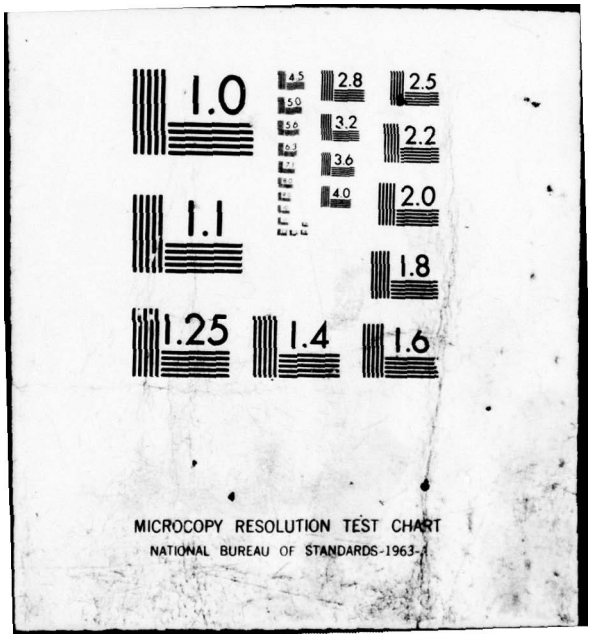
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NATIONAL DAM SAFETY PROGRAM. DOWNSVILLE DAM (NY342), DELAWARE R--ETC(U)
JUL 78 R J KIMBALL DACW51-78-C-0025

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LEVEL II

23

AD A068737

DELAWARE RIVER BASIN

DOWNSVILLE DAM

DELAWARE COUNTY, NEW YORK
INVENTORY NUMBER NY 342

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

DDC FILE COPY



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CONTRACT NO. DACW-51-78-C-0025

Prepared by

L. ROBERT KIMBALL and ASSOCIATES
615 W. Highland Ave. Ebensburg, Pa.

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Prepared For

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
NEW YORK, NEW YORK

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Downsville Dam
Pepacton Reservoir
Delaware County

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.
Downsville Dam was judged to be safe although further analysis was suggested.

AII 059

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

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LEVEL II

23

DELAWARE RIVER BASIN

DOWNSVILLE DAM

DELAWARE COUNTY, NEW YORK
INVENTORY NUMBER NY 342

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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B. Hydrologic Computations

C. Photographs

D. Pertinent Correspondence and Reports

E. Construction Drawings

F. Visual Check List

G. Engineering Data Check List

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Downsville (Pepacton Reservoir) Dam

State Located: New York

County Located: Delaware

Stream: East Branch of Delaware River

Date of Inspection: June 14, 1978

ASSESSMENT

The inspection and evaluation of the Downsville Dam did not reveal any problems which require further study or action. In general the dam is in excellent conditon.

A review of soils and embankment stability analysis should be conducted by the owner according to current criteria.

The hydrologic analysis indicated that the spillway and reservoir are adequate to control the P.M.F.

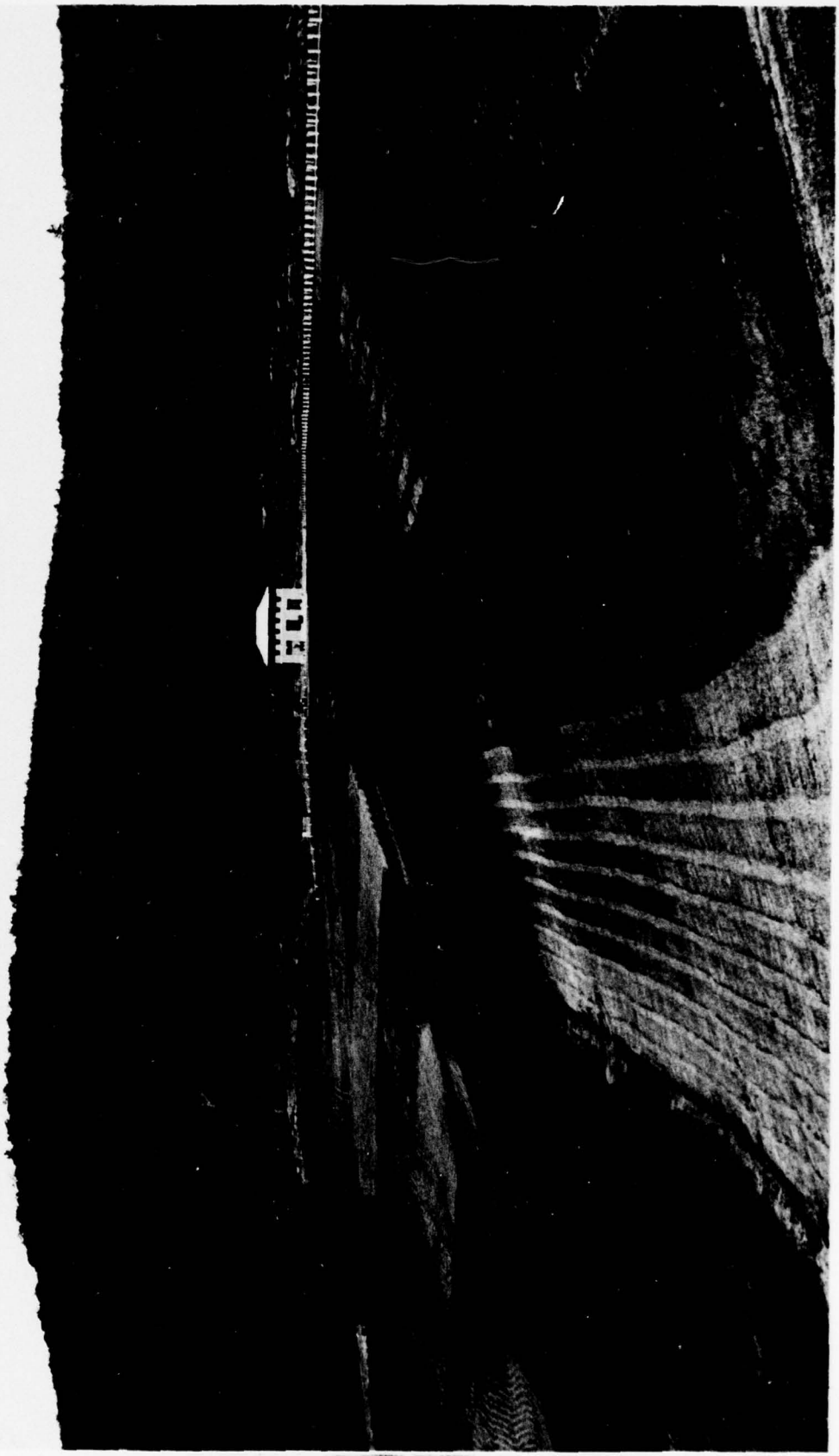
Submitted by: R. Jeffrey Kimball

R. Jeffrey Kimball, P.E.
L. ROBERT KIMBALL & ASSOCIATES
Registration No. PA26275 E

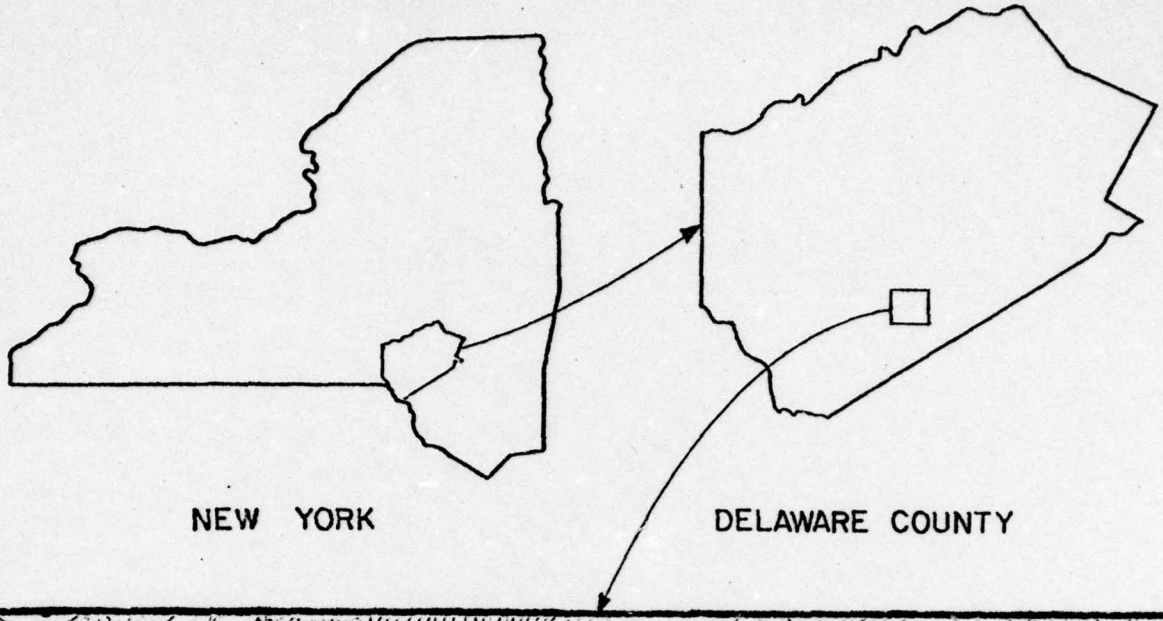
Approved by: Clark H. Benn

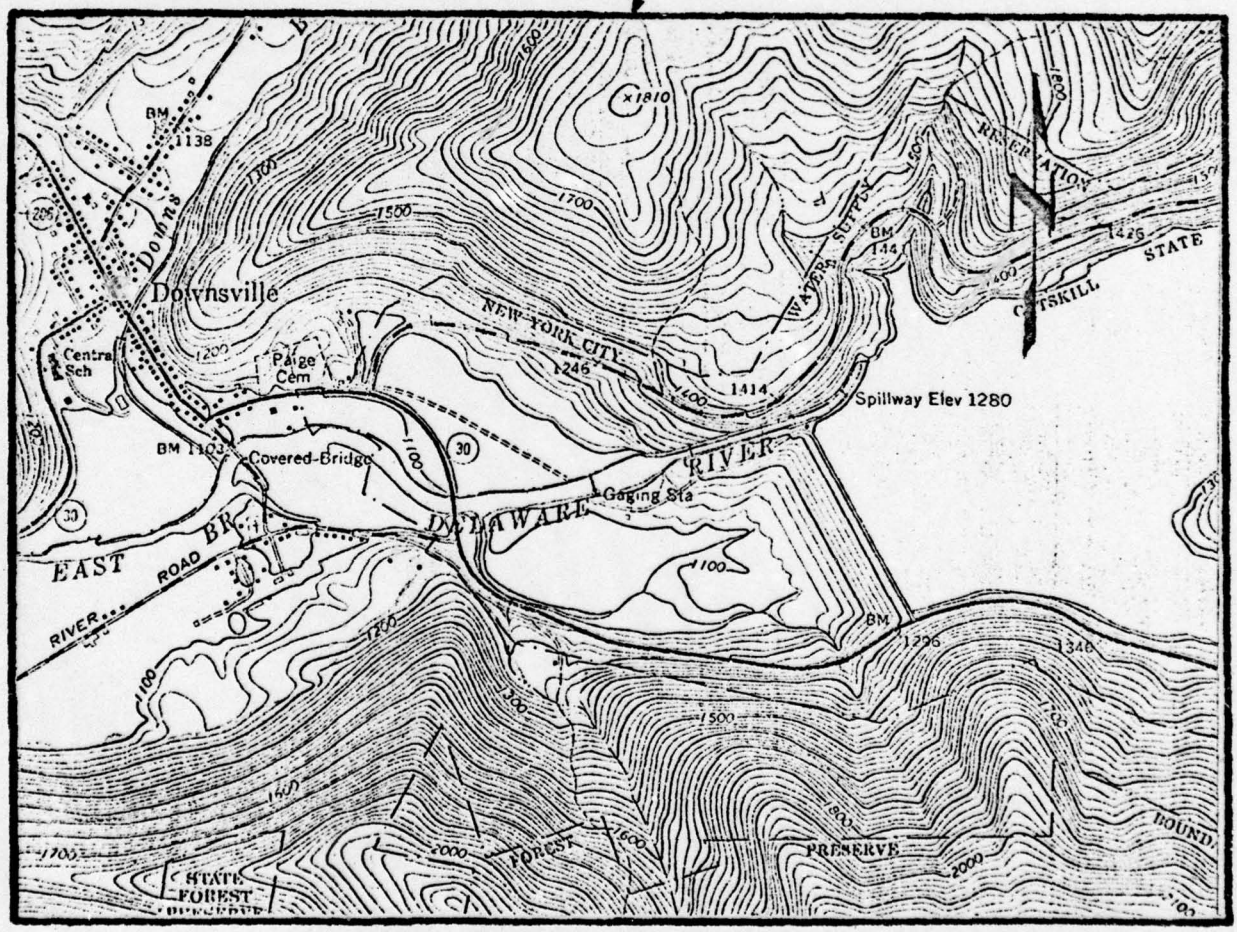
CLARK H. BENN
Colonel, Corps of Engineers
District Engineer

Date: 31 July 1978



OVERVIEW OF DOWNSTREAM SLOPE
FROM LEFT ABUTMENT





Downsville 7.5 minute quadrangle

DOWNSVILLE DAM

SITE LOCATION MAP

SCALE : 1"=2000'

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
DOWNSVILLE-PEPACTON RESERVOIR DAM ID #342

SECTION I: PROJECT INFORMATION

1.1 General:

a. Authority: Authority is provided by the National Dam Inspection Act Public Law 92-367.
Contract Number: DACW51-78-C-0025

b. Purpose of Project: Evaluation of non-Federal dams to identify dams which are a threat to life and property.

1.2 Description of Project:

a. Description of Dam and Appurtenances: The Downsville Dam is a zoned earthfill embankment with a concrete core wall and an embankment height of 204 feet. The downstream slope is terraced with slopes of 3:1 and 4:1. The upstream slopes are 2.5:1 to 3.3:1.

The emergency spillway, a side channel structure, is located at the right abutment. The spillway is an 800 foot long ogee weir discharging over a step to the sloping side channel. The side channel is partly excavated in rock and partly lined with concrete. At the dam axis the side channel flow enters an inclined tunnel to the construction diversion tunnel (40 foot diameter, maximum capacity 40,000 cfs). Downstream of the intake tunnel an open channel was excavated into rock, day-lighting at the stilling basin downstream.

The principal spillway inlet is through the diversion tunnel inlet. The channel is plugged upstream of the emergency spillway inclined tunnel directing flow to the concrete control tower at the right abutment. The water release chamber houses three main pipes with valves, one water conservation line and two larger drain lines. Flow beyond the gates is directed to the diversion tunnel downstream of the sloped intake channel in the emergency spillway (see appendix E Construction Drawings).

b. Location: The dam is located in Delaware county, 1 mile east of Downsville, New York on the East Branch of the Delaware River. The location of the dam can be found on the Downsville, New York 7.5 minute series U.S.G.S. quadrangle (see site location map).

c. Size Classification: The dam is a large size structure.

d. Hazard Classification: Downsville Dam/Pepacton Reservoir is a high hazard potential structure.

e. Ownership: The dam is owned by the City of New York.

f. Purpose of Dam: The dam is part of the New York City Water Supply System.

G. Design and Construction History: The dam was designed by New York City Engineers. Design and working drawings, construction records and photographs are available at the owners offices.

h. Normal Operating Procedures: Under normal conditions water is discharged to the water supply system.

A minimum discharge to the downstream river is required.

Maintenance is performed by city staff located at the dam.

1.3 Pertinent Data:

a. Drainage Area: The drainage area is recorded as 372 square miles. The watershed is primarily wooded hillside.

b. Discharge at Damsite:

Maximum known flood at damsite: Maximum record discharge 9,000 cfs date unknown - prior to 1971.

Spillway capacity at maximum design pool elevation: Reported 200,000 cfs.

Principal Spillway Capacity at Pool Elevation: Unknown

c. Elevation: (feet above MSL)

Top of Dam: 1,304.0

Maximum Pool Design Surcharge: Unknown

Spillway Crest: 1,280.0

Stream bed at Centerline of Dam: 1,100.0 estimated

Maximum Tailwater: Unknown

Principal Spillway/Water Release Chamber Inverts: Not known
Stream level downstream approximately 1,100.0'; upstream 1,120±

d. Reservoir:

Length of Normal Pool: 15.3 miles

Length of Maximum Pool: 18.0 miles

e. Storage: (acre-feet)

Normal Pool: 459,000

Design Surcharge: Unknown

Top of Dam: 609,740

f. Reservoir Surface Area: (acres)

Normal Pool: 5,700

Top of Dam: 6,900

g. Dam:

Type: Zoned earthfill with concrete core

Length: 2,400'

Height: 204'

Top Width: 45'

Side Slopes: Downstream 3:1 to 4:1 with terraces
Upstream 2.5 to 3.3:1

Zoning: Central core, upstream and downstream random and rock zones.

Impervious Core: Clay and concrete cutoff wall.

Cutoff: Concrete wall

Grout Curtain: None

h. Diversion and Regulating Tunnel:

Type: 40' tunnel to 8 foot tunnel to 3 pipes to 8 foot tunnel to 40' tunnel to stilling basin. Diversion tunnel has been plugged.

Length: 350' plus inlet and outlet sections

Closure: In gate house -three sets of valves on each of three pipes

Access: Controls in gate house

Regulating Facilities: 3 gates on each pipe - needle valves regulate flow pipes.

i. Spillway:

	Spillway weir	Side Channel
Type:	Ogee	Open channel to tunnel
Length:	800'	900' to tunnel 2,400' to end
Crest Elevation:	1,280.0'	Tunnel-approx. 1,210'
Upstream Channel:	None	Spillway weir
Downstream Channel:	Sidechannel	East Br. of Delaware River

j. Regulating Outlets: Water supply system- Discharge to 11.5 foot diameter tunnel

SECTION 2: ENGINEERING DATA

2.1 Design: Design drawings were available. No design calculations or reports were available.

2.2 Construction: Working drawings are available. Construction photographs are available. Monitor and soils testing data are available for construction.

2.3 Operation: Water level, rainfall and discharge records are kept. Control valve maintenance records are kept.

2.4 Evaluation: Excellent construction data is available. Sufficient data was not available for complete evaluation of the structure, particularly embankment stability.

SECTION 3: VISUAL INSPECTION

3.1 Findings:

a. General: Downsville Dam was inspected by personnel of L. Robert Kimball and Associates accompanied by city staff on June 14, 1978.

b. Dam: The dam appears to conform closely to the design drawings. The dam is well maintained. No problems, deficiencies or reasons for concern were noted.

c. Appurtenant Structures: No water was flowing over the spillway at the time of the inspection. The spillway and side channel were inspected and are in good condition.

The principal spillway gates and gate house are in good condition. Other portions were not observed.

d. Reservoir Area: No signs of instability were noted on the reservoir rim. The area is wooded with little development.

e. Downstream Channel: The downstream channel is the East Branch of the Delaware River. The immediate downstream area is a relatively wide clear flood plain.

3.2 Evaluation: The visual inspection did not reveal any problems or reasons for concern. In general the embankment and appurtenances appear to be in excellent condition.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures: Discharge from the lake is controlled by demands of the city water supply system and flow requirments in the downstream river.

4.2 Maintenance of Dam: The maintenance and operation of the dam is conducted by the Delaware Division of New York Water Supply. Excellent maintenance is conducted.

4.3 Maintenance of Operating Facilities: Operating and regulating facilities are well maintained.

4.4 Description of Any Warning System in Effect: No warning system is present.

4.5 Evaluation: The dam and appurtenant structures appear to be operated properly and well maintained.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Hydrologic Evaluation of Features:

a. Design Data: No design data was available, some spillway discharge capacity data was available.

b. Experience Data: The reservoir has been in service for 23 years. The maximum recorded discharge during this period was 9,000 cfs.

A rain gage is located at the dam. A U.S.G.S. gaging station is located immediately downstream.

c. Visual Observations: The spillway facilities appeared to be in good condition.

Several possible spillway capacity controls appear to exist: spillway weir, channel, weir at downstream top lip of exit channel. The probable control is the spillway ogee weir.

d. Overtopping Potential: Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF through the reservoir system. The PMF is that hypothetical flow induced by the most critical combination of precipitation, minimum infiltration losses, and concentration of run-off at a specific location, that is considered reasonably possible for a particular drainage area.

The drainage area contributing to the Downsville Reservoir is approximately 372 square miles. To develop the basic hydrologic working tool, the unit hydrograph, Snyder Coefficients were used. To establish the necessary equations, the Snyder Coefficients were calculated based on the watershed location, size, shape, etc.

A value for Snyder's Log (Tp) = 8.7 was calculated. Also, Snyder's Peak Coefficient (Cp) was assumed to be 0.6 based on other studies in the area and an average Ct = 2.0 was assumed.

Using Hydrometerological Report No. 33, the PMP index rainfall was determined to be 20.5 inches for a 24 hour duration, 200 square mile basin. The percentages of the index rainfall applied to other durations were interpolated from the plot of drainage area versus percent of 24 hour, 200 square mile. The computed PMF through the impounded storage was 133,800 CFS. Routing the PMF through the impounded storage reduced the peak flow by 23,500 CFS. A plot of PMF inflow and outflow hydrographs is included in the Appendix.

The ability of Downsville Dam to discharge the standard project flood (SPF) was also evaluated. The SPF peak flow of 56,400 CFS was routed through the reservoir. The SPF outflow is indicative of a pool elevation of 1286.0 feet above N.S.L. This allows for 18.0 feet of freeboard to the top of the dam, while the spillway is overtopped by 6.0 feet.

The PMF outflow is equivalent to 12.4 feet of freeboard to the top of dam (the spillway is overtopped by 11.6 feet).

To allow inflow and outflow hydrographs to be developed and routed, several assumptions were made.

1. Discharge values for the spillway obtained from the owner were assumed to be correct. Weir coefficients were calculated from this data and extrapolated for depths above those listed on the owners calculations.

2. The spillway is the controlling structure over the discharge tunnel and side channel.

SUMMARY OF HYDROLOGIC ANALYSIS
DOWNSVILLE RESERVOIR

Elevation Top of Dam = 1304.0'

Elevation Crest of Spillway = 1280.0'

PMF ROUTING

PMF Peak = 133,800 CFS

PMF After Routing Through Reservoir = 110,300 CFS

Elevation of Routed PMF corresponding to 110,300 CFS = 1291.6 feet above MSL

Freeboard Remaining = 12.4 feet

Spillway Surcharge = 11.6 feet

SPF ROUTING

SPF Peak = 56,400 CFS

SPF After Routing through Reservoir = 41,000 CFS

Elevation of Routed PMF corresponding to 41,000 CFS = 1286.0 feet

Freeboard Remaining = 18.0 feet

Spillway Surcharge = 6.0 feet

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability:

a. Visual Observations: No misalignment or settlement of the structure was observed. The emergency spillway is in good condition.

b. Design and Construction Data: No design data was available for review.

c. Operating Records: Operation of the structure does not appear to adversly affect structural stability.

d. Post Construction Changes: None known

e. Seismic Stability: Seismic stability computations are not available. The reservoir is located in seismic zone 1 and is assumed to present no hazard unless static conditions are unfavorable or marginal. Verification of embankment stability should be provided by the owner.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment:

a. Safety: The dam does not appear to present a danger to life or property, based on our visual inspection.

b. Adequacy of Information: The information made available was not adequate for complete analysis of the dam. The validity of available information appears to be good. The information does not include stability analysis.

c. Urgency: No emergency or immediate future action is necessary for this structure.

d. Necessity for Future Analysis: A formal detailed follow up study is not necessary.

A review of embankment stability should be completed by the owner to determine whether the embankment meets current state of the art criteria.

7.2 Recommendations:

1. A review of soils and stability analysis data should be completed by the owner or their consultants.

2. A formal surveillence program should be established and followed for the structure.

3. The owner should continue his excellent maintenance program.

APPENDIX A

GEOLOGY

Downsville Dam - Pepacton Reservoir

Pepacton Reservoir is located in the Catskill Mountains which has a unique geological history. Most of the bedrock in the Catskills are of Devonian age. These rocks were deposited in a terrestrial environment. During the Acadian Orogeny to the east, large quantities of clay, sand and gravel were stripped from the immense new mountains and deposited in the sea. This continued until New York was covered by a vast compound delta and alluvial plain. Because supply of erosional debris exceeded subsidence of the sea floor, the Catskill Delta or Clastic Wedge developed rapidly. In all, approximately 7,500 ft. of strata can be measured in the Catskill Mountains while in western Pennsylvania similarly aged deposits are only a few hundred feet thick.

In a general way, the deltic deposits tend to be sorted across the state. The coarsest sediments, sands and gravels, were deposited nearest to the source while fewer sediment silts and clays were deposited farther west. Because the bedrock near the Downsville Dam was deposited near the source, they are chiefly composed of sandstone. In addition to being deposited in a terrestrial environment these sediments were oxidized and have a reddish color. Occasionally these rocks are called the Catskill Red-Beds.

Locally the bedrock at the Downsville Dam is part of the Walton Formation. These rocks are similar to other red-beds and are durable and very resistant to erosion. This is indicated by the fact that most of the Catskill Clastic Wedge still exist after 360 m.y. of exposure to weathering and that its source area, the Acadian Mountains, have been extremely eroded away.

During the Pleistocene Epoch, the Pepacton Reservoir area and the Catskill Mountains were glaciated by both the continental ice sheets and later by local valley glaciers. The continental ice sheets contributed mostly to the present day topography of the area. The East Branch of the Delaware River Valley, which is the Pepacton Valley was enlarged from a pre-Pleistocene valley by the ice sheet. Valleys oriented normal to the ice movement, such as the Pepacton valley, generally have thick deposits of drift. This drift is unsorted and contain a large variety of sediment sizes. The drift is approximately 100 feet thick near the dam site.

During the retreat of the ice sheet, the East Branch of the Delaware River was a major drainage route for run off. Several now following north streams, such as Schoharie Creek, were blocked by the ice sheet. This caused them to drain south through the Pepacton Valley. Some of the drift was stratified and sorted by this action. Gravel and sand pockets can be found through out this valley.

Local valley glaciers were limited to the higher elevations. But they also contributed outwash to the Pepacton valley.

APPENDIX B

HYDROLOGIC COMPUTATIONS

DOWNSVILLE DAM

PRECIPITATION

WATERSHED IS LOCATED AT 42° 7' LATITUDE AND 74° 50' LONGITUDE.

FROM HYDROMETEOROLOGICAL REPORT NO. 33, PROBABLE MAXIMUM PRECIPITATION INDEX = 20.5"
(24-HOUR DURATION FOR 200 SQ. MILES)

FROM EM 1110-2-1411 THE STANDARD PROJECT INDEX PRECIPITATION FOR 24-HR DURATION = 8.9"
(ADJUSTED FOR DRAINAGE AREA)

DRAINAGE AREA

REPORTED DRAINAGE AREA = 372 SQ. MILES

SNYDER COEFFICIENTS

SNYDER'S LAG: $t_{pR} = C_t (.955)(L \times L_{ca})^{.3} + .25\, t_R$

$C_t = 2$, $L = 38.0$ MI., $L_{ca} = 19.0$ MI. $t_R = 3$ HR.

$t_{pR} = 14.5$ HR.

UNIT HYDROGRAPH PEAK DISCHARGE:

$$Q_{pR} = \frac{640 C_p A}{t_{pR}}$$

$C_p = 0.6$ $Q_{pR} = 9,850$ CFS

DOWNSVILLE DAM

ELEVATION - DISCHARGE RELATIONSHIP

ELEV. (FT.)	H (FT.)	C	DISCHARGE TOTAL Q (C.F.S.)
1280	0	0	0
1281	1	2.83	2500
1282	2	3.20	7250
1283	3	3.32	13800
1284	4	3.40	21760
1285	5	3.50	31305
1286	6	↑	41151
1287	7	|	51857
1288	8	|	63357
1289	9	|	75600
1290	10	|	88544
1291	11	|	102152
1292	12	|	116394
1293	13	|	131242
1294	14	|	146673
1295	15	|	162665
1296	16	|	179200
1297	17	|	196260
1298	18	|	213829
1299	19	|	231893
1300	20	|	250440
1301	21	|	269455
1302	22	|	288930
1303	23	↓ 3.50	308852
TOP OF DAM 1304	24	—	* 316311

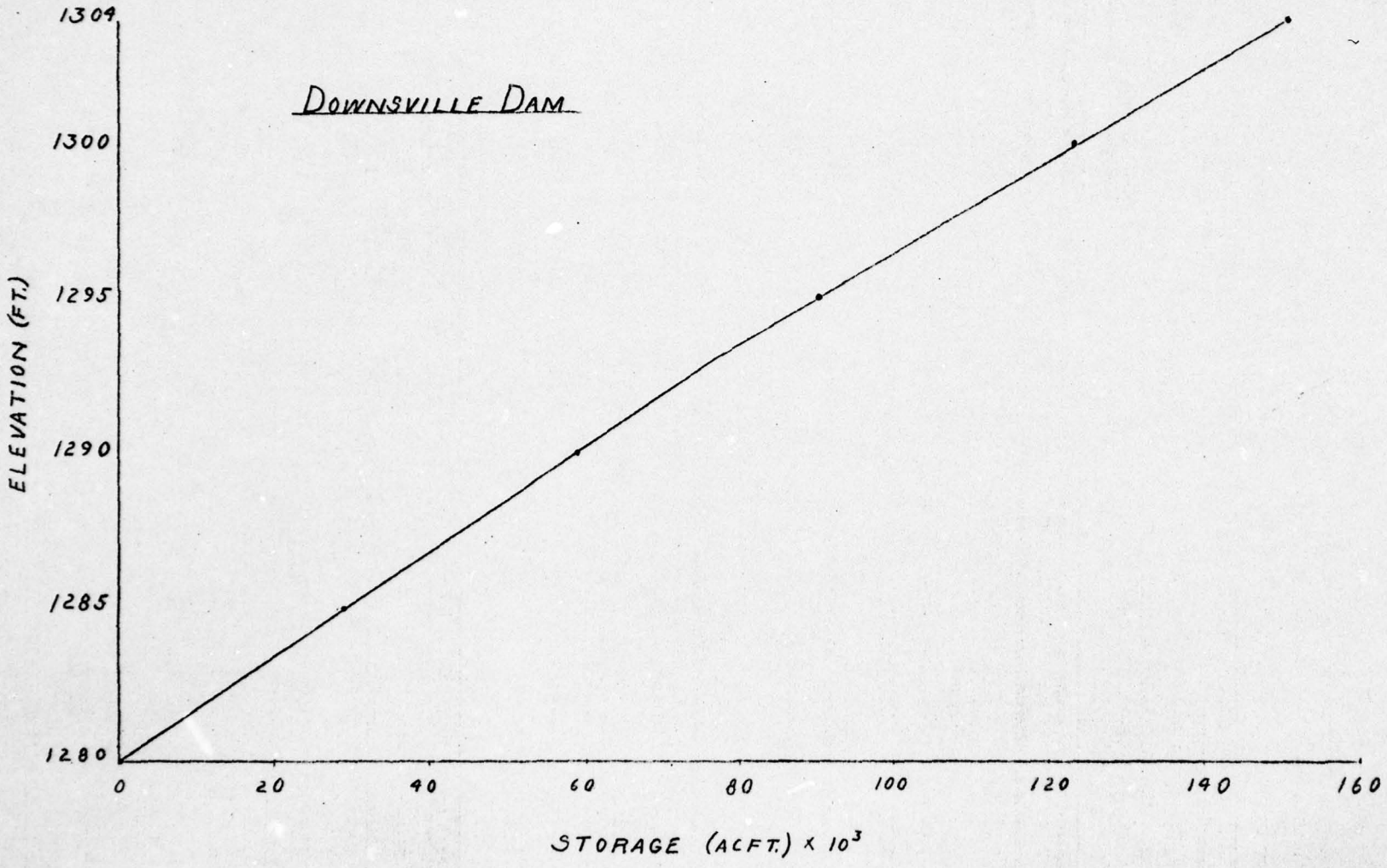
WEIR EQUATION: $Q = CLH^{3/2}$, $L = 800'$

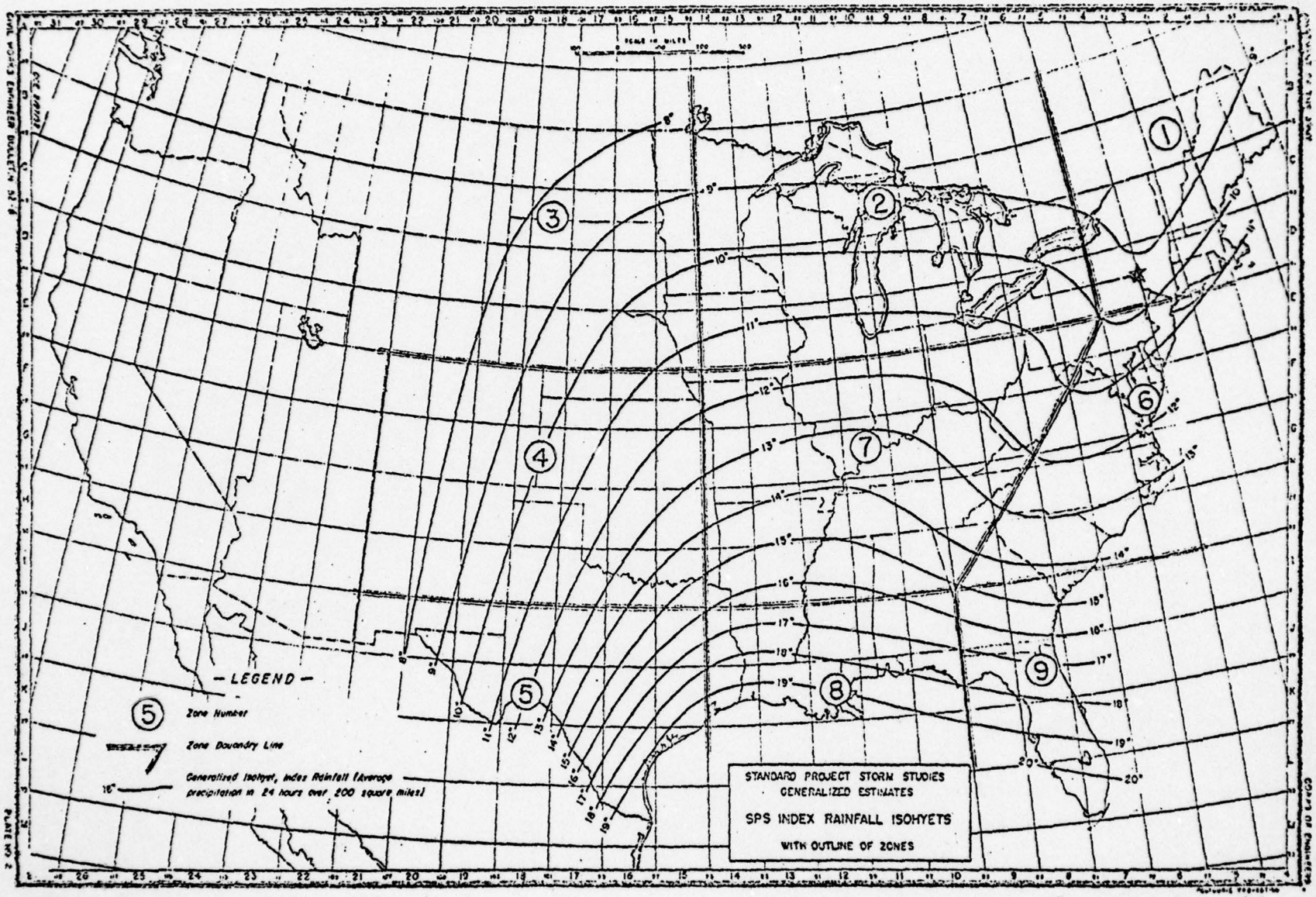
* COMBINED CHANNEL AND TUNNEL FLOW CONTROLS

DOWNSVILLE DAM

ELEVATION - STORAGE RELATIONSHIP

ELEV. (FT.)	SURFACE AREA (ACRES)	Δ ELEV. (FT.)	TOTAL STORAGE (AC-FT.)	TOTAL DISCHARGE (CFS)
1280	5627	0	0	0
1281	5682	1	5654	2500
1282	5736	1	11364	7250
1283	5791	1	17127	13800
1284	5845	1	22945	21760
1285	5900	1	28818	31305
1286	5954	1	34744	41151
1287	6008	1	40721	51857
1288	6063	1	46756	63357
1289	6118	1	52847	75600
1290	6172	1	58992	88544
1291	6226	1	65191	102152
1292	6281	1	71444	116394
1293	6336	1	77753	131242
1294	6390	1	84116	146673
1295	6444	1	90533	162665
1296	6499	1	97004	179200
1297	6554	1	103531	196260
1298	6608	1	110112	213829
1299	6662	1	116747	231893
1300	6717	1	123436	250440
1301	6772	1	130181	269455
1302	6826	1	136980	288930
1303	6880	1	143833	308852
TOP OF DAM 1304	6935	1	150740	316311


DOWNSVILLE DAM
ELEVATION (FT.)
1304
1300
1295
1290
1285
1280
0
20
40
60
80
100
120
140
160
STORAGE (AC FT.) x 10³



Standard project rainfall
for 24 hr period over a
200 sq. mi. area

HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01

DOWNSVILLE DAM
RESERVOIR AT TOP OF FLOOD POOL
TEST PMP

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
45	3	0	0	0	0	0	2	0	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	372.00	0.0	372.00	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	20.50	66.00	81.00	92.00	98.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.895

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	1.50	0.10	0.0	0.0

UNIT HYDROGRAPH DATA
TP 14.50 CP 0.60 NTA 0

RECESSION DATA
STRTQ 372.00 QRCSN -0.25 RTIOR 3.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC 5.52 AND R 4.72 INTERVALS

UNIT HYDROGRAPH 24 END-OF-PERIOD ORDINATES, LAG 14.54 HOURS, CP 0.61 VOL 1.00

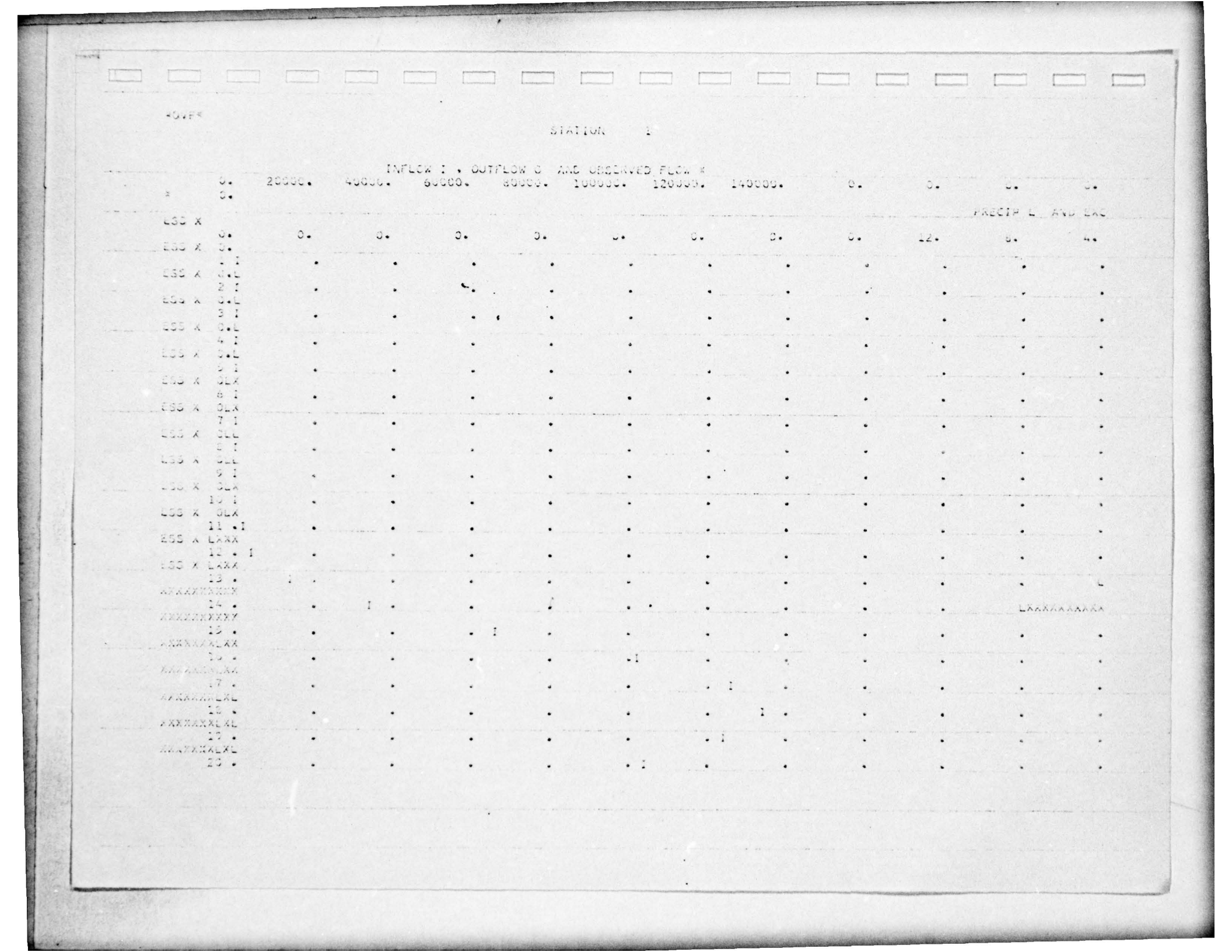
837.	3045.	5952.	8549.	9940.	9595.	8085.	6919.	5269.	4299.
3442.	2762.	2249.	1818.	1469.	1187.	960.	776.	627.	507.
410.	331.	268.	216.	175.	141.	114.	92.		

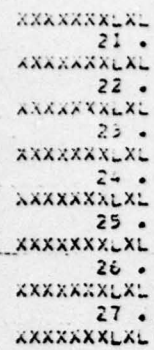
END-OF-PERIOD FLOW

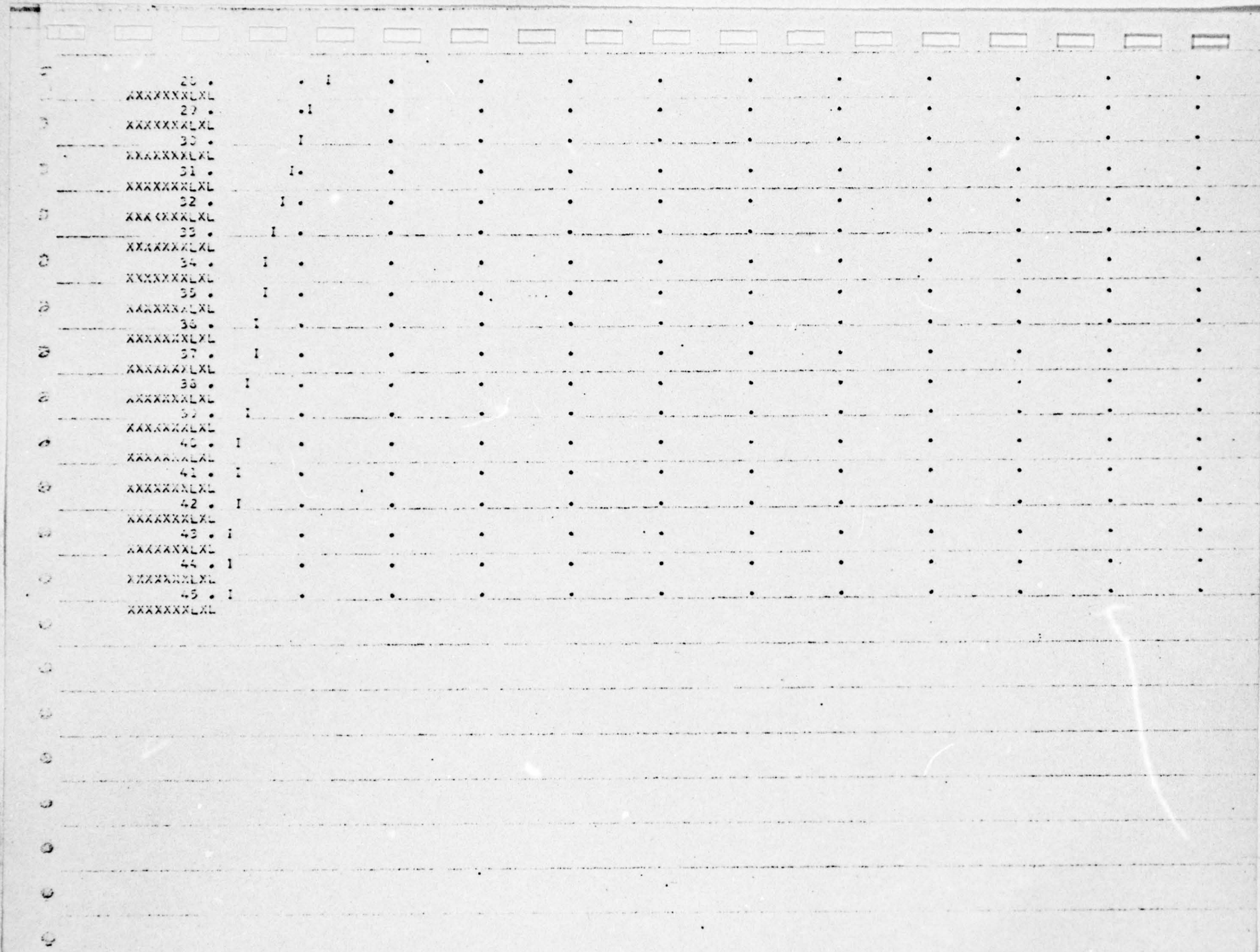
TIME	RAIN	EXCS	COMP N
1	0.03	0.00	339.
2	0.03	0.00	299.
3	0.09	0.00	268.
4	0.09	0.00	240.
5	0.28	0.00	215.
6	0.53	0.00	192.
7	0.04	0.00	172.
8	0.04	0.00	154.
9	0.40	0.00	139.
10	0.40	0.10	214.
11	1.38	1.08	1382.
12	1.38	1.08	4809.
13	3.99	3.69	13752.
14	8.11	7.81	34499.
15	0.61	0.31	86977.
16	0.61	0.31	101161.
17	0.0	0.0	125958.
18	0.0	0.0	133782.
19	0.0	0.0	123539.
20	0.0	0.0	105674.
21	0.0	0.0	84370.
22	0.0	0.0	68291.
23	0.0	0.0	55200.
24	0.0	0.0	44619.
25	0.0	0.0	36067.
26	0.0	0.0	31209.
27	0.0	0.0	28033.
28	0.0	0.0	25114.
29	0.0	0.0	22901.
30	0.0	0.0	20160.
31	0.0	0.0	18062.
32	0.0	0.0	16103.
33	0.0	0.0	14499.
34	0.0	0.0	12991.
35	0.0	0.0	11639.
36	0.0	0.0	10428.
37	0.0	0.0	9343.
38	0.0	0.0	8371.
39	0.0	0.0	7500.
40	0.0	0.0	6720.
41	0.0	0.0	6021.
42	0.0	0.0	5394.
43	0.0	0.0	4833.
44	0.0	0.0	4330.
45	0.0	0.0	3880.
SUM	17.99	14.38	1207429.

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME

CFS	193782.	127870.	160369.	50115.	1287421.
INCHES		3.25	10.10	15.04	15.45
AC-FT		64431.	200372.	493581.	3144..


STATION 1
INFLOW I , OUTFLOW O AND OBSERVED FLOW X
0. 20000. 40000. 60000. 80000. 100000. 120000. 140000.
0. 0. 0. 0.
PRECIP L AND LAC
0. 0. 0. 0. 0. 0. 0. 0. 12. 8. 4.


XXXXXXXLXL
21
XXXXXXXLXL
22
XXXXXXXLXL
23
XXXXXXXLXL
24
XXXXXXXLXL
25
XXXXXXXLXL
26
XXXXXXXLXL
27
XXXXXXXLXL



OVN

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	1	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE	0.	11364.	22945.	34744.	40721.	46756.	52847.	58992.	65191.	71444.
OUTFLOW	0.	7250.	21760.	41151.	51857.	63357.	75600.	88544.	102152.	116394.

TIME	EOP STOR	AVG IN	EOP OUT
1	522.	333.	333.
2	518.	316.	331.
3	507.	283.	324.
4	491.	254.	313.
5	472.	227.	301.
6	449.	204.	287.
7	425.	192.	271.
8	400.	163.	256.
9	373.	147.	240.
10	347.	176.	230.
11	486.	773.	310.
12	1130.	3115.	721.
13	3107.	9325.	1982.
14	8195.	24125.	5228.
15	18170.	50738.	11778.
16	32428.	84069.	37346.
17	47832.	113500.	65819.
18	60817.	120870.	91892.
19	67663.	128660.	107783.
20	68789.	113606.	110347.
21	65433.	94022.	103158.
22	60408.	76231.	91692.
23	54541.	61746.	79168.
24	48750.	49910.	67365.
25	43351.	40343.	56369.
26	38676.	33676.	48174.
27	34915.	29659.	41458.
28	31852.	26572.	36298.
29	29259.	23807.	32136.
30	27033.	21330.	28479.

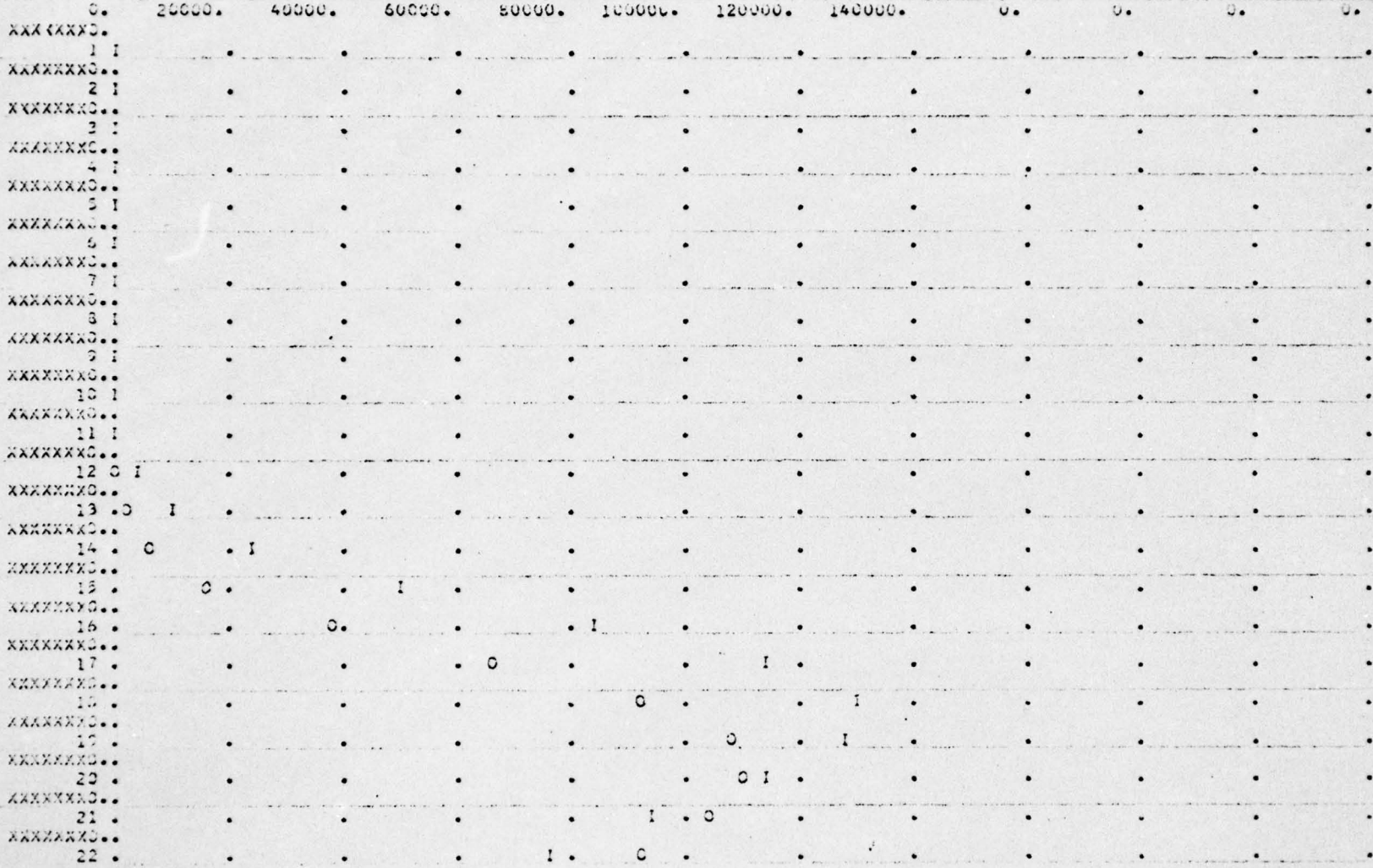
31	25104.	19111.	25307.
32	23418.	17123.	22537.
33	21893.	15341.	20442.
34	20456.	13745.	18642.
35	19008.	12315.	16941.
36	17831.	11034.	15352.
37	16650.	9886.	13883.
38	15579.	8857.	12531.
39	14593.	7936.	11296.
40	13695.	7110.	10170.
41	12879.	6370.	9149.
42	12141.	5708.	8223.
43	11474.	5114.	7387.
44	10837.	4582.	6914.
45	10191.	4105.	6502.
SUM			1229935.

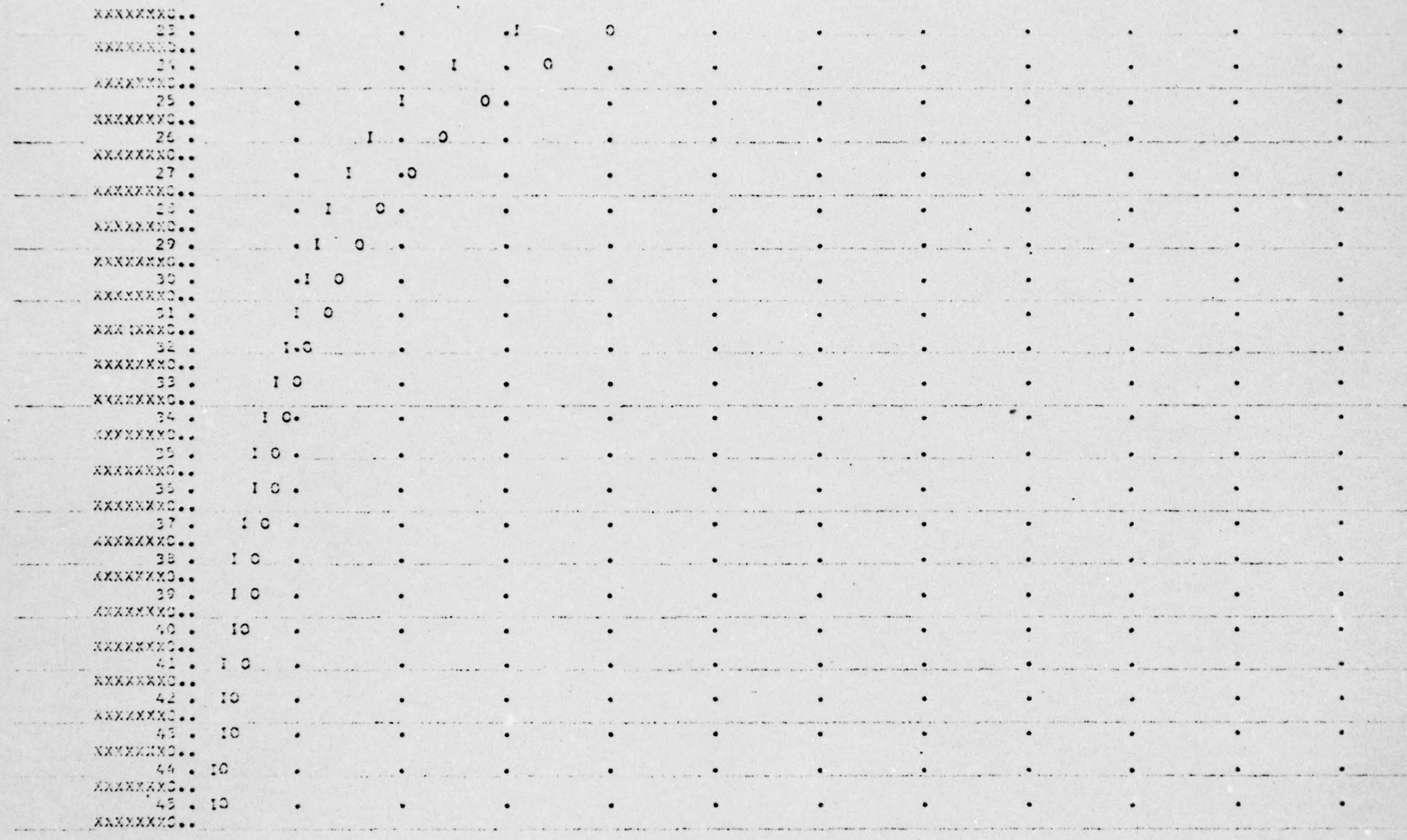
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	110347.	104065.	89610.	48299.	1229935.
INCHES		2.73	8.96	14.49	15.38
AC-FT		54110.	177831.	287545.	305100.

OVF

STATION 2

INFLOW I , OUTFLOW O AND OBSERVED FLOW *





RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	133782.	129870.	100969.	50115.	372.00
ROUTED TO	2	110347.	109065.	89610.	48299.	372.00

****
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
****

DOWNSVILLE DAM
RESERVOIR AT TOP OF FLOOD POOL
TEST SPF

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
45	3	0	0	0	0	0	2	0	0

JOPER	NMT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	372.00	0.0	372.00	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
8.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.895

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	1.50	0.10	0.0	0.0

UNIT HYDROGRAPH DATA
TP 14.50 CP 0.60 NTA 0

RECESSION DATA
STRTQ 372.00 QRCSN -0.25 RTIOR 3.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC 5.52 AND R 14.72 INTERVALS

UNIT HYDROGRAPH 26 END-OF-PERIOD ORDINATES, LAG 14.54 HOURS, CP 0.61 VOL 1.00

837.	3043.	5952.	8549.	9940.	9595.	8065.	6519.	5269.	4259.
3442.	2782.	2249.	1818.	1469.	1187.	960.	776.	627.	507.
410.	331.	268.	216.	175.	141.	114.	92.		

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	CONF
1	0.00	0.00	332.
2	0.00	0.00	299.
3	0.01	0.00	269.
4	0.01	0.00	240.
5	0.08	0.00	215.
6	0.16	0.00	192.
7	0.01	0.00	172.
8	0.01	0.00	154.
9	0.01	0.00	138.
10	0.01	0.00	124.
11	0.06	0.00	111.
12	0.06	0.00	100.
13	0.34	0.00	89.
14	0.69	0.00	80.
15	0.03	0.00	72.
16	0.03	0.00	64.
17	0.08	0.00	58.
18	0.09	0.00	52.
19	0.36	0.06	93.
20	0.36	0.06	258.
21	2.06	1.76	2014.
22	4.19	3.89	9460.
23	0.20	0.00	23382.
24	0.20	0.00	39512.
25	0.00	0.00	51749.
26	0.00	0.00	56373.
27	0.02	0.00	52180.
28	0.02	0.00	43280.
29	0.13	0.00	35064.
30	0.27	0.00	28342.
31	0.01	0.00	22909.
32	0.01	0.00	18519.
33	0.0	0.0	14968.
34	0.0	0.0	13074.
35	0.0	0.0	11714.
36	0.0	0.0	10498.
37	0.0	0.0	9403.
38	0.0	0.0	8425.
39	0.0	0.0	7548.
40	0.0	0.0	6763.
41	0.0	0.0	6059.
42	0.0	0.0	5429.
43	0.0	0.0	4864.
44	0.0	0.0	4358.
45	0.0	0.0	3905.
SUM	9.50	5.77	492800.

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME

CFS	56373.	54277.	41223.	20320.	492800.
INCHES		1.36	4.12	6.10	6.16
AC-FT		26928.	81806.	120972.	122245.

OVF

STATION 1

INFLOW I , OUTFLOW O AND OBSERVED FLOW *

0. 10000. 20000. 30000. 40000. 50000. 60000. 0. 0. 0. 0. 0.

* XXXXXO.

PRECIP L AND EXC

ESS X

0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 6. 4. 2.

ESS X XO.

1 I

ESS X XO.L

2 I

ESS X XO.L

3 I

ESS X XO.L

4 I

ESS X XO.L

5 I

ESS X XO.L

6 I

ESS X XOLX

7 I

ESS X XOLL

8 I

ESS X XOLL

9 I

ESS X XOLL

10 I

ESS X XOLL

11 I

ESS X XOLL

12 I

ESS X XOLL

13 I

ESS X XLLX

14 I

ESS X OLLX

15 I

ESS X OLLL

16 I

ESS X LLLL

17 I

ESS X LLLL

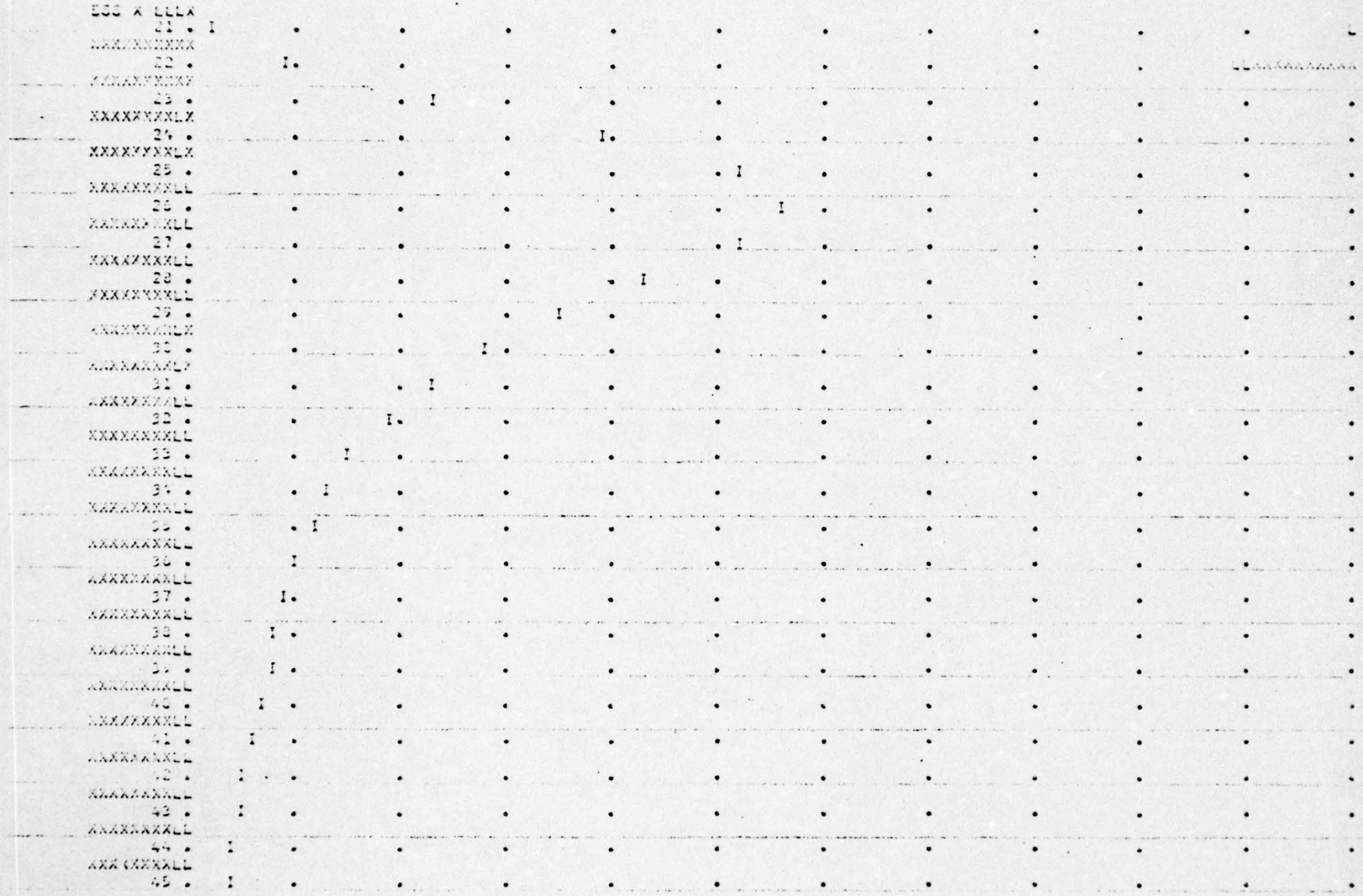
18 I

ESS X LLLL

19 I

ESS X LLLX

20 I



HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	1	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE	0.	11364.	22945.	34744.	46721.	46756.	52847.	58992.	65191.	71444.
OUTFLOW	0.	7250.	21760.	41191.	61857.	68357.	76600.	88544.	102182.	116396.

TIME	LOP STOR	AVG IN	LOP OUT
1	522.	568.	533.
2	515.	516.	531.
3	507.	498.	504.
4	491.	454.	513.
5	474.	427.	501.
6	449.	404.	487.
7	425.	382.	471.
8	400.	363.	456.
9	375.	346.	440.
10	351.	331.	424.
11	326.	318.	408.
12	303.	305.	393.
13	280.	94.	179.
14	258.	85.	165.
15	236.	76.	152.
16	217.	68.	139.
17	201.	61.	128.
18	184.	55.	117.
19	173.	72.	111.
20	188.	175.	120.
21	432.	1139.	269.
22	1678.	9787.	1071.
23	5205.	13421.	3321.
24	11626.	31347.	7578.
25	19770.	48530.	17782.
26	27370.	54061.	29033.
27	32570.	54277.	37578.
28	34671.	47780.	41031.
29	34298.	39222.	40419.
30	32503.	31703.	37469.

31	30084.	25626.	33460.
32	27439.	20714.	29149.
33	24884.	16743.	24917.
34	22821.	14021.	21354.
35	20699.	12394.	18945.
36	19015.	11105.	16837.
37	17527.	9940.	14986.
38	16235.	8914.	13353.
39	15082.	7987.	11910.
40	14062.	7156.	10631.
41	13157.	6411.	9497.
42	12352.	5744.	8488.
43	11635.	5147.	7589.
44	10970.	4611.	6798.
45	10311.	4131.	6078.
SUM			454656.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	41031.	40725.	34135.	18750.	454656.
INCHES		1.02	3.41	5.63	5.68
AC-FT		20205.	67741.	111627.	112763.

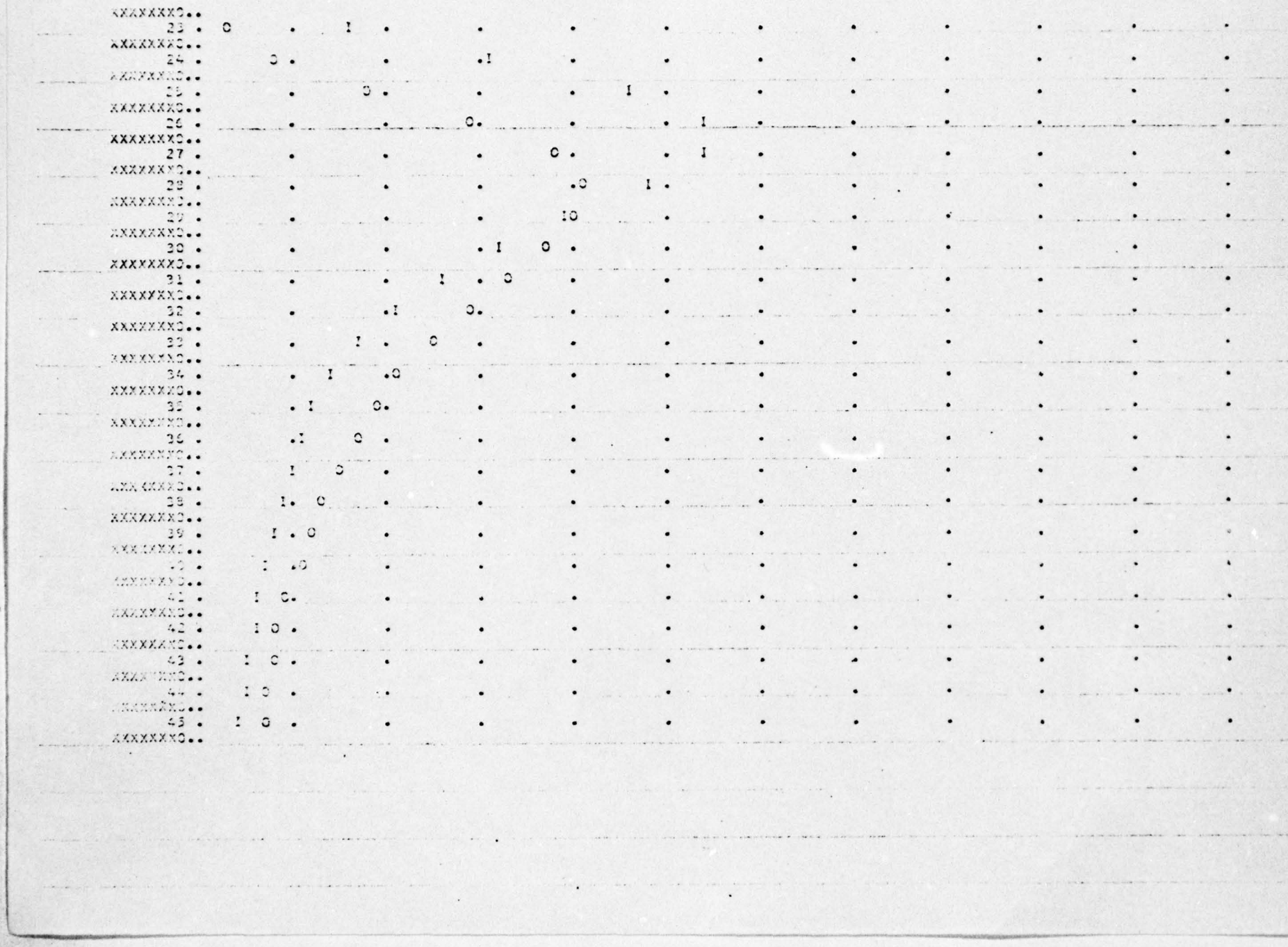
CVF

STATION 2

INFLOW I , OUTFLOW O AND OBSERVED FLOW *

0. 10000. 20000. 30000. 40000. 50000. 60000. 0. 0. 0. 0. 0.

XXXXXXXO.
1 I
XXXXXXXO..
2 I
XXXXXXXO..
3 I
XXXXXXXO..
4 I
XXXXXXXO..
5 I
XXXXXXXO..
6 I
XXXXXXXO..
7 I
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8 I
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17 I
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18 I
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19 I
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20 I
XXXXXXXO..
21 OI
XXXXXXXO..
22 .O I



RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	56375.	54277.	41225.	20320.	372.00
ROUTED TO	2	41031.	40725.	34135.	18790.	372.00

APPENDIX C

PHOTOGRAPHS

Photograph Index

1. Upstream slope form left abutment looking toward spillway weir.

2. Downstream slope from right abutment.

3. Side channel weir and emergency spillway.

4 & 5. Emergency spillway exit channel and inclined tunnel.

6. End of emergency spillway exit channel and stilling basin. End of 40 foot diameter tunnel is below water level.

7. Downstream exposure from top of dam.

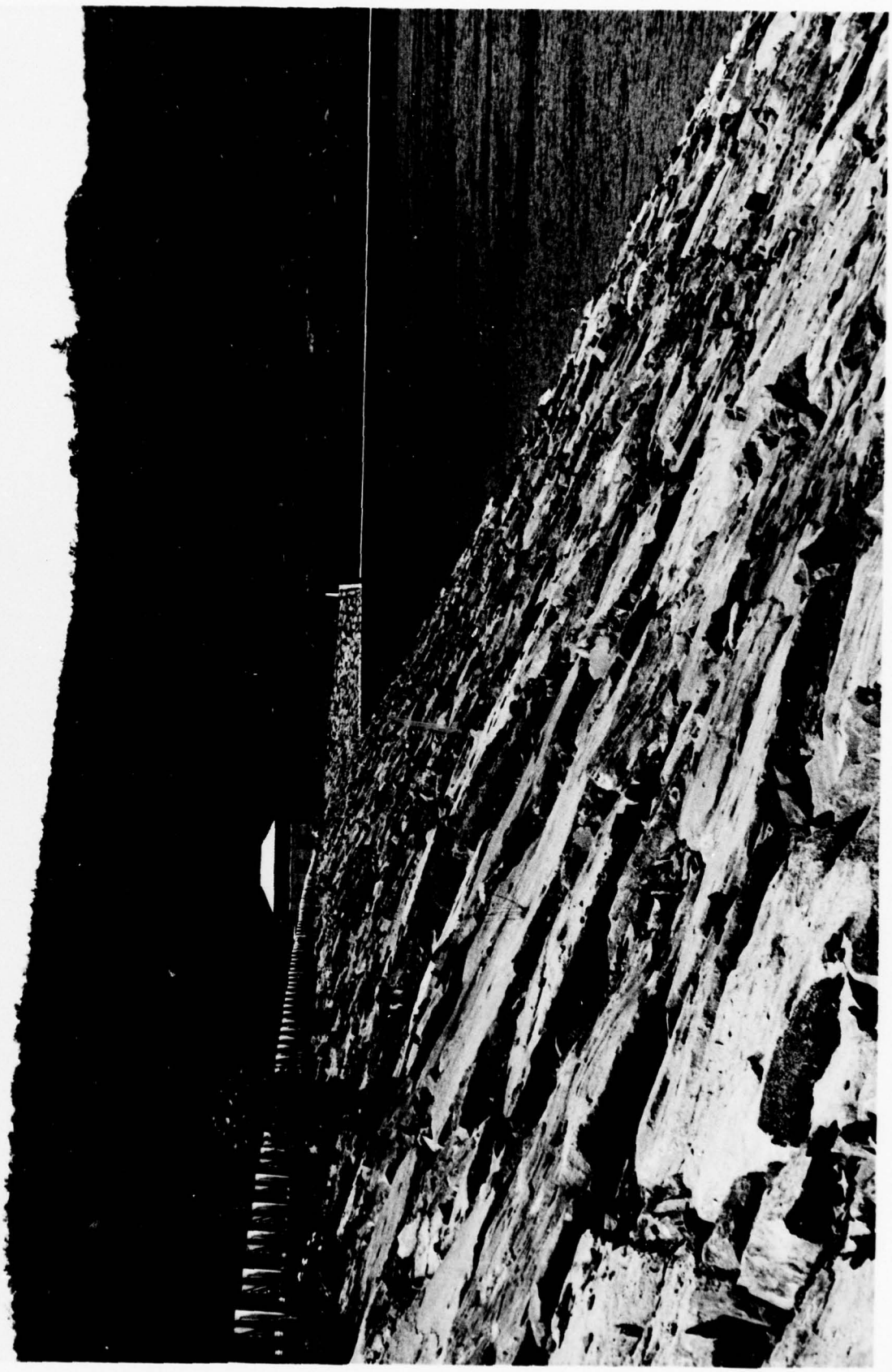


PLATE 1



PLATE 3

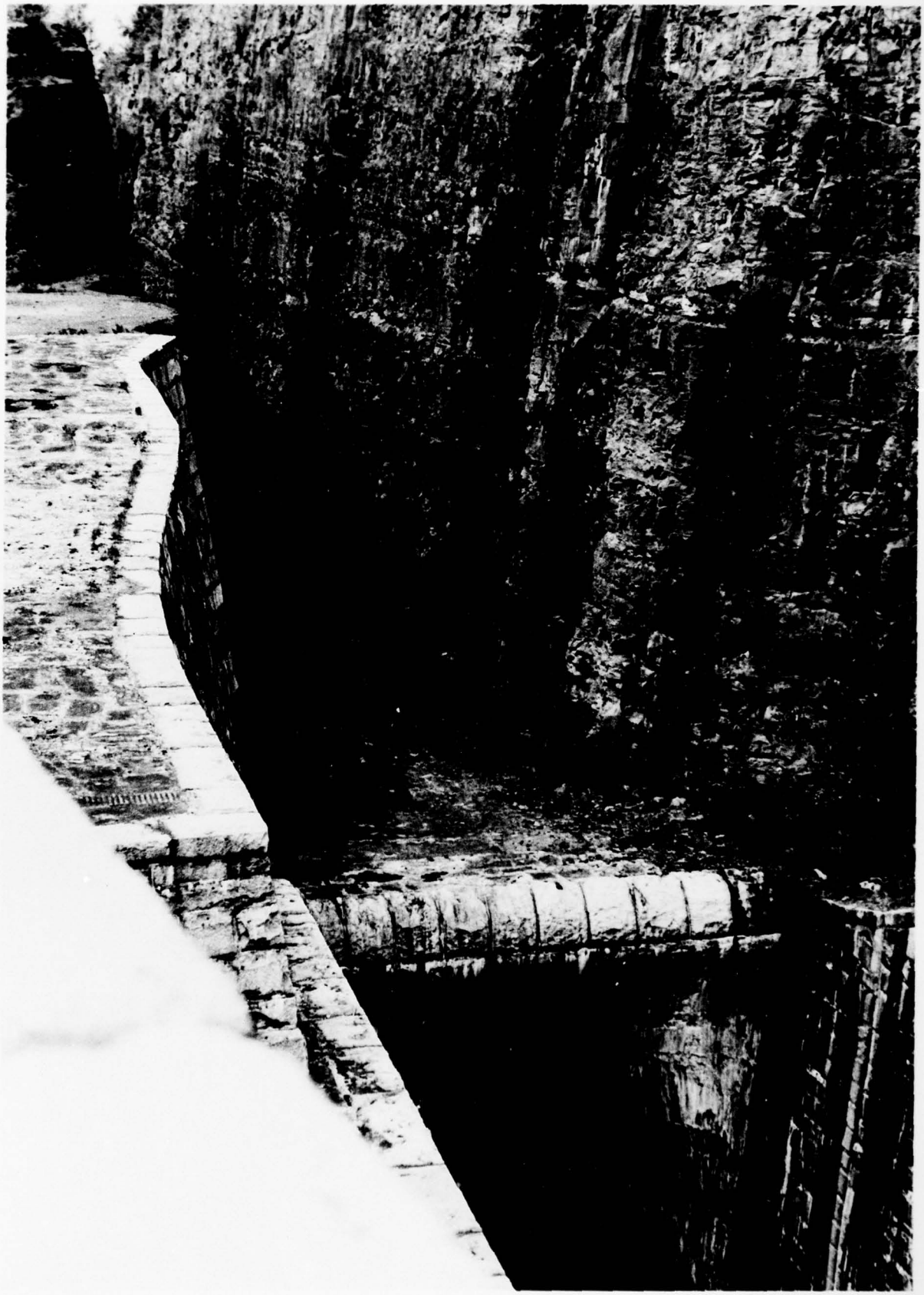


PLATE 5

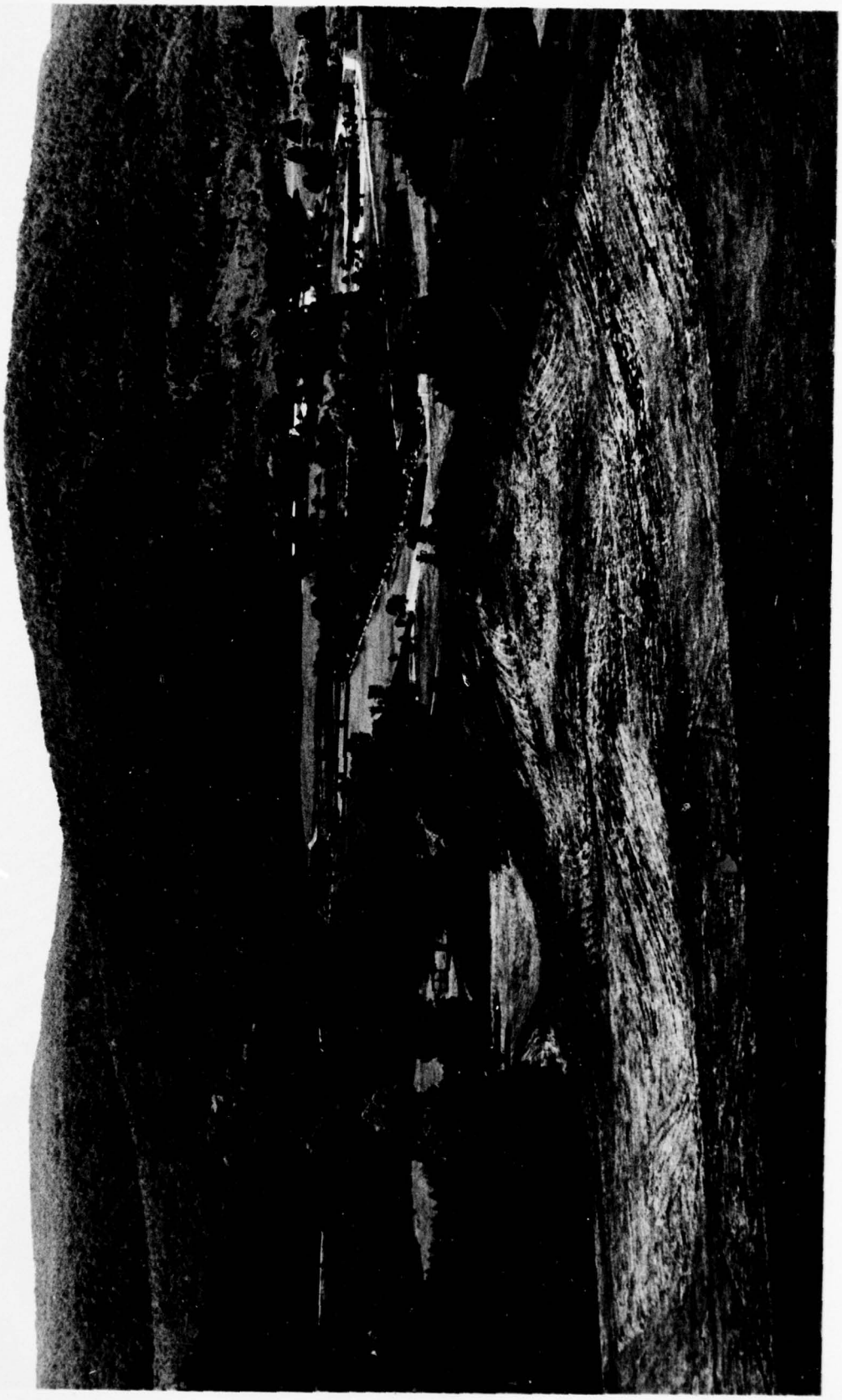


PLATE 7

APPENDIX D

PERTINENT CORRESPONDENCE AND REPORTS

Form E-61. 6-1-49-500 (91)-116)
Ord. 7-05-9

STATE OF NEW YORK

DEPARTMENT OF PUBLIC WORKS

ALBANY

Received May 10, 1950 Dam No. 146-1429

Disposition Watershed Delaware Riv. plotted

Foundation inspected

Structure inspected

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the Superintendent of Public Works, Albany, N. Y., in compliance with the provisions of Section 948 of the Conservation Law (see third page of this application) for the approval of specifications and detailed drawings, marked for the construction of the Downsville dam and appurtenant works.

herewith submitted for the { construction / ~~reconstruction~~ } of a dam herein described. All provisions of law will be complied with in the erection of the proposed dam. It is intended to complete the work covered by the application about August, 1954
(Date)

1. The dam will be on East Branch of the Delaware River flowing into Delaware River in the town of Colchester County of Delaware and about one mile upstream from the Village of Downsville
(Give exact distance and direction from a well-known bridge, dam, village main cross-roads or mouth of a stream)
2. Location of dam is shown on the Andes quadrangle of the United States Geological Survey.
3. The name of the owner is The City of New York
4. The address of the owner is New York, New York
5. The dam will be used for Water Supply
6. Will any part of the dam be built upon or its ~~pond~~ reservoir flood any State lands? No
7. The watershed above the proposed dam is 372 square miles.
8. The proposed dam will create a ~~pond~~ reservoir area at the spillcrest elevation of 5,700 acres and will impound 20 billion cubic feet of water.

to the superintendent of public works who shall thereupon pay the same into the state treasury. Any amount so levied shall thereupon become and be a lien upon the real property affected thereby, to the same extent as any tax levy becomes and is a lien thereon.

Any person in interest may, within thirty days from the service of any such order, appeal to the supreme court to determine the reasonableness of such order. At any time during such appeal to the supreme court upon at least three days' notice, the party appealing may apply for an order directing any question of fact to be tried and determined by a jury, and the court shall thereupon cause such question to be stated for trial accordingly and the findings of the jury upon such question shall be conclusive. Appeals may be taken from the supreme court to the appellate division of the supreme court and to the court of appeals in such cases, subject to the limitations provided in the civil practice act.

This section shall not apply to a dam where the area draining into the pond formed thereby does not exceed one square mile, unless the dam is more than ten feet in height above the natural bed of the stream at any point or unless the quantity of water which the dam impounds exceeds one million gallons; nor to a dock, pier, wharf or other structure under the jurisdiction of the department of docks, if any, in a city of over one hundred and seventy-five thousand population. This section as hereby amended shall not impair the effect of an order heretofore made by the conservation commission or commissioner under this section prior to the taking effect of chapter four hundred and ninety-nine of the laws of nineteen hundred and twenty-one, nor require the approval by the superintendent of public works, of plans and specifications theretofore approved by such commission or comissioner under this section.

The foregoing information is correct to the best of my knowledge and belief, and the construction will be carried out in accordance with the approved plans and specifications.

THE CITY OF NEW YORK, Owner

By Richard K. Deuel, authorized agent of owner.

Secretary, Board of Water Supply

Address of signer 120 Wall Street, New York 5, New York Date May 9, 1950

INSTRUCTIONS

Read carefully on the third page of this application the law setting forth the requirements to be complied with in order to construct or reconstruct a dam.

Each application for the construction or reconstruction of a dam must be made on this standard form, copies of which will be furnished upon request to the Department of Public Works, Albany, N. Y. The application must be accompanied by three sets of plans, and specifications. The information furnished must be in sufficient detail in order that the stability and safety of the dam can be determined. In cases of large and important dams assumptions made in calculating stresses and stability should be given.

Samples of materials to be used in the dam and of the material on which the dam is to be founded may be asked for, but need not be furnished unless requested.

If the dam constitutes a part of a public water supply, application should be made to the Water Power and Control Commission under Article XI of the Conservation Law.

An application for the construction or reconstruction of a dam must be signed by the prospective owner of the dam or his duly authorized agent. The address of the signer and the date must be given as provided for on the last page of the application form.

SECTION 948 OF THE CONSERVATION LAW

§ 948. Structures for impounding water; inspection of docks; penalties. No structure for impounding water and no dock, pier, wharf or other structure used as a landing place on waters shall be erected or reconstructed by any public authority or by any private person or corporation without notice to the superintendent of public works, nor shall any such structure be erected, reconstructed or maintained without complying with such conditions as the superintendent of public works may by order prescribe for safeguarding life or property against danger therefrom. No order made by the superintendent of public works shall be deemed to authorize any invasion of any property rights, public or private, by any person in carrying out the requirements of such order. The superintendent of public works shall have power, whenever in his judgment public safety shall so require, to make and serve an order, setting forth therein his findings of fact and his conclusions therefrom, directing any person, corporation, officer or board, constructing, maintaining or using any structure hereinbefore referred to, either remove the said structure or to repair or reconstruct the same within such reasonable time and in such manner as shall be specified in such order, and it shall be the duty of every such person, corporation, officer or board, to obey, observe and comply with such order and with the conditions prescribed by the superintendent of public works for safeguarding life or property against danger therefrom, and every person, corporation, officer or board failing, omitting or neglecting so to do, or who hereafter erects or reconstructs any such structure hereinbefore referred to without submitting to the superintendent of public works and obtaining his approval of plans and specifications for such structures when required so to do by his order or hereafter fails to remove, erect or to reconstruct the same in accordance with the plans and specifications so approved shall forfeit to the people of this State a sum not to exceed five hundred dollars to be fixed by the court for each and every offense; every violation of any such order shall be a separate and distinct offense, and, in such case of a continuing violation, every day's continuance thereof shall be and be deemed to be a separate and distinct offense. Such order shall not contain any provision to compel the owner to make repairs or proceed with reconstruction as specified in this section by any type of construction other than that of the dam itself. In addition to said forfeiture upon the violation of any such order, the superintendent of public works shall have power to enter upon the lands and waters where such structures are located, for the purpose of removing, repairing or reconstructing the same, and to take such other and further precautions which he may deem necessary to safeguard life or property against danger therefrom. In removing, repairing and reconstructing such dam the superintendent shall not deviate from the method, manner or specifications contained in the original order. The superintendent of public works shall certify the amount of the costs and expenses incurred by him for the removal, repair or reconstruction aforesaid, or in anywise connected therewith, to the board of supervisors of the county or counties in which the said lands and waters are located, whereupon it shall be the duty of such board of supervisors to add the amount so certified to the assessment rolls of such locality or localities as a charge against the real property upon which the dam is located designated or described by the superintendent of public works as chargeable therewith, and to issue its warrant or warrants for the collection thereof. Thereupon it shall become the duty of such locality or localities through their proper officers to collect the amount so certified in the same manner as other taxes are collected in such locality or localities, and when collected to pay the same

9. The maximum height of the proposed dam above the bed of the stream is 204 feet 0 inches.

10. The lowest part of the natural shore of the pond is Reservoir at the dam elevation is 2[illegible] feet vertically above the spillcrest, and everywhere else the shore will be at least 21 feet above the spillcrest.

11. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam Dam is designed against any possible failure

12. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) Sand, gravel and boulders. Concrete cut-off wall constructed to bed rock (sandstone).

13. Facing downstream, what is the nature of material composing the right bank? Same as No. 12

14. Facing downstream, what is the nature of the material composing the left bank? Same as No. 12

15. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing effect of exposure to air and to water, uniformity, etc. Rock not water-bearing. Overburden partly pervious but seepage prevented by concrete cut-off wall sealed to rock.

16. Are there any porous seams or fissures beneath the foundation of the proposed dam? None indicated by borings.

17. WASTES. The spillway of the above proposed dam will be 800 feet long in the clear; the waters will be held at the right end by a See Sheet 13, Acc. 66833 and Sheet 14, Acc. 66849 of contract drawings. the top of which will be feet above the spillcrest, and have a top width of feet; and at the left end by a the top of which will be feet above the spillcrest, and have a top width of feet.

18. The spillway is designed to safely discharge 200,000 cubic feet per second.

19. Pipes, sluice gates, etc., for flood discharge will be provided through the dam as follows: None provided

20. What is the maximum height of flash boards which will used on this dam? None

21. APRON. Below the proposed dam there will be an apron built of None feet long across the stream, feet wide and feet thick.

22. Does this dam constitute any part of a public water supply? Yes

Form E-61. 6-1-49-500 (9D-116)
Ord. 7-05-9

STATE OF NEW YORK

DEPARTMENT OF PUBLIC WORKS

ALBANY

Received May 10, 1950 Dam No. 146-1429

Disposition Watershed Delaware River plotted

Foundation inspected

Structure inspected

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the Superintendent of Public Works, Albany, N. Y., in compliance with the provisions of Section 948 of the Conservation Law (see third page of this application) for the approval of specifications and detailed drawings, marked for the construction of the Downsville dam and appurtenant works.

herewith submitted for the { construction / ~~reconstruction~~ } of a dam herein described. All provisions of law will be complied with in the erection of the proposed dam. It is intended to complete the work covered by the application about August, 1954 (Date)

1. The dam will be on East Branch of the Delaware River flowing into Delaware River in the town of Colchester County of Delaware and about one mile upstream from the Village of Downsville
(Give exact distance and direction from a well-known bridge, dam, village main cross-roads or mouth of a stream)
2. Location of dam is shown on the Andes quadrangle of the United States Geological Survey.
3. The name of the owner is The City of New York
4. The address of the owner is New York, New York
5. The dam will be used for Water Supply reservoir
6. Will any part of the dam be built upon or its pond flood any State lands? No
7. The watershed above the proposed dam is 372 square miles.
8. The proposed dam will create a reservoir pond area at the spillcrest elevation of 5,700 acres and will impound 20 billion cubic feet of water.

to the superintendent of public works who shall thereupon pay the same into the state treasury. Any amount so levied shall thereupon become and be a lien upon the real property affected thereby, to the same extent as any tax levy becomes and is a lien thereon.

Any person in interest may, within thirty days from the service of any such order, appeal to the supreme court to determine the reasonableness of such order. At any time during such appeal to the supreme court upon at least three days' notice, the party appealing may apply for an order directing any question of fact to be tried and determined by a jury, and the court shall thereupon cause such question to be stated for trial accordingly and the findings of the jury upon such question shall be conclusive. Appeals may be taken from the supreme court to the appellate division of the supreme court and to the court of appeals in such cases, subject to the limitations provided in the civil practice act.

This section shall not apply to a dam where the area draining into the pond formed thereby does not exceed one square mile, unless the dam is more than ten feet in height above the natural bed of the stream at any point or unless the quantity of water which the dam impounds exceeds one million gallons; nor to a dock, pier, wharf or other structure under the jurisdiction of the department of docks, if any, in a city of over one hundred and seventy-five thousand population. This section as hereby amended shall not impair the effect of an order heretofore made by the conservation commission or commissioner under this section prior to the taking effect of chapter four hundred and ninety-nine of the laws of nineteen hundred and twenty-one, nor require the approval by the superintendent of public works, of plans and specifications theretofore approved by such commission or comissioner under this section.

The foregoing information is correct to the best of my knowledge and belief, and the construction will be carried out in accordance with the approved plans and specifications.

THE CITY OF NEW YORK
, Owner

By Leonard A. Lucke, ~~authorized~~ agent of owner.

Secretary, Board of Water Supply
Address of signer 120 Wall Street, New York 5, New York Date May 9, 1950

INSTRUCTIONS

Read carefully on the third page of this application the law setting forth the requirements to be complied with in order to construct or reconstruct a dam.

Each application for the construction or reconstruction of a dam must be made on this standard form, copies of which will be furnished upon request to the Department of Public Works, Albany, N. Y. The application must be accompanied by three sets of plans, and specifications. The information furnished must be in sufficient detail in order that the stability and safety of the dam can be determined. In cases of large and important dams assumptions made in calculating stresses and stability should be given.

Samples of materials to be used in the dam and of the material on which the dam is to be founded may be asked for, but need not be furnished unless requested.

If the dam constitutes a part of a public water supply, application should be made to the Water Power and Control Commission under Article XI of the Conservation Law.

An application for the construction or reconstruction of a dam must be signed by the prospective owner of the dam or his duly authorized agent. The address of the signer and the date must be given as provided for on the last page of the application form.

SECTION 948 OF THE CONSERVATION LAW

§ 948. Structures for impounding water; inspection of docks; penalties. No structure for impounding water and no dock, pier, wharf or other structure used as a landing place on waters shall be erected or reconstructed by any public authority or by any private person or corporation without notice to the superintendent of public works, nor shall any such structure be erected, reconstructed or maintained without complying with such conditions as the superintendent of public works may by order prescribe for safeguarding life or property against danger therefrom. No order made by the superintendent of public works shall be deemed to authorize any invasion of any property rights, public or private, by any person in carrying out the requirements of such order. The superintendent of public works shall have power, whenever in his judgment public safety shall so require, to make and serve an order, setting forth therein his findings of fact and his conclusions therefrom, directing any person, corporation, officer or board, constructing, maintaining or using any structure hereinbefore referred to, either remove the said structure or to repair or reconstruct the same within such reasonable time and in such manner as shall be specified in such order, and it shall be the duty of every such person, corporation, officer or board, to obey, observe and comply with such order and with the conditions prescribed by the superintendent of public works for safeguarding life or property against danger therefrom, and every person, corporation, officer or board failing, omitting or neglecting so to do, or who hereafter erects or reconstructs any such structure hereinbefore referred to without submitting to the superintendent of public works and obtaining his approval of plans and specifications for such structures when required so to do by his order or hereafter fails to remove, erect or to reconstruct the same in accordance with the plans and specifications so approved shall forfeit to the people of this State a sum not to exceed five hundred dollars to be fixed by the court for each and every offense; every violation of any such order shall be a separate and distinct offense, and, in such case of a continuing violation, every day's continuance thereof shall be and be deemed to be a separate and distinct offense. Such order shall not contain any provision to compel the owner to make repairs or proceed with reconstruction as specified in this section by any type of construction other than that of the dam itself. In addition to said forfeiture upon the violation of any such order, the superintendent of public works shall have power to enter upon the lands and waters where such structures are located, for the purpose of removing, repairing or reconstructing the same, and to take such other and further precautions which he may deem necessary to safeguard life or property against danger therefrom. In removing, repairing and reconstructing such dam the superintendent shall not deviate from the method, manner or specifications contained in the original order. The superintendent of public works shall certify the amount of the costs and expenses incurred by him for the removal, repair or reconstruction aforesaid, or in anywise connected therewith, to the board of supervisors of the county or counties in which the said lands and waters are located, whereupon it shall be the duty of such board of supervisors to add the amount so certified to the assessment rolls of such locality or localities as a charge against the real property upon which the dam is located designated or described by the superintendent of public works as chargeable therewith, and to issue its warrant or warrants for the collection thereof. Thereupon it shall become the duty of such locality or localities through their proper officers to collect the amount so certified in the same manner as other taxes are collected in such locality or localities, and when collected to pay the same

9. The maximum height of the proposed dam above the bed of the stream is 204 feet 0 inches.

10. The lowest part of the natural shore of the pond is reservoir at the dam abutments is 24 feet vertically above the spillcrest, and everywhere else the shore will be at least 24 feet above the spillcrest.

11. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam Dam is designed against any possible failure

12. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) Sand, gravel and boulders. Concrete cut-off wall constructed to bed rock (sandstone).

13. Facing downstream, what is the nature of material composing the right bank? Same as No. 12

14. Facing downstream, what is the nature of the material composing the left bank? Same as No. 12

15. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing effect of exposure to air and to water, uniformity, etc. Rock not water-bearing. Overburden partly pervious but seepage prevented by concrete cut-off wall sealed to rock.

16. Are there any porous seams or fissures beneath the foundation of the proposed dam? None indicated by borings.

17. WASTES. The spillway of the above proposed dam will be 800 feet long in the clear; the waters will be held at the right end by a See Sheet 13, Acc. 66833 and the top of which will be Sheet 14, Acc. 66849 of contract drawings. feet above the spillcrest, and have a top width of feet; and at the left end by a the top of which will be feet above the spillcrest, and have a top width of feet.

18. The spillway is designed to safely discharge 200,000 cubic feet per second.

19. Pipes, sluice gates, etc., for flood discharge will be provided through the dam as follows: None provided

20. What is the maximum height of flash boards which will used on this dam? None

21. APRON. Below the proposed dam there will be an apron built of None feet long across the stream, feet wide and feet thick.

22. Does this dam constitute any part of a public water supply? Yes

DEC DAM INSPECTION REPORT Pepacton Reservoir

05	13	50	1429	110172	123	2
RB	CTY	YR. AP.	DAM NO.	INS. DATE	USE	TYPE

AS BUILT INSPECTION

- [1] Location of Spillway and outlet
- [1] Size of Spillway and outlet
- [1] Elevations
- [1] Geometry of Non-overflow section

[1] GENERAL CONDITION OF NON-OVERFLOW SECTION

- [1] Settlement
- [1] Joints
- [1] Undermining
- [1] Downstream Slope
- [1] Cracks
- [1] Surface of Concrete
- [1] Settlement of Embankment
- [1] Upstream Slope
- [1] Deflections
- [1] Leakage
- [1] Crest of Dam
- [1] Toe of Slope

[1] GENERAL CONDITION OF SPILLWAY AND OUTLET WORKS

- [1] Auxiliary Spillway
- [1] Joints
- [1] Mechanical Equipment
- [1] Service or Concrete Spillway
- [1] Surface of Concrete
- [1] Plunge Pool
- [1] Stilling Basin
- [1] Spillway Toe
- [1] Drain

- [1] Maintenance
- [3] Evaluation
- [C] Hazard Class
- [3] Inspector

COMMENTS:

extremely large structure.
good condition - well maintained
N.Y.C. Water Supply

DEC DAM INSPECTION REPORT

RB	CTY	YR. AP.	DAM NO.	INS. DATE	USE	TYPE
25	13	69	2589	10/72	003	1

AS BUILT INSPECTION

- [1] Location of Spillway and outlet
- [1] Elevations
- [1] Size of Spillway and outlet
- [1] Geometry of Non-overflow section

[1] GENERAL CONDITION OF NON-OVERFLOW SECTION

- [1] Settlement
- [1] Cracks
- [1] Deflections
- [1] Joints
- [1] Surface of Concrete
- [1] Leakage
- [1] Undermining
- [1] Settlement of Embankment
- [1] Crest of Dam
- [1] Downstream Slope
- [1] Upstream Slope
- [1] Toe of Slope

[4] GENERAL CONDITION OF SPILLWAY AND OUTLET WORKS

- [4] Auxiliary Spillway
- [1] Service or Concrete Spillway
- [1] Stilling Basin
- [1] Joints
- [1] Surface of Concrete
- [1] Spillway Toe
- [1] Mechanical Equipment
- [1] Plunge Pool
- [1] Drain

- [1] Maintenance
- [C] Hazard Class
- [3] Evaluation
- [03] Inspector

COMMENTS:

Big Job!

CONTRACT 401

BOARD OF WATER SUPPLY

OF THE

CITY OF NEW YORK

Information for Bidders, Forms of Bid, Contract, Bond and Certificates, Specifications and Drawings

FOR THE CONSTRUCTION OF THE

DOWNSVILLE DAM

AND

APPURTENANT WORKS

IN THE

TOWN OF COLCHESTER, DELAWARE COUNTY, NEW YORK

1950

Administrative Code of The City of New York, and such bidder will also be liable to pay to The City, on demand, the excess cost of the work, based on the contract prices for which the work shall subsequently be relet, including the cost of re-letting and less the amount of such deposit. If the said bidder to whom the contract is awarded shall execute the contract and furnish the said security within the time aforesaid, the amount of his deposit will be returned to him.

Approximate quantities.

Statement of Quantities.—The following is a statement, based upon the estimate of the Engineer, of the quantities of the various items of work, and of the nature and extent, as nearly as practicable, of the work required; the several bids will be computed, tested and canvassed by the quantities and kinds of work mentioned in this statement, viz.:

APPROXIMATE STATEMENT OF QUANTITIES

ITEM 1.	Borings	18,000 linear feet.

OPEN CUT ITEMS

ITEM 2.	Stream control	Lump sum.
ITEM 3.	Removal of soil	9,000 cubic yards.
ITEM 4.	Earth excavation	175,000 cubic yards.
ITEM 5.	Rock excavation in open cut	560,000 cubic yards.
ITEM 6.	Preparation of rock surfaces	2,000 square yards.
ITEM 7.	Rolled embankment, Class A	1,950,000 cubic yards.
ITEM 8.	Rolled embankment, Class B	4,750,000 cubic yards.
ITEM 9.	Refilling and embanking	550,000 cubic yards.
ITEM 10.	Rock embanking	1,050,000 cubic yards.
ITEM 11.	Surface dressing and grassing	100,000 cubic yards.
ITEM 12.	Timber and lumber in open cut	100 M feet B.M.
ITEM 13.	Concrete masonry in open cut	80,000 cubic yards.
ITEM 14.	Dry rubble masonry and paving	36,000 cubic yards.
ITEM 15.	Rubble paving in mortar	4,700 cubic yards.
ITEM 16.	Stone masonry in mortar	150 cubic yards.
ITEM 17.	Stone facing in mortar	14,000 cubic yards.
ITEM 18.	Granite coping, trim and curb	2,000 cubic yards.
ITEM 19.	Brick facing masonry	140 cubic yards.

ITEM 20.	Brick backing masonry	140 cubic yards.
ITEM 21.	Roof of superstructure of release water chamber	325 square yards.
ITEM 22.	Concrete pavement	300 cubic yards.
ITEM 23.	Bituminous macadam pavement	1,100 cubic yards.
ITEM 24.	Bituminous material	19,000 gallons.
ITEM 25.	Run of bank gravel	2,000 cubic yards.
ITEM 26.	Structural steel	150,000 pounds.

SHAFT AND TUNNEL ITEMS

ITEM 27.	Sinking shaft	4,200 cubic yards.
ITEM 28.	Excavation of tunnel	5,900 cubic yards.
ITEM 29.	Enlargements of shaft and tunnel	200 cubic yards.
ITEM 30.	Protective coatings of cement mortar	200 cubic yards.
ITEM 31.	Structural steel support in shaft and tunnel	200,000 pounds.
ITEM 32.	Timbering in shaft and tunnel	20 M feet B.M.
ITEM 33.	Steel interlinings	350,000 pounds.
ITEM 34.	Forms for masonry linings of shaft	150 linear feet of shaft.
ITEM 35.	Forms for masonry linings of valve and stilling chambers	130 linear feet of chamber.
ITEM 36.	Forms for masonry lining of release water tunnel	350 linear feet of tunnel.
ITEM 37.	Forms for masonry lining of inclined tunnel	180 linear feet of tunnel.
ITEM 38.	Concrete masonry in shaft	2,850 cubic yards.
ITEM 39.	Concrete masonry in tunnels	17,500 cubic yards.
ITEM 40.	Excess concrete masonry	500 cubic yards.

GENERAL ITEMS

ITEM 41.	Pumping	100,000 million foot-gallons.

ITEM 42.	Drilling holes in rock or masonry.....	2,500 linear feet.
ITEM 43.	Steel pipes for grouting.....	6,000 linear feet.
ITEM 44.	Making connections for grouting.....	800 connections.
ITEM 45.	Sand for filters, grout and protective coatings of cement mortar.....	700 cubic yards.
ITEM 46.	Mixing and placing grout.....	6,000 cubic yards.
ITEM 47.	Portland cement	210,000 barrels.
ITEM 48.	Crushed stone and gravel.....	1,300 cubic yards.
ITEM 49.	Vitrified, asbestos cement and reinforced concrete culvert pipes.....	27,000 linear feet.
ITEM 50.	Steel for reinforcing concrete.....	300,000 pounds.
ITEM 51.	Cast iron and steel pipes and fittings.....	50,000 pounds.
ITEM 52.	Miscellaneous cast iron, wrought iron and steel	220,000 pounds.
ITEM 53.	Bronze pipe castings.....	130,000 pounds.
ITEM 54.	Miscellaneous bronze, brass, copper, lead and monel metal	18,000 pounds.
ITEM 55.	Articles of aluminum.....	14,000 pounds.
ITEM 56.	Caring for, installing and testing equipment and metal work furnished by The City....	210,000 pounds.
ITEM 57.	Chlorination	250 chlorinator-months.
ITEM 58.	Liquid chlorine	350,000 pounds.
ITEM 59.	Passenger elevator	Lump sum.
ITEM 60.	Sanitary services	Lump sum.
ITEM 61.	Cleaning up	Lump sum.

Basis for comparing bids.

The quantities under Item 1 and Items 3 to 58, inclusive, are approximate only, being estimated by the Engineer and given as a basis for the uniform comparison of bids, and the Board does not expressly or by implication agree that the actual amount of work will correspond therewith.

Bidders are required to submit their estimates upon the following express conditions, which shall apply to, and become part of, every bid received, viz.:

Uncertainty in some quantities.

Attention is called to the uncertainty in the quantities of some of the kinds of work involved, where such quantities depend upon the nature and quality of the

materials encountered, which cannot be determined in advance. Generally, the intention has been to estimate all quantities liberally.

Prices not changed by change of quantities.

An increase or decrease in the quantity for any item shall not be regarded as a sufficient ground for an increase or decrease in the price, nor in the time allowed for the completion of the work, except as provided in the contract.

Bidders must satisfy themselves as to accuracy of approximate quantities.

Bidders must satisfy themselves, by personal examination of the location of the proposed work and by such other means as they may prefer, as to the actual conditions and requirements of the work and the accuracy of the foregoing estimate of the Engineer, and shall not, at any time after the submission of a bid, dispute or complain of such statement or estimate of the Engineer, nor assert that there was any misunderstanding in regard to the nature or amount of the work to be done.

Balanced bidding.

The excavation, masonry and other parts of the work have been divided into classes and items in order to enable the bidder to bid for the different portions of the work in accordance with his estimate of their costs, so that in the event of an increase or decrease in the quantity of any particular item of work, the actual quantity executed may be paid for at the price bid for that particular item.

Bidders referred to laws.

The attention of bidders is especially called to the provisions of Chapter 41, Title K, of the Administrative Code of The City of New York, as to the letting of contracts and payment for work; to the Labor Law and to the rules relating to mines and quarries, tunnel construction and control of silica dust in rock drilling promulgated thereunder by the Board of Standards and Appeals of the New York State Department of Labor; to the Workmen's Compensation Law; to the Public Health Law, and to Sections 734(1)-2.0 and 734(1)-2.1 of the Administrative Code of The City of New York.

No bid withdrawn.

No bid from person in arrears to City.

No bid will be allowed to be withdrawn, for any reason whatever, within 45 days after it has been deposited with the Board of Water Supply. No bid will be accepted from, nor contract awarded to, any person who is in arrears to The City of New York, upon debt or contract, or who is in default, as surety or otherwise, upon any obligation to The City of New York.

Bidder's ability.

Statement of qualifications and financial condition.

Before the award of the contract, any bidder may be required to show that he has the necessary facilities, experience, ability and financial resources to perform the work in a satisfactory manner and within the time stipulated, and that he has had experience in constructing works of the same nature. Any bidder may be required, after the opening of bids, to fill in, upon the blank form to be furnished by the Board to the bidder, a statement of the then existing qualifications and financial condition of the bidder, and also to submit the bidder's last financial statement prepared and certified to by a certified public accountant and sworn to by the bidder.

tests, the Contractor will be required to make tight or otherwise acceptably repair any leaky or otherwise defective work for which he may be accountable. The Contractor will not be required to unwater any portion of the work flooded in consequence of making such tests or placing the structures in service. During the course of the work, the Contractor will be required to test such valves, pipes, drains, stop shutters and other appurtenances as may be ordered, and he shall do any unwatering as may be required in connection therewith. Work done in connection with any of the testing or unwatering required by this section, which may be properly classified under any appropriate item, shall be estimated for payment under such item but all other work which may not be so classified shall be considered as having been included in the prices stipulated for the various items of the contract. The Contractor shall not be entitled to any compensation for delay in completing any portion of the work caused by such testing, except for an extension of time equivalent to the delay.

BORINGS

Item 1

Work included.

Sect. 1.1 Under Item 1 the Contractor shall make borings at such points as may be directed on and in the vicinity of the work of this contract and at other points in the Pepacton reservoir area. Such borings shall comprise the sinking of casings to a satisfactory seat in sound rock and core drilling to such depth as required to determine the depth and character of the earth cover and the character of the bed rock, the sinking of casings for observation purposes and the installation of piezometer tips; the making of vertical, horizontal or inclined core borings in rock or masonry to explore the ground in advance of the excavation, for grouting, to test the masonry or for other purposes. As a part of the work under this item, the Contractor shall recover and preserve, as ordered, the cores and such wash or dry samples of earth and other materials as do not yield cores, shall assist the Engineer in getting necessary measurements, in obtaining knowledge of the materials penetrated and in observing the ground water elevations, and shall satisfactorily restore all structures and areas damaged or disturbed in making the borings.

Borings to be started promptly and prosecuted continuously.

Sect. 1.2 The Contractor shall make satisfactory arrangements to begin promptly, as soon as such work is ordered, all borings that may be required during the existence of this contract, and shall prosecute the work on each boring during at least eight of the 24 hours of every working day until that boring is satisfactorily completed.

No compensation for delays in other operations.

Sect. 1.3 When borings are required that interfere with other work, such other operations shall be suspended or delayed, if necessary, to permit such borings to be satisfactorily and quickly made. The Contractor shall not be entitled to any compensation for such suspensions or delays other than that provided in the prices stipulated for the various items of this contract.

Sinking casings.

SECT. 1.4 Casings for borings shall be sunk vertically from the surface of the ground or excavations in earth, or may be placed at any angle in holes cored from the rock in the shaft, tunnels or other excavations if necessary to case off soft rock. Except as permitted by the Engineer, the diameter of the casings used shall not be less than that which will permit the taking of 1⅝-inch cores when sound rock is reached. Flush joint casings shall be used, if necessary, and reaming of holes shall be done, if ordered, to get the required size of casing to the depth at which the required cores may be drilled. Wash and dry samples shall be taken at the intervals directed. The Contractor shall leave in place any casings for borings which may be so ordered by the Engineer and shall cut off such casings at the elevations directed and thread and cap them as required. Casings not ordered left in place shall be removed and, when ordered, the holes shall be filled with sand as the casings are pulled.

Blasting.

SECT. 1.5 Blasting for the removal of boulders or other obstructions to the sinking of casings will be allowed only at such places and with such charges as will not damage the structures built under this contract or other property.

Core drilling.

SECT. 1.6 All core drilling shall be done with a diamond drill. Such drilling shall be done in the bed rock through casings, or in rock or masonry at ordered locations in the shaft, tunnel or open cut excavations. Large boulders shall also be drilled if they cannot be removed in advance of the casing by blasting or other methods. In bed rock as large a percentage of core as possible shall be recovered. To this end, the Contractor shall use such types of core barrels as ordered or approved and shall regulate the speed of his drill and remove the cores as frequently as directed. Except as otherwise permitted, the size of core shall not be less than 1⅝ inches.

Size of core.

Precautions against inflows of water.

SECT. 1.7 When so ordered, borings in the shaft and tunnels shall be made through plug cocks or valves on pipes set in the rock or concrete to permit inflows of water to be shut off and grouted.

Grouting core borings.

SECT. 1.8 All borings made from the ground that penetrate the rock to depths approaching the grade of the tunnels and, unless otherwise ordered, those near the shaft, of whatever depth, shall be filled with grout to the surface of the rock. Core borings made in the rock from the shaft or tunnels shall be satisfactorily grouted under pressure.

Preservation of samples.

SECT. 1.9 Samples of all materials penetrated by the borings, including rock and masonry cores, fragments of rock, and such wash and dry samples as may be ordered of materials which will not core, shall be preserved in receptacles furnished by the Board, numbered and marked so as to be identified readily and delivered to such place or places as may be ordered.

Measurement and payment.

SECT. 1.10 The quantity to be paid for under Item 1 shall be the number of linear feet of completed borings measured as follows: For surface borings,

the total depth of a boring in linear feet shall be measured from the surface of the ground, or from the bottom of the excavation in earth or rock from which the boring is started, to the elevation of the bottom of the casing or to the cutting edge of the core bit in the bottom of the boring in rock or to the bottom of the lowest piece of core in the core barrel if the entire core is not recovered. For core borings in rock or masonry in the shaft, tunnels or elsewhere, the total depth in linear feet shall be measured from the actual surface of the rock or masonry at which the drilling is started to the cutting edge of the core bit in the bottom or end of the boring, or to the greatest depth or distance from which core is recovered. The price per linear foot stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. Casing ordered left in place, including required cutting, threading and capping, will be paid for under Item 51. Timber and lumber ordered or approved for platforms in the shaft or tunnels shall be paid for under Item 32. If a boring in rock is lost through accident for which the Contractor is not responsible or is necessarily suspended before penetrating to the ordered depth, it shall be paid for only when the usefulness of such boring is, in the opinion of the Engineer, sufficient to warrant such payment. Should any boring be abandoned without the permission of the Engineer, no payment shall be made for any work done by the Contractor on such boring. Grouting without the application of pressure shall be done under Items 45 and 47; grouting under pressure, under Items 43 to 47, inclusive.

OPEN CUT ITEMS

STREAM CONTROL

ITEM 2

Work included.

SECT. 2.1 Under Item 2 the Contractor shall furnish all labor and materials, shall do all work and shall build, maintain and remove, if required, all temporary coffer-dams or other structures necessary for the temporary control of the waters of the East Branch of the Delaware river during the construction of the structures to be built under the other items of this contract. The Contractor shall, under this item, maintain the existing stream control structures and the channels leading thereto, beginning at the time to be designated by the Engineer and continuing until the completion of the work under this contract. The Contractor shall, under the other items of the contract, as far as they are applicable, make any ordered repairs or extensions to such stream control structures, shall remove portions thereof as ordered, shall remove earth and debris from the diversion tunnel and its inlet and outlet channels, shall construct the final closure of the diversion tunnel and shall do such other work within the diversion tunnel and

at the outlet as may be necessary to put all structures in operating condition, but any additional expense occasioned by such work shall be considered as having been included in the price stipulated for this item. Under this item, the Contractor shall submit for approval the scheme he proposes to follow in building the diversion tunnel plug together with detailed working drawings therefor, and he shall not start work on the diversion tunnel bulkhead until such scheme and drawings have been approved by the Engineer, but such approval shall not relieve the Contractor of his responsibility for the successful completion of this work. As a part of the work under this item, the Contractor shall unwater the diversion tunnel, including the stilling basin at its outlet, and shall keep it unwatered, to the extent required, to complete the work to be done in the diversion tunnel and at its outlet. The stop logs, gates on the closure bulkhead and the existing forms for grooves in the lining of the diversion tunnel shall be removed as directed and shall become the property of the Contractor.

Flood flows.

SECT. 2.2 The area of the watershed of the East Branch of the Delaware river above the dam site is about 371 square miles. A stream gaging station at Downsville, about one mile downstream from the dam site has a drainage area of 373 square miles and another at Harvard, about 12 miles further downstream, has a drainage area of 443 square miles. Records have been kept at these stations 8 and 15 years, respectively. The maximum peak flood flow of record at Harvard reached 31,400 cubic feet per second and yearly maximum peaks between 20,000 and 30,000 cubic feet per second have occurred five times. Peak flows of 4,000 cubic feet per second and over may be expected every year at the dam site. The diversion tunnel will accommodate a flow estimated as 40,000 cubic feet per second with the reservoir level at Elevation 1150. The reservoir has a capacity of about one billion cubic feet below Elevation 1150.

Capacity of the diversion tunnel and reservoir.

Responsibility of Contractor.

SECT. 2.3 The Contractor shall assume all risk of damage and delay and every expense of whatever nature which may be caused within the areas allotted for the work of this contract by the waters of the East Branch of the Delaware river due to any inadequacy of the temporary works constructed under this item or of existing works, until the completion of the work. The Contractor shall not place the stop logs or bulkhead to control the flow in the diversion tunnel until written orders therefor are given by the Engineer.

Payment.

SECT. 2.4 For all labor, equipment, materials, expenses and costs necessary to completely perform the work to be done under this item in the manner herein set forth and specified, the Contractor shall receive the lump sum stipulated for Item 2, but no part of this sum shall be paid before the final completion and acceptance of the entire work of this contract. Portions of temporary coffer-dams built by the Contractor and allowed to remain as part of ordered fills and embankments, ordered extensions, changes or repairs of structures built under other contracts, ordered or approved stop logs, tunnel closure bulkhead, all ordered excavation of existing masonry within the tunnel, and construction of the final closure plug therein will be included for payment under the appropriate items of this contract.

REMOVAL OF SOIL

ITEM 3

Work included.

SECT. 3.1 Under Item 3 the Contractor shall remove soil from designated areas, to the depths directed, and shall preserve and keep it separate from other materials for subsequent use for surface dressing under Item 11. Before starting any excavation or embankment, the soil shall be removed from the affected area if ordered by the Engineer and satisfactorily preserved for subsequent use. As a part of the work under this item, the Contractor shall remove and dispose of all trees, shrubs, stumps and roots exceeding one inch in diameter found within the areas from which soil is to be removed and which are not to be cared for as provided in Section 11 and shall do such grubbing as required.

Soil to be replaced.

SECT. 3.2 Should the Contractor fail to keep separate from other materials, any soil ordered removed under this item, or should the Contractor damage or render unfit for cultural purposes any soil within the areas ordered stripped or any soil in storage piles, or should the Contractor dispose of the soil removed under this item, he shall furnish at his own expense, from such areas as the Engineer may designate, an equivalent quantity of satisfactory soil.

Limits of requirements.

SECT. 3.3 Wherever, in the opinion of the Engineer, the soil is too poor in quality to warrant keeping it separate from other excavated materials or is not required for use under Item 11, it will not be ordered removed as soil, but shall be excavated, if required, under Item 4. Excavated soil may be placed directly in its final position, if so permitted; otherwise, it shall be deposited in temporary storage piles and, in any case, it shall be measured for payment in excavation only once, and then in its original position. No payment will be made under this item for removing soil from existing storage piles or from borrow areas for use under Item 11, such work being included under that item.

Measurement and payment.

SECT. 3.4 The quantity to be paid for under Item 3 shall be the number of cubic yards of soil, excavated in accordance with orders, measured in place in its original position before excavation. If any soil removed under this item is stored on lands not the property of The City, a lease of the land on which the soil is stored shall be obtained by the Contractor for the period of the contract and the lease shall be assigned to The City. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified.

EARTH EXCAVATION

ITEM 4

Work included.

SECT. 4.1 Under Item 4 the Contractor shall excavate to the lines ordered or approved, all earth and other materials which may not be properly classified

under Items 3, 5, 27 and 28, for the waste weir; the weir and waste channels; the release water chamber and cut-off wall; the improvement of the river channel; the trenches for the installation of piezometer pipes; the control of springs; brook relocations; ditches, pipes, drains, settling tanks or basins, settlement measurement plates, sewers and sewage disposal plant; fence posts, guard rails and other contract structures, and for grading, test pits, surface drainage and other contract purposes, as ordered. Any ordered excavation of rock spoil deposited under a previous contract and the ordered removal of stone and other walls, of dry rubble retaining walls, of bituminous or water bound macadam, gravel or cinder pavements and of foundations not requiring blasting, barring or wedging, shall be included under Item 4. Under Item 4 the Contractor shall clean out any material that may be deposited in the inlet channel, the diversion tunnel and the stilling basin at its outlet, whenever directed by the Engineer. As a part of the work under this item, the Contractor shall deliver acceptable excavated materials from the excavations made under this item to the sites of refills and embankments or to temporary storage piles, and shall dispose of all excavated materials unsuitable for refill or embankment and all surplus materials as provided in Section 12. The Contractor shall provide support for all excavations under this item and for pipes and other structures in or adjacent to such excavations, except as such support is included under Item 12, and shall maintain all excavations in good order. Without compensation other than that stipulated for the excavation ordered under this item, he shall construct drains, sumps and other works to prevent the entrance of water into the excavations and shall do all pumping, ditching and other required work necessary to remove and satisfactorily dispose of water from all excavations under this item and Item 5, except the pumping from the excavation for the cut-off wall which is included under Item 41, and from the diversion tunnel and the stilling basin at its outlet which is included under Item 2, and he shall do all other work and provide all equipment, materials and supplies, for which payment under other items is not provided and which are necessary for the completion of the work as a whole. No excavation will be included under Item 4 for temporary water supplies, for the Contractor's temporary buildings, camp and plant, for temporary roads except as provided in Section 14, for temporary drains and sumps, for diversion or drainage ditches at a borrow pit or for any other temporary structures of the Contractor. Detailed drawings of proposed access roads into excavations made under this item, shall be provided by the Contractor and only such roads as are approved by the Engineer shall be excavated but such excavation will not be included for payment under this item.

Excavations not included for payment.

Disposal of excavated materials.

SECT. 4.2 The Contractor shall use the excavated materials, when suitable, for building embankments, for refilling trenches and excavations, and for other purposes. He may deposit excavated materials directly in permanent positions in refills and embankments, so far as is consistent with the proper prosecution of the work. Materials which cannot be placed at once in permanent positions shall be deposited in storage piles at designated locations. Materials reexcavated from such storage piles shall not again be paid for as excavation.

Support of excavations.

SECT. 4.3 Excavations shall be made to approved slopes or, wherever ordered or permitted, the excavations shall be sheeted and braced, as directed or

approved, for the whole or a part of the depth. If so ordered or permitted, the sheeting shall be placed to meet the dimensions of the structure to be built and the masonry placed against it. Unless ordered left in place, sheeting and bracing will not be included for payment under any item, but shall be considered as a part of the work under Item 4. The Contractor shall submit for approval detailed designs of the types of construction he proposes to use for the support of earth in excavations. Where necessary, the Contractor shall build suitable bridges over trenches as required and shall erect and maintain guards as ordered. Such bridges and guards as are ordered or approved shall be included for payment under Items 12 and 26, only as specified in Sections 14, 15 and 56.

Bridges and guards.

Bottoms of excavations.

SECT. 4.4 The bottoms of excavations shall be taken out to the grades and shapes required for the structures to be built therein, and in no case shall the earth be dug by machinery nearer than six inches to the finished subgrade; the last six inches shall be removed with pick and shovel just before the placing of the masonry or other structures. Wherever the material is, in the opinion of the Engineer, sufficiently compact to permit a trench or other excavation to be taken out with steep sides without caving, the Contractor shall, when and where directed, excavate the material accurately to the prescribed limits and build the masonry or structures at these places without delay. Wherever the material at the established subgrade is found too soft or otherwise unsatisfactory for supporting the structure, it shall be excavated to such additional depth and within such limits as may be ordered. Spaces thus excavated shall be filled with concrete, or with gravel or earth carefully selected and thoroughly compacted, to be paid for under the appropriate items. Foundation platforms, if ordered, shall be constructed under Item 12.

Compact earth.

Soft bottom.

Modification of excavation.

SECT. 4.5 If, as the excavation progresses, it be found that the nature of the material at any place is such that it is desirable to modify the shape of the excavation, either by trimming back the side slopes, or taking out the excavation with steeper sides, or to greater depth, the Contractor shall make all such modifications as directed, without payment therefor other than at the price stipulated for this item.

Unauthorized excavations.

SECT. 4.6 If the action of the elements, the exigencies of the work, or other causes, should result in caving or washing of the banks or slopes, the Contractor shall take out additional material as directed, and no payment shall be made therefor or for refilling with concrete or other materials, except within the lines ordered or approved, the cost of such additional excavation and refilling with suitable material beyond such lines, if necessary, being considered as having been included in the price stipulated for this item.

Measurement and payment.

SECT. 4.7 The quantity to be paid for under Item 4 shall be the number of cubic yards of earth, as described in Section 4.1, measured in place as before excavation, that are excavated to the ordered or approved lines and disposed of in accordance with the above specifications. No material shall be measured twice for payment for excavation and no payment will be made for earth excavated from borrow pits or solely to provide materials to be placed under Items 7 to 11, inclusive. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any

other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. Sheeting and bracing, if ordered left in place, will be paid for separately under Item 12.

ROCK EXCAVATION IN OPEN CUT

ITEM 5

Work included.

SECT. 5.1 Under Item 5 the Contractor shall excavate to the limits ordered or approved, all ledge rock, any masonry requiring drilling, barring and wedging or blasting in open cut excavations and any boulder or portion of a boulder of a cubical content of ½ cubic yard or greater; and shall remove and dispose of such materials as provided in Section 12, or as ordered. In general, Item 5 shall include the excavation of rock, boulders and masonry, to the extent ordered or approved, for the waste weir, weir and waste channels, the portion of the release water chamber in open cut, retaining walls, sewers, pipes, drains, fence posts, guard rails and other contract structures to be built under this contract. The Contractor shall excavate, if and as ordered, any masonry portions of the overflow spillway of the coffer-dam and of the sewage disposal plant at the completion of the work. No excavations for temporary water supplies, for the Contractor's temporary buildings, camp or plant, for temporary roads, for temporary drains and sumps or other temporary structures of the Contractor shall be included for payment under Item 5, except as provided in Section 14.

Excavation lines.

SECT. 5.2 Rock shall be excavated to the neat lines shown on the drawings or ordered, within which no rock shall project. The Contractor may, subject to approval in each case, remove the rock to a flatter slope than authorized, but none of the cost of the additional quantities of excavation, or of refill, masonry or of any other work or construction made necessary by such flatter slopes, shall be borne by The City. At all points where concrete or other masonry will come in contact with the rock, blasting shall be done with closely drilled holes and light charges, and the loose rock shall be removed, unless otherwise ordered, and the surfaces against which masonry is to be placed shall be prepared as specified in Section 13G.10.

Precautions in excavation.

SECT. 5.3 In order to preserve the rock, against which masonry is to be placed, in the soundest possible condition, unusual precautions will be required in excavating. Rock may be removed by blasting only to the extent directed, and with explosives of such power and in such quantities and positions as will neither crack, shatter nor otherwise damage the sides and bottoms of the excavations and whenever, in the opinion of the Engineer, such blasting may cause damage, it shall be discontinued and the excavation continued by barring and wedging, channeling, close drilling or other methods, as directed or approved by the Engineer. In order to prevent damage to the foundations of the waste weir, one or more of these special methods shall be used in excavating the cut-off trench and, except as otherwise permitted by the Engineer, the portion of the weir channel adjoining the weir.

Rock excavation for channels.

SECT. 5.4 For those portions of the weir and waste channels which are to remain unlined, the Contractor shall take special care to excavate closely to the prescribed lines and to avoid unnecessary excavation beyond such lines. To this end, the Contractor shall excavate as required by barring, wedging, channeling, close drilling or other means, as directed by the Engineer. Such special methods shall be used in excavating the bottom 12 inches of the weir channel, if ordered by the Engineer. Should the Contractor in any way damage the surface, or excavate beyond the ordered limits, he shall, at his own expense, remove the loosened material to the extent ordered and replace such material with stone masonry to the satisfaction of the Engineer.

Preparation for inspection.

SECT. 5.5 Whenever directed during the progress of rock excavation, all dirt and loosened rock shall be removed from designated areas, and the surfaces of the rock shall be cleaned, using steam to melt snow and ice, if necessary. The water shall subsequently be removed from the depressions so that the whole surface of the areas can be inspected to determine whether seams or other defects exist.

Preparation of rock foundations.

SECT. 5.6 The surfaces of the rock against which masonry is to be placed shall be left sufficiently rough to provide a good bond and, if required, the foundations shall be cut to rough benches or steps. Before any masonry is built on or against the rock, the latter shall be thoroughly freed from all dirt, gravel, boulders, scale, loose fragments and other objectionable substances. Streams of water under sufficient pressure, stiff brushes, hammers and other effective means shall be used to accomplish this cleaning. In addition, where required, certain areas shall be specially prepared, as specified in Item 6, before placing any masonry.

Clearing rock for measurement.

SECT. 5.7 For the purpose of measuring rock before excavation, its surface shall be cleared of obstructions interfering with correct measurement, and the surface so cleared shall be of reasonable extent. The Contractor shall notify the Engineer when any rock is ready for measurement and only such rock as has been properly measured will be paid for.

Measurement and payment.

SECT. 5.8 The quantity to be paid for under Item 5 shall be the number of cubic yards of rock, boulders or portions of boulders of a content of ½ cubic yard or greater and masonry, as described in Section 5.1, that are excavated in accordance with orders, measured in place as before excavation and within the limits prescribed below. The division lines between excavation under Item 5 and excavation under Item 27 or 28 shall be the division lines between the open cut items and shaft or tunnel items shown on the drawings. Wherever all loose rock and rock debris are ordered removed from the bottom of an excavation in rock, as a foundation for masonry or otherwise, measurement shall be made to lines ten inches below the ordered neat lines of the excavation, as shown on the drawings or ordered. Where loose rock and rock debris are not ordered removed, measurement shall be made to the ordered neat lines. On the sides of the excavations in rock in open cut, measurement shall be made to lines ten inches outside of the ordered neat lines, as shown on the drawings or ordered. Excavations made outside of the ordered limits shall not be estimated for pay-

ment and shall be refilled with suitable material, as ordered, without compensation therefor. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. The removal of water from trenches and other open cut excavations in rock under Item 5 is included in Item 4. No payment will be made for excavating rock from quarries, or for temporary access roads, for the Contractor's temporary buildings, camp and plant, for temporary water supplies, for temporary drains or sumps or for other temporary structures of the Contractor. Any ordered excavation of rock spoil, including all boulders therein, deposited under a previous contract will be included under Item 4.

PREPARATION OF ROCK SURFACES

ITEM 6

Work included.

SECT. 6.1 Under Item 6 the Contractor shall specially prepare such areas of rock surfaces in the foundations for the waste weir, for the cut-off wall, on the sides and floor of the weir channel and elsewhere where watertightness is desired, as may be designated by the Engineer. In areas where such work is ordered, the joints and cavities shall be explored by drilling, channeling, raking out or by other approved means, and shall be carefully cleaned and filled with cement mortar or grout, as directed. All work under this item shall be in addition to the cleaning, washing and preparation of rock surfaces for bonding with masonry, as specified in Sections 5.6 and 13G.10.

Measurement and payment.

SECT. 6.2 The quantity to be paid for under Item 6 shall be the number of square yards of rock surfaces prepared as specified above, measured as follows: Each area of rock surface prepared in accordance with Section 6.1 shall be measured for payment as the number of square yards of area so treated, neglecting irregularities of the surface, and measuring each single area as not less than ten square yards. Each area shall be estimated for payment but once, regardless of the number of times it must be treated in order to have it in a satisfactory condition when the masonry or protective coatings of cement mortar are placed. The price per square yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified.

ROLLED EMBANKMENT, CLASS A AND CLASS B

ITEMS 7 AND 8

Work included.

SECT. 7.1 Under Items 7 and 8, respectively, the Contractor shall furnish and place in the dam, rolled embankment, Class A, and rolled embankment, Class

B, to the lines shown on the drawings, as specified herein, or as ordered by the Engineer. The refilling of trenches excavated for the installation of piezometer pipes shall also be done under these items. Rolled embankment, Class A, shall be placed and compacted to constitute a dense impervious core in the central portion of the dam and rolled embankment, Class B, shall be so constructed as to form a permanently stable shell, not necessarily impervious, enclosing the embankment, Class A. The division lines between the two classes of rolled embankment are approximately shown on Sheet 7 of the contract drawings. Carefully selected and graded material from the excavations and from approved borrow pits shall be used in the embankment to be placed under Item 7 and material from similar sources but with less restriction as to kind, quality, grading and moisture content shall be used in the embankment to be placed under Item 8. The materials to be used and their suitability for either Class A or Class B embankment, the moisture content of these materials when compacted, the maximum sizes of stones permitted in the embankment, the thicknesses of the layers of material placed in the embankment and the necessary rolling to attain the degree of compaction required in the various portions of the embankment shall be as hereinafter specified and as directed by the Engineer. The Contractor shall furnish all equipment, plant and labor required to obtain and transport the materials, control their moisture content and thoroughly compact them in place and shall cooperate to the fullest extent in utilizing the available material to the best advantage. The dumping, spreading, sprinkling or drying and compacting of embankment may be carried on simultaneously at different places. In case these operations tend to or actually do interfere with each other, the Engineer may require them to be done consecutively whenever in his judgment such procedure is necessary to insure the required quality of work. As a part of the work under Item 7, the Contractor shall, to the extent directed, remove any remnants of forms and appurtenant material from the cut-off wall and shall do any other work at and adjacent to the wall to prepare the surface for the placing of embankment and, as directed, move the soils laboratory constructed under Item 12.

Preparation of base.

SECT. 7.2 A firm base for the embankment shall be prepared where directed by placing drains for the control of ground water, by filling all existing pump and observation wells with suitable material placed in layers and tamped as ordered, by removal of all sewer or other pipes, by plugging or draining any springs encountered on the site and by removal of soil and unsuitable material. Sloping surfaces of the base of the embankment, particularly at the abutments, shall be stepped as directed by the Engineer. The preparation and grading of the abutments of the dam and the completion of such work in advance of placing embankment shall be done as directed by the Engineer. Immediately prior to placing embankment, the prepared foundation shall be ploughed, harrowed or otherwise worked as directed, to a depth of from six to eight inches, with the addition of water if required, and compacted in the manner specified in Section 7.6. All ordered excavation and removal of material necessary to prepare the foundations and all ordered masonry, pipes, grout, cement or other materials used for the control of springs shall be included for payment under the appropriate items, but no other direct payment shall be made for the preparation of foundations as herein

specified, it being considered that compensation therefor is included in the prices stipulated for the several items of excavation and embankment.

Quality of materials.

SECT. 7.3 Rolled embankment shall consist of suitable materials from borrow pits in the vicinity of the dam and from excavations required for other parts of the work. Materials containing an unacceptable proportion of silt will be unsuitable for either class of embankment. The relative fineness of the materials to be placed in each portion of the embankment and the approximate limits of each

Gradation of materials.

such portion shall be as ordered by the Engineer. In general, material containing the largest proportion of fines shall be placed in the central portion of the dam and that containing the largest proportion of sand and gravel shall be placed near the outer limits of the rolled embankment. The materials between these limits shall be placed so that the gradations in fineness will be as ordered, but the entire cross-section of the rolled embankment, Class A, shall be of material that will make all of it tight and impervious. While there is no requirement as to the degree of imperviousness throughout the embankment, Class B, the portions at and near the upstream and downstream slopes shall be constructed so as to be free draining and, if ordered, of run of bank gravel with oversized stones removed, or similar material, from borrow pits in the bottom portion of the reservoir area in the vicinity of the dam. Embankment material shall be free from stumps, roots,

Removal of stones.

ashes, oil or other perishable or foreign material. All stones larger than will pass through a 5-inch square opening, for Class A embankment, and through a 6-inch square opening for Class B embankment, shall be removed from the materials for the embankment before they are brought onto the embankment, by passing the materials through approved grizzlies. All such stones shall be disposed of as directed and, if of acceptable size and quality and free from earth, may, if approved by the Engineer, be placed directly in the rock embankment of the dam. In the embankment, accumulation in groups or nests of stones remaining in the material, particularly stones of the larger sizes, shall be kept to the practical minimum. A sufficient number of men shall at all times be available as the spreading and rolling are being done to remove all oversize stones, roots and other unsuitable materials and to separate the smaller stones. All excavation, transportation, operation of the grizzlies and placing operations shall be such as will produce a satisfactory mixture, gradation and moisture content of the materials after they have been spread and compacted. The completed embankment, Class A, shall be free from lenses, pockets, streaks or layers of material differing in texture

Mixing Class A materials.

from the surrounding material. Every effort shall be made in the borrow pits to mix the materials for Class A embankment as thoroughly as possible and at least two sources of supply shall always deliver such materials at any one place on the embankment. In the borrow pits such materials shall be loaded by power driven shovels which shall, as may be necessary or required, be operated as mixers with open dippers. Other loading devices may be approved, provided the mixing produced is as efficient as that of the shovels above specified. If necessary, additional mixing shall be done by disc harrowing or other approved method after the material has been spread on the embankment. Materials unsuitable for embankment of either class will be rejected and shall be disposed of as directed. The Contractor shall open up borrow pits at such locations and of such extent as ordered or approved by the Engineer, in order to enable the Engineer to select

materials of the required quality, gradation and moisture content. As may be necessary, the top surfaces of the borrow pits shall be stripped, graded and smooth rolled and otherwise treated so as to shed rain water. (See also Section 7.8).

Frozen materials.

SECT. 7.4 No frozen material shall at any time be used in the construction of the rolled embankment, Class A or Class B, and no material shall be placed on portions of such embankment which are frozen or which have been loosened by freezing. Upon the resumption of work after freezing weather, the surface of the embankment shall be prepared as specified in Section 7.2 or as directed by the Engineer.

Borrow pits.

SECT. 7.5 Borrow pits may be opened at such places on lands now owned by The City and in such manner as permitted, but not within 1,000 feet of the upstream toe of the dam, and shall not be carried closer than three feet to ledge rock. On the conclusion of the work, borrow pits above the flow line of the Pepacton reservoir shall be graded and sloped as required and all unsightly piles of rock, isolated boulders and other debris shall be removed or covered. All borrow pits shall be left in an acceptable condition at the completion of work under this contract as provided in Section 13. No direct payment will be made for these cleaning up operations, it being understood that the cost thereof is included in the price stipulated for Item 61.

Construction of embankment.

SECT. 7.6 Materials for the construction of embankment shall be transported on the dam in approved conveying units, having treads of such ample bearing areas that the completed fill will not be rutted by their passage. Conveying equipment shall not be permitted to follow tracks on the dam and the routes of travel shall be varied and spread out and ruts on the embankment shall be promptly filled and leveled off. The relation between the total loaded weight of any conveying unit and the tread areas shall be such that the conveyor unit will not cause ununiform compaction. All embankment surfaces over which hauling has been done shall be harrowed and scarified before any new layer is placed. The embankment material shall be evenly and uniformly spread in layers, as nearly as practicable seven inches thick for Class A embankment and as nearly as practicable eight inches thick for embankment, Class B. Arriving material shall be dumped in evenly spaced rows adjacent to each other and parallel with the axis of the dam, so that the spreading and rolling equipment will travel parallel to that axis. The spreading equipment shall be of the lightest practicable weight and no other equipment, except sprinkling trucks, and harrows as necessary, shall be permitted to pass over any layer that is being or has been prepared for rolling until after the rolling of that layer has been completed. Joints and laps in or between layers shall be carefully made so as to insure the continuity of each layer in all directions. Precautions shall be taken to assure equal loading on both sides of the cut-off wall. Each layer shall be thoroughly compacted to the extent required before a new layer is placed. Such compaction shall be accomplished by rolling with sheepsfoot rollers of approved designs or in special cases, with smooth rollers of required weight, or by other approved means, as herein specified. The number of roller trips shall be as ordered by the Engineer. (See Sections 7.10 and 7.14). The rollers shall be drawn by approved tractors having ample tread areas and corrugated treads. Their rate of travel shall not exceed 2½ miles per hour. It is the inten-

Thickness of layers.

Compaction of layers.

tion to obtain in the completed embankment a degree of compaction such that, in the Class A embankment the maximum dry density will be secured within the practical limits of the best construction practice, and in the Class B embankment the density necessary to resist shearing movement and insure permanent stability will be obtained. To this end, all methods and procedures must be carefully guarded and controlled. Samples for density determinations shall be taken by the Contractor for and under the supervision of the Engineer from the two layers just below the top layer at the point of sampling and after the rolling of the top layer has been completed. One such sample shall be taken for each 2,000 cubic yards of Class A embankment and one for each 4,000 cubic yards of Class B embankment, or more frequently as may be necessary.

Density samples.

Moisture content.

SECT. 7.7 The moisture content of the material placed in the embankment shall be as prescribed by the Engineer. For the Class A embankment such moisture content shall be, as nearly as practicable, that percentage, by weight, of water in the material, as will permit compaction of the material in the embankment to not less than 97 per cent. of the maximum density obtainable with the specified rolling equipment; for Class B embankment the moisture content shall be that which will permit compaction to the density necessary to resist shearing movement and insure a condition of permanent stability. Dry weight of a unit volume of the compacted material will be used in determining the density. Changes in the prescribed moisture content may be made from time to time to conform to changes in the character and grading of the material.

Control of moisture content at the borrow pits.

SECT. 7.8 It is anticipated that a considerable measure of control of the moisture, particularly for the Class A embankment material, will be effected in the borrow pits. This will necessarily be a continuous procedure and must be planned sufficiently in advance of procurement of material to be placed in the dam as will minimize delay in the progress of the work. To obtain the prescribed moisture content in embankment material and to insure as nearly as practicable that the moisture will be distributed uniformly throughout the material, the Contractor will be required to sprinkle or otherwise wet down the borrow pit areas when the material therein is too dry and to remove water therefrom when the material therein is too wet. Such removal of water may necessitate the construction of intercepting and diversion ditches, the constant exposure of the greatest possible area in the borrow pit to sun and air or the use of any other effective method which will reduce the moisture content to the percentage prescribed.

Control of moisture content at the embankment.

SECT. 7.9 The top surface of the embankment shall be sprinkled whenever necessary just before a new layer is placed and to prevent dust from reducing visibility. All such sprinkling shall be done by tank trucks of such light weight and having tires of such size as will not develop a degree of compaction in the layer being or to be rolled which will interfere with subsequent rolling operations. The delivery nozzles of the trucks shall be capable of close and accurate adjustment so that the water will be uniformly spread and closely controlled as to quantity without forming pools. Material which is found to be too wet when it reaches the embankment shall, before it is compacted and as directed by the Engineer, be spread over the embankment or otherwise exposed to the drying action of the sun and air and the excess moisture allowed to dry out before it is

compacted. The placing or rolling of material on the embankment, Class A, will not be permitted whenever rainstorms are imminent or during or immediately after rainfalls or when any other weather condition prevails which would increase the moisture content beyond the limit for satisfactory compaction. The embankment shall be brought up uniformly and its top shall be graded and sloped so that a minimum of rain water will be retained thereon. The top of the Class B embankment, except as may be permitted adjacent to the outside of the embankment, shall be kept at all times during its construction below the top of the Class A embankment in order to afford satisfactory drainage of surface water. The top of the embankment of either class shall be kept free from holes and depressions and all such as may be formed by any cause shall be promptly leveled off as directed by the Engineer. Pools of water from any source shall be promptly emptied and the holes filled with dry material. The Contractor shall take every precaution to prevent saturation of the embankment by rainfall. Whenever any portion of the embankment is to stand for one week or longer, during which period no additional layers of material are to be placed thereon, or whenever rainstorms are imminent, the embankment shall, if so ordered, be smooth rolled so as to readily shed water. Such smooth rolling shall not be included in the count of roller trips referred to in Sections 7.10 and 7.14. Before work is resumed on any such portion, it shall be harrowed and scarified, moistened or dried as required and recompacted as specified in Section 7.2 so that a tight bond will be obtained with the next layer to be placed. Compacted embankment that may be damaged by washing or otherwise shall be acceptably replaced by the Contractor without compensation therefor except as specified herein.

Smooth rolling.

SECT. 7.10 After each embankment layer has been spread to the required thickness and its moisture content has been adjusted, as necessary, to within the required limits, it shall be rolled as specified. Not less than fourteen trips of a single roller will be required on every portion of each layer of Class A embankment and not less than eight trips of a single roller will be required on every portion of each layer of Class B embankment. In order to perform this operation to best advantage on Class A embankment, the moisture content of the top layer and particularly of the one next below it must be right. In case embankment of either class sinks and weaves under the roller or under trucks and other equipment, it will be evident that the required degree of compaction is not being attained and that an adjustment in the moisture content is required. If at any place or time such sinking and weaving produce surface cracks and are of such character, amount or areal extent as, in the judgment of the Engineer, to indicate an unfavorable condition, he will order operations on that part of the embankment to be suspended until such time as it shall have become sufficiently solidified. The ideal condition of the embankment is that attained when the feet of the sheepsfoot roller penetrate deep into the layer being rolled and develop compaction in the layer beneath it, and when, at the same time, the entire embankment below these layers is so firm and hard as to show only the slightest weaving and deflection as the roller passes. Adjustments of the weights of the rollers may be ordered by the Engineer in order to obtain the required penetration of the feet of the rollers. In order to minimize the condition of sinking and weaving, the Contractor

Rolling of layers.

Sinking and weaving.

Insufficient compaction.

shall at all times keep the rolling operations spread out over the maximum practicable area. Adjacent roller trips shall overlap each other sufficiently to insure uniform compaction. If over any area the compaction obtained, as determined by the Engineer, is less than that obtained by the usual procedures in handling and compacting the materials, because of insufficient overlap, too thick layers, too much or too little moisture or other cause attributable to defective work, the condition shall be remedied and, if additional rollings are ordered, payment will not be made as specified under Section 7.14. If the material itself is unsatisfactory, or if additional rolling or other means fail to produce satisfactory results, the area in question shall be cleaned off down to material of satisfactory density and the cleaning off, replacement and rerolling shall be done by the Contractor without additional compensation.

Rollers.

SECT. 7.11 Approved sheepsfoot rollers shall be used for compacting all parts of the embankment which they can reach. Rollers procured by the Contractor for this work shall meet the following requirements. They shall be in units of the two-drum articulated type and shall be equipped with cleaner bars for keeping the spaces between the feet clear. Two sets of bars shall be provided if the rollers are to operate in both directions. Each roller drum shall be mounted so as to float freely within its frame and each shall be not less than 60 inches in diameter nor more than 60 inches long and shall weigh when empty not less than 2,100 pounds per linear foot. The drums shall be watertight and fitted with openings through which they may be weighted with water and sand. To each drum there shall be attached feet or teeth in staggered rows. These shall project approximately eight inches beyond the outer surface of the drum and their ends shall preferably be fitted with removable hardened metal shoes having a penetrating area of not more than six square inches when new. The spacing of the feet shall be reasonably uniform, both transversely and circumferentially, with one tamping foot for approximately each 110 square inches of the outer cylindrical surface of the drum. When the penetrating area of the feet or shoes on any of the rollers has been worn down to five square inches, they shall be replaced by new shoes or increased to their original area by welding on new metal. Not more than two roller units may be used in tandem, so that one trip in tandem will count as two trips of a single roller. In such case, however, the rollers shall be so coupled and the spacing and arrangement of the feet on the drums shall be such that the feet of the trailing roller will not track in those of the drum ahead. The type, design and details of rollers shall be subject to the preliminary approval of the Engineer before their employment on the work. As experience is gained in the compaction of the materials available for the embankment, certain changes in the details of the rollers may be indicated to improve their efficiency in securing the degree of consolidation specified or in obtaining greater uniformity or increased speed of operation. To attain these ends the Contractor shall make such alterations in the details of the rollers as ordered or permitted without payment therefor other than is included in the prices stipulated for Items 7 and 8.

Roller drums.

Feet on rollers.

Rollers in tandem.

Modification of rollers.

Special compacting.

SECT. 7.12 Compaction by approved hand operated, power driven mechanical tampers will be required along the junction between the embankment and the surface profile, along the sides of the cut-off wall, around the piers of the release

water chamber, around the casings over the settlement measurement plates, for the refilling of the trenches for the piezometer pipes if such compaction cannot be done by rolling and wherever, because of the topography or other condition, the required density cannot be obtained by the use of rollers. Material to be so compacted shall be spread by hand in layers not more than two inches thick for Class A embankment nor more than four inches thick for embankment, Class B, measured before compaction, and the degree of compaction attained by these tamping operations shall be equal in every respect to that secured by the sheepsfoot rollers.

Allowance for settlement.

SECT. 7.13 The embankment shall be built to such height as will, in the opinion of the Engineer, allow for subsequent shrinkage and settlement. All material placed and compacted within the limits ordered and designated by the Engineer will be estimated for payment as specified in Section 7.15 but no payment will be made for material placed outside of such limits.

Additional rolling.

SECT. 7.14 In case it should become necessary, in order to obtain the required degree of compaction, to do more rolling on any or all of the embankment layers than fourteen trips of a single roller drum for Class A embankment or eight such trips for Class B embankment, the Contractor shall do such additional rolling as the Engineer may order. For each ordered additional trip of a single roller, the quantity of Class A or Class B embankment placed and rolled shall be measured and computed for payment under Item 7 or 8 as increased by one per cent. of the volume of the layer or part thereof rolled by each such additional trip. The volume of rolled embankment, Class A or Class B, to be increased under the provisions of this section shall be the computed volume of the layer or part thereof which has been rolled by more than fourteen single roller trips for embankment, Class A, or more than eight such trips for embankment, Class B, the thickness of the layer always being taken as five inches for the former class and six inches for the latter. The number of roller trips shall be computed without regard to necessary overlaps or to rolling done in turning the equipment at the ends of the lanes or to such rolling parallel to the abutments as may be needed to secure the required degree of compaction in the embankment as close as possible to the junction between it and the abutments.

Measurement and payment.

SECT. 7.15 The quantity to be paid for under Item 7 shall be the number of cubic yards of rolled embankment, Class A, measured in final position from the surface of the foundation as excavated in accordance with orders or from the surface of the cut-off wall to the limits of the rolled embankment, Class A, shown on the drawings or designated by the Engineer. The quantity to be paid for under Item 8 shall be the number of cubic yards of rolled embankment, Class B, measured in final position from the surface of the foundation as excavated in accordance with orders, or from the ordered surface of rolled embankment, Class A, or from the surface of existing embankments to the limits of the rolled embankment, Class B, shown on the drawings or designated by the Engineer. The number of cubic yards of rolled embankment of each class measured for payment shall be increased because of more roller trips, as provided in Section 7.14 and shall also include the refilling of trenches for piezometer pipes. The prices per cubic yard stipulated for these items shall include all labor,

plant, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under these items in the manner herein set forth and specified.

REFILLING AND EMBANKING

ITEM 9

Work included.

SECT. 9.1 Under Item 9 the Contractor shall do all required refilling and embanking, except the rolled embankment for the dam under Items 7 and 8, rock embanking under Item 10, run of bank gravel under Item 25 and surface dressing under Item 11, to the lines shown on the drawings or ordered, for the upstream and downstream embankments of the dam; for sewage disposal plant and sewers if required, settling tanks or basins, drains, pipes, fence posts and other structures; for downstream and other grading; for covering the rock surfaces of the downstream slope of the dam and of spoil banks where ordered and for refilling, if required, of portions of the sewage disposal plant at the completion of the work; and he shall do any other ordered refilling and embanking necessary to complete the work under this contract. As a part of the work under this item, the Contractor shall repair any settlement, sliding or washing of refills and embankments made by him until the completion and acceptance of the work under this contract, without other compensation than that provided herein for refilling and embanking to the ordered lines and shall place and maintain temporary pavements or surfacing over all trenches in roadways and elsewhere, as required, to take care of traffic. This item shall not include any refilling or embanking made for temporary water supplies, for the Contractor's temporary buildings, camp or plant, for temporary roads, except as provided in Section 14, for the temporary storage of excavated materials, for temporary drains, sumps or other temporary structures of the Contractor.

Materials for refilling and embanking.

SECT. 9.2 Refills and embankments shall be made of materials from the excavations under Items 4, 5, 27, 28 and 29, in so far as they are acceptable, and from borrow pits on lands of The City or provided by the Contractor from other sources outside the limits of the work. All materials used for refills and embankments shall be free from frost, stumps, large roots, ashes, oil and other perishable or foreign matter. Earth for covering the surfaces of rock embankments and rock excavations shall be free from stones larger than six inches in diameter. Rock may be permitted in refills and embankments and when so placed shall be measured for payment as refilling and embanking. The stones forming the faces of such embankments shall be of suitable shapes and sizes and shall be placed to the prescribed lines as required. No stone shall be placed in the refill nearer than four inches to any pipe.

Foundations for embankments.

SECT. 9.3 All embankments shall be started on a firm foundation from which soil, stumps, large roots and other perishable material and earth loosened by freezing shall have been removed to the extent directed, as provided in Sections 11 and 3.1, and if, where a soil cover is to be placed, the depth of fill is less than two feet, oil, ashes and other foreign matter shall first be excavated as ordered. The

removal of soil, stumps and large roots shall be done under Item 3; the excavation of oil, ashes and other perishable and foreign matter, under Item 61.

Refilling trenches.

SECT. 9.4 Before pipes or drains are laid in a trench in rock, unless they are to be supported on concrete saddles or cradles, the bottom of the trench shall be refilled with approved material thoroughly compacted to the elevation directed. Refilling of trenches for pipes, drains and other structures shall be deferred, if ordered, until after any required hydrostatic tests shall have been completed. Other trenches and excavations shall be refilled as soon as practicable after the pipes, drains and other structures have been satisfactorily laid or constructed therein. Unless otherwise permitted, the Contractor shall refill the trenches for pipes, drains and other structures by depositing material in water or by flushing the material and working the mass with poles and bars until the refill is wet thoroughly and fills solidly the entire space about the pipes, drains or other structures. Unless otherwise permitted, where the refill in the trenches and about the structures is not deposited in water or puddled, the earth shall be placed in horizontal layers not over four inches thick and each layer shall be sprinkled and thoroughly compacted.

Puddling and flushing.

Compacting refills.

Temporary pavements incorporated in embankments.

SECT. 9.5 Any portions of temporary access or other roads of the Contractor that are not above the ordered surfaces of the earth embankments shall be included for payment as embankment under Item 9 if made of suitable material.

Embankments to be carried up level to prescribed lines.

Modifications may be permitted.

SECT. 9.6 Unless otherwise permitted, the embankments shall be carried up approximately level and built to the lines shown on the drawings or ordered. Material placed in the upstream and downstream embankments of the dam shall be deposited in layers not over two feet in depth and shall be uniformly compacted by the hauling equipment. Portions of embankments may be permitted to extend beyond the prescribed lines, but material placed outside of such lines will be considered as deposited in spoil banks or disposed of beyond the limits of the work, as prescribed under Section 12, and no payment will be made therefor under Item 9. So far as practicable, the rock fills in embankments shall be so selected, graded and placed that the volume of voids in the embankments shall be a minimum and the Contractor will be required to flush earth into such voids as may unavoidably occur in the upper portions of the rock fills. Earth embankment placed over rock fill shall be not less than one foot in thickness after complete consolidation and after all settlement into the underlying rock fill shall have occurred. When time for natural settlement is not available, the Contractor shall roll or tamp the earth embanking material in layers of approved thicknesses. Any settlement, sliding or washing of embanking materials after placing, that may occur before the completion and acceptance of the work under this contract, including the settlement of the earth into the rock fill, shall be remedied and the embankment brought to the required grade without other compensation than that provided under this item for refilling and embanking to the lines shown on the drawings or ordered.

Consolidation of embankments.

Settlement to be repaired.

Temporary surfacing over trenches.

SECT. 9.7 As soon as a section of trench in any public road, or in any other place where required, has been refilled and all plant and excess materials

have been removed, a temporary pavement or surfacing shall be laid over the trench, and it shall be satisfactorily maintained under this item until the permanent pavement is laid. Broken stone, gravel, pieces of concrete or other acceptable material taken from the trench shall be placed as a temporary surfacing, or the Contractor shall furnish and place broken stone, gravel or steam cinders for this purpose, as may be ordered or approved. As a part of the maintenance of the temporary surfacing over the trenches in public roads, the Contractor shall furnish water and sprinkle sufficiently to compact the surface of the trenches and prevent annoyance from dust.

Sprinkling.

Measurement and payment.

SECT. 9.8 The quantity to be paid for under Item 9 shall be the number of cubic yards of compacted refilling and embanking, as described in Section 9.1, including temporary pavements or surfacing, measured in final position, that are actually placed within the limits shown on the drawings or ordered. Refills shall be measured from the limits to which excavation under Item 3, 4 or 5 is measured for payment; embankments, from the surface on which the embanking material is placed. No deductions shall be made under Item 9 for the space occupied by a pipe having a cross-sectional area smaller than three square feet. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. No payment will be made for furnishing materials required for the refills and embankments in excess of that available from ordered excavations, except in the price stipulated for Item 9. No temporary surfacing or refill in roadways above the established grades will be paid for under Item 9 and no material placed outside the prescribed lines for refill and embankment will be paid for under this item, even though such material in refills and embankments may have been placed, with the permission of the Engineer, immediately adjacent to or contiguous with prescribed refills and embankments, as being a suitable place for the disposal of such materials, payment therefor being considered as having been included in the prices stipulated for the appropriate excavation items.

ROCK EMBANKING

ITEM 10

Work included.

SECT. 10.1 Under Item 10 the Contractor shall furnish and place rock embanking to the lines shown on the drawings or ordered on the slopes of the dam, in front of the waste weir, in the river channel of the East Branch of the Delaware downstream from the dam and elsewhere as ordered. As a part of the work under this item, the Contractor, as directed, shall repair any settlement, sliding or washing of rock embankments made by him until the expiration of this contract without other compensation than that provided herein for rock embanking. No material placed outside the prescribed lines for rock embanking shall be included under this item, even though such material may have been placed, with the permission of the Engineer, immediately adjacent to or contiguous with the prescribed rock embanking.

Quality of materials.

SECT. 10.2 Acceptable stones shall be used in rock embanking. The material shall be free from stumps, roots and other perishable or foreign material. Rock for the protection of slopes, embankments and channels shall be composed of durable stones of acceptable sizes and grading. No flat stones having a thickness less than one-fourth of the least linear dimension of the largest face area shall be used. Materials for rock embanking may be obtained from ordered excavations, from rock storage piles and from borrow areas in so far as they are satisfactory.

Placing.

SECT. 10.3 Stones for rock embanking shall be so selected, graded and placed throughout, as directed, that the volume of voids in the embankment shall be a minimum. Where earth is to be placed upon rock embanking, the top portion shall be graded from coarse to fine at the surface to provide a thoroughly filled outer layer of rock embanking to resist settlement and washing of the overlying earth into the rock fill. Material for the protection of slopes, embankments and channels shall be so placed that the smaller stones shall be at the under side of the rock fill, increasing in size to the top, as directed, so that the greater proportion of the large stones shall be at the surface. The stones in the outer three feet of the rock embanking on the upstream slope of the dam shall be large, angular stones.

Measurement and payment.

SECT. 10.4 The quantity to be paid for under Item 10 shall be the number of cubic yards of rock embanking, measured in final position, that are furnished and placed within the limits shown on the drawings or ordered, measured from the surfaces of underlying refills, from the surfaces of embankment placed under Item 8 or 9, from surfaces from which soil has been removed or other excavation made in accordance with orders, or from the original surface if no soil removal or other excavation has been ordered. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. No payment will be made for furnishing rock for embankments in excess of that available from ordered excavations except in the price stipulated for Item 10.

SURFACE DRESSING AND GRASSING

ITEM 11

Work included.

SECT. 11.1 Under Item 11 the designated surfaces of excavations, embankments, refills and other areas, except such areas as will be eventually covered by water shall be dressed to the extent ordered, with acceptable soil of the thickness directed, fertilized, seeded or sodded, and maintained, until the completion and acceptance of the entire work. In general, these areas shall include, but shall not necessarily be limited to, the downstream surface of the dam, the surface of the graded area downstream from the toe of the dam and the upper slopes of the weir, waste and outlet channels. Not more than 12 inches of soil

will be required, except on such areas as are designated for the planting of trees or shrubs, where the thickness of the soil dressing shall be as ordered.

Material for surface dressing.

SECT. 11.2 To the extent that suitable material is available from the excavations under Item 3, from existing storage piles or from areas within the reservoir flow line as designated by the Engineer, surface dressing shall be made from such material.

Preparation and placing.

SECT. 11.3 In general, soil shall not be deposited until, in the opinion of the Engineer, any refill or embankment upon which it is to be placed shall have approximately reached its final condition of settlement, or until satisfactory provision shall have been made for possible future settlement. Wherever necessary, the surface upon which the soil is to be placed shall be raked or otherwise satisfactorily prepared to insure a proper bond. The soil shall then be deposited to the thickness directed and acceptably rolled or tamped.

Fertilizing and seeding.

SECT. 11.4 After the soil has been placed in accordance with Section 11.3 and at such time as the Engineer shall order or approve, the Contractor shall place on the areas to be seeded or sodded, and rake in thoroughly, an approved chemical fertilizer at the rate of two tons per acre. The fertilizer shall be of 5-10-5 analysis and shall be a brand licensed and registered with the New York State Department of Agriculture and Markets. After the fertilizer has been applied to areas to be seeded, grass seed shall be sown uniformly at the rate of six bushels per acre and shall be satisfactorily raked in. The areas thus seeded shall then be satisfactorily rolled. Any portions of The City's lands on which grading is not required, but from which the turf has been removed or damaged as a result of the Contractor's operations, shall be resoiled if necessary, or spaded and likewise fertilized and seeded. Grass seed shall be from the latest crop available with a weed content not to exceed one per cent. and shall conform to the following analysis or an approved equivalent:

PER CENT. BY WEIGHT	VARIETY	PER CENT. PURITY	PER CENT. GERMINATION
50	Kentucky Blue Grass	85	80
20	Redtop	95	90
15	Domestic Rye Grass	95	85
10	Timothy	99	90
5	White Clover	97	90

The Contractor shall furnish a certificate of analysis and test from an approved laboratory showing that the seeds have been recently tested and meet all requirements of these specifications.

Sodding.

SECT. 11.5 Sound sods having a good quality of heavy grass shall be placed on gutters or berms, except where paved, in strips on slopes of embankments

or excavations adjacent to roads and, wherever required, a strip not less than one foot wide shall be placed along the edges of areas to be seeded, or on such other parts of the embankments or graded areas as directed, or where, in the opinion of the Engineer, washing is likely to occur before the seed has taken root. After the areas to be sodded have been brought to the ordered subgrade and fertilized, sods of a good quality of heavy grass, of shapes and sizes to be conveniently handled and to fit the areas to be sodded and of a uniform thickness of at least 1½ inches, shall be properly laid with a fair bearing and a smooth, even surface and beaten down firmly. On slopes and elsewhere, as directed, each sod shall be secured by at least two wooden pegs of ordered length. The total area to be sodded under this item shall not exceed five per cent. of the entire seeded and sodded areas on which soil is placed under this item.

Maintenance.

SECT. 11.6 All seeded and sodded areas shall be satisfactorily cared for and watered, and the grass cut, as directed, until the completion and acceptance of the work under this contract. Portions of these areas shall be resoiled, refertilized, reseeded or resodded, if required, to obtain a satisfactory result.

Measurement and payment.

SECT. 11.7 The quantity to be paid for under Item 11 shall be the number of cubic yards of soil, measured after compacting, that are actually placed, fertilized and seeded or sodded in accordance with the requirements of these specifications within the limits specified in Section 11.1, except that the Contractor shall make good, without additional payment therefor, any considerable settlement of any refill or embankment below the established lines and grades that shall take place before the completion of the entire contract. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. Payment for resoiling, seeding or sodding any lands beyond the limits of the ordered operations of the Contractor will be included under Item 61. No payment will be made under this item for resoiling, spading up, fertilizing, seeding, sodding or otherwise restoring any portion of the prescribed areas on which regrading is not required but on which the turf has been removed or damaged as a result of the Contractor's operations or for any required surface dressing and grassing in a borrow pit area.

TIMBER AND LUMBER IN OPEN CUT

ITEM 12

Work included.

SECT. 12.1 Under Item 12 the Contractor shall furnish all material for, build and leave permanently in place or maintain in good order as directed for the duration of this contract unless sooner ordered removed, structures of timber and lumber, as ordered, such as a movable building for a soils laboratory, stop logs and gates at the inlet to the diversion tunnel, foundation platforms, drains, poles,

fences and guards as specified in Section 15, bridges, trestles, barricades, fences and guards as specified in Section 14, ordered signs and notices, and other ordered timber and lumber work in structures above ground or in open cut. As a part of the work under this item, the Contractor shall furnish all nails, bolts, nuts, washers, spikes and other fastenings and shall paint and repaint as directed the fencing, guard rails and other semipermanent surface structures visible to the public, including ordered signs and notices thereon. Sheeting and bracing in excavations shall also be included in this item to the extent that such sheeting and bracing shall be of approved design and shall have been ordered left in place.

Timber and lumber not included under Item 12.

SECT. 12.2 No timber or lumber shall be included under Item 12 that is not described in Section 12.1 nor specifically ordered to be furnished under this item. Timber and lumber required for the Contractor's plant and buildings, for forms or other purposes of the Contractor, for chlorinator houses, for the repair of the Engineer's offices and buildings and for sheeting and bracing in excavations, unless ordered left in place, shall not be included under Item 12, but shall be considered as having been included in the prices stipulated for the various items of the contract.

Size, quality and workmanship.

SECT. 12.3 All timber and lumber used by order or with the approval of the Engineer shall be of the sizes directed or approved, new, and of suitable quality and sufficient strength for the purposes intended, except that second hand material, if approved, may be used for the sheeting and bracing of minor excavations and for other purposes where strength and appearance are not important considerations. If the Contractor is of the opinion that larger or additional pieces of timber or lumber than those ordered should be used in any of the structures, he may, unless otherwise directed, use such larger or additional pieces, but shall not be entitled to payment for any excess over and above the amount ordered. Workmanship shall be first class in all respects and all work shall be done with an accuracy suitable for the special purpose in each case. All structures to be built under this item shall be of ordered or approved design.

Maintenance and painting.

SECT. 12.4 All structures built under this item shall be maintained at all times in a neat, safe and serviceable condition, and they shall be promptly and thoroughly repaired as often as may be necessary to this end. Fences, guard rails and other structures included for payment under this item shall be painted two coats of approved paint as soon as completed, and repainted, as ordered.

Soils laboratory.

SECT. 12.5 The soils laboratory shall be a one-story building of about 400 square feet floor area, containing built-in work benches, shelving and closets, a sink and wash basin and provided with a water supply, adequate lighting and an approved chemical closet. It shall be built on sills or runners to facilitate moving as required under Item 7. A drawing and specifications of an acceptable building may be seen at the office of the Engineer, 120 Wall street, New York, N. Y. The sides and roof shall be covered with asphalt roofing material and the doors, windows and outside wood trim shall be painted with not less than two coats of sat-

isfactory paint of approved color. The finished wooden floor shall be given two coats of boiled linseed oil when completed. The building shall be serviced, maintained and repaired as specified in Section 55. Any work done or materials furnished in connection with the provisions of this section, which may properly be classified under one or more appropriate items shall be so classified and paid for, but no direct payment will be made for any work or materials which may not be so classified, the cost thereof being considered as having been included in the price stipulated for Item 12.

Measurement and payment.

SECT. 12.6 The quantity to be paid for under Item 12 shall be the number of thousand feet, board measure, of timber and lumber ordered or approved in structures and other wood work that may be included for payment under this item in accordance with Sections 12.1, 12.2 and 12.3, and that shall be furnished, placed and left in place or removed, as ordered or approved, in accordance with the preceding sections of this item, subject to the following limitations: Second hand timber that has been notched shall be estimated as of its minimum cross-section; round timber shall be estimated as square timber of the largest size, omitting fractions of an inch, which can be inscribed in the small end of the stick. For the construction of the soils laboratory as specified in Section 12.5, the quantity to be paid for shall be 25 board feet for each square foot of floor area within the exterior walls. The price per thousand feet, board measure, stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to furnish, fabricate and place in the work or build and maintain structures of timber or lumber of the kind and quality specified and in the manner herein set forth. Hardware, nails, bolts, spikes and other fastenings and any timber and lumber used in connection with the erection of the timber or lumber but not essentially a part thereof, will not be estimated for payment; compensation therefor shall be considered as having been included in the price stipulated for this item. Timber or other material removed shall be the property of the Contractor and, if suitable, may be used again. No direct payment will be made for the painting specified in Section 12.4, but the cost thereof shall be considered as having been included in the price stipulated for this item.

MASONRY

See Items 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 30, 38, 39, 40, 45, 46, 47 *and* 48.

GENERAL CONDITIONS

Description of masonry.

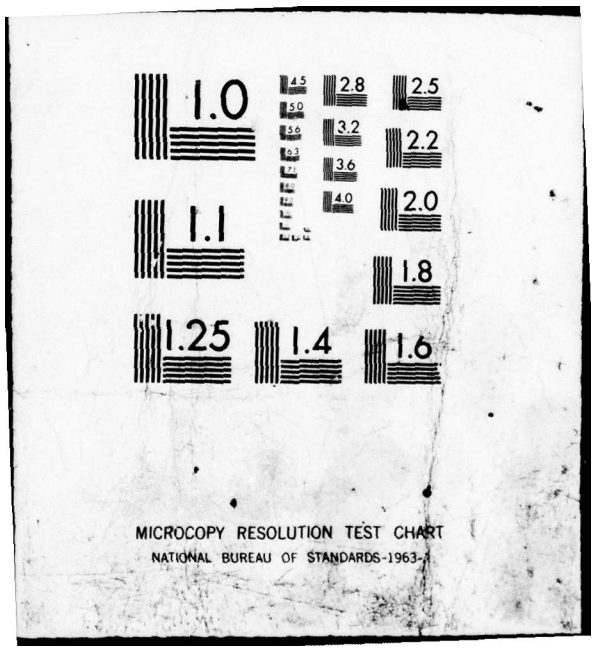
SECT. 13G.1 Concrete masonry will be used for completing the cut-off wall and closing the existing gaps; for the lining of the shaft and tunnels; for the closure of the diversion tunnel; for the release water chamber; for the waste weir; for drains, culverts, retaining walls, foundations and concrete pavement, and for such other purposes as may be shown on the drawings or ordered.

AD-A068 737 KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA F/G 13/2
NATIONAL DAM SAFETY PROGRAM. DOWNSVILLE DAM (NY342), DELAWARE R--ETC(U)
JUL 78 R J KIMBALL DACW51-78-C-0025

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NATIONAL BUREAU OF STANDARDS-1963-A

Stone masonry will be used for facing the waste weir and portions of the weir channel and for trim for the superstructure of the release water chamber and brick masonry for the facing and backing of the walls of this superstructure. Brick masonry, by special permission only, may be substituted for concrete in connection with grouting, stopping flows of water, construction of manholes or for other minor purposes. Any brick or stone masonry or mortar used by permission to take the place of concrete masonry in any part of the work shall be measured and paid for as a part of the masonry with which it is used. Stipulations for various materials, specified in the following general sections, apply to such materials wherever used, except in so far as the stipulations are modified in any particular item.

Materials

Cement.

Sect. 13G.2 For the masonry required under this contract, Portland cement of the quality specified under Item 47 shall be used.

Fine aggregate.

Sect. 13G.3 Fine aggregate for concrete and mortar shall be natural sand of such acceptable size and quality as are approved. All sand shall consist of clean, hard, strong, durable, insoluble and uncoated particles. It shall contain not more than one per cent. by weight of vegetable matter, nor more than three per cent. by weight of clay or silt, and shall be free from such quantities of other deleterious substances as will render it unsuitable. All sand shall be made clean by thorough washing. Any fine aggregate which breaks down into unacceptably fine material on boiling in water, or ten per cent. or more of the dry weight of which is soluble in a 1 to 1 solution of hydrochloric acid in 15 minutes, shall be rejected. Fine aggregate shall contain both fine and coarse particles, with none larger than will pass a ¼-inch mesh screen, and with such gradation in sizes of particles as will produce smoothly working concrete without tendency for the water to drain away. In general, sands containing an excess of fine grain sizes will not be acceptable. Sands shall be subject to tests for organic impurities by the colorimetric method, using a 3-per cent. solution of sodium hydroxide; also to tension mortar tests, and shall show strengths not less than those of similar tests made with standard Ottawa sand.

Coarse aggregate or ballast.

Sect. 13G.4 Coarse aggregate for concrete shall be approved gravel or fragments of acceptable stone broken to such sizes as are herein specified. A mixture of broken stone and gravel may be used, but only as permitted. Coarse aggregate shall consist of clean, hard, strong, durable, insoluble and uncoated pieces and shall not contain undesirable quantities of such that are soft, friable, thin, elongated or laminated; it shall be free from such dust, alkali, organic material, loam, clay, mica, schist or other deleterious substances as will render it unsuitable, and it shall be thoroughly washed so as to be clean at the time it is mixed in concrete. Pieces of coarse aggregate, approximately 1-inch cubes, shall, when immersed in 600 c.c. of a 1 to 1 solution of hydrochloric acid, show a loss from their original dry weight of not more than ten per cent. in 45 minutes. Coarse aggregate shall be of

the sizes suited to the various parts of the work and shall be kept separate according to size before being used in the concrete. The coarse aggregate shall be stored in the following sizes:

(1) Passing a 1½-inch mesh sieve and retained on a ¾-inch mesh sieve.

(2) Passing a ¾-inch mesh sieve and retained on a ¼-inch mesh sieve.

Each size of coarse aggregate shall be graded from fine to coarse within the limits shown, to the satisfaction of the Engineer. A greater maximum size for coarse aggregate may, however, be required in some parts of the work, while in others the maximum size may not be permitted to exceed ¾ inch. Coarse aggregate shall be kept in separate hoppers from fine aggregate, and any mixture of fine and coarse aggregates delivered to the work shall be screened and remixed in ordered proportions before use.

Samples of aggregates.

SECT. 13G.5 Samples of aggregates which the Contractor proposes to use shall be submitted to the Engineer at least two weeks before the Contractor plans to commence delivery at the site of the work. Aggregates shall not be delivered until the samples shall have been approved and, as delivered, they shall be in all respects equal to the approved samples. Samples of fine aggregate (about one quart) shall be submitted in glass jars with stoppers, and samples of not less than one cubic foot of coarse aggregate in suitable boxes or bags. All samples shall be plainly and neatly labeled with the place from which taken, where proposed to be used, the date, and name of collector.

Bricks.

SECT. 13G.6 Bricks shall be new, of the best quality, selected, well burned and hard entirely through, regular and uniform in shape and size, of compact texture and suitable for the purpose for which they are to be used. Samples of the bricks the Contractor proposes to use shall be submitted for approval before any bricks are delivered on the work. Bricks subject to efflorescence will not be acceptable.

Stones for masonry, paving and facing.

SECT. 13G.7 Stones for masonry, paving and facing shall be sound and durable and of established, acceptable weathering qualities, and of sizes and shapes appropriate to the particular work in hand, as specified or ordered. None of the finer grained sandstones, slates, shales nor any other stones which reed or split upon exposure shall be used. Stones for use on all exposed faces shall be selected for color, texture and harmony of appearance throughout the entire work. Stones for use in copings and at other points, as specified or ordered, shall be specially selected for regularity of shape and size. The stones shall be thoroughly cleaned before being brought to the place where they are to be used and shall be satisfactorily clean and wet when placed in the masonry. The use of acceptable stone from the excavations will be permitted.

Water.

SECT. 13G.8 Water for concrete, mortar and grout shall be clean and free from objectionable mineral salts, and suitable means shall be provided by the Contractor for controlling and accurately measuring it.

Concreting appliances and materials to be in readiness.

SECT. 13G.9 The Contractor shall have tools, machinery, appliances and all materials on hand by the time they may possibly be needed, so that concrete can be placed promptly to meet the construction requirements.

Preparing for concreting.

SECT. 13G.10 Before forms are placed for concrete to be built against rock or masonry in any part of the work, all loose or shattered rock, rock debris, earth or other loose material shall be removed from the surfaces against which concrete is to be placed, and the rock or masonry surfaces shall be cleaned by washing with a strong stream of water and scrubbing with brooms and by the use of air from the high pressure pipes, unless permission is granted for the use of another method demonstrated to be equally satisfactory.

Proportions.

SECT. 13G.11 Concrete shall be made of cement and aggregates of the qualities herein specified, combined in the proportions directed from time to time. In general, it will be mixed in the proportions of one volume of cement to about four to six volumes of the aggregates. The proportions of fine and coarse aggregates shall be determined by weight, unless otherwise permitted for small quantities under special conditions. The accuracy of the weighing devices shall be established at the expense of the Contractor by satisfactory tests. Allowance shall be made for variations due to moisture in the aggregates. In determining the proportions of the ingredients, 105 pounds of cement will be considered a cubic foot. The Contractor shall submit for approval plans of the proportioning devices he proposes to use. One central plant may be used for dry batching if desired.

Mixing.

SECT. 13G.12 Concrete shall be mixed in approved mechanical mixers of a type which dumps the mix before recharging, except that if permitted, and if the mixing is done in a satisfactory manner, relatively small quantities may be mixed by hand. The mixers shall not be charged in excess of their rated capacity as designated by the manufacturer. The quantity of water used shall be the minimum which will produce the consistency required by the conditions under which the concrete is to be placed. The water shall be accurately measured. The slumps shall be as ordered or approved, in general from two inches to seven inches. Particular care shall be taken to avoid mixtures that have an excessive water content. The mixing shall be in batches of the sizes directed and shall be thorough and continued, as directed, until every particle of coarse aggregate is covered with mortar of cement and fine aggregate. The time of mixing each batch after all ingredients are in the mixer shall be not less than one minute, or the time required for seventeen revolutions of the mixer, for each cubic yard of mixed ingredients but, whenever ordered, mixing shall be continued for such longer period as directed. No retempering will be allowed under any conditions, and all concrete which has its initial set before placing in the work shall be at once rejected and removed from the work. All concrete when it goes into the forms shall be of uniform consistency without segregation, and shall not contain lumps.

No retempering.

If at any time segregation occurs, the Engineer may require that the materials be satisfactorily remixed at the point of deposit. In case the concrete ingredients are assembled at a point distant from the work, they shall be kept dry and no water added during transportation to the work. Unless the cement is kept separate from the aggregates, all concrete so transported shall be finally mixed within one hour after assembly and, in case the fine aggregate contains more than six per cent. of moisture, this time shall not exceed ½ hour.

Central mixing plant.

SECT. 13G.13 The cement and the amount of each separate size of aggregate entering each batch of concrete shall be determined by direct weighing equipment furnished by the Contractor and approved by the Engineer, and it shall comply with the following requirements:

(1) Its accuracy shall conform to the requirements of the United States Bureau of Standards. Spring scales will not be permitted.

(2) It shall weigh each size of aggregate and the cement separately and each unit shall include an under and over weight indicator. The underweight indicator shall indicate the filling of the last 200 pounds of the batch. The overweight indicator shall indicate overweight to a maximum of 50 pounds. Both shall be graduated in a clear and legible manner. At the Contractor's option, cumulative weighing equipment may be used for aggregates only, instead of the individual weighing equipment herein specified. Such equipment shall be equipped with a visible dial, or equally suitable device, which will accurately indicate scale load at any stage of the weighing operation from zero to full load.

(3) It shall be so arranged that the operator may conveniently observe and inspect the operation of the bin gates and the materials in each weighing hopper. The under and over weight indicators or weighing dials and the water measuring device shall be in full view of the operator when he is at the controls.

(4) It shall be capable of ready adjustment for compensating for the varying weight of moisture contained in the aggregates, or for changing the batch weights.

(5) It shall be operated to control the weight of the cement and that of the fine and coarse aggregates to within one per cent. of the required weights for each. In special cases, the engineer may approve the use of manually operated equipment.

(6) It shall be so arranged as to permit the convenient removal of overweight material in excess of the prescribed tolerances.

Batching plants for dry mixing or for preparing the aggregates for transportation shall conform to the above requirements.

The Contractor shall provide standardized metallic weights for testing the accuracy of the weighing equipment and shall test the cement scales at least once daily and the other weighing equipment at least once weekly. All such tests shall be conducted in the presence of the Engineer.

The quantity of water shall be measured by a suitable tank or other measuring device of a type approved by the engineer and capable of measuring the water in variable amounts within a tolerance of one per cent. The mechanism shall be capable of being locked in position so as to deliver any specified amount of water to each batch. A positive quick acting valve shall be used for a cut off in the water line to the mixer. The operating mechanism must be such that leakage will not occur when the valves are closed. The use of horizontal tanks for the measurement of water will not be permitted.

Placing concrete.

Stiff concrete.

Protection of concrete from water.

Restrictions on masonry work in winter.

SECT. 13G.14 Concrete shall be deposited so as to maintain as nearly a level top surface as practicable in order to avoid segregation and shall be thoroughly vibrated with approved internal vibrators. If a relatively stiff mixture be ordered, it shall be spread in layers about 18 inches thick, as directed. Puddling and vibrating shall be thorough for each layer. In general, the methods shall be such as to give a compact, dense and impervious concrete. No concrete shall be placed against the surfaces of rock or concrete until all water entering the space to be filled with concrete has been cut off by caulking or has been diverted by means of pipes carried through the forms or the steel interlining, or in the case of water on the bottoms of the tunnels until it has been collected in blind drains or pipes and carried to the sumps. No concrete shall be deposited under water without the explicit permission of the Engineer, and then only in strict accordance with his directions, nor shall the Contractor, without explicit permission, allow water to rise on any masonry until after it has been in place for at least 24 hours. Except as permitted in each case, concrete masonry shall not be placed when the air temperature is below 45 degrees Fahrenheit, nor if, at the time of placing, it is probable that the air temperature will fall to 32 degrees Fahrenheit or lower within the following 24 hours. In all such cases, permission will be given only when acceptable methods of heating the concrete materials and of maintaining a sufficient temperature and moisture content of the air in contact with such masonry have been submitted and approved. The temperature of all concrete placed during cold weather shall be maintained at 50 degrees Fahrenheit or warmer for a minimum of 72 hours and it shall be cured as provided in Section 13G.19. When concrete masonry is placed in the tunnels during the winter, the Contractor shall satisfactorily heat the concrete aggregates and the mixing water and, by means of bulkheads, covers or other devices, shall keep the cold air away from the masonry.

Building fresh concrete on old.

SECT. 13G.15 For the proper bonding of fresh concrete with concrete which has set or partially set, such provision shall be made of steps, dovetails or other devices as may be prescribed. Whenever fresh and old concrete masonry are joined, the contact surface of the old concrete shall be thoroughly cleaned, using a stiff brush or other tools and a stream of water under pressure, if required, and the surface shall be clean and wet but free from pools of water at the moment the fresh concrete is placed. Special efforts shall be made to remove very thoroughly any laitance, waste mortar and other substances which would prevent

complete adhesion. Where ordered, a thick wash of rich mortar shall be brushed over the contact surface of the old concrete. Wherever required in open cut work, earth foundations shall be tamped or otherwise compacted, as directed. Wherever directed, platforms on earth shall be built as a part of such foundations and the ordered timber and lumber will be paid for under Item 12.

Contraction and other joints.

SECT. 13G.16 Expansion, contraction, slip or other special joints shall be formed wherever shown on the drawings or required. They shall be made by building smooth faces, acceptably coated with asphaltum paint or other approved substance, or separated by tar or asphalt saturated paper or fabric, as ordered, to prevent adhesion to the adjacent masonry and to permit expansion, contraction or other movement. Such joints as directed, wherever watertight work is required, shall have metal stops or shall be grooved or otherwise shaped, caulked to the extent ordered with acceptable packing material and filled with an acceptable, durable, waterproof and elastic cement, or otherwise formed and treated to prevent leakage. Compensation for the work required by this section shall be considered as having been included in the prices stipulated for the several items of masonry in connection with which the joints are built, except that any ordered metal work forming a part thereof, which is permanently built into the concrete, will be paid for under the appropriate items.

Placing reinforcement and setting metal work.

SECT. 13G.17 Portions of the concrete and other masonry, where shown on the drawings or ordered, shall contain steel reinforcing bars, structural steel or steel interlining to be furnished and placed under the appropriate items. There shall also be built into or set in or attached to the masonry, wherever directed, pipes, castings, metal frames, cast iron grooves, ladders, ladder rungs, bolts, metal strips, water stops or other objects shown on the drawings, required by the specifications, or as ordered; or else recesses, holes or projections necessary therefor shall be left or made in the masonry for metal work or other materials to be set under this or other contracts. All necessary precautions shall be taken when placing the concrete to prevent the reinforcement and other metal work or other materials above referred to from being displaced, broken or deformed. Wherever watertightness is required, concrete, or brick work when specifically ordered or permitted, shall be so placed around the pipes or other metal work as to effectively prevent leakage and secure perfect adhesion. All metal work set under this contract shall be properly protected against injury and kept free from rust, mortar or concrete.

Mortar and grout.

SECT. 13G.18 Mortar and grout shall be made of Portland cement and fine aggregate of the qualities specified, mixed by hand or machine in such proportions and in such manner as directed. Mortar and grout shall be prepared in quantities such that they may be entirely used before they shall have attained their initial set. Grout used for the tunnels and other structures and for other purposes, as ordered, shall be as specified under Item 46. Mortar used for protective coatings shall be as specified under Item 30.

Curing concrete masonry.

SECT. 13G.19 Every precaution shall be taken to prevent concrete and other masonry, wherever placed, from drying out until it has thoroughly set and hardened. To this end, sprinkling may be required to be begun as early as three hours after the placing of each section of masonry and thereafter it shall be kept continuously moist for 14 days. Wooden forms shall be wetted immediately before masonry is placed and shall be kept wet until removed. In the tunnels, suitably arranged spray nozzles or other approved means shall be provided.

Masonry construction may be stopped when conditions are unsuitable.

SECT. 13G.20 The construction of masonry may be prohibited at any time when, in the judgment of the Engineer, the conditions are unsuitable or the proper precautions are not being taken, or the work is being conducted in any way unsatisfactory to the Engineer. In all heavy sections of concrete, both the total volume and the rate of placing shall be regulated and controlled so as to avoid unduly high temperatures during the period while the cement is setting and hardening. All procedures in these matters shall be subject to the prior approval of the Engineer.

Defective masonry.

SECT. 13G.21 Any masonry which shall be found defective at any time before the completion of this contract shall be cut out to the extent ordered and replaced without additional payment therefor. Local repairs shall be made only if explicitly permitted and, if so ordered, they shall be made immediately on removal of the forms. No thin patches or plastering on concrete masonry will be permitted, but recesses shall be cut of a shape to retain the patches and of a depth to insure their permanency. If required, anchor bolts shall be set in drilled holes, and these and wire mesh or other suitable devices embedded in the patch. No mortar richer than one part of cement to 1½ parts of sand shall be used in repairs. Concrete or other masonry built in open cut that, before the expiration of the maintenance period, develops any defects from freezing or lack of moisture, or from any other cause for which the Contractor is responsible, shall be satisfactorily repaired or replaced at the expense of the contractor.

Maintenance.

Removing and replacing masonry.

SECT. 13G.22 If, in accordance with Article XIII, the Contractor removes as directed, portions of the masonry, and the work thus exposed for examination is found satisfactory, or if for any other reason he shall be ordered to remove masonry built in full accordance with this contract, he shall be paid for the excavation of such masonry the price stipulated for Item 5, 27 or 28, as may be appropriate. If the masonry, upon examination, is found to be of acceptable quality, the original masonry will be paid for as well as that used to refill the excavation. In connection with the removing and replacing of masonry in accordance with this section, no quantity shall be measured as less than one cubic yard.

Protection of masonry under construction.

SECT. 13G.23 All stones to be used for facings shall be carefully handled so as not to mar the exposed faces. The erection of derricks and other machinery or of centering and forms, or the landing and storing of stones or other heavy objects upon the surfaces of masonry under construction, or walking or

working over them, will not be permitted until an acceptable time has elapsed for the setting of the concrete or mortar of the masonry. Wherever ordered, the Contractor shall provide, at his own expense, timber coverings for the protection of fresh masonry and platforms for landing and storing stones, buckets and other heavy objects. These coverings and platforms shall have no supports on the masonry except where permitted. Care shall be exercised to avoid disturbing the stones in any way after they have been set, unless particular stones shall be ordered removed. Whenever a stone that has been set has its bond broken, it shall be taken up and reset.

Protecting exposed faces.

SECT. 13G.24 The facing of the waste weir, weir channel, release water chamber walls, retaining walls and all other masonry which is to be permanently exposed to view shall be effectively protected from injury or disfigurement by the falling of stones, tools, mortar or other objects until the final acceptance of the work. The Contractor shall build, at his own expense, timber or other acceptable coverings over the masonry facing, if necessary, for proper protection in the vicinity of landing platforms, under derricks, and in any other places where the faces are particularly liable to injury.

Test specimens of masonry.

SECT. 13G.25 As required for test purposes, the Contractor shall make, care for and store cylinders, cubes, beams, slabs or other shapes of concrete masonry or stone of any class and shall furnish the Engineer with small quantities of mortar or concrete, and shall receive therefor the prices stipulated under the different classes of masonry for the quantities as actually furnished in accordance with directions.

FINISHING CONCRETE SURFACES

Finish and protection of concrete.

SECT. 13G.26 Small projections on concrete surfaces and minor unevennesses at the junction of all forms and elsewhere, which are not serious enough to require the repairs stipulated in Section 13G.21, shall be removed or acceptably corrected upon removal of the forms, skilled men being employed for this purpose. Specially smooth surfaces will be required on the lining of the inclined tunnel. Concrete that is not placed against forms, as in the inverts of the tunnels and that in floors and steps without granolithic finish, shall be screeded to the required lines and grades and floated by skilled artisans to a smooth, even surface. For the top finish of walls and similar structures, the forms shall be overfilled with from one to 1½ inches of concrete. This excess concrete shall then be screeded off just before the initial set begins, as indicated by the apparent drying up of the surface, and worked to the completed and not too slick surface with a minimum of floating and troweling. At no time in the process of finishing any concrete surface shall it be dusted with dry Portland cement or any other material. Exposed surfaces which are not brought to an approved

finish as above provided, or which are not to receive a granolithic finish, shall, as directed, be rubbed to an acceptably smooth condition with a carborundum brick or finished by other approved method. In general, all such finishing shall be done in the dry, the purpose being to remove roughnesses and not to produce a slick surface. Completed linings, the walls and inverts of the tunnels and other finished masonry surfaces shall be protected carefully from all injury and left in satisfactory condition at the completion of the work.

Granolithic finish.

SECT. 13G.27 Concrete floors and other horizontal concrete surfaces, to the extent shown on the drawings or ordered, shall have a granolithic finish not less than 1½ inches in thickness, applied not more than one hour after placing the base, unless otherwise ordered or permitted. All granolithic finish shall be equal to the best sidewalk surfacing and shall be done by a skilled concrete finisher. Finished surfaces shall be divided by contraction joints and intermediate scoring, as indicated on the drawings or ordered. Granolithic finish that is not true to line and grade or that develops cracks or other defects shall be repaired or replaced, as provided in Section 13G.21.

Cleaning exposed surfaces.

SECT. 13G.28 The Contractor shall carefully clean all exposed surfaces of stone masonry, concrete masonry and brick work at the time designated prior to the final acceptance of the work. No direct payment shall be made for this, but compensation therefor shall be considered as having been included in the prices stipulated for the several items of masonry.

BRICK WORK

General method of laying bricks.

SECT. 13G.29 Bricks shall be laid in Portland cement mortar. Each brick shall be wet thoroughly just before being laid by immersion for a sufficient time to fill its pores with water, and after draining off the surplus water it shall be embedded in mortar at the bottom, sides and ends at one operation, care being taken to fill every joint, and the work shall be well and thoroughly bonded. Bricks shall be laid to the lines indicated, with joints as directed, but in general not less than ¼ inch. The outside surfaces of the brick work for manholes shall be plastered with cement mortar ½ inch thick.

PAYMENT

Payment under items only.

SECT. 13G.30 Except for other materials substituted for concrete masonry, as stipulated in Section 13G.1, notwithstanding any statement or implication to the contrary in any of the foregoing Sections 13G.1 to 13G.29, inclusive, no payment will be made for any of the work or materials or operations therein mentioned and described other than as provided in the payment clauses of the appropriate items of these specifications.

CONCRETE MASONRY IN OPEN CUT

ITEM 13

Work included.

SECT. 13.1 Under Item 13 the Contractor shall furnish all labor, equipment and materials, except cement, and shall place all concrete masonry in various structures in open cut as shown on the drawings or ordered. Such concrete masonry shall include that for the cut-off wall, the release water chamber, the waste weir, the weir and waste channels, the backing of stone facing as specified in Section 14.9, the stream gaging station if built, retaining walls, foundations, manholes, drains, posts, culverts, electric conduits and manholes and other structures, as shown on the drawings or ordered and not specifically included in the work to be done under other items. Under this item the Contractor shall also apply a granolithic finish, to the extent shown on the drawings or ordered, to the floors and other exposed concrete surfaces of the release water chamber. Certain portions of the concrete masonry placed under these items will be reinforced with steel and may contain structural steel, steel interlining, conduits and piping for various purposes or other materials as ordered. Such steel, conduits, piping or other materials will be paid for under appropriate items of the contract.

Materials and placing.

SECT. 13.2 The cement and coarse and fine aggregates, the mixing and placing of concrete, the construction of contraction joints, the placing of reinforcement and other metal work, the finishing and cleaning of exposed surfaces, the protection and curing of the concrete and the replacement and maintenance of the masonry shall conform to the requirements of Sections 13G.1 to 13G.30, inclusive, in so far as they are applicable. In the waste weir and elsewhere as ordered, the concrete shall be placed in blocks not more than 40 feet long and five feet high and there shall be a minimum interval of five days between the pouring of adjacent blocks. For concrete that is reinforced, the coarse aggregate shall be of such size as will work closely around the reinforcing metal, leaving no voids. As directed, the concrete shall be placed continuously within the limits designated, so as not to impair the strength of the structures or their individual members.

Forms.

SECT. 13.3 The Contractor shall provide all necessary forms and moulds for shaping the concrete, and the construction, use and removal of such forms and moulds shall comply with the requirements of Sections 13.4 to 13.6, inclusive. If the subgrade of any concrete structure in open cut should be such as to require the use of wooden platforms at any place, such platforms shall be furnished and placed under Item 12. All rods or wire ties that are allowed to remain in the concrete shall be removed to such depths from the face of the concrete as shall be ordered or approved, and the holes shall be immediately filled with cement mortar. For all expenses connected with providing, erecting, maintaining and removing the forms and finally disposing of them outside of the lands of The City, the Contractor shall receive no direct compensation, but the cost thereof shall be considered as having been included in the price stipulated for this item.

Construction of forms.

SECT. 13.4 All concrete forms shall be true to the required shapes and sizes, and shall be strong and rigid so as to withstand without deformation all operations incidental to placing the concrete. The forms when erected shall be watertight; any caulking with oakum or other material found necessary shall be done and suitable materials and tools therefor shall be provided. The smoothest practicable finished surface of the concrete will be required wherever it is part of a waterway. Suitable and effective devices shall be used to hold adjacent edges or ends of panels or other forms tightly together and in accurate alignment and in all cases to hold the forms tightly against the concrete which has been previously placed.

Surfaces of forms.

Holes through forms for pipes.

SECT. 13.5 Wherever it is necessary to lead drain or grout pipes through the concrete forms, the Contractor shall drill holes through the forms at any required positions for the passage of these pipes. Where panels are to be reused, satisfactory plugs that fill the holes flush with the face of the forms shall be provided. Panels in which too many holes have been made shall be replaced, as required.

Maintenance and removal of forms.

SECT. 13.6 The forms shall be maintained at all times in good condition as to accuracy of shape, strength, rigidity, watertightness and smoothness of surface. The Contractor shall keep all forms clean and in good repair and shall furnish and apply, as ordered, any soap, mineral oil, cold-water paint or other approved lubricant or antiadhesive coating. Directions as to the time of removing forms shall be strictly followed, and this work shall be done with great care, so as to avoid injury to the concrete or damage to any details. Forms unsatisfactory in any respect shall not be used and, if condemned, shall be immediately removed from the work.

Finish.

SECT. 13.7 The exposed surfaces of all floors, walls, pilasters and other parts of the release water chamber and the exposed surfaces of culverts, retaining walls, and of all other structures or portions of structures constructed under this item which are not to be screeded to an acceptable finish, shall be made with care against forms that are especially smooth and true. Except for those parts of these surfaces on which a granolithic or other special finish shall be ordered, all such exposed surfaces shall be finished as provided in Section 13G.26. Horizontal and exposed surfaces that are not placed against forms, and for which no special finish is ordered, shall be accurately screeded to the required lines and grades and troweled to smooth, even surfaces as provided in Section 13G.26. Where waterproofing is to be applied to concrete, the surface shall be left in a satisfactory condition for its application. Such care shall be taken as shall effectively prevent the formation of depressions from which water will not drain. The materials, construction, repair or replacement if ordered, and maintenance of granolithic finish shall comply with requirements of Sections 13G.1 to 13G.30, inclusive, in so far as they are applicable and particularly to Section 13G.27. If required, the granolithic finish shall include the forming of a sanitary cove base at the walls and partitions of the release water chamber.

Granolithic finish.

Removable slabs and beams.

SECT. 13.8 Portions of the main floor of the release water chamber, and of other structures if required, shall be made in the form of removable slabs, beams, panels or frames, strengthened with reinforcing or structural steel, or both, edged with metal work as shown on the drawings or ordered, and cast in place on the seats on which they are finally to rest. Where ordered, joints about the removable slabs shall be acceptably packed and filled with elastic cement, as provided in Section 13G.16. Cast iron thimbles, valve stem boxes, metal edgings, lifting devices and other metal work, also lifting holes, match marks and identifying numbers, shall be set, cast or moulded, as shown on the drawings or ordered.

Measurement and payment.

SECT. 13.9 The quantity of concrete masonry to be paid for under Item 13 shall be the number of cubic yards, measured in final position, that are actually placed in open cut within ordered or approved limits. For concrete structures built against the surfaces of rock excavations made under this contract the payment lines for rock excavation shall be the payment lines for concrete placed under this item. Concrete masonry placed in the shaft and tunnels, in concrete pavement or for the base or backing of rubble paving, shall not be included in this item. The division lines between the concrete of Item 13 and the concrete of Item 38 shall be the division lines between the open cut items and the shaft items shown on the drawings. No deduction shall be made for any embedded metal work or other solid material, nor for any opening or pipe with a cross-sectional area of less than one square foot, nor for any space, void, groove or recess of ½ cubic yard or less. Small quantities of rubble or brick masonry, including mortar or grout, that are used by permission for convenience in setting pipes, in manholes, in temporary walls or for other purposes in connection with concrete masonry in open cut, shall be measured and paid for under Item 13. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. No direct payment shall be made for concrete masonry placed outside of the ordered or approved limits, nor for concrete required to fill unauthorized excavations, nor for the cement therein, but the cost thereof shall be considered as having been included in the prices stipulated for the various items. To the extent that such materials are actually incorporated in the work in accordance with orders, wooden foundation platforms, cement, reinforcing and structural steel and other metal work and materials will be paid for under the appropriate items.

DRY RUBBLE MASONRY AND PAVING, RUBBLE PAVING IN MORTAR, STONE MASONRY IN MORTAR AND STONE FACING IN MORTAR

ITEMS 14, 15, 16 AND 17

Work included.

SECT. 14.1 Under Item 14 the Contractor shall furnish and place dry rubble paving on a portion of the upstream face of the dam, on earth slopes in the

vicinity of the waste weir, in drainage gutters, and elsewhere as shown on the drawings or ordered, together with all ordered sand and crushed stone or gravel used to bed the paving or to fill joints. Under this item, also, he shall furnish and place dry rubble masonry for retaining walls or other walls and for other purposes as ordered. Under Item 15 the Contractor shall furnish and place rubble paving in mortar for the invert of the weir channel or portions thereof, if ordered, on the slopes at the ends of the waste weir, for relocated brook channels, for drainage gutters, and elsewhere as shown on the drawings or ordered, together with ordered concrete bases and mortar or grout required to thoroughly fill all joints. Under Item 16 the Contractor shall furnish and place stone masonry in mortar for retaining walls and elsewhere as shown on the drawings or ordered. Under Item 17 the Contractor shall furnish and place stone facing in mortar for the waste weir, for the sides or portions of the sides of the weir channel, as ordered, for retaining walls and elsewhere as shown on the drawings or ordered, together with the concrete or other masonry backing specified to be furnished under this item. Drains shall be placed as provided in Section 14.4. Pipes ordered for drains will be paid for under the appropriate items.

Quality of materials and workmanship.

SECT. 14.2 Stones for masonry, paving and facing, sand and crushed stone or gravel shall be of the qualities specified in Sections 13G.7, 13G.3 and 13G.4, respectively. The mortar and grout shall be as specified in Section 13G.18 and the proportion of sand shall be as directed from time to time. All of the provisions of Sections 13G.1 to 13G.30, inclusive, in so far as they are applicable, shall apply to these items. The general color and texture of the stone of these items in the vicinity of the waste weir and weir channel shall be as ordered or approved.

Size and placing of stones.

SECT. 14.3 Masonry, paving and facing shall be built of stones of suitable size for the work in hand, having such minimum dimensions in each case as are specified or permitted. Stones for stone facing and masonry shall be roughly squared so as to present approximately flat rectangular faces and shall have sides sufficiently straight to provide joints of the thickness specified. Facing stones shall be laid so as to break joints as directed and with reeding planes normal to the exposed faces. The exposed faces of stones in rubble masonry and paving shall be approximately flat. For facing and paving, very few stones shall have a depth less than two-thirds that of the facing or paving and at least one-third of them shall be full depth and evenly distributed. At least one-fourth of the stones in any face of a rubble or stone masonry structure shall be headers evenly distributed throughout the surface and extending into the structure to such depth as directed. Stones used in facing and paving shall be placed with the longest dimension of the exposed face normal to the slope of the surface.

Drains.

SECT. 14.4 Drains of cast iron or vitrified pipe shall be laid behind stone facing, under rubble paving in mortar and through stone masonry in mortar as shown on the drawings or ordered. Vitrified pipe drains, laid with open joints and occasional lengths perforated, shall be surrounded with coarse uniform crushed stone or gravel. Acceptable methods shall be adopted to prevent their clogging with grout or mortar used in the construction of facing or paving. Pipes and man-

hole frames and covers used in the construction of drains will be included for payment under the appropriate items, but the cost of furnishing and placing coarse, uniform crushed stone or gravel and all other costs in connection with the construction of drains shall be considered as included in the price stipulated for the item with which used. In measuring quantities for payment under the various items, no deduction will be made for the space occupied by the drains and manholes.

Dry rubble masonry.

SECT. 14.5 Dry rubble masonry for walls and other structures, as ordered, shall be built of stones of sizes and shapes as directed. No stone shall be less than six inches in thickness, and no stone shall measure in its least horizontal dimension less than 12 inches nor less than its thickness. All spaces between stones shall be solidly packed with spalls. Selected stones, neatly pitched to line, shall be used at all angles and face stones shall be roughly squared so as to present approximately flat faces. Walls shall be coped with stones of thicknesses as ordered, extending entirely across their tops, with neatly squared edges and laid with close joints.

Dry rubble paving.

SECT. 14.6 For a portion of the upstream face of the dam and on adjacent reservoir slopes, heavy dry rubble paving shall be placed, bedded in crushed stone or gravel, and it shall be of the thickness and extent shown on the drawings or otherwise required for each place. In general, it shall be not less than two feet six inches thick, but at some places lighter paving may be used in accordance with directions. Stones shall have even top faces having an area, unless otherwise permitted, of not less than two square feet. Paving stones shall be placed in contact with each other, thoroughly bedded in crushed stone or gravel. Joints shall be thoroughly filled with tightly driven spalls to secure a solid construction with a firm, true water face. Dry rubble paving for gutters and other minor structures, as ordered, shall be built of stones of ordered sizes laid on edge, true to line and grade, bedded in sufficient sand to bring them to a uniform surface, thoroughly rammed in place and all joints swept full of sand.

Rubble paving in mortar.

SECT. 14.7 Heavy rubble paving in mortar for the weir channel, for the inlet to the inclined tunnel and elsewhere as ordered shall be of such thickness as may be required for each place. In general, the thickness of the paving will be three feet, measured from the surface of the paving to the payment line for rock excavation. Stones shall have even top faces having an area, unless otherwise permitted, of not less than two square feet. Paving stones shall be laid close together and supported on spalls or broken stone so that their top faces will form an even surface at the required slope having joints not exceeding three inches at the surface for the weir channel and inclined tunnel, and four inches elsewhere. Voids beneath and between the lower ends of the stones shall be packed tightly with clean broken stone of sufficient coarseness to permit penetration of grout. An occasional course across the channel shall be laid in mortar to form a stop, permitting grouting to be completed in sections. All joints shall be poured full, using a creamy grout mixed in ordered proportions. Paving may be laid on a mortar or concrete bed and mortar may be used in the joints, provided acceptable methods are adopted to completely fill all voids with spalls and mortar im-

mediately after the paving is laid to insure monolithic construction throughout. Mortar or grout shall be broomed into the joints of the paving and all excess mortar or grout shall be removed from the top of the paving by washing or other approved means. Lighter paving for relocated brook channels, gutters and elsewhere as ordered shall be built of stones of acceptable sizes, bedded in a 6-inch foundation of concrete, if required, laid as specified for heavy paving.

Stone masonry in mortar.

SECT. 14.8 Stone masonry in mortar for retaining walls, and elsewhere as ordered, shall be built of stones not less than eight inches by 16 inches by 16 inches, laid to break joints at least four inches. No continuous vertical joints will be permitted. Each stone shall be placed in a properly prepared bed of mortar and settled to a full bearing and vertical joints shall be filled with mortar thoroughly rodded. No spalls shall be used which in any way interfere with the placing of mortar. The requirements of Section 14.5 regarding selected stones, face stones and copings shall be complied with as ordered. Where ordered, drains shall be built and metal anchors shall be placed as specified in Sections 14.4 and 14.10.

Stone facing for excavated rock slopes.

SECT. 14.9 Stone facing in mortar for the sides or portions of the sides of the weir channel, of the thickness and extent shown on the drawings or ordered for each place, shall be laid against the excavated rock slopes. In general, for rock excavation under this contract, the thickness of the facing shall be three feet, measured from the plane of the pitch lines of the joints to the payment line for rock excavation. When placed against surfaces of rock excavations made under previous contracts, which are more than three feet from the ordered pitch lines of the facing, the extra masonry required shall be concrete masonry and shall be paid for under Item 13. Exposed faces of stones shall be not less than 12 inches by 24 inches, unless otherwise permitted. Facing stones shall be laid carefully to line, with face joints averaging about one inch and nowhere greater than two inches in thickness, in full mortar beds, with vertical joints thoroughly filled with spalls and mortar and spaces between the facing stones and the ledge rock filled with concrete, mortar or stone masonry in mortar as directed. Joints shall be pointed with a smooth tool before the mortar is set hard, the purpose being to have the joint-filling mortar monolithic and to require no raking out and separate pointing. The surfaces of joints shall be struck off neatly to the pitch lines and the faces of stones shall be left clean and free from mortar.

Stone facing for waste weir and concrete structures.

SECT. 14.10 The provisions of Section 14.9, in so far as they are applicable, shall apply to stone facing for the surface of the waste weir, retaining walls, and elsewhere as ordered, except as modified for the weir. The stone facing of the waste weir between its crest and toe shall be built of rock-faced stones having a total variation from their pitch lines of not more than one inch. The face joints shall not exceed one inch in width and adjacent stones shall be laid with edges flush. Stone facing of the waste weir and of other concrete structures may be laid in advance of the concrete masonry to serve as a form but shall not be built in greater lifts than are authorized. Continuous vertical contraction joints not more than ¾ inch wide shall be built, as directed, using stones which have been neatly pitched to line. Stone facing shall be well bonded with the supporting masonry or attached thereto by heavy metal anchors or dowels as directed.

Measurement and payment.

SECT. 14.11 The quantities to be paid for under Items 14 to 17, inclusive, shall be the number of cubic yards, respectively, of dry rubble masonry and paving, rubble paving in mortar, stone masonry in mortar and stone facing in mortar furnished and placed in accordance with orders within the limits prescribed, without deduction for drains. Division lines between these items shall be as shown on the drawings. For purposes of measurement, the exposed faces of structures under these items shall be assumed to be planes through the ordered location of pitch lines at the faces. The thickness of facing and paving shall be as shown on the drawings or ordered for each place. For structures built against the surfaces of rock excavations made under this contract, the payment lines for rock excavation shall be the payment lines for these items, and no payment will be made for concrete or other masonry required to fill unauthorized excavations outside these limits. For structures built against the surfaces of rock excavations made under other contracts, the payment lines for these items shall be the actual surfaces of the rock or as provided in Section 14.9. Joints between granite coping and the masonry constructed under Items 15, 16 and 17 shall be included for payment under these items. Concrete, sand, crushed stone or gravel, mortar and grout, within prescribed limits, used for backing or bedding the stone facing and paving or to fill joints therein shall be included for payment under the item with which used. If dry rubble masonry or paving is grouted in accordance with orders, it shall be measured for payment as stone masonry or rubble paving in mortar. The prices per cubic yard stipulated for these items shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under these items, in the manner herein set forth and specified. Cement, cast iron and vitrified pipes, drilling holes, dowels, and granite coping will be paid for under the appropriate items.

GRANITE COPING, TRIM AND CURB

ITEM 18

Work included.

SECT. 18.1 Under Item 18 the Contractor shall furnish all materials except dowels, anchors and other metal work and cement, and shall set in place all granite coping for the stone masonry work shown on the drawings or ordered, for coping the waste weir, the masonry facings in the weir channel and the portal of the inclined tunnel; for trim for the release water chamber, curbs adjacent to the chamber and for such other structures as are shown on the drawings or ordered. The granite work for the release water chamber includes the cornice, the base and belt course with incised lettering, the chimney cap, the sills of windows and doorways and granite curb adjacent to the chamber. As a part of the work under this item the Contractor shall do such trimming, drilling, cutting and dressing as may be ordered or approved. All materials and workmanship in connection with the setting of the granite coping, trim and curb shall comply with the general requirements of Sections 13G.1 to 13G.30, inclusive, in so far as they are applicable. The furnishing and placing of approved stainless elastic expansion

joint compound, prefabricated joint filler and mastic, as ordered, shall be included in this item.

Quality of granite.

SECT. 18.2 The granite shall be selected to meet the requirements of these specifications and shall be strong and durable, of uniform, medium to coarse grained texture, with an even distribution of constituent minerals, practically nonabsorbent, and free from discoloration or evidence of decay and from foreign inclusions and all other defects which would impair its strength or mar its appearance. It shall be a granite equal in its general color, tone and texture to the Deer Island, Goss pink granite quarried at Crotch Island, Stonington, Maine, by the John E. Goss Corporation, or to the Mount Waldo gray granite quarried and cut at Frankfort, Maine, by Grenci and Ellis, Incorporated, or to the Chelmsford, Massachusetts, gray granite quarried and cut by the H. E. Fletcher Company, at West Chelmsford, Massachusetts.

Quarries and plant.

SECT. 18.3 The granite shall be obtained from approved quarries producing stone of the quality specified, which has been demonstrated by exposure in structures to be resistant to weathering. The quarrying, cutting and finishing shall be done by approved firms having adequate facilities to produce finished granite as herein specified without causing delay to the work.

Samples and drawings.

SECT. 18.4 The Contractor shall submit for approval the name and location of the quarry and shop from which he proposes to furnish the granite and, if ordered, he shall provide as many duplicate samples, about eight inches by eight inches by two inches, as are required to show the extreme variations in quality, color and texture of the granite he proposes to furnish and each kind of finish shown on the drawings or ordered. Necessary working drawings and full size details of the lettering on the inscription panels will be furnished by the Engineer. The Contractor shall prepare and submit for approval all necessary shop and erection drawings showing the dimensions, profile, setting number, bedding, jointing, bonding and anchorage of each piece of granite. All granite work shall conform strictly to the approved samples and drawings, unless otherwise ordered.

Finishes.

SECT. 18.5 All exposed surfaces of the granite furnished under this contract shall be tooled as shown on the drawings or ordered, with no part of the surfaces below the pitch lines, and all finishes shall be equal to approved samples. The granite for coping the waste weir and toe of the waste weir shall be cut radially and dressed to profile, with no part of the surface more than ¼ inch above the pitch line. The coping for other masonry facings of the weir channel shall have a rock face finish, with no projections more than three inches above the pitch line. The coping over the portal of the inclined tunnel shall have a scabbled rough face, cut to profile, with no part of the surface more than four inches above the pitch line. In general, for the superstructure of the release water chamber, the cornices, the bases and bevels of all stones shall be hammered equal to four cut or coarser finish; the arrises, bed edges and jointing shall be carefully cut and in general shall conform to the quality of face finish; the belt course shall be four cut except for that portion where the inscription occurs which shall be six

cut. Door sills shall be four cut with wash and finished seats; window sills shall be four cut with wash, scotia and lugged ends, and all through stones shall be four cut on the inside. Joints between the stones of the chamber shall generally be ⅜ inch. Hand tooling necessary to give the stones the required finish may be required. Other styles of finish of approximately equal cost may be ordered or approved for any stone.

Cutting stones; beds and joints.

SECT. 18.6 All exposed surfaces of granite coping, trim and curb shall be out-of-wind, free from waves, projections or depressions except as allowed or required for a particular finish. The faces of all stones in the same plane and the lines and surfaces of adjoining arrises shall be continuous and flush at the joints. No patching or concealment of defects will be permitted. Stones shall be laid on natural beds. For vertical joints, the stones, in general, shall be cut full and approximately square for at least two inches from the faces of the joints, from which point they may fall away not to exceed one inch in 12 inches. For vertical joints in the waste weir, the stones shall be cut full and square for at least six inches from the faces of the joints. Joints in the waste weir shall be ½ inch, elsewhere joints shall be ¾ inch or as ordered. The beds and backs of stones shall be scabbled or split to surfaces which shall not vary more than one inch in 12 inches nor more than three inches either way from the dimension lines shown on the drawings. Stones for coping the masonry facings of the weir channel may be from three to nine feet long and shall be drilled for dowels or recessed for anchors, as ordered. Doweled stones three feet long shall have one 2½-inch hole on the center line and stones over three feet long shall have two or more 2½-inch holes, as ordered. Stones for coping the waste weir shall be approximately four feet thick, nine feet wide, normal to the weir, and of lengths varying from four to six feet. Granite work shall be provided with contraction or expansion joints as shown on the drawings or ordered, with beds and joints dressed throughout and provided with dowels and rabbets as required. The incised inscriptions shall be hand carved by skilled carvers to be approved by the Engineer and shall be true to the approved full size detail drawings.

Contraction joints.

Carving.

Inspection and shipment of granite.

SECT. 18.7 The finished stones will receive a preliminary inspection at the quarry or shop before shipment to the work and if found unsatisfactory shall be promptly replaced. After such inspection, the stones shall be carefully protected from injury and so packed for transportation and handled as to avoid marring the edges, surfaces and portions to be exposed in the structures. Any stone marred during its moving at the storage site or elsewhere, or in transportation or before or after installation and before final acceptance in the structures, shall be promptly replaced at the expense of the Contractor. No packing materials that will stain or discolor the stones shall be used. During freezing weather all lewis and other holes in the stones, as soon as the stone is fabricated, shall be filled and kept full of nonstaining and waterproof material.

Setting, pointing and cleaning.

SECT. 18.8 All stones shall be cleaned and wetted to the extent directed, immediately before setting, and each stone shall be lowered carefully into prop-

erly prepared full beds of mortar, as required, and tapped home to a full and solid bearing; the voids between the backs of stones and other masonry shall be filled with a dense plastic mortar, as required, during this operation and the stones accurately set to true and level lines. No stone work shall be laid when the temperature is below 45 degrees Fahrenheit or when it is probable that the air temperature will fall to 32 degrees Fahrenheit or lower within 24 hours. Attention is directed to the accuracy required and magnitude of the work involved in placing the coping stones of the waste weir, especially in forming their foundation, bedding, wedging, anchoring and grouting. The beds and joints of these stones shall be placed with special care to assure watertightness. The beds of coping stones for the waste weir may be required to be grouted with dense plastic mortar under pressure to an extent and in a manner as approved by the Engineer. The coping stones for the waste weir shall be carefully and accurately set in place with variations from true alignment and profile not to exceed ¼ inch and the difference in the adjoining surfaces shall be dressed as required. All joints shall be completely filled with dense mortar, carefully worked in and finished as the work progresses except where joints are to be left recessed and pointed later.

Projecting stone work to be protected.

The face of all granite work shall be kept free from mortar. As the setting of the granite proceeds, all projecting stone work that is liable to become damaged shall be protected with satisfactory nonstaining boards or boxing put together with galvanized nails to avoid rust staining the stones.

Cleaning.

On completion of all exterior and interior mason work of the chamber, and elsewhere as ordered, the granite shall be carefully cleaned with the other masonry work, using soap powder, boiled in clean water and applied vigorously with stiff fiber brushes. No wire brushes or acids shall be used.

Grouting of joints.

Clean, sharp sand may be used where permitted by the Engineer. Vertical joints between coping stones of the waste weir and elsewhere, if ordered, shall be caulked with oakum to a depth of two inches and these joints filled with mortar and thoroughly rodded. After the mortar is set the oakum shall be removed and the joints acceptably wetted and pointed.

Anchors and dowels.

SECT. 18.9 For all sections of walls of the release water chamber, where granite masonry is backed up by brick or concrete, or elsewhere, as ordered, galvanized steel or monel metal anchors not less than ¼ inch thick, 1¼ inches wide, turned down and cemented into the granite 1¼ inches and extending into the brick work or concrete not less than eight inches shall be provided. Anchors shall be provided for each stone as shown on the drawings or ordered. In general there shall be not less than two anchors to every superficial square yard of granite trim. The bonding of stones around the cornices shall be as shown on the drawings or required. Galvanized steel, monel metal or bronze dowels shall be used as directed. Special anchors will be shown on working drawings. Anchors for a portion of the chimney of the release water chamber and elsewhere as ordered shall be monel metal, $\frac{3}{16}$ inch thick, 1¼ inches wide, turned down 1¼ inches and of the required lengths, engaging in 24 U. S. gage monel metal dovetail slots not less than 1⅛ inches deep, felt filled and embedded in the concrete backing. All anchors shall be equal to the product of Hohmann and Barnard, Inc., New York, N. Y.

Mortar.

SECT. 18.10 Mortar for laying granite shall, in general and unless otherwise directed, consist of one part of Portland cement and two parts of fine aggregate by volume. The fine aggregate shall be such as to cause no staining of the stones or harmful chemical reaction with the cement. The mortar shall be mixed dry, in small batches, to which clean, fresh water shall be added and the whole remixed until thoroughly homogeneous. The mortar shall not be retempered after it has begun to set.

Granite curb.

SECT. 18.11 The granite furnished for the curbs shall be a durable stone of acceptable color and texture, equal to and in harmony with the granite furnished for the superstructure under this item, and shall be cut to ordered dimensions radial or straight and finished as required. In general, the granite curb shall be 6 inches wide by 16 inches deep of ordered or approved lengths. The straight curb shall have its front and back sawed parallel and hammer finished for at least eight inches down from the top or as otherwise required; the top beveled ½-inch in six inches and hammer finished. Any radial portions of curb shall be of the required radii at the front and back. The back of radial curbs may be vertical and for at least eight inches down from the top together with the top and front, shall be hammer finished and shaped to conform to the profile and finish of the straight curb. All curbs six inches in width shall have at least a 5-inch bed; wider curbs shall have proportionately larger beds. All curbs shall be set with front faces inclined as directed and to the lines and grades shown on the drawings or ordered.

Measurement and payment.

SECT. 18.12 The quantity to be paid for under Item 18 shall be the number of cubic yards of granite coping, trim and curb placed in the work in accordance with the drawings or orders, measured as stipulated below. Granite coping shall be measured in place without deductions for mortar joints between adjacent granite stones or for embedded metal work. For the waste weir, the coping shall be measured as having a cross-sectional area of 27.88 square feet and a length of 806 feet. The average cross-sectional area of the granite coping for the waste weir, as actually furnished and placed, shall not be less than 27.88 square feet. For other coping, trim and curb the granite shall be measured in place without deductions for open or mortar joints between adjacent granite stones or for embedded metal work, subject to the provision that no stone shall be estimated for payment as having a thickness greater than shown on the drawings or ordered. The exposed faces of the granite shall be assumed to be the surfaces defined by the draft or pitch lines, or the finished profiles of the smoothly dressed stones. On surfaces other than exposed faces, measurement shall be to the dimension lines shown on the approved shop and erection drawings without additions or deductions for allowable tolerances. All granite curb shall be measured as having a depth of 16 inches and straight curb as having a thickness of six inches. Mortar joints between the granite placed under this item and other masonry will not be paid for under this item but will be included for payment under the item for such other masonry. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item

or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. To the extent that such materials are incorporated in the work in accordance with orders, anchors, dowels and other metal work and cement will be paid for under the appropriate items, but no separate payment will be made for mortar. No direct payment will be made for packing the granite, boxing it in place, for cutting or for drilling holes for anchors, dowels or other metal work or other work required to complete the granite coping, trim and curb nor for forms, centers, bracing, scaffolding, joint compound and joint filler, the cost thereof being considered as having been included in the price stipulated for this item.

BRICK MASONRY

Items 19 and 20

Work included.

Sect. 19.1 Under Item 19 the Contractor shall furnish and place brick facing masonry for facing the surfaces of the walls and partitions for the exterior and interior of the superstructure of the release water chamber, as shown on the drawings or ordered. Under Item 20 the Contractor shall furnish and place brick backing masonry between the exterior and interior facings of the walls, and for the backing of the walls, the column housings and other parts of the superstructure of the release water chamber, for sewer and drain manholes and elsewhere, as shown on the drawings or ordered. Under these items the Contractor shall, as ordered, lay up for approval specimens of the proposed brick work. Fire clay flue lining for the chimneys will be furnished and placed under Item 49. The provisions of Sections 13G.1 to 13G.30, inclusive, shall apply to these items, in so far as they are applicable.

Bricks for exterior facing masonry.

Sect. 19.2 Bricks for facing the exterior of the walls and the chimney shall be solid, "A" grade quality, of variable color, manufactured from fire clay with admixtures producing a brick smooth in texture and gray in color with medium to coarse light brown spots appearing in the brick, equal to those distributed by Fredenburg and Lounsbury, New York, N. Y., or Belden Stark Brick Corp., New York, N. Y., and shall conform to the sample marked F, factory "S" Shade 914, or B 24, to be seen in the office of the Engineer, Room 1322, 120 Wall street, New York, N. Y. The bricks shall be approximately 2¼ inches by 3¾ inches by 8 inches in size, and as they come from the kiln, rejecting only underburned, badly broken, warped, rack marked, and cracked bricks and bats. Special length bricks will be required. If five bricks, selected as representing fairly the run of the lot delivered, after being thoroughly dried and then immersed in water for 24 hours, absorb more water than five per cent. of their weight, the whole lot shall be rejected. The stipulations of Section 13G.6 as are appropriate shall apply to bricks for exterior facing of the walls.

Bricks for interior facing masonry.

SECT. 19.3 Face bricks for facing the walls and partitions for the interior of the superstructure of the release water chamber shall be solid, "A" grade quality, of uniform color, manufactured from fire clay with admixtures producing a brick smooth and light buff in color, with fine scattered spots appearing through the brick, equal to those distributed by the Belden Stark Brick Corp., New York, N. Y., or Fredenberg and Lounsbury, New York, N. Y., and shall conform to the sample marked BS 82 or FL 804 Mingle to be seen at the office of the Engineer, Room 1322, 120 Wall street, New York City. In size, the bricks shall be approximately 2¼ inches by 3¾ inches by 8 inches. Bricks of special size or design will not be required. If five bricks, selected as representing fairly the run of the lot delivered, after being thoroughly dried and then immersed in water for 24 hours, absorb more water than eight per cent. of their weight, the whole lot shall be rejected.

Bricks for backing masonry.

SECT. 19.4 Common bricks of the quality specified in Section 13G.6 shall be used for the filler backing between the exterior and interior facings of the exterior walls and between the face brick of walls and partitions, for filler backing of the chimneys and the column housings of the release water chamber, for manholes and other miscellaneous purposes. In size, the bricks shall be approximately 2¼ inches by 3¾ inches by 8 inches. If five bricks, selected as representing fairly the run of the lot delivered, after being thoroughly dried and then immersed in water for 24 hours, absorb more water than 17 per cent. of their weight, the whole lot shall be rejected.

Mortar.

SECT. 19.5 Mortar for laying brick masonry shall consist of one part of Portland cement and two parts of fine or coarse aggregate by volume, as directed. The aggregates shall be such as to cause no staining of the brick. The mortar shall be mixed dry, in small batches, to which clean fresh water shall be added and the whole remixed until thoroughly homogeneous. The mortar shall not be retempered after it has begun to set. No lime shall be added.

Workmanship.

SECT. 19.6 The brick masonry shall be well bonded and anchored, as ordered. In general, every sixth course of the brick facing masonry shall be headers, except that for walls 8½ inches thick which are faced on both sides, all bricks shall be laid as stretchers and bonded every sixth course with approved galvanized corrugated wall ties or looped wire ties. The space between the bricks of the two faces shall be completely filled with mortar and bricks. Lintels, frames, thimbles, masonry ties and anchors, pipes, structural steel and other metal work shall be incorporated in the brick masonry, as directed, and all required arches, chases, recesses, corbels and other openings, projections or patterns of the brick masonry shall be built as shown on the drawings or ordered. The Contractor shall furnish all necessary approved centers, forms, guides and other temporary supports. The facings of the walls, the partitions, the column housings and the door and window openings shall be true to line and form. No bats shall be used, except where unavoidable, and nothing smaller than half bricks shall be used in making closures. Joints shall have such widths as directed, but none shall be less than ¼ inch or more than ½ inch, and all shall be finished full and flush, or raked

and tooled as ordered. So far as practicable, joints shall be finished as the masonry progresses. Before the completion of the work, any mortar in the faces of the joints which has become loose shall be removed and the joints acceptably pointed.

Final cleaning.

Upon completion of the interior and exterior mason work, all exposed brick, concrete and granite masonry surfaces shall be carefully cleaned, using soap powder boiled in clean water and applied vigorously with stiff fibre brushes or other approved means. No wire brushes shall be used. Clean, sharp sand may be used where permitted by the Engineer.

Measurement and payment.

SECT. 19.7 The quantities to be paid for under Items 19 and 20, respectively, shall be the number of cubic yards of brick facing masonry and the number of cubic yards of brick backing masonry as described above, placed in accordance with the drawings or orders, including the volume of all embedded metal work and with no deductions for any openings of a cross-sectional area of less than one square foot. Brick facing masonry shall be measured in place for payment under Item 19 as of a uniform thickness of four inches without allowance for headers or bonding extending into the backing masonry, except that for walls 8¼ inches thick, the entire wall between the two faces shall be measured for payment. Measurement for payment for brick backing masonry under Item 20 shall include the volume in place of all brick masonry not included under Item 19. Mortar joints between brick backing masonry and masonry placed under other items shall be measured for payment under Item 20. The prices per cubic yard stipulated for these items shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under these items in the manner herein set forth and specified. No separate payment will be made for mortar, but cement will be paid for under Item 47; metal ties and anchors will be paid for under the appropriate items.

ROOF OF SUPERSTRUCTURE OF RELEASE WATER CHAMBER

ITEM 21

Work included.

SECT. 21.1 Under Item 21 the Contractor shall furnish and place over the steel roof framing of the superstructure of the release water chamber, as indicated on the drawings or ordered, all materials, except cement, for the roof consisting of precast reinforced concrete roof slabs and nailing concrete battens, weatherproofing and sheet metal roofing of monel metal or approved equal. Bolts, studs, weld studs, nuts and other metal fastenings and the materials for filling the joints of the roof slabs and battens and for bedding them if required, shall be included under this item.

General description of slabs and battens.

SECT. 21.2 The slabs and battens shall be of the best quality, of maximum density and strength and shall be equal in all respects to those manufactured by Lastik Products Company, New York, N. Y. The fabricators of the slabs and

Shop assembling.

SECT. 26.4 All field connections of trusses to columns and all field connections of one truss member to another truss member shall be subpunched ⅛ inch, reamed, assembled in the shop and match marked, or shall be subpunched ⅛ inch and reamed to a metal templet. Interchange of such parts will not be permitted. No reaming of other field connections will be required, except that holes that must be enlarged to admit the rivets shall be reamed. Poor matching of holes shall be cause for rejection. Drifting to enlarge holes will not be permitted. Holes in material one inch or less in thickness may be punched full size, and holes in material more than one inch in thickness shall be subpunched and reamed, or drilled from the solid. Finished holes in general shall be 1/16 inch larger than the nominal diameter of the rivet. Sheared edges of material exceeding ¾ inch in thickness and carrying calculated stress shall have ¼ inch of metal planed from the sheared edge.

Sheared edges.

Fitting up bolts. Tension splices fully riveted.

Splices and field connections shall be securely bolted and tightly drawn together prior to riveting, using one bolt for not more than three holes. Tension splices shall be riveted up complete before blocking is removed.

Handling and storage.

All material shall be handled and stored, both at the shop and in the field, in a manner to prevent injury to the members and to minimize rusting and deterioration of the protective coatings. All beams and girders shall be stored with the webs vertical.

Bearing plates.

SECT. 26.5 Bearing plates shall be carefully set or shimmed to the required lines and grades before grouting in place. Grouting of the bearing plates shall be as directed. No load shall be placed upon bearing plates until the grout has set for such time as required by the Engineer.

Painting.

SECT. 26.6 All permanent steel work that is not to be embedded in concrete, including surfaces of metal which will come in contact or be inaccessible, shall be given a shop coat of Dixon's Red Lead Graphite Primer No. 101, or equal, immediately after shop fabrication is completed and, after erection, this coat of paint shall be repaired and maintained until the steel work is given the final coat of paint to be applied under this item. Before paint is applied to any metal, or before the metal is encased in concrete, the metal shall be thoroughly cleaned of all heavy rust, loose scale, dirt or other foreign material. All contact surfaces of field connections that are not to be embedded in concrete shall receive one additional coat of the above paint immediately before erection. Painting will not be permitted on wet or damp surfaces, or when, in the judgment of the Engineer, the temperature is too low to insure satisfactory results. Two field coats of paint shall be applied after all erection has been completed and the concrete work finished, except that immediately following the field riveting of members, the heads of such rivets, all abrasions of the shop coat and all field erection marks shall be covered with one coat of shop paint and permitted to become thoroughly dry before the first field coat is applied. The field coats shall be Dixon's Bright Aluminum No. 113-A, or approved equal. All threads and turned or faced surfaces shall receive a coat of white lead and tallow or other approved rust preventive before leaving the shop.

Painting field connections.

Field coats.

Measurement and payment.

SECT. 26.7 The quantity to be paid for under Item 26 shall be the number of pounds, scale weight, of the structural steel described in Section 26.1 incorporated in the structures in accordance with the specifications and directions or satisfactorily placed as ordered or approved, except that the total weight of structural steel to be paid for shall not exceed the weight computed from the approved designs by more than two per cent. Computed weights shall be based on 0.2833 pound per cubic inch of metal. The price per pound stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to furnish, paint and place in the work structural steel of the kind and quality specified and in the manner herein set forth.

SHAFT AND TUNNEL ITEMS

SINKING SHAFT

ITEM 27

Work included.

SECT. 27.1 Under Item 27 the Contractor shall excavate and dispose of all materials encountered in sinking the shaft for the release water chamber at or very near the location shown on the contract drawings. The excavation of ordered or approved temporary concrete blankets or bulkheads placed in the shaft to grout off water, and the ordered excavation of satisfactory concrete masonry in the shaft under the provisions of Article XIII and Section 13G.22, shall be included in the work of Item 27. With the exception of the work properly classified under other items, including the removal of water, the erection of timber or steel support, the placing of protective coatings and concrete linings, and grouting, the work to be done under this item shall include the furnishing of all labor, equipment and materials necessary to excavate the shaft in accordance with the provisions of the following sections and of the general sections, particularly of Sections 24 to 41, inclusive, and to dispose of the spoil in accordance with Section 12.

Order of work in shaft.

SECT. 27.2 The Contractor shall follow the procedure given in this section unless the Engineer shall approve a different procedure proposed by the Contractor in writing. The shaft shall have the section shown on Sheet 22 of the contract drawings or a modification thereof. During the period of sinking, protective coatings of cement mortar shall be applied to the rock surfaces of the shaft, under Item 30, as ordered by the Engineer. In addition to the applying of protective coatings the Engineer may, according to the degree of need, and as the shaft is being sunk, order local enlargements of the shaft excavation and the filling of such enlargements with concrete masonry in order to reduce the leakage or to prevent falling rock. Temporary support shall be placed, if ordered.

Protective coatings and concrete masonry.

Increase in size of shaft.

SECT. 27.3 Small increases in size and changes in shape of shaft excavation as shown on the drawings may be permitted, provided that the total cost to The City shall not be increased thereby; that is, in case the size of the shaft is increased, all quantities under this and other items, except Item 40, will be estimated for payment on the basis of the size and shape given on the drawings or ordered. Drawings showing the proposed change in size and shape shall be submitted to the Engineer for approval. New reference lines approved by the Engineer shall have the significance of the "A line", "B line" and "C line" in controlling the excavation, placing support, fixing the thickness of lining, or modifying the section as provided in Sections 34 to 39, inclusive, and in the measurement for excess concrete as specified in Section 40.2.

Grouting in shaft.

SECT. 27.4 Grout pipes shall be set and grouting done as directed in any part of the shaft. Whenever water is encountered in such amount as, in the opinion of the Engineer, to warrant its exclusion or reduction, excavation operations shall be suspended and holes shall be drilled to such number and in such manner as the Engineer may direct under either or both items 1 and 42 for the purpose of exploring the ground, providing means for consolidating it and for cutting off water by filling all seams and cavities with grout for which payment will be made under the appropriate items. Whenever, in the judgment of the Engineer, it is advisable that "feeler" holes be carried ahead of the excavation, such holes shall be drilled to such lengths and depths as ordered and shall be kept ahead as required. In order to accomplish the ends herein stated, the Contractor shall place all concrete blankets and other constructions specified in Section 41.3, and shall furnish and install all materials as may be ordered for the purpose of cutting off water and consolidating the ground. After grouting has been done under any requirement of this section, excavation operations shall not be resumed without the approval of the Engineer.

Measurement and payment.

SECT. 27.5 The quantity to be paid for under Item 27 shall be the number of cubic yards of the materials specified in Section 27.1, excavated and disposed of as herein specified and measured in place as before excavation. The measurement of rock excavation in the shaft shall be to the "B line" ordered under the provisions of Sections 31 and 34 to 38, inclusive, from the division line between open cut and shaft items to the division lines between the shaft and tunnel items, shown on the drawings. Excavation of concrete blankets or bulkheads shall be measured as the actual volume excavated within the ordered "B line". Enlargements of shaft sections ordered after excavation is begun, or enlargements ordered to remove naturally loose, unsound or disintegraded material outside of the "B line", shall be measured for payment under Item 29 as provided in Sections 37 and 39. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. Payment for permanent and temporary support and for caring for water in the shaft is included under Items 31, 32 and 41; for grouting, under Items 1 and 42 to 46, inclusive, and for cement, under Item 47. Excavations for plant and other purposes of the Contractor will not be estimated for payment.

EXCAVATION OF TUNNEL

ITEM 28

Work included.

SECT. 28.1 Under Item 28 the Contractor shall excavate all materials encountered in the release water tunnel and in the valve and stilling chambers to lines shown on the drawings or ordered, in accordance with appropriate stipulations of the general sections, particularly of Sections 24 to 41, inclusive. The excavation of ordered or approved concrete bulkheads and blankets placed in the tunnels to grout off water, and the ordered excavation of satisfactory concrete masonry in the tunnels under the provisions of Article XIII and Section 13G.22, shall be included in the work of Item 28. As a part of the work under this item, excavated materials shall be disposed of as specified in Section 12.

Grouting in tunnel.

SECT. 28.2 Grout pipes shall be set and grouting done as directed in any part of the tunnels. Whenever water is encountered in such amount as, in the opinion of the Engineer, to warrant its exclusion or reduction, excavation operations shall be suspended and holes shall be drilled to such number and in such manner as the Engineer may direct under either or both Items 1 and 42 for the purpose of exploring the ground, providing means for consolidating it and for cutting off water by filling all seams and cavities with grout for which payment will be made under the appropriate items. Whenever, in the judgment of the Engineer, it is advisable that "feeler" holes be carried ahead of the excavations, such holes shall be drilled to such lengths and depths as ordered and shall be kept ahead as required. These provisions look toward the exercise of reasonable precautions in approaching and passing through ground where bad or dangerous conditions have been or may be developed, as well as to keep the quantity of water entering the excavations down to a reasonable minimum in view of the fact that payment for pumping is provided under Item 41. In order to accomplish the ends herein stated, the Contractor shall place all concrete bulkheads, blankets and other constructions specified in Section 41.3, and shall furnish and install all materials as may be ordered for the purpose of cutting off water and consolidating the ground. After grouting has been done under any requirement of this section, excavation operations shall not be resumed without the approval of the Engineer.

Measurement and payment.

SECT. 28.3 The quantity to be paid for under Item 28 shall be the number of cubic yards of materials specified in Section 28.1, excavated and disposed of as herein specified and measured in place as before excavation to the "B line" ordered under the provisions of Sections 31 and 33 to 38, inclusive. Excavation of concrete bulkheads and blankets shall be measured as the actual volume excavated within the ordered "B line". Enlargements of tunnel ordered after excavation is begun, or enlargements of tunnel to remove naturally loose, unsound or disintegrated material outside of the "B line", shall be measured for payment under Item 29, as provided in Sections 37 and 39. The division lines between Items 27 and 28 shall be the division lines between the shaft and tunnel items as shown on the

drawings. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. Payment for permanent and temporary support and for caring for water is included under Items 31, 32 and 41; for protective coatings of cement mortar, under Item 30; for grouting, under Items 1 and 42 to 46, inclusive, and for cement, under Item 47. Excavations for plant and other purposes of the Contractor will not be estimated for payment.

ENLARGEMENTS OF SHAFT AND TUNNEL

ITEM 29

Work included.

SECT. 29.1 Under Item 29 the Contractor shall do such additional excavating as may be ordered to enlarge any part of shaft or tunnel in rock after excavation of that part has been begun or has been completed, and shall dispose of the excavated materials in accordance with the provisions of Section 12. Such enlargements may be ordered under the provisions of Sections 34, 35 and 37 to permit the use of support, to increase the thickness of the lining or to accomplish any other modification of type or size ordered, or under the provisions of Section 39 to remove naturally loose, unsound or disintegrated material. The relation between this item and the other items for rock excavation in shaft and tunnel is explained in Sections 36 to 39, inclusive.

Limits of enlargements.

SECT. 29.2 Except for excavations ordered under the provisions of Section 39, enlargements made under Item 29 shall be to limits governed by the same "A line" and "C line" stipulations that obtain for excavations for the typical or originally ordered sections, but the limits shall be related to an "A line" and a "C line" of the modified section or type instead of to those of the section or type originally ordered.

Measurement and payment.

SECT. 29.3 The quantity to be paid for under Item 29 for enlargements of section ordered under the provisions of Sections 34, 35 and 37 shall be the number of cubic yards of material measured as before excavation between the ordered "B line" of the modified section or type and the "B line" originally ordered, but for that portion of the periphery in which such enlargement is ordered, the enlargement shall be measured for payment as not less than six inches, whatever be the amount by which the "B line" is ordered moved out. For enlargements required beyond the "B line" under the provisions of Section 39 the quantity to be paid for under Item 29 shall be the number of cubic yards of naturally loose, unsound or disintegrated material between the "B line" of the section or type finally ordered, or the limits of payment for moving out such "B line" as provided in this section, and the actual surfaces to which the material shall have been removed in accordance with orders, or the surfaces of the pneumatically

placed cement mortar protective coatings, if any, that remain when the final cross-sections are taken, computed as before excavation in accordance with Section 39 and with the limitations provided therein. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified.

PROTECTIVE COATINGS OF CEMENT MORTAR

ITEM 30

Work included.

SECT. 30.1 Under Item 30 the Contractor, where ordered, shall place and maintain pneumatically applied protective coatings of cement mortar on the exposed rock surfaces of shaft, tunnel, channel or other excavations, to prevent them from drying, cracking, spalling or disintegrating or where, in the opinion of the Engineer, exposure to the air may make these surfaces unsafe before the permanent lining can be placed. This work shall be done in accordance with the specifications under this item and Sections 13G.1 to 13G.30, inclusive, in so far as they are applicable. Wherever protective coatings of cement mortar are to be applied, the Contractor shall clean and prepare the rock surfaces as prescribed in Section 13G.10, shall caulk seams where required and shall make provision for the omission of the coating at points where grout pipes will be eventually inserted in joints in the rock.

Limitations in use.

SECT. 30.2 Protective coatings of cement mortar shall not be used as a substitute for timber or steel support and no such coating shall be placed in any section of the work in which the ground is heavy or blocky or which for any other reason requires immediate temporary or permanent support, nor shall such coatings be placed where the ground is generally wet, porous or seamy. The compliance of the Contractor with orders to apply protective coatings of cement mortar shall not relieve him of his responsibility to maintain all portions of the work in a safe condition, as provided in Section 40.

Contractor not relieved of responsibility.

Materials.

SECT. 30.3 Sand for the protective coatings of cement mortar shall conform to the requirements of Section 13G.3, shall be so graded in grain size as to be best suited to the work and shall contain at least four per cent. and not more than eight per cent. of water by weight. The cement shall be Portland cement of the quality specified in Item 47 and the water shall be as required in Section 13G.8.

Mixing.

SECT. 30.4 The relative proportions of sand and cement shall be adjusted to the requirements of the work so as to produce protective coatings of greatest density. The sand and the cement shall be measured by volume and thoroughly mixed in an approved machine for a period of not less than one minute and then promptly placed in the pneumatic machine and deposited in the coatings, so as

to avoid partial setting of the cement. Mixed sand and cement remaining in the machine longer than 30 minutes after mixing shall be discarded and no payment shall be made for such discarded sand and cement. Mixing of mortar ingredients by hand will be allowed only in special cases by specific permission of the Engineer. All proportions and operations of mixing shall be subject to the orders of the Engineer.

Application of coatings.

SECT. 30.5 For applying the coatings, the Contractor shall provide apparatus of approved design which will apply the materials by means of pneumatic pressure and in which the required water will be supplied at a discharge nozzle. Facilities shall be provided for metering and controlling the addition of water to the sand and cement as it passes through the discharge nozzle. Air and water shall be provided in sufficient volumes and under such pressures as may be necessary for the best operating conditions, and such pressures shall be steady without pulsations or change except as may be required by wear of the nozzle, changes in length of hose or similar contingencies. In applying the cement mortar, the discharge nozzle shall be held so that the stream of material shall impinge, as nearly as possible, perpendicular to the surface being coated, and the velocity of discharge from the nozzle, the distance of the nozzle from the face and the amount of water used shall be regulated so as to produce a dense coating with the minimum rebound of material and no sloughing. Rebounding material shall not be used again but shall be removed from the work and disposed of by the Contractor as a part of the work under this item. If, in the opinion of the Engineer, the amount of rebound is excessive, such excess as estimated by him shall not be included for payment. In general, cement mortar coatings in the shaft or tunnels shall have a thickness of not less than ½ inch except that a lesser thickness will be permitted on projecting points of rock, but greater or lesser thicknesses may be ordered. In open cut the thickness of such coatings shall be as ordered. Wherever a coating is to be applied upon one previously placed, only sufficient time shall elapse between applications to insure that the material will not slough off. In case an additional coating is ordered over a previously placed layer which has set, the surface of the first layer shall be cleaned by means of air and water jets before starting work.

Thickness of coatings.

Additional coatings.

Measurement and payment.

SECT. 30.6 The quantity to be paid for under Item 30 shall be the number of cubic yards of protective coatings of cement mortar satisfactorily placed in the work in accordance with directions, measured as the sum of the volumes of cement and sand before mixing, with no deductions for rebound except that amount of rebound which, in the opinion of the Engineer, is excessive. In determining the volume of cement, 105 pounds of cement will be considered as one cubic foot. The volume of the water added to the cement and sand shall not be taken into consideration in the measurement of the volume to be paid for under this item. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. Cement will be paid for under Item 47 and sand under Item 45, except for deductions due to excessive rebound as herein specified.

STRUCTURAL STEEL SUPPORT IN SHAFT AND TUNNEL

ITEM 31

Work included.

SECT. 31.1 Under Item 31 the Contractor shall furnish at approved points of storage, transport to the work and erect structural steel support in shaft and tunnel, as provided in Sections 33 and 40 and, shortly before the concrete is placed, shall remove such of the lagging and other parts of the support as may be indicated on the drawings or ordered. Acceptable types of steel roof support for the release water tunnel are indicated on the contract drawings, but other types may be ordered or approved. Under this item shall also be included, if required, the furnishing and erection in the shaft, tunnel and diversion tunnel bulkhead of plain structural shapes, of shields of continuous steel plates supported on steel ribs but not riveted, for protection against excessive wetness over relatively large areas, and of steel plates covering the grout channels in the plug of the diversion tunnel. Also, under this item shall be included, to the extent ordered or approved, the furnishing and placing in holes, drilled under Item 42, of acceptable steel dowels or pins to hold up steel or timber support. Drawings for steel support and shields shall be submitted by the Contractor for approval. If so directed, steel support for the release water tunnel shall be kept on hand as a reserve, ready for use when needed, and in an amount sufficient to avoid delays.

Quality of materials.

SECT. 31.2 Structural and rivet steel to be used for shaft and tunnel support, for steel interlinings, for shields, and the steel for dowels or pins to hold up the roof support shall be new, unrusted stock, and shall comply with the requirements of the Standard Specifications for Steel for Bridges and Buildings, Serial Designation A7-46, of the American Society for Testing Materials. Steel for plates of rib supported shields shall be made by the basic open hearth method and the addition of molten metal to the open hearth shall be as approved and shall fulfill the requirements for Flange Steel as given in the Standard Specifications for Boiler and Fire-Box Steel for Locomotives, Serial Designation A30-46, and steel for rivets, the requirements of the Standard Specifications for Boiler Rivet Steel, Serial Designation A31-40, of the American Society for Testing Materials. All specimens and records shall be furnished and analyses and tests made as provided in the specifications above cited. The Engineer shall be informed in advance of all times of rolling, sampling and testing and shall be permitted to witness such of these operations as he desires. Duplicate samples shall be furnished to the Engineer whenever required. All steel furnished under this item shall be new and unrusted stock, but stock shapes, plates and bars may be used, provided satisfactory evidence of their compliance with the physical and chemical requirements is furnished.

Workmanship.

SECT. 31.3 Punching, shearing and riveting on all steel work under this item shall be well and accurately done. All steel for the support and the shields shall be given one coat of acceptable rust inhibitive paint, as directed. Subsequent operations in the shop and field shall be so conducted as to avoid rusting of the steel.

Measurement.

SECT. 31.4 Structural steel support and shields, and dowels or pins which are furnished, transported and erected in accordance with the drawings or orders, shall be paid for by weight in pounds under Item 31, using scale weights if available, otherwise the manufacturer's list weights, but provided that if payment is based on scale weight, any excess over the list weight beyond 2.5 per cent., for the total of this item, shall not be paid for. Rivets, bolts, nuts and washers used for connections shall also be included in the weights to be paid for under this item, but specimens for test shall not be included for payment. If the Contractor, for reasons of convenience to himself, furnishes material which, while approved as unobjectionable, is unnecessarily heavy, its weight shall be included for payment only to an extent equal to the weight of a design that is considered sufficiently heavy. Likewise, should the Contractor employ dowels or pins to hold roof support which, in the judgment of the Engineer, are unnecessarily numerous, or of unnecessarily large diameter or length, the weight of dowels or pins included for payment shall be that corresponding to the number, diameter and length of dowels or pins that are considered ample to sustain the weight imposed upon them.

Payment.

SECT. 31.5 The quantity to be paid for under Item 31 shall be the number of pounds of structural steel support in shaft and tunnel measured as specified in Section 31.4. Any steel support for the tunnel, not in excess of the ordered reserve, that may be on hand but not erected at the end of the work under this contract, shall become the property of the Contractor and shall be removed by him from the lands of The City, and the furnishing, transporting, storing and removal of such structural steel support shall be measured for payment at the rate of one-fifth of a pound for each pound of such structural steel support. Lagging and other parts of the erected support which may be removed shortly before the concrete lining is placed, or support removed for ordered enlargements, shall become the property of the Contractor and, if suitable, may be used again but no direct payment shall be made for such removal, the cost thereof being considered as having been included in the prices stipulated for the various items of the contract. The price per pound stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to furnish and place in the work structural steel support and steel dowels or pins of the kinds and qualities specified and in the manner herein set forth.

TIMBERING IN SHAFT AND TUNNEL

ITEM 32

Work included.

SECT. 32.1 Under Item 32 the Contractor shall furnish, place, maintain and remove as required, such timber, except wedges, as is ordered or approved in shaft and tunnel to maintain the completed excavations, for instrument platforms and ladders and platforms for borings under Item 1, and such other

timber and lumber as specified or ordered. Such timber shall include posts to support steel wall plates and timbering between the rock and the exterior surfaces of the structural steel support. As a part of the work under this item, the Contractor shall furnish all hardware, including nails, bolts, nuts, washers, spikes and other fastenings used in connection with the timber.

Quality of materials and workmanship.

SECT. 32.2 All timber used by order or with the approval of the Engineer shall be new, of the sizes directed or approved, of suitable quality and sufficient strength for the purposes intended, either square or round, shall be accurately fitted and wedged and kept tightly wedged at all times. Such sizes and spacing of timber shall be used as the nature of the ground may require. If the Contractor is of the opinion that larger or additional pieces of timber or lumber than those ordered should be used in any of the structures, he may, unless otherwise directed, use such larger or additional pieces, but shall not be entitled to payment for any excess over and above the amount ordered. Workmanship shall be first class in all respects and all work shall be done with an accuracy suitable for the special purpose in each case.

Measurement and payment.

SECT. 32.3 The quantity to be paid for under Item 32 shall be the number of thousand feet board measure, of timber and lumber furnished, placed, maintained and removed as required in structures and other wood work that may be included for payment under this item in accordance with Sections 32.1 and 32.2 and subject to the following limitations: No measurement for payment shall be made for wedges, nor shall any direct payment be made for any hardware used with the timber under this item, nor shall direct compensation be made for the cutting of recesses for posts under wall plates, but compensation therefor shall be considered as having been included in the price stipulated for Item 32. Where timber has been placed and enlargement of section is ordered under Item 29, which necessitates the removal of timber already placed in accordance with the stipulations of Item 32, all timber so removed which would have been paid for under Item 32 if no enlargement had been ordered, as well as the timber necessary to maintain the enlarged section, shall be paid for under Item 32 as stipulated. Round timber shall be estimated as square timber of the largest size, omitting fractions of an inch, which can be inscribed in the small end of the stick. The price per thousand feet, board measure, stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to furnish, place, maintain and remove as required, timber and lumber of the kind and quality specified and in the manner herein set forth. Hardware and wedges will not be estimated for payment; compensation therefor shall be considered as having been included in the price stipulated for this item. Timber or other material removed shall become the property of the Contractor and, if suitable, may be used again. Metal pins used to support instrument platforms and timber bents in the tunnel will be paid for under Item 31, and the drilling of holes therefor, under Item 42. No payment will be made under this item for platforms or falsework constructed in connection with the work of Item 31 nor for any other timber or lumber used for the purposes of the Contractor.

STEEL INTERLININGS

ITEM 33

Work included.

SECT. 33.1 Under Item 33 the Contractor shall furnish and erect steel interlinings in the shaft and valve chamber of the release water chamber substantially as indicated on the contract drawings. The steel interlinings shall be electric fusion welded, both in the shop and in the field, except the connections at wall and other castings which shall be bolted. Where castings are bolted to the interlinings, canvas gaskets dipped in red lead shall be furnished and placed under this item. The work to be done shall include all transportation, storage, protection from rust, cleaning, welding, testing and erection.

Quality of materials.

SECT. 33.2 Steel for plates and rivets, if used, shall be made by the basic open hearth process; the addition of molten metal to the open hearth shall be as approved. Steel for plates shall fulfill the requirements for Firebox Steel, Grade B, as given in the Standard Specifications for Low and Intermediate Tensile Strength Carbon-Steel Plate of Flange and Firebox Qualities, Serial Designation A285-46, and steel for structural shapes shall comply with the Standard Specifications for Steel for Bridges and Buildings, Serial Designation A7-46T, of the American Society for Testing Materials. All specimens and records shall be furnished and analyses and tests made as provided in the specifications above cited. The Engineer shall be informed in advance of all times of rolling, sampling and testing and shall be permitted to witness such of these operations as he desires. Duplicate samples shall be furnished to the Engineer whenever required. Electrodes for electric fusion welding shall be suitable for the welding to be done, fulfill the requirements of the Tentative Specifications for Iron and Steel Arc-Welding Electrodes, Serial Designation A233-45T, of the American Society for Testing Materials and shall not be larger than $\frac{3}{16}$ inch in diameter. Steel bolts and nuts shall comply with the requirements of Section 52.3.

Electrodes.

Dimensions, thickness of plates and type of joints.

SECT. 33.3 Unless otherwise ordered or approved, the steel interlinings shall be built up in the shop in lengths or sections as large as practicable for transportation and erection. The thickness of the steel plates will be not less than $\frac{1}{4}$ inch nor more than $\frac{1}{2}$ inch. All joints in the interlinings shall be electric fusion welded joints.

Pickling of steel during fabrication.

SECT. 33.4 At an approved stage in the shop operations, all steel plates and other steel work to be fabricated into the interlinings shall be pickled to remove mill scale by dipping vertically in a dilute sulphuric acid bath which shall be maintained at a strength of approximately five per cent. by volume of oil of vitriol and at a temperature of 125 degrees Fahrenheit. After washing, the remaining acid shall be neutralized by dipping the plates in an approved alkaline bath. Structural steel, bands and other steel work of these interlinings shall be similarly pickled, washed and the acid neutralized at such time as approved. Other methods of cleaning and removing mill scale may be submitted for approval. Subsequent

Protection from rust.

Final cleaning of all surfaces.

operations in the shop and field shall be so conducted as to avoid rusting of the steel, and immediately after fabrication all surfaces of these structures shall be thoroughly covered, by spraying or other effective method, with a heavy coating of boiled linseed oil, or otherwise acceptably protected. All surfaces shall be free from rust, dirt, grease or other foreign matter before concrete or mortar is deposited around or inside the interlinings and during fabrication and erection all surfaces as required shall be made equally clean.

Fabrication.

SECT. 33.5 All parts of the interlinings shall be accurately cut and formed to the shapes and dimensions shown on the working or approved shop drawings and all operations of fabrication and erection shall be done in accordance with the best shop and field practice for electric welding for the type and kind of welding required and as approved by the Engineer. The cutting of plates to size shall be by approved methods that will not injure the plates. Longitudinal seams in both shop and field assembly shall be alternated and oriented, as directed. Before the plates are rolled, the edges of the plates shall be formed to the required curvature by acceptable methods. The plates shall be cold rolled, except as otherwise approved, for their entire length to the required curvature which shall be continuous and uniform from edge to edge. The rolls shall be of sufficient length and of ample strength for the dimensions and thickness of plate being rolled. The edges of all plates shall be accurately machined, planed or milled to a straight line, true and smooth and shall be free from surface cracks and of such shape and dimensions as to allow thorough fusion and complete penetration, and as approved by the Engineer. All parts shall be adjusted to an accurate fit and be properly marked. Structural shapes shall be bent accurately to the curves required, and the surfaces which will come in contact when fabricated shall be free from burrs and bear over the entire width of the contact surfaces. The tolerances for the circumferences of the cylindrical sections shall be plus $\frac{7}{16}$ inch and the out-of-roundness at any cross-section, measured by the difference between the maximum and minimum diameters, shall not exceed $1\frac{1}{8}$ inches. The alignment of finished sections shall be straight with walls parallel to the axis of the pipe. A completed section of interlining shall have no reverse curvature, sudden change of curvature, kinks or injuries. Wood bracing of approved design and number shall be erected in the shop inside of each section of interlining, as ordered, in order to maintain its shape during transportation, erection in the field and placing concrete. Payment for such bracing will be made under Item 12.

Shaping and rolling plates.

Preparation of edges.

Tolerances.

Bolting.

SECT. 33.6 Where castings are bolted to the interlinings, or at other places if required, the holes shall be satisfactorily reamed and the bolts turned to a driving fit with the threads entirely outside of the holes. Where bolts are used, washers of suitable thickness shall be used under the nuts. Bolts shall be thickly coated with red lead paint before insertion and lead or soft copper grommets shall be provided, if required, to make the holes watertight.

Procedure qualifications.

SECT. 33.7 The welding procedure shall comply with the requirements of the Standard Qualifications for Welding Procedure and Welding Operators, Section IX, Part I, of the American Society of Mechanical Engineers Boiler

Construction Code, 1946 edition. The Contractor shall submit for approval a complete procedure specification with drawings for both shop and field work, as provided in Paragraph Q-101 of Section IX of the Code. Test welds made according to the approved procedure shall be made and tested as required in Section IX of the Code, and under the supervision of the Engineer.

Operator qualifications.

SECT. 33.8 All welding shall be done by experienced operators who are skillful and have had proper and adequate experience in the method of welding and with the materials to be used. No welding operator shall be employed who has not fully satisfied the requirements, including those for overhead welding, of Section IX, Part II, of the American Society of Mechanical Engineers Boiler Construction Code. Experienced welders, who have qualified under the Code and are so certified by the Contractor, will not be required to requalify if they have been engaged in welding of this character within three months. The preparation and testing of test welds shall be as required in Section IX, Part II, of the Code. Qualifying tests shall be made under the supervision of the Engineer who may require additional tests as the work progresses, and may demand the removal of any welder whose work on the interlinings is not satisfactory. The Contractor shall furnish all materials and bear all expenses of qualifying welders.

Welding.

SECT. 33.9 All welding shall be electric fusion welding by the electric arc process. Sections of interlining fabricated in the shop shall be welded by automatic welding machines using a submerged arc, except as otherwise approved. Hand welding with shielded arcs will be permitted as approved by the Engineer on special work that cannot be welded on automatic machines. In the field, all joints shall be hand welded. Double vee butt joints or double bevel tee joints shall be used. The joints of the interlinings that are to be welded in the field shall be single welded butt joints with backing strips, welded from the inside, except as otherwise approved. Approved backing strips shall be used for all butt joints that are welded from one side only. Structural shapes and backing strips shall be fillet welded where connected to plates. Other types of joints may be used where approved or ordered. All welds shall be made in such a manner as to have minimum residual stresses in the welds after cooling and to insure uniform distribution of the load throughout the welded sections with no tendency to produce eccentric loading or shear in the weld or the metal adjacent thereto. Undercutting along the sides of the finish pass shall not be permitted. If welding is interrupted for any reason, special care shall be taken, when welding is resumed, to get full penetration and thorough fusion between the weld metal and the plates and the weld metal previously deposited, chipping being done as required. All slag and scale shall be removed from each deposited layer of welded metal before additional welded metal is applied to its surface, and each layer shall be peened. The edges of the plates at longitudinal joints shall be accurately matched and retained in position during the welding operation. Tack welds may be used to hold the edges in line provided the tack welds are removed so that they do not become a part of the joint. Particular care shall be taken in matching up the edges of plates at circumferential joints to insure that all joints are properly aligned. The edges of plates when in position for welding shall be practically straight and parallel,

the maximum gap between the edges at any point being no more than ⅛ inch greater than the minimum gap required for welding. The maximum permissible parallel misalignment between plates at a joint shall be ⅛ inch. The reinforcement of the welds shall be built up uniformly from the surface of the plate to a maximum at the center of the weld. Particular attention is called, however, to the importance of the provision that there shall be no valley or groove along the edge or in the center of the weld, but that the deposited metal must be fused smoothly and uniformly into the plate surface, and the finish of the welded joints shall be reasonably smooth and free from irregularities, grooves or depressions.

Backing strips.

Where backing strips are used, they shall be shop welded to one end or side of each length of interlining with a fillet weld. Where backing strips are not used, the back of the weld shall be chipped to a sufficient depth to remove slag or other impurities, and welded.

Chipping and grinding.

At the ends of all sections of interlining, the surfaces of the welds that will be in contact after assembling either in the shop or field shall be chipped and ground to conform to the surfaces of the plates.

Test specimens.

SECT. 33.10 Test specimens shall be cut from coupons welded to and with the interlinings for this purpose or from the interlinings, if ordered. If a test specimen is cut from the interlining, an approved patch shall be welded over the opening. Test specimens shall be one inch or 1½ inches in width and not less than 14 inches in length, and the weld shall run transversely on the test piece and be in the middle of the specimen. The Contractor shall provide all facilities for the performance of all tests, either in the shop where the interlinings are being manufactured or in an approved testing laboratory.

Tests of shop joints.

Of joints which are welded in the shop, one tension and one bend test shall be made for each five sections of interlining, and if the test specimens fail to meet the following requirements, the section from which the specimens are taken will be rejected and retests of two additional specimens from another section of the same lot shall be made, each of which shall conform to the requirements specified. If these two additional specimens meet the requirements specified, the remaining sections of the group will be accepted, otherwise all of the sections of this lot will be rejected.

Tension test of weld.

In tension, the weld shall develop not less than 100 per cent. of the maximum tensile strength of the plate and the specimen shall break outside of the weld. A fracture at the point where the weld joins the plate will not be considered as meeting this requirement.

Bending test.

The bending test shall be made by bending the test specimen cold, 180 degrees around a pin, the diameter of which is 3½ times the thickness of the plate, without developing any cracks. In making the test, the weld shall be held in the middle of the bead and the metal on each side bent back 90 degrees from its original position, and the specimen shall be placed with the side representing the inside of the interlining next to the pin. The pin shall be provided with a groove to accommodate the bead on the weld. Under the bend test there shall be no objectionable fracture, either in the weld or the metal adjacent thereto.

Rewelding. Rewelding of sections of interlining that have not been accepted may be permitted, if requested. If allowed, the section to be rewelded shall have the old weld entirely removed, and after rewelding shall be reinspected and subjected to the tension and bending tests. For any section, one rewelding only will be permitted, after which, if it again fails to pass inspection and test, it will be finally rejected.

Inspection and test of field joints. All field welds will be inspected during and after the process of welding and special care shall be taken that proper procedure is followed in the rate of welding, the burn-off of the electrode, the fusion, the penetration, the formation of the bead and the regulation of the arc, so that all welds made under this item are equal in all respects to shop welds. Wherever directed by the Engineer, test specimens shall be provided as specified above and subjected to tension and bending tests. In addition to these tests, the Engineer will subject the welds to such additional tests and inspection as he may deem necessary. Any welded joint which, in the opinion of the Engineer, is unsatisfactory shall have the weld entirely removed and the joint shall be rewelded to the satisfaction of the Engineer.

Erecting interlinings. SECT. 33.11 The steel interlinings shall be erected in place in accordance with the working drawings or orders, shall be true to form, line and grade and exactly in the positions ordered. To this end, concrete piers, saddles and pedestal blocks shall be provided where required, and such precautions shall be taken and such special bracing of the interlinings shall be furnished and used as may be ordered or approved. Any concrete of any outer lining which prevents the erection or the satisfactory welding of the interlining in its ordered position shall be removed at the Contractor's expense to the extent ordered.

Interfering masonry to be removed.

Holes to be cut for pipes. SECT. 33.12 Suitable holes or openings shall be cut or tapped in the interlinings, where and as required, for pipes, castings and other metal work to be set under other items. Pilot holes smaller than the connected members may be required, these to be enlarged after alignment of the work in place. No unreinforced hole shall be located in a welded joint. When an unreinforced hole in the plate is located near a welded joint the minimum distance between the edge of the hole and the edge of the weld shall be at least one inch. All bolt holes shall be drilled in the field to match the connection flanges of the pipes. The burning out of holes through the castings will not be permitted.

Measurement and payment. SECT. 33.13 The quantity to be paid for under Item 33 shall be the actual number of pounds of steel interlinings in the substructure of the release water chamber, including stiffeners, backing strips, permanent bolts and nuts, steel washers and canvas gaskets incorporated in the work, and electrodes used in welding, that are furnished and erected in accordance with the drawings or orders, provided, however, that the total weight to be paid for shall not exceed by more than six per cent. the total weight as computed at 0.2833 pound per cubic inch from the sizes and dimensions of the material ordered. The price per pound stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to

furnish and place in the work the steel interlinings of the kind and quality specified and in the manner herein set forth. Metallic gaskets and grommets, if approved for any of the field joints, shall be paid for under Item 54.

FORMS FOR MASONRY LININGS OF SHAFT AND TUNNELS

ITEMS 34, 35, 36 and 37

Work included.

SECT. 34.1 Under Item 34, for the linings and masonry of the shaft; Item 35, for the linings and masonry of the valve and stilling chambers; Item 36, for the linings of the release water tunnel, and under Item 37, for the linings of the inclined tunnel, the Contractor shall furnish, maintain, erect and remove all moulds, centers and all bulkheads, templets or profiles, and furnish and maintain all screeds and all bonding groove or other forms necessary for the construction of the concrete masonry in the places hereinbefore designated. If a preliminary concrete outer lining is required in any portion of the shaft or in the tunnels, forms for such preliminary outer lining, as well as those for the inner lining, shall be furnished under Item 34, 35, 36 or 37, as the case may be.

Construction of forms.

SECT. 34.2 All concrete forms shall be true to the required shapes and sizes, and shall be strong and rigid so as to withstand without deformation all operations incidental to the placing of the concrete. The forms when erected shall be watertight; any caulking with oakum or other material found necessary shall be done and suitable materials and tools therefor shall be provided. Forms for use in the tunnels shall be so designed as to avoid unnecessary obstruction to the passage of men, materials or construction equipment.

Transportation through forms.

Surfaces of forms.

SECT. 34.3 The smoothest practicable finished surface of the concrete will be required wherever it is part of the waterway. Special attention is directed to the requirements for the inclined tunnel specified in Section 34.6. To secure this, all forms for this part of the work which are to be used repeatedly shall be of satisfactory metal construction; forms which are to be infrequently or once used may be of wood of approved construction. Suitable and effective devices shall be used to hold adjacent edges or ends of panels or other forms tightly together and in accurate alignment and in all cases to hold the forms tightly against the concrete which has been placed previously.

Holes through forms for pipes.

SECT. 34.4 Wherever it is necessary to lead drain or grout pipes through the concrete forms, the Contractor shall drill holes through the forms at any required positions for the passage of these pipes. Satisfactory plugs that fill the holes flush with the face of the forms shall be provided and panels in which too many holes have been made shall be replaced, as required.

Surfaces of wood forms.

SECT. 34.5 The surfaces of wood forms shall be tight and smooth; in the waterways, they shall produce concrete surfaces equal to those made upon metal forms. Wherever required, special forms shall be built in sections, erected complete upon the surface of the ground and satisfactorily rectified before being taken into the shaft or tunnels.

Inclined tunnel lining.

SECT. 34.6 The lining of the inclined tunnel and the vertical curve connecting the inclined and diversion tunnels shall have especially smooth waterway surfaces in true alignment and free from defects and patching. Concrete lining shall be placed continuously, wherever practicable, and construction joints shall be placed only where ordered or approved. All construction joints shall be normal to the waterway surface for at least six inches from such surface and the exposed corners of these joints shall be protected from injury at all times. Form supports and braces which cannot be removed shall be built of concrete as approved but, in so far as it is practicable, the use of such supports shall be avoided. Before proceeding with the construction of forms for placing the lining of the inclined tunnel, the Contractor shall submit to the Engineer for approval drawings showing the scheme he proposes to follow in constructing the lining, including details of the construction, erection, support and removal of the forms, the location and construction of joints in the masonry and the method of placing the concrete. All work in connection with the placing of the lining shall be done in accordance with the approved drawings. The entire finished surface of the lower half of the waterway shall be tested with rigid and true templets at least ten feet long. These templets shall be laid on the surface parallel with the axis of the tunnel and all irregularities of the surface shall be measured. All abrupt variations of the surface from these templets and any variation exceeding ½ inch in any 10-foot length of tunnel shall be eliminated. All corrections of surface finish shall be done by grinding. Patching to correct alignment will not be permitted. The grinding shall not weaken the final finished surface. The finished surfaces of these linings shall be thoroughly protected from injury at all times.

Special forms for outer concrete linings.

SECT. 34.7 If two successive concrete linings, one within the other, are required in any location in the shaft or tunnels, substantial offsets or corrugations of approved design may be required in the surface of the lining first placed to bond the inner lining more effectively to the outer and to prevent leakage, and special forms shall be provided for this purpose.

Forms to be promptly furnished.

SECT. 34.8 Shaft forms shall be promptly furnished to permit compliance with the order of work prescribed in Section 27.2. Forms for the release water tunnel shall be on hand by the time forms may possibly be needed to line a length of tunnel for the purpose of reducing leakage or preventing the disintegration or the falling of the rock. Forms shall be of such construction as to permit them to be readily moved and erected. Whenever, in the opinion of the Engineer, the number of forms provided by the Contractor is insufficient to maintain the required progress, additional forms shall be provided.

To permit required progress.

Maintenance and removal.

SECT. 34.9 The forms shall be maintained at all times in good condition as to accuracy of shape, strength, rigidity, watertightness and smoothness of surface. The Contractor shall keep all forms clean and in good repair and shall furnish and apply, as ordered, any soap, mineral oil, cold-water paint or other approved lubricant or antiadhesive coating. Directions as to the time of removing forms shall be strictly followed, and this work shall be done with great care, so as to avoid injury to the concrete or damage to any details. Forms unsatisfactory in any respect shall not be used and, if condemned, shall be immediately removed from the work.

Measurement and payment.

SECT. 34.10 Regardless of the number of linear feet of forms actually required, the quantity to be paid for in shaft, tunnels and chambers shall be the number of linear feet of such shaft, tunnel or chamber, measured on the axis or center line of the same within the limits hereinafter specified, in which the lining shall have been built with the kind of forms referred to. Where two successive concrete linings, one within the other, as described in Section 34.7, are required, measurement for payment as above described shall be made separately for each set of forms necessarily used in accordance with orders, but if a preliminary or outer lining is placed on only a part of the periphery of a shaft or tunnel the measurement shall be that proportion of the total length lined which the length of periphery lined bears to the total length of periphery. The quantities to be paid for under these items shall be the number of linear feet of forms satisfactorily furnished, maintained, erected and removed, measured as follows: For Item 34, for shaft, the distance from the division line between open cut items and shaft items to the axis of the release water tunnel; for Item 35, for the valve and stilling chambers, the distance between the division lines shown on the drawings; for Item 36, for the release water tunnel, the distances between ends of the linings in the two existing drifts and the division lines shown on the drawings; and for Item 37, for the inclined tunnel, the distance, measured along the center line, between the division line between open cut and tunnel items and existing lining of the diversion tunnel. The respective prices per linear foot of shaft, tunnel and chamber stipulated for these items shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to furnish, maintain, erect and remove forms for masonry linings of the several kinds and of the quality specified and in the manner herein set forth.

CONCRETE MASONRY IN SHAFT AND TUNNELS

ITEMS 38 AND 39

Work included.

SECT. 38.1 Under Item 38 the Contractor shall furnish all labor, equipment and materials, except cement, and shall place concrete masonry in the shaft, and under Item 39, concrete masonry in the tunnels. All such masonry shall be placed as shown on the drawings or ordered, and in accordance with the specifications under these items and Sections 13G.1 to 13G.30, inclusive, in so far as they are applicable. Concrete masonry for the closure bulkhead and plug in the diversion tunnel, for the inclined tunnel and for the valve and stilling chambers of the release

water chamber shall be included under Item 39. As part of the work under Item 39, the Contractor shall cool the concrete masonry in the diversion tunnel plug as specified in Section 38.6. Concrete masonry placed, as ordered or approved, in blankets or bulkheads used to grout off water in shaft and tunnel shall be included under Item 38 or 39. These items shall not include excess concrete masonry of Item 40, concrete masonry which is placed in temporary pump chambers, temporary sumps or enlargements made for the Contractor's plant or purposes (Sections 41.1 and 38.7) or concrete masonry which is placed in the shaft in excess of the requirements (Section 27.3).

Forms.

SECT. 38.2 Forms for the linings and masonry placed in the shaft, tunnels and chambers are provided for under Items 34 to 37, inclusive; all other forms required for the masonry placed under Items 38 and 39, including those for the plug of the diversion tunnel, the bulkhead at the inlet of the diversion tunnel and for other bulkheads, grouting channels or seals required in connection with grouting or for other purposes, for all minor details of the masonry and for concrete pedestals and other supports for forms, shall be considered as having been included in the prices stipulated for Items 38 and 39.

Placing concrete in tunnels.

SECT. 38.3 In the tunnels, special care shall be taken to force the concrete into all the unevennesses of the rock, whether the concrete be placed in the forms by hand or by other methods. Concrete for the lining in the upper portions of the tunnels shall be placed by pneumatic or mechanical methods through pipes. Such pipes shall discharge as nearly as practicable in the highest part of the space to be concreted. Cavities in a tunnel arch which, due to high breakage, extend considerably above the general level of the tunnel roof, shall be filled through vertical or inclined pipes discharging as nearly as possible at the highest point of the excavation. The portions of these pipes, and of vent pipes for the removal of air, that are necessarily left embedded in the concrete will be estimated for payment under Item 43. Longitudinal joints in the tunnel linings shall be true radial planes and satisfactory bonding grooves shall be provided where ordered, but such joints shall be avoided as far as practicable. Transverse joints shall be as ordered or approved.

Construction joints.

Concrete around steel support.

SECT. 38.4 Concrete linings in the tunnels shall not be placed until the provisions of Sections 30 and 32 have been complied with. Ordered removal of lagging from the steel roof support shall be done at such times before the concrete lining is placed as will not cause undue hazard from falling rock in the portion of the roof exposed by such removal. All spaces around the posts, ribs and wall plates of permanent steel support within the limits of the concrete lining shall be filled as completely as practicable, using mortar where required. All spaces which cannot by any practicable means be filled with concrete or mortar shall be grouted under the appropriate items.

Steel interlinings, reinforcement, piping and other metal work.

SECT. 38.5 Piping, the steel interlinings in the shaft and valve chamber and other metal work shall be placed under the appropriate items of the contract in the

concrete masonry, as shown on the drawings or ordered. Reinforcing steel under Item 50 may be required in portions of the concrete masonry linings of the shaft and tunnels. No concrete masonry shall be placed about the steel interlinings and other metal work until their surfaces are acceptably clean.

Cooling concrete in diversion tunnel plug.

SECT. 38.6 A system of pipes shall be placed in the concrete masonry of the diversion tunnel plug, as shown on the drawings or as approved. At such time and in such manner as directed, the Contractor shall circulate cooling water through this pipe system until the temperature of the concrete masonry in the plug has been satisfactorily reduced. Pipes embedded in the concrete will be included for payment under Item 43. No direct payment will be made for connecting the pipe system with a source of supply of cool water or for pumping or otherwise circulating water through the pipes, but compensation therefor shall be considered as having been included in the price stipulated for Item 39. After the temperature of the concrete masonry has been satisfactorily reduced, the embedded pipes shall be used for grouting, as ordered, and filled with grout under the appropriate items.

Filling enlargements of shaft and tunnel for plant.

SECT. 38.7 Enlargements of the shaft and tunnels made for the Contractor's plant, or for drainage channels provided for in Section 41.1, shall be refilled solidly either with concrete, with grouted dry packing or with other masonry, or their openings closed with massive concrete walls or arches to make a smooth waterway, and such linings, walls, columns or arches as may be required, to prevent falls of rock and permit the necessary grouting, shall be built as may be ordered. Such masonry beyond the established "B line", including cement, will not be estimated for payment, but compensation therefor shall be considered as having been included in the prices stipulated for the various items of the contract.

Measurement.

SECT. 38.8 The concrete masonry included under Items 38 and 39 shall be as stated in Section 38.1. Whatever the quantities of concrete actually placed, the quantities to be paid for under Items 38 and 39 in the shaft and in the portions of the tunnels, excavated under this contract, in which no permanent support has been placed, shall be the number of cubic yards of concrete measured from the ordered inside surface of the masonry to the "B line" described in Section 31 and shown on the drawings, or to the "B line" established under the provisions of Sections 36, 37 and 38. The division line between the concrete of Items 38 and 39 shall be the division line shown on the drawings; the division line between the concrete of Item 13 and that of Item 38 shall be the division line between open cut and shaft items shown on the drawings. To the extent that excavation of naturally loose, unsound or disintegrated material in the tunnels in rock shall have been made outside of the established "B line" in accordance with orders under the provisions of Section 39, the entire volume of concrete masonry used to fill such excavation outside of the established "B line", measured to the actual rock surfaces excavated, or to the surfaces of the protective coatings of cement mortar, if any, remaining when the final cross-sections are taken, without any deduction for the volume of grout subsequently placed, shall be estimated for payment under Items 38 and 39; provided, however, that no concrete masonry required to fill any

space excavated outside of the established "B line" shall be measured for payment under these items if the necessity for ordering such excavation has arisen through action or neglect of the Contractor, as described in Section 39. Concrete blankets or bulkheads required for grouting shall be measured for payment under Item 38 or 39 as the actual volume of masonry placed with approval within the established "B line". If, as provided in Section 27.3, a proposal of the Contractor to increase the size or change the shape of the shaft is approved, the concrete shall be measured to the lines corresponding to the size and shape of the shaft that are shown on the drawings or ordered.

Where concrete masonry is placed in lengths of tunnel permanently supported and dry packed, measurement of concrete masonry to be paid for under Item 39 shall be made as follows: At the top and sides, to the under side of the lagging, to and extending along the lines of the under sides of the dry packing stops, to the intersections of these lines with the established "B line", and to the established "B line" below these intersections. Where ribs only or ribs and lagging without dry packing are used for permanent support, measurement for the entire section shall be made to the "B line" established under the provisions of Section 31. In the event of ordered excavation beyond the established "B line" under the provisions of Section 39 below the stops for dry packing, or in case of such excavation in any part of the tunnel cross-section where ribs only or ribs and lagging without dry packing are used for the permanent support, measurement for payment under Item 39 of the concrete masonry filling such excavations shall be made as stipulated in the first paragraph of this section for tunnels not permanently supported. Mortar used at wall plates shall be estimated for payment as concrete, not as grout.

Measurement of concrete masonry placed in the diversion tunnel bulkhead and plug and in the inclined tunnel shall be the actual volume of concrete masonry placed.

No deductions shall be made for embedded steel ribs, steel lagging or other portions of steel support, steel shields, steel interlinings or other solid metal work embedded in the concrete of the shaft or tunnels, nor for any pipe having a cross-sectional area of less than one square foot, nor for any space, void, groove or recess of ½ cubic yard or less, but deduction shall be made for embedded timber which is estimated for payment under Item 32. The volume deductible from Item 39 for embedded timber shall be considered to be that proportion of the total volume of timber embedded in the concrete of Items 39 and 40 and estimated for payment under Item 32 which the yardage of concrete estimated under Item 39 bears to the total yardage of concrete estimated under Items 39 and 40.

Payment.

SECT. 38.9 The quantities to be paid for under Items 38 and 39 shall be the number of cubic yards measured as specified in Section 38.8. The prices per cubic yard stipulated for these items shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under these items in the manner herein set forth and specified. No direct payment shall be made for any forms, nor for dry packing, except as provided under Items 34 to 37, inclusive, but the cost thereof shall be considered as having been included in the prices stipulated for Items 38 and 39. Steel for reinforcing concrete will be paid for under Item 50.

Cement for such of the concrete masonry as is included for payment under Items 38 and 39 will be paid for under Item 47.

EXCESS CONCRETE MASONRY

ITEM 40

Work included.

SECT. 40.1 Under Item 40 is included the placing of that number of cubic yards of concrete masonry, if any, by which the actual quantity of concrete masonry in shaft and tunnel exceeds the quantity to be paid for under Items 38 and 39, measured as described in Section 38.8. In cases where the filling of enlargements is not to be estimated for payment (see Section 38.7), the concrete shall be measured to the "B line", that is, assuming no excess.

Measurement and payment.

SECT. 40.2 The quantity of concrete masonry to be paid for under Item 40 shall be the number of cubic yards of excess concrete described in Section 40.1. If at any time the Engineer shall be of the opinion that the Contractor is making the sections of shaft and tunnel unnecessarily large, the additional concrete used to fill the unnecessary excess spaces, beyond the quantities estimated under Items 38 and 39, shall not be included in the totals by which the quantity, if any, of excess concrete to be paid for under Item 40 is determined, nor shall the cement in such additional concrete be estimated for payment. Deduction shall be made for embedded timber which is estimated for payment under Item 32, the volume deductible from Item 40 for embedded timber being considered to be that proportion of the total volume of timber embedded in the concrete of Items 39 and 40 and estimated under Item 32 which the yardage of concrete estimated under this item bears to the total yardage estimated under Items 39 and 40. No deduction shall be made for the grout placed subsequent to the placing of the concrete masonry. The price to be paid for excess concrete masonry measured as above described shall be five dollars ($5.00) per cubic yard. All costs for excess concrete over and above the amounts to be paid the Contractor at this stipulated price shall be considered as having been included in the prices stipulated for the various items of the contract. The cement used in the excess concrete included for payment under Item 40 will be paid for under Item 47.

GENERAL ITEMS

PUMPING

ITEM 41

Work included.

SECT. 41.1 Under Item 41 the Contractor shall furnish and install the necessary machinery, piping and appliances for pumping that may be required for removing and satisfactorily disposing of water from the shaft, release water tunnel and connecting chambers and he shall do all work, not specifically covered by other

items, required to conduct water to the pumps and keep it from interfering with the progress or affecting the quality of the construction work. Also under this item, when ordered in writing by the Engineer, the Contractor shall take over the existing pumping facilities, by arrangement with Walsh Construction Company and B. Perini and Sons, Inc., or provide equivalent pumping facilities of his own, for the disposal of water from the excavation for the cut-off wall. He shall do all pumping necessary to continuously maintain in this excavation such ground water levels as will permit satisfactory placing of rolled embankment and shall furnish and install any additional machinery, piping and appliances for pumping that may be required. As part of the work under this item he shall furnish power for, operate and maintain all facilities, shall take all ordered precautions to limit the quantity of water to be pumped, as specified in Section 41.3, and shall remove all sediment as provided in Section 49. As directed or approved, he shall remove all these facilities.

Adequate plant and competent mechanics.

SECT. 41.2 The Contractor shall have on hand at all times sufficient machinery, piping and appliances for all ordinary emergencies. All machinery, piping and appliances shall be maintained in good working order. All pumping operations and the supply of power to the pumps shall be at all times under the direct charge of competent mechanics.

Provisions for reducing pumping.

SECT. 41.3 All necessary provisions shall be made for limiting the quantity of water to be pumped, as the Engineer shall determine, which shall appear at any juncture to be in the best interest of The City. Important provisions are given below:

Diversion of water.

(a) Surface and ground waters shall be intercepted and removed before entering the shaft, tunnels or other excavations. Concrete curb walls, earth dikes, ditches or other devices, if required, shall be constructed to prevent such inflows.

Wet ground in shaft and tunnel to be grouted before excavation.

(b) Whenever practicable, all water bearing seams or broken ground in shaft and tunnel which give evidence of yielding any considerable quantity of water shall be grouted previous to excavation preferably through gated pipes set in holes drilled in such ground. If excavation into such ground is permitted before grouting, and large inflows of water occur, they shall be grouted off in one or more of several ways, for example: By depositing concrete in the bottom of the shaft or building special bulkheads of concrete in the tunnel and grouting through pipes in which the inflows have been collected and allowing the grout to set before resuming excavation; by promptly collecting the water by means of drip pans and grout pipes and placing the permanent concrete in shaft or tunnel with or without special shields and dry packing, and grouting off the inflow as soon as the concrete is sufficiently strong. Payment will be made under the appropriate items for all such work, the excavation of concrete blankets or bulkheads being estimated under Item 27 or 28.

Large inflows to be grouted off.

Settling tanks or basins, weirs and meters.

SECT. 41.4 As ordered or approved, settling tanks or basins for the removal of sediment, weirs or other measuring devices and coverings for their protection shall be constructed by the Contractor under the appropriate items of the contract.

Any special devices, such as meters, will be provided by The City and shall be set and connected ready for use by the Contractor as a part of the work under this item. Under this item, also, shall be included, without payment other than is included in the price stipulated per million foot-gallons, the necessary piping to connect these measuring and settling devices for use.

Measurement and payment.

SECT. 41.5 The quantity to be paid for under Item 41 shall be the total number of million foot-gallons computed by multiplying the number of million gallons pumped by each pump, by the difference of elevation in feet between the average level from which such pump takes water and the reasonable level, as determined by the Engineer, to which the water must be raised for proper disposal. The price per million foot-gallons stipulated for this item shall cover all provisions of Section 41.1 and shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. Unwatering of the diversion tunnel, including the stilling basin at its outlet, for the purpose of completing the work therein and pumping from any excavations other than herein specified will not be estimated for payment under this item, but the cost of such work shall be considered as having been included in the prices stipulated for the items for excavation and stream control.

GROUTING

See Items, 1, 42, 43, 44, 45, 46 *and* 47

GENERAL CONDITIONS AND REQUIREMENTS

Explanation of grouting items.

SECT. 42G.1 All work of grouting required in connection with sinking shaft, driving tunnel, constructing the cut-off wall, the waste weir and weir channel, sealing the plug in the diversion tunnel and placing the lining in the inclined tunnel and for any other purpose as may be deemed necessary, shall be done under the following items: Item 1 provides for core borings in rock or masonry for grouting; Item 42, for the drilling of holes in rock or masonry for the steel pipes to be furnished and set under Item 43; Item 44, the labor incidental to connecting the grout pumps to the pipes to be grouted; Item 45, the furnishing of sand for grout; Item 46, the mixing and placing of the grout required, and Item 47, for Portland cement.

Purpose of grouting work.

SECT. 42G.2 Grout is to be used to impregnate and make strong and watertight any porous, weak or shattered rock; to fill seams in the rock; to fill any voids between the rock and any linings, facings or masonry structures; to fill spaces or voids in and about dry packing, steel support, interlinings or other metal work; to make closures in the linings of shaft and tunnel, or elsewhere as needed; to fill construction joints in concrete or masonry; to insure watertightness of the joints between successive layers or linings of concrete, or between a concrete lining and a concrete filling or plug; or for such other purposes as the Engineer shall direct. One of the most important uses of grouting will be that of stopping the inflows of water that may be encountered in rock

Stopping inflows of water.

excavation or which may develop subsequently, before or after the placing of the concrete lining or when the Pepacton reservoir is filled. Such groutings may be done through holes drilled under Item 42 in the exposed surfaces of the rock involved, or through holes drilled in such manner as to intercept the water bearing strata or veins at designated points, or through borings made under Item 1, or in connection with concrete bulkheads or blankets constructed for that purpose, or through holes drilled in concrete linings, or by any other method which the Engineer may order or approve. Grouting shall also be done as ordered to consolidate the rock before excavation in open cut is begun.

Plant and materials in readiness.

SECT. 42G.3 All plant and equipment and all requisite materials for grouting shall be in readiness to promptly grout off all inflows of water and to do all other grouting at such times and places as may be necessary to insure the rates of progress called for in Article VI. The assembly of plant and devices for grouting, the supplying and storing of materials and the order of grouting work in connection with the work under other items shall be such that, so far as practicable, operations under all items may be carried on without interference; but the importance of promptly grouting off inflows of water may be such that any or all other work that may interfere directly or indirectly with the grouting operations may be ordered stopped. For such ordered stopping of work the Contractor shall receive no compensation other than that included in the various items of the contract, nor any extension of time, such stopping of work being deemed an ordinary delay under the terms of Article VI.

Any or all other work may be stopped for grouting operations.

DRILLING HOLES IN ROCK OR MASONRY

ITEM 42

Work included.

SECT. 42.1 Under Item 42 the Contractor shall drill holes of the diameter ordered, from one inch to 2½ inches, inclusive, in rock or masonry, penetrating steel lagging or other steel, if encountered, for exploring the ground ahead of excavations in rock, for grouting, for inspection of grouting, for the insertion of anchor bolts, for the insertion of steel pins in connection with the erection of tunnel roof support, or for other purposes, wherever directed. Holes shall not be smaller in diameter than the size ordered, and not more than ½ inch larger. Holes drilled for grouting or other purposes shall be thoroughly cleaned out before grouting. This item shall not include, however, holes one inch or less in diameter for small anchor or expansion bolts; such holes shall be considered as appurtenant to the metal or other work to be attached and shall not be directly estimated for payment.

Measurement and payment.

SECT. 42.2 The quantity to be paid for under Item 42 shall be the actual number of linear feet drilled in accordance with orders, no hole, however, being reckoned as less than one foot in length. The price per linear foot stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified.

STEEL PIPES FOR GROUTING

ITEM 43

Work included.

SECT. 43.1 Under Item 43 the Contractor shall furnish and set steel pipes, as directed, in holes drilled under Items 1 and 42, in rock or masonry, in dry packing or other masonry as it is being built, or in other approved places, for grouting, for vent pipes, for pipes for cooling the masonry of the diversion tunnel plug, for drains, for tests or for other purposes. Typical arrangements of such pipes are shown on the contract drawings. As a part of the work under this item, the Contractor shall furnish, place and remove cast iron plugs as may be necessary for the care of water or for grouting, or to keep concrete from entering the grout pipes or fittings; shall do any drilling, rodding or other work in connection with keeping the pipes clear, including drilling of pipes for any ordered regrouting, and shall do any work and furnish all materials required in connection with keeping the pipes in position.

Pipes for grouting.

SECT. 43.2 The pipes for grouting shall be of steel, of the iron pipe size ordered, which in practically all cases will be 1½ inches but in no case larger than 2½ inches. Each shall be fitted, in general, at the end which will be adjacent to the finished surface of the masonry, with terminal fittings consisting of a standard steel coupling and a cast iron plug. Any other standard steel or cast iron fittings shall be supplied, as required, for the effective installation and use of the pipes; and all cutting, including beveling or notching vent pipes at the ends adjacent to the rock or steel interlining, required for their subsequent use as grout pipes or for other purposes, and all threading, bending and fitting necessary to erect all pipes complete, as ordered, shall be done.

Fittings and work required.

Installing pipes.

SECT. 43.3 All pipes shall be set at the places designated, and attention is particularly directed to the rigid requirement that the pipes for grouting shall be set with such frequency and in such locations as will make for complete filling with grout of joints, openings or other spaces in the rock outside of the shaft or tunnel lining; of voids between the rock and the shaft or tunnel lining; of voids at steel interlinings; of spaces in the dry packing; of voids at drip pans and elsewhere, as directed; further, to make for the direct and effective placing of grout, the lengths of steel pipes to carry the grout shall be as short as practicable. Where pipes are set in holes drilled in rock or masonry, secure and watertight joints shall be made between the pipes and the sides of the holes by caulking with oakum or by other acceptable means. Where pipes are to be built into the masonry linings of shaft or tunnel, the terminal fittings shall be kept entirely within and at least ½ inch from the finished face of the masonry, and suitable wooden or other plugs or forms shall be provided to prevent the concrete from surrounding and covering the ends of such fittings; the furnishing and placing of such wooden plugs or forms shall be included in the price stipulated for this item. Other plugs, of oakum or other approved material, shall be provided to prevent concrete from entering the pipes and fittings at the ends adjacent to the rock or steel interlinings, and the removal of such plugs shall permit the passage of grout through the pipes. All pipes for grouting shall be so firmly fixed in position that they will not be disturbed by the concreting or other operations.

Measurement and payment.

SECT. 43.4 The quantity to be paid for under Item 43 shall be the number of linear feet of pipes furnished and set in accordance with directions, with the additional allowances for fittings hereinafter stated: For each coupling, each elbow, whether 90 degrees or 45 degrees, each tee, and each bushing, one foot, and for each cross, Y-branch, or malleable iron union, two feet of pipe will be estimated. No separate allowance will be made for cast iron plugs or for nipples; the former will be considered as having been provided for in the allowance for the fittings in which they are used; the latter will be included in the lengths of pipes measured. In measuring the lengths of pipes, no deduction will be made for the lengths of included fittings. The price per linear foot stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to furnish and set in the work steel pipes of the kind and quality specified and in the manner herein set forth. Pipes used for grouting previous to excavation, though removed before completion of the work, shall be included for payment under Item 43 and shall become the property of the Contractor.

MAKING CONNECTIONS FOR GROUTING

ITEM 44

Work included.

SECT. 44.1 Under Item 44 the Contractor shall make hose connections from the pumps for injecting grout to any pipes set under Item 43. Under this item, also, he shall disconnect and clean the hose, shall furnish and set a straightway valve or plug cock on each pipe, including both those to which the grout pump is to be attached and those to be used as vents or indicators, shall remove such valve or cock when the grout shall have sufficiently set, shall install cast iron screw plugs in those pipes which leak or drip, and shall acceptably point all depressions in exposed surfaces of masonry due to the presence of the pipes.

Description of connections.

SECT. 44.2 Connections shall be made by suitable screw joint fittings, and shall be amply strong and so tight as to prevent leakage of grout under the required grouting pressures. Each valve or cock shall have a free opening of area equal to the bore of the pipe. Connections may have to be made with more than one size of pipe.

Covering pipes.

SECT. 44.3 Pointing over the ends of the pipes shall be done with mortar mixed and applied as ordered, and so finished that the exposed masonry faces shall be as smooth as though no pipes had been set.

Measurement and payment.

SECT. 44.4 The quantity to be paid for under Item 44 shall be the number of connections estimated as herein specified. The work to be done in connection with any pipe is much more in the case where the pump for injecting grout is to be attached to the pipe, than in the case where no attachment is made and the pipe is used solely as an indicator or a vent. In the measurement under Item 44 one connection will therefore be included for each of the pipes with which the grouting pump is actually connected and one connection for each three of the

other pipes used solely as indicators or vents, subject to the provisions that the connection shall have been made in accordance with orders and the grouting done to the extent at that time directed. If any ordered connection is made to a pipe, and if grouting is not done through this connection for any other reason than the fault of the Contractor, such connection shall be estimated for payment, and any reconnection for the purpose of an ordered regrouting, after a pipe has been once grouted to the extent then desired, shall also be estimated for payment. For each connection as described above the Contractor shall receive the price stipulated. This price shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein set forth and specified. Cement used in the mortar for pointing over the ends of the pipes will be paid for under Item 47.

SAND FOR FILTERS, GROUT AND PROTECTIVE COATINGS OF CEMENT MORTAR

ITEM 45

Work included.

SECT. 45.1 Under Item 45 the Contractor shall furnish, deliver and place in the filters to the depths required or as directed, filter sand of acceptable quality and sizes, and shall furnish at convenient points of storage on the work natural sand of the quality specified for grout and protective coatings of cement mortar. Under this item, he shall also mix and place grout without the application of pressure. Sections 13G.3 and 13G.5 of the specifications for fine aggregate for concrete shall apply equally to the sand furnished hereunder, in so far as they are applicable.

Sand for filters.

Screening and washing sand.

SECT. 45.2 The sand for filters shall consist of hard, durable, siliceous grains and any sand containing clay or a large proportion of shale or other soft rock particles will not be acceptable. After discarding such portions as are retained on a screen having not less than eight meshes to the linear inch, the sand shall be satisfactorily screened and washed, and clay, silt and materials finer than will be retained on a standard 60-mesh sieve shall be removed to the extent herein specified. In these operations, ample volumes of clean water shall be used and, unless otherwise permitted, not less than three washings of the sand will be required, until when dried not more than five per cent. by weight of the remaining material passes a standard 60-mesh sieve. The volumes of water and the methods employed shall be such as to give acceptably clean sand of the required grain sizes and uniformity. The sand after treatment shall have an effective size not less than 0.25 millimeter nor greater than 0.35 millimeter. By effective size is meant that grain size of the sand than which ten per cent. of that sand is finer.

Size of sand grains.

Sand for grout.

SECT. 45.3 The sand for grout shall be of such fineness that 100 per cent. will pass a standard 8-mesh sieve, and at least 45 per cent. by weight will pass a

standard 40-mesh sieve. The sand for grout and protective coatings of cement mortar, for convenience in handling and measuring into the mixers, shall, unless otherwise permitted, be put into strong sacks, each containing a standard volume of sand.

Sand to be put in sacks.

SECT. 45.4 Sand for filters shall be deposited on the prepared foundations by approved methods that will provide in any section a uniform mass of sand from top to bottom without stratification or unnecessary consolidation and shall be raked level to the required or ordered finished surfaces. The sand shall not be sluiced into place with water, nor placed in layers, nor shall it be tamped, rolled, puddled or otherwise compacted.

Placing sand for filters.

SECT. 45.5 The quantity to be paid for under Item 45 shall be the number of cubic yards of acceptable filter sand satisfactorily furnished and placed in accordance with requirements or orders, measured in final position in the filters; the number of cubic yards of sand actually mixed for grout placed in the work in accordance with orders and estimated for payment under Item 46 or placed without the application of pressure under this item, and the number of cubic yards of sand used in placing protective coatings of cement mortar under Item 30. For convenient measuring of sand in sacks by weight, 90 pounds of sand shall be considered to be one cubic foot. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to furnish, deliver and place in the work sand for filters, grout and protective coatings of cement mortar of the kinds and qualities specified and in the manner herein set forth.

Measurement and payment.

MIXING AND PLACING GROUT

ITEM 46

SECT. 46.1 Under Item 46 the Contractor shall mix and place, with the application of pressure, grout of cement and water, with or without sand, in the proportions directed, to fill seams, voids or spaces and for other purposes, all as described in Section 42G.2. All requisite precautions to prevent the setting of grout which may escape upon the exposed surfaces of the masonry, and all measures necessary for the removal of grout which may have adhered to such surfaces and for restoring such surfaces to their original condition, shall be included in the work under this item. All pressure grouting shall be done with direct acting power driven pressure pumps, except as small quantities of grout may be placed by other means, as permitted.

Work included.

SECT. 46.2. Portland cement of the quality specified under Item 47 shall be used for grout. The quality of the sand required is specified in Section 45.3.

Materials and mixtures.

Grout shall be mixed of a consistency suitable for the work in hand and constantly agitated. Grout for filling fine seams in the rock or other narrow spaces shall be neat cement and water. Such grout shall generally be very dilute, not infrequently so thin as to be "cement milk". Cement for such dilute grout shall be screened, if so directed, to remove the coarser particles. Grout for filling larger spaces, such as the voids in dry packing, shall generally contain sand and shall be as thick as can with certainty be made to flow unimpeded and to fill completely all the spaces behind the masonry and other linings. All materials shall be entirely free from lumps when put into the mixer.

Placing grout.

SECT. 46.3 The placing of grout shall, unless otherwise expressly ordered, be prosecuted continuously until completed to avoid disturbance of grout which has taken an initial set. The grout pumps shall be so operated and controlled that the grout will be delivered uniformly and steadily. Usually, dry cavities shall be grouted before wet cavities, and the grouting shall progress from pipe to pipe in the sequence ordered or approved. In going from lower to higher pipes, no connections shall be made to the higher pipes until the grout has completely filled the space below the higher pipes; as the grouting proceeds, the escape of grout from the upper holes in turn shall be permitted, as directed, as an indicator of successive satisfactory filling of spaces with grout of the required consistency. In general, grouting will be considered completed in any case when no more grout of the required mix and consistency can be forced in under the required pressure. In filling fine seams and consolidating broken ground with dilute grout, grouting shall be continued without thickening the mix, as long as the pipes will take it, unless there is evidence of a large part of the grout escaping. Regrouting of seams or spaces once grouted shall be done as frequently as may be directed to meet the rigid requirement *that all voids be filled completely with grout.*

Sequence of grouting wet and dry cavities and high and low pipes.

When filling of cavities will be considered completed.

Grouting pressures.

SECT. 46.4 The grouting pressures shall be as ordered and as are appropriate to the work in hand; for relatively large spaces, generally under 100 pounds per square inch; for small spaces and fine seams, the approximate maximum pressure will be 500 pounds per square inch. The time of beginning the grouting operations behind the shaft or tunnel linings and the method of conducting such operations shall be as directed; in general, grouting under pressures up to 100 pounds per square inch will not be permitted until the concrete affected has an age of at least fourteen days and for maximum pressures an age of at least thirty days.

Grouting to be done when concrete is sufficiently strong.

Measurement and payment.

SECT. 46.5 The quantity to be paid for under Item 46 shall be the actual number of cubic yards of grout mixed and placed in the work in accordance with directions. Grout shall be measured in its liquid state before placing in the work, and the Contractor shall provide water meters and other suitable means for convenient measuring. If, in the opinion of the Engineer, there is avoidable waste of grout, the volumes of grout, sand and cement thus wasted, as estimated by him, will not be included in the quantities to be paid for. The price per cubic yard stipulated for this item shall include all labor, equipment, materials, expenses and costs, not properly to be classified under any other item or items, necessary to completely perform the work to be done under this item in the manner herein

Deduction of waste.

set forth and specified. Cement will be paid for under Item 47 and sand under Item 45.

PORTLAND CEMENT

ITEM 47

Portland cement.

SECT. 47.1 Under Item 47 the Contractor shall furnish, deliver and place in the work Portland cement that has been manufactured at established American plants of such recognized capacity and quality of output as to insure a product at least equal to that hereinafter specified. Unless otherwise permitted, cement from not more than three plants shall be used and, in general, only the product of one plant shall be used at the same time in any section of the work. Within 15 days following the notice to begin work the Contractor shall submit for the approval of the Engineer the names of the plant or plants from which he proposes to furnish the cement and no cement shall be furnished from any plant until it has been approved. At the same time, he shall also furnish to the Engineer an estimated schedule of the monthly deliveries he will require from each of the said plants during the ensuing four months. This schedule shall be revised by the Contractor every 60 days thereafter.

General requirements.

SECT. 47.2 The cement and the clinker from which it is made will be subjected to thorough inspection, to tests, and to frequent analyses as provided in the following sections. The cement when delivered and used on the work shall be dry and free from lumps and caking.

Requirements of manufacture.

SECT. 47.3 The raw materials from which the cement clinker is made shall be thoroughly blended and finely and uniformly ground; either the dry or the wet process may be used. The flue dust from the kilns shall not be returned to the raw mix, but shall be rejected unless the nature of the raw materials and of the flue dust is such that the alkalinity of the finished cement is less than 3.8 and its content of free alkali is less than 3.5. (See Section 47.8 for test procedures). The kilns shall operate at about 2,700 degrees Fahrenheit and a continuous record of the temperature shall be kept. A regular record shall also be kept of the rates of kiln rotation; these records shall be available to the Engineer and are called for in order to insure the greatest possible uniformity of kiln output. The speed of kiln rotation and the kiln temperature shall be controlled and coordinated so as to produce a hard and completely burned clinker in which the combinations between the several oxides it contains have been substantially completed. Only a minimum of water may be used as an aid for cooling the clinker while it is hotter than dull red; at all other stages it shall be kept dry and protected from the weather. In general, the clinker shall be ground immediately after it has been made; occasionally, it may be stored, but not for a period longer than six weeks. Grinding aids shall not be employed unless they have been declared to and approved by the Engineer. No water or steam shall be permitted to come into contact with the cement or applied to it during or after the grinding

APPENDIX E

CONSTRUCTION DRAWINGS

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CONTRACT 401

City of New York

BOARD OF WATER SUPPLY

DOWNSVILLE DAM
AND
APPURTENANT WORKS

IN THE
TOWN OF COLCHESTER
COUNTY OF DELAWARE
NEW YORK

DECEMBER 1, 1949

Contract drawings for Contract 401 consist of the 39 sheets as listed below:

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8	66857	23	67972	38	68009
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11	66707	26	67975		
12	66845	27	67976		
13	66833	28	67977		
14	66849	29	67978		
15	66850	30	67979		

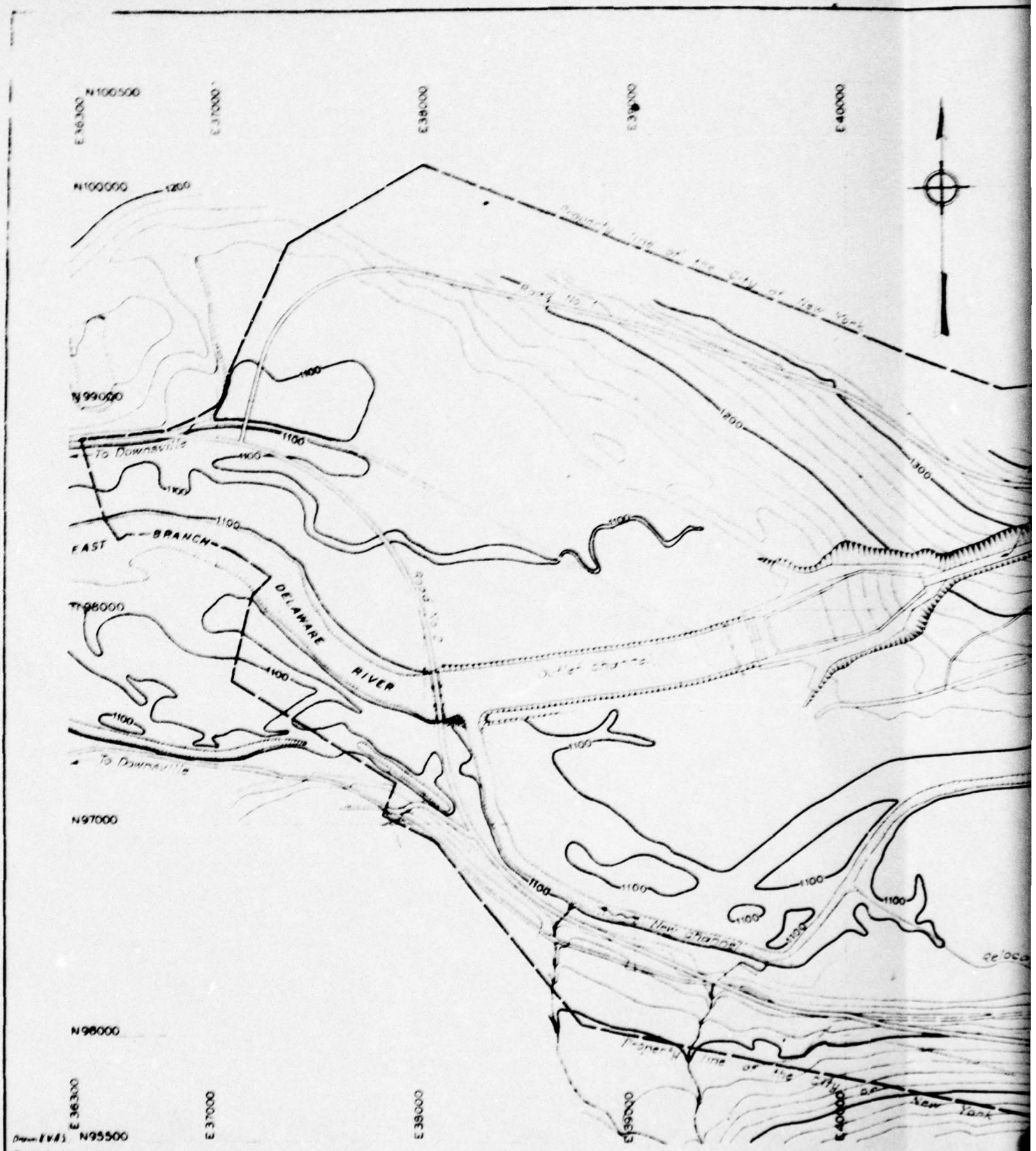
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John M. Fitzgerald
Chief Engineer

Yorke & Sawyer
Consulting Architect

File Cont 401-3.4 ED

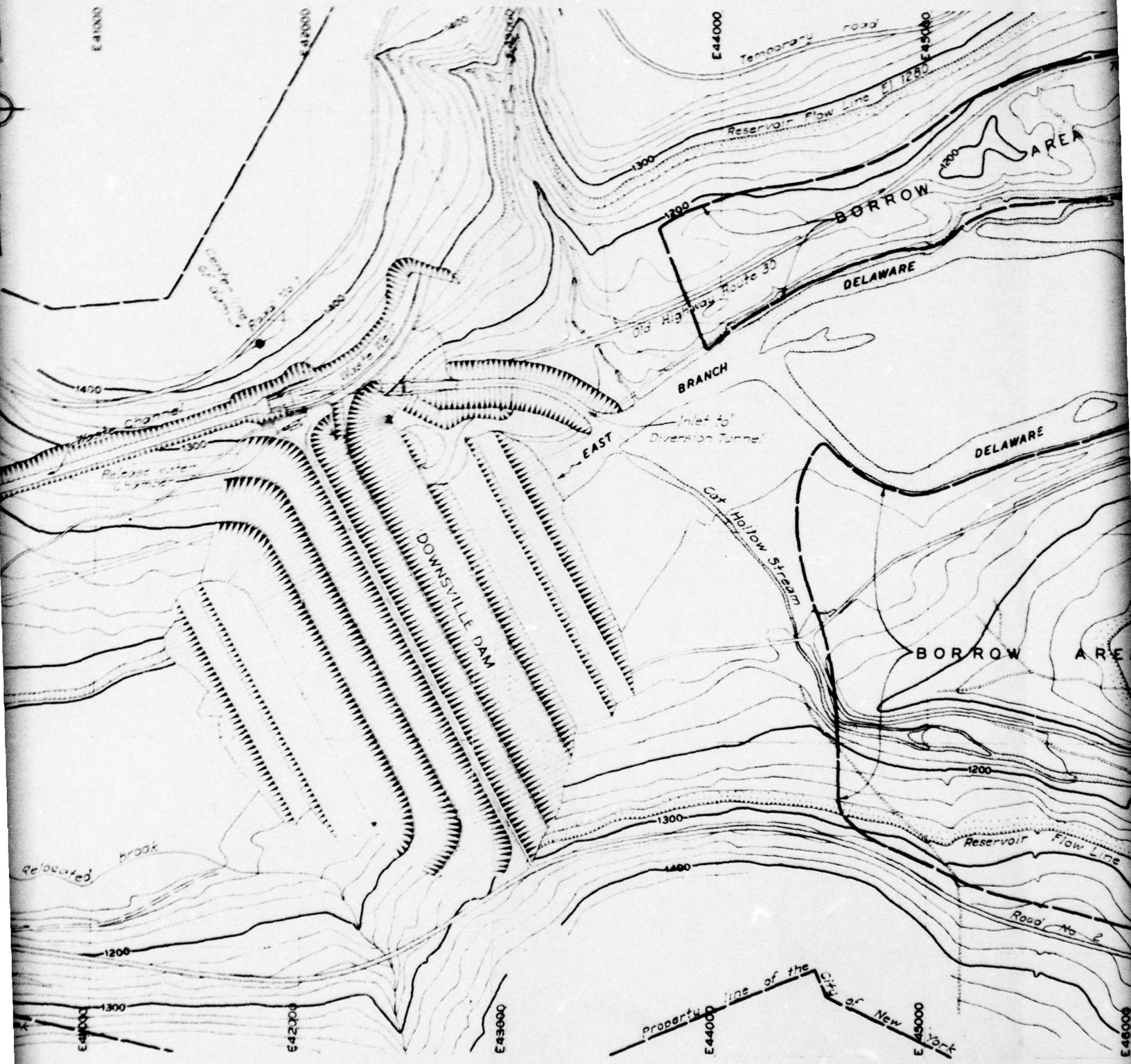
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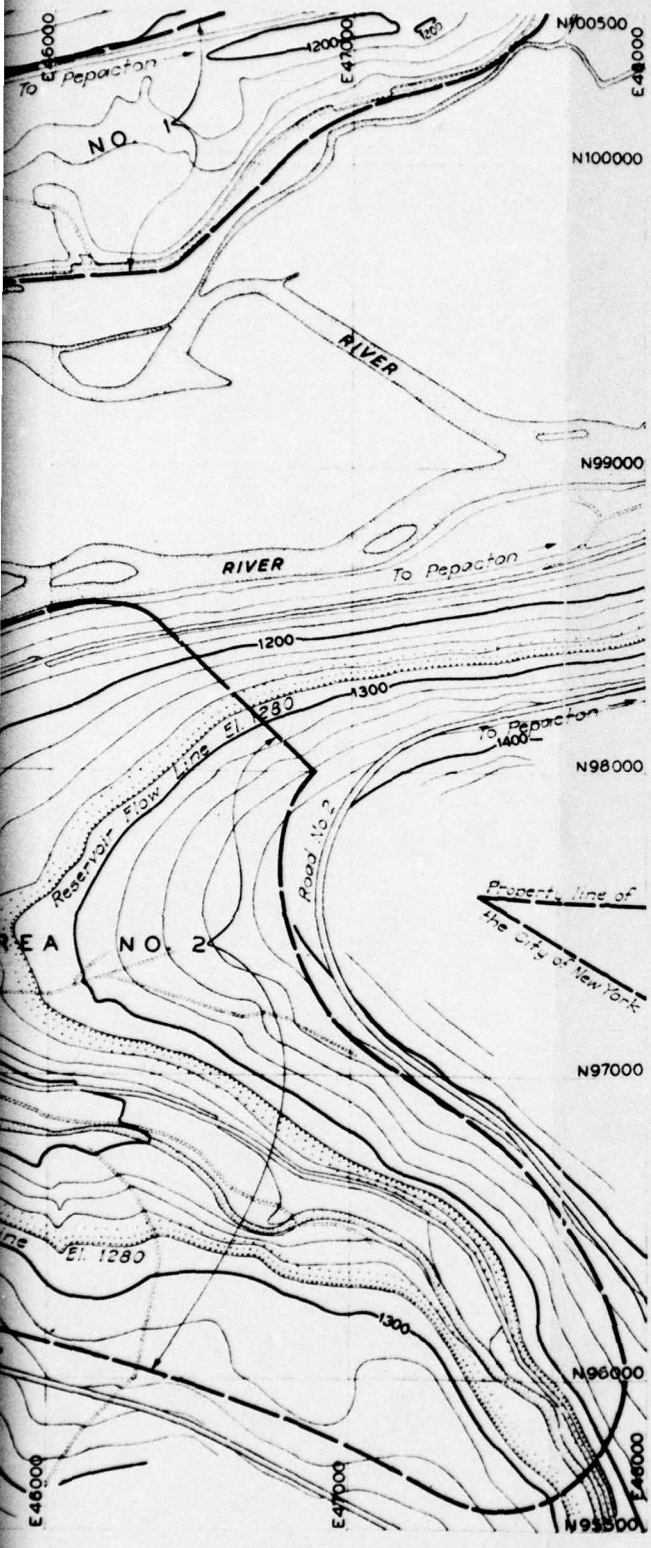
Drawn EVAS
Traced
Checked

Meelwin Matthews
Designing Eng

Ref. Nos 55461, 55466, 55468, 55469, 55650, 55651


E41000
E42000
E43000
E44000
E45000
E46000
Temporary road
Reservoir Flow Line El 1280
BORROW AREA
DELAWARE
Old Highway Route 30
EAST BRANCH
DELAWARE
Inlet to Diversion Tunnel
Cat Hollow Stream
DOWNSVILLE DAM
Relocated brook
Reservoir Flow Line
Road No 2
Property line of the City of New York
1200
1300
1400

CONTRACT 401 SHEET 2
SHEETS IN SET. 39



For existing topography see Sheet 3, Acc. 65405 and Sheet 4, Acc. 66693.

For Dam see Sheet 5, Acc. 66698, Sheet 7, Acc. 66476 and Sheet 6, Acc. 66665.

For Downstream Area Grading see Sheet 19, Acc. 66700.

For Borrow Areas see Sheet 8, Acc. 66857, Sheet 9, Acc. 66863 and Sheet 10, Acc. 66862.

For general plan and section of Waste Weir, Weir Channel and Waste Channel see Sheet 12, Acc. 66845.

For Diversion Tunnel Closure see Sheet 17, Acc. 66543.

For general plan and section of Release Water Chamber see Sheet 20, Acc. 67970.

City of New York

BOARD OF WATER SUPPLY

DOWNSVILLE DAM
LOCATION PLAN

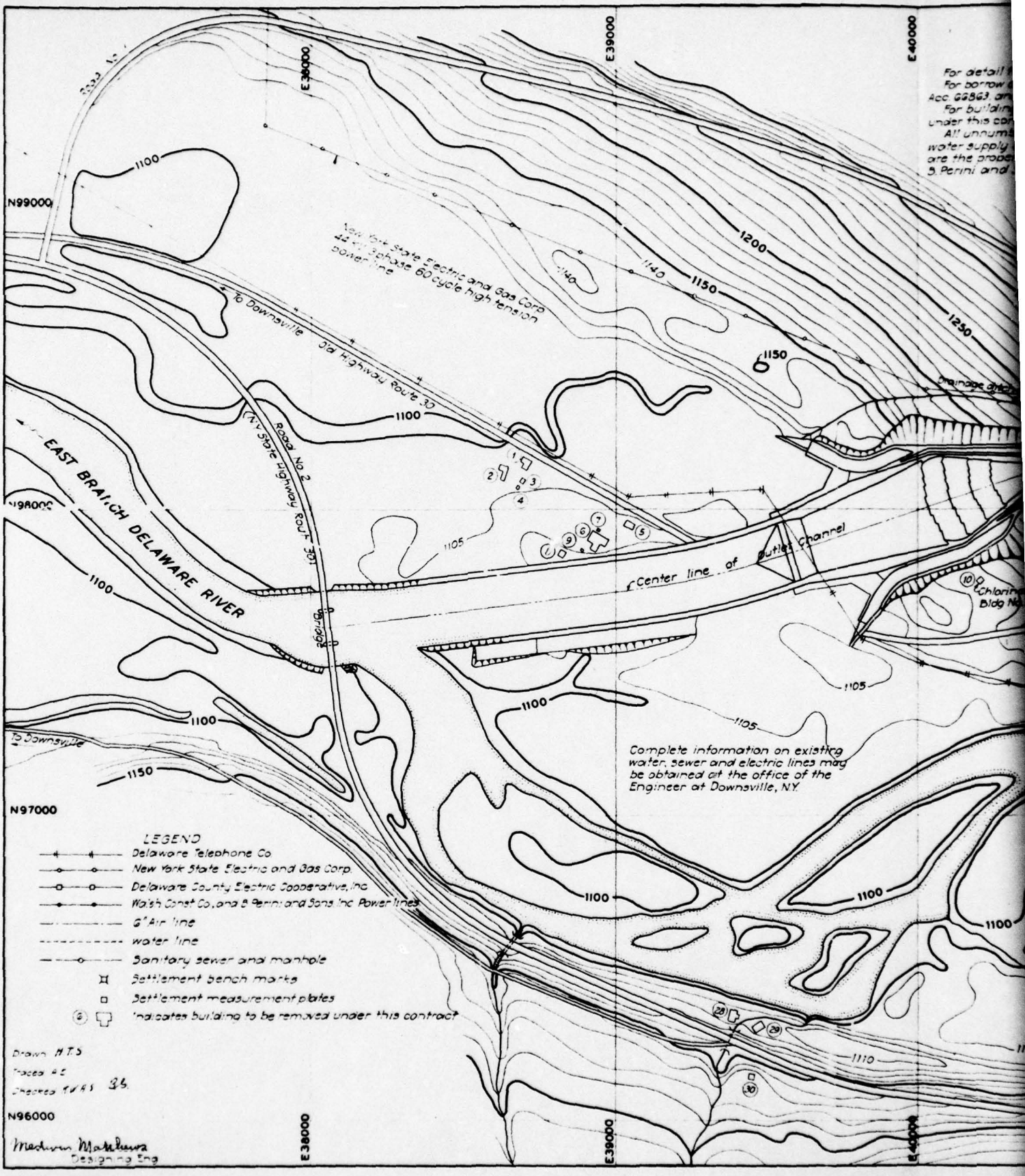
300 0 300 600Ft.

DECEMBER 1, 1949

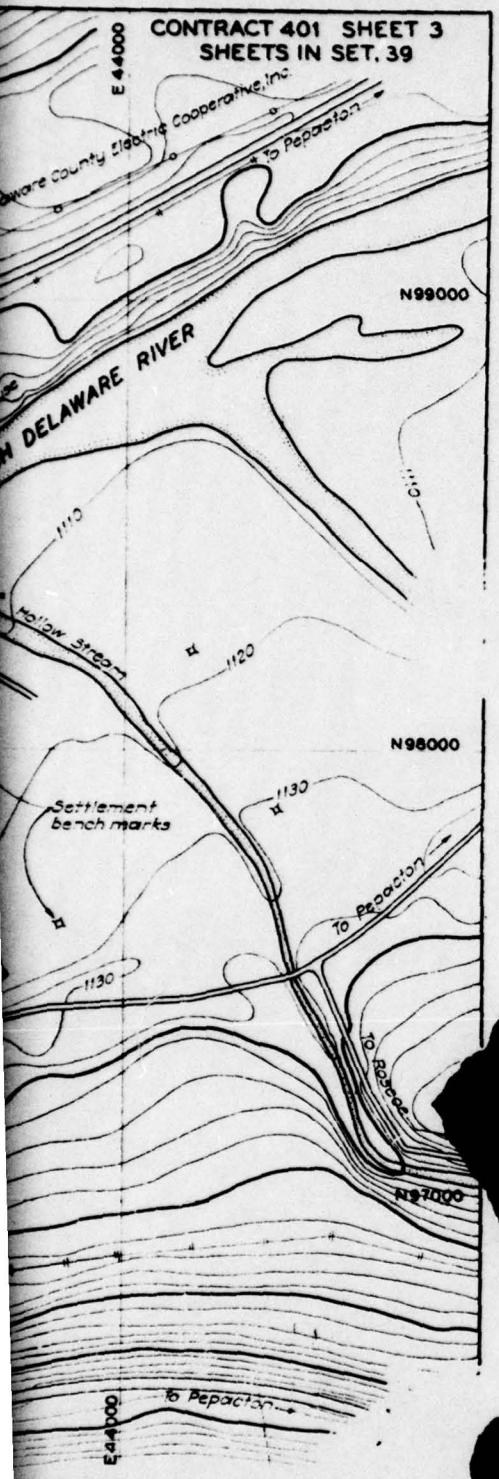
Dept Eng Hdqrs

File 401-3.4 ED

Acc 64195

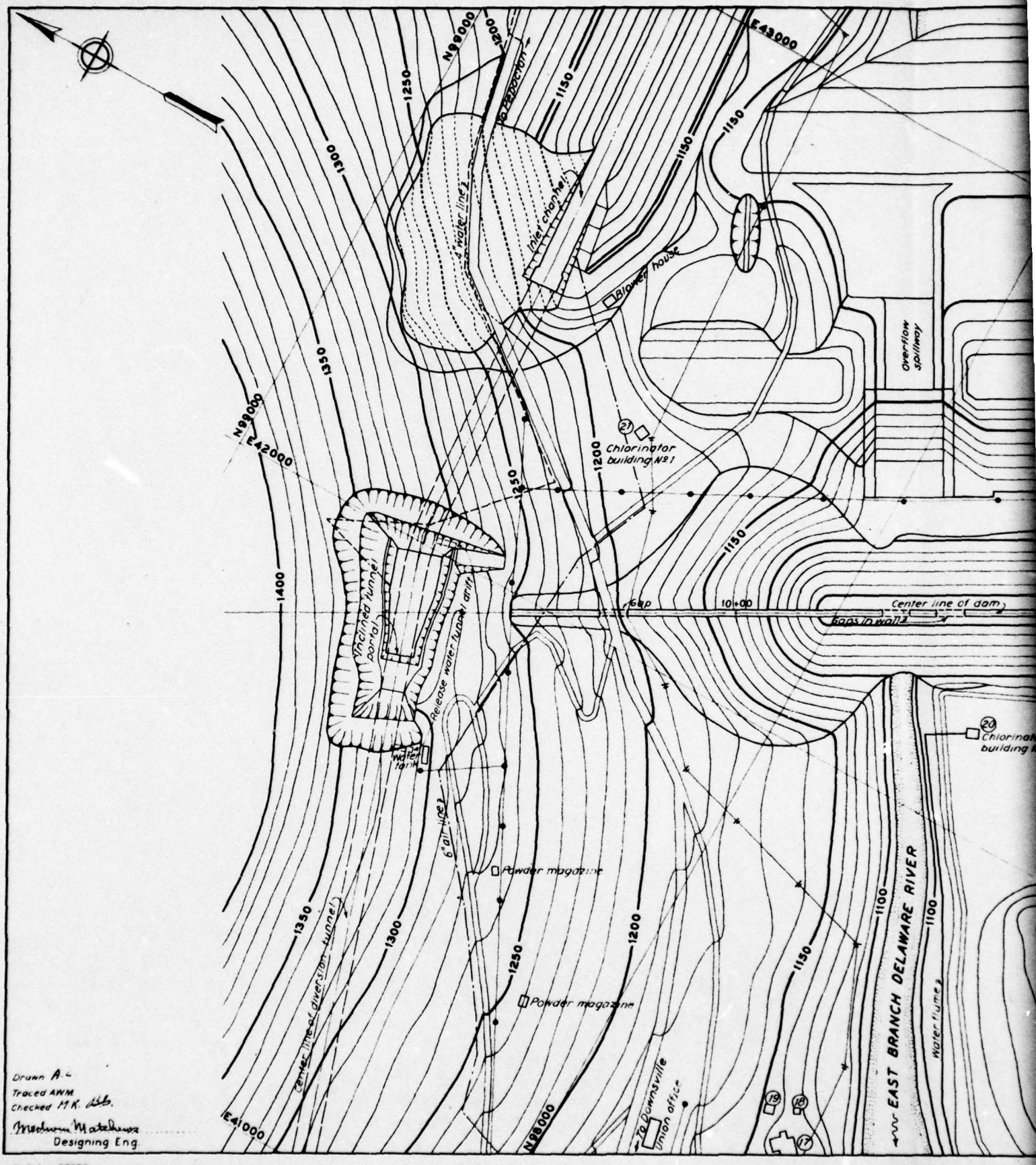

E39000
E40000
N99000
1100
1200
1150
1140
1250
New York State Electric and Gas Corp
44 KV 3 phase 60 cycle high tension
power line
To Downsville Old Highway Route 30
N.Y. State Highway Route 30A
Road No. 2
EAST BRANCH DELAWARE RIVER
N98000
1105
Center line of Outlet Channel
Bridge
To Downsville
1150
N97000
Complete information on existing water, sewer and electric lines may be obtained at the office of the Engineer at Downsville, N.Y.
LEGEND
Delaware Telephone Co
New York State Electric and Gas Corp
Delaware County Electric Cooperative, Inc
Walsh Const Co. and B. Perini and Sons Inc Power lines
6" Air line
water line
Sanitary sewer and manhole
Settlement bench marks
Settlement measurement plates
indicates building to be removed under this contract
Drawn M.T.S
Traced A.S
Checked R.V.R.S
N96000
Madison Matthews
Designing Eng
Ref Acc DRD418

etail topography see Sheet 4, Acc 66699.
rrow areas see Sheet 8, Acc 66957, Sheet 9
3, and Sheet 10, Acc 66862.
ildings (31) to (39) inclusive to be removed
is contract, see Sheet 9, Acc 66863
numbered buildings except those of the
pply and the sewage disposal plant
property of the Walsh Const Co and
and Sons, Inc.
E41000
E42000
E43000
N93000
Center line of dam
Road No 1
Inclined tunnel portal
Water tank
Diversion tunnel
Powder mag
Power Sta
Compressor house
Water cooler
Blacksmith shop
Union office
Well #2
Repair shop
Gas Sta
Chlorinator Bldg No 2
Chlorinator Bldg No 3
Water flume
Settling basin
Top soil storage (approximately 52,000 cu yds)
Settlement bench marks
Sewage Disposal Plant
Water pump house
Dosing tank
Septic tank
Chlorinator Bldg No 4
Sludge bed
Relocated Brook
Well pump #1
60" Culvert
Commissary
Lodge
Paved channel
Stone hopper
Batch plant
Office change house
First aid
Settlement measurement plates
Boiler house
Transformer
Concrete cut-off wall
Top of Cofferdam El 1175
Weldpoint repair
Overflow Spillway
Inlet Channel
Gate
Pump house
Chlorinator Bldg
Bldg
Power house
EAST BRANCH DEL
Delaware
Contractor's power line
Road No 2
Water supply tank
Tom Cole
Dept Eng Hdqrs



City of New York
BOARD OF WATER SU L.
DOWNSVILLE DAM
GENERAL TOPOGRAPHY
200 0 200 400 Ft
DECEMBER 1, 1949
File Cont 401-3.4 E D Acc 65405

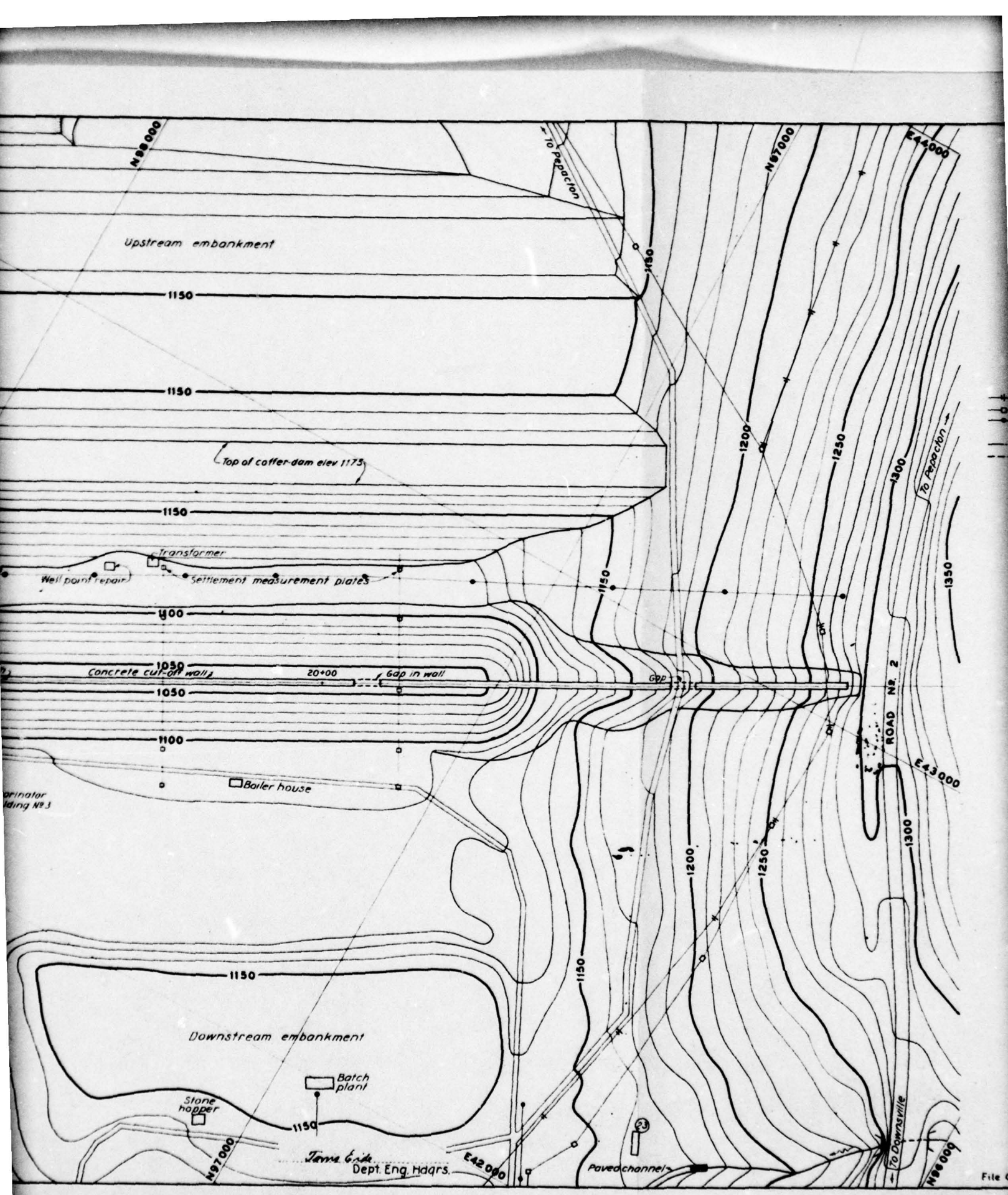
3



Drawn A. L.
Traced AWM
Checked M K. Lib.

Mechanical Mathematics
Designing Eng.

Ref-Acc. 66299


N98000
To Pepoction
N97000
E44000
Upstream embankment
1150
1200
1250
1300
1350
To Pepoction
Top of coffer-dam elev 1173
Transformer
Well point repair
Settlement measurement plates
1000
1050
Concrete cut-off wall
20+00
Gap in wall
GPP
1100
ROAD No. 2
E43000
Boiler house
Downstream embankment
Batch plant
Stone hopper
Town Site
Dept. Eng. Hqrs.
N97000
E42000
Paved channel
To Downsville
N96000

CONTRACT 401 SHEET 4
SHEETS IN SET. 39

For plan of dam see Sheet 5, Acc. 66698.
For profile of dam see Sheet 6, Acc. 66665.
For sections of dam see Sheet 7, Acc. 66476.

Legend

- Delaware Telephone Co
- Delaware County Electric Coop. Inc
- Walsh Const. Co. and B. Perini & Sons, Inc. Power lines.
- 6" Air line.
- Water line.
- Settlement measurement plates.
- (19) Indicates building to be removed under this contract.

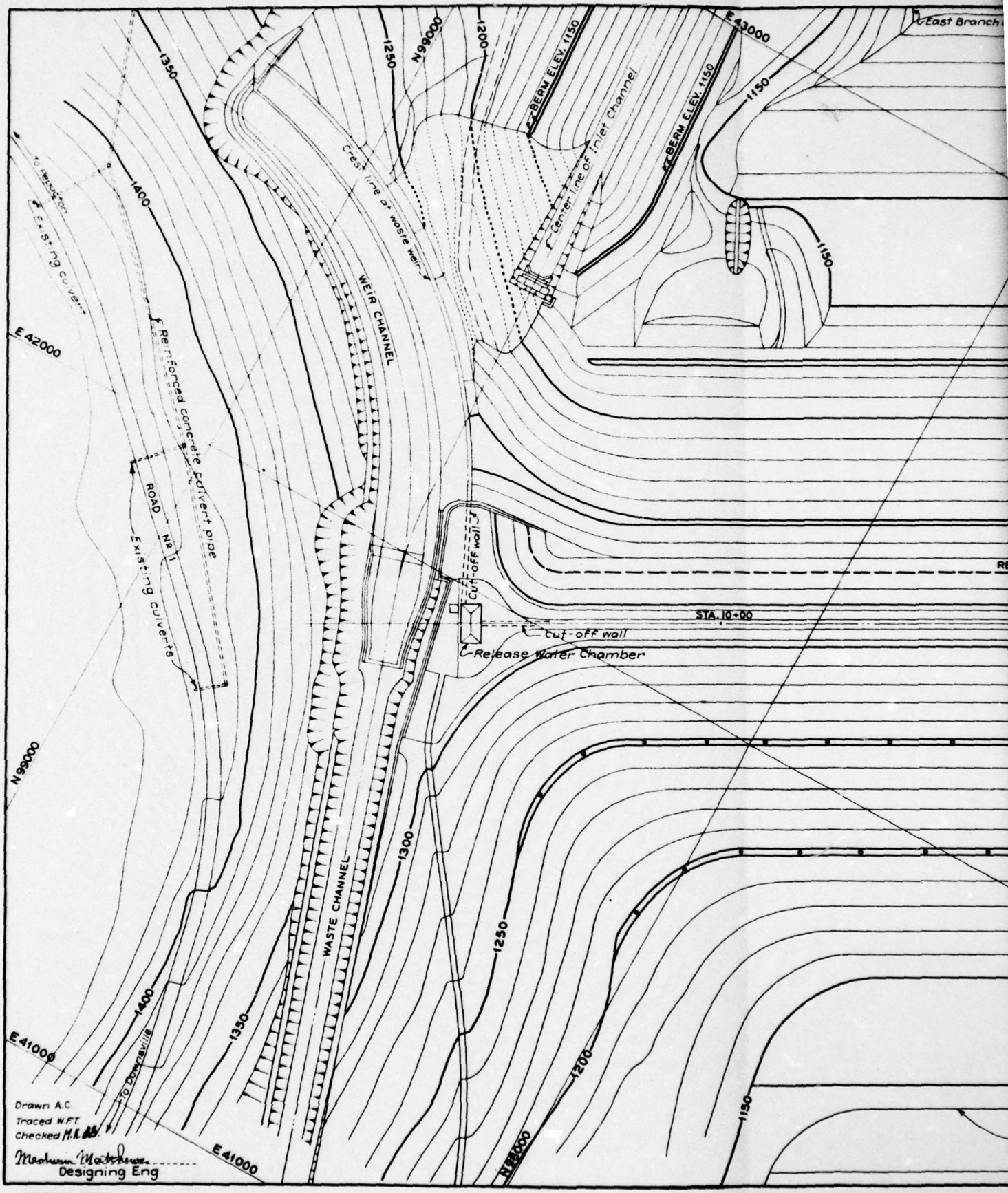
City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
DETAIL TOPOGRAPHY

100 0 100 200Ft

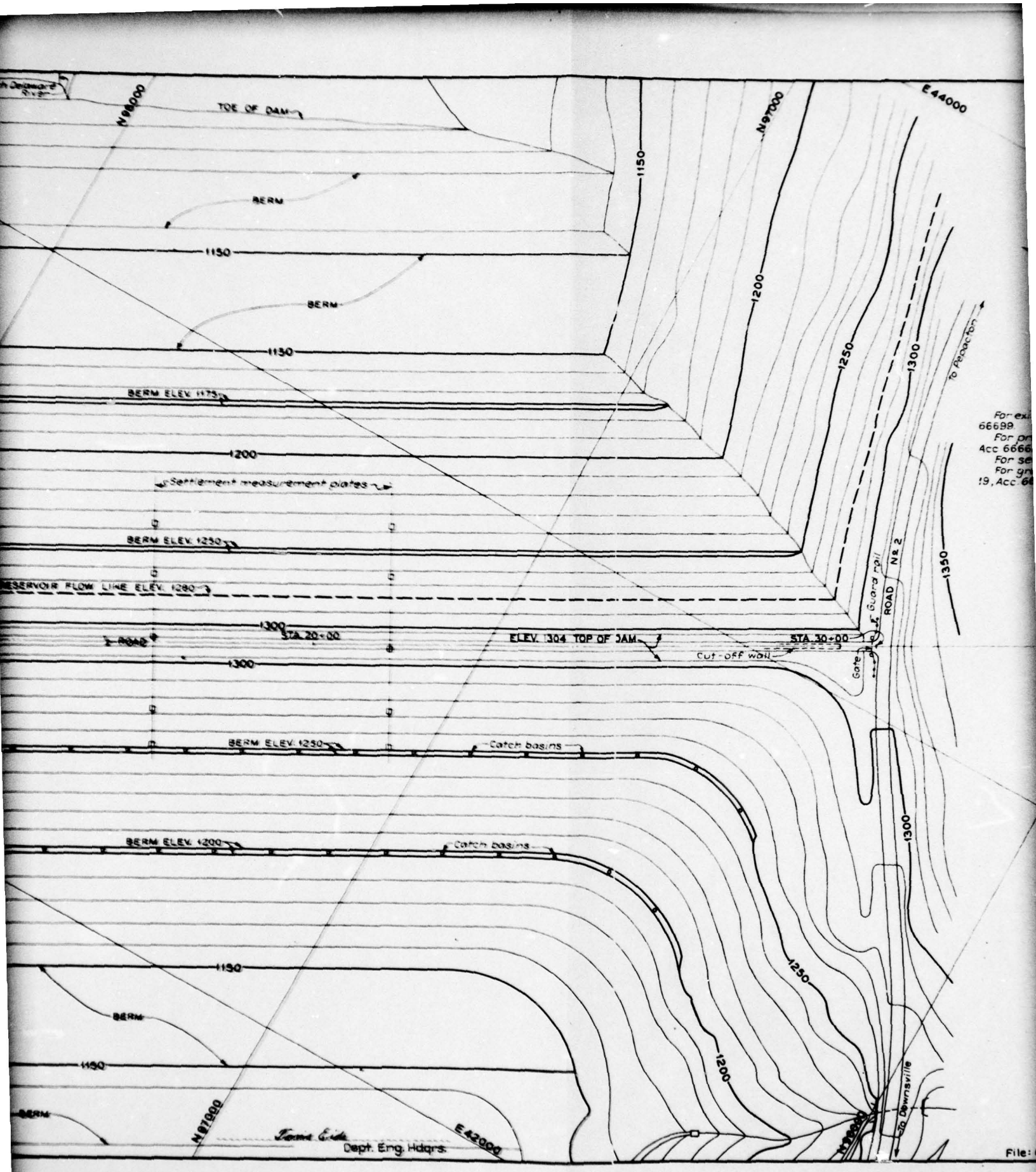
DECEMBER 1, 1949

File Cont 401-3.4 E D Acc. 66689

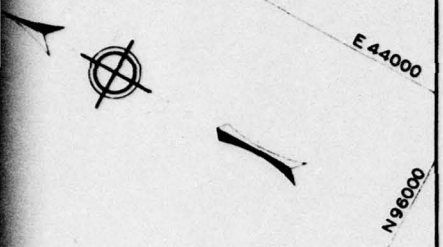
2, 1 3



Ref-Acc. 66810


N98000
TOE OF DAM
BERM
1150
BERM
1150
BERM ELEV. 1175
1200
Settlement measurement plates
BERM ELEV. 1250
RESERVOIR FLOW LINE ELEV. 1280
1300
ROAD
STA. 20+00
1300
BERM ELEV. 1250
Catch basins
BERM ELEV. 1200
Catch basins
1150
BERM
1150
BERM
N91000
E42000
Dept. Eng. Hdqrs.
N97000
E44000
1150
1200
1250
1300
1350
To Reaction
ELEV. 1304 TOP OF DAM
STA. 30+00
Cut-off wall
Gate
Guard rail
ROAD No. 2
1300
1250
1200
To Downsville
N93000
File:

CONTRACT 401 SHEET 5
SHEETS IN SET, 39



E 44000

N96000

isting detail topography see Sheet 4. Acc

rofile on center line of dam see Sheet 6,
65.

ections of dam see Sheet 7, Acc. 66476.

rading of downstream area see Sheet
66700.

E 43000

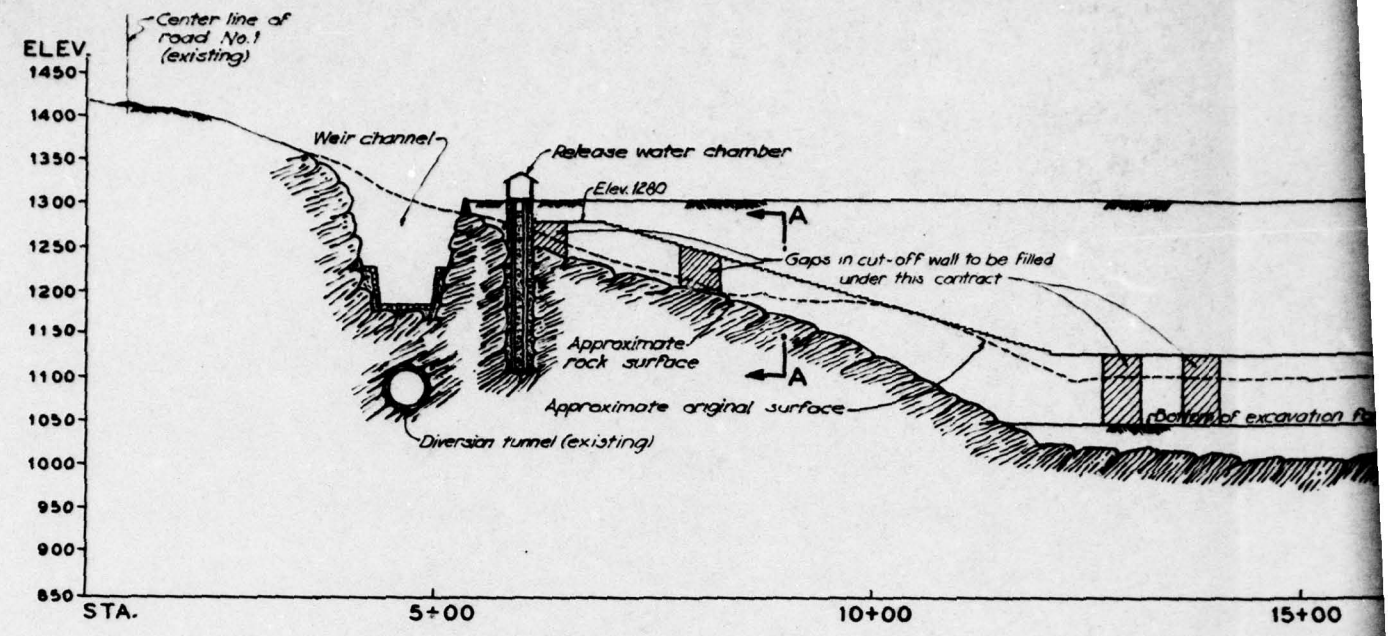
City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
PLAN

100 0 100 200Ft.

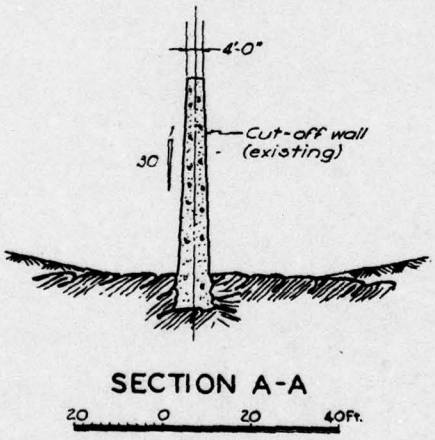
DECEMBER 1,1949

: Cont 401-3.4 E D Acc. 66698

3

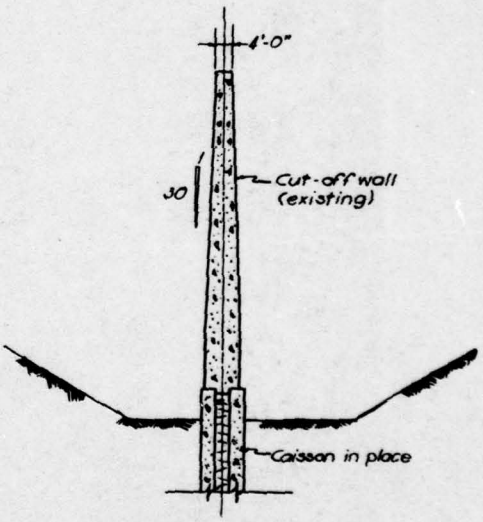


PROFILE



SECTION A-A

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SECTION B-B

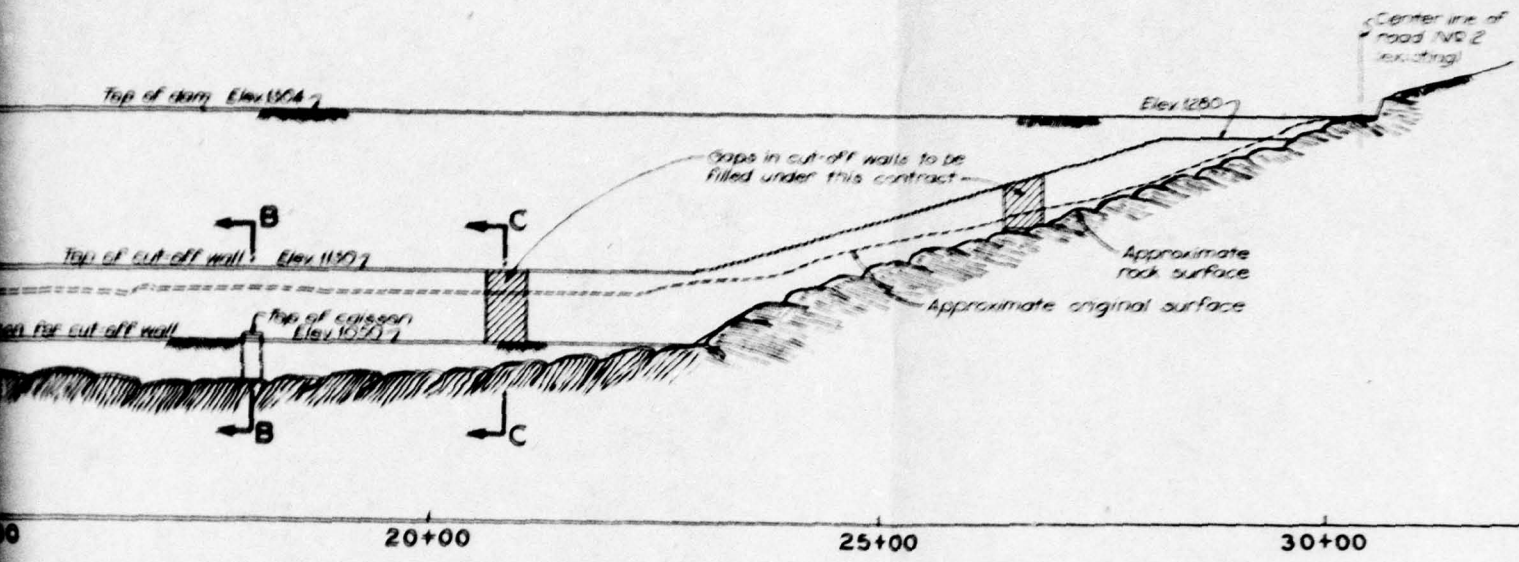
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Traced M.A.G.
Checked K.W.A.S. BB.

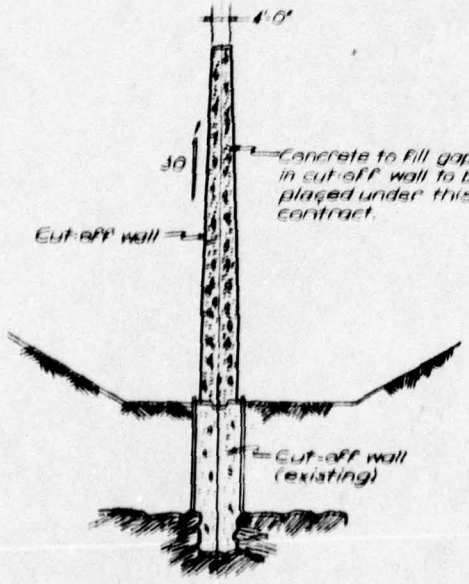
Designing Eng.

Ref-Acc. 66234

CONTRACT 401
• SHEETS IN SE



LE OF DAM ON CENTER LINE
(Looking upstream)



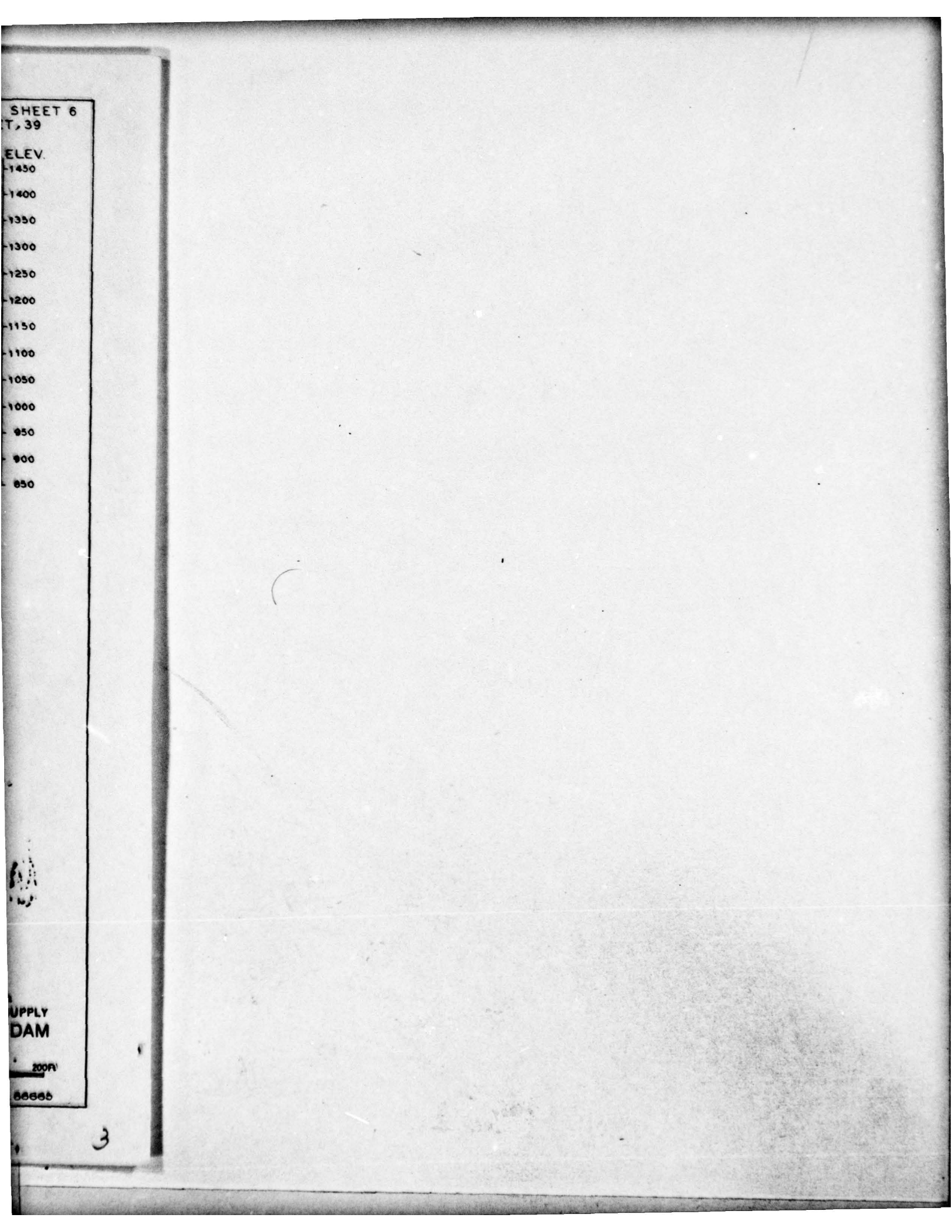
SECTION C-C

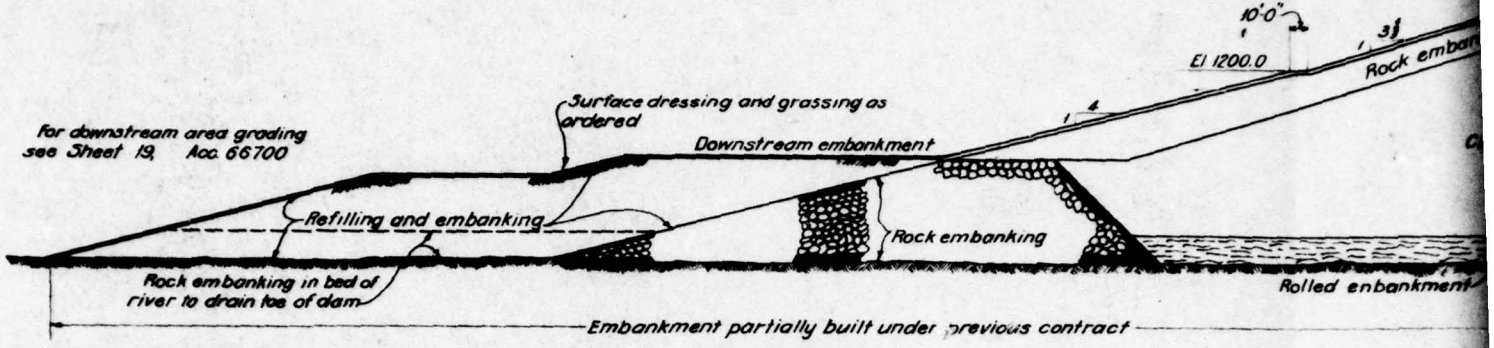
For plan of dam see sheet 5, Acc 66698.
For sections of dam see sheet 7, Acc 66476.

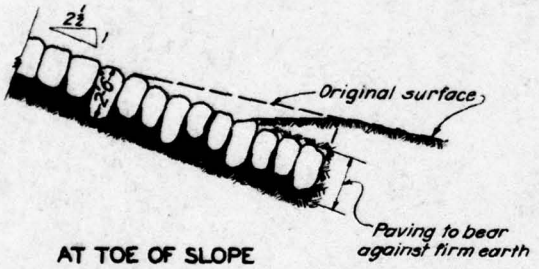
City of New York
BOARD OF WATER SU
DOWNSVILLE D
PROFILE

DECEMBER 1, 1949
File: Cont. 401-3.4 ED Acc. 6

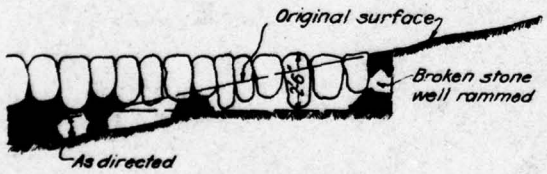
Dept Eng. Hdqrs.


SHEET 6
T, 39
ELEV.
1450
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
900
850
UPPLY
DAM
200FT
88685
3

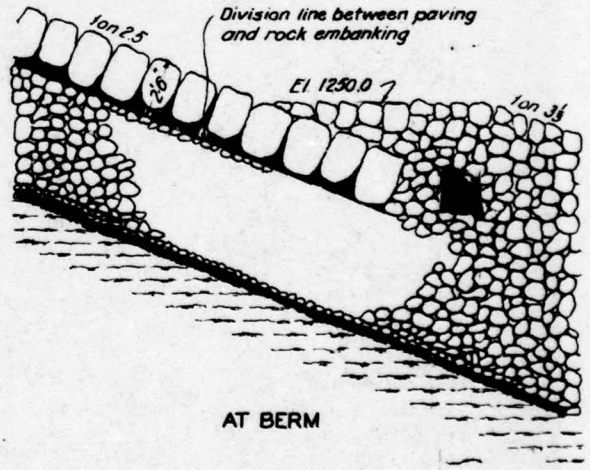




AT TOE OF SLOPE



AT ABUTMENT



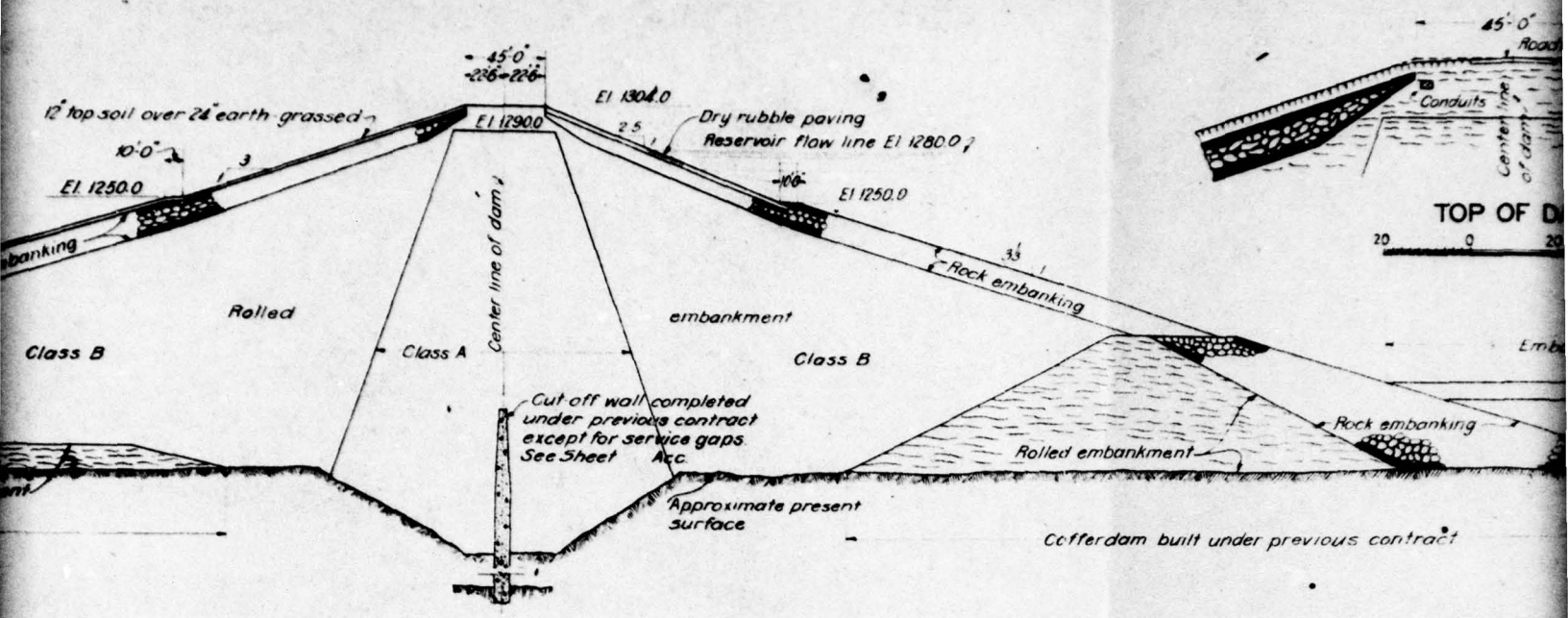
AT BERM

DRY RUBBLE PAVING

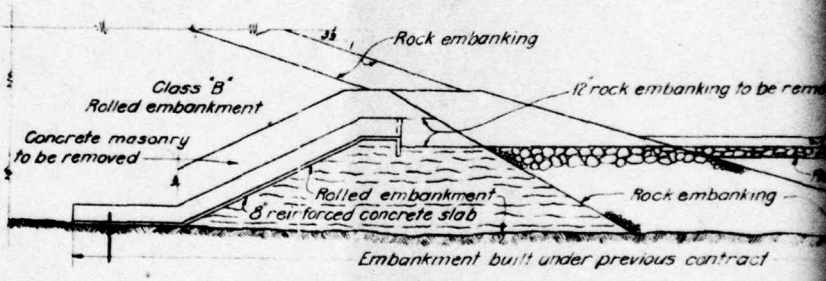
2 0 2 4 6 8 10Ft.

Drawn K.W.A.S.
Traced A.H.T.
Checked A.G.
Designing Eng.

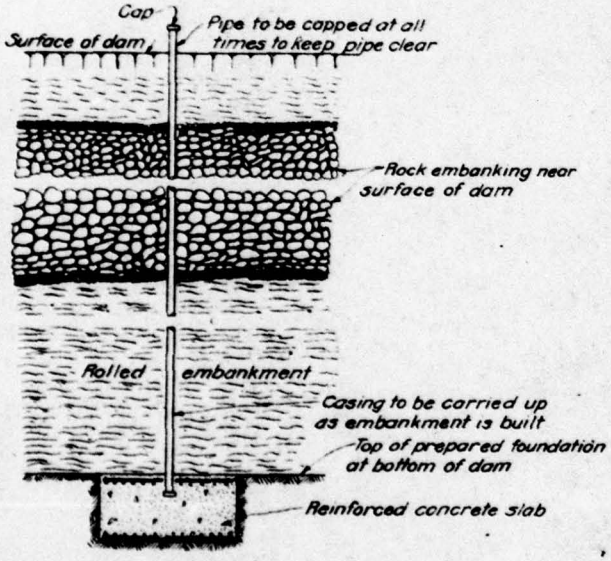
Ref-Acc 66163



TYPICAL SECTION

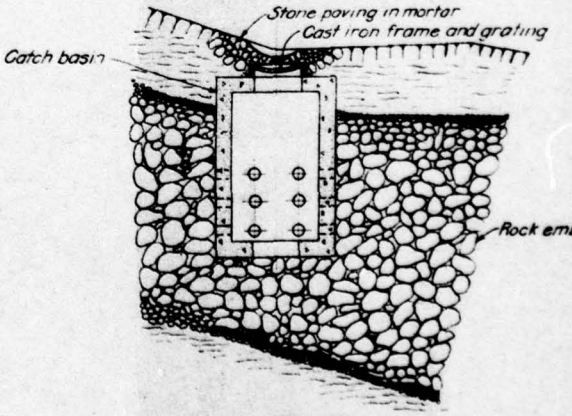


SECTION THROUGH OVERFLOW SPILLWAY



SETTLEMENT MEASUREMENT PLATE

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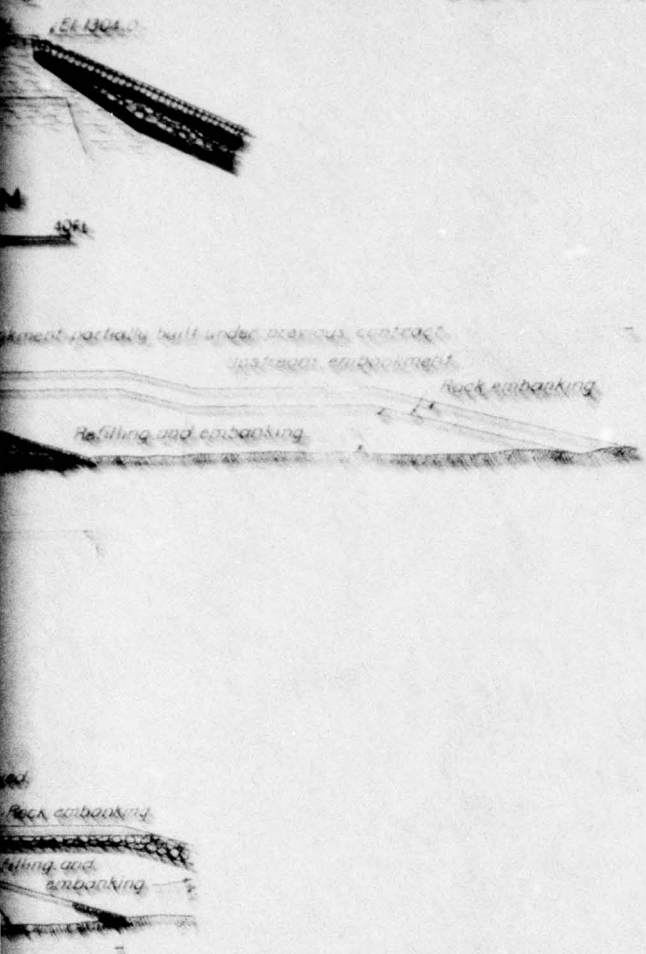


BERM DRAIN

2 0 2 4 6 8 10Ft

Dept Eng Hdqrs

CONTRACT 46 SHEET 7
SHEETS 1 TO 18



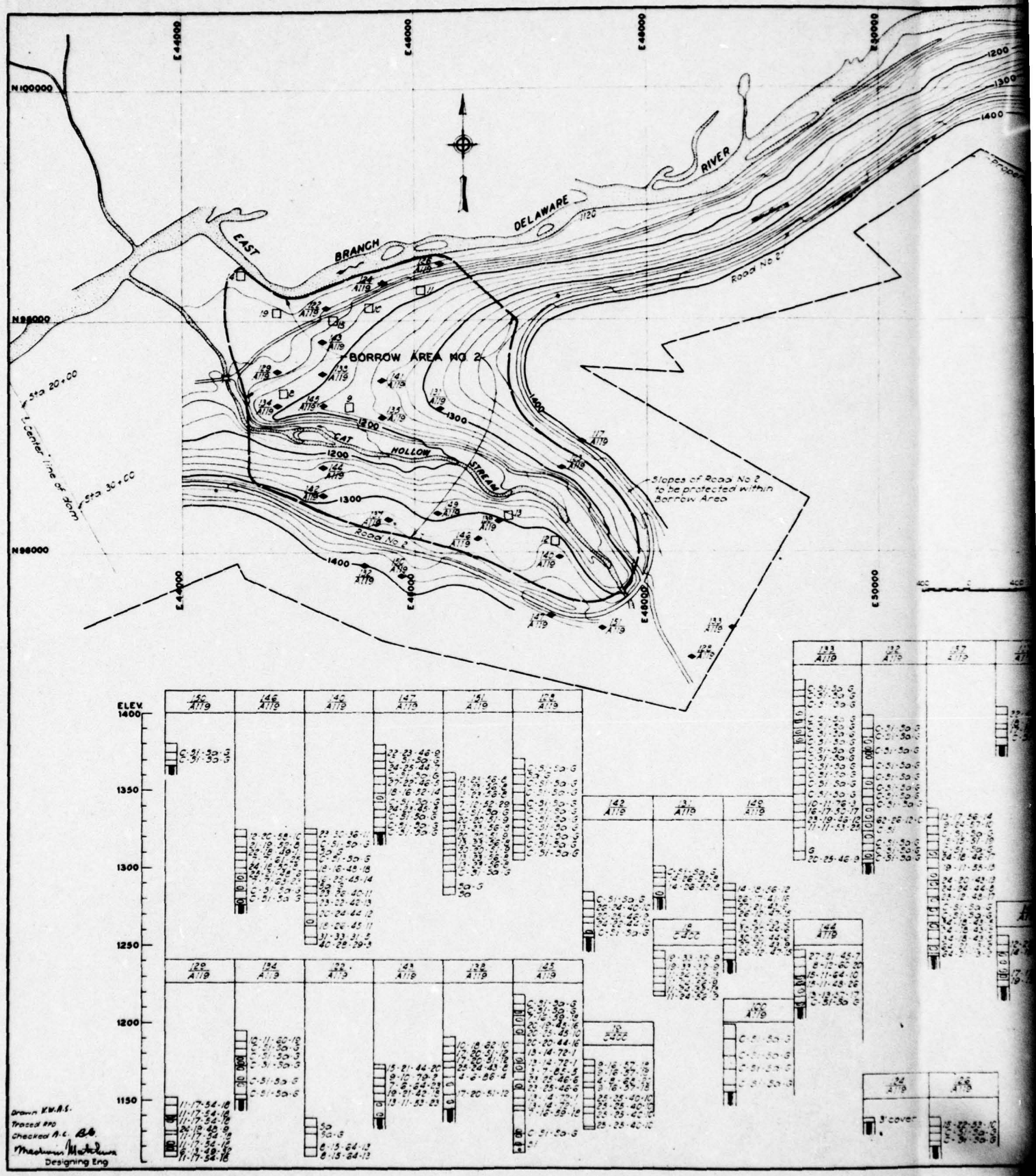
For plan of dam see Sheet 5 Acc 66698
For profile of dam see Sheet 6 Acc 66667

City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
SECTIONS

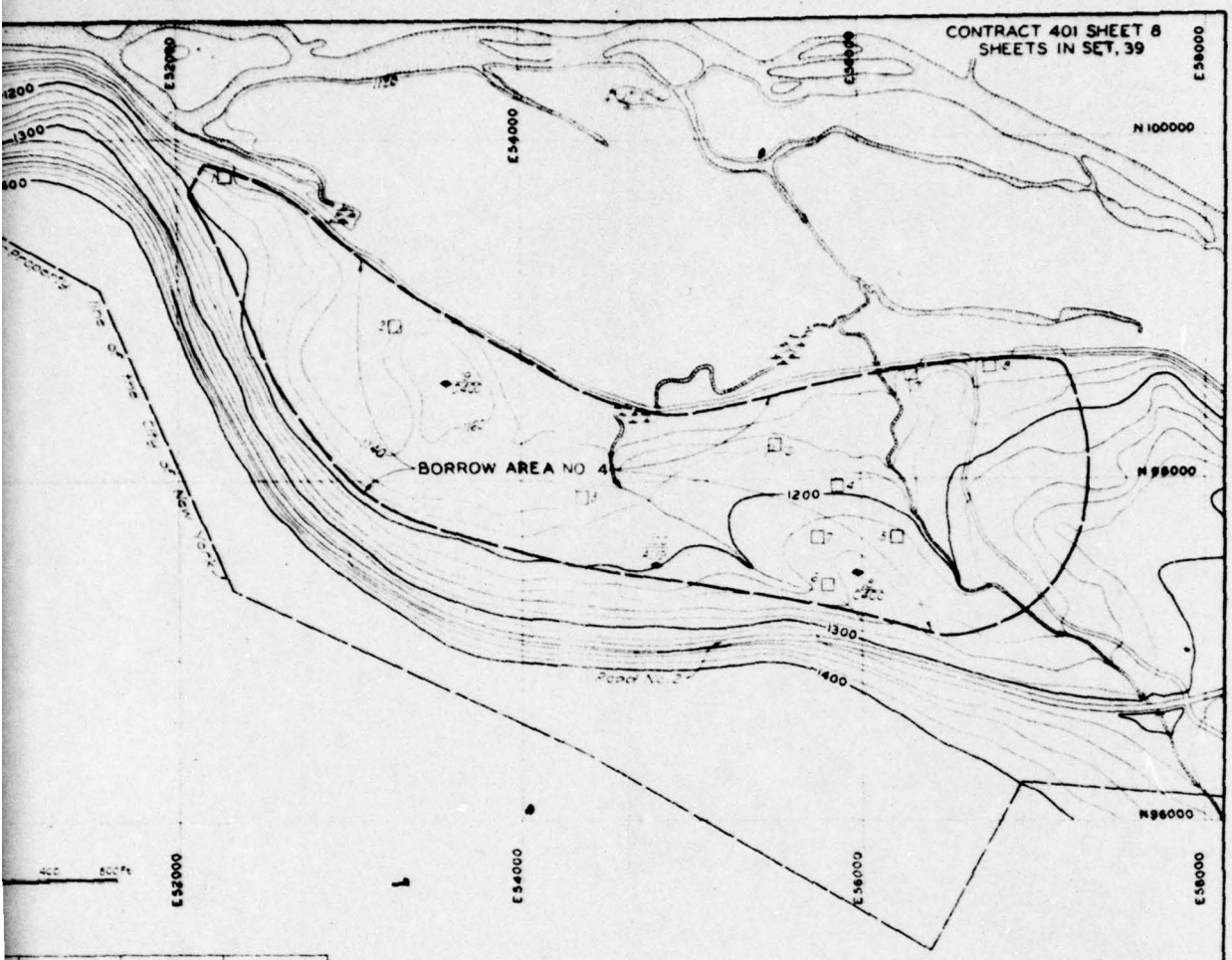
50 0 50 100 Ft

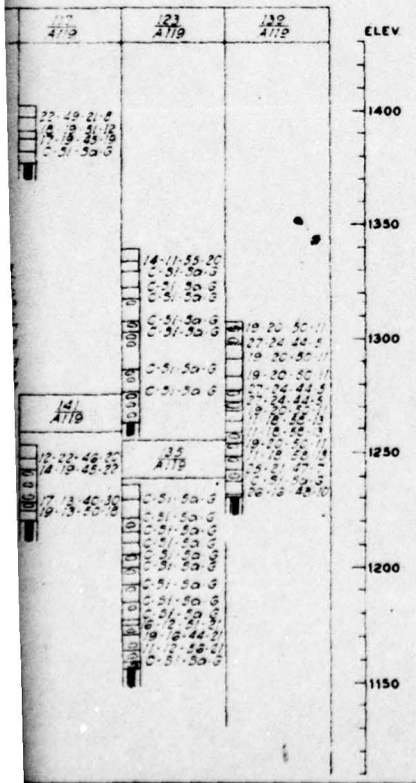
DECEMBER 1 1938

File Print 401-3.1 F 8 Acc 66178


E 44000
E 46000
E 48000
E 50000
N 100000
N 98000
N 96000
RIVER
DELAWARE
EAST
BRANCH
BORROW AREA NO 2
CAT
HOLLOW
STREAM
Road No 2
Slopes of Road No 2 to be protected within Borrow Area
Sta 20+00
Sta 30+00
Center line of dam
1200
1300
1400
ELEV.
1400
1350
1300
1250
1200
1150
Drawn K.W.A.S.
Traced RPD
Checked A.C.
Designing Eng
Ref-Acc DPD 456

CONTRACT 401 SHEET 8
SHEETS IN SET, 39





Borings have been made at the places and to the depths indicated.

Size Class Test and Grain Size Analysis in accordance with the U.S. Bureau of Soils Laboratory tests are performed on all fractions of less than the 3 inch size except as noted.

Numbers shown thus 5-30-65 indicate percentages of gravel, sand and silt respectively.

Where only percentages of clay, silt, sand and gravel are not shown, the proportions are by visual inspection of any sample.

Records of all borings and test pits and results of laboratory analyses may be examined at the office of the Engineer, Downsville, New York.

The City does not guarantee that these records are accurate, complete, or correctly interpreted.

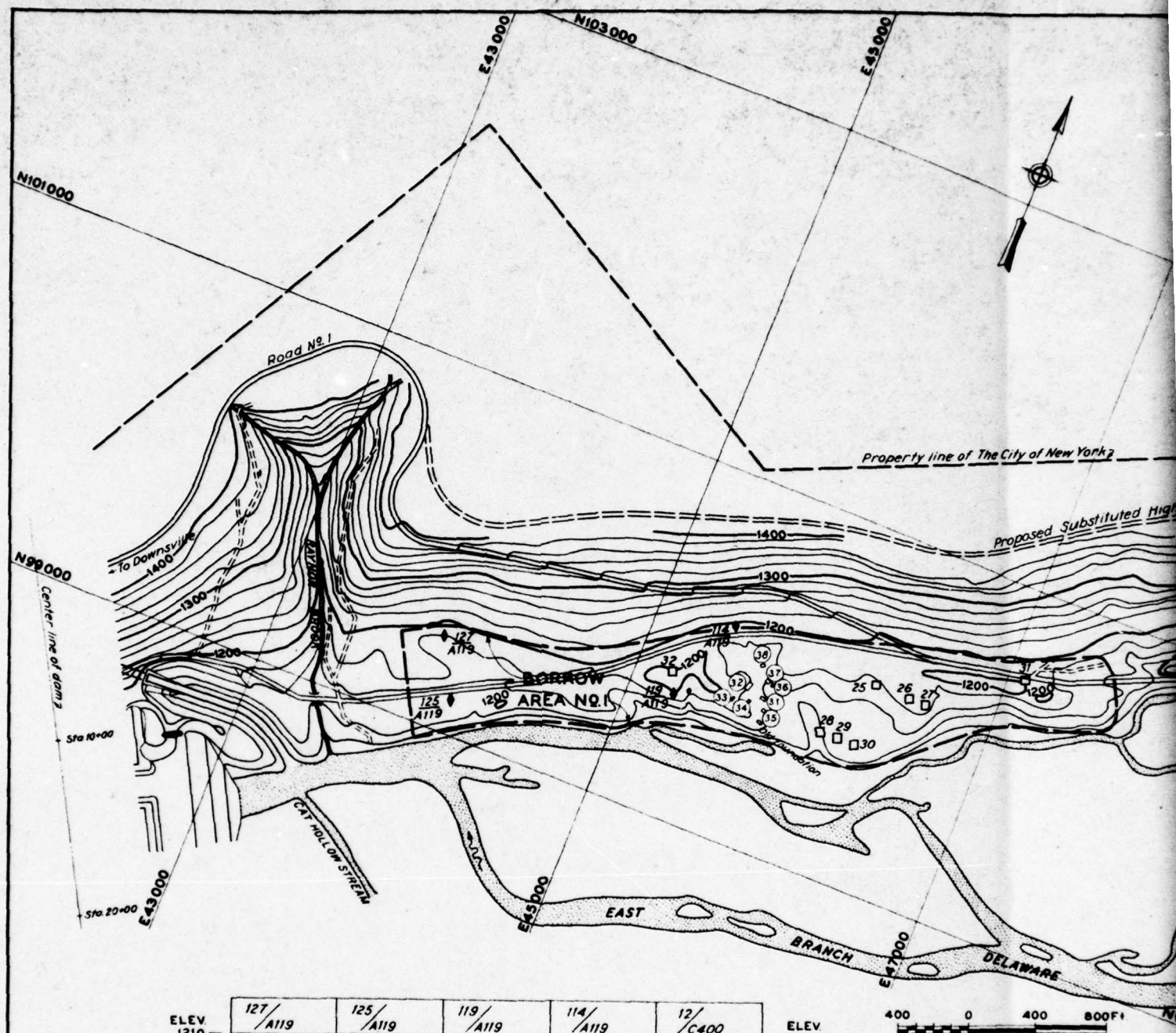
Legend
Cl - Clay
Si - Silt
Sa - Sand
G - Gravel
Cob - Cobbles
Rock Edge
Core Boring
Test pit
14/A119 - Number and contract of boring

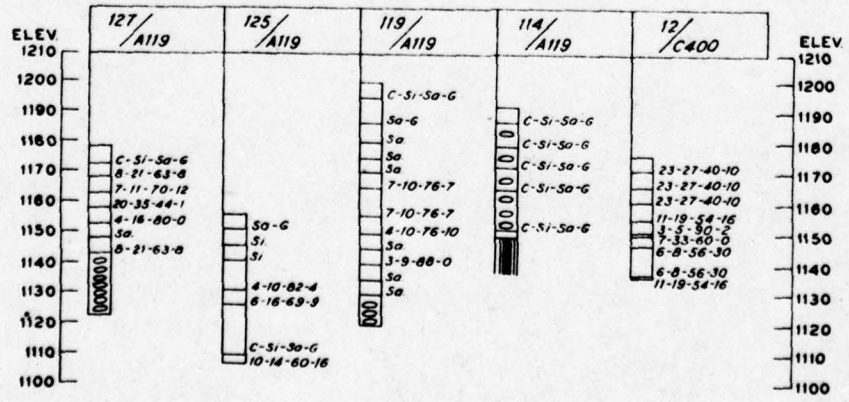
City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
BORROW AREAS NO. 2 AND NO. 4
PLAN AND BORING DATA
DECEMBER 1, 1949

Dept Eng Hdqrs

File Cont. 401-3.4 ED Acc 66857

2





Drawn K.W.A.S.
Traced A.W.M.
Checked A.C. A.L.

Meadwin Matthews
Designing Eng

Borings have been made at the places
to the depths indicated.

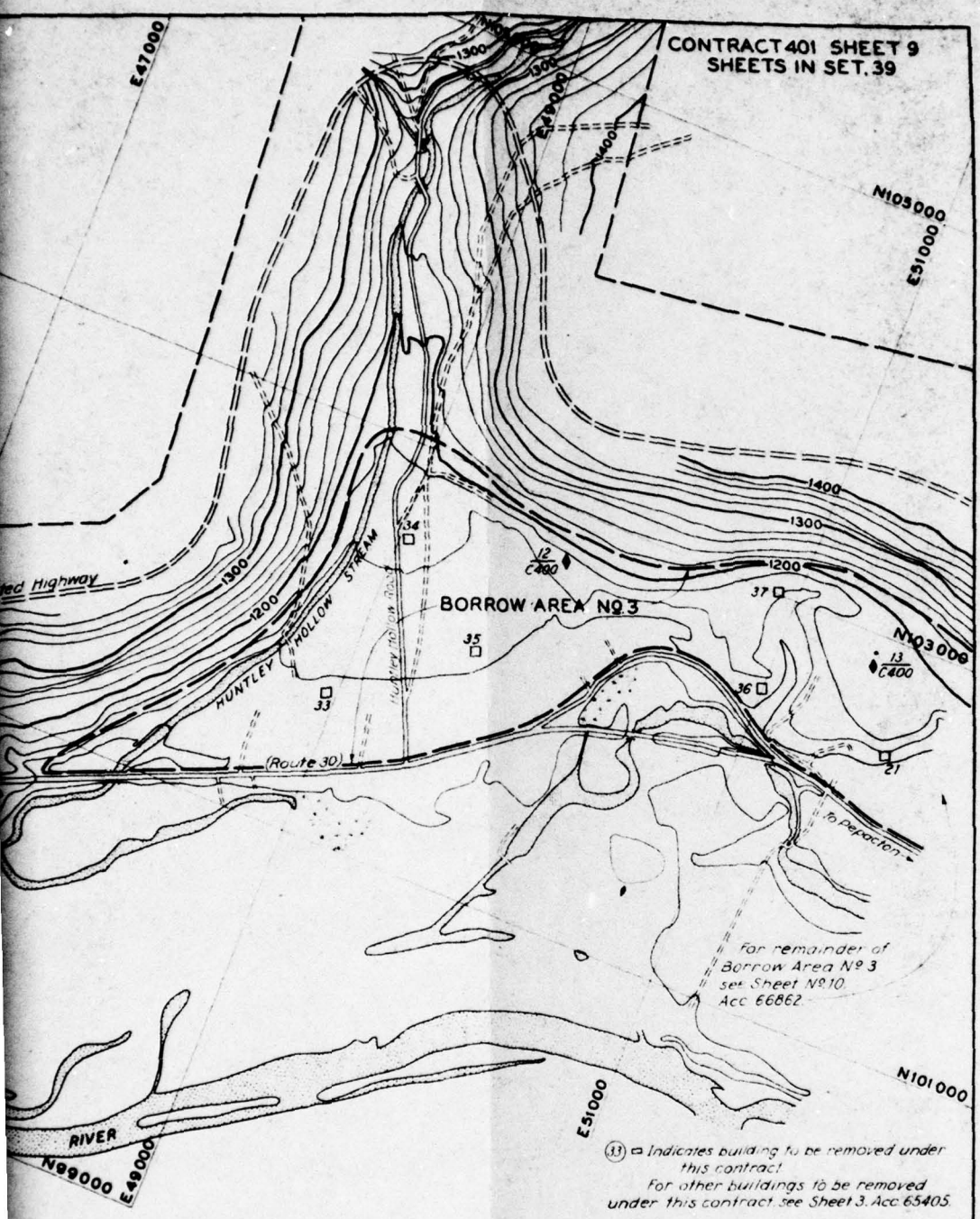
Size classifications given are in accorda
with the U.S. Bureau of Soils. Laboratory tests
performed on soil fraction finer than 1/8 inch
except as noted.

Numbers shown thus 10-20-60-10 indica
weight percentages of clay, silt, sand and gra
respectively.

Legend

C = Clay
Si = Silt
Sa = Sand
G = Gravel
= Boulder
= Rock ledge
= Boring
= Test pit
127/A119 = Number and contract of boring

Ref-Acc DPD 439



(33) ▭ Indicates building to be removed under this contract
For other buildings to be removed under this contract see Sheet 3. Acc 65405.

...laces and
...ccordance
...r tests are
...inch size.
...ndicate dry
...d gravel

Where dry weight percentages of clay, silt, sand and gravel are not shown, the analyses are by visual inspection of dry samples.

Records of all borings and test pits and results of laboratory analyses may be examined at the office of the Engineer, Downsville, New York.

The City does not guarantee that these records are accurate, comprehensive, or correctly interpreted

City of New York

BOARD OF WATER SUPPLY

DOWNSVILLE DAM

BORROW AREAS NO. 1 AND NO. 3

PLAN AND BORING DATA

DECEMBER 1, 1949

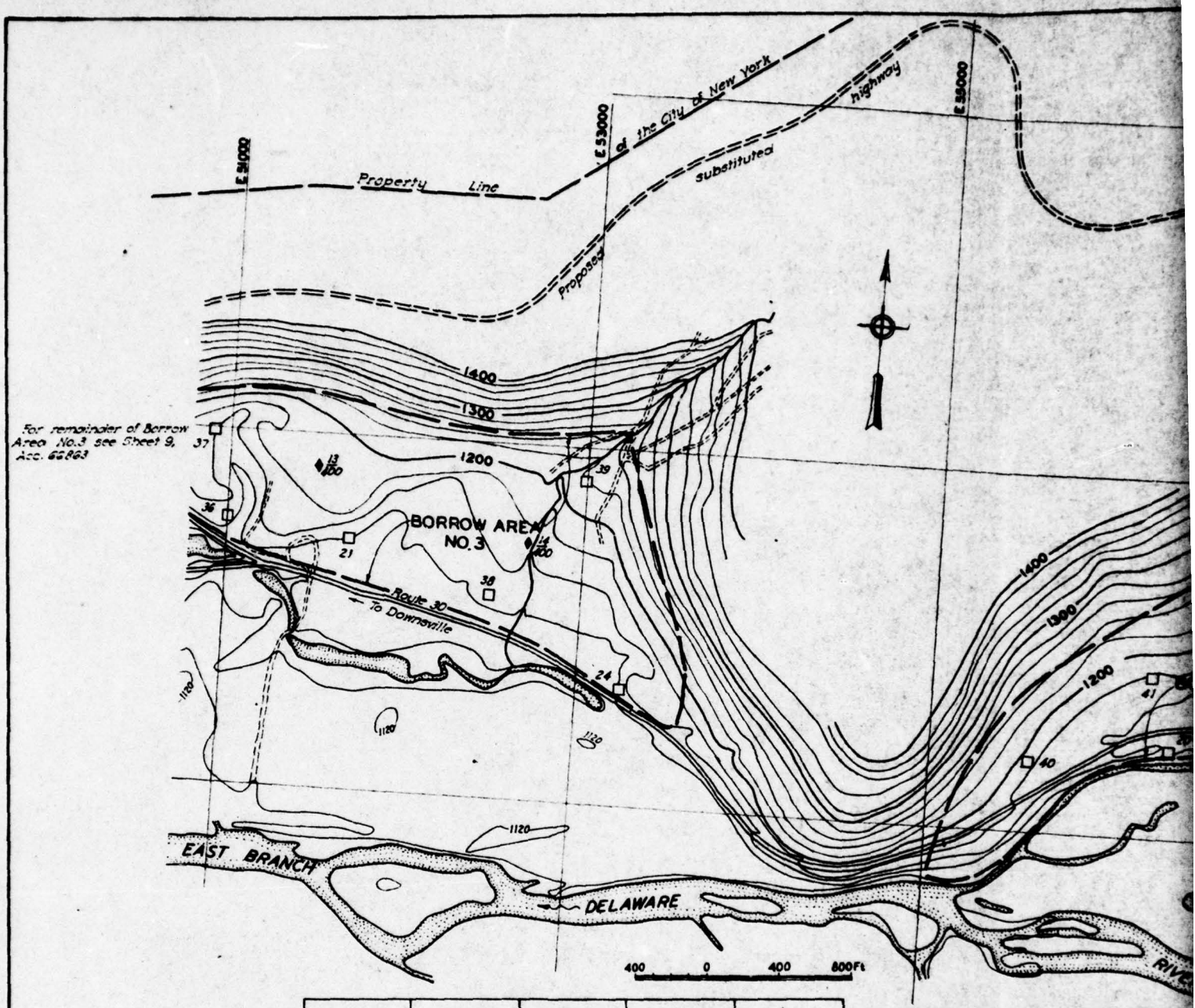
...ing

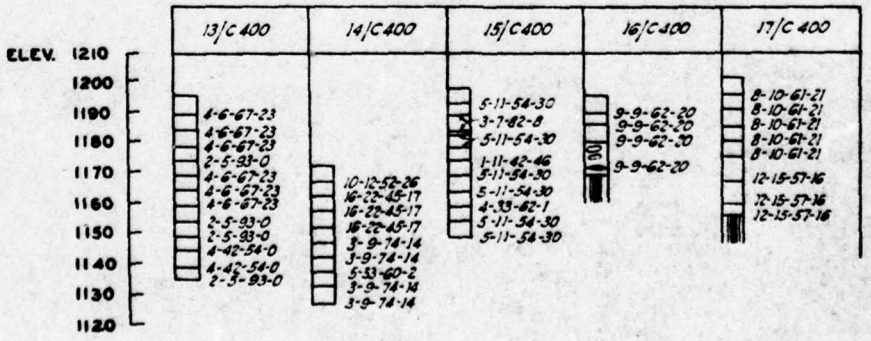
Dept Eng Hdqrs.

File Cont. 401-3.4 ED

Acc. 66863

2





Borings have been made at the places and to the depth indicated.

Size classifications are given in accordance with the U.S. Bureau of Soils. Laboratory tests are performed on soil fraction finer than $\frac{3}{4}$ inch size, except as noted.

Numbers shown thus 10-20-60-10 indicate dry weight percentages of clay, silt, sand and gravel respectively.

Where dry percentages of clay, silt sand and gravel are not shown the analyses are by visual inspection of dry samples.

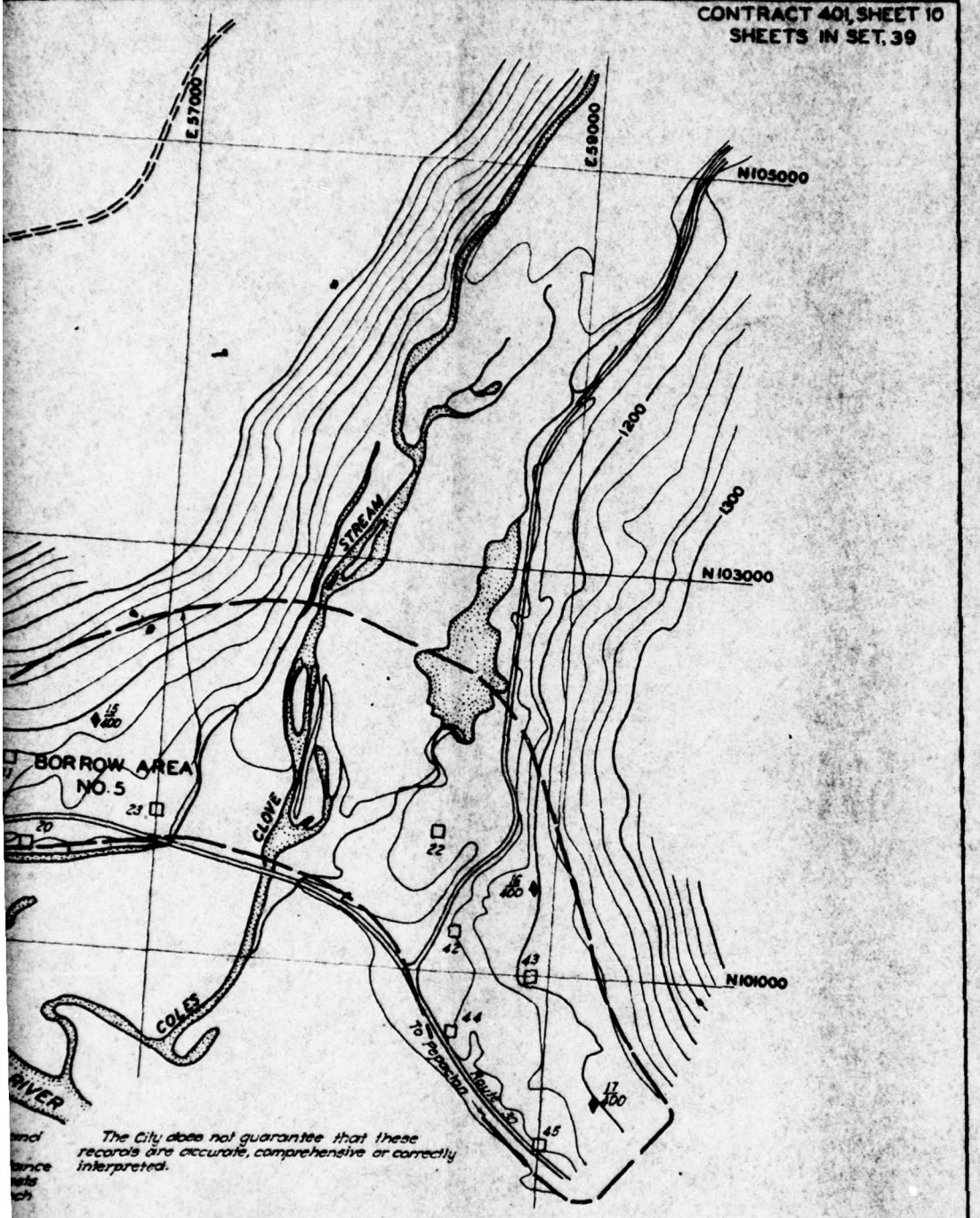
Records of all borings and test pits and results of laboratory analyses may be examined at the office of the Engineer, Downsville, New York.

Drawn KW A.S.
Traced S.A.C.
Checked A.C. BB.

Designing Eng.

Dept. Eng. Hdqrs.

CONTRACT 401, SHEET 10
SHEETS IN SET, 39



The City does not guarantee that these records are accurate, comprehensive or correctly interpreted.

Legend

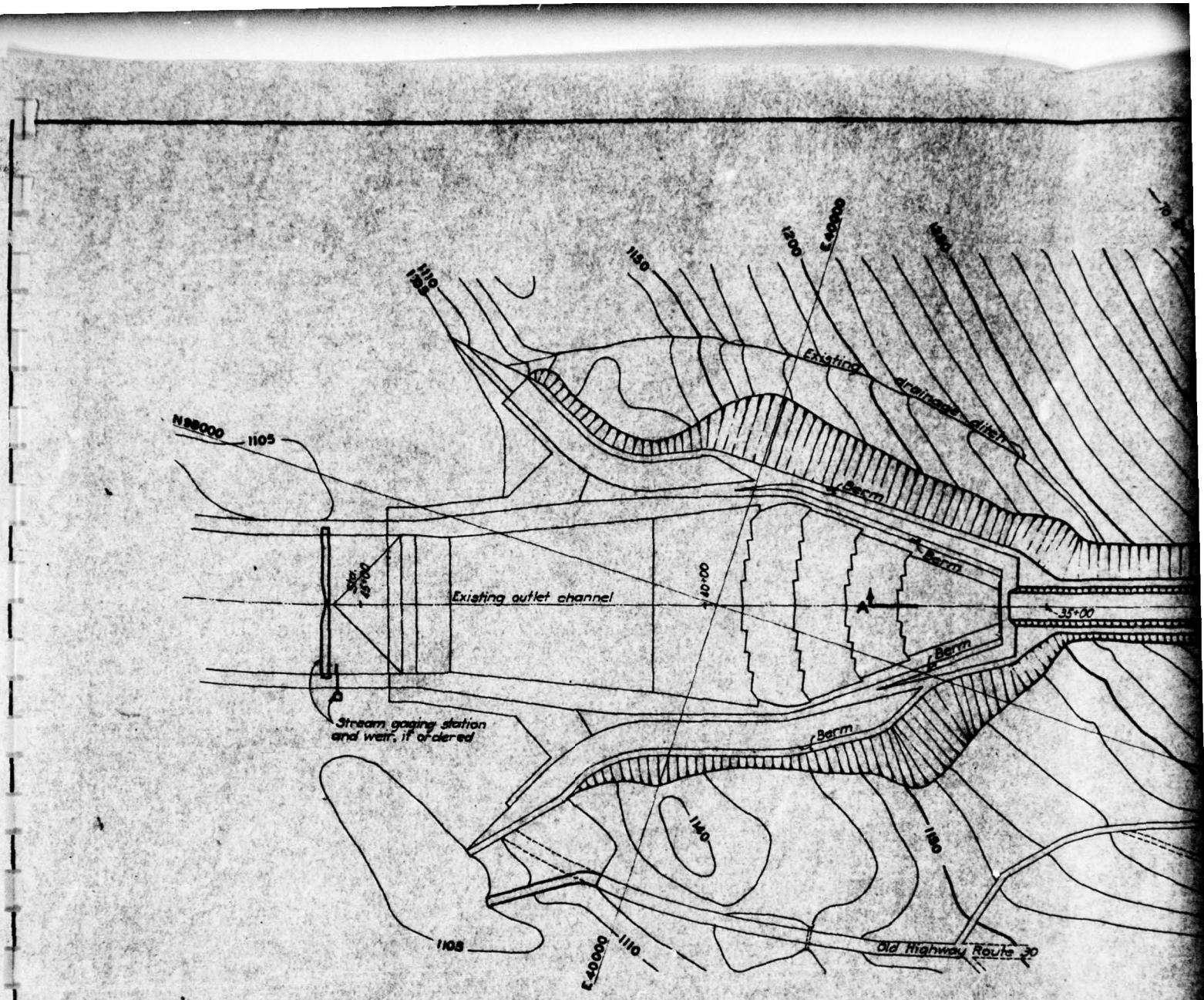
- Boulder
- Rock ledge
- Boring
- Test pit

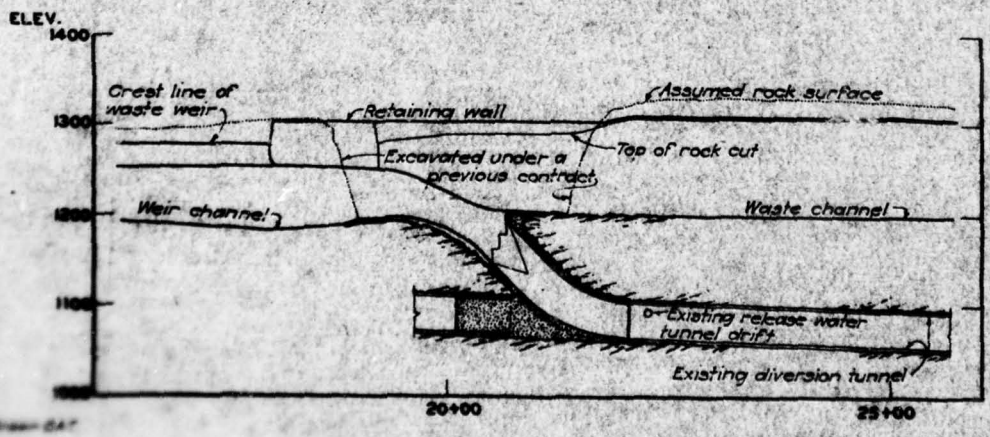
14/C400 = Number and contract of boring.

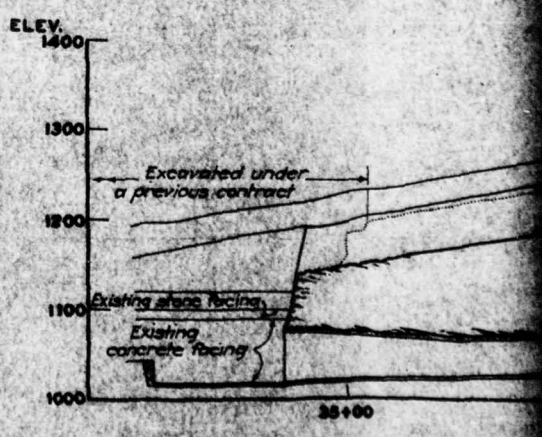
City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
BORROW AREAS NO. 3 AND NO. 5
PLAN AND BORING DATA
DECEMBER 1, 1949

File Cont. 401-3.4 ED Acc. 68862

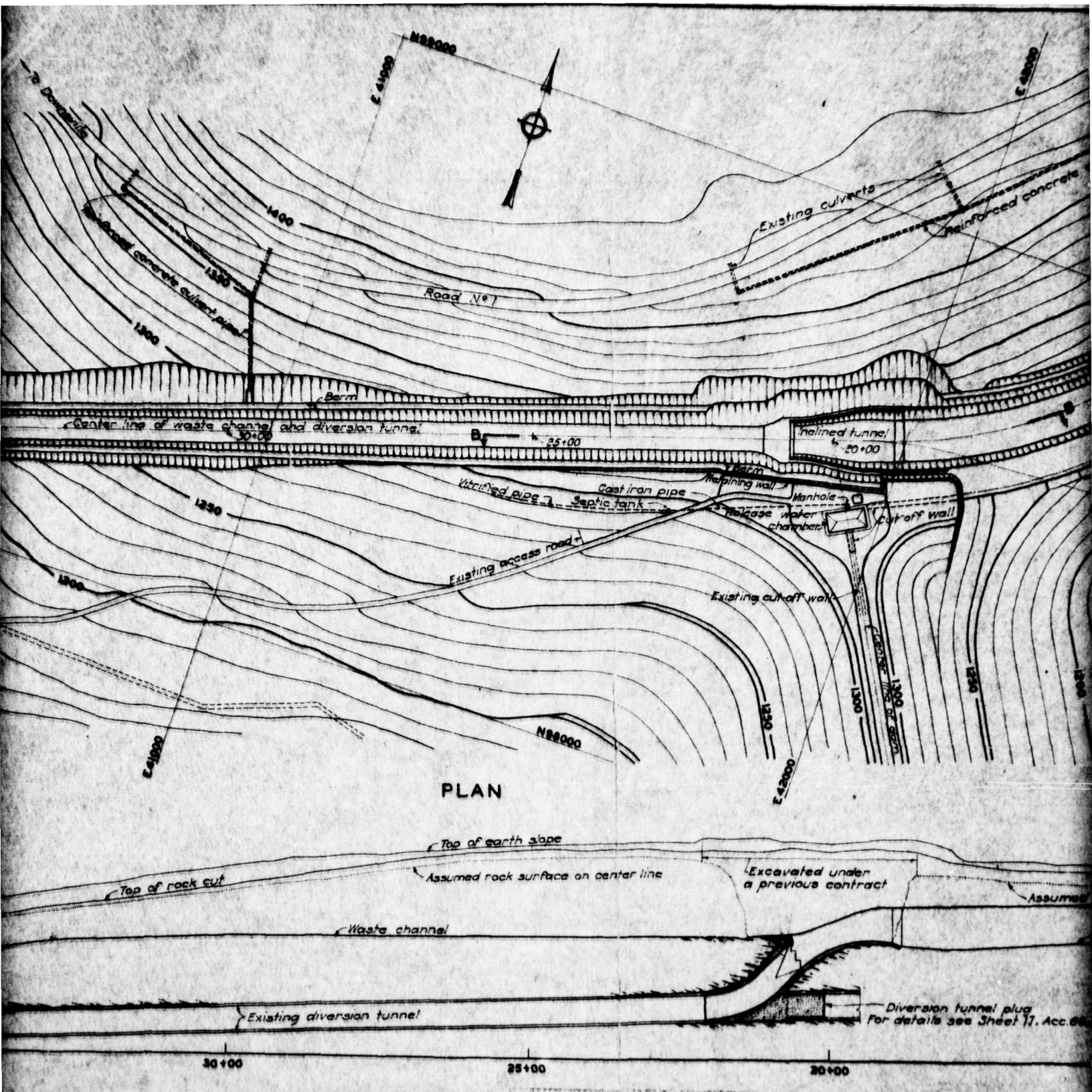
3


1200
E 40000
1150
1110
1105
Existing drainage ditch
Berm
Berm
Berm
Berm
N 39000
1105
Existing outlet channel
00+00
35+00
Stream gaging station and weir, if ordered
1140
1150
1105
E 40000
1110
Old Highway Route 30

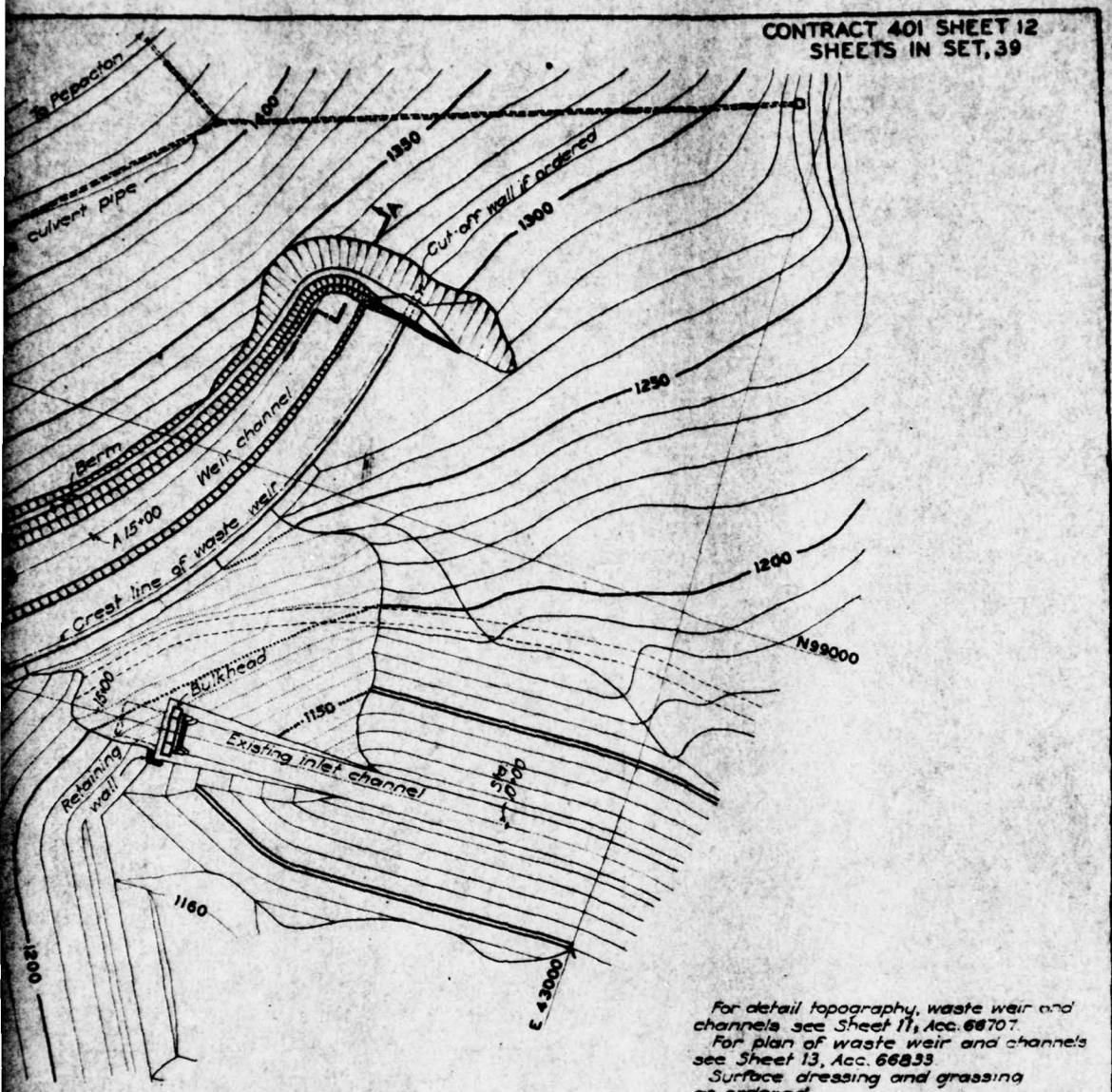

ELEV.
1400
1300
1200
1100
Crest line of waste weir
Retaining wall
Assumed rock surface
Top of rock cut
Excavated under a previous contract
Weir channel
Waste channel
Existing release water tunnel drift
Existing diversion tunnel
20+00
25+00


ELEV.
1400
1300
1200
1100
1000
Excavated under a previous contract
Existing shear facing
Existing concrete facing
35+00

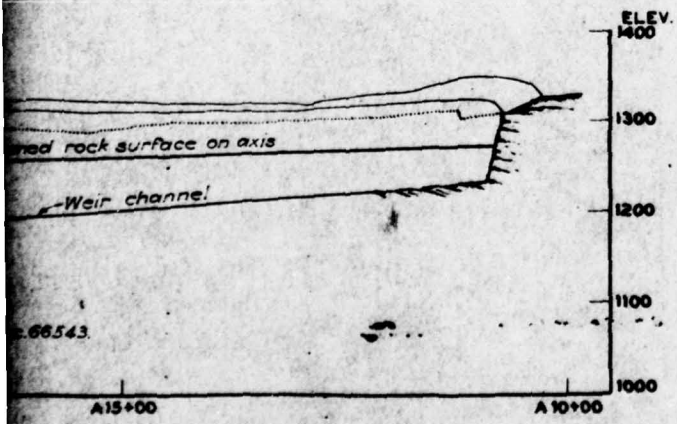
SECTION B-B


To Downsville
N88000
E41000
E42000
1400
1350
1300
1250
Reinforced concrete culvert pipe
Existing culverts
Reinforced concrete
Road No 1
Berm
Center line of waste channel and diversion tunnel
30+00
25+00
20+00
Inclined tunnel
Retaining wall
Manhole
Vitrified pipe
Septic tank
Cast iron pipe
Release water chamber
Cut-off wall
Existing access road
Existing cut-off wall
Center line of dam
N86000
E43000
PLAN
Top of earth slope
Top of rock cut
Assumed rock surface on center line
Excavated under a previous contract
Assumed
Waste channel
Existing diversion tunnel
Diversion tunnel plug
For details see Sheet 17, Acc. 68
30+00
25+00
20+00
SECTION A-A

CONTRACT 401 SHEET 12
SHEETS IN SET, 39



For detail topography, waste weir and channels see Sheet 11, Acc. 66707.
For plan of waste weir and channels see Sheet 13, Acc. 66833.
Surface dressing and grassing as ordered.



City of New York
BOARD OF WATER SUPPLY

DOWNSVILLE DAM

WASTE WEIR AND CHANNELS
GENERAL PLAN AND SECTIONS

100 0 100 200ft

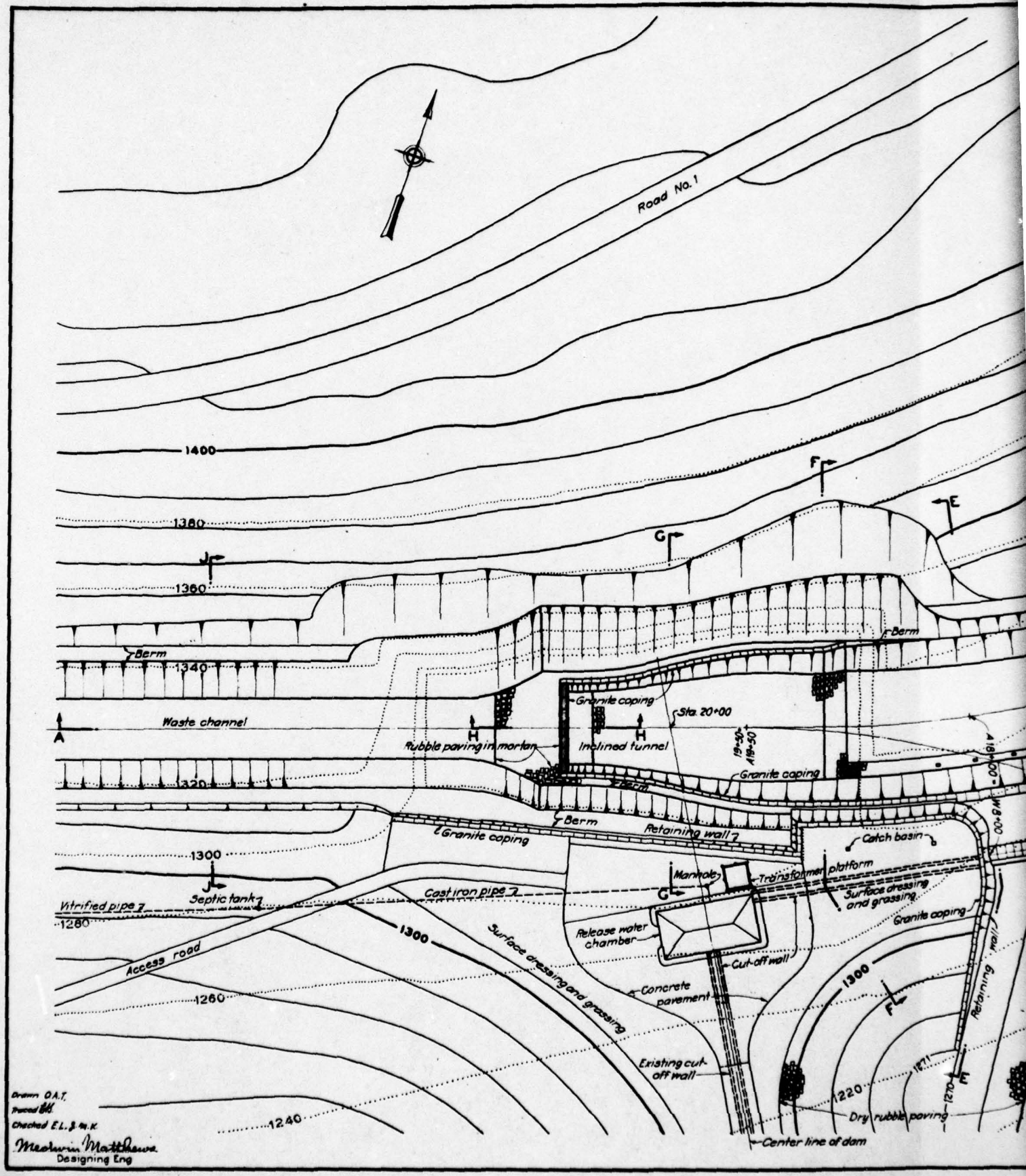
DECEMBER 1, 1948

Dept Eng Hdqrs

File - Cont 401-3.4 ED

Acc. 66845

3



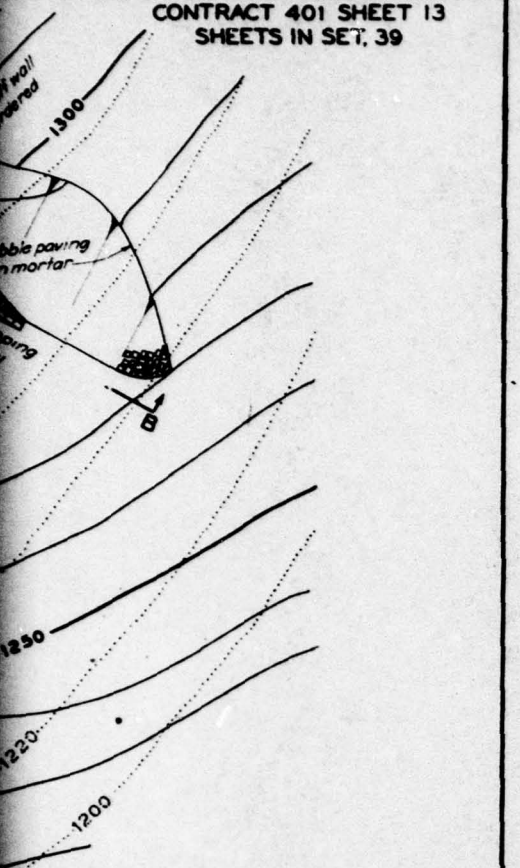
Drawn O.A.T.
Traced [illegible]
Checked E.L. & M.K.

Meadowin Matthews
Designing Eng

Ref-No. 65354

1400
1380
1360
1340
1320
1300
1280
1260
1240
1250
1220
1200
1180
1160
1150
1140
1250
1230
1200
1200
1180
1160
Contours of assumed surface of rock
1350
Surface dressing and grassing as ordered
℄ Berm
℄ Axis of weir channel
℄ Granite coping
Crest line of waste weir Elev 1280
℄ Granite coping
Rubble paving in mortar
W5+00
℄ Granite coping
W0+00
Cut-off wall if ordered
Rubble pa
in mort
Granite coping
Retaining wall
A 1:5000
℄ Center line of diversion tunnel
15+00
Bulkhead
Existing inlet channel
Rock embanking
Retaining wall
Berm
Berm
Elev 1175
Berm
Elev 1175
D
D
D
C
C
C
For gene
channel an
For Sect
Acc 66849.
For Sect
details see
For Sect
Acc 66850.
For detai
For floor
Sheet 27, Acc
This dra
trative of th
Working dra
be furnishe
DO
WAS
40
Dept Eng Hdqrs

CONTRACT 401 SHEET 13
SHEETS IN SET, 39



...r general plan and section of waste weir; weir
...nel and waste channel see Sheet 12, Acc. 66845.
...r Sections A-A, B-B, D-D and E-E see Sheet 14,
...6849
...r Section C-C and granite coping and drainage
...a see Sheet 16, Acc. 66844
...r Sections F-F, G-G, H-H and J-J see Sheet 15,
...6850
...r details of bulkhead see Sheet 18, Acc. 66744.
...r floor plan of release water chamber see
...22, Acc. 67976
...g drawing is to be considered as merely illus-
...n of the type of construction contemplated
...ng drawings showing necessary details will
...rnished.

City of New York
BOARD OF WATER SUPPLY

DOWNSVILLE DAM

WASTE WEIR AND CHANNELS

PLAN

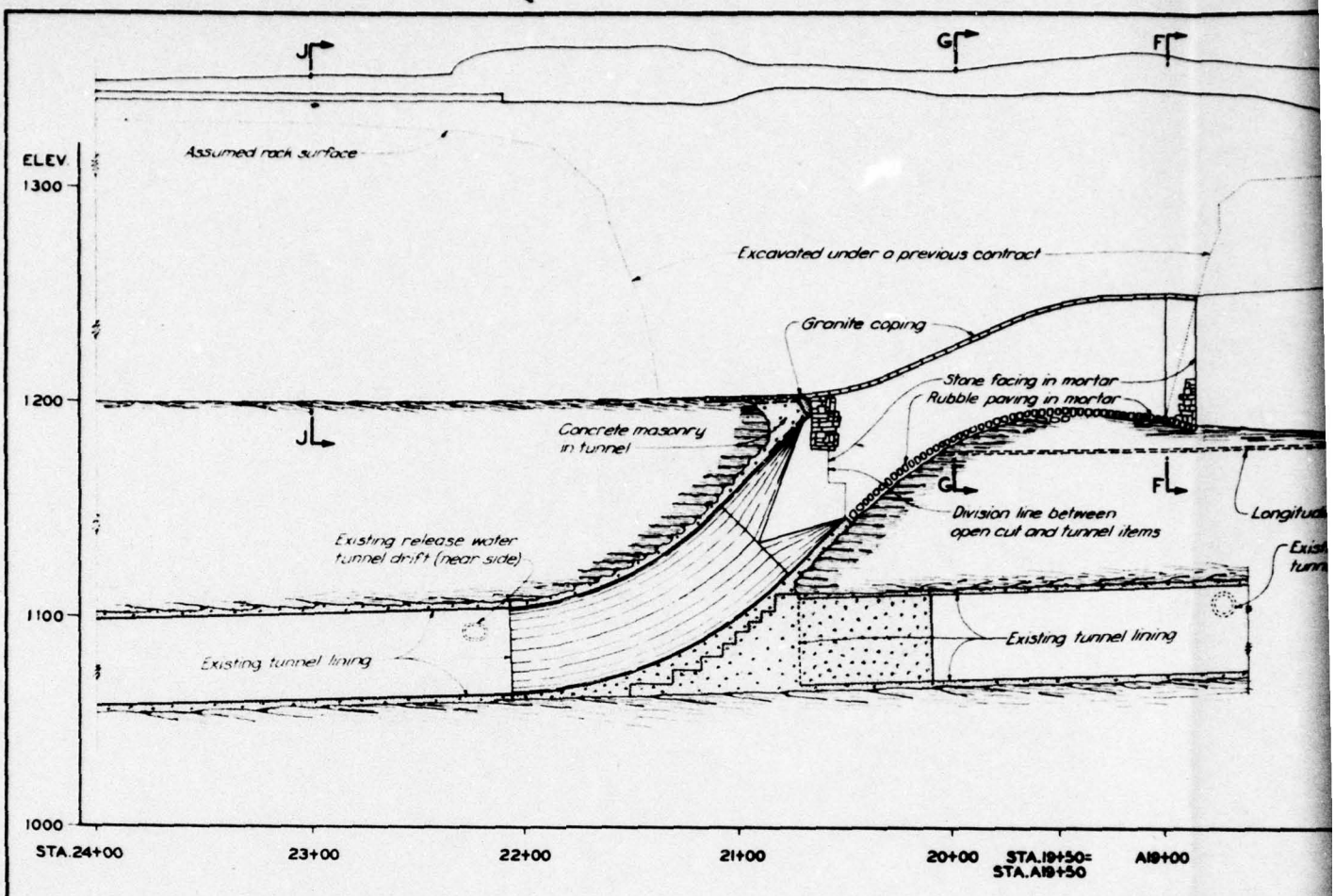
40 0 80 80ft

DECEMBER 1, 1948

File Cont 401-3.4 E.D. Acc 66833

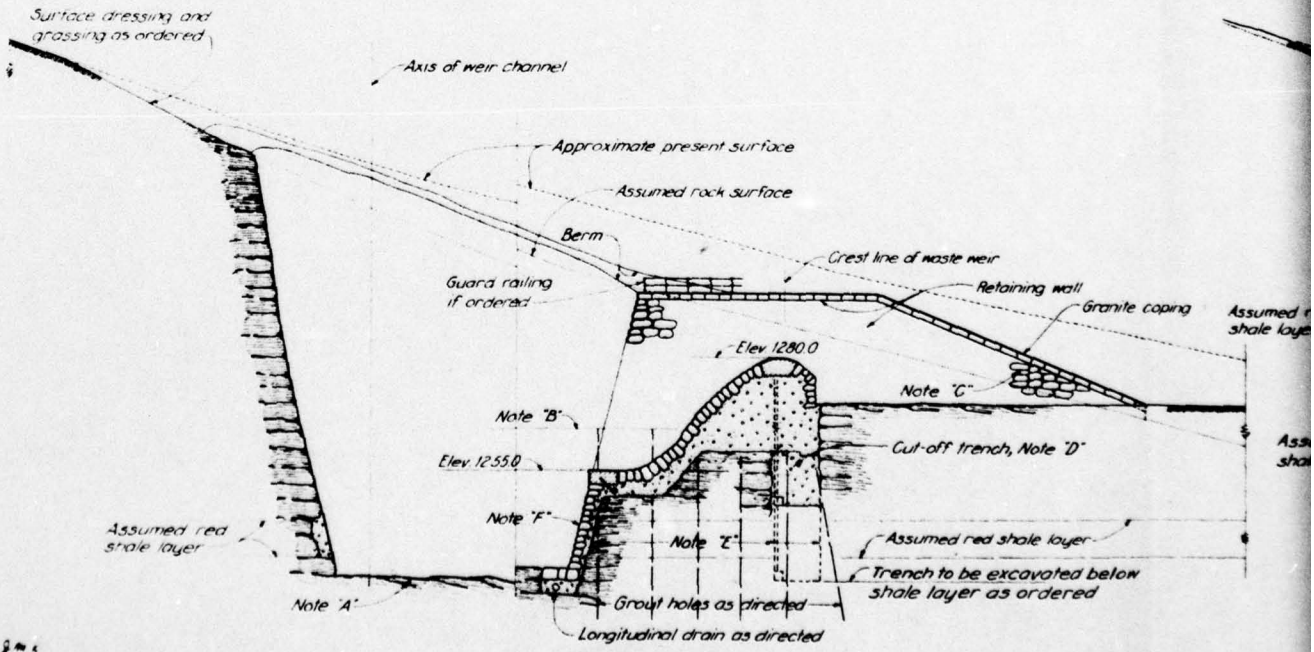
1

8



SECTION A-A

40 0 40 80ft

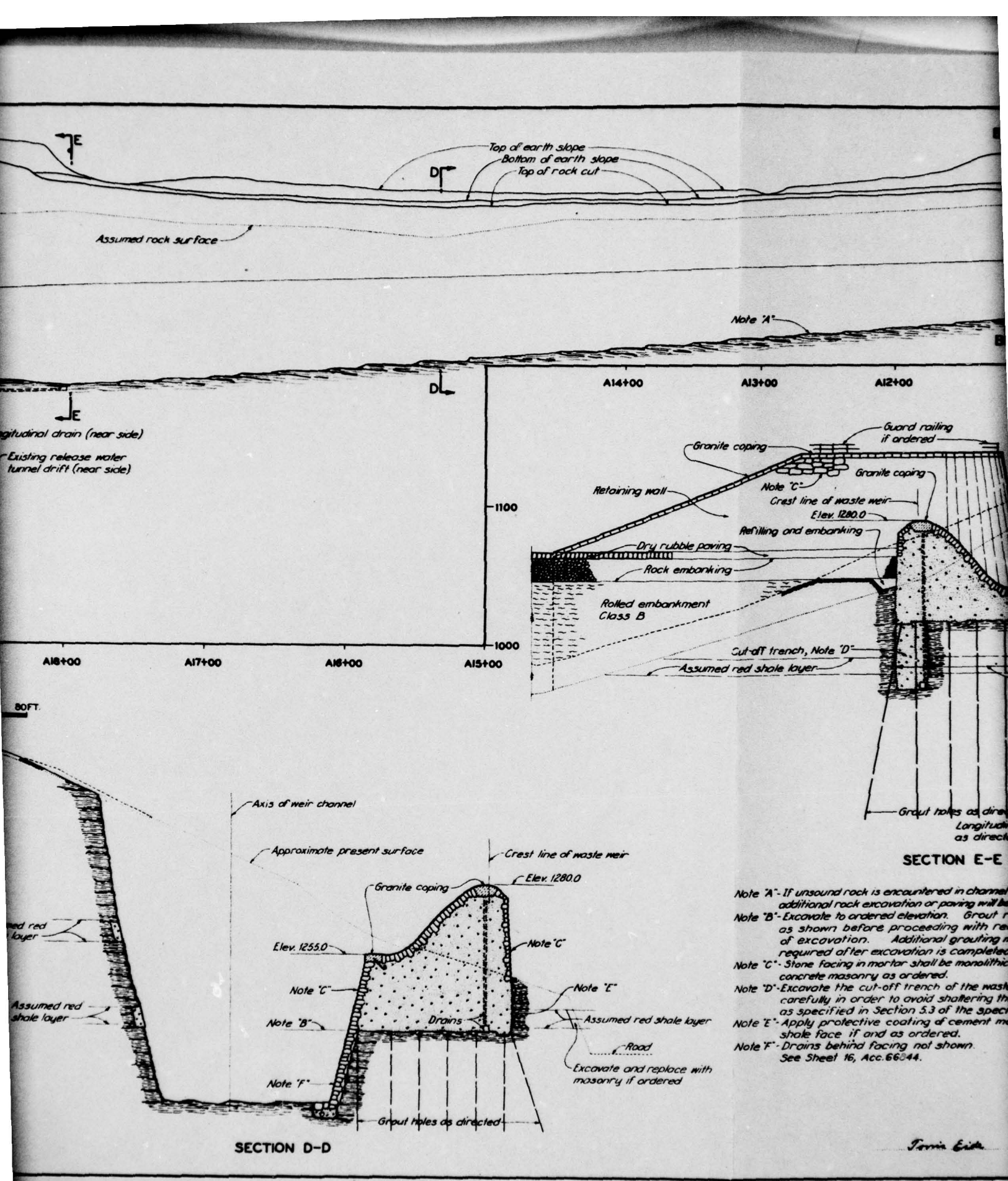


SECTION B-B

Drawn E.
Traced CP
Checked S.J.M.

Mechan Watkins
Designing Eng.

Ref. Acc FE264



SECTION E-E

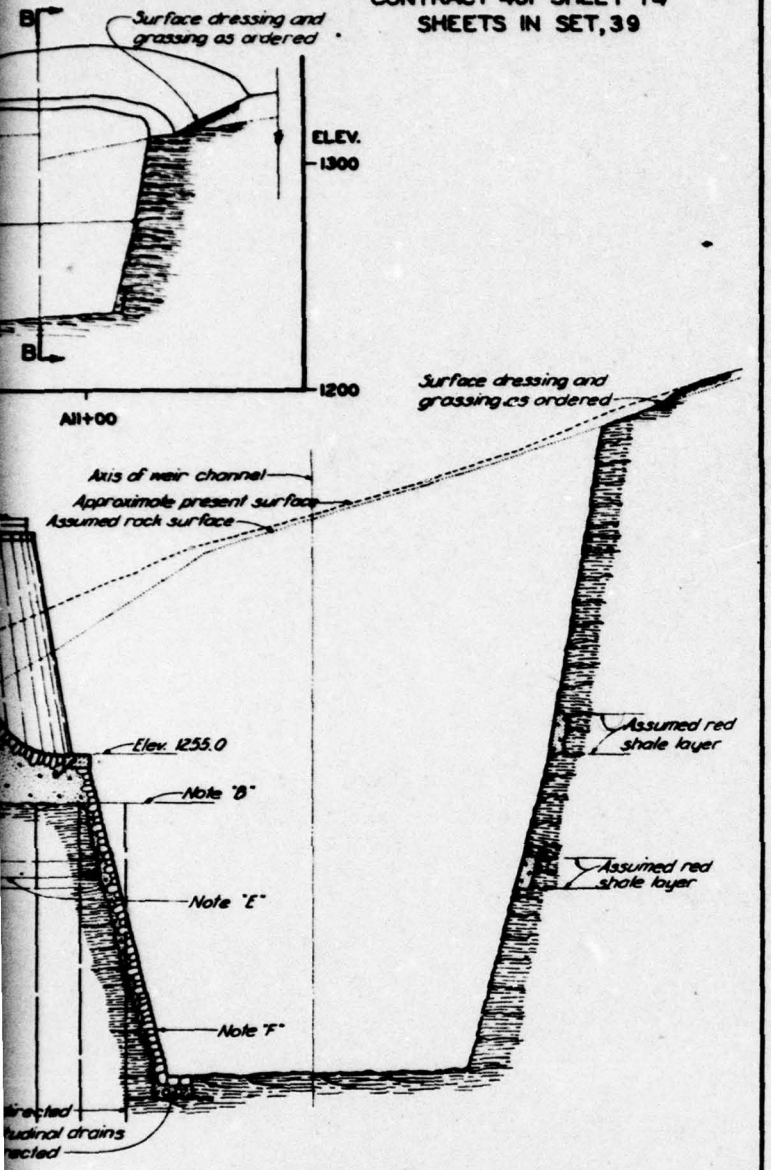
SECTION D-D

Note "A"- If unsound rock is encountered in channel
additional rock excavation or paving will be
Note "B"- Excavate to ordered elevation. Grout r
as shown before proceeding with re
of excavation. Additional grouting m
required after excavation is completed
Note "C"- Stone facing in mortar shall be monolithic
concrete masonry as ordered.
Note "D"- Excavate the cut-off trench of the waste
carefully in order to avoid shattering the
as specified in Section 5.3 of the specif
Note "E"- Apply protective coating of cement mo
shale face if and as ordered.
Note "F"- Drains behind facing not shown.
See Sheet 16, Acc. 66044.

Travis Eide

2

CONTRACT 401 SHEET 14
SHEETS IN SET, 39



nal invert
ll be ordered.
t rock.
remainder
g may be
ded.
thic with

aste weir
the rock,
ecifications.
mortar on

Exposed areas of shale or unsound rock to be protected with concrete or stone masonry if and as ordered.

For plan showing location of sections see Sheet 13, Acc. 66833 for Sections F-F, G-G and J-J see Sheet 15, Acc. 66850.

This drawing is to be considered as merely illustrative of the type and character of construction contemplated.

The cross-section and location of the waste weir is subject to change depending on the quality of the rock as disclosed by the excavation.

Working drawings showing location, cross-section and details of the waste weir will be issued.

City of New York

BOARD OF WATER SUPPLY

DOWNSVILLE DAM

WASTE WEIR AND CHANNELS

SECTIONS

20 0 20 40 Ft.

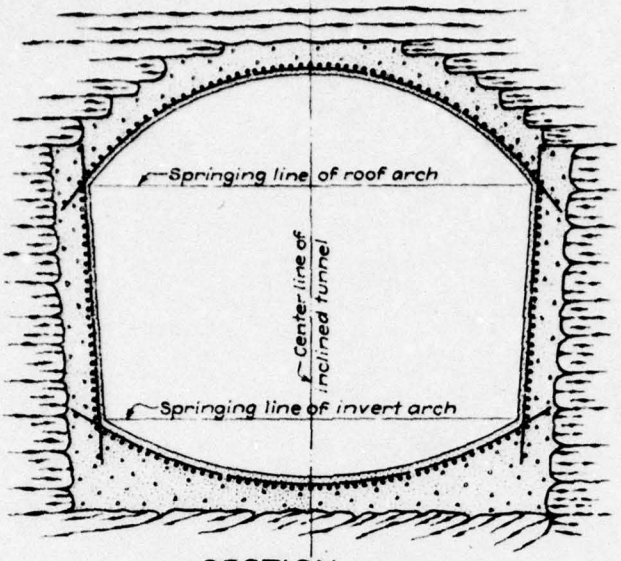
DECEMBER 1, 1949

Dept. Eng. Hdqrs.

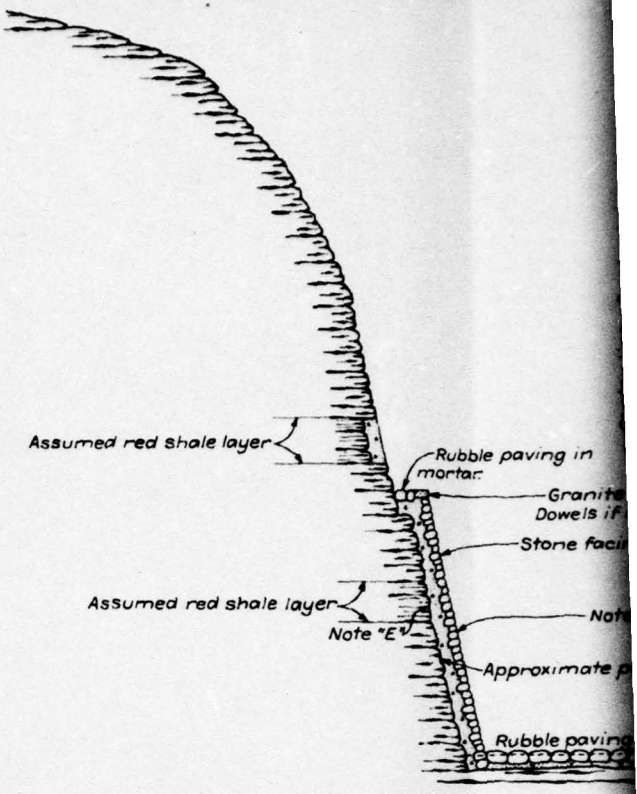
File 401-3.4 E D

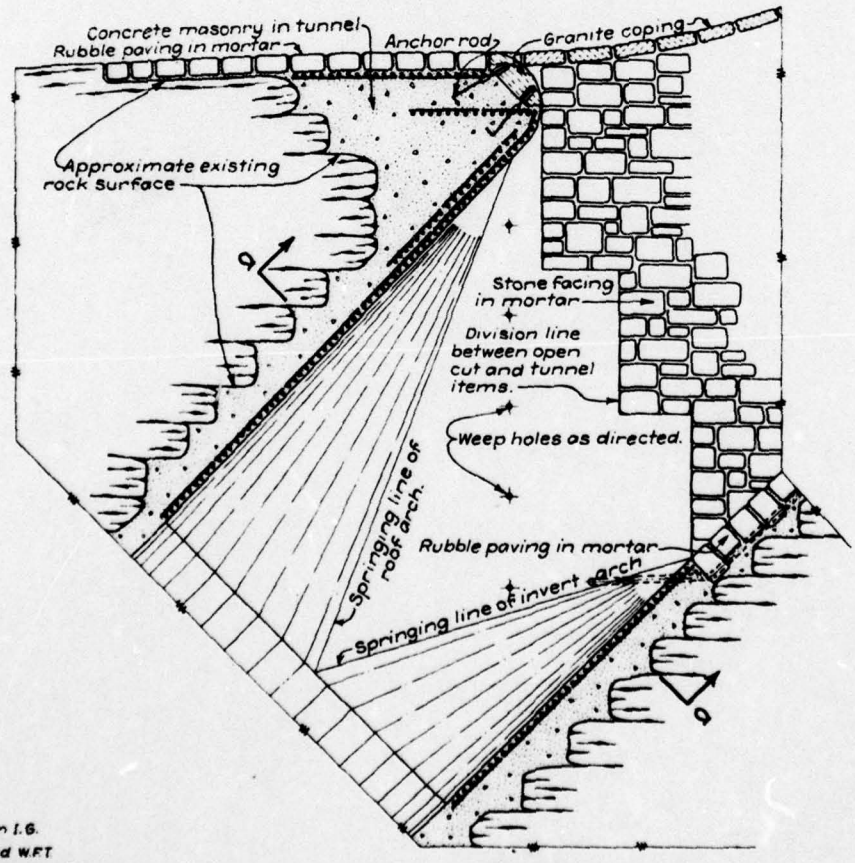
Acc. 66849

3



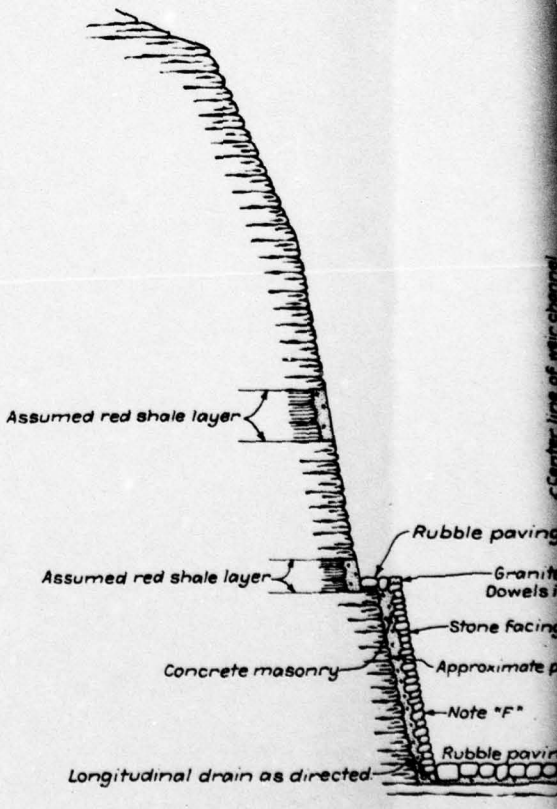
SECTION a-a





SECTION H-H

10 0 10 20 Ft.

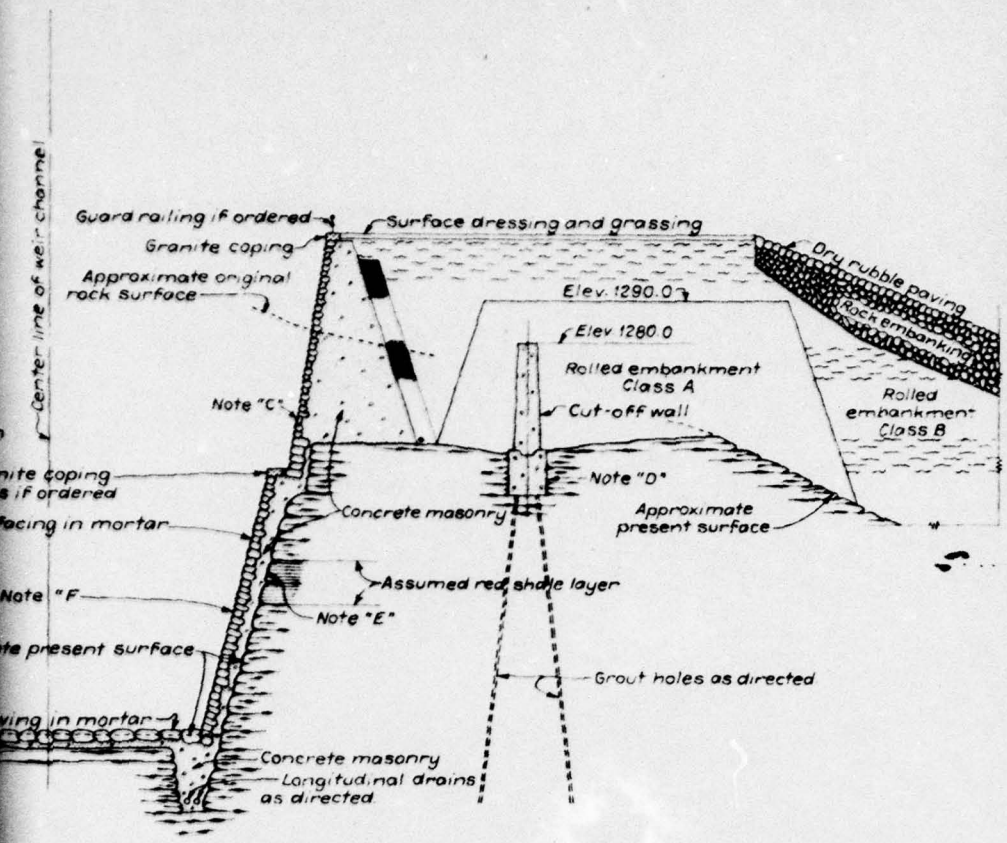


SECTI

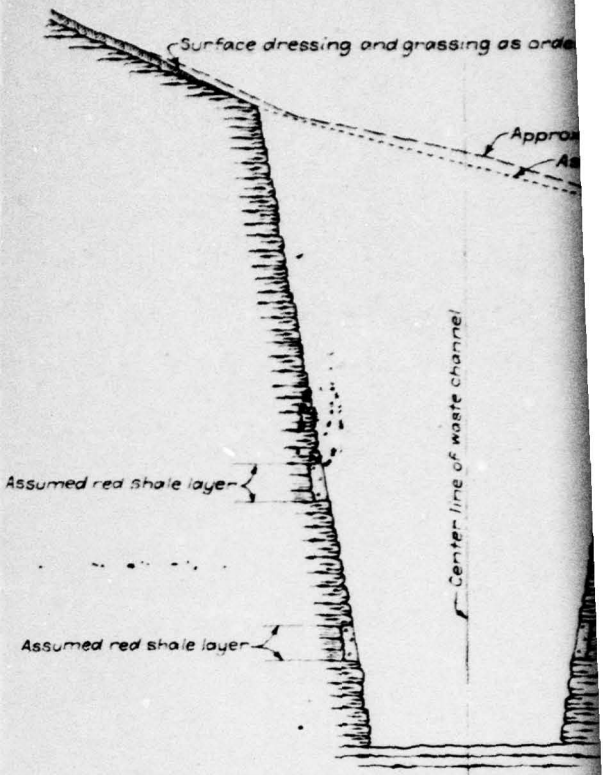
Drawn I.G.
Traced W.F.T
Checked E.L. J.A.K.

Meslwin Matthews
Designing Eng.

Ref-Acc. 66319



SECTION F-F



SECTION J-J

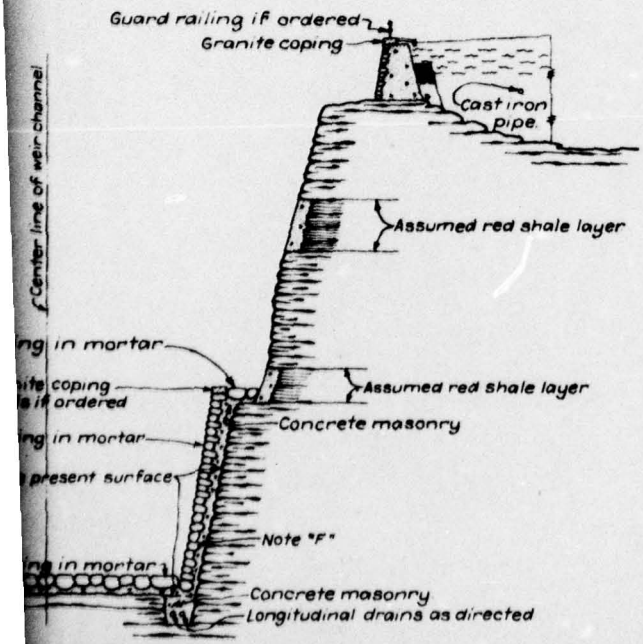
Note "C" Stone facing in mortar shall be monolithic with concrete masonry as ordered

Note "D" Excavate the cut-off trench carefully in order to avoid shattering the rock, as specified in Section 5.3 of the specifications.

Note "E" Apply protective coating of cement mortar on shale face if and as ordered.

Note "F" Drains behind facing not shown. See Sheet 16, Acc. 66844.

Exposed areas to be protected w if and as ordere For plan showin Sheet 13, Acc. 66 This drawing i illustrative of th construction co ings showing ne issued.



ON G-G

C
BOARD O
DOWI
WASTE W

Dept. Eng. Hdqrs.

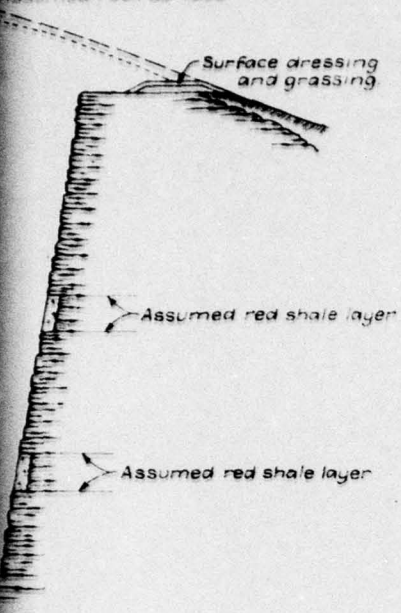
File:

2

CONTRACT 401 SHEET 15
SHEETS IN SET, 39

dered

oximate present surface
Assumed rock surface



J

eas of shale or unsound rock
d with concrete or stone masonry
ered.
owing location of sections see
66833.
ng is to be considered as merely
f the type and character of
contemplated. Working draw-
necessary details will be

City of New York
D OF WATER SUPPLY
WNSVILLE DAM
E WEIR AND CHANNELS
SECTIONS

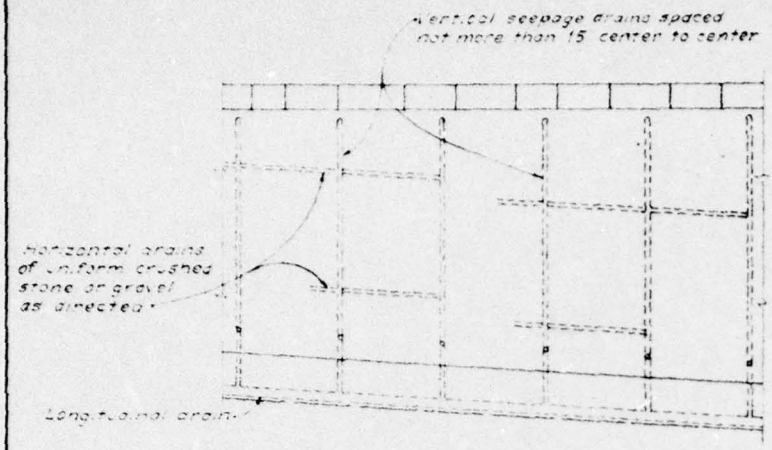
0 20 40Ft

DECEMBER 1,1949

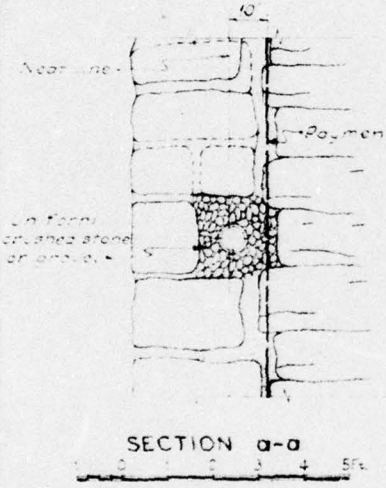
le: Cont. 401-3.4 E D

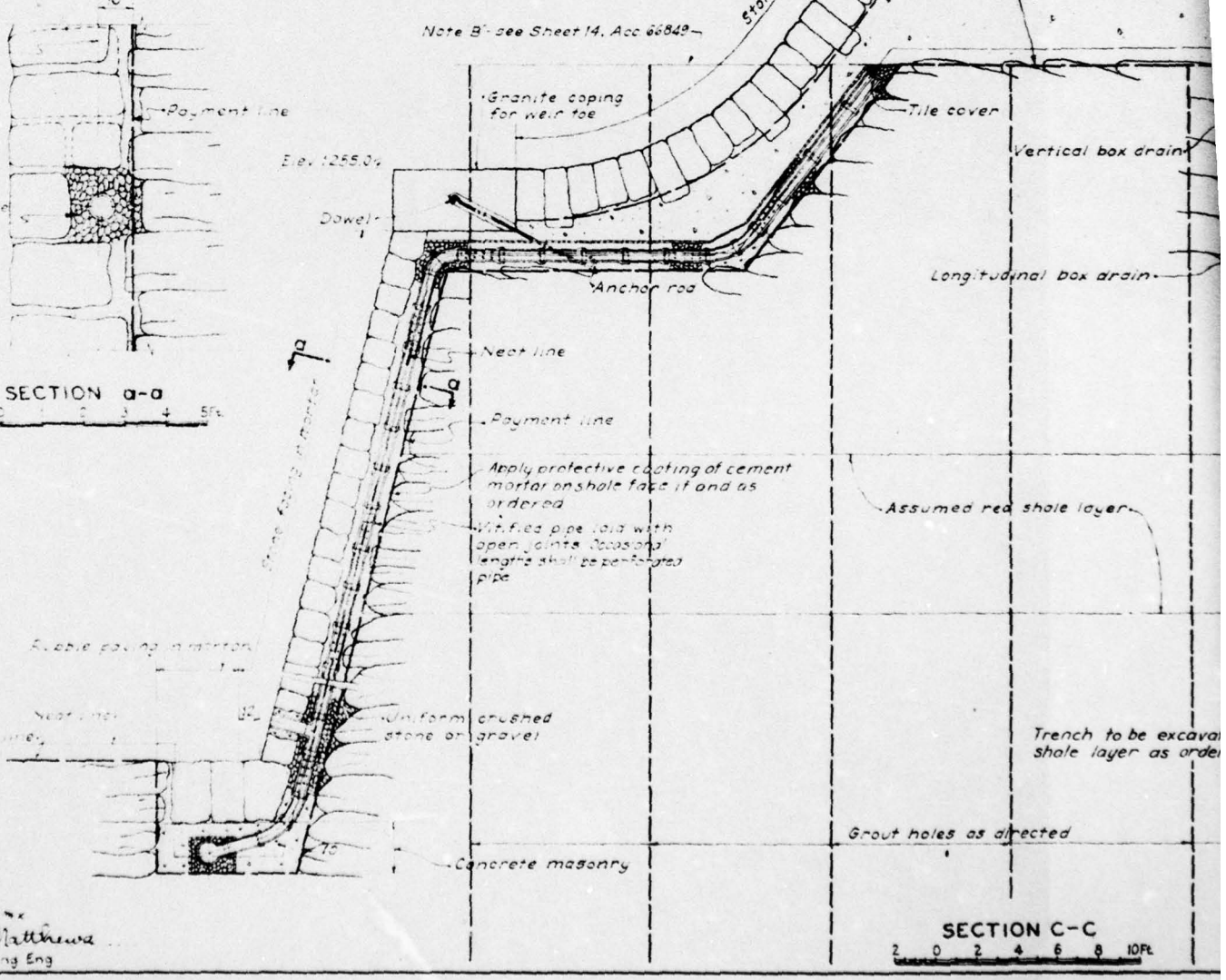
Acc. 66850

3



TYPICAL ELEVATION
Diagrammatic

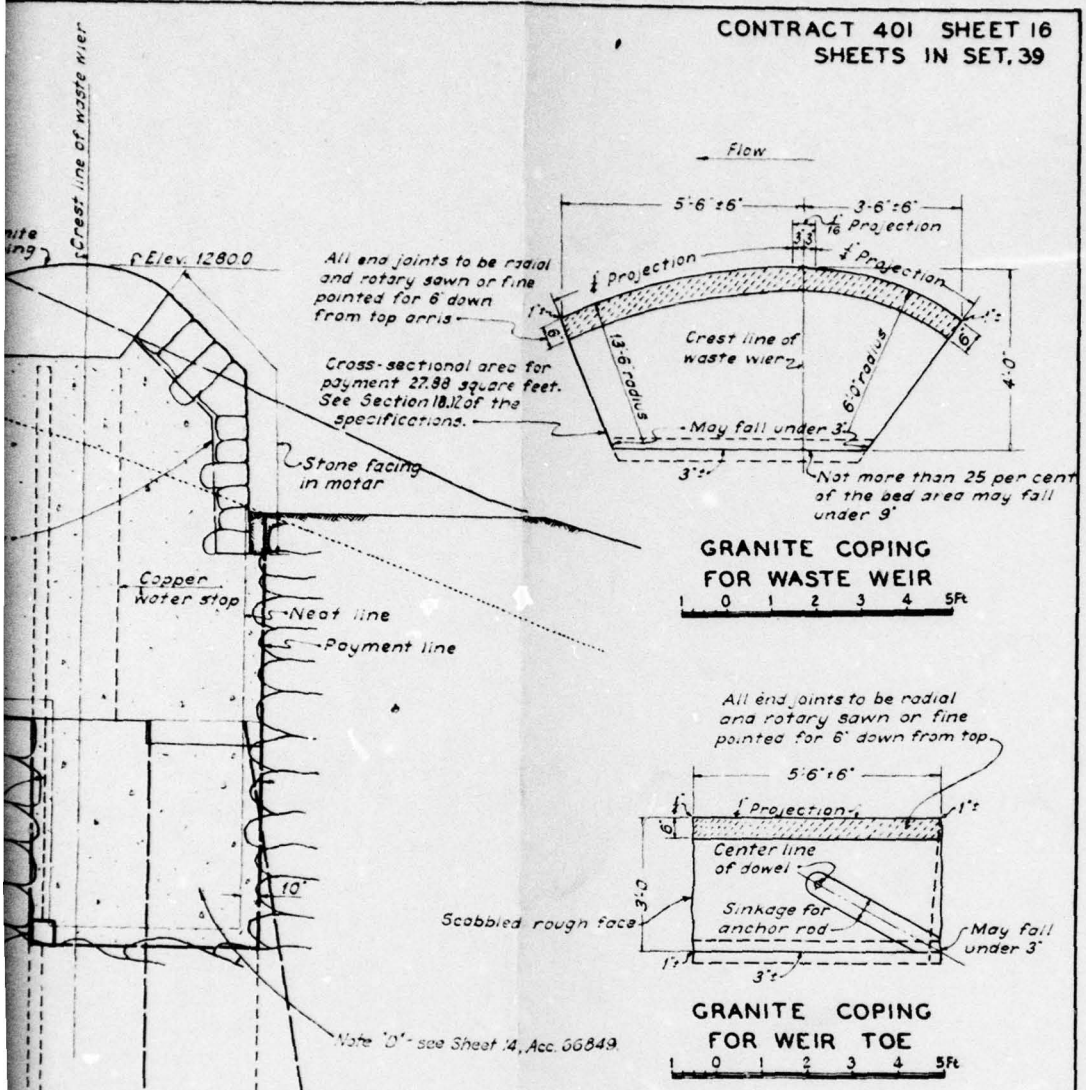




Drawn BF
Traced DF
Checked RAT 3-xx
Mechanics Matthews
Designing Eng

Ref-Acc 66248

CONTRACT 401 SHEET 16
SHEETS IN SET, 39



For plan showing location of Section C-C see Sheet 13, Acc 66833.

This drawing is to be considered as merely illustrative of the type and character of construction contemplated.

The cross-section and location of the waste weir is subject to change depending on the quality of the rock as disclosed by the excavation. Working drawings showing location, cross-section and details of the waste weir will be issued.

City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
WASTE WEIR AND CHANNELS
WEIR AND DRAINAGE DETAILS
2 0 2 4 6 8 10Ft
DECEMBER 1, 1949

Dept. Eng. Hdqrs.

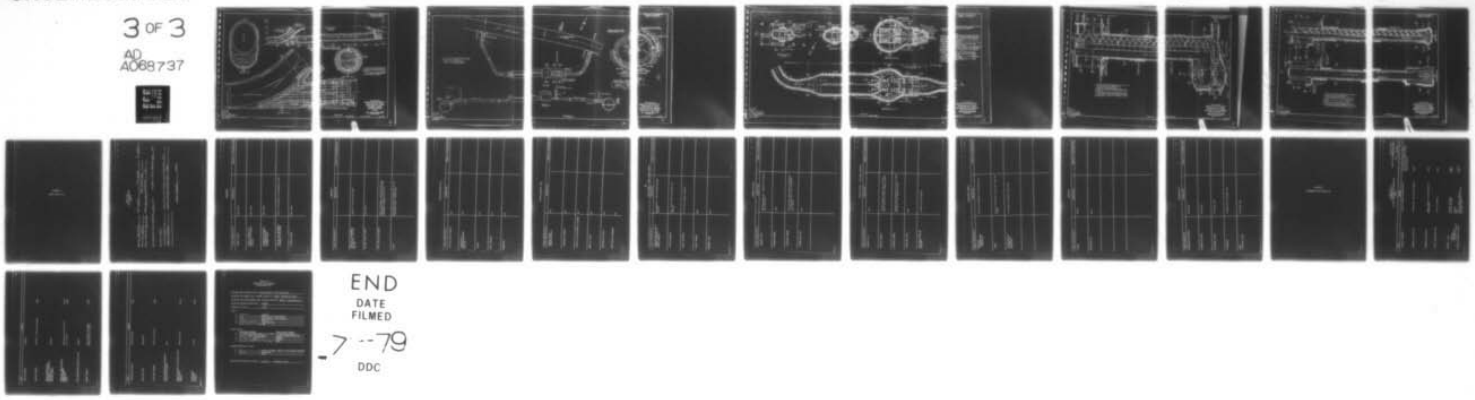
File Cont. 401 3.4 E D

Acc. 66844

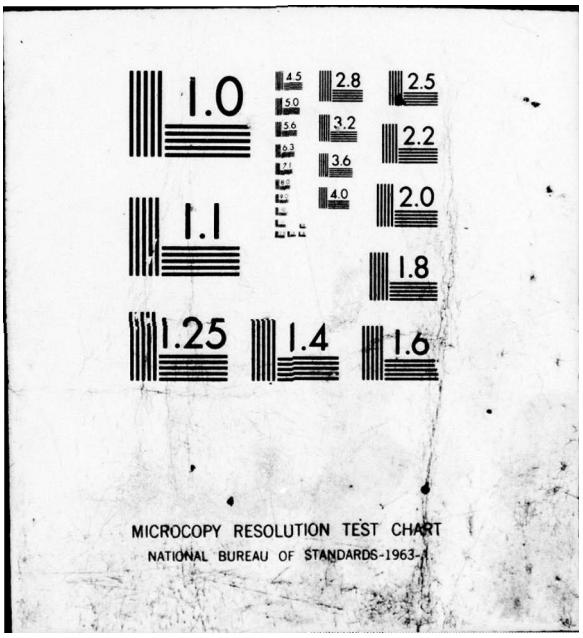
AD-A068 737 KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA F/G 13/2
NATIONAL DAM SAFETY PROGRAM. DOWNSVILLE DAM (NY342), DELAWARE R--ETC(U)
JUL 78 R J KIMBALL DACW51-78-C-0025

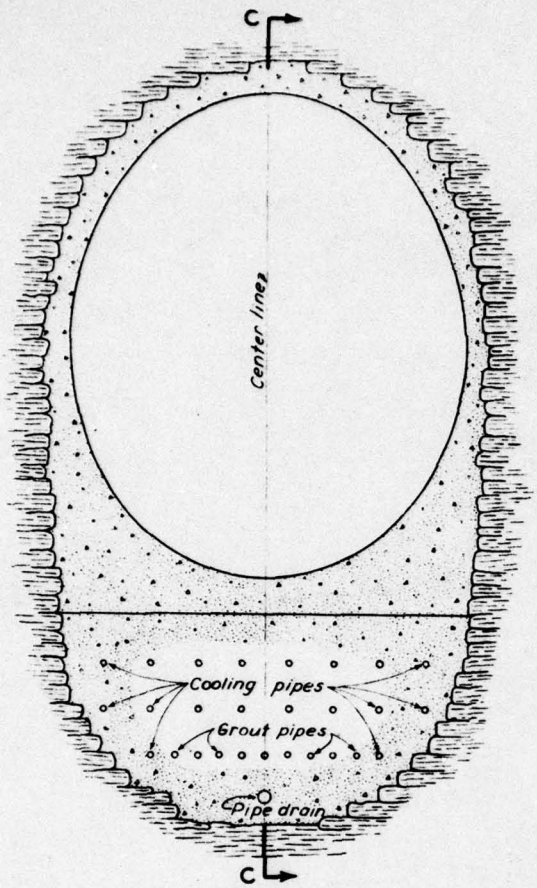
UNCLASSIFIED NL

3 OF 3
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A068737

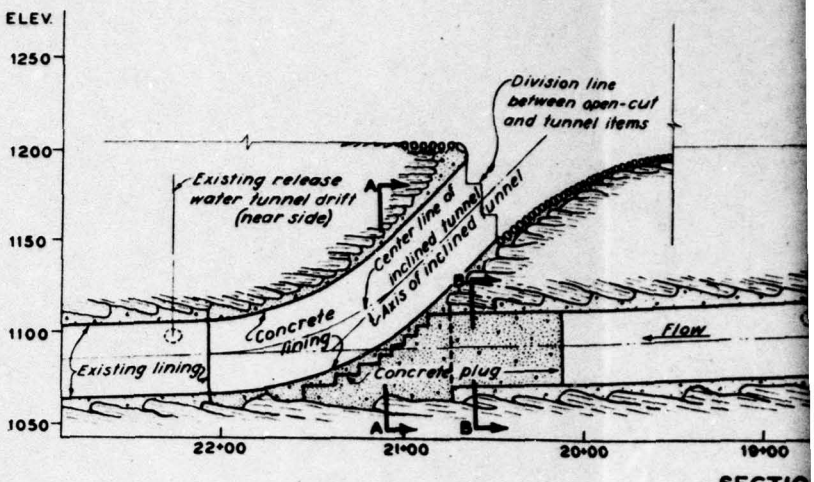


END
DATE
FILMED
-7-79
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

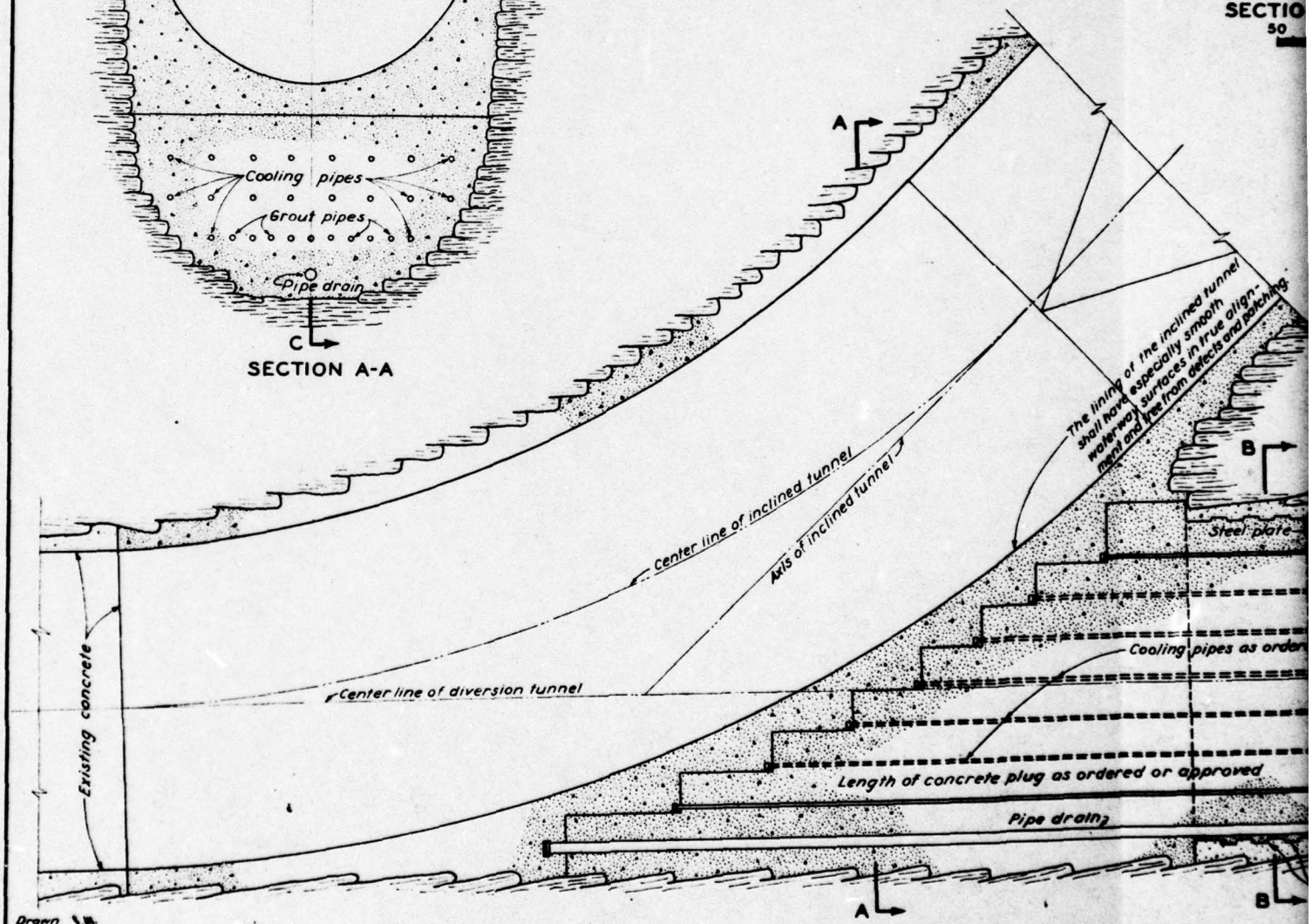


SECTION A-A



SECTIO

50

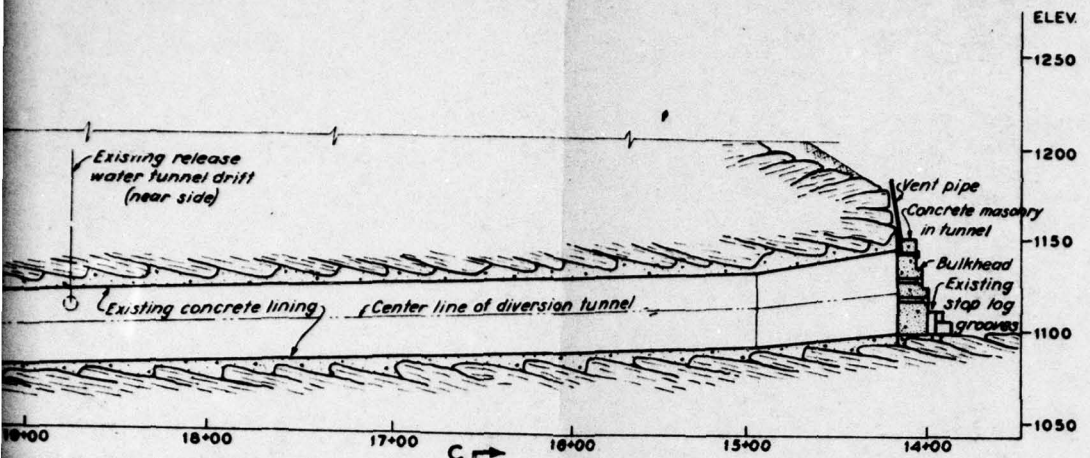


SECTION C-C

Drawn JM.
Traced A.W.M.
Checked E.L. Jones
Marlowe Matthews
Designing Eng

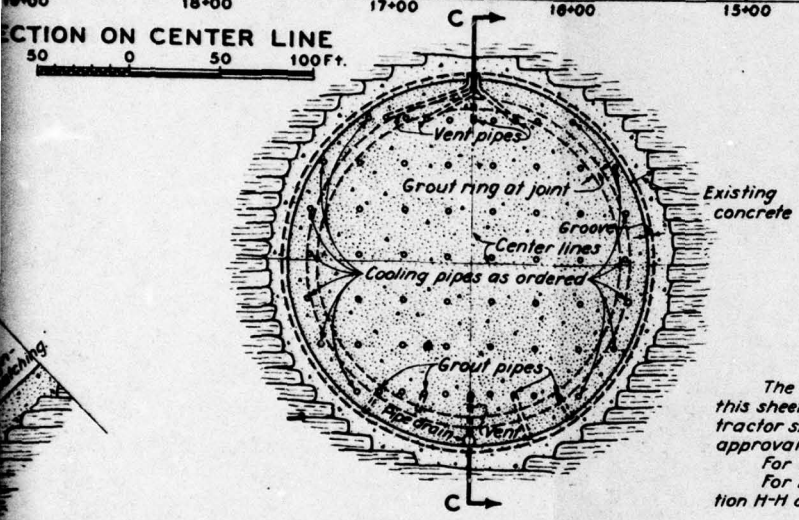
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CONTRACT 401 SHEET 17
SHEETS IN SET, 39



CTION ON CENTER LINE

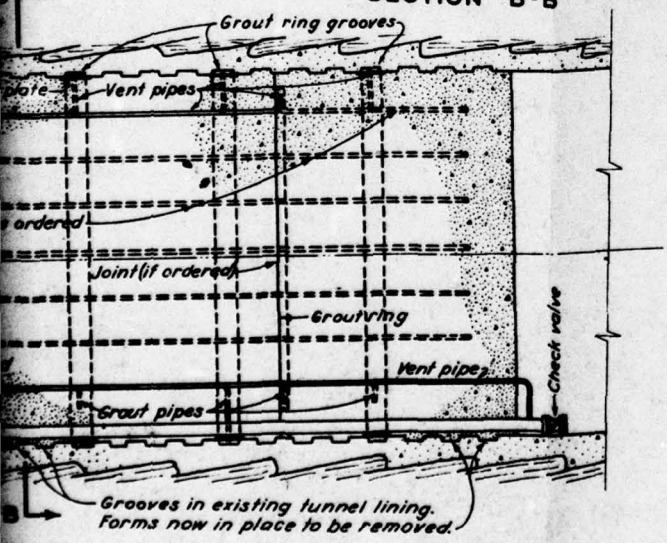
50 0 50 100 Ft.



The details of tunnel plug shown on this sheet are suggestive only. The Contractor shall submit detail drawings for approval.

For bulkhead see Sheet 18, Acc. 66744.
For inclined tunnel portal see Section H-H on Sheet 15, Acc. 66850.

SECTION B-B

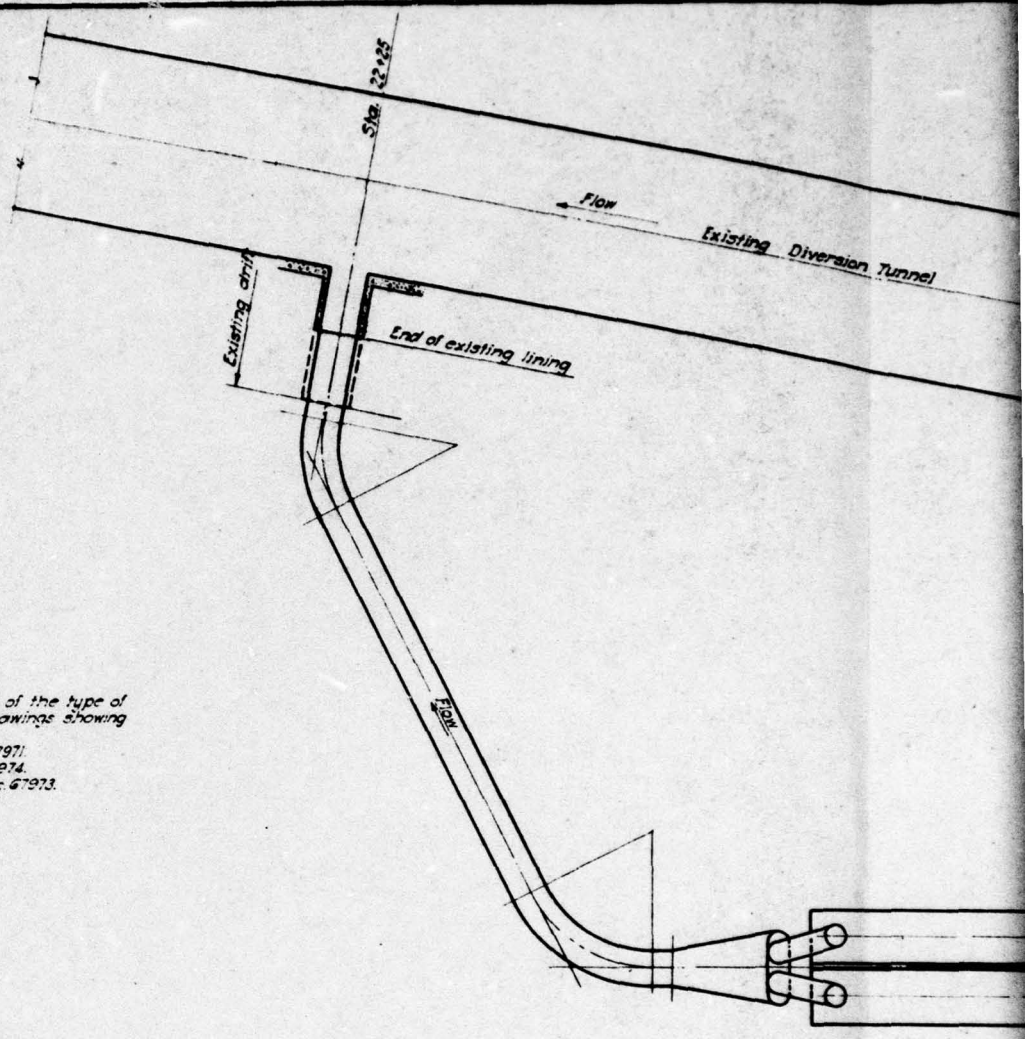


City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
DIVERSION TUNNEL
CLOSURE DETAILS
PLUG

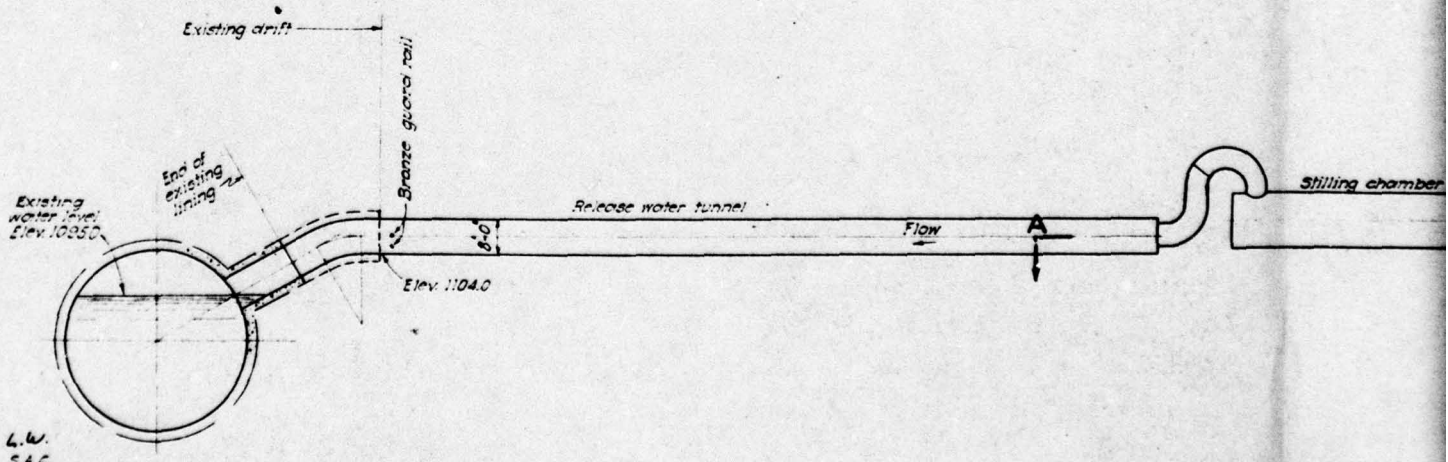
10 0 10 20 Ft.

DECEMBER 1, 1949

Dept. Eng. Hdqrs. File Cont. 401-3.4 E D Acc. 66543



This drawing is merely illustrative of the type of construction contemplated. Working drawings showing necessary details will be issued.
For Section A-A see Sheet 22, Acc. 67971.
For Section H-H see Sheet 25, Acc. 67974.
For Sections F-F & G-G see Sheet 24, Acc. 67973.



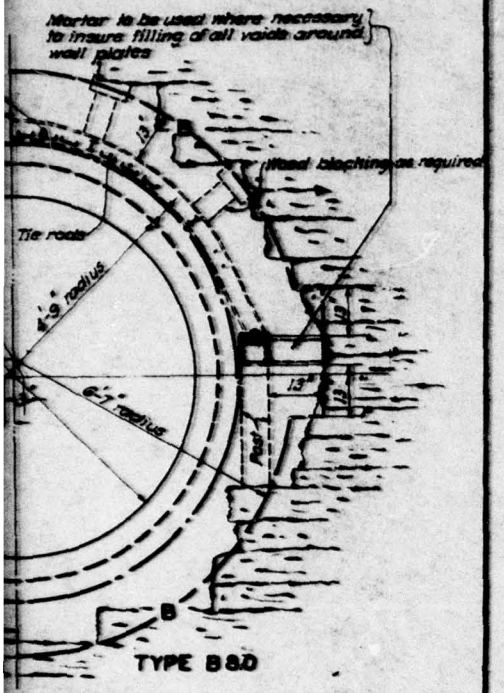
Drawn L.W.
Traced S.A.C.
Checked G.L.K. CPM

Designing Eng.

Ref. Acc. 65330

Travis Eads
Dept. Eng. Hdqrs

CONTRACT 401, SHEET 20
SHEETS IN SET, 39



TYPE B 8.0

SECTION
WATER TUNNEL

2 3 4 5Ft

A 8.0

Foot

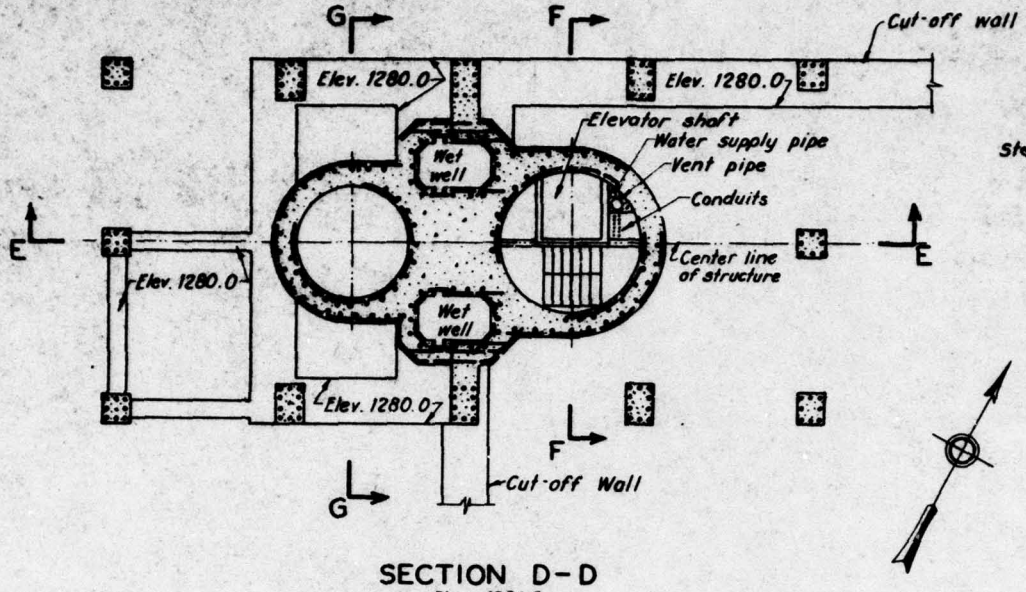
City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
RELEASE WATER CHAMBER
LOCATION PLAN AND PROFILE

20 0 20 40Ft

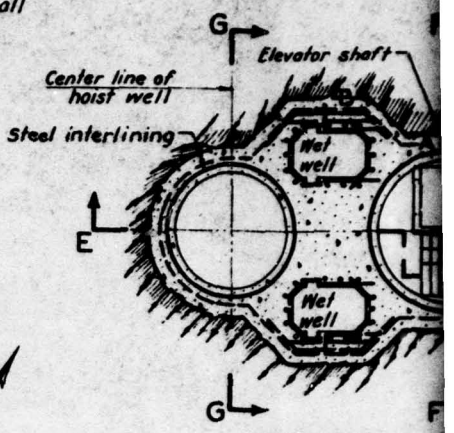
DECEMBER 1, 1949

File Cont 401-3.4 ED Acc. 67970

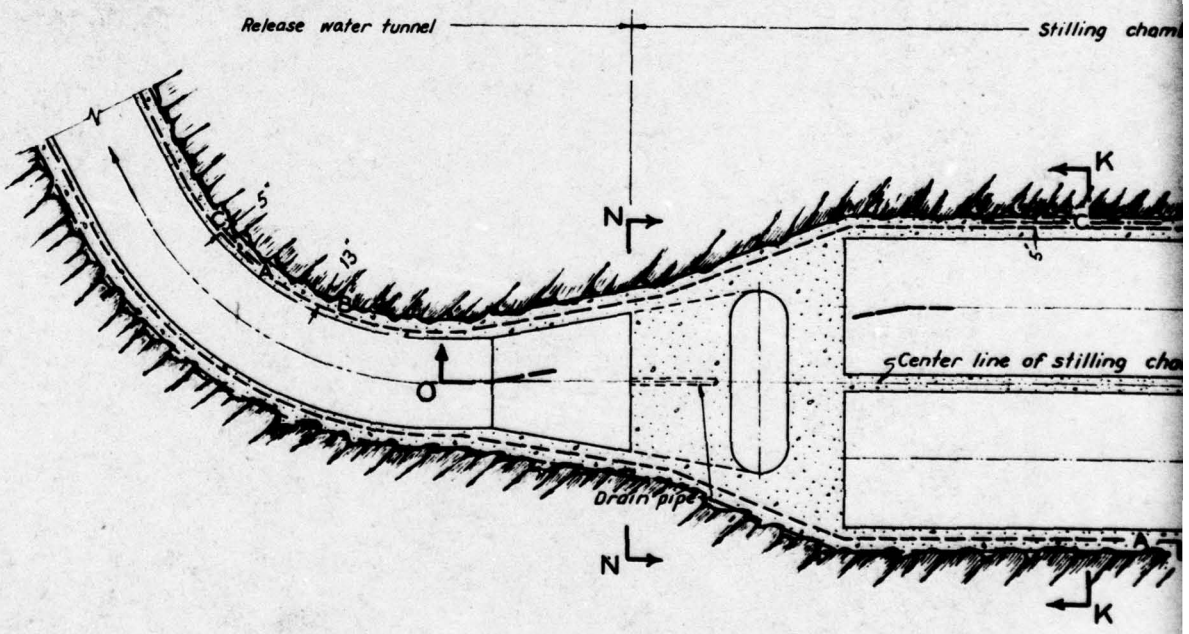
3



SECTION D-D
Elev. 1281.0

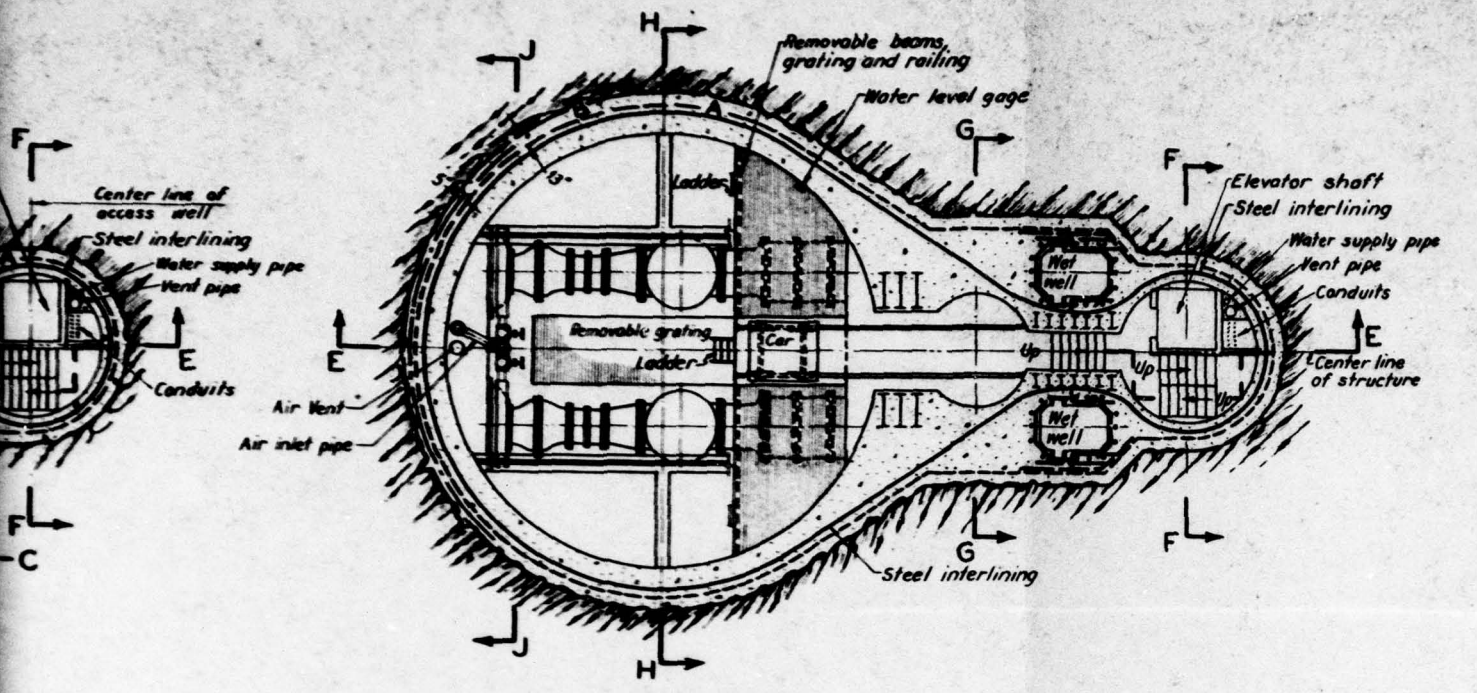


SECTION C-

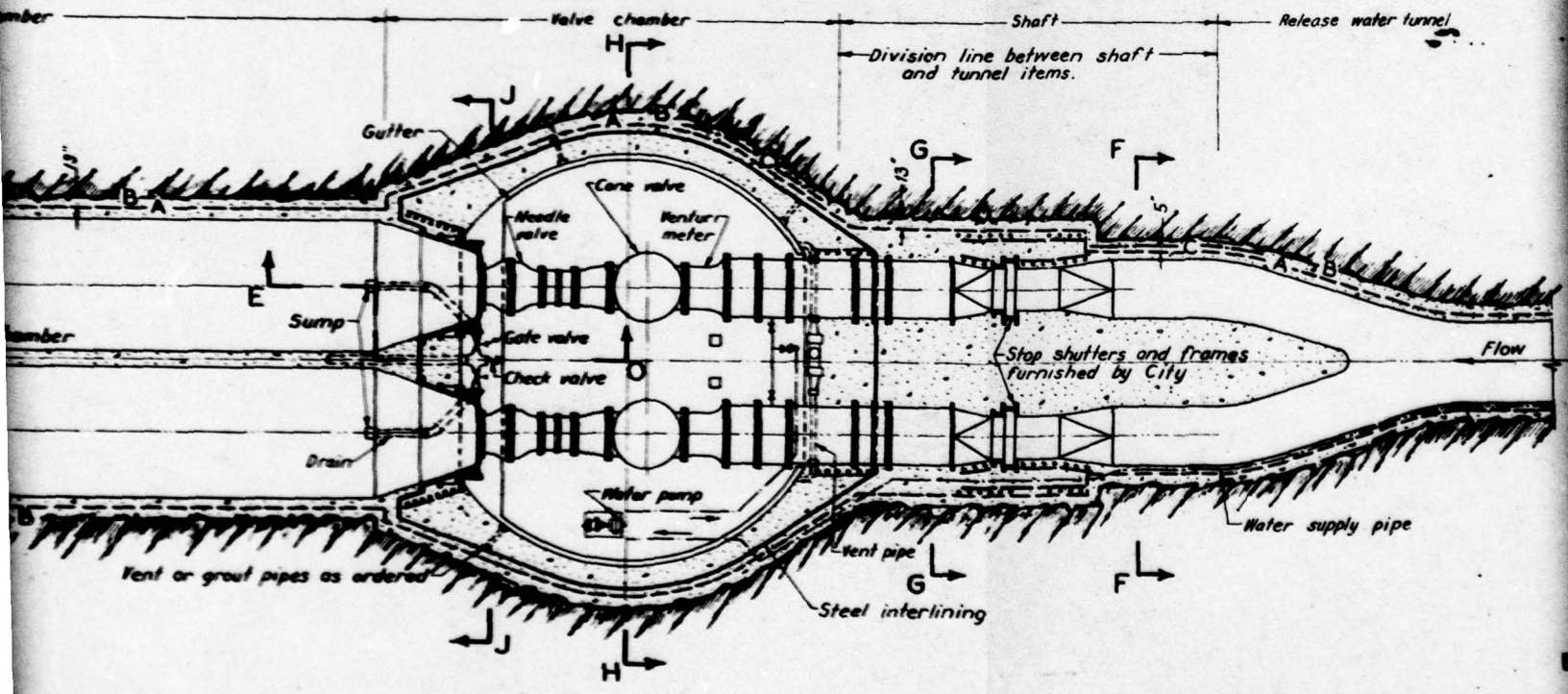


Drawn M.C.K
Traced L.G.
Checked L.B.R. C.P.M.
Melvin Matthews
Designing Eng.

Ref. Acc. 66359



SECTION B-B



SECTION A-A

Dept. Eng. Hdqrs

File Cent

2

CONTRACT 401 SHEET 22
SHEETS IN SET, 39

ing is to be considered as merely illustrative
of construction contemplated.
drawings will be issued.

TES:
concrete masonry, special care shall be
intain in their true position the steel
cast iron grooves, stop shutters with
and guides, and metal, vitrified and
ent pipes.
may be required in any portion of the
struction.
water pump, air compressor, venturi meters
needle valves to be set, but not
nder this contract.
ng blowers and ducts, lighting equipment and
ent are not included in this contract, but
or shall make provision for their future
such as foundations, anchor bolts, etc.

ion E-E see Sheet 23, Acc. 67972
ion F-F, G-G see Sheet 24 Acc. 67973
ns H-H, J-J, K-K, L-L, M-M, N-N, O-O see
c 67974.
g, platform car and stop shutter grooves
Acc 67981.
nly partially shown, is always
side "A" line.

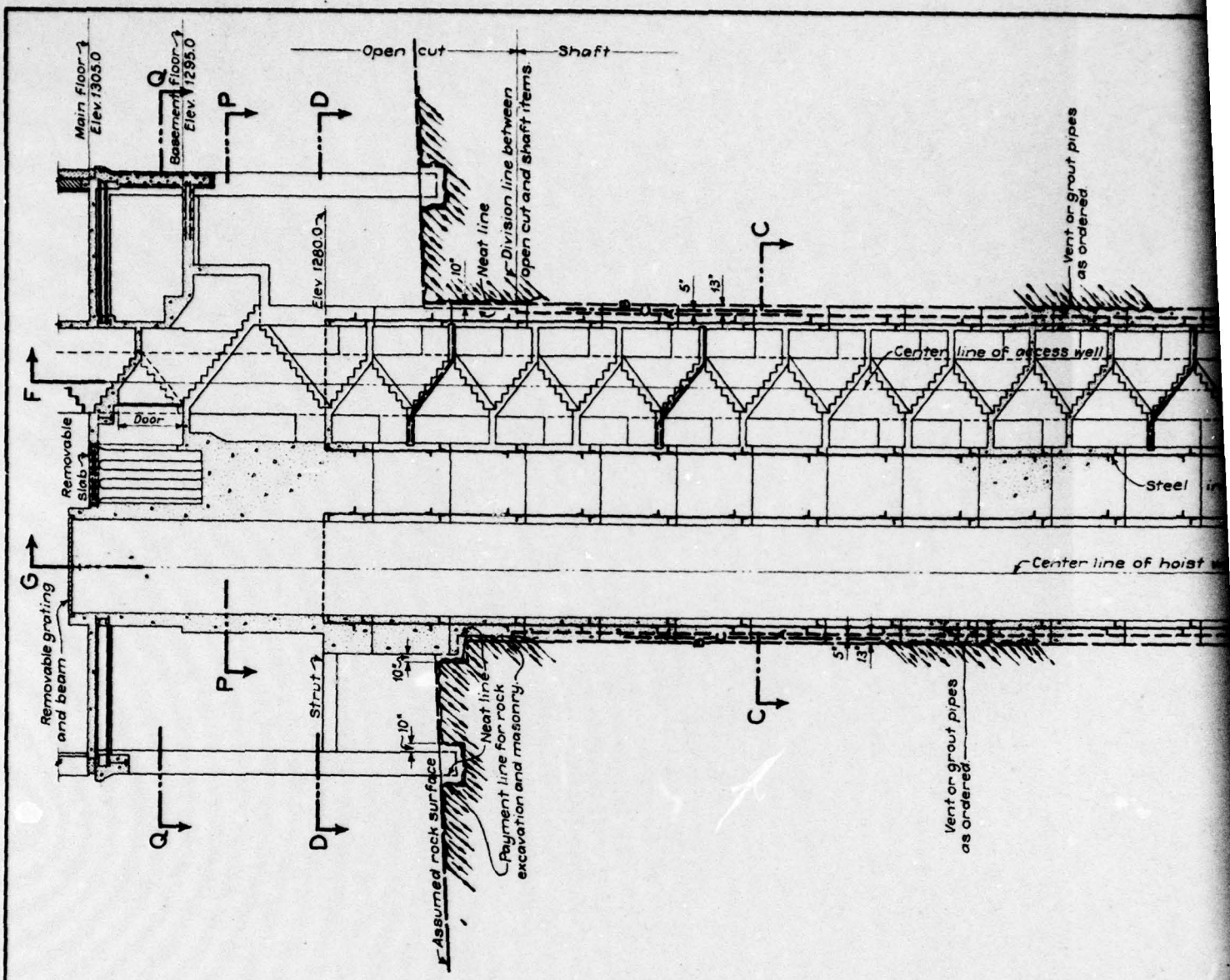
E

City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
RELEASE WATER CHAMBER
HORIZONTAL SECTIONS
0 2 6 10 14 18 22ft
DECEMBER 1,1949

t 401-3.4 E D Acc 67971

1

3



This drawing is to be considered as merely illustrative of the type of construction contemplated.
Working drawings will be issued.
For general notes see Sheet 22, Acc. 67971.
For location of Section E-E see Sheet 22, Acc 67971.
For Sections A-A, B-B, C-C and D-D see Sheet 22, Acc. 67971.
For Sections F-F and G-G see Sheet 24, Acc. 67973.
For Sections H-H and J-J see Sheet 25, Acc. 67974.
For Sections P-P and Q-Q see Sheet 26, Acc. 67975.
"C" line, only partially shown, is always 5 inches outside "A" line.

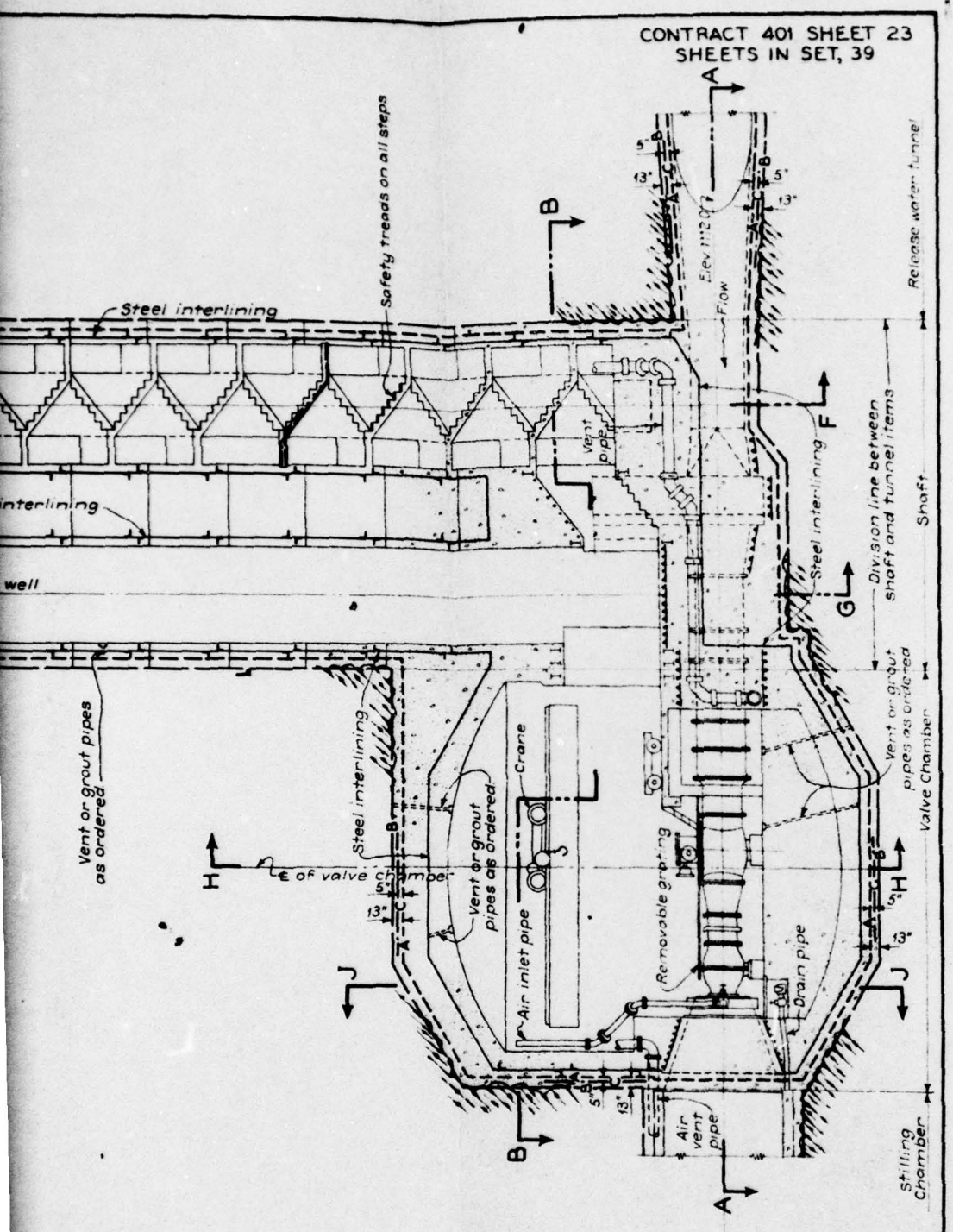
Drawn D.J.E.
Traced W.F.T.
Checked L.B.R. C.P.M.

Meadwin Matchless
Designing Eng.

Ferris Eaton

RWP-Acc. 66362

CONTRACT 401 SHEET 23
SHEETS IN SET, 39



City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
RELEASE WATER CHAMBER
VERTICAL SECTION E - E
1 0 2 6 10 14 18 22ft
DECEMBER 1, 1949

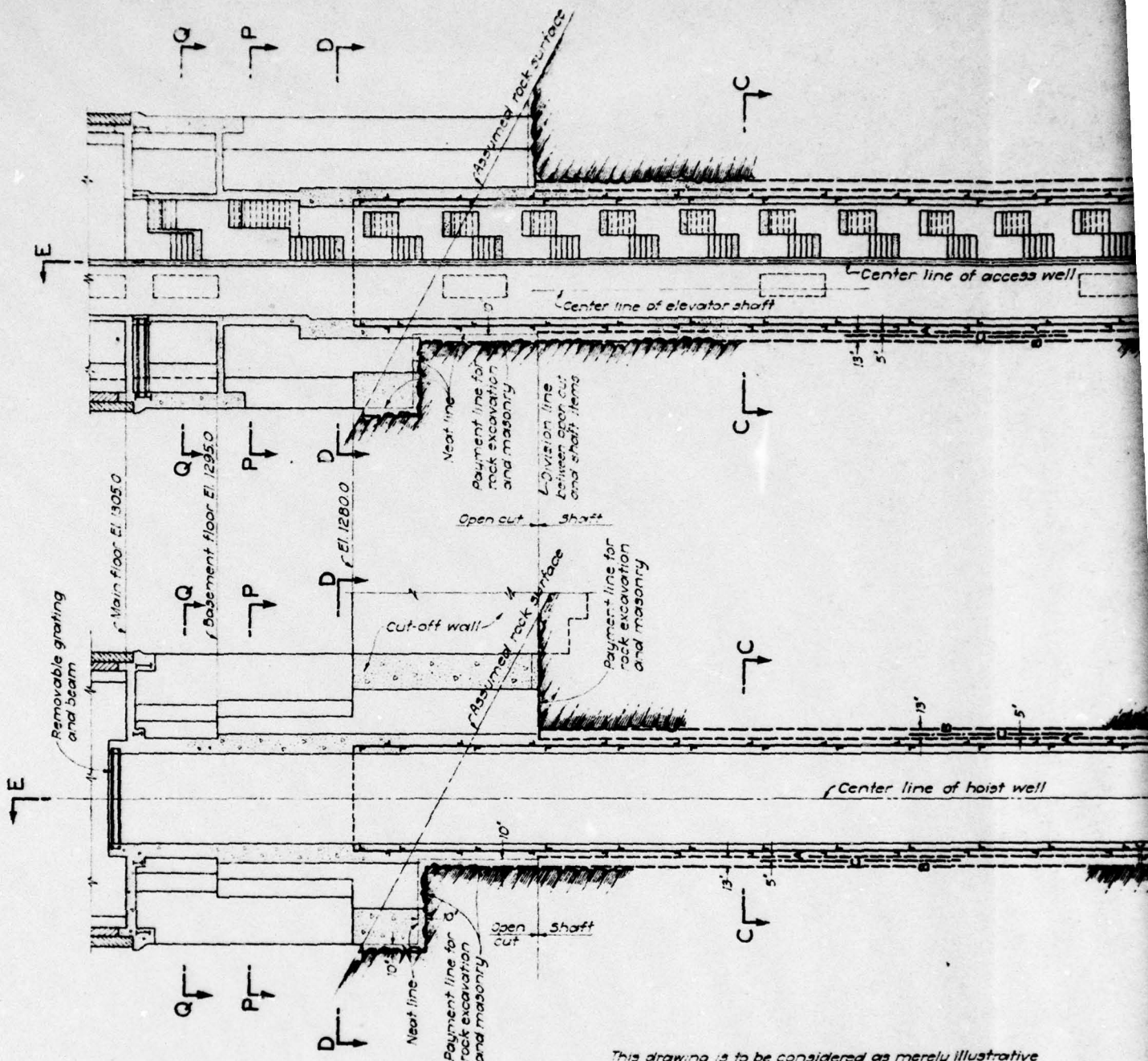
Dept. Eng. Hdqrs.

File: Cont. 401-3.4 E D

Acc 67972

1

2



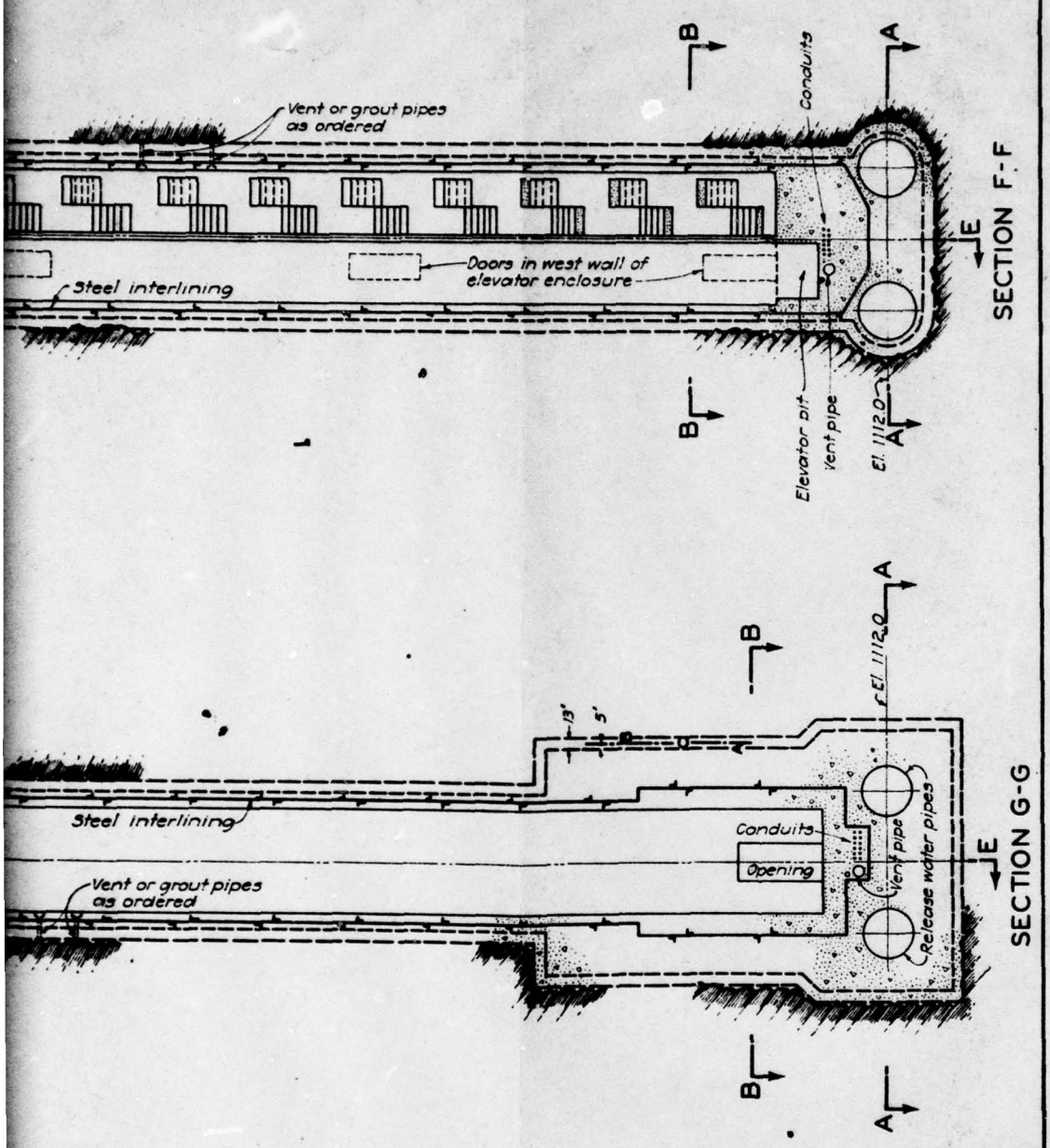
This drawing is to be considered as merely illustrative of the type of construction contemplated.
Working drawings will be issued.
For general notes see Sheet 22, Acc. G7971.
For location of Sections F-F and G-G see Sheet 22, Acc. G7971.
For Sections A-A, B-B, C-C and D-D see Sheet 22, Acc G7971.
For Section E-E, see Sheet 23, Acc. G7972.
For Sections P-P and Q-Q and steel reinforcement above El 1280 see Sheet 26, Acc. G7975.
"C" line, only partially shown, is always 5 inches outside "A" line.

Drawn M.C.A.
Traced A.E.
Checked L.B.R. CPM

Designing Eng

Ref - Acc. GG360

CONTRACT 401 SHEET 24
SHEETS IN SET, 39



City of New York
BOARD OF WATER SUPPLY
DOWNSVILLE DAM
RELEASE WATER CHAMBER
VERTICAL SECTIONS F F AND G G

1 0 2 6 10 14 18 22 Ft.

DECEMBER 1, 1949

Dept Eng Hdqrs

File: Cont. 401-3.4 E D

Acc G7975

APPENDIX F

VISUAL CHECK LIST

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME DAM Downsville Dam COUNTY Delaware STATE New York ID# NY 342

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(s) INSPECTION June 14, 1978 WEATHER clear, cool, wind TEMPERATURE 60°

POOL ELEVATION AT TIME OF INSPECTION 1,279.0 M.S.L. TAILWATER AT TIME OF INSPECTION None M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E.

Kevin Cloonan - Civil Engineer - New York City Water Supply

James T. Hockensmith

Jack Kane - Assistant Division Engineer - NYCWS

James T. Hockensmith RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None noted	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Good, no settlement or misalignment noted.	
RIPRAP FAILURES	None noted	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be good and stable.	
ANY NOTICEABLE SEEPAGE	None noted	
STAFF GAGE AND RECORDER	Daily recording of pool elevation and discharge by owner (1,279.0) and daily downstream readings by U.S.G.S.	
DRAINS	Only drains (catch basins) are on the downstream berms - functioning.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	
STAFF GAGE OF RECORDER:	N/A	

OUTLET WORKS - Water Supply System

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not observed - water flowing through conduit	
INTAKE STRUCTURE	Two - inlets which discharge into aquaduct.	
OUTLET STRUCTURE	11 1/2 foot diameter aquaduct	
OUTLET CHANNEL	None	
EMERGENCY GATE	None	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
CONCRETE WEIR	800 feet long weir - granite cap stone in good condition.	
APPROACH CHANNEL	None	
DISCHARGE CHANNEL	Rock cut open side channel discharging to inclined tunnel or to downstream open channel.	
BRIDGE AND PIERS	None	

GATED SPILLWAY - Principal Spillway

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None	
APPROACH CHANNEL	40 foot diameter tunnel into a 8 foot tunnel and into 40 foot diameter tunnel	
DISCHARGE CHANNEL	Through three conduits into 8 foot tunnel and into 40 foot diameter tunnel	
BRIDGE AND PIERS	None	
GATES AND OPERATION EQUIPMENT	3 valves on each conduit	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Wide flat floodplain, few obstructions.	
SLOPES	Flat in flood plain, side hills steep and stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	300 people immediately downstream	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Stable	
SEDIMENTATION	Minor	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None known	
OBSERVATION WELLS	None known	
SETTLEMENT PLATES	No longer read	
PIEZOMETERS	Installed but no longer read	
OTHER Settlement Gages	No longer read	

APPENDIX G

ENGINEERING DATA CHECK LIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM (Pepacton Res.) Downsville Dam

ID# NY 342

ITEM	REMARKS	
AS-BUILT DRAWINGS	Contract Drawings Specifications	New York City Water Supply New York City Board of Water Supply (Owners)
REGIONAL VICINITY MAP	Location Map (Contract Drawings)	Owner
CONSTRUCTION HISTORY	Yearly reports and photographs of Construction	Owner
TYPICAL SECTIONS OF DAM	Contract Drawings	Owner
OUTLETS - PLAN	Contract Drawings	Owner
- DETAILS	Contract Drawings	Owner
- CONSTRAINTS	Unknown	
- DISCHANCE RATINGS	Chart	U.S.G.S
RAINFALL/RESERVOIR RECORDS	U.S.G.S. gaging station reservoir level and discharge Rain gage on site	Owner

ITEM	REMARKS	
DESIGN REPORTS	Unknown	
GEOLOGY REPORTS	Geologic section and borings	Owner
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Unknown	
MATERIALS INVESTIGATIONS		
BORING RECORDS	Borings and cross sections	Owner
LABORATORY	Test results	Owner
FIELD		
POST-CONSTRUCTION SURVEYS OF DAM	Unknown	
BORROW SOURCES	Plan (contract drawings) borings and test results	Owner

ITEM	REMARKS	
MONITORING SYSTEMS	Yearly reports	Owner
MODIFICATIONS	None known	
HIGH POOL RECORDS	Daily strip charts	Owner
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None	
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Monthly reports	Owner
MAINTENANCE OPERATION RECORDS	At Dam	Owner

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Mostly wooded - 372 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1,280' - 459,000 acre-feet

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1304.0' - 609.700 ac-ft.

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1,304'

CREST:

a.	Elevation	1,280.0'
b.	Type	ogee weir to side channel
c.	Width	See drawings - ogee section
d.	Length	800 feet
e.	Location Spillover	right abutment
f.	Number and Type of Gates	none

OUTLET WORKS:

		Principal Spillway	Water Supply System
a.	Type	release water chamber - 8' tunnel	2 inlets into aquaduct
b.	Location	near right abutment	7 miles upstream from dam
c.	Entrance inverts	stream bed	Unknown
d.	Exit inverts	1,020	Unknown
e.	Emergency draindown facilities	yes	None

HYDROMETEOROLOGICAL GAGES:

a.	Type	U.S.G.S. gaging station - pool level recording
b.	Location	downstream
c.	Records	daily

MAXIMUM NON-DAMAGING DISCHARGE 9,000 cfs Maximum to date