Design of a Separate Sewerage System Gary, Lake County, Indiana

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1907

DESIGN

OF A

SEPARATE SEWERAGE SYSTEM

GARY, LAKE COUNTY, INDIANA

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A THESIS PRESENTED BY

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TO THE

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IN CIVIL ENGINEERING.

Alfred E. Phillips
Prof. Civil Engineering

The procedure in the design of this sewerage system may be outlined as follows: (1). Field-work, (2) Choice of system to be used and determination of quantities necessary for its design (3) design of the sanitary system, (4) design of the storm sewers, (5) specification and estimate of cost of the system.

(1). A plat of the town having been obtained from the Gary Land Company, a level survey only of the town was necessary. This survey was made during the second week of March, 1907. The east and west streets of the town, together with Broadway, its main street, were graded at this time. It was assumed however, that the remaining north and south streets would be graded before any sewer work was begun, therefore the profiles of the streets with a few exceptions were plotted with uniform grades between street intersections.

(2). Although it is not the purpose of this thesis to compare the merits of the combined and separate systems of sewerage a few comparisons would not be out of the way, provided they tend to show our reasons for adopting the latter system. Obviously, to secure successful results, the size of a sewer carrying both storm water and house sewerage must be sufficient to carry away the water during the heaviest rain storms. The system is yet to be designed, combined or separate, that will carry away all the water during such periods. During dry periods, however, the house sewerage alone must be taken care of. In a sewer large enough to take care of the storm water, the

house sewerage will be but a trickling stream along the bottom of the sewer. Unless the grade is comparatively steep, the velocity of the sewerage is low, and successions of dams are formed along the bottom by the settling of solid matters, both from the house sewerage and the storm water. In dry weather the sewerage stands in pools along the sewer and decomposes, giving out volumes of sewer gas.

It may be argued that small sewers such as are used to convey the house sewerage in the separate system, are much harder to clean than are the large combined sewers. This is probably true, and yet it is a fact that a properly designed system of small sanitary sewers, flowing nearly full, is not likely to become stopped up. While the separate system requires large quantities of water for its successful operation, regular flushing would improve the combined system also, were not the enormous quantity of water necessary to do so prohibitive, therefore the added expense may be considered justifiable.

The above comparisons, together with many others which might be mentioned, seem to favor the separate system. The deciding factor in this, as in most other cases, however, is the cost. The storm sewers in a separate system must necessarily be as large as those of the combined system, and the additional small sewers for house sewerage must be provided at a cost which increases by its full amount the cost of the separate over the combined system, but in the separate system, the storm sewers need only be placed a sufficient depth below the

pavement to prevent breakage, (three to five feet) while in the combined system they must be low enough to receive the house sewerage, (eight to ten feet). The saving in excavation and backfilling may more than cover the cost of the sanitary sewers. Besides, and this is especially true of Gary, storm sewers need not necessarily be carried up all the streets occupied by the sanitary sewers. A glance at the map of the town will show that if storm sewers are placed along the east and west streets, and the north and south streets, are correctly graded, the storm water falling on the pavements or house tops on the latter will flow down the gutters to the east and west street intersections, enter the sewers at these points and flow through the system to the river. Making the center of each block the highest point in the street grade with a fall towards each street intersection, will insure the safe disposal of storm water with the flow in the gutters nowhere exceeding 400', and in most cases not more than 335'.

After careful consideration of the designs of both systems, we have estimated that the cost of a separate system for Gary will be 15% cheaper than that of a combined system.

An Additional advantage of the separate system is the practical necessity for its use where treatment of house sewerage is either immediately necessary or may in the future become so. This is the case at Gary where, were the house sewerage not treated, pollution of the sluggish Calumet River with a corresponding spread of disease would undoubtedly result.

The town being in the process of building, no actual population exists. As a safe assumption a population of 153,000 is assumed giving a density of 25.5 per acre, the area of the town being 600 acres approximately.

(3). The amount of house sewerage may be safely taken as equal to the water supply per capita per day. A safe estimate is 175 gallons. The amount taken by each sanitary sewer may then be calculated. On account of the topography of the town, we decided to run sanitary sewers along each north and south street from the Wabash Railroad to Fifth Avenue, and from Third to Fifth, and an intercepting sewer from Fillmore Street to Georgia Street, and from Vermont Street to Georgia Street on Fifth Avenue, thence due north to the Calumet river.

As an example the amount of sewerage flowing through the Polk Street sewer is equal to 175 x 8.1 x 25.5 = 36,146 gallons = 3.36 cubic feet per second.

The velocity of sewerage in an 8" sewer flowing full at a grade of two feet in 1000' is 1.4 feet per second. The discharge for this velocity equals 29.38 cubic feet per second. The sewer will flow one-third full with a velocity of .75 x 1.4 equals 1.5 feet per second. Although a smaller sewer could be used 8" is a practical minimum.

The Fifth Avenue intercepting sewer starts at an elevation of 10' above water level at Fillmore street and drops with a grade .001 to Georgia Street. This necessitates the use of drop manholes at many of the junctions. A sample

of one is shown in the accompanying blueprints.

Each dead end is provided with a flush tank, details of which are shown in an accompanying blueprint. We advise the regulation of these tanks to empty at least once in six hours, intermittently throughout the system. Even more frequent flushing would be desirable.

Manholes are placed at each street intersection and in the middle of each block. We believe that these will afford ample means of cleaning the sewers without the use of intermediate hand or lamp-holes. All sewers are straight between manholes.

(4). A maximum rainfall of 1½" per hour is used in determining the size of the storm sewers. We have decided to split the town into the three sections, each drained by an intercepting sewer and its laterals. One of these intercepting sewers is located on Fillmore street, since a direct line to the River may be obtained without crossing under the L. S. & M. S. , and the B. & O., and the I. H. R.R. tracks. The sewer on Fillmore Street receives the water from the Third Avenue Sewer from Madison Street, the 4th, 5th, 6th and 8th Avenues sewers from Van Buren Street, and the 7th Avenue sewer from Jackson Street. The second intercepting sewer is located on Broadway and receives water from the laterals, on 4th, 5th, etc. avenues as shown on the plat. The third intercepting sewer is located on Georgia Street and has laterals on 5th, 6th, 7th and 8th Avenues. The grade of all storm sewers is .001.

Catch-basins are located in the grass plots on the northwest and southeast corners of all street intersections. Each catch-basin will receive water from both the east and west gutters of the streets for a distance of one-half block. The catch-basins are emptying into a manhole in the storm sewer. Details of catch-basin and manholes may be found in the accompanying blue prints.

Perhaps the most difficult work in the design of a separate system is to fit the sanitary system to the storm sewers with the least amount of extra excavation. The storm sewers often flow in the opposite direction to the sanitary, (as on 5th Avenue), but they must be kept above the sanitary sewers. A comparison of the following profiles, however, will show that the systems will pass at all points, also that the storm sewers are never closer than 2½' to the pavement.

The laterals of the sanitary system are everywhere above the grade of the 5th Avenue intersepting sewer.

Following are the plan and profiles of both systems, the necessary details of each and specifications and estimates of the cost of each system.

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S P E C I F I C A T I O N S

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For The

MATERIALS AND CONSTRUCTION OF SEWERS

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G A R Y , I N D I A N A

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GARY LAND COMPANY

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INSTRUCTIONS TO BIDDERS.

It is the intention of these specifications to provide for this improvement in a complete, thorough and workmanlike manner. The contractor to whom the work is awarded, shall furnish all materials, labor and appurtenances necessary to complete the work in accordance with these specifications, and anything omitted herein that may be reasonably interpreted as necessary to such completion is to be merged into the prices bid for the improvements. No bid will be accepted which does not contain an adequate or reasonable price for each and every item named in the schedule of 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 accuracy of the estimated quantities.

Bidders must present satisfactory evidence to the Company that they have been regularly engaged in the business of building sewers, or are reasonably familiar therewith, and that they are fully prepared with the necessary capital, materials and machinery to do the proposed work.

The Company expressly reserves the right to reject any or all bids, or to accept bids separately as to different sections of the work, or to accept any bid in the aggregate.

The plans and drawings showing locations and dimensions of sewers to be constructed, prepared by the Gary Land Company, and on file in its office with all notes, dimensions, figures and corrections thereon, shall be considered a part of these

specifications, and in the event of any discrepancy between plans and specifications, the judgement of the Company or its authorized agent shall be decisive thereon.

NATURE OF THE WORK.

The contractor shall, for the contract price per lineal foot for the sewer proper, furnish all the material and all tools and do all the work prescribed in these specifications, and shown on the plans attached, including foundation and all necessary work and material for building of outfall, shall make the requisite excavation for building the sewer, and its appertaining structures and connections, shall do all the ditching, diking, pumping, bailing and draining, all sheeting and shoring; shall make all provisions necessary to maintain and protect all buildings, walls, fences, trees, gas pipe, water pipe, conduits, sewers and other structures of whatever nature; shall provide all centers of forms; shall construct all foundations, all brick, tile, pipe, concrete, stone and timber work; shall set in place all iron work, and refill all trenches; and shall put in complete working order the sewers awarded him, and shall do each and all to the satisfaction of the Gary Land Company. The contract price is to include the cost of removal of trees, roots, timber or masonry structures or other obstacles, and the delay or damage occasioned by same, whether any of these obstacles are shown on the plan or not.

E X C A V A T I O N .

The ground shall be excavated in open trenches, except

where tunneling is considered necessary or proper by the Engineers, in such direction as is required, to the width and depth as may be necessary for the proper construction of the sewer according to plan.

The trenches must be of sufficient width to admit of ample room within the lines of the sheeting, to permit of the work being constructed in the manner and size specified. Wherever the nature of the ground will admit of it, the bottom of the excavation is to have the shape and dimensions of the outside of the lower half of the sewer. If the character of the ground met with in excavating is such that the external form of the sewers cannot be preserved, the excavation shall be made to conform as nearly as possible to the external shape and dimensions of the sewer. The space between the external sewer lines and the bottom and sides of the excavation as made, shall be filled with dry earth by the contractor.

The excavation of the trench shall not advance more than six hundred feet ahead of the completed masonry or pipe work, except, where, in the opinion of the Engineers, it is necessary to drain wet ground. Where rock is encountered in excavating the trenches, it is to be removed by drilling and blasting, or otherwise, to the level of the outside of the bottom of the sewer.

For all rock excavation, in addition to his price per foot of sewer, the contractor is to receive a compensation of $3.00 per cubic yard. Boulders, 1/4 cubic yard and over in size,

will be measured as rock excavation. Hardpan and boulder clay shall not be classed as rock, although it may be more economical to remove the same by blasting. No claim for an amount of money beyond the contract price of the work will be entertained or allowed on account of the character of the ground in which the trench or other excavations are made, except for the rock cutting heretofore specified. Tunnels shall be of such width and height as the Engineersmay direct, and shall be excavated in conformity with the cross section to be furnished by him.

SHEETING AND BRACING.

To secure the protection of the work the streets adjacent, buildings, or other improvements, the contractor must furnish and put in place at his own expense such shores, braces, sheeting, etc. as may be necessary for the safety of the work or the public. The sheeting and bracing shall be removed as the work progresses, in such manner as to prevent the caving in of the sides of the excavation, or any damage to the masonry.

The Gary Land Company may order the sheeting and bracing left in when in its opinion it is necessary for the protection of the work; in such cases only will a charge be allowed for the same at the rate of $18.00 per thousand B.M.

FOUNDATIONS.

Whenever the ground is sufficiently firm and unyielding, the masonry or pipes are to be laid directly on the bottom of the excavation; but whenever this shall not be the case and such foundation does not shown on the plan it shall be built of masonry, concrete, or of plank and timber, as the Engineers may

direct. Contractor will be allowed extra compensation for this work at prices named below for the different kinds of foundations required. The following are the prices to be paid for foundations timbering, sheeting, etc:

$18.00 per 1000' B.M. for plank and sheeting.
8.00 Per cubic yard for brick masonry.
7.00 per cubic yard for concrete.

PROTECTION AGAINST WATER.

When running quick-sand or other treacherous ground is encountered, the work shall be carried on day and night should the Engineers so require. The Contractor shall do all pumping and bailing, build all drains, and do all other work necessary to keep the trench and sewer clear of ground water, or storm water, during the progress of the work, and until the cement mortar is sufficiently set to be safe from injury.

B A C K F I L L I N G .

The surplus material taken from the trench is to be removed entirely from the street or disposed of in such a manner as directed. The backfilling shall in all cases be left with a smooth and even surface and a sufficient crown. Where required, the backfilling shall not be left unfinished more than 600' behind the completed masonry or pipe work. Ditches shall be opened and connected to the inlets of the catch-basin hereinafter provided for, so as to provide for the adequate drainage of the surface of the adjacent land and ditches.

F I L L I N G .

The sewers shall in all cases be covered with earth to

a depth of not less than 2½', and where the trenches do not furnish sufficient material the contractor shall supply such deficiency at his own expense. The embankment shall be of uniform grade and cross-section, and of the dimensions shown or specified in the plans or proposal sheet. The number of cubic yards stated in the proposal sheet is approximate only.

RESTORATION OF SURFACE OF STREET.

When the work is completed all surplus material, must be removed and the surface of the streets included in this contract must be left in as good a condition, in all respects, as it was before commencement of the work, and it must be maintained in such condition during a period of one year after acceptance of the work.

CENTERS AND PATTERNS.

The centers upon which the arches form must be strong and accurately made, and shall in no case be used until approved by the Engineers, and when, in his opinion, either the templets or centers become unfit for use they shall be removed from the work and new ones supplied by the contractor; on curves they must correspond to the radius of the curve.

M A S O N R Y .

Unless otherwise noted on the proposal sheet, all brick sewers, the internal diameters of which exceed 2½' and not more than 6', shall be built of two rings of brick; all brick sewers, internal diameters of which exceed 6', and are not more than 10', shall be built of three rings of brick. The courses are to be laid in line and kept perfectly straight in the direction of

the sewer and parallel to the rise of the same, and shall be

laid as stretchers, breaking joints with those in the adjacent courses. Every brick must be laid separately in full mortar joints on bottom, side and end. No joint shall exceed 1/2" in thickness. The mortar joints on the inside of the sewers, below the center lines, are to be carefully struck when laid. The refuse mortar to be scrapped off and removed entirely from the sewers before it has time to harden. All inverts or bottom courses are to be laid to line from templets, accurately made and correctly set to the lines and grade furnished.

M A N H O L E S .

All manholes are to be circular in section and 4' internal diameter. They are to be built with two rings of brick, giving a thickness of 8" to the wall. The bricks in the inside ring are to be set vertically. The outer ring may be built of bats as far as broken bricks on hand will go, otherwise whole bricks are to be used.

On sewers 4' in diamater and greater the manholes shall be supported by the arch invert of the sewers without additional foundation. On sewers less than 4' in diameter the invert of the sewer through the manholesshall be built of two rings of brick and on each side thereof shall be built a solid brick foundation 12" thick, making the entire foundation 4'6" in diameter.

The top of the manhole is to be 2' in diameter, being drawn in by means of nine header course the diameter being decreased 2" for each course, and an iron cover set thereon, (See

Drawings), tops of the covers of the manholes are to be at the grade of the streets; as given by the Engineers.

The cost of all manholes shall be separate from the price paid per lineal foot of sewer, and shall be estimated on the average depth of manholes as specified by the Engineers.

C A T C H - B A S I N S .

All catch-basins are to be circular in section and 4' internal diameter. They are to be built of two rings of brick upon a floor of two inch pine plank closely jointed. The bricks in the inner ring, (excepting the top and bottom header courses), are to be set vertically. The outer ring may be built of bats as far as broken bricks on hand will go, otherwise whole bricks are to be used. The brickwork shall be 7' deep; the top of the catch basin shall be 2' in diameter, being drawn in by means of nine header courses, the diameter being decreased two inches for each course, a top header course, being laid flush with the course below and an iron cover set thereon.

The catch-basins are to be connected to the sewer with 9" pipe and trap with 9" half-traps, the bottom of the traps are to be set 3'6" above the floor of the basin. The top of the cover shall be set at the grade given by the Engineers and when so directed the contractor shall set a piece of 9" pipe in the side of the basin at the proper elevation to receive the water from the adjacent ditches.

F L U S H T A N K S.

Flush tanks shall be constructed of hard burned bricks, carefully laid in cement mortar, so as to be water tight. They

shall be plastered, outside and in, with cement mortar. (as to form, size, and details, see drawings). The emptying device shall be selected and purchased by the Company, and shall be properly set by the contractor.

C O V E R S .

All covers used shall be of good quality of cast iron, the curb shall weigh not less than 330 lbs. and the lid shall weigh not less than 120 lbs.

P I P E L A Y I N G .

Each pipe is to be laid on a firm bed, and in perfect conformity with the line and levels given by the Engineers. The ends of the pipe are to abut close against each other in such a manner that there shall be no shoulder or want of uniformity of surface on the interior of the drain. The joints are to be as uniform as possible in thickness, and thoroughly filled with mortar; where pipe is laid in running sand the joints must be caulked with oakum. Each joint is to be wiped clean of mortar on the inside before another length of pipe is laid.

JUNCTION OF SEWERS.

The junction of two or more sewers must be made in strict conformity with the plans. The work must be done with special care and in a perfect manner and the brick at the joining edges must be shaped smoothly to proper curves and the two sewers join with a thorough bond, the cost of all junctions to be included in the price per lineal foot of the main sewer.

SIDE JUNCTIONS.

Intersections or lateral sewers, whether of brick or

pipe, and all junctions for catch-basin drains are to be built into the sewers at such places as are shown on the plans. 6" junctions for house drains to commence 10' from street corner and to be placed thence 25' apart throughout the blocks, or as otherwise shown on the plans.

"Y" branches shall not be covered until the Engineers have noted and recorded their exact position. The "Y" branches shall be elevated to correspond to the lateral sewers and house drains entering them. They shall be closed with an earthenware cap coated with cement and covered with sand.

The junctions are to be bricked off at the ends, thoroughly closing them. In no cases are the bricks to be placed inside the pipe. All dead ends of the sewers are to be closed with 8" of brickwork.

M A T E R I A L S .

All materials, of whatever nature, required in the construction of the sewers, catch-basins and manholes, shall be new and of the best quality, and shall be furnished by the contractor.

B R I C K S .

The bricks shall be the best quality for the purpose for which they are intended, uniform in quality, sound, and hard burned, free from lime and cracks, and to have a clear ringing sound when struck, whole with edges full and square, and of standard dimensions; there shall be a compact texture, and after

being thoroughly dried and immersed in water for 24 hours shall not absorb more than 15% in weight of water.

P I P E .

The vitrified earthenware pipe shall be straight, smooth and sound, thoroughly burned, well glazed, free from lumps or other imperfections, and with the least possible variation from the specified dimensions or true cylindrical shape. All straight pipe must be straight in the direction of the axis of the cylinder, with the ends cut at right angles with the axis of the pipe and the inner and outer surface of each pipe must be concentric. The thickness of the pipe shall be: for 18" pipe, 1¼"; for 15" pipe, 1-1/8"; for 12" pipe, 1"; and for 9" pipe, 7/8", with a limit of variations not exceeding 1/8" either way.

Iron pipe shall be used where the sewer runs under water - ways or railroads, or wherever it is deemed necessary by the Engineers. The joints shall be of lead, properly caulked. The lengths of pipe, their diameter and thickness, to be as directed by the Engineers.

C E M E N T .

The cement shall be fresh made, of some satisfactory and reliable brand, and of such quality and uniformity as has been demonstrated by the Company, to be of superior quality and thoroughly adapted for the construction of sewers and similar work, and shall be approved by the Engineers.

Natural cement shall be so finely ground that 80% of the whole will pass through a sieve of one hundred meshes to the

being thoroughly dried and immersed in water for 24 hours shall not absorb more than 15% in weight of water.

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lineal inch, and when treated in the usual manner for tensile strength, shall give results comparing favorably with the best brand of American Natural Cement. The cement, when tested in the usual manner, shall take an initial set in not less than twelve minutes.

Portland cement shall be of some brand of reputation known and established by use. It shall be ground so that 91% will pass through a sieve of one hundred meshes to the lineal inch, and when mixed, one part cement and three parts sand, shall show a tensile strength of 200 lbs. per square inch in seven days - one day in air and six days in water - and an increase of not less than 20% in strength at the end of 28 days, and an additional increase of 15% at the end of three months.

M O R T A R .

The mortar for brick work shall be made by carefully measuring and thoroughly incorporating one part of natural cement with two parts of clean, sharp sand in dry state, mixed with clean water to the proper consistency, and shall be used while fresh, and the use of mortar which has set and then been retempered will not be allowed. The mortar used in laying pipe sewers shall consist one part of natural cement and one part of clean sand mixed and used as above specified, all to be furnished by the contractor without extra charge.

C O N C R E T E .

All concrete shall be composed of one part Portland cement, three parts clean torpedo sand and six parts of broken stone. The stone shall be of good quality, graduated in size

angular in shape, and free from dirt or clay. All stone must be broken, so as to pass through a ring $\frac{1}{2}$" in diameter. The cement and sand shall be measured and shall be thoroughly mixed dry, until the mixture is of a uniform color, and shall be wet with as little water as will render it proper for use and thoroughly worked. The stone shall be added and whole shall be mixed until each stone is thoroughly coated with mortar. The stone shall be wet or washed, if required, before it is added to the mortar.

INSPECTION OF WORK AND MATERIALS.

All material, of whatever nature, shall be inspected upon the ground when delivered, by an inspector appointed by the Company, who shall, upon finding defective or poor material, of any kind, immediately report the same to the Engineer in charge of work, and the contractor shall, when notified by said Engineer or inspector, at once remove said defective or poor material from the line of the work.

Inspectors will be appointed whose duty it shall be to report to their superiors any neglect or disregard of these specifications by the contractor; but the right of final acceptance of condemnation of the work will not be waived thereby, nor by any other act of the Company by its officers or agents related thereto.

The contractor shall notify the Engineers 48 hours before beginning work on this contract of his intention to do so, and in case of a temporary suspension of the work, he shall

give a similar notice before resuming work. The contractor will be required to dig all stake holes necessary to give the lines and levels for the work in time for the daily visit of the Engineers in charge at such times as they may appoint, and shall furnish and drive all stakes as directed. All the work shall be executed in the best and most workmanlike manner, and no improper material shall be used, but all material of every kind shall fully answer the specifications, or if not particularly specified, shall be suitable for the place where used and satisfactory to the Company.

Whenever the word Engineer is used it is understood to mean the Gary Land Company. Any officer of the Company, the Engineer of the Company, or in his absence is duly appointed assistant or inspector representing him, limited to the special duties imposed on each.

EXTRA WORK.

The actual length of each sewer to be built may be more or less than the corresponding length given in the proposal sheet or plan, but no variation will be made in the rates on that account. No extra or customary measurement of any kind will be allowed in measuring the work under these specifications; but the actual length, area, solid contents, or number shall be considered, and the length shall be measured on the center line of the work whether straight or curved. The contractor will be paid the contract price for each unit of work done, which price will include the cost of all work herein described, including

all junctions, manholes, flush tanks, and catch-basins with their connections.

All loss or damage arising out of the nature of the work to be done, or from any detention or other unforeseen or unusual obstruction or difficulty which may be encountered in the prosecution of the work, or from the action of the elements shall be sustained by the contractor.

G U A R A N T E E .

It is understood and agreed that all labor and material shall be of such character that the entire work, including the restoration of the surface of the street, shall be and remain in good condition during the entire period of one year from the acceptance of the work, and the contractor hereby agrees to keep in perfect repair, during such period, the whole of his work, except in cases where the repairs may be rendered necessary by causes clearly beyond his control. If any of the contractor's work shall be found defective or incomplete during the period of one year after acceptance of the work and the contractor shall neglect to repair such defective work within fifteen days from the date of a notice from the Company directing him to make such repairs, then the Gary Land Company may make such repairs and restoration of the street at the expense of the contractor and shall deduct the cost thereof from any money belonging to the contractor in the control of the City.

DIRECTION AND SUPERINTENDENTS.

The contractor shall perform all the said work under the direction and superintendence of the Gary Land Company, and to its entire satisfaction, approval and acceptance. If the work shall not be begun at the time herein stipulated, or if the rate of which work shall be performed, shall not, in the judgement of the Company, be such as to insure its progress and completion in the time and manner herein stipulated, or if said work shall be wholly or in part improperly conducted, then the Company may declare the contract for said work forfeited. It is further understood and agreed that for the amount of damage or price determined by said Gary Land Company to be paid to the Company by said contractor for any such default, or for any money paid out by said Gary Land Company on account of said contractor in consequence of said default, there shall be applied in payment thereof a like amount of any money that may be due and owing to the contractor.

In case the said Company shall deem it necessary to declare any portion or section of said work forfeited, it is expressly stipulated and understood that such declaration of forfeiture shall not in any manner relieve the contractor for the covenants and conditions of the contract for said work, but the same shall be and remain valid and binding on said contractor.

CONTRACTOR'S DEFAULT.

The said work shall be prosecuted with such force as the Company shall deem adequate to its completion within the

time specified, and if at any time the contractor shall refuse or neglect to prosecute the work with a force sufficient, in the opinion of the said Company, for its completion out in said specified time, or if in any event the contractor shall fail to proceed with the work in accordance with the requirements and conditions of these specifications, the Company shall have full right and authority to take the work out of the hands of the contractor and to employ other workmen to complete the unfinished work, and so deduct the expense thereof from any money that may be due and owing to the contractor, or to relet the same to other contractors.

In case the contractor shall abandon or in any way or manner fail to complete said work in the time herein specified, the Gary Land Company is hereby authorized and empowered to pay to pay any laborer or laborers who have been employed by such contractor upon the above specified work, out of any of the funds due said contractor, any and all sums of money which may be found to be due and owing to such laborers, and without giving any notice whatsoever to said contractor of the intention so to do. And in every such case the Treasurer is hereby authorized and empowered to ascertain the amounts so due and owing to any such laborer or laborers, from said contractor in such manner, and upon such proof as he may deem sufficient, and without giving any notice of such proceedings to said contractor; and the amounts so found by him to be due and owing to such

laborers shall be final and conclusive as between said contractor, and may thereafter be paid over by said Gary Land Company to such laborers.

LABOR CLAIMS .

The Company reserves the right to refuse to issue a voucher and to direct that no payment shall be made to the contractor in case it has reason to believe that the said contractor has neglected or failed to pay any sub-contractor, workman, or employe for work performed on or about any of the sewers included in these specifications, until said Company is satisfied that such sub-contractor, workman, or employe is fully paid. After full completion of the work to the satisfaction of the Company, it reserves the right, to refuse a payment of 15% reserve, or any amount due said contractor, until it is satisfied that all sub-contractors, workmen and employes of said contractor have been fully paid. The failure of the Company to follow the above provision in regard to unpaid sub-contractors, workmen or employes shall in no wise affect the liability of the contractor or his sureties, to the city or to the persons who are or who may have been in his employ.

MANNER OF PAYMENT.

If the rate of progress shall be satisfactory to the Company and when it shall appear that all claims for labor as aforesaid shall have been satisfied, vouchers will be issued to said contractor during the making of said improvements for 85%

of the value of the work done in place, at the time of issuing such estimates, and vouchers for the balance or remainder will be issued upon the final completion and acceptance of the work.

TIME FOR COMPLETION OF WORK.

The work to be performed under these specifications shall be commenced within 15 days after the time of signing contract for same and shall be completed on or before..... and the said time specified for completion of the work is an essential condition of this contract. Provided, however, that if the contractor is delayed by the Company in the commencement of the work, or in case the work is suspended by order of the Company, then the time of such delay or suspension shall be added to the time for completion of this contract. After the date specified for the completion of this contract, the Company shall have the rights to issue permits to any person to make connections with the sewer herein provided for, although the work may not have been fully completed and accepted; and the issuance of any such permits shall not entitle the contractor to any additional allowance, or relieve him from any responsibility.

ASSIGNMENT PROHIBITED.

No part of the work herein specified shall be assigned or sub-contracted without the written consent of the Company and in no case shall such consent relieve the contractor from the obligations herein entered into by him, or change the terms of this agreement.

USE OF VACANT LOTS.

The contractor will not be allowed to occupy or use any vacant lots as a depository for stone, sand, gravel or other material without written permission of the owner or agent of the land, a copy of which shall be filed with the Company.

R A I L R O A D S .

All railroads not required to be taken up must be kept in running order where practicable. No allowance will be made for delays or other damages occasioned by the necessity of keeping the railroads in constant running order, or for removing or replacing the same when it is necessary to do so.

E M P L O Y E E S .

The contractor shall employ capable superintendents or foremen to represent him on the work, and they shall receive and obey orders from the Engineers. The Company shall have the authority to order the dismissal of any employe on the work who refuses or neglects to obey any of its instructions relating to the carrying out of the provisions and intent of these specifications, or who is incompetent, unfaithful, abusive, threatening, or disorderly in his conduct, and such person shall not be again employed on the work.

SWORN STATEMENTS REQUIRED.

No final estimate nor final payment will be made herein by the Company, or any of its officers or agents, until the contractor shall deliver to the Company a statement in writing setting out fully the amount, kind and quality of the several

materials delivered upon, used and incorporated in the work herein required to be done; said statement to be sworn to by said contractor before a notary public or other officer authorized to administer oath; and it is further agreed that the Company shall have a reasonable time in which to verify the accuracy of such sworn statement before such estimate or final payment is made.

ACCEPTANCE OR REJECTION OF BIDS.

No bids will be accepted from any persons or firm who may be in arrears to the County of Lake, upon debt or contract, or who may be in default as surety or otherwise, upon any obligation to said County, or behind specified time on any previous work. Companies or firms bidding for the work herein described must state in the proposals the individual names and places of residence of the persons comprising such company or firm.

The Company expressly reserves the right to reject any or all bids, or to accept bids separately as to any part of the work, or to accept any bid in the aggregate.

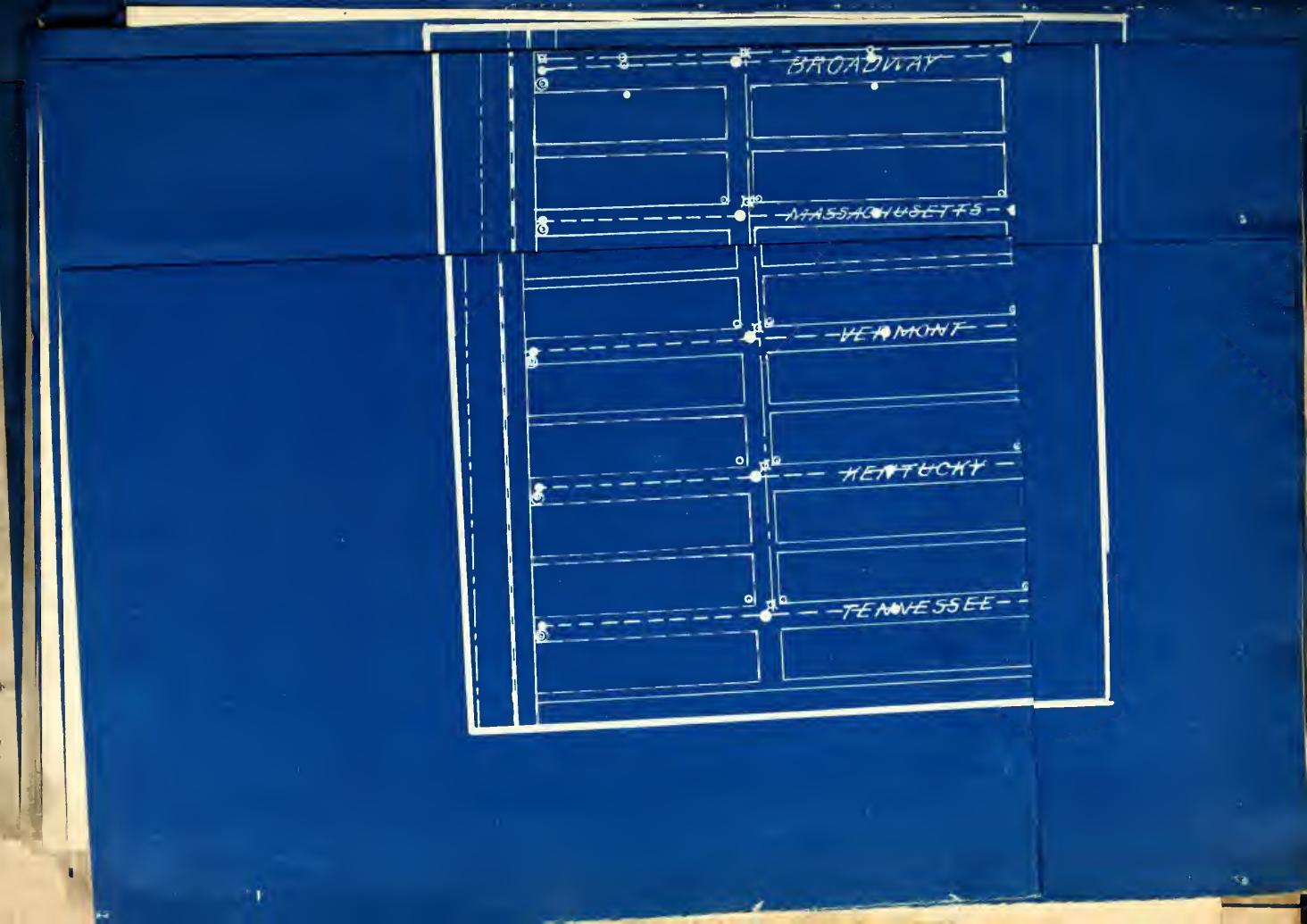
The undersigned hereby certifies that he has read the foregoing specifications, and that his proposal for the work is based on the conditions and requirements embodied therein, and should the contract be awarded to him he agrees to execute the work in strict accordance herewith.

Name .....

Residence .....

Name .....

Residence .....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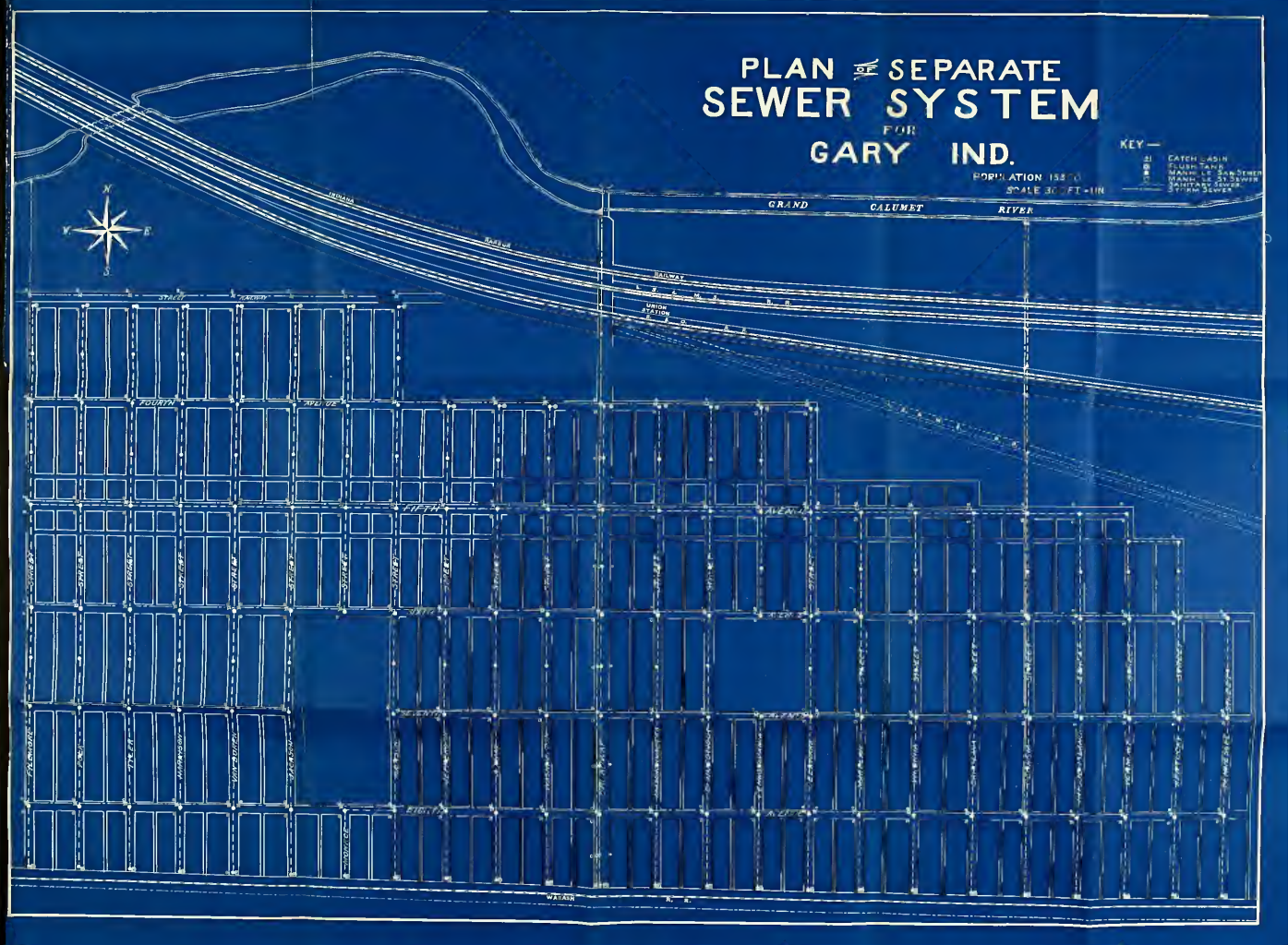
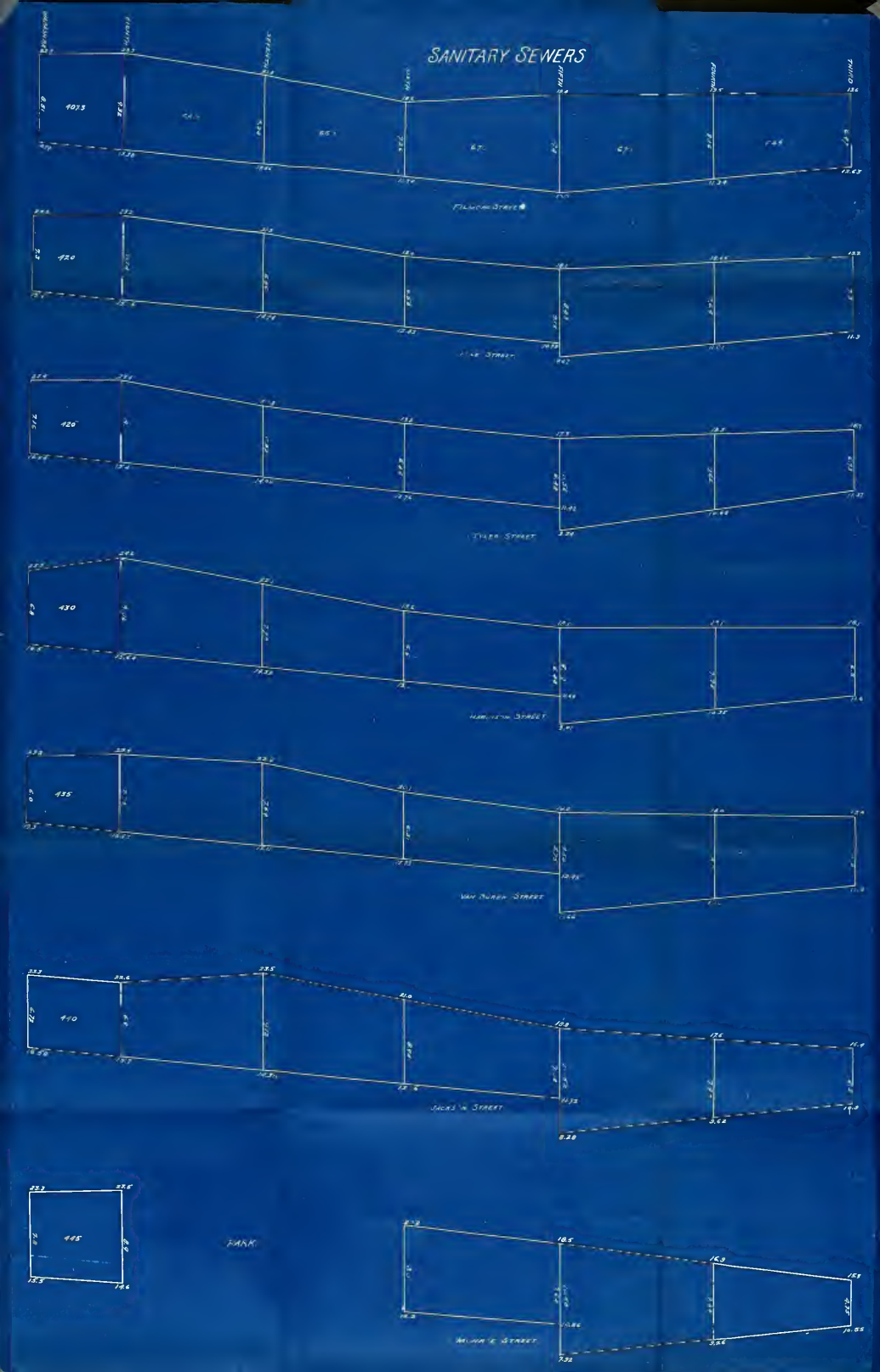
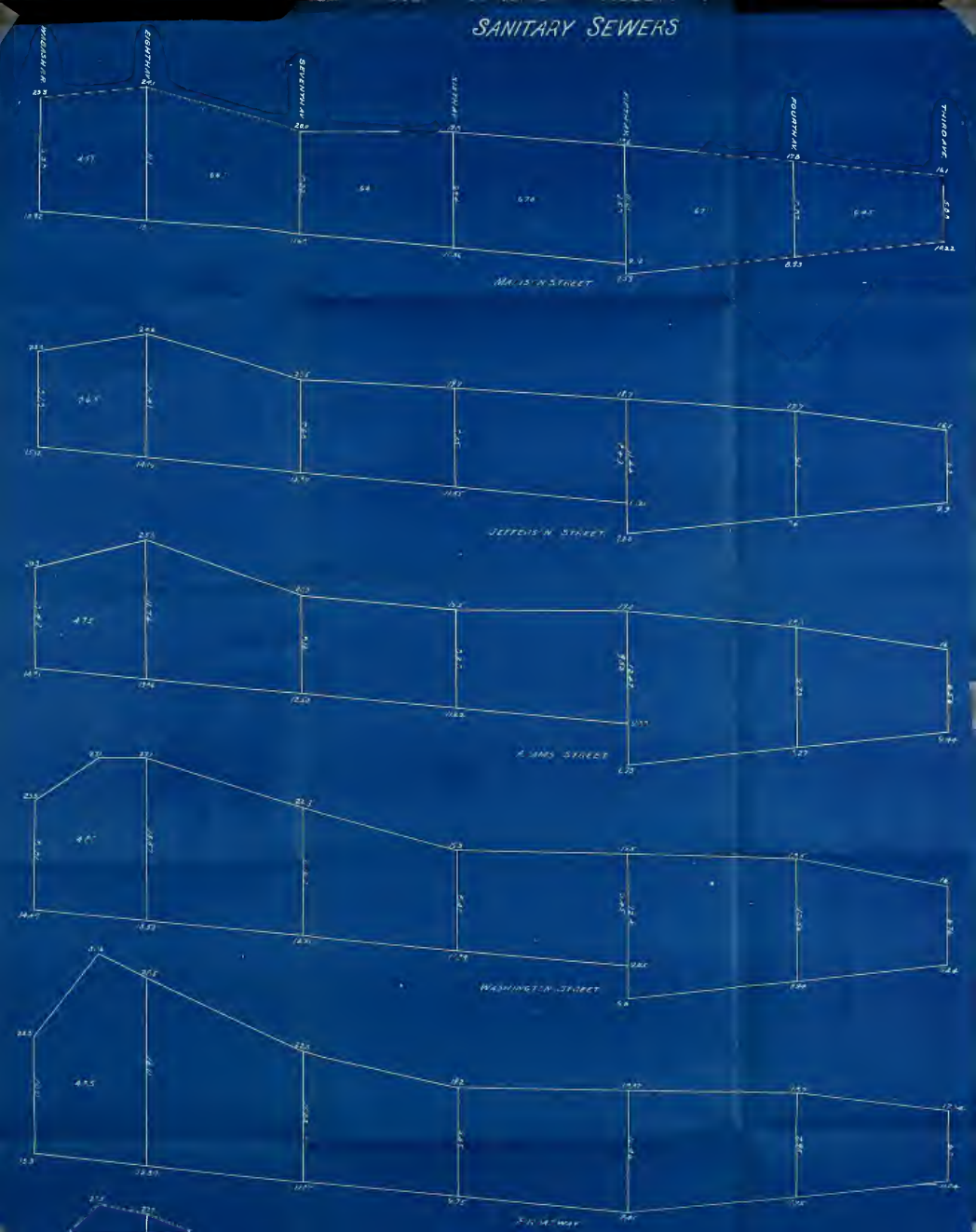
MASSACHUSETTS
VERMONT
KENTUCKY
TENNESSEE


PLAN OF SEPARATE
SEWER SYSTEM
FOR
GARY IND.
POPULATION 15000
SCALE 300 FT. = 1 IN.
KEY—
CATCH BASIN
FLUSH TANK
MANHOLE SAN. SEWER
MANHOLE ST. SEWER
SANITARY SEWER
STORM SEWER
GRAND CALUMET RIVER
INDIANA HARBOR RAILWAY
UNION STATION
FOURTH AVENUE
FIFTH AVENUE
WABASH R. R.

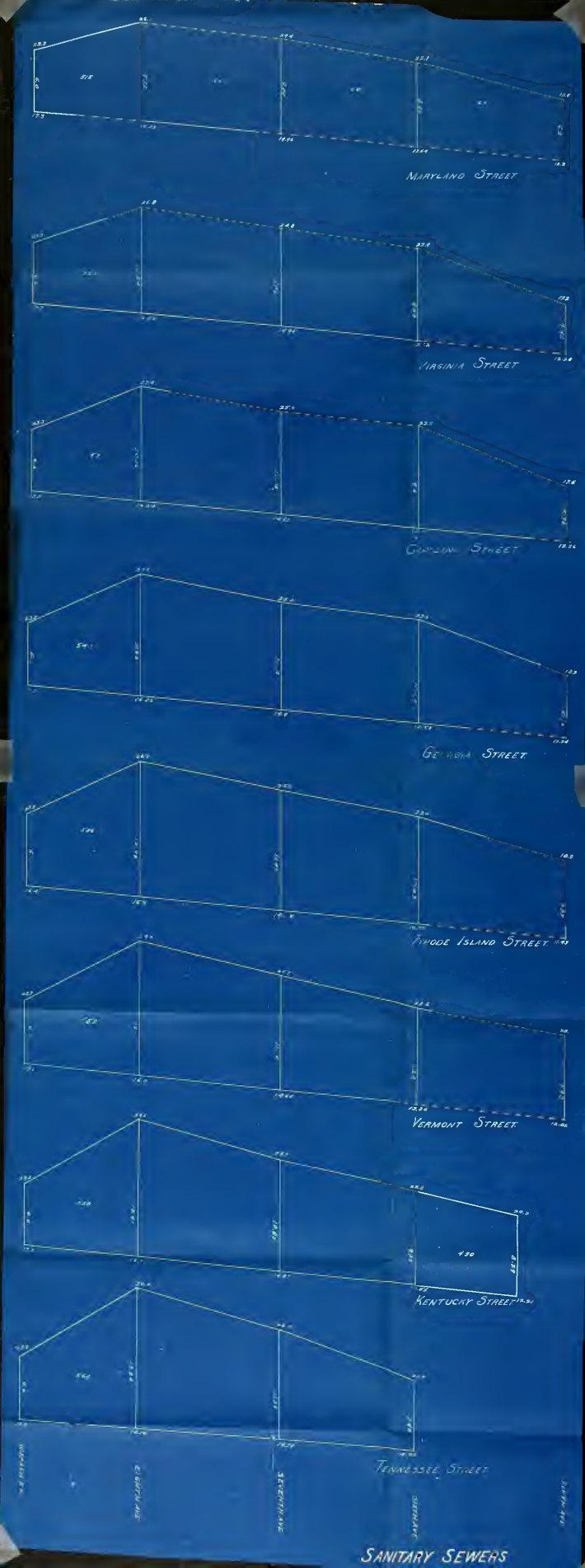

SANITARY SEWERS
Fillmore Street
Tyler Street
Harrison Street
Van Buren Street
Jacks'n Street
PARK
Wilmot Street

SANITARY SEWERS

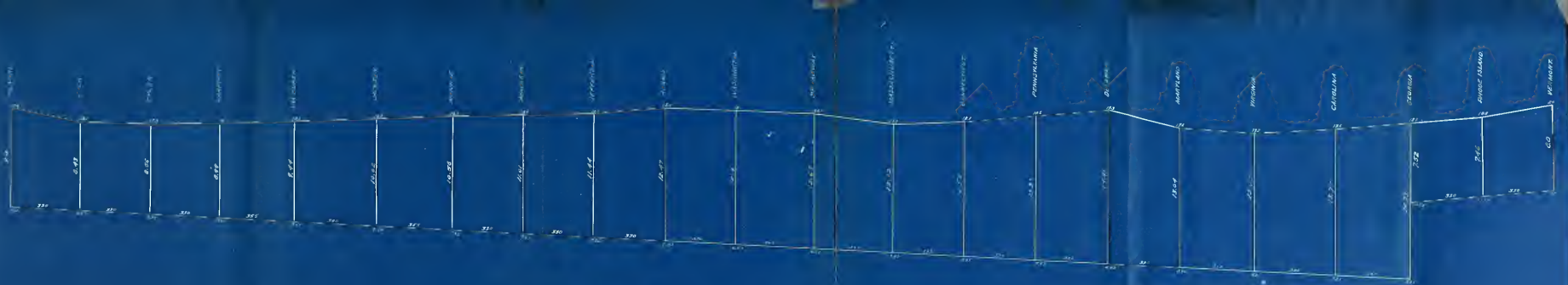


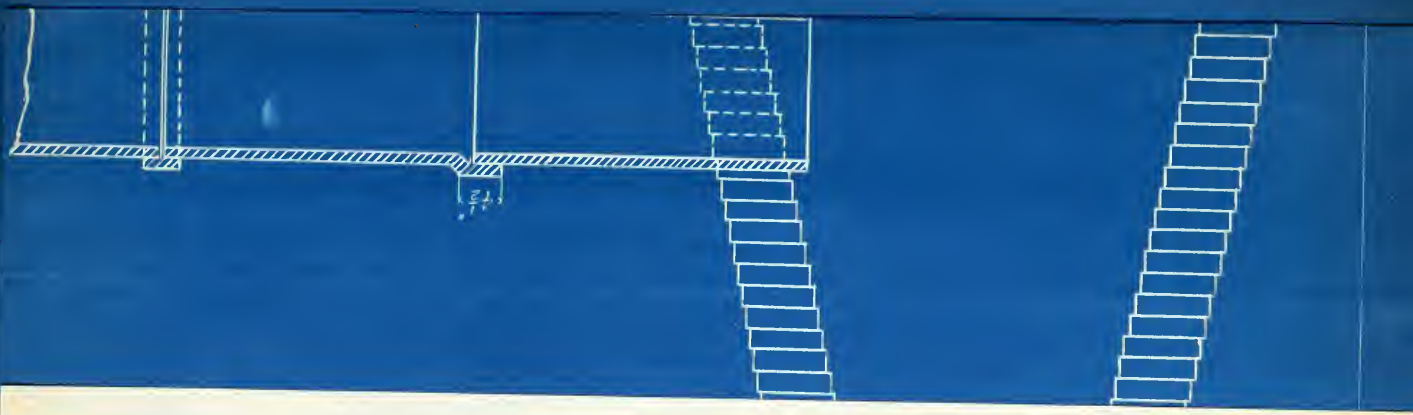

WASHINGTON STREET
RAILWAY
MASSACHUSETTS STREET
CONNECTICUT ST
PENNSYLVANIA STREET
DELAWARE STREET

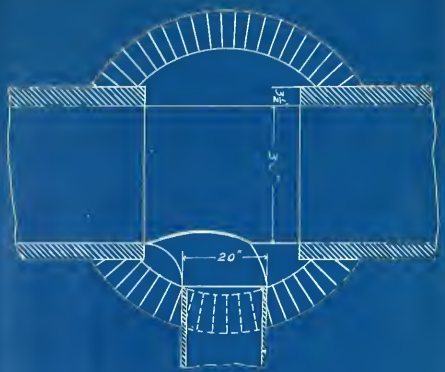
EIGHTH AVE.
13.0
16.0
16.6
552
6.2
17.1
17.3
WABASH R.R.

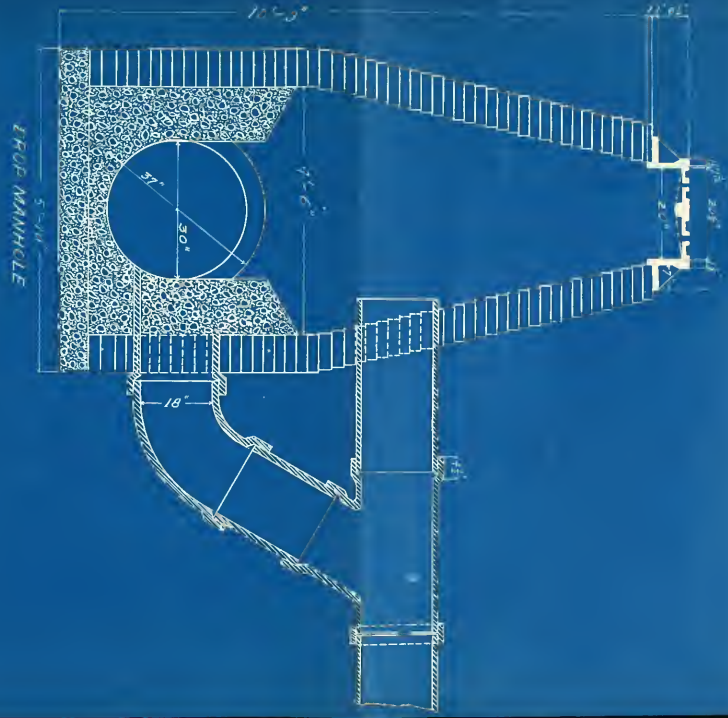

MARYLAND STREET
VIRGINIA STREET
GEORGIA STREET
RHODE ISLAND STREET
VERMONT STREET
KENTUCKY STREET
TENNESSEE STREET
SANITARY SEWERS


13.04
MARYLAND
12.97
VIRGINIA

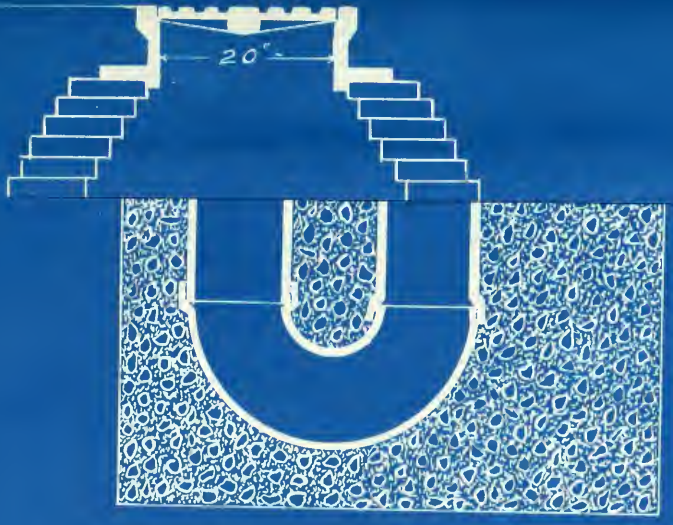

FIFTH AVENUE - SANITARY SEWER - Intercepting



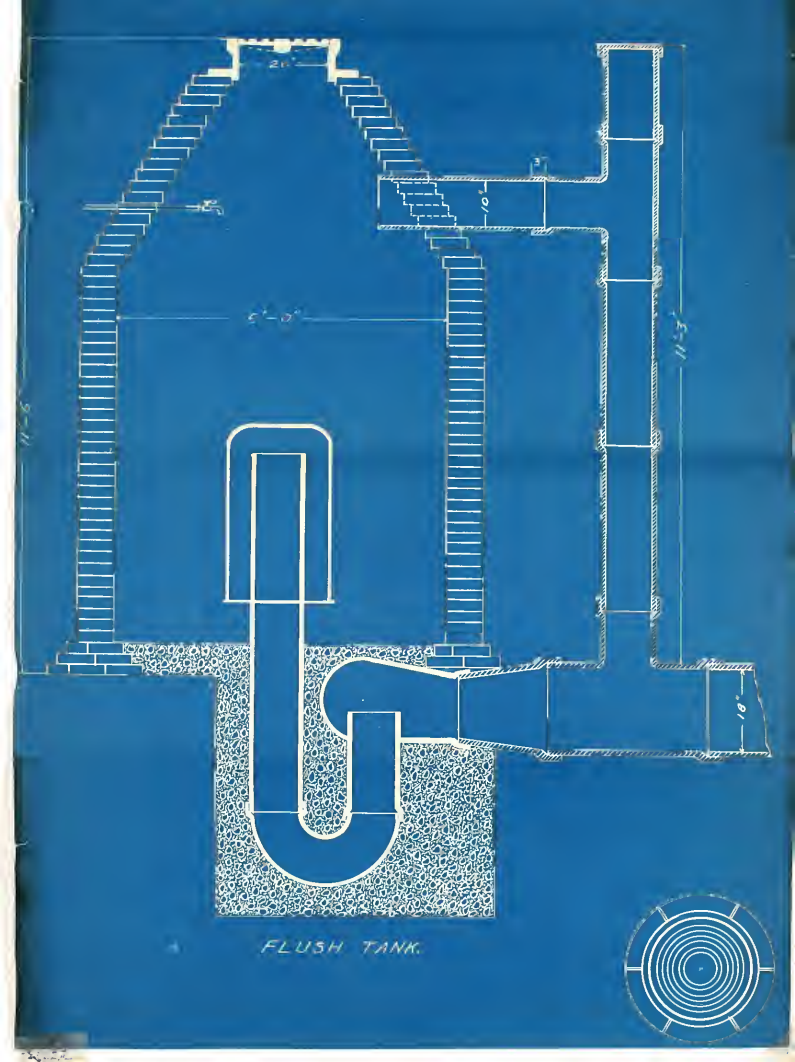




Standard Manhole Cone



FLUSH TANK.



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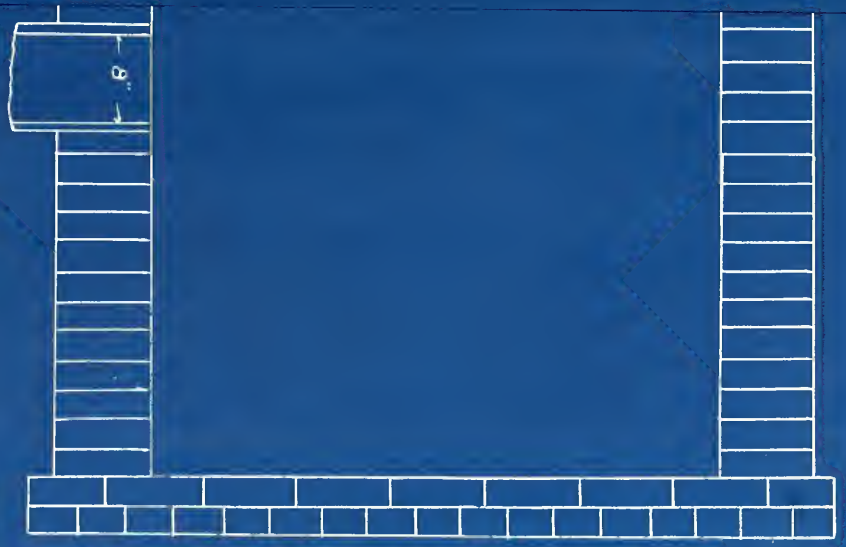
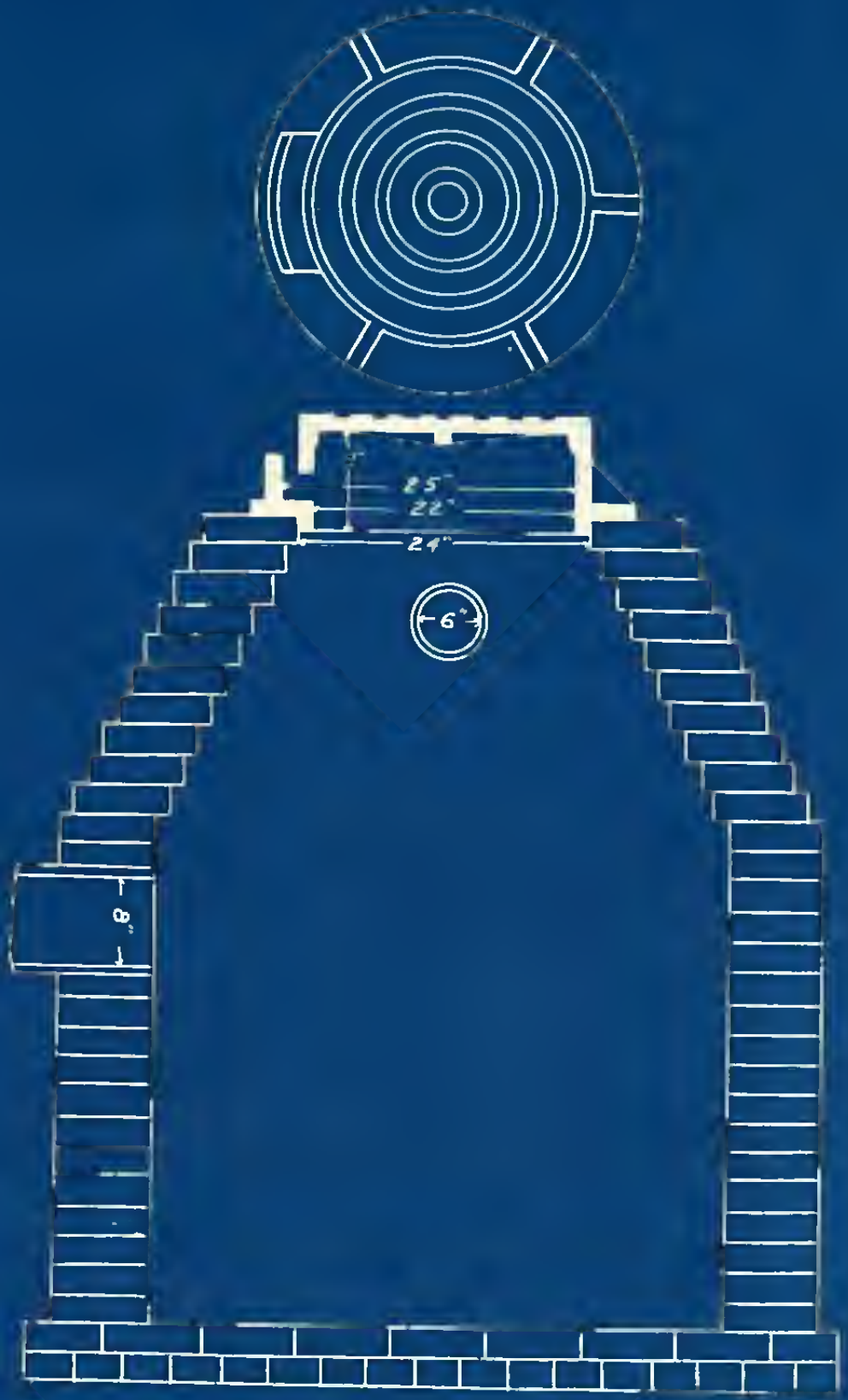
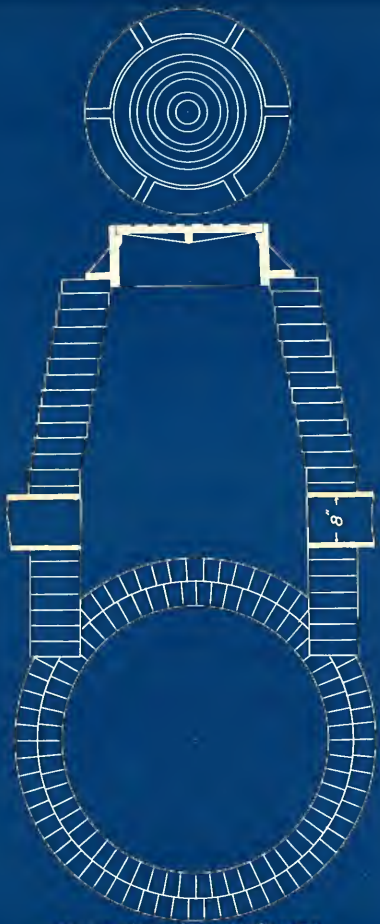


CATCH-BASIN STORM SEWER.



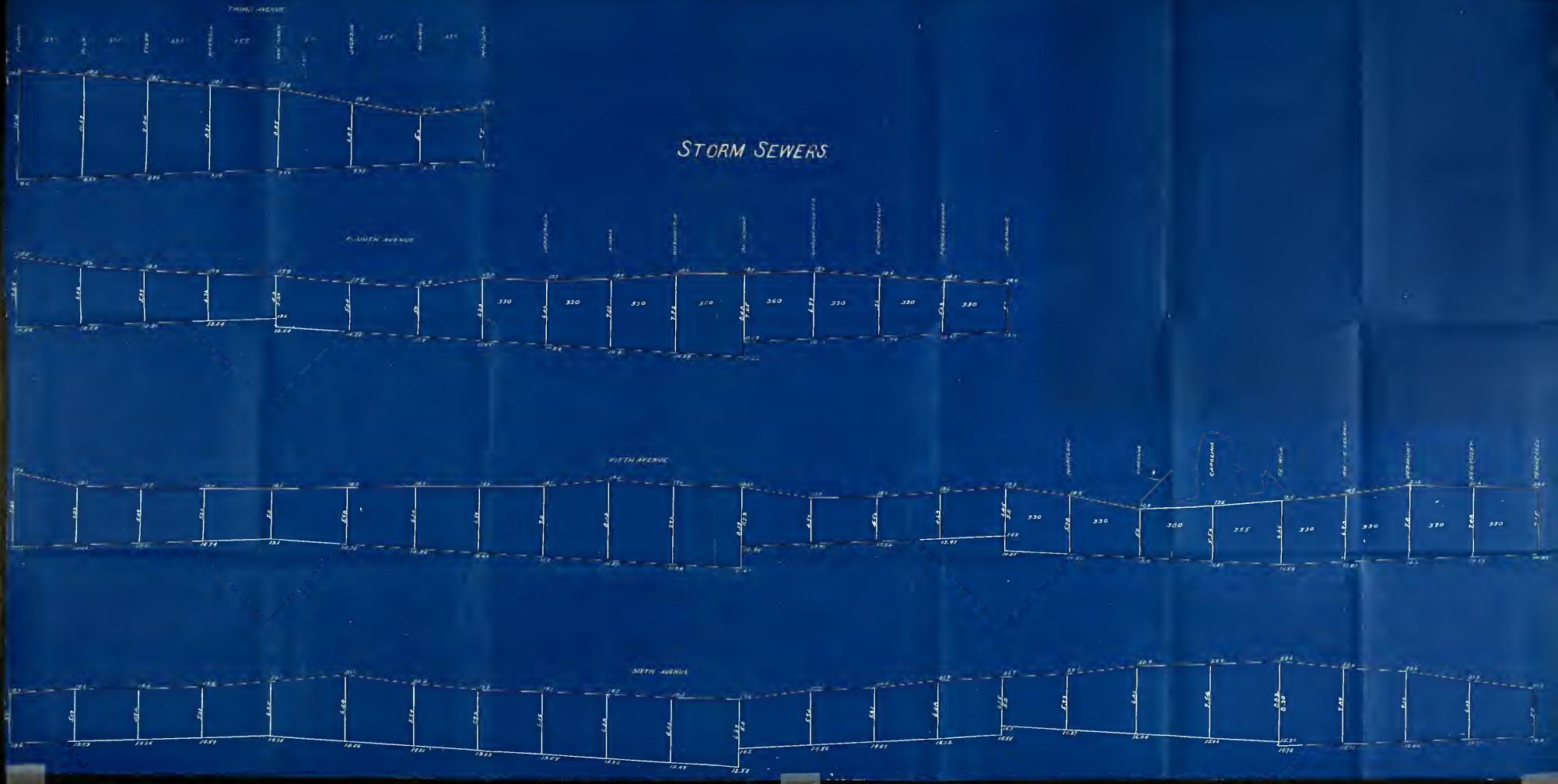
CATCH-BASIN STORM SEWER.



Manhole – Storm Sewer.


12.2
12.52
12.85
22.6
21.3
21.8
21.0
7.16
6.03
5.0
7.22
15.44
15.77
16.0

STORM SEWERS



2650	11	166	2
2510	9	168	2
2520	9	168	2
2945	9	170	2
2730	9	174	2
2215	9	174	2
2210	9	170	2
2250	8	130	3
2300	9	172	2
1575	7	138	1
1600	7	138	1
1710	7	140	1
1820	7	142	1
1980	7	142	1
1880	8	144	1
1758	8	130	1
1360	6	114	1
232	0	0	0
230	0	0	0
214	0	0	0
215	0	0	0
367	2	20	0
3760	11	218	0
3590	9	147	0
2325	7	0	0

TABLE OF APPROXIMATE COSTS.

	SANITARY SEWER			STORM SEWER			
	Amount	Price	Cost		Amount	Price	Cost.
Excavation	61286 Cu.Yd.	[illegible] per Cu.Yd.	$68391.50	Excavation	[illegible] Cu.Yd.	[illegible] per Cu.Yd.	$64541.80
Sheeting	1700000' b.m.	[illegible] per lin.ft.	$29534.00	Sheeting	[illegible] b.m.	[illegible] lin.ft.	$19493.00
Bk Filling	49023 Cu.Yd.	15¢ per Cu.Yd.	$7354.50	Bk Filling	[illegible] Cu.Yd.	15¢ per Cu.Yd.	$6615.00
8" Pipe	35050 lengths	52¢ per length	$18226.00	30" Pipe	[illegible] lengths	[illegible] per length	$55512.00
15" "	1662 lngths	$1.20 " "	$1994.50	Brick	[illegible]	$[illegible] per ft.	$106835.00
18" "	2203 "	$1.40 " "	$3084.20	Mortar	[illegible] Cu.ft.		
8" Y-Brchs	3810	55¢ " "	$2095.50	Manholes	145	$4[illegible] per M.H.	$5960.00
15" "	218	$1.25 " "	$272.50	Catch Basin	240	$[illegible] " C.B.	$4320.00
18" "	147	$1.50 " "	$220.50	Joints (30" Pipe)	[illegible]	Included in	Cost of Pipe.
Joints	38860	Included in	Cost of Pipe.	C.I. Pipe	[illegible] ft.	$[illegible]	$2800.00
Manholes	242	$40 per M.H.	$3680.00	Total	Sanitary Sewer	$1.85 per ft.	$143376.20
Flsh Tanks	42	$[illegible] Tank	$2520.00	"	Storm Sewer	$5.19 " "	$266676.80

Above Table Includes Cost of Labor.

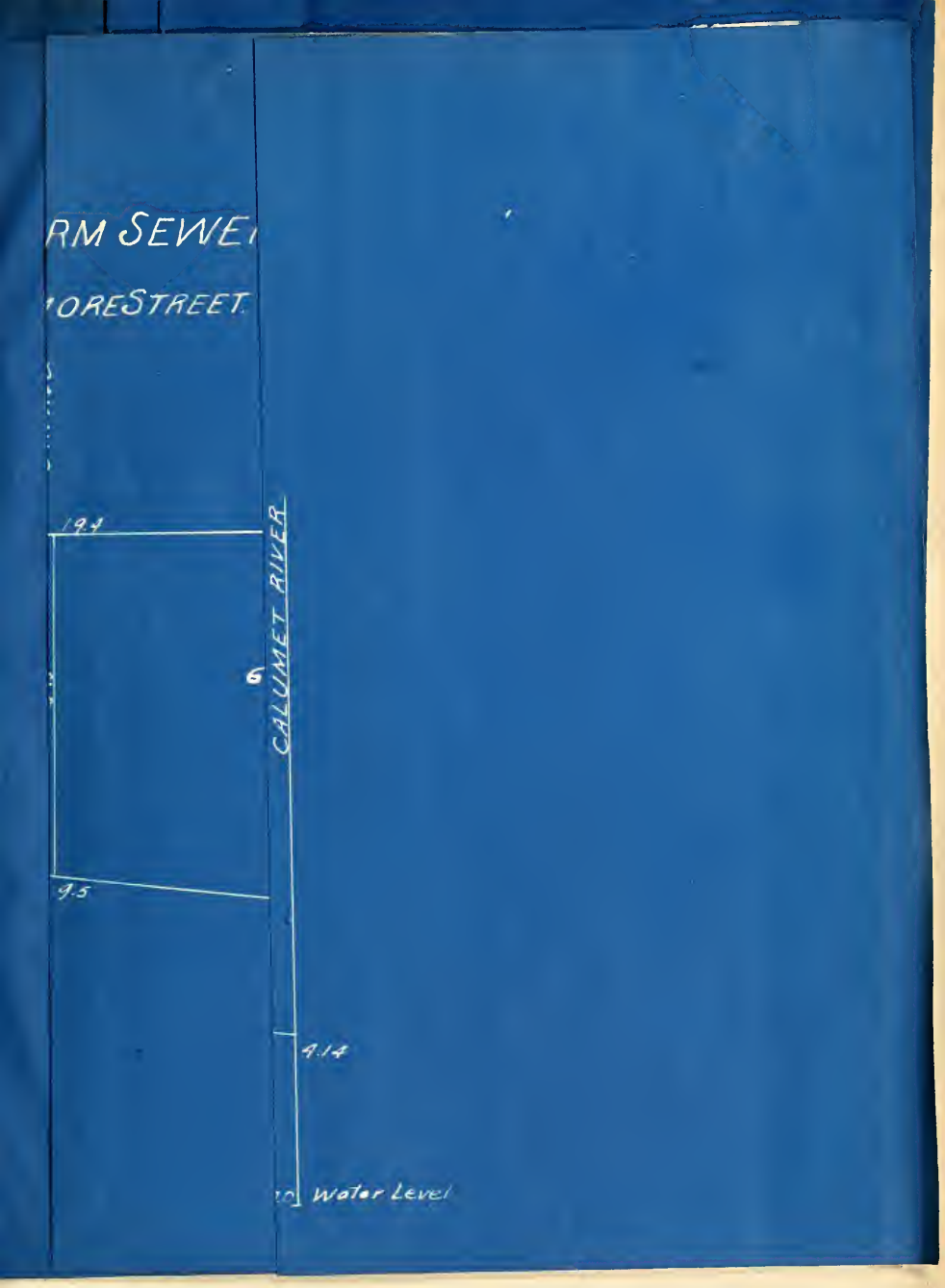
DATA FOR STORM SEWERS

STREET	FROM	To	Net Area Sq.Ft.	Sewage Cu.Ft./sec	Grade	Size	Length	Width Trench	Aver. M.H. Depth	Excav'n Cu.Yds.	No. M.H.	No. Catch Basins
Third	Madison	Harrison	456600	16	.001	30"	1345	3'-6"	5.88'	1330	4	4
"	Harrison	Filmore	"	"	"	3'	995	4'-6"	5.56	1720	3	3
Fourth	Van Buren	"	"	"	"	2'-6"	1345	3'-6"	5.54		4	8
"	"	Jefferson	"	"	"	"	1395	"	5.59		4	8
"	Delaware	Broadway	"	"	"	"	1350	"	6.18		4	4
(Totals)						"	4090	"	5.88	3140		
Fourth	Jefferson	Broadway	913200	28	"	3'-6"	1020	5'	7.48	1510	3	3
Fifth	Van Buren	Filmore	456600	16	"	2'-6"	1345	3'-6"	5.88		4	8
"	"	Jefferson	"	"	"	"	1395	"	6.06		4	8
"	Delaware	Broadway	"	"	"	"	1350	"	4.94		4	8
"	"	Georgia	"	"	"	"	1395	"	5.92		6	12
(Totals)						"	5485	"	5.7	4270		
Fifth	Tennessee	Georgia	260000	8	"	2'	1320	3'	7.2	1056	—	—
"	Jefferson	Broadway	913200	28	"	3'-6"	1020	5'	7.79	1510	3	6
Sixth	Van Buren	Filmore	456600	16	"	2'-6"	1345	3'-6"	5.54		4	8
"	"	Jefferson	"	"	"	"	1395	"	6.09		4	8
"	Delaware	Broadway	"	"	"	"	1350	"	5.68		4	8
"	"	Georgia	"	"	"	"	1395	"	6.79		4	8
(Totals)						"	5485	"	5.94	4270		
Sixth	Tennessee	Georgia	570750	20	"	3'	1320	4'-6"	6.88	1516	4	8
"	Jefferson	Broadway	913200	28	"	3'-6"	1020	5'	6.38	1325	3	6
Seventh	Van Buren	Filmore	456600	16	"	2'-6"	1725	3'-6"	5.85		5	10
"	"	Jefferson	"	"	"	"	710	"	585		1	2
"	Delaware	Broadway	"	"	"	"	1350	"	4.9		4	8
"	"	Georgia	"	"	"	"	1420	"	6.54		4	8
(Totals)					"	"	5205	"	5.78	3817		
Seventh	Tennessee	Georgia	570750	20	"	3'	1320	4'-6"	7.58	1663	4	8
"	Jefferson	Broadway	913200	28	"	3'-6"	1020	5'	7.08	1370	3	6
Eighth	Van Buren	Filmore	456600	16	"	2'-6"	1325	3'-6"	5.29		4	8
"	"	Jefferson	"	"	"	"	1395	"	6.2		4	8
"	Delaware	Broadway	"	"	"	"	1350	"	5.88		4	8
"	"	Georgia	"	"	"	"	1420	"	6.53		4	8
(Totals)					"	"	5485	"	5.97	4270		
Eighth	Tennessee	Georgia	570750	20	"	3'	1320	4'-6"	8.5	1970	4	8
"	Jefferson	Broadway	913200	28	"	3'-6"	1020	5'	10.37	1958	3	6
Filmore	8th	7th	456600	16	"	2'-6"	660	3'-6"	9.6	855	2	2
"	7 "	6 "	913200	32	"	3'-6"	"	5'	8.75	1221	2	2
"	6 "	5 "	1369800	48	"	4'	670	5'-6"	8.8	1362	2	2
"	5 "	4 "	1826400	64	"	4'-6"	"	6'	10.62	1785	2	2
"	4 "	3rd	2283000	80	"	5'	660	6'-6"	12.1	2290	2	2
"	3rd	Col. River	2680000	96	"	5'-6"	812	7'	13	3145	2	2
Broadway	8th	7th	1255650	44	"	4'	660	5'-6"	16.5	2420	4	4
"	7 "	6 "	2511300	88	"	5'	660	6'-6"	11.37	2075	2	4
"	6 "	5 "	3766950	132	"	6'	670	7'-6"	10.3	2235	2	4
"	5 "	4 "	5022600	176	"	6'-6"	"	8'	10.75	2300	2	4
"	4 "	Col. River	6250000	220	"	7'-6"	1260	9'	10	5040	5	4
Georgia	8 "	7th	1027350	36	"	4'	660	5'-6"	15.02	2120	2	2
"	7 "	6 "	2054700	72	"	5'	"	6'-6"	13.47	2370	2	2
"	6 "	5 "	2800000	108	"	5'-6"	670	7'	10.65	2080	2	2
"	5 "	Col. River	3550000	135	"	6'	1930	7'-6"	8.4	5370	6	2

DATA FOR SANITARY SEWER

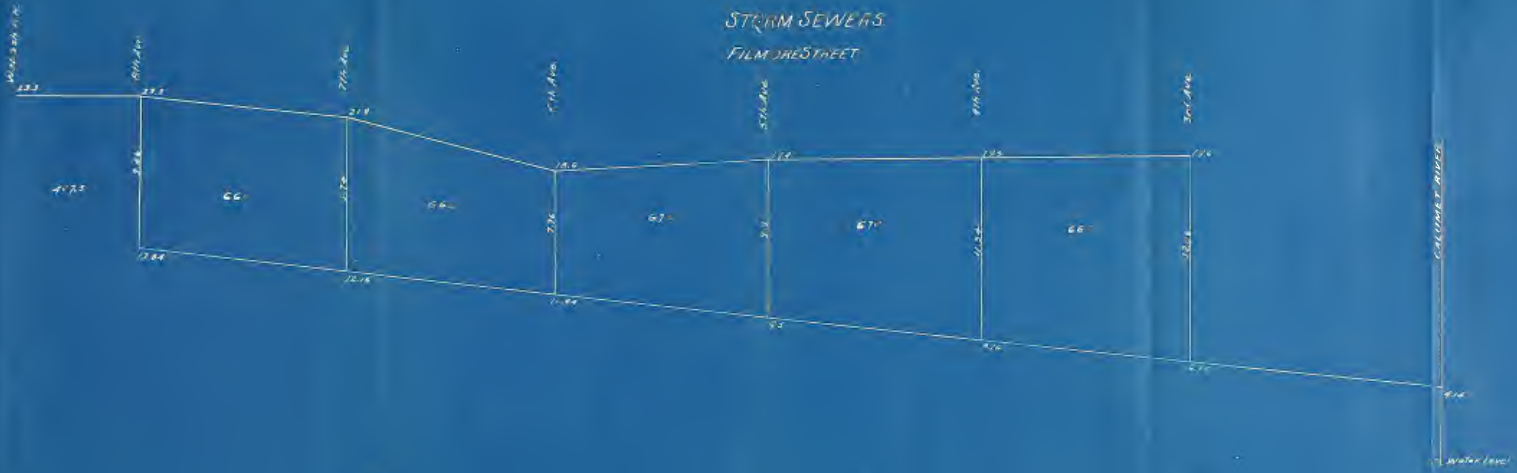
STREET	From	To	Area Acres.	Pop'l'n.	Sewage Gal. Daily	Grade	Size in.	Length	Width Trench	Aver. M.H. Depth	Excavat'n Cu.Yd.	No. Manholes	No. "Y" Brchs	No. Flush Tanks
Filmore	Wabash RR	3rd.	12.25	226	39725.0	.002	8	3712	24"	8.27'	2337	11	102	2
Polk	"	"	25.5	453	79550	.002	"	3725	"	7.38'	2073	11	204	2
Tyler	"	"	"	"	"	"	"	3730	"	7.23'	2070	11	204	2
Harrison	"	"	"	"	"	"	"	3735	"	7.5'	2080	11	204	2
Van Buren	"	"	"	"	"	"	"	3740	"	7.11	2070	11	204	2
Jackson	"	"	"	"	"	"	"	3745	"	7.84	2215	11	166	2
Monroe	"	"	16.8	301	52800	"	"	2430	"	7.9	1485	8	126	3
Madison	"	"	25.5	453	79550	"	"	3762	"	9.19	2650	11	166	2
Jefferson	"	4th	20.7	403	70600	"	"	3770	"	8.55	2510	9	168	2
Adams	"	"	"	"	"	"	"	3780	"	9.37	2520	9	168	2
Washington	"	"	"	"	"	"	"	3785	"	10.08	2945	9	170	2
Broadway	"	"	"	"	"	"	"	3790	"	9.72	2750	9	174	2
Massachusetts	"	"	"	"	"	"	"	3150	"	9.26	2215	9	174	2
Connecticut	"	"	"	"	"	"	"	3157	"	8.48	2210	9	170	2
Pennsylvania	"	"	"	"	"	"	"	3165	"	8.25	2250	8	130	3
Delaware	"	"	"	"	"	"	"	3170	"	8.68	2300	9	172	2
Maryland	"	5th	16.8	301	52800	"	"	2505	"	7.96	1575	7	138	1
Virginia	"	"	"	"	"	"	"	2510	"	8.12	1600	7	138	1
Carolina	"	"	"	"	"	"	"	2520	"	8.23	1710	7	140	1
Georgia	"	"	"	"	"	"	"	2530	"	8.79	1820	7	142	1
Rhode Island	"	"	"	"	"	"	"	2536	"	9.77	1990	7	142	1
Vermont	"	"	"	"	"	"	"	2542	"	9.49	1880	8	144	1
Kentucky	"	Alley	"	"	"	"	"	2368	"	9.56	1758	8	130	1
Tennessee	"	6th	12.9	239	41700	"	"	1884	"	9.64	1360	6	114	1
Eighth	Monroe	Madison	3.2	60	10500	.001	"	330	"	9.14	232	0	0	0
Seventh	Penna	Delaware	8.1	150	26250	"	"	330	"	9.07	230	0	0	0
Sixth	Tennessee	Kentucky	12.9	239	41700	"	"	330	"	8.37	214	0	0	0
Alley	Kentucky	Vermont	16.8	301	52800	"	"	330	"	8.4	215	0	0	0
Fifth	Georgia	Vermont	2.7	50	8750	"	"	660	"	7.1	367	2	20	0
Fifth	Filmore	Broadway	244.2	4454	840162.5	"	15	3760	30	10.45	3760	11	218	0
Fifth	Broadway	Georgia	478.2	10815	1524550	"	18	2770	"	13.28	3530	9	147	0
Outlet (Georgia)	5th	Col. River	725	15300	2500000	"	"	1930	"	13	2325	7	0	0

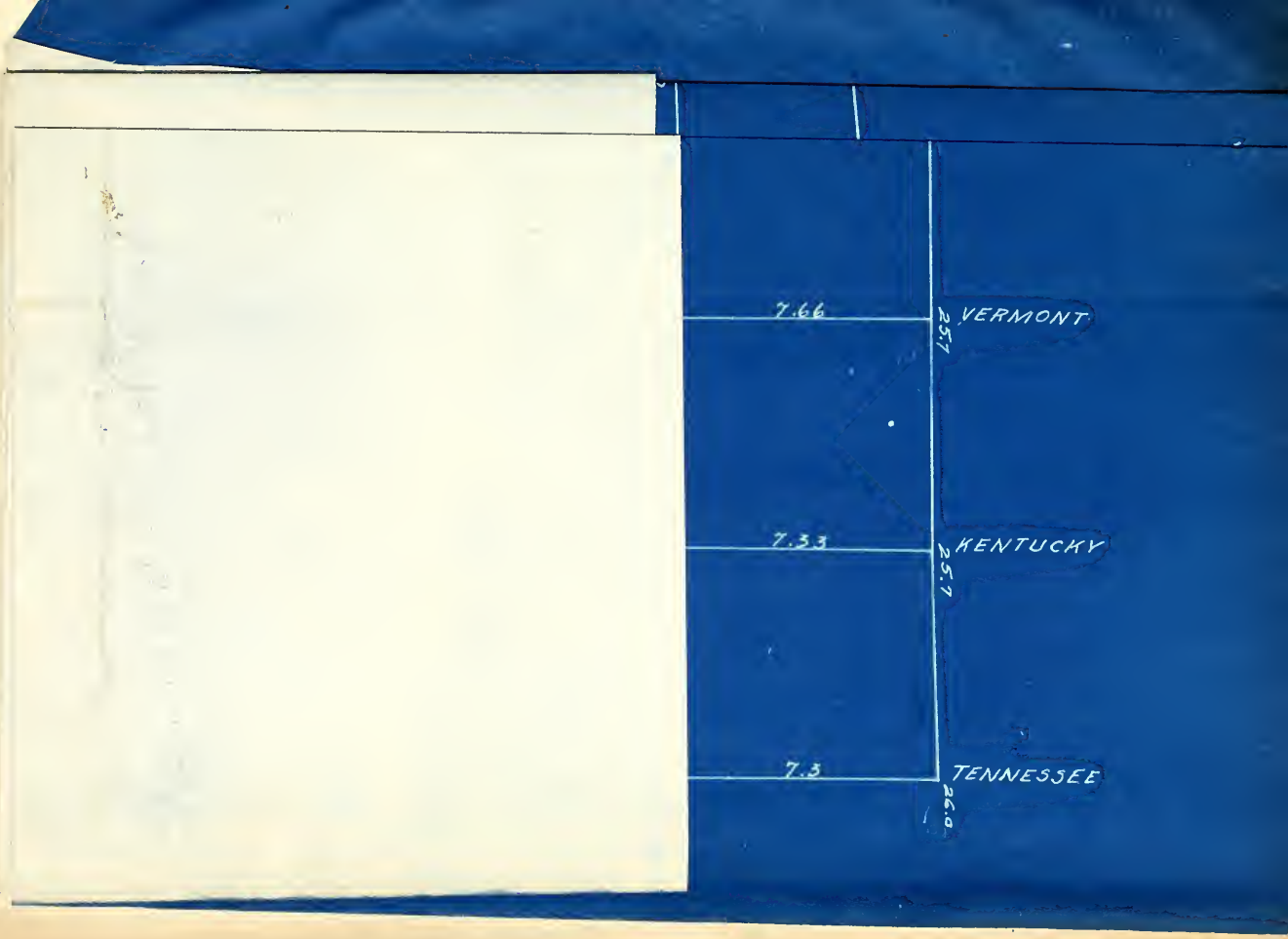
STORM SEWERS.


RM SEWE
ORE STREET.
19.1
6
CALUMET RIVER
9.5
9.14
Water Level

STORM SEWERS

FILMORE STREET

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25.7
VERMONT
7.33
25.7
KENTUCKY
7.3
26.0
TENNESSEE


STORM SEWERS
FILLMORE
POLK
TYLER
HARRISON
VAN BUREN
JACKSON
MONROE
PARK
MADISON
JEFFERSON
ADAMS
WASHINGTON
CHINAMEHAT
MASSACHUSETTS
CONNECTICUT
PENNSYLVANIA
SEVENTH AVENUE
EIGHTH AVENUE

STORM SEWERS