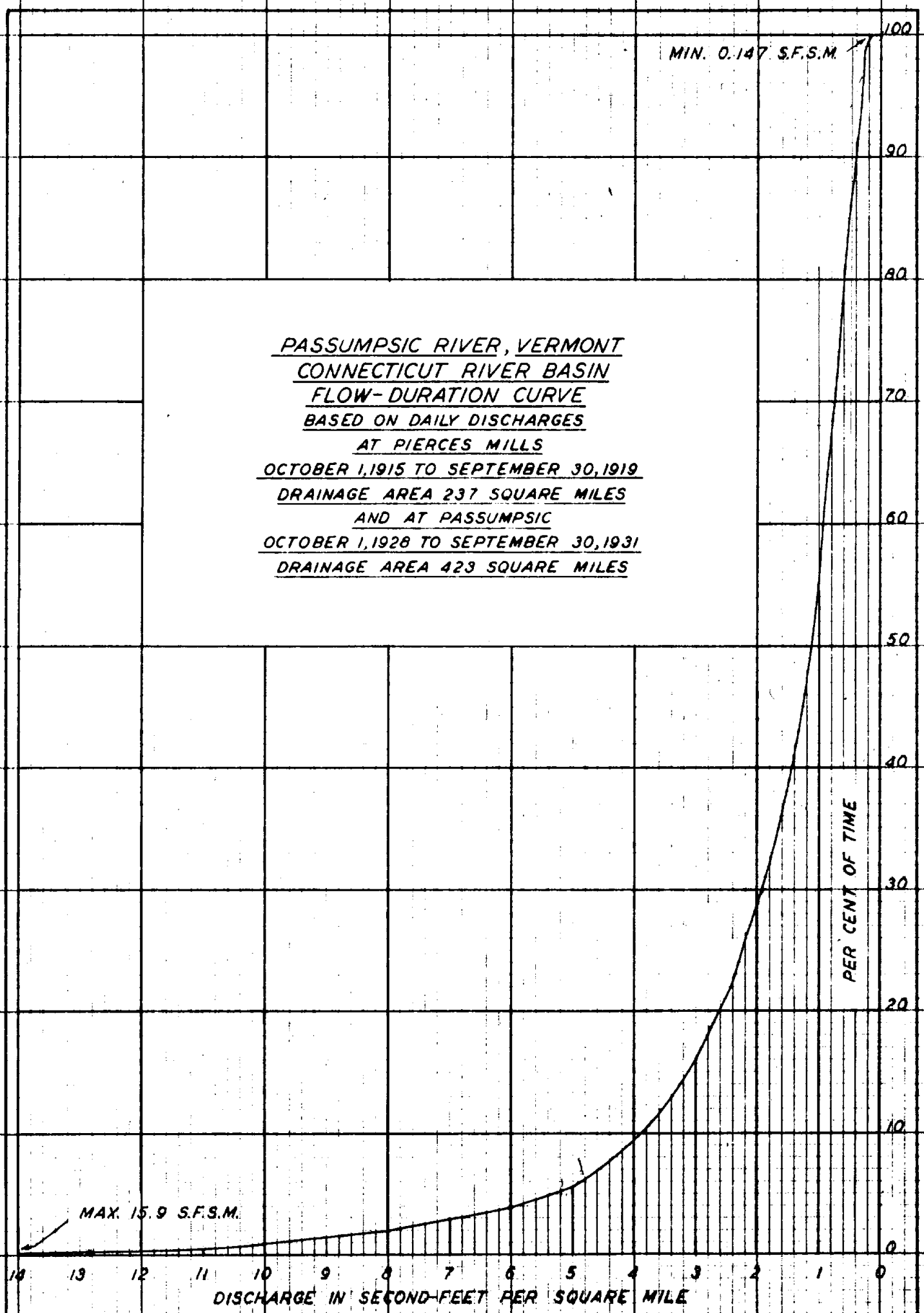
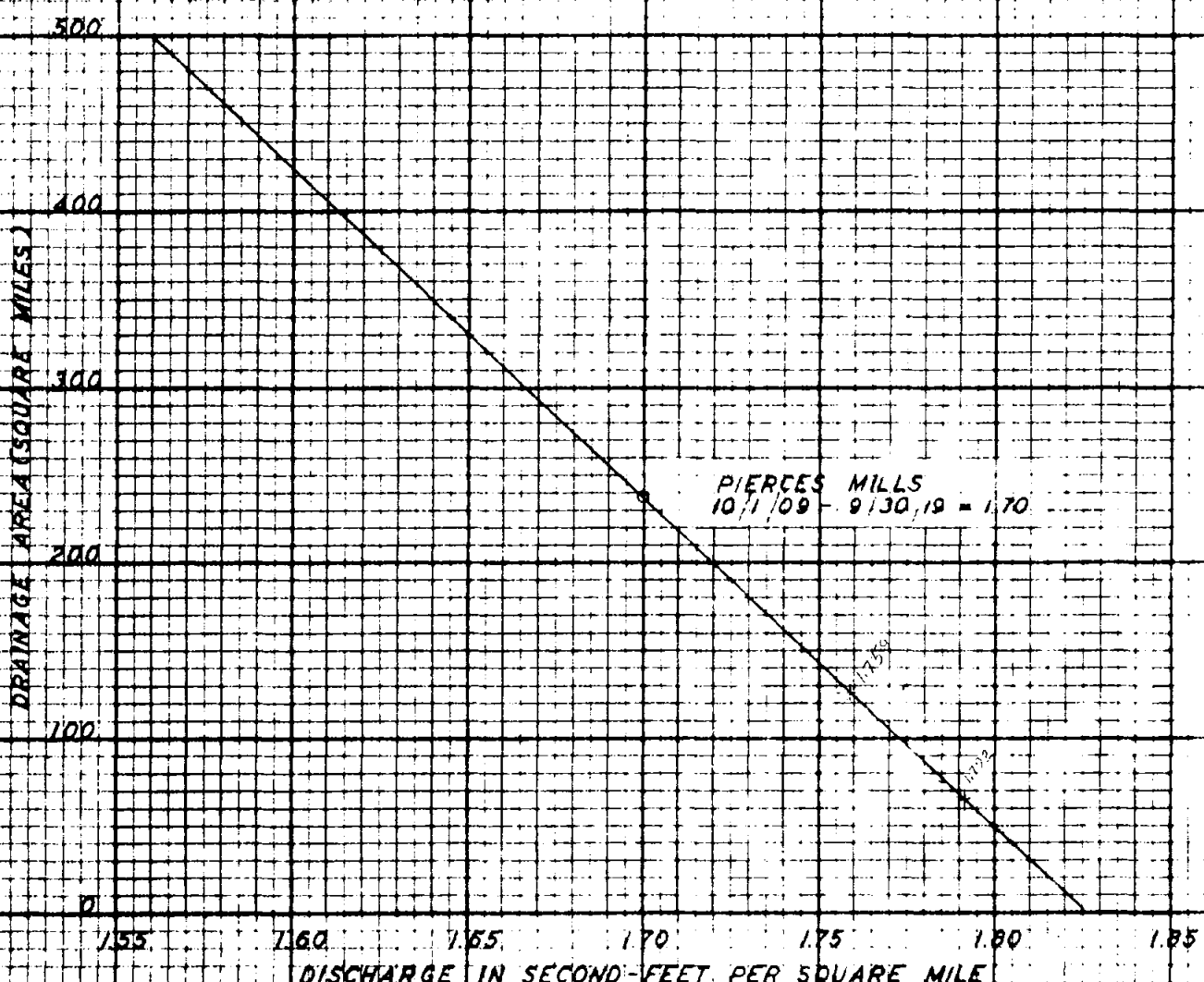

PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
FLOW-DURATION CURVE
BASED ON DAILY DISCHARGES
AT PIERCES MILLS
OCTOBER 1, 1915 TO SEPTEMBER 30, 1919
DRAINAGE AREA 237 SQUARE MILES
AND AT PASSUMPSIC
OCTOBER 1, 1928 TO SEPTEMBER 30, 1931
DRAINAGE AREA 423 SQUARE MILES
MIN. 0.147 S.F.S.M.
MAX. 15.9 S.F.S.M.
PER CENT OF TIME
100
90
80
70
60
50
40
30
20
10
0
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
DISCHARGE IN SECOND-FEET PER SQUARE MILE

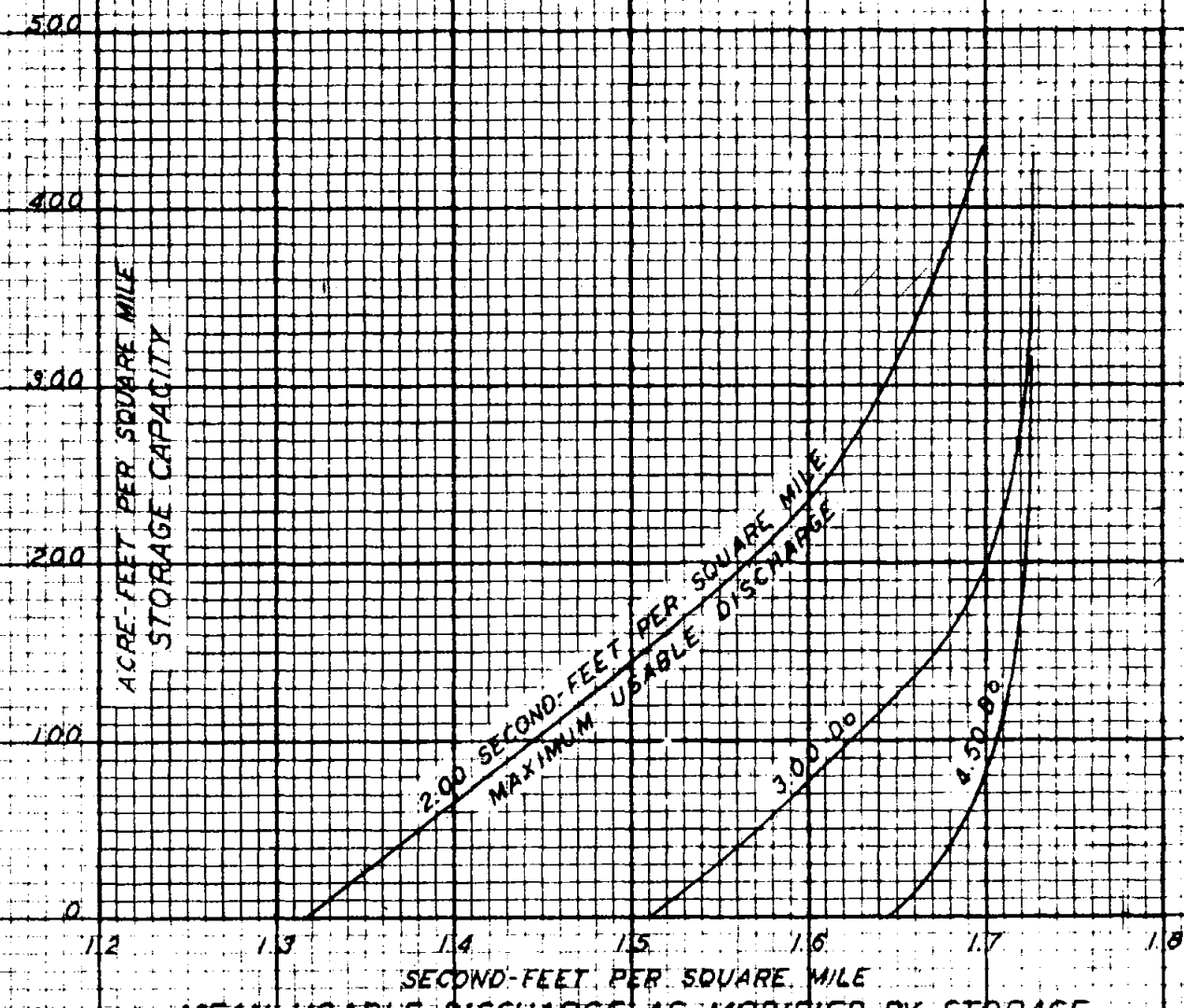
Figure 6

STATION	YEARS OF RECORD TO 1931 INCLUSIVE	MEAN YEARLY PRECIPITATION IN INCHES	
		NORMAL	OCT. 1, 1909 TO SEPT. 30, 1919
ST. JOHNSBURY, VT.	38	34.87	35.21



PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
ASSUMED MEAN DISCHARGE
ACCORDING TO DRAINAGE AREA

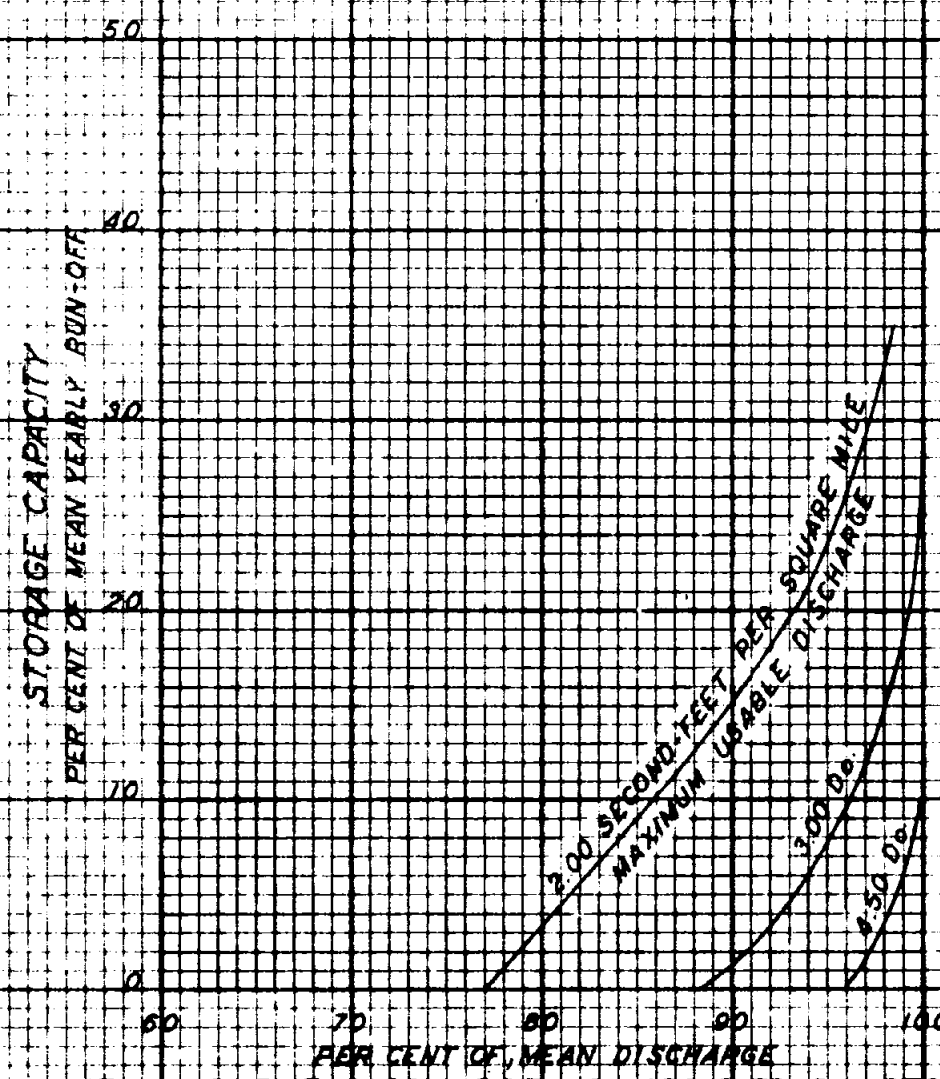
Figure 7



MEAN USABLE DISCHARGE AS MODIFIED BY STORAGE

PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
GRAPH SHOWING EFFECT OF
STORAGE ON MEAN USABLE DISCHARGE
BASED ON MEAN MONTHLY DISCHARGES AT PIERCES MILLS
JANUARY 1, 1910 TO FEBRUARY 28, 1919
DRAINAGE AREA 237 SQUARE MILES

Figure 9



MEAN USABLE DISCHARGE AS MODIFIED BY STORAGE

PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
GRAPH SHOWING EFFECT OF
STORAGE ON MEAN USABLE DISCHARGE
PERCENTAGE BASIS
BASED ON MEAN MONTHLY DISCHARGES AT PIERCE'S MILLS
JANUARY 1, 1910 TO FEBRUARY 28, 1919
DRAINAGE AREA 237 SQUARE MILES

Figure 9

Maximum usabl discharge second-feet per square mile	Mean usable discharge with no storage	
	Per cent of mean discharge	Second-feet per square mile at Pierces Mills
2.0	76.9	1.32
3.0	88.2	1.51
4.5	96.1	1.64

46. Potential power capacity.- In general, the developments have been designed for a maximum utilization of 2.0, 3.0 or 4.5 second-feet per square mile and the potential plant capacity based on 80 per cent overall efficiency would be 18.18, 27.27 and 40.91 horsepower respectively per foot of net head per 100 square miles of drainage area. The plant capacities vary from 600 horsepower at Mile 6.9 Joes Brook to 4,100 horsepower at East St. Johnsbury.

47. Potential power output.- The potential output is based on the mean usable stream flow at the sites less 10 per cent (i.e. 90 per cent utilization), the net head which is available at 75 per cent load and mean draft, and an overall efficiency of 80 per cent. The average annual plant outputs vary from 2,172,000 kilowatt-hours at Mile 6.9 Joes Brook to 13,600,000 at East St. Johnsbury.

48. Primary power.- The percentage of primary power output to be expected at each site is shown in Table 8. At plants with no storage (excepting Joes Brook) it is 19, 17, and 15 per cent for turbine capacities of 2, 3, and 4.5 second-feet per square mile respectively. At plants which would have usable storage it varies from 43 per cent at Mile 11.8 to 85 per cent at Victory. The statement of primary power at a plant is independent of the benefits which might accrue to that plant by development of upstream storage. Therefore, the development of storage for the purpose of increasing low stream flow would increase the stated percentage of primary power at down-stream sites.

The possible increase in minimum flow at a specific site due to storage at that site is shown in Table 8. It varies from 4 second-feet at

Center Pond to 80 second-feet at Victory.

Figure 10 shows the minimum discharge at Pierces Mills. Figure 11 is designed to show the same data in per cent of mean discharge and in addition it is applicable to various drainage areas since the mean discharge varies with drainage area as shown on Figure 7.

49. Cost of development of potential water power.- Table 8 gives a summary of the estimates of the cost of the development of power at each site. The cost varies from $184 per horsepower at South Danville to $1,048 at Mile 27.1.

50. Cost of potential power output.- Table 8 gives the estimated cost of output at each potential development. The cost at the best sites varies from 5.0 mills per kilowatt-hour at South Danville to 35.1 mills at Mile 27.1. The cost of output at combined storage and power developments, based on power costs, exclusive of the cost of storage, is shown in the same tabulation. It varies from 5.8 mills at Fish Hatchery to 9.7 mills at Victory.

51. Existing storage.- See Paragraph 17. The only storage of any importance used for stream flow regulation is at Joes Pond in the head waters of Joes Brook. The estimated usable capacity is 1,200 acre-feet. This storage benefits any plant on Joes Brook and the lowest plant (Roy Bros.) on the Passumpsic River.

52. Potential storage.- Table 6 shows that the potential storage at certain power sites increased by the potential storage at strictly storage sites amounts to 97,850 acre-feet at 11 sites. The storage at individual sites varies from 850 acre-feet at Center Pond to 58,000 at Victory.

A description of each potential storage site follows at the end of this appendix.

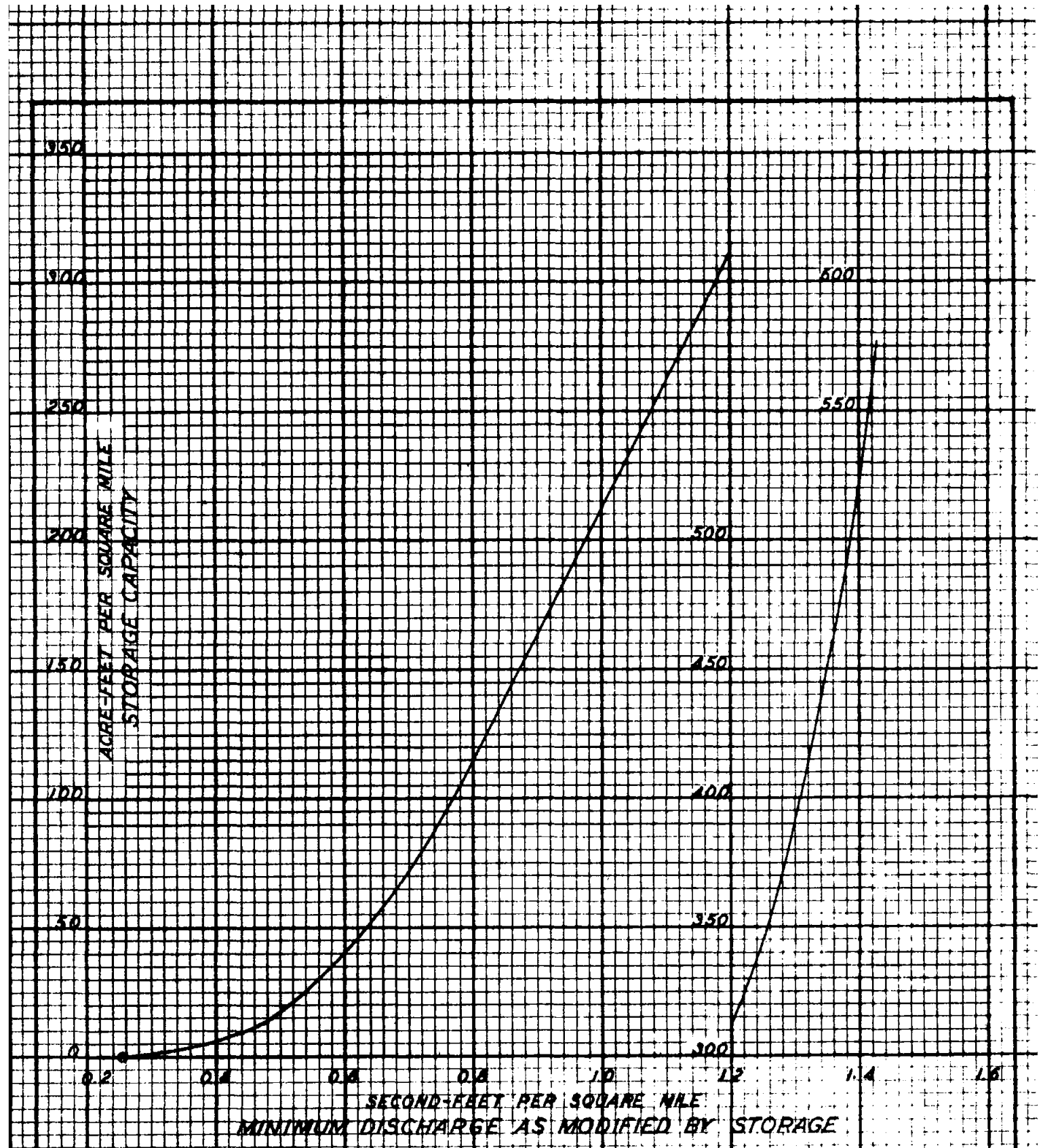
The head developed for power through which the potential storage would be used is shown in Table 6. The figures include 333.5 feet developed at Connecticut River plants below Passumpsic River.

Figure 4 shows the effect of storage on the hydrograph at Pierces Mills.

Figures 8 and 9 show the effect of storage on mean usable flow.

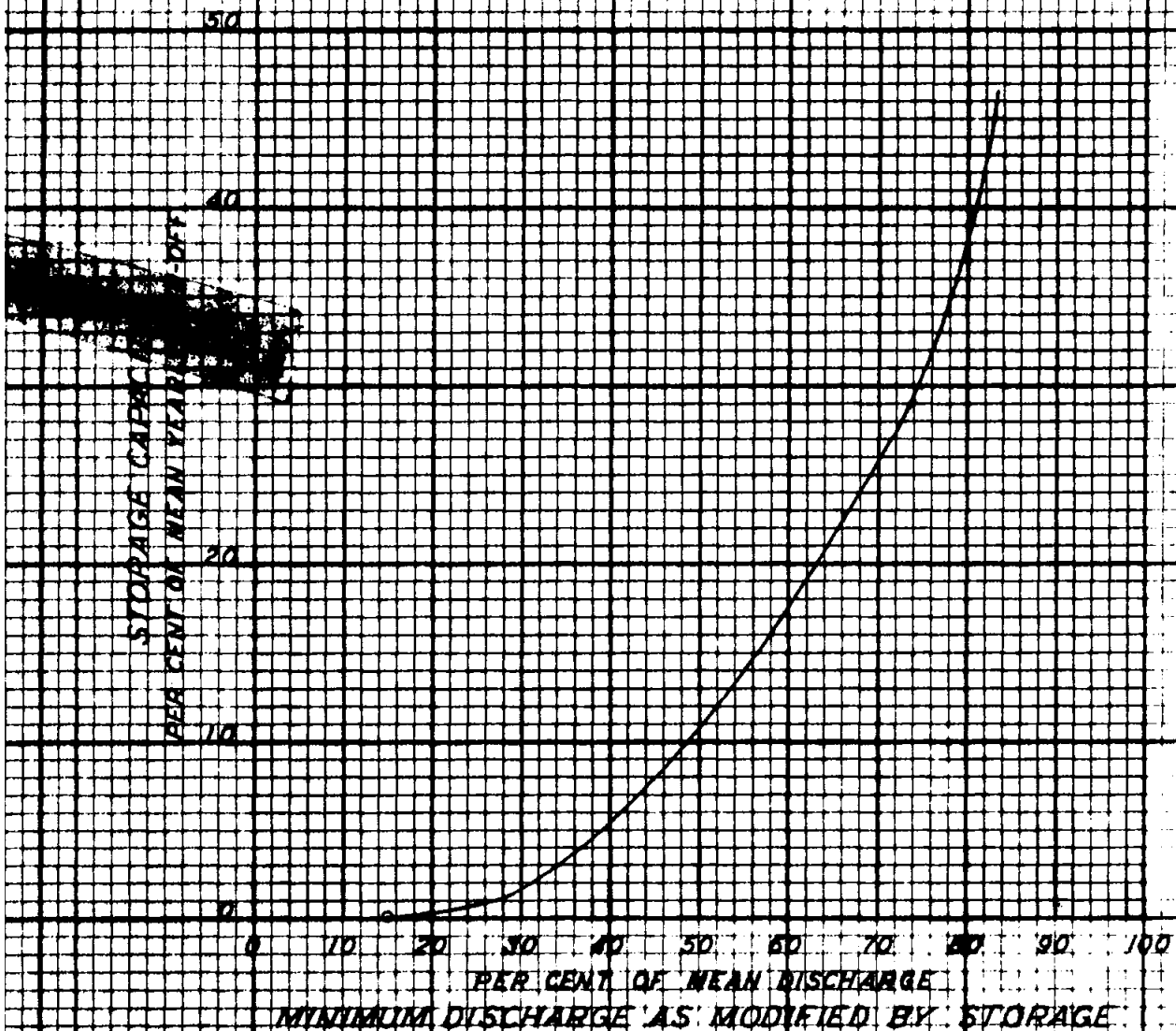
Figures 10 and 11 show the effect of storage on minimum flow.

Figure 12 is a mass curve of mean monthly discharges at Pierces Mills



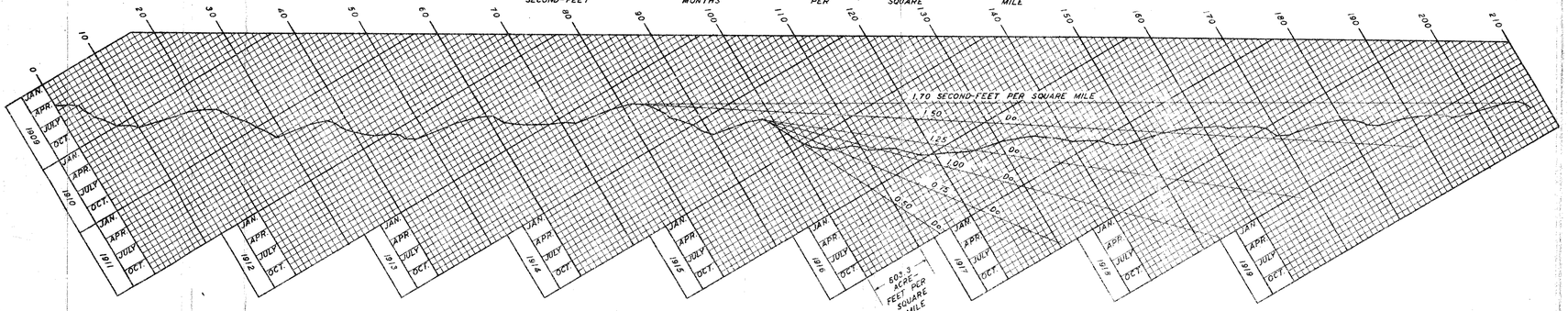
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
GRAPH SHOWING EFFECT OF
STORAGE ON MINIMUM DISCHARGE
BASED ON DAILY DISCHARGES AT PIERCE'S MILLS
JUNE 1, 1915 TO MAY 17, 1918 AND MAY 26, 1918 TO APRIL 3, 1916
DRAINAGE AREA 237 SQUARE MILES
PERIOD COVERED MAY 1, 1908 TO JULY 31, 1919

Figure 10

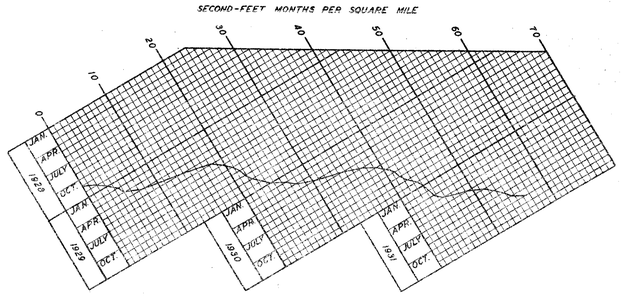


PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
GRAPH SHOWING EFFECT OF
STORAGE ON MINIMUM DISCHARGE
DRAINAGE BASIS
BASED ON DAILY DISCHARGES AT PIERCES MILLS
JUNE 1, 1913 TO MAY 17, 1916 AND MAY 26, 1916 TO APRIL 3, 1918
DRAINAGE AREA 237 SQUARE MILES
PERIOD COVERED MAY 1, 1908 TO JULY 31, 1918

Figure 4



AT PIERCES MILLS, VT.
DRAINAGE AREA 237 SQUARE MILES



AT PASSUMPSIC, VT.
DRAINAGE AREA 423 SQUARE MILES

PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
MASS CURVES OF MEAN MONTHLY NATURAL DISCHARGES

Figure 12

and shows the effect of potential storage on dependable flow.

Figure 13 shows the flow-duration curve at Pierces Mills as modified by potential storage.

53. Cost of potential storage.- Table 6 shows for each site: The total cost of storage; the unit cost per acre-foot; the head developed at present through which the stored water would be used; and the unit cost per foot of developed head per acre-foot of capacity.

The cost per acre-foot varies from $10.80 at Victory to $180 at Fish Hatchery.

The cost per acre-foot per foot of developed head through which used varies from 2.6 cents at Victory to 40.4 cents at Fish Hatchery.

54. Cost of competing power.- The Passumpsic River Basin lies within feasible transmission distance of existing and potential hydroelectric plants on the Connecticut River. Development of power on the Connecticut River will in general be found cheaper than on the small tributaries owing to the much larger usable stream flow. The new Frank L. Comerford hydroelectric peak-load station, with a capacity of 215,000 horsepower, is less than two miles from the mouth of the Passumpsic River. The new Bellows Falls hydroelectric station, with a capacity of 14,000 horsepower, is about 5 miles away. Both of these are Connecticut River plants, owned by the New England Power Association and tied in with their system of steam and hydroelectric plants. There is more power than market in this section and much of it is transmitted to Boston, Mass. and distant points.

The cost of steam-electric power based on a modern plant costing $90 to $126 per kilowatt with an economy of 2 pounds to 1-1/2 pounds of coal per kilowatt-hour, 12 per cent fixed charges, 40 per cent capacity factor, and $8.50 per gross ton for coal, should be about 12.3 to 11.6 mills per kilowatt-hour.

55. Conclusion.- There is potential water power available at a price comparable with steam power as follows: 14,770 horsepower at eight strictly power sites; 3,040 horsepower at two storage sites; 2,040 horsepower at two sites where storage might be developed for the coordinated use of power

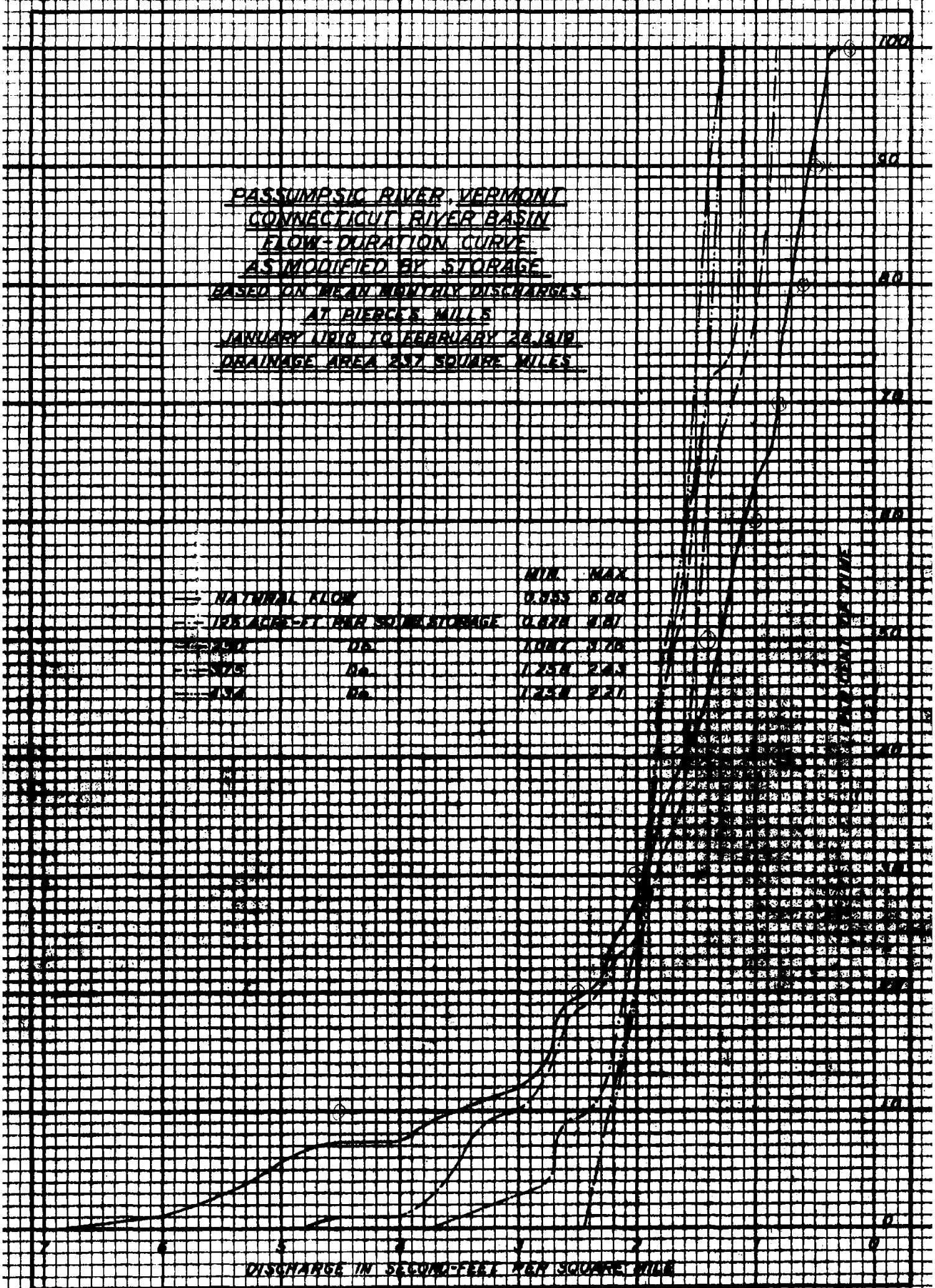

PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
FLOW-DURATION CURVE
AS MODIFIED BY STORAGE
BASED ON MEAN MONTHLY DISCHARGES
AT PIERCES MILLS
JANUARY 1,1910 TO FEBRUARY 28,1919
DRAINAGE AREA 237 SQUARE MILES
MIN. MAX.
NATURAL FLOW 0.855 6.88
125 ACRE-FT PER SQ. MI. STORAGE 0.828 4.81
250 Do. 1.087 3.76
375 Do. 1.258 2.43
434 Do. 1.258 2.21
100
90
80
70
60
50
40
30
20
10
0
7
6
5
4
3
2
1
0
DISCHARGE IN SECOND-FEET PER SQUARE MILE

Figure 13

and flood-control interests; total, 20,190 horsepower.

The local market could not absorb this power at present.

The existing power developments do not fully develop the potential power at the sites. A reasonable addition to the present installations would add over 6,000 horsepower to the installed capacity.

The low percentage of primary power at strictly power sites indicates the necessity of development of storage or the provision of auxiliary power.

Storage might feasibly be developed by combined power interests at four sites to the extent of 48,250 acre-feet, the bulk of which would be at Victory. The development of storage is not contingent on the development of the above-mentioned power.

A combination of flood-control and power interests might feasibly develop 18,100 acre feet of storage at two sites on the Passumpsic River which would be economically unsound for either interest alone.

Navigation on Connecticut River would not be adversely affected by the above construction.

VII. IRRIGATION

56. Precipitation.- Reference is made to Paragraph 14 showing the mean monthly precipitation at St. Johnsbury. It is evident that the mean yearly precipitation of 54.67 inches is sufficiently distributed throughout the year and in the growing season to make irrigation unnecessary.

57. Conclusion.- I am of the opinion that there is no need of irrigation.

VIII. [illegible]

58. Outline of plan.- Since irrigation and navigation are not involved a comprehensive plan requires coordination of flood control and power development, if possible. A feasible plan in brief is as follows:

(a) The construction of certain storage reservoirs by combined power interests to increase low stream flow, which reservoirs would have but minor effect on flood control.

(b) The construction of certain storage developments, with or without power development, which would benefit both power and flood-control interests but which would not be feasible for either interest alone.

(c) The construction of certain hydroelectric developments by power interests when there is a market for the power, which construction would have but minor effect on flood control.

59. Storage reservoirs.- Under classification (a), construction of the following reservoirs appears feasible if the cost be apportioned among the power-company beneficiaries on the Passumpsic and Connecticut Rivers; Victory, Center Pond, Clark Pond and Keiser Pond. The construction of Keiser Pond reservoir requires the construction of Joes Pond power development, which would be its principal source of water for storage.

Under classification (b) construction by coordinated power and flood-control interests of the following reservoirs on Passumpsic River appears to be the most feasible; mile 32.3 and mile 27.1. The cost of these two reservoirs is perhaps somewhat more than the combined interests could economically spend but it appears to be the best combination obtainable. Mile 23.95 is omitted from the plan because power interests could not finance it alone and all warranted flood-control expenditures would be absorbed at mile 32.3 and 27.1.

60. Power development.- Under classification (c) construction of power developments by power interests, when the market can absorb the power, appears to be feasible as follows: on Moose River; mile 11.8, East St. Johnsbury, and St. Johnsbury; on Joes Brook; Joes Pond, mile 6.9, South Danville, mile 3.75, and mile 1.0. If storage reservoirs at Victory and Keiser Pond under classification (a) and at mile 32.3 and mile 27.1 under classification (b) were built, the addition of power to the developments would be feasible.

61. Channel improvement.- None is included in the proposed plan.

62. Effect of the proposed works.- The effect on power interests of the construction of storage reservoirs under classification (a) would be a storage capacity of 48,250 acre-feet which might, by proper operation, increase the low flow of the Passumpsic River at its mouth from 117 to 365 second-feet.

This storage used once yearly through, say 420 feet of developed head, as would be the case for Victory storage, should produce 15,000,000 kilowatt-hours of power annually which would otherwise be lost. This power would be available at a time of year when most needed.

The effect of the Victory storage on the potential Moose River power developments would be to increase the primary power and total output above that stated in the summary. If the Victory storage were used to the best advantage of the East St. Johnsbury development, the effect at that development would be an increase of output from 13,500,000 to 15,300,000 kilowatt-hours and the primary power would be increased from 17 to 72 per cent.

The effect of the Keiser Pond storage on potential Joes Brook developments would be an increase in output and primary power. If the storage were used to the best advantage of the potential development at mile 3.75, the effect at that development would be an increase in output from 4,940,000 to 5,630,000 kilowatt-hours and the primary power would be increased from 7 to 49 per cent.

The construction of reservoirs under classification (b) would benefit flood-control interests. Based on the assumption that the reservoirs would be empty at the time of flood, the effect on a flood similar to that of November, 1927, is shown in Table 5. The reduction in peak flow at Lyndonville is estimated at 40 per cent; at St. Johnsbury above Moose River, 31 per cent, below Moose River, 29 per cent; at Passumpsic, 29 per cent; at East Barnet, 28 per cent; at Woodsville Narrows above Ammonoosuc River, 19 per cent; at South Newbury, 6 per cent; and at Wilder, 6 per cent. Power interests would benefit by a storage capacity of 18,100 acre-feet, which by proper operation, might increase the low stream flow of the Passumpsic River at its mouth from the present flow of 117 second-feet to 276 second-feet. This storage used once yearly through 619 feet of developed head should produce 6,940,000 kilowatt-hours of electrical energy annually which would otherwise be lost. This power would be available

at a time of year when most needed.

The effect on power interests of constructing the eight power developments under classification (c) would be the creation of hydroelectric-power capacity of 14,770 horsepower which should produce electrical energy at a cost comparable with steam. The estimated output is 56,661,000 kilowatt-hours yearly. The power which would be available at the four reservoir sites under classification (a) and (b) amounts to 5,420 horsepower.

63. Operation of the plan.- Those works proposed for the creation of power capacity will naturally not be built until there is a demand for the power and when built will be operated to the best advantage of the power system which builds them.

Those works which are designed primarily for increasing low stream flow must be operated for the benefit of the group which finances the construction. This should equitably include all who would be benefited both on the Passaic and Connecticut Rivers. An agency for storage operation would be required and the establishment of some center of gravity for the system at which point efforts toward stream control would be directed.

Those works designed for the mutual benefit of flood-control and power interests may offer some difficulties in operation as the aims are somewhat conflicting. Both interests must be respected, otherwise there can be no cooperative construction. Fortunately the greatest storms which are of the coastal type come in periods when the reservoirs should be practically empty. The record of floods on the Connecticut River at Hartford from 1659 to 1927 shows three important floods in May and one in July. The balance occurred in months when storage capacity would naturally be available. A reasonable operation of the storage would therefore require, at infrequent intervals, an artificial depletion of stored water predicated on advices from the Weather Bureau of an approaching storm of important intensity, and on a knowledge of ground water storage and water content of snow cover.

64. Estimated cost of completed works under the plan.- The cost of the works as abstracted from the summary of the cost estimates is as follows:

Storage, classification (a)

Serial No.	Development	Cost of storage only (dollars)	Controlled storage (acre-feet)	Cost per acre-foot (dollars)	Cost per acre-foot per foot of developed head through which used (cents)
8	Victory	410,000	38,000	10.80	2.6
1	Center Pond	32,000	830	38.60	7.1
6	Clark Pond	47,000	1,720	27.40	5.1
16	Keiser Pond	(1) 228,000	7,700	29.60	8.1
Total		717,000	48,250	14.9	

(1) Excluding the cost of Joes Pond power development which would be its source of water.

Storage, classification (b)

Serial No.	Development	Cost of storage only (dollars)	Total flood storage (acre-feet)	Cost per acre-foot (dollars)	Controlled storage (acre-feet)	Cost per acre-foot (dollars)	Cost per acre-foot per foot of developed head through which used (cents)
3	Mile 32.3	1,035,000	12,500	83	11,000	94	18.3
4	Mile 27.1	652,000	7,800	84	7,100	92	17.7
Total		1,687,000	20,300	83	18,100	93	

Power, classification (c)

Serial No.	Development	Cost (dollars)	Capacity (horsepower)	Cost per horsepower (dollars)	Yearly output (kilowatt-hours)	Cost of output per kilowatt-hour (mills)
9	Mile 11.8	1,040,000	3,100	335	11,100,000	11.4
10	East St. Johnsbury	766,000	4,100	187	13,500,000	7.3
11	St. Johnsbury	243,000	1,400	174	4,349,000	8.7
15	Joes Pond	203,000	1,020	200	4,530,000	7.5
17	Mile 6.9	126,000	600	210	2,172,000	10.4
18	South Danville	386,000	2,500	154	11,600,000	5.0
19	Mile 3.75	232,000	1,070	217	4,940,000	7.5
20	Mile 1.0	217,000	980	221	4,460,000	7.9
Total		3,212,000	14,770	217	56,651,000	

Power at storage developments under classification (a)

Serial No.	Development	Cost of power exclusive of cost of storage (dollars)	Capacity (horsepower)	Cost per horsepower (dollars)	Yearly output (kilowatt-hours)	Cost of output per kilowatt-hour (mills)
8	Victory	610,000	2,300	265	8,290,000	9.7
16	Keiser Pond	104,000	740	141	3,156,000	6.9
Total		714,000	3,040	235	11,446,000	

Power at storage developments under classification (b)

Serial No.	Development	Cost of power exclusive of cost of storage (dollars)	Capacity (horsepower)	Cost per horsepower (dollars)	Yearly output (kilowatt-hours)	Cost of output per kilowatt-hour (mills)
3	Mile 32.3	411,000	1,650	249	6,039,000	9.5
4	Mile 27.1	113,000	730	155	2,494,000	8.7
Total		524,000	2,380	220	8,533,000	

Summarizing the above estimates, the cost of developing 48,250 acre-feet of controlled storage at four sites for power use for increasing low stream flow is $717,000, or $14.90 per acre-foot. This is exclusive of the cost of the power development at Joes Pond which would be the source of water for Keiser Pond storage.

The cost of developing 18,100 acre-feet of controlled storage at two sites for flood protection is $1,587,000, or $93 per acre-foot.

The cost of developing 14,770 horsepower at eight power sites is $3,212,000, or $217 per horsepower.

The additional cost of developing 2,380 horsepower capacity at flood-control reservoirs is $524,000, or $220 per horsepower.

The additional cost of developing power to the extent of 3,040 horsepower at the Victory and Keiser Pond storage reservoirs is $714,000, or $235 per horsepower.

65. Distribution of cost of plan.- The cost of storage under classification (a) should be borne by the power-company beneficiaries on the Passumpsic and Connecticut Rivers in direct proportion to their benefits.

The cost of storage under classification (b) should be divided between the beneficiaries of flood control and the beneficiaries of power storage. It appears that $600,000 would be the maximum that the beneficiaries of flood control could pay for reasonably complete flood protection. The balance required is about all the power interests could pay for the expected benefits. The division of cost among power interests should be the same as for classification (a).

The cost of power at storage reservoirs under classification (b) should be borne by the interests which might construct and own the power equipment.

The cost of power development under classification (c) should be borne by the power interest which constructs and owns the individual plants.

There should be no Federal participation in the cost of the plan.

IX. CONCLUSION REFERRING NAVIGATION, POWER DEVELOPMENT, IRRIGATION, AND FLOOD CONTROL OF COMBINATIONS THEREOF.

66. Navigation and other Federal interests are not involved except to the extent of possible damage to Federal-aid highways.

Irrigation is not necessary.

Development of power to the extent of 14,770 horsepower with an annual output of 56,651,000 kilowatt-hours is practicable subject to the creation of a market, but it is thought that there are cheaper potential developments on larger rivers as yet undeveloped.

Development of storage by combined power interests to the extent of 48,250 acre-feet is feasible.

Development of power at four potential flood-control and storage reservoirs to the extent of 5,420 horsepower is feasible. The annual output would be 19,979,000 kilowatt-hours.

Important flood damage occurs and flood control is possible by the construction of reservoirs, but the expense is too great to be economically sound for flood-control interests alone.

Power and flood-control interests may be coordinated to provide considerable reduction in flood peaks and storage for power developments by the construction of reservoirs which would not be economically sound for either interest alone.

No important relief from floods is to be expected from the construction of reservoirs by power companies, for those reservoirs which would be feasible for power companies to build would have no important effect in reducing the peak of a flood similar to that of November, 1927.

X. RECOMMENDATIONS.

67. Reference is made to the general recommendations in the Connecticut River section of the report.

I recommend that a combination of power interests make detailed investigation of Victory, Center Pond, Clark Pond and Keiser Pond storage sites (if not already made), for the data available to me indicates them to be feasible developments if the cost can be prorated over the developed head through which the storage would be used.

Recommendations regarding power development are contingent on a market for the power, which does not appear to exist at present. Development of the eight power sites under classification (c) is not recommended unless the potential storage above the sites be developed. If this storage be developed, I recommend a comparison of the cost and benefits of these developments with potential developments in other basins which might serve the same market, to determine the economical sequence of construction. I further recommend that a power installation be added to Victory and Keiser Pond storage developments when built.

If a flood-control program be seriously considered by the public, I would recommend a more detailed investigation including probings of sites; mile [illegible], mile 27.1 and mile [illegible].95 to determine with more accuracy the cost at current prices and the available storage. I also recommend consideration of the report of the Advisory Committee of Engineers on Flood Control, Vermont, who have recommended two and estimated three sites not estimated in this report. Of these, a site on Millers Run, just above the mouth, and the Lyndonville site on Passumpsic River, just above West Branch, were omitted as probing facilities available did not produce sufficient data as to the location of suitable foundations. An alternative location at mile 2.0 on East Branch was chosen for the third site located by the Advisory Committee at the junction of Passumpsic River and East Branch. Based on

data available to me, I recommend the construction of developments Mile 32.3 and Mile 27.1, including power plants by coordinated power and flood-control interests, as offering the best solution of the flood problem.

As no Federal interest (other than possible flood damage to Federal-aid highways) is involved in the development or control of the water resources of the Pasquopric River, I do not recommend Federal participation in the cost.

(See following page for Paragraph 68.)

XI. DATA REGARDING POTENTIAL POWER AND STORAGE DEVELOPMENTS INVESTIGATED IN PASSUMPSIC RIVER BASIN

68. Center Pond, serial number 1, Center Pond Brook, Passumpsic River Basin, Vermont. Drainage area, 8.2 square miles. This potential development is a storage proposition only. At present there is a low dam at the outlet of the pond with a crest elevation of 1298.5 to 1299.1 and a gate 2.5 feet square giving 2.5-foot draft on the present pond. The present controlled storage is estimated at 200 acre-feet. It is proposed to raise the present pond level to elevation 1312 and provide for deeper draft to elevation 1301.5, giving a 10.5-foot maximum draft with 830 acre-feet of controlled storage. The dam site is 200 feet below the present dam. No ledge is exposed at the site but probings indicate its occurrence on the right bank at depths of 4.5 to 11 feet. Impervious foundation has been assumed on the left bank at depths of 5 to 12 feet. An earth and concrete dam is proposed 560 feet long of which 150 feet is concrete spillway section without flashboards or crest gates on the right bank. A 2.5-foot diameter sluice pipe is provided in the gate section for pond regulation.

Elevations and lengths are as follows:

Assumed lowest foundation,	1296
Normal water surface,	1301.5
Proposed lowest draft,	1301.5
Permanent spillway crest,	1312
Maximum highwater,	1315
Top of retaining section,	1317
Top of earth section,	1320
Length of earth section,	345 feet
Length of concrete retaining section,	60 feet
Length of sluice-gate section,	5 feet
Length of spillway section,	150 feet
Total length of dam,	560 feet

The pond at elevation 1312 would cover about 47 acres and extend about one-half mile.

Property damage is estimated as follows: Water rights and land, $2,000.

The flood-storage capacity in acre-feet is as follows: Above spillway to maximum high water, 320; below spillway, 830; total, 1,150.

The total cost is estimated at $32,000. Cost per acre-foot of total flood storage, $27.80. Controlled power storage, 830 acre-feet. Cost per acre-foot of controlled power storage, $38.60; cost per acre-foot per foot of devel-

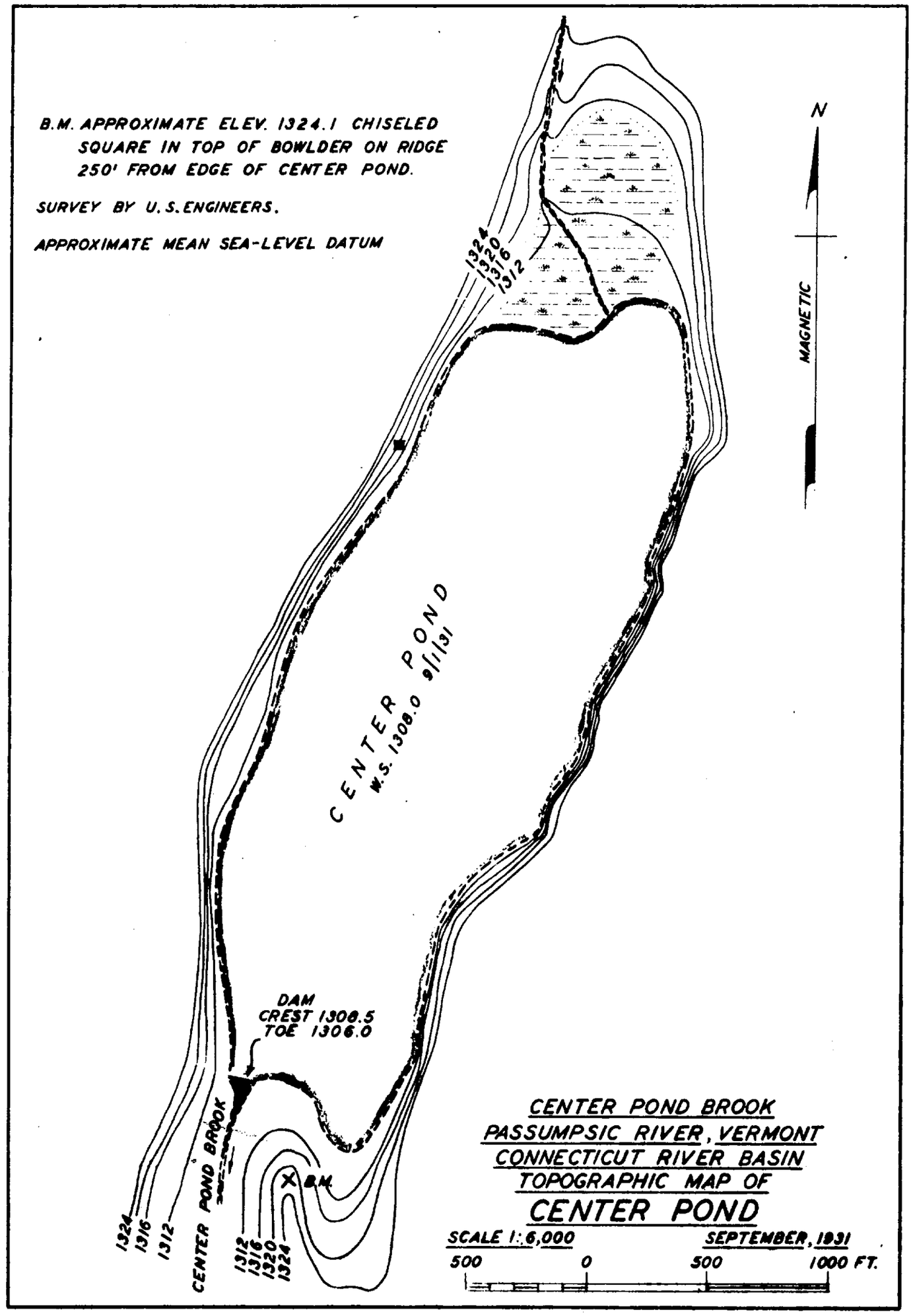
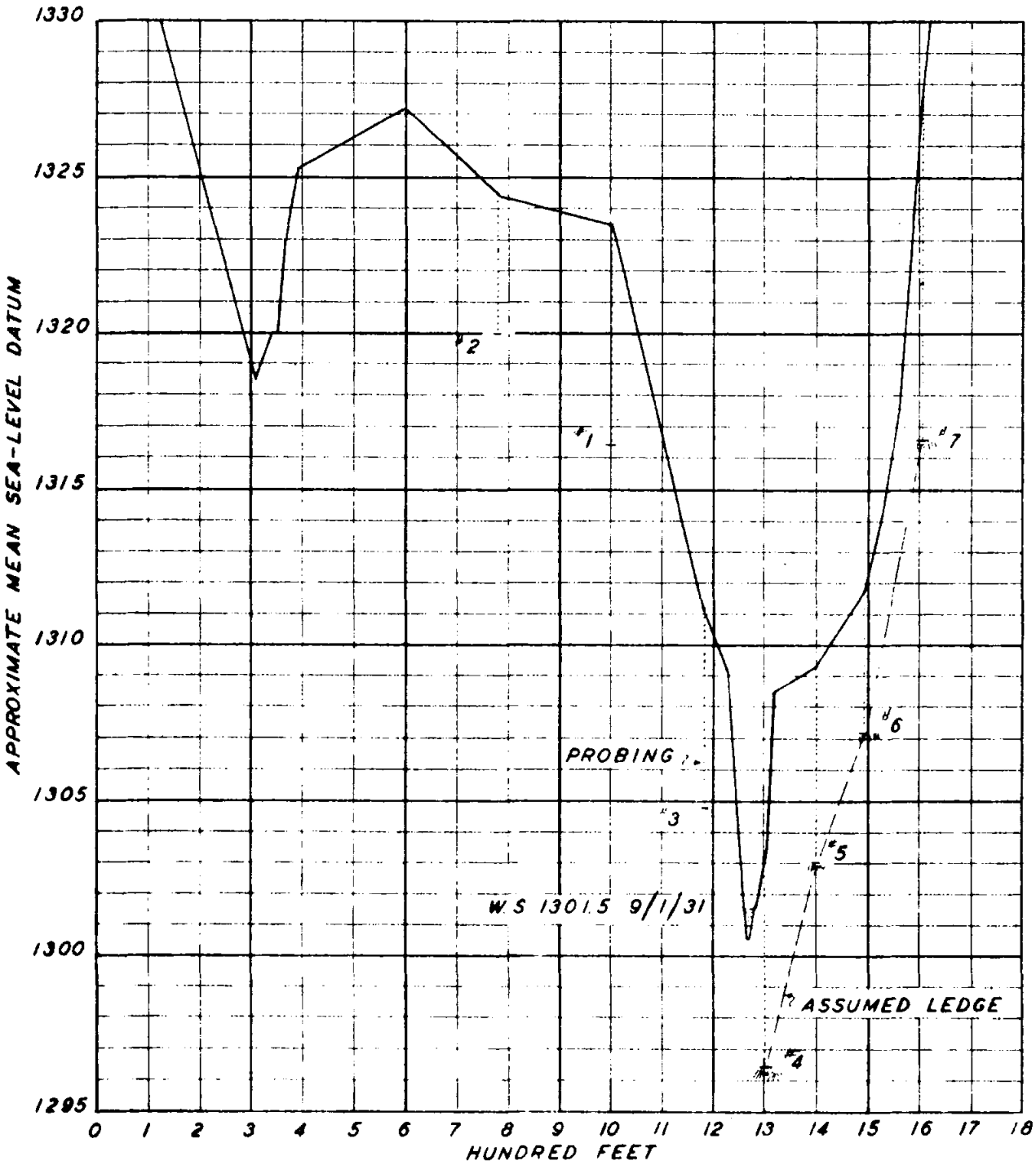

B.M. APPROXIMATE ELEV. 1324.1 CHISELED SQUARE IN TOP OF BOWLDER ON RIDGE 250' FROM EDGE OF CENTER POND.
SURVEY BY U.S. ENGINEERS.
APPROXIMATE MEAN SEA-LEVEL DATUM
N
MAGNETIC
1324
1320
1316
1312
CENTER POND
W.S. 1308.0 9/1/31
DAM
CREST 1308.5
TOE 1306.0
CENTER POND BROOK
B.M.
1324
1316
1312
1312
1316
1320
1324
CENTER POND BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
TOPOGRAPHIC MAP OF
CENTER POND
SCALE 1:6,000
SEPTEMBER, 1931
500
0
500
1000 FT.

Figure 14

B.M. APPROXIMATE ELEV. 1324.1, CHISELED SQUARE IN TOP OF BOWLDER ON RIDGE, 250 FEET FROM EDGE OF CENTER POND.

NOTE: CREST EXISTING DAM 1308.5 GATE SILL 1306

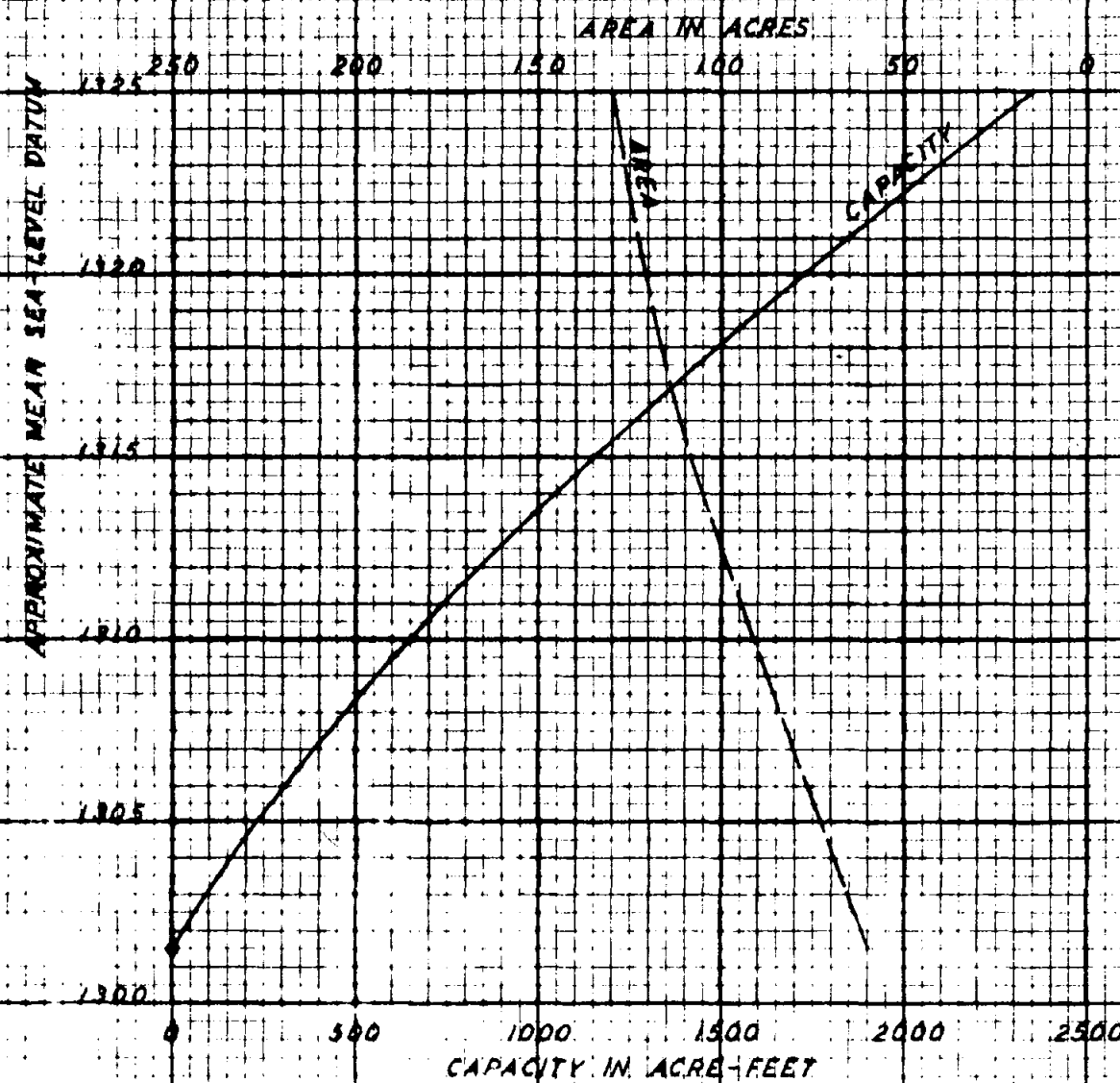


CENTER POND BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION AT

CENTER POND DAM SITE

LOOKING DOWNSTREAM
SEPTEMBER, 1931

Figure 15



CENTER POND BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
CENTER POND DAM SITE
DATA FROM SURVEY BY U.S. ENGINEERS

oped head through which used (642 feet), 7.1 cents.

The details of cost are as follows:

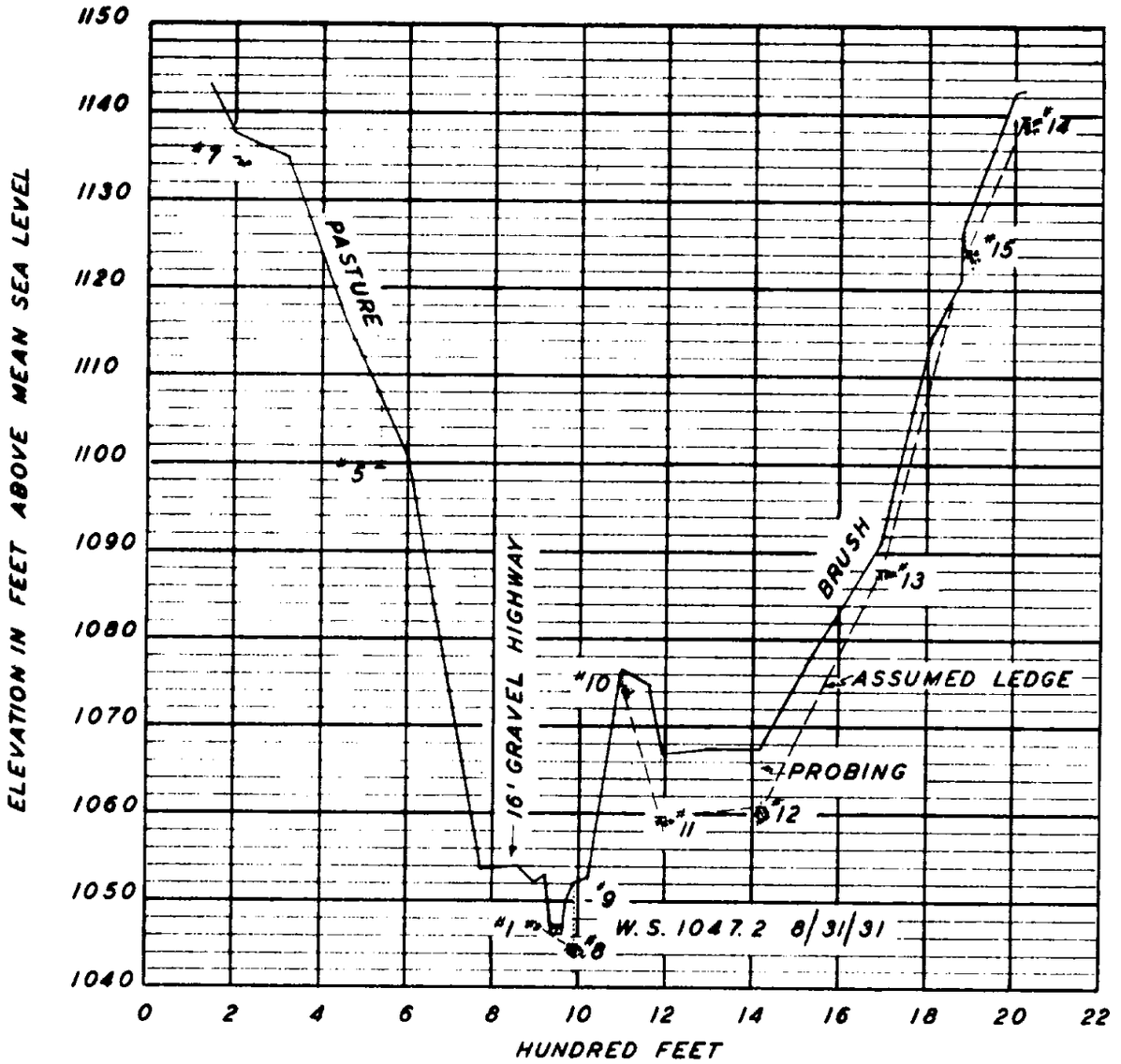
Dam,	$18,100
Total "A",	18,100
General expenses:	
Clearing reservoir,	1,400
Transportation,	2,200
Plant, camp, and general construction,	2,700
Total "B",	24,400
Engineering, contingencies, interest, taxes, and insurance,	5,700
Total "C",	30,100
Property and water rights,	2,000
Grand total cost,	32,100
Grand total cost in round figures,	32,000

69. Mile 2.0, serial number 8, East Branch, Passumpsic River Basin, Vermont. Drainage area, 12.9 square miles. This potential development is a storage proposition only, and would utilize the 59-foot fall between mile 4.5 and the dam site, none of which is developed at present. The dam site is at mile 2.0 East Branch, about three-quarters mile downstream from East Newark school. No ledge is exposed but probings indicate its occurrence near the river bed and on the right bank at depths varying from 3 to 7 feet. On the left bank it was assumed at depths varying from 13 to 23 feet. An earth and concrete dam 1,486 feet long is proposed, of which 61 feet is concrete spillway section without flashboards or crest gates at a high elevation on the right bank. A concrete conduit through the earth dam is provided for unwatering and pond control.

Elevations and lengths are as follows:

Assumed lowest foundation,	1045
Normal water surface, at site,	1047.2
Proposed lowest draft,	1047
Permanent spillway crest,	1106
Maximum high water,	1114
Top of earth and retaining sections,	1119
Length of earth section,	1,344 feet
Length of concrete retaining section,	80 feet
Length of spillway section,	61 feet
Total length of dam,	1,486 feet

B.M. ELEV. 1056.9, CHISELED SQUARE IN BOWLDER IN PASTURE 30' NORTHEAST OF CENTER LINE OF 16' GRAVEL HIGHWAY.

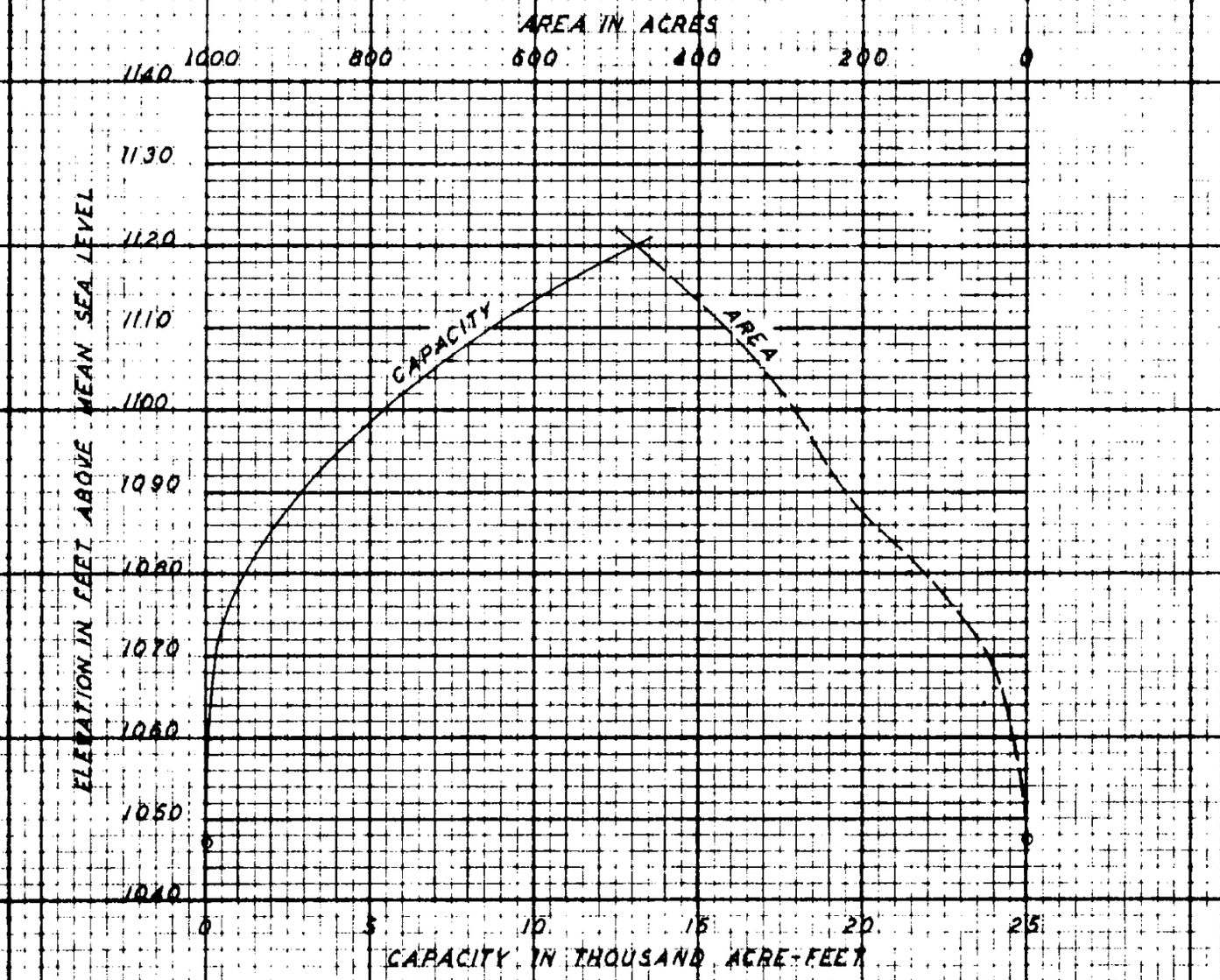


EAST BRANCH
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF

DAM SITE AT MILE 2.0

LOOKING DOWNSTREAM
AUGUST, 1931

Figure 17



EAST BRANCH
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 2.0
DATA FROM U.S. GEOLOGICAL SURVEY MAPS

Figure 18

The pond at elevation 1106 would cover about 320 acres and extend about 2.5 miles.

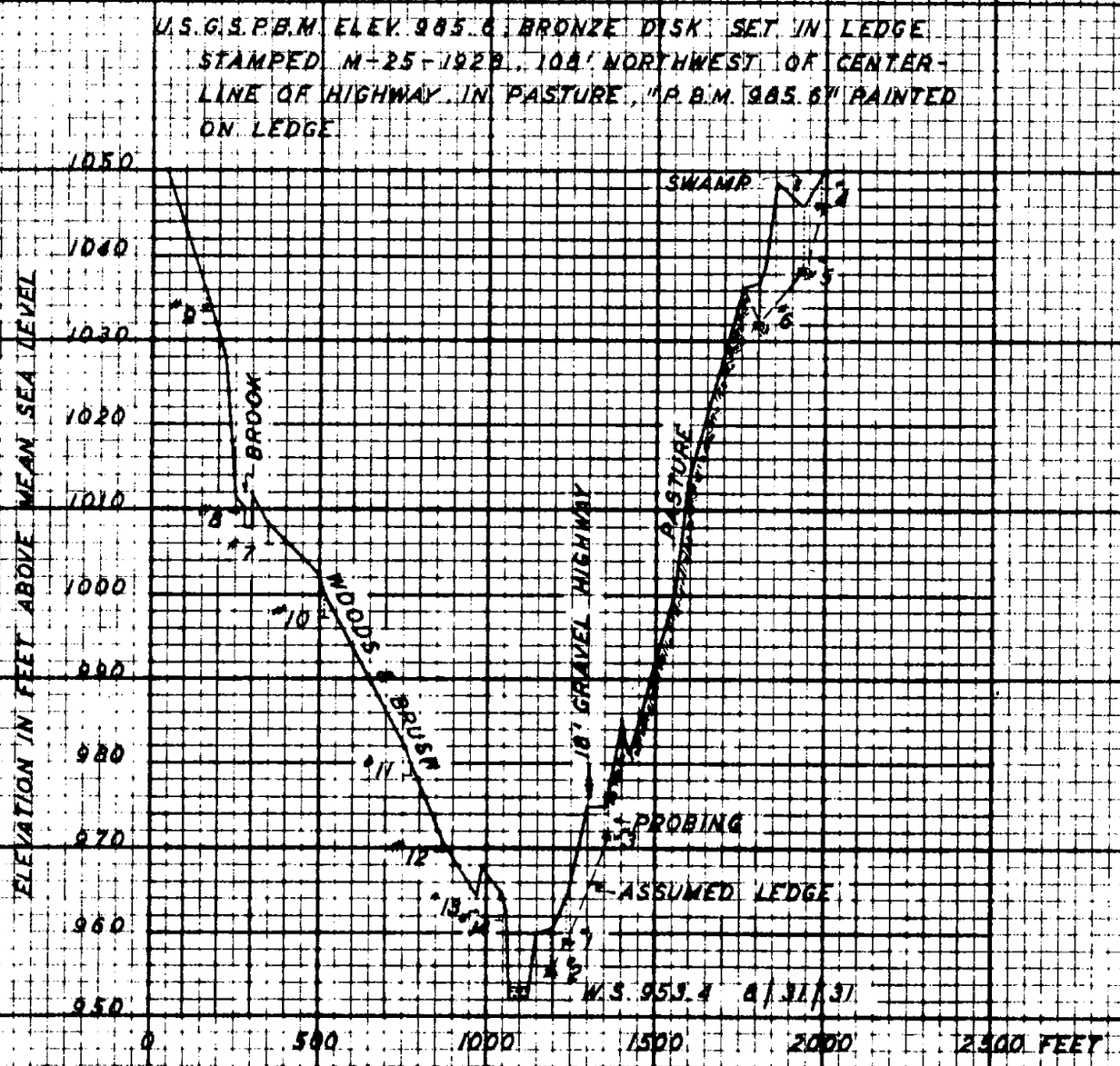
Property damage is estimated as follows: Land, 462 acres; buildings, six sets; roads, 3 miles; total damages, $99,600.

The flood-storage capacity in acre-feet is as follows: Above spillway to maximum high water, 3,000; below spillway, 7,400; total, 10,400. The maximum draft proposed is 59 feet, giving 7,400 acre-feet of controlled power storage.

The total cost is estimated at $746,000. Cost per acre-foot of total flood storage, $72. Cost per acre-foot of controlled power storage, $101; cost per acre-foot per foot of developed head through which used, (519 feet) 19.4 cents. The details of cost are as follows:

Unwatering,	$ 700
Dam,	401,300
Diversion conduit and control tower	24,100
Total "A",	426,100
General expenses:	
Clearing reservoir,	11,000
Relocation of roads,	87,000
Transportation,	8,100
Plant, camp, and general construction,	63,900
Total "B",	596,100
Engineering, contingencies, interest, taxes, and insurance,	137,100
Total "C",	733,200
Property,	12,600
Grand total cost,	745,800
Grand total cost in round figures	746,000

70. Mile 32.5, serial number 3, Passumpsic River, Vermont, about 2 miles below the village of East Haven. Drainage area, 47.5 square miles. This potential development would utilize the 167-foot fall on the main river from about one-fourth mile above the mouth of East Branch to the pond level of the proposed development at mile 27.1, Passumpsic River, and would utilize all the fall on the East Branch between mile 1.2 and the mouth of the stream. None of



PASSUMPSIC RIVER VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
DAM SITE AT MILE 32.3
LOOKING DOWNSTREAM
AUGUST, 1931

Figure 19

this head is developed at present. The dam site is at mile 32.3, just below the Essex-Caledonia County line, where ledge appears on or was found near the surface on the right bank and was assumed to be from 7 to 13 feet below the surface on the left bank. An earth and concrete dam is proposed, 1590 feet long, of which 162.5 feet is concrete spillway section with 10-foot flashboards at a high elevation on the right bank. A concrete conduit through the earth dam is provided for stream control during construction and it would be utilized permanently for pond regulation and power purposes.

Elevations and lengths are as follows:

Tail-water,	865
Assumed lowest foundation,	949
Normal water surface,	953.4
Proposed lowest draft for power,	990
Permanent spillway crest,	1020
Top of flashboards and maximum high water,	1030
Top of retaining section,	1032
Top of earth section,	1035
Length of earth section,	1,357.5 feet
Length of concrete retaining section,	70 feet
Length of spillway section,	162.5 feet
Total length of dam,	1,590 feet

The pond at elevation 1,030 would cover about 598 acres and extend about 2.4 miles on the main river, and would extend up the East Branch 1.25 miles.

Property damage is estimated as follows: Land, 445 acres; buildings, 22 sets; roads, 3.2 miles of 18-foot gravel; replacement of one bridge; 1 mile of 12-foot gravel road and five wooden bridges to be abandoned; one cemetery containing about 200 graves; telephone lines, 3.2 miles; additional water rights; pipe-line right of way, 2.2 miles; total damages, $146,500.

The flood-storage capacity in acre-feet is as follows: Above spillway, 4,800; below spillway, 7,700; total, 12,500. The maximum draft proposed for power is 4[illegible] feet, giving 11,[illegible] acre-feet of power storage.

A 5-foot diameter wood-stave pipe, 11,[illegible] feet long on the right bank of the river would conduct the water to a surge tank and power house located at mile 29.8, just below a highway bridge where the water elevation is 865. Two units would be installed utilizing 142.5 second-feet of water

or 3 second-feet per square mile at an average net head at full load of 127 feet, yielding 1,650 horsepower. The average net head at three-quarters load is estimated at 135.3 feet. The yearly output is estimated at 6,039,000 kilowatt-hours of which 61 per cent is primary power.

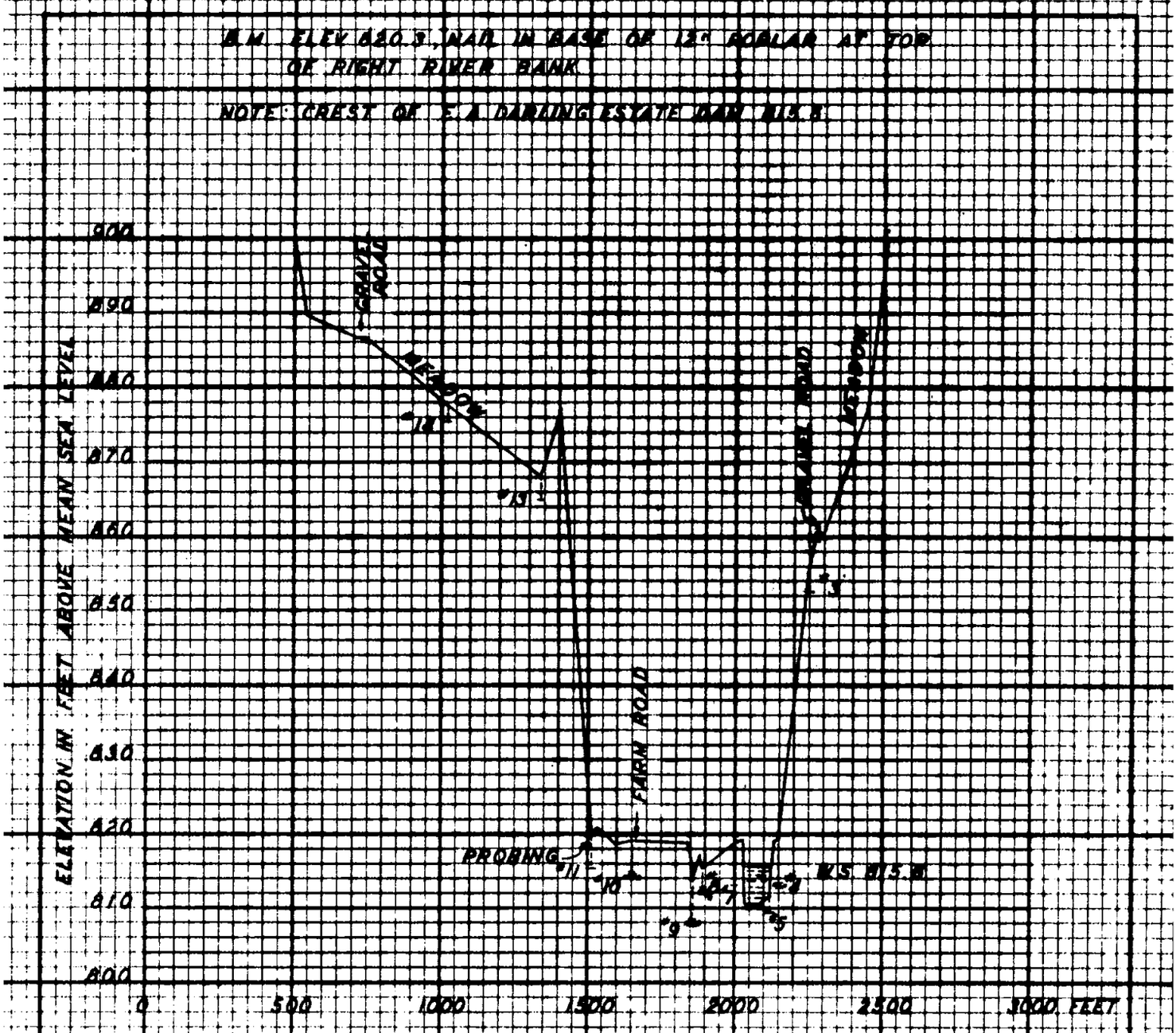
The total cost is estimated at $1,446,000. Cost per horsepower, $876. Cost of power production, per kilowatt-hour, 27.5 mills.

The cost of storage only is $1,035,000. Total flood storage, 12,500 acre-feet. Cost per acre-foot, $83. Power storage, 11,000 acre-feet. Cost per acre-foot, $94; cost per acre-foot, per foot of developed head through which used (519 feet) 18.2 cents.

The cost of power exclusive of cost of storage is $411,000. Cost of power production, per kilowatt-hour exclusive of cost of storage, 9.5 mills. The details of cost are as follows:

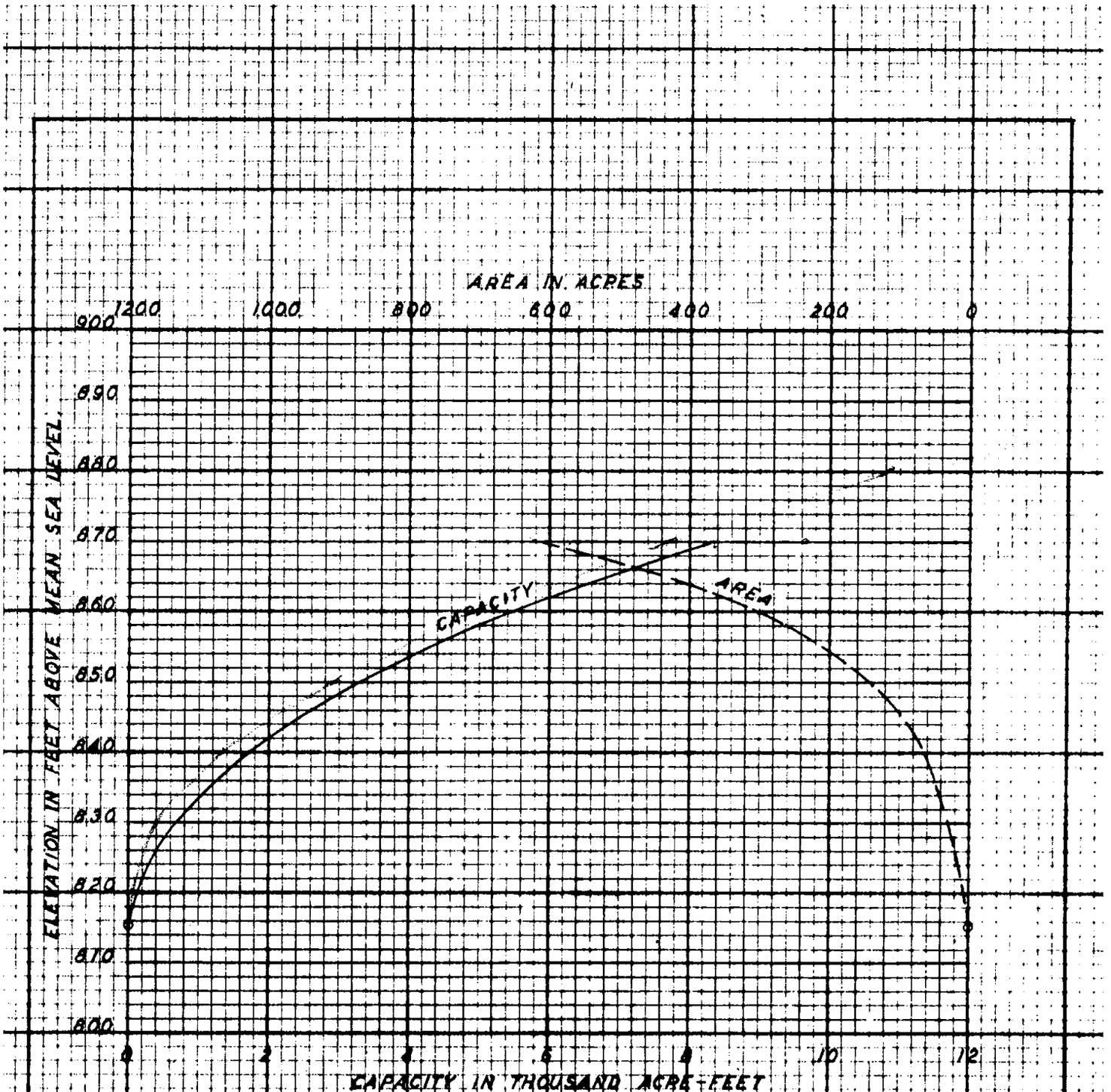
Unwatering,	$ 900
Dam,	548,000
Diversion and power conduit and control tower,	73,800
Pipe line,	176,200
Surge tank,	9,100
Penstock,	12,500
Power-house structure,	4,700
Power-house equipment, hydraulic and electrical apparatus,	43,900
Tailrace,	300
Total "A",	869,400
General expenses:	
Clearing reservoir,	2,700
Relocation of roads, telephone and transmission lines,	93,700
Relocation of cemetery,	3,000
Highway bridge,	3,400
Transportation,	24,300
Plant, camp, and general construction,	130,400
Total "B",	1,126,900
Engineering, contingencies, interest, taxes and insurance,	259,200
Total "C",	1,386,100
Property, water rights, and pipe-line right of way,	46,400
Total cost, without transformer station,	1,432,500
Outdoor transformer station,	13,100
Grand total cost,	1,445,600
Grand total cost in round figures,	1,446,000

91. Mile 27.1, serial number 4, Passumpsic River, Vermont. Drainage area, 58 square miles. This potential development would utilize all the head, 64 feet, between the tail-water of the proposed development at mile 32.3 and the pond level of the proposed development at mile 23.95. None of this head is developed for power at present. A small storage dam utilizes about 11 feet. The dam site is at mile 27.1, about 1,000 feet upstream from the village of East Burke. Ledge rock is not exposed at the site. Probings



PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
DAM SITE AT MILE 27.1
LOOKING DOWNSTREAM
SEPTEMBER, 1931

Figure 21



PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 27.1
DATA FROM U.S. GEOLOGICAL SURVEY MAPS

Figure 22

indicate its occurrence at depths of 4 to 10 feet in the valley and it has been assumed that it occurs at about the same depth on the right bank. An earth and concrete dam is proposed, 1,010 feet long, of which 162.5 is concrete spillway section with 10-foot flashboards in the present river bed. A 9-foot diameter valve is provided for pond regulation.

Elevations and lengths are as follows:

Tail-water,	804	
Assumed lowest foundation,	808	
Normal water surface,	810	
Present water surface on pond,	815.6	
Proposed lowest draft for power,	830	
Permanent spillway crest,	858	
Top of flashboards and maximum high water,	868	
Top of retaining section,	870	
Top of earth, intake, and gate sections,	873	
Length of earth section,	540	feet
Length of concrete retaining section,	280	feet
Length of intake section,	10	feet
Length of sluice-gate section,	17.5	feet
Length of spillway section,	162.5	feet
Total length of dam,	1,010	feet

The pond at elevation 868 would cover about 540 acres and extend about 2.7 miles.

Property damage is estimated as follows: Land, 694 acres; buildings, three sets; roads, one-half mile of 18-foot gravel, one-quarter mile of 12-foot gravel; pipe-line right of way, two-tenths mile; additional water rights; total damages, $38,200.

The flood storage capacity in acre-feet is as follows: Above spillway, 2,800; below spillway, 5,000; total, 7,800. The maximum draft proposed for power is 38 feet, giving 7,100 acre-feet of power storage.

A 5-foot diameter wood-stave pipe, 1,000 feet long, on the right bank would conduct the water to a surge tank and power house located at mile 28.88 between an existing dam and highway bridge, where two units would be installed utilizing 174 second-feet of water or 3 second-feet per square mile at an average net head at full load of 46.4 feet, yielding 730 horsepower. The average net head at three-quarters load is estimated at 47.8 feet. The yearly output is estimated at 2,494,000 kilowatt-hours of which 50 per cent is primary power.

The total cost is estimated at $765,000. Cost per horsepower, $1,048. Cost of power production, per kilowatt hour, 36.1 mills.

The cost of storage only is $652,000. Total flood storage, 7,800 acre-feet. Cost per acre-foot, $84. Power storage, 7,100 acre-feet. Cost per acre-foot, $92; cost per acre-foot, per foot of developed head through which used (519 feet), 17.7 cents.

The cost of power, exclusive of cost of storage is $113,000. Cost of power production, per kilowatt-hour, exclusive of cost of storage, 5.7 mills.

The details of cost are as follows:

Unwatering,	$ 4,800
Dam,	407,500
Pipe line,	12,300
Surge tank,	6,800
Penstock,	6,000
Power-house structure,	6,100
Power-house equipment, hydraulic and electrical apparatus,	38,600
Tailrace,	100
Total "A",	482,200
General expenses:	
Clearing reservoir,	6,000
Relocation of roads and transmission line,	18,700
Transportation,	20,200
Plant, camp, and general construction,	72,300
Total "B",	599,400
Engineering, contingencies, interest, taxes, and insurance,	157,900
Total "C"	757,300
Property, water rights, and pipe-line right of way,	19,500
Total cost, without transformer station,	756,800
Outdoor transformer station,	7,900
Grand total cost,	764,700
Grand total cost in round figures,	765,000

72. Mile 23.95, serial number 5, Passumpsic River, Vermont. Drainage area, 70 square miles. This potential development would utilize the 85-foot fall between the existing dam at the village of East Burke and the proposed power house site. None of this head is developed at present, although the pond would back water on the present dam at East Burke, which dam is now used for storage purposes only. The dam site is at mile 23.95, about 3 miles upstream from the village of Lyndonville, and just below a covered wooden

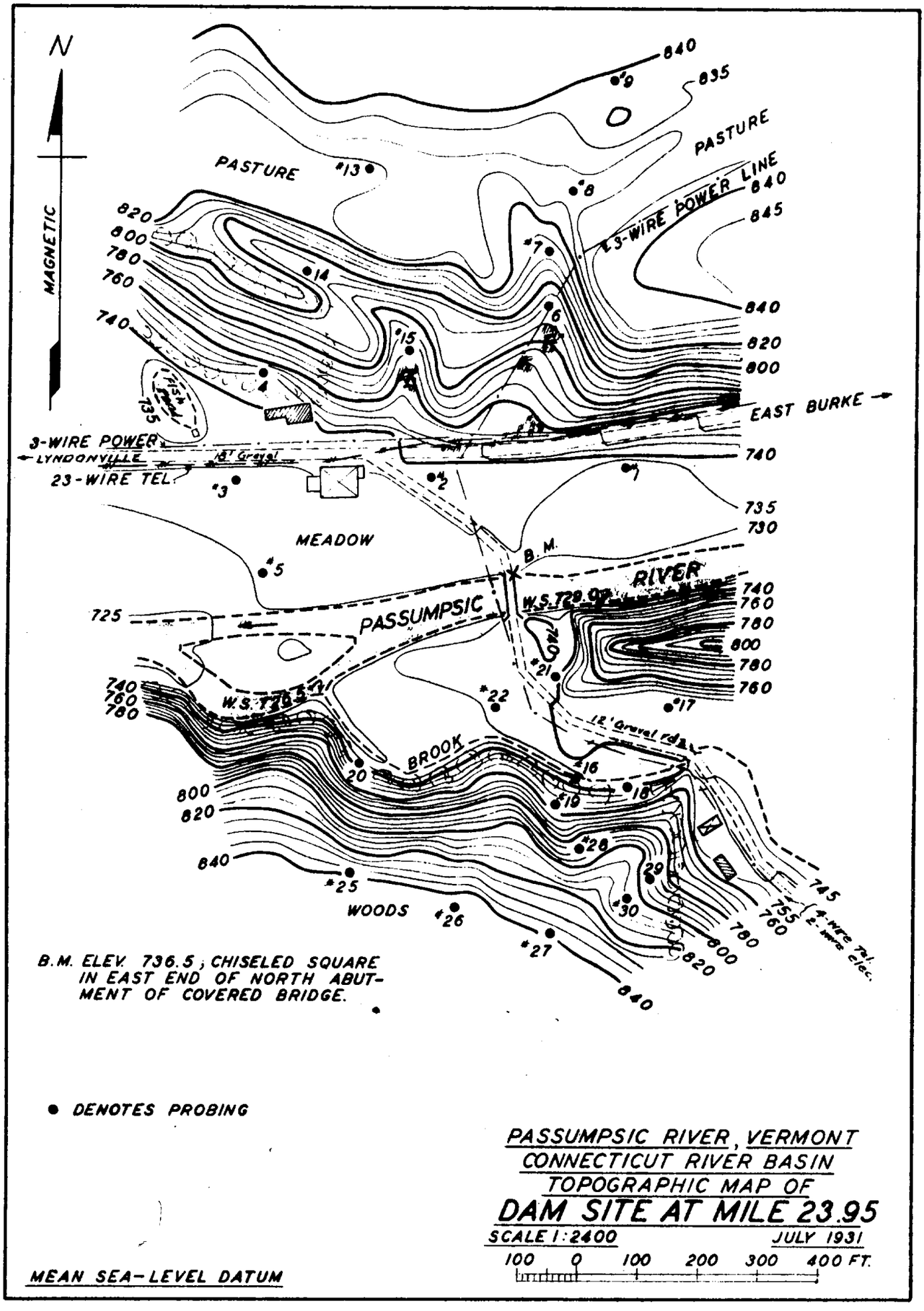
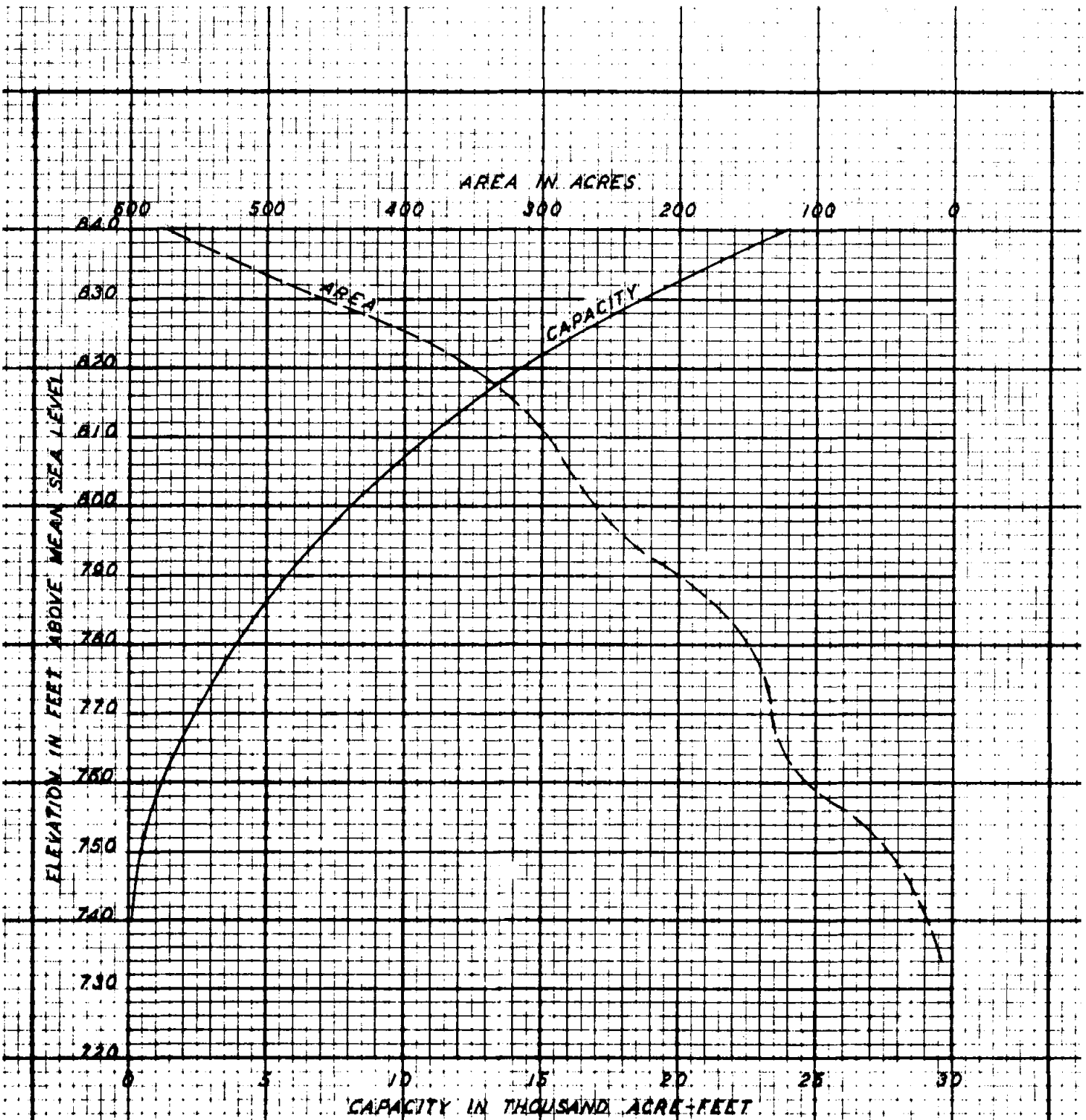

N
MAGNETIC
PASTURE
PASTURE
3-WIRE POWER LINE
EAST BURKE
3-WIRE POWER
LYNDONVILLE
18' Gravel
23-WIRE TEL.
MEADOW
B. M.
RIVER
PASSUMPSIC
W.S. 729.0
W.S. 735.5
BROOK
12' Gravel rd.
WOODS
Fish pond
4-wire tel.
2-wire elec.
B.M. ELEV. 736.5; CHISELED SQUARE IN EAST END OF NORTH ABUTMENT OF COVERED BRIDGE.
● DENOTES PROBING
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
TOPOGRAPHIC MAP OF
DAM SITE AT MILE 23.95
SCALE 1:2400
JULY 1931
100 0 100 200 300 400 FT.
MEAN SEA-LEVEL DATUM

Figure 23



PASSUMPSIC RIVER VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 23.95
DATA FROM CROSS SECTIONS

Figure 24

highway bridge where ledge appears on or was found near the surface on the right bank and was assumed to be at depths of 10 to 12 feet in the river bottom. Hard clay was found on the left bank and an impervious foundation was assumed about 20 feet below the surface. An earth and concrete dam is proposed 1,075 feet long, of which 192.5 feet is concrete spillway section with 10-foot flashboards at a high elevation on the right bank. A concrete conduit is provided for stream control during construction and it would be utilized permanently for pond regulation and power purposes.

Elevations and lengths are as follows:

Assumed lowest foundation,	725	
Tail-water,	725	
Normal water surface,	728	
Proposed lowest draft for power,	770	
Permanent spillway crest,	800	
Top of flashboards and maximum high water,	810	
Top of earth and retaining section,	815	
Length of earth section,	794	feet
Length of concrete retaining section,	88.5	feet
Length of spillway section,	192.5	feet
Total length of dam,	1,075	feet

The pond at the elevation of the flashboards (810) would cover about 295 acres and extend about 3 miles.

Property damage is estimated as follows: Land, 325 acres; buildings, 13 sets; roads, 3.5 miles of 18-foot gravel; replacement of one bridge; 3 miles of 10-foot earth road and one highway bridge would be abandoned; telephone lines, 3 miles; additional water rights; total damages, $104,500.

The flood-storage capacity in acre-feet is as follows: Above spillway, 2,800; below spillway, 8,000; total, 10,800. The maximum draft proposed for power is 40 feet, giving 8,400 acre-feet of power storage.

The power house would be located on the right side of the river near the toe of the dam where three units would be installed, utilizing 315 second-feet of water or 4.5 second-feet per square mile at an average net head of 67 feet, yielding 1,920 horsepower. The yearly output is estimated at 4,476,000 kilowatt-hours of which 48 per cent is primary power.

The total cost is estimated at $1,164,000. Cost per horsepower, $606. Cost of power production per kilowatt-hour, 30.1 mills.

The cost of storage only is $998,000.

Total flood storage, 10,800 acre-feet. Cost per acre-foot, $92. Power storage, 8,400 acre-feet. Cost per acre-foot, $119; cost per acre-foot per foot of developed head through which used (519 feet), 22.9 cents.

The cost of power, exclusive of cost of storage is $166,000. Cost of power production per kilowatt-hour exclusive of cost of storage, 6.7 mills.

The details of cost are as follows:

Unwatering,	$ 1,200
Dam,	535,300
Diversion and power conduit and control tower,	109,500
Penstock,	4,100
Power-house structure,	9,100
Power-house equipment, hydraulic and electrical apparatus,	58,800
Tailrace,	2,600
Total "A",	720,600
General expenses:	
Clearing reservoir,	3,200
Relocation of roads and telephone lines,	74,300
Transportation,	3,800
Plant, camp, and general construction,	108,100
Total "B",	910,000
Engineering, contingencies, interest, taxes, and insurance,	209,300
Total "C",	1,119,300
Property and water rights,	30,200
Total cost, without transformer station,	1,149,500
Outdoor transformer station,	14,400
Grand total cost,	1,163,900
Grand total cost in round figures	1,164,000

73. Clark Pond, serial number 6, West Branch, Passumpsic River Basin, Vermont. Drainage area, 3.2 square miles. This potential development is a storage proposition only. No controlled storage is developed at the present time. It is proposed to raise the present pond level 10 feet. The dam site is about 200 feet below the natural outlet of Clark Pond. No ledge is exposed at the site but probings indicate its occurrence on the right bank where it has been assumed at depths varying from 4 to 8 feet. On the left bank an impervious foundation has been assumed at various depths to a maximum of 21 feet. An earth and concrete dam 770 feet long is proposed of which 305 feet is concrete spillway section without flashboards on the right bank of the river. An earth dike would be required at a low saddle in the hills about 2,000 feet southeast of the dam site. Ledge is exposed at elevation 1530 on the northwest bank and probings indicate its occurrence at a depth of 10 feet at the lowest elevation of the cross section. Impervious foundation has been assumed at a depth of about 10 feet on the southeast bank.

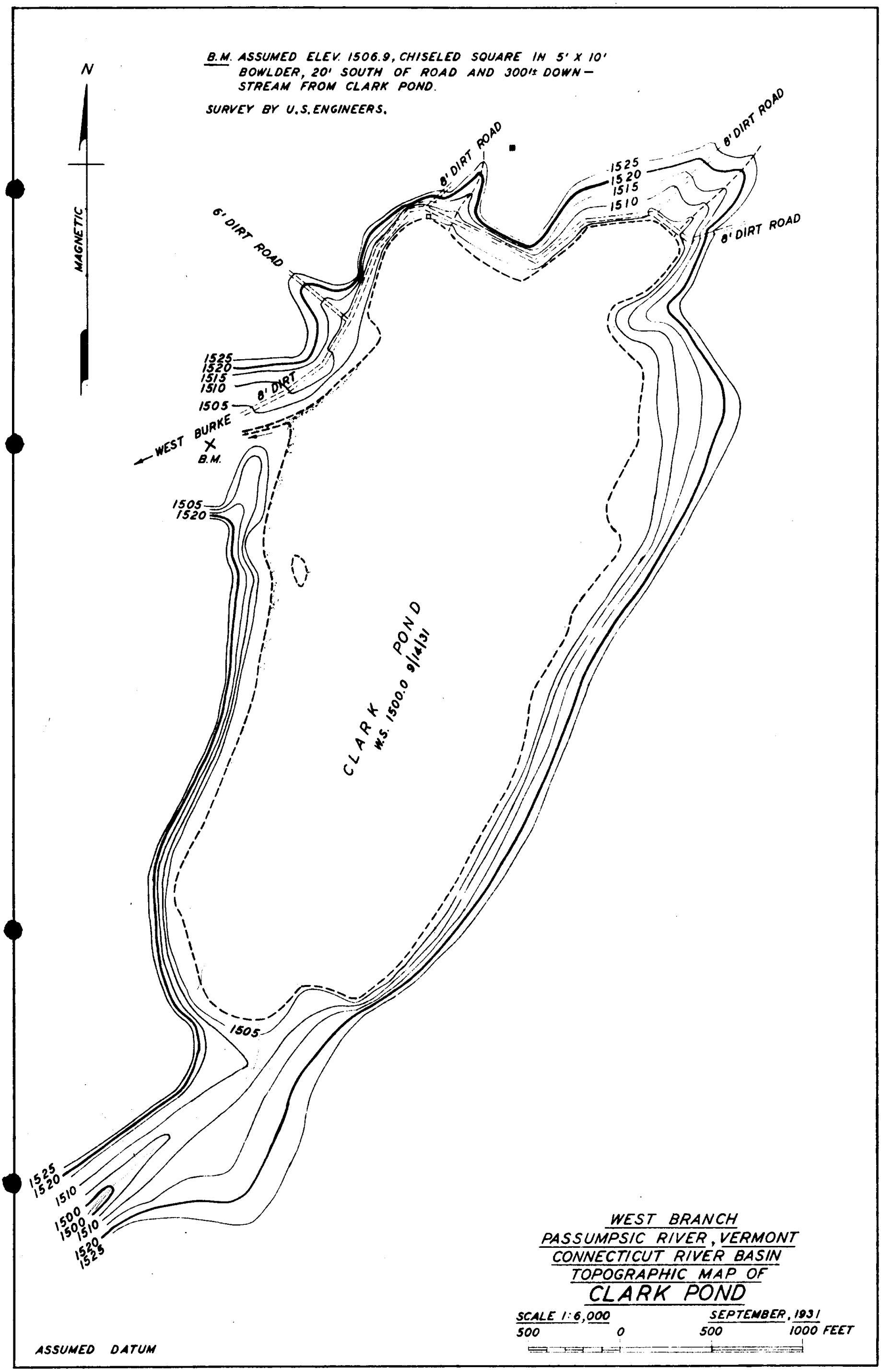
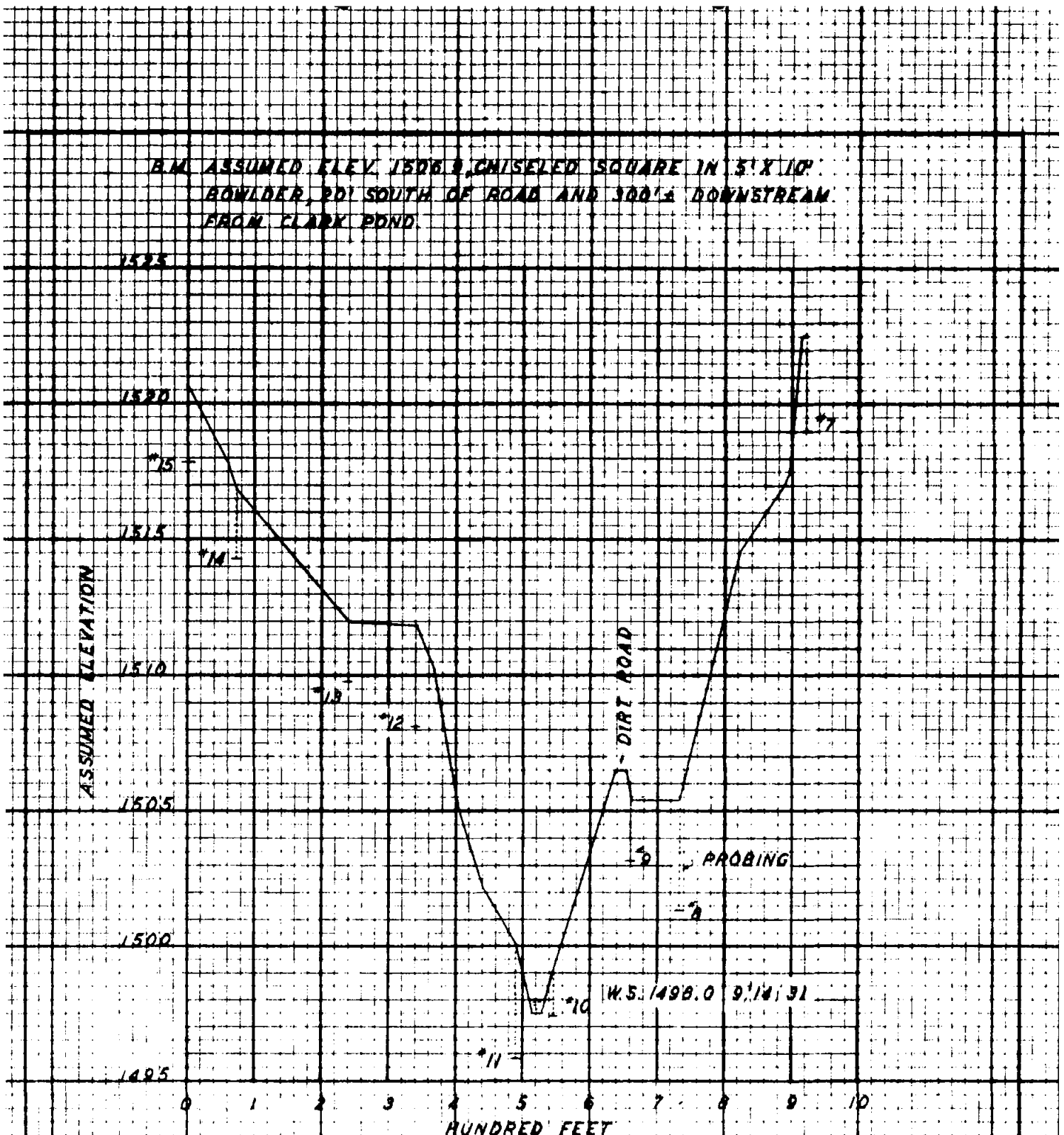
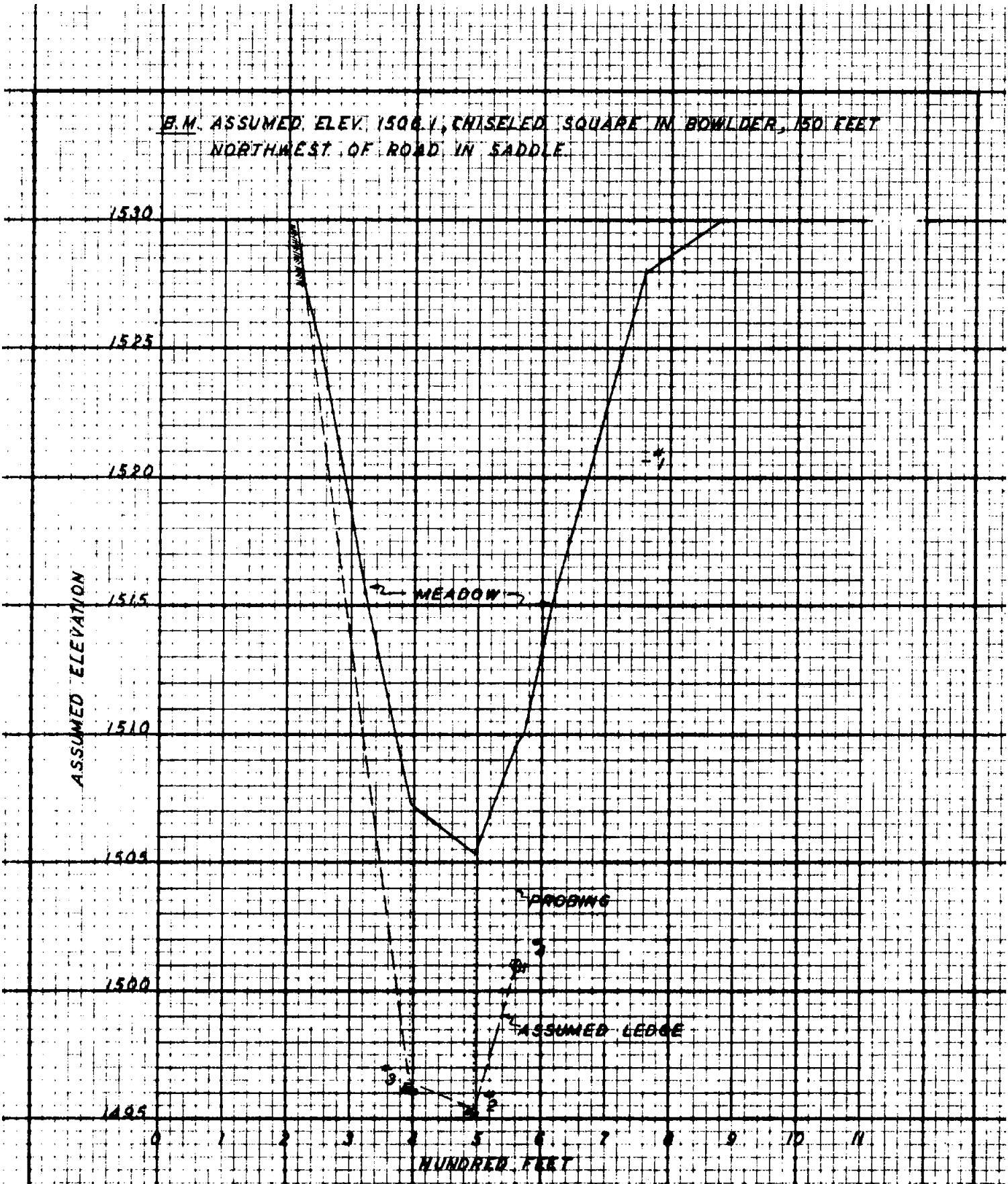

B.M. ASSUMED ELEV. 1506.9, CHISELED SQUARE IN 5' X 10' BOWLDER, 20' SOUTH OF ROAD AND 300'± DOWN-STREAM FROM CLARK POND.
SURVEY BY U.S. ENGINEERS.
N
MAGNETIC
8' DIRT ROAD
6' DIRT ROAD
8' DIRT
WEST BURKE
B.M.
1525
1520
1515
1510
1505
CLARK POND
W.S. 1500.0 9/14/31
1500
ASSUMED DATUM
WEST BRANCH
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
TOPOGRAPHIC MAP OF
CLARK POND
SCALE 1:6,000
SEPTEMBER, 1931
500 0 500 1000 FEET

Figure 25



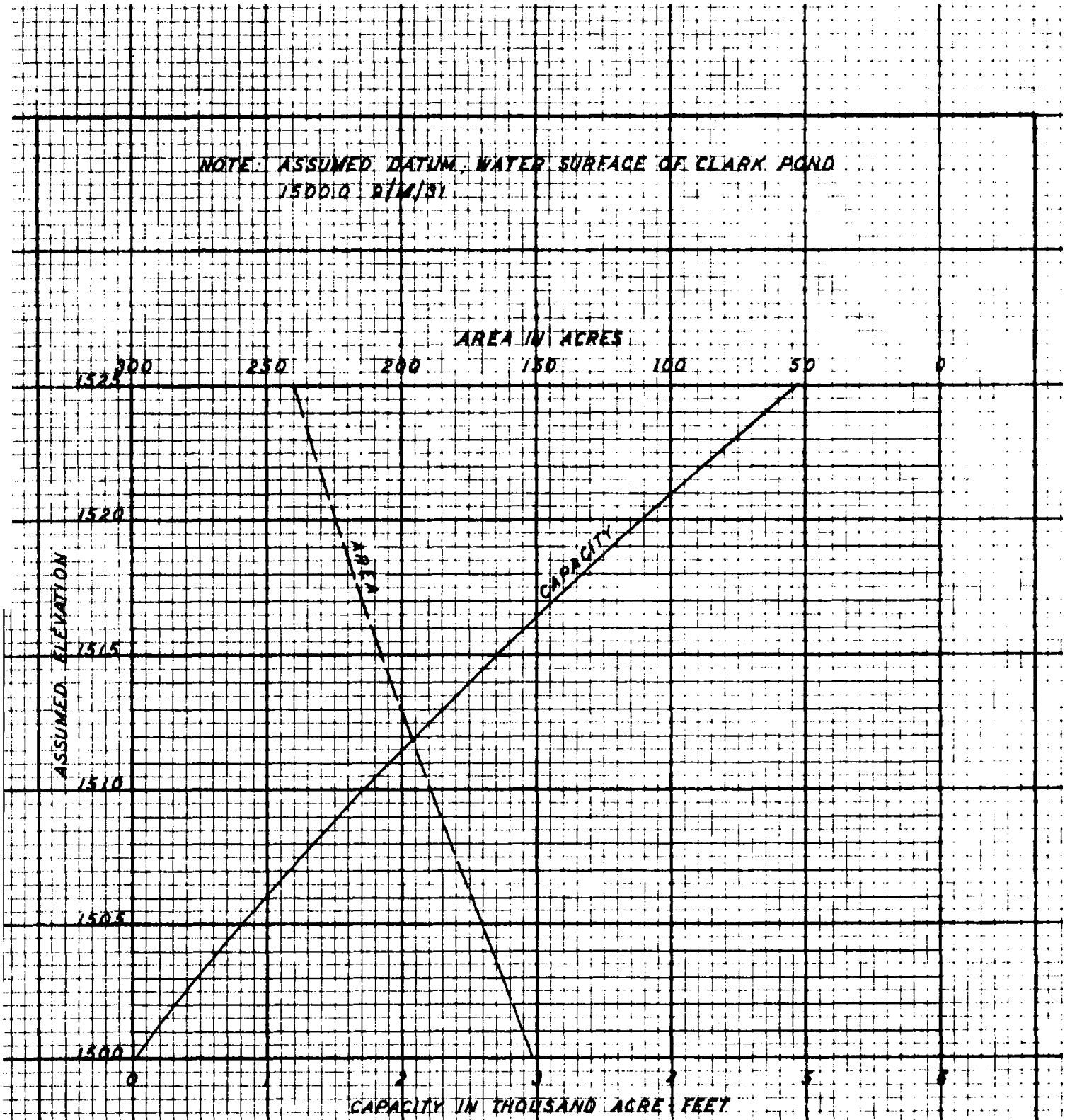
WEST BRANCH
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION AT
CLARK POND DAM SITE
LOOKING DOWNSTREAM
SEPTEMBER, 1931

Figure 26



WEST BRANCH
PASSUMPSIC RIVER VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION AT
DIKE SITE FOR
CLARK POND DAM SITE
LOOKING NORTHEAST
SEPTEMBER 1931

Figure 27



WEST BRANCH
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
CLARK POND DAM SITE
DATA FROM SURVEY BY U.S. ENGINEERS

Figure 28

This dike would be 313 feet long. A sluice pipe is provided at the left end of the spillway for pond control.

Elevations (assumed) and lengths are as follows:

Assumed lowest foundation	1495.
Normal water surface,	1498.
Proposed lowest draft,	1500.
Permanent spillway crest,	1510.
Maximum highwater,	1511.
Top of retaining section,	1513.
Top of earth section and dike,	1516.
Length of earth dike,	313 feet
Length of earth section, main dam,	528 feet
Length of concrete retaining section, main dam,	35 feet
Length of sluice-gate section, main dam,	5 feet
Length of spillway section, main dam,	205 feet
Total length of dam and dike,	1,083 feet

The above elevations are assumed and are based on a water elevation of Clark Pond, summer stage, of 1500. This may not be even approximately correct.

The pond at the elevation of the spillway (1510) would cover about 190 acres and extend about 1 mile.

Property damage is estimated as follows: Land, 45 acres; buildings, one boat house; roads, one narrow earth road to be abandoned; additional water rights; total damages, $2,200.

The flood-storage capacity in acre-feet is as follows: Above spillway, 180; below spillway, 1,720; total, 1,900. The maximum draft proposed is 10 feet, giving 1,720 acre-feet of controlled power storage.

The total cost is estimated at $47,000. Cost per acre-foot of total flood storage, $24.70. Cost per acre-foot of controlled power storage, $27.40; cost per acre-foot per foot of developed head through which used (531 feet), 5.1 cents.

The details of cost are as follows:

Dike,	$ 6,100
Dam,	23,200
Total "A",	29,300
General expenses:	
Clearing reservoir,	1,700
Transportation,	1,200
Plant, camp, and general construction,	4,400
Total "B",	36,600
Engineering, contingencies, interest, taxes, and insurance,	8,400
Total "C",	45,000
Property and water rights,	2,200
Grand total cost,	47,200
Grand total cost in round figures,	47,000

74. Lyndon Center, serial number 7, Mil 0.5, Millers Run, Passumpsic River Basin, Vermont. Drainage area, 54 square miles. The site is just above a cemetery on the right bank. A cross section of the valley was surveyed at the dam site and probings made. An area-capacity graph of the reservoir was computed from a topographic map recently made by the U. S. Geologic Survey in cooperation with the Vermont Flood-Control Committee. Probings to a depth of about 17 feet below water surface showed both banks and river bottom to be sand, although there was an indication of clay at one probing.

Owing to the lack of information regarding the location of suitable foundations, the cost of a development at this site has not been estimated.

The elevation of water surface at the dam site is 693. Property damage was noted to elevation 770 as follows: A state highway (18-foot gravel) runs the length of the valley; side roads are 10 to 12-foot earth; telephone and electric light lines parallel the highway most of the distance; some 15 buildings would be damaged with an estimated value of about $50,000. The bottom land is good hay meadow with hay and pasture hillsides, with a little brush and woods.

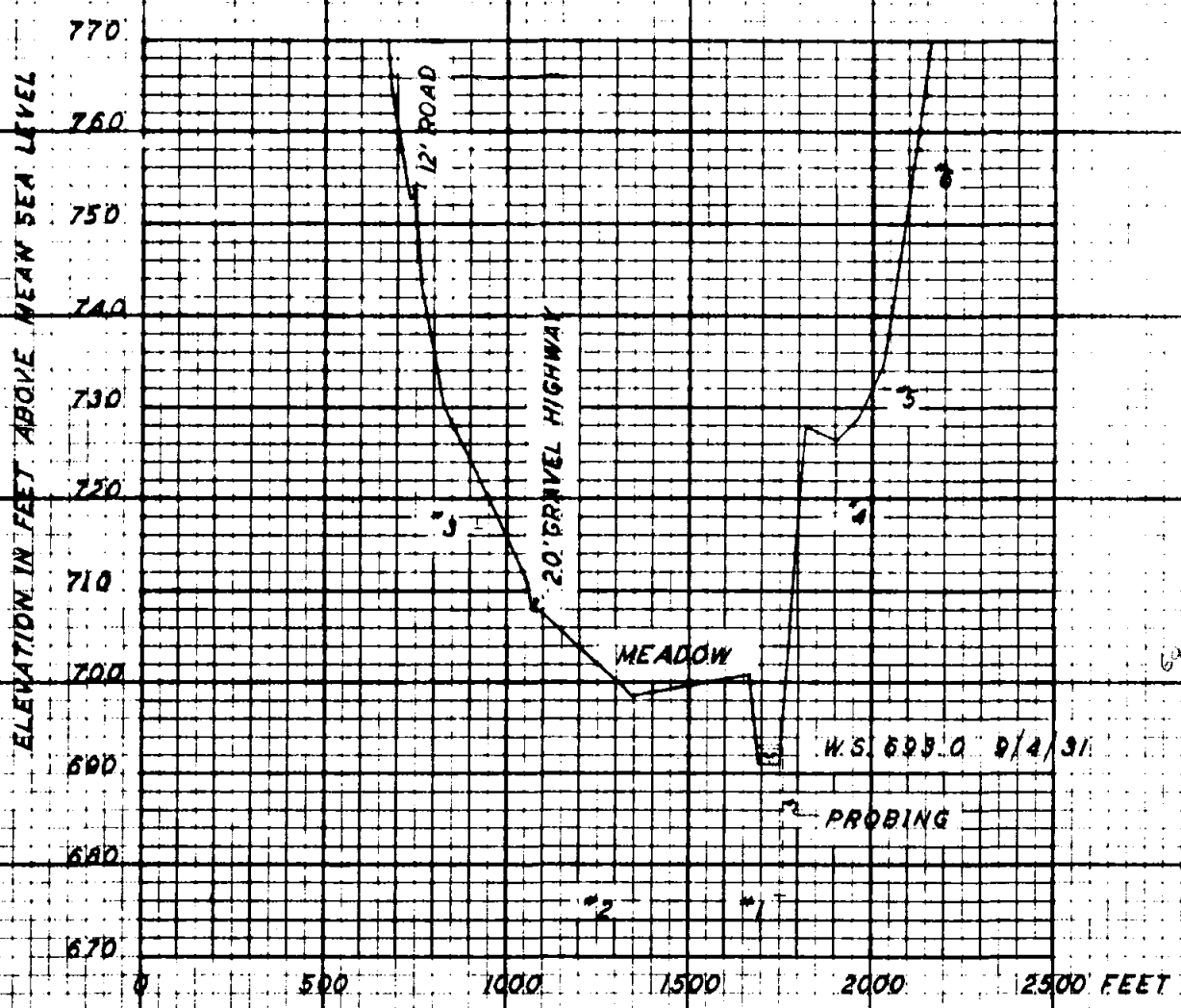
The total storage capacity of the reservoir at elevation 760 is about 23,000 acre-feet and the length of the dam at elevation 770 would be about 1,300 feet.

The Vermont Flood-Control Committee made an estimate of the cost of developing this site based on certain assumptions regarding foundations. This estimate may be summarized as follows:

Cost of storage, $1,135,000.
Estimated storage capacity above spillway, 360 million cubic feet. (About 8,300 acre-feet)
Estimated storage capacity below spillway, 1020 million cubic feet. (About 23,400 acre-feet)
Cost of storage per acre-foot, $48.50. (23,400 acre-feet)
Available power, 600 horsepower.
Available average net head, 47 feet.
Yearly output, total, 2,400,000 kilowatt-hours.
Yearly output, primary power, 1,500,000 kilowatt-hours.
Total cost, power and storage, $1,190,000.
Cost of power development alone, about $55,000.
Cost of power per horsepower, $92.

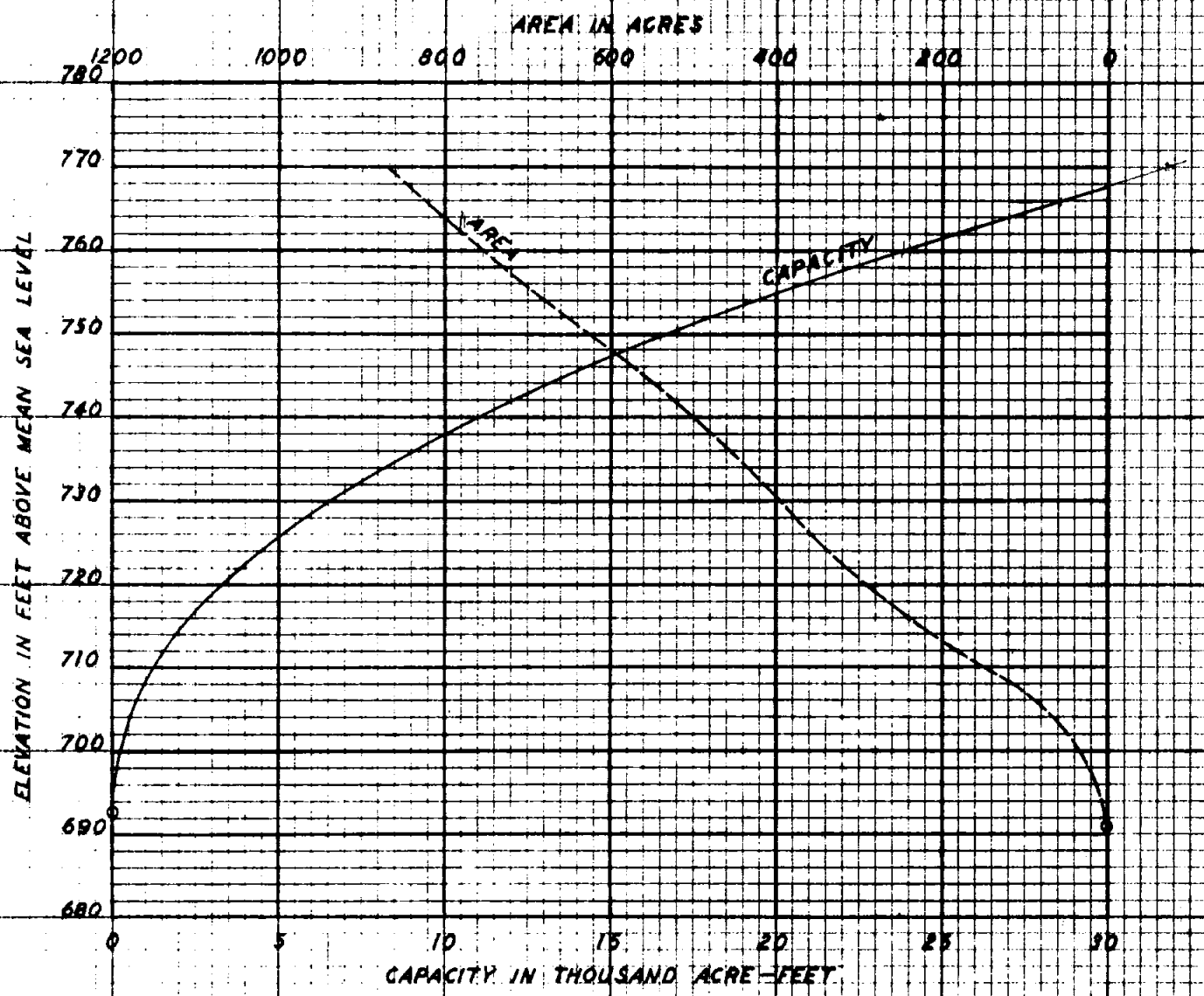
B.M. ELEV. 724.1, R.R. SPIKE IN ROOT OF 18" PINE, 150 FEET NORTH OF CENTER LINE OF GRAVEL HIGHWAY.

NOTE. 10-WIRE TELEPHONE LINE ON ROAD. 6-WIRE AND 10-WIRE TELEPHONE AND 2-WIRE POWER LINE ON HIGHWAY.



MILLERS RUN
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
LYNDON CENTER DAM SITE
LOOKING DOWNSTREAM
SEPTEMBER, 1931

Figure 29



MILLERS RUN
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
LYNDON CENTER DAM SITE
DATA FROM U.S. GEOLOGICAL SURVEY MAPS

Figure 30

This estimate is based on an earth dam with concrete spillway near the west side of the valley. Elevation of crest, 760. Elevation of top of earth dam, 775. The power house would be at the dam. Outlet gates and gate house are provided in a reinforced-concrete sluice through the earth dam.

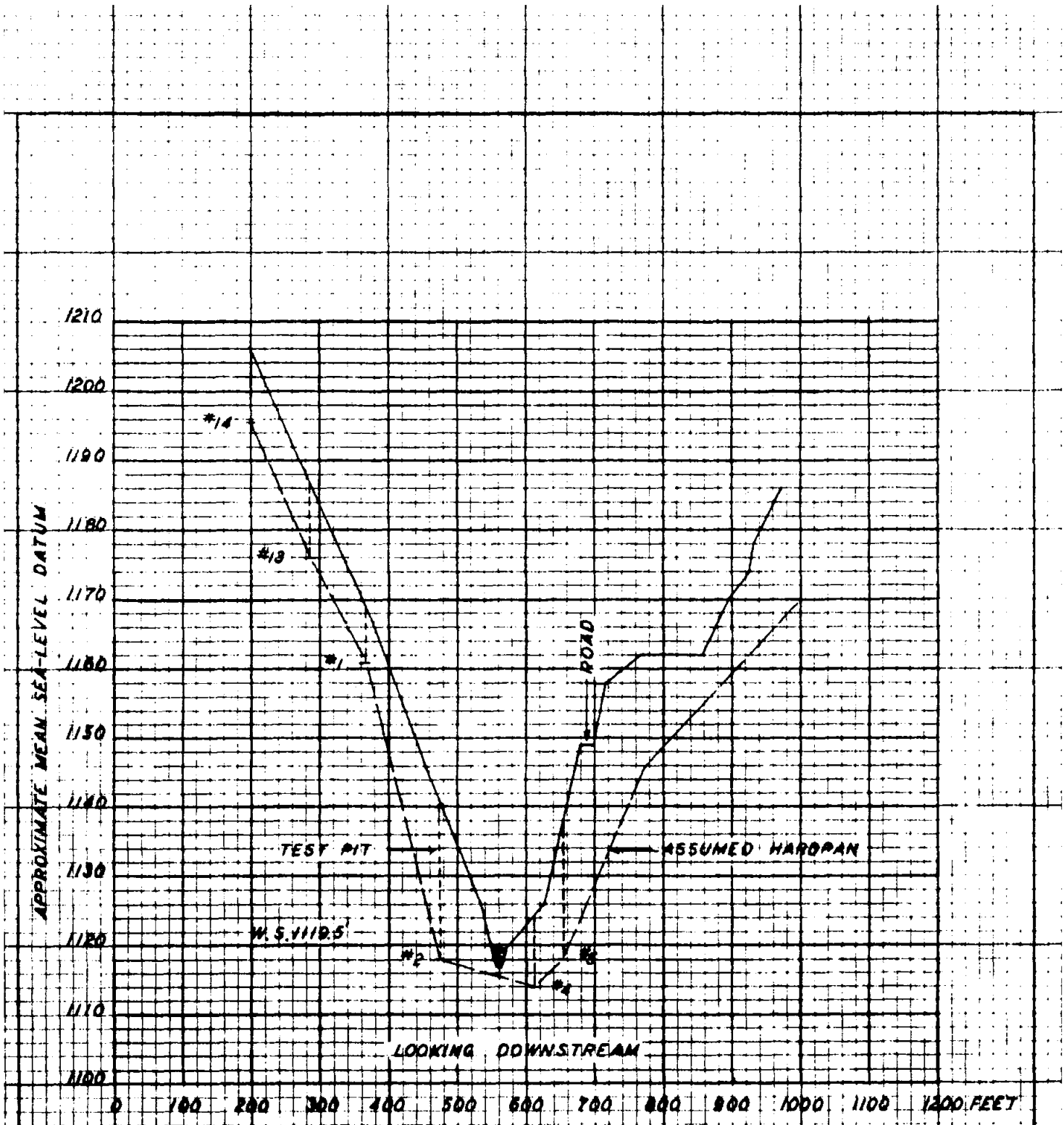
75. Victory, serial number 8, Moose River, Passumpsic River Basin, Vermont. Drainage area, 66 square miles. This potential development would utilize 168.5 feet of head above mile 14.1. None of this head is developed at present. The dam site is at mile 17.3, about one-half mile upstream from South Victory School and 500 feet downstream from an abandoned logging-railroad bridge. No ledge is exposed at the site but test pits made by private parties indicate suitable hard pan foundation over the entire dam at depths varying from 7 to 22 feet. An earth and concrete dam is proposed, 616 feet long, of which 266 feet is concrete spillway section without flashboards or crest gates, at a high elevation on the right bank. A sluice gate is provided in the gate section for stream control during construction and it would be utilized permanently for pond regulation.

Elevations and lengths are as follows:

Tail-water,	990
Assumed lowest foundation,	1114
Normal water surface,	1119.5
Proposed lowest draft for power,	1136
Permanent spillway crest,	1158.5
Maximum high water,	1166.5
Top of earth and gate section,	1170
Length of earth section,	320 feet
Length of intake section,	10 feet
Length of sluice-gate section,	20 feet
Length of spillway section,	266 feet
Total length of dam,	616 feet

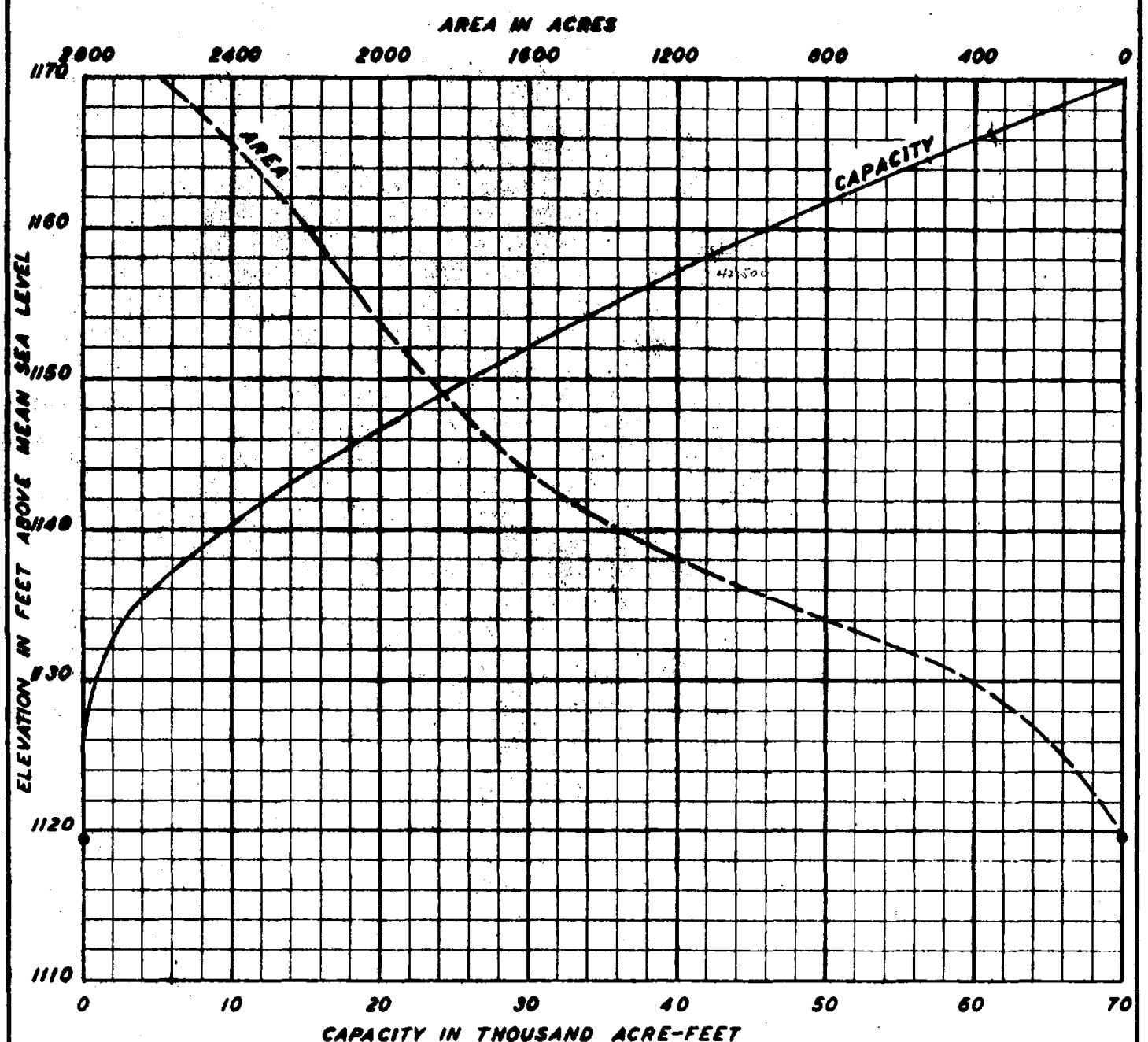
The pond at the elevation of the spillway (1158.5) would cover 2,144 acres, according to information supplied by private parties. It is not known, however, that this data in the form of an area-capacity curve is the result of an actual survey.

Property damage is estimated as follows: Land, 2,700 acres; buildings, 10 sets; roads, 4.5 miles of 12-foot gravel to be abandoned; pipe-line right of way, 3 miles; additional water rights; total damages, $114,000.



MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
VICTORY DAM SITE
DATA FROM SURVEY BY A PRIVATE COMPANY

Figure 31



MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
VICTORY DAM SITE
DATA FROM A PRIVATE COMPANY

Figure 32

The flood-storage capacity in acre-feet is as follows: Above spillway, 18,500; below spillway, 42,500; total, 61,000. The maximum draft proposed for power is 22.5 feet, giving 38,000 acre-feet of power storage.

A 6-foot diameter wood-stave pipe, 16,000 feet long, on the left bank of the river would conduct the water to a surge tank and power house located at mile 14.1 where the water elevation is 990. One unit would be installed, utilizing 198 second-feet of water or 5 second-feet per square mile, at an average net head at full load of 128.6 feet, yielding 2,300 horsepower. The average net head at three-quarters load is estimated at 137.4 feet. The yearly output is estimated at 8,290,000 kilowatt-hours of which 85 per cent is primary power.

The total cost is estimated at $1,020,000. Cost per horsepower, $443. Cost of power production, per kilowatt-hour, 14.8 mills.

The cost of storage only is $410,000. Total flood storage, 61,000 acre-feet. Cost per acre-foot, $6.72. Power storage, 38,000 acre-feet. Cost per acre-foot, $10.80; cost per acre-foot per foot of devel ped head through which used (420 feet), 2.6 cents.

The cost of power exclusive of cost of storage is $610,000. Cost of power production per kilowatt-hour exclusive of cost of storage, 9.7 mills. The details of cost are as follows:

Unwatering,	$ 3,000
Dam,	176,300
Pipe line,	314,600
Surge tank,	11,900
Penstock,	21,200
Power-house structure,	9,000
Power-house equipment, hydraulic and electric apparatus,	48,500
Tailrace,	1,700
Total "A",	586,200
General expenses:	
Clearing reservoir,	28,400
Transportation,	18,900
Plant, camp, and general construction,	87,900
Total "B",	721,400
Engineering, contingencies, interest, taxes, and insurance,	165,900
Total "C",	887,300
Property, water rights, and pipe-line right of way,	114,000
Total cost, without transformer station,	1,001,300
Outdoor transformer station,	16,600
Grand total cost,	1,017,900
Grand total cost in round figures,	1,020,000

70. Mile 11.8, serial number 9, Moose River, Passumpsic River Basin, Vermont. Drainage area, 77 square miles. This potential development would utilize the 201.5-foot fall between the highway bridge at mile 14.2, and a point about 1.7 miles below Concord, Vermont, at mile 7.8. A sawmill at Concord now utilizes 13.5 feet of this head. The dam site is at mile 11.8, Moose River, about 1 mile downstream from North Concord, at the state highway bridge where ledge is exposed at the spillway elevation on the right bank and was indicated by probings 2 to 4 feet below the surface at other places. On the left river bank ledge was indicated at a maximum depth of 21 feet, and impervious foundation was assumed at depths from 6 to 21 feet. An earth and concrete dam is proposed, 1,360 feet long, of which 212.5 feet is concrete spillway section with 10-foot flashboards at a high elevation on the right bank. A concrete conduit through the earth dam is provided for stream control during construction and it would be utilized permanently for pond regulation and power purposes.

Elevations and lengths are as follows:

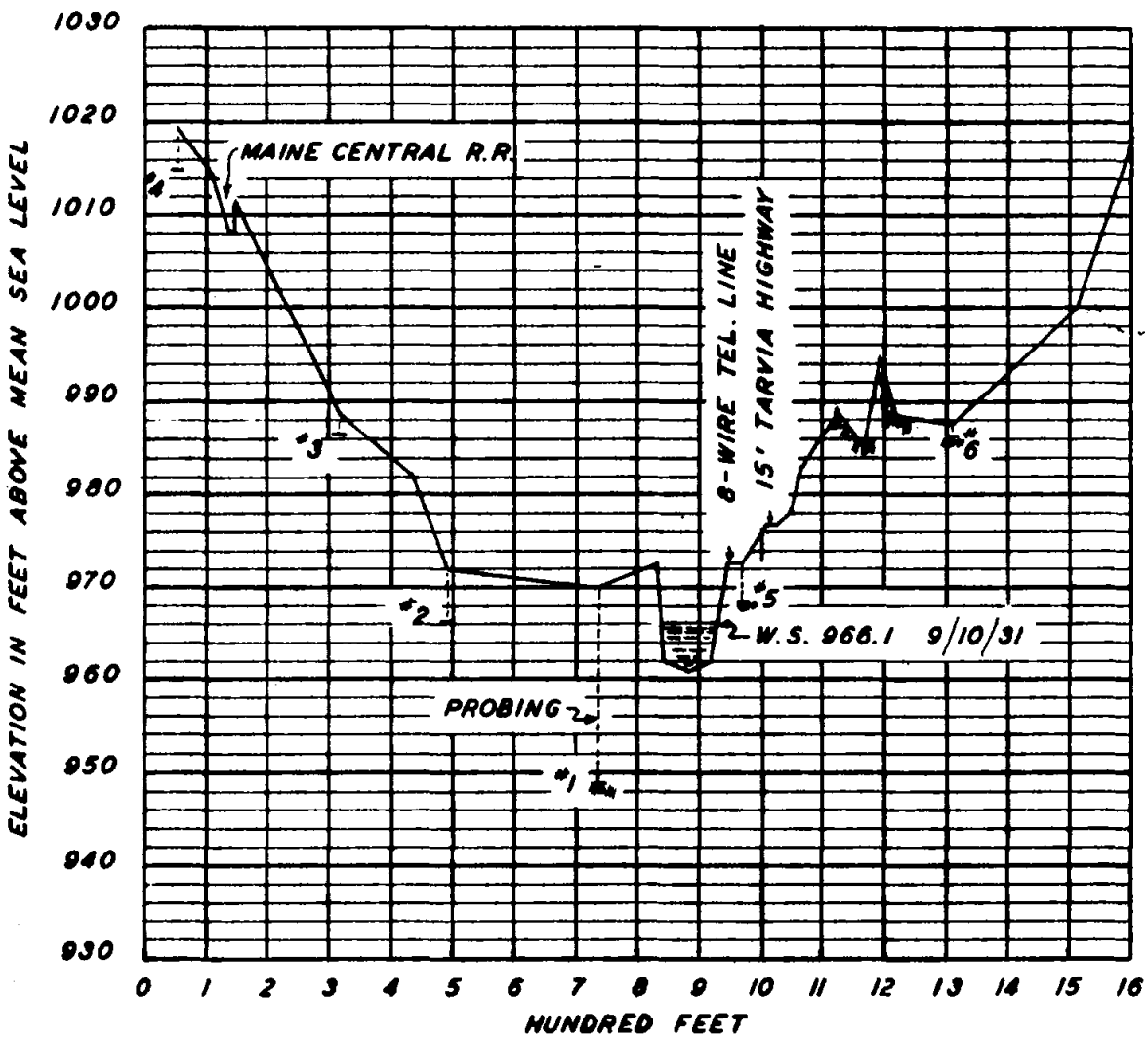
Tailwater,	800	
Assumed lowest foundation,	949	
Normal water surface,	966.1	
Proposed lowest draft for power,	981.5	
Permanent spillway crest,	991.5	
Top of flashboards and maximum high water,	1001.5	
Top of retaining section,	1003.5	
Top of earth section,	1006.5	
Length of earth section,	1,025	feet
Length of concrete retaining section,	122.5	feet
Length of spillway section,	212.5	feet
Total length of dam,	1,360	feet

The pond at the elevation of the flashboards (1001.5) would cover about 380 acres and would extend about 2.4 miles.

Property damage is estimated as follows: Land, 420 acres; buildings, two sets; roads, four-tenths mile of 18-foot tarvia, six-tenths mile of 12-foot gravel; replacement of one highway bridge; 1.2 miles of 12-foot gravel road on the left bank to be abandoned; additional water rights; pipeline right of way, 3.5 miles; total damages, $55,700.

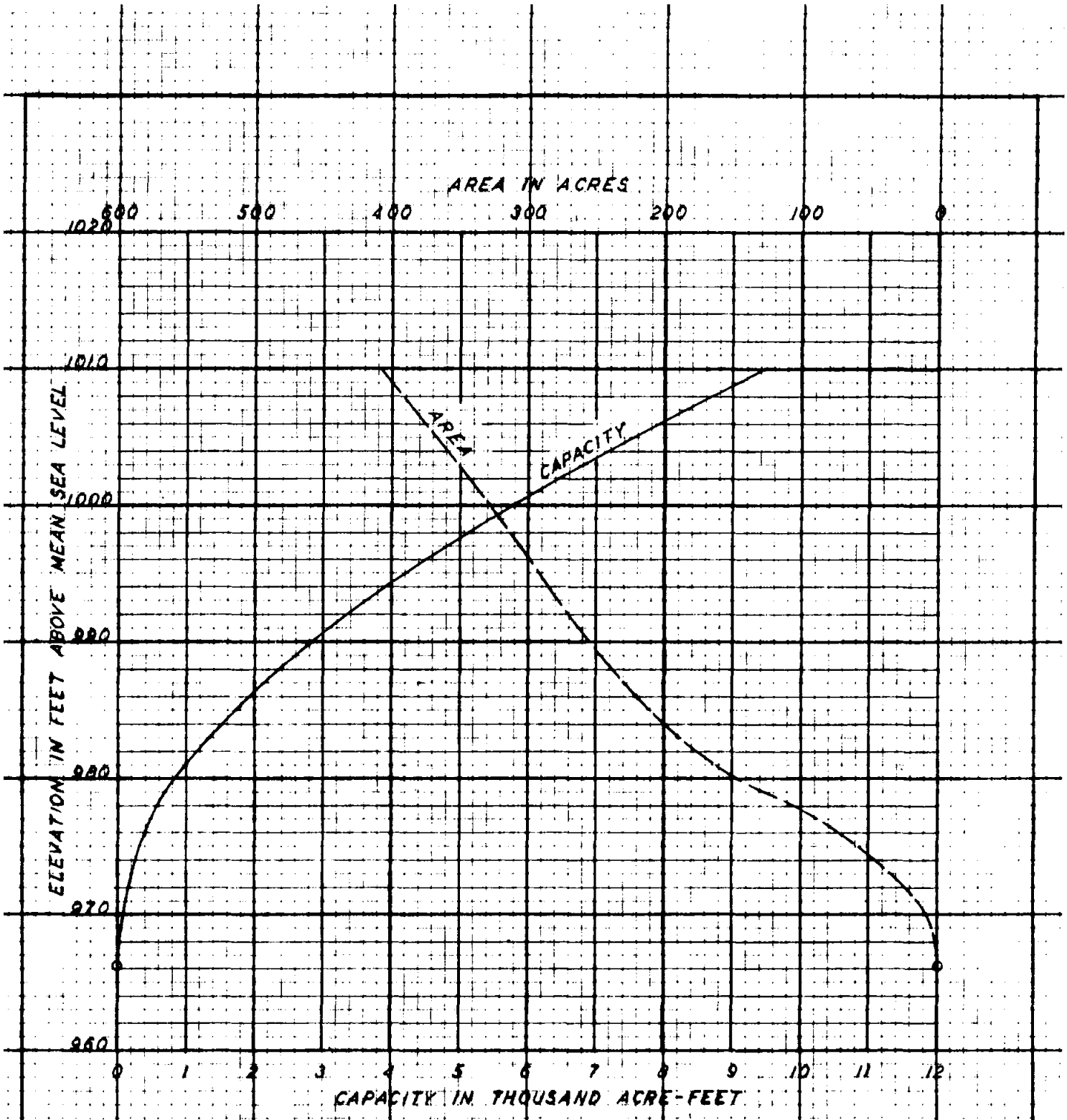
The flood-storage capacity in acre-feet is as follows: Above spillway, 3,100; below spillway, 3,200; total, 6,300. The maximum draft proposed for power is 20 feet, giving 3,200 acre-feet of power storage.

B.M. ELEV. 975.2, NAIL IN ROOT OF CEDAR TREE 100' SOUTH OF HIGHWAY BRIDGE; B.M. #1-200/00 PAINTED ON TREE.



MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
DAM SITE AT MILE 11.8
LOOKING DOWNSTREAM
SEPTEMBER, 1931

Figure 33



MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 11.0
DATA FROM U.S. GEOLOGICAL SURVEY MAPS

A 6-foot diameter wood-stave pipe is proposed, 18,500 feet long. The first 6,000 feet is on the left bank; a steel bridge is provided for a river crossing; and the remaining 12,500 feet of pipe is on the right bank, leading to a surge tank and power house at mile 7.8 where the tailwater elevation is 800. One unit would be installed, utilizing 231 second-feet of water or 3 second-feet per square mile at an average net head at full load of 147 feet, yielding 3,100 horsepower. The average net head at three-quarters load is estimated at 161 feet. This installation is based on complete river control being accomplished by a dam at Victory, a short distance upstream. The yearly output is estimated at 11,100,000 kilowatt-hours of which 43 per cent is primary power, exclusive of consideration of stream control at Victory.

The total cost is estimated at $1,040,000. Cost per horsepower, $336. Cost of power production, per kilowatt-hour, 11.4 mills.

The cost of storage only is $325,000. Total flood storage, 6,500 acre-feet. Cost per acre-foot, $51. Power storage, 5,200 acre-feet. Cost per acre-foot, $62; cost per acre-foot per foot of developed head through which used (406 feet), 15.5 cents.

The cost of power, exclusive of cost of storage is $717,000. Cost of power production per kilowatt-hour exclusive of cost of storage, 8.3 mills. The details of cost are as follows:

Unwatering,	$ 3,000
Dam,	148,900
Diversion and power conduit and control tower,	63,000
Pipe line,	369,700
Surge tank,	10,600
Penstock,	20,900
Power-house structure,	7,900
Power-house equipment, hydraulic and electrical apparatus,	63,300
Tailrace,	200
Total "A",	674,500
General expenses:	
Relocation of roads,	24,800
Highway bridge,	4,400
Transportation,	2,200
Plant, camp, and general construction,	101,200
Total "B",	807,100
Engineering, contingencies, interest, taxes, and insurance,	185,600
Total "C",	992,700
Property, water rights, and pipe line right of way,	26,500
Total cost, without transformer station,	1,019,200
Outdoor transformer station,	20,700
Grand total cost,	1,039,900
Grand total cost in round figures,	1,040,000

77. East St. Johnsbury, serial number 1[illegible], mile 4.75 Moose River, Passumpsic River Basin, Vermont. Drainage area, 108 square miles. This potential development would utilize the 176-foot fall from Knapp Brook, mile 5.45, to the private bridge behind the plant of the Cary Maple Sugar Company, at St. Johnsbury. None of this head is now utilized. The dam site is at mile 4.75, Moose River, just below the broken dam in the village of East St. Johnsbury, where ledge is exposed in the river bottom and part way up both banks. Where not exposed, probings indicate its occurrence at depths of 7 to 13 feet on the right bank and about 7 feet on the left bank. An earth and concrete dam is proposed, 235 feet long, of which 173 feet is spillway section with 2 and 5-foot flashboards. There is a short earth section at each end. A 10 by 10-foot spillway gate is proposed to reduce present high-water elevations. The permanent crest of the proposed dam is about the same elevation as the existing broken dam.

Elevations and lengths are as follows:

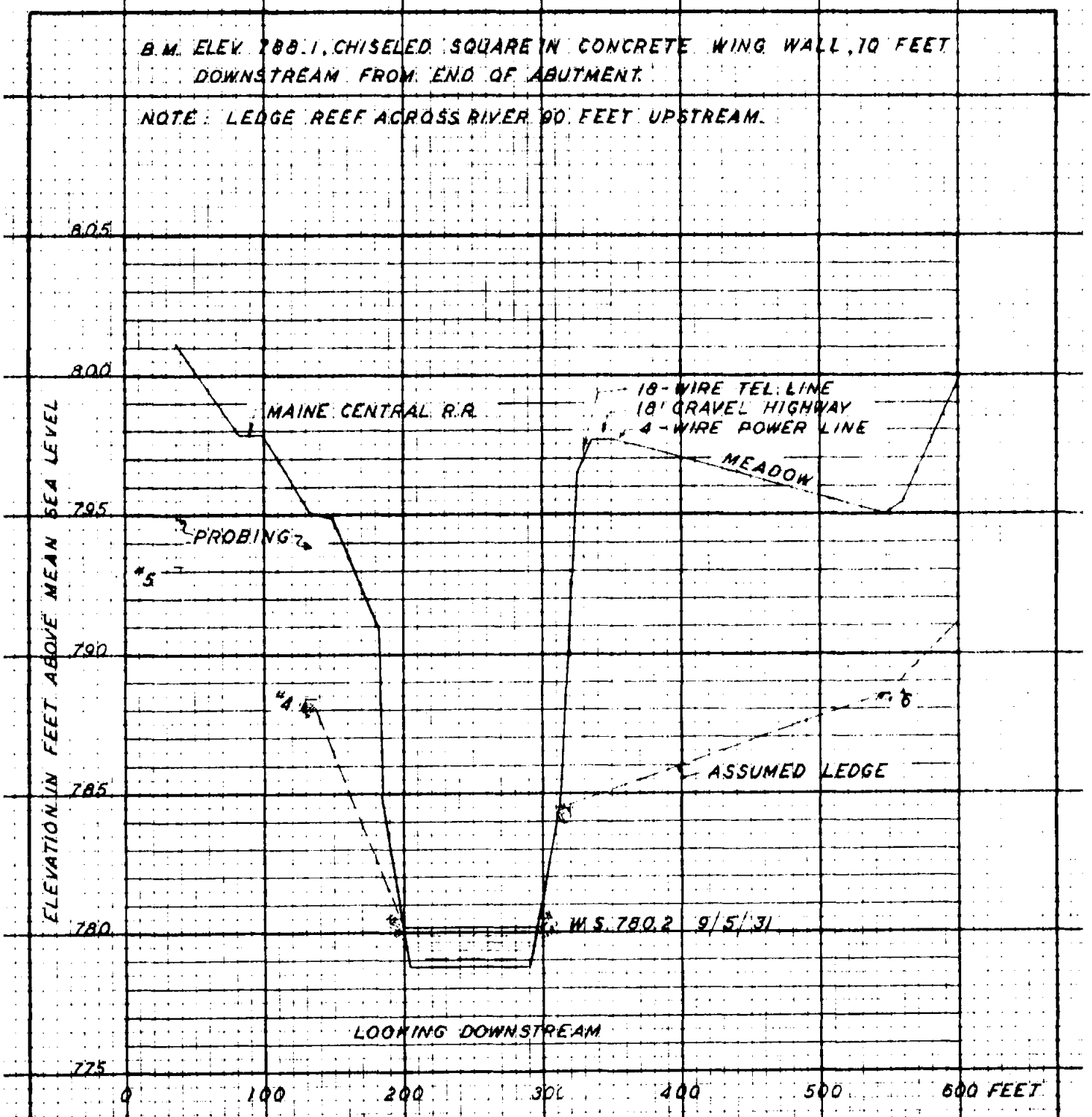
Tail-water,	615	
Assumed lowest foundation,	777	
Normal water surface,	780.2	
Spillway gate sill,	781	
Proposed lowest draft for power,	786	
Permanent spillway crest,	786 and 789	
Top of flashboards,	791	
Top of earth section and abutments,	798	
Length of earth section,	32	feet
Length of intake section,	15	feet
Length of crest-gate section,	15	feet
Length of spillway section,	173	feet
Total length of dam,	235	feet

The pond at the elevation of the flashboards (791) would cover approximately 2[illegible] acres and extend about 1 mile.

Property damage is estimated as follows: Land, 30 acres; additional water rights; pipe-line right of way; total damages, $16,4[illegible]0.

The storage capacity of the pond is negligible and only a nominal draft is proposed for power.

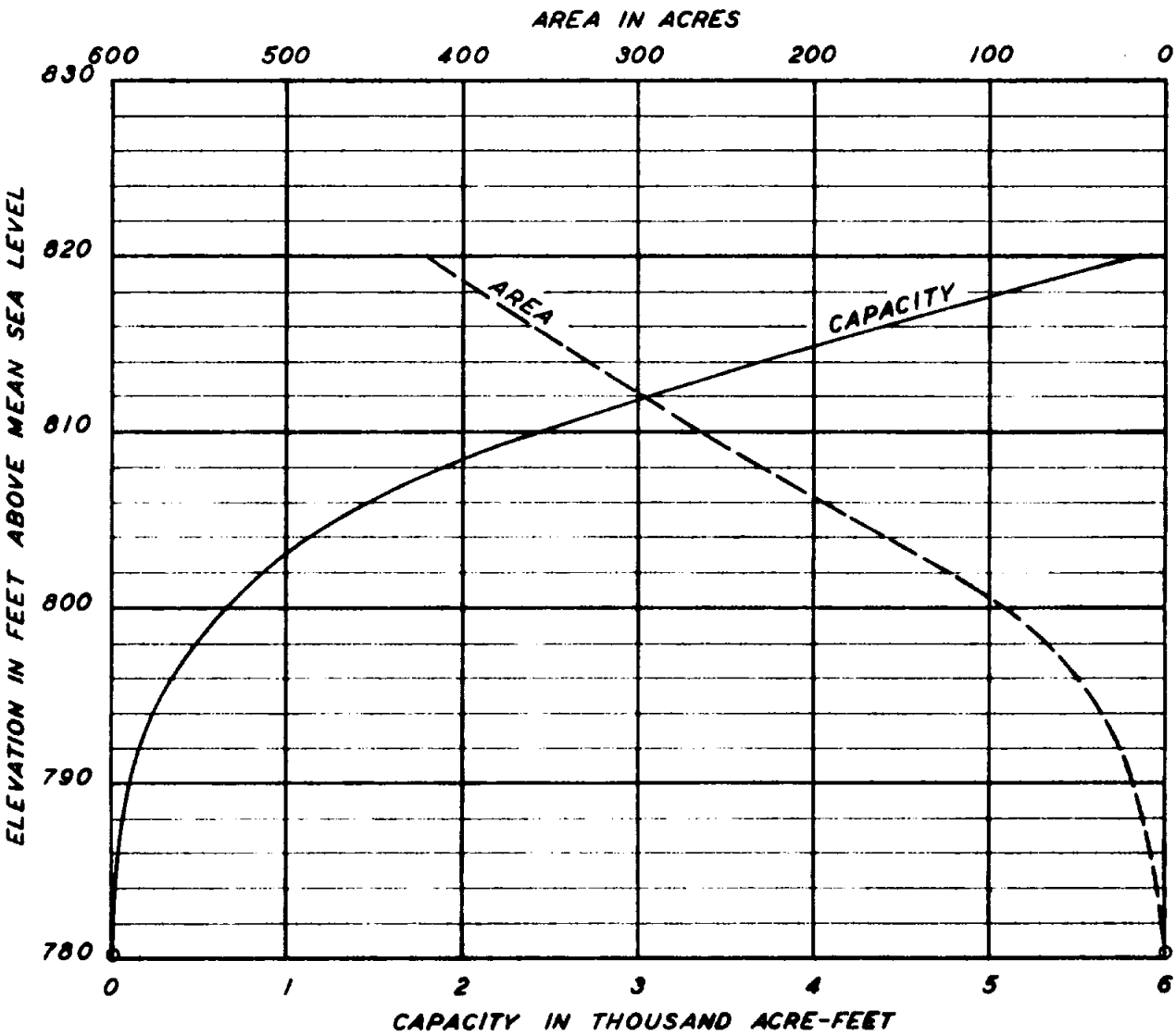
A 7-foot diameter wood-stave pipe, 15,800 feet long, on the right bank of the river would conduct the water to a surge tank and power house located just above the private bridge behind the Cary Maple Sugar Company plant at mile 1.1, St. Johnsbury, where the water elevation is 616.6. A



MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF

DAM SITE AT MILE 4.75
EAST ST. JOHNSBURY

SEPTEMBER, 1931



MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR

DAM SITE AT MILE 4.75

EAST ST. JOHNSBURY

DATA FROM U.S. GEOLOGICAL SURVEY MAPS

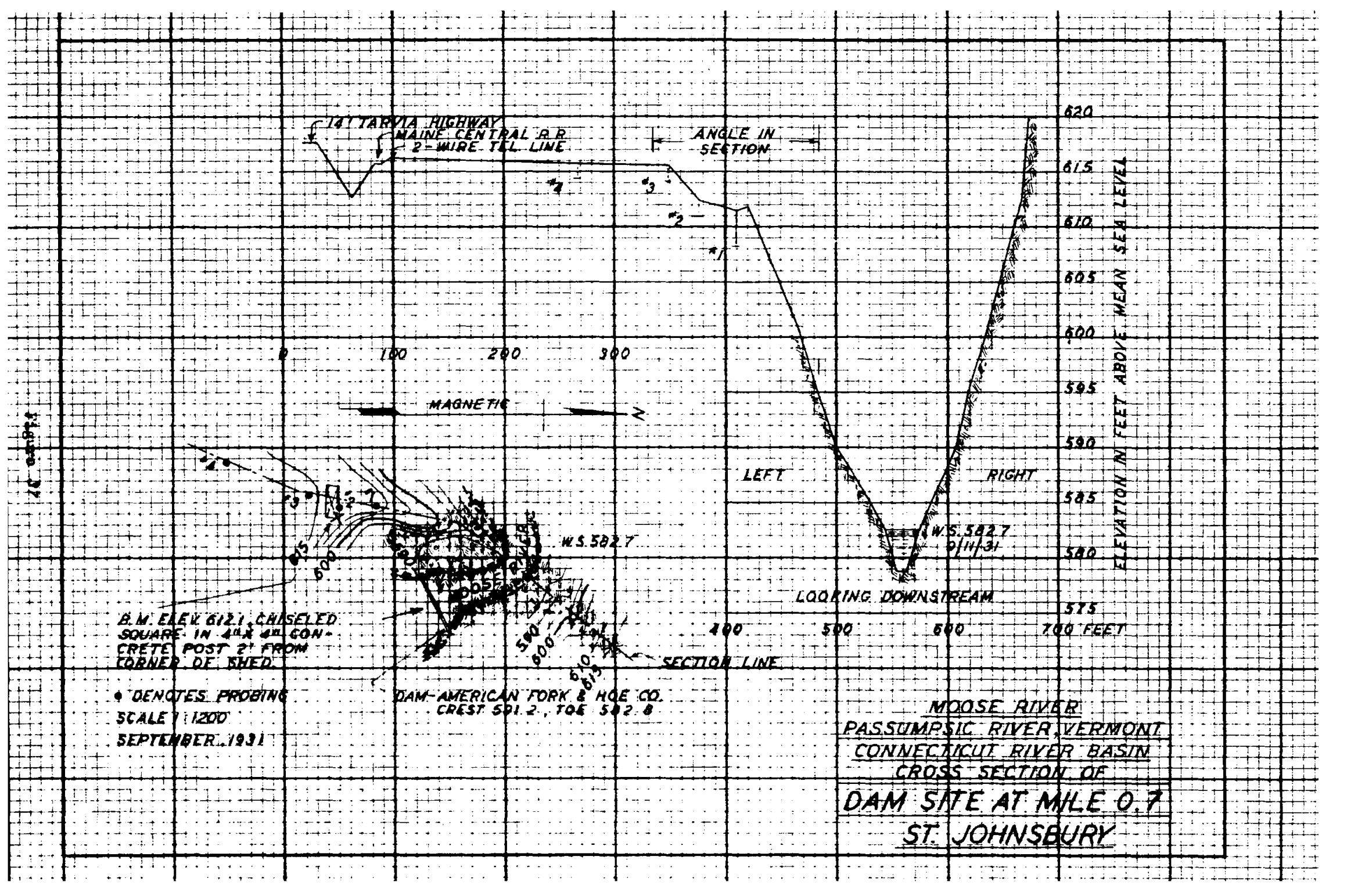
Figure 36

short tailrace would lower the tail-water to elevation 615. Two units would be installed, utilizing 324 second-feet of water or 3 second-feet per square mile at an average net head at full load of 138 feet, yielding 4,100 horsepower. The average net head at three-quarters load is estimated at 149.4 feet. The yearly output is estimated at 13,500,000 kilowatt-hours of which 17 per cent is primary power.

The total cost is estimated at $766,300. Cost per horsepower, $187. Cost of power production, per kilowatt-hour, 7.3 mills. The details of cost are as follows:

Unwatering,	$ 7,600
Dam,	19,700
Pipe line,	349,000
Surge tank,	19,100
Penstock,	18,200
Power-house structure,	10,400
Power-house equipment, hydraulic and electrical apparatus,	86,600
Tailrace,	600
Total "A",	511,300
General expenses:	
Transportation,	2,100
Plant, camp, and general construction,	76,700
Total "B",	590,100
Engineering, contingencies, interest, taxes and insurance,	135,700
Total "C",	725,800
Property, water rights, and pipe-line right of way,	16,400
Total cost, without transformer station,	742,200
Outdoor transformer station,	23,900
Grand total cost,	766,100
Grand total cost in round figures,	766,000

73. St. Johnsbury, serial number 11, mile 0.7, Moose River, Passumpsic River Basin, Vermont. Drainage area, 118 square miles. This potential development would utilize the 48-foot head at St. Johnsbury from about two-tenths mile above to three-tenths mile below the railroad bridge. Two existing dams would be flooded out by the proposed development; one about 13 feet high, located above the railroad bridge, and the other about 8 feet high, immediately above the site of the proposed dam, but they are not now utilized for power purposes. The dam site is at mile 0.7 about 75 feet below the abandoned log-crib dam owned by the American Fork and Hoe Company where ledge is exposed on the right bank and in the river bottom and is exposed or was found near the surface on the left bank. An earth and concrete dam is proposed, 285 feet long, the earth section on the left bank


14' TARVIA HIGHWAY
MAINE CENTRAL R.R.
2-WIRE TEL. LINE
ANGLE IN SECTION
#4
#3
#2
#1
620
615
610
605
600
595
590
585
580
575
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
0
100
200
300
400
500
600
700 FEET
MAGNETIC
N
LEFT
RIGHT
W.S. 582.7
W.S. 582.7
9/14/31
LOOKING DOWNSTREAM
B.M. ELEV. 612.1, CHISELED SQUARE IN 4" x 4" CONCRETE POST 2' FROM CORNER OF SHED.
SECTION LINE
DAM-AMERICAN FORK & HOE CO.
CREST 591.2, TOE 592.8
• DENOTES PROBING
SCALE 1:1200
SEPTEMBER, 1931
MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
DAM SITE AT MILE 0.7
ST. JOHNSBURY

being low and only 60 feet in length. A concrete spillway section 32.5 feet long with 10-foot flashboards is proposed at a high elevation on the right bank, and a crest-gate section with two 25 by 22-foot, and one 20 by 18-foot Tainter gates would provide for pond regulation.

Elevations and lengths are as follows:

Tail-water,	550
Assumed lowest foundation,	577
Normal water surface,	582.7
Spillway gate sills,	586 and 590
Permanent spillway crest,	598
Proposed lowest draft for power,	606
Top of flashboards and maximum high water,	608
Top of retaining section,	610 and 613
Top of intake section,	613
Top of earth section,	613
Length of earth section,	60 feet
Length of concrete retaining section,	80.5 feet
Length of intake section,	18 feet
Length of crest-gate section,	94 feet
Length of spillway section,	32.5 feet
Total length of dam,	285 feet

The pond at the elevation of the flashboards (608) would cover about 4 acres and extend about one-quarter mile.

Property damage is estimated as follows: Land, 12 acres; buildings, one set; additional water rights; pipe-line right of way, 1,200 feet; total damages, $5,620.

The storage capacity of the reservoir is negligible and only a nominal draft is proposed for power.

A 7.5-foot diameter wood-stave pipe, 1,200 feet long, on the left bank of the river would conduct the water to a surge tank and power house located at mile 0.45 where the water elevation is 560. Two units would be installed utilizing 354 second-feet of water or 3 second-feet per square mile at an average net head at full load of 43.5 feet, yielding 1,400 horsepower. The average net head at three-quarters load is estimated at 44.3 feet. The yearly output is estimated at 4,349,000 kilowatt-hours of which 17 per cent is primary power.

The total cost is estimated at $245,000. Cost per horsepower, $174. Cost of power production, per kilowatt-hour, 8.7 mills.

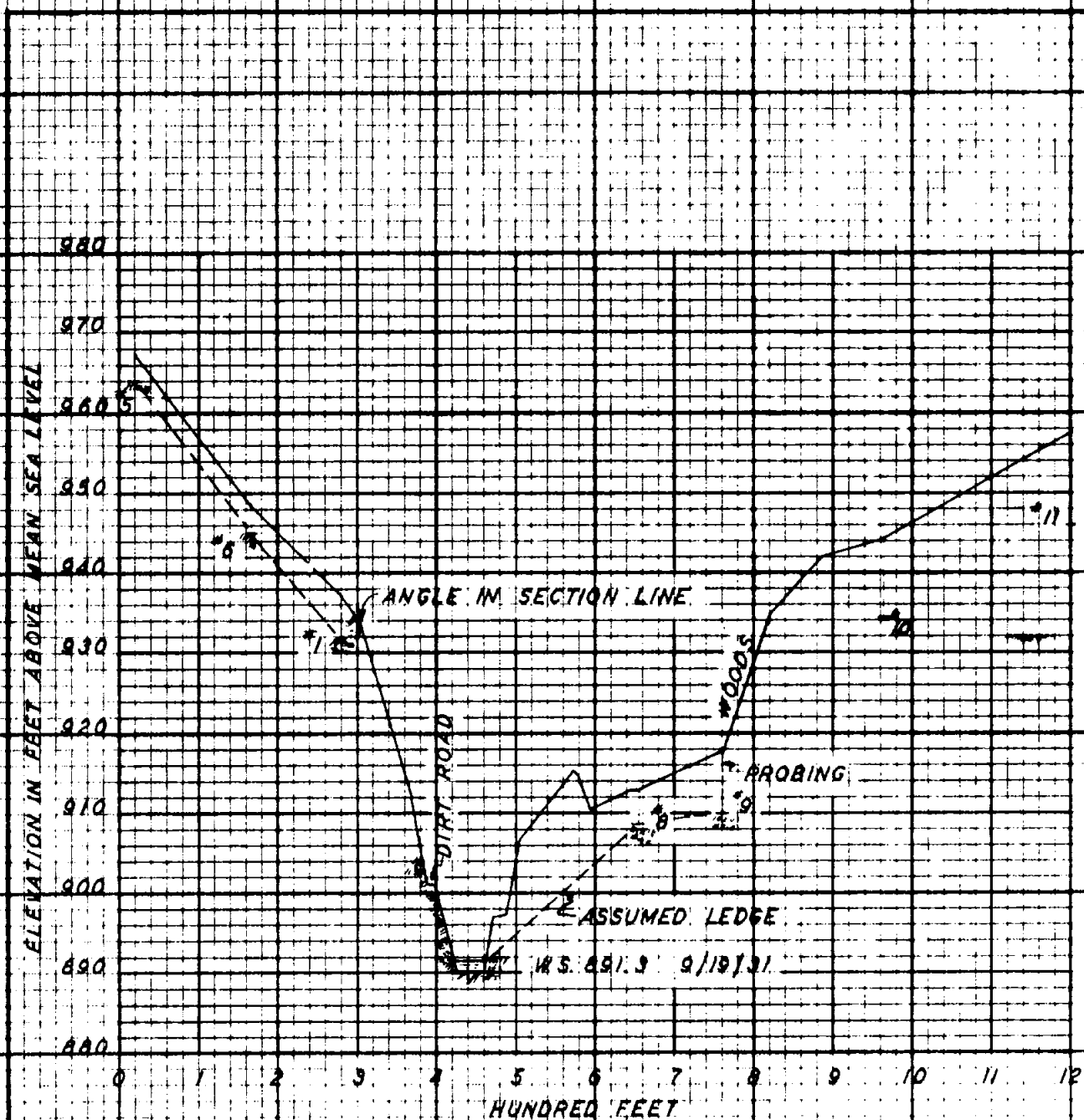
The details of cost are as follows:

Unwatering,	$ 9,200
Dam,	42,100
Pipe line,	22,600
Surge tank,	7,800
Penstock,	1[illegible],800
Power-house structure,	11,700
Power-house equipment, hydraulic and electrical apparatus,	55,800
Tailrace,	500
Total "A",	160,500
General expenses:	
Transportation,	800
Plant, camp, and general construction,	24,100
Total "B",	185,200
Engineering, contingencies, interest, taxes, and insurance,	42,600
Total "C",	227,800
Property, water rights, and pipe-line right of way,	3,600
Total cost, without transformer station,	231,400
Outdoor transformer station,	11,800
Grand total cost,	243,200
Grand total cost in round figures,	243,000

79. Goss Hollow, serial number 12, Burrough Brook, tributary to Sleepers River, Passumpsic River Basin, Vermont. Drainage area, 1[illegible].8 square miles. This potential development is a storage proposition only, and would utilize the 5[illegible]-foot fall in the 1.5 miles of brook immediately above the dam site. None of the head which would be utilized is developed at present. The dam site is just below the wooden highway bridge on Burrough Brook about 3 miles above its mouth. Ledge is exposed in the river bottom, and is exposed or was found near the surface on the left bank. Impervious foundation was assumed at depths from 4 to 16 feet on the right bank. An earth and concrete dam is proposed, 915 feet long, of which 100 feet is concrete spillway section without flashboards at a high elevation on the left bank. A 4.5-foot diameter sluice pipe is provided in the gate section for unwatering and pond control.

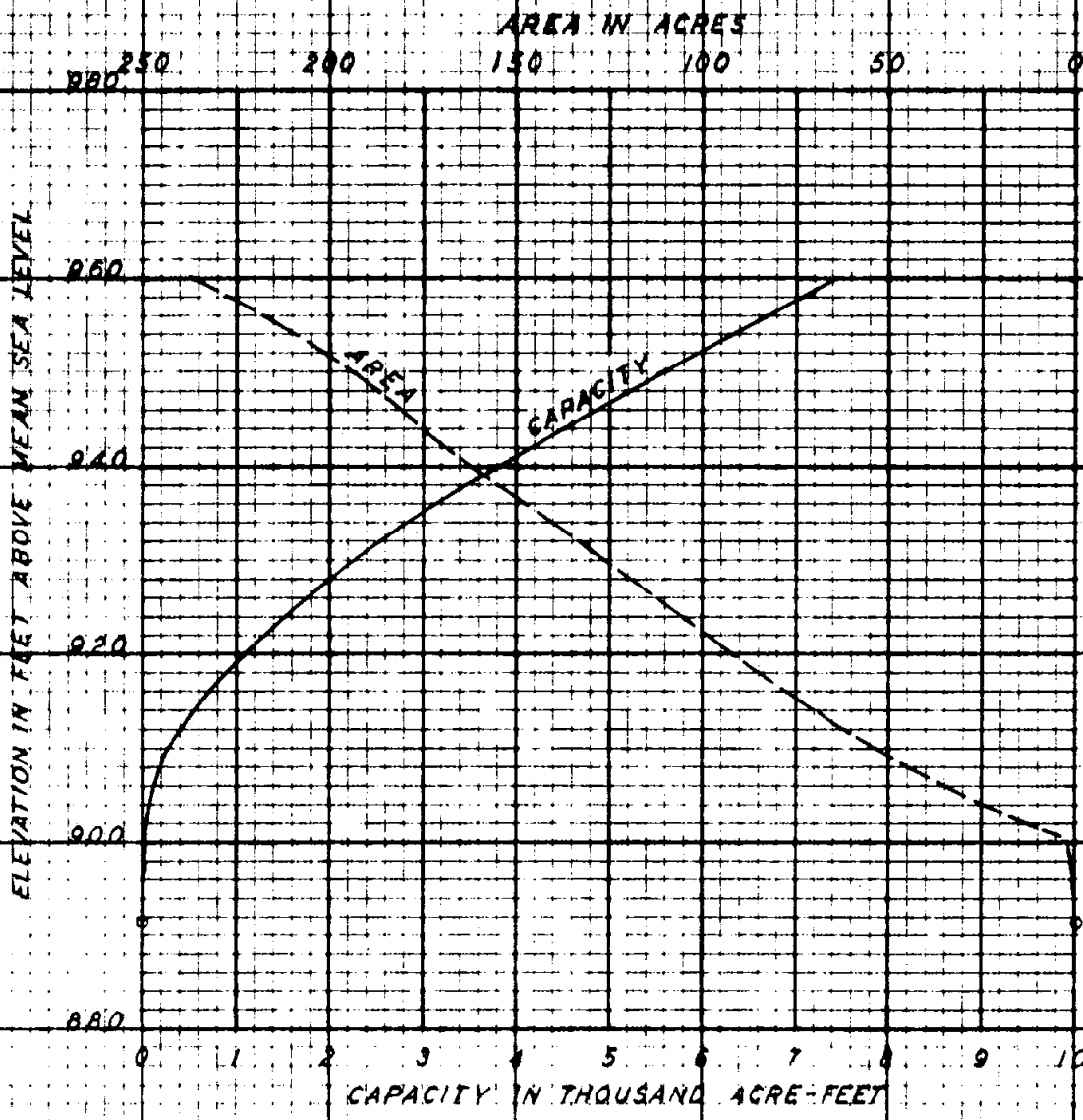
Elevations and lengths are as follows:

Assumed lowest foundation,	888	
Normal water surface,	891.5	
Proposed lowest draft,	892	
Permanent spillway crest,	941	
Maximum high water,	946	
Top of retaining section,	946 and 951	
Top of sluice gate section,	951	
Top of earth section,	951	
Length of earth section,	270	feet
Length of concrete retaining section,	530	feet
Length of sluice-gat section,	15	feet
Length of spillway section,	100	feet
Total length of dam,	915	feet



BURROUGH BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION AT
GOSS HOLLOW DAM SITE
LOOKING DOWNSTREAM
SEPTEMBER, 1931

Figure 38



BURROUGH BROOK
PASSUMPSIC RIVER VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
GOSS HOLLOW DAM SITE
DATA FROM CROSS SECTIONS.

Figure 32

The pond at the elevation of the spillway crest (941) would cover about 165 acres and extend about 1.5 miles.

Property damage is estimated as follows: Land, 200 acres; roads, one-quarter mile of earth road; one bridge, 12 feet by 30 feet; total damage, $6,900.

The flood-storage capacity in acre-feet is as follows: Above spillway, 900; below spillway, 4,000; total, 4,900. The maximum draft proposed is 49 feet, giving 4,000 acre-feet of controlled power storage.

The total cost is estimated at $296,000. Cost per acre-foot of total flood storage, $60. Cost per acre-foot of controlled power storage, $74.; cost per acre-foot, per foot of developed head through which used (397 feet), 18.6 cents.

The details of cost are as follows:

Unwatering,	$ 4,700
Dam,	177,900
Total "A",	182,600
General expenses:	
Clearing reservoir,	5,400
Relocation of roads,	3,200
Highway bridge,	1,700
Transportation,	18,600
Plant, camp, and general construction,	27,400
Total "B",	238,900
Engineering, contingencies, interest, taxes, and insurance,	55,000
Total "C",	293,900
Property,	2,000
Grand total cost,	295,900
Grand total cost in round figures,	296,000

80. Fish Hatchery, serial number 13, mile 3.3 Sleepers River, Passumpsic River Basin, Vermont. Drainage area, 40.8 square miles. This potential development would utilize the 12[illegible]-foot head from a point a short distance above the junction of Burrough Brook with Sleepers River to the foot of the ledge falls below the U. S. Fish Hatchery dam. None of this fall is developed for power at present although the Fish Hatchery dam, about 4 feet high, creates a small reservoir for the use of the hatchery. The dam site is at mile 3.3, about 250 feet upstream from the Fish Hatchery dam, where ledge is exposed on the left bank and river bottom, and at the railroad cut on the right bank. Impervious foundation was assumed in the meadow on the right bank at a depth of 26 to 28 feet. An earth and concrete dam is proposed, 1,520 feet long, of which 300 feet is concrete spillway

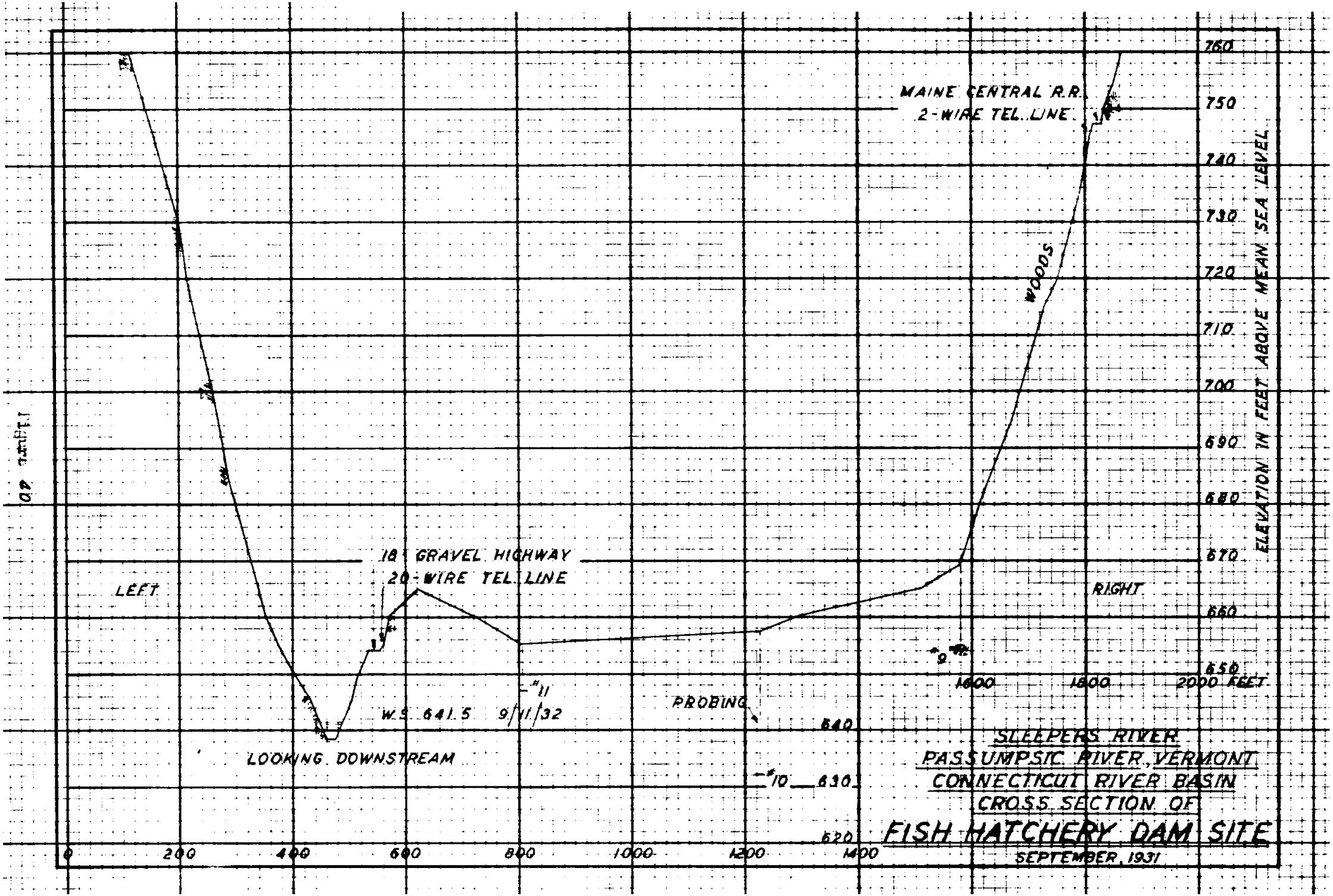
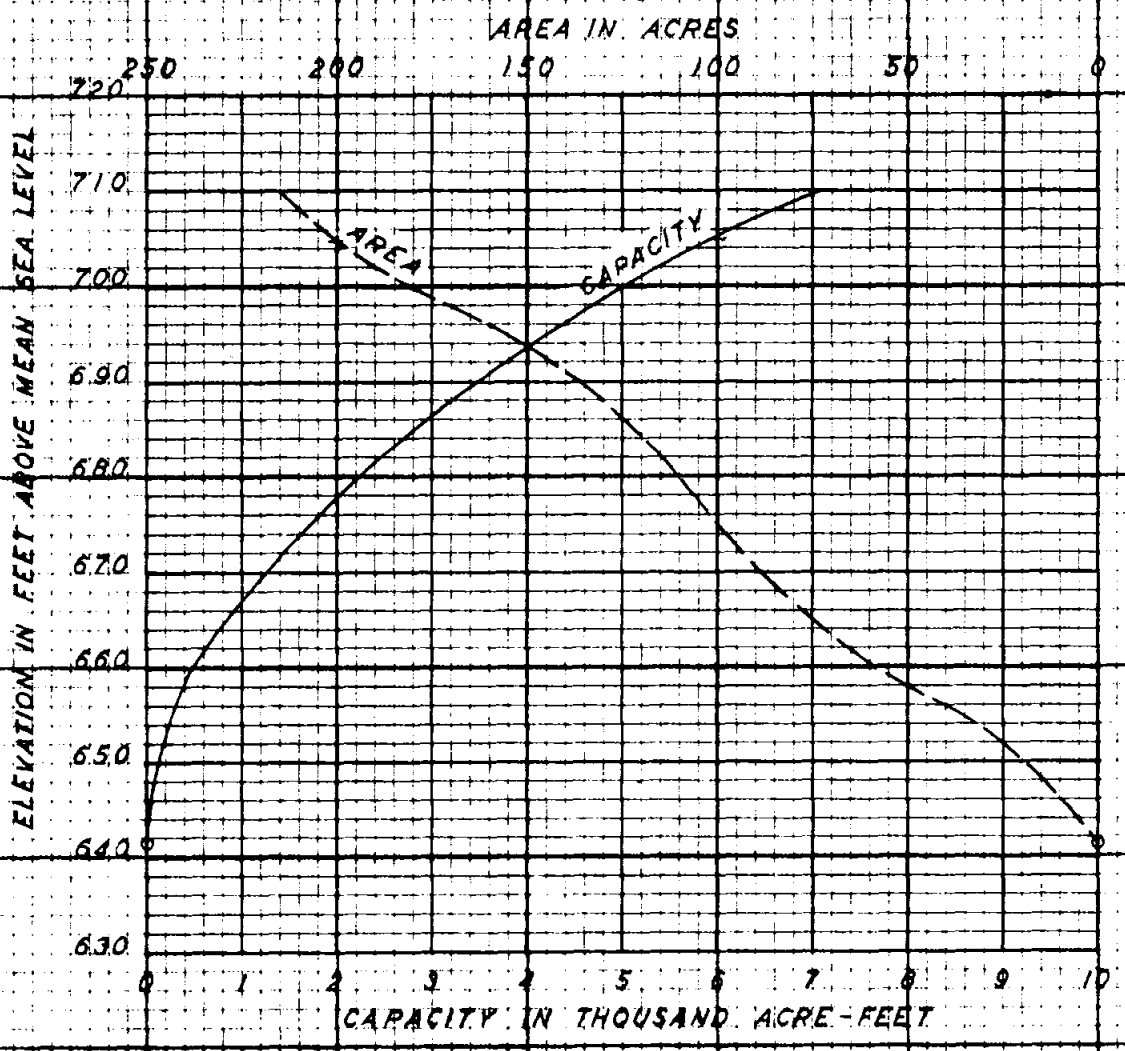

MAINE CENTRAL R.R.
2-WIRE TEL. LINE
WOODS
18' GRAVEL HIGHWAY
20-WIRE TEL. LINE
LEFT
RIGHT
#11
W.S. 641.5 9/11/32
PROBING
#10
#9
LOOKING DOWNSTREAM
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
760
750
740
730
720
710
700
690
680
670
660
650
640
630
620
0
200
400
600
800
1000
1200
1400
1600
1800
2000 FEET
SLEEPERS RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
FISH HATCHERY DAM SITE
SEPTEMBER, 1931

Figure 60



SLEEPERS RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
FISH HATCHERY DAM SITE
DATA FROM U.S. GEOLOGICAL SURVEY MAPS

Figure 41

section with 5-foot pin-type flashboards on the left bank. A sluice gate is provided in the gate section for pond regulation.

Elevations and lengths are as follows:

Tail-water,	590	
Assumed lowest foundation,	630	
Normal water surface,	641.5	
Proposed lowest draft for power,	662	
Permanent spillway crest,	705	
Top of flashboards and maximum high water,	710	
Top of retaining section,	715	
Top of earth section and abutments,	715	
Length of earth section,	1,165	feet
Length of concrete retaining section,	25	feet
Length of intake section,	10	feet
Length of sluice-gate section,	20	feet
Length of spillway section,	300	feet
Total length of dam,	1,520	feet

The pond at the elevation of the flashboards (710) would cover 215 acres and extend about 2.25 miles.

Property damage is estimated as follows: Land, 247 acres; buildings, four sets; roads, 2.7 miles of 18-foot gravel; bridges, one, 70 by 18 feet, one bridge to be abandoned; telephone lines, 2.7 miles; pipe-line right of way; total damages, $102,500.

The flood-storage capacity in acre-feet is as follows: Above spillway, 1,100; below spillway, 6,000; total, 7,100. The maximum draft proposed for power is 48 feet, giving 6,500 acre-feet of power storage.

A 4.5-foot diameter steel pipe, 540 feet long on the right bank would conduct the water to a power house located at about mile 3.2, where a tail-water elevation of 590 is to be obtained by a 200-foot tailrace. Two units would be installed utilizing 122 second-feet of water or 3 second-feet per square mile at an average net head of 100 feet, yielding 1,110 horsepower. The yearly output is estimated at 3,818,000 kilowatt-hours of which 54 per cent is primary power.

The total cost is estimated at $1,140,000. Cost per horsepower, $1,027. Cost of power production, per kilowatt-hour, 34.4 mills.

The cost of storage only is $1,041,000. Total flood storage, 7,100 acre-feet. Cost per acre-foot, $147. Power storage, 6,500 acre-feet. Cost per acre-foot, $160; cost per acre-foot per foot of developed head through which used (397 feet), 40.4 cents.

The cost of power exclusive of cost of storage is $99,500. Cost of power production per kilowatt-hour, exclusive of cost of storage, 5.8 mills. The details of cost are as follows:

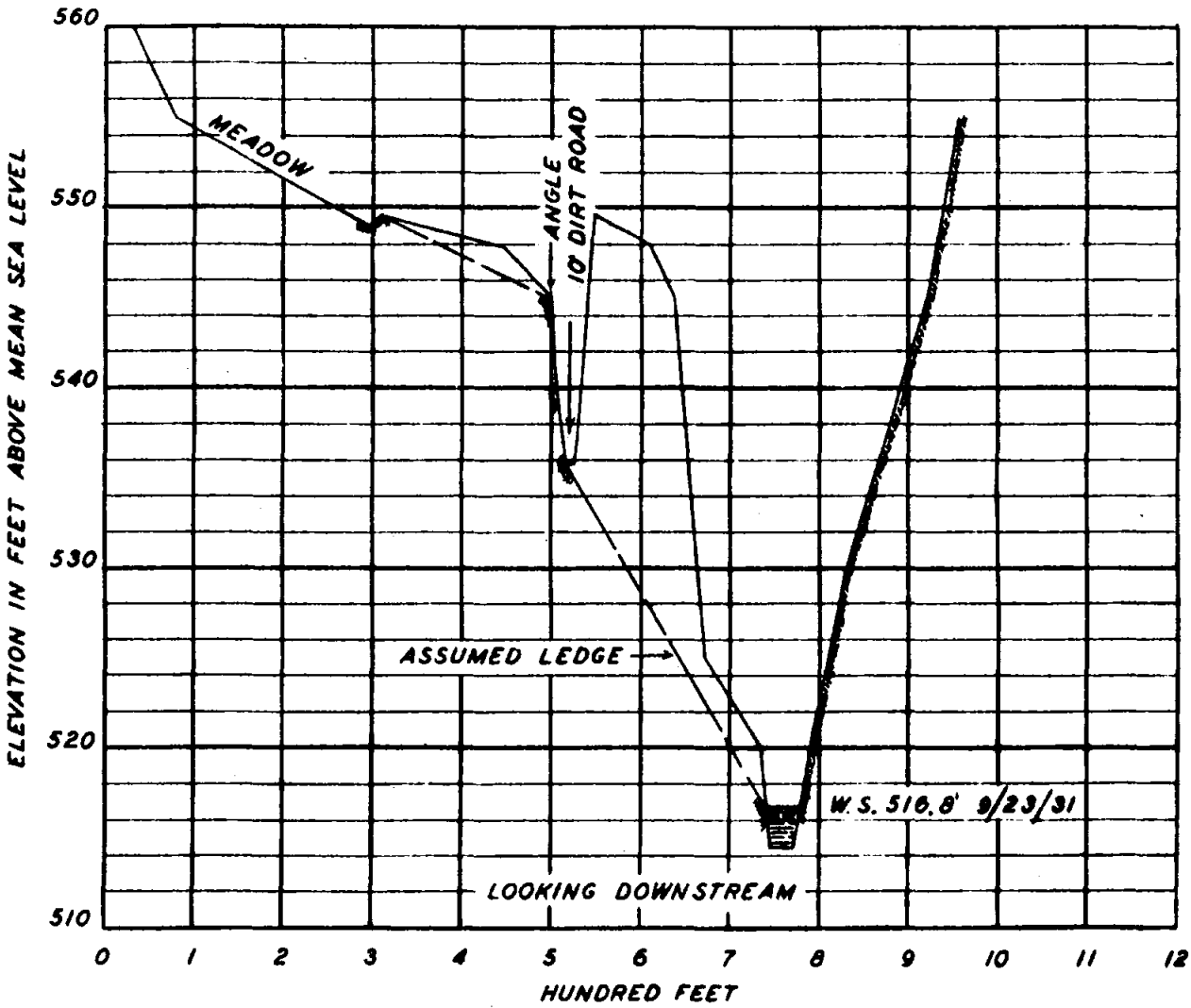
Unwatering,	5,400
Dam,	638,700
Penstock,	13,200
Power-house structure,	6,700
Power-house equipment, hydraulic and electrical apparatus,	38,400
Tailrace,	1,800
Total "A",	704,000
General expenses:	
Clearing reservoir,	600
Relocation of roads and telephone lines	80,200
Highway bridge,	7,000
Transportation,	9,200
Plant, camp, and general construction,	106,600
Total "B",	906,600
Engineering, contingencies, interest, taxes, and insurance,	208,500
Total "C",	1,115,100
Property and pipe-line right of way,	15,100
Total cost, without transformer station,	1,130,200
Outdoor transformer station,	10,100
Grand total cost,	1,140,300
Grand total cost in round figures,	1,140,000

81. Waterandrick, serial number 14, Waterandrick Brook, Passumpsic River Basin, Vermont. Drainage area, 16.7 square miles. This potential development is a storage proposition only. The site is just above the state highway bridge crossing the brook near its junction with the Passumpsic River. The cross section of the valley was surveyed at the dam site and is reproduced herein. An area-capacity graph of the reservoir was computed from a topographic map recently made by the U.S. Geological Survey in cooperation with the Vermont Flood-Control Committee. This is reproduced herein. No probings were made at the site, but ledge is exposed in the river and on both banks.

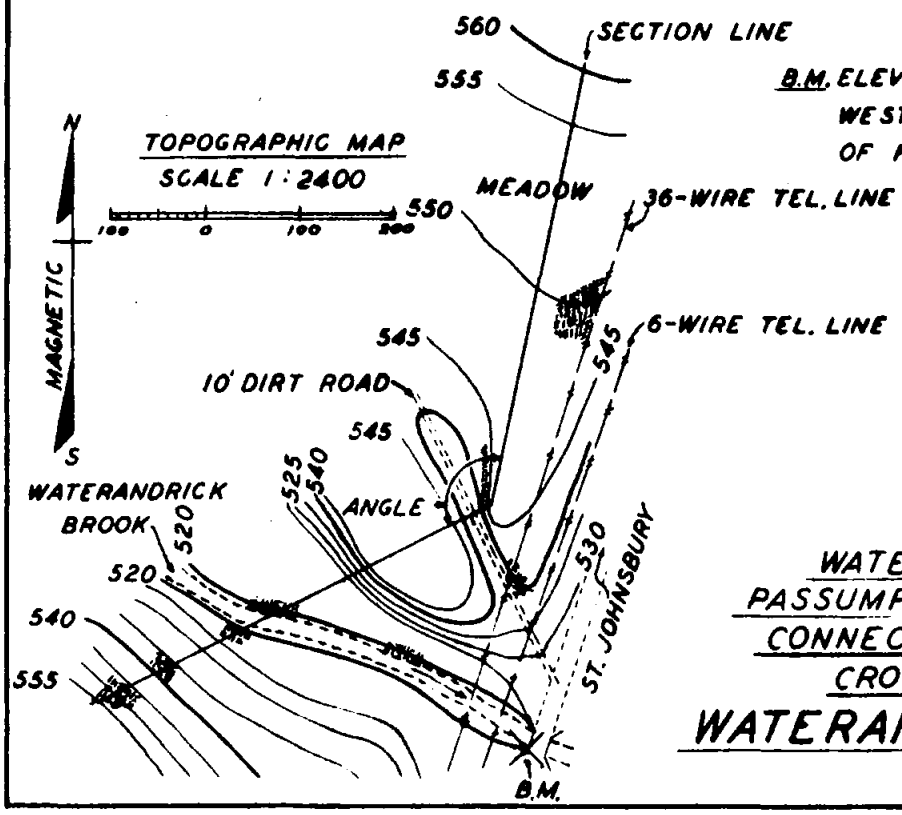
A rough estimate was made of the cost of a development at this site but it proved to be so expensive that no detailed estimate was made.

The elevation of water surface at the dam site is about 516 to 517. Rough figures were based on an earth dam with concrete spillway on the left bank with crest elevation of 550. The property damage would not be great. The bottom land is hay meadow and the hillsides are pastures. Very few buildings would be damaged.

The total storage capacity of the reservoir at elevation 550 is estimated at 1,225 acre-feet.



CROSS SECTION

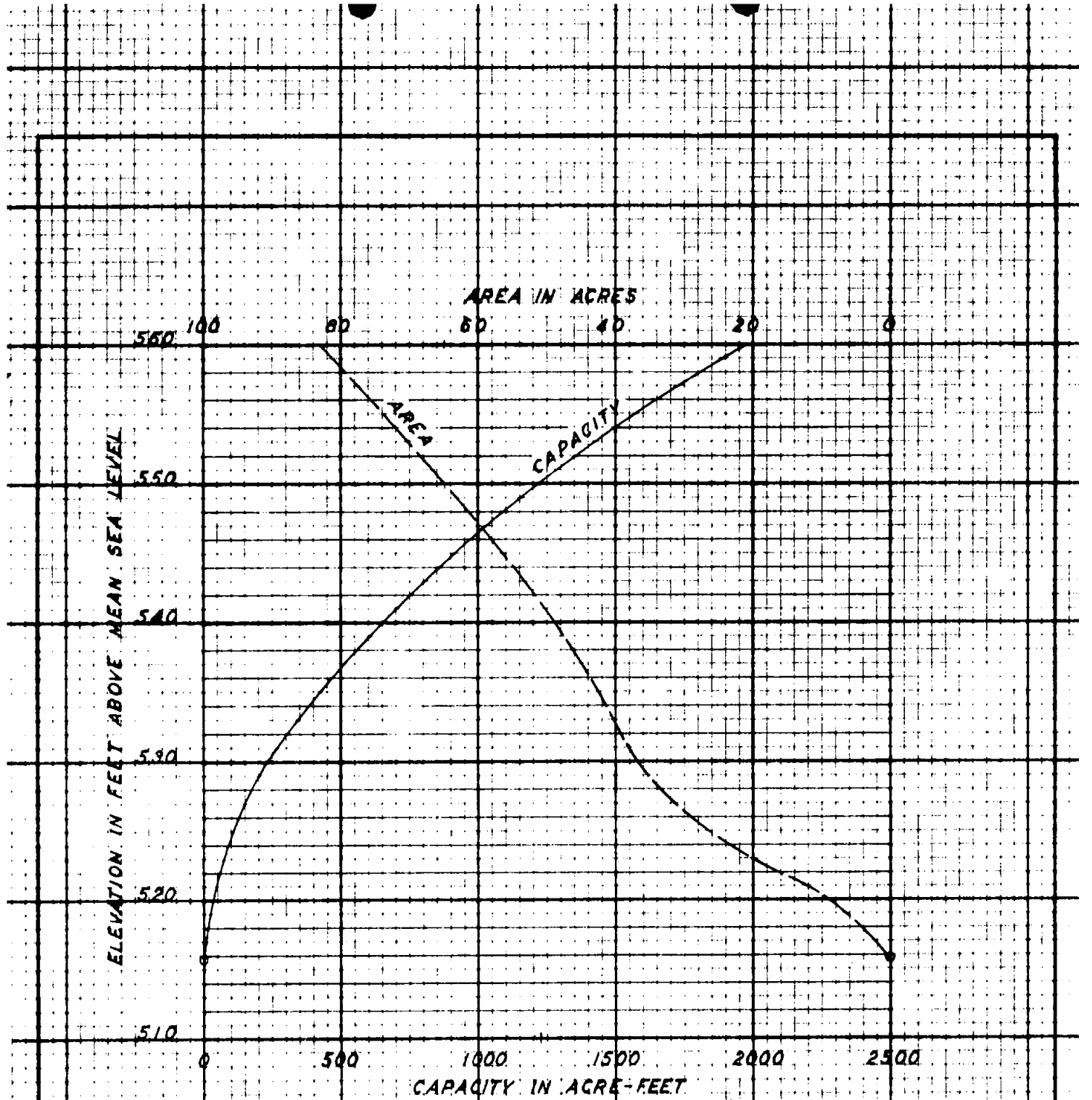


WATERANDRICK BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF

WATERANDRICK DAM SITE

SEPTEMBER, 1931

Figure 42



WATERANDRICK BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
WATERANDRICK DAM SITE
DATA FROM U.S. GEOLOGICAL SURVEY MAPS

Figure 43

82. Joes Pond, serial number 15, mil 10.95 Joes Brook, Passumpsic River Basin, Vermont. Drainage area, 28.9 square miles. This proposition is a redevelopment of the present Green Mountain Power Corporation Plant No. 15 and proposes the use of the present dam at the outlet of Joes Pond but with a new intake and new pipe line, which would divert the water away from the present river channel to a proposed power house and reservoir at Keiser Pond, which is on a small tributary to Joes Brook. It is not thought that this redevelopment will be economical until depreciation and obsolescence require major changes in the present power plant. This proposed development would utilize the 206.5-foot head between the present level of Joes Pond and the pond of the proposed development at the outlet of Keiser Pond.

Elevations and lengths are as follows:

Tail-water,	1342
Permanent spillway crest and lowest draft for power,	1547
Top of flashboards,	1548.5
Length of new intake section,	12 feet

Property damage is estimated as follows: Land, 10 acres; water rights; pipe-line right of way, 1 mile; total damages, $51,100.

It is understood the usable storage capacity in Joes Pond is negligible due to limitations of draft imposed by abutting property owners.

A 4-foot diameter wood-stave pipe, 5,000 long, on the right bank would conduct the water to a power house located at the head of the pond of the proposed Keiser Pond development, where two units would be installed, utilizing 58 second-feet of water or 2 second-feet per square mile at an average net head at full load of 195 feet, yielding 1,020 horsepower. The average net head at three-quarters load is estimated at 195.5 feet. The yearly output is estimated at 4,55[illegible] kilowatt-hours, of which 7 per cent is primary power. The design provides no surge tank nor automatic governor for the water turbine, therefore the pipe line is designed to withstand static head only. The design provides for by-passing excess water past the power house in order that the Keiser Pond reservoir may be filled during periods of high water, regardless of the demands for power.

The total cost is estimated at $203,000. Cost per horsepower, $220. Cost of power production, per kilowatt-hour, 7.5 mills.

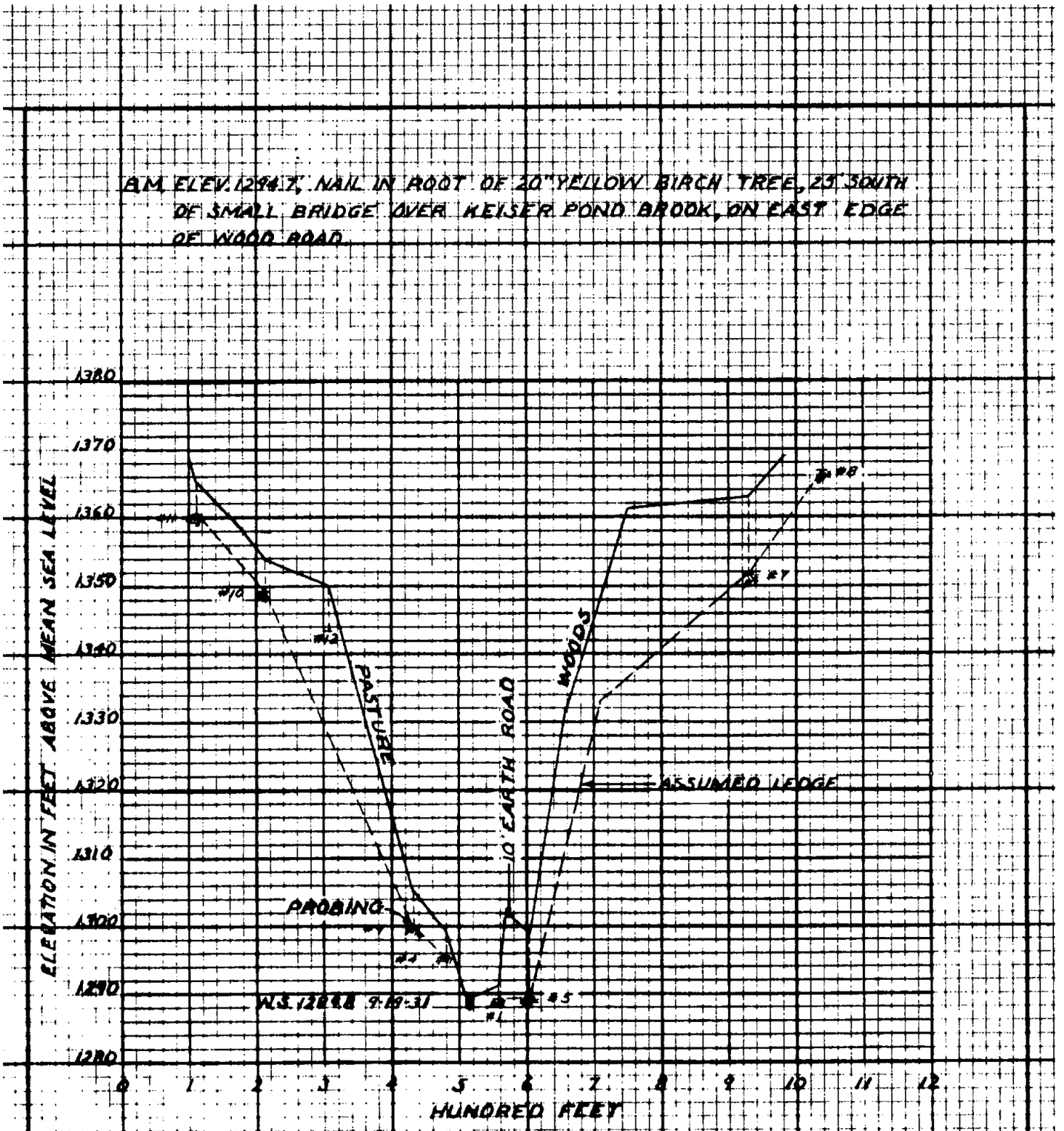
The capacity of Plant #15 which this proposition would supersede is 1,750 horsepower and the 1928 output was said to be about 2,800,000 kilowatt-hours.

The details of cost are as follows:

Unwatering,	$ 3,300
Dam,	2,600
Pipe line,	44,700
Penstock,	1,400
Power-house structure,	7,600
Power-house equipment, hydraulic and electrical apparatus,	32,200
Tailrace,	4,700
Total "A",	96,500
General expenses:	
Transportation,	4,800
Plant, camp, and general construction,	14,500
Total "B",	115,800
Engineering, contingencies, interest, taxes, and insurance,	26,700
Total "C",	142,500
Property, water rights, and pipe-line right of way,	51,100
Total cost, without transformer station,	193,600
Outdoor transformer station,	9,500
Grand total cost,	203,100
Grand total cost in round figures,	203,000

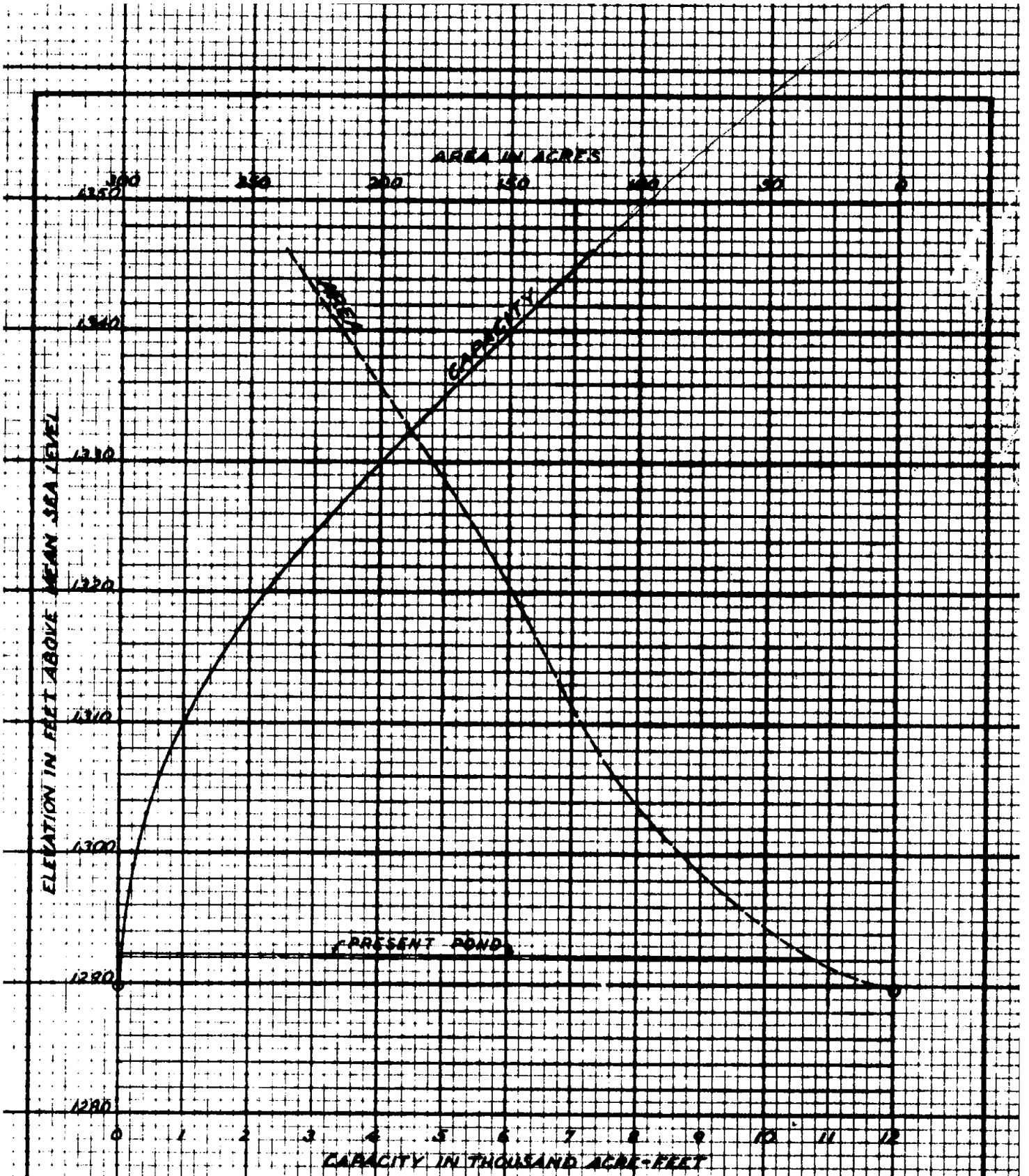
83. Keiser Pond, serial number 16, Joes Brook, Passumpsic River Basin, Vermont. Drainage area, 2.4 square miles of natural drainage area and 31.5 square miles including Joes Pond. This potential development would utilize the 110.5-foot head on Keiser Pond Brook, between the mouth of the brook and the power-house site for the proposed Joes Pond redevelopment.

It is proposed to divert water from Joes Pond to the Keiser Pond storage reservoir, as described under Joes Pond Redevelopment, serial number 15. None of this head is developed at present. The proposed dam will raise the present level of Keiser Pond 58 feet. The dam site is at the outlet of Keiser Pond. Ledge rock is not exposed at the site but probings indicate its occurrence at a depth of about 2 feet in the river bed and at depths varying from 3 to 25 feet on the banks. An earth and concrete dam is proposed, 610 feet long, of which 44 feet is concrete spillway section without flashboards or crest gates at a high elevation on the left bank. A concrete conduit through the earth dam is provided for unwatering and for stream control during construction, and it would be utilized permanently for power purposes.



KEISER POND BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
KEISER POND DAM SITE
LOOKING DOWNSTREAM
SEPTEMBER, 1931

Figure 44



KEISER POND BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
KEISER POND DAM SITE
DATA FROM SURVEY BY A PRIVATE COMPANY

Plate 45

Elevations and lengths are as follows:

Tail-water,	1239.5
Assumed lowest foundation,	1288
Normal water surface,	1289.8
Proposed lowest draft for power,	1300
Permanent spillway crest,	1350
Maximum high water,	1353
Top of abutment and earth section,	1358
Length of earth section,	486 feet
Length of concrete retaining section,	80 feet
Length of spillway section,	44 feet
Total length of dam,	610 feet

The pond at the elevation of the spillway (1350) would cover about 250 acres and extend about 1.5 miles.

Property damage is estimated as follows: Land, 263 acres; buildings, one set; roads, abandon 2 miles of 10 to 12-foot dirt roads; pipe-line right of way, two-tenths mile; total damages, $7,700.

The flood-storage capacity in acre-feet is as follows: Above spillway, 600; below spillway, 8,000; total, 8,600. The maximum draft proposed for power is 50 feet, giving 7,700 acre-feet of power storage.

A 52-inch wood-stave pipe, 900 feet long on the right bank of the brook would conduct the water to a surge tank and power house located at mile 8.2 on Joes Brook about 200 feet below the confluence of Keiser Pond and Joes Brooks, where two units would be installed, utilizing 93.9 second-feet of water or 3 second-feet per square mile at an average net head of 86.5 feet at full load, yielding 740 horsepower. The average net head at three-quarters load is estimated at 87.5 feet. The yearly output is estimated at 3,156,000 kilowatt-hours of which 49 per cent is primary power.

The total cost is estimated at $332,000. Cost per horsepower, $449. Cost of power production per kilowatt-hour, 14.5 mills.

The cost of storage only is $228,000. Total flood storage, 8,600 acre-feet. Cost per acre-foot, $26.50. Power storage, 7,700 acre-feet. Cost per acre-foot, $29.60; cost per acre-foot per foot of developed head through which used (366 feet), 8.1 cents.

The cost of power exclusive of cost of storage is $104,000. Cost of power production per kilowatt-hour, exclusive of cost of storage, 6.9 mills.

The details of cost are as follows:

Unwatering,	$ 2,200
Dam,	132,700
Diversion and power conduit and control tower,	18,600
Pipe line,	8,100
Surge tank,	8,100
Penstock,	8,300
Power-house structure,	7,000
Power-house equipment, hydraulic and electrical apparatus,	31,900
Tailrace,	300
Total "A",	214,200
General expenses:	
Clearing reservoir,	9,200
Transportation,	1,400
Plant, camp, and general construction,	32,100
Total "B",	256,900
Engineering, contingencies, interest, taxes, and insurance,	59,100
Total "C",	316,000
Property and pipe-line right of way,	7,700
Total cost, without transformer station,	323,700
Outdoor transformer station,	8,000
Grand total cost,	331,700
Grand total cost in round figures,	332,000

84. Mile 6.9, serial number 17, Joes Brook, Passumpsic River Basin, Vermont. Drainage area, 37 square miles. This potential development would utilize the 65-foot head between mile 7.5 at Harveys Hollow and theaveragepond level of the proposed development at South Danville. About 10 feet of this head is developed at the present time for a sawmill. The dam site is at mile 6.85, Joes Brook, at the site of an existing sawmill dam where ledge is exposed in the river bed and on the right bank. Probings indicate its occurrence at depths from 1 to 8 feet on the left bank. A concrete dam is proposed, 380 feet long, of which 127.5 feet is spillway section with 10-foot flashboards in the river bed and on the right bank. A 5-foot diameter sluice pipe is provided for pond regulation.

Elevations and lengths are as follows:

Tail-water,	1157
Assumed lowest foundation,	1198
Normal water surface,	1198.6
Permanent spillway crest,	1212
Top of flashboards and maximum high water,	1222
Top of retaining section,	1224
Top of gate and intake sections,	1227
Length of retaining section,	212.5 feet
Length of intake section,	20 feet
Length of sluice-gate section,	20 feet
Length of spillway section,	127.5 feet
Total length of dam,	380 feet

The pond at the elevation of the flashboards (1222) would cover

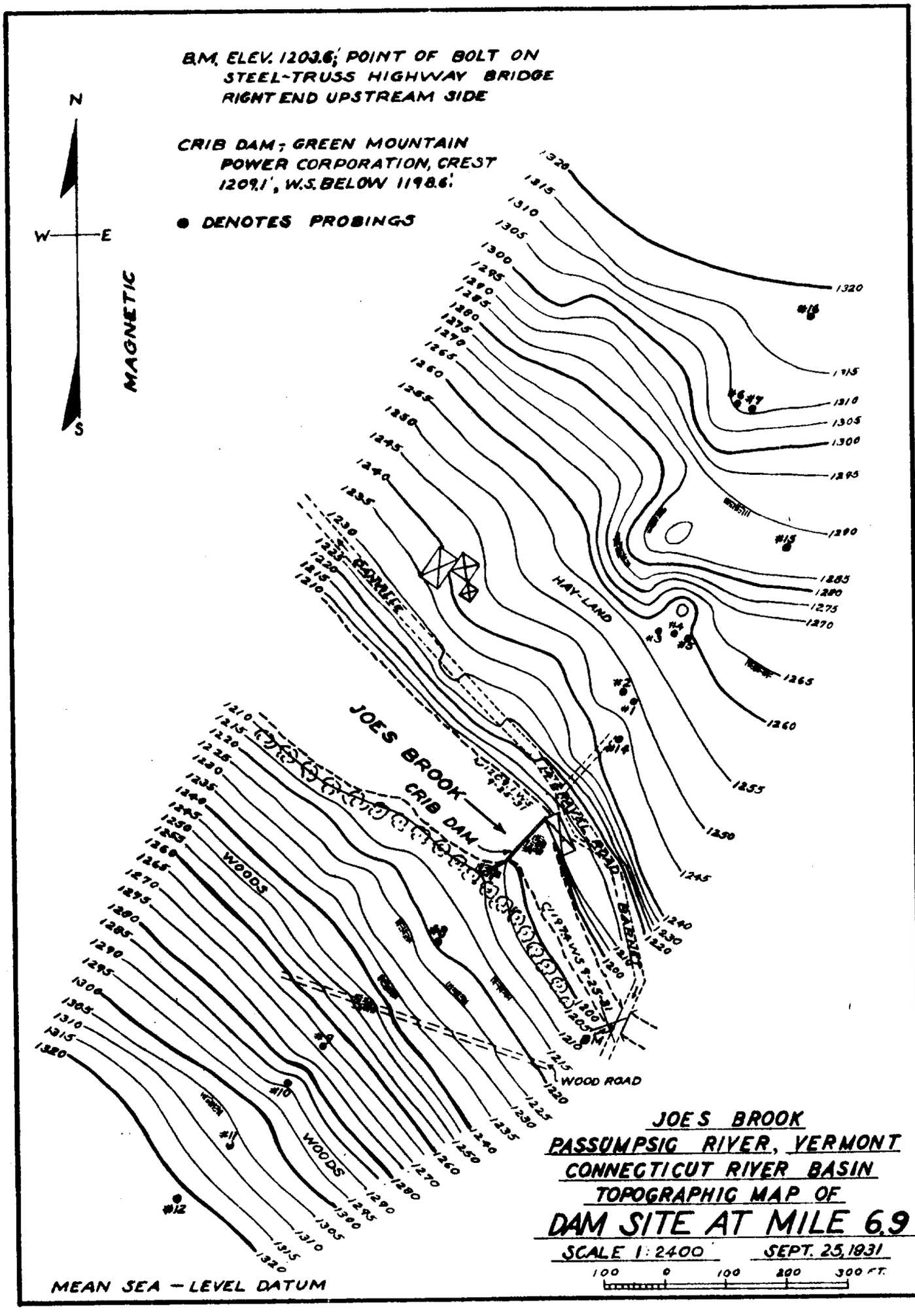
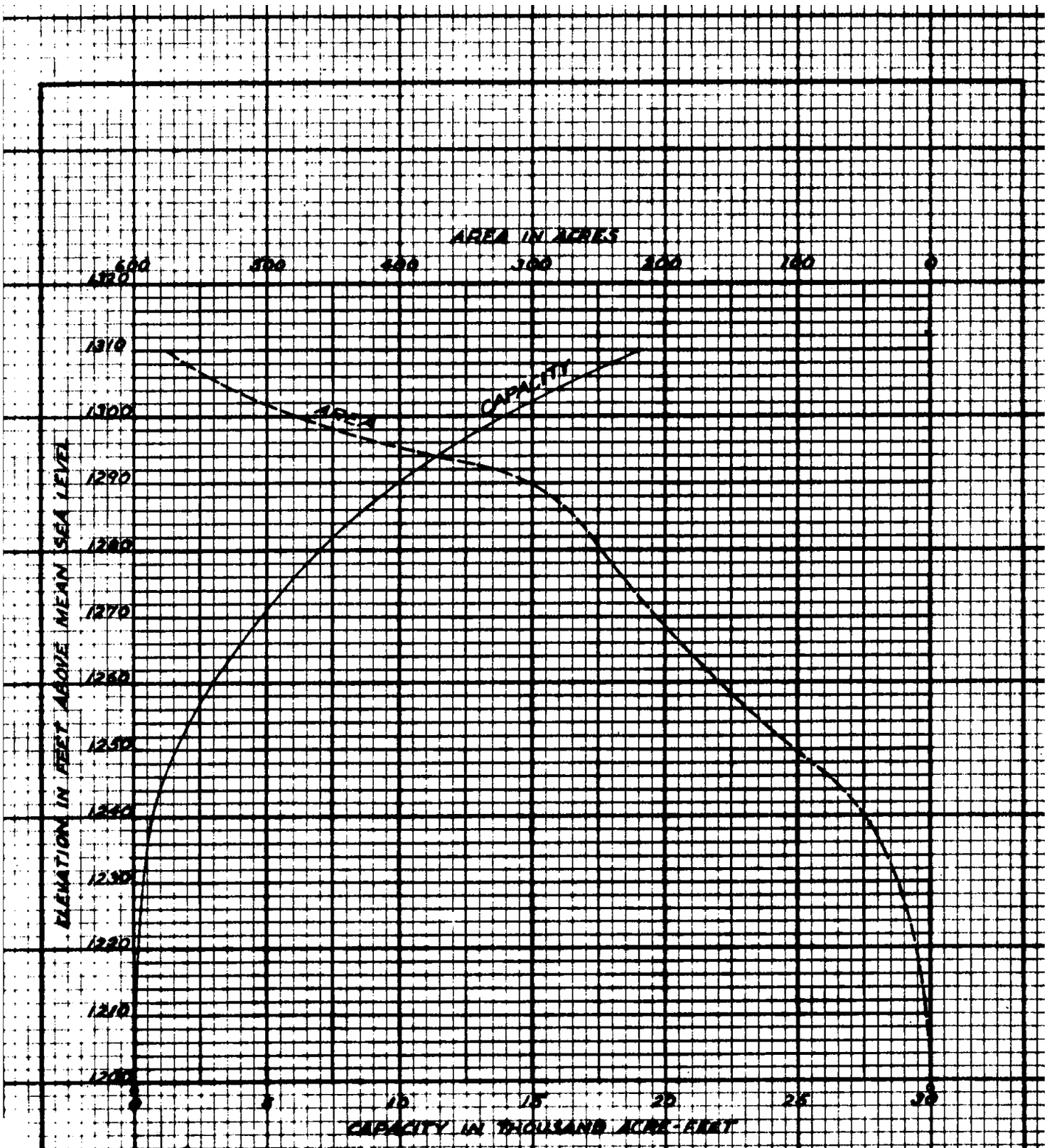

B.M. ELEV. 1203.6'; POINT OF BOLT ON STEEL-TRUSS HIGHWAY BRIDGE RIGHT END UPSTREAM SIDE
CRIB DAM; GREEN MOUNTAIN POWER CORPORATION, CREST 1209.1', W.S. BELOW 1198.6'
● DENOTES PROBINGS
N
W
E
S
MAGNETIC
JOES BROOK
CRIB DAM
HAY-LAND
WOODS
WOOD ROAD
MEAN SEA - LEVEL DATUM
JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
TOPOGRAPHIC MAP OF
DAM SITE AT MILE 6.9
SCALE 1:2400
SEPT. 25, 1931
100 0 100 200 300 FT.

Figure 46



JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 6.9
DATA FROM CROSS SECTIONS

Figure 47

about 13 acres and extend about six-tenths mile.

Property damage is estimated as follows: Land, 24 acres; buildings, none; additional water rights; pipe-line right of way, one-quarter mile; total damages, $2,310.

The storage capacity of the pond is negligible and only a nominal draft is proposed for power.

A 52-inch diameter wood-stave pipe, 1200 feet long on the left bank of the river would conduct the water to a surge tank and power house located at mile 6.6, about 800 feet downstream from the highway bridge below the dam, where the water elevation is 1157. Two units would be installed utilizing 111 second-feet or 3 second-feet per square mile at an average net head of 60 feet, yielding 600 horsepower. The yearly output is estimated at 2,172,000 kilowatt-hours, of which 5 per cent is primary power.

The total cost is estimated at $126,000. Cost per horsepower, $210. Cost of power production per kilowatt-hour, 10.4 mills.

The cost of a development based on a dam with spillway-crest elevation of 1237 and flashboard elevation of 1247, giving 80.5-foot average net head at full load and yielding 810 horsepower, was estimated to be $357,000. Cost per horsepower, $440. Cost of power production per kilowatt-hour, 16.4 mills. The yearly output on this basis would be 2,912,000 kilowatt-hours, of which 5 per cent is primary power.

The details of cost are as follows:

Unwatering,	$ 3,800
Dam,	28,600
Pipe line,	9,500
Surge tank,	2,500
Penstock,	2,900
Power-house structure,	5,800
Power-house equipment, hydraulic and electrical apparatus,	27,900
Tailrace,	200
Total "A",	81,200
General expenses:	
Transportation,	1,800
Plant, camp, and general construction,	12,200
Total "B",	94,900
Engineering, contingencies, interest, taxes, and insurance,	21,800
Total "C",	116,700
Property, water rights, and pipe-line right of way,	2,300
Total cost, without transformer station,	119,000
Outdoor transformer station,	7,100
Grand total cost	126,100
Grand total cost in round figures	126,000

85. South Danville, serial number 18, mile 6.15, Joes Brook, Passumpsic River Basin, Vermont. Drainage area, 45.7 square miles. This potential development would utilize the 350-foot fall from mile 6.5, between Harvey and South Danville, to mile 4.45, just below a broken dam at the village of Morses Mill. None of this head is utilized at present, although about 22 feet was formerly developed at two dams which are now abandoned. The dam site is at mile 6.15, Joes Brook, about 150 feet above the South Danville highway bridge. Ledge is exposed in the river bed and on the right bank while on the left bank probings indicate its occurrence at depths of 5 to 7 feet. An earth and concrete dam is proposed, 820 feet long, of which 162.5 feet is concrete spillway section with 10-foot flashboards at a high elevation on the left bank. A 4-foot diameter sluice is proposed for pond control.

Elevations and lengths are as follows:

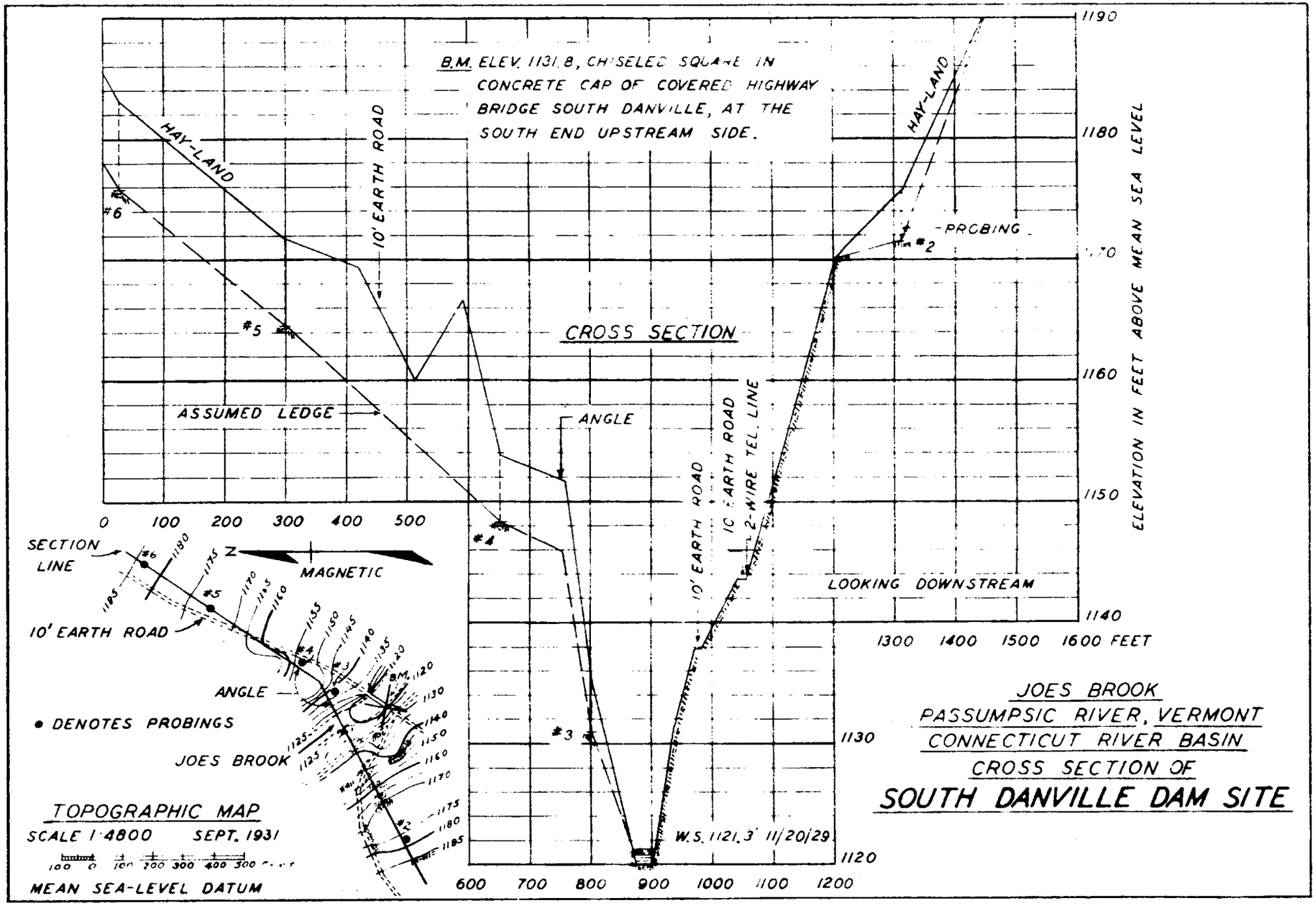
Tailwater,	811
Assumed lowest foundation,	1120
Normal water surface,	1121.3
Permanent spillway crest,	1151
Proposed lowest draft for power,	1151
Top of flashboards and maximum high water,	1161
Top of retaining sections,	1163 and 1166
Top of earth, gate, and intake sections,	1166
Length of earth section,	227.5 feet
Length of concrete retaining section,	406 feet
Length of intake section,	12 feet
Length of sluice-gate section,	12 feet
Length of spillway section,	162.5 feet
Total length of dam,	820 feet

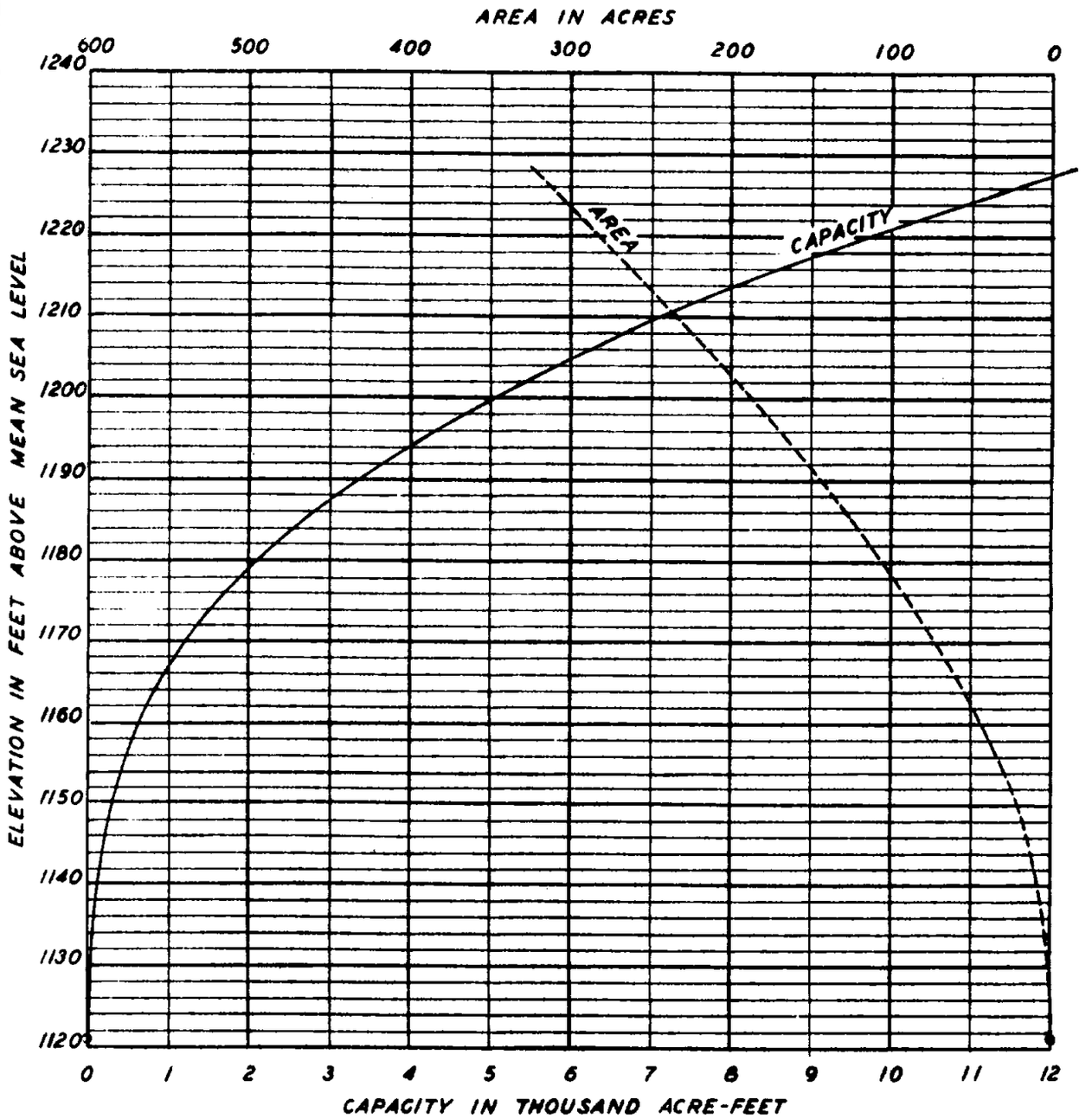
The pond at the elevation of the flashboards (1161) would cover about 45 acres and extend about four-tenths mile.

Property damage is estimated as follows: Land, 60 acres; buildings, one set; roads, abandon 1 mile of 10-foot earth road; telephone line, 1 mile; additional water rights; pipe-line right of way, 2 miles; total damages, $13,800.

The storage capacity in acre-feet is as follows: Above spillway, 400; below spillway, 300; total, 700. The maximum draft proposed for power is 10 feet, giving 400 acre-feet of power storage.

A 46-inch wood-stave and steel pipe, 9,000 feet long, on the right bank of the river would conduct the water to a power house located at mile 4.45, or 900 feet below the highway bridge at Morses Mill, where a tail-water


B.M. ELEV. 1131.8, CHISELED SQUARE IN CONCRETE CAP OF COVERED HIGHWAY BRIDGE SOUTH DANVILLE, AT THE SOUTH END UPSTREAM SIDE.
CROSS SECTION
HAY-LAND
10' EARTH ROAD
ASSUMED LEDGE
ANGLE
2-WIRE TEL. LINE
PROBING
LOOKING DOWNSTREAM
W.S. 1121.3' 11/20/29
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
1190
1180
1170
1160
1150
1140
1130
1120
0 100 200 300 400 500
600 700 800 900 1000 1100 1200
1300 1400 1500 1600 FEET
#2
#3
#4
#5
#6
SECTION LINE
MAGNETIC
N
B.M. 1120
JOES BROOK
• DENOTES PROBINGS
TOPOGRAPHIC MAP
SCALE 1:4800 SEPT. 1931
MEAN SEA-LEVEL DATUM
JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
SOUTH DANVILLE DAM SITE



JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
SOUTH DANVILLE DAM SITE
DATA FROM SURVEY BY A PRIVATE COMPANY

Figure 49

elevation of 811 is obtainable. No surge tank is provided nor is automatic-governor control of the turbine contemplated, the pipe line being designed to withstand static head only. Two units would be installed utilizing 91 second-feet of water, or 2 second-feet per square mile at an average net head at full load of 303.4 feet, yielding 2,500 horsepower. The average net head at three-quarters load is estimated at 315.6 feet. The yearly output is estimated at 11,600,000 kilowatt-hours, of which 14 per cent is primary power.

The total cost is estimated at $385,000. Cost per horsepower, $154. Cost of power production, per kilowatt-hour, 5 mills.

The details of cost are as follows:

Unwatering,	$ 5,900
Dam,	89,400
Pipe line,	87,400
Penstock,	1,400
Power-house structure,	8,100
Power-house equipment, hydraulic and electrical apparatus,	50,700
Tailrace,	1,000
Total "A",	243,900
General expenses:	
Clearing reservoir,	800
Relocation of telephone line,	300
Transportation,	6,000
Plant, camp, and general construction,	36,600
Total "B",	287,500
Engineering, contingencies, interest, taxes, and insurance,	66,100
Total "C",	353,400
Property, water rights, and pipe-line right of way,	13,500
Total cost, without transformer station,	366,900
Outdoor transformer station,	18,100
Grand total cost,	385,000

86. Mile 3.75, serial number 19, Joes Brook, Passumpsic River Basin, Vermont. Drainage area, 49 square miles. This potential development would utilize the 140-foot head from mile 4.0, about one-half mile below the village of Morses Mill, to mile 2.6, about 1,100 feet above Wardens Brook. None of this head is developed at present. The dam site is at mile 3.75, Joes Brook, where ledge is exposed in the river bed and probings indicate its occurrence at depths of 3 to 11 feet on both banks. A concrete dam, 519 feet long, is proposed, of which 162.5 feet is spillway section with 10-foot flashboards on the left bank; and the gate, intake, and retaining sections are in the bed of the river and on the right bank. Pond control is effected by means of a 5.5-foot diameter sluice pipe.

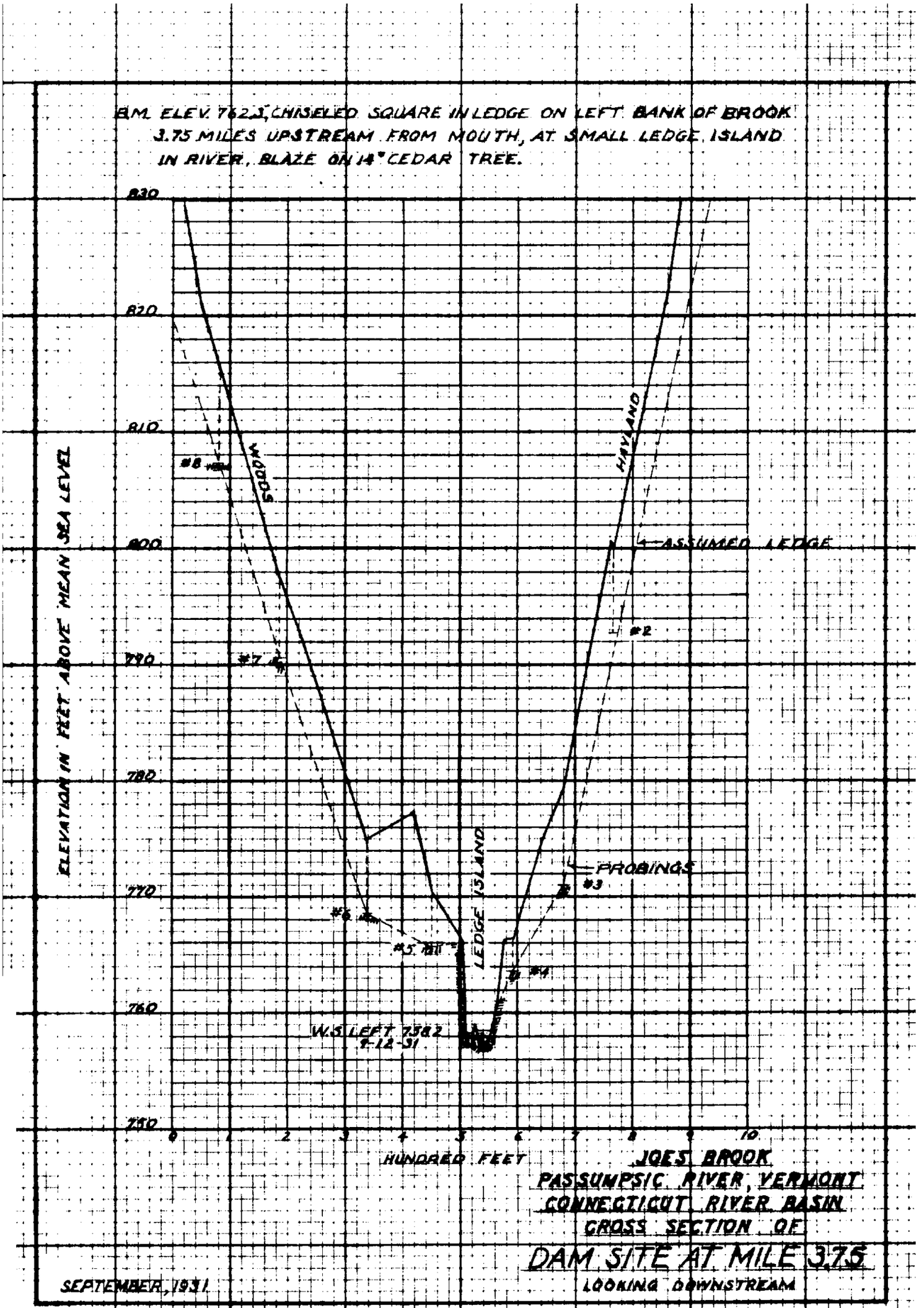

B.M. ELEV. 762.3, CHISELED SQUARE IN LEDGE ON LEFT BANK OF BROOK 3.75 MILES UPSTREAM FROM MOUTH, AT SMALL LEDGE ISLAND IN RIVER, BLAZE ON 14" CEDAR TREE.
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
830
820
810
800
790
780
770
760
750
WOODS
HAYLAND
ASSUMED LEDGE
PROBINGS
LEDGE ISLAND
#1
#2
#3
#4
#5
#6
#7
#8
W.S. LEFT 758.2
9-12-31
0
1
2
3
4
5
6
7
8
9
10
HUNDRED FEET
JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
DAM SITE AT MILE 3.75
LOOKING DOWNSTREAM
SEPTEMBER, 1931

FIGURE 50

Elevations and lengths are as follows:

Tail-water,	640
Assumed lowest foundations,	757
Normal water surface,	758.2
Permanent spillway crest,	770
Proposed lowest draft for power,	776
Top of flashboards and maximum highwater,	780
Top of gate, intake, and retaining sections,	785
Length of retaining section,	332.5 feet
Length of intake section,	14 feet
Length of sluice-gate section,	10 feet
Length of spillway section,	162.5 feet
Total length of dam,	519 feet

The pond at the elevation of the flashboards (780) covers about 11 acres and extends about four-tenths mile.

Property damage is estimated as follows: Land, 22 acres; buildings, none; roads, none; pipe-line right of way, 1.2 miles; additional water rights; total damages, $5,400.

The storage capacity of the pond is negligible and only a nominal draft is proposed for power.

A 52-inch diameter wood-stave pipe, 6,400 feet long, on the right bank would conduct the water to a surge tank and power house located at mile 2.6 about 1,100 feet above Wardens Brook, where two units would be installed utilizing 98 second-feet of water or 2 second-feet per square mile at an average net head at full load of 120 feet, yielding 1,070 horsepower. The average net head at three-quarters load is estimated at 126 feet. The yearly output is estimated at 4,940,000 kilowatt-hours of which 7 per cent is primary power.

The total cost is estimated at $232,000. Cost per horsepower, $217. Cost of power production, per kilowatt-hour, 7.5 mills.

The cost of the development based on a dam with spillway elevation of 808, giving 152.6-foot average net head at full load and yielding 1,360 horsepower, was estimated to be $595,000. Cost per horsepower, $437. Cost of power production, per kilowatt-hour, 12.4 mills. The yearly output on this basis would be 6,190,000 kilowatt-hours, of which 7 per cent is primary power.

The details of cost are as follows:

Unwatering,	$ 4,500
Dam,	37,700
Pipe line,	52,200
Surge tank,	4,500
Penstock,	7,500
Power-house structure,	7,000
Power-house equipment, hydraulic and electrical apparatus,	36,200
Tailrace,	300
Total "A",	149,900
General expenses:	
Clearing reservoir,	400
Transportation,	3,500
Plant, camp, and general construction,	22,500
Total "B",	176,300
Engineering, contingencies, interest, taxes, and insurance,	40,600
Total "C",	216,900
Property, water rights, and pipe-line right of way,	5,400
Total cost, without transformer station,	222,300
Outdoor transformer station,	9,800
Grand total cost,	232,100
Grand total cost in round figures,	232,000

87. Mile 1.0, serial number 20, Joes Brook, Passumpsic River Basin, Vermont. Drainage area, 57 square miles. This potential development would utilize the 108-foot head between the highway bridge at mile 1.8 and the highway bridge at mile 0.37. About 8 feet of this head was formerly utilized at a dam at about mile 1.5, but this dam is now broken and not used. The dam site is at mile 1.0, Joes Brook, about 100 feet above a concrete highway bridge. Ledge is exposed on the surface of the entire site. A concrete dam 375 feet long is proposed, of which 195 feet is spillway section with 10-foot flashboards in the bed of the river and on the left bank. The gate, intake, and retaining sections are on the right bank. Pond control is effected by means of a 4.5-foot diameter sluice pipe in the gate section.

Elevations and lengths are as follows:

Tail-water,	499
Assumed lowest foundation,	580
Normal water surface,	582
Permanent spillway crest,	597
Proposed lowest draft for power,	603
Top of flashboards and maximum high water,	607
Top of gate, intake, and retaining sections,	612
Length of retaining section,	156 feet
Length of intake section,	12 feet
Length of sluice-gate section,	12 feet
Length of spillway section,	195 feet
Total length of dam,	375 feet

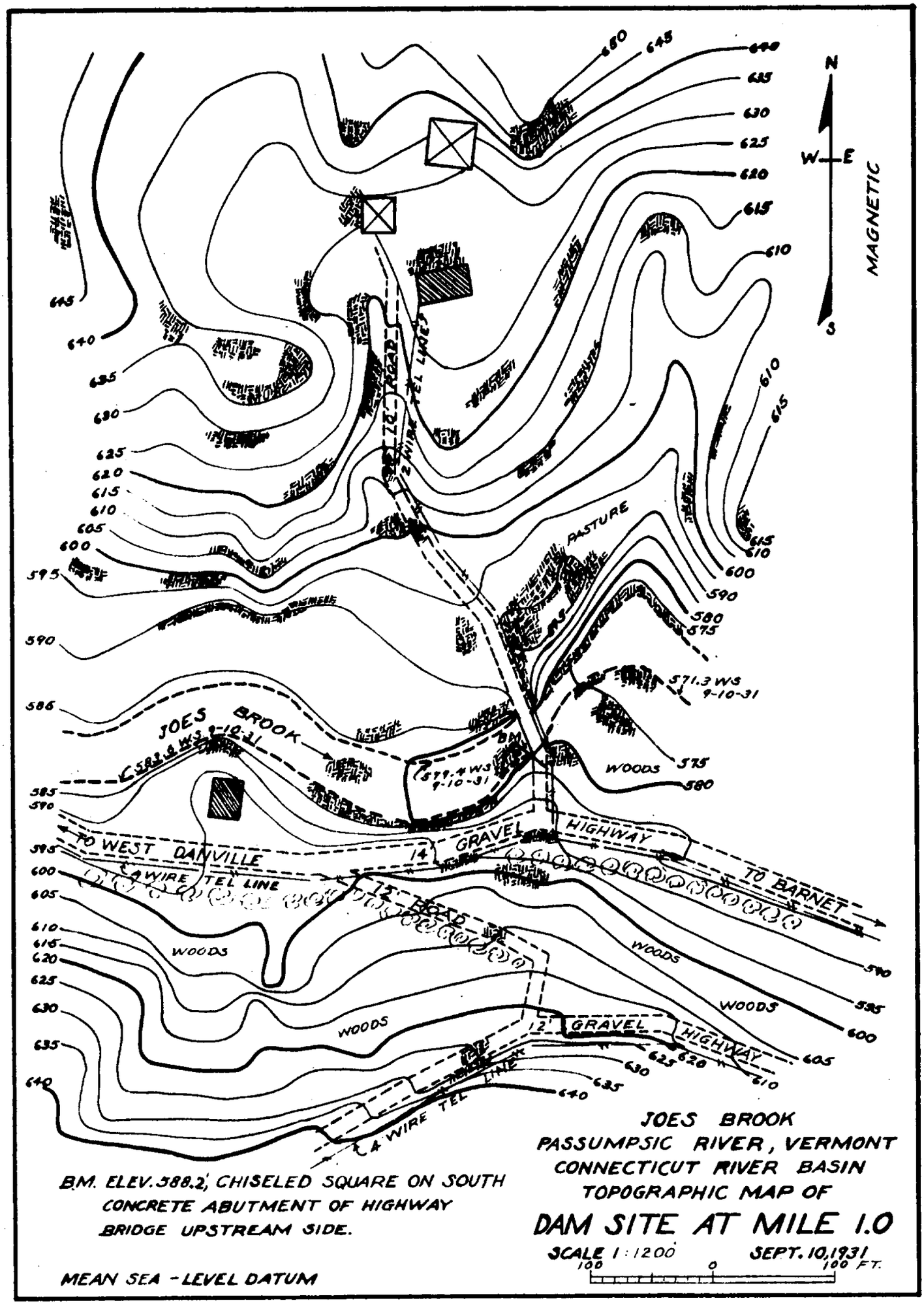
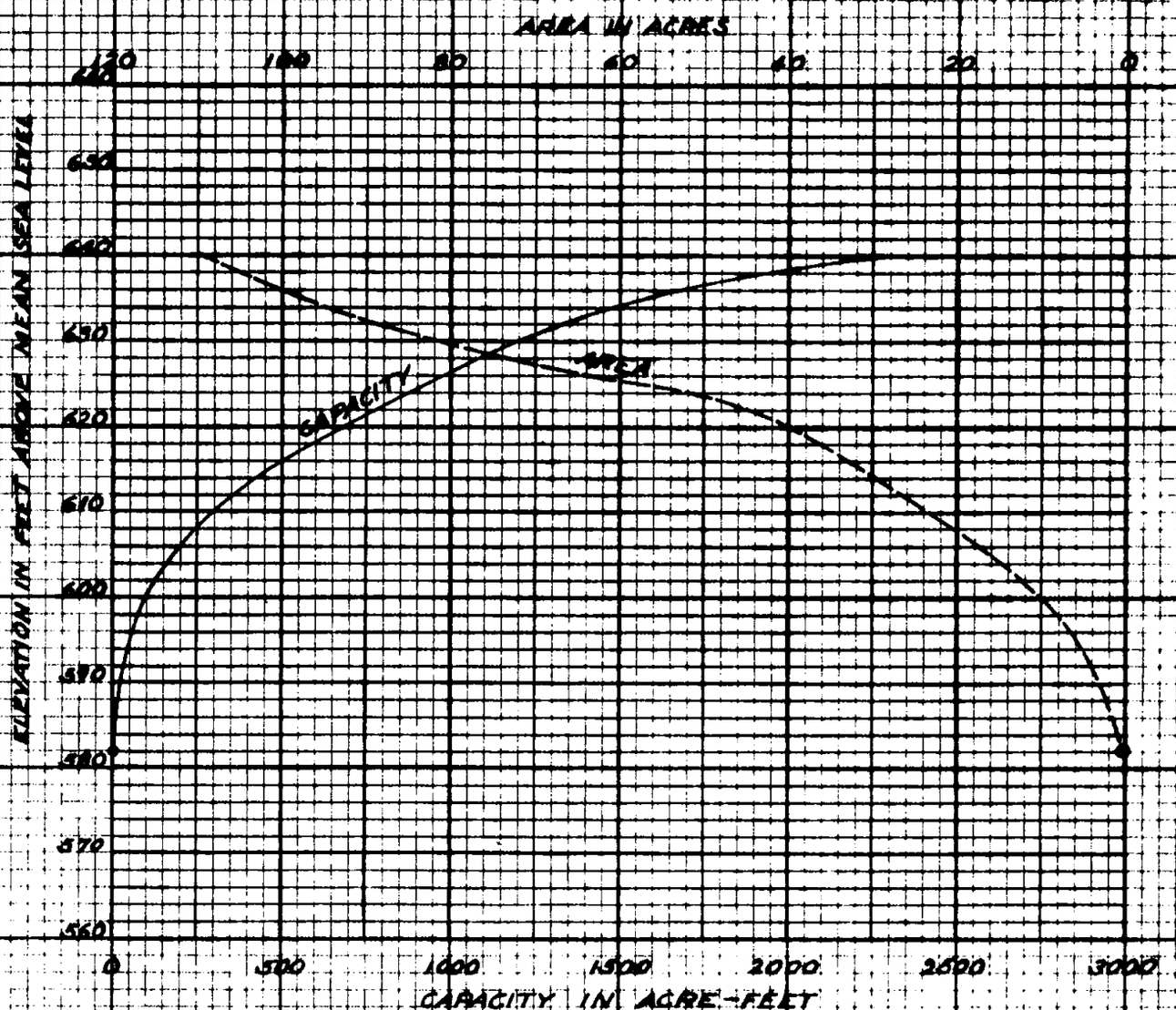

JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
TOPOGRAPHIC MAP OF
DAM SITE AT MILE 1.0
SCALE 1:1200
SEPT. 10, 1931
100 0 100 FT.
B.M. ELEV. 588.2', CHISELED SQUARE ON SOUTH CONCRETE ABUTMENT OF HIGHWAY BRIDGE UPSTREAM SIDE.
MEAN SEA - LEVEL DATUM
N
W E
S
MAGNETIC
JOES BROOK
TO WEST DANVILLE
TO BARNET
14' GRAVEL HIGHWAY
12' ROAD
12' GRAVEL HIGHWAY
4 WIRE TEL LINE
2 WIRE TEL LINE
PASTURE
WOODS
571.3 WS 9-10-31
579.4 WS 9-10-31
583.6 WS 9-10-31
BM

Figure 52



JOE'S BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 1.0
DATA FROM CROSS SECTIONS

Figure 53

The pond at the elevation of the flashboards (607) would cover about 20 acres and extend about seven-tenths mile.

Property damage is estimated as follows: Land, 32 acres; buildings, one set; roads, seven-tenths mile of 14-foot gravel; telephone line, 1 mile; additional water rights; pipe-line right of way, six-tenths mile; total damages, $21,100.

The storage capacity of the pond is negligible and only a nominal draft is proposed for power.

A 4.33-foot diameter wood-stave pipe 2,800 feet long on the right bank of the river would conduct the water to a surge tank and power house located at mile 0.37, just above a concrete highway bridge, where two units would be installed utilizing 114 second-feet of water or 2 second-feet per square mile at an average net head at full load of 94.8 feet, yielding 980 horsepower. The average net head at three-quarters load is estimated at 97.8 feet. The yearly output is estimated at 4,460,000 kilowatt-hours, of which 7 per cent is primary power.

The total cost is estimated at $217,000. Cost per horsepower, $221. Cost of power production, per kilowatt-hour, 7.9 mills.

The cost of a development based on a dam with spillway elevation of 630 and flashboard elevation of 640, giving 120.5-foot average net head at full load and yielding 1,250 horsepower, was estimated to be $471,000. Cost per horsepower, $377. Cost of power production, per kilowatt-hour, 10.9 mills. The yearly output on this basis would be 5,808,000 kilowatt-hours of which 22 per cent is primary power.

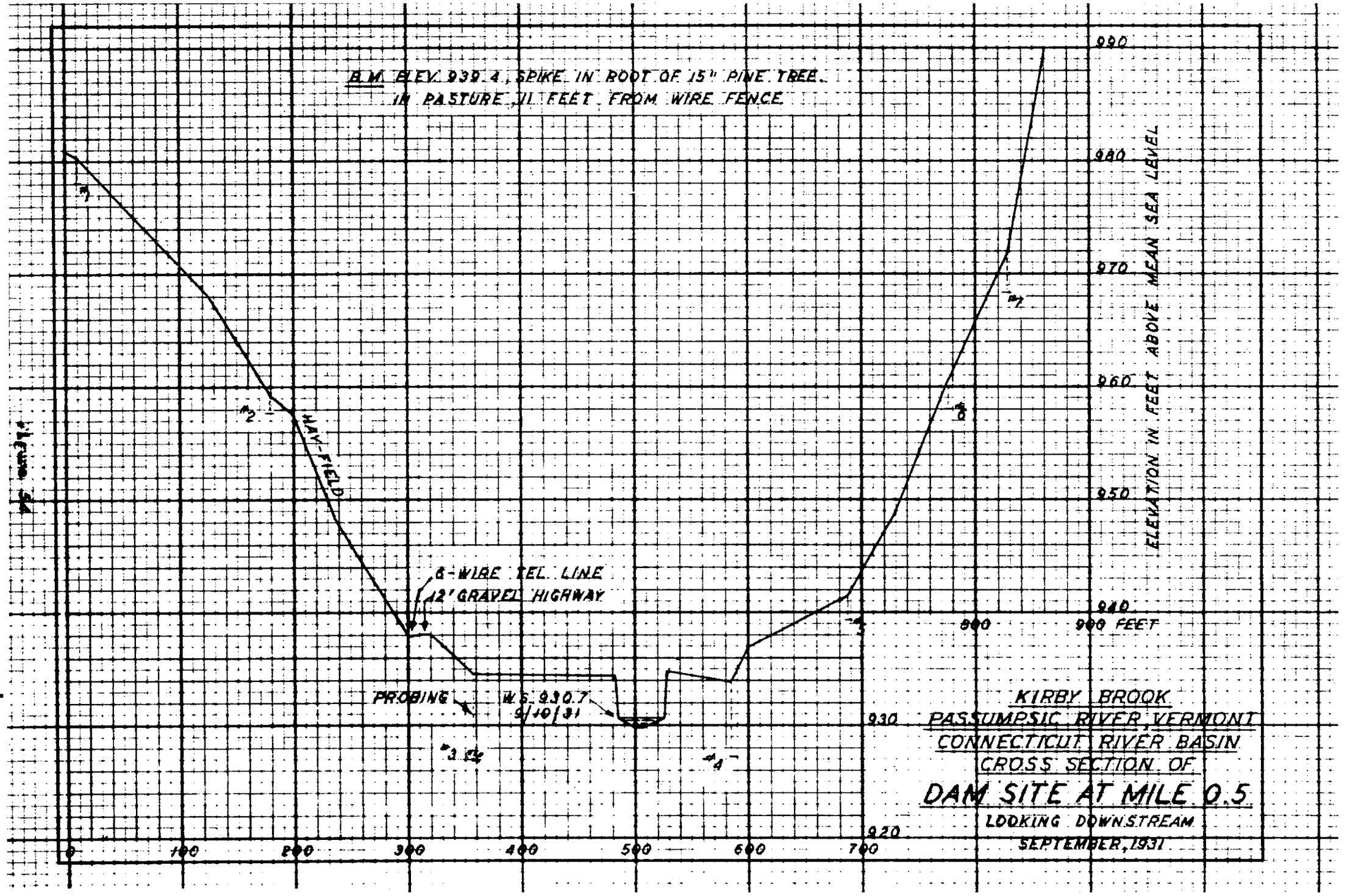
The details of cost are as follows:

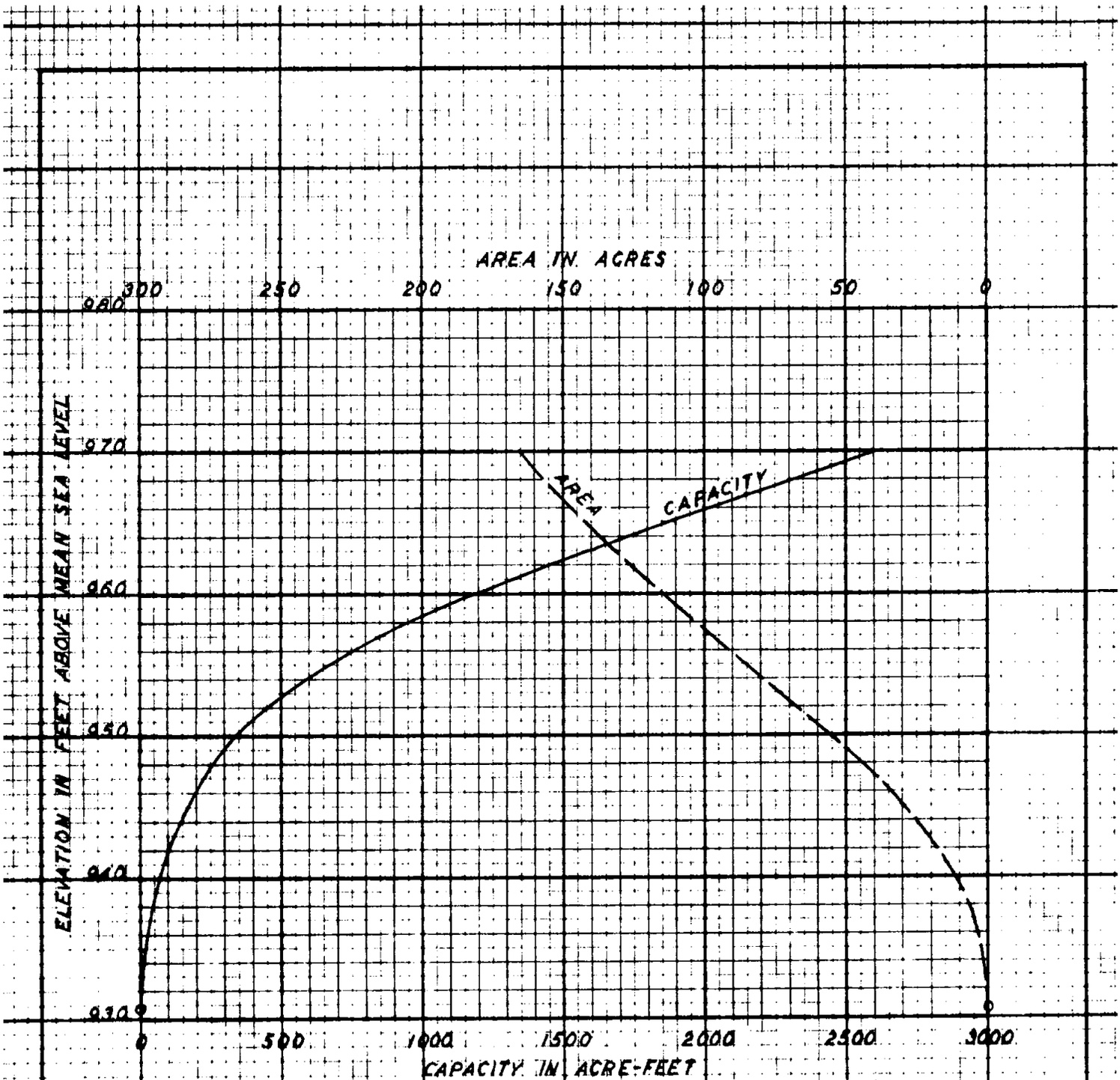
Unwatering,	$ 7,000
Dam,	39,800
Pipe line,	23,600
Surge tank,	5,100
Penstock,	10,100
Power-house structure,	5,100
Power-house equipment, hydraulic and electrical apparatus,	36,300
Tailrace,	200
Total "A",	127,200
General expenses:	
Relocation of road and telephone line,	15,700
Transportation,	600
Plant, camp, and general construction,	19,100
Total "B",	162,600
Engineering, contingencies, interest, taxes, and insurance,	37,400
Total "C",	200,000
Property, water rights, and pipe-line right of way,	5,400
Total cost, without transformer station,	205,400
Outdoor transformer station,	11,900
Grand total cost,	217,300
Grand total cost in round figures	217,000

88. Miscellaneous dam sites.- Figures 54 to 63 inclusive are maps of various dam sites or cross sections at same, and area-capacity curves of reservoirs at these sites. Estimates have not been made of the cost of developments at these locations as other methods of utilizing the head appeared more feasible.

89. Probings at dam sites.- Probings by means of an earth auger were made at practically all the dam sites. Owing to the natural limitations of this method and the presence of boulders at various sites, the results are not conclusive but form the basis for two assumptions made regarding the location of suitable foundation for the dams. The results of the probings are shown in Tables 11 and 12.

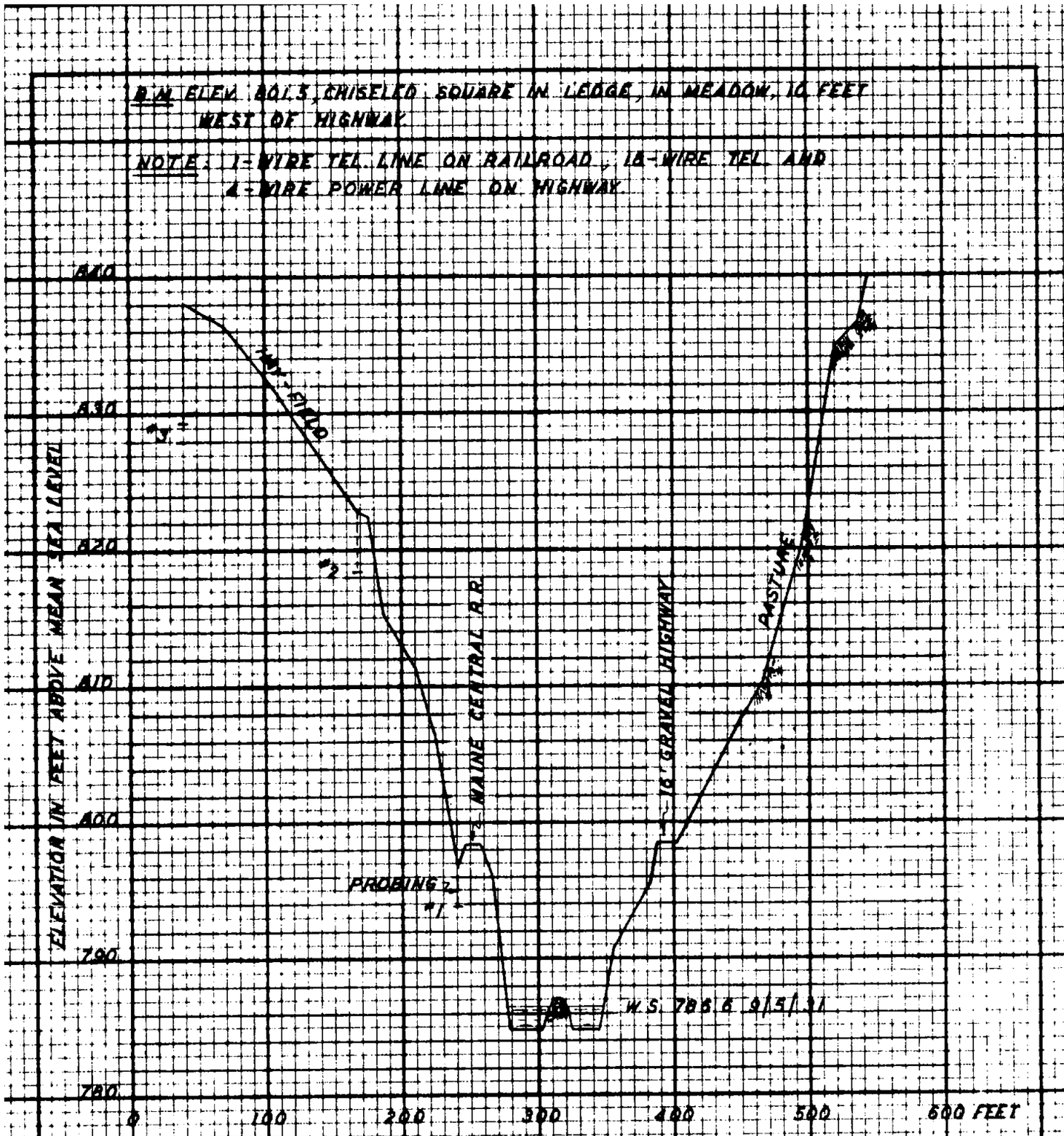
(See following pages for Tables 11 and 12)


B.M. ELEV. 939.4, SPIKE IN ROOT OF 15" PINE TREE.
IN PASTURE, 11 FEET FROM WIRE FENCE
HAY-FIELD
6-WIRE TEL. LINE
12' GRAVEL HIGHWAY
PROBING
W.S. 930.7
9/10/31
#1
#2
#3
#4
#5
#6
#7
990
980
970
960
950
940
930
920
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
0
100
200
300
400
500
600
700
800
900 FEET
KIRBY BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
DAM SITE AT MILE 0.5
LOOKING DOWNSTREAM
SEPTEMBER, 1931



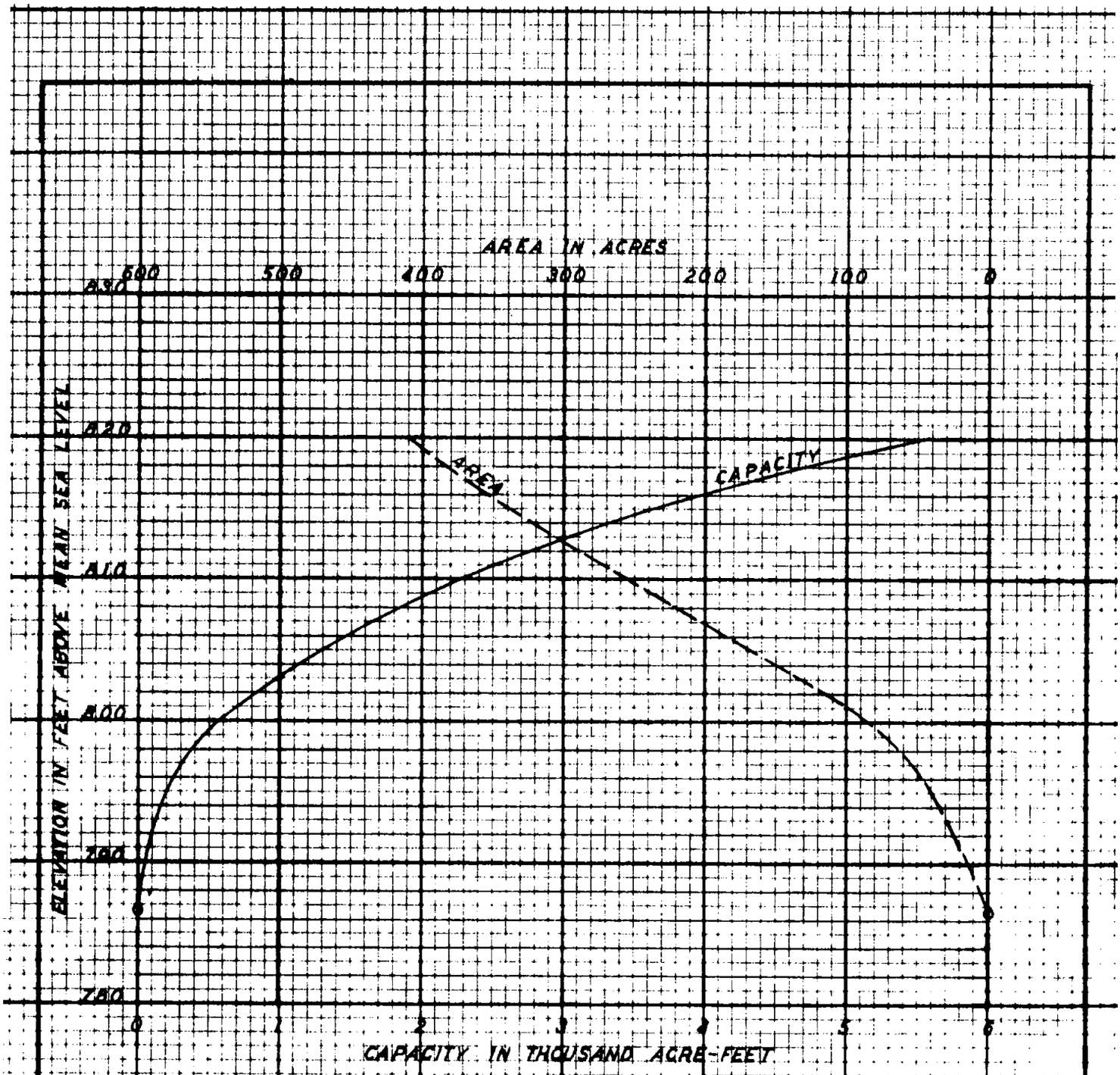
KIRBY BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 0.5
DATA FROM U.S. GEOLOGICAL SURVEY MAPS

Figure 55



MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
DAM SITE AT MILE 5.0
LOOKING DOWNSTREAM
SEPTEMBER, 1931

Figure 56



MOOSE RIVER
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 5.0
DATA FROM U.S. GEOLOGICAL SURVEY MAPS

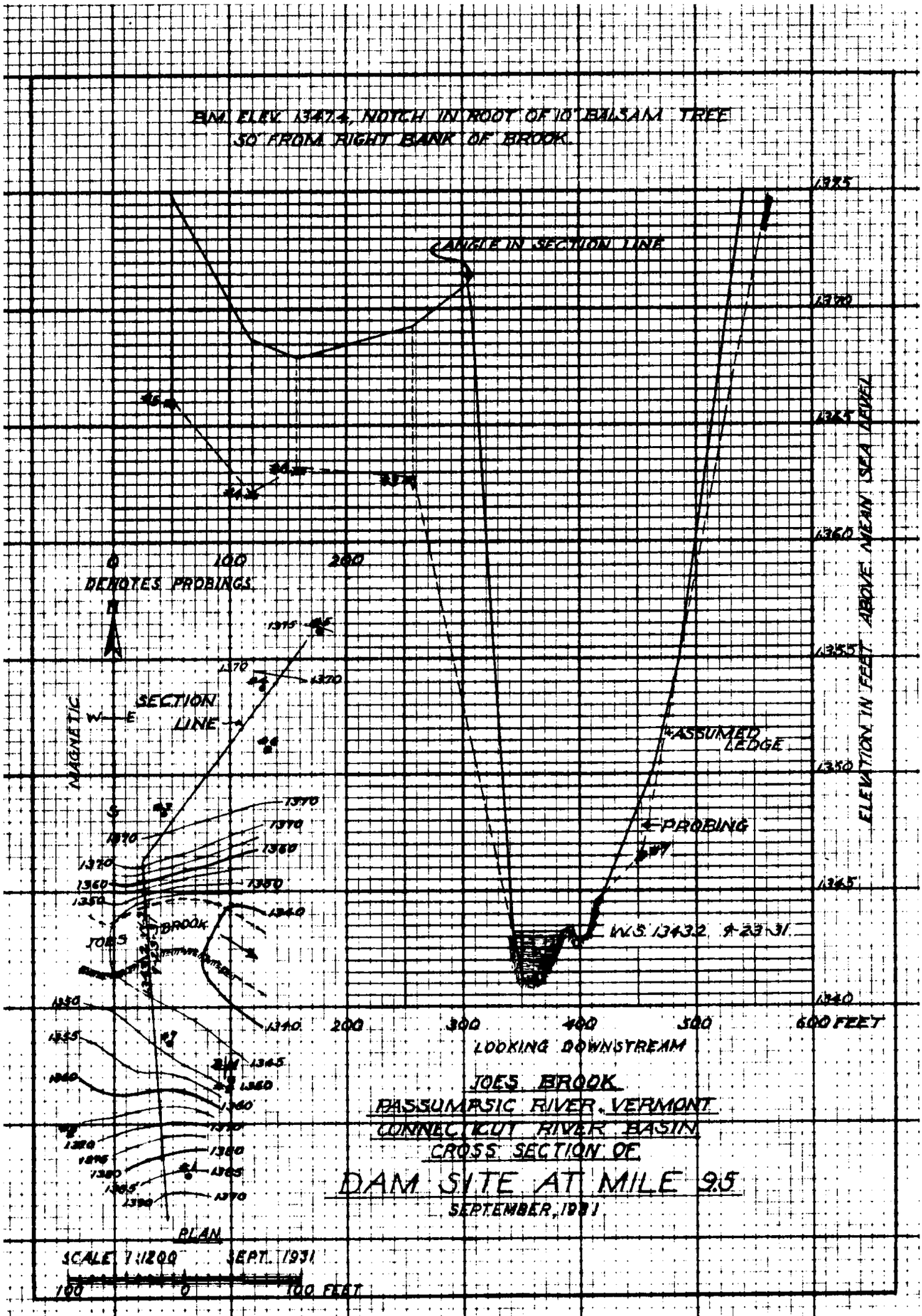
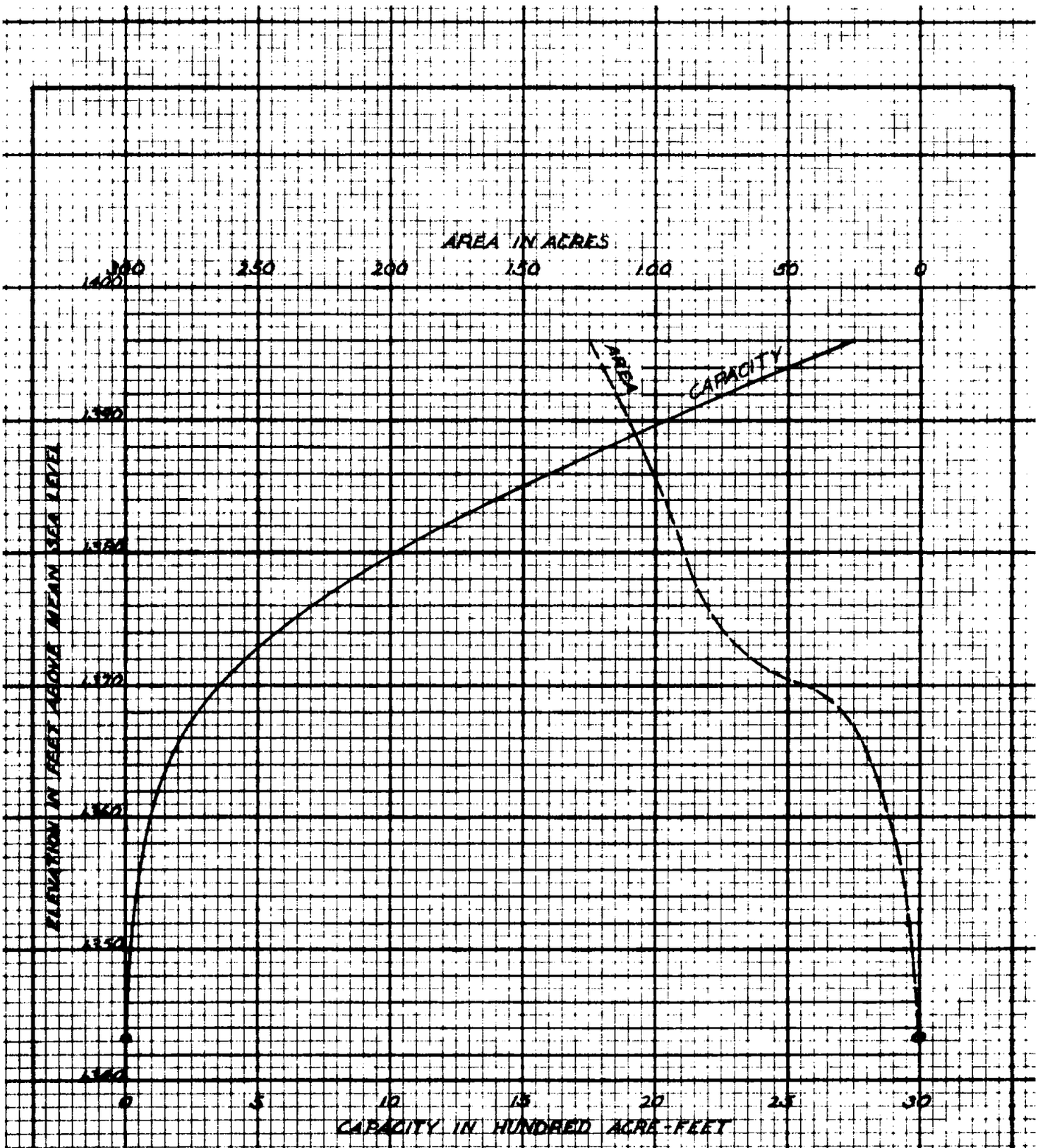

BM. ELEV. 1347.4, NOTCH IN ROOT OF 10" BALSAM TREE
50' FROM RIGHT BANK OF BROOK.
ANGLE IN SECTION LINE
DENOTES PROBINGS
SECTION LINE
MAGNETIC
ASSUMED LEDGE
PROBING
W.S. 1343.2 9-23-31
JOES BROOK
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
LOOKING DOWNSTREAM
600 FEET
JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
DAM SITE AT MILE 9.5
SEPTEMBER, 1931
PLAN
SCALE 1:1200 SEPT. 1931
100 FEET

Figure 58



JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 9.5
DATA FROM SURVEY BY A PRIVATE COMPANY

Figure 5.9

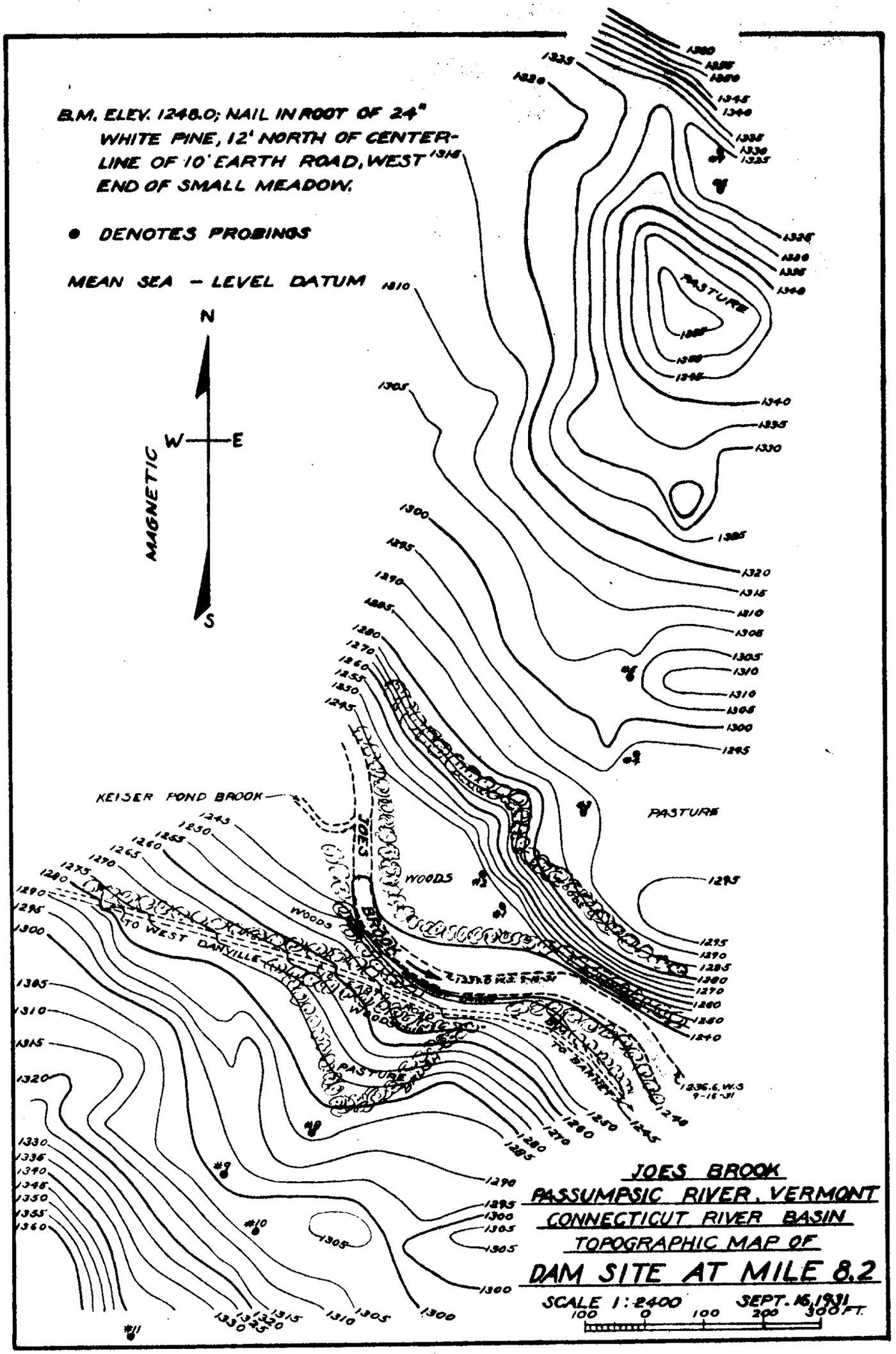
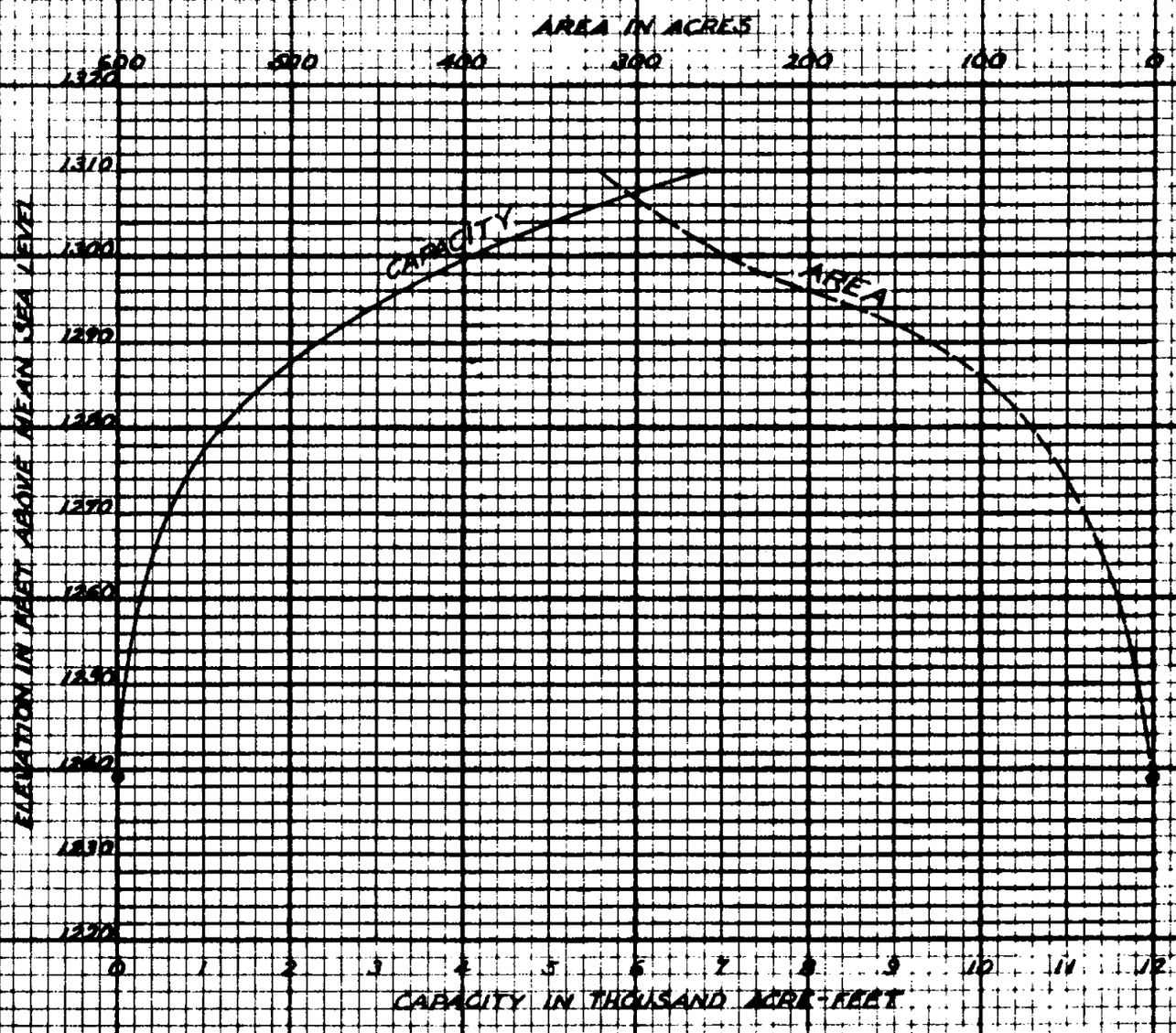

B.M. ELEV. 1248.0; NAIL IN ROOT OF 24" WHITE PINE, 12' NORTH OF CENTER-LINE OF 10' EARTH ROAD, WEST END OF SMALL MEADOW.
● DENOTES PROBINGS
MEAN SEA - LEVEL DATUM
N
W
E
S
MAGNETIC
PASTURE
KEISER POND BROOK
JOES BROOK
WOODS
TO WEST DANVILLE
TO DANVILLE
1236.6 W.S. 9-15-31
JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
TOPOGRAPHIC MAP OF
DAM SITE AT MILE 8.2
SCALE 1:2400
SEPT. 16, 1931
100 0 100 200 300 FT.

Figure 60



JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 8.2
DATA FROM CROSS SECTION BY U.S. ENGINEER AND
SURVEY BY A PRIVATE COMPANY

Figure 61

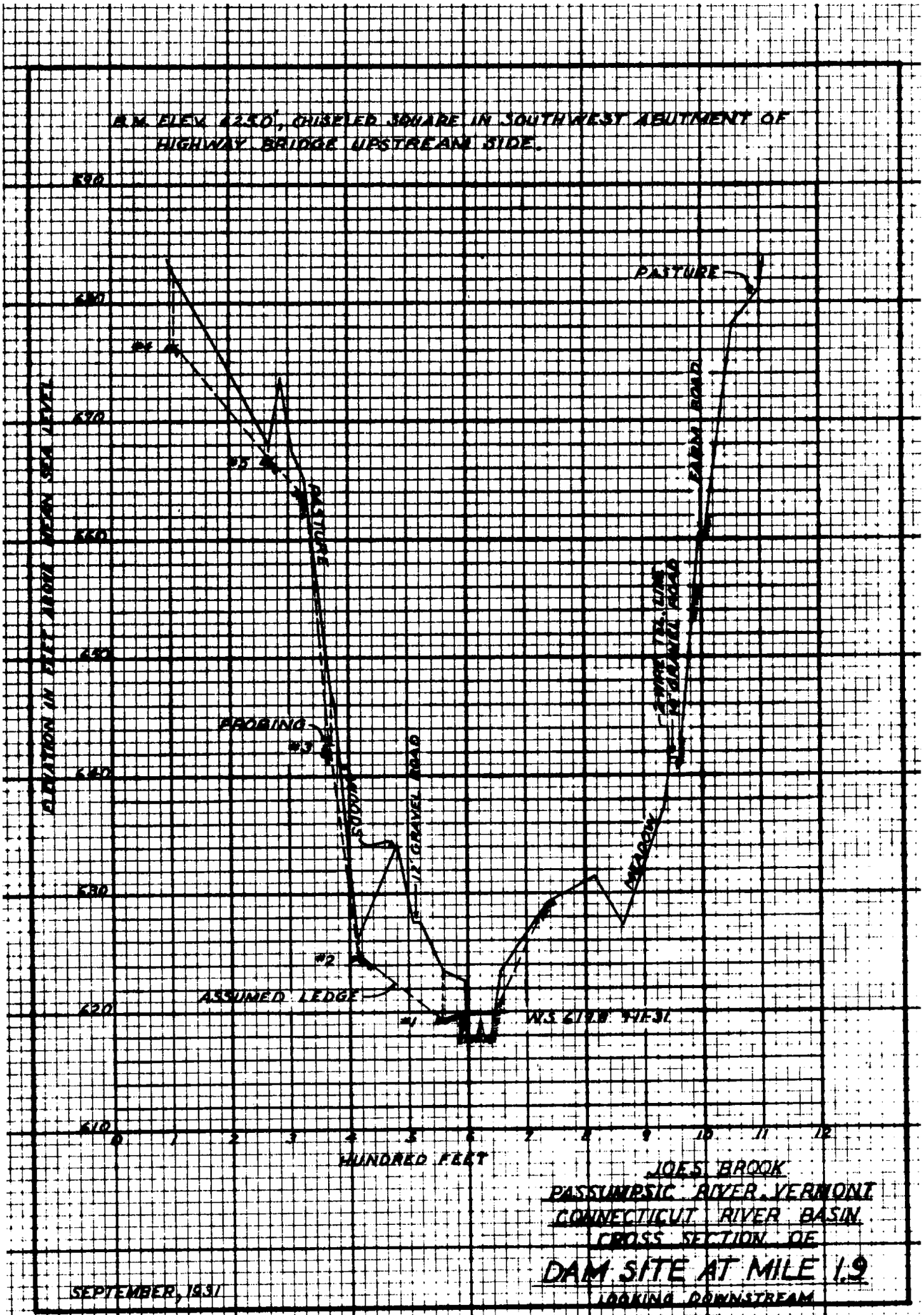
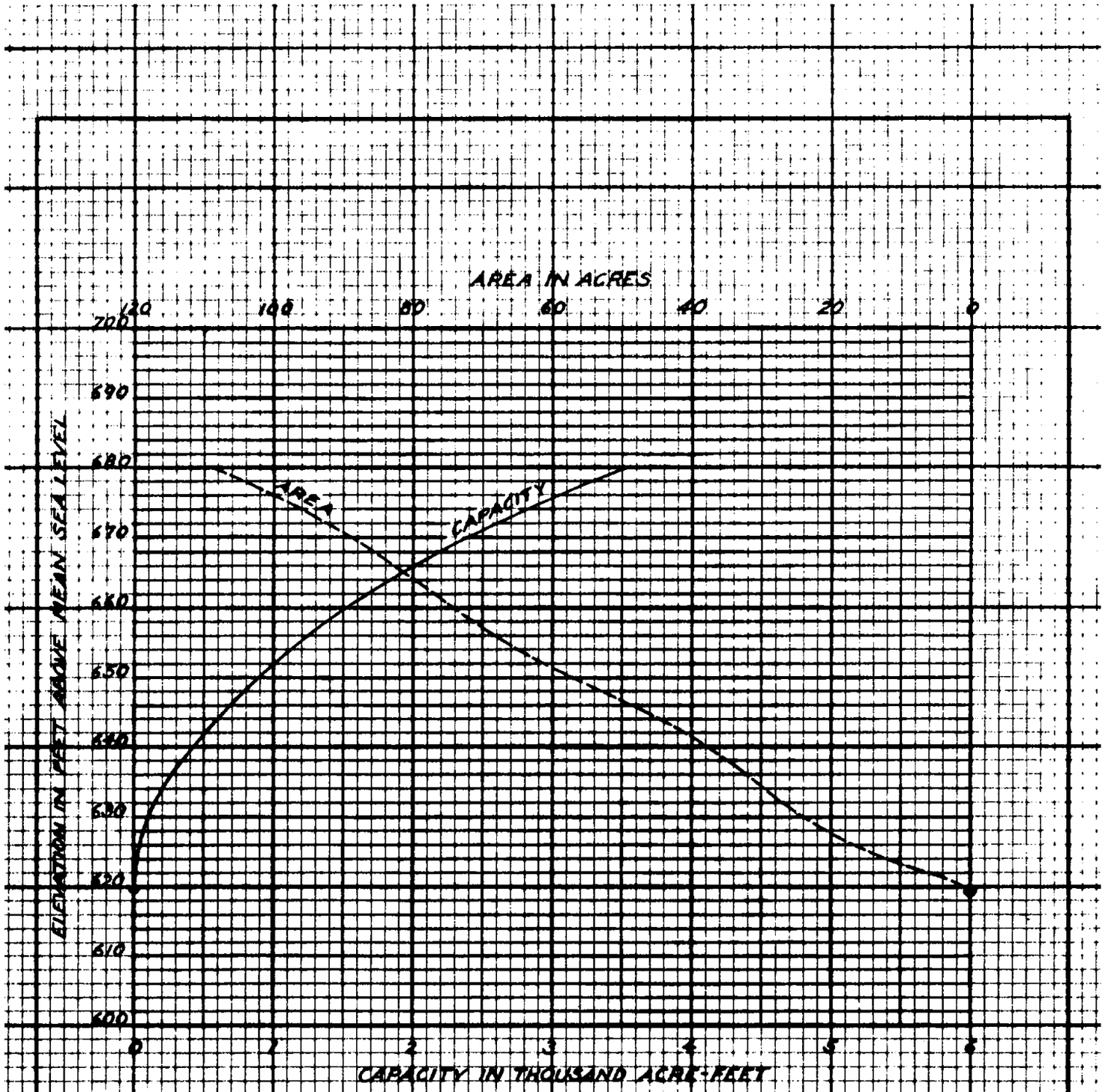

B.M. ELEV. 625.0', CHISELED SQUARE IN SOUTHWEST ABUTMENT OF HIGHWAY BRIDGE UPSTREAM SIDE.
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
690
680
670
660
650
640
630
620
610
0
1
2
3
4
5
6
7
8
9
10
11
12
HUNDRED FEET
PASTURE
#4
#5
PASTURE
PROBING
#3
WOODS
12' GRAVEL ROAD
#2
ASSUMED LEDGE
#1
W.S. 619.8 9-11-31
MEADOW
FARM ROAD
JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
CROSS SECTION OF
DAM SITE AT MILE 1.9
LOOKING DOWNSTREAM
SEPTEMBER, 1931

Figure 52



JOES BROOK
PASSUMPSIC RIVER, VERMONT
CONNECTICUT RIVER BASIN
AREA AND CAPACITY CURVES FOR
DAM SITE AT MILE 1.9
DATA FROM CROSS SECTIONS

Figure 63

TABLE 11.- PROBINGS AT DAM SITES ON PASSUMPSIC RIVER, VERMONT

Location	Probing Number	Surface Elevation	Depth in feet	Material	Bottom
Center Pond (on Center Pond Brook)	1	*1323.6	7.1	Sand	Bowlders
	2	*1324.4	4.5	Loam and sand	do.
	3	*1311.3	6.6	Wet sand and gravel	do.
	4	*1303.4	7.0	Sand, clay and gravel	Ledge
	5	*1309.3	6.3	Muck and wet sand	do.
	6	*1311.7	4.5	do.	do.
	7	*1327.4	10.9	Muck, wet sand and gravel	do.
Mile 2.0 (on East Branch)	1	1052.2	4.5	Wet loam and muck	Ledge
	2	1052.6	5.8	do.	do.
	3	1051.2	4.5	do.	do.
	4	1049.8	4.5	do.	do.
	5	1107.4	8.0	Sand	Caving sand
	6	1137.4	2.8	Wet sand	Rock
	7	1137.6	2.8	do.	Ledge
	8	1052.1	7.0	do.	do.
	9	1052.6	2.0	Sand	Bowlders
	10	1076.4	2.0	do.	Ledge
	11	1066.7	7.0	Muck and wet sand	do.
	12	1067.1	6.5	do.	do.
	13	1090.8	2.7	Muck and sand	do.
	14	1142.3	2.5	do.	do.
	15	1127.0	2.5	Wet muck	do.
Mile 32.3	1	964.4	5.1	Wet sand	Ledge
	2	960.3	4.5	do.	do.
	3	974.9	2.8	do.	do.
	4	1049.3	3.1	do.	do.
	5	1046.0	7.6	do.	do.
	6	1037.0	4.8	do.	do.
	7	1008.5	2.5	Sand	Bowlders
	8	1011.7	2.0	do.	do.
	9	1036.2	2.5	do.	do.
	10	1000.4	3.0	do.	do.
	11	980.2	1.5	Sand and gravel	do.
	12	971.0	1.4	Sand	do.
	13	964.3	2.0	do.	do.
	14	964.9	3.5	Hard sandy loam	do.

* Approximate mean sea-level datum.

TABLE 11. - PROBINGS AT DAM SITES ON PASSUMPSIC RIVER, VERMONT.-Continued.

Location	Probing Number	Surface Elevation	Depth in feet	Material	Bottom
Mile 27.1	1	875.0	4.7	Sand and gravel	Hard sand
	2	860.2	6.7	do.	Bowlders
	3	854.7	2.0	Sandy loam	do.
	4	819.2	5.7	Mud and loam	Ledge
	5	811.4	2.0	Mud and gravel	Gravel
	6	813.5	2.0	do.	Ledge
	7	818.8	5.5	Sandy loam	Rock
	8	814.9	3.0	Mud	Ledge
	9	814.1	6.0	do.	do.
	10	818.9	4.0	Wet sandy loam	do.
	11	820.0	4.7	Sandy loam	Rock
	12	877.2	3.0	Loam and gravel	Bowlders
	13	868.2	3.5	Sandy loam	do.
	14	877.7	2.0	do.	Hard packed sand
Mile 23.95	1	733.3	6.7	Loam and wet coarse sand	Ledge
	2	735.4	8.1	Sand loam and wet gravel	do.
	3	732.5	3.0	Loam and sand	Rock
	4	744.2	3.5	Wet sand	Bowlders
	5	730.2	2.0	Gravel	Caving sand
	6	789.3	1.5	do.	Ledge
	7	812.2	6.8	Loam and sand	do.
	8	827.9	4.2	Sand and gravel	Rock
	9	838.1	5.7	Sand	Ledge
	10	853.5	4.7	Coarse sand	Gravel
	11	860.7	3.5	Sand	Hard packed sand
	12	855.3	6.0	do.	Ledge
	13	823.8	18.5	Sand and clay	Caving sand
	14	791.4	8.5	Wet sand	Bowlders
	15	766.9	5.0	Sand	Ledge
	16	735.1	9.7	Wet sand	Coarse caving sand
	17	742.1	4.5	Loam and sand	Bowlder
	18	739.4	7.0	Clay	Hard clay
	19	753.8	6.5	Sand	Caving sand
	20	731.7	12.3	Wet sand	Wet coarse sand
	21	739.3	3.5	Sand	Coarse caving sand
	22	735.4	6.7	Wet sand	Rock
	23	873.2	5.5	Coarse sand	Coarse caving sand
	24	875.1	5.0	Hard sand	Caving sand and gravel

TABLE 11. - PROBINGS AT DAM SITES ON PASSUMPSIC RIVER, VERMONT.-Continued.

Location	Probing Number	Surface Elevation	Depth in feet	Material	Bottom
Mile 23.95 (Cont'd)	25	840.8	3.5	Fine sand	Fine caving sand
	26	849.8	3.5	Sandy loam	Hard packed sand
	27	839.2	5.0	Sand	Gravel
	28	788.3	15.5	Sand and clay	Hard clay
	29	788.5	2.5	Sandy loam	Hard loam
	30	804.7	6.3	Sand	Caving sand
Clark Pond (on West Branch)	1	**1495.7	2.5	Coarse sand	Ledge
	2	**1509.4	2.0	Sandy loam	Bowlders
	3	**1521.7	3.5	do.	Bowlder
	4	**1495.0	6.0	Mud	Bowlders
	5	**1496.6	4.0	Wet sand and gravel	do.
	6	**1522.3	6.2	Sand	do.
	7	**1522.5	3.5	Sandy loam	Bowlders
	8	**1505.5	4.2	Wet sand	Rock
	9	**1505.4	2.2	Loam and wet sand	Bowlders
	10	**1499.1	1.7	Loam	do.
	11	**1500.1	4.3	Wet loam	do.
	12	**1510.2	2.0	Loam	Rock
	13	**1512.1	2.3	do.	Bowlders
	14	**1516.9	2.7	Loam and sand	do.
	15	**1520.7	2.8	Loam	do.
Clark Pond dike site (on West Branch)	1	**1528.0	7.3	Loam and damp sand	Bowlders
	2	**1505.3	10.1	Wet sand and gravel	Ledge
	3	**1507.3	11.0	Loam, wet sand, and gravel	do.
	4	**1509.7	8.4	Wet sand and gravel	do.
Lyndon Center (on Millers Run)	1	693.0	16.5	Muck and sand	Clay
	2	698.6	22.5	Wet sand	Sand
	3	722.6	6.0	Sand	Caving sand
	4	726.1	8.0	do.	do.
	5	735.1	3.0	do.	Hard sand.
	6	760.5	6.5	do.	Caving sand
	7	791.6	6.0	do.	do.
Victory (on Moose River)	No probings by U. S. Engineers.				

** Assumed elevation.

TABLE 11.- PROBINGS AT DAM SITES ON PASSUMPSIC RIVER, VERMONT.-Continued.

Location	Probing Number	Surface Elevation	Depth in feet	Material	Bottom
Mile 11.8 (on Moose River)	1	970.2	21.0	Wet sand	Ledge
	2	972.2	6.0	Muck and clay	Bowlders
	3	988.9	2.0	Mud	do.
	4	1019.4	4.5	Wet loam and sand	do.
	5	972.8	4.3	Wet sand	Ledge
	6	987.8	1.5	Wet loam	do.
Mile 0.5 (on Kirby Brook)	1	980.3	2.3	Sandy loam	Bowlders
	2	959.3	1.5	do.	do.
	3	934.5	6.8	Wet sand	Ledge
	4	933.9	6.8	Loam	Bowlders
	5	941.5	2.3	do.	do.
	6	960.7	2.7	do.	do.
	7	971.9	3.5	Loam and sand	Bowlder
	8	1005.2	3.0	Sandy loam	Bowlders
Mile 5.0 (on Moose River)	1	796.4	2.7	Wet sandy clay and stones	Rock
	2	823.0	4.5	Loam	Bowlders
	3	838.0	8.7	Sandy loam and gravel	Gravel
	4	795.1	6.3	Sand and wet sand	Ledge
	5	801.1	8.0	do.	Something hard
	6	795.0	6.5	Mud and wet sand	Ledge
	7	805.1	10.7	Mud and soft clay	do.
St. Johnsbury (on Moose River)	1	611.3	3.3	Loam	Ledge
	2	612.3	1.5	do.	Bowlders
	3	615.6	1.5	do.	do.
	4	615.9	1.5	Filled in material	do.
Goss Hollow (on Burrough Brook)	1	937.4	5.4	Loam and sand	Ledge
	2	936.8	9.2	Wet sand	Gravel
	3	972.6	1.0	Loam	Ledge
	4	967.3	4.7	Sandy loam	do.
	5	967.3	3.5	Loam	do.
	6	948.9	3.8	do.	do.
	7	905.6	2.2	Loam and gravel	Rotten ledge
	8	913.1	4.7	Sand	Ledge
	9	917.5	7.3	Wet sand and gravel	do.
	10	944.1	9.5	Loam and wet sand	Gravel
	11	957.6	11.5	do.	do.

TABLE 11. - PROBINGS AT DAM SITES ON PASSUMPSIC RIVER, VERMONT.-Continued.

Location	Probing Number	Surface Elevation	Depth in feet	Material	Bottom
Fish Hatchery (on Sleepers River)	1	654.1	3.0	Clay	Ledge
	2	671.1	14.3	Hard sticky clay	do.
	3	664.9	6.0	Sand	Caving sand and gravel
	4	688.4	4.7	Sand and gravel	Coarse sand
	5	721.0	4.7	Sandy loam	Gravel
	6	718.7	3.5	do.	do.
	7	692.6	6.0	Sand	do.
	8	715.0	9.8	Hard sticky clay	Ledge
	9	669.9	14.7	Clayish loam, sand, and clay	do.
	10	857.8	25.5	Clay	Clay
	11	655.4	8.3	Clayish loam, wet sand, gravel, and clay	do.
Waterandrick Brook (on Waterandrick Brook)	No probings.				

TABLE 12. - PROBINGS AT DAM SITES ON JOES BROOK, VERMONT (Continued)
PASSUMPSIC RIVER BASIN

Location	Probing Number	Surface Elevation	Depth in feet	Material	Bottom
Mile 6.9	1	1249.8	6.5	Loam and sand	Ledge
	2	1246.9	5.0	do.	do.
	3	1257.6	4.0	do.	do.
	4	1259.0	5.5	do.	do.
	5	1259.9	3.6	do.	do.
	6	1311.1	4.0	Sand	do.
	7	1311.1	4.0	do.	do.
	8	1219.2	2.0	Muck	do.
	9	1267.3	4.0	Sand	do.
	10	1289.2	4.5	do.	do.
	11	1306.1	2.8	do.	do.
	12	1323.0	2.0	do.	do.
	13	1343.1	3.1	do.	do.
	14	1242.1	5.5	Wet sand and clay	do.
	15	1285.2	4.0	Sand	do.
	16	1317.2	4.3	do.	do.
	17	1325.6	4.5	do.	do.
	18	1330.1	3.4	do.	Bowlders
South Danville	1	1228.6	5.0	Sand	Ledge
	2	1175.7	3.9	Wet sand	do.
	3	1135.6	4.6	Wet sand and gravel	do.
	4	1153.8	5.7	Wet sand and gravel	do.
	5	1171.7	5.9	Wet sand and bowlders	do.
	6	1183.0	7.4	do.	do.
	7	1237.2	7.0	Sand and gravel	Rock
Mile 3.75	1	855.3	2.3	Sand and gravel	Ledge
	2	800.0	7.2	Sand	Gravel
	3	779.4	8.2	Wet sand and gravel	Ledge
	4	766.4	2.9	do.	do.
	5	770.5	4.9	Sandy clay	do.
	6	775.1	6.5	Muck and bowlders	do.
	7	797.7	7.0	Wet sand and bowlders	do.
	8	815.7	8.2	do.	do.
Mile 1.9	1	623.6	4.1	Wet sand	Ledge
	2	621.3	1.6	do.	do.
	3	647.0	4.3	do.	do.
	4	681.5	5.9	Clay	do.
	5	668.2	1.2	Sand	do.
Mile 1.0	No probings				

DETAILED ESTIMATES OF COST OF

POTENTIAL POWER AND STORAGE DEVELOPMENTS

ON PASSUMPSIC RIVER, VT.

CONNECTICUT RIVER BASIN

CONNECTICUT RIVER REPORT

UNDER HO. DOC. 308/69/1

CENTER POND RESERVOIR

Center Pond Brook (Passumpsic River basin) Vermont
(serial number 1)

Length of earth section, ...	345 feet
Length of concrete retaining section, . .	60 feet
Length of gate section, ...	5 feet
Length of spillway section, ...	150 feet
Total length of dam, ...	560 feet

Dam:

Earth section:					
Water cut-off,					
Steel sheet piling, . . .	55	tons at	$[illegible].45	$3,710	
Earth fill, ...	442	c.y. at	1.00	442	
Riprap, ...	360	do.	3.00	1,080	
Abutments,					
Excavation,					
Earth, ...	113	c.y. at	1.00	113	
Rock, ...	4	do.	3.50	14	
Concrete, ...	124	do.	11.25	1,395	$6,754
Concrete retaining section:					
Excavation,					
Earth, ...	160	c.y. at	1.00	160	
Rock, ...	42	do.	3.50	147	
Concrete, ...	60	do.	11.25	675	982
Gate section:					
Excavation,					
Earth, ...	741	c.y. at	1.00	741	
Rock, ...	7	do.	3.50	25	
Concrete, plain, ...	25	do.	11.25	281	
Gates, 2.5-foot diam., ...				360	
Steel pipe, ...	1,560	lbs. at	0.09	140	1,547
Spillway section:					
Excavation,					
Earth, ...	3,820	c.y. at	1.00	3,820	
Rock, ...	205	do.	3.50	717	
Concrete, plain, ...	382	do.	11.25	4,298	8,835
Total "A", ...					18,118

General expenses:

Clearing reservoir, ...	35 acres at 40.00	1,400	
Transportation in lieu of R. R. siding,		2,211	
Plant, ...	10 per cent of "A"	1,812	
Camp, ...	1 per cent of "A"	181	
General construction, ...	4 per cent of "A"	725	6,329
Total "B", ...			24,447

Engineering, superintendence and contingencies, ...	15 per cent of "B"	$3,567	
Interest, during construction, ...	6 per cent of "B"	1,427	
Taxes, during construction, ...	1 per cent f "B"	245	
Insurance, during construction, ...	1 per cent of "B"	245	$5,624
Total "C", ...			30,071
Property and water rights:			
Additional water rights, ...			2,000
Total cost, ...			32,071
		say,	32,000

Summary.

Total flood storage to maximum high water, ... 1,150 acre-feet

Cost per acre-foot, ...$27.80

Controlled power storage, ... 850 acre-feet

Cost per acre-foot, ...$38.60

MIL 2.0 DEVELOPMENT
East Branch (Passumpsic River basin) Vermont
(serial number 2)

Length of earth section, ...	1,344 feet
Length of concrete retaining section, . . .	80 feet
Length of spillway section, ...	61 feet
Total length of dam, ...	1,485 feet

Unwatering and stream control:					$650
Dam:					
Earth section:					
Excavation,					
Earth, ...	23,983	c.y. at	$1.00	$23,983	
Rock, ...	734	do.	3.50	2,569	
Water cut-off,					
Concrete core wall, . .	734	do.	11.25	8,258	
Earth fill, ...	335,777	do.	1.00	335,777	
Riprap, ...	6,545	do.	3.00	19,635	
Abutments,					
Excavation,					
Earth, ...	52	c.y. at	1.00	52	
Rock, ...	6	do.	3.50	21	
Concrete, ...	400	do.	11.25	4,500	394,795
Concrete retaining section:					
Excavation,					
Earth, ...	121	c.y. at	1.00	121	
Rock, ...	76	do.	3.50	266	
Concrete, ...	200	do.	11.25	2,250	2,637
Spillway section:					
Excavation,					
Earth, ...	194	c.y. at	1.00	194	
Rock, ...	113	do.	3.50	396	
Concrete, plain, ...	292	do.	11.25	3,285	3,875
Diversion conduit, control tower:					
Diversion conduit:					
Excavation,					
Earth, ...	1,099	c.y. at	1.00	1,099	
Concrete,					
Conduit, 19.6 sq. ft. area, . . .	381	lin. ft. at	34.95	13,316	
Concrete, in portals, .	20	c.y. at	11.25	225	
Racks, ...	20	sq. ft. at	0.50	10	
Riprap, ...	22	c.y. at	3.00	66	
Stop-logs, ...	320	feet b.m. at	0.10	32	14,739

Diversion conduit, control tower: (Cont'd)

Control tower:

Excavation,				
Earth, ...	75 c.y. at	11.00	825	
Rock, ...	20 do.	3.50	70	
Concrete, plain, ...	47 do.	11.25	529	
light rein-forced, . . .	227 do.	20.00	4,540	
Valve, 5.0-foot diam., ...			4,032	
Bridge, ...	30 lin. ft. at	5.00	150	29,396
Total "A", ...				426,092

General expenses:

Clearing reservoir, . . .	274 acres at	40.00	10,960	
Relocation of roads, bridges, etc:				
Roads, ...	3 miles at	29,000	87,000	
Transportation in lieu of R.R. siding,			8,146	
Plant, ...	10 per cent of "A"		42,609	
Camp, ...	1 per cent of "A"		4,261	
General construction, ...	4 per cent of "A"		17,044	170,020
Total "B", ...				596,112

Engineering, superintendence and contingencies, . . .	15 per cent of "B"		89,417	
Interest, during construction, .	6 per cent of "B"		35,767	
Taxes, during construction, . . .	1 per cent of "B"		5,961	
Insurance, during construction, .	1 per cent of "B"		5,961	137,106
Total "C", ...				733,218

Property and water rights:

Land, ...	462 acres at	10.00	4,620	
Buildings, ...	six sets		8,000	12,620
Total cost, ...				745,838

Power storage, ... 7,392 acre-feet.
Cost per acre-foot, ... 100.90

Flood storage, maximum high-water, ... 10,359 acre-feet.
Cost per acre-foot, ... 72.00

WILL 32.3 DEVELOPMENT
Passumpsic River, Vermont
(serial number 3)

Length of earth section, ...	1,357.5	feet
Length of concrete retaining section, .	70.0	feet
Length of spillway section, ...	162.5	feet
Total length of dam, ...	1,590	feet

Unwatering and stream control:					$900
Dam:					
Earth section:					
Excavation,					
Earth, ...	25,780	c.y. at	$1.00	$25,780	
Rock, ...	670	do.	3.50	2,345	
Water cut-off,					
Concrete, ...	670	c.y. at	11.25	7,538	
Earth fill, ...	432,971	do.	1.00	432,971	
Riprap, ...	5,912	do.	3.00	17,736	
Abutments,					
Excavation,					
Rock, ...	9	c.y. at	3.50	32	
Concrete, ...	1,879	do.	11.25	21,139	
Concrete wall, ...	264	do.	11.75	3,102	510,643
Concrete retaining section:					
Excavation,					
Rock, ...	57	c.y. at	3.50	200	
Concrete, ...	133	do.	11.25	1,497	
Steel, handrail, ...	70	ft. at	1.00	70	1,767
Spillway section:					
Excavation,					
Rock, ...	465	c.y. at	3.50	1,628	
Concrete, plain, ...	2,612	do.	11.25	29,385	
plain, ...	75	do.	11.75	881	
Bridge, ...				813	
Flashboards, ...	150	lin.ft.at	18.00	2,700	
Steel, reinforcing, ...	1,200	lbs. at	0.06	72	
Steel, handrail, ...	163	lin.ft.at	1.00	163	35,642
Diversion and power conduit, control tower:					
Diversion and power tunnels:					
Excavation,					
Earth, ...	2,276	c.y. at	1.00	2,276	
Concrete conduit,					
78.5 sq. ft., ...	158.5	lin.ft.at	72.00	11,268	
188.7 sq. ft., ...	218	do.	101.18	22,067	
Concrete, cradles, ...	44	c.y. at	11.75	517	
Concrete, plain, inportals,	148	do.	11.25	1,665	
Steel pipe, ...	152,1[illegible]	lbs. at	0.09	13,694	
Racks, ...	80	sq. ft. at	0.50	40	
Riprap, ...	31	c.y. at	3.00	93	51,610

Diversion and power conduit, control tower: (Cont'd)

Control tower:					
Excavation,					
Earth, ...	193	c.y. at	$1.00	$193	
Rock, ...	48	do.	3.50	168	
Concrete, plain, ...	175	do.	11.25	1,969	
light reinforced, . . .	434	do.	20.00	8,680	
Vent pipe, ...	75	ft. at	3.50	263	
Drainpipe, ...				159	
Bridge, ...				160	
Valves, one 8-ft. diam., ...				6,496	
Valves, one 5-ft. diam., ...				4,116	$22,204
Pipe line:					
Excavation:					
Earth, ...	11,600	lin. ft. at	1.72	19,952	
Pipe, wood-stave, ...	11,600	do.	12.47	144,652	
Cradles, ...	11,600	do.	1.00	11,600	176,204
Surge tank:					
Excavation,					
Earth, ...	117	c.y. at	1.00	117	
Concrete, ...	32	do.	11.25	360	
Steel, pipe, ...	81,477	lbs. at	0.09	7,333	
Steel, structural, . . .	12,609	lbs. at	0.10	1,261	9,071
Penstock:					
Excavation,					
Earth, ...	440	lin.ft.at	1.72	757	
Pipe,					
Steel, including fittings, . . .	122,600	lbs. at	0.09	11,034	
Cradles, ...	440	lin.ft.at	1.00	440	
Concrete anchorage, ...	24	c.y. at	11.25	270	12,501
Power house:					
Substructure:					
Excavation,					
Earth, ...	97	c.y. at	1.00	97	
Rock, ...	14	do.	3.50	49	
Concrete, plain, ...	91	do.	16.25	1,479	
light reinforced, . . .	16	do.	20.00	320	
Valves, two 3-ft. diam., ...				1,800	
Stop-logs, tailrace, . . .	270	feet b.m.at	0.10	27	
Steel, reinforcing, . .	1,323	lbs. at	0.06	79	
Steel, structural, . . .	2,294	lbs. at	0.10	229	4,080
Superstructure, ...	5,880	cu. ft. at	0.35		2,058

Power house: (Cont'd)			
Equipment:			
Rotor wheels, governors, and draft tubes, two units totaling 1,760 horsepower, ...		$16,100	
Generators and exciters, two units totaling 1,180 kilowatts, ...		12,320	
Switchboards, switches and auxiliary apparatus, 1,180 kilowatts at $10.00, ...		11,800	
Crane, 5-ton, ...		1,250	
Supplies, 1,180 kilowatts at $ 0.50, ...		590	$42,060
Grading:			
Back filling, ...	368 c.y. at $1.00	368	368
Tailrace:			
Excavation:			
Earth, ...	251 c.y. at 1.00	251	251
Total "A", ...			989,359
General expenses:			
Clearing reservoir, ...	69 acres at 40.00	2,760	
Relocation of roads, bridges, etc:			
Roads, ...	3.2 miles at 29,000	92,800	
One highway bridge, steel, 18 by 50 ft., ...		3,487	
Telephone and transmission lines, ...	3.2 miles, ...	896	
Cemeteries, ...	200 graves, ...	3,000	
Transportation in lieu of R. R. siding, ...		24,281	
Plant, ...	10 per cent of "A"	56,936	
Camp, ...	1 per cent of "A"	8,694	
General construction, ...	4 per cent of "A"	34,774	237,548
Total "B", ...			1,126,907
Engineering, superintendence and contingencies, ...	15 per cent of "B"	169,036	
Interest, during construction, . . .	6 per cent of "B"	67,614	
Taxes, during construction, ...	1 per cent of "B"	11,269	
Insurance, during construction, . . .	1 per cent of "B"	11,269	259,188
Total "C", ...			1,386,095
Property and water rights:			
Land, ...	445 acres at $20.00	8,900	
Buildings, ...	22 sets	30,000	
Additional water rights, ...		5,260	
Pipe line right of way, 2.2 miles at 1,000		2,200	46,360
Total cost, without transformer station, ...			1,432,455

Step-up outdoor transformer station:

Structure, ...	$750	
Transformers and switches, ...	12,435	$13,185

Total cost, including transformer station, ... 1,445,640

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 1,560 horsepower.
Output, per year, ... 6,059,000 kilowatt-hours.

Cost of installation,	Including transformer station
Total, ...	$1,445,640
Per installed horsepower, ...	876

Cost of power production,

Fixed charges, 10.5 per cent of total cost, . . .	151,792
Operation, $2.35 per 1,000 kilowatt-hours, . . .	14,192
Total, ...	165,984
Per kilowatt-hour, ...	27.5 mills

Cost of power production, exclusive of cost of storage,

Per kilowatt-hour, ... 9.5 mills

MILE 27.1 DEVELOPMENT
Passumpsic River, Vermont
(serial number 4)

Length of earth section, ...	540	feet
Length of concrete retaining section, . . .	280	feet
Length of intake section, ...	10	feet
Length of gate section, ...	17.5	feet
Length of spillway section, ...	162.5	feet
Total length of dam, ...	1,010	feet

Unwatering and stream control:					$4,850
Dam:					
Earth section:					
Excavation,					
Earth, ...	6,720	c.y. at	$1.00	$6,720	
Rock, ...	242	do.	3.50	847	
Water cut-off,					
Steel sheet piling, . . .	52	tons at	73.13	3,805	
Concrete cut-off, ...	242	c.y. at	11.25	2,722	
Earth fill, ...	150,591	do.	1.00	150,591	
Riprap, ...	2,432	do.	3.00	7,296	
Abutments,					
Excavation,					
Earth, ...	789	c.y. at	1.00	789	
Rock, ...	14	do.	3.50	49	
Concrete, ...	4,014	do.	11.25	45,157	$17,974
Concrete retaining section:					
Excavation,					
Earth, ...	1,978	c.y. at	1.00	1,978	
Rock, ...	551	do.	3.50	1,928	
Concrete, ...	4,373	do.	11.25	49,196	53,032
Intake section:					
Excavation,					
Earth, ...	101	c.y. at	1.00	101	
Rock, ...	35	do.	3.50	123	
Concrete, plain, ...	426	do.	11.25	4,792	
light reinforced,	19	do.	20.00	380	
Gate, 5 by 5 feet, including hoist, ...				2,150	
Racks, ...	100	sq.ft.at	4.00	400	
Vent pipes, ...	46	lin.ft.at	3.50	161	
Stop-logs, ...	300	feet b.m.at	0.10	30	
Steel, pipe, ...	9,100	lbs. at	0.09	819	
Handrail, ...	10	lin.ft.at	1.00	10	8,986

Dam (Cont'd):					
Gate section:					
Excavation,					
Earth, ...	152	c.y. at	$1.00	$152	
Rock, ...	63	do.	3.50	220	
Concrete, plain, ...	575	do.	11.25	9,844	
light reinforced, . . .	8	do.	20.00	160	
Gates, 1 9-foot diameter valve, ...				7,840	
Steel pipe, ...	18,800	lbs. at	0.09	1,116	
Stop-logs, ...	1,200	feet b.m.at	0.10	120	
Racks, ...	70	sq. ft. at	0.50	35	$19,487
Spillway section:					
Excavation,					
Earth, ...	1,503	c.y. at	1.00	1,503	
Rock, ...	770	do.	3.50	2,695	
Concrete, plain, . . .	8,816	do.	11.25	99,180	
plain reinforced,	75	do.	11.75	881	
light reinforced,	41	do.	20.00	820	
Flashboards, ...	150	lin.ft.at	18.00	2,700	
Steel, reinforcing, .	1,200	lbs. at	0.06	72	
Hand rail, ...	163	lin. ft. at	1.00	163	108,014
Pipe line:					
Excavation:					
Earth, ...	1,000	lin. ft. at	1.72	1,720	
Pipe, wood stave, ...	1,000	do.	9.54	9,540	
Cradles, ...	1,000	do.	1.00	1,000	12,260
Surge tank:					
Excavation,					
Earth, ...	54	c.y. at	1.00	54	
Concrete, ...	97	do.	11.25	1,091	
Steel, ...	62,976	lbs. at	0.09	5,668	6,813
Penstock:					
Excavation,					
Earth, ...				363	
Pipe:					
Steel, including fittings, . . .	57,000	lbs. at	0.09	5,130	
Cradles, ...				220	
Concrete anchorage, ...	24	c.y. at	11.25	270	5,983
Power house:					
Substructure:					
Excavation,					
Earth, ...	63	c.y. at	1.00	63	
Rock, ...	39	do.	3.50	136	
Concrete, plain, ...	4	do.	11.25	45	
plain reinforced, . .	135	do.	16.25	2,194	
light reinforced, . .	24	do.	20.00	480	
Valves, one 3.5-foot diam., one 3.0-foot diam.,				2,040	
Stop-logs, tailrace, . .	300	feet b.m. at	0.10	30	
Steel, reinforcing, . .	1,764	lbs. at	0.06	106	
Steel, structural, . . .	3,380	lbs. at	0.10	338	5,432

Power house:			
Superstructure, ... 7,850 cu. ft. at $0.30			$2,349
Equipment:			
Water wheels, governors, and draft tubes, two units totalling 780 horsepower, ...		22,080	
Generators and exciters, two units totaling 524 kilowatts, ...		7,794	
Switchboards, switches and auxiliary apparatus, 524 kilowatts at $10.00, ...		5,240	
Crane, one 5-ton, ...		1,100	
Supplies, . . 524 kilowatts at $ 0.50, ...		262	36,566
Grading:			
Back filling, ... 435 c.y. at $1.00		435	435
Tailrace:			
Excavation:			
Earth, ... 2 c.y. at 2.00		4	
Rock, ... 28 do. 3.50		98	102
Total "A", ...			482,243
General expenses:			
Clearing reservoir, ... 200 acres at 30.00		6,000	
Relocation of roads,			
Roads, ... 0.5 miles at 29,000		14,500	
Roads, ... 0.25 miles at 16,000		4,000	
Transmission lines, ... 0.5 mile		160	
Transportation in lieu of base siding,		20,191	
Plant, ... 10 per cent of "A",		48,224	
Camp, ... 1 per cent of "A",		4,823	
General construction, ... 4 per cent of "A",		19,290	117,168
Total "B", ...			599,411
Engineering, superintendence and contingencies, ... 15 per cent of "B",		89,912	
Interest, during construction, . . 6 per cent of "B",		35,964	
Taxes, during construction, ... 1 per cent of "B",		5,994	
Insurance, during construction, . . 1 per cent of "B",		5,994	137,864
Total "C", ...			737,275
Property and water rights:			
Land, ... 594 acres at $20.00, ...		11,880	
Buildings, ... three sets, ...		7,000	
Additional water rights, ...		440	
Pipe line right-of-way, 0.2 mile, ...		200	19,520
Total cost, without transformer station, . . .			756,795

Step-up outdoor transformer station:

Structure, ...	.750	
Transformers and switches, ...	7,113	$7,863
Total cost, including transformer station, ...		764,658

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 734 horsepower.
Output per year, ... 2,494,000 kilowatt-hours.

Cost of installation,	Including transformer station
Total, ...	$764,658
Per installed horsepower, ...	1,042

Cost of power production,

Fixed charges, 10.5 per cent of total cost, . .	80,289
Operation, $3.92 per 1,000 kilowatt-hours, . .	9,776
Total, ...	90,065
Per kilowatt-hour, . . .	36.1 mills

Cost of power production, exclusive of cost of storage, 8.7 mills

MILE 23.95 DEVELOPMENT
Passumpsic River, Vermont
(serial number 5)

Length of earth section, ...	794.0 feet
Length of concrete retaining section, . . .	88.5 feet
Length of spillway section, ...	192.5 feet
Total length of dam, ...	1,075.0 feet

Unwatering and stream control:					$1,200
Dam:					
Earth section:					
Excavation,					
Earth, dry, ...	16,002	c.y. at	$1.00	$16,002	
Rock, ...	300	do.	3.50	1,050	
Water cut-off,					
Steel sheet piling, . . .	89.2	tons at	65.00	5,798	
Concrete core wall, . . .	300	c.y. at	11.25	3,375	
Earth fill, ...	389,935	do.	1.00	389,935	
Riprap, ...	3,821	do.	3.00	11,463	
Abutments,					
Excavation,					
Earth, ...	793	c.y. at	1.00	793	
Rock, ...	10	do.	3.50	36	
Concrete, ...	2,140	do.	11.25	24,075	
Concrete wall, ...	537	do.	11.75	6,310	458,836
Concrete retaining section:					
Excavation,					
Earth, ...	1,948	c.y. at	1.00	1,948	
Rock, ...	85	do.	3.50	298	
Concrete, ...	248	do.	11.25	2,790	5,036
Spillway section:					
Excavation,					
Earth, ...	33,435	c.y. at	1.00	33,435	
Rock, ...	531	do.	3.50	1,859	
Concrete, plain, ...	2,737	do.	11.25	30,791	
plain, ...	75	do.	11.75	881	
Bridge, ...				963	
Flashboards, ...	180	lin.ft.at	18.00	3,240	
Miscellaneous,					
Steel, reinforcing, . . .	1,200	lbs. at	0.06	72	
Steel, handrail, ...	193	lin.ft.at	1.00	193	71,434
Diversion and power conduit, control tower:					
Diversion and power tunnels:					
Excavation,					
Earth, ...	5,816	c.y. at	1.00	5,816	
Concrete conduit,					
122.7 sq. ft. area, . . .	161.5	ft. at	94.00	15,181	
283.5 do. . . .	233	do.	131.00	30,523	
Concrete, cradles, ...	71	c.y. at	11.75	834	
Concrete, plain, ...	212	do.	11.25	2,385	
Steel pipe, ...	211,725	lbs. at	0.09	19,065	
Racks, ...	124	sq. ft. at	0.50	62	
Riprap, ...	36	c.y. at	3.00	108	73,964

Diversion and power conduit, Control tower: (Continued)					
Control tower:					
Excavation,					
Earth, ...	490	c.y. at	$1.00	$490	
Rock, ...	87	do.	3.50	305	
Concrete, plain, ...	335	do.	11.25	3,769	
light reinforced, . .	659	do.	20.00	13,180	
Vent pipe, ...	81	lin.ft.at	8.00	648	
Valve, 7-ft. diameter, ...				5,586	
Valve, 10-ft. diameter, ...				11,600	$36,818
Penstock:					
Excavation,					
Earth, ...	70	lin.ft.at	2.44	171	
Pipe,					
Steel, including fittings, ...	38,620	lbs. at	0.09	3,474	
Cradles, ...	170	lin.ft.at	0.87	148	
Concrete anchorage, ...	32	c.y. at	11.25	360	4,153
Power house:					
Substructure:					
Excavation,					
Earth, dry, ...	212	c.y. at	1.00	212	
Rock, ...	84	do.	3.50	294	
Concrete, plain, ...	188	do.	16.25	3,055	
light reinforced,	41	do.	20.00	820	
Valves, three 4-ft. diam., ...				5,940	
Stop-logs, tailrace, ...	306	feet b.m.at	0.10	31	
Steel, reinforcing, ...	2,970	lbs. at	0.06	178	
Steel, structural, ...	8,928	do.	0.10	893	11,123
Superstructure, ...	13,200	cu.ft.at	0.30	3,960	3,960
Equipment:					
Water wheels, governors, and draft tubes, three units totaling 2,040 horsepower, ...				20,355	
Generators and exciters, three units totaling 1,370 kilowatts, ...				16,800	
Switchboards, switches and auxiliary apparatus, 1,370 kilowatts at $10.00, ...				13,700	
Crane, one 5-ton, ...				1,250	
Supplies, . . 1,370 kilowatts at $ 0.50, ...				685	52,790
Tailrace:					
Excavation:					
Earth, ...	2,345	c.y. at	1.00	2,345	
Rock, ...	72	do.	3.50	252	2,597
Total "A", ...					720,611

General expenses:

Clearing reservoir, ...	80 acres at $40.00	$3,200	
Relocation of roads, bridge, etc.:			
Road, ...	0.5 mile at 29,000	14,500	
Road, ...	3 miles at 16,000	48,000	
Bridge, 18 ft. by 70 ft., ...		9,673	
Telephone lines, ...	3 miles	2,100	
Transportation in lieu of R.R. siding, ...		3,863	
Plant, ...	10 per cent of "A")		
Camp, ...	1 per cent of "A")		
General construction, ...	4 per cent of "A")	108,091	$189,417
Total "B", ...			910,028
Engineering, superintendence and contingencies, ...	15 per cent of "B")		
Interest, during construction, ...	6 per cent of "B")		
Taxes, during construction, ...	1 per cent of "B")		
Insurance, during construction, . . .	1 per cent of "B").		209,306
Total "C", ...			1,119,334

Property and water rights:

Land, ...	325 acres at 30.00	9,750	
Buildings, ...	13 sets	20,000	
Additional water rights, ...		440	30,190
Total cost, without transformer station, ...			1,149,524

Step-up outdoor transformer station:

Structure, ...		750	
Transformers and switches, ...		13,659	14,409
Total cost, including transformer station, ...			1,163,933

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 1,920 horsepower.
Output per year, ... 4,476,000 kilowatt-hours.

Cost f installation,	Including transformer station
Total, ...	$1,163,933
Per installed horsepower, ...	606

Cost of power production.

Fixed charges, 10.5 per cent of total cost, ...	122,213
Operation, $2.01 per 1,000 kilowatt-hours, ...	12,578
Total, ...	134,791
Per kilowatt-hour,	30.1 mills

Cost of power production, exclusive of cost of storage,

Per kilowatt-hour, 6.7 mills

CLARK POND DEVELOPMENT
West Branch, (Passumpsic River) Vermont
(serial number 6)

Dike:

Total length (all earth section) . . . . . 513 feet

Main dam:

Length of earth section, ...	525 feet
Length of concrete retaining section, ...	35 feet
Length of gate section, ...	5 feet
Length of spillway section, ...	205 feet
Total length of dam, ...	770 feet
Total length of dam and dike, ...	1,283 feet

Dike:					
Earth section,					
Water cut-off,					
Steel sheet piling, ...	33.1	tons at	$70.57	$2,336	
Earth fill, ...	2,955	c.y. at	1.00	2,955	
Riprap, ...	769	sq. yd. at	1.00	769	$6,060
Main dam:					
Earth section,					
Water cut-off,					
Steel sheet piling, . . .	53	tons at	64.94	3,442	
Earth fill, ...	3,362	c.y. at	1.00	3,362	
Riprap, ...	1,565	sq. yd. at	1.00	1,565	
Abutments,					
Excavation,					
Earth, ...	163	c.y. at	1100	163	
Rock, ...	4	do.	3.50	14	
Concrete, ...	155	do.	11.25	1,744	10,290
Concrete retaining section:					
Excavation,					
Earth, ...	50	c.y. at	1.00	50	
Rock, ...	24	do.	3.50	84	
Concrete, ...	10	do.	11.25	113	247
Gate section:					
Excavation,					
Earth, ...	391	c.y. at	1.00	391	
Rock, ...	7	do.	3.50	25	
Concrete, plain, ...	26	do.	11.25	293	
Valve, one 2-ft. diam., ...				240	
Steel pipe, ...	1,100	lbs. at	0.09	99	1,048

Dam: (Cont'd)

Spillway section:

Excavation,				
Earth, ...	3,816 c.y. at	$1.00	$3,816	
Rock, ...	276 do.	3.50	966	
Concrete, plain, ...	812 do.	11.25	6,885	11,667
Total "A", ...				29,312

General expenses:

Clearing reservoir, ...	41 acres at 40.00	1,640	
Transportation in lieu of R.R. siding, ...		1,215	
Plant, ...	10 per cent of "A"	2,931	
Camp, ...	1 per cent of "A"	293	
General Construction, ...	4 per cent of "A"	1,172	7,251
Total "B", ...			36,563

Engineering, superintendence and contingencies, ...	15 per cent of "B"	5,484	
Int rest, during construction, ...	6 per cent of "B"	2,194	
Taxes, during construction, ...	1 per cent of "B"	366	
Insurance, during construction, . . .	1 per cent of "B"	366	8,410
Total "C", ...			44,973

Property and water rights:

Land, ...	45 acres at 15.00	675	
Buildings, ...	one boathouse,	25	
Additional water rights, ...		1,500	2,200
Total cost, ...			47,173

Storage below spillway, ... 1,720 acre-feet
Cost per acre-foot, ... $27.40

Total flood storage to maximum high water, ... 1,900 acre-feet
Cost per acre-foot, ... $24.70

VICTORY DEVELOPMENT
Mile 17.3 Moose River (Passumpsic River basin) Vermont
(serial number 8)

Length of earth section, ...	320 feet
Length of intake section, ...	10 feet
Length of gate section, ...	20 feet
Length of spillway section, ...	266 feet
Total length of dam, ...	616 feet

Unwatering and stream control:					$2,990
Dam:					
Earth section:					
Excavation,					
Earth, ...	7,292	c.y. at	$1.00	$7,292	
Hard pan, ...	157	do.	3.50	550	
Water cut-off,					
Concrete core and cut-off walls, ...	177	do.	11.75	2,080	
Earth fill, ...	14,300	do.	1.00	14,300	
Riprap, ...	753	do.	3.00	2,259	
Abutments,					
Excavation,					
Earth, ...	1,962	do.	1.00	1,962	
Hard pan, ...	14	do.	3.50	49	
Concrete, ...	3,252	do.	11.25	36,585	65,077
Intake section:					
Excavation,					
Earth, ...	175	c.y. at	1.00	175	
Hard pan, ...	34	do.	3.50	119	
Concrete, plain, ...	400	do.	11.75	4,700	
light reinforced,	19	do.	20.00	380	
Gates, one 8 by 6 ft., ...				2,500	
Racks, ...	113	sq.ft.at	4.00	452	
Vent pipes, ...	40	lin.ft.at	3.50	140	
Stop-logs, ...	400	feet b.m.at	0.10	40	
Steel pipe, ...	11,025	lbs. at	0.09	992	
Handrail, ...	10	lin.ft.at	1.00	10	9,508
Sluice-gate section:					
Excavation,					
Earth, ...	1,863	c.y. at	1.00	1,863	
Hard pan, ...	66	do.	3.50	231	
Concrete, plain, ...	808	do.	11.25	9,090	
light reinforced,	32	do.	20.00	640	
Gate, one 11 x 11 ft., ...				8,745	
Gate hoist, 45-ton, ...				4,000	
Racks, ...	96	sq.ft.at	0.50	48	
Stop-logs, ...	860	feet b.m.at	0.10	86	
Steel pipe, ...	69,300	lbs. at	0.09	6,237	
Concrete cradles, ...	125	lin.ft.at	2.20	275	31,215

Dam: (Continued)

Spillway section:

Excavation,					
Earth, dry, ...	14,533	c.y. at	$1.00	$14,533	
Hard pan, ...	1,155	do.	3.50	4,042	
Concrete, plain, ...	3,520	do.	11.25	39,600	
plain reinforced, ...	420	do.	11.75	4,935	
light reinforced, ...	372	do.	20.00	7,440	$70,550

Pipe line:

Excavation,					
Earth, ...	16,000	lin.ft.at	2.24	35,840	
Pipe (wood-stave), ...	16,000	do.	16.22	259,520	
Cradles, ...	16,000	do.	1.20	19,200	314,560

Surge tank:

Excavation,					
Earth, ...	36	c.y. at	1.00	36	
Concrete, ...	66	do.	11.25	743	
Steel, ...	123,336	lbs. at	0.09	11,100	11,879

Penstock:

Excavation,					
Earth, ...	800	lin.ft.at	2.24	1,120	
Pipe:					
Steel, including fittings, ...	212,000	lbs. at	0.09	19,080	
Cradles, ...	800	lin.ft.at	1.20	800	
Anchorages, ...	36	c.y. at	11.25	405	21,205

Power house:

Substructure:					
Excavation,					
Earth and rock, ...				680	
Concrete, plain, ...		at	16.25	3,669	
light reinforced, ...		at	20.00	250	
Valve, one 5-ft. diam., ...				5,264	
Stop-logs, tailrace, ...	1,100	feet b.m. at	0.10	110	
Steel reinforcing, ...				100	
Steel structural, ...				400	10,453
Superstructure, ...	9,042	cu.ft. at	0.30		2,713
Equipment:					
Water wheels, governors, and draft tubes, one unit totaling 2,440 horsepower, ...				11,550	
Generators and exciters, one unit totaling 1,650 kilowatts, ...				13,720	
Switchboards, switches and auxiliary apparatus, 1,650 kilowatts at $10.00, ...				16,500	
Chain block, .. 10-ton, ...				500	
Supplies, . . 1,650 kilowatts at $ 0.50, ...				825	43,095
Grading:					
Back filling, ...	1,190	c.y. at	1.00		1,190

Power house: (Continued)

Tailrace:

Complete, including excavation, concrete and riprap, ...			$1,750
Total "A", ...			586,185

General expenses:

Clearing reservoir, ...	667 acres at $40.00	$26,400	
Transportation in lieu of R.R. siding, ...		18,900	
Plant, ...	10 per cent of "A")		
Camp, ...	1 per cent of "A")		
General construction, ...	4 per cent of "A")	87,928	136,228
Total "B", ...			721,413
Engineering, superintendence and contingencies, ...	15 per cent of "B")		
Interest, during construction, . . .	6 per cent of "B")		
Taxes, during construction, ...	1 per cent of "B")		
Insurance, during construction, . . .	1 per cent of "B").		165,925
Total "C", ...			887,338

Property and water rights:

Land and buildings, based on cost of a large portion already acquired, including legal and engineering expenses, ...		105,000	
Additional water rights, ...		6,000	
Pipe-line right of way, ...	3 miles at 1,000	3,000	114,000
Total cost, without transformer station, ...			1,001,338

Step-up outdoor transformer station:

Structure, ...		750	
Transformers and switches, ...		15,850	16,600
Total cost, including transformer station, ...			1,017,938
say, ...			1,020,000

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ...	2,300 horsepower.
Output per year, ...	8,290,000 kilowatt-hours.

Cost f installation,	Including transformer station
Total, ...	1,020,000
Per installed horsepower, ...	443

Summary, including cost of power production (continued)

Cost of power production,

Fixed charges, 10.5 per cent of total cost.	107,100
Operation, $1.92 per 1,000 kilowatt-hours, ...	15,917
Total, . . .	123,017
say, ...	125,000
Per kilowatt-hour,	14.8 mills

Cost of power, exclusive of cost of storage,

Per kilowatt-hour,	9.7 mills

MILE 11.8 DEV LEVEL

Moose River (Passumpsic River basin) Vermont

(serial number 9)

Length of earth section, ...	1,025	feet
Length of concrete retaining section, .	122.5	feet
Length of spillway section, ...	212.5	feet
Total length of dam, ...	1,360	feet

Unwatering and stream control: (exclusive of diversion conduit), . . .					$3,000
Dam:					
Earth section:					
Excavation,					
Earth, ...	24,289	c.y. at	$1.00	$24,289	
Rock, ...	550	do.	3.50	1,925	
Water cut-off,					
Steel sheet piling, . . .	4	tons at	73.75	295	
Concrete, ...	550	c.y. at	11.75	6,462	
Earth fill, ...	90,124	do.	1.00	90,124	
Riprap, ...	2,552	do.	3.00	7,656	
Abutments,					
Excavation,					
Rock, ...	3	c.y. at	3.50	11	
Concrete, ...	100	do.	11.25	1,125	131,887
Concrete retaining section:					
Excavation,					
Earth, ...	114	c.y. at	1.00	114	
Rock, ...	80	do.	3.50	312	
Concrete, ...	241	do.	11.25	2,711	3,137
Spillway section:					
Excavation,					
Earth, ...	234	c.y. at	1.00	234	
Rock, ...	360	do.	3.50	1,260	
Concrete, plain, ...	562	do.	11.25	6,322	
plain reinforced,	105	do.	11.75	1,234	
light reinforced,	53	do.	20.00	1,060	
Flashboards, ...	195	bm.ft. at	18.00	3,510	
Steel, reinforcing, . . .	1,680	lbs. at	0.06	101	
Steel, handrail, ...	213	lin.ft. at	1.00	213	13,934

Moose River Mile 11.8 Moose R.

Diversion and power conduit, control tower:

Diversion and power conduit:

Excavation,					
Earth, ...	13,513	c.y. at	$1.00	$13,513	
Concrete,					
132.7 sq. ft. area, . . .	49	lin.ft.at	66.00	3,234	
285.5 do. , . . .	104	do.	100.00	10,400	
Concrete, cradles, ...	43	c.y. at	11.75	506	
Concrete, plain inportals,	197	do.	11.25	2,216	
Steel pipe, including fittings, . .	98,210	lbs. at	0.09	8,839	
Racks, ...	128	sq. ft. at	0.50	64	
Riprap, ...	37	c.y. at	3.00	111	
Stop-logs, ...	1,200	feet b.m.at	0.10	120	$39,002

Control tower:

Excavation,					
Earth, ...	600	c.y. at	1.00	600	
Rock, ...	78	do.	3.50	273	
Concrete, plain, ...	275	do.	11.25	3,094	
light reinforced,	245	do.	20.00	4,900	
Gate, one 6 by 6 ft., ...				2,400	
Gate, one 11.5 by 11.5 ft., ...				8,604	
Gate hoist, 41-ton, ...				3,800	
Vent pipe, ...	39	lin.ft.at	3.50	136	
Bridge, ...				100	23,967

Pipe line:

Excavation:					
Earth, ...	17,900	lin.ft.at	2.24	40,096	
Pipe, wood-stave, ...	18,500	do.	15.86	293,410	
Cradles, ...	18,450	do.	1.20	22,140	
Bridge, ...				4,034	359,680

Surge tank:

Excavation,					
Earth, ...	36	c.y. at	1.00	36	
Concrete, ...	66	do.	11.25	743	
Steel, ...	109,422	lbs. at	0.09	9,848	10,627

Penstock:

Excavation,					
Earth, ...	500	lin.ft.at	2.24	1,120	
Pipe:					
Steel, including fittings, ...	209,150	lbs. at	0.09	18,824	
Cradles, ...	500	lin.ft.at	1.20	600	
Anchorages, ...	36	c.y. at	11.25	405	20,949

Power house:

Substructure:

Excavation,

Earth, dry, ...	68 c.y. at	$1.00	$68	
Rock, ...	53 do.	3.50	186	
Concrete, plain, ...	4 do.	11.25	45	
plain reinforced, .	176 do.	16.25	2,860	
light reinforced, . .	26 do.	20.00	520	
Valves, one 5-foot diam., ...			5,600	
Stop-logs, tailrace, ...	600 feet b.m. at	0.10	60	
Steel, reinforcing, ...	1,705 lbs. at	0.06	102	
Steel, structural, ...	5,100 do.	0.10	510	$10,050
Superstructure, ...	10,809 cu. ft. at	0.30		3,243

Equipment:

Water wheels, governors, and draft tubes, one unit totaling 3,280 horsepower, ...	13,200	
Generators and exciters, one unit totaling 2,202 kilowatts, ...	16,240	
Switchboards, switches and auxiliary apparatus, 2,202 kilowatts at $10.00, ...	22,020	
Crane, . . . 15-ton hand operated, ...	2,050	
Supplies, . . 2,202 kilowatts at $ 0.50, ...	1,101	54,611
Grading:		
Back filling, ... 307 c.y. at 1.00		307
Tailrace:		
Excavation:		
Earth, ... 36 c.y. at 1.00	36	
Rock, ... 27 do. 3.50	95	131
Total "A", ...		674,525

General expenses:

Relocation of roads, bridges, etc:		
Roads, ... 0.4 mile at 38,000	15,200	
Roads, ... 0.6 mile at 16,000	9,600	
Bridge, 15 by 50 ft., ...	4,370	
Transportation in lieu of R.R. siding, ...	2,185	
Plant, ... 10 per cent of "A"	67,453	
Camp, ... 1 per cent of "A"	6,745	
General construction, ... 4 per cent of "A"	26,981	132,534
Total "B", ...		807,059
Engineering, superintendence and contingencies, ... 15 per cent of "B"	121,059	
Interest, during construction, . . . 6 per cent of "B"	48,424	
Taxes, during construction, ... 1 per cent of "B"	8,071	
Insurance, during construction, . . . 1 per cent of "B"	8,071	185,625
Total "C", ...		992,684

Property and water rights:

Land, ...	420 acres at	$25.00	$10,500	
Buildings, ...	two sets		3,500	
Additional water rights, ...			9,000	
Pipe-line right of way, ...			3,500	$26,500

Total cost, without transformer station, ... 1,019,184

Step-up outdoor transformer station:

Structure, ...	750	
Transformers and switches, ...	19,950	20,700

Total cost, including transformer station, ... 1,039,884

say, 1,040,000

Summary, including cost of power production.

Installed power at 80 per cent efficiency, ... 3,100 horsepower.
Output per year, ... 11,100,000 kilowatt-hours.

Cost of installation,	Including transformer station
Total, ...	$1,040,000
Per installed horsepower, ...	335

Cost of power production,

Fixed charges, 10.5 per cent of total cost, ...	109,200
Operation, $1.56 per 1,000 kilowatt-hours, ...	17,316
Total, ...	126,516
say, ...	127,000
Per kilowatt-hour, . . .	11.4 mills

Cost of power, exclusive of cost of storage,

Per kilowatt-hour, . . . 8.3 mill

EAST ST. JOHNSBURY DEVELOPMENT
Mile 4.75 Moose River (Passumpsic River Basin) Vermont
(serial number 10)

Length of earth section, ...	32 feet
Length of intake section, ...	15 feet
Length of gate section, ...	15 feet
Length of spillway section, ...	173 feet
Total length of dam, ...	235 feet

Unwatering and stream control:					$7,490
Dam:					
Earth section:					
Water cut-off,					
Steel sheet piling, ...	4	tons at	$68.50	$274	
Earth fill, (included in spillway earth excavation)					
Abutments,					
Excavation,					
Earth, ...	71	c.y. at	1.00	71	
Rock, ...	5	do.	3.50	18	
Concrete, ...	112	do.	11.25	1,260	1,623
Intake section:					
Excavation,					
Rock, ...	117	c.y. at	3.50	410	
Concrete, plain, ...	126	do.	11.75	1,481	
light reinforced, . .	12	do.	20.00	240	
Gate, 7.5 by 10 feet, including hoist, ...				2,400	
Racks, ...	228	sq.ft.at	4.00	912	
Vent pipes, ...	13	lin.ft.at	8.00	104	
Stop-logs, ...	1,260	feet b.m.at	0.10	126	
Penstock pipe, ...	7,400	lbs. at	0.09	666	
Steel handrail, ...	15	lin.ft.at	1.00	15	6,354
Gate section:					
Excavation,					
Rock, ...	29	c.y. at	3.50	102	
Concrete, plain, ...	34	do.	11.25	383	
plain, ...	50	do.	11.75	588	
light reinforced, . .	3	do.	20.00	60	
Gate, one 10 by 10 feet, ...				2,350	
Gate hoist, 2-ton, ...				800	
Steel handrail, ...	15	lin.ft.at	1.00	15	
Steel reinforcing, ...	440	lbs. at	0.06	26	4,324
Spillway section:					
Excavation,					
Earth, ...	268	c.y. at	1.00	268	
Rock, ...	262	d .	3.50	917	
Concrete, plain, ...	462	do.	11.25	5,198	
Flashboards, ...	173	lin.ft.at	5.74	993	7,376

East St. Johnsbury

Pipe line:					
Excavation:					
Earth, ...	16,800	c.y. at	$2.84	$44,872	
Pipe, wood-stave, ...	15,800	do.	17.85	282,030	
Cradles, ...	15,800	do.	1.40	22,120	$349,022
Surge tank:					
Excavation,					
Earth, ...	59	c.y. at	1.00	59	
Concrete, ...	41	do.	11.25	461	
Steel, pipe, ...	130,155	lbs. at	0.09	11,714	
Steel, structural, ...	69,255	do.	0.10	6,926	19,160
Penstock:					
Excavation,					
Earth, ...	300	lin.ft.at	2.84	852	
Pipe:					
Steel, including fittings, . . .	179,800	lbs. at	0.09	16,182	
Cradles, ...	300	lin.ft.at	1.40	420	
Concrete anchorages, ...	71	c.y. at	11.25	799	18,253
Power house:					
Substructure:					
Excavation,					
Rock, ...	154	c.y. at	3.50	539	
Concrete, plain, ...	5	do.	11.25	56	
plain, ...	237	do.	16.25	3,851	
light reinforced,	34	do.	20.00	680	
Valves, two 4.5-ft. diam., ...				9,856	
Stop-logs, tailrace, . . .	405	feet b.m.at	0.10	41	
Steel, reinforcing, . . .	2,374	lbs. at	0.06	143	
Steel, structural, . . .	6,504	do.	0.10	650	15,816
Superstructure, ...	13,200	cu.ft.at	0.30	3,960	3,960
Equipment:					
Water wheels, governors, and draft tubes, two units totaling 4,310 horsepower, ...				20,900	
Generators and exciters, two units totaling 2,900 kilowatts, ...				23,744	
Switchboards, switches and auxiliary apparatus, 2,900 kilowatts at $10.00, ...				29,000	
Crane, 7.5-ton hand operated, ...				1,600	
Supplies, . . 2,900 kilowatts at $ 0.50, ...				1,450	76,694
Grading:					
Back filling, ...	495	c.y. at	1.00	495	495
Tailrace:					
Excavation,					
Rock, ...	218	c.y. at	3.50	763	763
Total "A", ...					$11,350

General expenses:			
Transportation in lieu of R.R. siding, ...		$2,070	
Plant, ...10 per cent of "A")			
Camp,. . . . . 1 per cent of "A")			
General construction,. . . . . 4 per cent of "A")		76,700	$78,770
Total "B",.			590,100
Engineering, superintendence and contingencies, ... 15 per cent of "B")			
Interest, during construction,. . . 6 per cent of "B")			
Taxes, during construction, ... 1 per cent of "B")			
Insurance, during construction, . . 1 per cent of "B").			135,723
Total "C",.			725,823
Property and water rights:			
Land,. . . . . 30 acres at $30.00		900	
Additional water rights, ...		12,500	
Pipe-line right of way,. . . . . 3 miles at 1,000		3,000	16,400
Total cost, without transformer station,.			742,223
Step-up outdoor transformer station:			
Structure, ...		800	
Transformers and switches, ...		23,100	23,900
Total cost, including transformer station,.			766,123
		say,	766,000

Summary, including cost of power production.

Installed power, 90 per cent efficiency, ... 4,100 horsepower.
Output per year, ... 13,500,000 kilowatt-hours.

Cost of installation,	Including transformer station
Total,.	$766,000
Per installed horsepower, ...	187

Cost of power production.

Fixed charges, 10.5 per cent of total cost, ...	80,430
Operation, $1.34 per 1,000 kilowatt-hours,.	18,090
Total, ...	98,520
say, ...	98,500
Per kilowatt-hour, ...	7.3 mills

ST. JOHNSBURY DEVELOPMENT
Mile 0.7 Moose River (Passumpsic River Basin) Vermont
(serial number 11)

Length of earth section, ...	60	feet
Length of concrete retaining section, . .	80.5	feet
Length of intake section, ...	16	feet
Length of crest-gate section, ...	94	feet
Length of spillway section, ...	32.5	feet
Total length of dam, ...	283	feet

Unwatering and stream control:					$5,630
Dam:					
Earth section:					
Excavation,					
Earth, ...	55	c.y. at	$1.00	$55	
Rock, ...	20	do.	3.50	70	
Water cut-off,					
Concrete core wall, ...	43	c.y. at	11.75	505	
Earth fill, ...	70	do.	1.00	70	700
Concrete retaining section:					
Excavation,					
Earth, ...	27	c.y. at	1.00	27	
Rock, ...	95	do.	3.50	333	
Concrete, ...	265	do.	11.25	2,981	3,341
Intake section:					
Excavation,					
Rock, ...	25	c.y. at	3.50	88	
Concrete, plain, ...	116	do.	11.75	1,363	
light reinforced,	8	do.	20.00	160	
Gate, 8 by 8 feet, including hoist, ...				2,050	
Racks, ...	203	sq.ft.at	4.00	812	
Vent pipe, ...	13	lin.ft.at	8.00	104	
Stop-logs, ...	1,450	feet b.m.at	0.10	145	
Penstock pipe, ...	7,800	lbs. at	0.09	702	
Steel, handrail, ...	16	lin.ft.at	1.00	16	5,440
Crest-gate section:					
Excavation,					
Rock, ...	216	c.y. at	3.50	756	
Concrete, plain, ...	365	do.	11.25	4,106	
plain, ...	625	do.	11.75	7,344	
light reinforced,	23	do.	20.00	460	
Gates,					
one 20 by 18 feet, ...				4,822	
one 25 by 22 feet, ...				12,716	
Gate hoist, 15-ton, ...				2,450	
Steel, handrail, ...	94	lin.ft.at	1.00	94	
Steel, reinforcing,	5,625	lbs. at	0.06	538	33,086

Dam: (continued)					
Spillway section					
Excavation,					
Rock, ...	68	c.y. at	$3.50	$238	
Concrete, plain, ...	171	do.	11.25	1,924	
plain, ...	15	do.	11.75	176	
Bridge, ...				163	
Flashboards,	30	lin.ft.at	18.00	540	
Steel, reinforcing, . . .	240	lbs. at	0.06	14	
Steel, hand-rail, ...	33	lin.ft.at	1.00	33	3,088
Pipe line:					
Excavation,					
Earth, ...	1,200	lin.ft.at	3.16	3,792	
Pipe, wood-stave, ...	1,200	do.	14.14	16,968	
Cradles, ...	1,200	do.	1.50	1,800	22,560
Surge tank:					
Excavation,					
Earth, ...	178	c.y. at	1.00	178	
Rock, ...	118	do.	3.50	413	
Concrete, ...	59	do.	11.25	664	
Steel, ...	72,307	lbs. at	0.09	6,508	7,763
Penstock:					
Excavation,					
Earth, ...	225	lin.ft.at	3.16	711	
Pipe:					
Steel, including fittings, . . .	97,250	lbs. at	0.09	8,753	
Cradles, ...	225	lin.ft.at	1.50	338	
Concrete anchorages, ...	90	c.y. at	11.25	1,013	10,815
Power house:					
Substructure:					
Excavation,					
Rock, ...	176	c.y. at	3.50	616	
Concrete, plain, ...	7	do.	11.25	79	
plain, ...	279	do.	16.25	4,534	
light reinforced,	45	do.	20.00	900	
Valves, one 4.5-ft., and one 6-ft. diam., . . .				7,336	
Stop-logs, tailrace, . .	500	feet b.m.at	0.10	50	
Steel, reinforcing, . . .	2,916	lbs. at	0.06	175	
Steel, structural, . .	9,700	lbs. at	0.10	970	14,660
Superstructure, ...	12,960	cu.ft. at	0.30	3,888	3,888

Power house:(Cont'd)

Equipment:

Water wheels, governors, and draft tubes, two units totaling 1,490 horsepower, ...	$24,472	
Generators and exciters, two units totaling 1,000 kilowatts, ...	12,208	
Switchboards, switches and auxiliary apparatus, 1,000 kilowatts at $10.00, ...	10,000	
Crane, . . . 5-ton hand operated, ...	1,250	
Supplies, . . 1,000 kilowatts at $ 0.50, ...	500	$48,430

Grading:

Back filling, ... 540 c.y. at $1.00	540	540

Tailrace:

Excavation,		
Rock, ... 97 c.y. at 3.50	340	340
Total "A", ...		160,281

General expenses:

Transportation in lieu of R.R. siding, ...	829	
Plant, ... 10 per cent of "A"	16,028	
Camp, ... 1 per cent of "A"	1,603	
General construction, ... 4 per cent of "A"	6,411	24,871
Total "B", ...		185,152

Engineering, superintendence, and contingencies, ... 15 per cent of "B"	27,773	
Interest, during construction, ... 6 per cent of "B"	11,109	
Taxes, during construction, ... 1 per cent of "B"	1,852	
Insurance, during construction, ... 1 per cent of "B"	1,852	42,586
Total "C", ...		227,738

Property and water rights:

Land, ... 12 acres at $10.00	120	
Buildings, ... one set	1,500	
Additional water rights, ...	1,750	
Pipe-line right of way, ... 0.25 mile at 1,000	250	3,620
Total cost, without transformer station, ...		231,358

Step-up outdoor transformer station:

Structure, ...	750	
Transformers and switches, ...	11,094	11,844
Total cost, including transformer station, . . .		243,202

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 1,400 horsepower.
Output per year, ... 4,349,000 kilowatt-hours.

Cost of installation,	Including transformer station
Total, ...	$243,202
Per installed horsepower, ...	174

Cost of power production,

Fixed charges, 10.5 per cent of total cost,	25,536
Operation, $2.86 per 1,000 kilowatt-hours,	12,438
Total, ...	37,974
Per kilowatt-hour, . . .	8.7 mills

GOOD HOLLOW DEVELOPMENT
Durrough Brook, Sleepers River, (Passumpsic River basin) Vermont
(serial number 12)

Length of earth section, ...	270 feet
Length of concrete retaining section, . . .	530 feet
Length of gate section, ...	15 feet
Length of spillway section, ...	100 feet
Total length of dam, ...	915 feet

Unwatering and stream control:					34,680
Dam:					
Earth section:					
Water cut-off,					
Steel sheet piling, ...	51.5	tons at	$70.00	$3,605	
Earth fill, ...	3,647	c.y. at	1.00	3,647	
Riprap, ...	500	do.	3.00	1,500	8,752
Concrete retaining section:					
Excavation,					
Earth, ...	4,012	c.y. at	1.00	4,012	
Rock, ...	1,340	do.	3.50	4,690	
Concrete, ...	12,664	do.	11.25	142,470	
Steel, handrail, ...	340	lin.ft. at	1.00	340	151,512
Gate section:					
Excavation,					
Rock, ...	56	c.y. at	3.50	196	
Concrete, plain, ...	750	do.	11.25	8,438	
Valve, one 4.5-ft. diam., ...				3,695	
Steel pipe, ...	9,000	lbs. at	0.09	810	13,140
Spillway section:					
Excavation,					
Earth, ...	311	c.y. at	1.00	311	
Rock, ...	159	do.	3.50	557	
Concrete, plain, ...	320	do.	11.25	3,600	4,468
Total "A", ...					182,552
General expenses:					
Clearing reservoir, ...	136	acres at	40.00	5,400	
Relocation of road, ...	0.25	mile at	13,000	3,250	
Relocation of bridge, 12 by 30 ft., ...				1,700	
Transportation in lieu of R.R. siding, ...				18,635	
Plant, ...	10	per cent of "A"		18,255	
Camp, ...	1	per cent of "A"		1,826	
General construction, ...	4	per cent of "A"		7,302	56,368
Total "B", ...					238,920

Engineering, superintendence and contingencies, ...	15 per cent of "B"	$35,958	
Interest, during construction, ...	6 per cent of "B"	14,335	
Taxes, during construction, ...	1 per cent of "B"	2,389	
Insurance, during construction, ...	1 per cent of "B"	2,389	$54,961
Total "C", ...			293,871
Property and water rights:			
Land, ... 200 acres at $10.00		2,000	2,000
Total cost, ...			295,871

Summary

Total flood storage, ... 4,900 acre-feet.

Cost per acre-foot, ... $60.40

Storage below spillway, ... 4,000 acre-feet.

Cost per acre-foot, ... $74.00

FISH HATCHERY DEVELOPMENT
Mil 5.3 Sleepers River (Passumpsi River Basin) Vermont
(serial number 13)

Length of earth section, ...	1,165 feet
Length of concrete retaining section, . .	25 feet
Length of intake section, ...	10 feet
Length of gate section, ...	20 feet
Length of spillway section, ...	300 feet
Total length of dam, ...	1,520 feet

Unwatering and stream control;					$5,450
Dam:					
Earth section,					
Excavation,					
Earth, ...	822	c.y. at	$1.00	$822	
Rock, ...	58	do.	3.50	203	
Water cut-off,					
Steel sheet piling, . . .	523	tons at	65.10	34,047	
Concrete, ...	58	c.y. at	11.25	653	
Earth fill, ...	351,891	do.	1.00	351,891	
Riprap, ...	6,472	do.	3.00	19,416	
Abutments,					
Excavation,					
Rock, ...	11	c.y. at	3.50	39	
Concrete, ...	2,950	do.	11.25	33,188	440,259
Concrete retaining section:					
Excavation,					
Rock, ...	29	c.y. at	3.50	102	
Concrete, ...	56	do.	11.25	630	732
Intake section:					
Excavation,					
Rock, ...	70	c.y. at	3.50	245	
Concrete, plain, ...	438	do.	11.75	5,188	
light reinforced,	32	do.	20.00	640	
Gate, one 4.5 by 4.5 feet, including hoist, . . .				2,250	
Racks, ...	70	sq.ft.at	4.00	280	
Vent pipes, ...	54	lin.ft.at	3.50	189	
Stop-logs, ...	3,888	feet b.m.at	0.10	389	
Penstock pipe, ...	6,000	lbs. at	0.09	540	
Steel, handrail, ...	10	lin.ft.at	1.00	10	9,701
Sluice-gate section:					
Excavation,					
Rock, ...	133	c.y. at	3.50	466	
Concrete, plain, ...	968	do.	11.25	10,890	
light reinforced,	47	do.	20.00	940	
Valve, 8-ft. diameter, ...				6,000	
Steel pipe, ...	11,000	lbs. at	0.09	990	
Steel handrail, ...	20	lin.ft.at	1.00	20	
Racks, ...	64	sq.ft.at	0.50	32	19,388

Fish Hatchery

Dam: (Cont'd)				
Spillway section:				
Excavation,				
Earth, ...	430 c.y. at	$1.00	$430	
Rock, ...	1,237 do.	3.50	4,330	
Concrete, plain, . . .	14,384 do.	11.25	161,820	
Flashboards, ...	300 lin.ft.at	6.80	2,040	$168,620
Penstock:				
Excavation,				
Earth, ...	540 lin.ft.at	1.48	799	
Pipe:				
Steel, including fittings, . . .	129,700 lbs. at	0.09	11,673	
Cradles, ...	540 lin.ft.at	0.90	486	
Concrete anchorages, ...	19 c.y. at	11.25	214	13,172
Power house:				
Substructure:				
Excavation,				
Rock, ...	178 c.y. at	3.50	623	
Concrete, plain, ...	2 do.	11.25	23	
plain, ...	203 do.	16.25	3,299	
light reinforced,	11 do.	20.00	220	
Valves, two 3-ft. diam., ...			1,920	
Stop-logs, tailrace, . . .	648 feet b.m.at	0.10	65	
Steel, reinforcing, . .	1,404 lbs. at	0.06	84	
Steel, structural, . . .	2,128 do.	0.10	213	6,447
Superstructure, ...	6,240 cu.ft. at	0.30		1,872
Equipment:				
Water wheels, governors, and draft tubes, two units totaling 1,180 horsepower, .			16,790	
Generators and exciters, two units totaling 790 kilowatts, ...			10,080	
Switchboards, switches and auxiliary apparatus, 790 kilowatts at $10.00, ...			7,900	
Crane, 5-ton hand operated, ...			1,250	
Supplies, . . 790 kilowatts at $ 0.50, ...			395	36,415
Grading:				
Back filling, ...	390 c.y. at	1.00	390	390
Tailrace:				
Excavation,				
Rock, ...	444 c.y. at	3.50	1,554	1,554
Total "A", ...				703,980

General expenses:

Cl ering reservoir, ... 15 acres at	$40.00	$600	
Relocation of roads, bridges, etc:			
Road, ... 2.7 miles at	29,000	78,300	
Bridge, 18 by 70 feet, ...		7,000	
Telephone lines, ... 2.7 miles		1,890	
Transportation in lieu of S.N. siding, ...		9,235	
Plant, ... 10 per cent of "B"		70,398	
Camp, ... 1 per cent of "B"		7,040	
General construction, . . . 4 per cent of "B"		28,159	$202,622
Total "B", ...			906,602
Engineering, superintendence and contingencies, . . 15 per cent of "B"		135,990	
Interest, during construction, 6 per cent of "B"		54,396	
Taxes, during construction, . . 1 per cent of "B"		9,066	
Insurance, during construction, 1 per cent of "B"		9,066	208,518
Total "C", ...			1,115,120
Property and water rights:			
Land, ... 247 acres at	20.00	4,940	
Buildings, ... four sets		10,000	
Pipe-line right of way, . . .15 mile at	1,000	150	15,090
Total cost, without transformer station, ...			1,130,210
Step-up outdoor transformer station:			
Structure, ...		750	
Transformers and switches, ...		9,330	10,080
Total cost, including transformer station, ...			1,140,290

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 1,110 horsepower.
Output, per year, ... 3,818,000 kilowatt-hours.

Cost of installation,	Including transformer station.
Total, ...	$1,140,290
Per installed horsepower, ...	1,027

Cost of power production,

Fixed charges, 10.5 per cent of total cost,	119,750
Operation, $3.09 per 1,000 kilowatt-hours,	11,798
Total, ...	131,528
Per kilowatt-hour, ...	34.4 mills

Cost of power production, exclusive of cost of storage,

Per kilowatt-hour, ... 5.8 mills

JOES POND RESERVOIR DAM
Mile 10.95, Joes Brook (Passumpsic River basin), Vermont
(serial number 15)

Length of new intake section, ... 12 feet

Total length of dam, (new construction only) 12 feet

Unwatering and stream control:				33,350
Dam: Use present dam with new intake section.				
Intake section: (new)				
Removing present sawmill, ...			3500	
Construction changes in present intake section, . . .			200	
Valve, one 4-foot diam., ...			1,260	
Racks, ...	85 sq. ft. at	4.00	340	
Vent pipe, ...	12 lin.ft.at	3.50	42	
Stop-logs, ...	300 feet b.m.at	0.10	30	
Steel pipe, ...	2,100 lbs. at	0.09	189	2,561
Pipe line:				
Excavation:				
Earth, ...	5,000 lin.ft.at	1.26	6,300	
Pipe, wood-stave, 4-ft. diam., ...	5,000 do.	6.14	30,700	
Valve, one 4-ft. diam., ...			3,000	
Cradles, ...	5,000 lin.ft.at	0.80	4,000	
Concrete anchorages, . .	62 c.y. at	11.25	698	
Stop-logs, ...	200 feet b.m.at	0.10	20	44,718
Penstock: 17 feet of 4-ft. diam. and 66 feet of 2.75-ft diam.				
Excavation,				
Earth, ...			63	
Pipe:				
Steel, including fittings, .	13,140 lbs. at	0.09	1,183	
Cradles, ...			40	
Concrete anchorage, . . .	7 c.y. at	11.25	79	1,365
Power house:				
Substructure:				
Excavation,				
Earth, ...	700 c.y. at	1.00	700	
Concrete, plain, . . .	186 do.	16.25	3,023	
light reinforced, .. .	23 do.	20.00	460	
Valves, two 1.75-ft. diam., ...			500	
Stop-logs, tailrace, .	600 feet b.m.at	0.10	60	
Steel, reinforcing,	1,300 lbs. at	0.06	78	
Steel, structural,	2,700 do.	0.10	270	5,091

Power house:				
Superstructure, ...	5,240 cu. ft. at	30.30		31,872
Equipment:				
Water wheels, governors, and draft tubes, two units totaling 1,082 horsepower, ...			13,800	
Generators and exciters, two units totaling 726 kilowatts, ...			8,960	
Switchboards, switches and auxiliary apparatus, 726 kilowatts at 210.00, ...			7,260	
Crane, one 5-ton, ...			1,250	
Supplies, . . 726 kilowatts at $ 0.50, ...			363	31,633
Grading:				
Riprap, ...	30 c.y. at	3.00	90	
Retaining wall, concrete, .	100 do.	11.25	1,125	1,215
Tailrace:				
Excavation:				
Earth, ...	2,470 c.y. at	1.00	2,470	
Concrete, plain, ...	16 do.	16.25	260	
light reinforced,	56 do.	20.00	1,120	
Riprap, ...	230 do.	3.00	940	4,890
Total "A", ...				96,495
General expenses:				
Transportation in lieu of R. R. siding, ...			4,860	
Plant, ...	10 per cent of "A"		9,650	
Camp, ...	1 per cent of "A"		965	
General construction, ...	4 per cent of "A"		3,860	19,335
Total "B", ...				115,830
Engineering, superintendence and contingencies, ...	15 per cent of "B"		17,375	
Interest, during construction, . . .	6 per cent of "B"		6,950	
Taxes, during construction, ...	1 per cent of "B"		1,158	
Insurance, during construction, . .	1 per cent of "B"		1,158	26,641
Total "C", ...				142,471
Property and water rights:				
Land, ...	10 acres at	15.00	150	
Additional water rights, ...			50,000	
Pipe-line right of way, ...	1 mile at	1,000	1,000	51,150
Total cost, without transformer station, ...				193,621
Step-up outdoor transformer station:				
Structure, ...			750	
Transformers and switches, ...			8,726	9,476
Total cost, including transformer station, ...				203,097

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 1,018 horsepower.
Output per year, ... 4,530,000 kilowatt-hours.

Cost of installation,	Including transformer station
Total, ...	$203,097
Per installed horsepower, ...	200

Cost of power production,

Fixed charges, 10.5 per cent of total cost,	21,325
Operation, $2.79 per 1,000 kilowatt-hours,	12,639
Total, ...	33,964
Per kilowatt-hour, . . .	7.5 mills

KEISER POND DEVELOPMENT
Joes Brook (Passumpsic River basin) Vermont
(serial number 16)

Length of earth section, ...	486	feet
Length of concrete retaining section, . . .	80	feet
Length of spillway section, ...	44	feet
Total length of dam, ...	610	feet

Unwatering and stream control:					$1,200
Dam:					
Earth section:					
Excavation,					
Earth, ...	5,877	c.y. at	$1.00	$5,877	
Rock, ...	195	do.	3.50	683	
Water cut-off,					
Steel sheet piling, . .	52	tons at	66.00	3,432	
Concrete, ...	195	c.y. at	11.25	2,194	
Earth fill, ...	104,555	do.	1.00	104,555	
Riprap, ...	1,950	do.	3.00	5,850	
Abutments,					
Excavation,					
Earth, ...	1,059	c.y. at	1.00	1,059	
Rock, ...	5	do.	3.50	18	
Concrete, ...	206	do.	11.25	2,306	125,974
Concrete retaining section:					
Excavation,					
Earth, ...	89	c.y. at	1.00	89	
Rock, ...	27	do.	3.50	95	
Concrete, ...	97	do.	11.25	1,091	1,275
Spillway section:					
Excavation,					
Earth, ...	470	c.y. at	1.00	470	
Rock, ...	84	do.	3.50	294	
Concrete, plain, ...	372	do.	11.25	4,185	4,949
Diversion and power conduit, control tower:					
Diversion and power conduit:					
Excavation,					
Earth, ...	360	c.y. at	1.00	360	
Rock, open cut, ...	177	do.	3.50	620	
Concrete, conduit, 4.33-ft. diam., ...	328	lin.ft.at	25.50	8,364	
Concrete, plain in portals,	36	c.y. at	11.25	405	
Steel pipe, ...	44,100	lbs. at	0.09	3,969	
Racks, ...	54	sq.ft.at	4.00	216	13,934

Keiser Pond

Diversion and power conduit, control tower: (Cont'd)

Control tower:				
Excavation,				
Earth, ...	29 c.y. at	$1.00	$29	
Rock, ...	15 do.	3.50	53	
Concrete, plain, ...	33 do.	11.25	371	
light reinforced,	148 do.	20.00	2,960	
Steel pipe, including fittings,	1,575 lbs. at	0.09	142	
Gate, one 4.3 by 4.3 feet,)				
Gate hoist, ...).			2,350	
Vent pipe, ...	60 lin.ft. at	3.50	210	
Bridge, ...			125	$6,240
Pipe line:				
Excavation:				
Earth, ...	900 lin.ft. at	1.40	1,260	
Pipe, wood-stave, 52 inch diam., ...	900 do.	6.69	6,021	
Cradles, ...	900 do.	0.87	783	8,064
Surge tank:				
Excavation,				
Earth, ...	19 c.y. at	1.00	19	
Concrete, ...	29 do.	11.25	326	
Steel, ...	52,810 lbs. at	0.09	4,753	5,098
Penstock:				
Excavation,				
Earth, ...	350 lin.ft. at	1.40	490	
Concrete anchorages, ...	16 c.y. at	11.25	180	
Pipe, steel, ...	81,125 lbs. at	0.09	7,301	
Cradles, ...	350 lin.ft. at	0.87	305	8,276
Power house:				
Substructure,				
Excavation,				
Rock, ...	118 c.y. at	3.50	413	
Concrete, plain, ...	3 do.	11.25	34	
plain, ...	177 do.	16.25	2,876	
lightreinforced,	11 do.	20.00	220	
Valves, two 30-inch, ...			1,200	
Stop-logs, tailrace, . .	360 feet b.m. at	0.10	36	
Steel, reinforcing, . .	1,400 lbs. at	0.06	84	
Steel, structural, . .	2,640 lbs. at	0.10	264	5,127
Superstructure, ...	6,240 cu.ft. at	0.30		1,872

Power house: (Cont'd)

Equipment:				
Water wheels, governors, and draft tubes, two units totaling 784 horsepower, ...			$16,100	
Generators and exciters, two units totaling 526 kilowatts, ...			7,840	
Switchboards, switches and auxiliary apparatus, 526 kilowatts at $10.00, ...			5,260	
Crane, one 5-ton, ...			1,250	
Supplies, . . 526 kilowatts at $ 0.50, ...			263	$30,713
Grading:				
Back filling, ...	390 c.y. at	$1.00	390	
Riprap, ...	50 do.	3.00	150	
Retaining walls, concrete,.	60 do.	11.25	675	1,215
Tailrace:				
Excavation:				
Rock,.	64 c.y. at	3.50	224	
Concrete, ...	5 do.	11.25	56	280
Total "A", ...				214,217
General expenses:				
Cl aring reservoir, ...	230 acres at	40.00	9,200	
Transportation in lieu of R.R. siding, ...			1,395	
Plant,.	10 per cent of "A"		21,422	
Camp, ...	1 per cent of "A"		2,142	
General construction, ...	4 per cent of "A"		8,569	42,728
Total "B",.				256,945
Engineering, superintendence and contingencies,. . . .	15 per cent of "B"		38,542	
Int rest, during construction, . .	6 per cent of "B"		15,417	
Taxes, during construction,. . . .	1 per cent of "B"		2,569	
Insurance, during construction,. .	1 per cent of "B"		2,569	59,097
Total "C", ...				316,042
Property and water rights:				
Land, ...	265 acres at	15.00	3,945	
Buildings,.	one set		3,500	
Pipe-line right of way, ...			200	7,645
Total cost, without transformer station, . . .				323,687
Step-up outdoor transformer station:				
Structure, ...			750	
Transformers and switches, ...			7,271	8,021
Total cost, including transformer station, . .				331,708

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 738 horsepower.
Output per year, ... 3,156,000 kilowatt-hours.

Cost of installation,	Including transformer station
Total, ...	$331,708
Per installed horsepower, ...	449

Cost of power production,

Fixed charges, 10.5 per cent of total cost, . .	34,829
Operation, $5.42 per 1,000 kilowatt-hours, . .	10,794
Total, ...	45,623
Per kilowatt-hour, ...	14.5 mills

MILE 6.9 DEVELOPMENT
Joes Brook (Passumpsic River basin), Vermont
(serial number 17)

Length of concrete retaining section, . .	212.5 feet
Length of intake section, ...	20 feet
Length of gate section, ...	20 feet
Length of spillway section, ...	127.5 feet
Total length of dam, ...	380.0 feet

Unwatering and stream control:					$3,725
Dam:					
Concrete retaining section:					
Excavation,					
Earth, ...	174	c.y. at	$1.00	$174	
Rock, ...	218	do.	3.50	763	
Concrete, ...	577	do.	11.25	6,456	7,372
Intake section:					
Excavation,					
Rock, ...	37	c.y. at	3.50	130	
Concrete, plain, ...	194	do.	11.25	2,187	
light reinforced,	6	do.	20.00	120	
Gate, one 4.4 by 4.4 feet,)					
Gate hoist, ...)				850	
Racks, ...	64	sq.ft.at	4.00	256	
Vent pipes, ...	20	lin.ft.at	3.50	70	
Stop-logs, ...	200	feet b.m.at	0.10	20	
Steel pipe, ...	3,300	lbs. at	0.09	297	
Steel handrail, ...	20	lin.ft.at	1.00	20	3,945
Gate section:					
Excavation,					
Rock, ...	39	c.y. at	3.50	137	
Concrete, plain, ...	232	do.	11.25	2,610	
light reinforced,	8	do.	20.00	160	
Gate, one 5 by 5 feet,)					
Gate hoist, ...)				1,075	
Steel pipe, ...	5,100	lbs. at	0.09	459	
Handrail, ...	20	lin.ft.at	1.00	20	
Racks, ...	20	sq.ft.at	0.50	10	4,471
Spillway section:					
Excavation,					
Rock, ...	276	c.y. at	3.50	962	
Concrete, plain, ...	743	do.	11.25	8,359	
plain, ...	45	do.	11.75	529	
light reinforced,	32	do.	20.00	640	
Flashboards, ...	120	lin.ft.at	18.00	2,160	
Steel, reinforcing, . . .	720	lbs. at	0.06	43	
Steel, handrail, ...	150	lin.ft.at	1.00	150	12,823

Pipe line:					
Excavation:					
Earth, ...	120	lin.ft.at	$1.40	$1,680	
Pipe, wood-stave, ...	1,200	d .	5.66	6,792	
Cradles, ...	1,200	do.	0.87	1,044	$9,516
Surge tank:					
Excavation,					
Earth, ...	22	c.y. at	1.00	22	
Concrete, ...	35	do.	11.25	394	
St el, ...	22,038	lbs. at	0.09	2,094	2,510
Penstock:					
Excavation,					
Earth, ...				158	
Pipe, steel, including					
fittings, ...	27,000	lbs.		2,430	
Cradles, ...				104	
Concrete anchorages, ...	16	c.y. at	11.25	180	2,872
P wer house:					
Substructure:					
Excavation,					
Earth, ...	11	c.y. at	1.00	11	
Rock, ...	102	do.	3.50	357	
Concrete, plain, ...	3	do.	11.25	34	
plain, ...	160	do.	16.25	2,600	
light reinforced, . .	11	do.	20.00	220	
Valves, two 3-ft. diam., ...				1,600	
Stop-logs, tailrace, ...	500	feet b.m.at	0.10	50	
Steel, reinforcing, ...	1,404	lbs. at	0.06	84	
Steel, structural, ...	2,640	do.	0.10	264	5,220
Superstructure, ...	6,240	cu.ft.at	0.30		1,872
Equipment:					
Water wheels, governors, and draft tubes, two units totaling 644 horsepower, ...				12,650	
Generators and exciters, two units totaling 432 kilowatts, ...				7,840	
Switchboards, switches and auxiliary apparatus, 432 kilowatts at $10.00, ...				4,320	
Crane, 5-ton, ...				1,250	
Supplies, . . 432 kilowatts at $ 0.50, ...				216	26,276
Grading:					
Back filling, ...	390	c.y. at	1.00		390

Power house:(Cont'd)

Tailrace:

Excavation,

Rock, ...	51 c.y. at	$3.50	$179
Total "A", ...			81,171

General expenses:

Transportation in lieu of R.R. siding, ...		1,545	
Plant, ...	10 per cent of "A"	8,117	
Camp, ...	1 per cent of "A"	812	
General construction, ...	4 per cent of "A"	3,247	13,721
Total "B", ...			94,892
Engineering, superintendence, and contingencies, . . .	15 per cent of "B"	14,234	
Interest, during construction, . .	6 per cent of "B"	5,693	
Taxes, during construction, . . .	1 per cent of "B"	949	
Insurance, during construction, .	1 per cent of "B"	949	21,825
Total "C", ...			116,717

Property and water rights:

Land, ...	24 acres at 15.00	360	
Additional water rights, ...		1,700	
Pipe-line right of way, . . .	0.25 mile	250	2,310
Total cost, without transformer station,			119,027

Step-up outdoor transformer station:

Structure, ...	750	
Transformers and switches, ...	6,372	7,122
Total cost, including transformer station,		126,149

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 506 horsepower.
Output per year, ... 2,172,000 kilowatt-hours.

Cost of installation,	Including transformer station
Total, ...	$126,149
Per installed horsepower, ...	210

Cost of power production,

Fixed charges, 10.5 per cent of total cost, . .	13,246
Operation, $4.29 per 1,000 kilowatt-hours, . .	9,318
Total, ...	22,564
Per kilowatt-hour, ...	10.4 mills.

SOUTH DANVILLE DEVELOPMENT
Mile 6.15, Joes Brook (Passumpsic River basin), Vermont
(serial number 18)

Length of earth section, ...	227.5 feet
Length of concrete retaining section, . . .	406.0 feet
Length of intake section, ...	12.0 feet
Length of gate section, ...	12.0 feet
Length of spillway section, ...	182.5 feet
Total length of dam, ...	830.0 feet

Unwatering and stream control:					$5,892
Dam:					
Earth section,					
Excavation,					
Earth, ...	1,200	c.y. at	$1.00	$1,200	
Rock, ...	114	do.	3.50	399	
Water cut-off,					
Concrete, ...	114	c.y. at	11.25	1,283	
Earth fill, ...	2,000	do.	1.00	2,000	
Riprap, ...	230	do.	3.00	690	
Abutments,					
Excavation,					
Earth, ...	650	c.y. at	1.00	650	
Rock, ...	4	do.	3.50	14	
Concrete, ...	100	do.	11.25	1,125	7,331
Concrete retaining section:					
Excavation,					
Earth, ...	390	c.y. at	1.00	390	
Rock, ...	790	do.	3.50	2,765	
Concrete, ...	5,356	do.	11.25	60,255	63,320
Intake section:					
Excavation,					
Rock, ...	22	c.y. at	3.50	77	
Concrete, plain, ...	102	do.	11.25	1,148	
light reinforced,	12	do.	20.00	240	
Gate, one 3.83 by 3.83 feet, Gate hoist, ...				650	
Racks, ...	52	sq.ft.at	4.00	208	
Vent pipe, ...	18	lin.ft.at	3.50	63	
Stop-logs, ...	720	feet b.m.at	0.10	72	
Steel pipe, ...	3,200	lbs. at	0.09	288	2,746
Gate section:					
Excavation,					
Rock, ...	26	c.y. at	3.50	91	
Concrete, plain, ...	166	do.	11.25	1,868	
light reinforced,	5	do.	20.00	100	
Gate, one 4 by 4 feet, Gate hoist, ...				750	
Stop-logs, ...	400	feet b.m. at	0.10	40	2,849

Dam: (Cont'd)

Spillway section:

Excavation,				
Earth, ...	2,400 c.y. at	$1.00	$2,400	
Rock, ...	219 do.	3.50	766	
Concrete, plain, ...	384 do.	11.25	5,420	
plain, ...	75 do.	11.75	881	
light reinforced,	38 do.	20.00	760	
Flashboards, 10-ft. stop-chion type, . . .	150 lin.ft. at	18.00	2,700	
Steel, reinforcing, . . .	1,200 lbs. at	0.06	72	
Steel, handrail, ...	162 lin.ft.at	1.00	162	$11,161

Pipe line:

Excavation:				
Earth, ...			13,870	
Pipe, wood-stave, 3.83-ft. diam., ...	8,950 lin.ft.at	6.12	54,774	
Pipe, steel, 3.83-ft diam., ...	130,000 lbs.		11,700	
Concrete cradles, ...			6,980	
Concrete anchorages, ...	8 c.y. at	11.25	90	87,414

Penstock:

Excavation,				
Earth, ...			80	
Pipe:				
Steel, including fittings, ...	14,000 lbs. at	0.09	1,260	
Cradles, ...			45	1,385

Power house:

Substructure:

Excavation,				
Rock, ...	138 c.y. at	3.50	483	
Concrete, plain, ...	3 do.	11.25	34	
plain, ...	208 do.	16.25	3,380	
light reinforced, .	11 do.	20.00	220	
Valves, two 2-foot diam., ...			760	
Stop-logs, tailrace, ...	500 feet b.m. at	0.10	50	
Steel, reinforcing, ...	1,400 lbs. at	0.06	84	
Steel, structural, ...	2,700 lbs. at	0.10	270	5,278
Superstructure, ...	6,240 cu.ft.at	0.30		1,872

Equipment:

Water wheels, governors and draft tubes, two units totaling 2,678 horsepower, ...		14,560	
Generators and exciters, two units totaling 1,798 kilowatts, ...		15,232	
Switchboards, switches and auxiliary apparatus, 1,798 kilowatts at $10.00, ...		17,980	
Crane, on 5-ton, ...		1,250	
Supplies, . . 1,798 kilowatts at $0.50 , ...		899	49,921

Power house:				
Grading:				
Back filling, ...	390 c.y. at	$1.00	$390	
Riprap, ...	45 do.	3.00	135	
Retaining wall, concrete, . .	114 do.	11.25	1,273	$1,798
Tailrace:				
Excavation,				
Rock, ...	280 c.y. at	3.50		980
Total "A", ...				243,947
General expenses:				
Clearing reservoir, ...	25 acres at	20.00	500	
Relocation of telephone line, . .	1 mile at	280.00	280	
Transportation in lieu of R.R. siding, ...			6,000	
Plant, ...	10 per cent of "A"		24,395	
Camp, ...	1 per cent of "A"		2,440	
General construction, ...	4 per cent of "A"		9,758	43,373
Total "B", ...				287,320
Engine ring, superintendence and contingencies, ...	15 per cent of "B"		43,098	
Interest, during construction, ...	6 per cent of "B"		17,239	
Taxes, during construction, ...	1 per cent of "B"		2,873	
Insurance, during construction, . . .	1 per cent of "B"		2,873	66,083
Total "C", ...				353,403
Property and water rights:				
Land, ...	65 acres at	10.00	600	
Building, one set, ...			800	
Additional water rights, ...			10,400	
Pipe-line right of way, ...	2 miles at	1,000	2,000	13,500
Total cost, without transformer station, ...				366,903

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Step-up outdoor transformer station:				
Structure, ...			750	
Transformers and switches, ...			17,310	18,060
Total cost, including transformer station, . . .				384,963
			Say	385,000

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 2,800 horsepower.
Output per year, ... 11,600,000 kilowatt-hours.

Cost of installation.	Including transformer station
Total, ...	385,000
Per installed horsepower, ...	154

Cost f power production.

Fixed charges, 10.5 per cent of total cost, . .	40,425
Operation, $1.50 per 1,000 kilowatt-hours, . .	17,400
Total, ...	57,825
	Say 57,800
Per kilowatt-hour, ...	5 mills

MILE 3.75 DEVELOPMENT
Joes Brook (Passumpsic River basin), Vermont
(serial number 19)

Length of concrete retaining section, . .	332.5	feet
Length of intake section, ...	14	feet
Length of gate section, ...	10	feet
Length of spillway section, ...	162.5	feet
Total length of dam, ...	519	feet

Unwatering and stream control:					$4,504
Dam:					
Concrete retaining section:					
Excavation,					
Earth, ...	1,495	c.y. at	$1.00	$1,495	
Rock, ...	405	do.	3.50	1,426	
Concrete, ...	1,537	do.	11.25	17,291	20,214
Intake section:					
Excavation,					
Rock, ...	27	c.y. at	3.50	95	
Concrete, plain, ...	166	do.	11.75	1,951	
light reinforced, .	12	do.	20.00	240	
Gate, one 4.33 by 4.33 feet,)					
Gate hoist, ...)				800	
Racks, ...	56	sq.ft.at	4.00	224	
Vent pipes, ...	17	lin.ft.at	3.50	60	
Stop-logs, ...	1,000	feet b.m.at	0.10	100	
Steel pipe, ...	4,500	lbs. at	0.09	405	
Steel handrail, ...	14	lin.ft.at	1.00	14	3,889
Gate section:					
Excavation,					
Rock, ...	19	c.y. at	3.50	67	
Concrete, plain, ...	111	do.	11.25	1,249	
light reinforced,	8	do.	20.00	160	
Gate, one 4.5 by 4.5 feet,)					
Gate hoist, ...)				950	
Steel pipe, ...	3,780	lbs. at	0.09	338	2,764
Spillway section:					
Excavation,					
Earth, ...	1,034	c.y. at	1.00	1,034	
Rock, ...	272	do.	3.50	952	
Concrete, plain, ...	391	do.	11.25	4,399	
plain, ...	75	do.	11.75	881	
Bridge, ...				813	
Flashboards, 10-foot, . . .	150	lin.ft.at	18.00	2,700	
Steel, r inforcing, . . .	1,200	lbs. at	0.06	72	10,861

Pipe line:					
Excavation:					
Earth, ...	6,400	lin.ft.at	$1.40	$8,960	
Pipe, wood-stave, 52-inch,	6,400	d .	5.88	37,632	
Cradles, ...	6,400	do.	0.87	5,568	$52,160
Surge tank:					
Excavation,					
Earth, ...	17	c.y. at	1.00	17	
Concrete, ...	13	do.	11.25	146	
Steel, tank and riser, . .	35,752	lbs. at	0.09	3,218	
Steel, structural, (tower)	11,115	do.	0.10	1,112	4,493
Penstock:					
Excavation,					
Earth, ...	320	lin.ft.at	1.42	454	
Pipe, steel, including fittings, .	73,820	lbs. at	0.09	6,644	
Cradles, ...	320	lin.ft.at	0.87	278	
Concrete anchorages, ...	16	c.y. at	11.25	180	7,556
Power house:					
Substructure:					
Excavation,					
Rock, ...	118	c.y. at	3.50	413	
Concrete, plain, ...	3	do.	11.25	34	
plain, ...	177	do.	16.25	2,876	
light reinforced,	11	do.	20.00	220	
Valves, two 30-inch, ...				1,200	
Stop-logs, tailrace, . .	360	f.b.m.at	0.10	36	
Steel, reinforcing, . .	1,400	lbs. at	0.06	84	
Steel, structural, . .	2,640	lbs. at	0.10	264	5,127
Superstructure, ...	6,240	cu.ft.at	0.30		1,872
Equipment:					
Water wheels, governors, and draft tubes, two units totaling 1,136 horsepower, ...				16,100	
Generators and exciters, two units totaling 762 kilowatts, ...				9,632	
Switchboards, switches and auxiliary apparatus, 762 kilowatts at $10.00, ...				7,620	
Crane, 5-ton, ...				1,250	
Supplies, . . .	762	kilowatts at $ 0.50, ...		381	34,983
Grading:					
Back filling, ...	390	c.y. at	1.00	390	
Riprap, ...	30	do.	5.00	150	
Retaining wall, concrete,	60	do.	11.25	675	1,215

Power houses (Cont'd)

Tailrace:

Excavation:

Rock, ...	64 c.y. at	$3.50	$224	
Concrete, ...	5 do.	11.25	56	$280

Total "A", ... 149,908

General expenses:

Clearing reservoir, ...	11 acres at	40.00	440	
Transportation in lieu of R.R. siding, ...			3,500	
Plant, ...	10 per cent of "A")			
Camp, ...	1 per cent of "A")			
General construction, . . .	4 per cent of "A"). . .		22,486	26,426

Total "B", ... 176,334

Engineering, superintendence and contingencies, . .	15 per cent of "B")	
Interest, during construction,	6 per cent of "B")	
Taxes, during construction, . .	1 per cent of "B")	
Insurance, during construction,	1 per cent of "B")	40,557

Total "C", ... 216,891

Property and water rights:

Land, ...	.22 acres at	15.00	330	
Pipe-line right of way, . .	1.2 miles		1,200	
Additional water rights,.			3,900	5,430

Total cost, without transformer station, . . 222,321

Step-up outdoor transformer stations:

Structure, ...	750	
Transformers and switches, ...	8,990	9,740

Total cost, including transformer station, . 232,061

Say 232,000

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 1,070 horsepower.
Output per year, ... 4,840,000 kilowatt-hours.

Cost of installation,	Including transformer station
Total, ...	$232,000
Per installed horsepower, ...	217

Cost of power production,

Fixed charges, 10.5 per cent of total cost, . . .	24,360
Operation, $2.62 per 1,000 kilowatt-hour , . . .	12,943
Total, ...	37,303
Say	37,000
Per kilowatt-hour,. . .	7.5 mills.

MILE 1.0 DEVELOPMENT
Joes Brook (Passumpsic River basin) Vermont
(serial number 20)

Length of concrete retaining section, . .	156 feet
Length of intake section, ...	12 feet
Length of gate section, ...	12 feet
Length of spillway section, ...	195 feet
Total length of dam, ...	375 feet

Unwatering and stream control:				$7,030
Dam:				
Concrete retaining section:				
Excavation,				
Rock, ...	162 c.y. at	$3.50	$567	
Concrete, ...	553 do.	11.25	6,221	6,788
Intake section:				
Excavation,				
Rock, ...	10 c.y. at	3.50	35	
Concrete, plain, ...	118 do.	11.25	1,328	
light reinforced,	8 do.	20.00	160	
Gate, one 4.33 by 4.33 feet,)				
Gate hoist, ...)			750	
Racks, ...	64 sq.ft.at	4.00	256	
Vent pipe, ...	18 lin.ft.at	3.50	63	
Stop-logs, ...	500 feet b.m. at	0.10	50	
Steel pipe, ...	2,500 lbs. at	0.09	225	2,867
Gate section:				
Excavation,				
Rock, ...	24 c.y. at	3.50	84	
Concrete, plain, ...	162 do.	11.25	1,823	
light reinforced,	5 do.	20.00	100	
Gate, one 4.5 by 4.5 feet,)				
Gate hoist, ...)			950	
Stop-logs, ...	600 feet b.m. at	0.10	60	
Racks, ...	30 sq.ft.at	0.50	15	
Steel pipe, ...	3,800 lbs. at	0.09	342	3,374
Spillway section:				
Excavation,				
Rock, ...	520 c.y. at	3.50	1,820	
Concrete, plain, . . .	1,730 do.	11.25	19,463	
plain, ...	90 do.	11.75	1,058	
light reinforced,	45 do.	20.00	900	
Flashboards, 10-ft. stan-chion type, ...	180 lin.ft.at	18.00	3,240	
Steel, reinforcing, . .	1,450 lbs. at	0.06	87	
Steel, handrail, ...	195 lin.ft.at	1.00	196	26,763

Mile 1.0

Pipe line:					
Excavation,					
Earth, ...	2,800	lin.ft.at	$1.40	$3,920	
Pipe, wood-stave, 4.5-ft.					
diam., ...	2,800	do.	6.16	17,248	
Cradles, ...	2,800	do.	0.87	2,436	$25,604
Surge tank:					
Excavation,					
Earth, ...	32	c.y. at	1.00	32	
Concrete, ...	15	do.	11.25	169	
Steel, tank, ...	25,700	lbs. at	0.09	2,313	
Steel, structural, . . .	26,000	do.	0.10	2,600	5,114
Penstock:					
Excavation,					
Earth, ...				613	
Pipe:					
Steel, including					
fittings, . .	99,600	lbs. at	0.09	8,964	
Concrete cradles, ...				384	
Concrete anchorages, ...	16	c.y. at	11.25	180	10,141
Power house:					
Substructure:					
Excavation,					
Rock, ...	40	c.y. at	3.50	140	
Concrete, plain, ...	114	do.	16.25	1,853	
light reinforced,	16	do.	20.00	320	
Valves, two 2.5-ft. diam., ...				1,280	
Stop-logs, tailrace, . .	150	feet b.m. at	0.10	15	
Steel, reinforcing, . .	1,100	lbs. at	0.06	66	
Steel, structural, . .	2,410	do.	0.10	241	5,915
Superstructure, ...	6,240	cu.ft. at	0.30	1,872	1,872
Equipment:					
Water wheels, governors and draft tubes, two units totaling 1,044 horsepower, ...				16,100	
Generators and exciters, two units totaling 700 kilowatts, ...				10,304	
Switchboards, switches and auxiliary apparatus, 700 kilowatts at $10.00, ...				7,000	
Crane, one 5-ton, ...				1,250	
Supplies, . . 700 kilowatts at $ 0.50, ...				350	35,004
Grading:					
Back filling, ...	390	c.y. at	1.00	390	
Riprap, ...	14	do.	3.00	42	
Retaining wall, concrete,	16	do.	11.25	180	612

Power house: (Cont'd)

Tailrace:

Excavation,

Rock, ...	20 c.y. at	$3.50	$70	
Concrete, ...	3 do.	11.25	34	$104

Total "A", ... 127,188

General expenses:

Relocation of road, 14-ft.gravel, 0.7 mile at	22,000	15,400	
Relocation of telephone line, 1.0 mile at	280	280	
Transportation in lieu of R. R. siding, ...		620	
Plant, ...	10 per cent of "A"	12,719	
Camp, ...	1 per cent of "A"	1,272	
General construction, ...	4 per cent of "A"	5,088	35,379

Total "B", ... 162,567

Engineering, superintendence and contingencies, ...	15 per cent of "B"	24,385	
Interest, during construction, . . .	6 per cent of "B"	9,754	
Taxes, during construction, ...	1 per cent of "B"	1,626	
Insurance, during construction, . . .	1 per cent of "B"	1,626	37,391

Total "C", ... 199,958

Property and water rights:

Land, ...	32 acres at $25.00	800	
Buildings, ...	one set	800	
Additional water rights, ...		3,800	
Pipe-line right of way, . . .	0.6 mile at 1,000	600	5,400

Total cost, without transformer station, . . . 205,358

Step-up outdoor transformer station:

Structure, ...	750	
Transformers and switches, ...	11,176	11,926

Total cost, including transformer station, . . 217,284

Say 217,000

Summary, including cost of power production.

Installed power, 80 per cent efficiency, ... 980 horsepower.
Output per year, ... 4,480,000 kilowatt-hours

Cost of installation,	Including transformer station
Total, ...	217,000
Per installed horsepower, ...	221
Cost of power production,	
Fixed charges, 10.5 per cent of total cost, .	22,785
Operation, $8.82 per 1,000 kilowatt-hours, ..	12,577
Total, ...	35,362
Say	35,400
Per kilowatt-hour, . . .	7.9 mills.