REPORT

ON

A SEWERAGE COLLECTION SYSTEM

FOR

THE CITY OF SAN DIEGO

INCLUDING

SPECIFICATIONS

AND

DETAILED ESTIMATE OF COST

BY

CHAS.G.FRISBIE.
Consulting Engineer.

FEBRUARY,1932.

CHAS. G. FRISBIE
CONSULTING ENGINEER
1201 HIBERNIAN BUILDING
LOS ANGELES, CALIFORNIA
METROPOLITAN 1618

Feb.14,1932.

Honorable City Council,
City of San Diego,
San Diego, California.

Gentlemen:

In compliance with the terms of the contract, entered into January 2,1931, by the Council of the City of San Diego providing for a study and compilation of plans and specifications and estimates for a sewerage collection system for the City of San Diego, I have submitted to the City Manager the plans and specifications and other data called for under the above contract.

I herewith submit to the City Council my report on the proposed sewerage collection system.

Respectfully,

Chas. G. Frisbie

INTRODUCTORY:

The Council of the City of San Diego, on January 2, 1931, entered into a contract calling for studies, surveys, profiles, plans and specifications for a sewerage collection system for the City of San Diego. By a resolution of the Council at a later date I was named as the engineer to perform the work called for in the contract mentioned.

The contract of January 2,1931 required that the work be completed within one year, but before the expiration of the year an extension of forty-five days was requested by me and granted by the Council.

The contract required that the work to be done should be approved by the Manager before the same should be accepted by the City.

We realized that for the Manager to approve the sewerage collection plans it would be necessary for him and the City Engineer's office to keep in close contact with the work and the general scheme as it was evolved, and have consulted with these departments throughout the work.

We have had splendid and intelligent co-operation on the part of the City Manager, the City Planning Engineer and the City Engineer's office and we believe that their interest and advice in making fundamental decisions and in checking the work as it progressed has been conductive to a better general plan and consequently advantageous to the City of San Diego,

PRESENT CONDITIONS:

The sewerage of La Jolla, Pacific Beach, Point Loma, Ocean Beach, Mission Beach and San Diego at the present time flows into the Pacific Ocean and San Diego Bay through numerous outfall sewers. The untreated sewerage flowing into the ocean and the bay is objectionable and unsanitary and tends to pollute the beaches and the waters of San Diego Bay.

PURPOSE OF PLANS:

The fundamental purpose of these studies and plans is to provide San Diego and its suburbs with a sewerage collection system that will adequately provide for future growth and will concentrate the sewerage at the most feasible locations for proper treatment, thus eliminating the objectionable features now existing.

EXISTING RECORDS:

Thousands of maps, profiles and plans of existing sewers, tanks, sewerage pumping plants, streets and appurtenant structures are on file in the City Engineer's office.

Many maps and records pertaining to population, type of buildings and city growth are on file in the office of the City Planning Commission compiled under the direction of the City Planning Engineer.

COMPILATION OF RECORDS:

All of the above records have been scanned and wherever found of value to these studies prints have been made or the data copied or transferred to other maps. All the existing sewers in San Diego were transferred to large maps on a scale of 400 feet to the inch. These maps showed the size of pipes, elevation of inverts, location of manholes and street grades wherever such data was necessary in making the studies for design. Copies of these maps have been filed with the City Engineer's office.

The entire area from which sewerage was to be collected was divided into drainage areas and these areas transferred to tracing paper. These areas were laid over the maps of the City Planning Commission and the various buildings of different types counted and recorded on each area and these tracings have been filed with the City Engineer's office.

Prints of street plans, sewer plans and profiles were obtained in all of the areas where such detail was necessary.

SURVEYS:

Over many sections where the construction of intercepting sewers would be necessary no street plans or profiles were available, which necessitated surveys over these lines.

GAGE READINGS:

At a number of points on existing sewers gage readings of the twenty-four hour flow were obtained, and later these readings combined with the data on population contributing to the flow plotted on curves and tabulated. These curves and tabulations are shown on Exhibits Nos. 1,2,3,4 and 5 attached hereto.

POPULATION:

The population of San Diego has increased as a whole 100% each ten years for the period between 1910 and 1930. The rate of growth over the entire area has not been uniform. In some sections the growth has not been over 50% in a ten year period while in some areas the growth was over 500%.

The population indicated by the census in some areas is less than the actual population that will be contributing sewerage on account of the floating population not included in the census count. This floating population consists of local people who stay

at the beaches over week ends and during summer months and of non-residents who live in San Diego during only a portion of each year. On account of the disparity between the actual people living in a particular area at some season of the year and that indicated by the census count, the buildings in each drainage area were counted and the maximum density of population for any season of the year for the corresponding area calculated from these counts.

CITY GROWTH:

A careful study of the present density of population was made in each drainage area and an estimate made of the probable future growth for the next 30 years so that adequate capacity would be provided in the design of the collection sewers. The rate of growth for the future in different sections of the city would vary, dependant upon the present density of population, the nature of improvements, the topography and the desirability of the various areas for residential or business purposes. The tabulation of present population, density, future population and density with the total population that will be contributing sewerage at any point on the collection lines have been filed with the City Engineer's office.

PROVISION FOR FUTURE GROWTH:

The collection sewers and pumping plants have been designed of a capacity ample for the growth of the city for the next 30 years.

DESIGN:

The design of sewers is based on an average daily flow of 75 gallons of sewerage per capita, a minimum flow rate of 37.5 gallons, and a maximum flow rate of 126 gallons per capita daily. The sewers are designed of sufficient size to carry the maximum flow that would occur 30 years hence, The hydraulic data used in the design is embodied in the curves attached hereto and shown in Exhibits Nos. 1 to 32 inclusive.

GENERAL PLANS:

The general plan of sewerage collection for the various sections of the City is as outlined below:

LA JOLLA AND PACIFIC BEACH:

A collection sewer to intercept all possible existing and future sewer lines has been located running from the north portion of La Jolla to the lower end of Rose Canyon. All of the sewerage from the lower areas along the coast and just north of La Jolla is to be pumped into the main collection line by a series of 7 sewage pumps. Five of these pumping plants will be new plants and two will be existing plants with a few changes.

POINT LOMA, OCEAN BEACH, MISSION BEACH:

A collection sewer is located along the west side of Point Loma through Ocean Beach to a point near the San Diego River northwest of Old San Diego where the sewer is to discharge into the main collection sewer running to the proposed disposal plant at the foot of 32nd Street. The sewerage from Mission Beach and from the low portion of Ocean Beach is to be pumped into the interceptor by 2 pumping plants which are existing plants and which will require some change of equipment and remodeling to meet the new conditions.

The remaining portion of Point Loma on the east slope is to be served by a collection sewer located along the east side of the peninsula and thence northeasterly to a point on the main collection sewer about 3000 feet southeasterly from the point where the West Point Loma and Mission Beach lines are to enter the same. The area that is too low to be served by gravity flows into two pumping plants from which the sewerage is to be pumped into the collection sewer. One of these pumping plants is an existing plant that can be utilized with slight modification and the other is to be a new plant.

MORENO:

The area northeast of the San Diego River and north of Old San Diego is to be served by a short collection sewer that discharges into the main lines about 1000 feet southeasterly from the most northwesterly end thereof.

MISSION VALLEY:

All of the Mission Valley south of the San Diego River and the residential area sloping north toward Mission Valley are to be served by a collection sewer that starts from a

point just north of La Mesa Colony and discharges into the main collection sewer at a point just northwest of Old San Diego.

OLD SAN DIEGO AND SAN DIEGO:

A large sewer main is to be located along the bay and runs in a southeasterly direction to the foot of 32nd Street. This line is to convey all of the sewerage from Point Loma, Mission Beach, Ocean Beach, Mission Valley, Old San Diego and the main portion of the City of San Diego to a proposed treatment plant near the Destroyer Base at the foot of 32nd Street. Two pumping plants are to be located in this line to lift the sewerage to an elevation sufficient to ge a proper grade.

One sub-main about a mile long will be brought in to the main just south of the last pumping plant to intercept several of the higher existing sewers and to eliminate as much pumping as possible.

CHOLLAS VALLEY AND SOUTH CHOLLAS VALLEY:

A collection main is to be constructed from the east boundary of San Diego in a southwesterly direction down the Chollas Valley to the foot of 32nd Street. A branch line about 4 miles long comes into the main Chollas Valley line in the vicinity of 40th Street. This branch line will serve the drainage area just north of the Chollas Valley.

Another main sewer is to be constructed down the South Chollas Valley to serve the area drained into that valley.

The general locations of all these collection lines, pumping plants and sites for treatment are shown on the topographic map attached hereto as Exhibit "A".

PLANS:

Plans of all the sewer lines, pumping plants and appurtenant structures have been made on standard sheets and filed with the City Manager.

ESTIMATES:

Careful estimates have been made of the costs of the various sewer collection lines, the pumping plants, the pressure lines and the appurtenant structures. Several studies were made of different plans of sewerage collection and treatment of certain portions of the sewage at different points and the comparative costs considered in deciding on the plan adopted. The estimates and comparative costs are shown in appendix 1.

STUDIES FOR ALTERNATE PLANS:

A plan for collecting for treatment all of the sewage from Point Loma, Mission Beach, Ocean Beach, Moreno, Mission Valley and Old San Diego to a site about one mile northwest of Old San Diego was given consideration. This site for treatment would not be far removed from a large high class residential area and would be in the path of the prevailing winds. This plan was compared with the plan of carrying the sewage from the above areas to the proposed treatment plant site at the foot of 32nd Street.

The 32nd Street Treatment Plant site is far removed from any desirable residential areas, is located where the prevailing winds will blow away from the city and is preferable in every respect as a treatment site, if the costs of the latter plan would not exceed the former by an excessive amount.

These two plans for the purpose of discussion and comparison and comparative estimates we shall designate as Plan No. 1 and Plan No. 2.

Under Plan No. 1 the location of the treatment site is not so desirable as Plan No. 2, the investment cost in treatment plant per million gallons daily capacity is greater and the cost of treatment per million gallons will be greater than would obtain under Plan No. 2, but the investment cost in pipe lines and the cost of pumping will be less under Plan No. 1 than under Plan No. 2. The advantages and disadvantages of the two plans, so far as cost is concerned, fairly well offset one another with the advantage of location very decidedly in favor of No. 2 Plan which latter plan was adopted.

For the comparative costs under Plan No. 1 and Plan No. 2 see Estimate No. 30 in Appendix No. 1.

A plan for running another line above the C-1 Low Line through the main part of San Diego was given consideration. This higher line would be costly and its construction through the main part of San Diego undesirable, but it would eliminate some pumping at Pumping Plant No. 14. However the added cost of pumping is more than offset by the interest and amortization on the added investment of the higher line.

The plan of intercepting the sewage in the higher line we shall call Plan No. 3 and that of permitting the sewage to flow to C-1 Low Line to be lifted by Pumping Plant No. 14 we shall call Plan No. 4. For the comparative costs under Plan No. 3 and Plan No. 4 see Estimate No. 31, Appendix No. 1. It was finally decided to have a short higher line that would be only about a mile long and would not pass through the main part of San Diego but that would intercept most of the sewage without pumping.

I herewith submit the above report with the accompanying data, plans, specifications and estimates.

Chas. G. Finshie

Consulting Engineer.

APPENDIX NO. 1

COST ESTIMATES

COMPARATIVE COSTS

BETWEEN PLANS NOS. 1 AND 2

AND

BETWEEN PLANS NOS. 3 AND 4.

ESTIMATES

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

RE-CAPITULATION

LAJOLLA AND PACIFIC BEACH- A-1 LINE

Pipe lines and appurtenant structures	$206,453.00	
Pumping Plants- new- Nos.1,2,3,4&5	29,403.00	
Pumping Plants - existing Nos.6&7	1,767.00	
Miscellaneous items	725.00	
		$238,348.00

POINT LOMA, MISSION BEACH
OCEAN BEACH, EAST POINT LOMA.

Pipe lines and appurtenant structures	$208,673.00	
" " " " B-1 line structures	150,622.00	
Pumping Plants Nos.9and 10 to B-1 line	3,175.00	
" " " lland 12 to B-2 "	7,030.00	
Miscellaneous items	150.00	
		$369,650.00

MORENO LINE- B-5 LINE

Pipe lines and appurtenant structures	$ 49,801.00

MISSION VALLEY LINES- B-3 LINE

Pipe lines and appurtenant structures	$285,209.00

CHOLLAS VALLEY LINE- C-2 LINE

Pipe lines and appurtenant structures		
Main Line	$167,142.00	
West Branch	39,233.00	
Miscellaneous items	425.00	
		$206,800.00

SOUTH CHOLLAS VALLEY LINE- C-3 LINE

Pipe lines and appurtenant structures	$ 84,694.00

	Balance forward	$1,204,502.00

MAIN LINE - OLD TOWN & SAN DIEGO TO PUMP NO. 14. THENCE TO C-1 HIGH LINE- C-1 LOW LINE.

Pipe lines and appurtenant structures	$587,855.00	
Pumping plants nos. 13 and 14	115,901.00	
Beardlesly Street Lateral	3,450.00	
		$ 707,206.00

MAIN BRANCH -15th& J STREETS, SAN DIEGO TO JUNCTION WITH PRESSURE LINES FROM PUMP NO. 14 C-1 HIGH LINE.

Pipe lines and appurtenant structures	$ 49,266.00

MAIN TRUNK LINES- BEARDSLEY AND COLTON. TO TREATMENT PLANT SITE AT 32nd ST. C-1 HIGH LINE.

Pipe lines and appurtenant structures	$ 313,462.00

TOTAL- Sewer lines, appurtenant structures and pumping plants $2,304,436.00

ESTIMATED COST TREATMENT PLANTS

Rose Canyon-

1932 capacity	850,000 g.d.	$145,000.00	
1962 "	3,500,000 "	306,000.00	
			$ 306,000.00

32nd Street Plant

1932 capacity	12,000,000 g.d.	$750,000.00	
1962 "	40,000,000 "	$2,000,000.00	
			$2,000,000.00

Total cost collection system and treatment plants	$4,610,436.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED AS A-1 LINE

LA JOLLA & PACIFIC BEACH LINE:

Length:

865.80'	Avg. cut	4.86'	8"	Cast Iron pipe	@ $1.93	$	1,671.00
281.38'	" "	9.17'	8"	" " "	@ 2.27		639.00
1281.80'	" "	4.56'	8"	" " "	@ 1.93		2,473.00
1359.76'	" "	11.9 '	12"	sewer pipe	@ 1.67½		2,277.00
1807.21'	" "	7.17'	12"	" "	@ 1.50½		1,434.00
585.00'	" "	8'	15"	" "	@ 2.18½		1,278.00
2367.23'	" "	17'	15"	" "	@ 2.31½		5,480.00
3377.95'	" "	8.8'	15"	" "	@ 2.20½		7,448.00
4482.12'	" "	12'	18"	" "	@ 3.02½		13,558.00
1021.00'	" "	14'	18"	" "	@ 3.12½		3,190.00
121.00'	" "	8.25'	10"	" "	@ 1.42		171.00
234.10'	" "	6.25'	10"	" "	@ 1.36		318.00
1555.10'	" "	11.5'	21"	" "	@ 3.60		5,598.00
2565. '	" "	19'	21"	" "	@ 4.14		10,619.00
2886.02'	" "	11'	21"	" "	@ 3.60		10,389.00
10080. '	" "	11.2'	21"	" "	@ 3.60		36,288.00
2019.66'	" "	17.3'	24"	" "	@ 4.66½		9,422.00
6223.34'	" "	9.8'	24"	" "	@ 4.37		27,195.00
776.50'	" "	24'	10"	" "	@ 2.19		1,700.00
1813.90'	" "	9.2'	10"	" "	@ 1.43		2,594.00
2034.57'	" "	11'	12"	" "	@ 2.37½		4,832.00
884.07'	" "	6.47'	10"	C. Iron pipe	@ 2.92		2,581.00
909.26'	" "	6'	10"	" "	@ 2.50		2,273.00
798.12'	" "	6'	10"	sewer pipe	@ 1.64		1,309.00
1354.80'	" "	17'	10"	" "	@ 1.53		2,072.00
1077.55'	" "	4.8'	4"	C. Iron pipe	@ 1.13		1,217.00
677.52'	" "	9'	4"	" "	@ 1.26		854.00
2418.70'	" "	10.3'	10"	sewer pipe	@ 1.43		3,458.00
3500.00'	Take up & relay	4'	10"	C. Iron pipe	@ 1.50		5,250.00
480.00'	Avg. cut	4'	10"	" "	@ 2.92		1,401.00
339.29'	" "	8.3'	8"	sewer pipe	@ 1.77		600.00
62212.29 Lin.Ft.						$	170,619.00
11.782 Miles							

Manholes	concrete 2452 Lin.Ft. @ $11.20	$ 27,462.00
Pavement	to cut out 27,908 sq.ft. @ 5¢	1,395.00
"	new concrete 27,908 " " @ 25¢	6,977.00
	Total	$ 206,453.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED AS B-1 LINE

B-1 LINE:

Length:

321.77'	Avg.Depth	6.4'	Dry	24"	sewer pipe	@	$4.16	$	1,338.00
466.57'	"	13'	"	24"	"	@	4.58		2,136.00
710.14'	"	4.5'	"	10"	"	@	1.48		1,051.00
918.96'	"	10'	"	10"	"	@	1.63		1,498.00
1127.40'	"	23'	"	10"	"	@	2.52		2,841.00
200 '	"	5'	"	8"	"	@	1.30		260.00
2553.89'	"	11'	"	10"	"	@	1.63		4,163.00
745 '	"	4'	"	8"	"	@	1.30		968.00
568.05'	"	6.37'	"	12"	"	@	1.72		977.00
1140.00'	"	21'	"	12"	"	@	2.89		3,295.00
830.00'	"	26'	"	15"	"	@	4.11		3,411.00
1520.00'	"	16'	"	15"	"	@	2.76		4,195.00
1140.00'	"	11'	"	15"	"	@	2.37		2,702.00
1031.62'	"	10.6'	"	15"	"	@	2.37		2,445.00
863.49'	"	15.5'	"	15"	"	@	2.76		2,383.00
202.13'	"	14'	quite wet	27"	"	@	11.35		2,294.00
193.75'	"	6½'	" "	27"	"	@	9.56		1,852.00
575.87'	"	6.65'	very wet	27"	"	@	11.70		6,737.00
1465.80'	"	14'	" "	27"	"	@	13.36		19,583.00
45.64'	"	3'	" "	27"	"	@	10.52		480.00
490.00'	"	no cut	" "	27"	C.Iron	@	28.00		13,720.00
2556.13'	"	6½'	" "	27"	sewer pipe	@	10.31		26,354.00
60 '	"	no cut	" "	27"	C.Iron	@	25.00		1,500.00
611.68'	"	4'	" "	27"	sewer pipe	@	10.52		6,435.00
1952.00'	"	11'	" "	27"	"	@	12.81		25,005.00
2271.51'	"	10'	" "	30"	"	@	13.23		30,052.00
736. '	"	4'	" "	6"	C.Iron	@	1.89		1,391.00
4344. '	"	4'	" "	14"	C.Iron	@	4.51		19,591.00
Manholes	569.5'	dry	@	$11.20					6,378.00
"	283.5'	wet	@	15.50	27" & 30" pipe				4,394.00
Pavement	to cut out								1,541.00
"	2" asphalt wearing surface 4" base								7,703.00
						Total		$	208,673.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED AS B-2 LINE

EAST POINT LOMA LINE:

All pipe over 24" - the price includes vitrified clay liners.
All pipe in very wet excavation- the price includes concrete cradles.

Length:

1394.31'	Avg. Cut	9'	very wet	10" sewer pipe	@	$6.34	$8,840.00
75.92'	"	13'	dry	4" cast iron pipe	@	1.86	141.00
1177.99'	"	14½'	"	10" sewer pipe	@	2.15	2,404.00
530.25'	"	19.3'	quite wet	10" " "	@	6.56	3,477.00
2046.11'	"	12.3'	very wet	10" " "	@	6.94	14,200.00
377.94'	"	5.3'	" "	10" " "	@	5.78	2,184.00
259.00'	"	3.5'	" "	12" " "	@	5.58	1,433.00
300.00'	"	4.2'	quite wet	8" cast iron pipe	@	4.55	1,365.00
910.39'	"	4.2	dry	8" " " "	@	1.96	1,784.00
1157.28'	"	7.6'	"	12" sewer pipe	@	1.64	1,898.00
1180.00'	"	9.5'	"	15" " "	@	2.30	2,714.00
1620.00'	"	16'	"	15" " "	@	2.76	4,471.00
540.00'	"	18½'	"	15" " "	@	3.12	1,685.00
370.00'	"	18'	"	18" " "	@	3.98	1,473.00
1644.50'	"	9'	"	18" " "	@	3.04	4,999.00
920.00'	"	15.2'	"	18" " "	@	3.67	3,376.00
810.00'	"	10.5'	"	18" " "	@	3.36	2,722.00
1620.00'	"	9'	"	8" " "	@	1.34	2,171.00
1057.27'	"	8'	slightly wet	21" " "	@	3.84	4,060.00
2700.00'	"	11'	very wet	21" " "	@	9.00	24,300.00
1441.86'	"	10'	" "	21" " "	@	9.00	12,976.00
390.64'	"	4'	" "	21" " "	@	7.80	3,047.00
877.26'	"	4.5'	" "	24" " "	@	8.68	7,614.00
346.93'	"	6'	dry	8" " "	@	1.96	680.00
20 '	"	10.5'	very wet	8" " "	@	6.00	120.00
278 '	"	4'	" "	8" " "	@	5.04	1,401.00
2367.62'	"	8½'	" "	24" " "	@	9.34	22,113.00
al 26353.27							

Manholes	354.5'	very wet	@ $ 15.50	5,495.00
	594.5'	dry	@ 11.20	6,658.00
	57	quite wet	@ 12.50	712.00
Pavement	to cut out	2189 sq.ft.	@ 5¢	109.00
"	4" x 6" concrete	" "	@ 25¢	547.00
			Total	$ 150,622.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED AS B-5 LINE

MORENO LINE:

All pipe over 24"ø the price includes ovitrified clay liners.
All pipe in very wet excavation- the price included concrete cradles.

Length:

3841.45'	avg.	cut	12'	very	wet	18"	sewer pipe @$	7.19	$27,619.00
943.10'	"	"	13.3	"	"	15"	" "	6.66	6,281.00
375 '	"	"	none	"	"	16"	cast iron pipe@$	14.50	5,438.00
680 '	"	"	10'	"	"	15"	sewer pipe @	6.44	4,379.00
873.61'	"	"	7'	slightly	wet				
						15"	" " @	2.50	2,184.00
120 '	"	"	2'		"	15"	" " @	1.53	184.00
56.01'	"	"	5'		"	15"	" " @	2.04	114.00
934.03	"	"	1.6'	dry		15"	" " @	1.38	1,289.00
7263.20 ft.									
1.376 miles									

21 manholes 206.5 ft.(avrg.length 10') @$11.20	2,313.00
No pavement	
TOTAL	$49,801.00

SEWERAGE COLLECTION LINES
CITY OF SAN DIEGO

DESIGNATED B-3 LINES

MISSION VALLEY LINE:

All pipe over 24"- the price includes vitrified clay liners.
All pipe in very wet excavation- the price includes concrete cradles - No pavement.

Length:

699.70'	Avg. Cut	9½'	very wet	27"	pipe	@	$12.40	$	8,676.00
339.70'	" "	7.65'	" "	27"	"	@	12.16		4,131.00
244.94'	" "	13'	" "	27"	"	@	13.15		3,220.00
285.00	" "	8'	" "	27"	"	@	12.16		3,465.00
300.00	" "	8½'	" "	"	"	@	12.16		3,648.00
350.00'	" "	9'	" "	"	"	@	12.16		4,256.00
405.57'	" "	9.3'	" "	"	"	@	12.16		4,931.00
261.67'	" "	10'	" "	"	"	@	12.40		3,244.00
106.23	" "	9½'	" "	"	"	@	12.40		1,317.00
97.90'	" "	13'	" "	"	"	@	13.15		1,321.00
257.32'	" "	17'	" "	"	"	@	13.33		3,378.00
500.00'	" "	16'	" "	"	"	@	13.33		6,565.00
500.00'	" "	11'	quite wet	"	"	@	11.38		5,690.00
500.00'	" "	9½'	" "	"	"	@	11.38		5,690.00
140. '	" "	5'	dry	"	"	@	6.47		906.00
1573.06'	" "	7'	"	"	"	@	6.67		10,492.00
954.17'	" "	8'	"	"	"	@	6.72		6,412.00
1370 '	" "	9½'	"	"	"	@	7.16		9,809.00
1000 '	" "	10'	"	"	"	@	7.16		7,160.00
90 '	" "	11'	"	"	"	@	7.25		652.00
564 '	" "	12.5'	"	"	"	@	7.34		4,139.00
500 '	" "	13'	"	"	"	@	7.34		3,670.00
509.66'	" "	14'	"	"	"	@	7.74		3,945.00
396.00'	" "	14.5'	"	"	"	@	7.87		3,116.00
261.00'	" "	16'	"	"	"	@	8.00		2,088.00
2598.27'	" "	0 to 6		24"	"	@	2.77		7,197.00
7775.45'	" "	6 to 8'		"	"	@	3.35		25,947.00
1718.48'	" "	8' to 10'		"	"	@	4.08		7,011.00
2468.69'	" "	10' to 12'		"	"	@	4.41		10,866.00
573.94'	" "	12' to 14'		"	"	@	4.61		2,645.00
450.00'	" "	25'		"	"	@	6.07		2,731.00
440.7 '	" "	0 to 6'		"	"	@	2.77		1,221.00
440.7 '	" "	6' to 8'		"	"	@	3.35		1,476.00
272. '	" "	8' to 10		"	"	@	4.08		1,110.00
730.15'	" "	10' to 12		"	"	@	4.41		3,280.00
1735 '	" "	12' to 14'		"	"	@	4.61		7,998.00
1524.60'	" "	14' to 16'		"	"	@	4.97		7,577.00
300 '	" "	16' to 18'		"	"	@	4.97		1,491.00
588.39'	" "	20' to 22'		"	"	@	5.74		3,377.00
675.59'	" "	24' to 26'		"	"	@	6.08		4,107.00
378.39'	" "	18' to 20'		"	"	@	5.52		2,088.00
34876.27									$200,983.00

MISSION VALLEY LINE (Cont.)

Length:							
34876.27'						Forward	$200,983.00
710 '	Avg. Cut	0 to 6'	18"	pipe	@	$2.56	$ 1,817.00
611.5 '	" "	6 to 8'	"	"	@	2.72	1,672.00
861.60'	" "	8 to 10'	"	"	@	3.05	2,628.00
1951.31'	" "	10 to 12'	"	"	@	3.37	6,576.00
771.95'	" "	14 to 16'	"	"	@	3.68	2,841.00
310.00'	" "	16 to 18'	"	"	@	4.25	1,317.00
3645.99'		6 to 8'	15"	"	@	1.98	7,219.00
1073.12'		8 to 10'	"	"	@	2.23	2,297.00
582.54'		10 to 12'	"	"	@	2.31	1,346.00
(571 '		6 to 8'	21"	"	@	3.34	1,907.00
(997 '		8 to 10'	"	"	@	3.60	3,589.00
(204 '		0 to 6	10"	"	@	1.27	259.00
(580 '		6 to 8	10"	"	@	1.32	765.00
(533 '		8 to 10	10"	"	@	1.58	842.00
2338.57'		6 to 8'	8"	"	@	1.10	2,572.00
1812.73'		8 to 10'	8"	"	@	1.38	2,501.00
3023.10'		6 to 8'	10"	"	@	1.32	3,990.00
3160.00'		8 to 10'	10"	"	@	1.58	4,993.00
270 '		10 to 12'	10"	"	@	1.64	443.00
325 '		12 to 14	10"	"	@	1.97	640.00
877.36'		0 to 6'	8"	"	@	0.94	824.00
1073.84'		6 to 8'	8"	"	@	1.10	1,181.00
2656.43'		8 to 10'	8"	"	@	1.38	3,666.00
310 '		10 to 12'	8"	"	@	1.52	471.00
221.36'		12' to 14'	8"	"	@	1.73	384.00
240 '		0 to 6'	8"	"	@	0.94	226.00
439 '		6 to 8'	8"	"	@	1.10	483.00
1488 '		8 to 10'	8"	"	@	1.38	2,053.00
Total 66471.67'							$ 260,485.00

Manholes

1629 lin.ft.	@	$ 11.20 under 2 ft. in diameter	18,245.00
418 lin.ft.	@	15.50	6,479.00
			$ 285,209.00

No pavement.

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED AS C 1 - LOW LINE

MAIN LINE- OLD TOWN & SAN DIEGO TO PUMP NO. 14:

LENGTH

3331.31'	avrg. cut	13 1/3'	very wet-	30" pipe	@$12.25		$ 40,742.00
3844.35'	" "	17½ '	" "	42" "	17.85		68,622.00
480.75'	" "	16'	" "	18" "	6.68		3,211.00
350.00'	" "	8'	dry	10" "	1.47		514.00
1738.00'	" "	15.3 '	"	45" "	12.89		22,402.00
2481.00'	" "	9.37 '	"	45" "	12.14		30,119.00
815.88'	" "	"	"	45" "	12.14		9,905.00
2041.99'	" "	9 '	"	45" "	12.14		24,789.00
1719.67'	" "	14.3 '	"	45" "	12.75		21,908.00
7686.22'	" "	13.6 '	slightly wet	51" "	14.57		111,988.00
3818.76'	" "	12.15'	very wet	63" "	26.48		101,120.00
1159.32'	" "	16'	" "	63" "	27.95		32,402.00
2609.89'	" "	14.6 '	" "	63" "	27.57		71,955.00
712.75'	" "	26'	" "	63" "	33.91		24,169.00
32792.89 lin ft. or 6.2 miles							563,846.00

320 lin.ft. avrg. cut 10' dry 30" C.I.pipe @ $13.00		4,160.00
65 " " " " 20' " 42" " " @ 24.00		1,560.00
Manholes 482 lin.ft.@$11.20		5,398.00
" 749.5 lin.ft.@$15.50		11,617.00
Pavement Harasthy St. to cut out 2250 sq.ft.		112.00
" " " new - 2250 sq.ft.		562.00
Where storm drain comes into ocean Line of wakefield sheet piles to keep tide out and sand bags. 100 lin.ft. protection		600.00
	TOTAL	$ 587,855.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED AS C-1 -HIGH LINE

MAIN BRANCH - 15th & J STREETS TO JUNCTION WITH PRESSURE LINE FROM PUMP NO. 14.

Length:

263.87'	avrg.cut	14'	dry	12"	sewer	pipe	@ $1.92	$ 507.00
1047.78'	"	" 18'	"	12"	"	"	2.02	2117.00
620.94'	"	" 25'	"	36"	"	"	11.37	7060.00
140.18'	"	" 12'	"	36"	"	"	9.60	1346.00
170.12'	"	" 8'	"	36"	"	"	9.20	1565.00
170 '	"	" 7.5'	"	39"	"	"	10.00	1700.00
1615.51'	"	" 18'	"	39"	"	"	10.97	17722.00
900 '	"	" 12'	"	39"	"	"	10.57	9513.00

4928.40 lin.ft. total
0.93 miles.

Manholes - 294 lin.ft.@$11.20	3293.00
Pavement cut out -14910 sq.ft.@5¢	741.00
" new 14810 sq.ft.@25¢	3702.00
TOTAL	$39266.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED C-1 - HIGH LINE

MAIN TRUNK LINE
BEARDSLEY STREET TO 32ND STREET TREATMENT SITE.

Length

312.75'	avrg.cut-	13.25'	very wet	66"	sewer pipe		$ 7,961.00
354.31'	" "	9'	" "	66"	" "		8,662.00
362.79'	" "	5'	" "	66"	" "		8,544.00
378.33'	" "	5'	" "	66"	" "		8,910.00
378.33'	" "	5'	" "	66"	" "		8,910.00
378.34'	" "	13.5'	" "	66"	" "		9,625.00
320 '	Siphon	Inlet chamber incl. cofferdam					1,066.00
"	"	Outlet "	"	"			1,066.00
"	"	pipe in place					9,952.00
"	"	bulkhead to keep tide out					2,298.00
160 '	avrg.cut	10'	very wet	66"	sewer pipe		3,949.00
157.33'	" "	6½ '	" "	66"	" "		3,776.00
250 '	" "	7 '	" "	66"	" "		6,000.00
28.50'	" "	14'	" "	66"	" "		725.00
100 '	" "	16'	" "	75"	" "		2,946.00
170 '	" "	7½'	" "	75"	" "		4,267.00
191.71'	" "	19'	" "	75"	" "		5,751.00
422.91'	" "	15½'	" "	75"	" "		12,458.00
422.91'	" "	14'	" "	75"	" "		12,196.00
422.92'	" "	15'	" "	75"	" "		24,524.00
368.75'	" "	16'	" "	75"	" "		10,863.00
462.08'	" "	17'	" "	66"	" "		12,245.00
255 '	" "	12'	" "	66"	" "		6,439.00
60 '	" "	8'	" "	66"	" "		1,413.00
66.41'	" "	22'	" "	66"	" "		1,866.00
381.41'	" "	28'	" "	66"	" "		11,167.00
381.41'	" "	27½'	" "	66"	" "		11,167.00
153.51'	" "	26'	" "	66"	" "		4,439.00
330 '	" "	24½'	" "	66"	" "		425.00
330 '	" "	23½'	" "	66"	" "		9,398.00
330 '	" "	23'	" "	66"	" "		9,372.00
330 '	" "	23½'	" "	66"	" "		9,372.00
330 '	" "	23½'	" "	66"	" "		9,372.00
330 '	" "	22½'	" "	66"	" "		9,273.00
330 '	" "	21'	" "	66"	" "		9,362.00
330 '	" "	19½'	" "	66"	" "		9,451.00
330 '	" "	18'	" "	66"	" "		8,910.00
330 '	" "	16½'	" "	66"	" "		8,745.00
330 '	" "	15½'	" "	66"	" "		8,632.00
330 '	" "	14½'	" "	66"	" "		8,521.00
10899.91 feet	or 2.07 miles						
Manholes 534 lin.ft.@$17.50							9,345.00
						TOTAL	$ 313,462.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED AS C-2 LINE

CHOLLAS VALLEY LINE:

Length:

435'	Avg.cut	6.21'	dry	45"	Sewer pipe @	$7.61	$ 3,310.00
100'	" "	5.25'	"	"	" "	6.65	665.00
1115'	" "	12.48'	"	"	" "	12.80	14,272.00
1547'	" "	9.6 '	"	"	" "	12.53	19,383.00
800'	" "	9.7'	"	"	" "	12.53	10,024.00
269'	" "	13.9 '	"	"	" "	12.91	3,472.00
115'	" "	15'	"	"	" "	13.29	1,528.00
332'	" "	6.4'	"	"	" "	12.09	4,013.00
128'	"fill		"	"	" "	11.09	1,419.00
784'	avg.cut	7.25'	"	36"	" "	9.94	7,793.00
865'	" "	7 9'	"	33"	" "	9.17	7,932.00
990'	" "	11.6'	"	33"	" "	9.34	2,466.00
1203'	" "	9.1'	"	30"	" "	8.60	10,345.00
616.5'	" "	11.3'	"	30"	" "	8.72	5,375.00
2521'	" "	10.4'	"	18"	" "	2.87	7,235.00
292'	" "	11.5'	"	18"	" "	2.91	850.00
815'	" "	11.56'	"	18"	" "	2.91	2,372.00
2597'	" "	8.63'	"	15"	" "	2.11	5,480.00
5366'	" "	8'	"	15"	" "	2.11	11,322.00
3845'	" "	8.3'	"	15"	" "	2.11	810.00
5576'	" "	9.6"	"	12"	" "	1.62	9,033.00
5116.32'	"	8.23'	"	10"	" "	1.38	7,060.00
135'	" "	7'	quite wet	42"	" "	12.50	1,687.00
160'	" "	4.5'	"	42"	" "	12.30	1,968.00
120'	on trestle			42"	C.I. pipe		3,238.00
881.64'	av.cut	8.25'	"	42"	sewer pipe	12.60	11,108.00
33264.64	lin.ft.total						

Manholes	672 lin.ft.@	$11.20	7,526.00
"	352 "	15.50	5,456.00
		TOTAL	$ 167,142.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED AS WEST BRANCH
C-2 LINES

WEST BRANCH C-2 LINE:

Length:

1045.42'	avrg.cut	4.5'	-10"	sewer	pipe	@$1.15	$ 1,202.00
351.42'	"	5'	"	"	"	"	404.00
680.32'	"	5.5'	"	"	"	"	782.00
600.93'	"	6'	"	"	"	"	691.00
334.59'	"	6.5'	"	"	"	1.20	402.00
230.98	"	7'	"	"	"	"	277.00
266.35'	"	7.5'	"	"	"	"	320.00
451.80'	"	8'	"	"	"	"	554.00
351.41'	"	9'	"	"	"	1.26	443.00
97.50'	"	13'	"	"	"	1.42	139.00
227.05'	"	6'	-12"	"	"	1.43	325.00
930.61 '	"	6.5'	"	"	"	1.43	1,331.00
312 '	"	7'	"	"	"	1.47	459.00
700.92'	"	9'	"	"	"	1.60	1,122.00
227.05	"	23.5	"	"	"	2.24	508.00
292.66	"	5'	"	"	"	1.43	419.00
321.38'	"	5.5'	"	"	"	1.43	459.00
381.72'	"	6.5'	"	"	"	1.43	546.00
1106.93'	"	7'	"	"	"	1.47	1,627.00
614.05'	"	7.5'	"	"	"	1.47	902.00
1305.19'	"	6'	"	"	"	1.43	1,866.00
866.62 '	"	8'	"	"	"	1.55	1,344.00
562.83'	"	8.5'	"	"	"	1.55	873.00
309.44'	"	9.5'	"	"	"	1.65	511.00
292.66'	"	10'	"	"	"	1.65	483.00
292.65'	"	12.5'	"	"	"	2.08	609.00
292.65'	"	13'	"	"	"	2.08	609.00
349.45'	"	15'	"	"	"	2.22	776.00
283.84'	"	19'	"	"	"	2.22	630.00
292.66'	"	10.5'	"	"	"	1.65	483.00
374.82'	"	11'	"	"	"	1.65	619.00
375 '	"	20'	"	"	"	2.22	832.00
659.24'	"	5'	-15"	"	"	1.94	1,278.00
221.26'	"	7.5'	"	"	"	1.94	429.00
280.68'	"	8.5'	"	"	"	2.00	561.00
603.93'	"	9'	"	"	"	2.00	1,208.00
386.65'	"	10'	"	"	"	2.00	773.00
218.62'	"	11'	"	"	"	2.18	477.00
721.66'	"	12'	"	"	"	2.18	1,573.00
375 '	"	16'	"	"	"	2.57	964.00
1481.31'	"	10.5'	"	"	"	2.00	2,963.00
20081.28'							
Manholes 576.8 lin.ft. dry @$11.20							6,460.00
						TOTAL	$ 39,233.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

DESIGNATED AS C-3 LINE

SOUTH CHOLLAS VALLEY LINE:

Length:

1524.75'	wet	8.0'	27"	Sewer pipe	@	$10.00	$ 15,247.00
376.64'	dry	8.0'	27"	" "	@	6.88	2,591.00
380.48'	"	10.5'	"	" "	@	6.93	2,636.00
395.00'	"	14.5'	"	" "	@	7.20	2,844.00
380.21'	"	13'	"	" "	@	7.08	2,690.00
384.91'	"	10.3'	"	" "	@	6.93	2,667.00
379.86'	"	13.5'	"	" "	@	7.16	2,720.00
190.05'	"	18.5'	"	" "	@	7.74	1,471.00
235.66'	"	12'	"	" "	@	7.08	1,568.00
508.61'	"	5'	"	" "	@	5.33	2,710.00
100.00'	"	7½'	"	" "	@	6.88	688.00
234.75'	"	13'	"	" "	@	7.08	1,664.00
374.60'	"	8.3'	"	" "	@	6.88	2,577.00
190.00'	"	8.16'	"	" "	@	6.88	1,307.00
320.00'	"	8'	"	" "	@	6.88	2,201.00
340.00'	"	8.16'	24"	" "	@	4.40	1,496.00
190.00'	"	8.7'	"	" "	@	4.40	836.00
330.02'	"	10.16'	"	" "	@	4.40	1,452.00
330.02'	"	11'	"	" "	@	4.40	1,452.00
327.56'	"	10'	"	" "	@	4.40	1,441.00
60.00'			24"	C. Iron pipe	@	8.10	486.00
375.00'	Avg. Cut	8.7'	21"	sewer pipe	@	3.37	1,264.00
431.50'	" "	8.8'	21"	" "	@	3.37	1,454.00
241.66'	" "	8.7'	21"	" "	@	3.37	814.00
80.00'	" "	7.6'	21"	" "	@	3.37	270.00
385.57'	" "	9'	21"	" "	@	3.37	1,299.00
50 '	" "	9½'	18"	" "	@	2.73	136.00
110 '	" "	4'	18"	" "	@	2.44	268.00
115.57'	" "	6'	18"	" "	@	2.63	305.00
110 '	" "	6'	"	" "	@	2.63	289.00
385.56'	" "	6.6'	"	" "	@	2.62	1,014.00
492.12'	" "	7.3'	"	" "	@	2.63	1,294.00
50 '	" "	7.5'	"	" "	@	2.63	131.00
70 '	" "	2.25'	"	" "	@	2.44	171.00
345.32'	" "	8'	"	" "	@	2.69	929.00
465.32'	" "	8'	"	" "	@	2.69	1,251.00
465.32'	" "	8'	"	" "	@	2.69	1,251.00
170 '	" "	7'	"	" "	@	2.69	457.00
225.72'	" "	3.7'	"	" "	@	2.44	551.00
380.71'	" "	6.5'	"	" "	@	2.63	1,011.00
15.00'	" "	16.5'	"	" "	@	3.04	46.00
40 '	" "	16.5'	"	" "	@	3.04	122.00
464.35'	" "	6.8'	"	" "	@	2.69	1,249.00
11497.17							$ 68,320.00

SOUTH CHOLLAS VALLEY LINE (Cont.)

Length:								
					Forward			$ 68,320.00
11497.17'								
361.99'	Avg.	Cut	6½'	18"	Sewer	Pipe	@ $2.63	952.00
361.98'	"	"	7'	18"	"	"	@ 2.63	952.00
361.96'	"	"	8'	18"	"	"	@ 2.69	952.00
330.00'	"	"	5'	18"	"	"	@ 2.50	825.00
148.69'	"	"	8'	18"	"	"	@ 2.63	391.00
529.98'	"	"	8.7'	18"	"	"	@ 2.69	1,426.00
325.00'	"	"	8'	18"	"	"	@ 2.69	874.00
435.86'	"	"	7.75'	18"	"	"	@ 2.69	1,172.00
409.95'	"	"	8'	18"	"	"	@ 2.69	1,103.00
120. '	"	"	7½'	18"	"	"	@ 2.69	323.00
80.95'	"	"	3'	18"	"	"	@ 2.44	198.00
209 '	"	"	6'	18"	"	"	@ 2.63	550.00
90 '	"	"	6'	"	"	"	@ 2.63	237.00
72 '	"	"	3'	"	"	"	@ 2.44	176.00
210.68'	"	"	6.75'	"	"	"	@ 2.69	567.00
210 '	"	"	8'	"	"	"	@ 2.69	565.00
40 '	"	"	5'	"	"	"	@ 2.50	100.00
82 '	"	"	7'	"	"	"	@ 2.63	216.00
40.68'	"	"	12½'	"	"	"	@ 2.94	120.00
17442.64	Total feet							$ 80,019.00
	Manholes		250	Lin.ft.	@	$11.20		2,800.00
	"		121	"	"	@ 15.50		1,875.00
							Total	$ 84,694.00

No pavement.

ESTIMATES

MISCELLANEOUS ITEMS NOT INCLUDED IN GENERAL ESTIMATE

Pressure Lines:

(a)	Pacific Ave. from Pump Sta.No.6 MHs and handholes	$ 225.00
(b)	Mission Beach from Pump Sta.No.9 MHs and handholes	350.00
(c)	LaPlaya Pacific Beach No. 7 Connecting to existing discharge	150.00
(d)	Point Loma No. 12 Connecting to existing discharge	150.00

Gravity Lines:

(e)	32nd Street No. 15 Gravity line discharge chamber To MH on C-2 line	125.00
	Additional MHs on C-2 line	300.00
	Beardsley Street Stub from South	3,450.00
	TOTAL	$ 4,750.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO.

PUMPING PLANT ESTIMATE

PUMPING PLANT NO. 1.- North La Jolla.

Concrete bottom - 500 cu.ft.		$ 150.00
" walls - 1126sq.ft. av.thickness 14"		709.00
" roof - 91 sq.ft. " " 7"		32.00
" " 91 sq.ft. " " 10.5"		42.00
" partition wall -243 sq.ft. 15" thick		158.00
" bowl - 55 cu.ft.		16.00
" walls around float wells -270 sq.ft. 6"		111.00
" walls entrance shaft- 80 sq.ft. 6" thick		33.00
" roof over float wells- 14 sq.ft.-6" "		6.00
" walls vent shaft-29 sq.ft.- 8" thick		14.00
" " " " 65 " 6" "		27.00
" roof over vent shaft less manholes 9sq.ft.		4.00
" floor over beams A-70 sq.ft.-6" thick		17.00
" Beams A&B		15.00
Reinforcement - 12830# @5¢		641.00
Finishing and painting concrete		100.00
Steps - 48		19.00
Reinforced concrete pipes 24" diam. 5½' long		12.00
Cast iron manholes and frames 3@$15		45.00
Cast iron manholes and frames - rectangular		20.00
Bar grate over sump 52 sq.ft.and floor grate 8sq.ft.		20.00
Excavation - 347 sq.ft.		434.00
Rental of crane and clam shell		75.00
Pumping labor - 347 hrs.@50¢		173.00
Rental of pump, hose etc.		35.00
Cofferdam		1,095.00
	$	4,003.00
Overhead and profit and contingency 25%		1,001.00
		5,004.00
Pumps, electrical equipment, pipes & fittings		3,136.00
TOTAL	$	8,140.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

PUMPING PLANT ESTIMATE

PUMPING PLANT NO. 2- North La Jolla.

Concrete bottom -252 cu.ft.		$ 76.00
" exterior walls -270 sq.ft.-av.	13½" thick	167.00
" " " 244 " "	11½" "	134.00
" " " 540 " "	10 " "	270.00
" roof over -281 sq.ft.- "	8 " "	101.00
" partition wall- 221 sq.ft. "	12 " "	121.00
" walls around float wells -246 sq.ft.	6" thick	101.00
" " entrance shaft-10 sq.ft.	6" "	4.00
" roof over float wells-14 sq.ft.	6" "	8.00
" floor over beam A- 86 sq.ft.	6" "	47.00
" floor beams		20.00
Painting and finishing concrete		75.00
Reinforcement 9555# @ 5¢		478.00
Steps - 37 @ 40¢		15.00
Reinforced concrete pipe		5.00
Manhole frame and cover		15.00
Manhole frame and cover - rectangular		20.00
Bar grate over sump and floor grate - 45 sq.ft.		20.00
Excavation - 266 cu.yds.@$1.50		399.00
Rental of crane and clam shell		50.00
Shoring sheet piles driven with maul		94.00
		$ 2,220.00
Overhead and profit 20%		444.00
		2,664.00
Pumps, mechanical equipment, pipes & fittings		3,041.00
TOTAL		5,705.00

SEWERAGE COLLESTION SYSTEM
CITY OF SAN DIEGO

PUMPING PLANT ESTIMATE

PUMPING PLANT #3- La Jolla.

Concrete bottom 254 cu.ft.		$ 76.00
" ex. walls 202 sq.ft. 13½" thick		127.00
" " " 91 " 21" "		73.00
" " " 99 " 9" "		40.00
" " " 221 " 10½" "		113.00
" " " 57 " 12" "		32.00
" roof over wall 13 sq.ft. 6" thick		34.00
" " " beam 2-6"by12"by6½'		6.00
" floor interior 80 sq.ft. 6"		24.00
" " beams 2-6"by 12"by6½'		6.00
" " columns 2- 12"by12"by15'		39.00
" side walls 60 sq.ft. 12" thick		28.00
Re-inforcing steel 5810#		291.00
Steps		5.00
Manhole- rectangular		25.00
Floor grates		3.00
Break out portion of bottom of old tank		50.00
Grate over sump		10.00
Finishing and painting concrete		50.00
Excavation - soft sandstone 140 cu.yds		420.00
Rental of crane and clamshell		60.00
Pumping labor 140 cu.yds.		140.00
Rental of pump hose		35.00
Sheeting wales and braces in place		157.00
		$ 1853.00
Overhead and profit 25%		463.00
		2316.00
Pumps,electrical equipment,pipes and fittings		3495.00
TOTAL		$ 5811.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

PUMPING PLANT ESTIMATE

PUMPING PLANT NO. 4.-La Jolla.

Concrete bottom -321 cu.ft.		$ 96.00
" exterior walls- 908 sq.ft. avg.1'thick		518.00
" roof -199 sq.ft.- 6¾" thick		70.00
" partition wall-215 sq.ft.-10" thick		118.00
" walls around float walls-80.5sq.ft.6"thick		36.00
" walls around entrance 15sq.ft.-6" thick		7.00
" over beams A-70 sq.ft.-6"thick		32.00
" floor beams A- 2-6"by6"by7		5.00
Finishing and painting concrete		60.00
Reinforcing cement -8595# @5¢		430.00
Steps 3/4"0 - 23		9.00
Steel cover over float wells -168#		10.00
R.C. pipe 24"		5.00
Cast iron manhole B		15.00
Bar grate over sump and floor -60 sq.ft.		20.00
Manhole frame and cover-rectuangular		20.00
Excavation - dry - 211 cu.yds.@$1.50		316.00
Rental of crane and clam shell		50.00
Shoring - sheet piles driven with maul		94.00
		$1,917.00
Overhead and profit 20%		383.00
		2,300.00
Pumps, electrical equipment, pipes and fittings		2,281.00
TOTAL		$4,581.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

PUMPING PLANT ESTIMATE

PUMPING PLANT #5- La Jolla:

Concrete bottom - 348 cu.ft.	$ 104.00
Concrete exterior walls -896 sq.ft. -11½" thick	511.00
Concrete roof - 232 sq.ft. - 6½" thick	74.00
Concrete partiton walls 204 sq.ft. avrg.thickness 10"	106.00
Concrete walls aroubd float walls -805 sq.ft.6" thick	338.00
Concrete walls entrance shaft 22sq.ft.6"thick	9.00
Concrete floor over beam A-70sq.ft. 6" thick	22.00
Concrete floor beams A&B	15.00
Steel cover over float wells	15.00
Reinforced concrete pipe 24" diam.	5.00
Finishing andmpainting concrete	75.00
Cast iron manhole and frame and cover	15.00
Bar grate over sump and floor grate	20.00
Manhole and cover - rectangular	25.00
Excavation - dry 220 cu.yds	330.00
Rental of crane and clam shell	75.00
Shoring	94.00
Rental of pump suction hose and pipe	35.00
Re-inforcement 8150#	407.00
Steps	8.00
Incidentals	25.00
	2,308.00
Overhead and contingency 25%	577.00
	2,885.00
Pumps,wlectrical equipment and fittings	2,281.00
TOTAL	$ 5,166.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

PUMPING PLANT ESTIMATE

PUMPING PLANT NO. 11.- East Point Loma.

Concrete bottom - 466 cu.ft.	$ 140.00
" interior walls -1044 sq.ft.avg.15" thick	679.00
" roof -225 sq.ft. - avg. thickness 8.17"	86.00
" partition walls-218 sq.ft.-13½" thickness	135.00
" walls around flat well-805sq.ft.-6" thick	338.00
" walls entrance shaft-22 sq.ft.-6" thick	9.00
" floor over beam A-70 sq.ft.-6" thick	22.00
" floor beams A&B	15.00
Steel cover over float wells 168#	10.00
Reinforced concrete 24" diam.	5.00
Finishing and painting concrete	75.00
Cast iron manhole frame and cover	15.00
Bar grate over sump 52 sq.ft. & floor grate 8sq.ft.	20.00
Manhole frame and cover - rectangular	20.00
Excavation - 240 cu.yds.	360.00
Rental of crane and clam shell	75.00
Pumping labor - 240 @50¢	120.00
Rental of pump, suction hose and pipe	35.00
Cofferdam	1,076.00
Reinforcement 11350# @5¢	568.00
Steps - 3/4" 0 - 21	8.00
	$ 3,851.00
Overhead and congingency 25%	963.00
	4,814.00
Pumps, electrical equipment, pipes and fittings	2,216.00
TOTAL	$ 7,030.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

PUMPING PLANT ESTIMATES

PUMPING PLANT NO. 13- Kurtz and Hortensia Streets.

Concrete bottom - 5116 cu.ft.		$ 1,637.00
" circular walls - 5554 cu.ft.		2,141.00
" circular walls- exterior -3543 sq.ft.		706.00
" " " interior -3220 sq.ft.		634.00
" roof slab - 1215 sq.ft. avrg. 13" thick		668.00
Partition wall - 909 sq.ft. avrg. 18" thick		664.00
Column 1-24"by 24"by 23' and forms		125.00
" 2-2-18"by18"by23' " "		87.00
" 3-2-24"by24"by23' " "		125.00
Hor. col. 4- 2-18"by24"by17½' and forms		60.00
Roof beams Nos. 1 to 8 inclusive		237.00
Floor beams #1 - 2- 12"by 14"by6'		10.00
" " #2 1-12"by14"by7.5'		7.00
Balcony floor slab 174 sq.ft. - 6" thick		54.00
Wall above roof 16'by 3' - 48 sq.ft.-8" thick		22.00
Walls around concrete manhole 12'by3' - 6" thick		14.00
Excavation and sinking caisson 2658 cu.yds.		10,632.00
Spiral staircase - steel		200.00
Steel ladder 13' high		30.00
Railing - gas pipe 30 lin.ft.		60.00
Cast iron frame and cover		15.00
Cast iron frame and cover - rectangular		25.00
Re-inforcing steel 59465#		2,379.00
Water supply		50.00
Derrick - erect and lower and repair& dead man		875.00
Set up boiler and duplex pump		100.00
Make up ejector		225.00
Set up pump and pump hole		100.00
Rent boiler		250.00
8 guide piles 320'		96.00
Cables and bolts for lowering		200.00
4 hand winches		300.00
Drive piles		80.00
Load and unload outfit		120.00
Freight on outfit		100.00
Pumping during construction of pit		300.00
Hauling outfit		200.00
Cutting edge		200.00
Liability Ins.		475.00
Incidentals and supplies		2,500.00
Bond 1½%		510.00
	$	27,313.00
Overhead and profit		8,194.00
Total cost of caisson		35,507.00
Pumps, electrical equipment, pipes and fittings		12,942.00
TOTAL	$	48,449.00

SEWERAGE COLLECTION SYSTEM
CITY OF SAN DIEGO

PUMPING PLANT ESTIMATE

PUMPING PLANT NO. 14.

Concrete	
Bottom - 7032 cu.ft.	$ 2,250.00
Circular walls concrete 8106 cu.ft.	3,242.00
" " forms exterior 5508 sq.ft.	1,102.00
" " " interior 5086 sq.ft.	1,007.00
Roof slab 1474 sq.ft. avrg,13" thick and forms	811.00
Partition wall 1400 sq.ft. avrg.27" thick	1,330.00
Columns	366.00
Roof beams	226.00
Floor beams	52.00
Floor girders	40.00
Floor slab 628 sq.ft. 10" thick	264.00
Wall above roof 125 sq.ft. 13" thick	75.00
" " " 100 " 12" "	57.00
" " " 48 " 6" "	20.00
Ladders 80 lin.ft.	160.00
Reinforcing steel	3,576.00
Excavation & sinking caisson dry 1090 cu.yds.	2,725.00
" " " wet 2730 cu.yds.	10,920.00
Cast iron manhole frames and covers	50.00
Machinery shaft cover concrete	125.00
Painting wet pit asphalt	100.00
Floor grates 37 sq.ft.	20.00
Water supply	100.00
Derrick- erect andlower repairs and deadman	875.00
Set up boiler and duplex pump	100.00
Make up ejector	225.00
Set up pump to pump hole	100.00
Rent boiler	250.00
8 girder piles 320'	96.00
4 hand winches	300.00
Cables for lowering	200.00
Drive 8 guide piles	80.00
Load and unload outfit	120.00
Freight on outfit	100.00
Haul outfit to site	200.00
Pumping during construction	450.00
Cutting edge - channel iron	250.00
Liability Ins.	520.00
Incidentals and supplies	3,200.00
Bond	700.00
	36,384.00
Overheand and profit 30%	10,915.00
	47,299.00
Pumps, electrical equipment , pipe and fittings	20,153.00
TOTAL	$ 67,452.00

ESTIMATES OF ALTERATIONS

TO ESISTING PUMPING PLANTS

PUMPING PLANT NO. 6.

Pacific Beach No. 1.

New pumps, motors, starters and pipe and fittings to connect with existing intake and pressure pipes	$ 1,542.00

PUMPING PLANT NO. 7.

Pacific Beach No. 2.

Changing runners in 2 pumps from 4"by 12" to 4" by 10"	$ 225.00

PUMPING PLANT NO. 9.

Mission Beach.

New pumps, motors, starters and pipe and fittings to connect with existing intake and pressure pipes	$ 1,750.00

PUMPING PLANT NO. 10.

Ocean Beach.

New pumps, motors, starters and pipe and fittings to connect with existing intake and pressure pipes	$ 1,425.00

PUMPIMG PLANT NO. 12.

No changes in plant	--------

PUMPING PLANT NO. 15.

No changes in plant	--------

ESTIMATE NO. 30

POINT LOMA, MISSION BEACH, OCEAN BEACH, MISSION VALLEY, MORENO, OLD TOWN SEWAGE - COMPARATIVE COSTS

ITEM	PLAN NO. 1 Sewage to N.of Old Town	PLAN NO. 2 Sewage to 32nd Street
B4 Line	$ 93,314.00	----------
B5 Line	46,000.00	$ 49,801.00
C1 Low	311,469.00	587,855.00
C1 High below Pump #14	302,562.00	313,462.00
Pump #13	6,500.00	48,449.00
Pump #14	63,500.00	67,452.00
Pumps operating cost: capitalized	---------	84,100.00
Treatment Plant cost	282,750.00	195,000.00
Treatment Plant Cost: capitalized	504,784.00	299,100.00
Total comparative costs	$1,610,879.00	$1,645,219.00

NOTE: All items that have no bearing on the comparative costs are omitted.

ESTIMATE NO. 31.

COMPARATIVE COSTS

BETWEEN PLANS NOS. 3 AND 4.

ITEM	PLAN NO.3 Intercepting part with Cl-High Line	PLAN NO.4 Sewage dropped into Cl-Low Line
Cl- Low Line	$512,379.00	$587,855.00
Cl- High Line	221,194.00	49,266.00
Pump #14	63,000.00	67,452.00
Pump operating cost: Capitalized	----------	53,800.00
Total comparative costs	$796,573.00	$ 758,373.00

GAGE POINT Nº 15

DATE GAGE READING THURSDAY MAY 14, 31

SIZE PIPE 16" SLOPE .0008

MIN. FLOW PER HOUR 720.0 C.F. = 5386.0 GAL.

AV. " " " 1297.4 C.F. = 9705.2 GAL.

MAX. " " " 2376.0 C.F. = 17773.7 GAL.

TOTAL FLOW FOR 24 HOURS 31137.6 C.F. = 232924.8 GAL.

AREA SERVED 978 ACRES

AVERAGE FLOW PER ACRE .00037 C.F.S.

POPULATION SERVED 5746.

DISCHARGE PER CAPITA 24 HRS 5.42 C.F. = 40.5 GAL.

AV. DISCHARGE PER CAPITA PER SECOND = .000063

MAX. " " " " " = .000115

LOCATION - ON 16" INTERCEPTOR AT HORTENSIA AND KURTZ STREETS PRESSED

DEPTH INCHES	3.90	3.60	3.50	3.50	3.50	3.50	3.50	4.00	5.50	6.25	5.75	5.50	5.00	5.00	5.20	4.80	4.60	4.50	4.60	4.90	5.00	4.75	4.60	4.50
DEPTH % DIAM.	24.4	22.5	21.9	21.9	21.9	21.9	21.9	25.0	34.4	39.1	35.9	34.4	31.3	31.3	32.5	30.0	28.8	28.1	28.8	30.6	31.3	29.7	28.8	28.1
C.F.S.	0.255	0.21	0.20	0.20	0.20	0.20	0.20	0.27	0.51	0.66	0.56	0.52	0.425	0.425	0.46	0.395	0.36	0.34	0.36	0.41	0.425	0.38	0.355	0.34

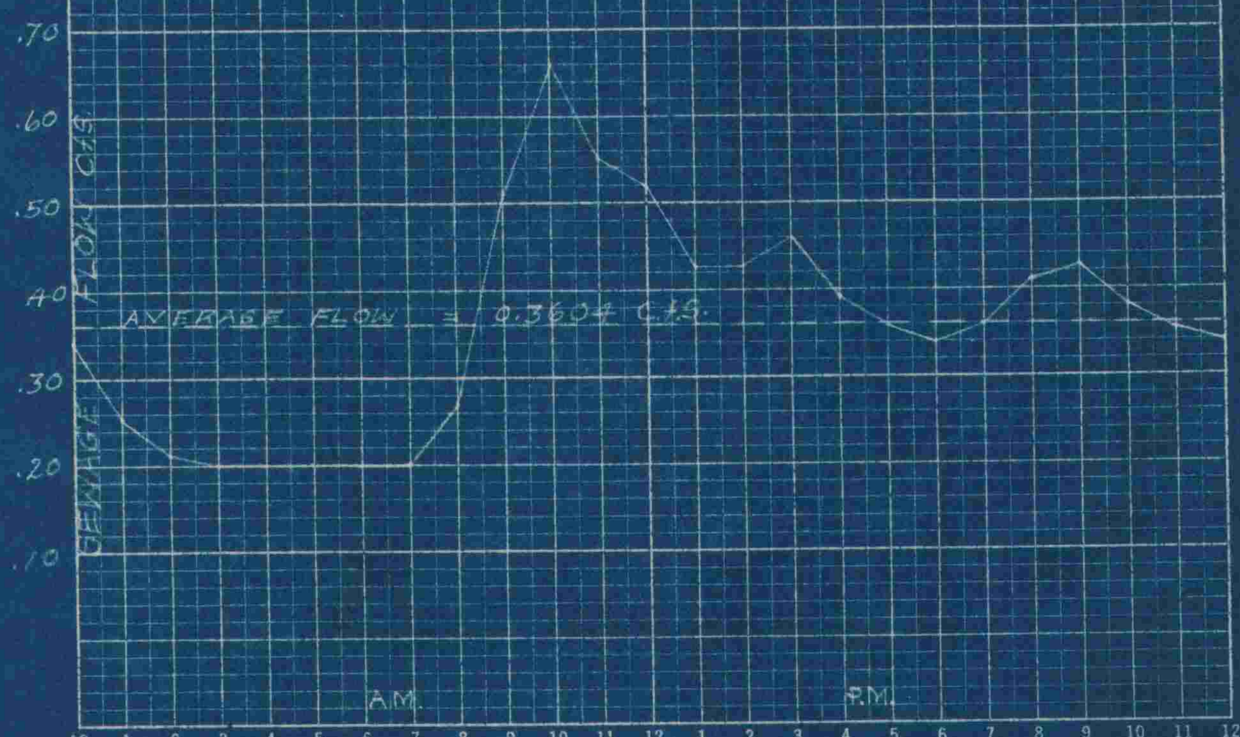


Exhibit 1.

GAGE POINT No. 18

DATE GAGE READING THURSDAY MAY 21, 1931

MIN. FLOW PER HOUR	504.0 C.F. =	3770.2 GAL.
AV. " " "	2296.8 C.F. =	17181.2 GAL.
MAX. " " "	4320.0 C.F. =	32315.8 GAL.
TOTAL FLOW FOR 24 HOURS	55123.2 C.F. =	412349. GAL.

AREA SERVED 656 ACRES

AVERAGE FLOW PER ACRE .00097 C.F.S.

POPULATION SERVED 6576

DISCHARGE PER CAPITA 24 HRS. 8.380 C.F. = 62.7 GAL.

AV. DISCHARGE PER CAPITA PER SECOND = .000097

MAX. " " " " " = .000782

LOCATION - QUINCE AND CALIFORNIA STREETS - OLIVE STREET OUTFALL

	DEPTH INCHES	%DIAM	C.F.S.
12	3.00	21.4	.32
1	2.50	17.9	.20
2	2.25	16.1	.17
3	2.25	16.0	.15
4	2.25	16.4	.15
5	2.50	17.1	.17
6	2.70	19.3	.22
7	6.00	42.9	1.20
8	5.70	40.7	1.10
9	5.50	39.2	1.00
10	5.50	39.2	1.00
11	5.00	35.7	.86
12	5.00	35.7	.86
1	4.50	32.1	.75
2	5.00	35.7	.86
3	4.00	28.5	.63
4	4.20	30.0	.61
5	4.50	32.1	.69
6	3.40	24.2	.46
7	3.50	25.0	.47
8	3.50	25.0	.47
9	4.10	29.3	.58
10	4.00	28.6	.54
11	3.60	25.7	.45

SEWAGE FLOW C.F.S.

1.50
1.25
1.00
.75
.50
.25
0

AVERAGE FLOW = 0.639 C.F.S.

A.M. P.M.

12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12

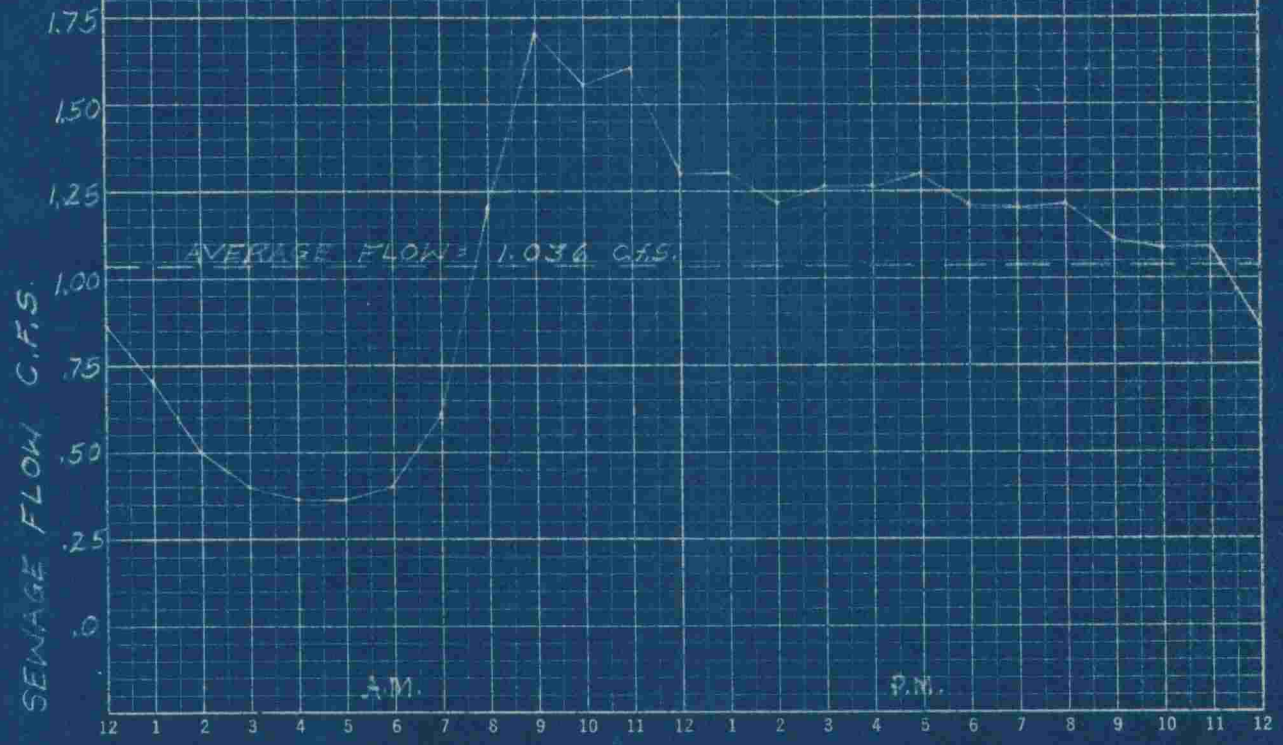
14" Pipe Slope .004 Exhibit 2

GAGE POINT No. 21

DATE GAGE READING TUESDAY MAY 26. 1931

MIN. FLOW PER HOUR 1332 C.F. = 9964.03 GAL.
AV. FLOW PER HOUR 3719.6 C.F. = 27899.27 GAL.
MAX. FLOW PER HOUR 6120. C.F. = 45780.66 GAL.
TOTAL FLOW FOR 24 HRS. 89510.4 C.F. = 67 9582.55 GAL.
AREA SERVED 865 ACRES
AVERAGE FLOW PER ACRE .0012 C.F.S.
POPULATION SERVED 13213
DISCHARGE PER CAPITA 24 HRS 6.771 C.F. = 51.4 GAL.
AV. DISCHARGE PER CAPITA PER SECOND .000078
MAX. " " " " " .000129
LOCATION - LAUREL AND CALIFORNIA STREETS - OLIVE STREET OUTFALL

C.F.S.	INCHES	% DIA. DEPTH
1.70	4.50	32.2
1.50	3.90	27.2
1.40	3.74	24.7
1.37	3.30	23.5
1.37	3.20	23.3
1.40	3.45	24.7
1.66	4.40	31.1
1.80	6.00	42.8
1.70	7.20	51.4
1.55	6.96	49.8
1.60	7.00	50.0
1.30	6.30	45.0
1.30	6.30	45.0
1.22	6.10	43.6
1.26	6.20	44.2
1.26	6.20	44.2
1.30	6.30	45.0
1.22	6.10	43.6
1.20	6.00	42.9
1.22	6.10	43.6
1.12	5.80	41.4
1.08	5.60	40.0
1.08	5.60	40.0
0.86	5.00	35.7



14" Pipe Slope .004 Exhibit 3

GAGE POINT No. 24

DATE GAGE READING MONDAY JUNE 22, 1931

MIN. FLOW PER HOUR 2700. C.F. = 20,197. GAL.

AVERAGE FLOW PER HOUR 6480. C.F. = 48,474. GAL.

MAX. FLOW PER HOUR 11,660. C.F. = 87,233. GAL.

TOTAL FLOW FOR 24 HRS. 155520. C.F. = 1,163,367. GAL.

AREA SERVED 309. ACRES

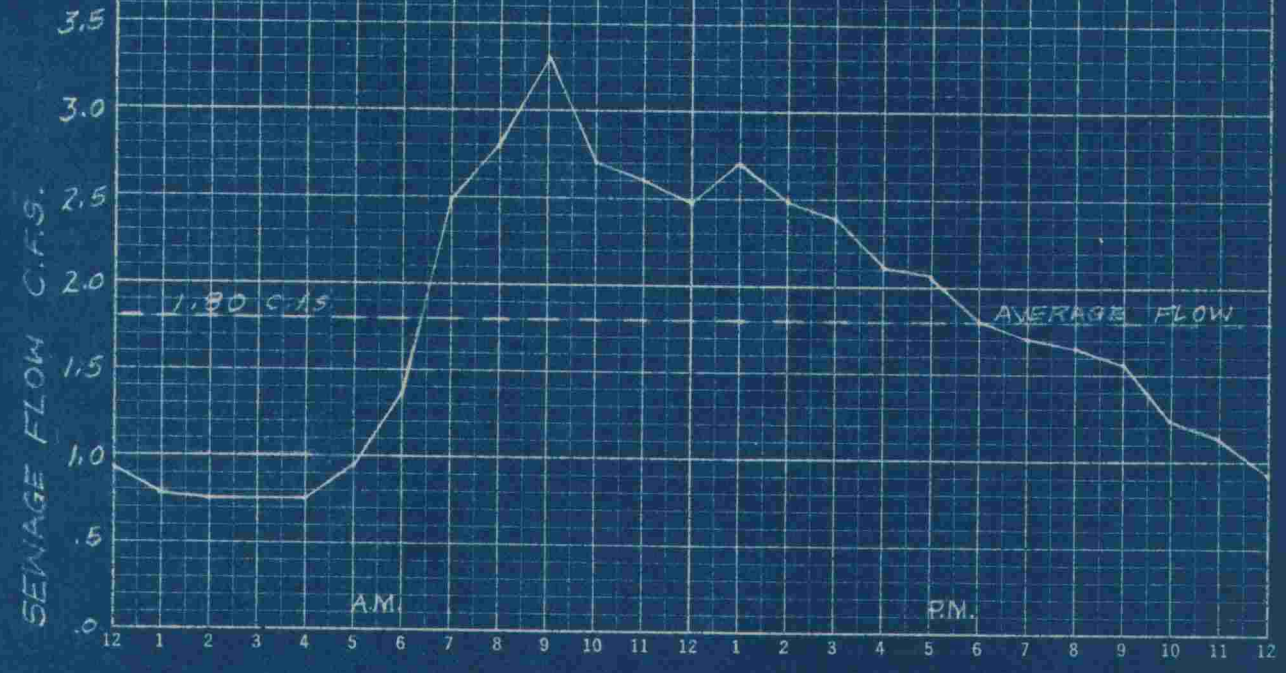
AREA DOWN TOWN SERVED 85.6 ACRES

AVERAGE FLOW DOWN TOWN C.F. per SEC. per ACRE = .0124

AVERAGE FLOW RESIDENTIAL DIST. C.F.S. per ACRE = .0033

LOCATION - EIGHTH AND L STREETS

DEPTH INCHES	% DIA.	C.F.S.
5.00	20.8	.77
4.90	20.4	.75
4.90	20.4	.75
4.90	20.4	.75
5.50	22.9	.94
6.25	25.8	1.36
8.80	36.7	2.48
9.40	38.9	2.80
10.00	41.7	3.30
9.70	38.0	2.70
8.90	37.0	2.60
8.50	35.4	2.48
7.74	33.8	2.52
8.50	35.4	2.48
8.44	35.0	2.39
8.10	33.4	2.11
7.70	32.9	2.05
7.60	31.6	1.80
7.40	30.8	1.70
7.20	30.0	1.65
6.70	28.4	1.50
6.25	26.0	1.23
5.90	24.6	1.12
5.40	22.5	0.92



24" Pipe Slope .0015 Exhibit 4

GAGE POINT No. 25

DATE GAGE READING. THURSDAY, JUNE 23, 1931.

Minimum Flow Per Hour	418. C.F.	=	3127. Gal.
Average Flow Per Hour	878. C.F.	=	6,568. Gal.
Maximum Flow Per Hour	1,368. C.F.	=	10,233. Gal.
Total Flow in 24 Hours	21,082. C.F.	=	157,704. Gal.

Area Served = 37.5 Acres

Area Down Town Served = 19.80 Acres

AVERAGE FLOW ENTIRE AREA C.F.S. per ACRE = .0035

LOCATION - SEVENTH AND K STREETS

DEPTH INCHES	% DIA	C.F.S.
2.20	36.7	.155
2.30	38.3	.167
2.20	36.7	.155
2.00	33.3	.129
1.90	31.7	.116
2.50	41.7	.196
2.80	46.7	.244
3.20	53.3	.308
3.35	55.8	.332
3.50	58.3	.362
3.25	54.2	.218
3.27	53.7	.312
3.30	55.0	.327
3.60	60.0	.380
3.35	55.8	.330
3.20	53.3	.308
3.15	52.5	.303
3.10	51.7	.294
2.65	44.2	.219
2.25	37.5	.161
2.55	42.5	.205
2.55	42.5	.205
2.32	38.7	.172
2.20	36.7	.155

SEWAGE FLOW C.F.S.

1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 0

0.244 c.f.s. = Average Flow

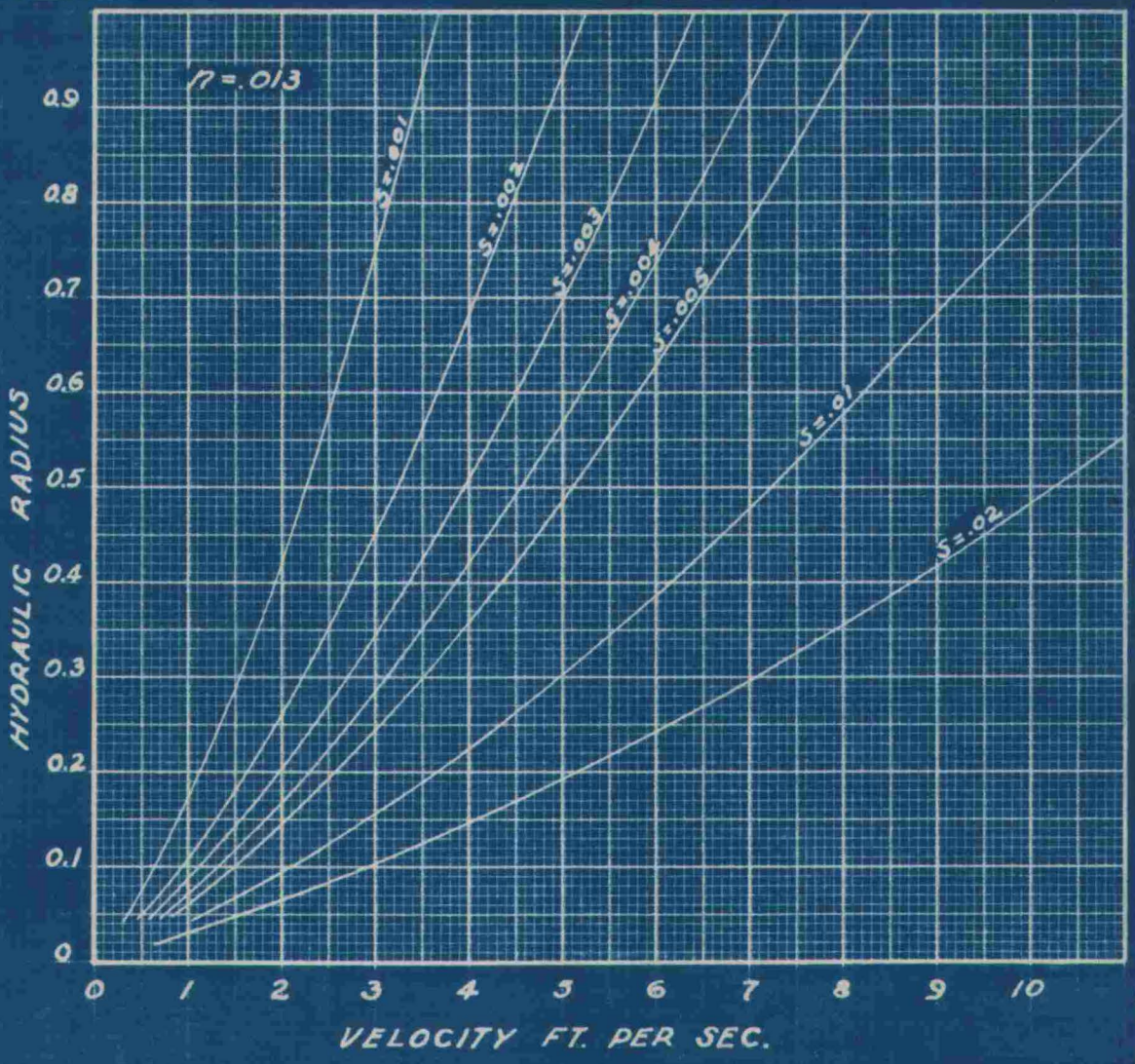
AM: 12 1 2 3 4 5 6 7 8 9 10 11 12

PM: 12 1 2 3 4 5 6 7 8 9 10 11 12

S.851

KEUFFEL & ESSER CO., N.Y. NO. 339-150
One Day by Hours.

6" Pipe Slope .0125 Exhibit 5.



FROM KUTTER'S FORMULA

$$V = \left[\frac{41.6 + \frac{1.811}{n} + \frac{.00281}{S}}{1 + \left(41.6 + \frac{.00281}{S}\right)\frac{n}{\sqrt{r}}} \right] \sqrt{rS}$$

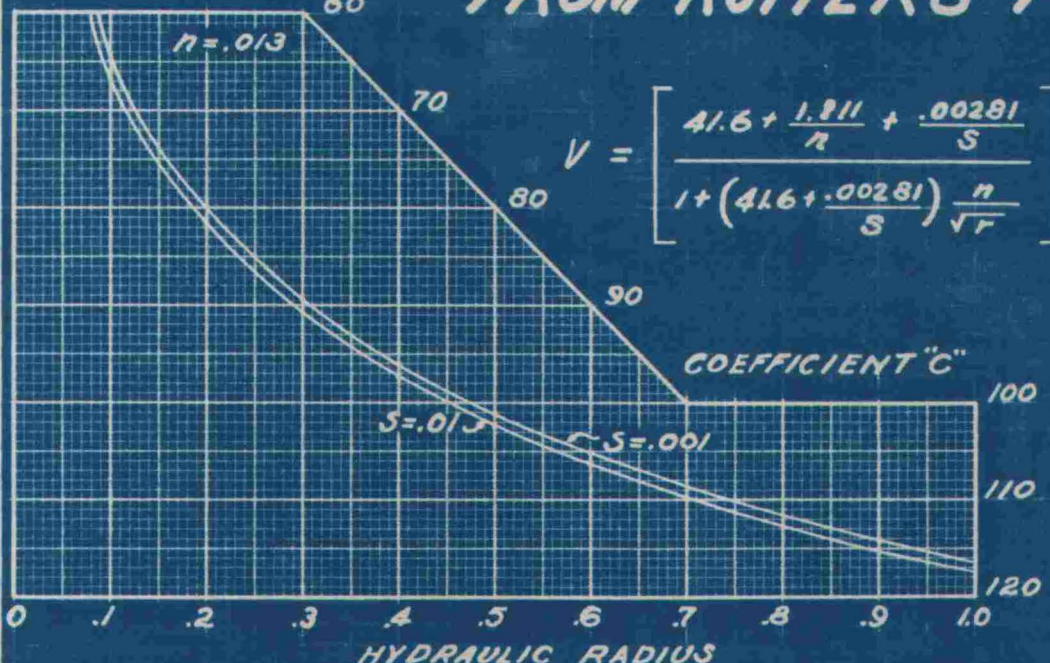
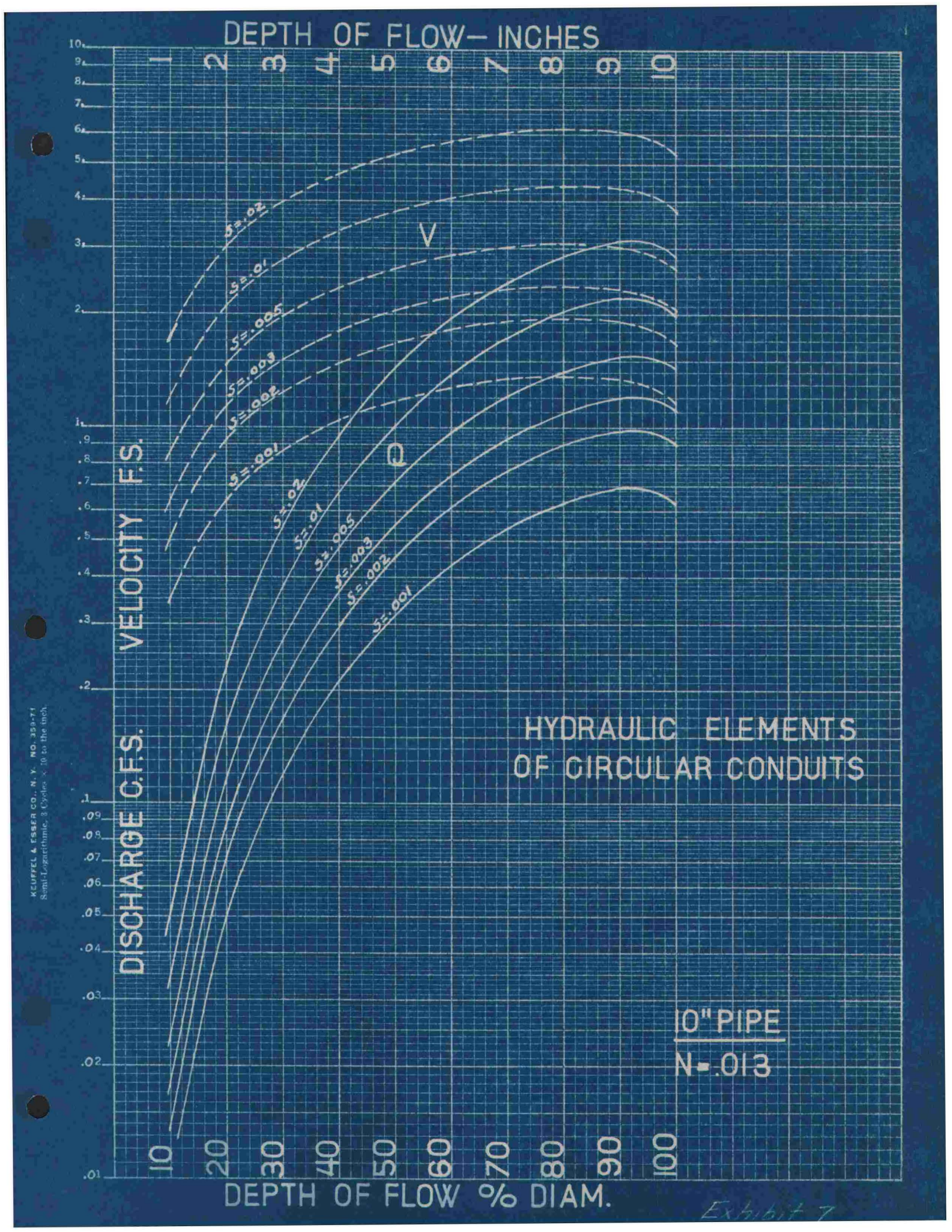
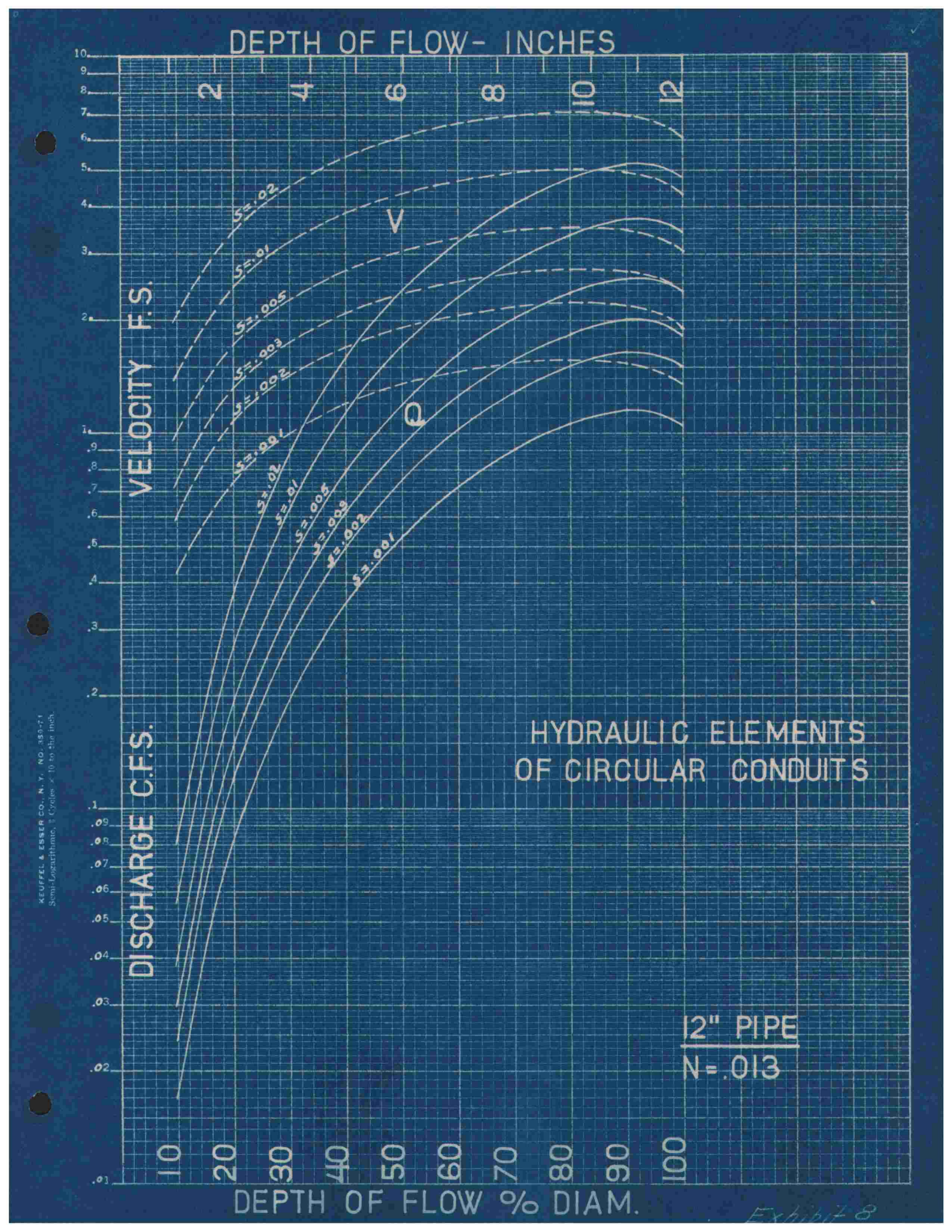
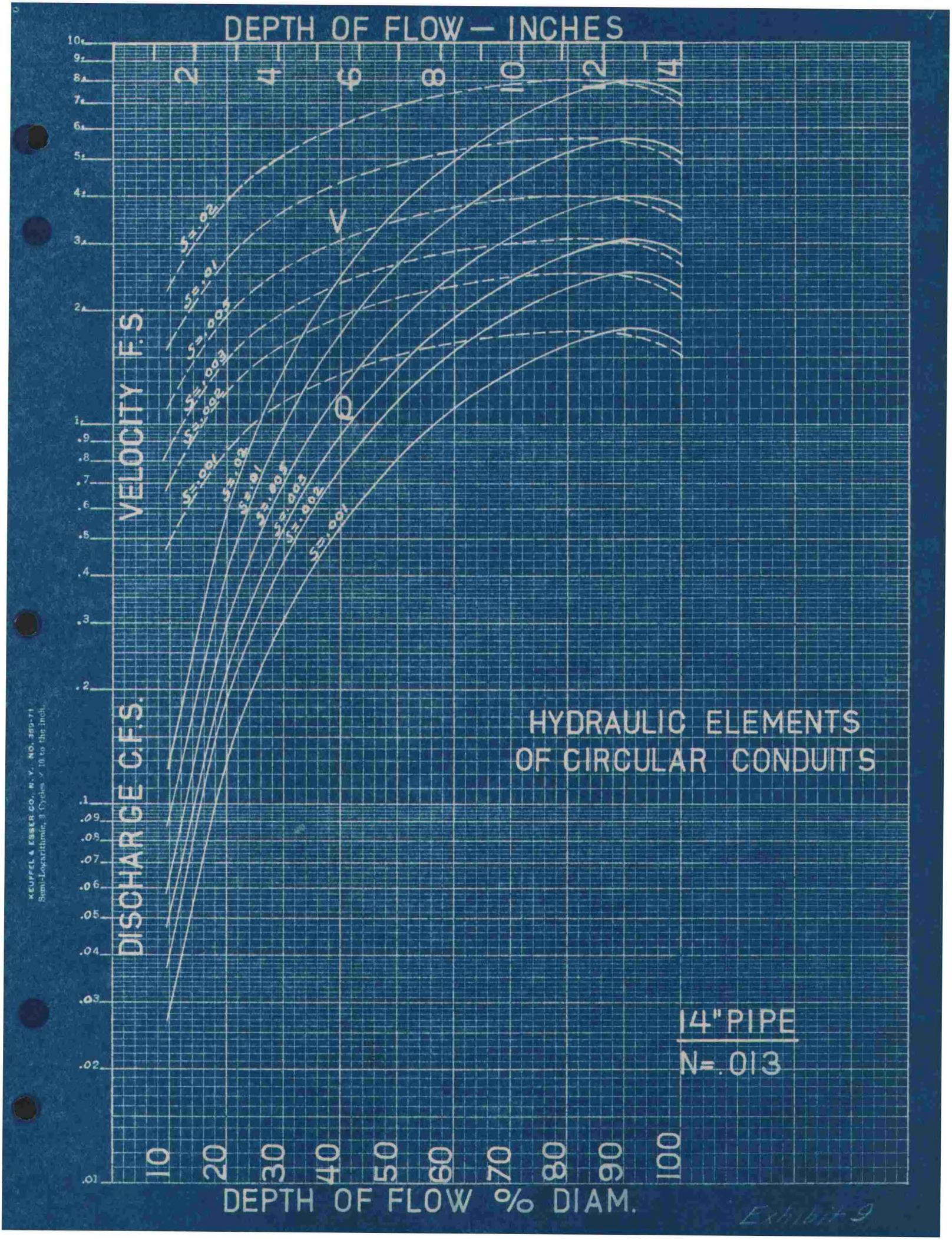


Exhibit 6.


DEPTH OF FLOW— INCHES
1
2
3
4
5
6
7
8
9
10
VELOCITY F.S.
DISCHARGE C.F.S.
V
Q
S=.02
S=.01
S=.005
S=.003
S=.002
S=.001
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
10" PIPE
N=.013
10
20
30
40
50
60
70
80
90
100
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N.Y. NO. 359-71
Semi-Logarithmic, 3 Cycles x 10 to the inch.
Exhibit 7


DEPTH OF FLOW- INCHES
2
4
6
8
10
12
VELOCITY F.S.
DISCHARGE C.F.S.
V
Q
S=.02
S=.01
S=.005
S=.003
S=.002
S=.001
S=.02
S=.01
S=.005
S=.002
S=.001
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
12" PIPE
N=.013
10
20
30
40
50
60
70
80
90
100
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N.Y., NO. 359-71
Semi-Logarithmic, 5 Cycles x 10 to the inch.
Exhibit 8


DEPTH OF FLOW — INCHES
VELOCITY F.S.
DISCHARGE C.F.S.
V
Q
S=.02
S=.01
S=.005
S=.003
S=.002
S=.001
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
14" PIPE
N=.013
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N. Y. NO. 359-71
Semi-Logarithmic, 3 Cycles x 10 to the inch.
Exhibit 9

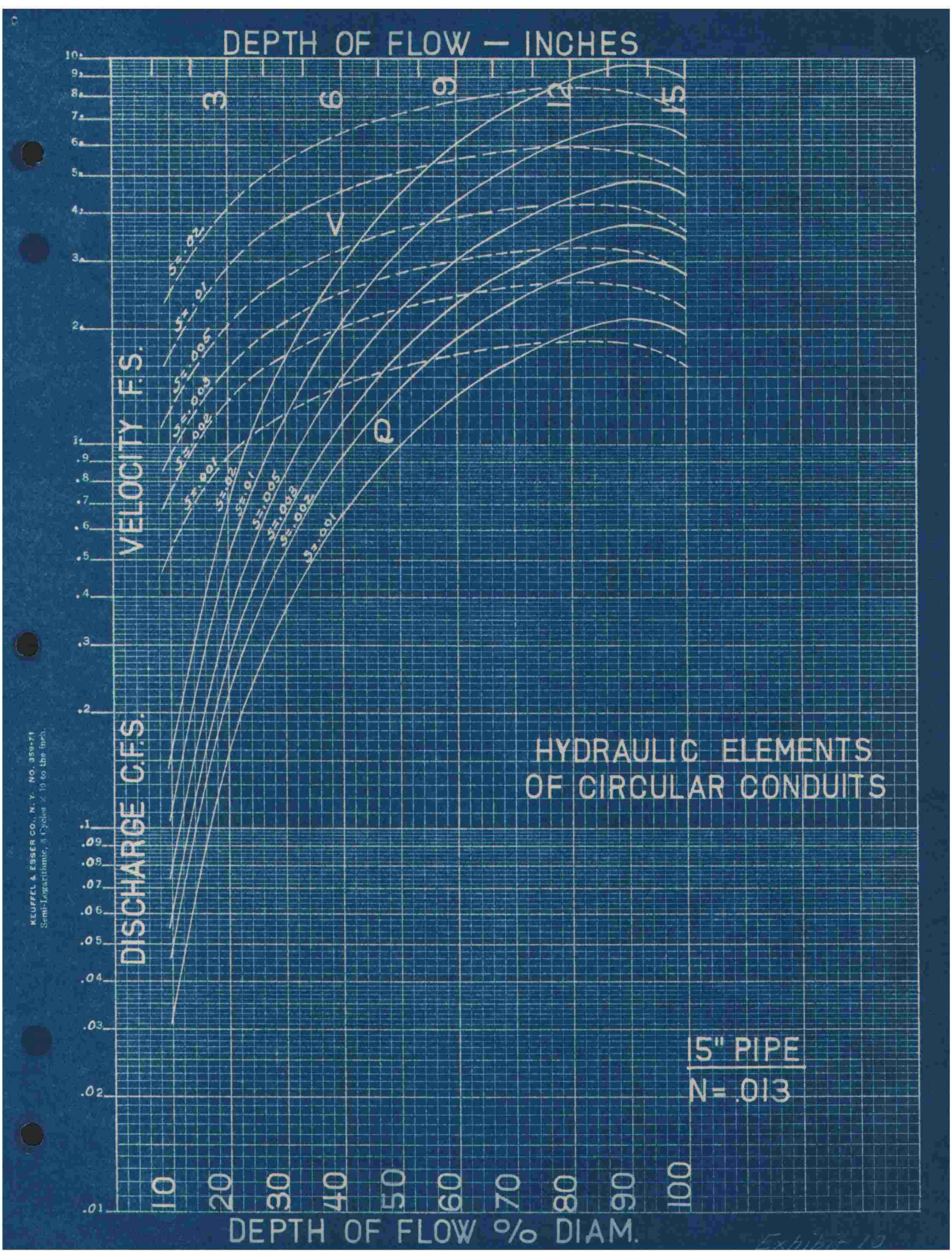
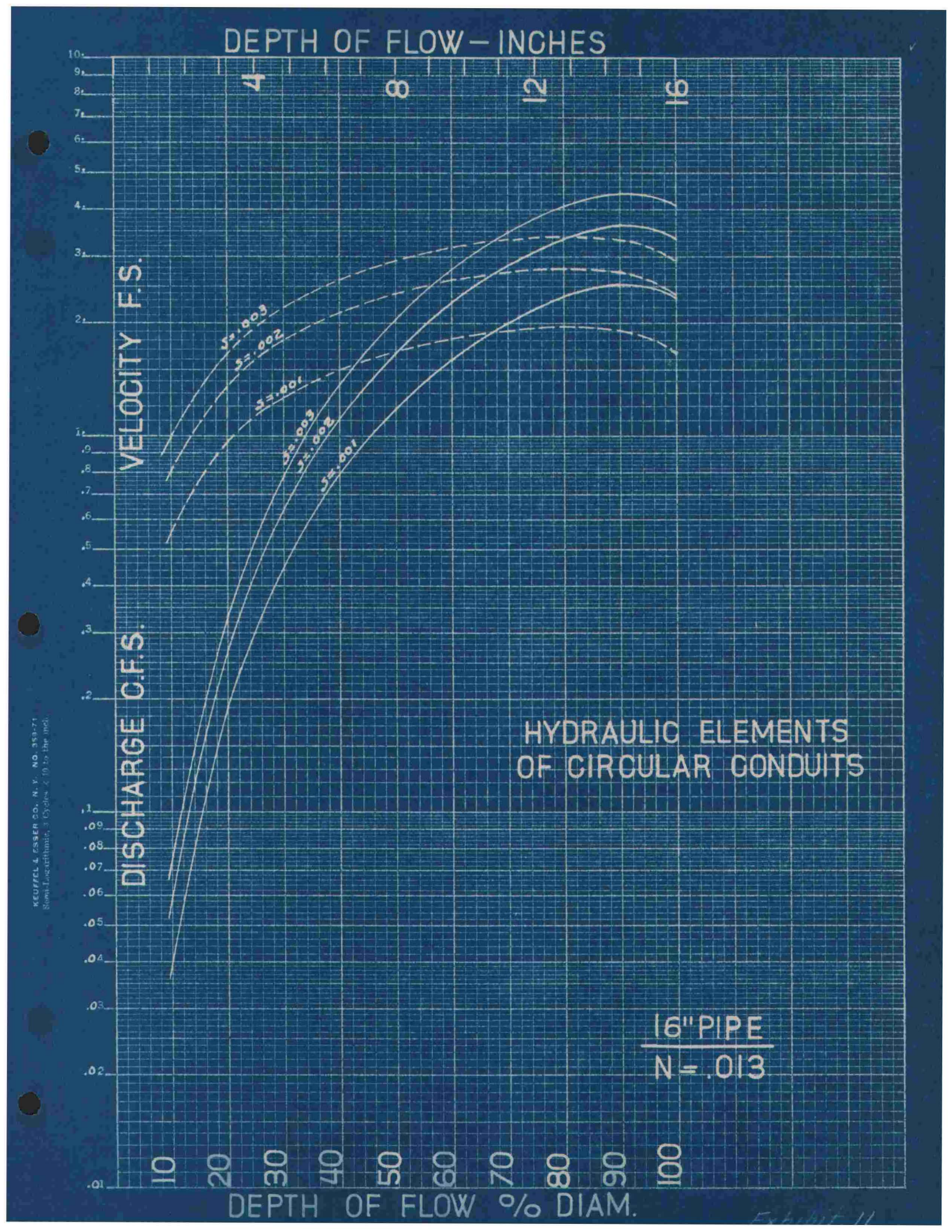

DEPTH OF FLOW — INCHES
3
6
9
12
15
VELOCITY F.S.
DISCHARGE C.F.S.
V
Q
S=.02
S=.01
S=.005
S=.003
S=.002
S=.001
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
15" PIPE
N=.013
10
20
30
40
50
60
70
80
90
100
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N. Y. NO. 359-71
Semi-Logarithmic, 3 Cycles × 10 to the inch.

Exhibit 10


DEPTH OF FLOW – INCHES
4
8
12
16
VELOCITY F.S.
DISCHARGE C.F.S.
S=.003
S=.002
S=.001
S=.003
S=.002
S=.001
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
16" PIPE
N=.013
DEPTH OF FLOW % DIAM.
10
20
30
40
50
60
70
80
90
100
KEUFFEL & ESSER CO. N.Y. NO. 353-71
Semi-Logarithmic, 3 Cycles x 10 to the inch

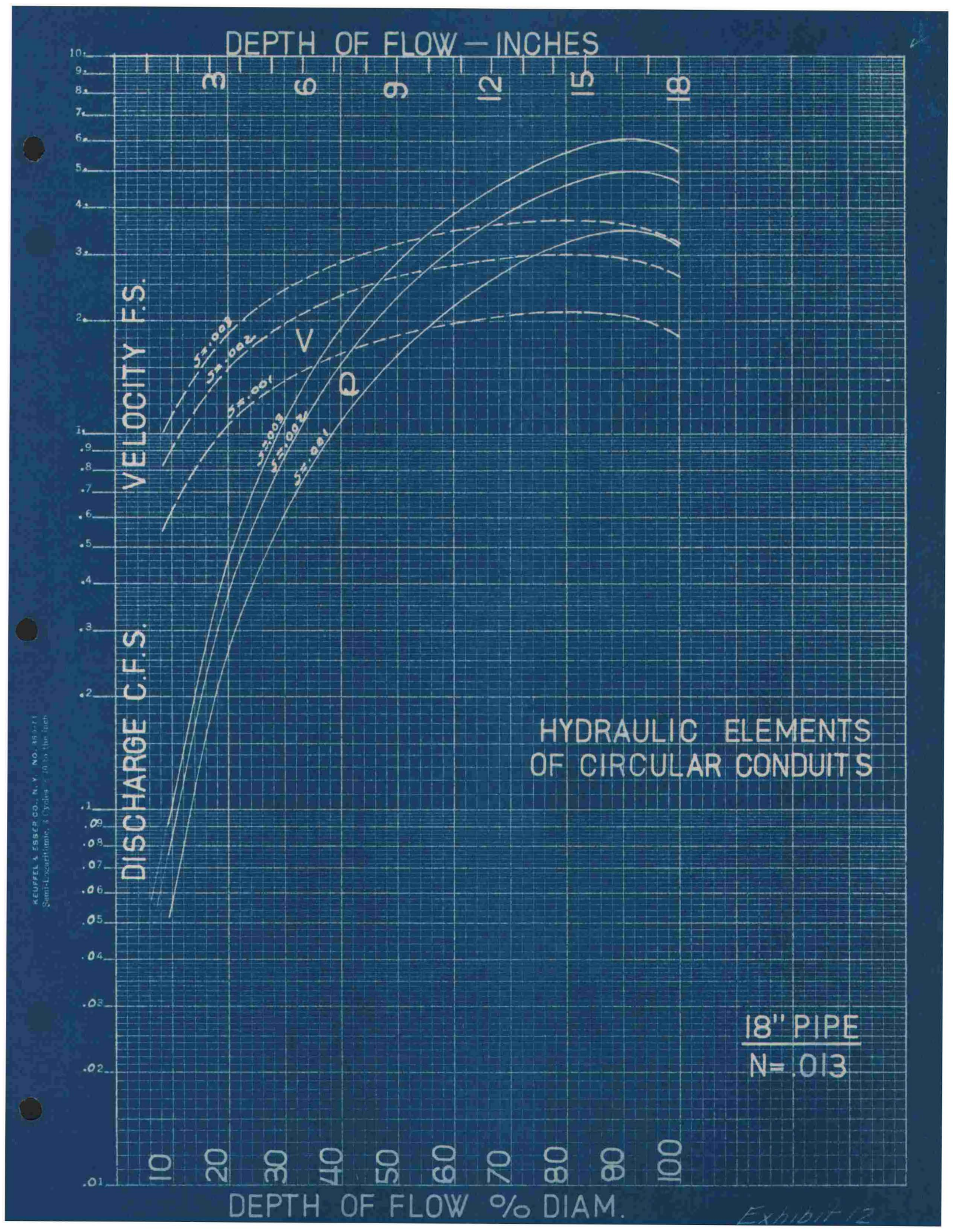
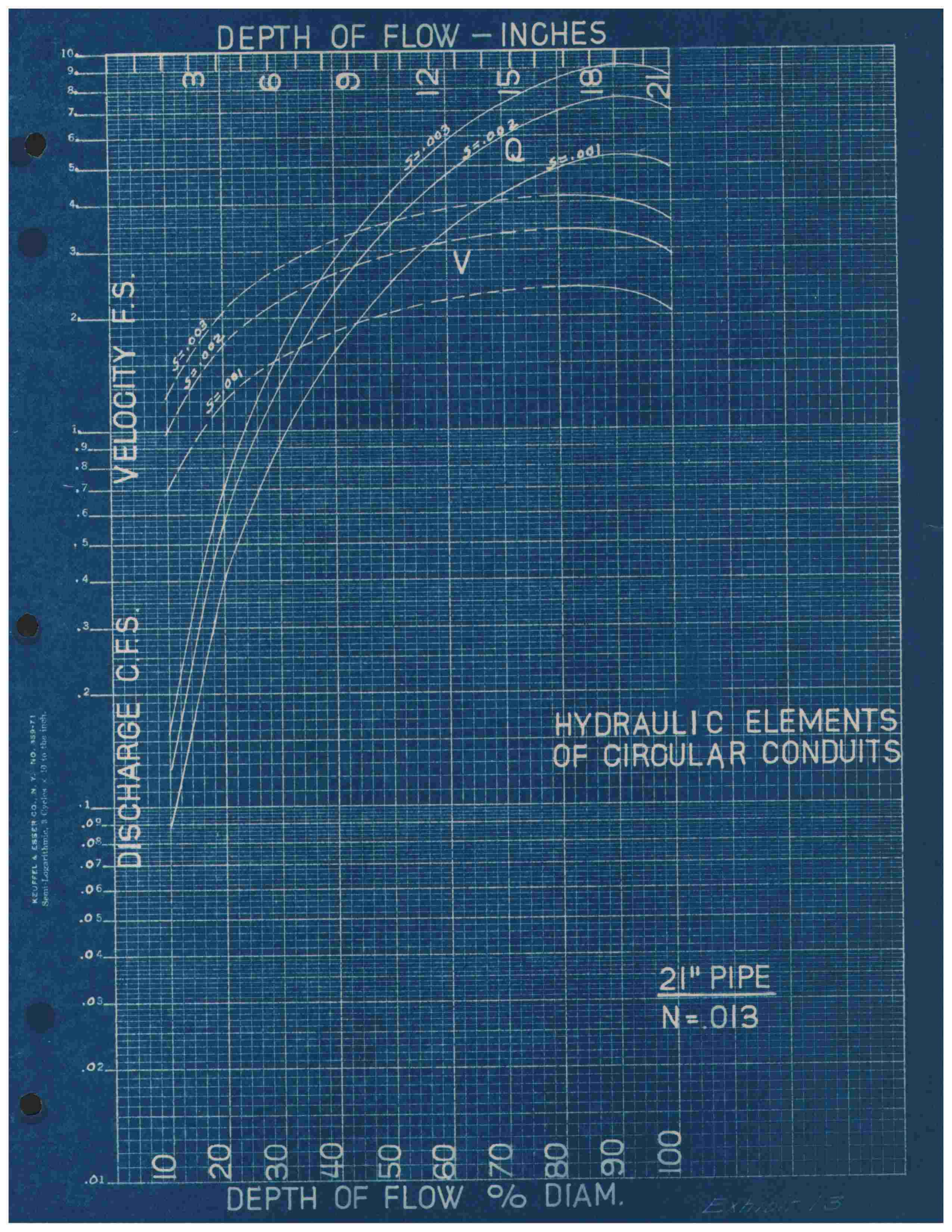
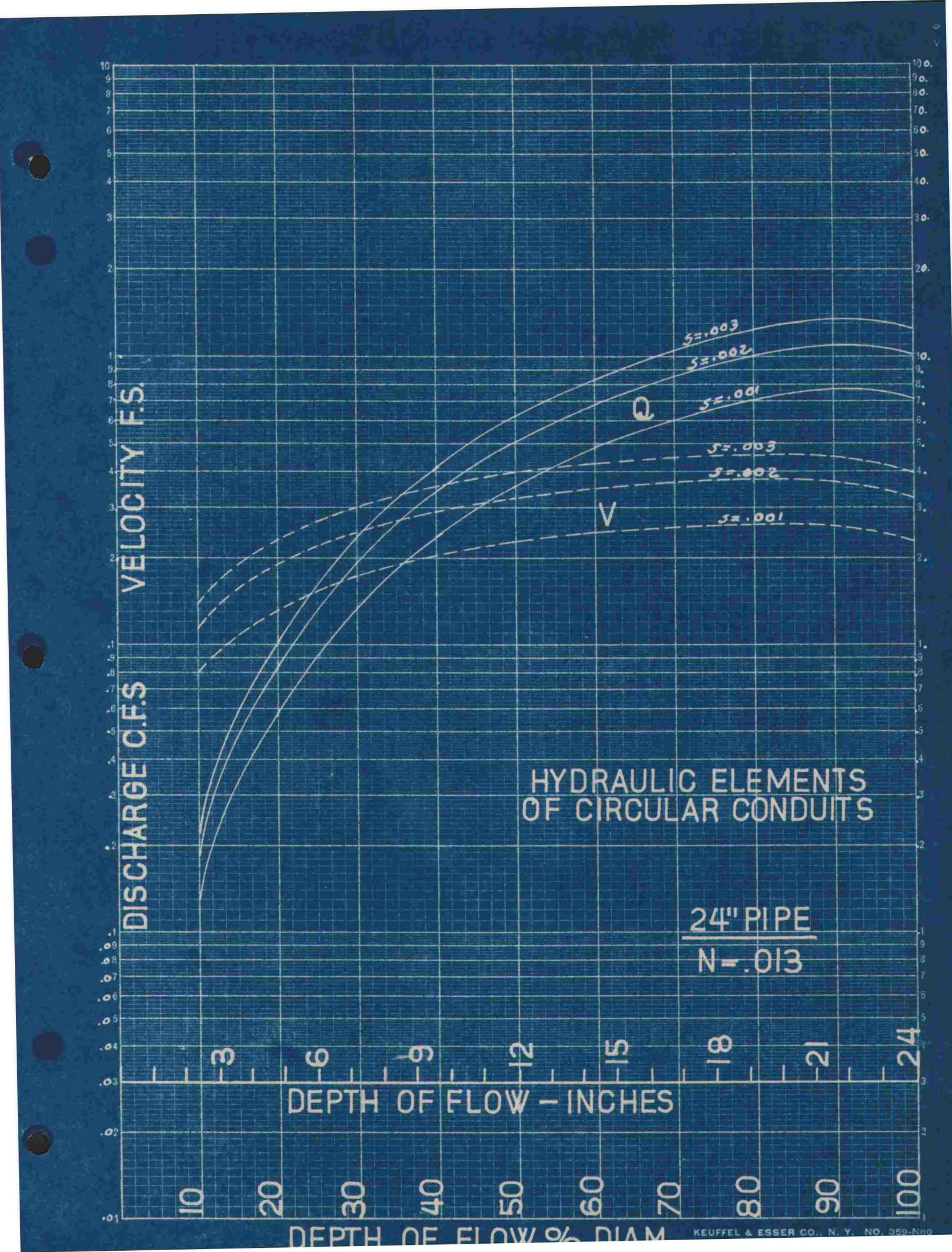
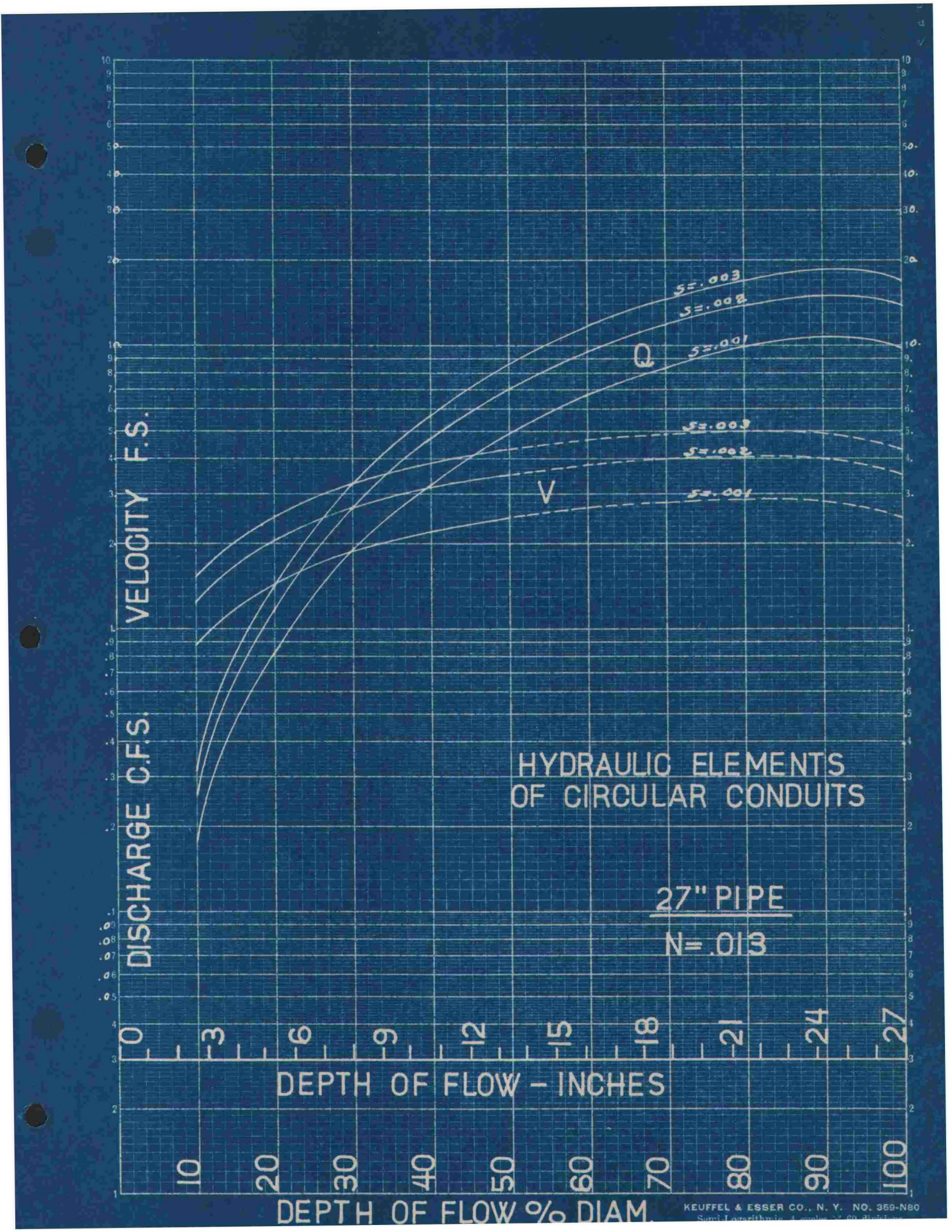
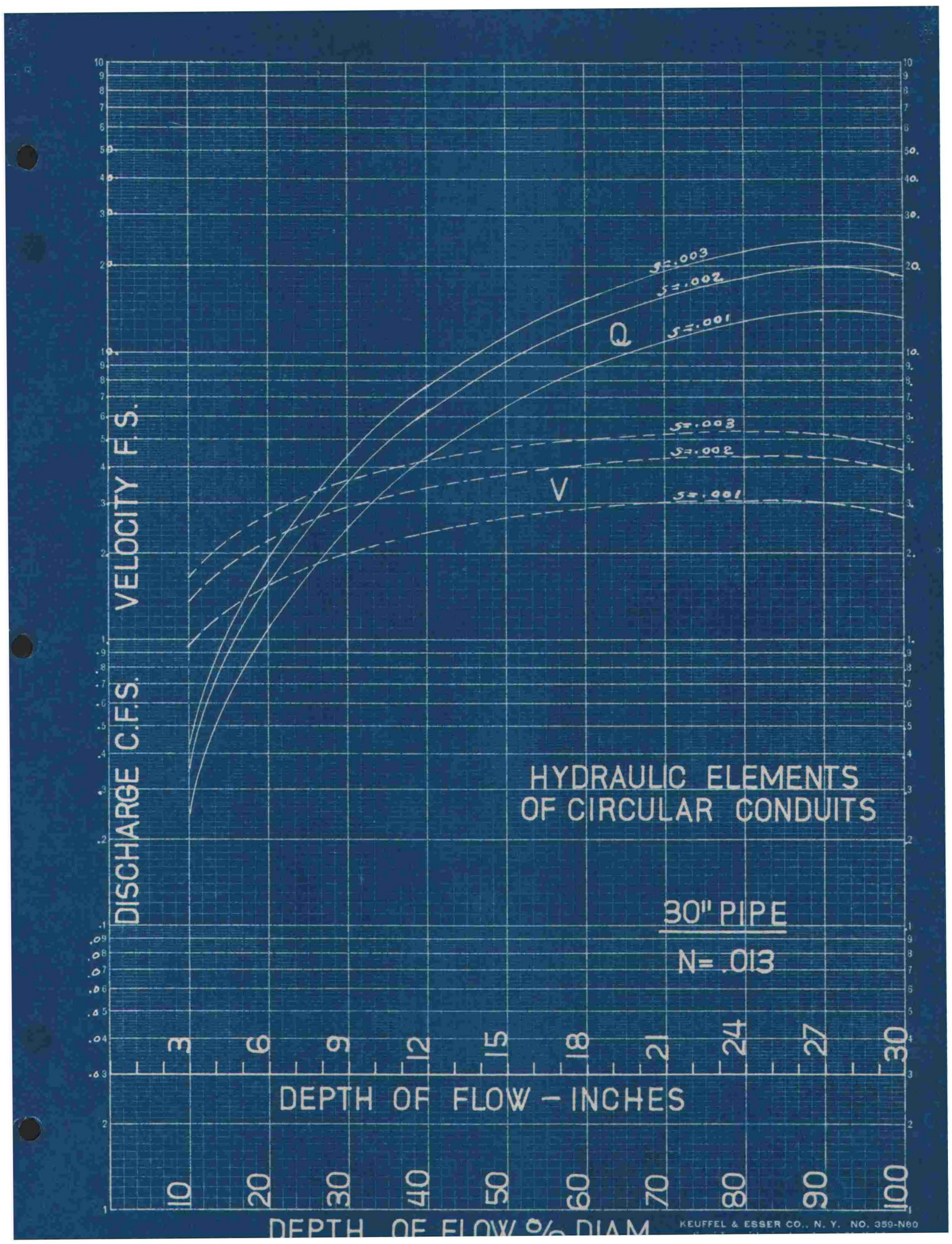

DEPTH OF FLOW — INCHES
3
6
9
12
15
18
VELOCITY F.S.
DISCHARGE C.F.S.
10
9
8
7
6
5
4
3
2
1
.9
.8
.7
.6
.5
.4
.3
.2
.1
.09
.08
.07
.06
.05
.04
.03
.02
.01
S=.002
S=.0042
S=.001
S=.003
S=.0022
S=.001
V
Q
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
18" PIPE
N=.013
10
20
30
40
50
60
70
80
90
100
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N.Y. NO. 459-71
Semi-Logarithmic, 3 Cycles x 10 to the inch

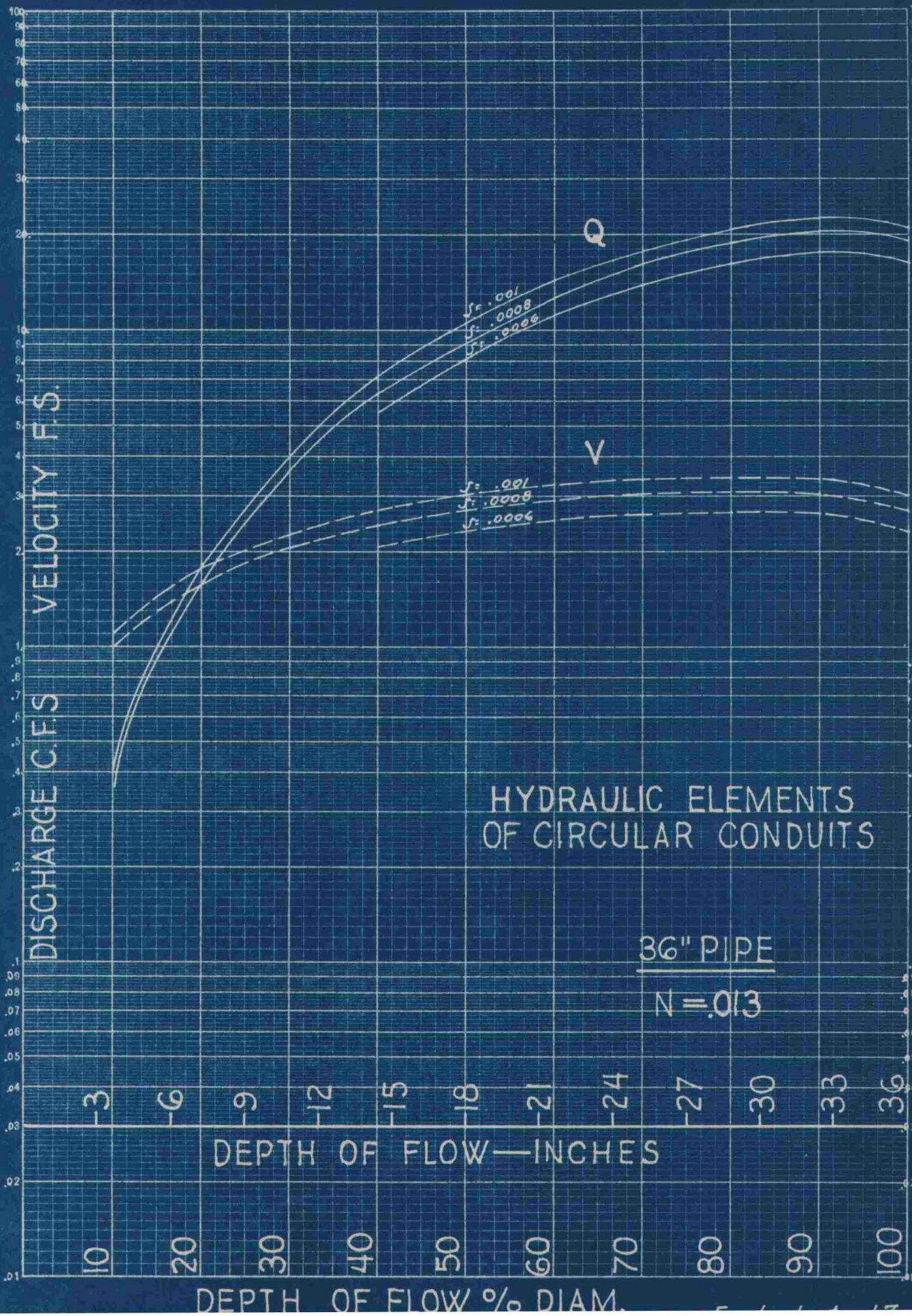
Exhibit 12


DEPTH OF FLOW – INCHES
3
6
9
12
15
18
21
S=.003
S=.002
S=.001
Q
V
VELOCITY F.S.
DISCHARGE C.F.S.
10
9
8
7
6
5
4
3
2
1
.9
.8
.7
.6
.5
.4
.3
.2
.1
.09
.08
.07
.06
.05
.04
.03
.02
.01
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
21" PIPE
N=.013
10
20
30
40
50
60
70
80
90
100
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N. Y. NO. 359-71
Semi-Logarithmic, 3 Cycles x 10 to the inch.
Exhibit 13


DISCHARGE C.F.S
VELOCITY F.S.
S=.003
S=.002
S=.001
Q
S=.003
S=.002
S=.001
V
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
24" PIPE
N=.013
3
6
9
12
15
18
21
24
DEPTH OF FLOW - INCHES
10
20
30
40
50
60
70
80
90
100
DEPTH OF FLOW % DIAM
KEUFFEL & ESSER CO., N. Y. NO. 359-N80


VELOCITY F.S.
DISCHARGE C.F.S.
S=.003
S=.002
S=.001
Q
S=.003
S=.002
S=.001
V
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
27" PIPE
N=.013
0
3
6
9
12
15
18
21
24
27
DEPTH OF FLOW - INCHES
10
20
30
40
50
60
70
80
90
100
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N. Y. NO. 359-N80


DISCHARGE C.F.S.
VELOCITY F.S.
S=.003
S=.002
S=.001
Q
V
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
30" PIPE
N=.013
DEPTH OF FLOW - INCHES
DEPTH OF FLOW % DIAM
KEUFFEL & ESSER CO., N. Y. NO. 359-N80



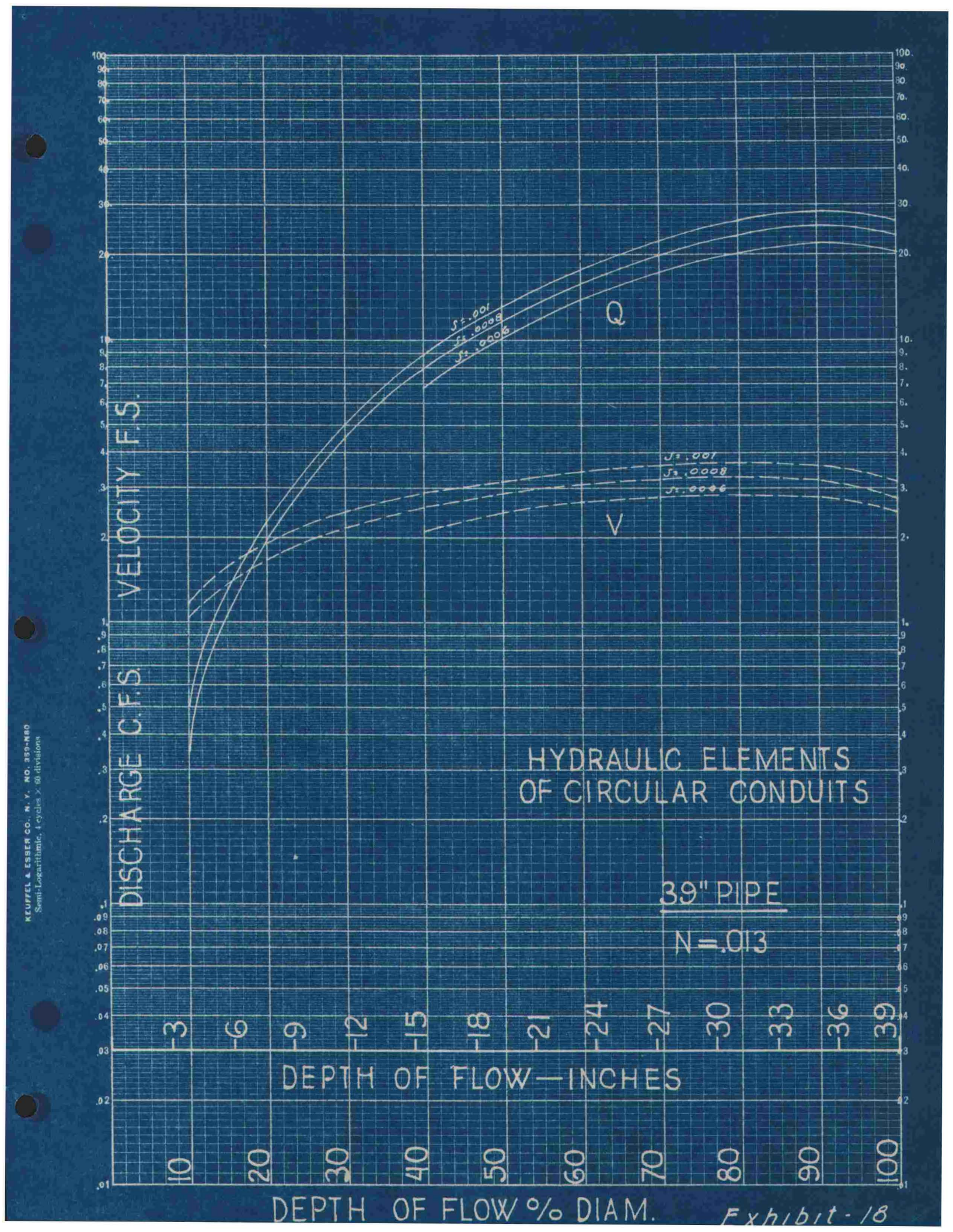

DISCHARGE C.F.S. VELOCITY F.S.
Q
V
Sf=.001
Sf=.0008
Sf=.0006
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
39" PIPE
N=.013
DEPTH OF FLOW—INCHES
3
6
9
12
15
18
21
24
27
30
33
36
39
DEPTH OF FLOW % DIAM.
10
20
30
40
50
60
70
80
90
100
KEUFFEL & ESSER CO., N.Y. NO. 359-N80
Semi-Logarithmic, 4 cycles x 90 divisions

Exhibit - 18

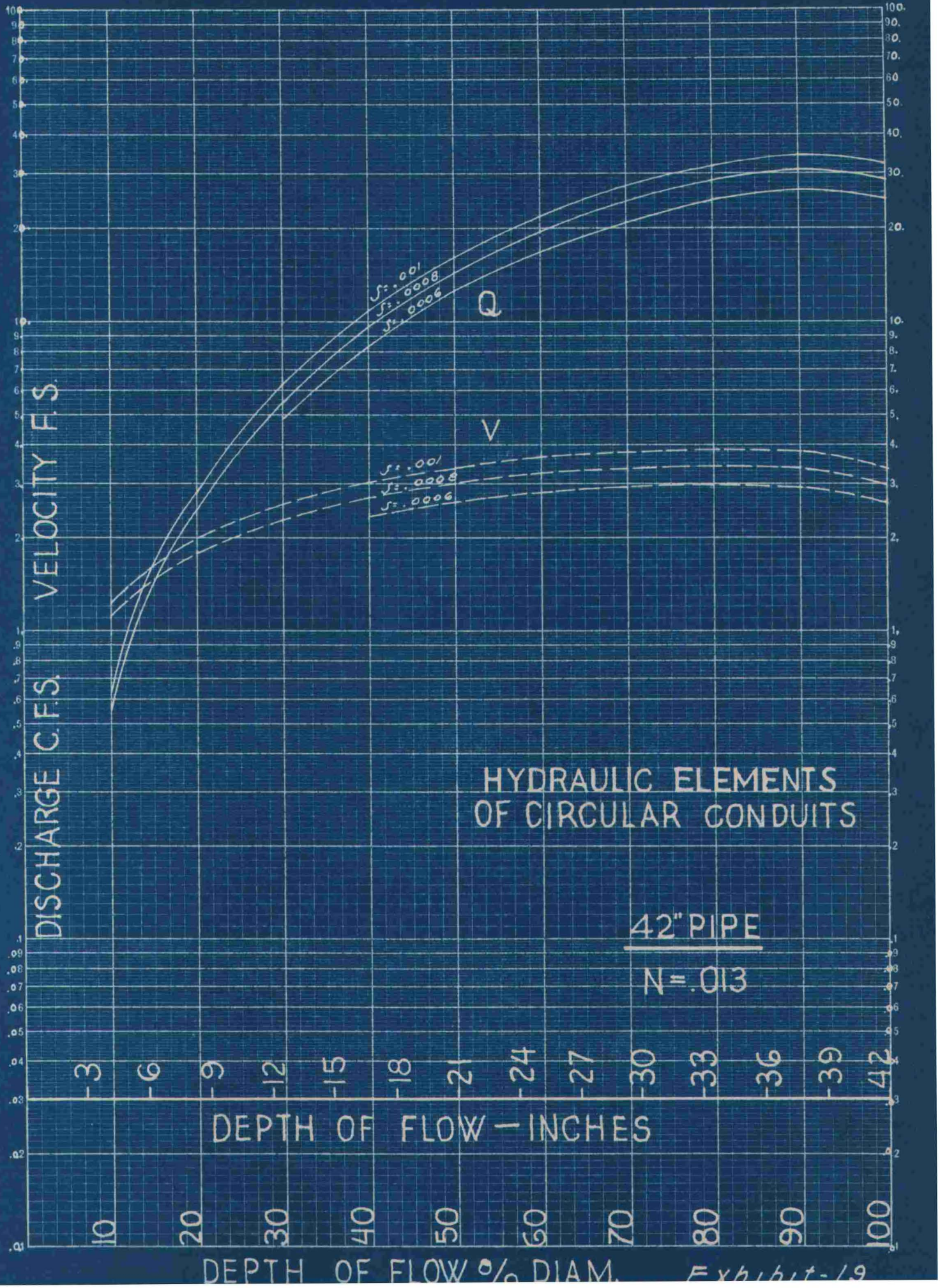
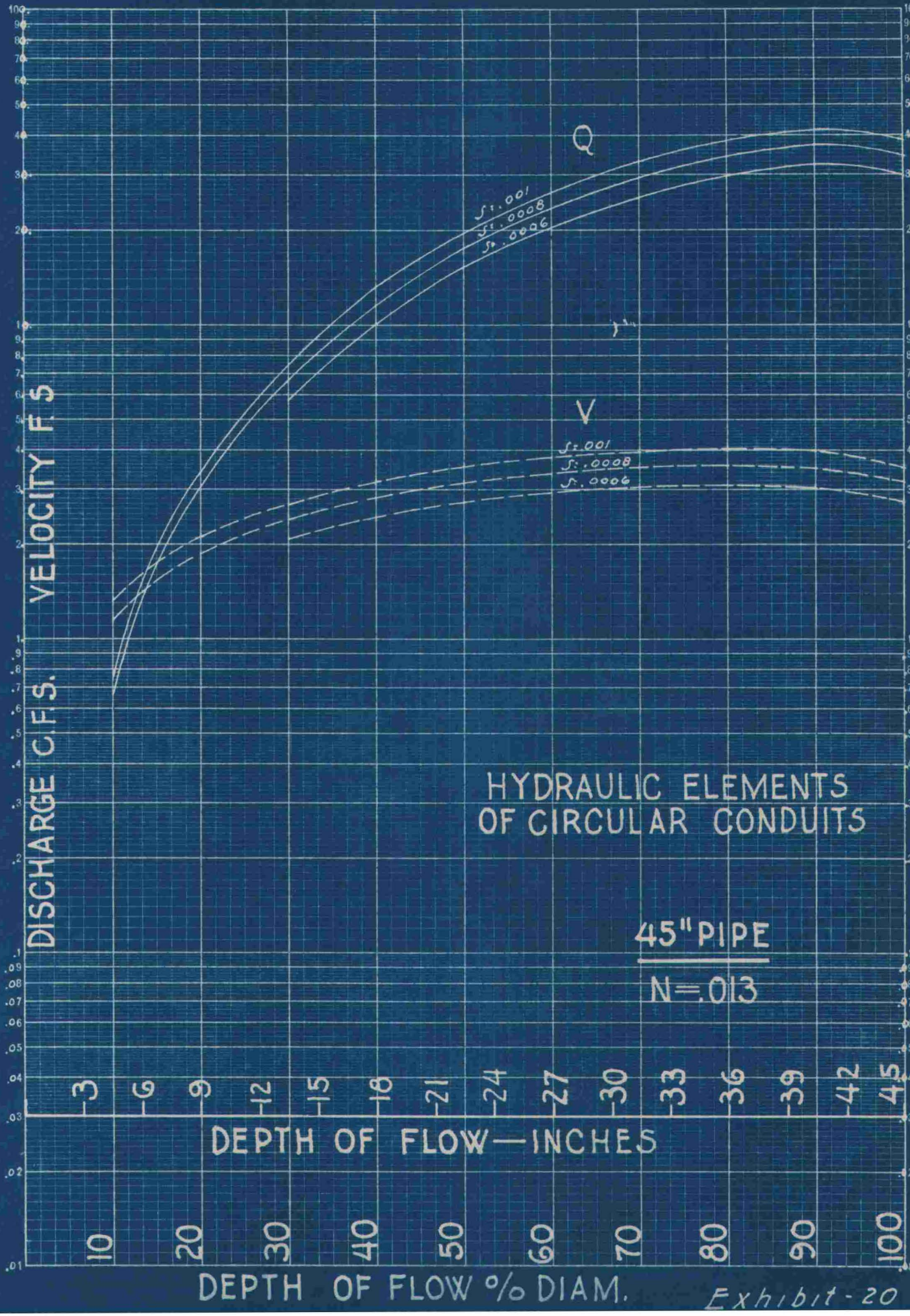
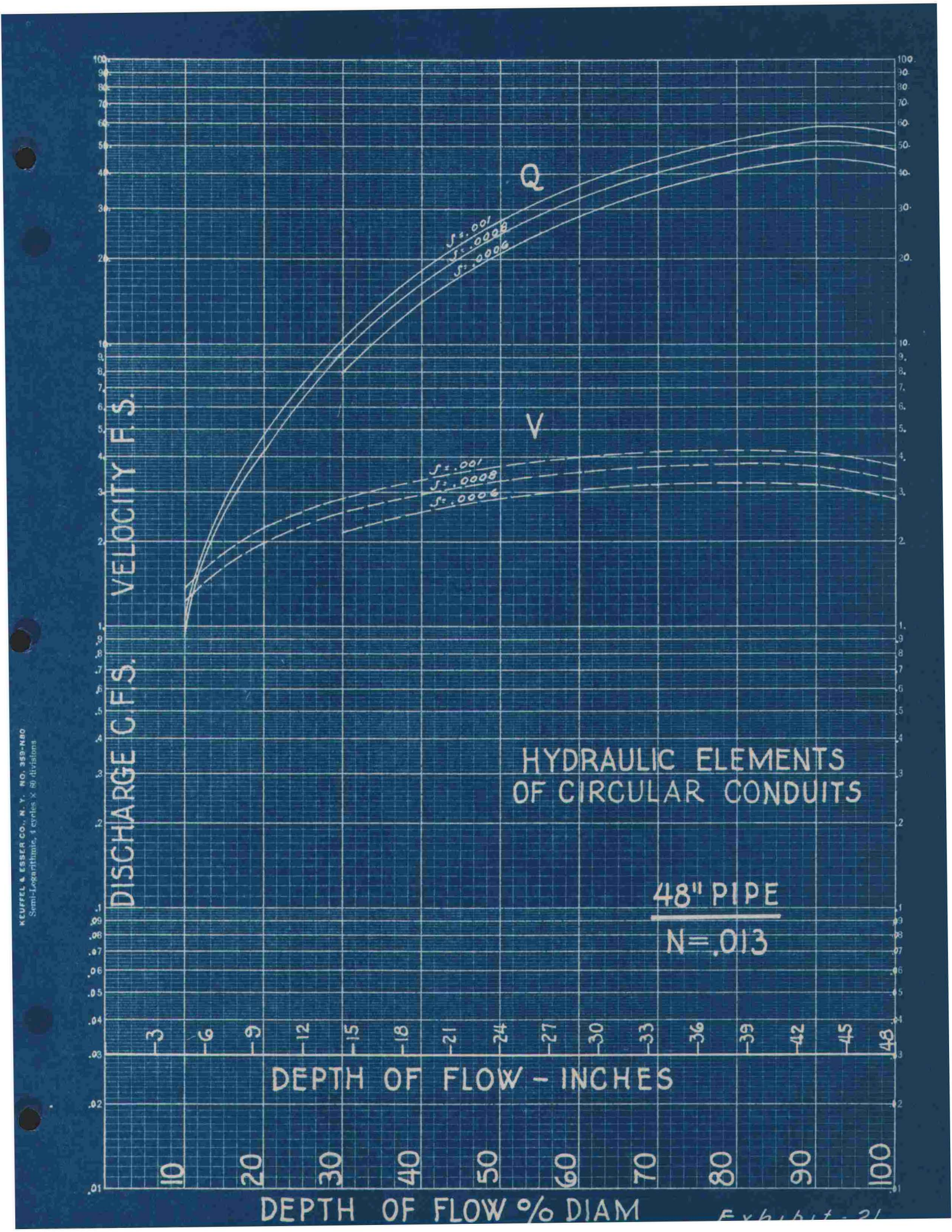


Exhibit-19



KEUFFEL & ESSER CO., N. Y. NO. 359-N60
Semi-Logarithmic, 1 cycles / 60 divisions

Exhibit-20


DISCHARGE C.F.S. VELOCITY F.S.
Q
V
S=.001
S=.0008
S=.0006
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
48" PIPE
N=.013
DEPTH OF FLOW - INCHES
DEPTH OF FLOW % DIAM
KEUFFEL & ESSER CO., N. Y. NO. 359-K80
Semi-Logarithmic, 3 cycles × 80 divisions
Exhibit 21

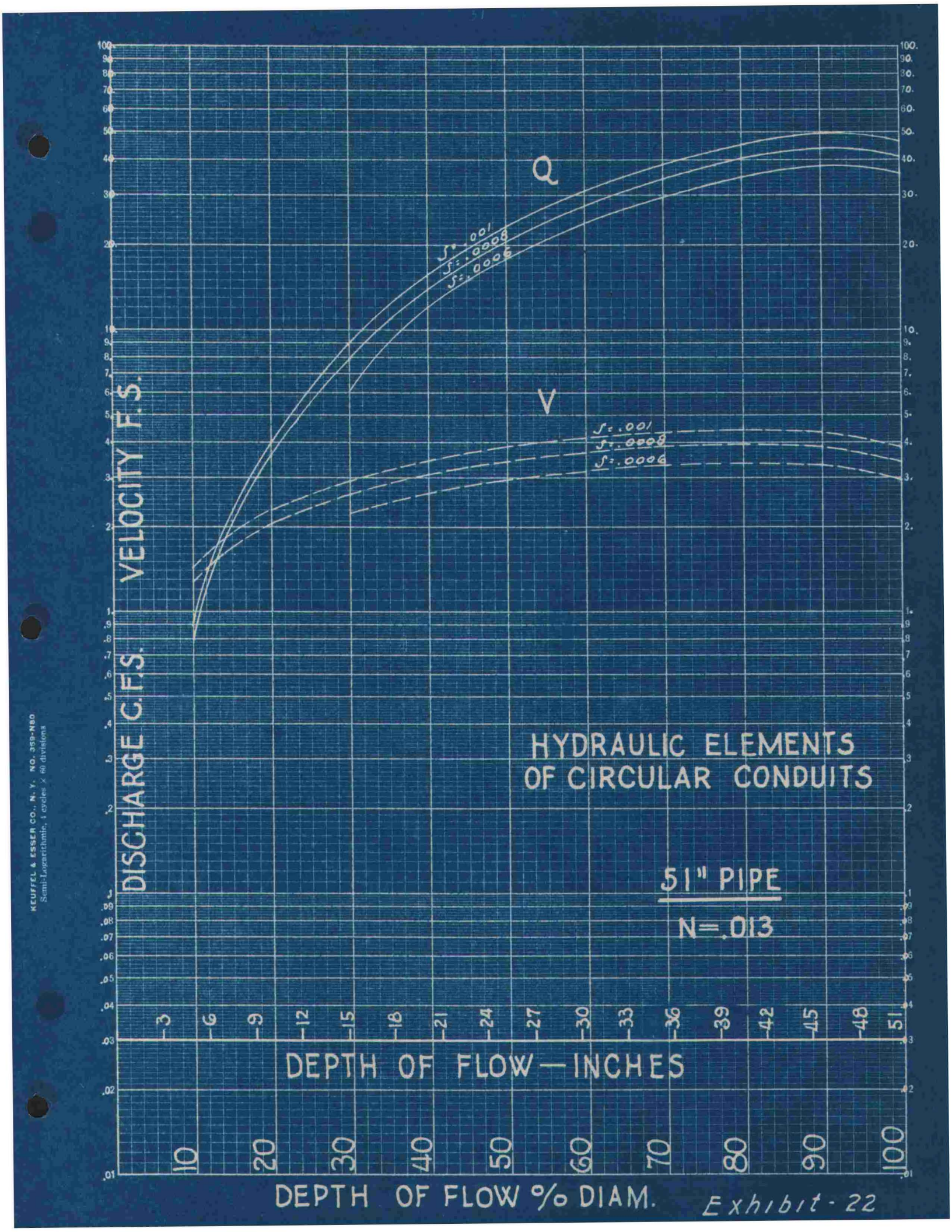

DISCHARGE C.F.S. VELOCITY F.S.
Q
V
S=.001
S=.0008
S=.0006
S=.001
S=.0008
S=.0006
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
51" PIPE
N=.013
DEPTH OF FLOW — INCHES
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N.Y. NO. 359-N80
Semi-Logarithmic, 1 cycles x 60 divisions

Exhibit - 22

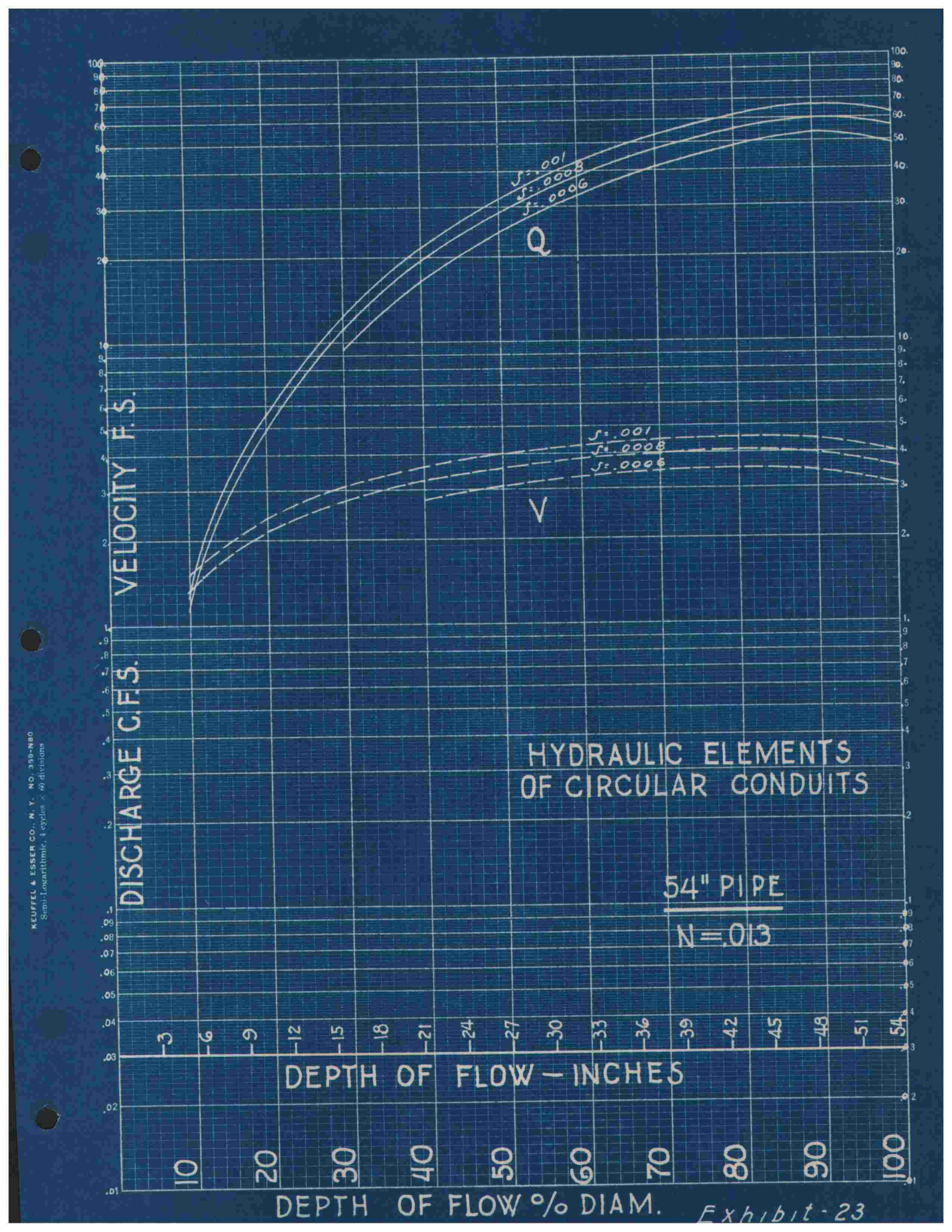
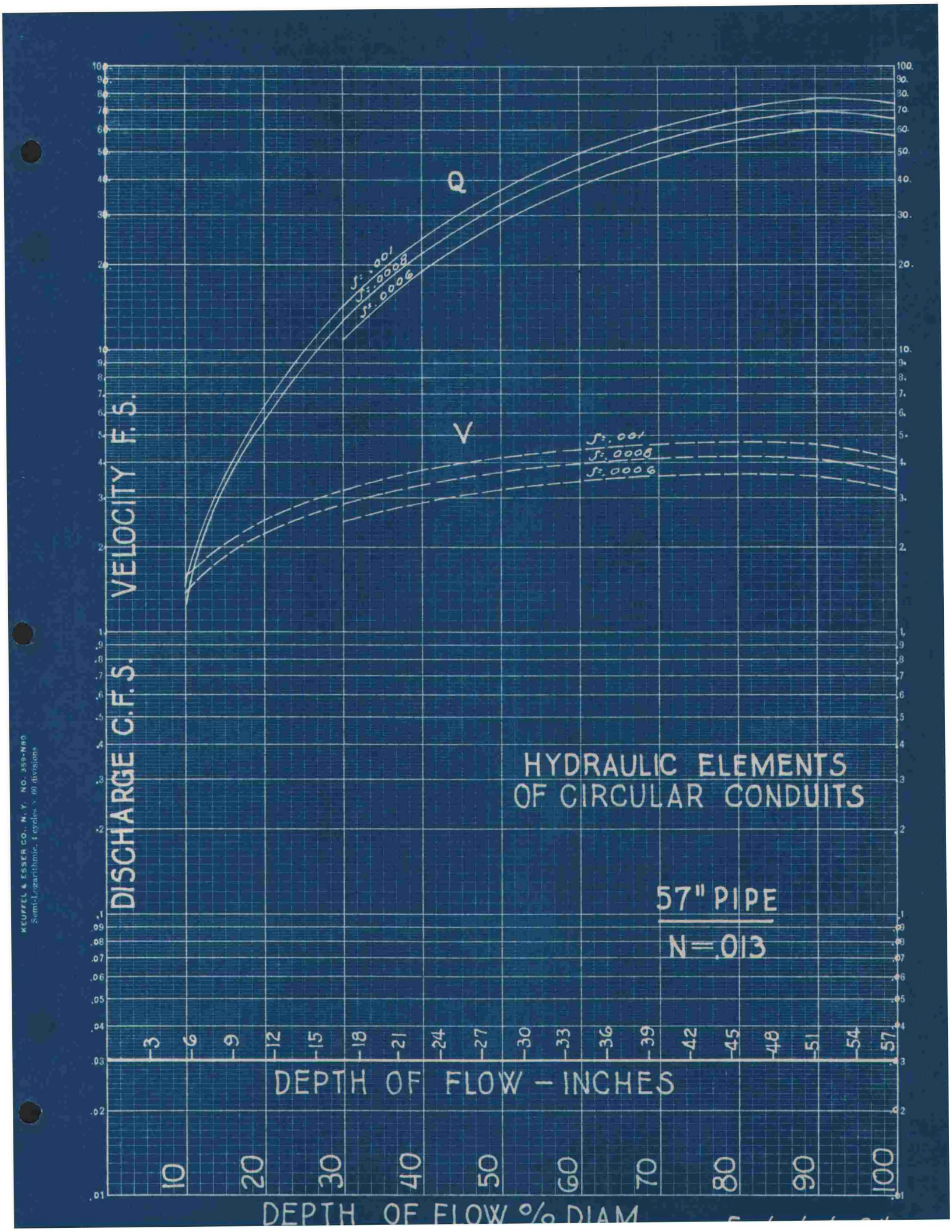

DISCHARGE C.F.S.
VELOCITY F.S.
S=.001
S=.0008
S=.0006
Q
S=.001
S=.0008
S=.0006
V
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
54" PIPE
N=.013
DEPTH OF FLOW - INCHES
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N.Y. NO. 359-N80
Semi-Logarithmic, 4 cycles x 60 divisions

Exhibit-23


DISCHARGE C.F.S. VELOCITY F.S.
Q
V
S=.001
S=.0008
S=.0006
S=.001
S=.0008
S=.0006
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
57" PIPE
N=.013
DEPTH OF FLOW - INCHES
DEPTH OF FLOW % DIAM
KEUFFEL & ESSER CO., N. Y. NO. 359-N80
Semi-Logarithmic, 4 cycles x 60 divisions

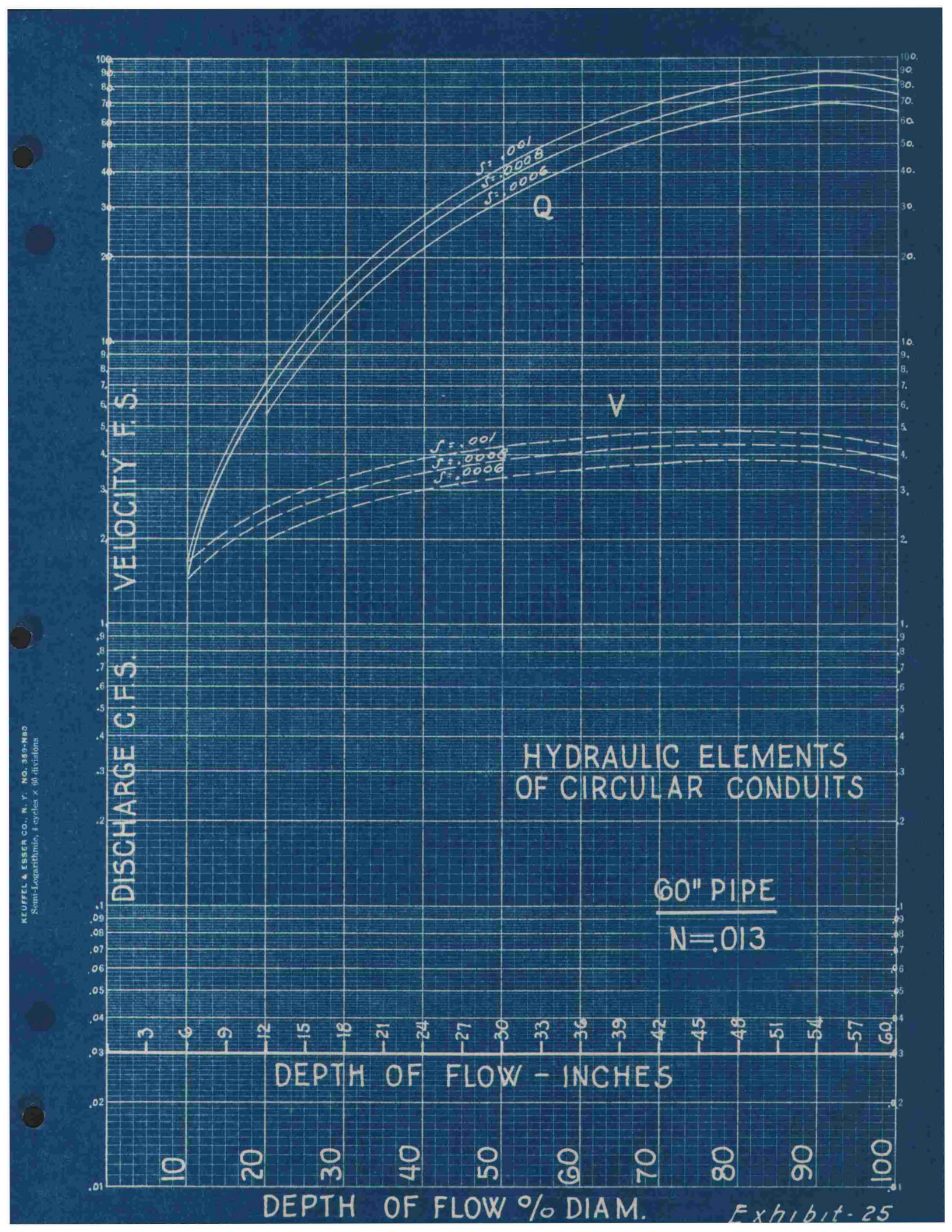

DISCHARGE C.F.S. VELOCITY F.P.S.
Q
V
S = .001
S = .0008
S = .0006
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
60" PIPE
N = .013
DEPTH OF FLOW - INCHES
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N. Y. NO. 359-N80
Semi-Logarithmic, 4 cycles × 90 divisions

Exhibit-25

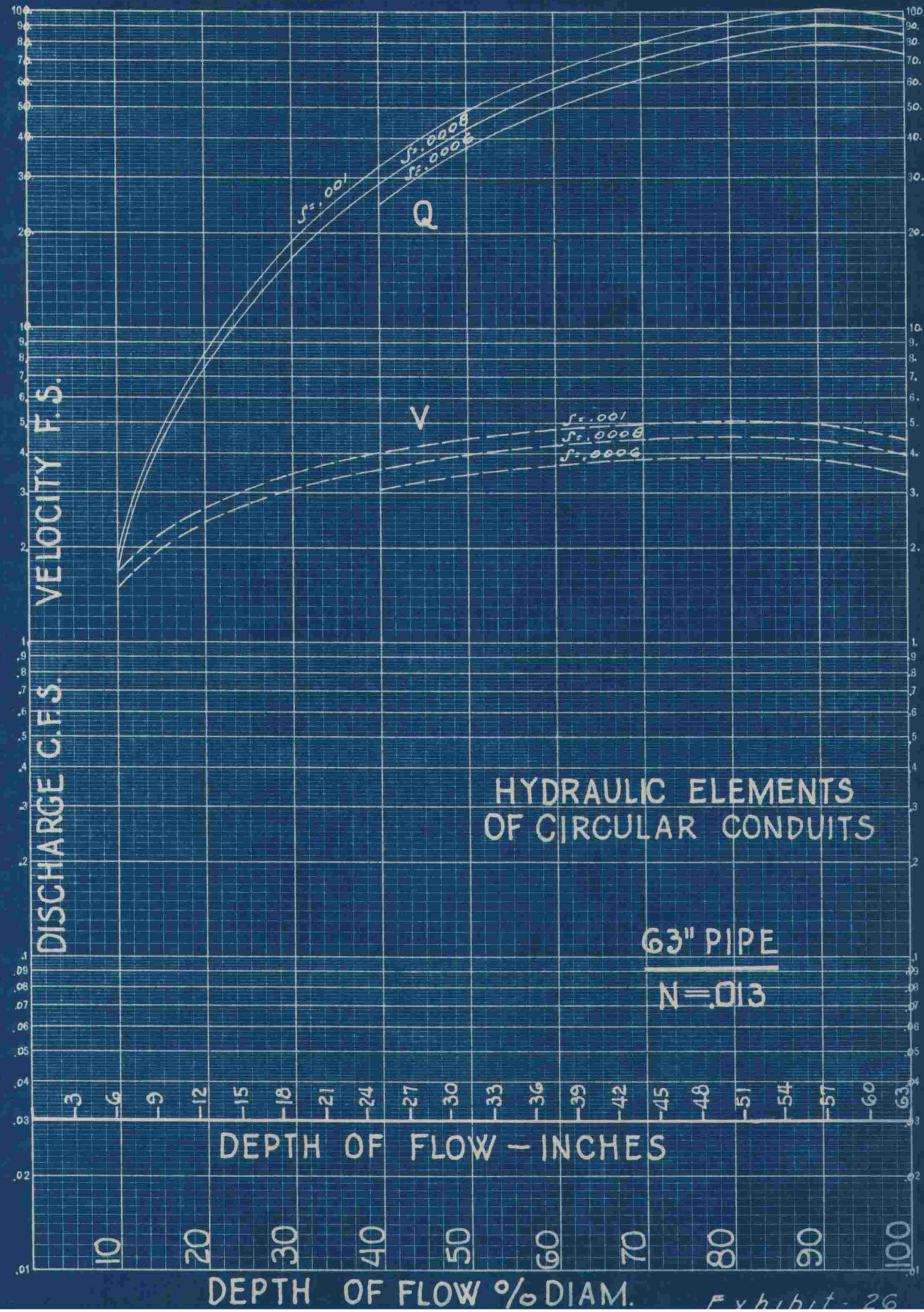
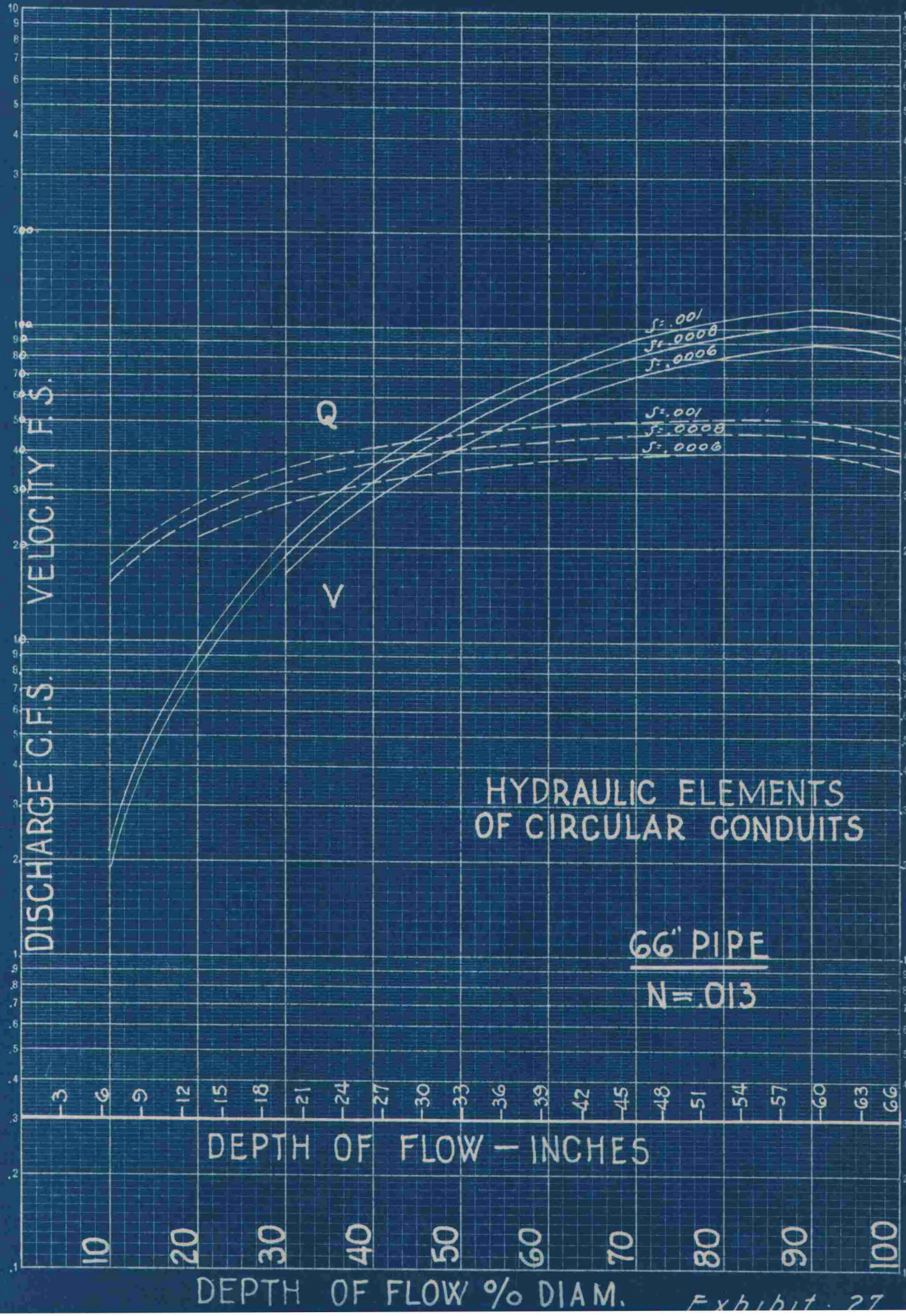
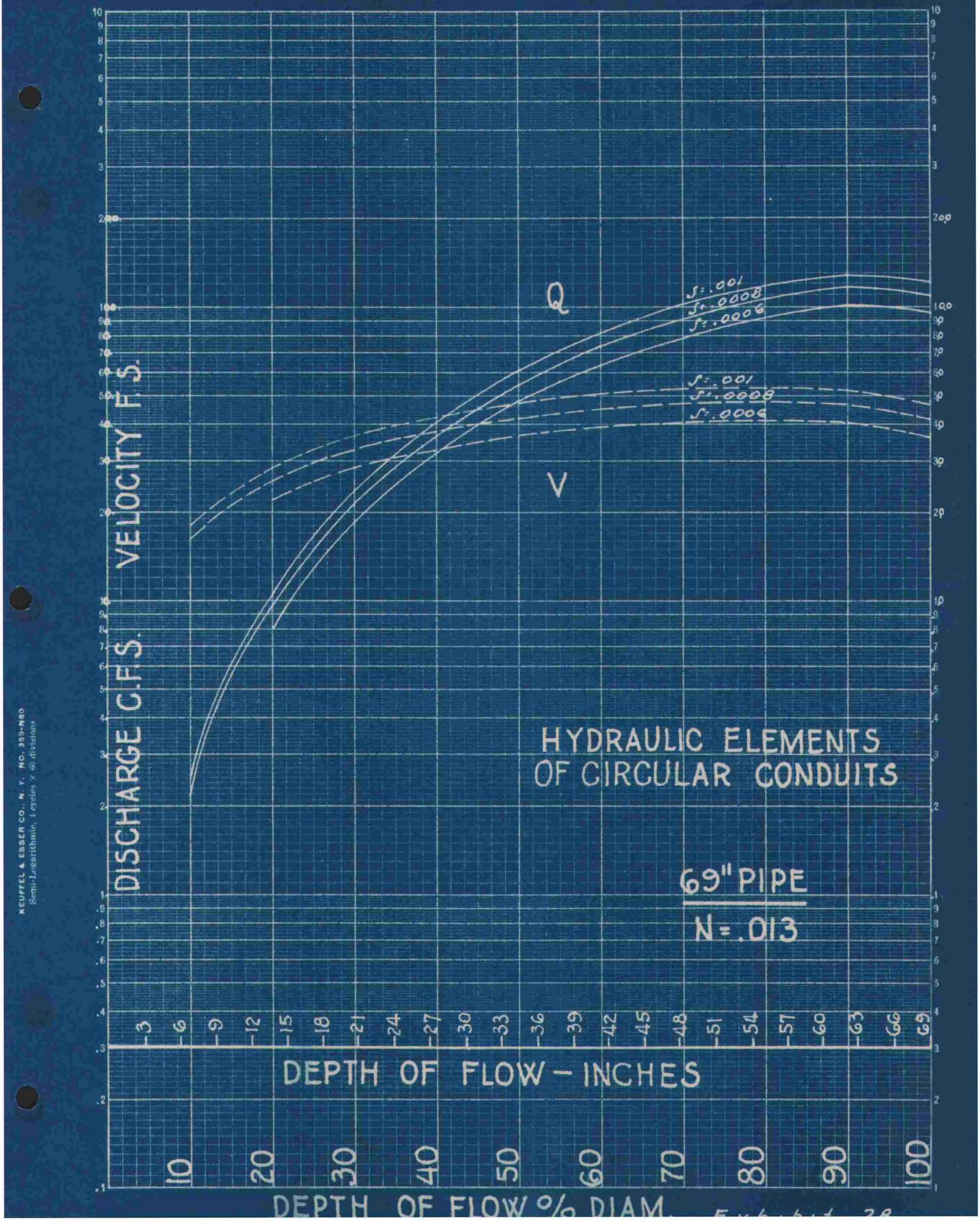


Exhibit - 26



KEUFFEL & ESSER CO., N. Y. NO. 339-N80
Semi-Logarithmic, 4 cycles × 60 divisions

Exhibit 27


DISCHARGE C.F.S. VELOCITY F.S.
Q
V
S=.001
S=.0008
S=.0006
S=.001
S=.0008
S=.0006
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
69" PIPE
N=.013
DEPTH OF FLOW - INCHES
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N. Y. NO. 359-N80
Semi-Logarithmic, 4 cycles × 90 divisions

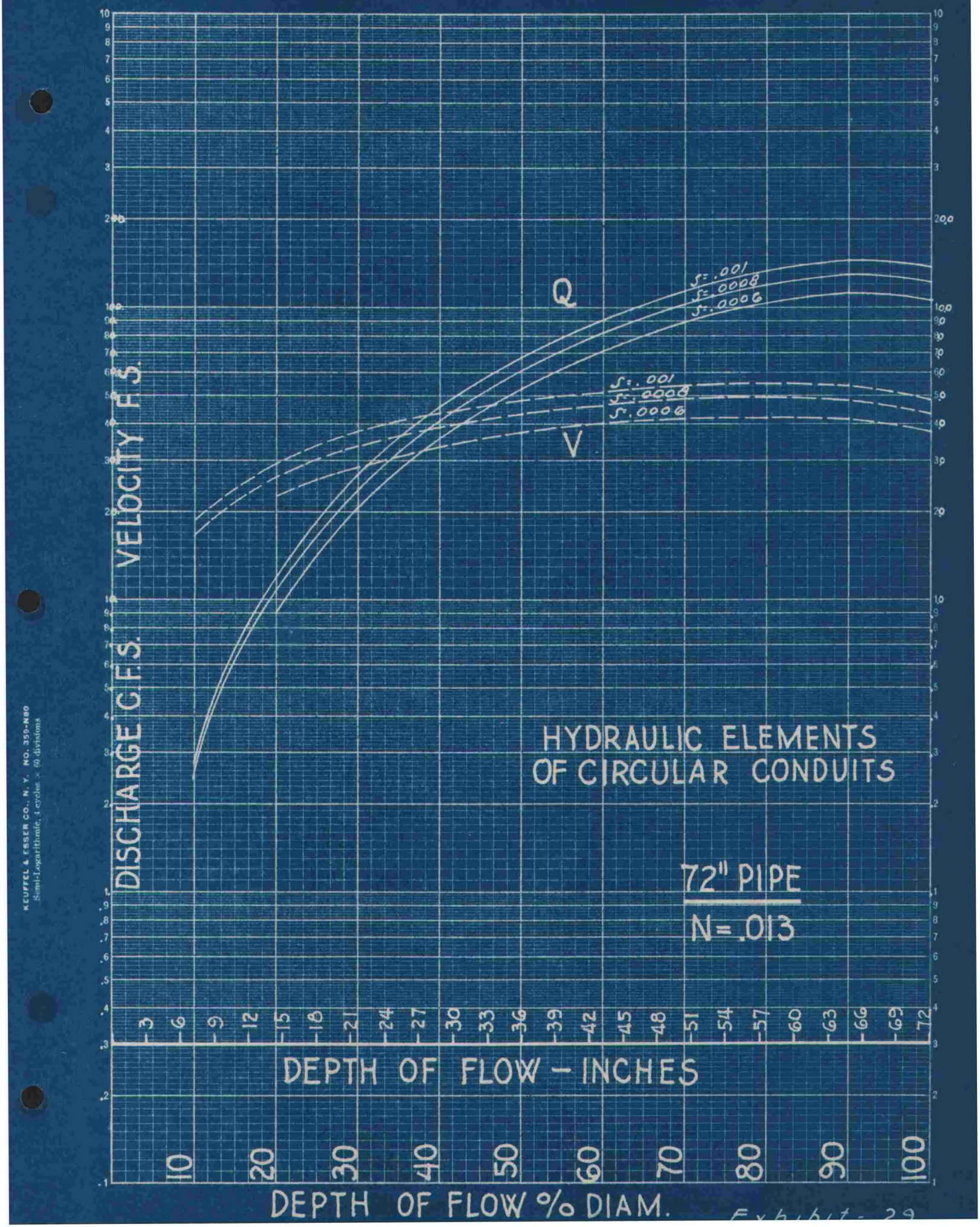

DISCHARGE C.F.S. VELOCITY F.S.
Q
V
S=.001
S=.0008
S=.0006
S=.001
S=.0008
S=.0006
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
72" PIPE
N=.013
3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72
DEPTH OF FLOW - INCHES
10 20 30 40 50 60 70 80 90 100
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N. Y. NO. 359-N80
Semi-Logarithmic, 4 cycles x 60 divisions

Exhibit - 29

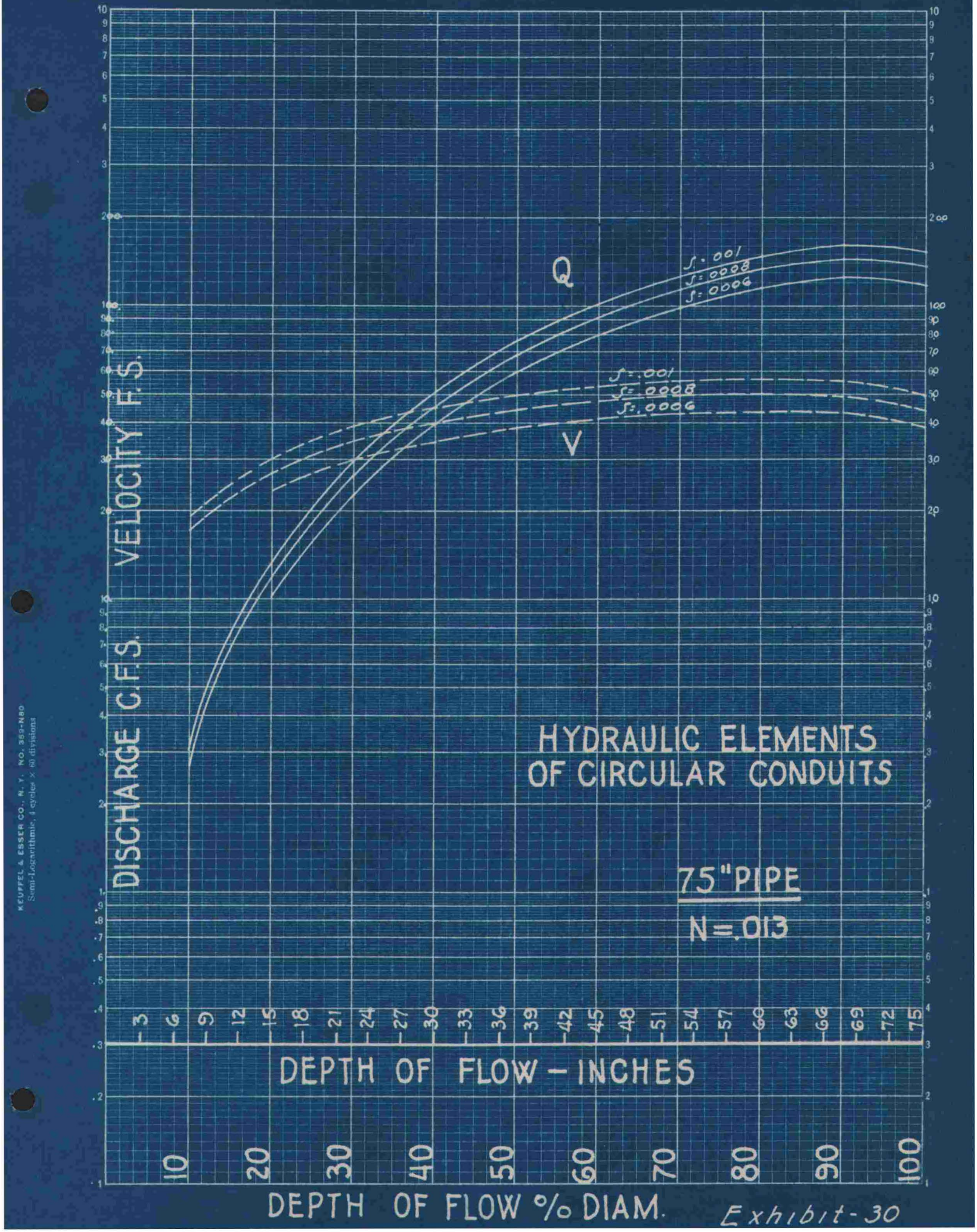
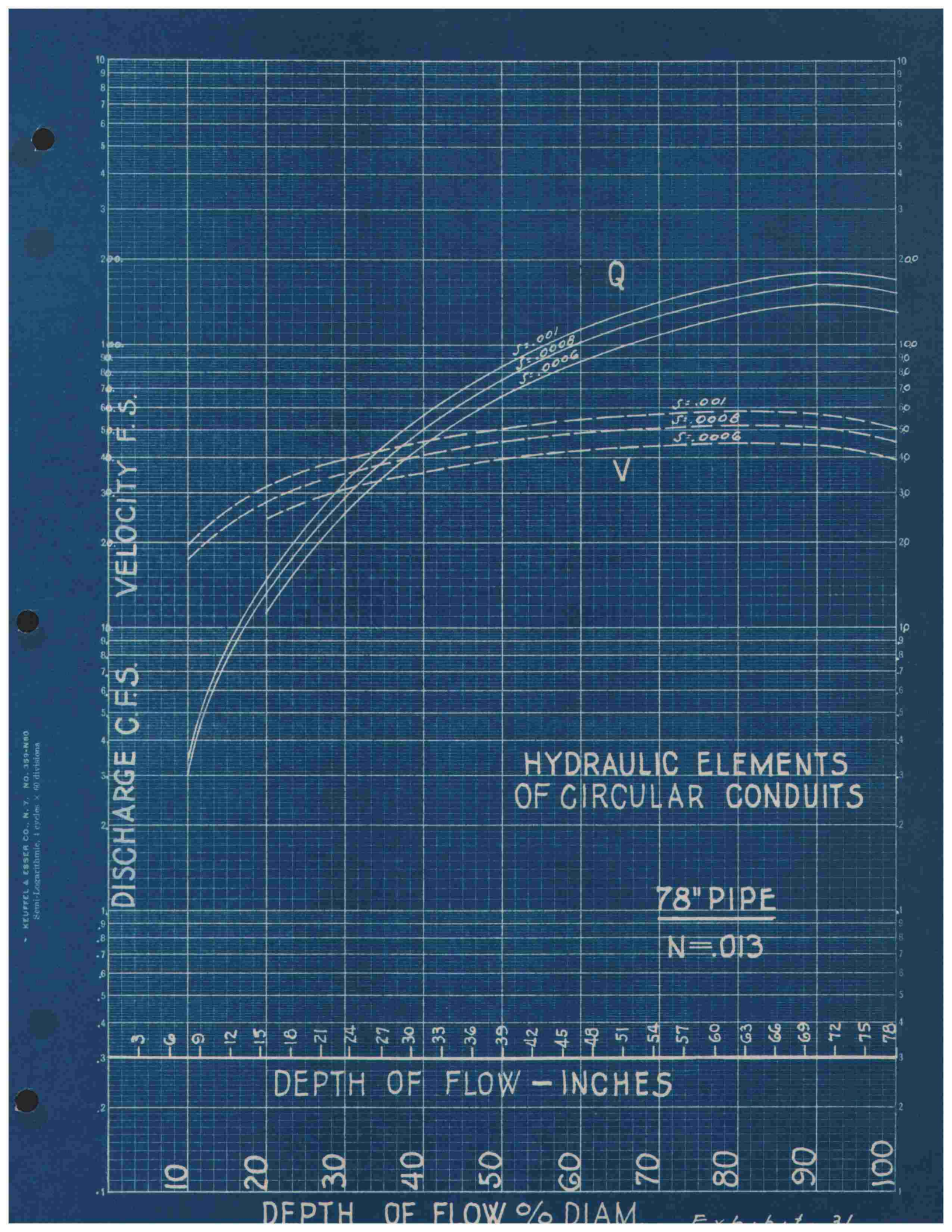
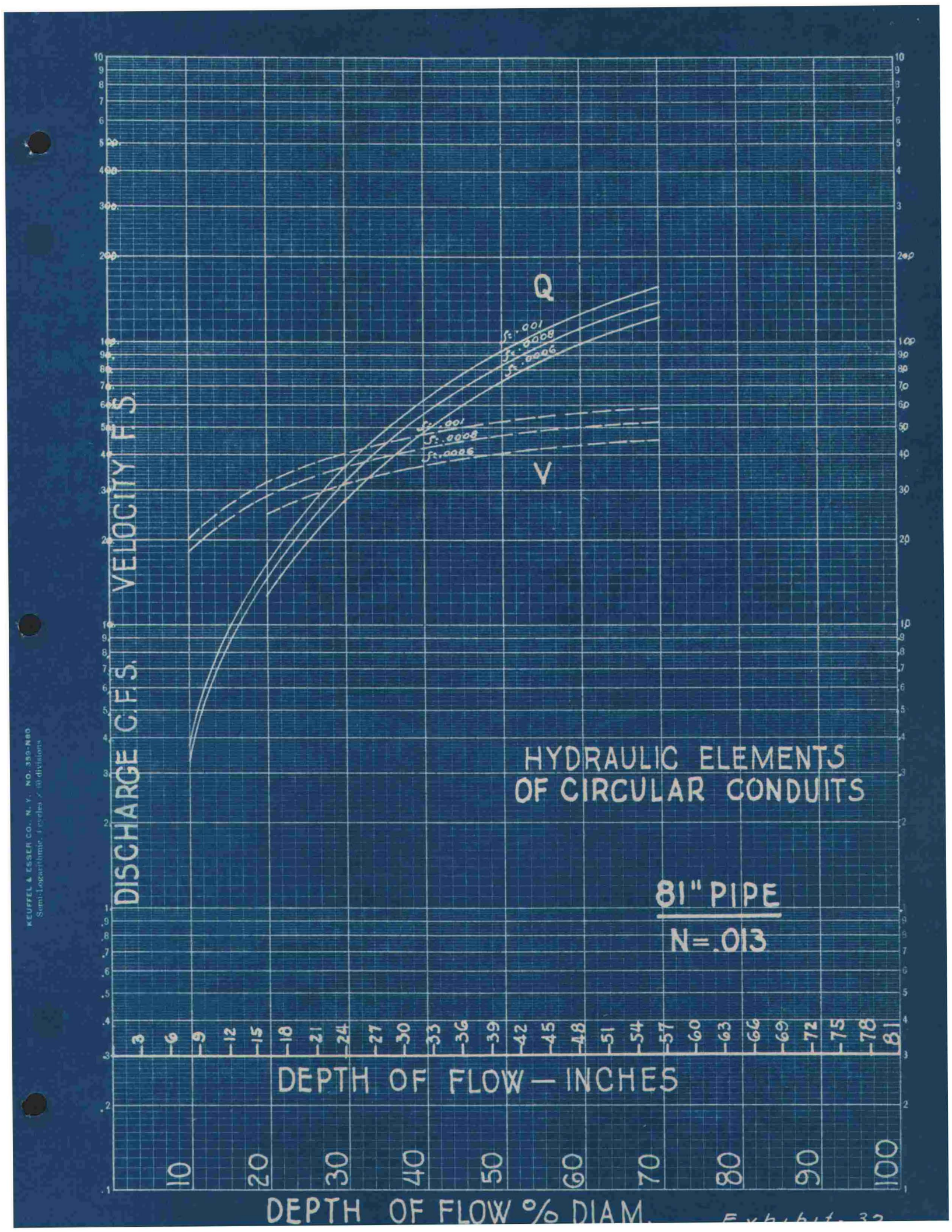

DISCHARGE C.F.S. VELOCITY F.S.
Q
S=.001
S=.0008
S=.0006
V
S=.001
S=.0008
S=.0006
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
75" PIPE
N=.013
DEPTH OF FLOW - INCHES
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N. Y. NO. 359-N80
Semi-Logarithmic, 4 cycles × 80 divisions

Exhibit-30


DISCHARGE C.F.S. VELOCITY F.P.S.
Q
V
S=.001
S=.0008
S=.0006
S=.001
S=.0008
S=.0006
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
78" PIPE
N=.013
DEPTH OF FLOW - INCHES
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N.Y., NO. 359-N60
Semi-Logarithmic, 1 cycles x 60 divisions


Q
S=.001
S=.0008
S=.0006
V
S=.001
S=.0008
S=.0006
VELOCITY F.P.S.
DISCHARGE C.F.S.
HYDRAULIC ELEMENTS
OF CIRCULAR CONDUITS
81" PIPE
N=.013
3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 78 81
DEPTH OF FLOW — INCHES
10 20 30 40 50 60 70 80 90 100
DEPTH OF FLOW % DIAM.
KEUFFEL & ESSER CO., N. Y. NO. 359-N80
Semi-Logarithmic, 3 cycles x 10 divisions