INVESTIGATION OF THE RESOURCES
OF THE DELAWARE RIVER BASIN

THESIS C. E. - 62

R. A. WINKLER AND E. J. SHOOSMITH

U.S. GEOLOGICAL SURVEY
J. W. POWELL, DIRECTOR

PENNSYLVANIA-NEW JERSEY
EASTON SHEET

Henry Gannett, Chief Topographer.
Marcus Baker, Geographer in charge.
Triangulation by Geological Survey of New Jersey.
Topography by Geological Survey of New Jersey and W. R. Atkinson
Surveyed in 1887-8

G.S. of N.J.
Atkinson

Scale $\frac{1}{62.500}$

0 ½ 1 2 3 4 5 Miles

Contour Interval 20 feet.
Datum is mean Sea level.

Edition of Oct. 1891. reprinted June 1900.

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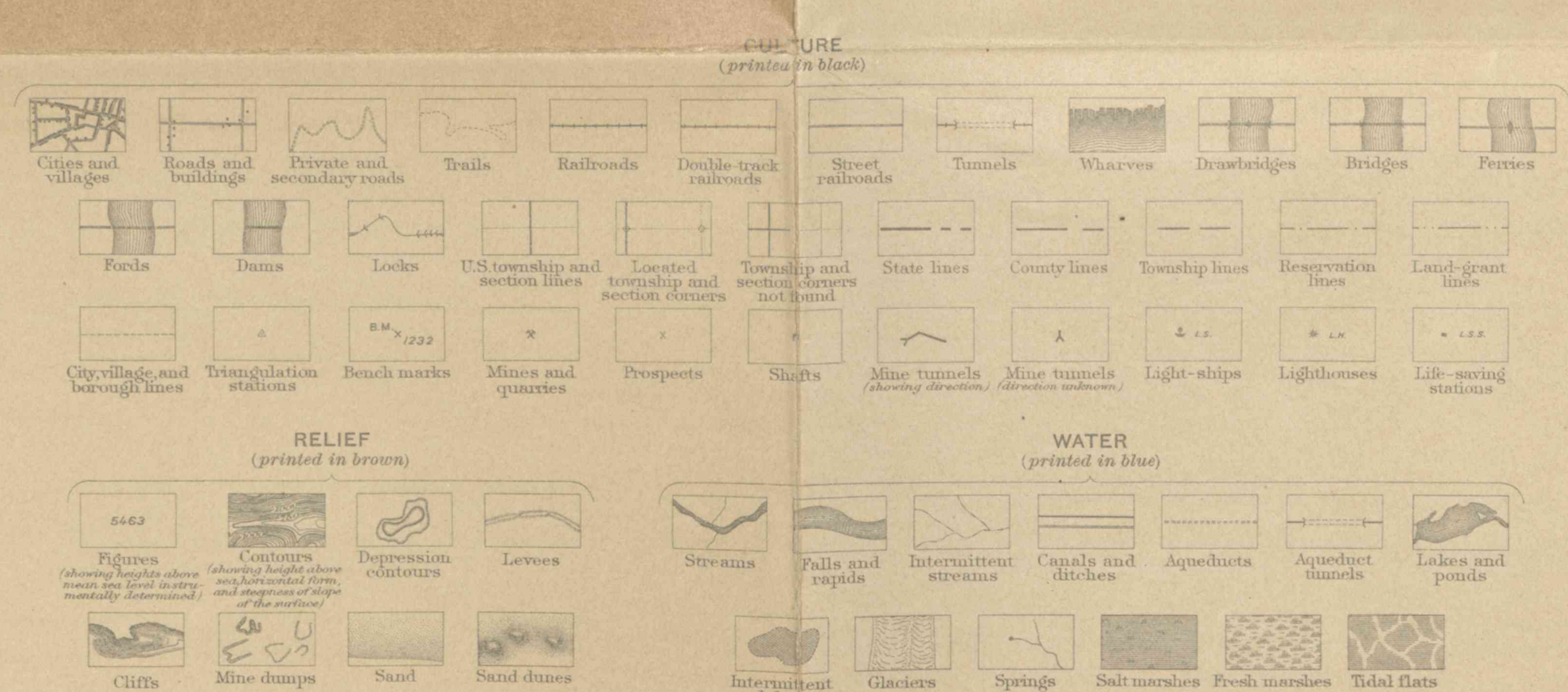
CONVENTIONAL SIGNS



U.S.GEOLOGICAL SURVEY.
J.W.POWELL, DIRECTOR.

PENNSYLVANIA–NEW JERSEY
DELAWARE WATER GAP SHEET

Henry Gannett, Chief Topographer.
Marcus Baker, Geographer in charge.
Triangulation by U.S.Coast and Geodetic Survey.
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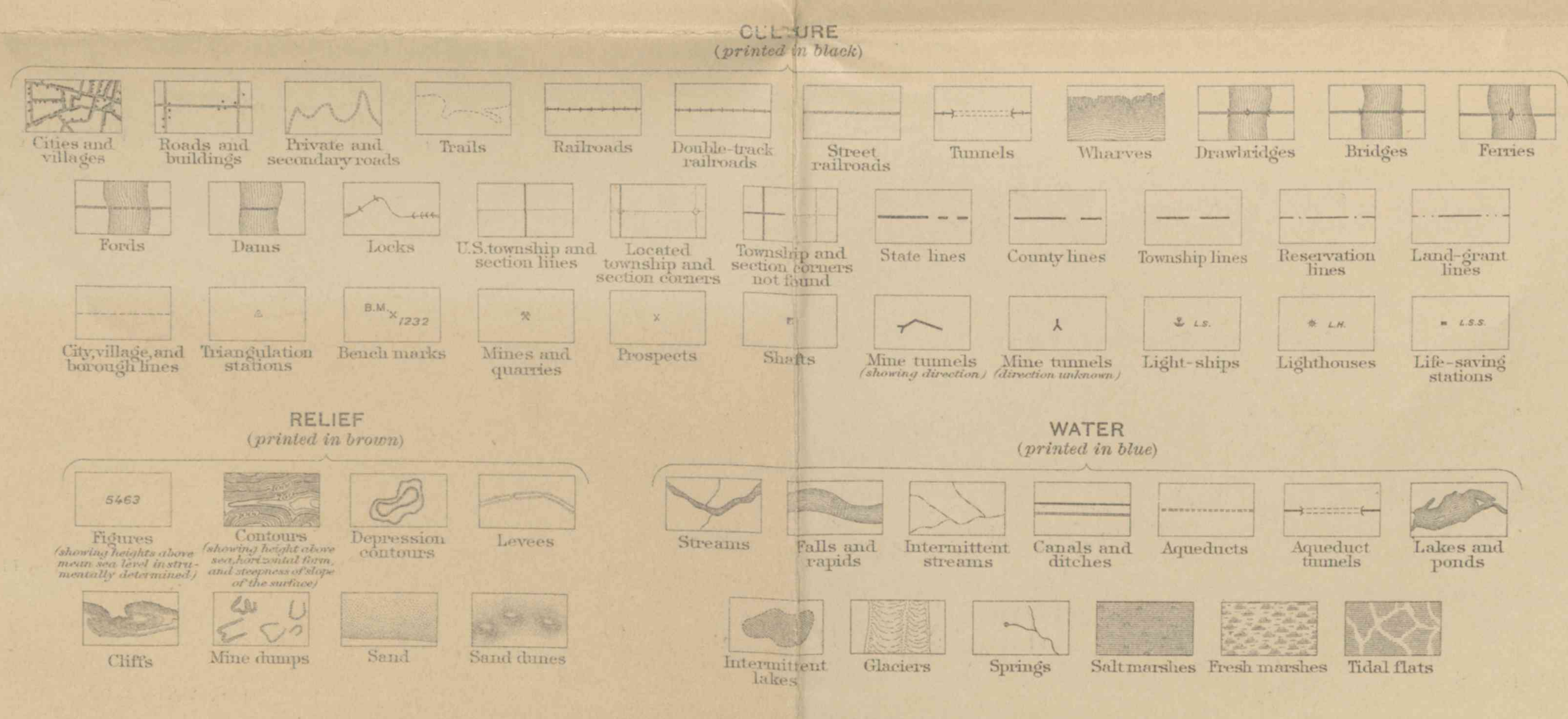

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SUBMITTED BY

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LAFAYETTE COLLEGE

DEPARTMENT OF CIVIL ENGINEERING

JUNE 195~~0~~2

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INTRODUCTION

This thesis is written in an attempt to show the importance of the waters of the Delaware River and how they may be utilized with reference to water supply, flood control, recreational aspects and additional power requirements, with emphasis upon the proposed project at Wallpack Bend.

This importance of the Delaware River Basin is further increased by its location in one of the most important industrial areas of the world. This area includes the states of New York, Pennsylvania, New Jersey, and Delaware, and such major cities as New York, Philadelphia, Trenton, and Wilmington. The ever-expanding industrial program of this region, such as the construction of the new United States Steel Company plant at Morrisville, Pennsylvania, will undoubtedly result in additional water problems to those already existing.

Engineers throughout the country have been solving similar problems by construction programs such as the Tennessee Valley Authority, Hoover Dam on the Colorado River, and the Grand Coulee and McNary Dams on the Columbia River.

Since there has been no large scale development of the water resources of this region, a program of this type is long overdue. To a large extent the future of this country depends upon the welfare and prosperity of this area. This region cannot continue to thrive without an adequate source of good water.

I.. NEED FOR UTILIZING THE WATERS OF THE DELAWARE BASIN

Studies of population, water consumption and capacity of available existing supplies indicate that within the next thirty years the Northern New Jersey Metropolitan District and the area served by New York City will need an additional 465 million gallons of water daily. Within a period of another twenty years (1980 to 2000) the requirements of these areas will probably increase by an equal quantity.

Philadelphia's existing sources of supply from the Schuylkill River and the Delaware River are adequate in quantity but, because of pollution, inferior in quality. For the past thirty years a better source of upland water supply has been advocated for this city.

There is an immediate need for increasing the dry weather flow at Trenton to at least 4000 cubic feet per second and possibly to about 4800 cubic feet per second. Under present conditions, the natural summer flow at Trenton averages approximately 2300 cubic feet per second, but often falls below 2000 cubic feet per second. When the spring run-off comes, at least fifty percent of the Delaware's total annual water yield will rush to the sea over a period of three and one-half months. This leaves insufficient water to keep the river at a proper level and still supply the needs of the area for the remaining eight and one-half months. When the river flow drops below a certain level at Trenton, salt water from the ocean intrudes into the river. The resultant damage has cost enough over the years to build many dams.

What this salinity does to the great manufacturing industries of the lower Delaware is evidenced by the great deal of expense necessary to soften millions of gallons of water daily which are taken directly from the river. During high salinity periods, manufacturing plants depending on fresh water either have to import water in tank trucks - a ridiculously expensive process - or install costly evaporators to eliminate the salt.

This salinity problem is a hindrance to any new industries being contemplated, and, unless a satisfactory water supply is assured within a reasonable time, existing companies might be inclined to divert some of their manufacturing operations to some other location.

II. COMPANIES AND ADMINISTRATIVE BODIES INTERESTED IN UTILIZING THE DELAWARE RIVER.

A. Utility Companies

In addition to the water companies of the New York and Philadelphia areas, several power companies are interested in the water control problem. Public Service of Newark has fallen behind the demand for power over the past few years and is in need of an additional source. New Jersey Power and Light Company is confronted with the same problem.

The Pennsylvania Power and Light Company, which covers a district larger than that of any single power company in the east, already has a steam generating plant under construction at Martin's Creek on the Delaware River. It would be profitable for them to connect their system with a hydro-power project which would develop from this utilization program.

B. Incodel - Their Program

The most active organization concerned with the Delaware River is the Interstate Commission on the Delaware River Basin - otherwise known as Incodel. This is an agency of the states of Pennsylvania, New Jersey, New York, and Delaware. It was created in 1936 and is composed of five members from each of the four states.

The Legislatures of Pennsylvania, New Jersey, and New York directed Incodel in 1949 to make a comprhensive engineering survey of the Delaware River Basin, and to recommend a water conservation project that would assure adequate water supplies in future years for millions of persons residing within the metropolitan areas of the basin states.

Acting under this directive, Incodel proposed in January, 1951, that the states enter into an interstate compace setting up an administrative agency to carry out a water supply and stream flow regulation program that would benefit residents and industries alike.

Incodel proposed the following twelve point conservation program for the Delaware River Basin:

1. Unified Basin Development - to formulate a unified and sound plan for development of the Delaware River Basin..

2. Water Supply - to integrate the activities of New York, New Jersey, and Pennsylvania in planning future water supply projects.

3. Flood Control - to promote the co-ordination of federal, state and local government projects for flood control.

4. Industrial Waste - to encourage the installation of works for the treatment and recovery of industrial wastes.

5. Municipal Sanitation - to assist governmental agencies in forwarding the construction of sewage collection and treatment plants.

6. Forestry - to compaign for the institution of appropriate forest protection measures.

7. Soil Conservation - to secure the adoption of a basin wide program to prevent soil erosion.

8. Schuylkill River Restoration Project - to work for the early completion of the Schuylkill River clean-up project.

9. Navigation - to protect "State's interests" in the development of federal navigation projects.

10. Port and Transportation - to urge improvements and extensions of port and transportation facilities.

11. Ground Water Protection - to secure the acceptance of programs for the protection of ground water resources.

12. Recreation - to aid in the protection and promotion of the recreational assets of the region.

Incodel's program assumes that the power features of the proposed project would be constructed and financed by the public agency representing the joint interests of the four states involved and that the power facilities would be leased to and operated by locally established, privately owned power companies.

III. SITES SELECTED FROM INVESTIGATIONS

A. General Survey of the Delaware River Basin

The upper third of the Delaware River Basin above Wallpack Bend is sparsely settled andlargely wooded. It is rugged land with a high yield of water. Because the underlying rocks are largely insoluble, the water flowing over them is ideally soft.. The forest blanket on the steep slopes protects the soil cover from erosion, resulting in water with relatively little turbidity.. The annual water crop from this area is of highest value for use as water supply and stream flow regulation. It can be collected at high elevations, permitting its delivery to centers of need by gravity.

B. Sites Chosen Under the Incodel Plan

The first proposed unit on Incodel's project is a 2000 foot dam on the West Branch of the Delaware River at Cannonsville, New York. After Cannonsville, the project calls for a pair of reservoirs approximately 75 miles to the southeast - a small one at Barryville, straddling the Delaware River on the New York-Pennsylvania line, and a huge one on the lower Neversink, extending from Godeffroy to Summitville in New York State. The preceding stages of the project are already under construction.

After Godeffroy will come a reservoir approximately 45 miles down-river at Wallpack Bend, on the Delaware itself between New Jersey and Pennsylvania.

The structure at Cannonsville, a vital cornerstone to the whole plan for harnessing the Delaware, would hold back 117,500,000,000 gallons in the headwaters, where nature is most wasteful at the time of the spring run-off. This site affords control over a greater length of the river and a good quality water supply located advantageously with regard to New York City as to elevation and distance.

The Barryville reservoir would catch the waters of a vast drainage area, covering 2756 square miles, and divert them to Godeffroy, 17 miles to the east. This would be done by means of a monstrous tunnel 25 feet in diameter.

The Godeffroy reservoir, 4500 feet long and 165 feet high, would have a tremendous storage capacity of 263,000,000,000 gallons. Its own tunnel, 65 miles long and 1000 feet below the surface at some places, would carry water to Brooklyn and Northern New Jersey reservoirs.

Engineers estimate that the Cannonsville, Barryville, and Godeffroy projects, coupled with New York City's new reservoirs, can fill out the water needes of New York City and Northern New Jersey until at least 1980.

A large lake created by a dam at Wallpack Bend would assure a continuous flow of water each day, if needed, to boost the river in the Philadelphia and New Jersey areas, and would serve as a backstop for any additional water supply which those areas might need in the future.

This thesis is primarily concerned with the activities of Incodel and their proposal for a dam at Wallpack Bend.

IV. REASONS FOR THE SELECTION OF WALLPACK BEND

A. Topographic and Geologic Features

In past ages the Pocono region has been extensively eroded by glacial action leaving a plateau of elevation varying from about 600 feet to over 2,000 feet above sea level. Due to this glacial action there are typically many swampy areas at the headwaters of the streams. In some cases, the valleys have been filled with glacial material which later was partially eroded by the present streams. Thus, it is not uncommon to find ledge rock exposed on one side of a valley and deep glacial drift on the other. The ledge rock is frequently covered by glacial material of great and unknown depth, but where exposed, it usually is of good quality at reasonable depth as it has been subjected to only comparatively recent weathering.

The steepness of the stream slopes and the prevalence of glacial deposits result in a rarity of dam sites sufficiently low on the watersheds to permit storage of a large proportion of the total yield.

At the Wallpack Dam site the right abutment (looking downstream) is a steep limestone rock cliff rising rapidly to an elevation far above the flow line of the reservoir. At places this cliff is deeply weathered and has a mantle of residual material covering to a depth of some 20 feet or more, while at other points the ledge rock is exposed. The Delaware River at this point is about 400 feet wide at normal stages.

The limestone is of close texture; dark gray-blue in color; hard, with some partings of hard shale but no evidence of extensive cavities common in softer limestone. The shale interlayers areadvantageous as a deterrent to passage of water through the rock.

At the left abutment the surface rises gently from the river bank and the ledge rock near the river is covered with a mantle of alluvial material and glacial outwash to an average depth of perhaps 50 feet. Beyond the main dam there is a saddle where ledge rock is exposed or is covered by a few feet of residual material and top soil. To the left of this saddle the ground which shows ledge rock at or near the surface rises rapidly to an elevation high above the flow line of 420.

B. Population

In general, the area is heavily forested and largely devoted to recreational purposes and farming with a minimum of industrial development. The largest municipality on any of the watersheds is Honesdale, which has a population of about 6,000.

The density of resident population of the Pocono region is about 34 persons per square mile but due to the camps, cottages, resort hotels and hunting lodges throughout the area, the summer population is increased to approximately 41 persons per square mile.

Above Wallpack Bend where the watershed area is 3735 square miles, the only other scattered municipalities of any considerable size are Liberty, population about

5,000, Monticello, about 4,000 and Port Jervis, population about 10,000. In this area the density of resident population is only about 31 persons per square mile.

C. Hydrologic Features of River

The East and West Brahches of the Delaware have their sources in the Catskill Mountain region of Eastern New York, at elevation above 2,000 feet, and unite near the New York-Pennsylvania boundary to form the main river. The course is then in a generally southeasterly direction to Port Jervis where the river makes a sharp bend to the southwest and continues in that direction to a short distance below the mouth of the Lehigh, where it again changes direction and continues southeasterly to below the head of tidewater at Trenton and thence southwesterly to Delaware Bay.

In the upper portion of the watershed, the topography is mountainous and contains numerous lakes and ponds. Below the Water Gap, where the river cuts through the Kittatiny Ridge, the valley gradually widens and the precipitous sides become gently sloping hillsides.

Delaware River water at Wallpack Bend is a typical upland stream water, only lightly polluted and coming well within the recommended standards of the U. S. Public Health Service for raw water at the source of supply. Analyses of this water at Dingman's Ferry made by the Department of Health of the State of New Jersey from 1923 to 1944, and analyses of samples of water taken from the river at the same location for the Board of Consulting Engineers in

1945, show the B. coli content to average less than forty percent of that allowable under the U. S. Public Health Service recommendations.

The water is relatively low in color and turbidity, indicating only light loading for the filtration process. Coagulation of this water is readily accomplished with moderate chemical dosages as has been demonstrated by actual treatability tests. The water is soft and is low in total alkalinity, with some addition of alkalinity being necessary at times. No special treatment would be required generally for tastes or odors although during short periods, microscopic growths might make such treatment desirable but this could readily be coordinated with the filtration process. Provision for taste and odor treatment is necessary for any upland sources of supply.

V. WALLPACK BEND DAM

A. Quantitative Analysis of Available Water Possible

The stream flow records of the United States Geological Survey and of the Pennsylvania Water and Power resources Board were used in all hydraulic computations. The so-called "Incodel" period, embracing the 13 water years between October 1, 1928 and September 30, 1941, was the period considered..

Comparison with all records of flow for the streams involved shows that the "Incodel" period spans the lowest flow critical interval of recorded stream flow history on the Delaware River watershed.. Watershed areas were determined by checked planimeter measurement of the latest revised topographic maps of the Federal Government, some of which have been included in this report.

To allow for evaporation from the water surfaces created by proposed reservoir, the maximum water area of the reservoir was deducted from the watershed area above the dam site and the remainder recorded as "net watershed area" in all computations and tables dealing with reservoirs. The assumption that all rain which falls on the maximum area of the reservoir is lost through evaporation constitutes a safe and conservative method for taking care of additional evaporation from water surfaces in this climate..

Thus, from Incodel's "Area And Capacity Curves For Wallpack Bend Reservoir" it was found that for an elevation of 420 feet (headwater elevation), there would be a water surface area of 9,500 acres, and a storage capacity of 372,-000 acre-feet. For an elevation of 377 feet, the water surface area would be 3,800 acres and the storage capacity would be 86,000 acre-feet; and for an elevation of 360 feet, the water surface area would be 2,400 acres and the storage capacity would be 36,400 acre-feet.

B. Description of Dam and Reservoir Proposed by Incodel

The maximum height of the concrete masonry dam from foundation to roadway will be about 170 feet and its length about 1850 feet. The overflow section of the dam will be provided with 22 Taintor gates capable of discharging a flood of 240,000 cubic feet per second without rise in headwater elevation at the dam. The greatest flood of record occurred on October 10, 1903 and developed a flow of 220,000 cubic feet per second as recorded at Belvidere, N. J.. which would be equivalent to a flow of approximately 190,000 cubic feet per second at Wallpack Bend.. Provision of crest gates is essential because it is necessary to minimize rise headwater during a flood which otherwise might cause material damage in Port Jervis.

There will be six conduits with slide gate control, through the overflow section of the dam to provide for release of water when water in the reservoir is below the elevation of the sills of the Taintor regulating gates..

The section of the dam is conservatively designed for a 50% uplift assumption. There are two galleries in the dam, the upper one being for access to and operation of the slide gates controlling the conduits for release of compensation water and the lower gallery for grouting and drainage of the foundation. The grouting will be done by stage grouting methods, and after the grouting is completed the five inch diameter drainage holes are to be drilled into the foundation from the downstream side of the gallery.

The top of the dam will support a roadway of width sufficient for two lanes of traffic. The mechanism for operating the Taintor gates will be located beneath the roadway.

At the left of the overflow section on the New Jersey side of the dam will be located a non-overflow gravity section of concrete masonry dam in which provision will be made for penstocks leading to a possible future power plant. Beyond this section the non-overflow masonry dam will project a short distance into an earth dam section which will be wrapped around the masonry dam in the form of a cone. A steel sheet pile cut-off extending to ledge rock is provided under this earth dam but there is no need for a similar cut-off in the saddle as here the earth dike is founded on ledge rock.

An outlet tower with racks and control gates for withdrawl of water at three levels will be located a short distance upstream from the dam to provide for entry of water through a shaft into the conduit leading to Philadelphia.

Should it be found advisable a fish ladder or fish way could be provided in this dam to permit fish to pass upstream at time of spawning.

In order to comply with the rules and regulations of the Interstate Commission on the Delaware River Basin, the Pennsylvania Water and Power Resources Board and the decision by the United States Supreme Court governing release of water for use and benefit of downstream communities and individual riparian owners, the Board adoptedthe following formual:- Whenever the flow of the stream is equal to or less than 0.6 cubic feet per second per square mile of watershed area above the point of development, all the natural flow of the stream shall be released. Whenever the natural flow of the stream at the point of development exceeds 0.6 cubic feet per second per square mile of watershed area above the point of development, at least 0.2 cubic feet per second per square mile shall be released.

The reservoir above the dam will extend northwestward up the Delaware River to about the Matamoras-Port Jervis highway bridge and northward up the Neversink River to about two miles above the Tristate Rock. The lake thus formed will be some 30 miles in length, on-half mile in width for much of its length and will have an area of approximately 9,500 acres.

The reservoir when filled to flow line level at elevation 420 will have a storage capacity of 121.5 billion gallons (372.2 thousand acre-feet) and at 43 feet maximum drawdown will have a residual capacity of 30 billion gallons (92 thousand acre-feet) thus profiding effective storage capacity of 91.5 billion gallons (280.2 thousand acre-feet).

C. Location Survey

1. Descriptive

The following location survey, dam center-line stake-out, and profile were made possible through data obtained from Mr. Franz of the Bethlehem office of Incodel. His assistance was highly appreciated.

Since topography maps were obtained from the U. S. Chief of Geologic Surveys and Incodel, the location survey and dam center-line profile were all that was necessary to round-out the picture at Wallpack Bend. Two trips were made to the dam site early in March, but inclement weather prevented any extensive field work from being accomplished.

Because of the steep river bank and thick forest on the Pennsylvania side of the Delaware River, a horizontal control traverse was run from an old copper mine monument located approximately one-half mile southwest of Flatbrookville, New Jersey, to the northwest terminus of the dam proposed by Incodel.

The complete traverse was run by a three man crew, the system field notes shown on the following pages being adopted for simplicity. Time did not permit a fine adjustment of the traverse.

The center-line of the dam was staked out, using this terminus as station 0 plus 00 and elevation 441.00 feet above sea level.

For obtaining the profile of the river bed along this established center-line, it was necessary to rent a boat at Rosencran's Ferry, about 1½ miles upstream from the dam location. The water line elevation was established from station 20 plus 00 south.. One crew member was required to keep the boat as near line as possible at approximate 50 foot stations while another sounded the river bed with a 20 foot length of 1½ inch pipe marked at one-half foot intervals. The transitman on the New Jersey shore aided by reading approximate stadia distances while keeping the boat on line.

Control stakes were set 150 feet below and above the dam center-line on the New Jersey bank but time did not permit any more river sections to be taken..

Above picture was taken at Rosencran's Ferry, our point of embarkation on the Delaware River. This point is about $1\frac{1}{2}$ miles from proposed dam site, as indicated on the Corps of Engineers Flatbrookville Quadrangle.

Heading downstream with full equipment. Pennsylvania shore seen in background.

Approaching dam site. Top of valley ridge increasing in elevation.

Exposed ledge rock on Pennsylvania side which would form tie-in of abutment..

Photographs of Wallpack Bend showing steep rising slopes
and forestry conditions existing.

Looking downstream below dam site showing gradually declin-
ing ridge and a good indication of the width of the river.

Carrying center line of dam through heavy brush and trees.

Establishing line to edge of river at proposed site of dam..

Set-up on center line of dam, New Jersey side, opposite exposed ledge rock on Pennsylvania side of river.

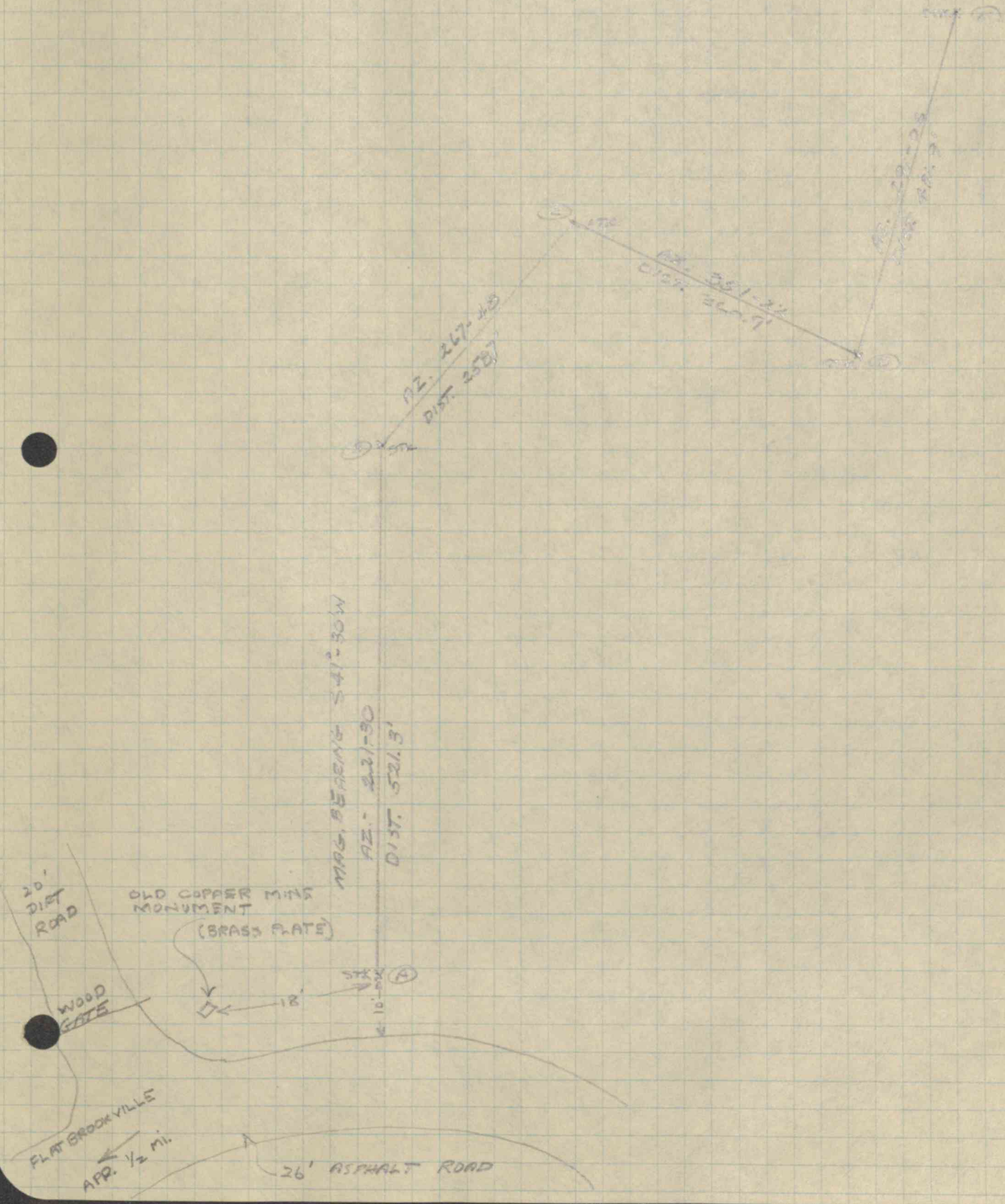
DATE: 4/10/52
TEMP.: 61° F
WEATHER - CLEAR, WINDY.
SHEET 1 OF 4

WALLPACK DEAD SURVEY
NEW JERSEY TRAVERSE

INST. - WINKLER
ROD & CHAIN - SNOOSMITH, RUSK.

LOCATION SURVEY WAS STARTED FROM A STAKE WHICH WAS DRIVEN IN THE LOCATION SHOWN.

USED AZIMUTH SYSTEM, 0° - 00' MAGNETIC NORTH.

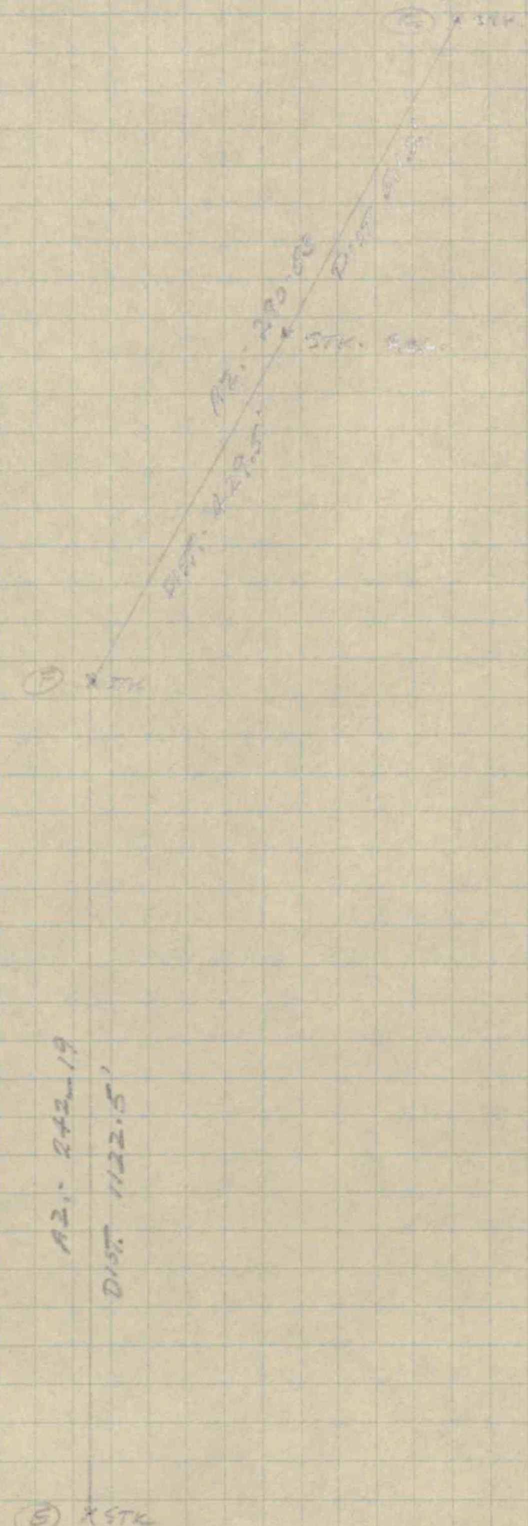


DATE: 4/10/62 25
TEMP: 50°F
WEATHER: CLEAR WINDY
SHEET 2 OF 4

WALLPACK BEND SURVEY
N. J. TRAVERSE

INST. - WILK...
ROD & CHAIN - SHOEMITH, DUSK.

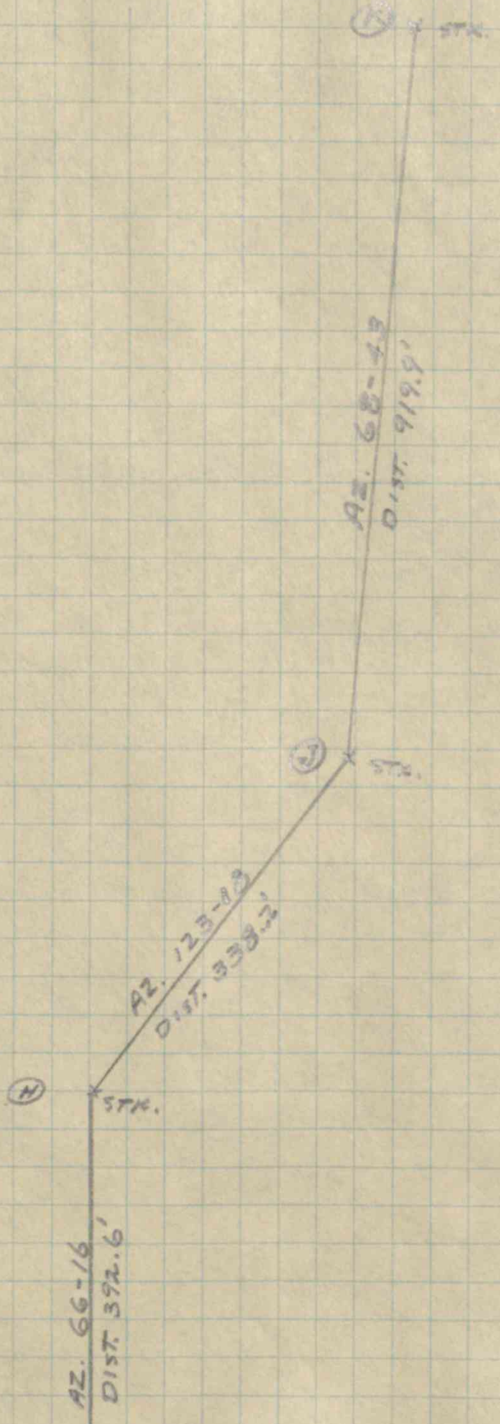
G N W GROUND STAKE OF DAM ¢.



WALLPACK BEND SURVEY
N. J. TRAVERSE

INST. - SHOOSMITH
ROD & CHAIN - WINKLER, RUSK

DATE 4/11/62
TEMP. 48°F
WEATHER - CLOUDY
SHEET 3 OF 4

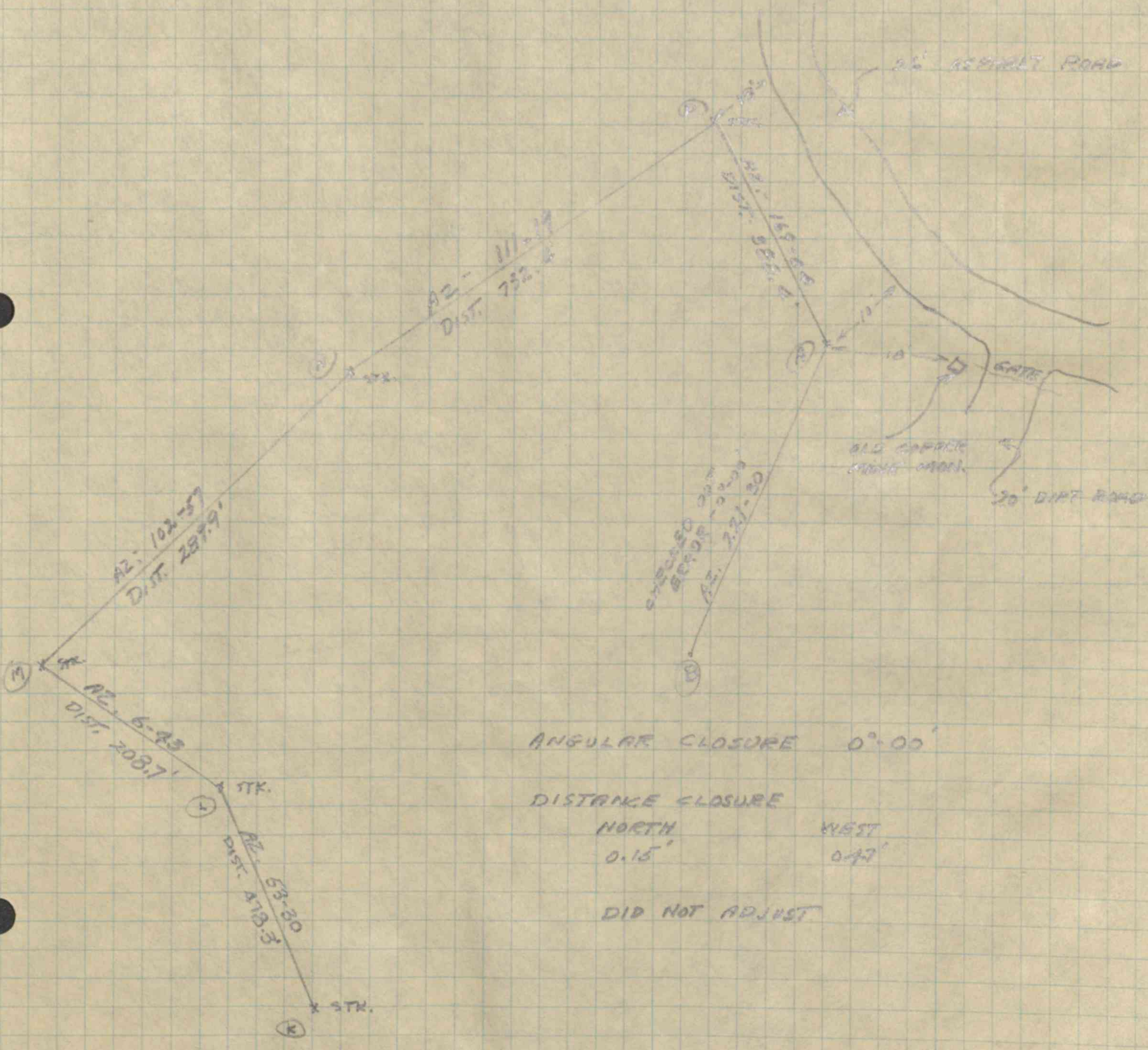


NW GROUND STAKE OF DAM ℄.

WALLPACK BEND SURVEY
NEW JERSEY TRAVERSE

DATE - 4/11/62
TEMP. 46°F
WEATHER - CLOUDY
SHEET 4 OF 4

INST. - SHOODSMITH
ROD & CHAIN - WHARLEY, RUSK



ANGULAR CLOSURE 0°-00'

DISTANCE CLOSURE

NORTH	WEST
0.15'	0.47'

DID NOT ADJUST

CLOSURE OF N.J. TRAVERSE, WALLPACK BEND SURVEY

ANGULAR CLOSURE

STATION	INTERIOR ANGLE (° - ')
B	133 - 42
C	95 - 86
D	240 - 16
E	228 - 47
F	131 - 26
G	44 - 37
H	122 - 58
J	234 - 35
K	195 - 13
L	226 - 47
M	83 - 46
N	171 - 38
P	122 - 15
A	127 - 34
	2151 - 540
	+ 9
	2160° CHECK

NO. OF ANGLES = 14

(N-2) = 12

12 × 180° = 2160°

$\frac{540}{60} = 9°$

Closure of New Jersey Traverse, Wallpack Bend Survey

Computation of Latitude & Departure

Quantity	Departure East	Departure West	Log Sine	Log Cos	Latitude North	Latitude South
S 41-30W			$\bar{1}.82126$	$\bar{1}.87446$		
521.3'			2.71709	2.71709		
A to B		345.42'	2.53835	2.59155		390.43'
S 87-48W			$\bar{1}.99968$	$\bar{2}.58419$		
256.8'			2.40960	2.40960		
B to C		256.61'	2.40928	0.99379		9.86'
N 8-38W			$\bar{1}.17641$	$\bar{1}.99505$		
360.9'			2.55739	2.55739		
C to D		54.18'	1.73380	2.55244	356.81'	
N 68-54W			$\bar{1}.96986$	$\bar{1}.55630$		
431.9'			2.63538	2.63538		
D to E		402.93'	2.60524	2.19168	155.48'	
S 62-19W			$\bar{1}.94720$	$\bar{1}.66706$		
1122.5'			3.05019	3.05019		
E to F		994.00'	2.99739	2.71725		521.50'
N 69-07W			$\bar{1}.97049$	$\bar{1}.55202$		
940.7'			2.97345	2.97345		
F to G		878.90'	2.94394	2.52547	335.33'	
N 66-16E			$\bar{1}.96162$	$\bar{1}.60474$		
392.6'			2.59395	2.59395		
G to H	359.39'		2.55557	2.19869	158.01'	
S 56-42E			$\bar{1}.92211$	$\bar{1}.73959$		
338.2'			2.52917	2.52917		
H to J	282.67'		2.45128	2.26876		185.68'
N 68-43E			$\bar{1}.96932$	$\bar{1}.55988$		
919.9'			2.96374	2.96374		
J to K	857.16'		2.93306	2.52362	333.90'	
N 53-30E			$\bar{1}.90518$	$\bar{1}.77439$		
459.6'			2.66238	2.66238		
K to L	369.45'		2.56756	2.43677	273.38'	
N 6-43E			$\bar{1}.06804$	$\bar{1}.99701$		
208.7'			2.31952	2.31952		
L to M	24.41'		1.38756	2.31653	207.27'	
S 77-03E			$\bar{1}.98881$	$\bar{1}.35044$		
289.9'			2.46225	2.46225		
M to N	282.53'		2.45106	1.81269		64.97'
S 68-41E			$\bar{1}.96922$	$\bar{1}.56053$		
732.4'			2.86475	2.86475		
N to P	682.29'		2.83397	2.42528		266.24'
S 10-56E			$\bar{1}.27799$	$\bar{1}.99204$		
388.40'			2.58928	2.58928		
P to A	73.67'		1.86727	2.58132		381.35'
Totals	2931.57	2932.04			1820.18	1820.03

-2931.57   -1820.03

Error 0.47' Dep.   0.15' Lat.

WALLPACK BEND SURVEY

DATE - 5/10/52
TEMP - 52°
WEATHER - CLOUDY
SHEET 1 OF 2

℄ STAKE-OUT

INST. - WINKLER
ROD & CH. - SHOOSMITH, RUSK

AZ. 169-50

SET STAKES AT 100' STATIONS — 1+70 N

1+00 N

RIDGE SLOPE, STA 1+00 N TO 2+00 S, SOME EXPOSED ROCK SURFACES

0+00 — STA (G) OF TRAVERSE

BACKSIGHT ON (F) AZ. 116-53

1+00 S

ROLLING TOPOGRAPHY, WOODED, WITH SLIGHT UNDERBRUSH STA 2+00 S TO 10+00 S

2+00 S

3+00 S

4+00 S

5+00 S

6+00 S

7+00 S

8+00 S

GRADUAL SLOPE, THICK SHRUB UNDERBRUSH, STA 10+00 S TO 13+50 S

9+00 S

10+00 S

11+00 S

12+00 S

13+00 S

WALLPACK BEND SURVEY

DATE - 5/10/52
TEMP - 52°
WEATHER - CLOUDY
SHEET 2 OF 2

℄ STAKE-OUT

INST. - WINKLER
ROD & CH. - SHOOSMITH, RUSK

SET STAKES AT 100' STATIONS

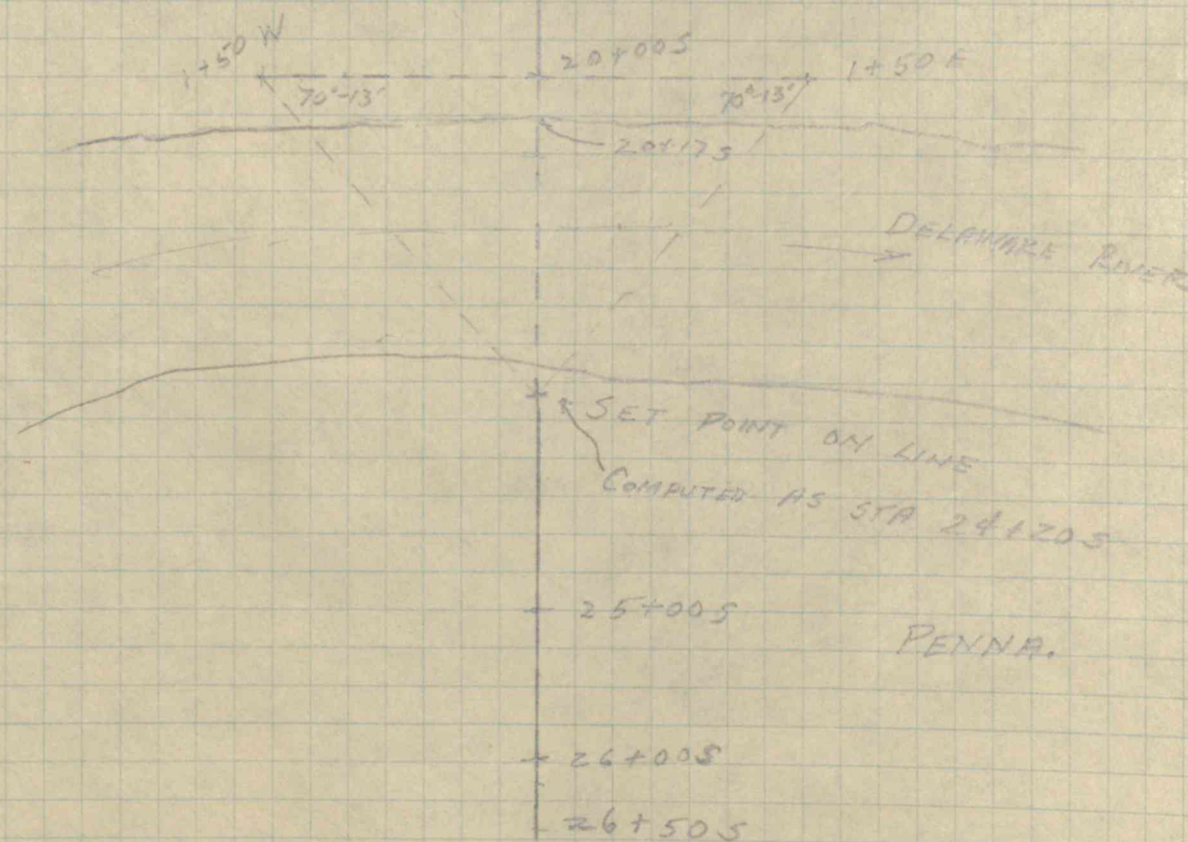
RIDGE APP. 14+30 S

RIVER SCRUB TREES, SANDY SOIL, SLIGHT UNDERBRUSH STA 17+00 S TO 20+17 S

EDGE OF RIVER, STA 20+17 S

NEW JERSEY

13+00 S
14+00 S
15+00 S
16+00 S
17+00 S
18+00 S
19+00 S



PROFILE ℄ WALLPACK BEND DAM

DATE 5/19/52
WEATHER - CLOUDY
TEMP. - 57°F
SHEET 1 OF 3

INST. - SHOO-MITH
ROD - WINKLER

ELEVATIONS BASED ON STA Ⓖ OF TRAVERSE, TOP OF STAKE EL. 441.0'

STA	+	H.I.	−	ROD	ELEV.
TOP STAKE Ⓖ 0+00	11.3	452.3			441.0
T.P.	11.6	462.8	1.1		451.2
1+00 N				2.9	459.9
1+70 N				0.7	462.1
0+00	1.3	442.3			441.0
T.P.	1.7	433.2	10.8		431.5
T.P.	0.6	422.7	11.1		422.1
T.P.	1.5	417.8	6.4		416.3
1+00 S				7.2	410.6
T.P.	0.3	406.5	11.6		406.2
2+00 S				6.8	399.7
3+00 S				6.6	399.9
4+00 S				6.5	400.0
5+00 S				2.6	403.9
6+00 S				7.6	398.9
T.P.	0.9	401.1	6.3		400.2
7+00 S				8.8	392.3
8+00 S				8.7	392.4
8+50 S				1.9	399.2
9+00 S				1.0	400.1
10+00 S				2.2	398.9
LARGE ROCK BY TALL BURNT TREE			8.6		392.5

PROFILE ℄ WALLPACK BEND DAM

DATE 5/22/52

TEMP - 54° F

INST - SHOOSMITH

WEATHER - CLEAR

ROD - WINKLER

STA	+	H. I.	−	ROD	ELEV.
LARGE ROCK BY BURNT TREE	1.6	394.1			392.5
T.P.	0.7	383.9	10.9		383.2
11+00 S				4.8	379.1
T.P.	1.3	373.8	11.4		372.5
T.P.	2.2	366.8	9.2		364.6
12+00 S				5.6	361.2
T.P.	3.0	359.1	10.7		356.1
13+00 S				8.4	350.7
T.P.	0.8	348.6	11.3		347.8
14+00 S				3.8	344.8
15+00 S				3.6	345.0
16+00 S				7.1	341.5
17+00 S				1.8	346.8
18+00 S				3.9	344.7
19+00 S				11.7	336.9
T.P.	1.2	338.3	11.5		337.1
20+00 S				5.2	333.1
20+17 S River Level 3:50 P.M.				11.2	327.1

PROFILE ℄ WALLPACK BEND DAM — DATE 5/23/52

WEATHER - CLEAR

TEMP - 59° F

SHEET 3 OF 3

RIVER SECTION

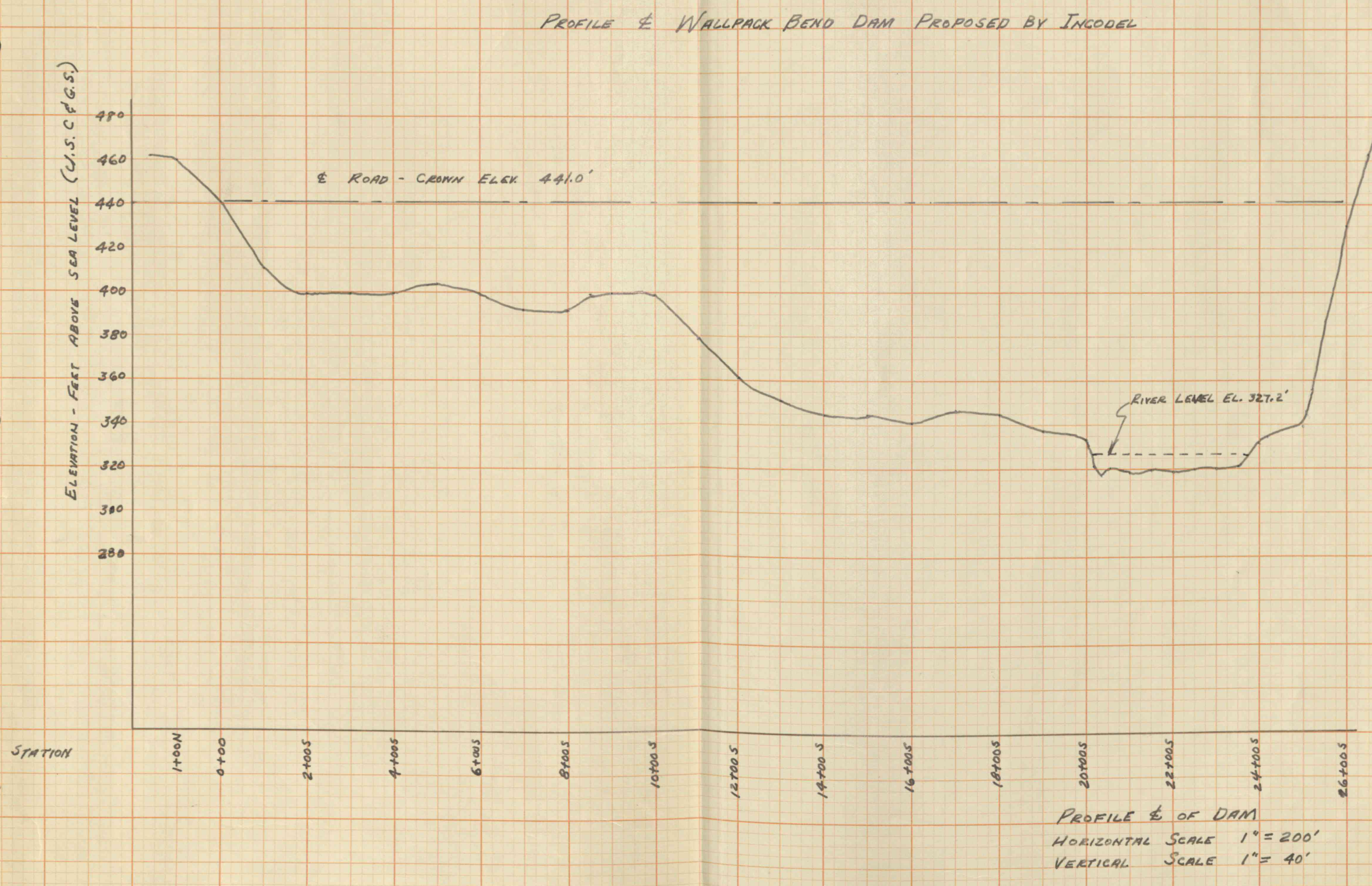
INST - WINKLER

ROD & BOAT - SHOEMITH, RUSK

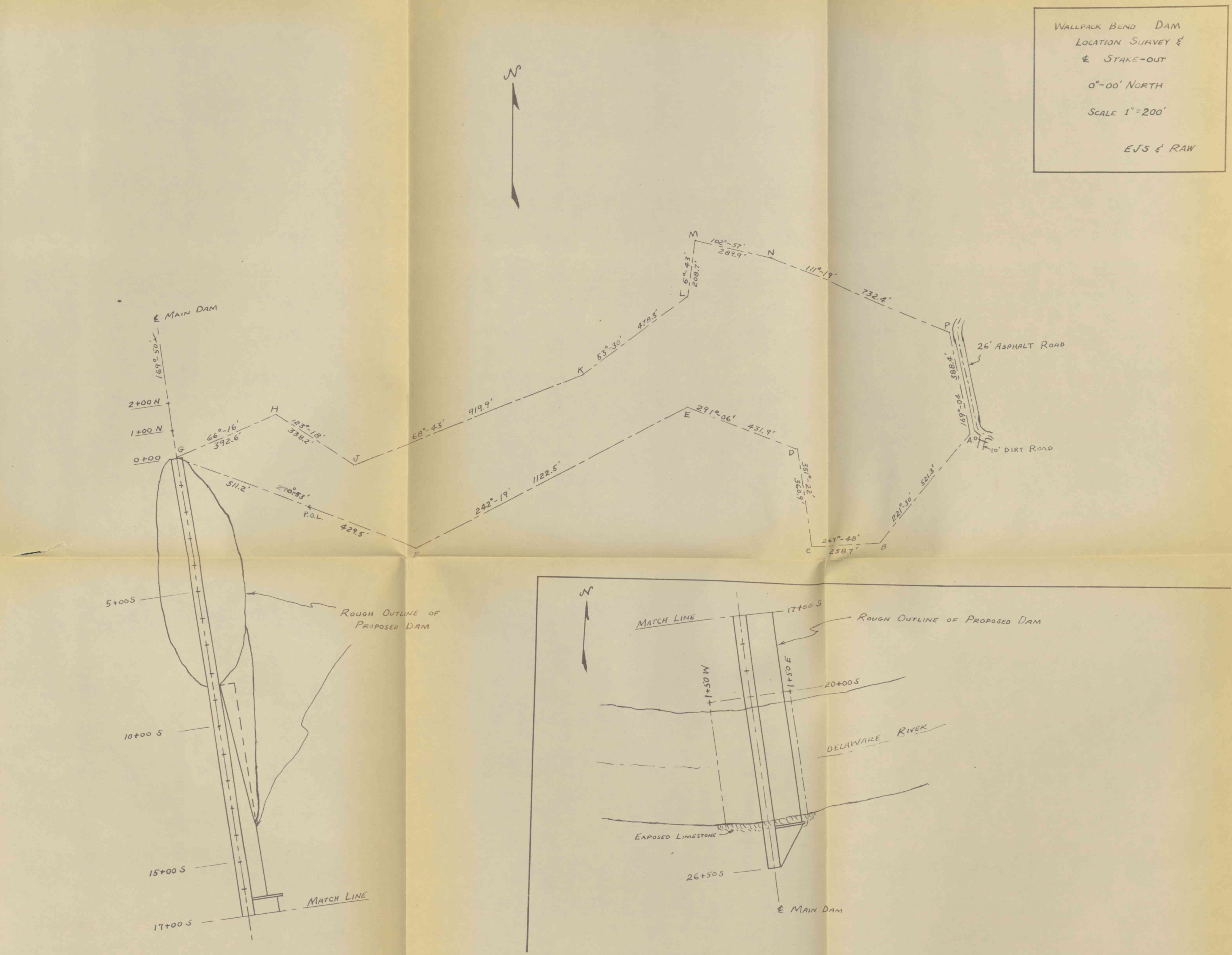
STA	+	H.I.	−	ROD or SOUNDING	ELEV.
20+00 S	4.8	337.9			333.1
RIVER LEVEL 20+19 S	8:15 A.M.			10.7	327.2
20+24 S				16.5	321.4
20+40 S				19.5	318.4
20+55 S				17.0	320.9
21+00 S				19.0	318.9
21+50 S				18.0	319.9
22+00 S				18.5	319.4
22+50 S				17.5	320.4
23+00 S				17.5	320.4
23+50 S				16.5	321.4
23+90 S — RIVER L. 1:15 PM.				10.7	327.2
24+00 S				6.1	331.8
STAKE 24+20 S				3.6	334.3
PENNA. 24+20 S	10.9	345.2			334.3
25+00 S				5.9	339.3
25+11 S				0.00	345.2
T.P.	11.7	356.3	0.6		344.6
25+30 S				0.00	356.3

River Soundings — 2" pipe

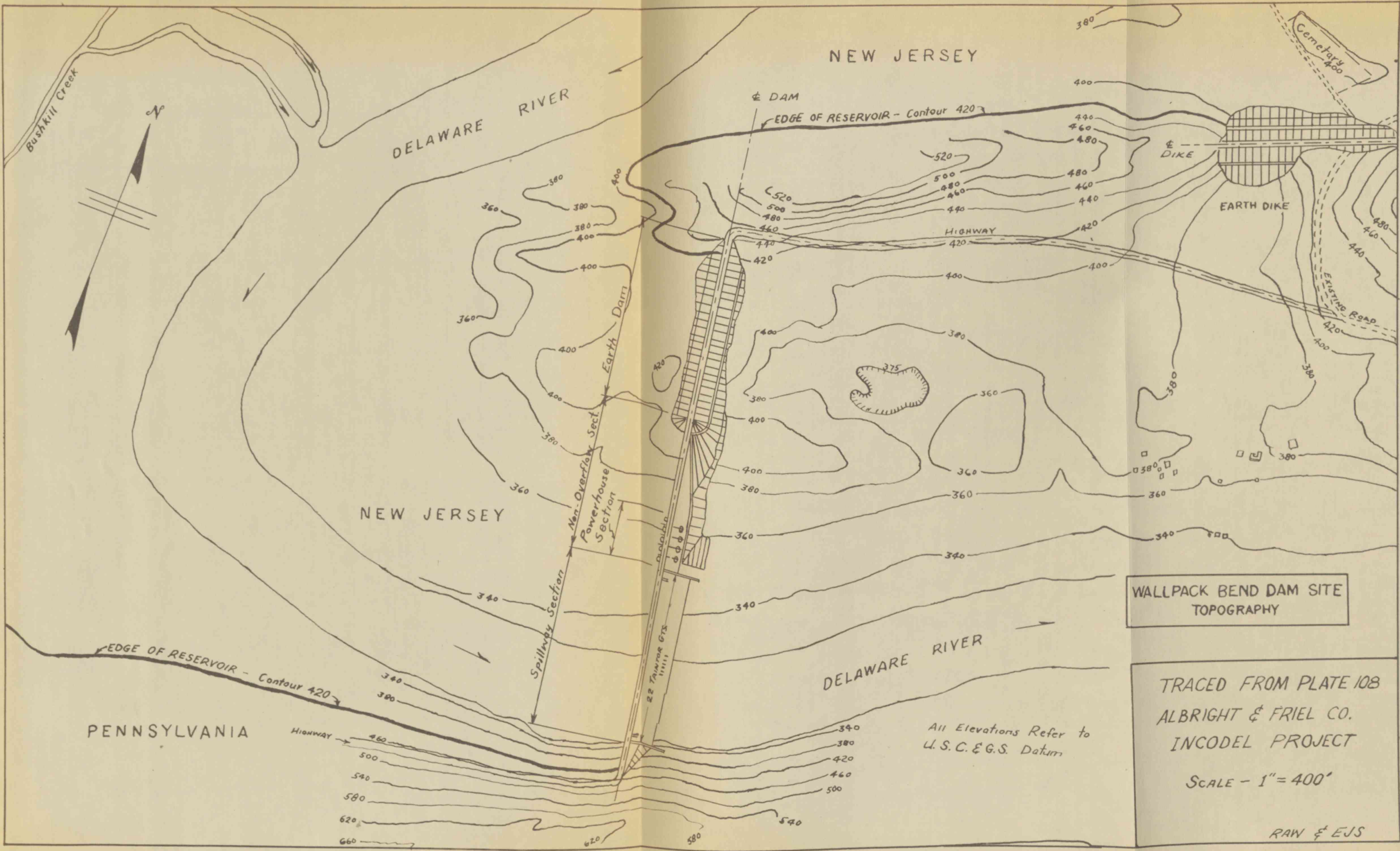
BECAUSE OF TIME, WILL TAKE 26+00 S & 26+50 S ON SAME SLOPE AS 25+00 S TO 25+30 S



PROFILE ℄ WALLPACK BEND DAM PROPOSED BY INCODEL
ELEVATION - FEET ABOVE SEA LEVEL (U.S.C.&G.S.)
480
460
440
420
400
380
360
340
320
300
280
℄ ROAD - CROWN ELEV. 441.0'
RIVER LEVEL EL. 327.2'
STATION
1+00N
0+00
2+00S
4+00S
6+00S
8+00S
10+00S
12+00S
14+00S
16+00S
18+00S
20+00S
22+00S
24+00S
26+00S
PROFILE ℄ OF DAM
HORIZONTAL SCALE 1" = 200'
VERTICAL SCALE 1" = 40'



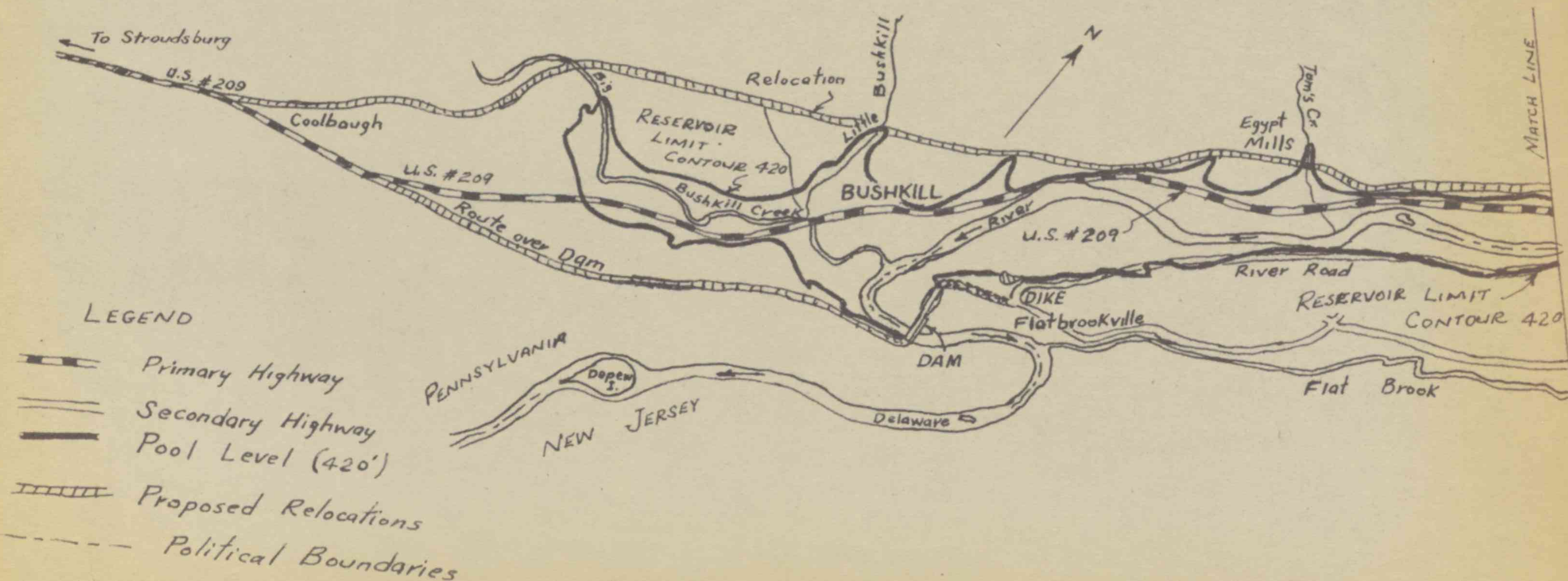
Wallpack Bend Dam
Location Survey &
℄ Stake-out
0°-00' North
Scale 1" = 200'
EJS & RAW
N
℄ Main Dam
169°-50'
2+00 N
1+00 N
0+00
G
66°-16'
392.6'
H
123°-18'
338.2'
J
68°-43'
919.9'
K
53°-30'
478.3'
L
6°-43'
208.7'
M
102°-57'
289.9'
N
111°-19'
732.4'
P
26' Asphalt Road
388.4'
169°-04'
A
10' Dirt Road
221°-30'
521.3'
B
267°-48'
258.7'
C
351°-22'
360.9'
D
291°-06'
431.9'
E
242°-19'
1122.5'
F
511.2'
290°-33'
P.O.L.
429.5'
5+00 S
Rough Outline of Proposed Dam
10+00 S
15+00 S
Match Line
17+00 S
N
Match Line
17+00 S
Rough Outline of Proposed Dam
1+50 W
1+50 E
20+00 S
Delaware River
Exposed Limestone
26+50 S
℄ Main Dam


WALLPACK BEND DAM SITE
TOPOGRAPHY
TRACED FROM PLATE 108
ALBRIGHT & FRIEL CO.
INCODEL PROJECT
SCALE – 1" = 400'
RAW & EJS
All Elevations Refer to
U.S.C.&G.S. Datum
NEW JERSEY
NEW JERSEY
PENNSYLVANIA
DELAWARE RIVER
DELAWARE RIVER
Bushkill Creek
N
℄ DAM
EDGE OF RESERVOIR – Contour 420
EDGE OF RESERVOIR – Contour 420
℄ DIKE
EARTH DIKE
Cemetery
HIGHWAY
HIGHWAY
EXISTING ROAD
Earth Dam
Non-Overflow Sect.
Powerhouse Section
Spillway Section
22 TAINTOR GTS.

General Plan of Wallpack Bend Reservoir

Section 1 of 4

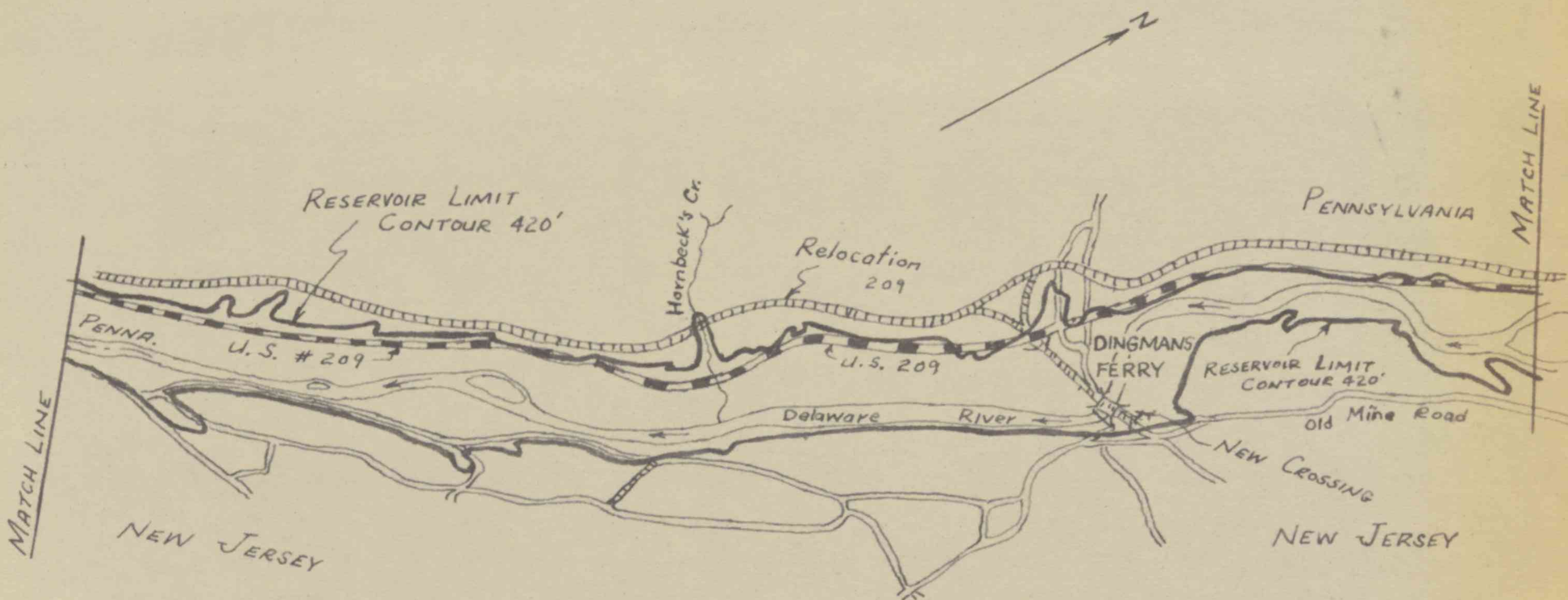
Length - App. 30 Miles
Average Width - App ½ Mile
Surface Elev. (Max.) - 420' Above Sea Level
Capacity - 121.5 Billion Gallons
Area - App. 9,500 Acres



Scale 1" = 1 mile

GENERAL PLAN OF WALLPACK BEND RESERVOIR

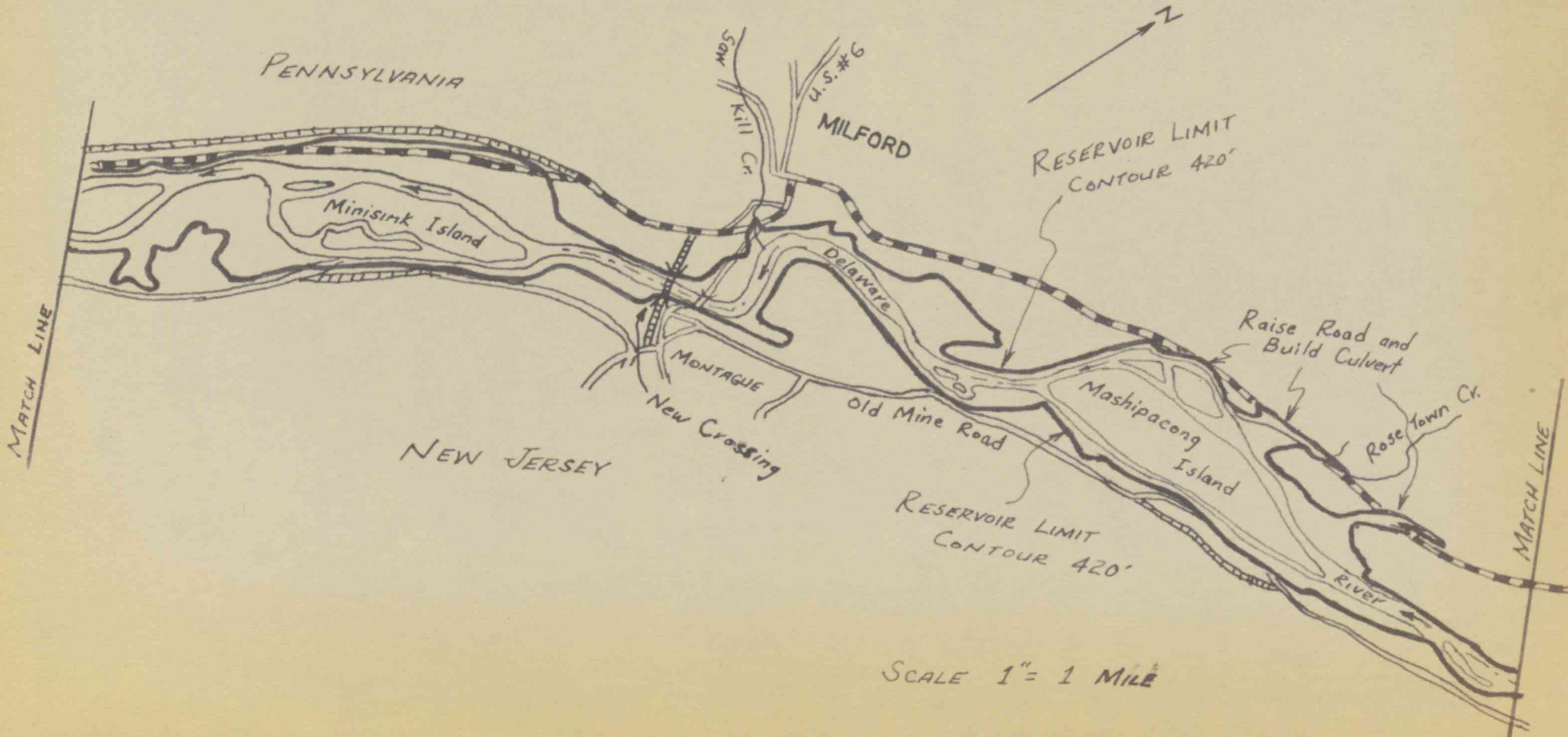
SECTION 2 OF 4



SCALE - 1" = 1 MILE

General Plan of Wallpack Bend Reservoir

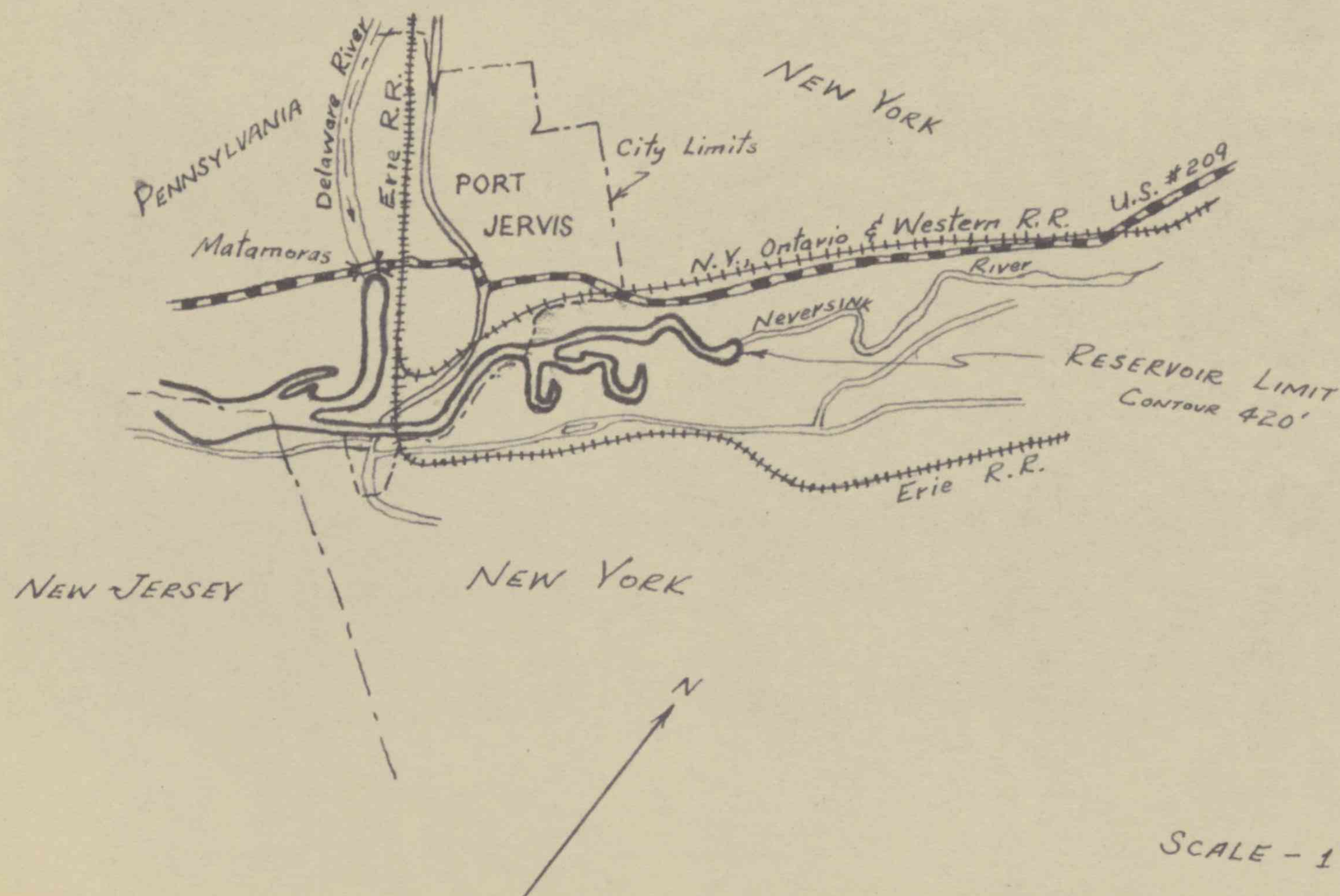
Section 3 of 4



Scale 1" = 1 Mile

General Plan of Wallpack Bend Reservoir

Section 4 of 4



Scale - 1" = 1 Mile

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PENNSYLVANIA-NEW JERSEY
BUSHKILL QUADRANGLE
7½-MINUTE SERIES

Mapped by the Geological Survey
1944

APPROXIMATE MEAN DECLINATION, 1944

Scale 1:31680

Contour interval 20 feet
Datum is mean sea level

ROAD CLASSIFICATION
1946

Polyconic projection. 1927 North American datum
5000 yard grid based on U.S. zone system, A
10000 foot grids based on New Jersey and Pennsylvania (North) rectangular coordinate systems

BUSHKILL, PA.-N.J.
Edition of 1947
N4100—W7500/7.5

THE TOPOGRAPHIC MAPS OF THE UNITED STATES

The United States Geological Survey is making a series of standard topographic maps to cover the United States. This work has been in progress since 1882, and the published maps cover more than 47 percent of the country, exclusive of outlying possessions.

The maps are published on sheets that measure about 16½ by 20 inches. Under the general plan adopted the country is divided into quadrangles bounded by parallels of latitude and meridians of longitude. These quadrangles are mapped on different scales, the scale selected for each map being that which is best adapted to general use in the development of the country, and consequently, though the standard maps are of nearly uniform size, the areas that they represent are of different sizes. On the lower margin of each map are printed graphic scales showing distances in feet, meters, miles, and kilometers. In addition, the scale of the map is shown by a fraction expressing a fixed ratio between linear measurements on the map and corresponding distances on the ground. For example, the scale $\frac{1}{62,500}$ means that 1 unit on the map (such as 1 inch, 1 foot, or 1 meter) represents 62,500 of the same units on the earth's surface.

Although some areas are surveyed and some maps are compiled and published on special scales for special purposes, the standard topographic surveys and the resulting maps have for many years been of three types, differentiated as follows:

1. Surveys of areas in which there are problems of great public importance—relating, for example, to mineral development, irrigation, or reclamation of swamp areas—are made with sufficient detail to be used in the publication of maps on a scale of $\frac{1}{31,680}$ (1 inch = one-half mile) or $\frac{1}{24,000}$ (1 inch = 2,000 feet), with a contour interval of 1 to 100 feet, according to the relief of the particular area mapped.

2. Surveys of areas in which there are problems of average public importance, such as most of the basin of the Mississippi and its tributaries, are made with sufficient detail to be used in the publication of maps on a scale of $\frac{1}{62,500}$ (1 inch = nearly 1 mile), with a contour interval of 10 to 100 feet.

3. Surveys of areas in which the problems are of minor public importance, such as much of the mountain or desert region of Arizona or New Mexico, and the high mountain area of the northwest, are made with sufficient detail to be used in the publication of maps on a scale of $\frac{1}{125,000}$ (1 inch = nearly 2 miles) or $\frac{1}{250,000}$ (1 inch = nearly 4 miles), with a contour interval of 20 to 250 feet.

The aerial camera is now being used in mapping. From the information recorded on the photographs, planimetric maps, which show only drainage and culture, have been made for some areas in the United States. By the use of stereoscopic plotting apparatus, aerial photographs are utilized also in the making of the regular topographic maps, which show relief as well as drainage and culture.

A topographic survey of Alaska has been in progress since 1898, and nearly 44 percent of its area has now been mapped. About 15 percent of the Territory has been covered by maps on a scale of $\frac{1}{500,000}$ (1 inch = nearly 8 miles). For most of the remainder of the area surveyed the maps published are on a scale of $\frac{1}{250,000}$ (1 inch = nearly 4 miles). For some areas of particular economic importance, covering about 4,300 square miles, the maps published are on a scale of $\frac{1}{62,500}$ (1 inch = nearly 1 mile) or larger. In addition to the area covered by topographic maps, about 11,300 square miles of southeastern Alaska has been covered by planimetric maps on scales of $\frac{1}{125,000}$ and $\frac{1}{250,000}$.

The Hawaiian Islands have been surveyed, and the resulting maps are published on a scale of $\frac{1}{62,500}$.

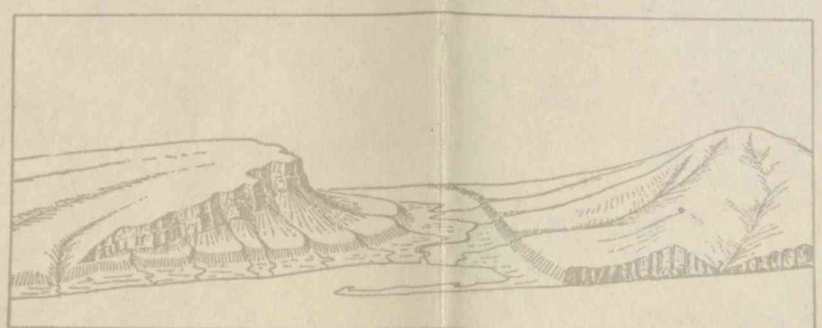
A survey of Puerto Rico is now in progress. The scale of the published maps is $\frac{1}{30,000}$.

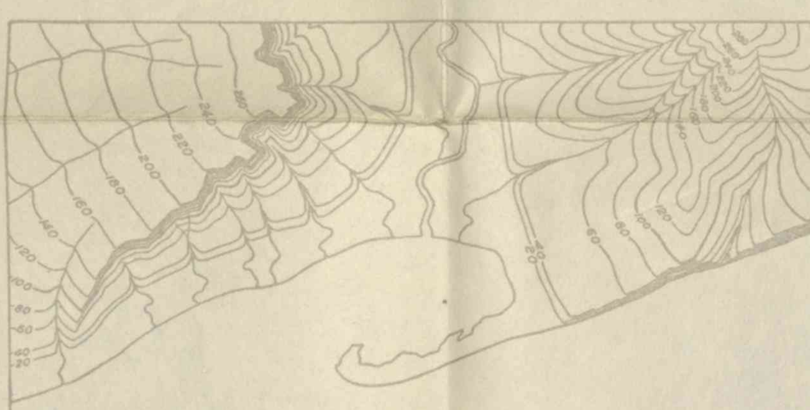
The features shown on topographic maps may be arranged in three groups—(1) water, including seas, lakes, rivers, canals, swamps, and other bodies of water; (2) relief, including mountains, hills, valleys, and other features of the land surface; (3) culture (works of man), such as towns, cities, roads, railroads, and boundaries. The symbols used to represent these features are shown and explained below. Variations appear on some earlier maps, and additional features are represented on some special maps.

All the water features are represented in blue, the smaller streams and canals by single blue lines and the larger streams by double lines. The larger streams, lakes, and the sea are accentuated by blue water lining or blue tint. Intermittent streams—those whose beds are dry for a large part of the year—are shown by lines of blue dots and dashes.

Relief is shown by contour lines in brown, which on a few maps are supplemented by shading showing the effect of light thrown from the northwest across the area represented, for the purpose of giving the appearance of relief and thus aiding in the interpretation of the contour lines. A contour line represents an imaginary line on the ground (a contour) every part of which is at the same altitude above sea level. Such a line could be drawn at any altitude, but in practice only the contours at certain regular intervals of altitude are shown. The datum or zero of altitude of the Geological Survey maps is mean sea level. The 20-foot contour would be the shore line if the sea should rise 20 feet above mean sea level. Contour lines show the shape of the hills, mountains, and valleys, as well as their altitude. Successive contour lines that are far apart on the map indicate a gentle slope, lines that are close together indicate a steep slope, and lines that run together indicate a cliff.

The manner in which contour lines express altitude, form, and grade is shown in the figure below.





The sketch represents a river valley that lies between two hills. In the foreground is the sea, with a bay that is partly enclosed by a hooked sand bar. On each side of the valley is a terrace into which small streams have cut narrow gullies. The hill on the right has a rounded summit and gently sloping spurs separated by ravines. The spurs are truncated at their lower ends by a sea cliff. The hill at the left terminates abruptly at the valley in a steep scarp, from which it slopes gradually away and forms an inclined tableland that is traversed by a few shallow gullies. On the map each of these features is represented, directly beneath its position in the sketch, by contour lines.

The contour interval, or the vertical distance in feet between one contour and the next, is stated at the bottom of each map. This interval differs according to the topography of the area mapped: in a flat country it may be as small as 1 foot; in a mountainous region it may be as great as 250 feet. In order that the contours may be read more easily certain contour lines, every fourth or fifth, are made heavier than the others and are accompanied by figures showing altitude. The heights of many points—such as road intersections, summits, surfaces of lakes, and benchmarks—are also given on the map in figures, which show altitudes to the nearest foot only. More precise figures for the altitudes of benchmarks are given in the Geological Survey's bulletins on spirit leveling. The geodetic coordinates of triangulation and transit-traverse stations are also published in bulletins.

Lettering and the works of man are shown in black. Boundaries, such as those of a State, county, city, land grant, township, or reservation, are shown by continuous or broken lines of different kinds and weights. Public roads suitable for motor travel the greater part of the year are shown by solid double lines; poor public roads and private roads by dashed double lines; trails by dashed single lines. Additional public road classification if available is shown by red overprint.

Each quadrangle is designated by the name of a city, town, or prominent natural feature within it, and on the margins of the map are printed the names of adjoining quadrangles of which maps have been published. More than 4,100 quadrangles in the United States have been surveyed, and maps of them similar to the one on the other side of this sheet have been published.

Geologic maps of some of the areas shown on the topographic maps have been published in the form of folios. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped, and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. Two hundred twenty-five folios have been published.

Index maps of each State and of Alaska and Hawaii showing the areas covered by topographic maps and geologic folios published by the United States Geological Survey may be obtained free. Copies of the standard topographic maps may be obtained for 10 cents each; some special maps are sold at different prices. A discount of 40 percent is allowed on an order amounting to $5 or more at the retail price. The discount is allowed on an order for maps alone, either of one kind or in any assortment, or for maps together with geologic folios. The geologic folios are sold for 25 cents or more each, the price depending on the size of the folio. A circular describing the folios will be sent on request.

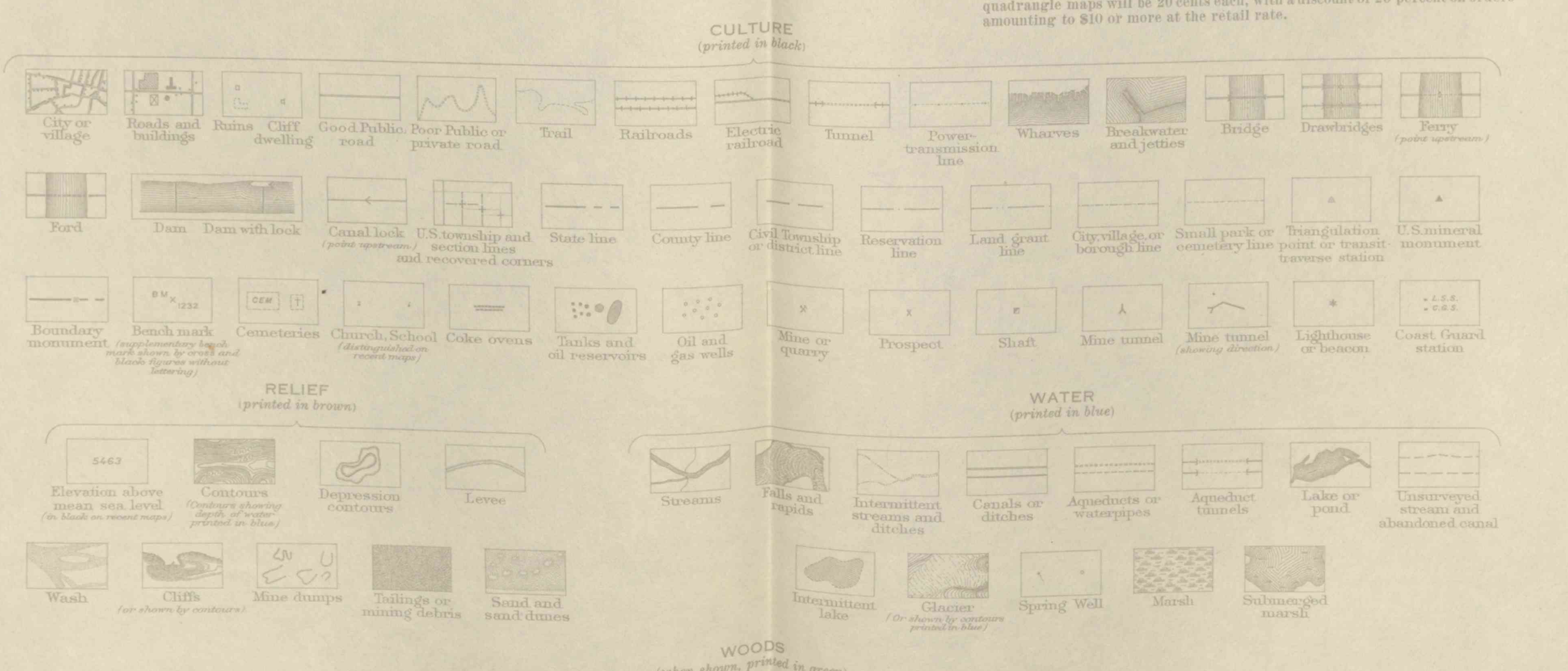
Applications for maps or folios should be accompanied by cash, draft, or money order (not postage stamps) and should be addressed to

THE DIRECTOR,
United States Geological Survey,
Washington, D. C.

November 1937.

STANDARD SYMBOLS

NOTE:—Effective on and after October 1, 1946, the price of standard topographic quadrangle maps will be 20 cents each, with a discount of 20 percent on orders amounting to $10 or more at the retail rate.



LEGEND:

RESERVOIR BOUNDARIES

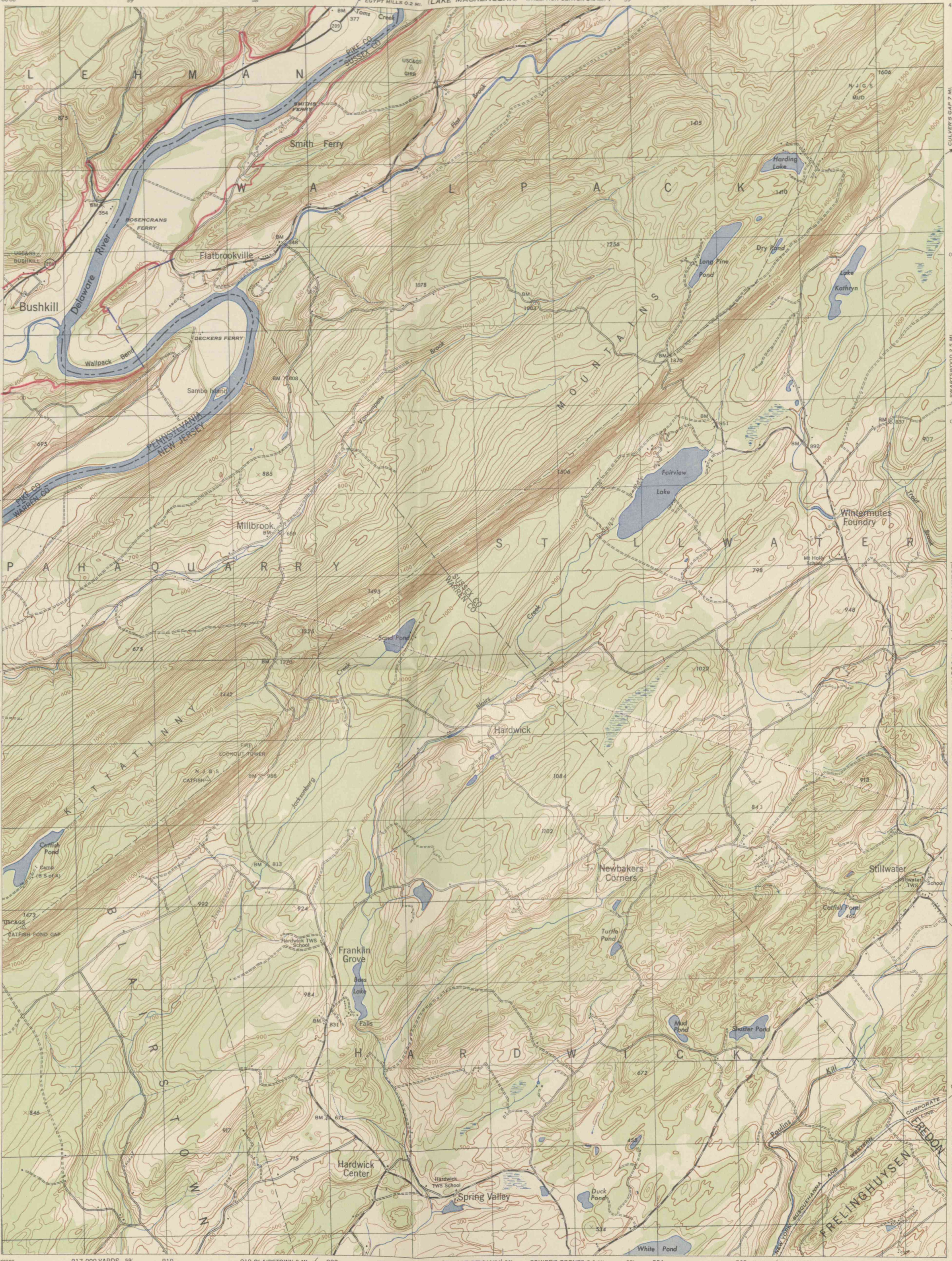
CENTER LINE OF DAMS

NEW JERSEY
FLATBROOKVILLE QUADRANGLE
GRID ZONE "A"

WAR DEPARTMENT
CORPS OF ENGINEERS, U. S. ARMY

FIRST EDITION-AMS 1

NEW JERSEY
FLATBROOKVILLE QUADRANGLE
GRID ZONE "A"



(PORTLAND)

75°00'00" 817 000 YARDS 59' 818 819 BLAIRSTOWN 2 MI. 820 57' 821 (BLAIRSTOWN) 56' SQUIRE'S CORNER 0.3 MI. 55' 824 825 54' MARKSBORO 0.6 MI. 53' 827 74°52'30"

First Edition 1943
Prepared under the direction of the Chief of Engineers
U. S. Army 1942
Topography by Fairchild Aerial Surveys, Inc.
Los Angeles, California
By Stereophotogrammetric Process.
Control by U. S. Coast and Geodetic Survey
and Fairchild Aerial Surveys, Inc.
Aerial photography by Fairchild Aerial Surveys, Inc.
Polyconic Projection, North American Datum 1927

ROAD CLASSIFICATION 1943

Dependable hard-surface, heavy-duty road. — Loose-surface graded, dry weather road. — U. S. Route 160

Secondary, hard-surface, all-weather road. — Dirt road. — State Route 30

More than two lanes indicated by note along road with tick at point of change. 3 LANE | 4 LANE

Scale 1:31,680

1 ½ 0 1 Mile

1000 500 0 1000 2000 Yards

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

THOUSAND YARD GRID COMPUTED FROM "GRID SYSTEM FOR PROGRESSIVE MAPS IN THE U. S." ZONE A. U. S. C. & G. S. SPECIAL PUBLICATION NO. 59

THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO "THE CHIEF OF ENGINEERS, WASHINGTON, D. C."

9°06' 162 MILS
MAGNETIC NORTH
Y
1°18' 22 MILS

APPROXIMATE MEAN DECLINATION 1942
ANNUAL MAGNETIC CHANGE 0'

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C. 107234
1943
30TH ENGINEER BATTALION REPRODUCTION PLANT, FORT BELVOIR, VA.
1943

FLATBROOKVILLE, N. J.
N4100-W7452.5/7.5

PENNSYLVANIA - NEW JERSEY
LAKE MASKENOZHA QUADRANGLE
GRID ZONE "A"

WAR DEPARTMENT
CORPS OF ENGINEERS, U. S. ARMY

FIRST EDITION - AMS 1

PENNSYLVANIA - NEW JERSEY
LAKE MASKENOZHA QUADRANGLE
GRID ZONE "A"

First Edition 1943
Prepared under the direction of the Chief of Engineers
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Topography by Fairchild Aerial Surveys, Inc.
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Dirt road.
State Route 30
More than two lanes indicated by note along road with tick at point of change.
3 LANE | 4 LANE

Scale 1:31,680

1 Mile
2000 Yards

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

THOUSAND YARD GRID COMPUTED FROM "GRID SYSTEM FOR PROGRESSIVE MAPS IN THE U. S." ZONE A. U. S. C & G. S. SPECIAL PUBLICATION NO. 59
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO "THE CHIEF OF ENGINEERS, WASHINGTON, D.C."

APPROXIMATE MEAN
DECLINATION 1942
ANNUAL MAGNETIC CHANGE 0'

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 107232
1943

30TH ENGINEER BATTALION REPRODUCTION PLANT, FORT BELVOIR, VA.
1943

LAKE MASKENOZHA, PA. - N. J.
N4107.5-W7452.5/7.5

RESERVOIR BOUNDARIES

VI. WATERSHED AND RESERVOIR SANITATION.

The following recommedations should be followed to maintain proper sanitary conditions concerning the Wallpack Bend reservoir and watershed. During the process of the construction of the dam, the impound area should be roughly staked out to an elevation 425, which is approximately 5 feet above reservoir surface elevation. All timber should be cut and removed from this area - and the brush, long grass, and rubbage gathered up and burned. It will not be necessary to remove the sod, because sod forms a firm foundation and will prevent the erosion of the soil. The contents of privies and cesspools and the adjacent contaminated soil should be removed, and the excavations should be filled with sand, gravel, or loam. Other polluted areas of large size, such as barn yards, may be covered with a layer of sand or gravel without prior excavation. All buildings and other structures, and generally wooden fences, should be removed. Land should be purchased to a distance of at 1,000 feet beyond the water's edge.

Since the impound of the reservoir will extend from Wallpack Bend to Port Jervis, the sewage treatment facilities of such towns as Port Jervis, Matamoras, Millford, Montague, Dingman's Ferry, Layton, Wallpack Center, Flatbrookville, and Bushkill should be inspected for their adequacy of treatment.

To prevent the formation of stagnant water in shallow areas around the edge of the reservoir, all areas above elevation 418 on the reservoir area sould be excavated to that elevation.

The region surrounding the upper Delaware Basin is well known for its excellent recreational aspects. Easily accessible from both the Philadelphia and New York areas, this section has long been used as a playground by the residents of these concentrated population centers. With this in mind, coupled with such features as the Pocono Mountains and the Delaware Water Gap, it is suggested that all facilities possible be used at Wallpack Reservoir to further enhance the recreational value of this region.

However, for sanitary reasons, these recreational facilities must be controlled. All areas to be set aside for fishing, swimming, picnicking, and hunting, should be kept at safe distances from intakes. These areas should also be policed regularly and kept clear of trash and refuse.

VII. MISCELLANEOUS

A. Property Damages

Since this dam will not diminish the normal flow of the Delaware River below WallpackBend, there will be no grievances to adjacent property owners in that location. Above the dam on the New Jersey sideof the river, no communities of large extent or important roads will be hampered by the impounded water. However, because of the presence of privately owned roads and dwellings, agreements for the acquirement of these properties and compensation for the structures thereon must be made with the respective owners.

A slightly different situation exists on the Pennsylvania side of the river. Just above the dam, parts of the present town of Bushkill will be under water and therefore will require more extensive negotiations between the state agency for the construction of the dam and the community owners. Also, in this region, portions of United States Highway 209 will be covered and therefore require re-routing. In this case the state agency must negotiate with the Federal Government. The remaining portions of the land on the Pennsylvania side of the river will be treated in the same manner as those mentioned on the New Jersey side.

Four highway bridges and one railroad bridge are within the limits of inundated lands or the protective marginal strip, as follows:

Delaware River Crossing

A three span steel truss highway bridge, without walkways, at Dingman's Ferry, having total span length of approximately 555 feet and owned by the Delaware Bridge Company. This bridge would be replaced at a higher elevation, in the same location, and approach roads would be raised.

A three span steel truss highway bridge, without walkways, at Milford, having a total span length of approximately 525 feet. It is reported the Bridge Commission has replacement of this bridge under consideration, at a location some 1,000 feet downstream. Such relocation could readily be accomplished as needed to conform to water elevation of the filled reservoir.

Neversink River

A single span steel truss highway bridge, 125 feet in length on concrete abutments, at Port Jervis. Top of abutments are at elevation 427 and bridge floor at elevation 431.6 Pool level elevation of 420 will not affect this bridge..

A single span steel deck bridge on stone abutments owned by the Erie Railroad Company. Clearance between bottom of main girders and full pool elevation would be approximately nine feet. No alterations are considered necessary..

Sawkill Creek

A modern concrete spandrel arch bridge carrying highway U. S. 209 at Milford. Roadway elevation is 11 feet above pool level and arch ribs at the crown would have clearance of about six feet. No alterations are considered necessary.

A new road should be built from U. S. 209 just north of Coolborough to the dam and be carried across the top of the dam to connect with the New Jersey highway system.

No railroads extend along the river bank between Wallpack Bend and Port Jervis but railroad yards in that city would require minor adjustment.

B. Soil Conservation on the Watershed Area

Because of the close association between water and soil it is necessary to include a program of soil and forest conservation in this report.

Although most of the watershed area is wooded, some sections have been cleared and are being farmed. Therefore, the possibility of soil erosion must be considered and methods taken to avoid its occurrence. Cleared areas not being farmed should be protected by planting a grass cover. To prevent excessive erosion in gullies, check dams must be built. This will also prevent additional quantities of silt from being washed into the reservoir. Practices, such as crop rotation, terracing, and contour strip cropping, are recommended. In addition to preventing wasteful soil erosion, these practices help control the amount of silt carried into the reservoir and thus reduce the turbidity of the water.

VIII. CONCLUSION

From the foregoing material presented in this thesis, it is concluded that the proposed project for the construction of a dam at Wallpack Bend should be undertaken.

It has been shown that by the utilization of the waters of the Delaware River in this region increased water supply, better flood control, improvement in recreational facilities, and additional power requirements may be had.

Also, the problems of this important industrial region in the vicinity of the Delaware River can be overcome and the welfare and prosperity of this area greatly increased.

It is further recommended that the State agencies undertake the development of this project in their own vital requirements rather than the Federal Government which will be participating at State and Local levels and have the tendency to smother the sense of well-being and responsibility. Also, interstate cooperation will prevent the control of the river basin from being concentrated at the National Capitol, so distant from the life of the people of the region.

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