CONNECTICUT RIVER FLOOD CONTROL PROJECT

CHICOPEE, MASS.

CONNECTICUT RIVER MASSACHUSETTS

ANALYSIS OF DESIGN FOR BERTHA AVENUE PUMPING STATION

ITEM C.5a - CONTRACT

APRIL 1940

CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

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I. INTRODUCTION

I. INTRODUCTION.

A. <u>AUTHORIZATION AND PAST REPORTS</u>. - The Bertha Avenue Pumping Station is a part of the local protection works for the City of Chicopee. The Chicopee Dike project is a part of the Connecticut River flood control plan included in the Comprehensive Plan of Flood Control for the Connecticut River as described in House Document No. 455, 75th Congress, 2nd Session, and authorized under the Flood Control Act approved June 28, 1938.

B. <u>NECESSITY FOR THE STATION</u>. - As a part of the flood protection works for that section of Chicopee between the Willimansett Section and the Chicopee River, a pumping station adjacent to the dike near Bertha Avenue is necessary to discharge the sewage and storm run-off into the river and thus prevent the accumulation of water behind the dike above Elevation 55.0 during periods of high water. The drainage area tributary to the Bertha Avenue Pumping Station is 335 acres. This area is drained by a small brook and is served by a 10-inch sanitary sewer. During periods of high water a natural basin adjoining the pumping station will serve as a storage pond for peak discharges of the brook in excess of the pumping capacity. The available capacity of the storage pond is 16.4 acre-feet which can be obtained by allowing the water surface of the pond to rise from Elevation 47.0 to Elevation 55.0 mean sea level datum. Pumping will be necessary when the river stage exceeds Elevation 47.0. During periods of normal river stage the discharge from the brook and the 10-inch sanitary sewer will flow through a gravity conduit to be constructed adjacent to the pumping station into an existing twin pipe conduit under the dike to the river.

C. <u>CONSULTATION WITH THE CITY OF CHICOPEE</u>. - Preliminary to and during the actual design of the station, consultations were held with officials representing the City of Chicopee. These latter include the Mayor, the City Engineer, the head of the Sewer Department and others. The pumping station design, as finally developed, meets with the approval, in its essentials, of the City of Chicopee.

D. SHORT DESCRIPTION OF THE STATION. - The building which will house the pumps and other equipment will consist of a reinforced concrete substructure and a superstructure, one story high, of structural steel and brick with glass block panels serving as windows. The sloping concrete roof slab of the building will be covered directly with a 4-ply asphalt and gravel roof. The engine room will contain the gasoline engines and right angle gear units for the two 30-inch volute pumps. An overhead crane will be installed for handling the equipment. A ramp from the top of the dike will provide access to the pumping station.

The reinforced concrete conduit adjacent to the east wall of the pumping station substructure will serve as the gravity flow intake chamber of the brook and 10-inch sanitary sewer during low stages of the river and will be connected to the existing twin 36-inch C. I. pipe conduit outlet which passes under the dike to the river and which is provided with flap valves at the outfall. The flap valves together with a gate at the gravity flow intake entrance will prevent flooding due to backwater from the river at high stages. The gravity flow intake chamber will act as a pressure conduit when the pumps are in operation and the gate at the entrance of the intake is closed. The storm run-off and sanitary sewer will flow into a pump suction chamber in the west side of the station during flood stages.

II. SELECTION OF SITE.

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The pumping station site is on the east side of the Boston & Maine Railroad tracks, as close to the landside toe of dike as is practicable and adjacent to the existing conduit.

This location was chosen for the following principal reasons: first, the existing sewer and brook discharge at the site; second, from thorough investigations it was found that it is not economically feasible to divert the sewage and storm water to any other point for discharge to the river; third, a natural storage pond which reduces the pumping capacity of the station is available at the site and fourth, the foundation conditions are satisfactory for the construction of the station.

III. SOIL INVESTIGATIONS.

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Foundation conditions were determined by three 2-1/2-inch drive sample borings. In addition, one 6-inch bore hole was explored to recover undisturbed samples for consolidation tests. Location of applicable borings shown on Plate No. 9 (by others). Foundation conditions are shown in a geologic section on Plate No. 11 (C.5a-Ald). Numbers in boring logs on this profile are those of the Providence Soil Classification shown graphically on Plate No. 12 and described in Table No. 1. Slightly compressible material silt, clay and fine sand interstratified is found under the station in a layer approximately 65 feet thick.

The estimated dead load of the station is 0.9 tons per square foot. This is reduced by hydrostatic uplift and weight of soil excavated so that the net dead load is approximately 0.5 tons per square foot. An additional load of approximately one ton per square foot is supplied by the fill for the access road and parking space on the riverside of the stations.

Based on settlements observed on the adjacent dike and on results of consolidation tests, settlements of the pumping station have been estimated to vary from 2 inches to 3 inches on the riverside and from 1 to 2 inches on the storage pond side. The resulting differential settlements from 1 inch to 1-1/2 inches are due largely to the concentration of load from the parking space fill on the riverside of the station. These settlements will occur rapidly at nearly the same rate as load is applied. No additional settlements will be contributed by the earth dike since settlement from this source has already occurred during the period of dike construction from June to October, 1939. The specifications provide that backfill and fill for parking space shall be placed as early as possible and before starting the brick work of the building. By this means settlements, which are primarily due to the fill, will be completed before the superstructure is finished and equipment aligned.

During installation of the conduit which carries the discharge from this station, the fine foundation sand became quick due to surface fluffing when the excavation had proceeded only a short distance below ground water. However, even the initial slight loads of the refill caused fairly complete consolidation of the material. To avoid this difficulty it is proposed to lower the ground water before excavating for the station.

TABLE NO. I
PROVIDENCE SOIL CLASSIFICATION
U. S. ENGINEER OFFICE
PROVIDENCE, R. I.

CLASS	DESCRIPTION OF MATERIAL
1	Graded from Gravel to Coarse Sand. - Contains little medium sand.
2	Coarse to Medium Sand. - Contains little gravel and fine sand.
3	Graded from Gravel to Medium Sand. - Contains little fine sand.
4	Medium to Fine Sand. - Contains little coarse sand and coarse silt.
5	Graded from Gravel to Fine Sand. - Contains little coarse silt.
6	Fine Sand to Coarse Silt. - Contains little medium sand and medium silt.
7	Graded from Gravel to Coarse Silt. - Contains little medium silt.
8	Coarse to Medium Silt. - Contains little fine sand and fine silt.
9	Graded from Gravel to Medium Silt. - Contains little fine silt.
10	Medium to Fine Silt. - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.
10 C	Medium Silt to Coarse Clay. - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.
11	Graded from Gravel or Coarse Sand to Fine Silt. - Contains little coarse clay.
12	Fine Silt to Clay. - Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.
12 C	Clay. - Contains little silt. Possesses behavior characteristics of clay.
13	Graded from Coarse Sand to Clay. - Contains little fine clay (colloids). Possesses behavior characteristics of silt.
13 C	Clay. - Graded from sand to fine clay (colloids). Possesses behavior characteristics of clay.

IV. HYDROLOGY.

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A. DRAINAGE AREA CHARACTERISTICS. - The drainage area of 335 acres, tributary to the Bertha Avenue Pumping Station as shown on Plate 1, consists, at the present time, entirely of partially developed and undeveloped land. In estimating the amount of protection to be provided for storm run-off, the entire drainage area is considered as partially developed residential area. The drainage area is divided topographically into three parts of different characteristics. Part C_1 consists of 160 acres of flat undeveloped land having considerable vegetation. Part C_2 consists of 90 acres of wooded bluffs and part C_3 consists of 85 acres of flat farm land containing a large percentage of swampy ground which provides appreciable natural storage. The letter symbol "C" designates partially developed residential areas. With the exception of one 20-inch sewer about 600 feet long, having a capacity of approximately 5 c.f.s., and its 12- inch lateral, the run-off from the entire drainage area is collected in natural channels.

B. RAINFALL RECORDS. - The following table derived from data presented in Miscl. Pub. #204 U.S.D.A., "Rainfall Intensity-Frequency Data" by D. L. Yarnell, presents the best available analysis of rainfall rates for different frequencies and durations to be expected at Chicopee, Massachusetts.

MAXIMUM AVERAGE HOURLY RAINFALL RATES AT CHICOPEE, MASSACHUSETTS.

Frequency years	Duration of storm in minutes			
	30	60	120	240
2	1.96	1.16	0.65	0.50
5	2.50	1.60	0.92	0.62
10	3.00	1.85	1.12	0.75
25	3.90	2.42	1.46	0.94
50	4.10	2.70	1.70	1.06

C. <u>DIKE SEEPAGE</u>. - The seepage flow through the dike is expected to be small and should not contribute significant quantities of flow to the total run-off.

D. <u>RUN-OFF RECORDS</u>. - Records of the type that would be useful in estimating the run-off from the drainage area at Chicopee are not available.

E. <u>DESIGN RUN-OFF</u>. - In computing the maximum rate of run-off, the average intensity of precipitation used was that for the two hours of most intense rainfall of a storm having a frequency of 10 years for the City of Chicopee, according to the Yarnell relations. The use of a 10-year 2-hour storm has been adopted as a standard for the most intense storm for which it is economically justifiable to provide pumping capacity even in highly developed urban areas. There is evidence that this standard is more severe than similar standards adopted by numerous principal cities for use in designing storm water drains.

Run-off coefficients are determined from consideration of the size, shape and slopes of the drainage area, the types of development, the existence and type of natural or constructed drainage courses and the surface and subsurface storage. All of these factors are weighted to give the adopted figure which is, in the final analysis, based upon judgment and experience. In general, the drainage area is divided into three types for both the present state of development and an estimated future state of development. The three types are fully developed commercial and industrial, fully developed residential, and partially developed residential.

In computing run-off the product of the rainfall intensity and the run-off coefficient is modified by introducing a multiplier which is called the relative-protection-factor. When providing protection from run-off for a composite area it is not necessary to furnish the same degree of protection for a partially developed residential area as a fully developed industrial area. Allowance for this fact is made by introducing the relative-protection-factor (R.P.F.) which is the index of the amount of protection from run-off which one area warrants relative to another. The relative-protection-factor is defined as the ratio of the intensity of precipitation used in computing the run-off from a given area to the intensity of precipitation of the basic design storm. In other words, the adopted basic rainfall intensity multiplied by the R.P.F. gives the rainfall intensity for which protection from run-off is provided. The R.P.F. is a function of the amount of local flooding of short duration, which can be tolerated on the different types of drainage area, and of the relative topographic positions, in the drainage area, of the divisions having different types and states of development. An R.P.F. of 1.0 is used for fully developed industrial and commercial areas, 0.8 for fully developed residential areas, and 0.6 for partially developed areas. A relative-protection-factor of 0.8 corresponds approximately to a 5-year storm as compared to 1.0 for a 10-year storm and 0.6 corresponds approximately to a 2-year storm.

It may occur that a partially developed portion of the drainage area, or one fully developed that is not provided with a complete system of storm drains, is so topographically situated that lines of natural drainage will prevent local ponding, and will concentrate excess run-off in other areas where additional ponding cannot be tolerated. In such cases the relative-protection-factor cannot be considered as a function of type of development only, and it may be desirable in exceptional cases to increase the factor to more than 1.0.

The following divisions of the drainage area, as described in "A", together with appropriate rainfall rates and run-off coefficients were used. Owing to the location and nature of the drainage area it was deemed unnecessary to consider other than the present state of development of the drainage area.

Type	Area Acres	Rainfall in/hr.	Run-off Coefficient	R.P.F.	Q c.f.s.
C_1	160	1.12	0.30	0.60	32.3
C_2	90	1.12	0.80	0.70	56.4
C_3	85	1.12	0.10	0.60	5.2
				Total	93.9

F. <u>STORAGE POND</u>. - It is feasible to use as a storage pond a natural basin in a brook valley that lies adjacent to the pumping station. This pond will serve to store the run-off during periods of peak discharge, thereby decreasing the required pumping capacity. Consideration of the local topography led to the selection of Elevation 55 as the maximum pond level that would be permissible before damage due to flooding would begin.

G. <u>RUN-OFF HYDROGRAPH</u>. - Using the 10-year frequency rainfall curve for Chicopee as constructed from data by Yarnell (Rainfall Intensity - Frequency Data by D. L. Yarnell - Misc. Pub. #204 U.S.D. A.), a run-off hydrograph for a storm of 8-hour duration as shown on Plate 6 was developed in the following manner. The 10-year rainfall values were multiplied by an R.P.F. of 0.63, the weighted value for the total drainage area, to give the design rainfall values from which was constructed the hypothetical rain-graph shown on Plate 6. The following table gives the amounts of rainfall for various durations, as taken from the Yarnell data, and the corresponding design values.

	Amount of Rainfall in Inches for duration in hours.			
	1	2	4	5
Yarnell 10-year frequency	1.85	2.24	3.00	3.60
Design	1.17	1.40	1.88	2.27

The weighted value of the maximum peak-run-off-coefficient, 0.38, computed from the coefficients as given in the table under "E" above, was assumed to apply to those peaks in the rain-graph preceding the maximum peak. A time lag of one hour was obtained by approximate computation of the time of concentration, and the total amount of run-off to be considered in design was assumed to occur in 10 hours. The ratio of the total run-off in 10 hours to the total design eight-hour rainfall was estimated to be 0.53 as shown in the computation tabulated below:

Type	Area Acres	Total run-off coefficient	Area x coefficient
C_1	160	0.50	80.0
C_2	90	0.95	85.5
C_3	85	0.15	12.7
			178.2

Weighted value of total-run-off coefficient $= \frac{178.2}{335} = 0.53$.

The graph of storage capacity versus required pumping rate as shown on Plate 8 was derived from the run-off hydrograph.

V. REQUIRED DISCHARGE CAPACITY

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A. PUMP CAPACITY REQUIRED.- The pumps will be required to discharge storm flow or dry-weather flow whenever the Connecticut River stage exceeds Elevation 47, which corresponds to less than 1-year frequency peak stage on the Connecticut River, after the 20-reservoir plan, and which is at present equalled or exceeded for a total of 44 days per average year as shown on the stage duration curve (Plate 7). The discharge values given in the table below are obtained from the studies explained under IV Hydrology.

Dry-weather flow	less than 1 c.f.s.
Maximum storm flow	100 c.f.s.
Top of dike	El. 72.7 m.s.l.
Connecticut River design flood stage	El. 67.4 m.s.l.
Normal intake water surface	El. 47.0 m.s.l.
Maximum intake water surface	El. 55.0 m.s.l.
Design maximum static head 67.4-47.0	20.4 ft.
10-year peak stage on Connecticut River (after 20-reservoir plan)	El. 57.0 m.s.l.

As shown on the storage capacity curve (Plate 8) 16.4 acre-feet of storage is available at Elevation 55 and the corresponding required pumping capacity is 35 c.f.s. Hence, the design pumping capacity, including flow from dike toe drains, is 40 c.f.s. at a static head of 10 feet (57.0-47.0).

B. INSTALLED PUMPING CAPACITY. - The installation will consist of two pumps having a capacity of 36 c.f.s. each. This provides sufficient capacity, with ample provisions for mechanical failure, to discharge the maximum design storm flow. The discharge capacity of the pumps will be less against the maximum static head of approximately 20 feet imposed by the Connecticut River design flood stage, Elevation 67.4 m.s.l. This design is considered conservative in view of the extremely rare probability of a peak stage on the Connecticut River being coincident with a maximum storm run-off from the local drainage area.

VI. MECHANICAL DESIGN

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A. PUMP DRIVE. - The Bertha Avenue Pumping Station is one of seven pumping stations to be constructed in Chicopee. Prior to the design of any of the stations an investigation was made of the available electric power facilities with the view of employing electric motor drive for the pumps. The results of the investigation indicated that adequate and suitable power supplies were available from two power systems serving the vicinity. However, the City of Chicopee was unable to come to a satisfactory agreement with the power companies on the question of rates and requested this office to provide gasoline engines to drive the pumps. (See Analysis of Design Jones Ferry Pumping Station, Chicopee, Mass.).

The gasoline engines for the Bertha Avenue Pumping Station will be of the heavy-duty industrial type capable of continuously driving the pumps at their rated speed under any head condition developed. The engines will not use over 85 percent of their developed horsepower. They will be mounted on concrete bases and directly connected through flexible couplings to the right angle gear units.

B. PUMPS.- From the utlimate required pumping capacity of 40 c.f.s. as determined in Section IV, it was determined that provisions should be made to install two pumps. To install a larger number of pumps would materially increase the cost of the station without resulting in any great advantage and to provide only one pump would seriously limit the operating flexibility and reliability of the station.

No provisions were made in the capacity determined in Section IV for possible mechanical failure of equipment. To provide for this contingency, it is considered necessary that either pump should be capable of delivering about 90 percent of the 40 c.f.s., or 36 c.f.s. This factor causes the total station capacity to be 72 c.f.s. A study of pumping equipment indicated that two 24-inch volute pumps would be required; each pump to have a capacity of 16,000 G.P.M., or 36 c.f.s. against a static head of 10 feet.

The use of volute pumps is predicated on the fact that on various occasions when the river is at flood stage and there is fairly low storm run-off from the protected area it will be necessary to pump raw or but slightly diluted sewage. Should pumps of the axial flow type be provided it would be necessary to install a third pump of the volute type to handle the sewage.

C. RIGHT ANGLE GEAR UNITS. - The gear units will be of the self-contained type designed for transmitting the power from the horizontal engine shaft through a gear train to the vertical pump shaft. The units will be inclosed in a cast iron and structural steel housing and will have a service factor of not less than 1.25 times the maximum power required to drive the pumps under any condition of head.

D. CRANE. - A four-ton overhead crane will be installed in the engine room to facilitate the repairing of any items of equipment. The crane will be of standard construction and hand operated throughout.

E. GASOLINE SYSTEM. - Gasoline will be stored in a 900 gallon tank buried in the ground adjacent to the pumping station. Each engine will be supplied through an individual line running directly to the tank. Drip pans will be provided on the engines and connected to a common header running back to the tank. All gasoline piping will be 3/4" I. D. copper tubing with flared joint connections. At such points where the gasoline lines are imbedded in concrete or pass through beams, they will be protected by wrought iron pipe sleeves.

F. SLUICE GATE. - A hand operated sluice gate will be located at the entrance to the gravity discharge conduit. This gate will normally be kept open to permit water to flow by gravity to the river. It will be closed only at such times when it is necessary to prevent back flow from the river.

G. HEATING SYSTEM. - The heating system will consist of an oil-burning heating stove of the cabinet type with built-in electrically driven blower which will provide heat circulation throughout the engine room.

H. ELECTRIC LIGHTING SYSTEM. - The electric power for lighting the pumping station will be supplied at 115 volts, single phase, 60 cycles, A.C. from the City of Chicopee municipal power system. In case of an interruption of power of this source, provisions have been made so that the station can be lighted from one of the 12-volt engine batteries. The A.C. lighting system will provide for entrance lights, engine room and pump-room lights, floodlights, convenience outlets, and a battery charger for the engine batteries. All circuits will be controlled from an eight-circuit automatic circuit breaker type of panelboard. A double throw disconnect switch will provide a means for connecting the station electric system to either the outside source or to permit its connection to a standby generating set if it is later installed. The D.C. emergency lighting system will consist of two lighting outlets; one in the engine room, and one in the pump room.

VII. STRUCTURAL DESIGN

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A. SPECIFICATIONS FOR STRUCTURAL DESIGN.

1. General. - The structural design of the Bertha Avenue pumping station has been executed in general in accordance with standard practice. The specifications which follow cover the conditions affecting the design of the reinforced concrete and structural steel.

2. Unit weights. - The following unit weights for material were assumed in the design of the structure:

Water	62.5	# per cubic foot
Dry earth	100	# " " "
Saturated earth	125	# " " "
Concrete	150	# " " "

3. Earth pressures. - For computing earth pressure caused by dry earth Rankine's formula was used. For saturated soils an equivalent liquid pressure of 80 pounds per square foot per foot of depth was assumed.

4. Structural steel. - The design of structural steel was carried out in accordance with the standard specifications for Steel Construction for Buildings of the American Institute of Steel Construction.

5. Reinforced concrete. - In general, all reinforced concrete was designed in accordance with the "Joint Committee on Standard Specifications for Concrete and Reinforced Concrete" issued in January 1937.

a. Allowable working stress. - The allowable working stress in concrete used in the design of the pump house structure and conduits is based on a compressive strength of 3,000 pounds per square inch in 28 days.

b. Flexure (f_c). -

	Lbs. per sq. in.
Extreme fibre stress in compression	800

b. Flexure (f_c). (Cont'd.) — Lbs. per sq. in.

Extreme fibre stress in compression adjacent to supports of continuous or fixed beams or rigid frames 900

c. Shear (v). -

Beams with no web reinforcement and without special anchorage 60

Beams with no web reinforcement but with special anchorage of longitudinal steel 90

Beams with properly designed web reinforcement but without special anchorage of longitudinal steel 180

Beams with properly designed web reinforcement and with special anchorage of longitudinal steel 270

Footings where longitudinal bars have no special anchorage 60

Footings where longitudinal bars have special anchorage 90

d. Bond (u). -

In beams, slabs, and one way footings 100

Where special anchorage is provided 200

The above stresses are for deformed bars.

e. Bearing (f_c). -

Where a concrete member has an area at least twice the area in bearing. 500

f. Axial compression (f_c). - Lbs. per sq. in.

Columns with lateral ties 450

g. Steel stresses. -

Tension 18000

Web reinforcement 16000

h. Protective concrete covering

Type of members	Minimum cover in inches
Interior slabs	1-1/2
Interior beams	2
Members poured directly against the ground	4
Members exposed to earth or water but poured against forms	3

For secondary steel, such as temperature and spacer steel, the above minimum cover may be decreased by the diameter of the temperature or spacer steel rods.

B. BASIC ASSUMPTIONS FOR DESIGN. -

1. Roof slab. - The roof slab is of reinforced concrete. It is designed to carry the full dead load plus a live load of 40# per square foot of roof surface.

2. Roof beams. - The roof beams are of structural steel encased in concrete fireproofing. They are designed to carry the full dead load, plus the full live load of 40# per square foot of roof surface. In addition to taking up the roof load, these beams, together with the columns to which they are connected, form portal frames which take up wind load and crane thrusts on the building. The end connections are designed to take up all such horizontal loads.

3. Columns. - a. Structural steel columns in the walls of the superstructure take up the direct roof loads as well as all wind loads on the superstructure. In addition, the columns in the side walls carry crane brackets which support the crane runway. These columns are designed to carry full live and dead load from the roof; dead load, live load and impact effect from the traveling crane; bending due to eccentrically applied loads, and bending due to wind load on the building. No point of inflection was considered in the column designed, a pin-ended condition at the base being assumed.

b. Columns other than the crane columns in the building designed for full dead load and live load from roof, plus wind load on the building.

c. Allowable stress in columns figured from formula

$$P/A = \frac{18000}{1 + \frac{l^2}{18000}}$$

With a maximum allowable stress of 15,000# per square inch for dead load plus live load, and a maximum allowable stress of 20,000# per square inch for combined dead load, live load and wind load; l/r limited not to exceed 120. loads are the estimated dead load plus a uniform load of 300# per square foot.

d. For the floor beams, the design loads are the estimated dead loads, the actual machinery loads, a concrete base slab load under the gasoline engine and right angle gear units, and a uniform load of 200# per square foot on the unoccupied portion of the floor slabs which contribute loads to the beams under consideration. For the machinery loads, an impact factor of 100 percent has been added.

4. Pump room, suction chamber and discharge conduit walk and slabs.

a. The station is located behind the flood protection dike. The walls are of reinforced concrete to Elevation 63.83 and of brick and steel construction from thereon up.

b. In designing the pump room, suction chamber and discharge conduit walk and slabs, the assumption was made that the whole transverse section acted as a continuous frame hinged at the connections of the pump room walk with the engine room floor slab.

c. The continuous frame was investigated for two conditions of loading: (1) saturated earth against the outside walls and no water in either the suction chamber or the discharge conduit; (2) saturated earth against the outside walls and maximum water pressure in both the suction chamber and the discharge conduit. For maximum water pressure in the suction chamber, the reservoir water surface at the north end of the building was assumed to be at an elevation of 56.0'. For maximum water pressure in the discharge conduit, the river surface was assumed to be at an elevation of 72.7'. The loading on the base slab was taken as the distributed load of the building less the weight of the base slab.

5. Gravity discharge conduit. - The discharge conduit is attached to and runs the full length of the east wall of the station. The conduit has an internal cross-section of 5 feet wide by 7.5' high. At the south wall of the station, the conduit passes into a 10-foot transition section which connects with the two existing 36" C.I. pipes.

During low river stages, the flow will run by gravity through the conduit. In times of high water, the flow will be diverted to the suction chamber and pumped through the conduit. At these times, the conduit will become a pressure conduit, the maximum head amounting to about 30 feet.

6. Trash racks and raking platform. - There are two trash racks at this station; one located at the gravity flow conduit intake, the other located at the suction chamber intake. The rack at the gravity flow conduit intake consists of two sections (3'3" x 16'4") supported by two 8-inch I-beams anchored into the conduit side walls. The rack at the suction chamber intake consists of one section (4'6" x 13'2") hinged 12.5 feet above the bottom of the chamber and revolves on a 6-inch diameter pipe which acts as a pin or trunnion. This rack is held in a horizontal position against the raking platform by cable wound on a winch located on the raking platform. Cast iron bearings in the chamber side walls provide support for the pipe trunnion. Cast iron stops anchored into the flow slab hold the rack in alignment when it is in position for screening.

The trash racks are made of structural channel frame which supports 4 x 3/8 inch round edge grating bars. The bars are spaced 3-1/8 inches and 3-5/8 inches in the clear in the suction chamber and gravity flow racks respectively. The racks are welded throughout.

The trash racks are designed on the assumption of stoppage of 50 percent of flow with the water rising above the top of the trash racks.

7. Stairways and ladders. - An open grating steel stairway leads from the pump room floor to the engine room floor. A steel ladder is provided on the outside of the building for access to the roof of the building.

8. Steady beams. - The steady beams consist of two channels each, their flanges connected with lattice bars and batten plates. The

pump shafts will pass through an opening between the middle batten plates and will be supported sidewise by bearings bolted to the top batten plates. The steady beams will be bolted to the side walls with four 7/8 inch anchor bolts at each end. To obtain a firm bearing against the walls, the connection angles and bearing plate at one end of the beam will be shipped to the site loose with holes punched in the angles. Matching holes in each steady beam will be drilled in the field after each beam has been firmly shimmed against the walls. The steady beams are designed to take a side thrust of 1,000 pounds applied at the shaft bearing.

C. ARCHITECTURE. - The pumping station will be a building of modern design in keeping with the architectural treatment used on similar projects elsewhere on the Connecticut River. This design will give a pleasing appearance without undue emphasis being placed on purely decorative features.

The pumping station will be a flat-roofed, brick and glass block structure 25'6" x 25'6" overall. The 12.5 inch thick brick walls, capped with a cast stone coping, extend above the roof slab to form a parapet wall around the entire roof. A flat type roof was chosen as being economical and in keeping with the architectural design, as well as serving as a location for the engine exhaust mufflers. The roof system consists of steel beams encased in concrete and supported by steel columns. The roof slab will be 5 inches thick, covered with a cinder concrete fill sloped to drain. There are no outside pilasters. Inside the building there are pilasters at the chimney and at each structural steel column, the pilasters forming fire-proof column encasements. The engine room floor will be 6-inch structural concrete slab, with a monolithic finish.

A hand-operated traveling crane of 4 tons lifting capacity will operate for the full length of the building and will be used for installing and moving pumps and machinery. Access for the crane hoist to the pump room will be had through openings in the machinery room floor, these openings being normally covered with removable checkered floor plates.

There will be no window sash in the building. Light will be admitted through large glass block panels, glass blocks being chosen in preference to sash because of the exposed location of the pumping station near the river banks. The well-diffused and uniform light which they provide and their appearance is also in keeping with the spirit of the architectural design. To provide ventilation, adjustable louvres have been placed low in the brick walls and a wind-driven exhaust ventilator has been placed on the roof.

Two doors give access into the building. The main entrance door, 6' wide by 9' high, consists of two leaves of hollow steel construction and give entrance directly to the engine room floor. It is large enough to provide adequate clearance for any replacement of mechanical equipment which may be required in the future. The small hollow steel door on the north end of the building provides a service exit to the sluice gate hoists.

VIII. CONSTRUCTION PROCEDURE.

VIII. CONSTRUCTION PROCEDURE

A. SEQUENCE OF OPERATIONS. - The schedule of work will require the contractor to complete the pumping station and appurtenant works in 220 calendar days after receipt by the contractor of notice to proceed.

B. CONCRETE CONSTRUCTION.

1. Composition of concrete. - The concrete will be composed of cement, fine aggregate, coarse aggregate and water so proportioned and mixed as to produce a plastic, workable mixture. All concrete will be Class A except the pumping station base slab and the manhole base which will be Class B. Class A concrete will have an average compressive stress of not less than 3400 lbs. per square inch in accordance with a standard 28-day test. The average compressive stress for Class B concrete will be 3000 lbs. per square inch in accordance with a standard 28-day test. Concrete aggregates will be of suitable quality and will be tested by the Central Concrete Testing Laboratory at West Point.

2. Laboratory Control. - A small concrete testing laboratory is available in the West Springfield Area of the district for use principally to control the quality of concrete during construction. The tests performed here will supplement those made at the Central Laboratory. Facilities will be available for testing the grading of aggregates, designing concrete mixtures, mixing of trial concrete batches for the purpose of developing actual relations between the compressive strength and the water cement ratio, and the casting of concrete cylinders for compressive strength tests.

a. Cement. - Cement will be tested by a recognized testing laboratory and results of these tests shall be known before the cement is used. True Portland Cement of a well known and acceptable brand will be used throughout.

b. Fine aggregate. - Natural sand will be used as a fine aggregate. The aggregate will be subject to thorough analysis, including magnesium sulphate soundness tests, and tests made on mortar specimens for compressive strength.

c. Coarse aggregate. - Marked gravel or crushed stone of required sizes will be used as coarse aggregate. It will consist of hard, tough and durable particles free from adherent coating and will be free from vegetable matter. Only a small amount of soft friable, thin or elongated particles will be allowed. The aggregate will be subject to accelerated freezing and thawing tests and to thorough analysis, including magnesium sulphate tests for soundness.

d. Water. - The amount of water used per bag of cement for each batch of concrete will be predetermined; in general, it will be the minimum amount necessary to produce a plastic mixture of the strength specified. Slump tests will be required in accordance with the specifications.

3. Field Control.

a. Storage. - The concrete components will be stored in a thoroughly dry, weather-tight and properly ventilated building. The fine and coarse aggregates will be stored in such a manner that inclusion of foreign material will be avoided.

b. Mixing. - The exact proportions of all materials in the concrete will be predetermined. The mixing will be done in approved mechanical mixers of a rotating type, and there will be adequate facilities for accurate measurement and control of each of the materials used in the concrete. Mixing will be done in batches of sizes as directed and samples will be taken for slump tests and for compressive strength tests. Inspectors will at all times supervise and inspect the mixing procedure.

c. Placing. - Concrete will be placed before the initial set has occurred. Forms will be clean, oiled, rigidly braced and of ample strength. Concrete poured directly against the ground will be placed on clean damp surfaces. Mechanical vibrators will be used and forking or hand spading will be applied adjacent to forms on exposed surfaces to insure smooth, even surfaces. The location of vertical and horizontal construction joints as well as contraction and expansion joints, and the location of upper water stops are indicated on the drawings. The locations of construction joints are tentative and may be changed to suit conditions in the field. Before placing concrete, all reinforcing steel will be inspected and pouring of the concrete will be supervised and directed by Government inspectors. Adequate precautions will be taken if concrete is to be placed in cold or hot weather.

C. STRUCTURAL STEEL CONSTRUCTION. -

1. Superstructure framework. - The superstructure framework consists of beams and columns which will form a skeleton frame for the exterior walls and roof, and will provide a runway for the hand operated

crane. The columns will be securely anchored to the substructure concrete walls and will be connected to the roof beams with web connection angles and wind bracing connections. The crane rails will be fastened to the crane runway beams with bent hook bolts. Crane stops at each end of the runway will prevent the traveling crane from running into the end walls.

2. Walkways and stairways. - The stairway treads in the pump room will be supported on structural steel channels anchored to the suction chamber roof and on steel beams anchored to the engine room floor beams. Wrought iron pipe railings are to be fastened to the top flanges of the stairway channels.

3. Trash racks. - The trash racks are made up of structural channel frames which support 4" x 5/8" grating bars. The bars for the gravity flow intake are spaced 4" in the clear while those for the suction intake are spaced 3-1/8" in the clear. The racks are welded throughout.

4. Removable floor plates. - Access for the crane to pump room will be obtained by removing checkered floor plates which cover the opening in the engine room floor. The removable covers consist of 3/8-inch checkered plates welded to the 2-1/2" flanges of 3" x 2-1/2" angles. The ends are supported on angle frames anchored into the floor concrete. The opening in the floor is covered with 3 - 6' x 2'-3" sections. Lifting handles are provided in the plates for easy removal.

5. Miscellaneous angles and frames. - Miscellaneous structural steel such as door frames, angles, grilles, etc., will be erected and placed as indicated on the drawings and at such time as required.

D. ACCESS ROAD. - An access road will be provided for the pumping station. This road will have a bituminous surfacing.

IX. SUMMARY OF COST.

IX. SUMMARY OF COST.

The total construction cost of the Bertha Avenue Pumping Station and mechanical equipment has been estimated to be $56,200, including 15 percent for engineering and 10 percent for contingencies.

This amount has been distributed as follows:

(1)	Pumping Station. -	
	a. Concrete features	$12,500
	b. Superstructure	7,000
	c. Miscellaneous	5,800
		$25,300
(2)	Mechanical equipment	30,900
	Total	$56,200

(1) a. The concrete features included under the pumping station Item (1) a. consist of intake structures, building foundation to and including operating floor structural slab, suction intake and gravity conduit.

(1) b. The superstructure consists of the complete building above the operating floor.

(1) c. Miscellaneous items are common excavation and backfill, miscellaneous iron and steel, trash racks, ramp, and other items not included in (1) a. and (1) b.

(2) The mechanical equipment consists of pumps, gasoline engines, gear units, crane, check valves, valves and piping, sluice gate system, and miscellaneous items.

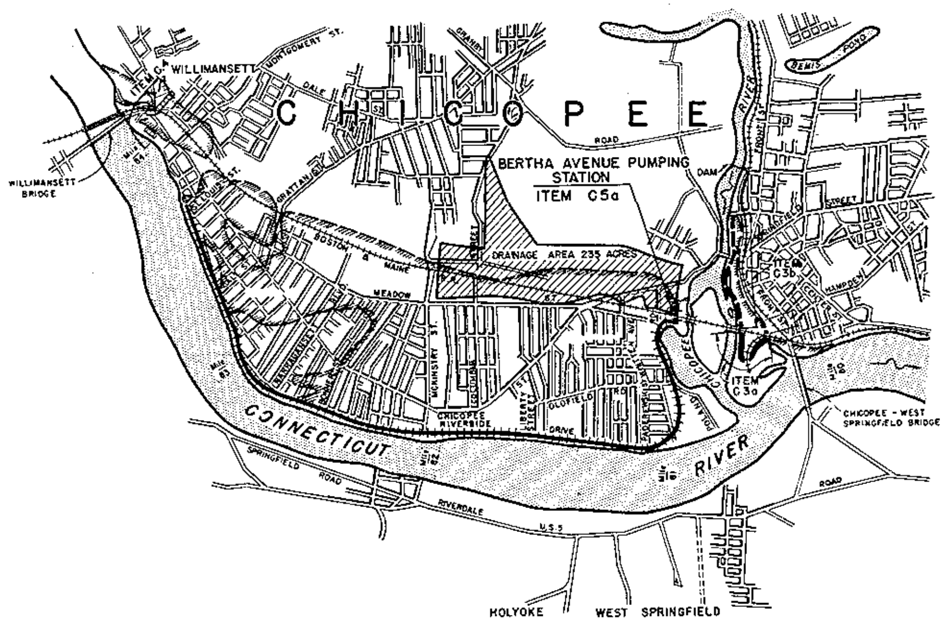
ANALYSIS OF DESIGN

BERTHA AVENUE PUMPING STATION

INDEX OF PLATES

Plate No.	Title
1	Project Location and Index
2	Reservoir Plan
3	General Plan
4	Hydrograph No. 1
5	Hydrograph No. 2
6	Run-off Hydrograph
7	Stage Duration Curve
8	Pumping Rate and Storage Capacity
9	Subsurface Explorations
10	Borrow Areas
11	Geologic Section
12	Providence District Soils Classification
13	Pumping Station Plan and Details, Architectural
14	Pumping Station Elevations, Architectural
15	General Arrangement of Equipment
16	Miscellaneous Details
17	Output of Pumps
18	Pumping Station Perspective
19	Organization Chart

LOCATION MAP
SCALE 1"=8 MILES



VICINITY MAP
SCALE 1"=1500'

LEGEND

- Dikes completed Item C1 and C2.
- Item C3a Fiscal Year 1940 Unit, West of B&M.R.R. South Bank Chicopee River.
- Item C3b Future Construction, Fiscal Year 1940 Unit, South Bank Chicopee River.
- Item C4 Fiscal Year 1940 Section Willimansett Dike
- Overflow Limits, March 1936 flood.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY
Δ	10/8/40	Sheet No. 33 added.			

CONNECTICUT RIVER FLOOD CONTROL
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.

PROJECT LOCATION AND INDEX

CONNECTICUT RIVER MASSACHUSETTS
IN 33 SHEETS SCALE: 1 IN. = 1500 FT. SHEET NO. 1
1500' 0 1500' 3000'

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL 1940

SUBMITTED: [signature] SENIOR ENGINEER HEAD, DESIGN SECTION
APPROVAL RECOMMENDED: [signature] PRINCIPAL ENGINEER CHIEF, F.C. ENGINEERING DIV.
APPROVED: [signature] LT. COL., CORPS OF ENGINEERS DISTRICT ENGINEER

DESIGNED: [signature] ASST. ENGINEER
DRAWN: W.S.B. TRACED: E.A.H. CHECKED: [initials]
FISCAL YEAR 1940
FILE NO. CT-4-2285

C.5a

PLATE NO. 1

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

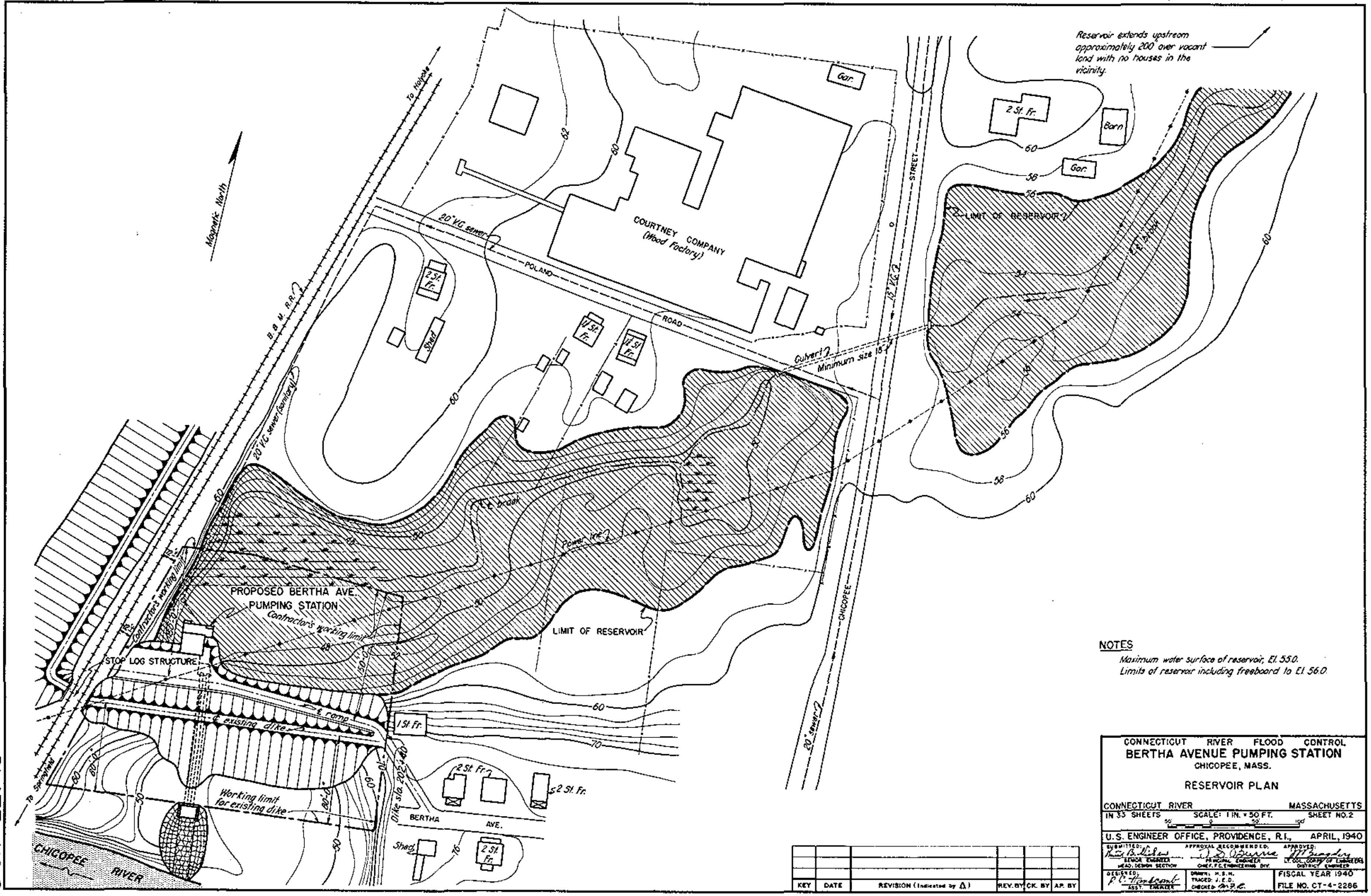
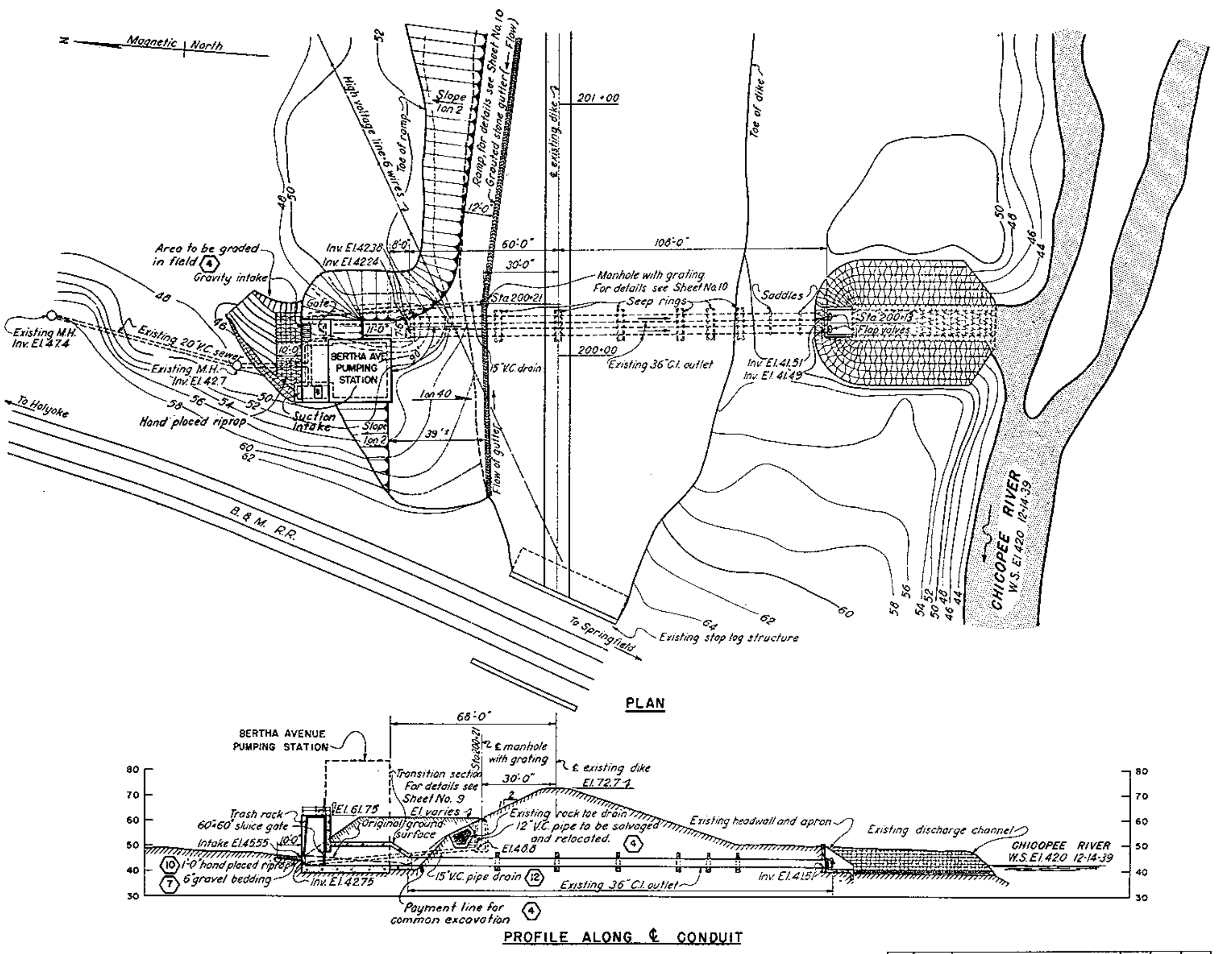


PLATE NO. 2

C.5a

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTE

Elevations refer to Mean Sea Level Datum.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE, MASS.

GENERAL PLAN

CONNECTICUT RIVER — MASSACHUSETTS

IN 33 SHEETS — SCALE: 1 IN.=20 FT. — SHEET NO. 3

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ASS'T. ENGINEER — DRAWN: R.G.T. & W.S.H. — TRACED: L.A.O. & F.O.K. — CHECKED

FISCAL YEAR 1940

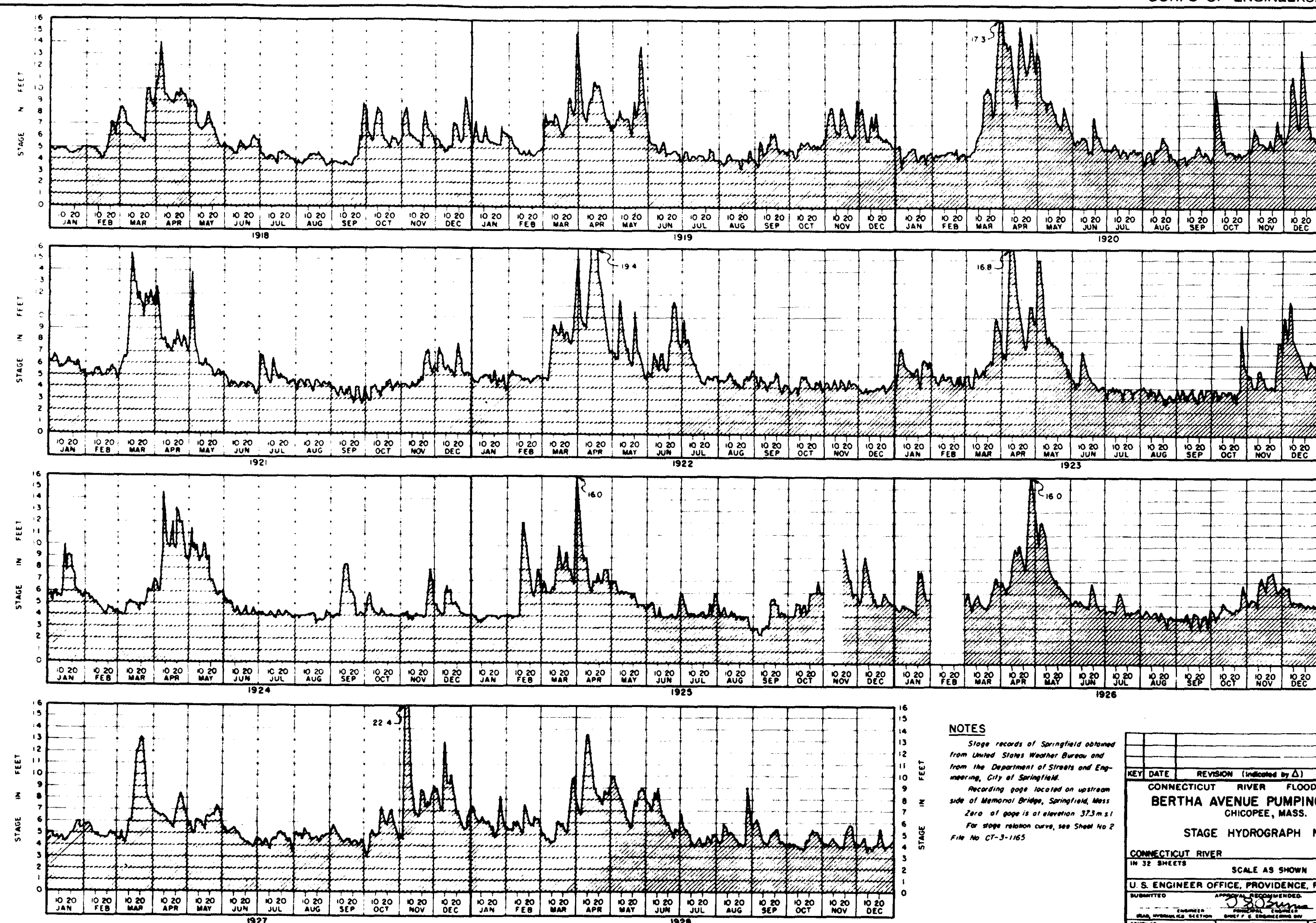
FILE NO. CT-4-2287

C5a

PLATE NO. 3

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTES

Stage records of Springfield obtained from United States Weather Bureau and from the Department of Streets and Engineering, City of Springfield.

Recording gage located on upstream side of Memorial Bridge, Springfield, Mass

Zero of gage is at elevation 37.3 m.s.l

For stage relation curve, see Sheet No 2 File No CT-3-1165

KEY	DATE	REVISION (indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE, MASS.

STAGE HYDROGRAPH NO. 1

CONNECTICUT RIVER — MASSACHUSETTS

IN 32 SHEETS — SCALE AS SHOWN — SHEET NO. 4

U. S. ENGINEER OFFICE, PROVIDENCE, R. I., APRIL, 1940

SUBMITTED: ENGINEER, HEAD, HYDRAULICS SECTION

APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF F. & ENGINEERING DIV

APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASSOC. ENGINEER

DRAWN W.C.N. & B.A.L. TRACED L.K.P. CHECKED

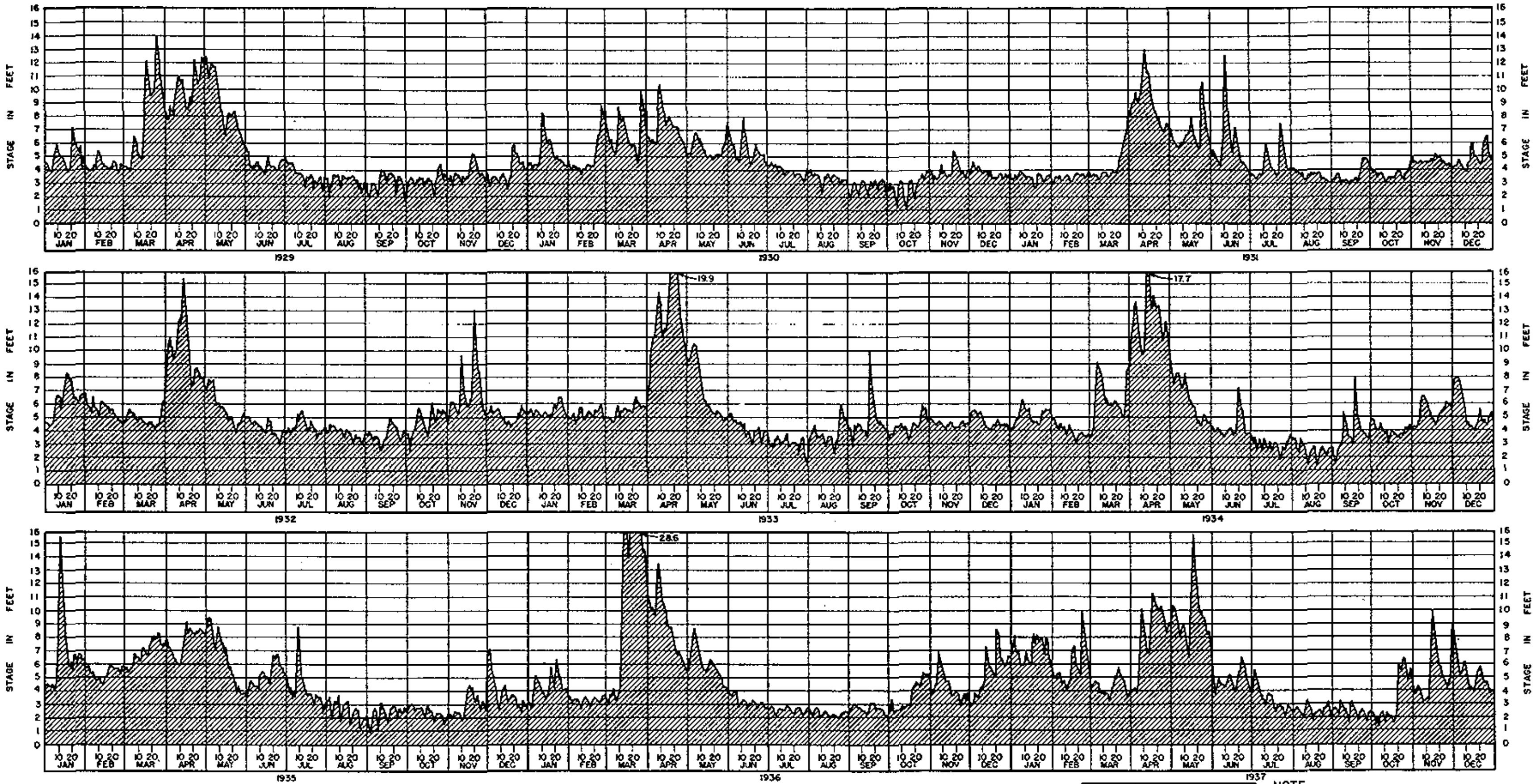
FISCAL YEAR 1940

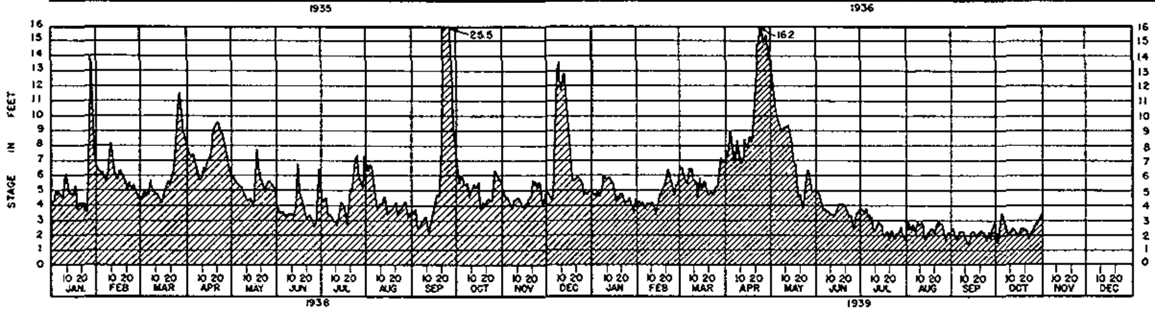
FILE NO. CT-3-1164

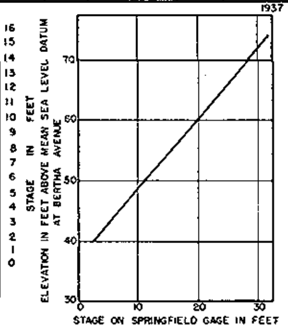
PLATE NO. 4

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY







NOTE

For notes pertaining to this sheet see Sheet No. 1 File No. CT-3-1164

KEY	DATE	REVISION (indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE, MASS.

STAGE HYDROGRAPH NO. 2

CONNECTICUT RIVER — MASSACHUSETTS

IN 33 SHEETS — SCALE AS SHOWN — SHEET NO. 5

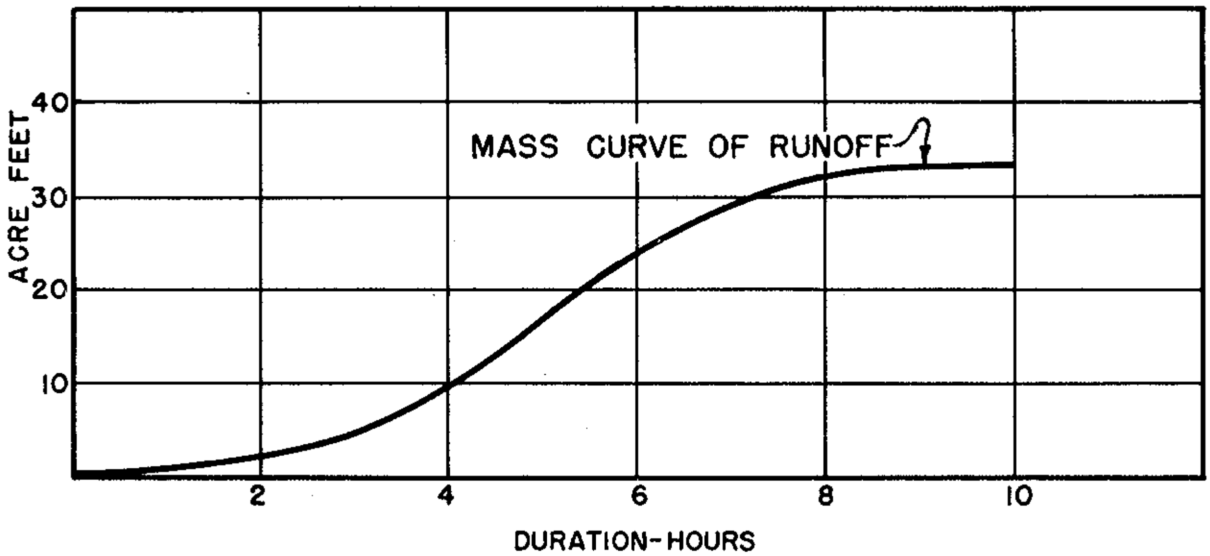
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., APRIL, 1940

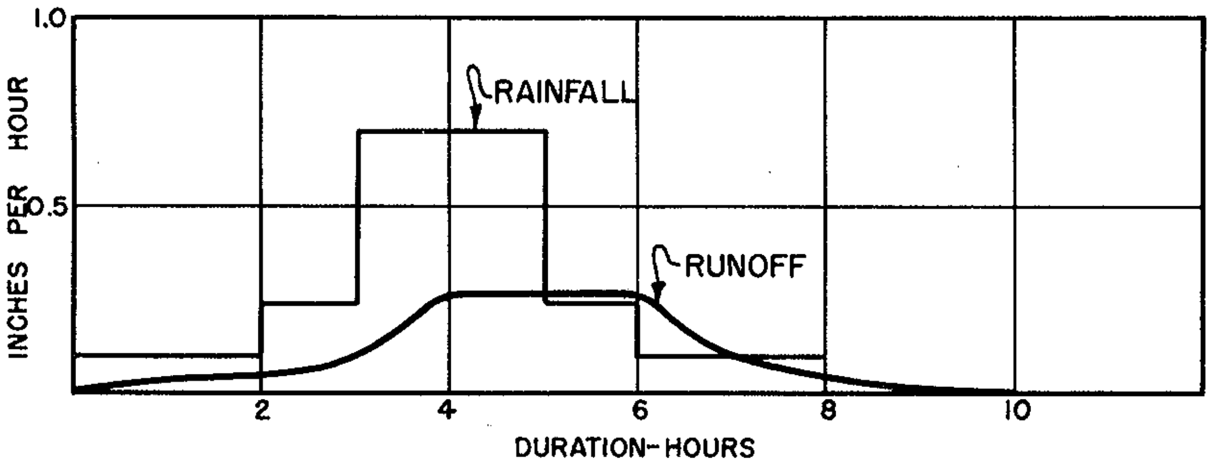
SUBMITTED: [signature] ENGINEER, HYDRAULICS SECTION — APPROVAL RECOMMENDED: [signature] PRINCIPAL ENGINEER, CHIEF OF ENGINEERING DIV. — APPROVED: [signature] LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: [signature] — DRAWN: W.C.N. & G.A.L. — TRACED: F.E.K. — CHECKED: — FISCAL YEAR 1940 — FILE NO. CT-3-1165

C.5a

PLATE NO. 5





DRAINAGE AREA = 335 ACRES

TOTAL RAINFALL = 2.27"

TOTAL RUNOFF = 1.20" = 33.5 A.F.

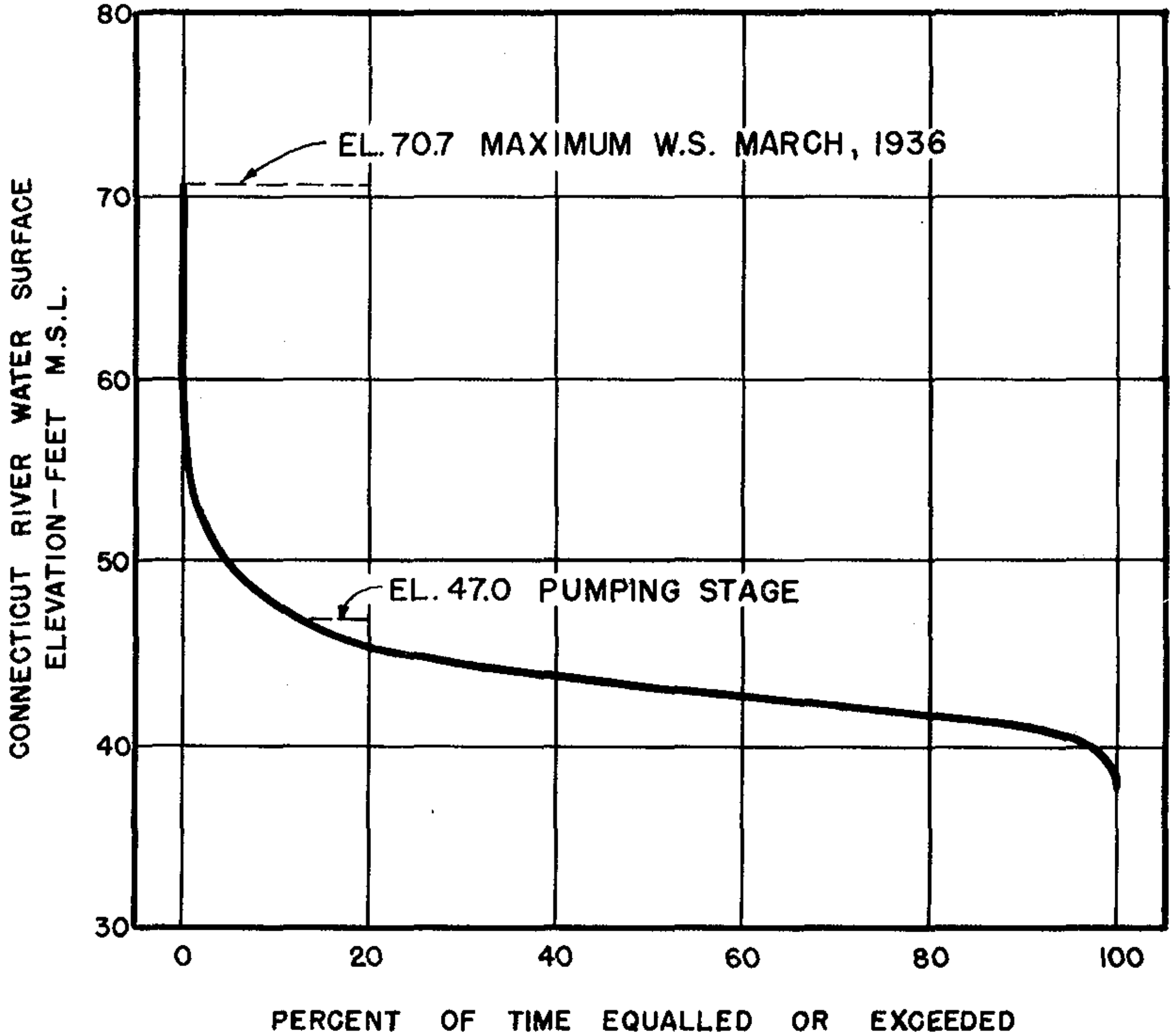
$$\frac{\text{TOTAL RUNOFF}}{\text{TOTAL RAINFALL}} = 0.53$$

BERTHA AVENUE PUMPING STATION

RUNOFF HYDROGRAPH

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. APRIL 1940

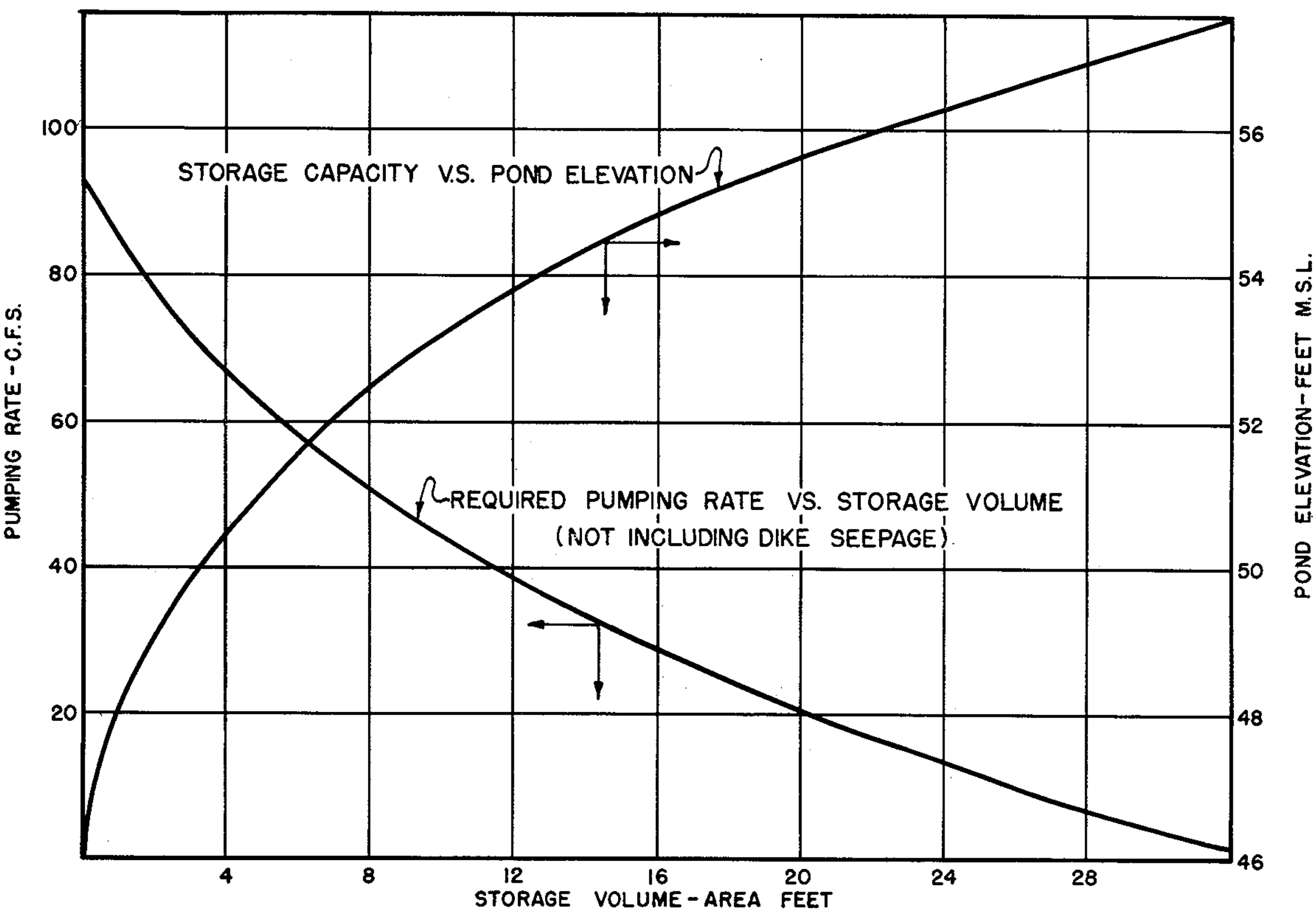
PLATE NO. 6



BERTHA AVENUE PUMPING STATION

STAGE DURATION CURVE

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. APRIL 1940



BERTHA AVENUE PUMPING STATION

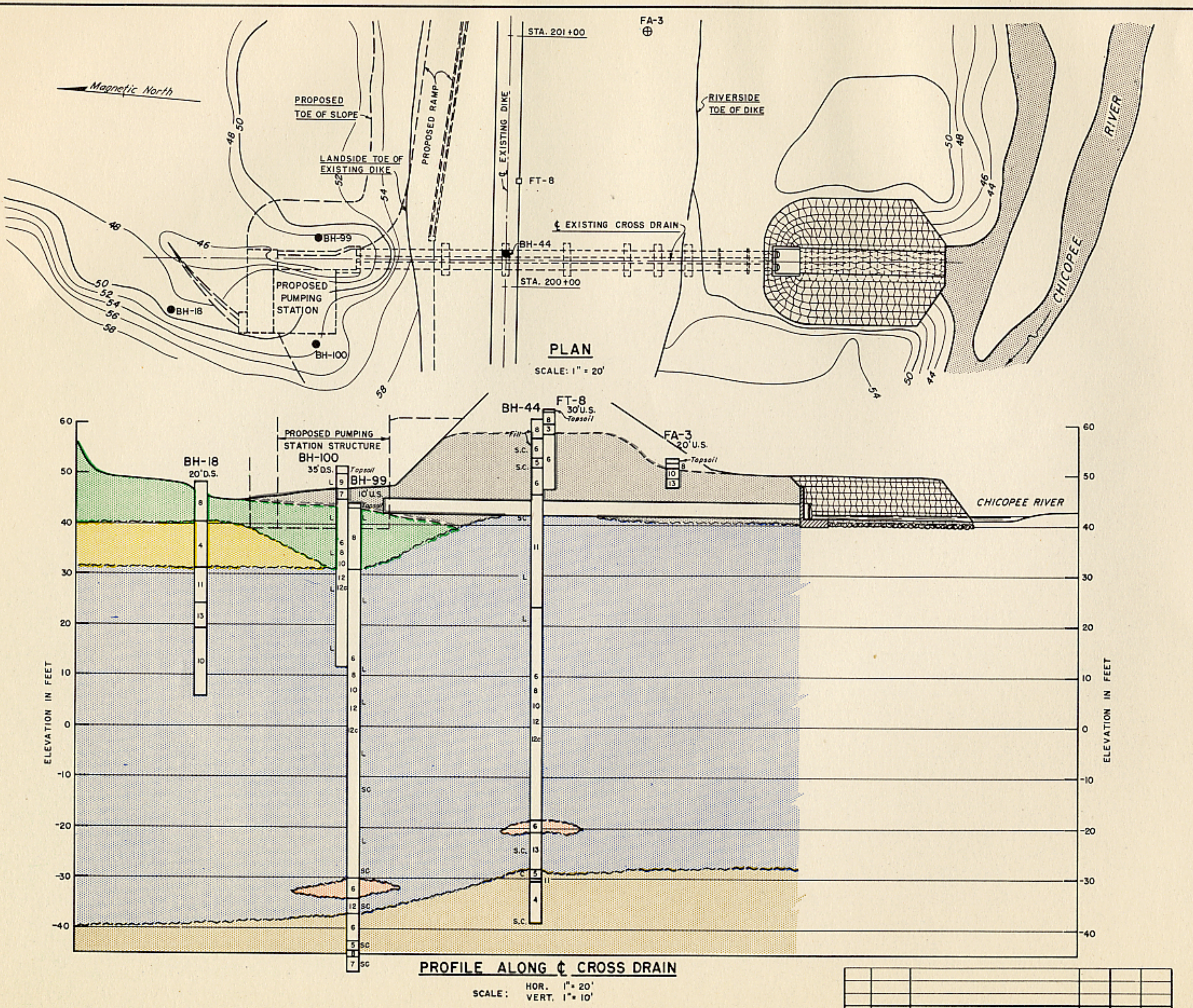
PUMPING RATE AND STORAGE CAPACITY

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. APRIL 1940

PLATE NO. 8

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



DESCRIPTION OF SOIL CLASSES

- [1] Graded from Gravel to Coarse Sand - Contains little medium sand.
- [2] Coarse to Medium Sand - Contains little gravel and fine sand.
- [3] Graded from Gravel to Medium Sand - Contains little fine sand.
- [4] Medium to Fine Sand - Contains little coarse sand and coarse silt.
- [5] Graded from Gravel to Fine Sand - Contains little coarse silt.
- [6] Fine Sand to Coarse Silt - Contains little medium sand and medium silt.
- [7] Graded from Gravel to Coarse Silt - Contains little medium silt.
- [8] Coarse to Medium Silt - Contains little fine sand and fine silt.
- [9] Graded from Gravel to Medium Silt - Contains little fine silt.
- [10] Medium to Fine Silt - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.
- [10C] Medium Silt to Coarse Clay - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.
- [11] Graded from Gravel or Coarse Sand to Fine Silt - Contains little coarse clay.
- [12] Fine Silt to Clay - Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.
- [12C] Clay - Contains little silt. Possesses behavior characteristics of clay.
- [13] Graded from Coarse Sand to Clay - Contains little fine clay (colloids). Possesses behavior characteristics of silt.
- [13C] Clay - Graded from sand to fine clay (colloids) Possesses behavior characteristics of clay.

LEGEND

- L — *Loose material*
- SC — *Slightly compact material*
- C — *Compact material*
- VC — *Very compact material*
- ● BH - *Drive sample bore hole*
- ⊕ FA - *Foundation auger boring*
- □ FT - *Foundation test pit*
- U.S. - *Upstream of cross drain*
- D.S. - *Downstream of cross drain*

NOTES

Proposed construction shown by heavy broken line.

Classes 6, 8, 10, 12 & 12C indicated in bore hole records generally occur in alternating bands, having thin layers of fine clay interbedded with thicker layers of silt or fine sand.

Samples, test results, and logs pertaining to the materials from the bore holes are available for inspection by interested parties at the United States Engineer Office, Providence, R.I.

Elevations refer to Mean Sea Level Datum.

For color key see Plate No. 11.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE MASS.

SUBSURFACE EXPLORATIONS

CONNECTICUT RIVER — MASSACHUSETTS

IN 33 SHEETS — SCALE: 1 IN = 20 FT. (20' 0 20' 40') — SHEET NO. 6

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL 1940

SUBMITTED: SENIOR GEOLOGIST, HEAD, GEOLOGY SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

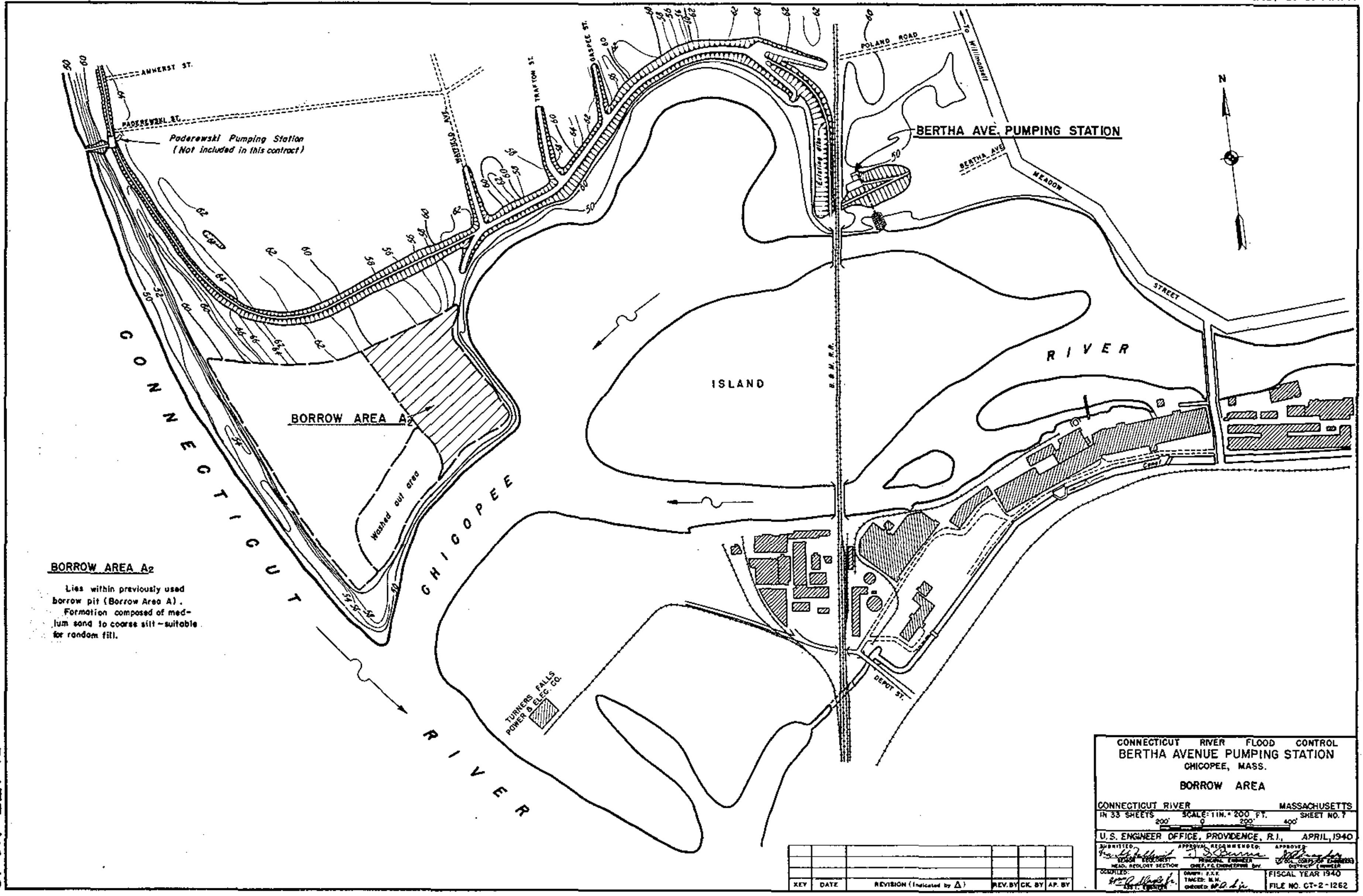
COMPILED: ASST. ENGINEER — DRAWN: J. McL. TRACED: C. J. M. CHECKED: — FISCAL YEAR 1940 FILE NO. CT-2-1261

C. 5a

PLATE NO. 9

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



BORROW AREA A_2

Lies within previously used borrow pit (Borrow Area A). Formation composed of medium sand to coarse silt — suitable for random fill.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.

BORROW AREA

CONNECTICUT RIVER — MASSACHUSETTS

IN 33 SHEETS — SCALE: 1 IN. = 200 FT. — SHEET NO. 7

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL, 1940

SUBMITTED: Senior Geologist, Head, Geology Section — APPROVAL RECOMMENDED: Principal Engineer, Chief, F.C. Engineering Div. — APPROVED: Lt. Col., Corps of Engineers, District Engineer

COMPILED: Asst. Engineer — DRAWN: F.X.F. TRACED: M.H. CHECKED

FISCAL YEAR 1940

FILE NO. CT-2-1262

C.5a

PLATE NO. 10

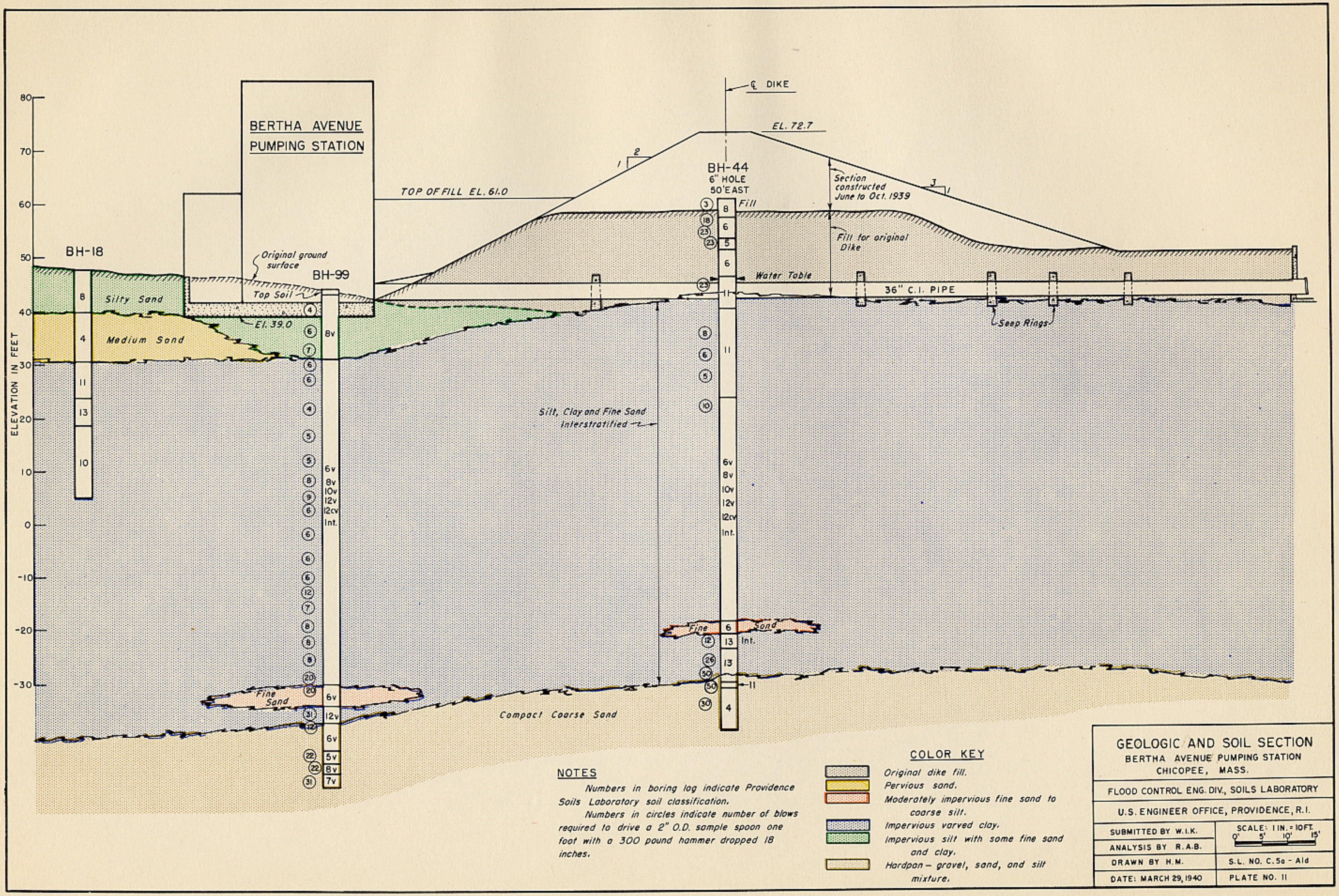

BERTHA AVENUE
PUMPING STATION
℄ DIKE
EL. 72.7
TOP OF FILL EL. 61.0
BH-44
6" HOLE
50' EAST
Fill
Section constructed June to Oct. 1939
Fill for original Dike
Water Table
36" C.I. PIPE
Seep Rings
BH-18
BH-99
Original ground surface
Top Soil
Silty Sand
Medium Sand
El. 39.0
Silt, Clay and Fine Sand Interstratified
Fine Sand
Compact Coarse Sand
ELEVATION IN FEET
NOTES
Numbers in boring log indicate Providence Soils Laboratory soil classification.
Numbers in circles indicate number of blows required to drive a 2" O.D. sample spoon one foot with a 300 pound hammer dropped 18 inches.
COLOR KEY
Original dike fill.
Pervious sand.
Moderately impervious fine sand to coarse silt.
Impervious varved clay.
Impervious silt with some fine sand and clay.
Hardpan – gravel, sand, and silt mixture.
GEOLOGIC AND SOIL SECTION
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.
FLOOD CONTROL ENG. DIV., SOILS LABORATORY
U.S. ENGINEER OFFICE, PROVIDENCE, R.I.
SUBMITTED BY W.I.K.
ANALYSIS BY R.A.B.
DRAWN BY H.M.
DATE: MARCH 29, 1940
SCALE: 1 IN. = 10 FT.
S.L. NO. C.5a – A1d
PLATE NO. 11

PLATE NO. 11

PROVIDENCE DISTRICT SOIL CLASSIFICATION

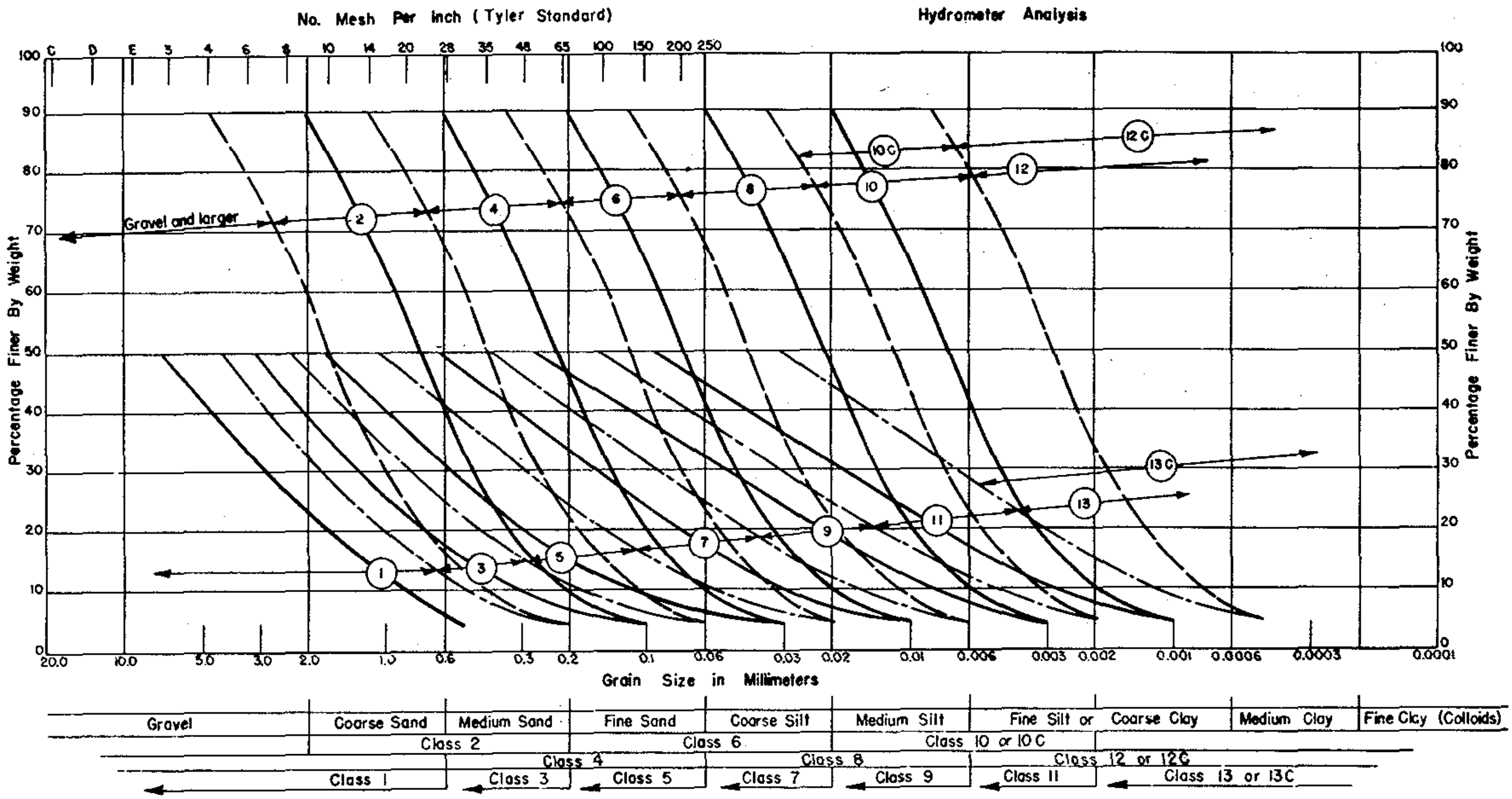
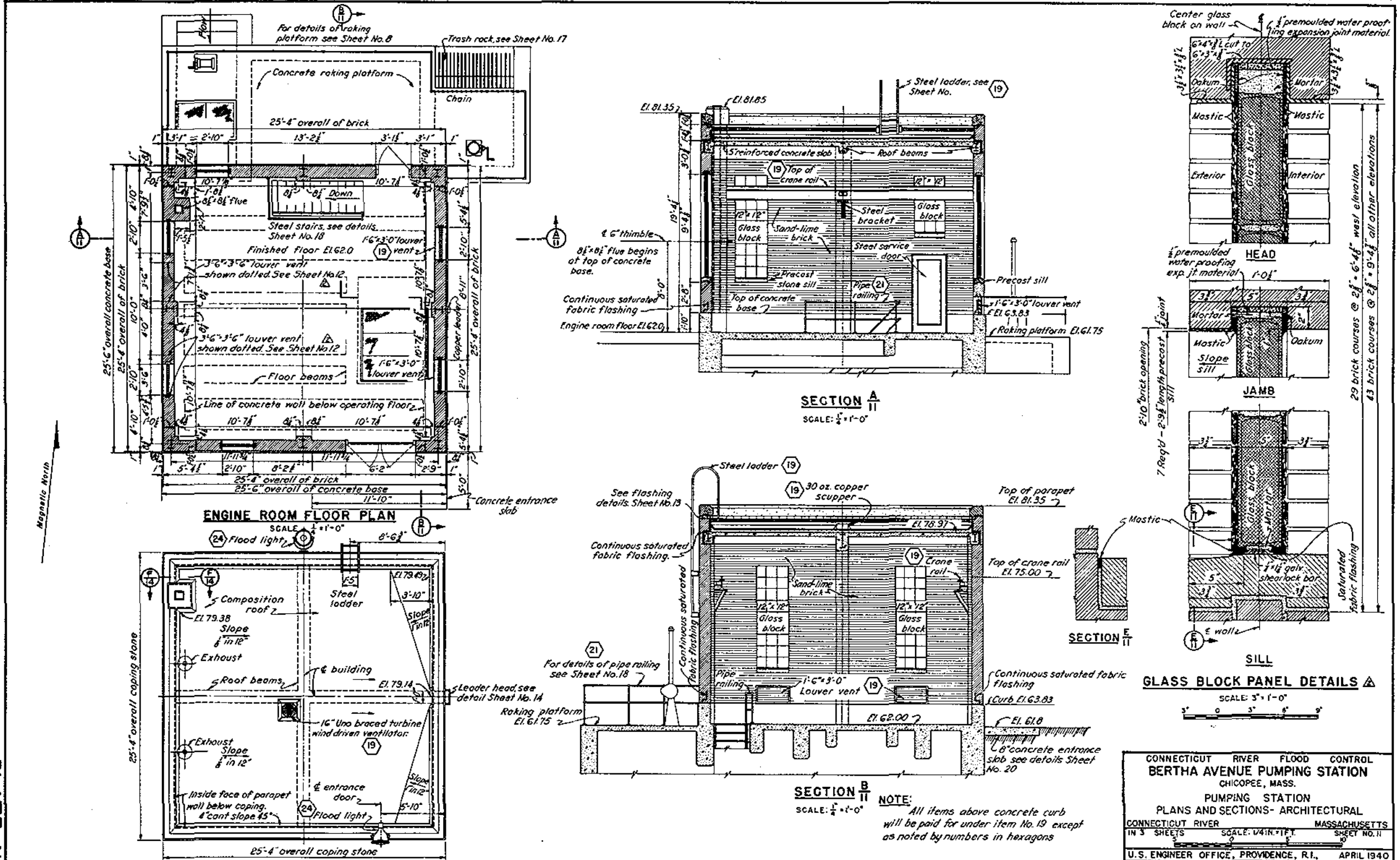


DIAGRAM SHOWING LIMITS OF SOIL CLASSES

PLATE NO. 12

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTE: All items above concrete curb will be paid for under item No. 19 except as noted by numbers in hexagons

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY
△	10-9-40	Glass block panel details changed. Louvre vents added to floor plan.			

CONNECTICUT RIVER FLOOD CONTROL
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.
PUMPING STATION
PLANS AND SECTIONS - ARCHITECTURAL

CONNECTICUT RIVER — MASSACHUSETTS
IN 3 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 11

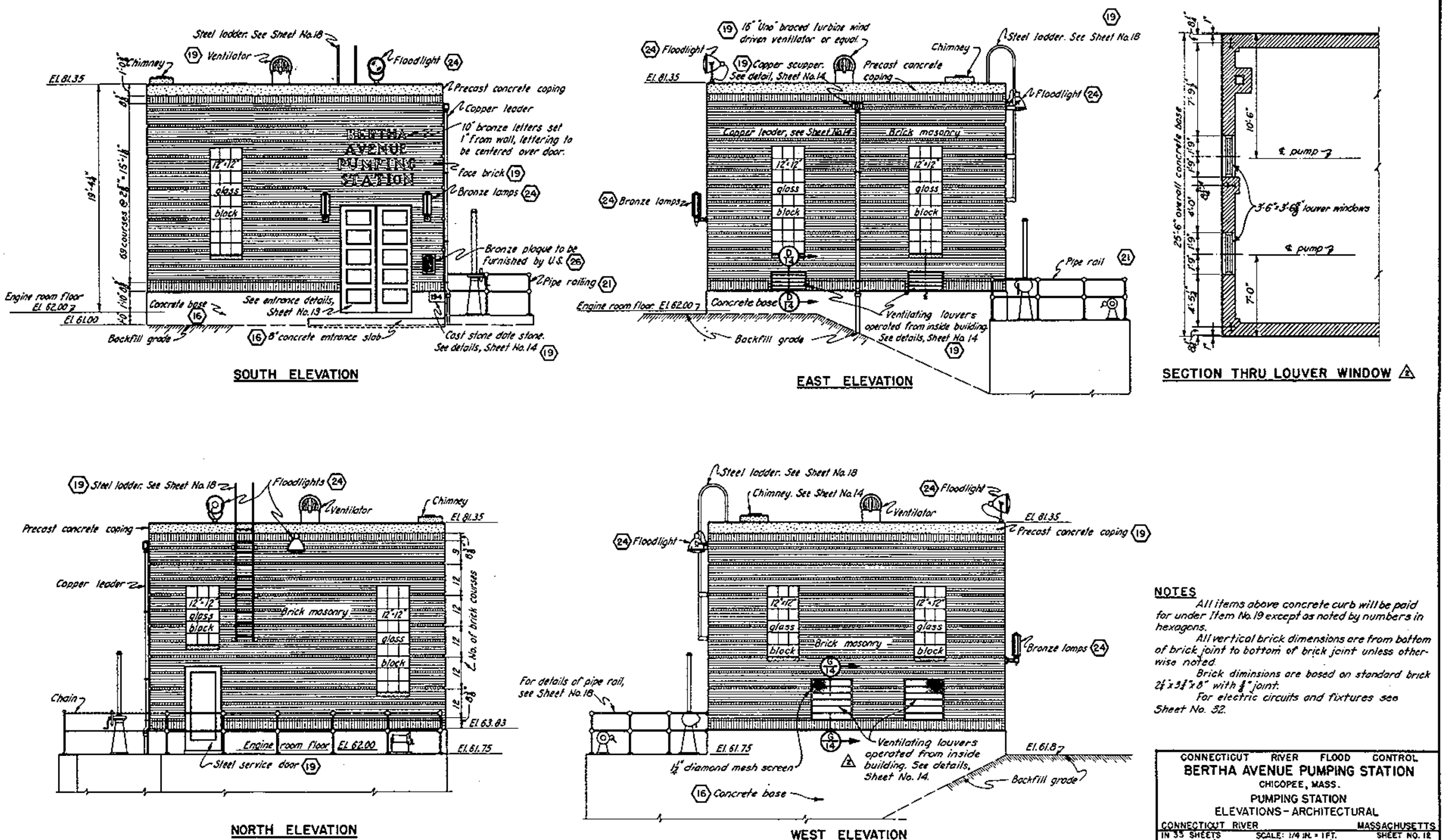
U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — APRIL 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVED, RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

FISCAL YEAR 1940
FILE NO. CT-4-2291

PLATE NO. 13

C.5a



NOTES

All items above concrete curb will be paid for under Item No. 19 except as noted by numbers in hexagons.

All vertical brick dimensions are from bottom of brick joint to bottom of brick joint unless otherwise noted.

Brick dimensions are based on standard brick $2\frac{1}{4}" \times 3\frac{3}{4}" \times 8"$ with $\frac{3}{8}"$ joint.

For electric circuits and fixtures see Sheet No. 32.

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY
△	10-9-40	Windows changed - louvres added			

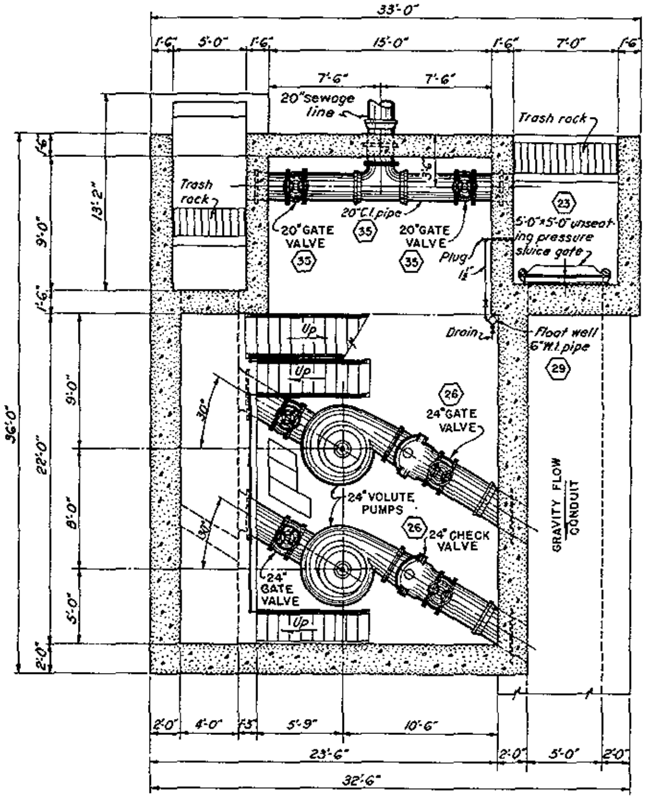
CONNECTICUT RIVER FLOOD CONTROL
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.
PUMPING STATION
ELEVATIONS - ARCHITECTURAL
CONNECTICUT RIVER MASSACHUSETTS
IN 33 SHEETS SCALE: 1/4 IN. = 1 FT. SHEET NO. 12
U.S. ENGINEER OFFICE, PROVIDENCE, R.I. APRIL 1940
SUBMITTED: HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER
DESIGNED: — DRAWN: — TRACED: — CHECKED:
FISCAL YEAR 1940
FILE NO. CT-4-2292

C.5a

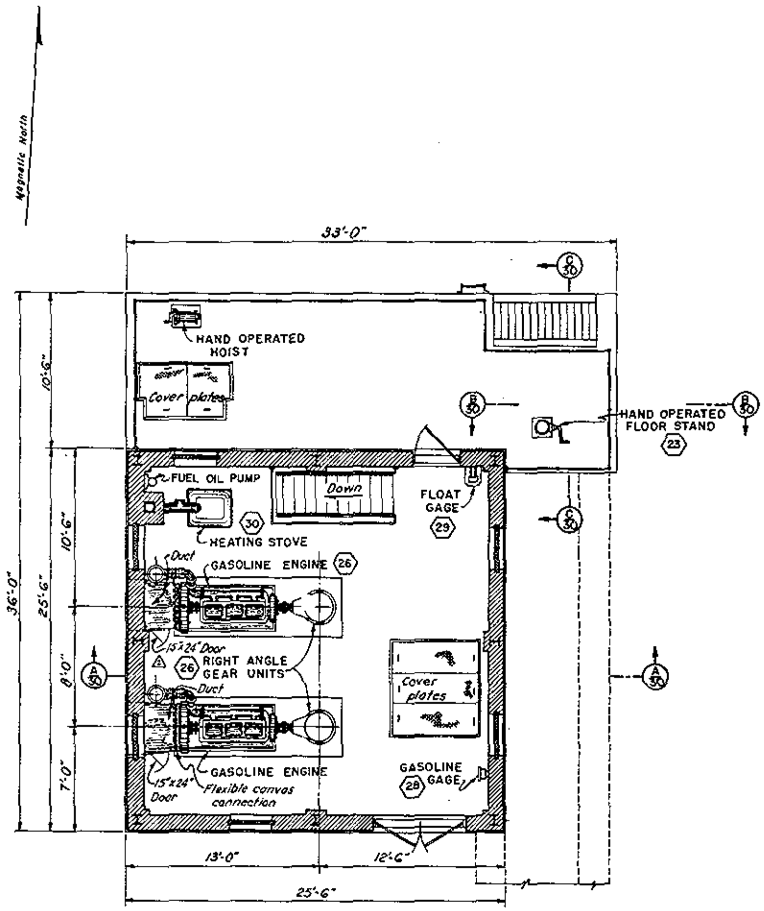
PLATE NO. 14

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PUMP ROOM PLAN



ENGINE ROOM PLAN

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE, MASS.

GENERAL ARRANGEMENT OF EQUIPMENT

CONNECTICUT RIVER — MASSACHUSETTS

IN 33 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 29

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL, 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: — DRAWN: — TRACED: — CHECKED:

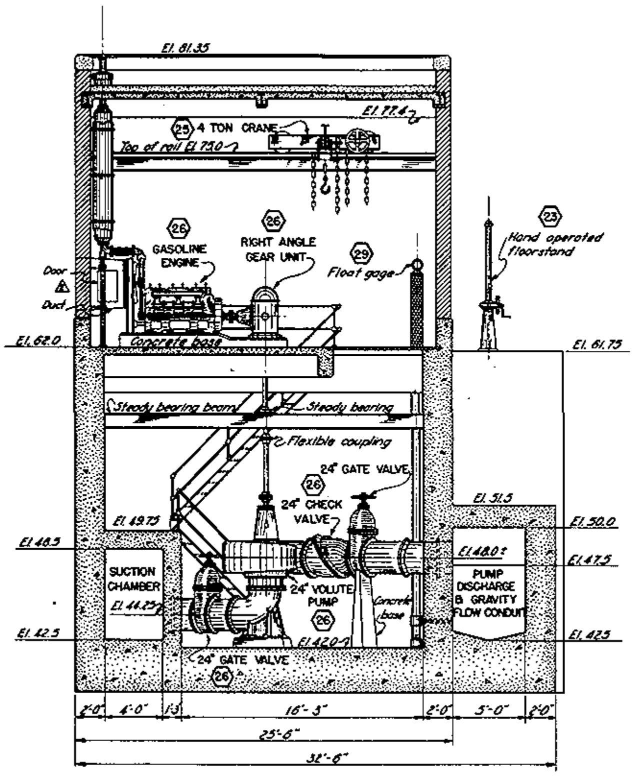
FISCAL YEAR 1940

FILE NO. CT-4-2309

KEY	DATE	REVISION (indicated by Δ)	REV. BY	CK. BY	AP. BY
Δ	10-9-40	Addition of Ducts and Louvers			

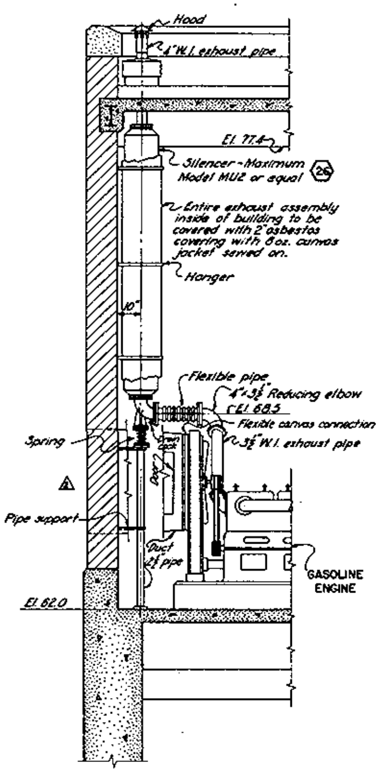
C.5a

PLATE NO. 15



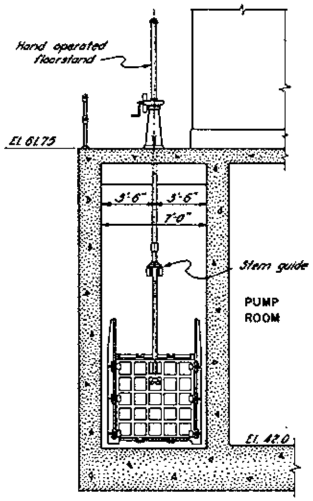
SECTION A/29

SCALE: 1/4" = 1'-0"



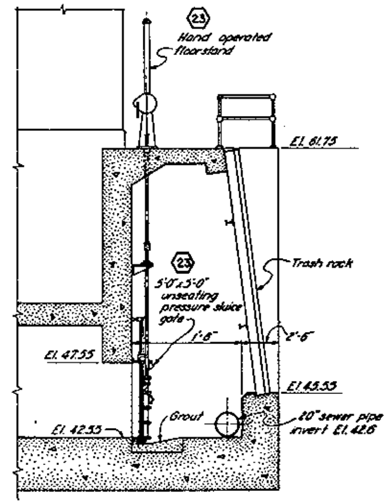
DETAIL OF GASOLINE ENGINE EXHAUST

SCALE: 1/2" = 1'-0"



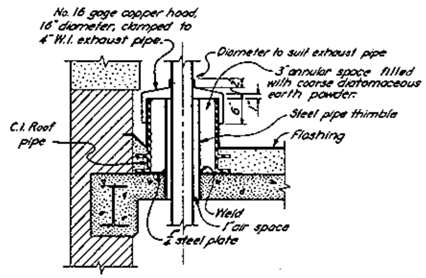
SECTION B/29

SCALE: 1/4" = 1'-0"



SECTION C/29

SCALE: 1/4" = 1'-0"



DETAIL OF ENGINE EXHAUST AT ROOF

SCALE: 1" = 1'-0"

NOTE

The exact elevation of the steady bearing beams shall suit the equipment furnished.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY
Δ	10-3-40	Addition of Ducts and Louvers	[signature]	[signature]	[signature]

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE, MASS.

MISCELLANEOUS DETAILS

CONNECTICUT RIVER — MASSACHUSETTS

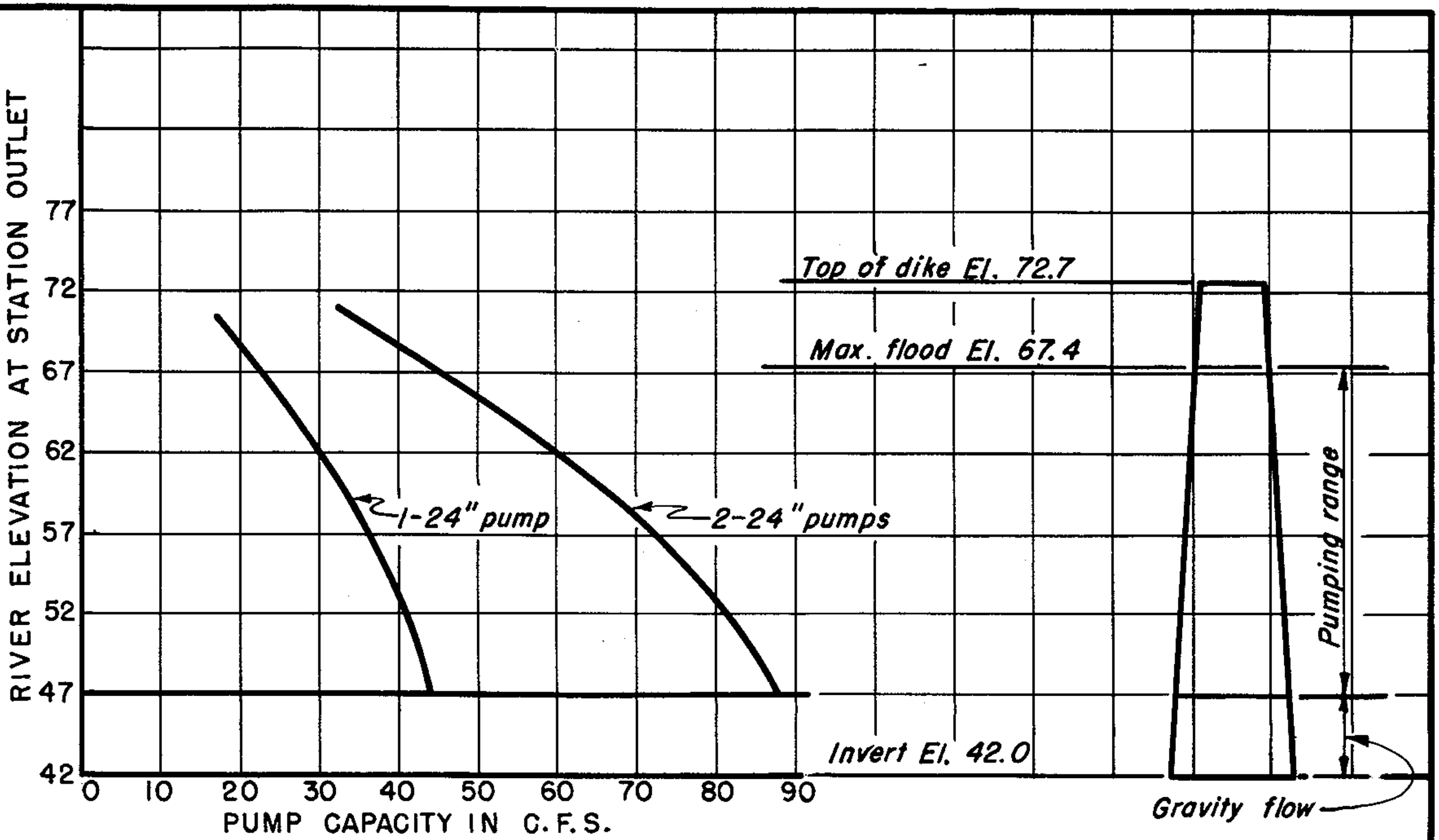
IN 33 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 30

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL, 1940

SUBMITTED: [signature] SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: [signature] PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: [signature] LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: [signature] — DRAWN: W.B. TRACED: L.V.R. CHECKED: [signature] — FISCAL YEAR 1940 — FILE NO. CT-4-2310

PLATE NO. 16



CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVE. PUMPING STATION

PUMPING CAPACITY

U.S. ENGINEER OFFICE PROVIDENCE, R. I.

PLATE NO. 17

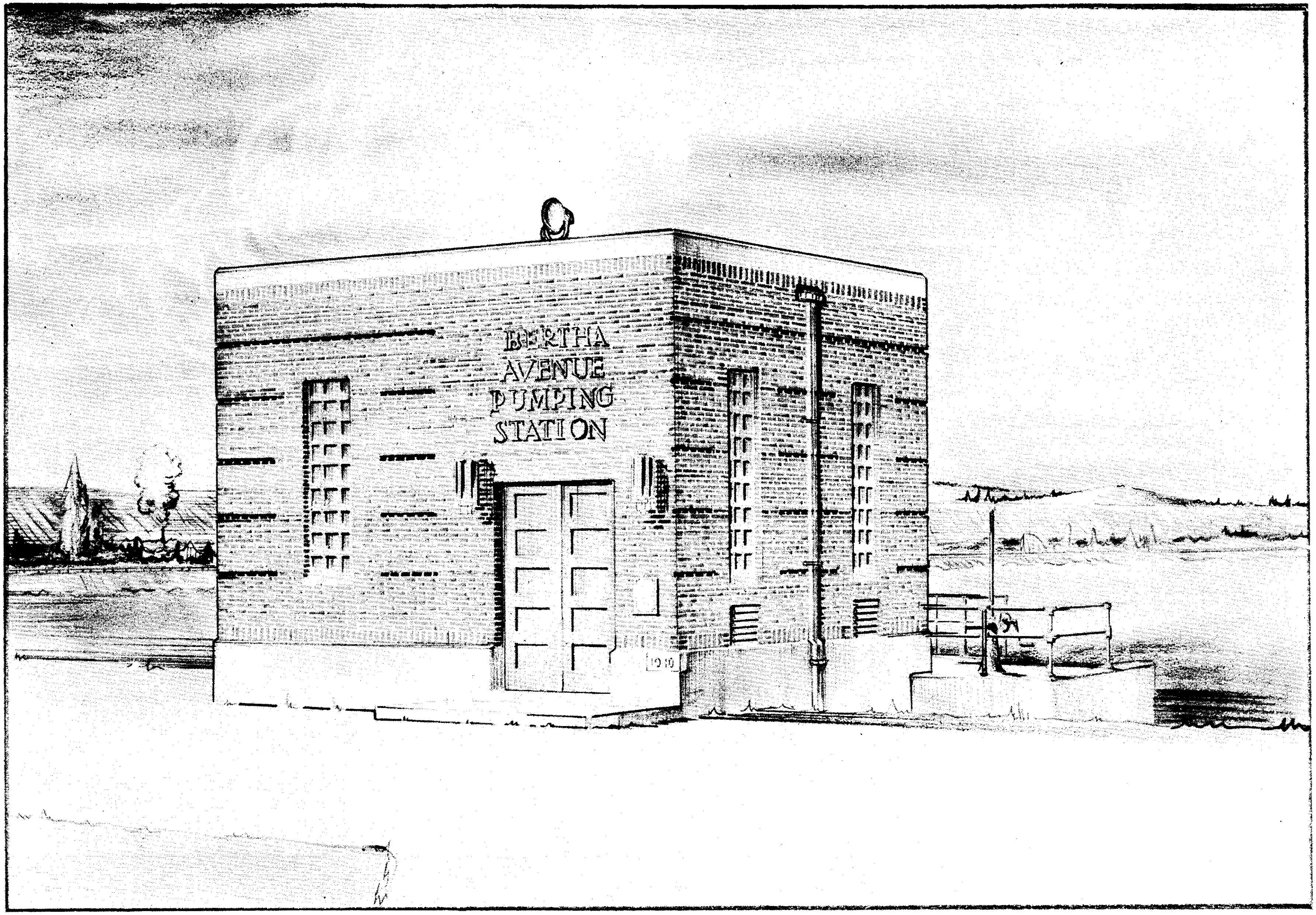
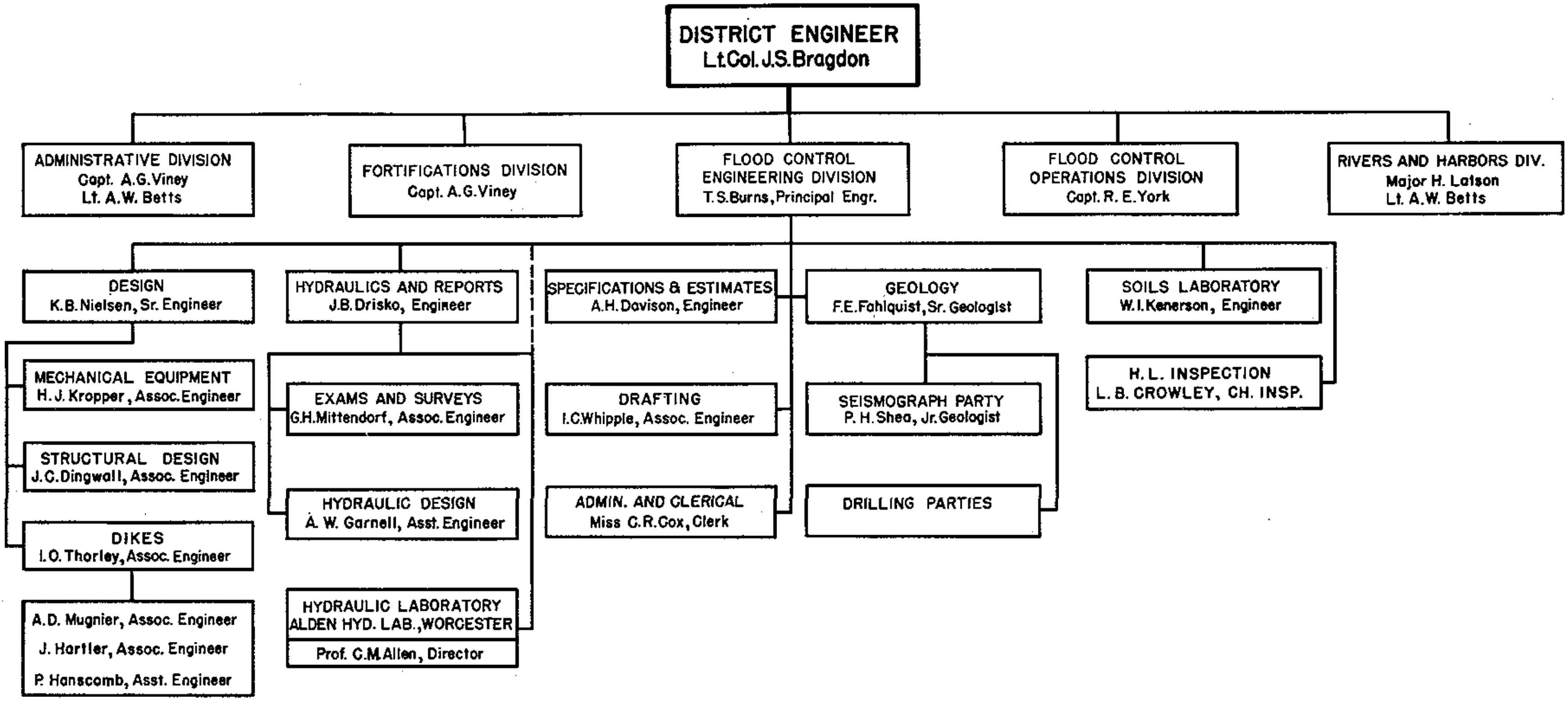


PLATE NO. 18



ORGANIZATION CHART

FLOOD CONTROL
ENGINEERING DIVISION

U.S. ENGINEER OFFICE, PROVIDENCE, R.I.

PLATE NO. 19