



WATER & SEWER DESIGN MANUAL

(SECOND EDITION)

2011



Water Department
Design Branch

CITY OF PHILADELPHIA WATER DEPARTMENT DESIGN BRANCH

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Introduction



Introduction

The objective of the Water and Sewer Design Manual is to promote uniformity in the presentation of Plans by establishing a general format and outlining detailed information which is required for the preparation of complete water and sewer contract drawings. This combination, in conjunction with high standard of professional drafting technique, will preclude, to the greatest extent possible, any unnecessary work in the preparation of the plans. It will also assist the designer in avoiding errors and omissions which could consequently require extensive alterations and corrections.

The accuracy and completeness of all drawings will enable the Contractor to submit a sound equitable bid for the project and reduce the potential construction conflicts.

It is the intent of this manual to give guidance for the orderly preparation of final construction plans. The methods, procedures and examples are to be followed so as to promote consistency in the preparation of Plans. This manual may be used as a general guideline only. Engineers and design professionals should not solely rely on these guidelines, but must always use their professional judgment in the development of plans and specifications. This manual is not intended nor should it be used in substitution for the judgment of engineering and design professionals. It remains the sole responsibility of the design professional to develop plans which are consistent with all laws and regulations and which are based on sound engineering judgment. Compliance with the guidelines contained in this manual does not assure design acceptance by the Water Department. The Water Department will exercise its best professional judgment, on a case by case basis, in its review of each design application.

The draftsman and/or Engineer will be required to perform a field visit of each block to obtain the physical features as well as acquaint himself/herself with any unusual requirements of the location which may be important in the preparation of the design or specifications for the project.

This document supersedes any previous Water and/or Sewer Design Manuals. In order to provide an overview of the various design steps and the order in which they are performed, enclosed with this document is a project flow chart. The flow chart schematically represents the general process of projects from initiation to completion, for both water & sewer projects.

In order to provide a reference of the type of construction of sewers done at the turn of the century, attached is a copy of the 1907 Sewer Standard Details. These details should be used as a reference to further understand the existing sewer system. These details do not purport to accurately describe or show the exact configuration of any specific sewer, but rather to demonstrate the type of construction used at the time of the construction of many of the sewers we are presently replacing.

All illustrations of lettering, line weight, etc. shown in the appendices and sample drawings are to be used as a template for CAD drawings. All drawings prepared by consultants shall be prepared on a CAD system, unless specifically exempted, and shall be submitted to the Water Department upon design completion.

Section

1

Project Initiation

A. Work Numbers

1. Water & Sewer locations are typically initiated in our Planning and Research section, where water main break histories and sewer examination reports are evaluated. Locations are then grouped together, where appropriate, into contract packages and forwarded to the Design Branch and/or to Engineering consultants.
2. When received by the Design Branch these packages are given a work number (contract number). For locations which require no sewer work, a water work number will be assigned in the W-20000-D series. For a contract which includes sewer work, a number will be assigned in the S-40000-RD series. The prefix signifies whether it is a water only contract (W) or a contract containing sewer work, with or without water work, (S). The suffixes have the following meanings:
 - A - Sewer for New Development (Assessable)
 - B - Sewer to Relieve Unsanitary Conditions (Assessable)
 - C - Water Main Construction (Assessable)
 - D - Distribution System Rehabilitation
 - E - Eastwick Urban Renewal
 - F - Storm Flood Relief Sewer
 - G - Green Infrastructure
 - I - Sewer and/or Water for Industrial Development
 - M - Reinforcing Mains
 - O - Water or Sewer Operations
 - R - Reconstruction of Existing Sewer
 - X - Contracts including Streets Department Paving Items
3. Work numbers will be assigned only by the Design Branch front office staff.
4. Work numbers should be used on all correspondence or other material related to that particular project or contract.

B. Service Information

1. Once the work number is assigned, the service information is obtained for contracts with water main relay work. The service list is obtained from our billing records, and not from an actual field survey. These records are based on billing addresses, therefore the actual location of the service pipe shall be verified in the field by the designer. Additional service information, if required, may be requested from the Customer Service Unit at 29th and Cambria Sts.
2. For projects done by consultants, the service lists from our billing records will be ordered by the Water Department and forwarded to the consultant.

C. Utility Information

1. Once the work number is assigned the front office staff orders the utility information using the “one call” system. In addition the City Plan and Highway Supervisor’s plans are obtained from the Streets Department. All the utility information is compiled into “utility bags”. Upon receipt of all the requested information the “utility bag” is forwarded to the Drafting and Technical Pool to begin the base plan(s).
2. The City Plan contains the official curblineline and houseline footprint of a given location. This will be used as the footprint of the base plan and confirmed during the field visit.
3. The utility information obtained from the individual utilities shall be placed on the base plan. The Highway Supervisor’s plan should not be used for that purpose, but rather as supplementary information.
4. For projects done by consultants all this information will be ordered and obtained by the consultant.

Section

2

Water Contract Drawings

A. Drawing Size

1. Sheet - 36" x 24"
2. Inside Border 34" x 23" (1-1/2" from left, 1/2" from top, bottom, right) (See Appendix Ia)
3. Title Block - 9" x 5" located in lower right hand corner (See Appendix Ic.).

B. Materials

1. Final Drawing shall be on mylar, with an erasable ink.
2. Mylar shall be .004 inch thick polyester base, sensitized and matted on both sides.

C. Drafting

1. Scales
 - a) Plan - 1" = 20' except as otherwise specifically approved.
 - b) On new construction, where 1" = 30' scale can reduce the number of sheets, it may be used, with the approval of the Water-Sewer Design Section supervisor.
 - c) Cross Sections - 1/4" = 1'-0" or as otherwise appropriate
 - d) Profile (where required) –Horizontal: 1" = 20' (or match plan)
Vertical: 1" = 5'
2. Lettering
 - a) All text size and style shall conform to the examples shown in Appendix IIb.
 - b) Title block information shall be as shown on Appendix Ic.
 - c) Existing utilities shall be indicated using upper and lower case lettering and shall be slanted.
 - d) All streets shall be kept clear of notes as much as possible. The name of the main street shall be placed along the top of the sheet. No abbreviations shall be used on the main street.
 - e) The words street, road, avenue, etc., should be spelled out on main streets and abbreviated on intersecting streets.
 - f) Lettering shall be oriented as shown in Appendix IIb.
 - g) For Private Cost Contracts, the words "PRIVATE COST" in a 0.24" arial font shall be placed above the title block.
3. Line Weight (in descending order of line weight)
 - a) Proposed water main
 - b) House lines, Right-of-way lines
 - c) Curblines, property line
 - d) Utilities
 - e) Leaders
4. Symbols and Abbreviations
 - a) Symbols and abbreviations shown in Appendix IIa shall be used.
 - b) Any other symbols and abbreviations shall be defined on the Contract Drawings.
5. Drawing Orientation
 - a) When part of a joint sewer and water reconstruction contract, water drawing to be oriented same as sewer drawing.
 - b) When separate water relay contract, north shall be up in reference to a horizontal line.
6. Cross Sections
 - a) All water drawings shall contain a typical cross section. Drawings shall contain more than one cross section if the underground structures or utilities change substantially such as under a bridge.
 - b) On a joint sewer and water reconstruction contract, the water cross sections shall match those of the sewer drawings.
 - c) On a separate water relay contract, all cross-sections on a given street shall be taken in the same direction.

D. Water Base Plan Information

1. City Plan Information

- a) Houseline distance and angles, street and Right-of-way widths, name of street and state route number if state highway (see Appendix VI for a list of state highways and their accompanying state route numbers).
 - b) City Plan Elevations shall be shown on assessable Contracts.
 - c) Street Status - Legally open or not legally open; at grade or not at grade, only label if not legally open or not at grade.
 - d) Cartway and footway widths shall be dimensioned.
2. Pertinent Information
- a) The Consultant's name shall be shown on the base plan to the left of the title block stipulating who prepared the base plan and/or design. The base plan and/or design completion date shall be shown directly beneath the Consultant's name. For consultant's projects the drawing shall be stamped by a registered Professional Engineer in the state of Pennsylvania. If only the base plan or design was prepared by the consultant, the wording should reflect such.
 - b) The words "AUTHORIZED BY ORDINANCE OF COUNCIL" shall be placed above the title block on base plans when the main street has no City water main and one is being proposed.
 - c) The words "PRELIMINARY ASSESSMENT" shall be placed at the bottom center of each sheet, on base plans when the main street has no water main and one is being proposed. For assessable projects, drawings shall be sent to the District Surveyor to obtain the preliminary assessment.
 - d) Miscellaneous information that shall be provided on each plan drawing.
 - 1) Ward number
 - 2) "One Call" Numbers
 - 3) Water Plat Number
 - 4) Highway District Number
 - 5) Survey District Number
 - 6) Ordinance Date (if possible)
 - 7) Preliminary Assessment (if applicable)
 - (e) The drawing's title block should always contain the date that the most recent changes were completed.
3. Plan View Information
- a) Paving Information
 - 1) Existing footway, curb and roadway material shall be fully identified.
 - 2) Driveway, tree wells and wheelchair ramps shall be indicated.
 - 3) Footways, if special pattern (particularly brick), shall be carefully identified.
 - 4) Deteriorated footway shall be noted.
 - b) Traffic Information
 - 1) Direction of traffic along with parking information shall be shown on all streets including intersecting streets. Symbols used shall be as shown on the sample drawings in the Enclosures section.
 - c) Labeling
 - 1) Mains in streets within six (6) inches of City Plan grade or in Right-of-way shall have their depth specified ("cover").
 - 2) Mains in new streets or in streets known to be not at confirmed grade, labeling of the proposed main shall be discussed with the supervisor of the Water & Sewer section.
 - d) Above Ground Features
 - 1) Steps, cellar doors, fire hydrants, parking meters, trees (including diameter), manhole covers, traffic signs and signals, utility poles, and all street furniture (phone booths, mailboxes, benches, etc.) shall be identified as shown in Appendix IIa.
 - 2) If the water main is relayed in the footway, all existing curb stops, sewer vent boxes, and gas valves that fall within the water main trench area shall be shown. (see Appendix IIa).
 - 3) Property lines shall be indicated, along with sufficient street addresses to identify all properties. The address label shall be parallel to street it is related to.
 - 4) All lots not containing structures shall be so labeled (open lot, parking lot, etc.)
 - e) Overhead bridges shall be shown and the elevation of the underside of the bridge shall be indicated on the base plan.
 - f) Match lines shall be shown on base plans when required.
4. Misc. Field Information
- a) The final design and specifications are very dependent on the field investigation, and the information obtained from the field visit. The engineers and/or designers which visit the field location should pay special attention to the visible details of the block which may be useful in later making design decisions. Examples of such items are:

- Condition of paving, signs of paving disruptions due to Water Department infrastructure failures, etc. This information will assist in establishing appropriate paving limits.
 - Evidence of hydrant relocations or damaged or knocked over hydrants. This information will assist in locating new hydrants.
 - Potential construction interferences such as low bridges, tree interference, overhead wires or structures, etc.
 - Condition of homes, are any vacant or collapsing, etc.
 - These are a few examples of the type of information required to properly design a contract.
5. Utility information shall be given as follows:
- a) Each Utility shall be identified in the following order: Water, H.P.F.S., PECO, Sewer, Verizon, Gas, Streets-Traffic, SEPTA, Public Property-Transit, W.U., Cable TV.
 - b) Show all existing water main valves and label with valve numbers, which will be assigned by Water Operations during their review.
 - c) Label existing sewers in ft. and inches if brick, or in inches if RC pipe.
 - d) Each former utility if so identified on manholes or highway supervisor's drawing shall be identified (i.e. Keystone, City Transit, PTC)
 - e) Size (width x height) except sewer which is (height x width).
 - f) Cover to top of conduit
 - g) All information shall be correct at the point identified, if cover varies slightly, the range (min. to max.) may be given. If size changes, if cover varies significantly or if either is relevant to the design where changes occur, they shall be labeled as often as required.
 - h) High voltage electrical conduits shall be separately labeled with voltage and boxed in.
 - i) SEPTA and railroad tracks shall be shown as accurately as possible, but not dimensioned. Their status (active, inactive, paved over) shall be stated.
 - j) Utility lines shall be drawn using the type of line shown in Appendix IIc.
 - k) Sewer inlets shall be accurately shown.
 - l) Utilities other than water and sewer shall be shown as double line when their width is 42" or greater.
 - m) Existing water mains and sewers on a water only contract shall be double lined when 24" and over, except that egg-shaped sewers shall always be double lined. For a water sheet of a sewer contract see "Sewer base plan information" elsewhere in this manual.
 - n) Distance shall be given from curb line.
 - o) Abandoned utilities shall be labeled "abandoned".

E. Proposed Water Main

- 1. Plan View (Contract Plans)
 - a) The proposed water mains shall be located and dimensioned from the centerline of the proposed water main to the nearest curb line.
 - b) All proposed valves and fittings shall be shown. All proposed valves shall be labeled with valve numbers which will be assigned by Water Operations during their review.
 - c) Match lines shall be shown on all Contract Plans, where required.
- 2. Cross Section (Contract Plans)
 - a) The proposed water main shall be shown in the correct location in the cross section. The proposed water main shall be dimensioned from the center line of the proposed main to the curb and identified.
 - b) Where there is a railroad bridge shown on the base plan, a cross section of the railroad bridge with underside elevations showing the proposed water main shall be shown. Bridge foundations shall also be shown.

F. Sample Drawing

- 1. Attached in the Enclosures section is a sample water drawing which demonstrates the final look of the drawing. Take note of the lettering style and scale, line widths, as well as the general look and character of the drawing.

Section

3

Sewer Contract Drawings

A. Drawing Size

1. Sheet - 30" x 42"
2. Outer Border - 29" x 41" (1/2" from left, 1/2" from top, bottom, right)
3. Inside Border - 27" x 39" (1" from left, 1" from top, bottom, right) (see Appendix Ib)
4. Title Block - 5" x 9" in lower right corner (See Appendix Id).

B. Materials

1. Drawing shall be on mylar, with an erasable ink.
2. Mylar shall be .004 inch thick polyester base, in sensitized and matted on both sides.

C. Drafting

1. Scales
 - a) Plan - 1" = 20' except as otherwise specifically approved.
 - b) On new construction, where 1" = 30' scale can reduce the number of sheets, it may be used, as approved by the Water & Sewer Section supervisor.
 - c) Sections - 1/4" = 1'-0" or as otherwise appropriate
 - d) Profile - Horizontal: 1" = 20' (or match plan)
Vertical: 1" = 5'
2. Lettering
 - a) All lettering shall conform to Appendix IIb.
 - b) Existing utilities shall be indicated using upper and lower case lettering and shall be slanted.
 - c) Ordinance Date shall be 0.175".
 - d) Preliminary Assessment shall be 0.14".
 - e) Name of sewer system shall be 0.24" arial.
 - f) Title block information shall be as shown in Appendix Id.
 - g) All streets shall be kept clear of notes as much as possible. The name of the main street shall be placed along the top of the sheet. No abbreviations shall be used on the main street.
 - h) The words street, road, avenue, etc., should be spelled out on main streets and abbreviated on intersecting streets.
 - i) Lettering shall be in accordance with Appendix IIb.
 - j) For Private Cost Contracts, the words "PRIVATE COST" in a 0.24" arial shall be placed above the title block.
3. Line Weight (in descending order of line weight)
 - a) Proposed sewer
 - b) House lines, Right-of-way lines
 - c) Curb lines, property lines
 - d) Utilities
 - e) Leaders
4. Symbols and Abbreviations
 - a) Symbols and abbreviations shown in Appendix IIa shall be used.
 - b) Any other symbols and abbreviations shall be defined on the Contract Drawings.
5. Drawing Orientation
 - a) Generally drawing should be oriented with the main street on the sheet being oriented horizontally across the sheet, and north being oriented up in reference to a horizontal line
6. Profiles
 - a) All sewer Contract Drawings shall contain a Profile.

7. Cross Sections

- a) All sewer Contract Drawings shall contain a cross section.
- b) Cross sections, on sewer sheets shall be taken looking up stream, except where there is a summit manhole, in which case all sections shall be taken in the same direction.

D. Sewer Base Plan Information

1. City Plan Information

- a) Houseline distance and angles, street and Right-of-way widths, name of street and legislative route number if state highway (see Appendix VI for a list of state highway route numbers).
- b) City plan elevations shall be shown on all sewer drawings.
 - 1) If the survey elevations are within 6" of the City Plan data, then it shall be assumed to be at City Plan.
 - 2) If the survey elevations are different than City Plan data by more than 6", then the existing street elevation and City Plan elevations shall be shown.
- c) Survey Bench Mark (place in upper left hand comer) The survey bench mark should be obtained from the Streets Department Survey District (see Appendix Vf).
- d) Street Status - Legally open or not legally open; at grade or not at grade. Only label when not legally open or not at grade (greater than 6" difference from City Plan).
- e) Cartway and footway widths shall be dimensioned.
- f) City Plan information, where it deviates from actual existing physical curblines, the City Plan curblines shall be shown dashed and the actual existing physical curblines shall be shown solid.

2. Pertinent Information

- a) The Consultant's name or in-house unit shall be shown on the base plan to the left of the title block stipulating who prepared the base plan or design. The base plan and/or design completion date shall be shown directly beneath the Consultant's name. For consultant's projects the drawing shall be stamped by a registered Professional Engineer in the state of Pennsylvania. If only the base plan or design was prepared by the consultant, the wording should reflect such.
- b) Base plan legend shall be shown in the upper right hand comer of the base plan whenever possible.
- c) The words "AUTHORIZED BY ORDINANCE OF COUNCIL" shall be placed above the title block on base plans when the main street has no City sewer and one is being proposed.
- d) The words "PRELIMINARY ASSESSMENT" shall be placed at the bottom center of each sheet, on base plans when the main street has no sewer and one is being proposed. For assessable projects, drawings shall be sent to the District Surveyor to obtain the preliminary assessment.
- e) Name of the sewer system shall be placed above the title block on all sewer sheets, when appropriate.
 - 1) Example
 - a) Dobson's Run
 - b) Wingohocking System
 - c) Main Relief, etc.
- f) Miscellaneous information that shall be provided on each plan drawing
 - 1) Ward number.
 - 2) Sewer Plat Number
 - 3) Highway District Number
 - 4) Streets Survey District Number
 - 5) One Call Serial Number
 - 6) Ordinance Date (if applicable)
 - 7) Preliminary Assessment (if applicable)
 - 8) Outfall Number (if applicable)
- g) Title block should always contain the date on which the most recent changes were completed.

3. Plan View Information

- a) Property owners shall be shown on base plans where there is no existing sewer.
- b) All buildings shall be indicated along with type of construction (e.g., 3 sty. brick bldg., vacant lot, hospital, hotel, school, etc.) and first floor elev. of the corner properties, as well as any intermediate properties with non-uniform elevation differences.
- c) District Standard Measurement shall be used for all distances.

- d) All block distances shall be indicated on the base plan.
 - e) All street grades along the gutters shall be indicated. The direction of stormwater flow shall be indicated by placing arrow heads on the curbs pointing in the downgrade direction.
 - f) All existing sewer manholes including the first manhole on each connecting sewer, shall be identified with field invert and rim elevations. Inside top of crown elevations are required on the base plan for design purposes, to be removed from final plans. Field invert elevations of the main sewer manholes are required in the profile.
 - g) All elevations shall be identified at the summits and sumps of street. Elevations shall be noted for both the top and bottom of curb.
 - h) All elevations shall be identified at the street intersections at the P.C., P.I., and P.T. of the curb.
 - i) Overhead bridges shall be shown and the elevation of the underside of the bridge shall be indicated on the base plan.
 - j) Match lines shall be shown on base plans when required.
 - k) Where there is no existing sewer, the locations and invert elevations of sanitary laterals at the points where the house laterals connect to the septic systems shall be identified on the base plan.
 - l) All existing laterals over 6 inches in diameter shall be shown dashed on the base plan and indicated with the lateral size and material, where information is available.
 - m) All existing sewers shall be shown as double dashed lines on the base plan and labeled with its size and material.
 - n) Paving information
 - 1) Existing footway, curb and roadway material shall be fully identified.
 - 2) Driveway, tree wells and wheelchair ramps shall be indicated.
 - 3) Footways, if special pattern (particularly brick), shall be carefully identified.
 - 4) Deteriorated footway shall be noted.
 - o) Traffic Information
 - 1) Direction of traffic along with parking information shall be shown on all streets including intersecting streets. Symbols used shall be as shown on the sample drawings and in Appendix IIa.
 - p) Above Ground Features
 - 1) Steps, cellar doors, fire hydrants, parking meters, trees (including diameter), manhole covers, traffic signs and signals, utility poles, and all street furniture (phone booths, mailboxes, benches, etc.) shall be identified as shown in Appendix IIa.
 - 2) All existing curb stops, sewer vent boxes, and gas valves shall be shown (see Appendix IIa).
 - 3) Property lines shall be indicated, along with sufficient street addresses to identify all properties.
 - 4) All lots not containing structures shall be so labeled (open lot, parking lot, etc.)
4. Misc. Field Information
- a) The final design and specifications are very dependent on the field investigation, and the information obtained from the field visit. The engineers and/or designers which visit the field location should pay special attention to the visible details of the block which may be useful in later making design decisions. Examples of such items are:
 - Condition of paving, signs of paving disruptions due to Water Department infrastructure failures, etc. This information will assist in establishing appropriate paving limits.
 - Evidence of hydrant relocations or damaged or knocked over hydrants. This information will assist in locating new hydrants.
 - Potential construction interferences such as low bridges, tree interference, overhead wires or structures, etc.
 - Condition of homes, are any vacant or collapsing, etc.
 - These are a few examples of the type of information required to properly design a contract.
5. Utility information shall be given as follows:

- a) Each utility shall be identified in the following order: (Water, H.P.F.S., PECO, sewer, Verizon, Gas, Streets Traffic, SEPTA, Public Property-Communication, Public Property-Transit, W.U., Cable TV, etc.)
 - b) Each former utility if so identified on manholes or Highway Supervisor's drawing shall be identified (i.e. Keystone, City Transit, PTC, etc.)
 - c) Pipe size (width x height) except sewer which shall be height x width.
 - 1) Brick sewers shall be labeled in feet and inches (e.g. 2'-6" x 1'-8")
 - 2) Reinforced concrete pipe shall be labeled in inches (e.g. 36" RCP)
 - 3) Box sewers, whether brick or reinforced concrete shall be labeled in feet and inches. The above nomenclature, if used consistently, assists in quick identification and approximate dating of the sewer.
 - d) The distance from the utility to curb shall vary uniformly between dimensions.
 - e) High voltage electrical conduits shall be separately labeled with voltage, and boxed in.
 - f) SEPTA and railroad tracks shall be shown as accurately as possible, but not dimensioned. Their status (active, inactive, or paved over) shall also be stated.
 - g) Utility lines shall be drawn using the types of lines shown in Appendix IIc.
 - h) Existing sewer inlets shall be accurately shown and indicated as to size and type.
 - i) Utilities other than existing water and sewer shall be shown as double line when their width is 42" or greater.
 - j) All existing sewers shall be shown as double line.
 - k) All water mains 24" or greater in diameter shall be shown as double line.
 - l) Abandoned utilities (when shown) shall be labeled abandoned.
6. Profile (Base Plan)
- a) Show confirmed curb regulation of the curb closest to existing sewer. Profile shall show both actual and City Plan curb lines if there is a greater than 6" difference between the two. If the difference is 6" or less then show the confirmed City Plan curb lines only.
 - b) All existing sewers and manholes shall be shown and identified with field invert elevations.
 - c) Match lines shall be shown on all profiles, when required.
 - d) The elevations of bridge footings and the underside of bridges shall be indicated on the profile.
 - e) SEPTA or railroad track and track status at intersecting street shall be shown (active, inactive, or paved over).
 - f) Show all utilities which fall within the projected trench line (outside dimensions) or cross the proposed sewer, assuming construction in place.
7. Cross Section (Base Plan)
- a) All cross sections shall be shown beneath the profile or on the side of the profile, if possible. Sufficient space shall be left on the sheet to place standard notes.
 - b) All utilities shall be shown in the entire cartway and both footways to the house lines. Abandoned utilities (when shown) shall be labeled (abandoned).
 - c) The cross section shall be taken from the plan looking toward the high end of the existing sewer, except where you have a summit manhole, where all sections shall be taken in the same direction. If no sewer exists, the cross section shall be taken upgrade, based on gutter grades.
 - d) Existing footway, curb and roadway material shall be fully identified.
 - e) Where there is a railroad bridge shown on the base plan, a cross section of the railroad bridge with underside elevations shall be shown on the base plan. (This is in addition to the standard cross section for the base plan).
 - f) The cross section shall be taken at a point where there is the most utility congestion.
 - g) City Plan information, where it deviates from existing.

E. Proposed Sewer

1. Plan View (Contract Plans)
- a) The proposed sewer shall be located and dimensioned from the center line of the proposed sewer to the nearest curb line.
 - b) All new manholes shall be identified. Invert elevations at new manholes shall be included at changes in direction, size or grade and at terminating manholes (except when the sewer terminates at a concrete collar).
 - c) All new inlets and inlet pipe shall be shown and identified. See Appendix IIIb for Preferred Inlet Locations.

- d) All new concrete collars, brick bulkheads, vent pipes and inlet pipes shall be shown and identified.
 - e) Match lines shall be shown on all Contract Plans, where required.
 - f) Applicable standard notes shall be placed on Sheet No. 1 of the proposed sewer Contract. (See Appendix IIIa to obtain proper notes).
 - g) All junction chambers, separating chambers and utility manholes shall be identified. All additional information or instructions concerning these structures shall be written in the specifications.
2. Profile (Contract Plans)
 - a) In the profile the sewer shall be shown at the correct size and grade and identified. The manholes and their elevations, when applicable, shall also be shown and identified.
 - b) The new sewers that are shown in the profile that are connected into the main sewer shall be identified. The size of the new sewer and the invert elevation at the connection shall be shown at the correct location in the profile.
 - c) All new concrete collars, concrete cut-off walls and vent pipes along with their invert elevations shall be shown and identified in the profile.
 - d) All chambers shall be shown in profile. All additional information or instructions concerning these chambers shall be written in the specifications.
 - e) Match lines shall be shown on all sewer Contract Plans, where required.
 3. Cross Section (Contract Plans)
 - a) The new sewer shall be shown in the correct location in the cross section looking up-stream. The new sewer shall be dimensioned from the center line to the curb and identified.
 - b) Where there is a railroad bridge shown on the base plan, a cross section of the railroad bridge with underside elevations showing the new sewer looking up-stream shall be shown. Bridge foundations shall also be shown.

F. Sample Drawing

1. Attached are five sample sewer drawings which demonstrate the final look of the drawings for various types of sewer systems. Take note of the lettering style and scale as well as line widths, as well as the general look and character of the drawings. Attached are the following:
 - Combined Sewer (Plan, Profile & Section)
 - Separate Sewer System (Plan, Profile & Section)
 - Box Sewer (Plan, Profile & Section)
 - Box Sewer (Details)
 - Sewer Lining (Plan)

Section

4

Water Technical Design Information

A. Proposed Water Main Design

1. Location for New Developments
 - a) Cartway 36 feet or less - the main shall be located in the center of the street.
 - b) If ordinance specifies footway lay, or, if one side of street is park or other non-assessable, the footway location shall be coordinated with Verizon, PECO, and Gas.
2. Location for Relay
 - a) Where cartways are less than 36 feet wide and if a dual main has not been specified, the location of the centerline of the proposed main shall be as follows, in order of decreasing desirability.
 - 1) Center of street (greater than 3 feet from nearest curb)-nearer the center the better.
 - 2) Footway - greater than 3 feet from the curb (Distance from proposed water main to buildings should be maximized, if within 6 feet of a building the design should be approved by the Supervisor of the Water & Sewer Section).
 - 3) Gutter - within 3 feet of curb.
 - 4) Footway - within 3 feet of curb.

Generally, the water main trench shall be located away from the curb to avoid increased installation costs as well as increased difficulty in future maintenance.
 - b) Where the services on the two sides of the street are extremely unbalanced, as a row of homes opposite a school or factory, a footway location adjacent to the homes may be preferred.
 - c) The closest a new 8 inch main can be installed next to an existing 6 inch main is 18 inches center to center, 24 inches is preferred.
 - d) Proposed water mains shall be located such that the water main is completely outside a line drawn on a 2 vertical to 1 horizontal slope from the outside trench line of the sewer (existing or proposed) and such that there exists a minimum of 3'-0" between the respective trenches. If for whatever reason this is not feasible it shall be approved by the Supervisor of the Water/Sewer Section.
 - e) Where a sewer, for whatever reason, is to be abandoned and is 16" in diameter or greater it shall be filled with controlled density fill/flowable fill as specified in the Water Department Sewer Standards.
 - f) Where a water main, for whatever reason, is to be abandoned and is 16" in diameter or greater it shall be filled with controlled density fill/flowable fill.
3. Utility Interference
 - a) Philadelphia Gas Works
 - 1) The City has an agreement with PGW, which basically states that if the proposed sewer and/or water main places the gas main within a 2 vertical to 1 horizontal influence line, the City will reimburse PGW for up to 50% of the replacement costs. It is therefore in the Water Department's best interests to evaluate our locations for proposed water mains/sewers in context of the potential costs associated with reimbursement to PGW. See Appendix Ve for the Water Department /PGW Agreement.
 - b) Other Utilities
 - 1) If other utilities have constructed their facilities over our water main or have installed their facility in our proposed location after they have been informed of our plans to relocate in a specific location, then they shall be responsible for either relocating their

- facility or reaching an agreement with the Water Department where we will relocate our facility and the other utility will pay for any additional costs to the Water Department.
- 2) Utility presence in the street is by permit of the Streets Department. A highway opening permit must be obtained through the Streets Department's Guaranteed Paving Information System (GPIS) for each location where they install a new facility. This permit, along with the highway opening permit guidelines establishes the terms and conditions under which all utilities are governed in City streets. This permit gives the City and all its Departments certain rights concerning the relocation of non-city utility's facilities, for the benefit of the City. Due to the costs involved in relocating infrastructure, much prudence and engineering judgment must be used in invoking our rights with respect to other utilities. See Appendix Vb for a further explanation and reference samples of the GPIS application.
4. Limits of proposed mains in major streets (cartway 26 feet or wider).
 - a) Intermediate intersections shall be completely rehabilitated and set up for future relay. Exception is made for intersections with ductile iron (D.I.) or cast iron tyton joint (C.I.T.J.) pipe. (1970 vintage or newer)
 - b) The end intersections shall be completely rehabilitated if any of the following apply:
 - 1) Concurrent sewer work extends into the intersection.
 - 2) Previous relay of adjacent streets has extended up to or into the intersection.
 - 3) Intersecting street water main is 100 years old or older.
 - c) If the end intersection is not to be rehabilitated, the tie-in shall be as follows:
 - 1) If the intersecting main is greater than 6 inches. In general, the limit shall be at the intersecting main.
 - 2) If the intersecting main is 6 inches, attempt to tie into the existing leg without entering the intersection (i.e. at curblin) or if due to the geometry it is necessary to enter the intersection, still attempt to tie into the existing leg.
 5. Limits of proposed mains in secondary streets (cartway less than 26 foot wide).
 - a) Intermediate streets shall be rehabilitated. Exception shall be made for intersections with D.I. or C.I.T.J pipe (1970 vintage or newer).
 - b) End intersections are not to be rehabilitated unless required:
 - 1) For concurrent sewer construction.
 - 2) To finish off intersection from previous relay.
 - 3) By geometry.
 - c) If intersection is not to be rehabilitated, follow the instructions under 4c above.
 6. Relay size
 - a) Except as otherwise specified, minimum relay is 8 inch.
 - b) On a dual main relay, one main may be 6 inches if no fire hydrants are connected, except center City locations which shall be 8 inches minimum.
 - c) In cul-de-sacs the water main loop beyond the hydrant tee can be relayed with 6 inch main.
 - d) Specific Relay size shall be provided by the Planning Unit.
 - 1) For sewer projects, water relay requirements will be provided concurrently with sewer requirements on a completed sewer base plan.
 - 2) For in-house water only projects the water relay requirements are available in the CAPIT (Capital Program Integrated Tracking System) pipe estimate screen of scheduled locations.
 - 3) For consultants designing a water only project, the water main relay requirements will be provided upon receipt of a completed water base plan.

Consultants shall submit 3 paper sets of all completed base plans to the Manager, Design Branch, who in turn will have them logged into the CAPIT system and forwarded to the planning unit. For Contracts with multiple locations, the base plans for all locations in that contract shall be completed and submitted together.
 7. Pipe Material
 - a) All mains shall be ductile iron pipe with push-on joints unless otherwise specified by the Water Department.
 - b) For class of ductile iron pipe see Water Department Standard Specifications.

8. Valves

- a) Size - all valves 12 inches and smaller are line size.
- b) Type – all valves other than tapping valves are Water Department Standard resilient seat mechanical joint gate valves furnished with retainer glands.
- c) Line valve location:
 - 1) When the main is in the cartway 8 feet or further from the nearest curb, the valve shall be located on the house line.
 - 2) When the main is in the cartway less than 8 feet from the nearest curb, the valve shall be located on the curb line.
 - 3) When the main is in the footway the valve shall be located on the house line unless conditions make it necessary to be placed closer to the curb line.
- d) Fire hydrant and service connection valve locations.
 - 1) Domestic and fire service connection valves shall be located as close to the main as possible.
 - 2) Fire hydrant valves shall be connected directly to the hydrants anchoring tee.
- e) Appurtenances
 - 1) All valves shall be supplied with Water Department 7 inch plastic or cast iron valve boxes.

9. Fire Hydrants

- a) Type - all fire hydrants shall be Water Department Standard with mechanical joint inlets furnished with retainer gland.
- b) All existing hydrants that are affected by the proposed water main relay, regardless of type or age, shall be replaced with hydrants with center compression locks.
- c) Maximum spacing between hydrants:
 - 1) Residential areas - 600 feet
 - 2) Commercial/Industrial areas - 500 feet
 - 3) The existence of high pressure fire service hydrants shall not affect the above spacing.
- d) Color Coding
 - 1) All hydrants shall be color coded by having their bonnets painted in accordance with the following, based on water main size:
 - a) 6"-8" Orange
 - b) 10"-12" Green
 - c) 16"- Larger Red
- e) Location:
 - 1) All hydrants except those used for blow-off and/or for dewatering purposes shall be 18 inches from curb, located near intersections and connected to the main near but behind the line valve (away from the intersection).
 - 2) Where possible, hydrants shall face streets at least 26 feet wide.
 - 3) Where possible, hydrants shall face the wider street at a particular intersection.
 - 4) If there are multiple acceptable locations for a fire hydrant at an intersection based on the above criteria, then consideration should be given to:
 - a) Choosing a location which due to the existing traffic patterns will minimize the risk of an automobile knocking the hydrant down in the future.
 - b) Choosing a location which based on the parking patterns on the intersecting streets will maximize parking spaces in that immediate area.
 - 4) On water relay, as well as new construction, the placement of hydrants in the middle of the block shall be avoided, provided all other requirements are met.
- f) Valving
 - 1) All fire hydrant legs shall have a 6 inch valve located nearer to the main. The hydrant valve, wherever possible shall be placed onto the hydrant anchoring tee.
 - 2) Whenever possible a hydrant anchoring tee rather than a mechanical joint tee should be used for the hydrant leg.
- g) Water mains in relation to fire hydrants:
 - 1) Fire hydrants used for fire protection shall not be connected to mains less than 8 inches in diameter.

- 2) For water mains laid in the footway, a minimum distance of 5 feet from the curb for 8 inch mains is required for a straight hydrant connection (5'-3" for 12 inch mains).
 - 3) For water mains laid in the cartway, a minimum distance of 3 feet from the curb is required for a straight hydrant connection.
- h) Fire Department review of fire hydrant eliminations:
- 1) Any Contract which contains water main relay work shall be sent to the Fire Department for review. A print shall be made and marked up showing which hydrants are being added and which hydrants are being removed. All hydrants to be removed shall be circled in red, all hydrants to remain shall be circled in orange, all new hydrants shall be circled in blue, and all direct removal and replacements of hydrants shall be circled in brown, as shown on the Legend for Fire Department Review of Fire Hydrant Elimination in Appendix IV. All drawings shall have a legend denoting the system of marking used attached to the print.
 - 2) The print, along with a letter requesting their review, shall be sent to:
 - a) Philadelphia Fire Department
Planning & Research
240 Spring Garden Street
Philadelphia, PA 19123
Attn.: Lt. Anthony Reel

10. Water Main Depth

- a) Cover
 - 1) Mains 12 inches and under are normally installed at 4 foot cover.
 - 2) Mains 16 inches and over, minimum cover shall be as defined in the Water Main Standard Details.
 - 3) 3'-6" cover or less shall only be used when absolutely necessary.
- b) Crossing Sewer
 - 1) The vertical distance between water main and sanitary sewer shall be a minimum of 18 inches.
- c) Gas Mains
 - 1) The proposed water main trench shall be completely outside a line drawn on a 2 vertical to 1 horizontal slope from the outside edge of the gas main trench, unless this is not feasible.
 - 2) 12" vertical clearance is required between the pipes.
 - 3) If these guidelines are violated then PGW will replace their gas main in the affected area, and this work shall fall under the PGW agreement.
- d) Existing Water Main
 - 1) The existing water main that is to be abandoned at the completion of the relay shall remain in service during the work, except intersections beyond the line valves. In cases of possible conflict, bends or offsets shall be used to bend around the existing water main.
 - 2) If the existing water main to be abandoned is 16" or greater it should be filled with controlled density fill/flowable fill.
- e) Railroads
 - 1) Pipelines crossing active tracks may require a casing pipe. When casing pipe is required it shall be installed at 5'-6" cover and shall be provided with casing insulators. Casing pipe installed by jacking and boring will be steel and by open cut, ductile iron. Casing pipe shall be sized as follows:

<u>Water Main</u>	<u>Casing Pipe</u>
8"	16"
12"	20"
16"	24"
 - 2) For more information consult the Pipeline Occupancy Specifications for the specific railroad (Conrail, Amtrak, CSX, Norfolk Southern, SEPTA)
 - 3) Contract drawing shall contain a section and profile of the water main and casing pipe at the railroad crossing showing the casing pipe details.

4) For in-house design, eight prints of the Contract Drawing showing the railroad crossing and three copies of the Pipe Data Sheet shall be sent to:

- a) Mr. Brian Mohl Manager, Capital Program
ARA Tower, 2nd Floor
1101 Market Street
Philadelphia, PA 19107
215-685-6339

requesting that he submit the prints and pipe data sheets to the railroad for review. Consultants shall submit their design directly to the railroads.

5) Prior to designing the railroad crossing the designer shall establish the present status of the tracks (i.e. active, inactive, primary, secondary or abandoned). This parameter shall affect the method of design of the crossing.

11. Service Connections

- a) All services other than those with D (discontinuance) permits and those to empty lots shall be replaced.
- b) Supply lines which have current accounts shall be replaced and reconnected.
- c) Supply lines for unoccupied Non-Billed Accounts (NB-9 accounts), shall be replaced including a new curb stop. The new curb stop shall not be reconnected to the existing service pipe. The new curb stop shall be left in the "off" position and the house side of the curb stop shall be capped or plugged.
- d) The supply line to an NB-9 property which is found to be occupied shall be replaced. The new curb stop shall be reconnected to the existing service piping. Customer Service shall be notified whenever this condition is observed.
- e) No lot, unless it is a current account, shall receive a new supply line.
- f) Ferrule type services (2-1/2 inches and smaller) shall be replaced with K copper unless polyethylene is specified by the corrosion control consultant. Such services shall be installed with one continuous length of copper service pipe between the ferrule at the main and the curb stop.
- g) Ferrule type services shall be replaced from the main up to and including the curb stop.
 - 1) Main in Footway - curb stops for adjacent properties shall be on the house side of the main within 4 feet of the main. When polyethylene is used there may be exceptions. Please verify current policy.
 - 2) Main in cartway or opposite footway - curb stop shall be 18 inches from the curb line in the footway.
- h) Depth of proposed service piping:
 - 1) All service piping shall be placed at 4' cover including the proposed curb stop.
 - 2) If the existing curb stop is at a different elevation than the proposed curb stop, the proposed curb stop shall be placed at 4' cover and the necessary adjustment shall be made on the distributing pipe between the proposed curb stop and the house.
- i) Valve type services (4 inches and larger) for mains in the cartway shall be replaced to the curb.
- j) Ferrule type services are replaced on an equal size basis except minimum is 3/4 inch and 1-1/4 inch is replaced by 1-1/2 inch.
- k) Valve type services are replaced size for size except that 4 inch tee branch and a 4 inch valve are used for 3 inch services.

12. Fittings

- a) All fittings 12 inch and under shall be 350 psi compact ductile iron mechanical joint.
- b) All fittings 16 inch and over shall be ductile iron mechanical joint (350 psi 24 inch and under).
- c) The openings on all fittings shall be mechanical joint bells.
- d) Vertical Offsets
 - 1) Vertical offsets 1'-0" or less shall be done by pipe deflection where possible.
 - 2) Where bends are required for vertical offsets bends (1/32 and 1/16) are preferred as they reduce the size of necessary thrust blocks.
- e) Horizontal bends except as otherwise necessary shall be 1/8 (45") bends.

- f) Where possible, a pair of rotated bends is preferable to separate horizontal and vertical bends.
- g) All thrust fittings, bends, branch of tees, offsets, caps and plugs, and sleeves shall be provided with ductile iron retainer glands. In addition, when the distance of any existing fitting to a thrust fitting is less than 10 feet, it shall also have miscellaneous iron and steel harnessing as detailed in the Standard Details for Water Mains.
- h) When a push-on joint is within 10 feet of a thrust fitting, fire hydrant, valve or sleeve, the push-on joint shall be harnessed with miscellaneous iron and steel as detailed in the Standard Details for Water Mains.
- i) All thrust fittings and fire hydrants shall receive concrete thrust blocks.

B. Quantities for Water

1. Bill(s) of Materials shall be provided on each drawing indicating all fire hydrants, valves and valve boxes and fittings shown on that sheet.
 - a) The order of the Bill of Materials shall be as follows:
 - Fire Hydrants
 - Valves (descending size)
 - Crosses
 - Tees
 - Bends
 - Offsets
 - Reducers
 - Sleeves
 - Caps
 - Plugs
 - b) The Engineer shall calculate the tonnage of ductile iron fittings to be used on each project to be incorporated into the specifications. See Appendix VII for a list of weights for ductile iron fittings.
2. Pipe Totals
 - a) The total of each pipe size (rounded to next highest 5 feet) shall be shown on each sheet. On multi-sheet contracts, the total for all sheets shall be separately shown on Sheet 1.
 - b) Pipe total heading shall be as follows:
 - "Pipe Totals This Sheet"
 - "Pipe Totals All Sheets"
3. Services
 - a) The length of service pipe for ferrule type services for mains in the cartway or opposite footway shall be the distance from the main to the curb plus 5.5 feet. This allows for both the 4' expansion loop and the 18 inch distance from the curb to the curb box.
 - b) For mains in the adjacent footway a total service pipe length of 7 feet shall be used.
 - c) When polyethylene service pipe is used there may be exceptions. Please verify current policy.
4. Excavation
 - a) Quantities shall be computed in accordance with the current edition of Water Department Standard Details, except as necessary to increase quantities for deeper installations or prior roadway stripping by others.
5. Paving
 - a) Repaving quantities in asphalt surfaced streets shall be calculated using the current Standard Details.
 - b) Repaving quantities in concrete surfaced streets, concrete driveways and footways shall be based on replacement to the existing joints or a saw cut depending on the wording of the specifications and the paving requirements.
 - c) Brick and slate footways are replaced in kind.
 - d) Binder quantities, when not specified by Streets Department, shall be based on a 1.5 inch minimum thickness weighing 100 pounds per square yard per inch thick, and specified in tons.
 - e) Backfill in State Highways shall be (2RC) from 6 inches above the main to 1 foot below the surface (2'-0" with 4'-0" cover). (2RC) is specified in tons (use 100 pound/cubic foot).
 - f) Concrete base in State Highways shall be 10 inches thick high-early strength concrete.
 - g) Concrete base in City Streets shall be 8 inches thick.

- h) Repaving quantities in City and State Highways are specified separately.
- i) Whenever a curb requires removal, the footway will require replacement to at least the first joint and the cartway shall be reconstructed for 2 feet from curb.
- j) When the proposed main is located in a City Street so that the outside of the trench is within 3 feet or less from curb, the repaving shall extend from cutback line on one side, to the curb on the other. In addition the curb and one block of footway shall be evaluated for potential replacement.
- k) When the proposed main is located in a State Highway so that the outside of the trench is within 4 feet or less from curb, the repaving shall extend from cutback on one side, to the curb on the other. In addition the curb and one block of footway shall be evaluated for potential replacement.
- l) When the proposed water main is located in an intersection and crosses from State Highway to City Street, it shall be noted that the State Highway terminates at the curb line of the State Highway and the intersecting City Street begins. The paving quantities shall reflect this.
- m) If the Streets Department paving requirements request additional paving to be added to the contract and will be paid for by the Streets Department, those quantities should be separated and placed in the proposal of the specifications as a separate section of P-items and an X should be added to the suffix of the work number. In addition the front office staff of the Design Branch shall be notified, in order to update the log book and the computer database.
- n) Where full width street restoration is required, a full width 6" stone sub-base shall be required. This will be a separate payment item.

6. Curb

- a) When the proposed main is located so that the outside of the trench is within 3 feet of the curb on City Streets or 4 feet on State Highways, evaluation of the curb and footway to the first joint shall be performed.
- b) Full width street reconstruction usually requires curb replacement which in turn requires the replacement of at least one paving block of footway.

7. Quantity Tabulation

- a) See Appendix IV for Water Relay Quantity input sheets and Water Record of Data sheet.

Section

5

Sewer Technical Design Information

A. Hydraulic Study

1. Upon completion of the base plan, a print of the base plan and the utility bag is forwarded to Planning Unit for hydraulic sizing. (Consultants shall submit three prints of the base plan and the utility bag to the Design Branch, who will in turn forward the package to the Planning Unit.) The Information obtained from the Planning Unit shall be used for hydraulic sizing. Actual final design location, configuration, and limits shall be based on the Engineer's judgment encompassing all aspects of the design process.

B. Proposed Sewer Design (General)

1. Size of Sewer
 - a) Size of sewer is typically calculated by the Planning and Research Section, however, it may be changed if grades are adjusted.
 - b) Size of proposed sewers is based on quantity of flow, grade and velocity.
 - c) For comparative pipe data see Appendix VIII "Velocities & Flow Capacities of Pipe Sewers".
2. Velocity Restrictions
 - a) Minimum velocity to insure a self cleaning sewer is 3 ft/sec.
 - b) Maximum velocity to insure no abrasion of the invert is 15 ft/sec.
 - c) In certain areas of the City, where rock excavation or naturally steep grades make maintaining a velocity of 15 ft/sec costly and prohibitive, higher velocities may be used. Prior to designing a sewer with a velocity higher than 15 ft/sec, the situation shall be discussed with the Supervisor of the Water/Sewer Section. If the flow velocity is greater than 15ft/sec, Class V, Wall C RCP pipe shall be used/considered instead of Class III, Wall B RCP. The Class V, Wall C pipe is made with higher strength concrete and is approximately $\frac{3}{4}$ inch thicker and will lengthen the life of the pipe in these conditions. A PWD Design Supervisor should be consulted in these situations.
3. Sewer Materials
 - a) In separate systems the sanitary sewer is made of vitrified clay and the stormwater sewer is made of reinforced concrete pipe.
 - b) In combined systems the sewer is made of reinforced concrete pipe.
 - c) For large sewers (above 84" in diameter), cast in place reinforced concrete box sewers may be required.
 - d) For sewers with velocities above 20 ft/sec a special liner or other special precaution may be required. Class V, Wall C RCP may be an option, please contact a PWD Design Supervisor for guidance.
 - e) For further information on sewer materials consult the Standard Details and Specifications for Sewers.
4. Minimum Grades
 - a) In spite of minimum velocity requirements, a minimum grade of .5ft/100ft. (0.5%) is recommended.
5. Location
 - a) On sewer reconstruction projects the sewer is typically reconstructed in the same location as the existing sewer.
 - b) Sewer elevations may vary from existing conditions depending on the existing and future conditions of the upper and lower end.

- c) Connection to intersecting sewer shall be as follows:
 - 1) Where practicable sewers shall match spring lines. (Spring line is the centerline of a circular sewer or the line that bisects an egg shaped sewer at a point $2/3$ the height above the invert.)
 - 2) If not practicable sewers may match inverts.
 - d) At all times proposed sewers shall be placed so as to receive all existing laterals.
 - e) Proposed sewers and water mains shall be located such that the water main is completely outside a line drawn on a 2 vertical to 1 horizontal slope from the outside trench line of the sewer, or there exists a minimum of 3'-0" clearance between the sewer and water main trench, whichever is greater. In rare cases due to excessive utilities, a water main may be approved to be placed in close proximity to the sewer, but this must be approved by a PWD Design Supervisor.
 - f) Where a sewer, for whatever reason, is to be abandoned and is 16" in diameter or greater it shall be filled with controlled density fill/flowable fill.
 - g) On new sewer construction, the sewer shall be located so as to minimize lateral length, however at all times it shall be located in the cartway, or Philadelphia Water Department Right of Way where no cartway is present.
 - h) For new sewer construction, proposed sewers shall be placed at a depth to insure proper drainage of the lowest portion of each property and/or structure in the development.
6. Utility Interference
- a) Philadelphia Gas Works
 - 1) The City has an agreement with PGW, which basically states that if the proposed sewer and/or water main places the gas main within a 2 vertical to 1 horizontal influence line, PGW will replace the gas main, and the City will reimburse PGW for up to 50% of the replacement cost for the gas main. It is therefore in the Water Department's best interests to evaluate our locations for proposed water mains/sewers in context of the potential costs associated with reimbursement to PGW. See Appendix Ve for the Water Department/PGW Agreement.
 - b) Other Utilities
 - 1) If other utilities have constructed their facilities over our sewer then they shall be responsible for either relocating their facility or reaching an agreement with the Water Department where we will relocate our facility and the other utility will pay for any additional costs to the Water Department.
 - 2) Utility presence in the street is by permit of the Streets Department. A highway opening permit must be obtained through the Streets Department's Guaranteed Paving Information System (GPIS) for each location where they install a new facility. This permit, along with the highway opening permit guidelines establishes the terms and conditions under which all utilities are governed in City streets. This permit gives the City and all its Departments certain rights concerning the relocation of non-city utility's facilities, for the benefit of the City. Due to the costs involved in relocating infrastructure, much prudence and engineering judgment must be used in invoking our rights with respect to other utilities. See Appendix Vb for a further explanation and reference samples of the GPIS application.
7. Foundation and Substructure Conditions
- a) For new construction, a complete soil investigation shall be performed with borings taken at least once for every 150 feet of sewer.
 - 1) In cases where the standard penetration resistance value (or N-value) is consistently 17 blows per foot or greater, pile supports are not required by the Water Department. Where soil conditions are poor, the sewer along with the laterals, inlet pipes, inlets and manholes will be required to be placed on piles.
 - 2) In areas of moderately poor soils, other means of support may be acceptable. Each case shall be evaluated on an individual basis.
 - b) For sewers reconstructed where poor soil is suspected or where no soil information is available, similar precautions shall be taken.

- c) Where borings are required, a plan showing the location of the proposed borings along with a memo requesting the borings shall be sent to the PWD Design Branch.
 - d) Where a ground water level is determined to exist within the proposed sewer excavation, special precautions shall be specified, such as:
 - 1) Well points to draw down the water level in the area of the sewer construction.
 - 2) Underdrainage system to drain water away from the construction area.
 - e) All sewers shall be installed on a concrete cradle as defined in the Water Department Standards, as a minimum. When the soil investigation information requires further support, special foundations shall be used, such as spread footings, piles and pile caps, etc.
8. Sheathing & Shoring
- a) Sheathing and shoring using steel soldier beams shall be included in the contract, where the sewer trench is 18' deep or greater, or where, based on good engineering judgment and practice such is warranted. Items to evaluate are:
 - Depth of proposed sewer
 - Type of soil
 - Proximity to other major/minor utilities
 - Proximity to structures
 - Condition & Foundation type of adjacent structures
 - b) The Sheathing & Shoring is typically designed by the contractor and submitted for approval to the Water Department.

C. Vent Design (Sanitary and Combined Sewer Systems)

1. Size and Materials
 - a) Vents shall be 12" vitrified clay pipe.
2. Configuration
 - a) Vents shall be installed such that they are self draining in case water were to enter them, via infiltration or overflow.
 - b) Vents shall be installed such that they will not act as an overflow until the water level is at least as high as the inside top of crown of the higher sewer.
3. Location
 - a) Existing vents may be reconnected where engineering judgment deems it acceptable. Engineering judgment shall include but not be limited to:
 - Age and probable condition of vent
 - Proximity of existing vent to street disruption of proposed sewer construction
 - Length, Cost, and difficulty of replacing existing vent pipe.
 - b) Where a new vent is to be installed, vent shall be installed at the upper end of all combined sewers, and shall vent to an adjacent sewer. Whenever possible, vents shall be installed from the upper end manhole to a manhole on the adjacent sewer. If there is no convenient manhole on the adjacent sewer then the vent shall be connected directly to the adjacent sewer.
4. Vent Installation
 - a) New vent installation may deviate from the existing. Therefore it will be necessary to excavate at the connection of the existing vent(s) to the existing adjacent sewer and seal the vent openings in the existing adjacent sewer.

D. House Lateral Design

1. Size and Materials
 - a) In separate systems the stormwater lateral is typically 6" vitrified clay pipe (VCP) and the sanitary lateral is typically 5" VCP.
 - b) In combined systems the lateral is typically 6" VCP.
 - c) In certain areas where poor soils are present, ductile iron laterals may be required. (If used, a corrosion control engineering study may be required).
2. Grade and Depths
 - a) House lateral traps shall be 7' deep to the invert, wherever possible.
 - b) House laterals shall maintain a minimum slope of 2%.
 - c) If lateral grades exceed a 1 to 1 slope, a riser shall be used as detailed in the Sewer Standards.
 - d) Typically house laterals are placed in an open cut trench without concrete cradle.
 - e) When soil conditions warrant, special foundation should be used, such as cradles or piles.

3. Plumbing Convention
 - a) Laterals shall be installed and shown such that the sanitary lateral is located downstream of the stormwater lateral in relation to the flow of the main sewer.
4. Connection to sewer
 - a) House laterals shall be connected to the sewer by wye branches or saddle connections as per Water Department Standards for Sewers.
 - b) Typically in a sewer reconstruction project, the house laterals are not replaced, but are reconnected to the new sewer, within the sewer trench.
 - c) Where lateral reconstruction occurs outside the sewer trench the proposed lateral work should be shown on the cross section or otherwise detailed.
 - d) When sewer is within 5 feet of curb, all house laterals on the short side of the street shall be replaced up to and including the house trap and vent. The new house laterals shall be ductile iron pipe, and the house trap and vent shall be cast iron pipe.
5. Streets 16 feet wide or less
 - a) When streets are 16 feet or less in width, all house laterals on both sides of the street shall be replaced up to and including the house trap and vent. The new house laterals shall be ductile iron pipe, and the house trap and vent shall be cast iron pipe.

E. Inlets

1. Size and Materials
 - a) Typically, inlets shall be 4 feet, except where large and fast flows are expected, where a 6' inlet or 4' vane grate may be required.
2. Inlet Replacement Policy
 - a) Replace all No. 1, No. 2, No. 3, or No. 4 inlets. Inlet pipe diameter for existing No. 3 and No. 4 inlets is 12" and 8" respectively, and therefore, shall be reconstructed with 15" diameter VCP.
 - b) Replace all inlets in poor condition. Check with the Superintendent of Sewer Maintenance Section.
 - c) Replace all grate inlets with open mouth grate inlets if possible.
 - d) All inlets which are not required to be replaced by the above criteria and do not appear to be in obvious poor condition from field observations, shall be examined by sewer maintenance. A plan showing the inlets to be examined along with a cover letter/memo requesting the examination shall be sent to:
 - 1) Philadelphia Water Department-Collector Systems
ARA Tower, 4th Floor
1101 Market Street
Philadelphia PA 19107
ATTN.: Mr. Mark Waas, P.E., Chief, Collector Systems 215-685-6203
 - e) Should there be habitual delays in obtaining this inspection information please contact PWD Design Branch.
 - e) If the inlet pipe is 15" in diameter and in good condition, reconstruction of the inlet pipe will not be necessary.
 - f) Preference of Inlet Types:
 - 1) Open mouth grate inlet (preferred).
 - 2) City inlet (where open mouth grate is not possible).
 - 3) Grate inlet (where curb is depressed).
 - 4) Grate inlet (not preferred).
 - g) Size of open mouth grate, city, and modified grate inlets:
 - 1) 4 foot for street grades of 3.5% or less.
 - 2) 6 foot or 4' vane grate for street grades over 3.5%.
 - h) See Appendix IIIb for sketch of preferred inlet locations. Although the PWD has preferences for inlet type and placement, there may be other factors that could dictate the actual inlet selection and placement. Some of these factors may include the following: ADA ramps, curb bumpouts, street furniture, utility lines, castings, hydrants, street drainage, etc. Should there be questions about what would be acceptable in these situations you may contact the PWD Design

Branch for guidance. Appendix Vh of this manual provides some general guidance on ADA ramp design requirements.

3. Inlet Materials
 - a) Inlets shall be precast reinforced concrete conforming to the Water Department Standard Details and Specifications for Sewers and the Quality Assurance Program, except as may be required at special locations.
 - b) Where utility conflicts warrant, custom sized catch basins constructed of cast-in-place concrete or brick shall be substituted for the precast.
 - c) All pertinent casting shall also conform to the above standards.
4. Inlet Installation
 - a) Inlets shall be installed in accordance with the Water Department Standard Details and Specifications for Sewers.
 - b) For poor soil areas, special foundation requirements shall be provided, similar to that used on the sewer.
5. Inlet Pipes
 - a) Inlet pipes shall be 15" VCP
 - b) If inlet pipe grades exceed a 1 to 1 slope, a riser shall be used as detailed in the Philadelphia Water Department Standard Details and Specifications for Sewers.
 - c) Inlet pipes shall be connected to the sewer by wye branches as per Water Department Sewer Standards.
 - d) Any deviations from this policy will require prior approval by the supervisor of the Water & Sewer section.

F. Manholes

1. Size
 - a) Manhole risers typically are 4 foot in diameter.
 - b) 6 foot diameter manhole risers may be used where special conditions warrant.
2. Materials
 - a) Manholes and all their components shall conform to the Water Department's Standard Details and Specifications for Sewers and the Quality Assurance Program.
3. Location
 - a) Manholes shall be located at all locations of change of direction, grade or size of sewer.
 - b) Manholes shall also be placed so as to maintain a maximum distance between manholes of 300 feet for sewers 48" in diameter and under and 400 feet for sewers 54" and over in diameter.
4. Type
 - a) Whenever the upstream sewer invert elevation is higher than the downstream sewer invert elevation of a manhole by less than 2 feet, a standard manhole may be used.
 - b) If the difference between the inlet sewer invert elevation and the outlet sewer invert elevation is greater than 2 feet, a drop manhole shall be used for sanitary sewers, a wellhole shall be used for stormwater and combined sewers.
5. Manholes on Separate Systems
 - a) Where sanitary manholes are required on a separate system, the stormwater sewer will require a turn out to avoid the sanitary manhole.
 - b) The stormwater sewer shall require a manhole upstream of the turnout.
6. Drop Manholes
 - a) Wherever drop manholes are required they shall be designed in accordance with the Water Department's Standard Details and Specifications and the Quality Assurance Program.
 - b) The vertical pipe sewer shall be located on the exterior of the manhole and encased in concrete. In certain instances the vertical pipe sewer may be located inside the drop manhole. In such cases a 6' diameter manhole shall be used. This situation shall be detailed on the drawings. The 6' interior drop manhole shall be considered in depths exceeding 18'.
 - c) The manhole shall also have a cleanout for accessing the sanitary sewer.
 - d) All sewers upstream of a drop manhole shall have a manhole within 25' of the drop for maintenance purposes.
7. Wellholes
 - a) Wellholes shall be in accordance with the Water Department's Standard Details and Specifications and the Quality Assurance Program.

- b) Wellholes shall contain drip slabs to dissipate the energy of the storm flow between each wellhole riser section between the two pipes.
 - c) Where the flow is large, the velocity great, or the vertical drop large, granite block invert and drip slabs or special abrasive resistant concrete may be required.
 - d) All sewers both upstream and downstream of a wellhole shall have manholes for maintenance purposes, as wellholes are not man accessible. The upstream and downstream manholes shall be located within 25' of the wellhole where practicable.
8. Manhole or Wellhole structures below water table
- a) Manholes placed below the water table or sanitary manholes with inverts below 0.00 city datum, shall use an approved water tight gasket material around all openings into them to prevent infiltration.

G. Box Sewer Design

1. Design Criteria

- a) Box sewers shall be designed and constructed in accordance with the recommendations of ACI 350 Concrete Sanitary Engineering Structures.
- b) Design loading shall consist of a minimum H-20 loading at the street surface in addition to all other dead loads. If actual loading is greater, then use the larger loading condition. However, a minimum of 1200 psf shall be used.
- c) Minimum wall thickness shall be 12 inches.
- d) Minimum roof slab thickness shall be 12 inches.
- e) Minimum base slab thickness shall 15 inches.
- f) Minimum reinforcing bar size shall be #4.
- g) Since box sewers are typically formed on the interior only and the exterior face of the walls are poured against the trench sheathing, an additional 3" of cover should be added to the exterior face of the box sewer. This will allow for any variations in the sheathing. This additional 3" cover should not be included in the design, and is in addition to the minimum wall thickness in the previous paragraph.

2. Materials

- a) Concrete shall be ready-mixed and shall be batched, mixed, and transported in accordance with ASTM C94 - Standard Specification for Ready Mixed Concrete. Concrete shall have a 28 day compressive strength of 4000 psi and be air-entrained.
- b) Reinforcing steel shall consist of deformed steel bars that are rolled from new billet-steel and shall conform to ASTM A 615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. The bars shall be tested in accordance with ASTM A 370 - Standard Methods and Definitions for Mechanical Testing of Steel Products. All reinforcing steel shall be Grade 60.
- c) Rubber dumbbell type waterstops and vitrified clay liner plates shall be in accordance with specifications outlined in the Water Department's Standard Details and Specifications.

3. Inverts

- a) The invert of rectangular reinforced concrete combined or sanitary sewers shall be constructed with a 156° vee shape at 12° off the horizontal. Rectangular reinforced concrete stormwater conduits shall be constructed with flat inverts.
- b) For velocities over 12 feet per second vitrified clay liner plates, stone block, or redressed blocks shall be used for the invert, or other means of abrasion control should be used.

4. Construction Joints

- a) Transverse and longitudinal construction joints shall have a keyway 2 inches deep and 4 inches wide and a rubber dumbbell type waterstop.
- b) Transverse construction joints shall be constructed at the end of each section at a distance not to exceed 50 feet.

5. Connections and Transitions

- a) Transitions from existing sewers to box sewers of different sizes, or between two sections of different size box sewers, shall be done with flare sections.
- b) Flare sections shall not be counted in the quantity of linear feet of box sewer. They shall be separated for lump sum payment per each flare section.
- c) Connections between the existing sewers and the proposed box sewer shall be detailed.

H. Trunk Sewers

1. Trunk sewers are large combined flow sewers servicing large areas of the city which drain both sanitary and storm flow from smaller combined flow sewers servicing smaller areas of the city.
 - a) Typically Trunk Sewers flow toward the rivers and creeks, thereby toward the Intercepting Sewers.
 - b) Dry weather flow of the Trunk Sewers is diverted to the Intercepting Sewers via Intercepting Chambers.
 - c) During periods of wet weather, the volume of flow in the Trunk Sewer exceeds the capacity of the Intercepting Chamber's slot and forces the excess flow to go to the river. This is known as a Combined Sewer Overflow (CSO).

I. Intercepting Sewers

1. Intercepting Sewers (Interceptors) are the main sanitary sewers which service large areas of the city and carry the sanitary flow to the wastewater treatment facilities. These sewers have limited number of connections.
 - a) Connections usually consist of other sanitary sewers which service smaller portions of the city.
 - b) Lateral connections are typically not permitted into the Intercepting Sewers.
 - c) All connections into intercepting sewers must be specifically approved and connection details must be approved to insure integrity of the Intercepting Sewer System.
 - d) Intercepting Sewers are typically located along creeks and rivers as these are the naturally occurring low areas of the city.
 - e) Special precautions should be taken to limit any infiltration and/or exfiltration from the intercepting Sewer System.

J. Quantities for Sewer Work

1. Excavation
 - a) Excavation shall be calculated in cubic yards based on a payment width equal to the width of the standard concrete cradle width for pipe sewers and the outside faces of box sewers. See standard details & specifications for sewers.
 - b) The interior volume of the existing sewers is not included in the quantity for excavation.
 - c) The excavation quantity for inlet pipes, vent pipes, house laterals beyond sewer trench, etc., shall be calculated and included in the quantity for excavation.
 - d) For excavations less than 18' deep, where other reasons do not warrant or where good engineering judgment does not require steel soldier beams, timber sheathing is to be used, the sheathing and shoring shall not be included, but rather paid for the quantity used and left in place at the fixed unit price specified. The amount of sheathing and shoring shall be calculated and specified in the proposal.
 - e) For excavations greater than 18', or where other reasons warrant, or where good engineering judgment requires, sheathing and shoring including steel beams should be used. There may be instances where steel soldier beam sheathing and shoring may not be required such as areas where v-cut or step sheathing may be used. These special situations shall be evaluated on an individual basis and shall be approved by the supervisor of the Water & Sewer section.
2. Length of Pipe
 - a) The length of each size of pipe sewer or each combination of separate system sewers shall be calculated. Pipe length shall be calculated through manholes. Pipe length shall not be calculated through wellholes or drop manholes. Where there is a pipe size change at a manhole the larger pipe size shall extend through the manhole and be measured accordingly.
 - b) Use 4 feet of lateral piping for the quantity of lateral piping needed for each existing lateral connection, unless additional lateral piping is specified.
 - c) The length of inlet pipe shall be calculated separately.
3. Inlets
 - a) Number of inlets of each type shall be calculated separately.
4. Manholes
 - a) The number of each type of manhole (e.g. manholes for pipes 30" and under).
5. Paving
 - a) Repaving quantities in asphalt surfaced streets shall be calculated using the current Standard Details.

- b) Repaving quantities in concrete surfaced streets, concrete driveways and footways shall be based on replacement to the existing joints or a saw cut depending on the wording of the specifications.
 - c) Brick and slate footways are replaced in kind, with quantities approximated using the coefficients for asphalt surface repaving.
 - d) Binder quantities, when not specified by Streets Department, shall be based on a 1.5 inch thickness weighing 100 pounds per square yard per inch thick, and specified in tons.
 - e) Backfill in State Highways shall be (2RC) from 6 inches above the sewer to 1 foot below the surface. (2RC) is specified in tons (use 100 pound/cubic foot).
 - f) Concrete base in State Highways shall be 10 inches thick high-early strength concrete.
 - g) Concrete base in City Streets shall be 8 inches thick.
 - h) Repaving quantities in City and State Highways are specified separately.
 - i) Whenever a curb requires removal, the footway will require replacement to at least the first joint and the cartway shall be reconstructed for 2 feet from curb.
 - j) When the proposed sewer is located in a City Street so that the outside of the trench is within 3 feet or less from curb, the repaving shall extend from cutback line on one side, to the curb on the other. In addition the curb and one block of footway shall be evaluated for potential replacement.
 - k) When the proposed main is located in a State Highway so that the outside of the trench is within 4 feet or less from curb, the repaving shall extend from cutback on one side, to the curb on the other. In addition the curb and one block of footway shall be evaluated for potential replacement.
 - l) When the proposed water main is located in an intersection and crosses from State Highway to City Street, it shall be noted that the State Highway terminates at the curb line of the State Highway and the intersecting City Street begins. The paving quantities shall reflect this.
 - m) When the water trench is located near the sewer trench, the paving between trenches shall also be removed and repaved.
 - n) If the Streets Department paving requirements request additional paving to be added to the contract and will be paid for by the Streets Department, those quantities should be separated and placed in the proposal of the specifications as a separate section of P-items and an X should be added to the suffix of the work number. In addition the front office of the Design Branch shall be notified.
 - o) Where full width street restoration is required, a full width 6" stone sub-base shall be required. This will be a separate payment item.
6. Curb
- a) When the proposed main is located so that the outside of the trench is within 3 feet of the curb on City Streets or 4 feet on State Highways, valuation of the curb and footway to the first joint shall be performed.
 - b) Full width street reconstruction usually requires curb replacement which in turn requires the replacement of at least one paving block of footway.
7. Quantity Tabulation
- a) See Appendix IV for Sewer Reconstruction Quantity input sheet and Sewer Record of Data sheet.

K. CURED IN PLACE LINING (CIPP)

1. Sewer reconstruction may not be the preferred method to rehabilitate an existing sewer. Using a CIPP liner may be a consideration in many cases including the following:
 - a) heavy/severe utility conflict
 - b) under/alongside active rails
 - c) under/along streams/rivers/creeks
 - d) sanitary only replacement in separate sewer system areas
 - e) sensitive business areas
 - f) high traffic areas
 - g) downtown locations

2. If you are considering a CIPP liner replacement method, you must first get the Approval of a PWD Design Supervisor before pursuing the change in scope of work. If a significant utility conflict is found during the drafting of the base plans, the engineer or consultant shall contact a PWD Design Supervisor to discuss the potential for a trenchless solution (CIPP or other method). This may save unnecessary drafting hours/expense for a full base plan when one is not necessary for CIPP (See base plan requirements below).
3. The existing pipe size and capacity also must be a consideration. The sewer must not be in a surcharged condition, or need to be upsized. PWD Planning can determine the capacity of the existing sewer.
4. CONDITIONS for lining:
 - a) Circular sewers must not be out of round by more than 10% to 15%. A point repair may be completed prior to lining to fix the defect prior to lining. If there are many repairs required, reconstruction should again be considered.
 - b) Access to sewer manholes on both ends of the segment is required. A manhole may be added, if practical, to the end of a sewer segment to facilitate the lining. This would be built concurrent to the lining work if at all possible.
 - c) A sewer inspection video is REQUIRED on all potential lining projects.
 - d) A sewer video should be requested through a PWD Design Supervisor only. PWD Flow Control Unit will complete the video at their earliest convenience.
 - e) Once the video is completed, the condition of the sewer should be assessed.
 - f) If there are significant repairs required or the can not be lined, reconstruction or another method of replacement shall be discussed with a PWD Design Supervisor
5. Base plan requirements

The base plan requirements are much more limited than a standard base plan.

 - a) The city plan should be drawn to scale.
 - b) The sewer as-built location shall be called out including manholes, as well as the rim and invert elevations.
 - c) A chart showing the minimum liner thicknesses required including the sewer sizes, lengths and thicknesses to be lined.
 - d) An example of a completed lining base plan can be provided to the consultant as requested.
 - e) The sewer limits to be lined shall be called out in bold, including the manholes within the limits of the lining.
6. Design requirements

The following shall be required for all lining projects:

 - a) PWD Planning shall provide the Estimated Theoretical Dry Weather Flows for each location to be lined. A formal request must be submitted from a consultant to PWD Planning.
 - b) A liner thickness calculation shall be provided by the Engineer or Consultant using the ASTM F-1216.
7. Manhole lining
 - a) All manholes within the limits of CIPP rehabilitation shall be lined.
8. Specifications
 - a) SECTION 2705 MANHOLE LINING and SECTION 2768 SEWER LINING shall be added to all lining projects.

Section

6

Contract Review

A. Utility Review-Upon completion of the preliminary design, the project shall be submitted for review to the various City departments and other utilities. For in-house and Consultant projects, prior to submitting projects to utilities for review, the preliminary water and/or sewer designs shall be reviewed by the PWD Project Engineer and Water/Sewer Engineering Supervisor. Once these drawings have been reviewed and corrected they may be submitted to the various agencies, for their comments. The amount of time to complete the utility review process may vary greatly depending on the complexity of the project. Included in the utility review process may be further explanatory correspondence and/or meetings which may be required to satisfactorily coordinate the PWD's proposed work with other utility companies and agencies. Coordination with the Streets Department in regards to traffic maintenance, paving requirements and ADA ramp designs (where ramps will be impacted) is also a big part of the utility review process. See Appendix Vh for guidance regarding ADA ramp design requirements. See Appendix X for contact information for City of Philadelphia departments and city and private utilities.

1. Corrosion Control:

a) One set of water prints is sent to:

1) Corpro Companies, Inc.
1380 Enterprise Drive
West Chester, PA 19380
Attn.: Walter T. Young, PE

610-344-7002

(OR)

Cor-Trol Services, Ltd.
47 General Warren Blvd.
Malvern, PA 19355
Attn.: George Gehring, PE

484-786-9414

2). After a field investigation, a report will be returned recommending "Standard" corrosion control (sand backfill and coating of joints) or "Special" corrosion control measures, in which case specifications, cost estimates and/or plans will be provided for inclusion in the Contract Documents.

2. Assessments

a) For assessable jobs (those having an "A", "B", or "C" in the suffix of the Work No.) two sets of prints are sent to the appropriate District Surveyor (See Appendix Vd for a list of survey districts) to obtain the preliminary assessment and "deducts". This information shall be added to the Contract Drawings.

3. Paving Requirements

a) One set of prints and a letter of transmittal are sent to:

1) Streets Department
Municipal Services Building, 9th Floor, Room 940
1401 J.F. Kennedy Boulevard
Philadelphia, PA 19102-1675
Attn.: William Mautz

215-686-5511

4. Maintenance of Traffic Requirements

a) One set of prints and a letter of transmittal are sent to:

- 1) Streets Department
Municipal Services Building, 9th Floor, Room 980
1401 J.F. Kennedy Boulevard
Philadelphia, PA 19102-1675
Attn.: Patrick J. O'Donnell 215-686-5524
5. Fire Department
 - a) One set of prints of all water sheets marked according to the instructions as described elsewhere in this manual, are sent to:
 - 1) Philadelphia Fire Department
Planning & Research
240 Spring Garden Street
Philadelphia, PA 19123
Attn.: Lt. Anthony Reel 215-686-1354
6. Utility Review
 - a) One set of prints (except as noted) and a letter of transmittal are sent to the following utilities on all projects. Cable company submittals shall only be sent to the cable company servicing that area.
 - 1) Verizon
900 Race Street (6th Floor)
Philadelphia, PA 19107-2425
Attn.: Brian M. Magee 215-351-6051
 - 2) PECO Energy
830 South Schuylkill Avenue
Philadelphia, PA 19146
Attn.: Louis Robinson 215-731-3283
 - 3) PGW
800 West Montgomery Ave.
Philadelphia, PA 19122
Attn.: John Lennon 215-684-6368

Note: If it is expected that the gas main will fall within a 2 to 1 influence of the water main or sewer construction, please state such in the transmittal.

 - 4) SEPTA (2 sets of prints)
1234 Market St., 13th Floor
Philadelphia, PA 19107
Attn.: Amanda Robinson 215-580-8315
 - 5) Comcast Cablevision
4400 Wayne Avenue
Philadelphia, PA 19140
Attn.: Al Munson 215-920-2789
 - 6) Any other utility or agency which may be required due to their presence at a particular location.
7. Railroad Review
 - a) When proposed main parallels or crosses any rail structure, or Right-of-Way belonging to and/or operated by the railroads, eight sets of the appropriate plan (rolled not folded) showing elevations and profile in accordance with the railroad's pipeline occupancy specifications and requirements, along with three copies of a completed Railroad Crossing Form (Pipe Date Sheet) shall be sent to the appropriate railroad:
 - 1) Consolidated Rail Corp. (www.conrail.com)
1717 Arch Street, 32nd Floor
Philadelphia, PA 19103
Phone: 856-231-7233

Fax: 856-231-2432
 Attn: Anthony R. DiArenzo (Real Estate)

- 2) CSX Transportation, Inc. (www.csx.com)
 301 West Bay Street, Suite 900
 Jacksonville, Florida 32202
 Attn.: Corridor Occupancy Services (J180)
 Permitting Contact: Charlie Myers (phone: 904-633-1503)
- 3) Norfolk Southern Railway Company (www.nscorp.com)
 Applications for pipe crossings are submitted to:
 AECOM
 Attn: NS Pipe and Wire Administrator
 1700 Market Street, 16th Floor
 Philadelphia, PA 19103
 NSUtilities@aecom.com
- 4) AMTRAK (www.amtrak.com)
 30th Street Station
 Philadelphia, PA 19104
 Phone: 215-349-1108 / 4848
- 5) SEPTA (www.septa.org)
 1234 Market Street
 Philadelphia, PA 19107
 Attn: Lydia Grose (lgrose@septa.org)
 Phone: 215-580-8255 / 215-964-4578

A copy of the correspondence shall be sent to the following:

- 1) Philadelphia Water Department
 ARA Tower, 2nd Floor
 1101 Market Street
 Philadelphia, PA 19107
 Attn.: Mr. Brian Mohl, Manager Capital Program 215-685-6339
- 2) Philadelphia Water Department
 ARA Tower, 2nd Floor
 1101 Market Street
 Philadelphia PA 191 07
 Attn.: Mr. Michael Lavery, Manager, Design Branch 215-685-6280

Private Cost Contracts shall be submitted to Railroad by the developer.

Projects designed by consultants shall be submitted to the railroad directly.

- b) All projects involving railroad review shall be discussed with the Supervisor of the water/sewer Section during the design phase.

8. Street Trees

- a) When the proposed main is in City streets, 2 sets of plans shall be sent to:

- 1) Philadelphia Parks and Recreation
 Street Tree Management Division Office
 1515 Arch Street, 10th Floor
 Philadelphia, PA 19102
 Attn: Frances Piller, District Manager

9. Work in Fairmount Park

- a) When the proposed main is located in Fairmount Park, Plans shall be sent to:

1) Philadelphia Parks and Recreation
 1515 Arch Street, 10th Floor
 Philadelphia, PA 19102
 Attn.: Stephanie Craighead
 Phone: 215-683-0210

10. Water Department

- a) For designs done by Water Department Design Branch, one (1) set of prints shall be sent to the Planning Unit, prior to submittal of the plans to the other utilities and prior to submittal to Water Operations and Collector Systems. Upon receipt of Planning Unit's comments, Design Branch shall submit the plans for utility review to all the other utilities and to Water Operations and Collector Systems. Three (3) sets of prints shall be sent to Water Operations, and two (2) sets of prints shall be sent to Collector Systems.
- b) For designs done by others, three (3) sets of prints shall be sent to Water Operations, two (2) to Collector Systems, one (1) to the planning unit, and two (2) sets of preliminary design plans shall be sent to the Water Department Design Branch for review. Water Operations, Collector Systems and the Planning Unit shall forward their comments to the Design Branch. Water Operations will comment on the design as well as provide valve numbers for all valves existing and proposed on the project. Collector systems will comment on the design as well as provide manhole numbers for all manholes existing and proposed on the project. Comments from all the units will be addressed by the Design Branch in one review.
- c) Plans shall be sent to the following:

- a) Philadelphia Water Department-Design Branch
 ARA Tower, 2nd Floor
 1101 Market Street
 Philadelphia PA 19107
 ATTN.: Mr. Michael Lavery, Manager, Design Branch 215-685-6280
- b) Philadelphia Water Department-Planning Unit
 ARA Tower, 2nd Floor
 1101 Market Street
 Philadelphia PA 19107
 ATTN: Manager, Planning & Research 215-685-6324
- c) Philadelphia Water Department-Water Operations
 ARA Tower, 2nd Floor
 1101 Market Street
 Philadelphia PA 19107
 ATTN.: Mr. James Brady, P.E., Chief, Water Operations 215-685-9591
- d) Philadelphia Water Department-Collector Systems
 ARA Tower, 4th Floor
 1101 Market Street
 Philadelphia PA 19107
 ATTN.: Mr. Mark Waas, P.E., Chief, Collector Systems 215-685-6203

- d) The sewer sheets of all sewer projects shall be reviewed by the Water Department's Design Branch.

Section

7

Contract Finalization

A. Checking

1. Upon receipt of the utility responses the Engineer shall evaluate all utility comments and check the final design for conformance to the Water Department standards as well as for good engineering judgment.
2. The Engineer shall verify all the existing utilities as well as check the new design. On Consultant projects, the Water Department's Engineer only checks the Consultant's design.
3. Upon completion of the checking process the Engineer shall review the drawings with the Water/Sewer Engineering Supervisor. The PWD's Water/Sewer Engineering Supervisor shall give the okay for final mylar drawings to be printed for both in-house and Consultant projects. For in-house projects, the mylar drawings shall be signed by the Project Engineer, the Water/Sewer Engineering Supervisor and the Chief of Design. For Consultant projects, the signatures shall be provided by the appropriate counterparts in their organization and the drawings shall be stamped by a Professional Engineer licensed in Pennsylvania.

B. Quantities

1. Once the final design is approved the Engineer shall calculate the final quantities. Two (2) independent sets of quantities must be prepared on each project. Any discrepancies between the two (2) sets of quantities should be resolved at this time.
2. The final quantities shall be placed on an input sheet and given to the Specifications Section along with any special verbiage required to be incorporated into the specifications. See Appendix IV for both water and sewer input sheets. Consultants need not supply the Water Department with input sheets as they are an in-house design aid.
3. For projects done by Consultants the method may vary; however, it is strongly recommended that two sets of quantities are prepared to avoid errors and/or omissions.

C. Specifications

1. For in-house projects, the Engineer shall forward the following to the Specifications Section in order for them to prepare the final specifications:
 - Front Office specification folder for the particular project. Folder should contain one (1) copy of all utility responses, except paving and gas where two (2) copies are required. The specification folder shall also contain one (1) copy of the service list.
 - One (1) set of prints
 - Quantity Input sheets
 - Traffic requirements, if unusual, otherwise the Specification Section shall provide the traffic requirements.
 - One (1) copies of the rodent control plan. (Sewer projects only)
 - List of return plan reference drawings. (Sewer projects only)
 - List of reference contract drawings. (Sewer projects only)
 - Borings if required.
 - Any special details or paragraphs particular to the specific project.
2. The Specifications Section shall prepare the final specifications using the input sheet and any specific comments pertinent to that project
3. The Specifications Section shall prepare the Engineer's estimate for the contract
4. Upon completion of the specifications, they are returned to the Engineer for his final inspection and approval. It shall be the Engineer's responsibility to insure that the specifications were prepared as required and that all appurtenant paragraphs are included in the final specification.

5. For Consultant projects, the specifications and estimate shall be prepared by the Consultant and submitted to Design Branch for final review and approval.

D. Highway Permit Application

1. The Engineer shall prepare an excel spread sheet with the locations of the pipes to be built as part of the project. The spread sheet shall be down loaded into the Streets Department's Guaranteed Paving Information System (GPIS) for utility review prior to issuance of a Highway Opening Permit Application. (See Appendix Vb for a sample Excel spreadsheet)
2. For projects done by Consultants, the Consultant shall prepare the excel spread sheet and submit it as part of their final design package to the Water Department. The Water Department will upload the spreadsheet into the GPIS system. The Consultant shall not prepare the GPIS spreadsheet until the design drawings have been approved by the PWD Water/Sewer Engineering Supervisor.

E. Finalization

1. Once the Engineer has completed the final inspection they shall package the following items together in a manila envelope and submit it to the Water/Sewer Supervisor.
 - Memo from PWD Water/Sewer Engineering Supervisor approving final plans & specs.
 - 1 set of mylar drawings (signed & rolled)
 - 2 sets of prints (1 rolled & 1 folded)
 - 1 copy of the PGW response letter
 - 1 copy of the Philadelphia Streets Department paving response letter
 - 1 copy of the specifications
 - CD or DVD containing the following electronic documents: specifications in Microsoft Word format, design drawings in AutoCAD or Micro-Station format, GPIS spreadsheet in Microsoft Excel format, engineer's estimate of construction cost in Microsoft Excel format, one copy of each utility response letter in Adobe PDF format
 - 1 Transmittal of tracings form
2. Consultants shall forward the package to the Chief of Design. In addition to the items listed on the Final Design Package Checklist in the Enclosures section, the consultant should submit one (1) Letter of Transmittal with Engineer's estimate. For consultants the Transmittal of tracings form will be prepared by the Water Department Design Branch.
3. At this time the contract package is forwarded to Projects Control to advertise, bid and award the contract.
4. At this time projects are considered completed and consultants can bill the Water Department for the design.

F. Addendums

1. If during the course of advertising the contract it becomes necessary to modify the contract in anyway, an addendum shall be prepared.
2. All addendums shall be prepared in accordance with the Guidelines for Preparing Addendums. (See Appendix IX)
3. Addendums required for projects prepared by consultants due to errors, omissions, negligence, or poor engineering judgment of the consultant, shall be prepared by the consultant at no additional cost to the City.
4. All addendums shall be approved by the PWD Water/Sewer Engineering Supervisor before forwarding to the Projects Control Unit. Consultants shall forward addendums to the Design Branch, who in turn, will forward them to the Projects Control Unit.
5. In addition the Engineer's estimate should be revised, and shall accompany the addendum.

Section

8

Consultant Billing

A. General:

1. All locations assigned to a particular work number shall be billed for only one invoice.
2. All invoices shall stipulate the amount remaining in the contract after deducting the amount of that particular invoice.
3. All invoices shall reference the Water Department work number for that particular project and the Consultant's contract number with the City.

B. Submittals:

1. Payment for final design shall not be made until the Consultant has submitted all of the documents required for contract finalization. At that time an acceptance letter will be issued.
2. For unit price invoicing, the Consultant shall submit their linear foot estimates along with the invoice as payment for base plans and design work is based on a linear foot unit price. The invoice must also include a copy of the approval letters for the base plans and the final design package.
3. For hourly invoicing, Consultant shall submit employee time sheets with the invoice to document all work hours covered by the invoice.
4. Consultant shall submit a contract summary spread sheet along with each invoice summarizing the amount invoiced for each project assigned and the amount remaining in the contract.

C. Water and/or Sewer Design Work:

1. Typically on water-only projects, Consultants are given both the base plan and the design portions of the project.
2. Sewer projects may be sewer only or may be both water and sewer for any given location.
3. Consultants may submit invoices for base plan preparation at the completion and acceptance of the base plans by the Water Department, Planning Unit. Once the consultant receives the hydraulic recommendations and approval letter from the Planning Unit they may submit an invoice for the base plan portion of the work.
4. Consultants may submit invoices for a partial payment of 50% of the design fee once preliminary design plans have been submitted to the Water Department, no approval letter necessary. Consultants may invoice for the remainder of the design fee at the completion of the design process. The project is considered complete when the Water Department has reviewed and accepted the final plans, specifications, estimate, etc.
5. If given only the base plan portion or only the design portion of the work, the consultant may bill the Water Department upon completion of the Water Department review and acceptance of that particular portion.
6. Consultants shall submit the base plan or design invoice for all locations of a specific work number at one time in order to minimize billing paperwork. Partial submittals will not be accepted.

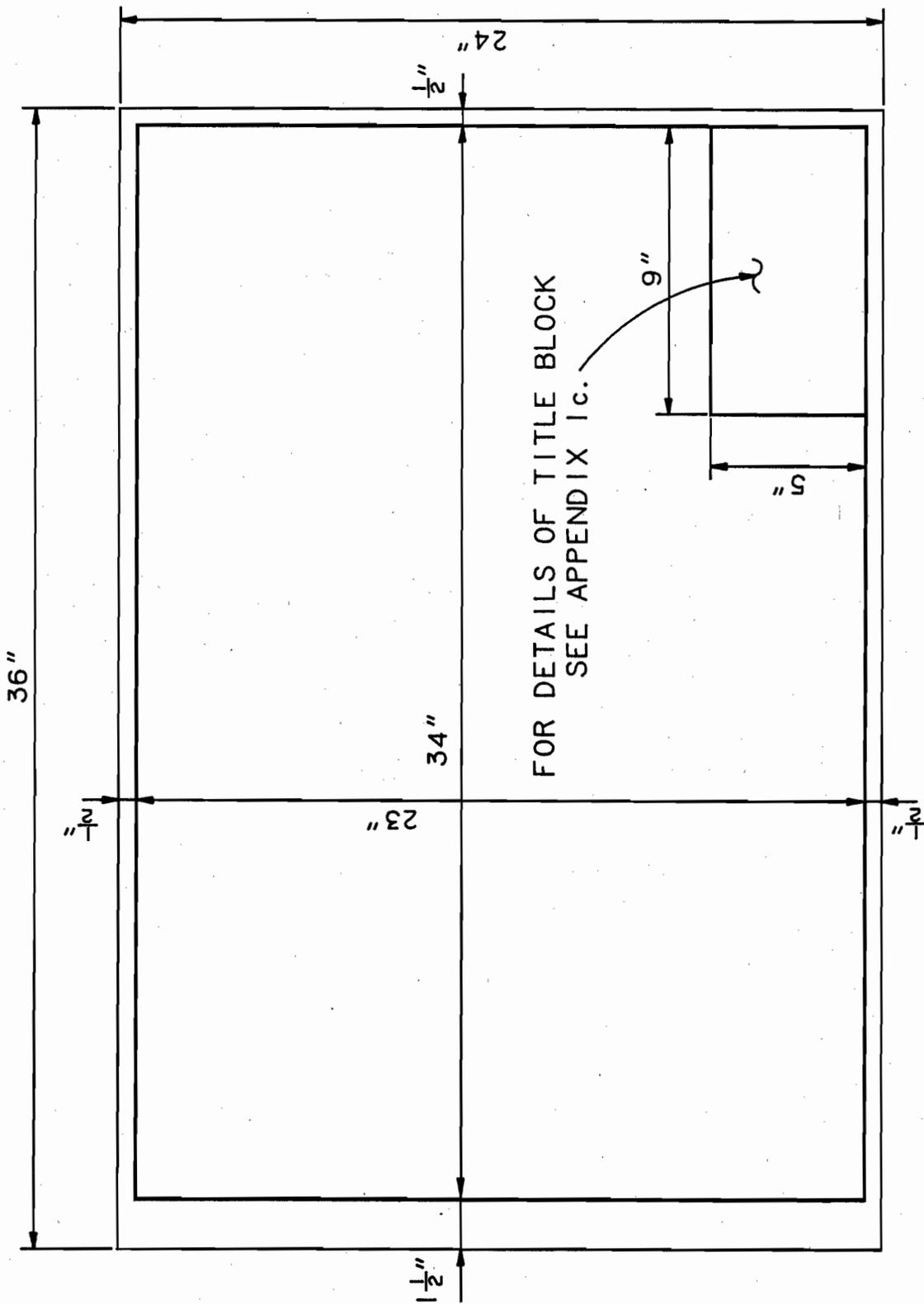
D. Corrosion Control

1. The corrosion control engineering service shall be paid for by the Water Department directly to the corrosion control consultant. The corrosion control consultant shall invoice the Water Department directly. In addition, the Water Department shall receive a copy of the corrosion control report along with prints of the corrosion control plans if required.

Appendix

I

- a - Drawing Size and Borders (Water)
- b - Drawing Size and Borders (Sewer)
- c - Title Block (Water Drawing)
- d - Title Block (Sewer Drawing)



A1A

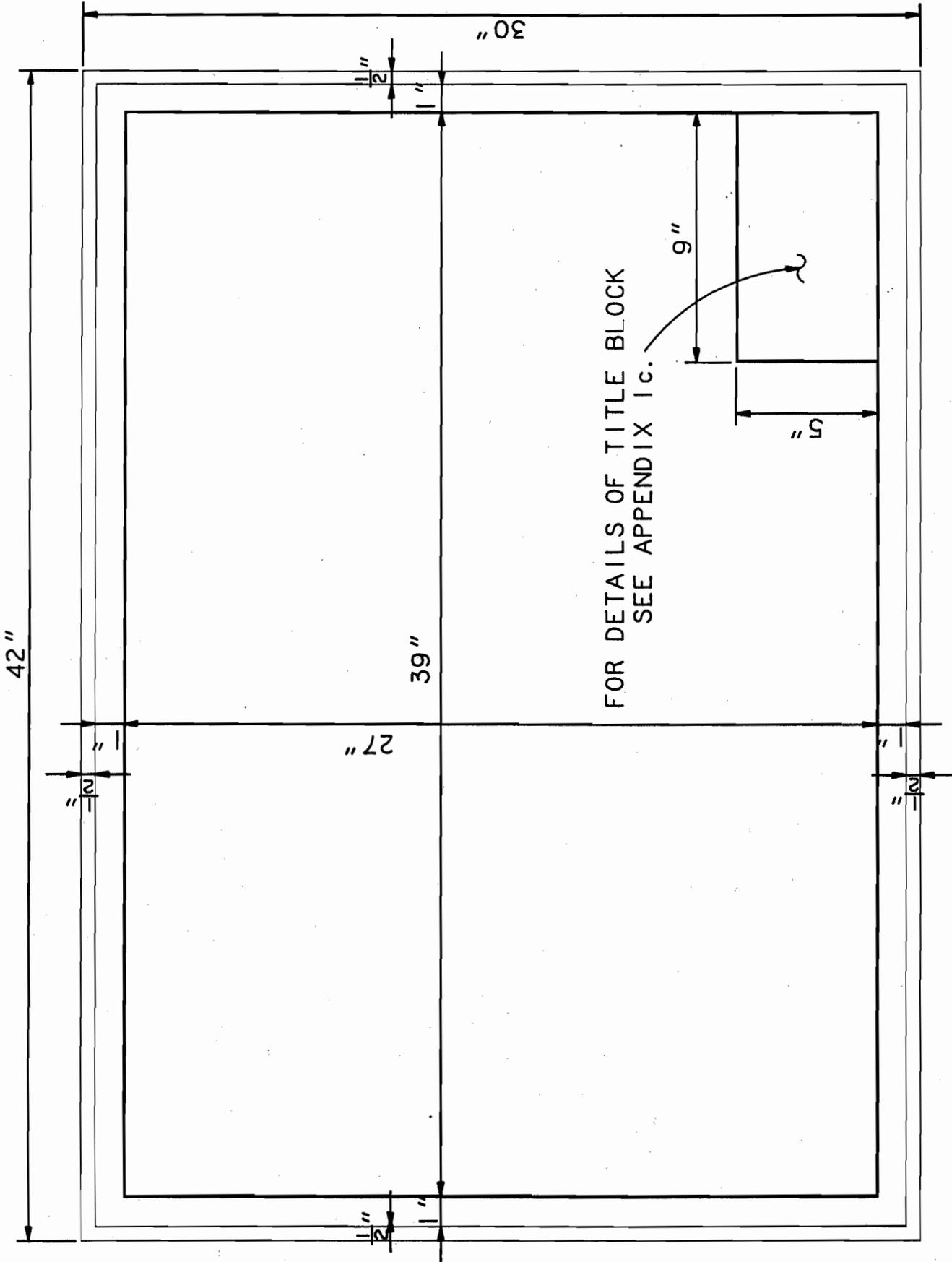


APPENDIX Ia.
Border Size - Water

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A1B



APPENDIX Ib.
Border Size - Sewer

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APPENDIX Ic
Title Block - Water

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OF

NOTICE: 

PURSUANT TO THE REQUIREMENTS OF PENNSYLVANIA ACT 287 OF 1974 (THE UNDERGROUND UTILITY LINE PROTECTION ACT), AS AMENDED BY PA ACT 199 OF 2004, THE CONTRACTOR SHALL CONTACT THE PENNSYLVANIA ONE CALL SYSTEM AT 1-800-242-1776, AT LEAST 3 DAYS PRIOR TO EXCAVATION.

HIGHWAY DISTRICT NO. 11 WARD NO. 22

SURVEY DISTRICT NO. 33 WATER PLAT NO. 44

ONE CALL SERIAL NO. 12345678

WATER MAIN RELAY PROJECT

MARKET STREET

FROM

2ND STREET

TO

3RD STREET

14"

APPROVED

CHIEF, DESIGN BRANCH, ENGINEERING DIVISION

APPROVED

GENERAL MANAGER, PLANNING AND ENGINEERING

APPROVED

WATER COMMISSIONER

CITY OF PHILADELPHIA
WATER DEPARTMENT

SCALES:

PLAN 1" = 20'
AND AS NOTED

WORK NO. W-12345D

SHEET NO. W-1 OF 2 SHEETS

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APPENDIX Id
Title Block - Sewer

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PAGE NO.

OF

NOTICE: $\frac{1}{4}$ "

PURSUANT TO THE REQUIREMENTS OF PENNSYLVANIA ACT 287 OF 1974 (THE UNDERGROUND UTILITY LINE PROTECTION ACT), AS AMENDED BY PA ACT 199 OF 2004, THE CONTRACTOR SHALL CONTACT THE PENNSYLVANIA ONE CALL SYSTEM AT 1-800-242-1776, AT LEAST 3 DAYS PRIOR TO EXCAVATION.

HIGHWAY DISTRICT NO. _____ WARD NO. _____
 SURVEY DISTRICT NO. _____ DRAINAGE SHT. NO. _____ OUTFALL NO. _____
 ONE CALL SERIAL NO. _____

$\frac{1}{2}$ "

SEWER REHABILITATION PROJECT

MARKET STREET $\frac{1}{2}$ "

FROM $\frac{1}{2}$ "

TO $\frac{1}{2}$ "

2ND STREET $\frac{1}{2}$ "

3RD STREET $\frac{1}{2}$ "

$\frac{1}{4}$ "

APPROVED

CHIEF, DESIGN BRANCH, ENGINEERING DIVISION $\frac{1}{8}$ "

APPROVED

GENERAL MANAGER, PLANNING AND ENGINEERING

APPROVED

WATER COMMISSIONER $\frac{1}{4}$ "

CITY OF PHILADELPHIA $\frac{1}{2}$ "

WATER DEPARTMENT $\frac{1}{2}$ "

SCALES:

PLAN 1" = 20'

PROFILE 1" = 20'

HORZ. 1" = 5'

VERT. 1" = 5'

WORK NO. S-12345D $\frac{1}{2}$ "

SHEET NO. S-1 OF 2 SHEETS $\frac{1}{2}$ "

$\frac{1}{8}$ "

DRAWN BY	
PROJECT ENGR.	
SUPERVISOR	
DATE	

Appendix

III

a - Symbols and abbreviations

b - Lettering

c - Utility Line Styles

Legend Items

□V	Vent Box - Sewer
□G	Gas Box
□W	Water Box
□?	Unknown Curb Box
○P	Pole
○LP	Lamp Post
○IP	Iron Post
○	Bollard
● PM	Parking Meter
⊖	PE Pole
⊖*	PE Pole W/Light
○SP	SEPTA Pole
○TS	Traffic Sign
○TL	Traffic Light
⊕ 6"	Tree W/Trunk Size In "
⊕ 10"	Tree Stump W/Trunk Size In "
⊖	Hedge
○FH	Fire Hydrant
○FA	Fire Alarm Box
○STP	Standpipe
Ⓣ	Electrolysis Test Station
<u>Door</u>	Door Sill
H/R	Handicapped Ramp
	Driveway
○CC	Coal Chute
○DS	Down Spout
□MB	Mail Box
CATV	Cable TV Access Box
Traffic Control	Traffic Signal Controller
Phone	Pay Phone
GRATE	Steam Grate
○	Sewer Manhole
○	Manhole Symbol For The Following - BTCo, PECo, EB, KTCo, SEPTA, AT&T, & CATV
⊕	Manhole Lid Of Unknown Origin
○	Water Or Gas Valve
#1	Old Grate Inlet, No's. 1, 2, 3, & 4
#1	Old Open Mouth Inlet, No's. 1, 2, 3, & 4

⊗	Cellar Door
□SS	Survey Stone
×-×-×	Fence - Any Type
≡	Steps
▧	Porch
⊞	Window Grate
Bus Shelter	SEPTA Bus Shelter
Bench	Bench
○	Trash Receptacle
C. Curb	Concrete Curb
Asphalt Paving	
Macadam Paving	
Bituminous Paving	
Concrete Paving	
Parking Lot	
Vacant Lot	
Grass	
C. Ftw.	Concrete Footway
Br. Ftw.	Brick Footway
Sl. Ftw.	Slate Footway
Gr. Ftw.	Granite Footway
Br. Gutter	Brick Gutter
C. Dr.	Concrete Driveway
S.R.L.	Sewer Return Location
S.R.E.	Sewer Return Elevation
Dep. Curb	Depressed Curb
Gr. Curb	Granite Curb
Blue St. Curb	Blue Stone Curb
St. Wall	Stone Wall
Br. Wall	Brick Wall
C. Wall	Concrete Wall

A111



APPENDIX IIa

Symbols & Abbreviations

CHECKED BY: _____

PAGE NO. _____

of _____

Various Standard Arrow Symbols



*Standard North
Arrow - Shown
Full Size.*



*Curb Flow Arrow - On Sewer
Plans Only. Place On Curb
Lines To Indicate Direction
Of Stormwater Flow In Gutter.*

NO PARKING
PARKING

ST.



← PARKING
NO PARKING →

*Two Way Traffic
Three Operating Lanes
Parking North Side
No Parking South Side*

ST.

PARKING
PARKING

ANY STREET

1st.

*To Be Ascertained During Field Trip.
Existing Parking Conditions On Main And
Cross Streets As Shown On Plan.*

2nd.

*Arrow Indicates Traffic Direction.
Number Of Arrows Indicate Operating Lanes.*

A112



APPENDIX IIa (cont'd) Symbols & Abbreviations

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of _____

Standard Water Main Fittings

NEW - As They Appear On The Water Contract Drawing.	NEW - As They Appear On The Sewer Contract Drawing.	EXISTING - As They Appear On Water & Sewer Contract Drawings.	SYMBOL DESCRIPTION
			<i>90° Bend</i>
			<i>45° Bend</i>
			<i>22 1/2° Bend</i>
			<i>11 1/2° Bend</i>
			<i>Cross</i>
			<i>Tee</i>
			<i>Cap</i>
			<i>Plug</i>
			<i>Reducer</i>
			<i>Valve</i>
			<i>Sleeve</i>
			<i>Offset</i>
			<i>Air Valve</i>
			<i>Blow Off</i>
			<i>Hydrant - Standard</i>
			<i>Hydrant - Super Pumper</i>
			<i>Hydrant - High Pressure Fire Service</i>

A113



APPENDIX IIa (cont'd) Symbols & Abbreviations

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PAGE NO. _____

of _____

Manholes And Concrete Collar

NEW - As They Appear On The Sewer Contract Drawing.	NEW - As They Appear On The Water Contract Drawing.	EXISTING - As They Appear On Water & Sewer Contract Drawings.	Symbol Description
    	    	    	<p><i>Manhole - Stormwater Or Sanitary</i></p> <p><i>Wellhole</i></p> <p><i>Drop Manhole</i></p> <p><i>Special Manhole</i></p> <p><i>Interior Drop Manhole</i></p>
			<p><i>Concrete Collar</i></p>

A116



APPENDIX IIa (cont'd) Symbols & Abbreviations

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of _____

Inlets

<i>NEW - As They Would Appear on a Sewer Contract Drawing</i>	<i>NEW - As They Would Appear on a Water Contract Drawing</i>	<i>EXISTING - As They Would Appear on a Water or Sewer Contract Drawing</i>	<i>Symbol Description</i>
			4' Open Mouth Grate
			4' City
			4' Highway Grate
			4' Vane Grate
			6' Open Mouth Grate
			6' City
			6' Highway Grate
			6' Vane Grate



APPENDIX IIa (Cont'd)
Symbols and Abbreviations

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OF

Street Names - Upper Case, Arial bold font

BELGRADE STREET

NO PARKING
PARKING 

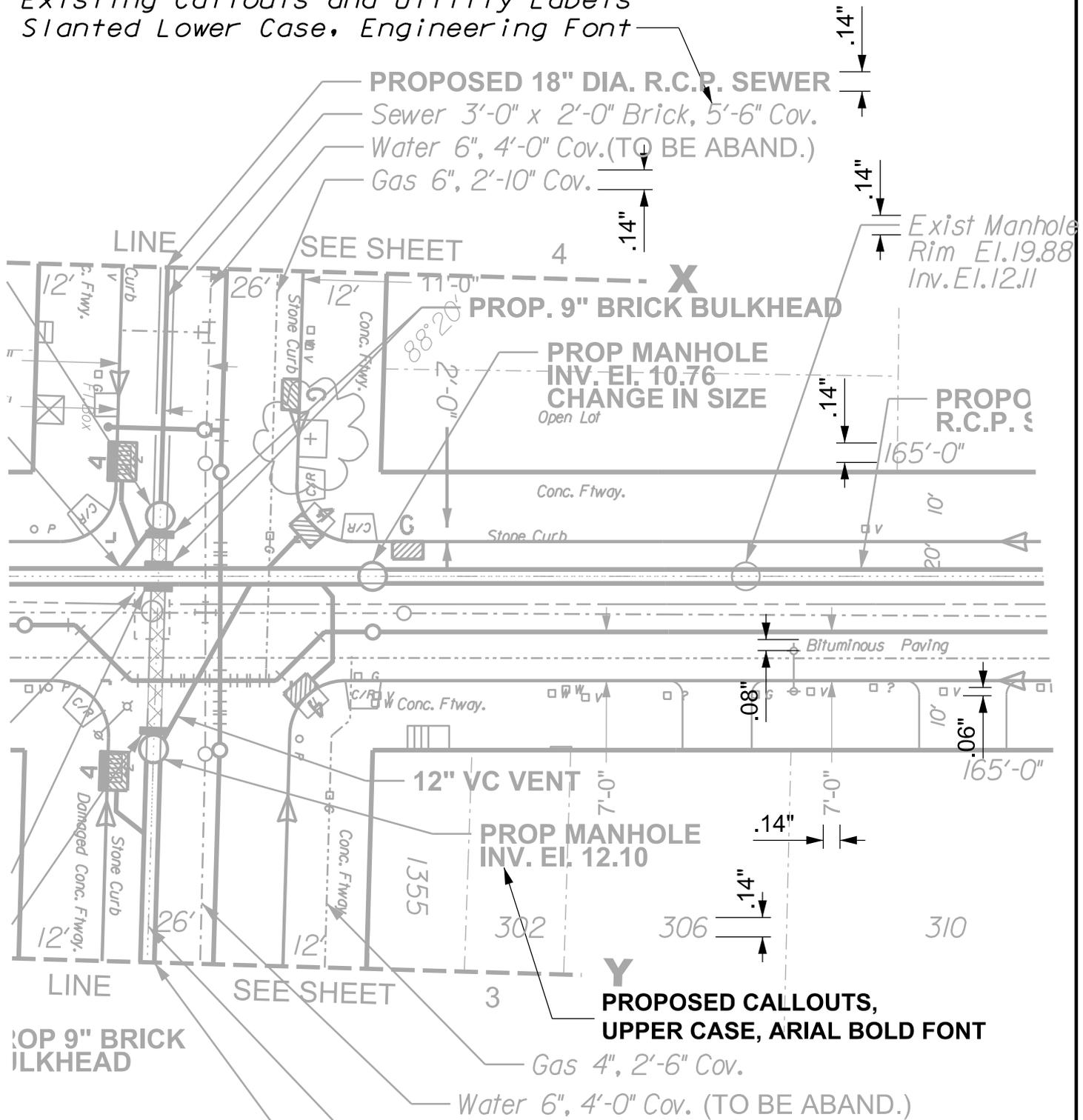
Existing Callouts and Utility Labels
Slanted Lower Case, Engineering Font

PROPOSED 18" DIA. R.C.P. SEWER

Sewer 3'-0" x 2'-0" Brick, 5'-6" Cov.

Water 6", 4'-0" Cov. (TO BE ABAND.)

Gas 6", 2'-10" Cov.



PROP. 9" BRICK BULKHEAD

PROP MANHOLE

INV. EI. 10.76

CHANGE IN SIZE

Open Lot

PROPO
R.C.P. S

PROP 9" BRICK
BULKHEAD

PROPOSED CALLOUTS,
UPPER CASE, ARIAL BOLD FONT

Gas 4", 2'-6" Cov.

Water 6", 4'-0" Cov. (TO BE ABAND.)

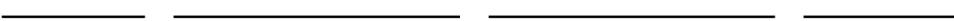


APPENDIX I Ib Lettering

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PAGE NO.

OF

	Houseline	1.5mm
	Curbline	1.25mm
	Ex. Water Line	.5mm
	Gas Line	.5mm
	Ex. Sewer Line	.5mm
	Verizon Line	.5mm
	PECo Line	.5mm
	Railroad	.5mm
	Proposed Water Main	1.5mm
	Proposed Sewer	1.5mm
	Proposed Water Main (on Sewer Sheet)	1.5mm
	Proposed Sewer (on Water Sheet)	1.5mm



APPENDIX IIc Linestyles

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OF



- a - Standard Notes for Water and Sewer Sheets
- b - Preferred Inlet Locations

NOTES:

- ① REMOVE FRAME & COVER - SEE SPEC'S.
- ② REMOVE FIRE HYDRANT - SEE SPEC'S.
- ③ REMOVE PIPE AND/OR FITTING & RECONNECT.
- ④ ROTATE FITTINGS AS REQUIRED.

GENERAL NOTES:

- EXISTING WATER MAINS SHALL BE CUT & PLUGGED AS APPROVED BY THE CITY ENGINEER.
- THE CONTRACTOR SHALL MAINTAIN A MINIMUM 6-INCH CLEARANCE BETWEEN ALL UNDERGROUND STRUCTURES AND THE NEW WATER MAINS.
- BILLS OF MATERIAL AND PIPE TOTALS ARE FOR THE CONVENIENCE OF THE CONTRACTOR ONLY AND PAYMENT WILL BE MADE ONLY FOR THE ACTUAL AMOUNT OF PIPE AND APPURTENANCES INSTALLED.
- FIRE HYDRANTS SHALL NOT BE CONSTRUCTED OR RELOCATED UNTIL SUCH LOCATIONS HAVE BEEN APPROVED BY THE WATER DEPARTMENT CONSTRUCTION DIVISION IN THE FIELD.
- ALL DISTANCES SHOWN ARE IN DISTRICT STANDARD MEASUREMENT.

A111D



APPENDIX IIIa
Standard Water Notes

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NOTES:

ALL DISTANCES SHOWN ARE IN DISTRICT STANDARD MEASUREMENT. PAYMENT FOR ALL WORK WILL BE BASED UPON THAT STANDARD.

THE LOCATIONS AND ELEVATIONS OF THE EXISTING SEWERS ARE APPROXIMATE. THE ELEVATIONS OF THE EXISTING SEWER AT THE TERMINATING CONNECTION POINTS TO THE PROPOSED SEWER MUST BE FIELD CHECKED PRIOR TO CONSTRUCTING THE NEW SEWER.

THE THICKNESS OF THE ARCHES AND THE CHARACTER AND THE EXTENT OF THE CRADLES OF THE EXISTING SEWERS ARE UNKNOWN

SEAL OPEN ENDS OF SEWER WITH VITRIFIED PIPE STOPPERS AND OPEN ENDS OF STORMWATER CONDUITS WITH BRICK BULHEADS.

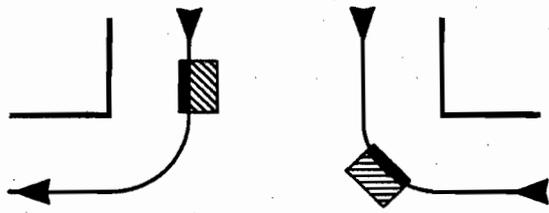
REMOVE EXISTING PIPE STOPPERS AND BRICK BULKHEADS PRIOR TO CONNECTING TO EXISTING SEWERS OR STORMWATER CONDUITS.

REGISTERED PROPERTY OWNERS' NAMES AND ZONING CLASSIFICATIONS ARE CORRECT AS OF / / THE DATE THE SEWER BASE PLAN WAS APPROVED.

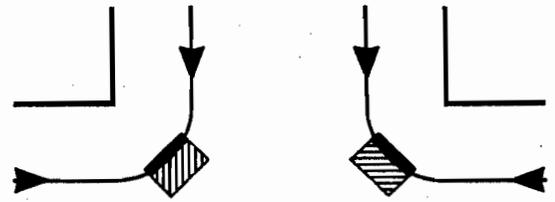
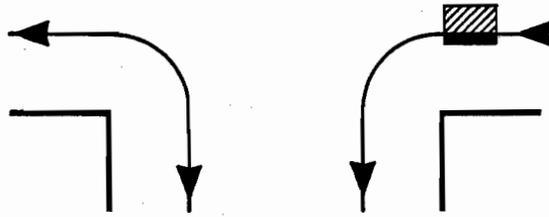
- Ⓐ DENOTES EXISTING INLET TO BE ABANDONED.
- Ⓡ DENOTES EXISTING INLET TO BE RECONNECTED.
- Ⓞ DENOTES 4 FT. CITY INLET.
- Ⓟ DENOTES 6 FT. CITY INLET.
- ▨ Ⓞ DENOTES 4 FT. OPEN MOUTH GRATE INLET.
- ▨ Ⓟ DENOTES 6 FT. OPEN MOUTH GRATE INLET.
- ▧ Ⓞ DENOTES 4 FT. HIGHWAY GRATE INLET.
- ▧ Ⓟ DENOTES 6 FT. HIGHWAY GRATE INLET.



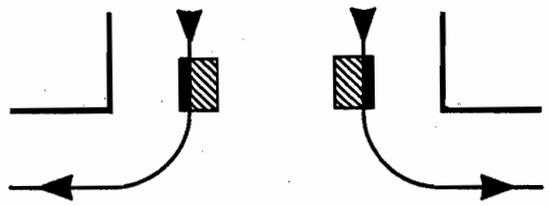
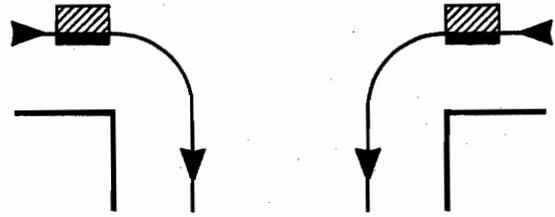
APPENDIX IIa (Cont'd)
Symbols and Abbreviations



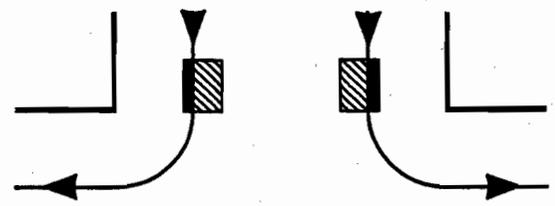
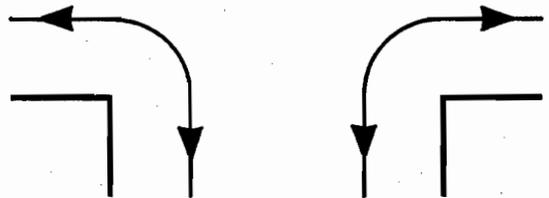
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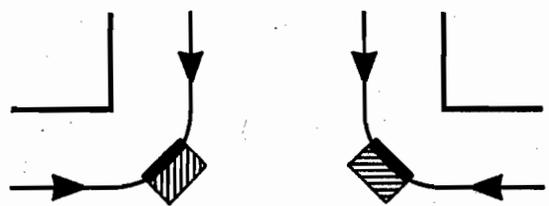
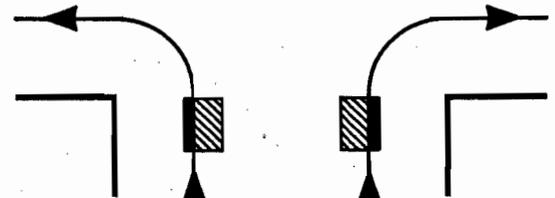
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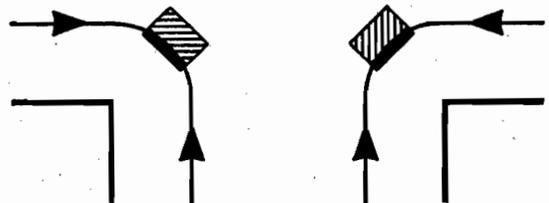
3



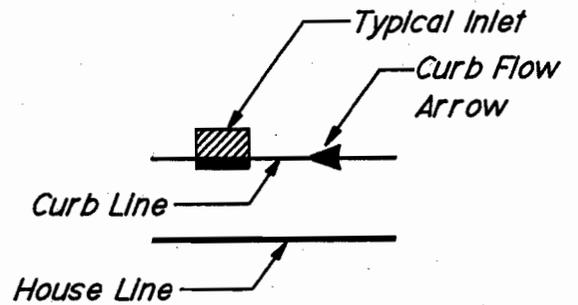
4



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Legend:



A115



APPENDIX IIIb
Preferred Inlet Locations

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of



Sewer Record Sheet

Sewer Reconstruction Quantity Input Sheet

Water Record Sheet

Water Relay Quantity Input Sheet (City Paving)

Water Relay Quantity Input Sheet (State Route Paving)

Legend for Fire Dept Review of Hydrant Elimination

Sewer

Record of Data for Sewer Work.....City of Philadelphia Water Dept.

Contract No.		Location
Date Received		
Prepared By	Date	

Items	Size	Qty.	Unit	Item #
Excavation (for pipe sewers)			CY	S1000
Sheathing & Shoring			MBM	S1050
RC Pipe (on conc. cradle)	18"		LF	S3018
"	21"		"	S3021
"	24"		"	S3024
"	30"		"	S3030
"	36"		"	S3036
VC Pipe (not in conc. cradle)				
Lateral Connection (house)	6"		LF	S7006
Vent Connection	12"		"	S7212
Inlet Connection	15"		"	S7215
Manholes:				
30" & Under			EA.	S8010
36" & Over			"	S8020
Inlets:				
4' Open Mouth Grate			EA.	S8100
4' City			"	S8104
4' Highway Grate			"	S8106
Grout (fill for aband. pipes)			CY	S8200

Paving Items	Qty.	Unit	Item #
Conc. Curb (min. 25 lf)		LF	S9000
Conc. Footway (min. 25 sy)		SY	S9003
8" Conc. Driveway (min. 25 sy)		"	S9009
Milling		"	S9105
Subbase, 6" depth (incl subgrad'g)		"	S9204
(Use Item # S9204 when conc. base restoration exceeds 50% of a street)			
Topsoil & Sod (min. 25 sy)		"	S9302
8" Conc. Base - City Streets		"	S9400
10" H.E.S. Conc. Base - State Hwy		"	S9402
Variable Depth Superpave Binder		Tons	S9411
Superpave Wearing Course 1-1/2"		SY	S9418
Superpave Paving 1-1/2" x 1-1/2"		"	S9447
10" Finished Concrete Paving		"	S9436
ADA Compliant Curb Ramp		EA	S9512

Traffic Requirements: Approved By: _____

_____ Normal Working Hours: 7:00 a.m. to 3:30 p.m.

_____ Restricted Working Hours: 9:00 a.m. to 4:00 p.m. or _____ to _____

For: _____ Entire Job

_____ Specific Blocks or Intersections

_____ Night Work, Hours: _____ to _____

Note: Additional requirements can be attached.

Traffic (lump Sum) \$ _____ W9500

Streets Dept. Items			
Milling		SY	P9105
Asphalt Wearing Course 1-1/2"		"	P9407
Asphalt Paving 1-1/2" x 1-1/2"		"	P9422
Misc. Items			

1. Total no. of sewer sheets..... EA.

2. Total length of all sewers:

(a) combined system..... LF

(b) separate system..... LF

(c) box sewer..... LF

(exclude lateral, vent & inlet connections)

3. Total length of sewer base plan/s

(a) prepared by Survey..... LF

(b) prepared by Survey & Design..... LF

(c) prepared by Consultants..... LF

(d) prepared by Consultants..... LF

5. Engineer(s): _____

6. Drafted by: _____

LEGEND FOR FIRE DEPARTMENT REVIEW OF FIRE HYDRANT ELIMINATION

FIRE HYDRANT LEGEND

-  INDICATES HYDRANT TO BE REMOVED
-  INDICATES HYDRANT TO BE INSTALLED
-  INDICATES HYDRANT TO BE REMAIN
-  INDICATES HYDRANT TO BE REMOVED AND REPLACED

FIRE HYDRANT LEGEND

-  INDICATES HYDRANT TO BE REMOVED
-  INDICATES HYDRANT TO BE INSTALLED
-  INDICATES HYDRANT TO BE REMAIN
-  INDICATES HYDRANT TO BE REMOVED AND REPLACED

FIRE HYDRANT LEGEND

-  INDICATES HYDRANT TO BE REMOVED
-  INDICATES HYDRANT TO BE INSTALLED
-  INDICATES HYDRANT TO BE REMAIN
-  INDICATES HYDRANT TO BE REMOVED AND REPLACED

FIRE HYDRANT LEGEND

-  INDICATES HYDRANT TO BE REMOVED
-  INDICATES HYDRANT TO BE INSTALLED
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FIRE HYDRANT LEGEND

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-  INDICATES HYDRANT TO BE REMOVED AND REPLACED

FIRE HYDRANT LEGEND

-  INDICATES HYDRANT TO BE REMOVED
-  INDICATES HYDRANT TO BE INSTALLED
-  INDICATES HYDRANT TO BE REMAIN
-  INDICATES HYDRANT TO BE REMOVED AND REPLACED



- a - Highway Opening Guidelines
 - b - Highway Opening Permit Application (GPIS)
 - c - Opening and Restoring Street Openings
 - d - Police Support for Utility Construction
 - e - Philadelphia Gas Works (PGW) Agreement
 - f - Streets Department Survey Districts
 - g - Highway Districts
 - h – ADA Handicap Ramp Design Guidance
-

REGULATIONS OF THE DEPARTMENT OF STREETS

CITY OF PHILADELPHIA

STREET OPENINGS AND EXCAVATIONS

- 1. HOME RULE CHARTER - DEPARTMENT OF STREETS - COMMITTEE OF HIGHWAY SUPERVISORS:** On January 7, 1952 the Department of Streets absorbed the functions of the Board of Highway Supervisors, which was established by Ordinance of March 17, 1884.

Article 5, Chapter 5, Department of Streets, Section 5-501 of the Home Rule Charter provides as follows:

"Street Openings and Excavations. The Department of Streets shall determine the location, time, method and manner of making any opening or excavation in any City street, of installing any underground street structure, and of any repaving required because of such openings, excavations or installations."

The Committee of Highway Supervisors is an Advisory Departmental Committee on Street Openings.

The Committee meets on the second and fourth Tuesdays of each month to act on applications filed with the Street Commissioner for permission to install or to remove structures in legally opened City Streets.

- 2. DEFINITION OF TERMS:** Wherever in this application, or these regulations, the term "Commissioner" is used, it shall mean the Street Commissioner; wherever the term "Applicant" or a pronoun in the place of it is used, it shall mean and intend the person or agency submitting this application and agreeing to these regulations; wherever the term "Permittee" or a pronoun in the place of it is used, it shall mean and intend the person or agency to whom the permit has been issued; wherever the term "Chief of Highways" or a pronoun in the place of it is used, it refers to the Chief of the Highway Section of the Department of Streets, City of Philadelphia, acting either directly or through any assistant duly appointed by him.
- 3. METHOD OF MAKING APPLICATION:** The applicant for permission for the opening and structural occupancy of a highway in the city of Philadelphia shall file with the Commissioner:
 - (a) A written application indicating the full name and business address of the Applicant (registered owner of property of record), and a statement of the character and purpose of the proposed work.
 - (b) At least six blue prints showing the complete details of the proposed work and indicating the character and location of all adjacent existing structures.
 - (c) A summary of such other information as may be necessary to enable the Commissioner to reach a full and definite understanding of the entire situation.

4. **ALTERATION OF APPLICATION:** After the approval by the Commissioner of an application and the issuance of the permit, the terms, conditions or intent of the application, and the accompanying drawings shall not thereafter be altered or departed from without the previously obtained consent of the Commissioner; except that, in cases of emergency the Chief of Highways may when necessary authorize modifications.
5. **PREREQUISITES FOR THE ISSUANCE OF A PERMIT:** No permit will be issued until the applicant shall have:
 - (a) Complied with the provisions of the ordinance (where necessary) granting the specific privilege.
 - (b) Presented to the Commissioner a certificate from the City Solicitor to the effect that a satisfactory bond has been filed, when this is necessary.
 - (c) Presented to the Commissioner a certificate from the City Treasurer to the effect that any requisite payments have been made.
 - (d) Presented to the Commissioner an agreement from the Contractor, who is under liability to the City for the maintenance of any pavement involved, authorizing the opening of the pavement and providing for its restoration, and further agreeing that the guarantee will be in no way affected thereby.
 - (e) Agree to comply with the regulations of the Department of Streets, as indicated herein.
6. **POSSESSION OF PERMIT:** Persons in charge of construction work on the highways must have in their possession, at all times while so engaged, the permit issued by the Chief of Highways.
7. **PERIOD OF VALIDITY OF PERMIT:** Permits shall be valid for a period of twelve months from the date of approval of the application by the Commissioner. If no work is performed under the permit during this period, the permit will be void at the expiration of the twelve month period. Voided permits may be renewed upon application and upon approval by the Commissioner at any time during the twelve month period, immediately following the date of expiration, and upon payment of the customary fee, but such permits will only be good for a period of thirty days from the date of approval. At the expiration, twenty four months from the date of approval of an original permit, applicants may submit a new application for a permit, subject to the approval of the Commissioner and to the payment of the usual fee.
8. **MAINTENANCE PERMITS:** The Chief of Highways is hereby authorized to issue permits covering the performance of maintenance work, such permits to be good for a period of ninety days.
9. **RESERVATION OF SPACE:** As an aid in the planning for the construction of future service facilities, applications may be made to the Commissioner of the allocation of space for future structures. Upon approval of the allocation by the Commissioner and the payment of a fee determined in the same manner as for construction permits, such allocation will be reserved until such time as another application from a, utility company may be made for such

reserved space, at which time the Commissioner will determine the use to which the said allocation may be made. The Commissioner reserves the right to reconsider such allocations and to cancel them at any time as may seem best in the interest of the City.

- 10. VIOLATION OF REGULATIONS:** If any work or precaution necessary to protect the public in the use of the highways be omitted or imperfectly performed by the permittee, then the Chief of Highways shall serve a formal notice on the responsible permittee, and immediately cause the necessary corrective work to be performed at the expense of the permittee. Failure at any time fully and faithfully to comply with these regulations, and such further regulations as the Commissioner may from time to time prescribe, or to pay promptly such expenses as herein authorized, shall immediately operate as a forfeiture of permits issued, and debar the permittee from receiving any further permits until released by action of the Commissioner.
- 11. DANGER SIGNALS:** The permittee shall erect and maintain all necessary barricades, red lanterns and danger signals at breaks or openings in the highways, material storage piles, etc. The lights shall be kept burning from twilight until sunrise, and where necessary, a watchman shall be provided for the safety of the public. The permittee shall be responsible for any accidents that may occur by reason of his neglect to comply with these requirements until the work is completed, and until he has removed from the highways all dirt, debris, materials, tools and equipment.
- 12. RESPONSIBILITY FOR INJURIES TO PERSONS OR DAMAGE TO PROPERTY:** The permittee shall be responsible for any injury to persons or any damage to any property resulting from or by the construction or maintenance of the work herein indicated, or the occupation of the highway thereby, or defects or obstructions, or from any other cause whatsoever during the progress of the work or any time before its completion; and he shall indemnify and save harmless the City of Philadelphia from all suits or actions of every character, name and description, brought for or on account of any injuries or damages received or sustained by any property, person or persons by or from the construction or maintenance of the work herein indicated, the occupation of the highway thereby, negligence in safeguarding the work, improper methods of materials used in constructing, or by or on account of any act or omission of the said permittee or his agents or employees.
- 13. LIMITATION OF OPERATION:** At no time shall more than 500 linear feet of highway be opened or obstructed to traffic without the permission of the Chief of Highways. In the case of electrical conduits this permission shall be subject to the approval of the Chief of the Electrical Bureau.
- 14. TRAFFIC REGULATIONS:** The work shall be conducted in such a manner as to insure the least possible obstruction to traffic. The convenience of the general public and of the residents along the highway shall be provided for as far as possible. Temporary approaches to any crossings or intersecting highways shall be provided and kept in thoroughly safe condition, wherever required by the Chief of Highways. On highways occupied by railway tracks, temporary approaches to the entrance and exits of railway cars shall, where necessary, be provided and maintained. No highway shall be closed to traffic except by specific permission of the Chief of Highways, and such highways closed to traffic shall be protected by effective barricades and standard Department of Streets signs placed as directed.

- 15. ACCESSIBILITY OF HIGHWAYS:** The footways, gutters, inlets and portions of highways adjoining the work or in its vicinity shall not be obstructed nor fouled more than is absolutely necessary. Lawns or grass plots shall not be used for storage purposes. On improved streets the materials, tools and equipment required in connection with the work shall be neatly and properly stored upon the footway at least 1 foot back of the curbing, and leaving at all times for pedestrians a space which shall be at least 4 feet in width, if circumstances so permit.
- 16. SAN ITARY ARRANGEMENTS:** The permittee shall provide and maintain for his employees such sanitary arrangements as may be directed by the Chief of Highways and shall enforce their exclusive use.
- 17. REMOVAL OF TEMPORARY STRUCTURES, etc.:** After the completion of the work, the permittee shall, within 24 hours, remove all temporary structures built by him, and all rubbish and surplus materials of all kinds from the site of the work and leave the whole clean and presentable.
- 18. UNDEDICATED HIGHWAYS:** Applications involving the opening and occupancy of undedicated highways shall be accompanied by affidavits indicating the consent of the owner or owners.
- 19. APPROVAL OF DRAWINGS:** Before any work is begun, the drawings for such work shall be approved by the Department of Streets. Subject to this requirement, drawings for the following characters of construction shall also be approved by the Chiefs of the several administrative subdivisions as indicated:

CHARACTER OF WORK	APPROVED BY
Electrical, Telephone and Telegraph Conduits.....	Department of Licenses & Inspections
Gas Pipes.....	Highway Section
Refrigerating Pipes.....	Water Department
Sewer.....	Water Department
Vaults.....	Surveys & Design Bureau
Water Pipes.....	Water Department
Steam Mains.....	Water Department

- 20. LINES AND GRADES:** Where permanent pavement and curbing do not exist, the permittee will be required to obtain from the district surveyor the necessary line and grade stakes, and for this service the permittee will be required to pay in accordance with the schedule of charges specified by the Bureau of Surveys and Design. The permittee will be responsible for preservation of all monuments and bench marks and for all stakes after being set by the District Surveyor, and any disturbed stakes must be replaced by the district surveyor and paid for at the rate previously indicated.

- 21. NOTICE OF PROPOSED WORK:** Before any highway surface shall be opened under a permit, written twenty-four hour notice shall be given by the permittee to the Chief of Highways, and also to the Commissioners of the several other departments and to the public utilities whose structures are liable to be encountered or encroached upon of the time, location and extent of the proposed opening. The Water Department shall also be notified of the intention to open any footway pavement or surface.
- 22. INSPECTION OF WORK:** All work and materials used in building structures and in restoring or maintaining pavements shall be satisfactory to the Chief of Highways and any work or material condemned by him must be replaced at once. Condemned material shall be immediately removed from the site of the work.
- 23. SPECIAL INSPECTORS:** When, in the judgment of the Commissioner, it shall be deemed desirable or necessary to employ one or more special inspectors to supervise the proposed work, such inspector or inspectors shall be appointed by the Chief of Highways, and a sufficient sum shall be deposited by the applicant with the Chief of Highways for the payment of such service.
- 24. INTERFERENCE WITH EXISTING STRUCTURES:** New structures shall not interfere with existing structures, or their connections, except where absolutely necessary, and then only with previously obtained written consent of the Commissioners of the Departments having jurisdiction over the structures involved. Any modification of existing structures found to be necessary must be made by or under the direction of the department or public utility concerned and at the sole expense of the permittee. All necessary supports and protections to existing structures shall be promptly supplied by or at the expense of the permittee and to the satisfaction of the department or public utility concerned.
- 25. CHANGE IN LOCATION OF EXISTING STRUCTURES:** If, in the construction of water or gas mains, sewers, or any other municipal work, it shall become necessary to change the location of any existing privately owned structures occupying the highways, their location shall be changed, at the sole expense of the owners, to such new locations as shall be directed by the Commissioner.
- 26. MAINTENANCE OF EXPOSED STRUCTURES:** All privately owned structures occupying locations in City Highways, that maybe exposed during the construction, reconstruction of water mains, gas mains, sewers or other municipal work, shall be safeguarded and maintained during the course of the work by the permittee. Should the condition of the exposed structure be such as to require reconstruction or the placing of permanent supports, such work shall be performed by and at the sole expense of the owners of the structure.
- 27. MINIMUM DEPTH OF STRUCTURES:** The minimum depth of structures shall be as follows:
- (a) Roadway between Curb Lines - No portion of a new structure, when in place, shall be less than twenty-four (24) inches below the surface of the pavement, except that portion which is designed to form a part of the pavement.

(b) Footways, Curb to Building Line - No portion of a new structure, when in place, shall be less than fifteen (15) inches below the footway surface, except that portion which is designed to form a part of the paving.

(c) Vaults - The outside top of vault shall be at least four (4) feet below the established grade of the sidewalks over the same, in the erection, construction or reconstruction of such vaults.

- 28. ELECTRICAL SERVICE CONNECTIONS AND MANHOLES:** Permits for electrical service connections or for the construction of manholes on the lines of existing underground conduits where such construction is of advantage to the City for the betterment of the system may be issued by the Chief of Highways without reference to the Committee after approval by the Chief of the Electrical Bureau. Service connections shall extend in a straight line perpendicular to the line of the conduit main.
- 29. REFRIGERATING PIPES:** Applicants for permission to lay refrigerating pipes shall enter into an agreement, and give a bond satisfactory to the City Solicitor in the sum of Twenty-five thousand (\$25,000.00) Dollars, indemnifying the City for any loss or damages that may occur in the exercise of the privileges herein granted, or that may hereafter be granted by the Commissioner and shall also be conditioned upon faithful compliance with all the provisions indicated herein. The methods and materials used in the construction of refrigerating pipes shall be subject to the approval of the Chief of Highways, and Chief Engineer of the Water Department, and before laying any pipes, the permittee shall furnish to the Chief of Highways a certificate from a responsible agency, certifying to the character, quality, size, thickness and condition of the pipe and fittings and indicating the test to which the pipe has been subjected. Each length of pipe shall be tested and certified to before being laid. The pipe line, after being constructed and before the trench is backfilled, shall be subject to hydrostatic test of at least 300 pounds per square inch for a period of at least three hours. This test shall be made in the presence of the Chief Engineer of the Water Department, or his duly appointed representative, and the pipe line to be approved shall meet these requirements.
- 30. LEAKPROOFING OF VAULTS:** Vaults shall be so constructed as to prevent the leakage of gas or water into them. When pipes or conduits are laid within two feet of vaults, the permittee will be required to make the vault leak proof.
- 31. BACKFILLING OF TRENCHES AND OTHER OPENINGS IN HIGHWAYS:** The trenches and other openings in Highways shall not be backfilled until all tests as required by the various Utility Companies and/or the Water Department have been completed. The trenches and other openings shall be carefully backfilled with excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or other approved materials, free from large clods of earth or stones, deposited in six-inch layers. Care shall be taken to insure thorough compaction of the fill under the haunches of water, sewer, gas, steam, oil or other pipes. Each layer shall be thoroughly compacted by rolling, tamping with mechanical rammers, or by hand tamping with heavy iron tampers, the tamping face area of which shall not exceed 25 square inches. Each layer shall be compacted to a density at least equal to that of the surrounding earth, so that paving of the area can proceed immediately after backfilling has been completed. Where water, sewer, gas, steam, oil or other pipes are specially coated for protection against corrosion, care shall be taken not to damage the coating. Any trenches and other openings improperly backfilled or where settlement occurs,

shall be reopened to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade. Upon completion of the backfilling of trenches and other openings in Highways where traffic is allowed, these trenches and openings shall be immediately repaved temporarily with suitable material and maintained until permanent paving is constructed.

- 32. EXPOSED SURFACES OF STRUCTURES:** All exposed surfaces of iron structures forming parts of the pavement shall have a roughened surface with projections rising not more than one-half inch, and spaced not more than two and one-half inches apart, of a design as approved by the Commissioner.
- 33. RESTORATION OF PAVEMENTS:** All pavements shall be promptly restored to the extent directed by the Chief of Highways and with the same character of material, equal in composition and in color to match the existing adjacent pavement, and in accordance with the latest standard specifications of the Department of Streets.
- 34. MAINTENANCE OF PAVEMENTS:** All restored pavements shall be maintained in a condition satisfactory to the Chief of Highways, during the time of any existing guarantee, or as required by Ordinance of Council, but in no case for a period of less than five (5) years. Notices to permittees to make maintenance repairs to pavements shall receive attention within twenty-four (24) hours.
- 35. MAINTENANCE OF STRUCTURES:** All structures shall at all times be maintained in a condition satisfactory to the Chief of Highways.
- 36. DRAWINGS OF FINISHED WORK:** Immediately after the completion of the work the permittee shall file complete detail drawings to a scale satisfactory to the Commissioner, showing the work as constructed, together with a record of the character and location of previously existing structures encountered during the progress of the work.
- 37. RE-OCCUPATION OF VAULT SPACE:** The City shall in no case be liable for any claim for damages arising from the vacation by the permittee, or the reoccupation and use by the City for public purposes of any portion or portions of highway space between the building lines that have been occupied by vaults. The permittee hereby assumes full responsibility for all claims arising from the occupation or vacation of the highway by and from the construction, maintenance and removal of vaults.

Approved and adopted by

Department of Streets
(Committee of Highway Supervisors)
August 23, 1955

Approvals for Utility Street Openings Guaranteed Paving Information System (GPIS)

The City of Philadelphia Streets Department Right-of-Way Unit manages the street opening process for utility-related work through its electronic Guaranteed Paving Information System (GPIS). GPIS consolidates the City's paving and reconstruction databases into a GIS database platform, which enables better coordination of street opening projects and self-service for street opening permits.

All utility projects in the public right-of-way must be entered into the GPIS system in order to secure a Highway Opening Permit from the Streets Department. The utility companies input their proposed utility line location information into the system electronically and it allows the City's Right-of-Way Managers as well as other utility companies to review and flag any conflicts with the proposed work. It also allows the Highways Division to track its resurfacing and street reconstruction activity. The application is constantly looking for scheduling overlaps and work that is planned during the one year guarantee period after resurfacing occurs. This allows Right of Way Managers to work with the utilities to reschedule work so that disruptions to the road surface and to citizens are minimized.

The Philadelphia Water Department has worked in conjunction with the Streets Department and the GPIS developers to create a utility that allows a Water Department user to upload an Excel file in a predefined format containing the utility line offset information into the GPIS system. Locations of all proposed water and/or sewer lines for each Water Department project must be entered into the Excel sheet once the design has been finalized. The Water Department provides training to each of its Consultants regarding the setup of the GPIS Excel sheet. A sample GPIS Excel sheet with associated water/sewer design drawings has been provided for reference.

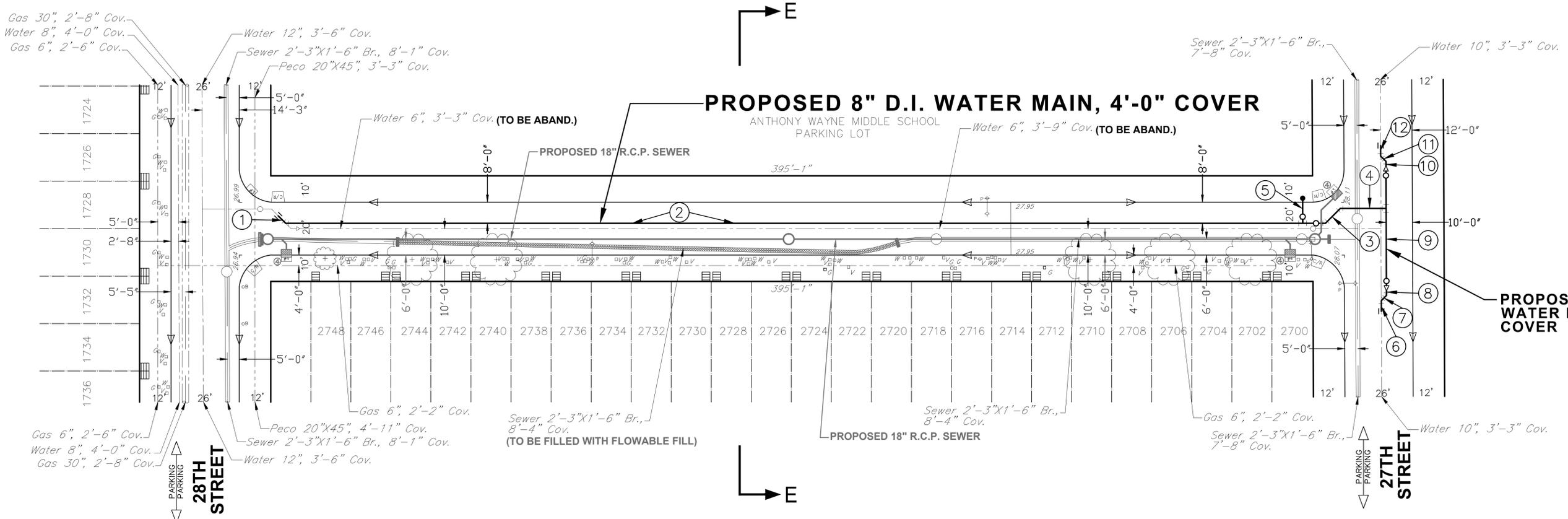
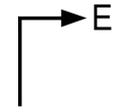
SAMPLE GPIS EXCEL SPREADSHEET

NO.	WSSPU	Config TYPE	On		From			TO			OFFSET			DIAGONAL			DIAMETER		Trench Width		ROADWAY LENGTH		FOOTWAY LENGTH		QUANTITY	COVER		Inner Duct										
			Street	Code	ft	in	cl	Street	Code	ft	in	cl	Street	Code	ft	in	cl	Street	Code	in	ft	in	ft	in		ft	in	ft	in	1	0	0						
1	6458	Main Across	Pierce Street	64640	15	0	EE	28th Street	88350	18	0	EE	28th Street	88350	5	0	SN	Pierce Street	64640	8	0	SN	Pierce Street	64640	8	2	0	4	0	0	0		4	0	1	0	0	
2	6458	Main	Pierce Street	64640	18	0	EE	28th Street	88350	7	0	WW	27th Street	88330	8	0	SN	Pierce Street	64640	0	0	0	None	None	8	2	0	394	0	0	0	1	4	0	1	0	0	
3	6458	Main Across	Pierce Street	64640	7	0	WW	27th Street	88330	1	0	WW	27th Street	88330	8	0	SN	Pierce Street	64640	2	6	SN	Pierce Street	64640	8	2	0	8	0	0	0	1	4	0	1	0	0	
4	6458	Main	Pierce Street	64640	1	0	WW	27th Street	88330	10	0	WE	27th Street	88330	2	6	SN	Pierce Street	64640	0	0	0	None	None	8	2	0	17	0	0	0	1	4	0	1	0	0	
5	6458	Main Across	Pierce Street	64640	8	0	SN	Pierce Street	64640	1	6	NN	Pierce Street	64640	15	6	WW	27th Street	88330	0	0	0	None	None	6	1	6	8	0	1	6	1	4	0	1	0	0	
6	6458	Main Across	27th Street	88330	20	0	SS	Pierce Street	64640	17	0	SS	Pierce Street	64640	12	0	WE	27th Street	88330	0	0	0	None	None	10	2	2	3	0	0	0	1	4	0	1	0	0	
7	6458	Main Across	27th Street	88330	17	0	SS	Pierce Street	64640	15	0	SS	Pierce Street	64640	12	0	WE	27th Street	88330	12	0	WE	27th Street	88330	10	2	2	3	0	0	0	1	4	0	1	0	0	
8	6458	Main Across	27th Street	88330	15	0	SS	Pierce Street	64640	12	6	SS	Pierce Street	64640	10	0	WE	27th Street	88330	0	0	0	None	None	10	2	2	3	0	0	0	1	4	0	1	0	0	
9	6458	Main Across	27th Street	88330	12	6	SS	Pierce Street	64640	12	6	NN	Pierce Street	64640	10	0	WE	27th Street	88330	0	0	0	None	None	12	2	4	50	0	0	0	1	4	0	1	0	0	
10	6458	Main Across	27th Street	88330	12	6	NN	Pierce Street	64640	15	6	NN	Pierce Street	64640	10	0	WE	27th Street	88330	0	0	0	None	None	10	2	2	3	0	0	0	1	4	0	1	0	0	
11	6458	Main Across	27th Street	88330	15	6	NN	Pierce Street	64640	18	0	NN	Pierce Street	64640	10	0	WE	27th Street	88330	12	0	WE	27th Street	88330	10	2	2	3	0	0	0	1	4	0	1	0	0	
12	6458	Main Across	27th Street	88330	18	0	NN	Pierce Street	64640	21	0	NN	Pierce Street	64640	12	0	WE	27th Street	88330	0	0	0	None	None	10	2	2	4	0	0	0	1	4	0	1	0	0	
13	6458	Main	Pierce Street	64640	11	0	WW	27th Street	88330	5	0	WW	27th Street	88330	6	0	NS	Pierce Street	64640	0	0	0	None	None	12	2	3	6	0	0	0	1	6	0	1	0	0	
14	6458	Main	Pierce Street	64640	5	0	WW	27th Street	88330	11	0	EE	28th Street	88350	6	0	NS	Pierce Street	64640	0	0	0	None	None	18	3	0	378	0	0	0	1	8	6	1	0	0	
15	6458	Main Across	Pierce Street	64640	4	0	NN	Pierce Street	64640	6	0	SN	Pierce Street	64640	4	0	WW	27th Street	88330	11	0	WW	27th Street	88330	15	2	6	17	0	0	0	1	4	0	1	0	0	
16	6458	Main Across	Pierce Street	64640	0	0	SS	Pierce Street	64640	6	0	NS	Pierce Street	64640	20	6	WW	27th Street	88330	22	6	WW	27th Street	88330	15	2	6	5	0	0	0	1	4	0	1	0	0	
17	6458	Main Across	Pierce Street	64640	0	0	SS	Pierce Street	64640	6	0	NS	Pierce Street	64640	18	0	EE	28th Street	88350	16	0	EE	28th Street	88350	15	2	6	5	0	0	0	1	4	0	1	0	0	
18																																				1	0	0

NOTE:

- SEE GPIS REFERENCE SAMPLE WATER SHEET AND SEWER SHEET FOR LINE SEGMENT NUMBERING
- THE WSSPU NUMBERS ARE PROVIDED BY THE WATER DEPARTMENT.
- THE CITY STREET CODES ARE PROVIDED BY THE WATER DEPARTMENT.

PIERCE STREET



PROPOSED 8" D.I. WATER MAIN, 4'-0" COVER
ANTHONY WAYNE MIDDLE SCHOOL
PARKING LOT

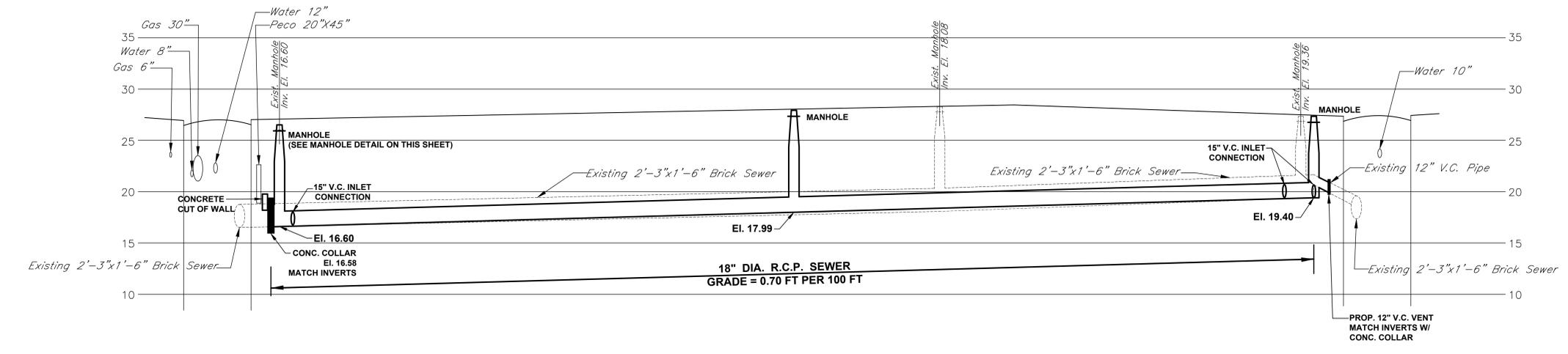
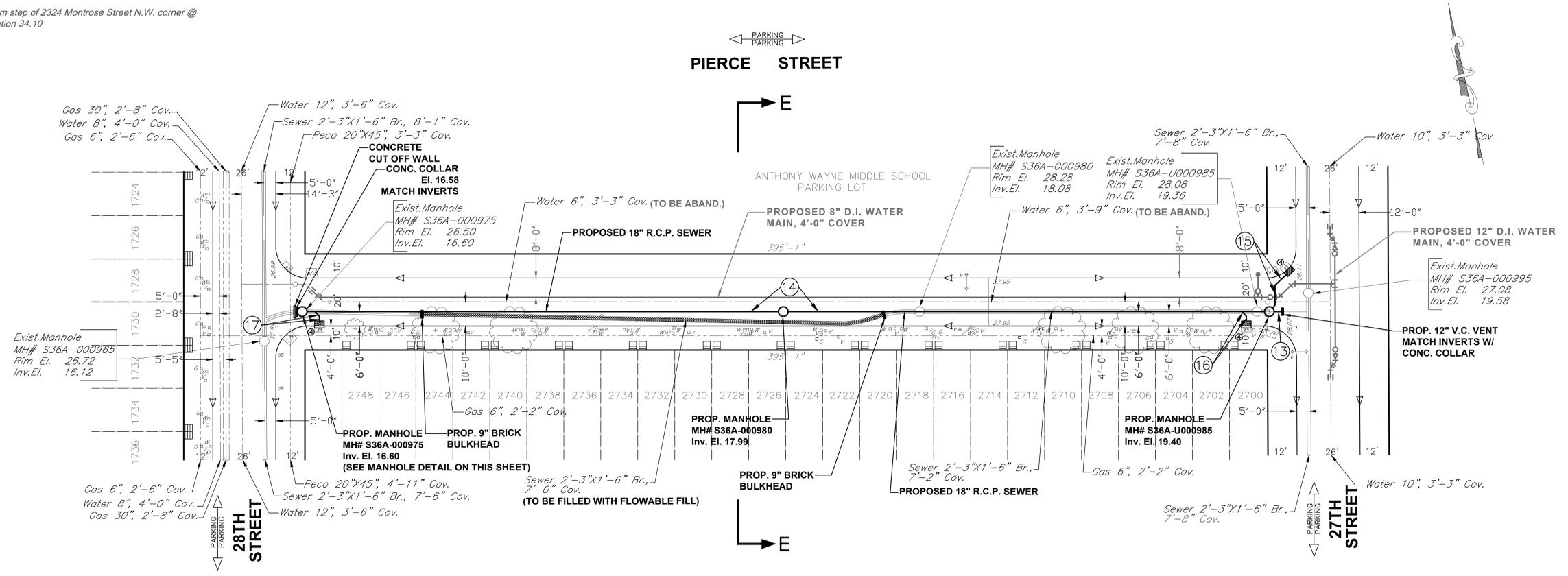
PROPOSED 12" D.I. WATER MAIN, 4'-0" COVER

GPIS REFERENCE SAMPLE WATER SHEET

CITY OF PHILADELPHIA
WATER DEPARTMENT

SCALES:
PLAN 1" = 20'
AND AS NOTED

CONTROLLING BENCHMARK: Bottom step of 2324 Montrose Street N.W. corner @
Elevation 34.10



GPIS REFERENCE SAMPLE SEWER SHEET

CITY OF PHILADELPHIA
WATER DEPARTMENT

SCALES:
PLAN 1" = 20'
PROFILE HORZ. 1" = 20'
VERT. 1" = 5'



REGULATIONS

Department of Streets Regulations For Openings and Restoring Street Openings

(Adopted June 1, 2006)

OPENINGS

Before proceeding with the opening of a street, the area immediately adjacent to the work site shall be made safe with lights, barricades or other devices approved by the Streets Department to insure the safety of the motoring public, pedestrians, and the individuals doing the work.

The equipment being used, whether stationary, such as a compressor, or active, such as a backhoe, shall be located and operated in a manner such that it may effectively be used to accomplish its designated work but at the same time its location and operation should offer a minimum of interference with vehicular and pedestrian traffic.

The material removed from the ditch shall be piled in a location adjacent to the ditch so that it does not interfere with vehicular and pedestrian traffic. Excavated materials in excess of the amount needed for backfill shall be removed and the street cleaned.

The top of a tunnel in a paved street shall not be less than five feet from the surface of the street and the tunnel shall not extend more than five feet from the curb.

No trenches or excavations shall be left open overnight unless approved by the Chief Highway Engineer. Open excavations shall be protected with concrete jersey barriers, steel plates, or other methods approved by the Chief Highway Engineer. Steel plates shall be pinned in each corner with a smooth headed pin that does not protrude above the plate more than 0.5 inches. The pins must extend into the street surface at least 3 inches. The plate must extend at least 12 inches beyond the edge of the excavation in all directions. The plate must be ramped with asphalt at least 6 inches wide. The plate must be removed immediately upon completion of permanent restoration.

BACKFILLING

Ditches and other street openings shall not be backfilled until all tests required by the various utility companies and/or the Water Department have been completed.

Trenches and other street openings shall be carefully backfilled with materials approved by the Streets Department and shall be equivalent to clean excavated soil, loam, sandy clay, sand and gravel.

The backfill shall be thoroughly compacted in layers not exceeding six inches by rolling tamping with mechanical rammers or by hand tamping with heavy iron tampers.

Upon completion of the backfill the street opening shall be made safe by topping the dirt backfill with an asphaltic cold mix paving material in a level plane with the surrounding roadway surface and not creating a hump or depression in the restoration area.

The refilling of all tunnels shall be thoroughly compacted by ramming. The surface over tunnel shall be broken down if required by the Streets Department, the opening shall be refilled and the refilling thoroughly compacted by ramming.

RESTORATION

Before restoration of the pavement, the base course shall be cut back six inches wider than the original opening on all sides. If the edge of the base course adjacent to and paralleling the curb is within two (2) feet of the edge of the paving or curb, after cut back, the paving shall be removed between the edge of the cut back and edge of paving or curb. The surface course shall be cut back six inches from the outer edge of the original opening. The thickness of the base course restoration shall equal the thickness of the existing pavement but shall not be less than eight inches in depth. This same depth applied to streets with stone black base or other types of temporary paving base. The concrete shall be brought up to the same level as the existing base course.

Just prior to the application of the asphalt top to the ditch, all exposed vertical surfaces of existing binder and surface course shall be painted with hot asphaltic cement. The surface of the concrete base shall be thoroughly cleaned and the application of a tack coat of bituminous material E-1 (AASHO Equivalent RS-1) in the amount of 1/15 of a gallon per square yard shall be applied.

Asphaltic binder shall be then installed up to one inch from the existing roadway surface and compacted, using either an approved mechanical roller or hot iron tampers weighing not less than 25 pounds.

The finished or wearing surface of the restored ditch shall match in kind the existing roadway surface pavement. It shall be installed and compacted in the same manner as the asphaltic binder. The topped of ditch shall have a smooth surface showing no evidence of honeycomb, roller or iron marks.

After topping is completed the seam between the existing surface course and the newly restored top shall be neatly sealed with asphaltic cement. If the ditch is to be immediately opened to traffic, dry sand, or Portland cement shall be evenly spread over the newly installed seal to prevent it being picked up or spread by automobile tires.

If the restoration is to be in finished concrete roadway paving, the dimensions shall be the same as for base restoration. The finished edge of restoration in concrete pavement shall be made with a concrete saw just prior to the paving operation. The minimum depth of cut shall be 1 ½ inches.

TIMING OF RESTORATION

Between July 1 and November 30 of each year, permanent restoration of all street openings less than twenty-five square yards in size shall be performed within thirty (30) days after backfilling. Between December 1 and March 31 of the following year, if inclement weather does not allow permanent restoration, street openings may be temporarily restored with cold patch and maintained until permanent restoration is performed.

SPECIAL SITUATIONS

There will be no cut back required for a ditch with a surface area one-half square yard or less.

If the ditch restoration occurs in a black base street or stone base country road, the concrete base restoration may be brought up to within one inch of the roadway surface.

Unless approved in writing by the Chief Highway Engineer, restorations in streets that have granite block, brick, or other special surfaces must be restored in kind. The use of asphaltic or black base will be permitted only where a ditch has to be restored because the street must immediately be opened to traffic. Such cases would include ditches in track areas and streets with only one lane available for traffic. Black base may also be used to patch ditches in inclement weather or where the use of concrete would be impossible or impractical due to future construction. In all cases the permission of the Highway District engineer must be obtained in writing before black base can be used for ditch restoration.

PLUMBERS DITCHES

Plumbers shall comply with regulations governing the opening and backfilling of ditches. **If** they comply with said regulations, plumbers shall be responsible for their ditch openings for a period of thirty (30) days after receipt in the Street Department of the postal card supplied by the Department of Licenses and Inspections at the time the permit. If the backfilling and topping is inadequate, or was performed improperly, the plumber's responsibility for the opening shall continue.

Failure by the plumber to notify the City that an opening was made and backfilled will not release the plumber of responsibility and may be cause for the City to deny him any future permits.

* * * * *

**GUIDELINES FOR ASSIGNING POLICE SUPPORT
FOR
UTILITY CONSTRUCTION**

NOVEMBER 9, 2006

In the interest of public safety it may be necessary to assign Police support to a utility construction project. The following guidelines are utilized by the Department of Streets in determining the need for Police assistance in conjunction with utility construction. In the event of unforeseen conditions the City reserves the right to deviate from these guidelines.

1. AFFECTED AREAS

The areas of the City in which consideration is given to require Police support are as follows:

- Center City - bounded by the Delaware River on the east, the Schuylkill River on the west, Spring Garden Street on the north, and South Street on the south.
- University City - bounded by 30th street on the east, 40th Street on the west, Powelton Avenue on the north, and Civic Center Blvd. and Baltimore Avenue on the south.
- Roosevelt Blvd. from 9th Street to City Limits.
- All other arterial routes throughout the City, which includes State Highways.

2. CONSTRUCTION TIMES

Construction in travel lanes is not allowed during the below listed traffic peak hours.

Morning traffic peak hours are from 6:30A.M to 9:30 A.M.

Evening traffic peak hours are from 3:30 P.M. to 6:30 P.M.

There are no regular traffic peak hours on the weekend.

Daytime construction in Center City may occur between the hours of 9:30A.M. and 3:30 P.M.

Nighttime construction in Center City may occur between the hours of 6:30 P.M. and 6:30 A.M. However, construction on Walnut Street in Center City must occur between the hours of 11:00 P.M. and 6:30 A.M.

3. CRITERIA FOR ASSIGNING POLICE SUPPORT

During business hours (8:00 A.M. to 5:00 P.M.) Police support is assigned at the discretion of the Department of Streets whenever the utility construction will require the closing of a single travel lane or multiple travel lanes. The Police Department determines the number of Police officers required for the construction project. Construction occurring on the sidewalk or in a parking lane will not require Police support. Streets that have a roadway width of ten (10) feet or less will not require Police support unless an emergency condition warrants it. During non-business hours, a Police supervisor will have the discretion to make the determination for Police support.

4. CONTRACT FOR POLICE SUPPORT

When it has been determined by the Department of Streets that Police support is required, the permittee or contractor shall enter into a contract with the Police Department by contacting the Traffic Police Captain's office at **(215) 685-1554** a minimum of twenty-fours (24) hours before starting work. If the utility project has more than one location on any given day, the contractor shall request that Police support be assigned per work crew. This officer must have a vehicle and the fee will include payment for use of the vehicle.

5. POLICE CONTACT

In the event it becomes necessary to contact the Police to resolve an issue, the contractor or permittee may call the Police Traffic Unit at **(215) 685-1552**. This phone number is available 24 hours/7 days a week.

6. TEMPORARY NO-PARKING SIGNS WITH POLICE SUPPORT

In the event that the construction will require the restriction of on-street parking, the Police will post temporary no-parking signs prior to the start of construction.

7. TEMPORARY NO-PARKING SIGNS WITHOUT POLICE SUPPORT

In the event that the construction will require the restriction of on-street parking, and no Police assistance is required, it is the responsibility of the contractor to post the temporary no parking signs twenty-four hours before the start of construction. These signs may be obtained at the 5th Highway District located at Whitaker Avenue and Luzerne Street. The office number is **(215) 685-9843**.

8. MAINTENANCE AND PROTECTION OF TRAFFIC

Work zone traffic control shall be in accordance with PADOT Publication 213.

9. EMERGENCY CONSTRUCTION

An emergency is defined in Section 11-700 (1) (n) of the Right-of-Way Management Ordinance as "A condition, that in the judgment of the (Streets) Commissioner, constitutes an imminent risk to the health, welfare, or safety of the public, or has caused or is likely to cause Facilities already installed to be unusable and result in the loss of the services provided through the facilities."

In accordance with the Department of Streets Regulations for Right-of-Way Management, Paragraph 5, Construction Permits, the permittee shall, within twenty-four hours of learning of the emergency condition, contact the Right-of-Way Unit at **(215) 686-5618**. Within seven (7) calendar days of completing construction, the permittee shall obtain an emergency street opening permit from the Right-of-Way Unit.

In the event it becomes necessary to perform emergency construction as defined, the contractor shall call Municipal Radio at **(215) 686-4514** to alert the Police Department and the Streets Department. The contractor will be asked to provide their name, the name of the company for whom they are working, the location of the work, the nature of the emergency work, whether they will require a partial or full street closure and a contact number where they can be reached. Municipal Radio will notify the Police Department's Operations Desk as well as the Fire Department and SEPTA. In the event Police protection is required, the contractor shall call Traffic Police at **(215) 685-1552**.

If a Police Officer questions the contractor on the job site, they will refer the officer to the Police Department's dispatcher for verification that the emergency was properly called in. If there is a question regarding the need for Police support during non-business hours, a Police supervisor will have the discretion to make the determination.

On the following morning Municipal Radio will fax a list of emergency utility construction projects that required either full or partial closure to the Street's Department's Right-of-Way Unit at **(215) 686-5064**.

Approved and adopted by the Committee of Highway Supervisors on November 9, 2006.

* * * * *



City of Philadelphia

LAW DEPARTMENT
1101 Market Street
5th Floor
Philadelphia, PA 19107
(215) 685-6116

Romulo L. Diaz, Jr.
City Solicitor

MEMORANDUM

To: Romulo L. Diaz, Jr., City Solicitor
From: J. Barry Davis, Divisional Deputy City Solicitor
Date: August 25, 2005
Subject: PGW/Water Department Settlement and Reimbursement Agreement

The attached agreement, provided for your signature, settles all reimbursement obligations of the Water Department to PGW through December 31, 2004 for PGW pipe relocation work caused by water/sewer reconstruction. In addition, the agreement establishes the new framework for PGW to request reimbursements from the Water Department when PGW must relocate its pipes.

Under the settlement, the Water Department will pay PGW the following amounts from the Water Fund's construction account (capital funds):

<u>Year</u>	<u>Amount</u>
FY 2004	\$ 1,069,451
FY 2005 (1/2 year)	\$ 757,266
Total	\$ 1,826,717

PGW would like to receive these funds as quickly as possible. Please have Jackie call me after the documents are signed. If you have any questions, please call me.

SETTLEMENT AND ENFORCED WORK REIMBURSEMENT AGREEMENT

This Settlement and Enforced Work Reimbursement Agreement (this "Agreement"), made and entered into as of the 1st day of July 2005, by and between PHILADELPHIA FACILITIES MANAGEMENT CORPORATION, a non-profit Pennsylvania corporation in its capacity as operator and manager of the municipally owned PHILADELPHIA GAS WORKS pursuant to an Agreement with the City of Philadelphia dated December 29, 1972, as amended (collectively, "PGW") and THE CITY OF PHILADELPHIA, by and through its WATER DEPARTMENT ("PWD"),

WITNESSETH:

WHEREAS, PGW and PWD are parties to that certain "Basic Agreement" effective September 1, 1988, as supplemented by that certain "Working Agreement" dated November 28, 1988 (collectively, the "Reimbursement Agreement"), which has governed reimbursement levels to PGW for PGW work on enforced City reconstruction projects; and

WHEREAS, for several years PGW has objected to certain of the financial terms of the Reimbursement Agreement as they pertain to enforced PWD projects; and

WHEREAS, PGW and PWD have engaged in discussions to modify the terms of the Reimbursement Agreement as it pertains to PWD projects, including without limitation, with respect to future funding levels; and

WHEREAS, as a result of such discussions, PGW and PWD settled and resolved their dispute about reimbursement sums due for PWD's fiscal year 2003 (i.e., July 1, 2002 – June 30, 2003) (each such one year period beginning on July 1 being the "FY") and prior years, all in accordance with the terms and conditions of that certain Memorandum of Agreement between the parties dated on or about November 23, 2003 (the "Memorandum of Agreement"); and

WHEREAS, from FY 2004, inclusive, PGW has continued to work in good faith on enforced PWD reconstruction projects during the pendency of such discussions; and

WHEREAS, PGW and PWD have reached an agreement in principle regarding the terms and conditions of reimbursement to PGW for enforced PWD work performed in FY 2004 and forward and wish to forever settle and memorialize such terms in this Agreement.

NOW, THEREFORE, in consideration of the mutual covenants and agreements herein contained, PGW and PWD hereby agree as follows:

1. Term; Termination of Reimbursement Agreement.

1. This Agreement shall be effective as of the date first set forth above and shall continue for a period of one (1) year thereafter (the "Initial Term"). Thereafter, this Agreement shall automatically be renewed for successive periods of one (1) year unless

written notice of termination is given by a party to the other party not later than ninety (90) days prior to the end of the then current term; provided, however that any work performed or project commenced by PGW during the term of this Agreement shall be reimbursed by PWD in accordance with the terms hereof even if submission of required invoices does not occur until after the Agreement terminates.

2. The Reimbursement Agreement shall be deemed terminated as of June 30, 2003 at 11:59 P.M., Eastern Standard Time.

2. Definitions. Except in those certain instances where the text expressly states another meaning, when used in this Agreement the following terms shall mean:

1. "Enforced Service Work" shall mean work undertaken by PGW to renew or reconnect any existing gas services connected to any gas Main impacted by Physical Interference Work, Slope Interference Work, or qualifying Practical Minimum Footage Allowance Work categories. Enforced gas services shall be further identified by the following sub-categories: (.1) Bare or Unprotected Steel Services, (.2) Protected Steel Services, (.3) Plastic Services, and (.4) Plastic Services Without Valve. Enforced Service Work may also be referred to by the parties as "Work Category 5".

2. "Main" shall mean any PGW gas main. Main shall be further identified by the following sub-categories: (.1) Ductile Iron Main, (.2) Plastic Main, (.3) Coated and Unprotected Steel Main, and (.4) Cathodically Protected Steel Main.

3. "PGW Convenience Work" shall mean work done to replace and/or renew an existing PGW Main or install a new PGW Main for engineering, economic or other reasons, other than Physical Interference Work, Slope Interference Work, or Practical Minimum Footage Allowance Work. PGW Convenience Work will not qualify for reimbursement. PGW Convenience Work may also be referred to by the parties as "Work Category 4".

4. "Physical Interference Work" shall mean work undertaken because the existing Main is in direct physical interference of a PWD installation or directly undermined by the PWD trench. Physical Interference Work may also be referred to by the parties as "Work Category 1".

5. "Practical Minimum Footage Allowance Work" shall mean additional work necessary to replace the existing Main which is impacted by either Physical Interference Work or Slope Interference Work and any work recommended from an engineering perspective in order to avoid difficult or impractical tie-ins even though it is neither within the Physical Interference Work or Slope Interference Work zones. This will be limited to no more than fifteen percent (15%) of the footage determined using the Physical Interference Work and Slope Interference Work criteria, based upon a per block calculation. Practical Minimum Footage Allowance Work may also be referred to by the parties as "Work Category 3."

6. "Prudent Main List" shall mean a list of Mains scheduled for replacement by PGW ranked in order of replacement priority, with a lower number indicating greater priority of replacement. The Prudent Main List is re-ordered from time to time.
7. "Service" shall mean any PGW gas service connected to a Main.
8. "Slope Interference Work" shall mean work undertaken because the existing Main is within the zone of influence of a PWD installation. The zone of influence is defined by the area within a 1:2 slope line (one horizontal – two vertical) from the bottom outside edge of the PWD excavation. Slope Interference Work may also be referred to by the parties as "Work Category 2".
3. Payment for FY 2004 and First Two Quarters of FY 2005. Not later than July 1, 2005, PWD shall pay PGW the sum of One Million Eight Hundred and Twenty-Six Thousand Seven Hundred and Seventeen Dollars (\$1,826,717) as compensation for all PGW work undertaken as a result of PWD enforced work completed by PGW during FY 2004 (\$1,069,451) and the 1st and 2nd Quarters of FY 2005 (\$757,266).
4. Revision of Memorandum of Agreement. Paragraph 4 of the Memorandum of Agreement shall be deemed rescinded and of no effect.
5. Reimbursement for Main Replacement. PWD will reimburse PGW for enforced Main relocation in accordance with the percentages identified in Schedule "A" (by type of Main and Prudent Main List priority) and the then current prices for such Main as identified in Schedule "B" for the applicable sizes of Main, calculated as follows:

of Main work linear feet (Slope Interference Work footage and/or Physical Interference Work) + # of Practical Minimum Work linear feet (not to exceed 15% of enforced footage for each block of a project)

**multiplied by
the applicable reimbursement percentage identified on Schedule "A"**

**multiplied by
the then current applicable prices identified on Schedule "B"
for new pipe for a size no greater than the existing Main.**

PWD will not reimburse PGW for new Mains where there were no existing Mains being replaced. The parties further acknowledge and agree that PWD will not reimburse PGW for any incremental betterment to PGW's facilities as part of the enforced Main relocation (e.g., for increasing the pipe size of the relocated Main). In such instance reimbursement will be based upon the applicable unit prices for the existing Main.

6. Reimbursement for Enforced Service Work. PWD will reimburse PGW for Enforced Service Work when the Service was connected to a Main qualifying for reimbursement under this Agreement. Percentage Reimbursement shall be according to Schedule "A"

and Schedule "B" for all sizes and types of Enforced Service Work, calculated as follows:

of Enforced Services (renewals or reconnects)

multiplied by

the applicable reimbursement percentage from the associated Main as set forth on Schedule "A"

multiplied by

the then current applicable price for a gas service renewal or reconnection as set forth on Schedule "B"

7. Reimbursement for Paving. PWD will pay for the costs of street paving within the limits of its construction projects. PGW will be responsible for its paving costs outside the PWD construction area. PWD will not pay for sidewalk paving, except (i) to the extent such paving cost is already included in the unit costs identified on Schedule "B", or (ii) with respect to individually invoiced projects, and then only and to the same extent the project is reimbursable as a percentage set forth on Schedule "A".

8. Invoicing and Documentation.

1. For any project in which PGW seeks reimbursement hereunder, PGW will submit an invoice for reimbursement to PWD consisting of the following as a minimum:

1. an itemized list of all existing enforced and new relocated PGW gas main footage and unit costs by city block, size, type, whether it is Physical or Slope Interference or Practical Minimum Footage Allowance, etc.; and,

2. an itemized list of all enforced gas services within the limits of enforced gas mains, existing & new service pipe size and material, property address, whether it's a renewal or reconnect, and the unit cost; and,

3. an associated detailed drawing showing the relocated gas main, size, dimensions, the enforced gas services, etc.

Attached as Exhibit "C" is an example of an invoice meeting the criteria set forth above. Invoices shall be submitted to PWD not later than ninety (90) days after project completion. Any undisputed invoice or portion thereof shall be paid by PWD not later than ninety (90) days after receipt.

2. The prices effective for each project shall be those in effect pursuant to Schedule "B" on the date the project is completed.

3. No less frequently than every six (6) months, PGW will provide PWD with an updated Prudent Main List with Mains rank-ordered for replacement priority from 1 through 1,000, with "1" being of the highest priority. Except as required by applicable

law, PWD shall not disclose to any other persons or entities the existence, nature or subject matter of the Prudent Main List, except solely to employees, contractors, or consultants with a need to know.

4. For a period of three (3) years from the completion of any project subject to this Agreement, the parties shall maintain complete records of all books, documents, papers, records, supporting costs, proposals, accounting records, employee time sheets, payroll records, and other documents pertaining to costs incurred in performing the work on the projects that are the subject of this Agreement. In any year of the term, PWD may examine, with PGW's cooperation, the records of up to five (5) individual projects with a value of less than \$100,000 each, in order to evaluate whether unit pricing, rather than work order pricing for such projects, is cost effective for PWD. Such examination shall be for informational purposes only.
9. Compliance. The parties shall comply with all applicable federal, state, and local laws, rules, and regulations, either in existence or as may be imposed in the future, including Title 31 U.S. Code § 1352, which prohibits funds from being expended by the recipients or any lower tier sub-recipients of a federal contract grant, loan or cooperative agreement to pay any person for influencing or attempting to influence a federal agency or Congress in connection with the awarding of any federal contract, the making of any federal grant or loan, or the entering into of any cooperative agreement.
10. Choice of Law. This Agreement shall be governed by and construed and enforced in accordance with the laws of the Commonwealth of Pennsylvania, without reference to conflicts of law.
11. Counterparts. This Agreement may be executed by the parties hereto in any number of separate counterparts and all of such counterparts when together shall be deemed to constitute one and the same instrument.
12. Severability. If any provision of this Agreement or the application thereof to any person or circumstances shall to any extent be held invalid, then the remainder of this Agreement or the application of such provision to persons or circumstances other than those as to which it is held invalid shall not be affected thereby, and each provision of this Agreement shall be valid and enforced to the fullest extent permitted by law.
13. Duly Authorized Representative. The signatories to this Agreement are duly authorized to execute this Agreement on behalf of PWD and PGW.
14. Binding Agreement. The respective rights and obligations provided in this Agreement shall bind and shall inure to the benefit of the parties hereto, their legal representatives, successors and assigns.
15. No Waiver. Nothing contained herein shall constitute any commitment, obligation or intent on either party to forebear from exercising its rights and remedies in the event of a default hereunder.

16. No Disclosure. Except as required by applicable law or regulation, the parties agree not to share or disclose this agreement or the terms herein contained with any non-party.
17. Integration. This Agreement contains all the agreements, conditions, understandings, representations and warranties made between the parties hereto with respect to the subject matter hereof for the time periods set forth herein and supersedes all prior negotiations, letter agreements and proposals (either written or oral). This Agreement may not be modified or terminated orally or in any manner other than by an agreement in writing signed by both parties hereto or their respective successors in interest.
18. Further Assurances. The parties agree to execute such further and other documents and instruments and take such further and other actions as may be necessary to carry out and give full effect to the transactions contemplated by this Agreement.
19. Notice. All notices and communications required to be given in writing under this Agreement shall be sent by United States mail, postage prepaid, or delivered by hand delivery with receipt obtained, to the addresses below or at such other addresses as PWD and PGW may designate in writing from time to time.

If intended for PWD:

Brian Mohl, Capital Programs Manager
Philadelphia Water Department
1101 Market Street, 2nd Fl. ARA
Philadelphia, PA 19107

With a copy to:

J. Barry Davis, Esq.
Divisional Deputy City Solicitor
C/o Philadelphia Water Department
1101 Market Street, 5th Fl. ARA
Philadelphia, PA 19107

If intended for PGW:

Mike Jones, P.E.
Philadelphia Gas Works
800 West Montgomery Avenue
Philadelphia, PA 19122

With a copy to:

Abby L. Pozefsky, Esq.
S.V.P. and General Counsel
Philadelphia Gas Works

800 W. Montgomery Ave
4th Floor
Philadelphia, PA 19122

All notices shall be deemed received five (5) calendar days after mailing or upon actual receipt, whichever is earlier.

20. It is understood and agreed that in entering into this Agreement, PFMC does so solely in its capacity as operator and manager of the municipally-owned Philadelphia Gas Works under the Agreement dated December 29, 1972 between PFMC and the City of Philadelphia, as amended from time to time, and not otherwise; and further, that any payments required to be made by PFMC as a result of or arising out of its entering into this Agreement shall be made solely from the revenues of the Philadelphia Gas Works.

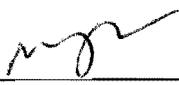
IN WITNESS WHEREOF, PGW and PWD have caused this agreement to be executed by their duly authorized representatives as of the date first above written.

Attest:

By:

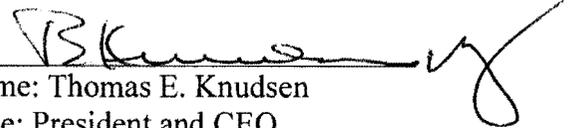
Name: Abby L. Pozefsky
Title: Assistant Secretary

Approved:


Romulo L. Diaz, Jr., City Solicitor

PHILADELPHIA FACILITIES
MANAGEMENT CORPORATION, in its
capacity as operator and manager of
Philadelphia Gas Works

By:


Name: Thomas E. Knudsen
Title: President and CEO

THE CITY OF PHILADELPHIA
by and through its WATER DEPARTMENT

By:


Name: Bernard Brunwasser
Title: Commissioner

SCHEDULE "A"
REIMBURSEMENT CATEGORIES AND
PERCENTAGE REIMBURSEMENT

Pipe Type for Main and Associated Service Replacement/ Renewal	PGW Gas Prudent Main List Rank¹	Physical Interference Work	Slope Interference Work²	Practical Min. Footage Allowance³
Cast Iron	1-250	0%	0%	0%
" "	251-500	25%	25%	25%
" "	> 500	50%	50%	50%
Ductile Iron	1-250	0%	0%	0%
" "	251-500	25%	25%	25%
" "	> 500	50%	50%	50%
Plastic Main	1-250	0%	0%	0%
" "	251-500	25%	0%	25%
" "	> 500	50%	0%	50%
Unprotected Steel	1-250	0%	0%	0%
" "	251-500	25%	0%	25%
" "	> 500	50%	0%	50%
Cathodically Protected Steel	1-250	0%	0%	0%
" "	251-500	25%	0%	25%
" "	> 500	50%	0%	50%

NOTES:

¹ Prudent Main List rank for a project shall be as of the date that PGW receives a project review request for a project from PWD.

² Notwithstanding the chart percentages for Slope Interference Work, **no** reimbursement shall be paid to PGW for Slope Interference Work relating to Main laid after 1976 if PGW re-lays the replacement Main of the same size in the same location.

³ Notwithstanding the chart percentages for Practical Minimum Footage Allowance Work, the value of such reimbursement may not exceed 15% of the value of the qualifying enforced footage.

SCHEDULE "B"
REIMBURSEMENT PRICING
PGW FY 2004

MAIN PRICING FOR JOBS UNDER \$100,000

SIZE	UNIT COST PER LINEAR FOOT
10" and Smaller Low Pressure Mains	\$122 Linear Foot
All High Pressure Mains	\$180 Linear Foot
12" and Larger Low Pressure Mains	Per individual project work order

MAIN PRICING FOR JOBS \$100,000 AND OVER

SIZE	UNIT COST PER LINEAR FOOT
10" and Smaller Low Pressure Mains	Per individual project work order
All High Pressure Mains	Per individual project work order
12" and Larger Low Pressure Mains	Per individual project work order

SERVICE RENEWALS/REPLACEMENTS PRICING FOR JOBS UNDER \$100,000

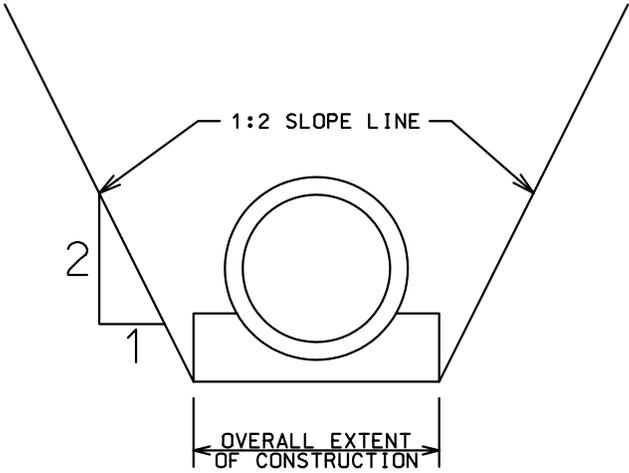
SIZE	UNIT COST
1.25" and smaller	\$1557
2" and greater	\$8733

SERVICE RENEWALS/REPLACEMENTS PRICING FOR JOBS OVER \$100,000

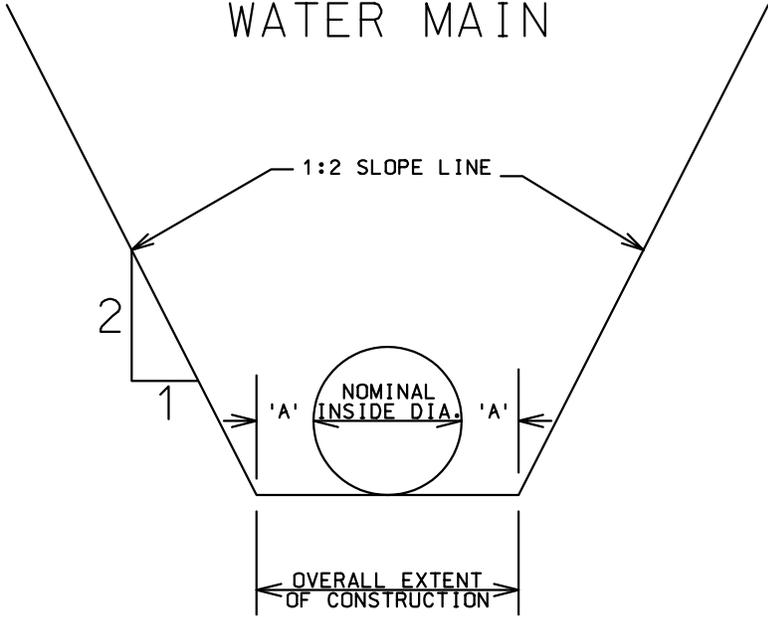
SIZE	UNIT COST
1.25" and smaller	Per individual project work order
2" and greater	Per individual project work order

The parties acknowledge that with the exception of individual work orders, the prices listed above are derived from PGW's Capital Budget. Accordingly, this Schedule "B" shall be deemed to be automatically amended from time to time to reflect currently approved unit prices for the foregoing categories in PGW's current Capital Budget (as approved by the Philadelphia Gas Commission). Such changes shall be valid and applicable each year during the term for projects completed during that PGW Fiscal Year (i.e., September 1 to August 31). The parties acknowledge that unit prices shall be effective for the entire applicable PGW fiscal year, notwithstanding the actual approval date of the Capital Budget.

SEWER STRUCTURE

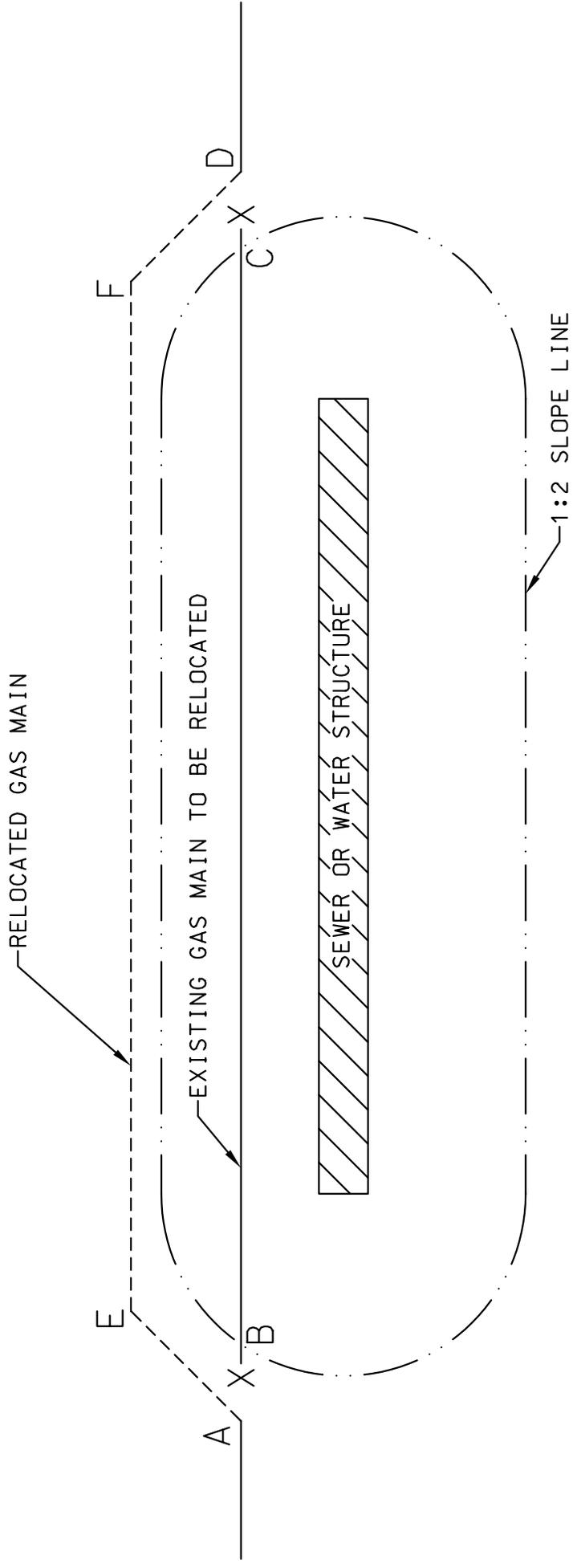


WATER MAIN



NOMINAL INSIDE DIA.	'A'
6" DIA. & LESS	6"
OVER 6" DIA. & LESS THAN 24" DIA.	8"
24" DIA. & OVER	12"

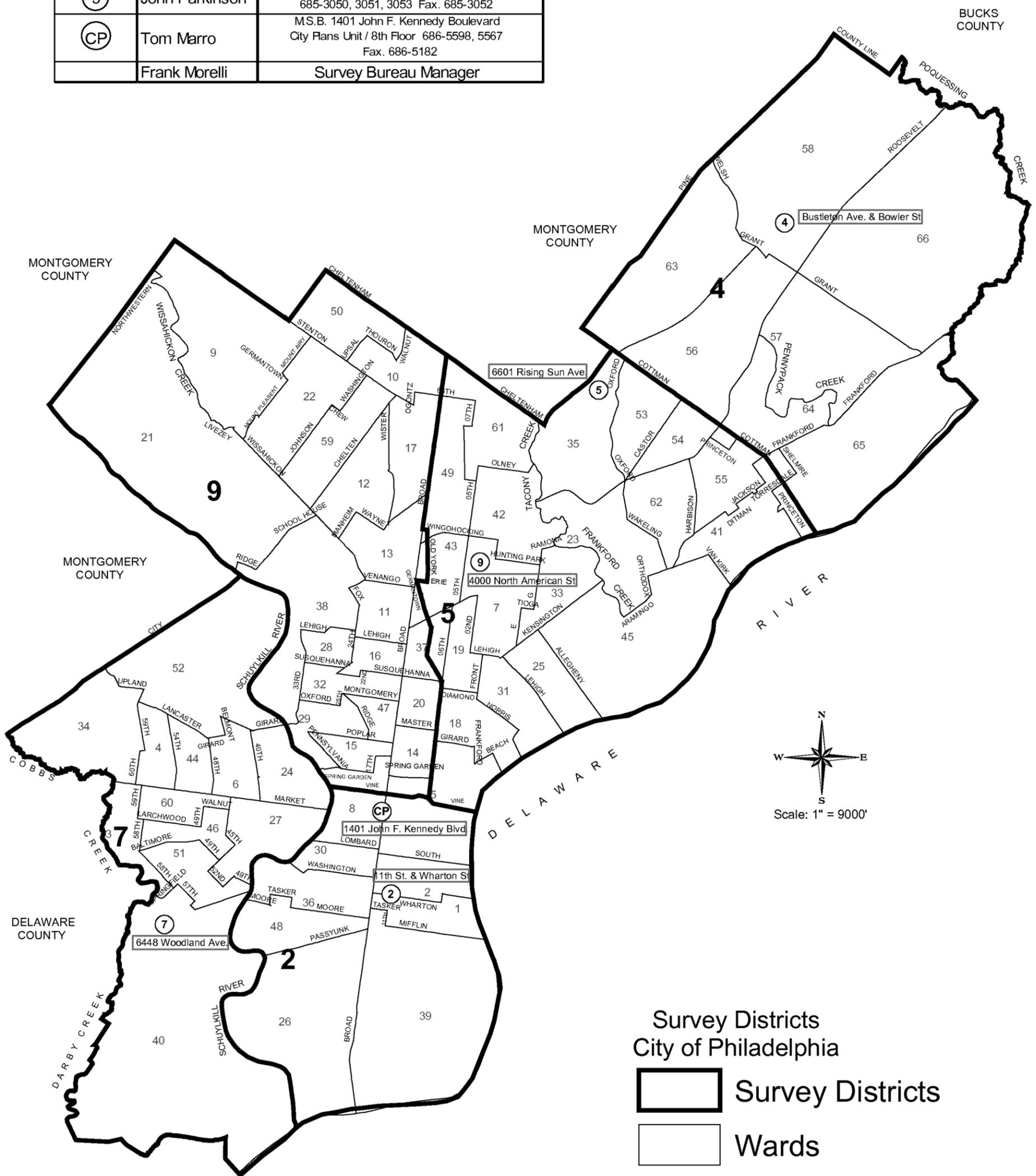
FIGURE 1



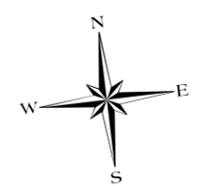
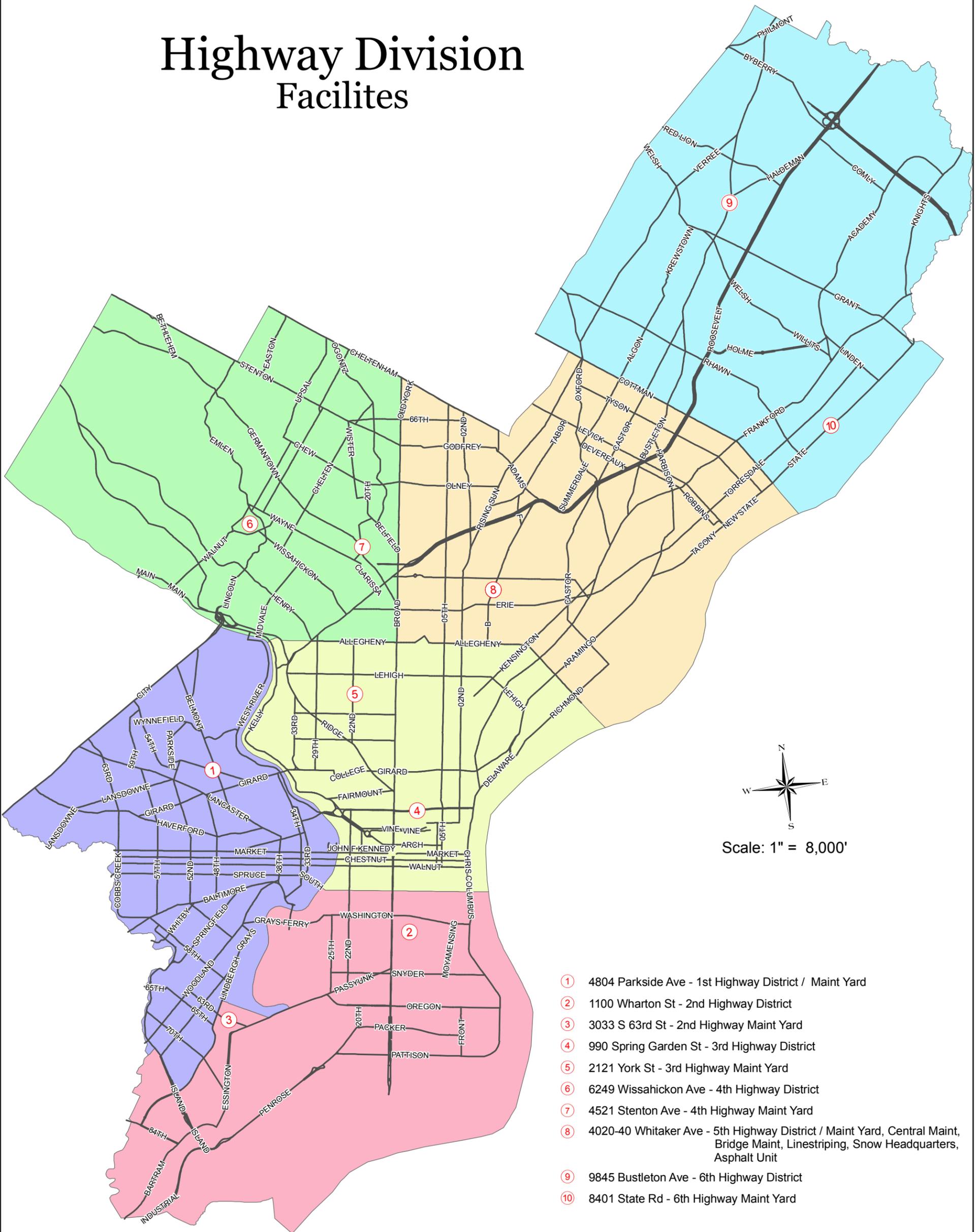
POINTS (A) AND (D) AND DISTANCE (AEFD) TO BE SUCH AS TO GIVE
 THE PRACTICAL MINIMUM FOOTAGE AS GOVERNED BY LOCAL PHYSICAL CONDITIONS

FIGURE 2

District	Surveyor	Office
②	Bob Goodman	S.W. Corner of 11th Street & Wharton Street 19147 2nd floor 685-1865 Fax. 685-1851
④	Mark Zeitz	Bustleton Avenue & Bowler Street 19115 685-0350, 0351 Fax. 685-0354
⑤	Herman Ledger	6601 Rising Sun Avenue 19111 685-0585, 0586 Fax. 685-0561
⑦	Al Bommentre	6448 Woodland Avenue 19142 685-2668, 2669 Fax. 685-2661
⑨	John Parkinson	4000 North American Street 19140 685-3050, 3051, 3053 Fax. 685-3052
Ⓢ	Tom Marro	M.S.B. 1401 John F. Kennedy Boulevard City Plans Unit / 8th Floor 686-5598, 5567 Fax. 686-5182
	Frank Morelli	Survey Bureau Manager



Highway Division Facilities



Scale: 1" = 8,000'

- ① 4804 Parkside Ave - 1st Highway District / Maint Yard
- ② 1100 Wharton St - 2nd Highway District
- ③ 3033 S 63rd St - 2nd Highway Maint Yard
- ④ 990 Spring Garden St - 3rd Highway District
- ⑤ 2121 York St - 3rd Highway Maint Yard
- ⑥ 6249 Wissahickon Ave - 4th Highway District
- ⑦ 4521 Stenton Ave - 4th Highway Maint Yard
- ⑧ 4020-40 Whitaker Ave - 5th Highway District / Maint Yard, Central Maint, Bridge Maint, Linestriping, Snow Headquarters, Asphalt Unit
- ⑨ 9845 Bustleton Ave - 6th Highway District
- ⑩ 8401 State Rd - 6th Highway Maint Yard

District	Office			Yard		
	District Engineer/Assistant	Phone	Fax	Yard Supervisor	Phone	Fax
1	John Getty / Barry Cox	685-0168, 69, 72	685-0178	Victor Young	685-0170, 71	685-0178
2	John Getty / Sal Bonnano	685-1858, 59	685-1863	Greg Bundy	685-4281, 82	685-1634
3	Frank Dachowski / Jim Taber	685-3922, 23, 33	685-3925	Darryl Egleton	685-9776, 77	685-9775
4	Frank Dachowski / Bill Robertson	685-2191, 92, 65, 66	685-2190	Kevin Williams	685-2193, 94	685-2164
5	John Murphy / Paul Yates	685-9843, 50	685-9839	Latees Thomas	685-9819, 20	685-9815
6	John Murphy / Ron Francis	685-0652, 53	685-0386	Paul Hesper	685-8271, 72	685-8286

ADA Ramp Replacement Guidance

The Philadelphia Streets Department reviews all Water Department infrastructure projects in the public right-of-way and provides requirements for the restoration of street paving. Sometimes the scope of water/sewer work and the required paving restoration will necessitate the replacement of handicap ramps at intersections. The Streets Department will typically provide a list of required ramp replacements in their paving review letter. Design drawings for the ramp replacements are to be included as part of the water/sewer bid documents. The ramp designs must be submitted to the Streets Department (City Streets & State Highways) and the Pennsylvania Department of Transportation District 6 (State Highways) for review and approval. Consultants should contact both of the above to obtain their latest design requirements. The following documents have been provided as a reference to assist in understanding the scope of work that is required for ADA ramp designs:

- Ramp Design Guidance Language
- Sample ADA Ramp Design Drawings
- PennDOT CS-4401 Form
- PennDOT ADA Technically Infeasible (TIF) Form

Handout For March 30, 2011 CHS ADA Ramp Subcommittee

The final CHS ADA Ramp Policy should have a section describing the requirements for ramp design submission and for providing as built inspection documentation. The language noted below is offered as a draft for discussion to the subcommittee. This language is currently used for developer jobs which include ramps to be approved by the Streets Department and PennDOT.

“Ramp Design Guidance” Language for Project Review Comments by Streets

12/2/10

Language for jobs (includes a State Route in project)

ADA curb cut ramp design and construction must comply with PennDOT RC-67M and PennDOT Publication 13M (DM-2). Additional design guidance is provided in the PennDOT District 6-0 ADA Curb Reference Guide. (<http://www.dot.state.pa.us/pennDOT/districts/district6.nsf/services?OpenForm>)

This job includes a State Route location; therefore all designs must be reviewed for approval and acceptance prior to construction by both PennDOT and the Streets Department. A total of 5 copies are to be submitted; three(3) to PennDOT & two (2) to Streets Department. The design submission should include the following, in a 3 ring binder:

- Transmittal Letter (list intersections, ramp locations)
- ADA Ramp Plans, signed by the Engineer (11 by 17 inch size)
- PennDOT CS-4401 Form (with pictures inserted) & PennDOT ADA Technically Infeasible (TIF) Form, as required.

For every ADA curb ramp constructed, the Engineer & Contractor must jointly perform an inspection to ensure ADA compliancy to the approved design standards. **An as-built construction submission should be submitted to both PennDOT and Streets Department, no later than 15 days after ramp construction is completed.** The submission should be made electronically (excel, Autocad or pdf) on a CD and should include the following:

- Transmittal Letter (list intersections, ramp locations)
- As built ADA Ramp Plans, signed by the Engineer
- PennDOT CS-4401 Post Inspection Form (with pictures inserted) & PennDOT ADA Technically Infeasible (TIF) Form (if constructed ramp does not meet approved design standards).

For further details contact Elias Issac, Streets Department ADA Coordinator at 215-686-5511 or elias.issac@phila.gov.

As part of the ramp design you are completing for your client, you should obtain a Highway Street Opening Permit, using the Streets Department web based system called “GPIS.” This permit gives authorization to your client to excavate the ramp construction area in the Right of Way and assures that all affected utilities with facilities in the area have reviewed and approved your proposal. The GPIS project permit entry should be applied for in the name of the developer who is building the ramp (not in the name of the contractor or your consultant firm). Passwords and Logins to the GPIS system can be obtained by contacting Michelle Brisbon at 215 686 5621 or michelle.brisbon@phila.gov.

To assure that this process has been completed, please provide the GPIS project number and GPIS permit number in your future resubmission cover letter.

Language for jobs (NO State Routes in project)

ADA curb cut ramp design and construction must comply with PennDOT RC-67M and PennDOT Publication 13M (DM-2). Additional design guidance is provided in the PennDOT District 6-0 ADA Curb Reference Guide. (<http://www.dot.state.pa.us/pennDOT/districts/district6.nsf/services?OpenForm>)

All designs must be reviewed for approval and acceptance prior to construction by the Streets Department. The design submission should include the following, two (2) copies, each in a 3 ring binder:

- Transmittal Letter (list intersections, ramp locations)
- ADA Ramp Plans, signed by the Engineer (11 by 17 inch)
- PennDOT CS-4401 Form (with pictures inserted) & PennDOT ADA Technically Infeasible (TIF) Form, as required.

For every ADA curb ramp constructed, the Engineer & Contractor must jointly perform an inspection to ensure ADA compliancy to the approved design standards. **An as-built construction submission should be submitted to Streets Department, no later than 15 days after ramp construction is completed.** The submission should be made electronically (excel, Autocad or pdf) on a CD and should include the following:

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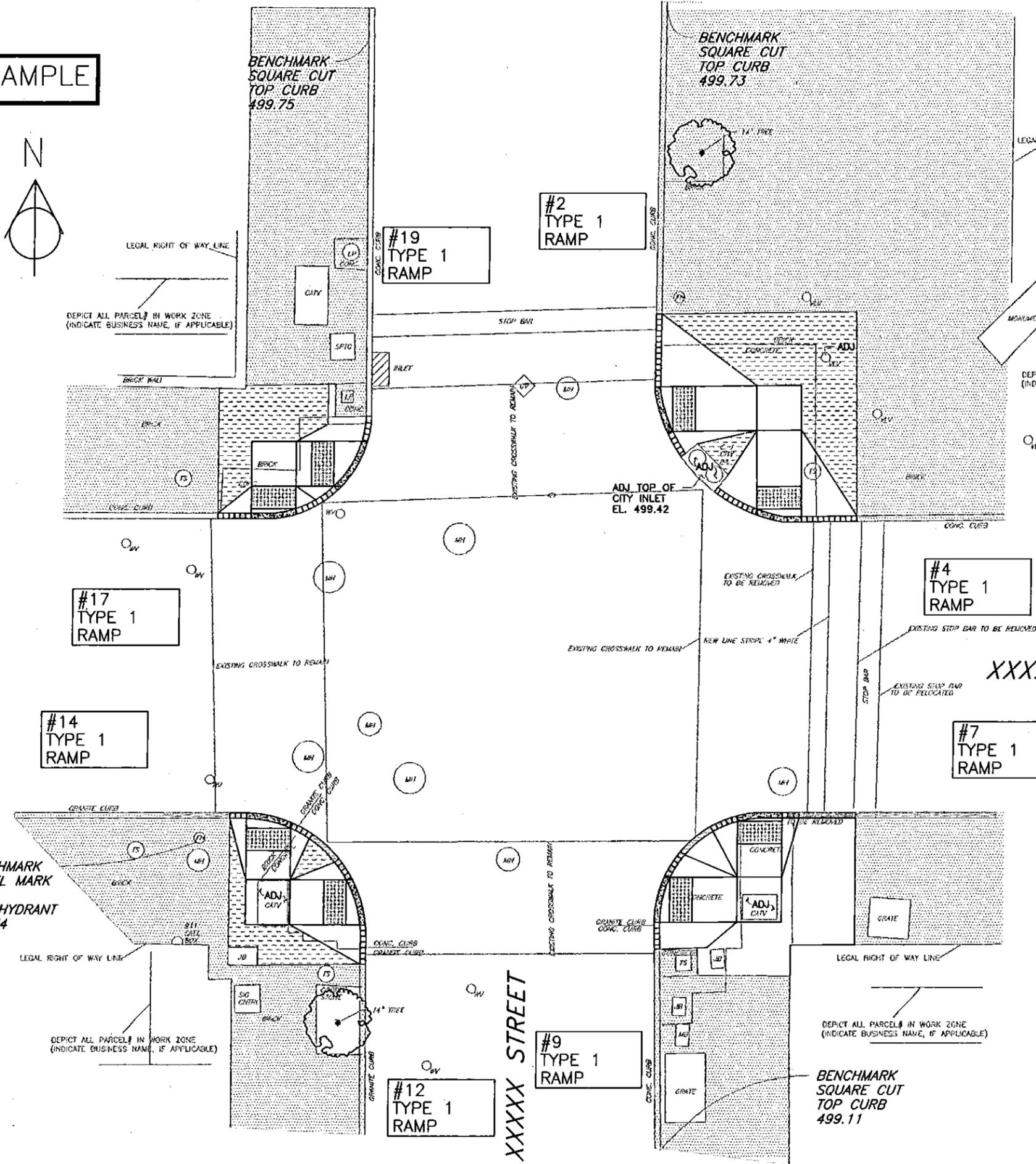
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SAMPLE

CURB RAMP ITEM TABULATION

RAMP ID	CONCRETE CURB	CONCRETE CURB, PIGMENTED	GRANITE CURB, 6" WIDE FOR CURB RAMPS	CONCRETE FOOTWAY PAVING	BRICK FOOTWAY PAVING	CURB RAMP	SIDEWALK DETECTABLE WARNING SURFACES	CURB RAMP, PIGMENTED	PARK SERVICE CURB RAMP
NO.	LF	LF	LF	SY	SY	SY	SF	SY	SY
02	X				X		X	X	
04									
07	X			X		X	X		
09									
12			X		X		X	X	
14									
17	X	X			X		X	X	
19									



LEGEND

- 04 RAMP ID NUMBER
- PROPOSED CURB
- PROPOSED TAPERED CURB
- PROPOSED DEPRESSED CURB
- PROPOSED SIDEWALK DETECTABLE WARNING SURFACE
- PROPOSED 24" SWL STOP BAR
- PROPOSED PEDESTRIAN PUSH BUTTON
- 500.00 PROPOSED ELEVATION
- TC 500.00
BC 500.00 PROPOSED TOP OF CURB ELEVATION
PROPOSED BOTTOM OF CURB ELEVATION
- 500.00 EXISTING ELEVATION TO BE MAINTAINED
- EXISTING CURB
- EXISTING SIDEWALK TO REMAIN
- EXISTING SIGN
- EXISTING INLET
- EXISTING 24" SWL STOP BAR
- TC PROPOSED SLOPE OF TOP OF TAPERED CURB
- ADJ ADJUST ELEVATION OF MANHOLE RIM, UTILITY GRATE, WATER VALVE, CATV COVER, ETC.
- BRICK SIDEWALK/FOOTWAY TRANSITION AREA

REVISION #	REVISION	DATE	BY
1			
2			
3			



RAMP AND CROSSWALK LAY OUT PLAN: XXXX St & xxxxx (Intersection name)

PROJECT NAME:

DESIGNER NAME & ADDRESS:

CORRECT: (Signature) JOHN DOW Date (mm/dd/yyyy)
ENGINEER OF RECORD

CHECKED BY:

DRAWN BY:

PROJECT # , CITY BID #, ECMS #

SAMPLE



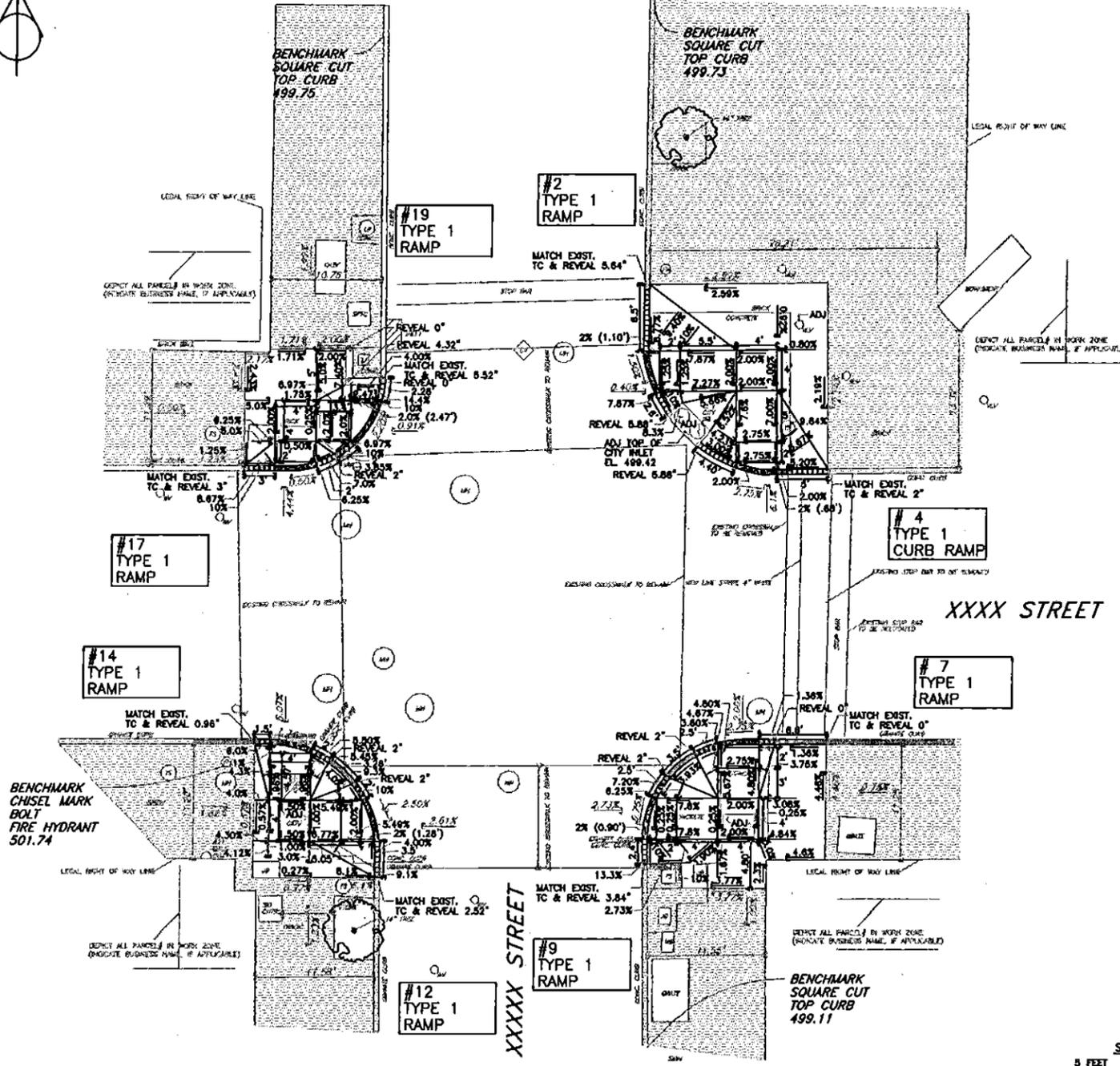
PAVEMENT MARKING INFORMATION

DESCRIPTION	NAME, TITLE, DEPARTMENT	REFERENCE #	DATE
CROSSWALK/PAVEMENT MARKINGS APPROVED BY:			
CROSSWALK/PAVEMENT MARKINGS REVISED BY:			
CONTROLLED INTERSECTION ? YES/NO	<input type="checkbox"/> 2 WAY STOP <input type="checkbox"/> 4 WAY STOP <input type="checkbox"/> SIGNALISED		

RAMP FEATURE TABULATION

TABLE REFERENCE: SEE PENN DOT RAMP INSPECTION FORM CS 4401 FOR EXPLANATION OF FEATURES

LOCATION / CORNER	North-West (NW)	North-East (NE)	South-East (SE)	South-West (SW)
RAMP ID NUMBER	02	04	07	09
CURB RAMP TYPE				
CURB LINE ROAD SLOPE (X)				
RAMP ANGLE TO SIDEWALK (degrees)				
PUSH BUTTON PROPOSED ? (Y/N)				
WATER PONDING EXISTS ? (Y/N)				
CHEEK WALL PROPOSED ? (Y/N)				
PROPERTY OWNER CONSENT LETTER REQUIRED ? (Y/N)				
UTILITY BOX ADJUSTMENTS REQUIRED Y/N				
STREET CROSS SLOPE (X)				
ALGEBRAIC GRADE DIFFERENCE (X)				
RAMP WIDTH - A				
RAMP LENGTH - B				
RAMP SLOPE - C (X)				
LEFT FLARE SLOPE - D (X)				
LEFT FLARE SLOPE - F (X)				
RIGHT FLARE SLOPE - G (X)				
RIGHT FLARE SLOPE - I (X)				
LEFT SIDEWALK WIDTH - J				
LEFT CURB REVEAL - K				
RIGHT SIDEWALK WIDTH - M				
RIGHT CURB REVEAL - N				
RIGHT FLARE LENGTH - O				
LANDING DEPTH - P				
LEFT SIDEWALK CROSS SLOPE-Q (X)				
RIGHT SIDEWALK CROSS SLOPE-R (X)				
MAXIMUM LANDING SLOPE - S (X)				
MAXIMUM CHEEK WALL HEIGHT-U				
MAXIMUM LANDING SLOPE - V (X)				
MAXIMUM RAMP CROSS SLOPE-W (X)				
CROSSWALK CURB OFFSET - X				
LEFT CROSSWALK WIDTH - Y				
RIGHT CROSSWALK WIDTH - YY				
LEFT STOP BAR & CROSSWALK OFFSET - Z				
RIGHT STOP BAR & CROSSWALK OFFSET - ZZ				
LEFT CROSSWALK & FLARE OFFSET-AA				
RIGHT CROSSWALK & FLARE OFFSET-BB				
LEFT SIDEWALK TRANSITION SLOPE-CC (X)				
LEFT SIDEWALK TRANSITION CROSS SLOPE-DD (X)				
RIGHT SIDEWALK TRANSITION SLOPE-EE (X)				
RIGHT SIDEWALK TRANSITION CROSS SLOPE-FF(X)				
TECHNICAL INFRASTRUCTURE APPROVAL REQUESTED ? Y/N				
LEVEL OF SERVICE: MEETS RC-67M ? Y/N				



XXXX STREET

XXXXX STREET



RAMP CONSTRUCTION PLAN: XXXXXXXX St & xxxxxxx St. (Intersection name)

PROJECT NAME:

DESIGNER NAME & ADDRESS:

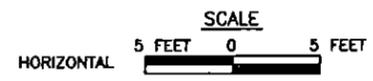
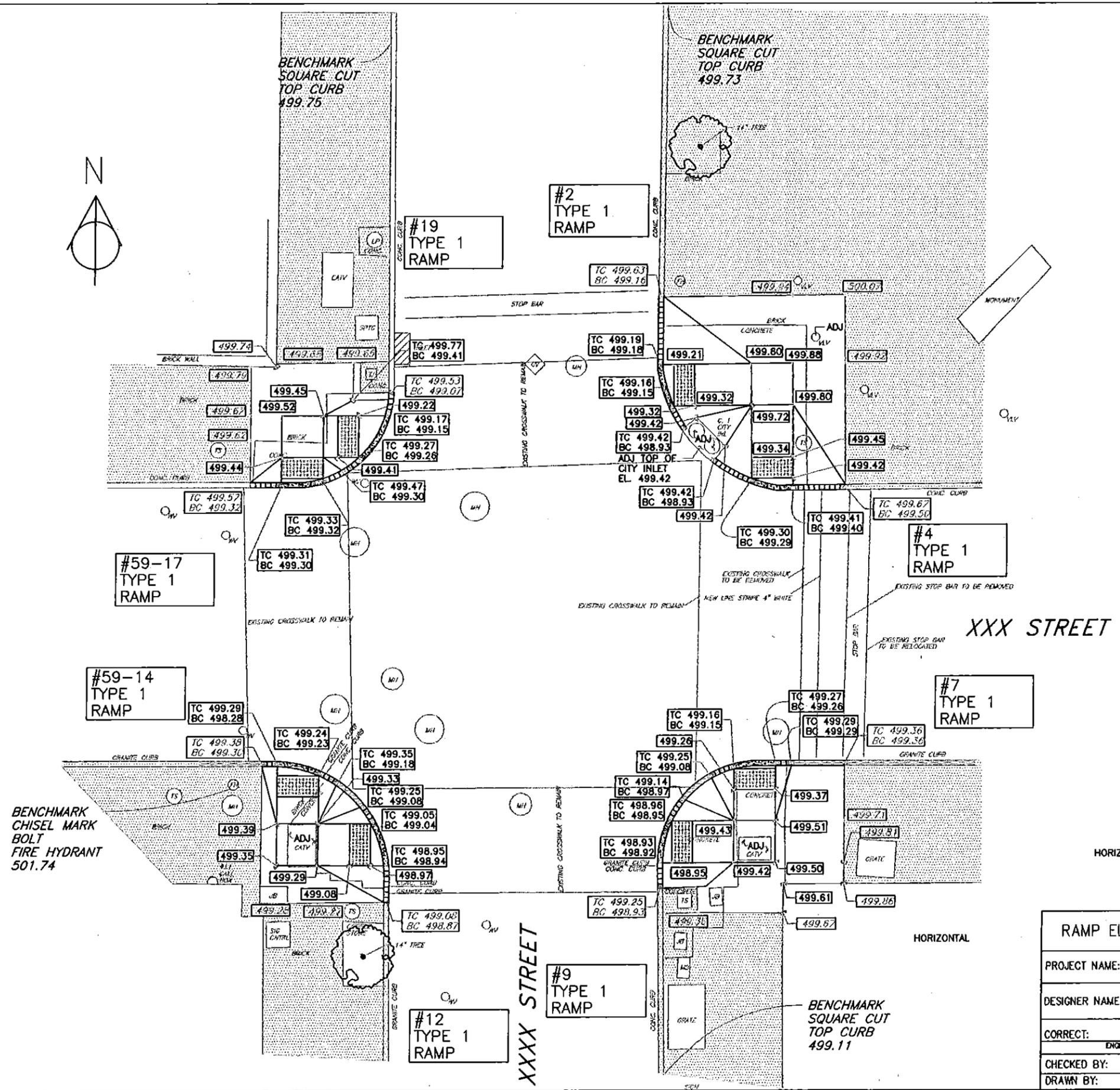
CORRECT: (Signature) JOHN DOW Date (mm/dd/yyyy)

CHECKED BY: PROJECT #, CITY BD #, ECMS #

DRAWN BY:

REVISION #	REVISION	DATE	BY
1			
2			
3			

SAMPLE
 Note: This sheet is OPTIONAL



REVISION #	REVISION	DATE	BY
1			
2			
3			

RAMP ELEVATION PLAN: XXXXX St & xxxxx (Intersection Name)

PROJECT NAME:

DESIGNER NAME & ADDRESS :

CORRECT: (Signature) JOHN DOW Date (mm/dd/yyyy)
ENGINEER OF RECORD

CHECKED BY:

DRAWN BY:

PROJECT # , CITY BID #, ECMS #



See the last tab of this workbook for instructions

*Date of Investigation (yyyy dd mm)				
Field Investigators 1				
Field Investigators 2				
*Engineering District Code				
*County Name				
*County Code (auto)	(Automatically Filled In)			
*Municipality Name				
*Municipality Code (auto)	(Automatically Filled In)			
Construction Phase	<input type="checkbox"/> Constructed <input type="checkbox"/> Ex-Surveyed <input type="checkbox"/> Missing			
Ramp Crosses	<input type="checkbox"/> State Rte <input type="checkbox"/> Local Rte <input type="checkbox"/> Both			
Photo Log Number				
Number of Photos				
Ramp Surface	<input type="checkbox"/> Brick <input type="checkbox"/> Concrete <input type="checkbox"/> Other			
Surface Stable, Firm, and Slip Resistant	<input type="checkbox"/> No <input type="checkbox"/> Yes			
Elevation Differences > 1/4"	<input type="checkbox"/> No <input type="checkbox"/> Yes			(X/16")
Grate Openings or Gaps > 1/2"	<input type="checkbox"/> No <input type="checkbox"/> Yes			(X/16")
Utilities in Path of Travel	<input type="checkbox"/> No <input type="checkbox"/> Yes			
Water Ponding in Path of Travel	<input type="checkbox"/> No <input type="checkbox"/> Yes			
Detectable Warning Surface (DWS)	<input type="checkbox"/> No <input type="checkbox"/> Yes			
DWS type (if applicable)	<input type="checkbox"/> Mat <input type="checkbox"/> PolConc <input type="checkbox"/> PolCom <input type="checkbox"/> Iron <input type="checkbox"/> Steel <input type="checkbox"/> Brick <input type="checkbox"/> Other			
Pedestrian Crossing and Type	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> N/A <input type="checkbox"/> 1Ramp 1Crossing <input type="checkbox"/> 1Ramp 2Crossing			
Ramp Leads to Accessible Path	<input type="checkbox"/> No <input type="checkbox"/> Yes			
Longitudinal / Cross slope in Front of Ramp		%		%
Turning Maneuver in Street	<input type="checkbox"/> No <input type="checkbox"/> Yes			
Turning Maneuver at Top of Ramp (Smax)	<input type="checkbox"/> No <input type="checkbox"/> Yes			
ECMS #		Alg Δ Grade		%
Intersection Ramp # of #				
*Ramp Location (Use Figure Below)				
*Curb Ramp Type				
*North Leg		(segment)		(offset)
*North Leg Desc.	<input type="checkbox"/> SR <input type="checkbox"/> St <input type="checkbox"/> Other			
*East Leg		(segment)		(offset)
*East Leg Desc.	<input type="checkbox"/> SR <input type="checkbox"/> St <input type="checkbox"/> Other			
*South Leg		(segment)		(offset)
*South Leg Desc.	<input type="checkbox"/> SR <input type="checkbox"/> St <input type="checkbox"/> Other			
*West Leg		(segment)		(offset)
*West Leg Desc.	<input type="checkbox"/> SR <input type="checkbox"/> St <input type="checkbox"/> Other			

1 RAMP, 1 CROSSINGS

NOTE: CROSSING MAY BE MARKED OR UNMARKED

1 RAMP, 2 CROSSINGS

NOTE: CROSSING MAY BE MARKED OR UNMARKED

ACCESSIBLE PUSH BUTTONS

DIMENSIONS ARE ABSOLUTE FOR NEW INSTALLATIONS

Accessible Push Buttons	<input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> N/A			
Sketch Used To Collect Field Information	<input type="checkbox"/> No <input type="checkbox"/> Yes			
Asset # (auto)	□--(Automatically Filled In)--(Automatically Filled In)----			
* Status	<input type="checkbox"/> Current <input type="checkbox"/> Archive			
Archive Ramp at location #:				
Level of Service	<input type="checkbox"/> Meets RC-67M <input type="checkbox"/> As Per Contract Documents <input type="checkbox"/> Ex - Provides Max Access <input type="checkbox"/> Non-Compliant			

See the last tab of this workbook for instructions

TYPE 1

MAX ALG. CHANGE IN GRADE _____ %
 TOP TURNING AREA
 IF YES, MAX SLOPE "S" _____ %

TYPE 1A

MAX ALG. CHANGE IN GRADE _____ %

TYPE 2

MAX ALG. CHANGE IN GRADE _____ %

TYPE 3

MAX ALG. CHANGE IN GRADE _____ %
 TOP TURNING AREA
 IF YES, MAX SLOPE "S" _____ %

TYPE 4

MAX ALG. CHANGE IN GRADE _____ %
 TOP TURNING AREA
 IF YES, MAX SLOPE "S" _____ %

TYPE 4A

MAX ALG. CHANGE IN GRADE _____ %
 TOP TURNING AREA
 IF YES, MAX SLOPE "S" _____ %

TYPE 5

MAX ALG. CHANGE IN GRADE _____ %
 RAILING NO YES
 "CC" RAIL HEIGHT _____ INCHES

TYPE 6

MAX ALG. CHANGE IN GRADE _____ %

BLENDED TRANSITION

MAX ALG. CHANGE IN GRADE _____ %

NON-TYPICAL

"A" RAMP WIDTH
 "B" RAMP LENGTH
 "C" RAMP SLOPE
 "D" LT FLARE SLOPE
 "I" RT FLARE SLOPE
 "J" LT SIDEWALK WIDTH
 "M" RT SIDEWALK WIDTH
 "P" SIDEWALK LANDING DEPTH
 "Q" LT SIDEWALK CROSS SLOPE
 "R" RT SIDEWALK CROSS SLOPE
 "S" SIDEWALK LANDING MAX SLOPE
 "W" RAMP MAX CROSS SLOPE

MAX ALG. CHANGE IN GRADE _____ %
 SIDEWALK TURNING AREA
 IF YES, DESIGNATE MAX SLOPE "S" _____ %

TYPE A MEDIAN

TYPE B MEDIAN

"0.00" inches or %		
*	A	(IN)
*	B	(IN)
*	C	(%)
*	D	(%)
*	E	(%)
*	F	(%)
*	G	(%)
*	H	(%)
*	I	(%)
*	J	(IN)
*	K	(IN)
*	L	(IN)
*	M	(IN)
*	N	(IN)
*	O	(IN)
*	P	(IN)
*	Q	(%)
*	R	(%)
*	S	(%)
*	T	(IN)
*	U	(IN)
*	V	(%)
*	W	(%)
*	X	(IN)
*	Y	(IN)
*	YY	(IN)
*	Z	(IN)
*	ZZ	(IN)
*	AA	(IN)
*	BB	(IN)
*	CC	(IN)

(05-08)



ADA Technically Infeasible Form

(Additional Explanation Sheet)

Investigated Design Alternative #1

--

Investigated Design Alternative #2

--

Investigated Design Alternative #3

--

Summary

--

TIF #:

*(TIF Number automatically assigned. All fields marked with * provide data for TIF #)*



State Highway Route Numbers

APPENDIX VI

STATE HIGHWAY ROUTE NUMBERS

LEGEND:

SR – STATE ROUTE

LR – LEGISLATIVE ROUTE

(OLD DESIGNATION FOR STATE HIGHWAYS)

SEPTEMBER 25, 2000

STREET	SR#	LR#	FROM	TO	MILES
Academy Rd	1013	1032	I-95/Delaware Expy	Willits Rd	0.66
	1013	67294	Willits Rd	Knights Rd	4.13
Adams Ave	1002	67049	Crescentville Rd	Roosevelt Blvd	0.98
	1007	67350	Torresdale Ave	Tacony St	0.07
Allegheny Ave	2014	67288	Ridge Ave	Delaware Ave	5.4
Allens Ln	4003	67329	Wissahickon Ave	Germantown Ave	1.3
Aramingo Ave	2009	67047	Delaware Ave	Harbison Ave	4.01
Arch St.	3007	67317	Columbus Blvd	16th St	1.35
	3031	67005 A	Schuylkill Ave W	30th St	0.11
B St	1003	67339	Allegheny Ave	Erie Ave	0.6
Baltimore Ave	13	67283	39th St	City Limits	2.55
Bartram Ave	3019		I-95/Delaware Expy	Island Ave	1.41
	3002		Island Ave	84th St	0.59
Belmont Ave	3005	67365	Lancaster Ave	City Ave	2.34
Berkley St	4009	67306	Wayne Ave	Germantown Ave	0.17
Bethlehem Pike	4007	67028	Germantown Ave	Stenton Ave	0.66
Bridge St	1009	67298	Frankford Ave	Tacony St	0.75
	1009	67340	Tacony St	Richmond St	0.53
Broad St	3001	67373	I-95/Delaware Expy	Oregon Ave	1.2
	291	67312	Oregon Ave	S Penn Sq	2.33
	611	67312	Filbert St	67th Ave	6.88
Bustleton Ave	1009	67332	Frankford Ave	Harbison Ave	1.28
	1009		Harbison Ave	Welsh Rd	3.81
	532	67332	Welsh Rd	Woodhaven Rd	2.03
	532		Woodhaven Rd	County Line Rd	0.9
Castor Ave	1005	67288	Delaware Ave	Richmond St	0.53
	1005	67347	Richmond St	Bustleton Ave	6.08
Cecil B Moore Ave	2010		10th St	Ridge Ave	1.11
Cheltenham Ave	1002	67059	Crescentville Rd	Old York Rd	1.58
	309	46116	Old York Rd	Ogontz Ave	1.09
	2035	46116	Ogontz Ave	Ivy Hill Rd	1.46
Chester Ave	3023	67282	65th St (W)	65th St (E)	0.04
	3023	67282	52nd St	45th St	0.62
	3023		45th St	42nd St	0.21
Chestnut St	3008	67318	Columbus Blvd	Broad St	1.12
	3	67318	Broad St	Schuylkill Ave W	1.01
	3	67351	Schuylkill Ave W	Cobbs Creek Pkwy	3.38
Chew Ave	4004	67346	Olney Ave	Mt Airy Ave	2.16
City Ave	4006		Ridge Ave	I-76/Schuylkill Expy	0.34
	1		I-76/Schuylkill Expy	City Limits	4.45
Civic Center Bl	3005	67060	University Ave	Convention Ave	0.35
Clarissa St	4007	67306	Hunting Park Ave	Roberts Ave	0.51
Cliveden St	4013	67029	Park Line Dr	Lincoln Dr	0.45
Cobbs Creek Pkwy	3015	67368	Woodland Ave	Hoffman Ave	1.95
	3015	67284	Baltimore Ave	Walnut St	1.36
	3	67367	Walnut St	Market St	0.2
Columbus Blvd	2001	67025	Oregon Ave	Spring Garden St	3.01
Cottman Ave	1012	67293	I-95/Delaware Expy	State Rd	0.11
	73	67293	State Rd	City Limits	4.41
County Line Rd	2038	9033	Bustleton Ave	City Limits	0.38

STREET	SR#	LR#	FROM	TO	MILES
Crescentville Rd	1002	67059	Adams Ave	Cheltenham Ave	0.29
Dauphin St	2012	67332	Aramingo Ave	Front St	0.84
	2012		Front St	Broad St	1.25
	2012		Broad St	Ridge Ave	1.59
Delaware Ave	2001	67025	Spring Garden St	Aramingo Ave	1.09
	1005	67288	Allegheny Ave	Castor Ave	0.49
Eakins Oval	3007	67030	South/East side		0.08
	3007	67002	North/West side		0.08
Easton Rd	4021	67354	Mt Airy Ave	Wadsworth Ave	0.46
Elmwood Ave	3021	67308	Lindbergh Blvd	58th St	0.2
	3021		58th St	63rd St	0.5
	3021		63rd St	Island Ave	1.09
Erie Ave	1004	67331	Kensington Ave	Hunting Park Ave	3.56
Essington Ave	3019	67311	Passyunk Ave	Bartram Ave	1.52
Filbert St	2004		Juniper St	Broad St	0.06
Frankford Ave	2007		Delaware Ave	Kensington Ave	3.74
	2007		Kensington Ave	Robbins St	2.11
	13		Robbins St	City Limits	4.62
B Franklin Pkwy	3007	67002	16th St	Logan Circle (east)	0.21
	3007	67002	Logan Circle (west)	Eakins Oval	0.65
Germantown Ave	4005	67353	Broad St	Washington La	2.79
	4007	67303	Washington La	Bethlehem Pike	2.37
Girard Ave	2008	67302	Richmond St	S College Ave	2.65
	2008	67030	W College Ave	29th St	0.3
	2006	67301	29th St	34th St	0.61
	30	67301	34th St	Lancaster Ave	1.22
Godfrey Ave	4002		Crescentville Rd	Broad St	1.55
Grant Ave	1018	67357	State Rd	Welsh Rd	3.15
Grays Ave	3021	67309	49th St	Lindbergh Blvd	0.29
Grays Ferry Ave	3021	67309	34th St	Woodland Ave	0.83
Harbison Ave	2009	67047	Aramingo Ave	Roosevelt Blvd	1.79
Haverford Ave	3018		Lancaster Ave	City Ave	3.91
Henry Ave	4001	67343	Allegheny Ave	Cathedral Rd	5.14
Hoffman Ave	3015	67368	58th St	Cobbs Creek Pkwy	0.12
Holme Ave	1016	67296	Roosevelt Blvd	Academy Rd	1.88
Huntingdon Pk	232	67325	Pine Rd	Fillmore St	0.14
Hunting Park Ave	3033	67286	Kelly Dr	Ridge Ave	0.11
	13	67286	Ridge Ave	Broad St	2.34
I-76/Schuylkill Expy	76	67278	Passyunk Ave	City Ave	9.34
I-95/Delaware Expy	95	795	City Limits	City Limits	21.92
I-676/Vine St Expy	676	67045	I-95/Delaware Expy	I-76/Schuylkill Expy	2.02
Independence Mall E	2003		Walnut St	Race St	0.34
Independence Mall W	2005		Walnut St	Race St	0.34
Industrial Hwy	291	67054	Island Ave	City Limits	1.53
Island Ave	3013	67281	Woodland Ave	Industrial Hwy	1.93
Juniper St	2004	67360	Market St	Filbert St	0.07
Kelly Dr	3007		Eakins Oval	Lincoln Dr	4.48
J F Kennedy Blvd	2004		Broad St	15th St	0.08
	3037		15th St	Schuylkill Ave W	0.84
	3028		30th St	Market St	0.24

STREET	SR#	LR#	FROM	TO	MILES
Keystone St	1024	67327	Robbins St	Levick St	0.12
Kingsessing Ave	3023	67282	52nd St	61st St	0.92
	3023		61st St	Cemetery Ave	0.21
	3023		Cemetery Ave	65th St	0.09
Knights Rd	1015	67338	Frankford Ave	City Limits	2.49
Lancaster Ave	3005	67314	33rd St	34th St	0.12
	3005		34th St	Belmont Ave	1.11
	3012	67010	Belmont Ave	Girard Ave	0.55
	30	67010	Girard Ave	City Ave	2.11
Lehigh Ave	2014	67356	Richmond St	Kensington Ave	1.04
	2014		Kensington Ave	Ridge Ave	3.25
Levick St	1008	67022	State Rd	Frankford Ave	0.88
	13	67020	Frankford Ave	Roosevelt Blvd	0.75
	1008	67358	Roosevelt Blvd	Rising Sun Ave	1.6
Lincoln Dr	3007		Kelly Dr	Ridge Ave	0.02
	4013	67029	Cliveden St	Mt Pleasant Ave	1.14
	4013		Mt Pleasant Ave	Allens La	0.2
Lindbergh Blvd	3021	67309	Grays Ave	Elmwood Ave	0.47
	3025	67309	Elmwood Ave	65th St	0.8
Linden Ave	1016	67295	Academy Rd	I-95/Delaware Expy	0.95
Logan Circle	3007	67002			0.05
Market St	2004	67360	Columbus Blvd	Juniper St	1.14
	3010	67313	15th St	Cobbs Creek Pkwy	4.29
	3	67313	Cobbs Creek Pkwy	City Limits	0.11
Marshall Rd	3031	67284	Cobbs Creek Pkwy	City Limits	0.06
Midvale Ave	4011	67363	Kelly Dr	Wissahickon Ave	1.22
Mt Airy Ave	4021	67354	Germantown Ave	Easton Rd	0.98
Moyamensing Ave	291	67023	Broad St	20th St	0.62
Old York Rd	611	67014	67th Ave	Cheltenham Ave	0.53
Olney Ave	4004	67346	Rising Sun Ave	Wister St	2.25
Oregon Ave	2001	67025	Columbus Blvd	Broad St	1.73
Oxford Ave	232	67341	Roosevelt Blvd	Rhawn St	3.05
Parkside Ave	3017	67369	Girard Ave	52nd St	1.12
Park Line Dr	4013	67029	Walnut La	Cliveden St	0.07
Passyunk Ave	3019	67310	Broad St	Essington Ave	2.72
Pennsylvania Ave	2006	67030	Spring Garden St	25th St	0.18
	3011	67301	25th St	26th St	0.1
Penrose Ave	291	67023	20th St	Pattison Ave	0.54
	291		Pattison Ave	26th St	0.26
	291		26th St	Island Ave	2.44
Philmont Ave	1030	67346	Byberry Rd	City Limits	1.02
Poplar St	2008	67302	24th St	W College Ave	0.09
Princeton Ave	73	67328	Frankford Ave	State Rd	0.81
	1010	67328	State Rd	I-95/Delaware Expy	0.11
Race St	3009	67004	6th St	8th St	0.17
Rhawn St	1014	67359	Pine Rd	State Rd	4.56
Richmond St	2001	67348	Delaware Ave	Lehigh Ave	0.62
	2001		Lehigh Ave	Bridge St	3.05

STREET	SR#	LR#	FROM	TO	MILES
Ridge Ave	3009		Spring Garden St	33rd St	2.24
	13	67030	33rd St	Hunting Park Ave	0.86
	3009	67030	Hunting Park Ave	Allegheny Ave	0.38
	3009	67030	Allegheny Ave	Gustine Lk Ramp (S)	1.03
	3009	67029	Gustine Lk Ramp (S)	Main St	0.31
	3009		Main St	Northwestern Ave	4.7
Rising Sun Ave	1001	67326	Roosevelt Blvd	Cottman Ave	3.08
Robbins St	13	67327	Roosevelt Blvd	Frankford Ave	0.91
	1024	67327	Frankford Ave	Keystone St	0.64
Roberts Ave	4009	67364	Henry Ave	Wayne Ave	1.31
Roosevelt Blvd	1	67009	9th St	City Limits	11.7
Roosevelt Expy	1	67058	I-76/Schuylkill Expy	9th St	2.95
Schuylkill Ave W	3026	67057	Walnut St	Arch St	0.29
Sedgley Ave	2016		Allegheny Ave/9th St	Allegheny Ave/11th St	0.2
Snyder Ave	2002	67372	Columbus Blvd	Vare Ave	2.81
S College Ave	2008	67302	24th St	Girard Ave	0.26
S Penn Sq	3022	67002	Broad St	15th St	0.07
Spring Garden St	2006	67030	Columbus Blvd	Eakins Oval (E)	2.18
	3014	67002	Eakins Oval (W)	Lancaster Ave	1.13
State Rd	73	67350	Levick St	Cottman Ave	1.11
	1007	67350	Cottman Ave	Grant Ave	2.86
	1007		Grant Ave	City Limits	0.07
Stenton Ave	4002	67017	Broad St	Ogontz Ave	0.45
	4002	67049	Ogontz Ave	Bethlehem Pike	3.94
	3003	46086	Bethlehem Pike	Northwestern Ave	0.73
Tacony St	1007	67350	Adams Ave	Bridge St	1.01
	1007	67048	Bridge St	Levick St	1.43
Torresdale Ave	1004	67331	Kensington Ave	Linden Ave	5.93
University Ave	3003	67278	34th St	Baltimore Ave	0.63
Upsal St	4017	67345	Germantown Ave	Cheltenham Ave	2.15
Vare Ave	76	67278	Passyunk Ave	34th St	0.7
Verree Rd	1001	67324	Oxford Ave	Bustleton Ave	4.07
Vine St (service rds)	2676	67045	7th St	20th St	1.09
Wadsworth Ave	4021	67354	Thouron Ave	Cheltenham Ave	0.46
Walnut La	4013		Ridge Ave	Park Line Dr	0.8
	4015	67345	Park Line Dr	Wayne Ave	0.78
Walnut St	3006	67319	Columbus Blvd	Broad St	1.12
	3	67319	Broad St	Schuylkill Ave W	1.01
	3	67352	Schuylkill Ave W	Cobbs Creek Pkwy	3.35
Washington La	4007	67304	Wayne Ave	Germantown Ave	0.91
	4019	67304	Germantown Ave	Cheltenham Ave	1.93
Wayne Ave	4007	67305	Windrim Ave	Washington La	1.74
	4015	67345	Washington La	Lincoln Dr	0.27
Welsh Rd	1011	67321	Willits Rd	Roosevelt Blvd	1.02
	532	67321	Roosevelt Blvd	Bustleton Ave	0.93
	1011	67321	Bustleton Ave	City Limits	1.09
W College Ave	2006	67030	Poplar St	Girard Ave	0.09
Whitaker Ave	1003	67339	Erie Ave	Roosevelt Blvd	1.7
Whitby Ave	3017	67370	52nd St	Cobbs Creek Pkwy	0.67
Willits Rd	1011	67321	Welsh Rd	Academy Rd	1.39

STREET	SR#	LR#	FROM	TO	MILES
Wissahickon Ave	4003	67330	Hunting Park Ave	Allens La	3.26
Woodhaven Rd	1022	67334	City Limits	Roosevelt Blvd	1.49
	63	1029	Roosevelt Blvd	City Limits	2.6
Woodland Ave	3021	67309	Grays Ferry Ave	49th St	0.02
	3013	67281	Island Ave	City Limits	0.12
5th St	2003		Race St	Spring Garden St	0.61
6th St	2005		Race St	Spring Garden St	0.61
8th St	3009		Race St	Vine St	0.11
15th St	3022	67002	S Penn Sq	Kennedy Blvd	0.11
	3029	67006 A	Kennedy Blvd	Vine St	0.31
16th St	3027	67006 B	Kennedy Blvd	Vine St	0.31
25th St	2006		Pennsylvania Ave	Poplar St	0.38
26th St	3003	67278	Penrose Ave	I-76/Schuylkill Expy	1.13
	3011	67031	Pennsylvania Ave	Girard Ave	0.41
29th St	3011	67030	Girard Ave	Allegheny Ave	1.99
	3011		Allegheny Ave	Hunting Park Ave	0.07
30th St	3031	67005	Market St	Arch St	0.09
33rd St	3005	67060	Convention Ave	Lancaster Ave	0.47
	13	67333	Girard Ave	Ridge Ave	1.19
34th St	3003	67278	I-76/Schuylkill Expy	University Ave	0.41
	3035	67316	Market St	Lancaster Ave	0.09
38th St	13	67278	Baltimore Ave	Chestnut St	0.32
	13		Chestnut St	Lancaster Ave	0.35
	3003	67278	Lancaster Ave	Haverford Ave	0.22
42nd St	3023	67282	Chester Ave	Baltimore Ave	0.06
49th St	3021	67309	Grays Ave	Woodland Ave	0.14
52nd St	3023	67282	Kingsessing Ave	Chester Ave	0.09
	3017	67370	Whitby Ave	Haverford Ave	0.9
	3017		Haverford Ave	Lancaster Ave	0.82
	3017		Lancaster Ave	Parkside Ave	0.32
58th St	3015	67368	Hoffman Ave	Baltimore Ave	0.18
63rd St	3004	67371	Passyunk Ave	Lindbergh Blvd	0.49
	3015	67367	Market St	City Ave	1.87
65th St	3004	67320	Lindbergh Blvd	Chester Ave	1.02
	3004	67282	Chester Ave	City Limits	0.29
84th St	3002	67280	Bartram Ave	City Limits	0.8

Appendix

VII

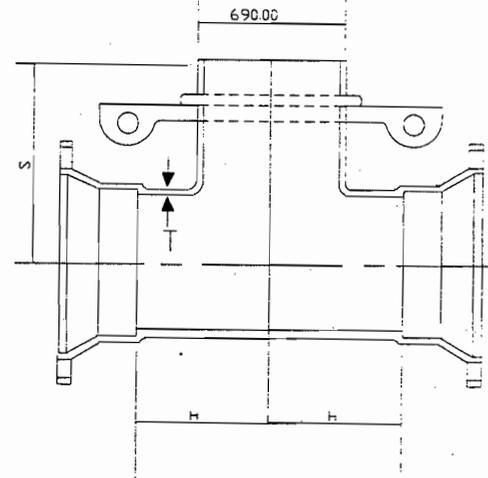
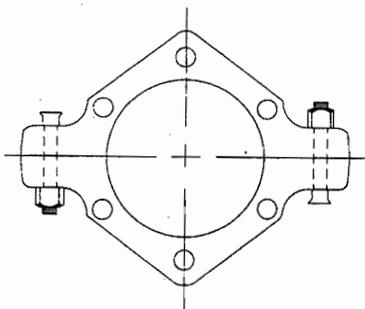
Weight of Ductile Iron Fittings

APPENDIX VII

WEIGHT OF DUCTILE IRON FITTINGS

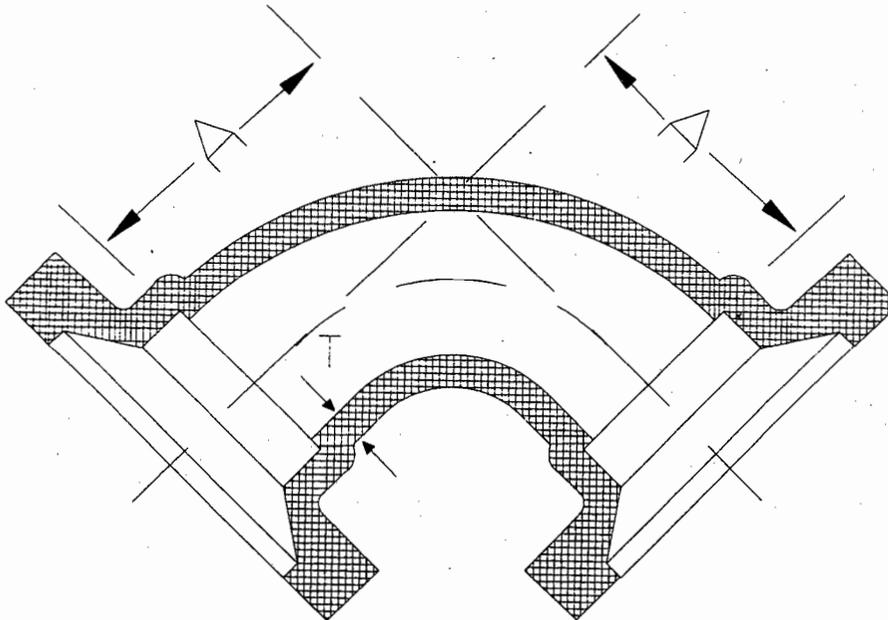
HYDRANT ANCHORING TEES

RUN in.	BRANCH in.	WEIGHT lbs.	"H" in.	"T" in.	"S" in.	"TI" in.	MATERIAL	RATING psi	SOURCE
6	6	64	6.2	0.37	10.00	0.37	DI	350	USP
8	6	79	6.2	0.39	11.00	0.37	DI	350	USP
10	6	104	6.3	0.41	12.50	0.37	DI	350	USP
12	6	129	6.3	0.43	13.50	0.37	DI	350	USP



MECHANICAL JOINTS 1/4 BENDS
(90 DEGREES)

SIZE in.	WEIGHT lbs.	"A" in.	"T" in.	MATERIAL	RATING psi.	SOURCE
3	23	3.50	0.33	DI	350	C153
4	27	4.00	0.34	DI	350	C153
6	39	5.00	0.36	DI	350	C153
8	57	6.50	0.38	DI	350	C153
10	89	7.50	0.40	DI	350	C153
12	108	9.00	0.42	DI	350	C153
14	340	14.00	0.66	DI	350	C110
16	430	15.00	0.70	DI	350	C110
18	545	16.50	0.75	DI	350	C110
20	680	18.00	0.80	DI	350	C110
24	1,025	22.00	0.89	DI	350	C110
30	1,690	25.00	1.03	DI	350	C110
36	2,475	28.00	1.15	DI	350	C110
42	3,410	31.00	1.28	DI	350	C110
48	4,595	34.00	1.42	DI	350	C110



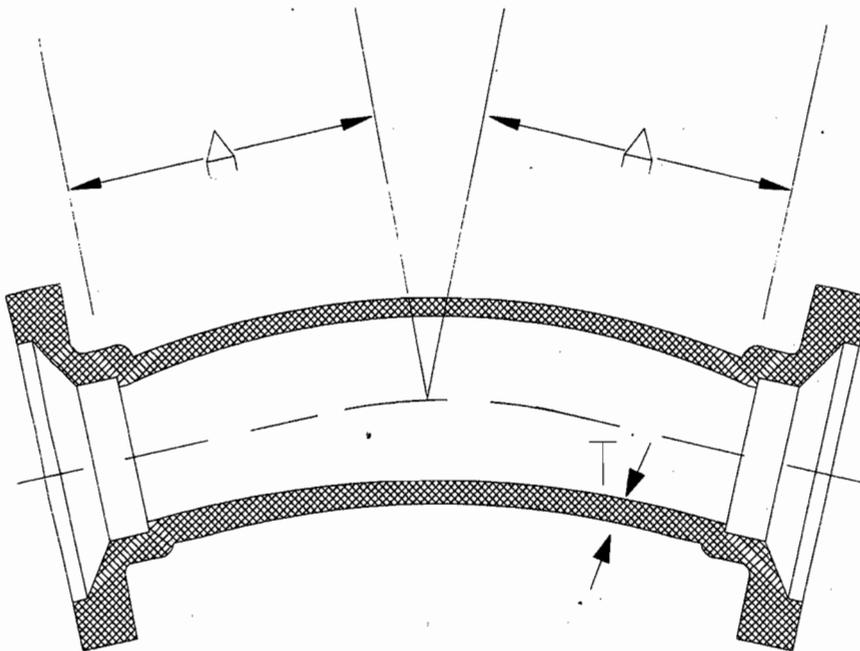
90 ° Bends

**MECHANICAL JOINT 1/8 BENDS
(45 DEGREES)**

SIZE	WEIGHT	"A"	"T"	MATERIAL	RATING	SOURCE
in.	lbs.	in.	in.		psi	
3	21	1.50	0.33	DI	350	C153
4	23	2.00	0.34	DI	350	C153
6	32	3.00	0.36	DI	350	C153
8	46	3.50	0.38	DI	350	C153
10	70	4.50	0.40	DI	350	C153
12	86	5.50	0.42	DI	350	C153
14	270	7.50	0.66	DI	350	C110
16	340	8.00	0.70	DI	350	C110
18	420	8.50	0.75	DI	350	C110
20	530	9.50	0.80	DI	350	C110
24	755	11.00	0.89	DI	350	C110
30	1,380	15.00	1.03	DI	350	C110
36	2,095	18.00	1.15	DI	350	C110
42	2,955	21.00	1.28	DI	350	C110
48	4,080	24.00	1.42	DI	350	C110

**MECHANICAL JOINT 1/16 BENDS
(22 1/2 DEGREES)**

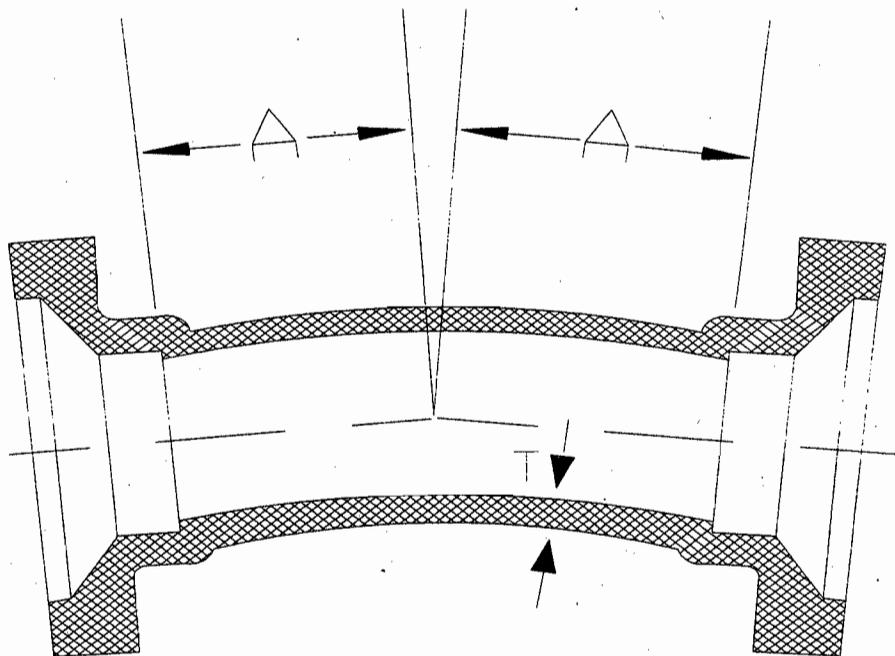
SIZE	WEIGHT	"A"	"T"	MATERIAL	RATING	SOURCE
in.	lbs.	in.	in.		psi	
3	16	1.00	0.33	DI	350	C153
4	18	1.50	0.34	DI	350	C153
6	32	2.00	0.36	DI	350	C153
8	46	2.50	0.38	DI	350	C153
10	64	3.00	0.40	DI	350	C153
12	84	3.50	0.42	DI	350	C153
14	275	7.50	0.66	DI	350	C110
16	345	8.00	0.70	DI	350	C110
18	430	8.50	0.75	DI	350	C110
20	535	9.50	0.80	DI	350	C110
24	765	11.00	0.89	DI	350	C110
30	1,400	15.00	1.03	DI	350	C110
36	2,135	18.00	1.15	DI	350	C110
42	3,020	21.00	1.28	DI	350	C110
48	4,170	24.00	1.42	DI	350	C110



0
22 1/2 BENDS

**MECHANICAL JOINT 1/32 BENDS
(11 1/2 DEGREES)**

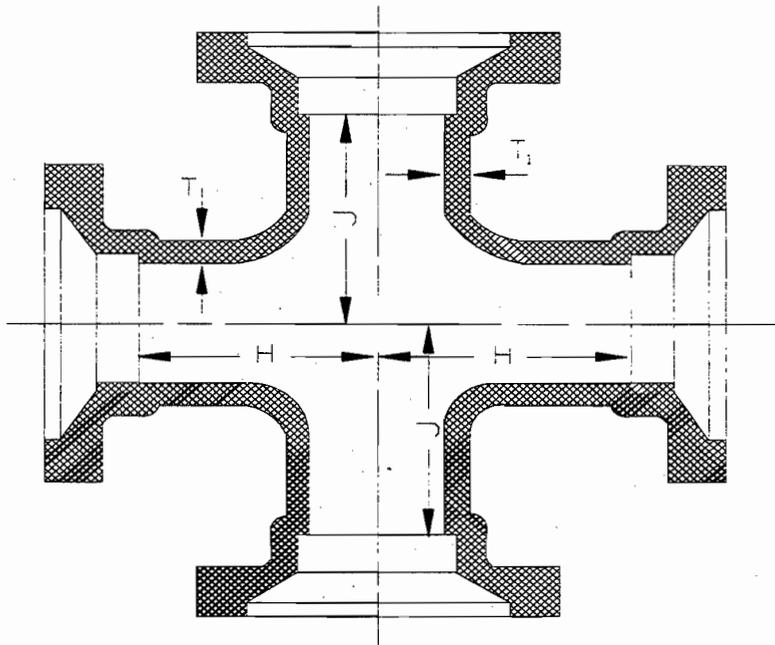
SIZE in.	WEIGHT lbs.	"A" in.	"T" in.	MATERIAL	RATING psi	SOURCE
3	14	1.00	0.33	DI	350	C153
4	16	1.25	0.34	DI	350	C153
6	30	1.50	0.36	DI	350	C153
8	42	1.75	0.38	DI	350	C153
10	58	2.00	0.40	DI	350	C153
12	74	2.25	0.42	DI	350	C153
14	275	7.50	0.66	DI	350	C110
16	345	8.00	0.70	DI	350	C110
18	430	8.50	0.75	DI	350	C110
20	540	9.50	0.80	DI	350	C110
24	770	11.00	0.89	DI	350	C110
30	1,410	15.00	1.03	DI	350	C110
36	2,145	18.00	1.15	DI	350	C110
42	3,035	21.00	1.28	DI	350	C110
48	4,190	24.00	1.42	DI	350	C110



11 1/2⁰ BENDS

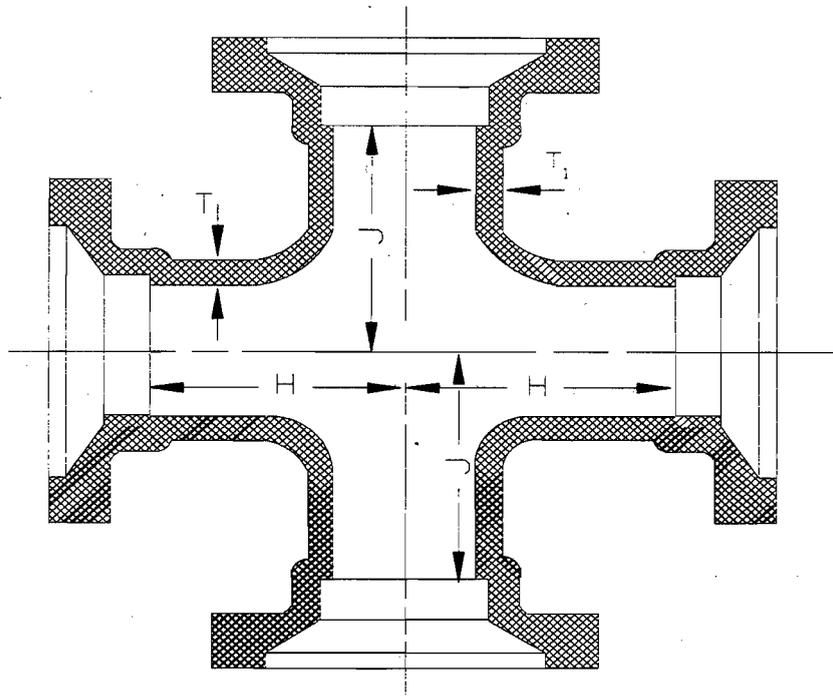
MECHANICAL JOINT CROSSES

RUN in.	BRANCH in.	WEIGHT lbs.	"H" in.	"T" in.	"J" in.	"TI" in.	MATERIAL	RATING psi	SOURCE
3	3	70	5.50	0.48	5.50	0.48	25	250	C110
4	3	90	6.50	0.52	6.50	0.48	25	250	C110
4	4	105	6.50	0.52	6.50	0.52	25	250	C110
6	3	125	8.00	0.55	8.00	0.48	25	250	C110
6	4	140	8.00	0.55	8.00	0.52	25	250	C110
6	6	160	8.00	0.55	8.00	0.55	25	250	C110
8	4	185	9.00	0.60	9.00	0.52	25	250	C110
8	6	205	9.00	0.60	9.00	0.55	25	250	C110
8	8	235	9.00	0.60	9.00	0.60	25	250	C110
10	4	260	11.00	0.68	11.00	0.52	25	250	C110
10	6	285	11.00	0.68	11.00	0.55	25	250	C110
10	8	310	11.00	0.68	11.00	0.60	25	250	C110
10	10	380	11.00	0.80	11.00	0.80	25	250	C110
12	4	340	12.00	0.75	12.00	0.52	25	250	C110
12	6	360	12.00	0.75	12.00	0.55	25	250	C110
12	8	385	12.00	0.75	12.00	0.60	25	250	C110
12	10	460	12.00	0.87	12.00	0.80	25	250	C110
12	12	495	12.00	0.87	12.00	0.87	25	250	C110
14	6	475	14.00	0.66	14.00	0.55	DI	350	C110
14	8	500	14.00	0.66	14.00	0.60	DI	350	C110
14	10	540	14.00	0.66	14.00	0.68	DI	350	C110
14	12	585	14.00	0.66	14.00	0.75	DI	350	C110
14	14	635	14.00	0.66	14.00	0.66	DI	350	C110



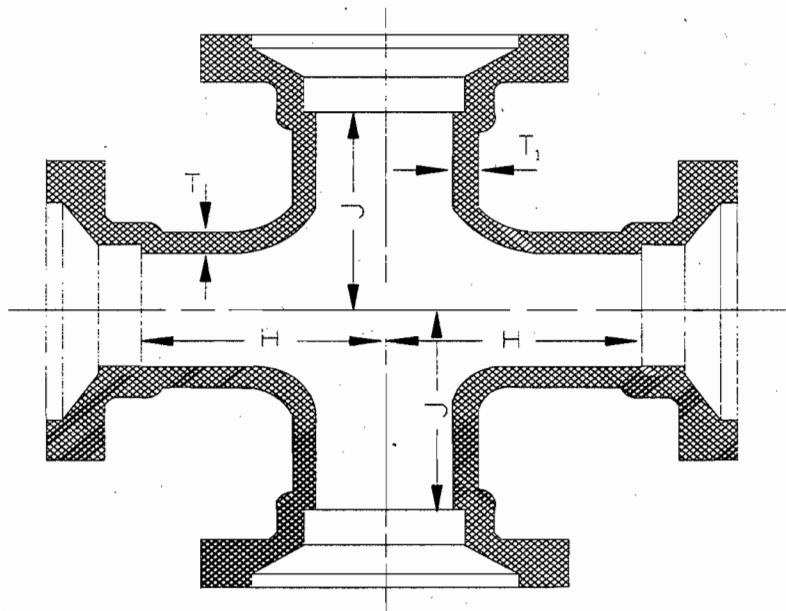
MECHANICAL JOINT CROSSES
(CONTINUED)

RUN in.	BRANCH in.	WEIGHT lbs.	"H" in.	"T" in.	"J" in.	"TI" in.	MATERIAL	RATING psi	SOURCE
16	6	575	15.00	0.70	15.00	0.55	DI	350	C110
16	8	605	15.00	0.70	15.00	0.60	DI	350	C110
16	10	645	15.00	0.70	15.00	0.68	DI	350	C110
16	12	685	15.00	0.70	15.00	0.75	DI	350	C110
16	14	735	15.00	0.70	15.00	0.66	DI	350	C110
16	16	790	15.00	0.70	15.00	0.70	DI	350	C110
18	6	625	13.00	0.75	15.50	0.55	DI	350	C110
18	8	655	13.00	0.75	15.50	0.60	DI	350	C110
18	10	685	13.00	0.75	15.50	0.68	DI	350	C110
18	12	725	13.00	0.75	15.50	0.75	DI	350	C110
18	14	870	16.50	0.75	16.50	0.66	DI	350	C110
18	16	930	16.50	0.75	16.50	0.70	DI	350	C110
18	18	995	16.50	0.75	16.50	0.75	DI	350	C110
20	6	760	14.00	0.80	17.00	0.55	DI	350	C110
20	8	790	14.00	0.80	17.00	0.60	DI	350	C110
20	10	820	14.00	0.80	17.00	0.68	DI	350	C110
20	12	860	14.00	0.80	17.00	0.75	DI	350	C110
20	14	905	14.00	0.80	17.00	0.66	DI	350	C110
20	16	1,085	18.00	0.80	18.00	0.70	DI	350	C110
20	18	1,155	18.00	0.80	18.00	0.75	DI	350	C110
20	20	1,230	18.00	0.80	18.00	0.80	DI	350	C110
24	6	1,025	15.00	0.89	19.00	0.55	DI	350	C110
24	8	1,045	15.00	0.89	19.00	0.60	DI	350	C110



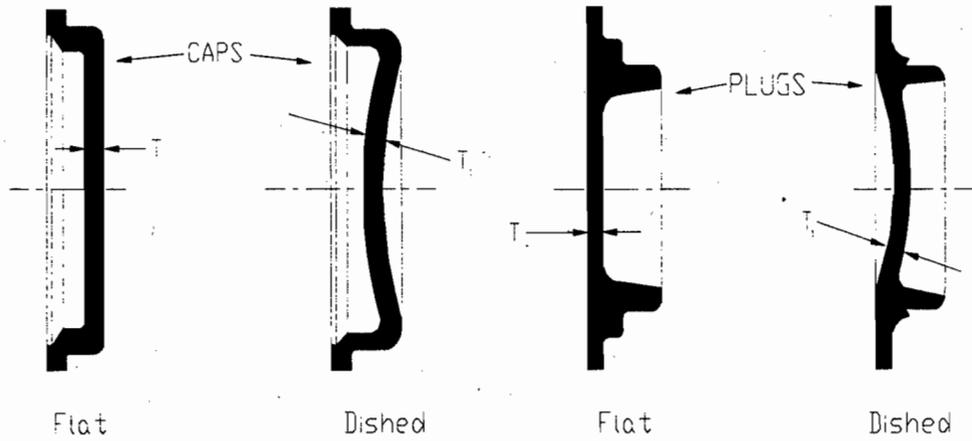
MECHANICAL JOINT CROSSES
(CONTINUED)

RUN in.	BRANCH in.	WEIGHT lbs.	"H" in.	"T" in.	"J" in.	"TI" in.	MATERIAL	RATING psi	SOURCE
36	20	2,805	20.00	1.15	26.00	0.80	DI	250	C110
36	24	2,910	20.00	1.15	26.00	0.89	DI	250	C110
36	30	3,965	28.00	1.15	28.00	1.03	DI	250	C110
36	36	4,370	28.00	1.15	28.00	1.15	DI	250	C110
42	12	3,640	23.00	1.28	20.00	0.75	DI	250	C110
42	14	3,675	23.00	1.28	30.00	0.66	DI	250	C110
42	16	3,715	23.00	1.28	30.00	0.70	DI	250	C110
42	18	3,755	23.00	1.28	30.00	0.75	DI	250	C110
42	20	4,645	23.00	1.28	30.00	0.80	DI	250	C110
42	24	3,910	23.00	1.28	30.00	0.89	DI	250	C110
42	30	5,040	31.00	1.28	31.00	1.03	DI	250	C110
42	36	6,655	31.00	1.78	31.00	1.58	DI	250	C110
42	42	7,145	31.00	1.78	31.00	1.78	DI	250	C110
48	12	4,955	26.00	1.42	34.00	0.75	DI	250	C110
48	14	4,985	26.00	1.42	34.00	0.66	DI	250	C110
48	16	5,025	26.00	1.42	34.00	0.70	DI	250	C110
48	18	5,065	26.00	1.42	34.00	0.75	DI	250	C110
48	20	5,115	26.00	1.42	34.00	0.80	DI	250	C110
48	24	5,210	26.00	1.42	34.00	0.89	DI	250	C110
48	30	5,495	26.00	1.42	34.00	1.03	DI	250	C110
48	36	6,790	34.00	1.42	34.00	1.15	DI	250	C110
48	42	8,815	34.00	1.96	34.00	1.78	DI	250	C110
48	48	9,380	34.00	1.96	34.00	1.96	DI	250	C110



MECHANICAL JOINT CAPS AND PLUGS

SIZE in.	CAP lbs.	PLUG lbs.	"T" in.	MATERIA	RATIN psi	SOURC
3	12	10	0.50	25	250	C110
4	15	15	0.60	25	250	C110
6	25	25	0.65	25	250	C110
8	45	45	0.70	25	250	C110
10	60	65	0.75	25	250	C110
12	80	85	0.75	25	250	C110
14	120	115	0.82	DI	250	C110
16	155	145	0.89	DI	250	C110
18	195	185	0.96	DI	250	C110
20	240	225	1.03	DI	250	C110
24	345	335	1.16	DI	250	C110
30	590	575	1.03	DI	250	C110
36	850	815	1.15	DI	250	C110
42	1,180	1,100	1.28	DI	250	C110
48	1,595	1,455	1.42	DI	250	C110

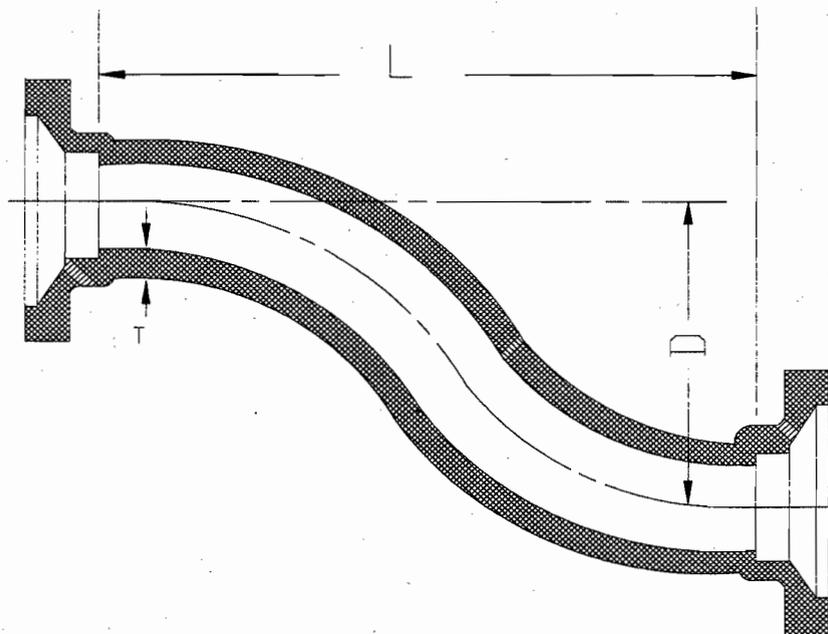


MECHANICAL JOINT LONG SLEEVES

SIZE in.	WEIGHT lbs.	"L" in.	"T" in.	MATERIAL	RATING psi	SOURCE
3	30	12.0	0.48	25	250	C110
4	45	12.0	0.52	25	250	C110
6	65	12.0	0.55	25	250	C110
8	85	12.0	0.60	25	250	C110
10	115	12.0	0.68	25	250	C110
12	145	12.0	0.75	25	250	C110
14	225	15.0	0.82	DI	350	C110
16	275	15.0	0.89	DI	350	C110
18	330	15.0	0.96	DI	350	C110
20	380	15.0	1.03	DI	350	C110
24	505	15.0	1.16	DI	350	C110
30	1,085	24.0	1.37	DI	350	C110
36	1,495	24.0	1.58	DI	350	C110
42	1,940	24.0	1.78	DI	350	C110
48	2,405	24.0	1.96	DI	350	C110

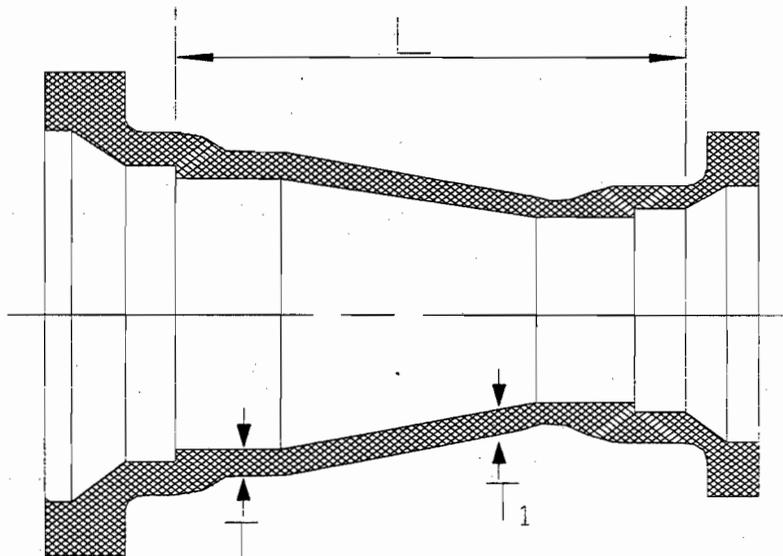
MECHANICAL JOINT OFFSETS

SIZE in.	"D" in.	WEIGHT lbs.	"L" in.	"T" in.	MATERIAL	RATING psi	SOURCE
3	6	50	19	0.48	25	250	C110
3	12	60	22	0.48	25	250	C110
3	18	75	30	0.48	25	250	C110
4	6	75	19	0.52	25	250	C110
4	12	85	22	0.52	25	250	C110
4	18	105	30	0.52	25	250	C110
6	6	110	20	0.55	25	250	C110
6	12	135	26	0.55	25	250	C110
6	18	165	33	0.55	25	250	C110
8	6	160	21	0.60	25	250	C110
8	12	200	28	0.60	25	250	C110
8	18	245	35	0.60	25	250	C110
10	6	220	22	0.68	25	250	C110
10	12	280	30	0.68	25	250	C110
10	18	340	38	0.68	25	250	C110
12	6	320	26	0.75	25	250	C110
12	12	420	37	0.75	25	250	C110
12	18	520	48	0.75	25	250	C110
14	6	365	27	0.66	DI	350	C110
14	12	465	38	0.66	DI	350	C110
14	18	570	49	0.66	DI	350	C110
16	6	440	27	0.70	DI	350	C110
16	12	580	40	0.70	DI	350	C110
16	18	690	50	0.70	DI	350	C110



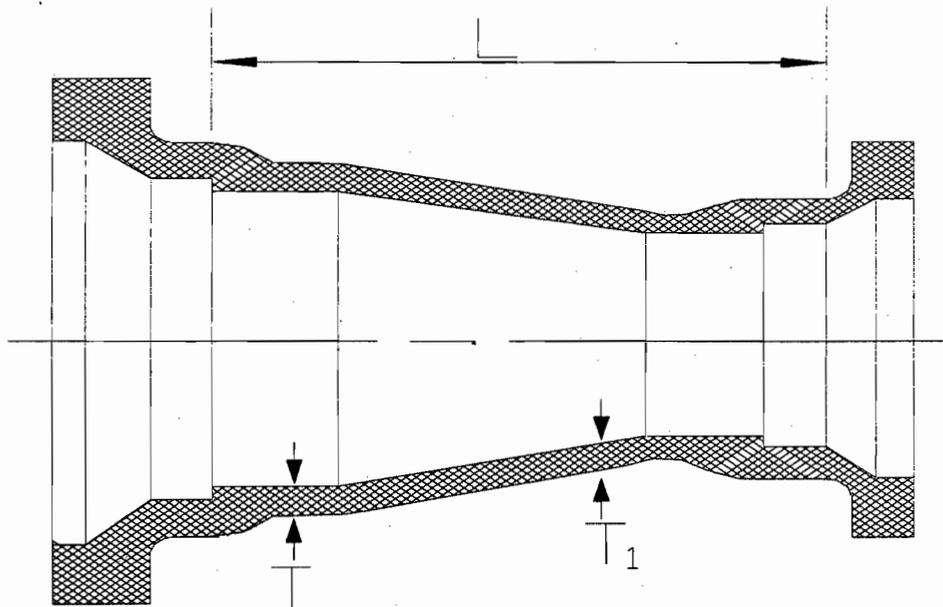
MECHANICAL JOINT REDUCERS

FROM in.	TO in.	WEIGHT lbs.	"L" in.	"T" in.	"T1" in.	MATERIAL	RATING psi	SOURCE
4	3	18	3	0.34	0.33	DI	350	C153
6	3	22	5	0.36	0.33	DI	350	C153
6	4	24	4	0.36	0.34	DI	350	C153
8	4	32	5	0.38	0.34	DI	350	C153
8	6	36	4	0.38	0.36	DI	350	C153
10	4	46	7	0.40	0.34	DI	350	C153
10	6	48	5	0.40	0.36	DI	350	C153
10	8	50	4	0.40	0.38	DI	350	C153
12	4	58	9	0.42	0.34	DI	350	C153
12	6	60	7	0.42	0.36	DI	350	C153
12	8	60	5	0.42	0.38	DI	350	C153
12	10	64	4	0.42	0.40	DI	350	C153
14	6	190	16	0.66	0.55	DI	350	C110
14	8	210	16	0.66	0.60	DI	350	C110
14	10	230	16	0.66	0.68	DI	350	C110
14	12	255	16	0.66	0.75	DI	350	C110
16	6	230	18	0.70	0.55	DI	350	C110
16	8	250	18	0.70	0.60	DI	350	C110
16	10	280	18	0.70	0.68	DI	350	C110
16	12	305	18	0.70	0.75	DI	350	C110
16	14	335	18	0.70	0.66	DI	350	C110
18	8	295	19	0.75	0.60	DI	350	C110
18	10	325	19	0.75	0.68	DI	350	C110



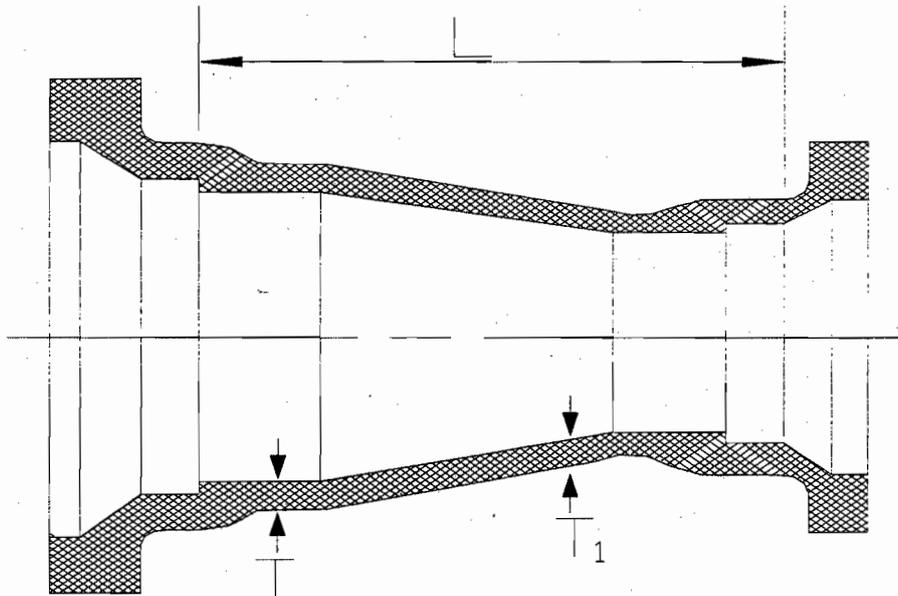
MECHANICAL JOINT REDUCERS
(CONTINUED)

FROM in.	TO in.	WEIGHT lbs.	"L" in.	"T" in.	"TI" in.	MATERIAL	RATING psi	SOURCE
18	12	350	19	0.75	0.75	DI	350	C110
18	14	380	19	0.75	0.75	DI	350	C110
18	16	415	19	0.75	0.75	DI	350	C110
20	10	375	20	0.80	0.80	DI	350	C110
20	12	405	20	0.80	0.80	DI	350	C110
20	14	430	20	0.80	0.80	DI	350	C110
20	16	470	20	0.80	0.80	DI	350	C110
20	18	510	20	0.80	0.80	DI	350	C110
24	12	550	24	0.89	0.89	DI	350	C110
24	14	575	24	0.89	0.89	DI	350	C110
24	16	615	24	0.89	0.89	DI	350	C110
24	18	660	24	0.89	0.89	DI	350	C110
24	20	705	24	0.89	0.89	DI	350	C110
30	18	990	30	1.03	1.03	DI	250	C110
30	20	1,050	30	1.03	1.03	DI	250	C110
30	24	1,165	30	1.03	1.03	DI	250	C110
36	20	1,450	36	1.15	1.15	DI	250	C110
36	24	1,580	36	1.15	1.15	DI	250	C110
36	30	1,855	36	1.15	1.15	DI	250	C110
42	20	1,915	42	1.28	1.28	DI	250	C110
42	24	2,060	42	1.28	1.28	DI	250	C110
42	30	2,370	42	1.28	1.28	DI	250	C110
42	36	2,695	42	1.28	1.28	DI	250	C110



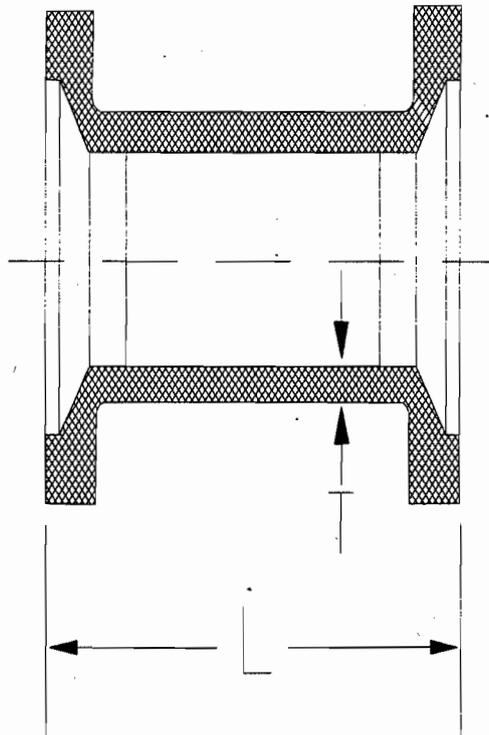
MECHANICAL JOINT REDUCERS
(CONTINUED)

FROM in.	TO in.	WEIGHT lbs.	"L" in.	"T" in.	"TI" in.	MATERIAL	RATING psi	SOURCE
48	30	3,005	48	1.42	1.03	DI	250	C110
48	36	3,370	48	1.42	1.15	DI	250	C110
48	42	3,750	48	1.42	1.28	DI	250	C110



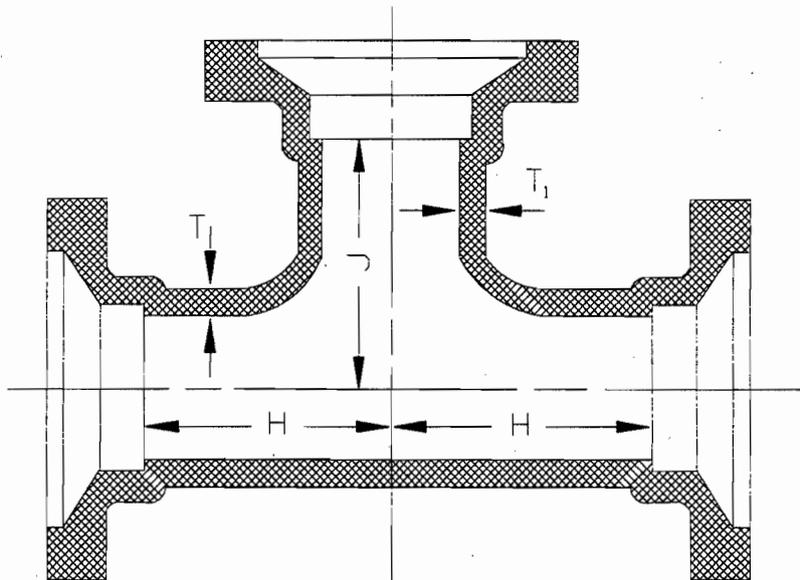
MECHANICAL JOINT SHORT SLEEVES

SIZE in.	WEIGHT lbs.	"L" in.	"T" in.	MATERIAL	RATING psi	SOURCE
3	16	7.5	0.33	DI	350	C153
4	18	7.5	0.34	DI	350	C153
6	28	7.5	0.36	DI	350	C153
8	38	7.5	0.38	DI	350	C153
10	52	7.5	0.40	DI	350	C153
12	66	7.5	0.42	DI	350	C153
14	165	9.5	0.82	DI	350	C110
16	200	9.5	0.89	DI	350	C110
18	240	9.5	0.96	DI	350	C110
20	275	9.5	1.03	DI	350	C110
24	360	9.5	1.16	DI	350	C110
30	745	15.0	1.37	DI	350	C110
36	1,030	15.0	1.58	DI	350	C110
42	1,330	15.0	1.78	DI	350	C110
48	1,645	15.0	1.96	DI	350	C110



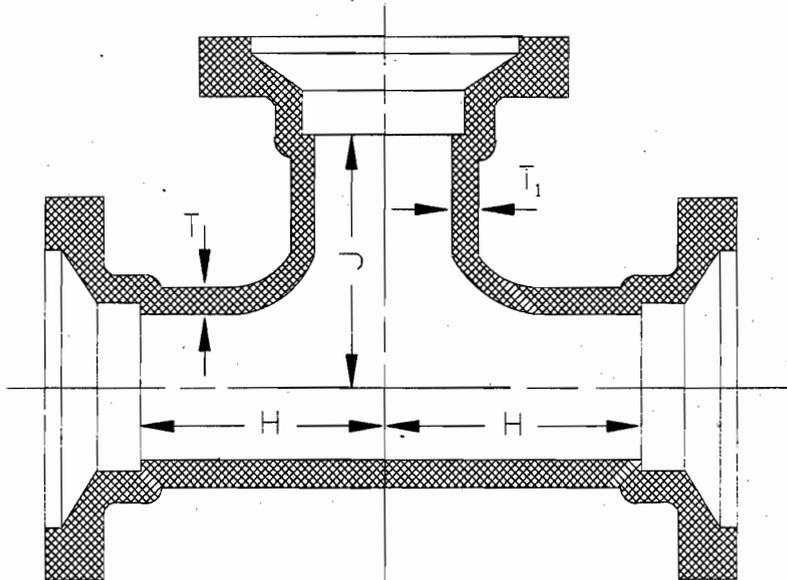
MECHANICAL JOINT TEES

•RUN in.	BRANCH in.	WEIGHT lbs.	"H" in.	"T" in.	"J" in.	"T1" in.	MATERIAL	RATING psi	SOURCE
3	3	28	3.00	0.33	3.00	0.33	DI	350	C153
4	3	30	3.50	3.50	4.00	0.33	DI	350	C153
4	4	32	4.00	4.00	4.00	0.34	DI	350	C153
6	3	42	3.50	3.50	5.00	0.33	DI	350	C153
6	4	46	4.00	4.00	5.00	0.34	DI	350	C153
6	6	56	5.00	5.00	5.00	0.36	DI	350	C153
8	4	60	4.00	4.00	6.50	0.34	DI	350	C153
8	6	72	5.00	5.00	6.50	0.36	DI	350	C153
8	8	86	6.50	6.50	6.50	0.38	DI	350	C153
10	4	78	4.00	4.00	7.50	0.34	DI	350	C153
10	6	90	5.00	5.00	7.50	0.36	DI	350	C153
10	8	105	6.50	6.50	7.50	0.38	DI	350	C153
10	10	120	7.50	7.50	7.50	0.40	DI	350	C153
12	4	94	4.00	4.00	8.75	0.34	DI	350	C153
12	6	110	5.00	5.00	8.75	0.36	DI	350	C153
12	8	125	6.50	6.50	8.75	0.48	DI	350	C153
12	10	140	7.50	7.50	8.75	0.40	DI	350	C153
12	12	160	8.75	8.75	8.75	0.42	DI	350	C153
14	6	435	14.00	14.00	14.00	0.55	DI	350	C110
14	8	450	14.00	14.00	14.00	0.60	DI	350	C110
14	10	465	14.00	14.00	14.00	0.68	DI	350	C110
14	12	495	14.00	14.00	14.00	0.75	DI	350	C110
14	14	520	14.00	14.00	14.00	0.66	DI	350	C110



MECHANICAL JOINT TEES
(CONTINUED)

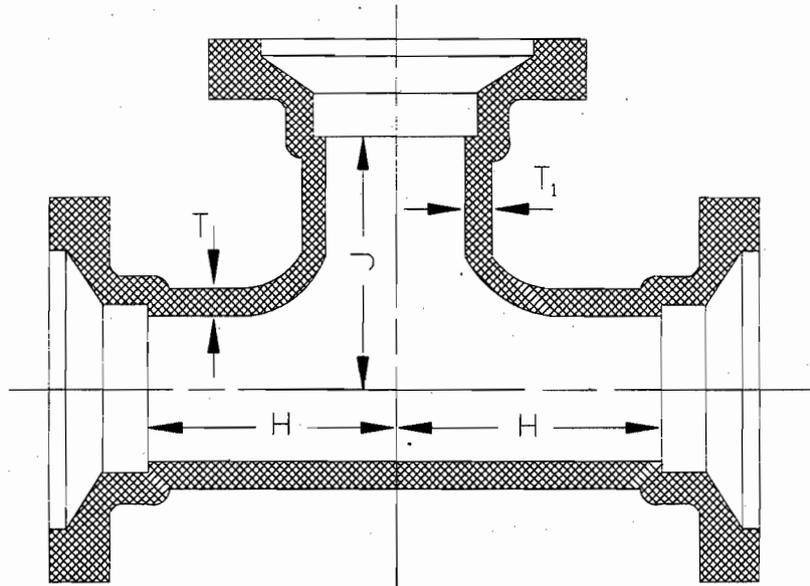
RUN in.	BRANCH in.	WEIGHT lbs.	"H" in.	"T" in.	"J" in.	"TI" in.	MATERIA.L	RATING psi	SOURCE
16	6	540	15.00	0.70	15.00	0.55	DI	350	C110
16	8	550	15.00	0.70	15.00	0.60	DI	350	C110
16	10	570	15.00	0.70	15.00	0.68	DI	350	C110
16	12	590	15.00	0.70	15.00	0.75	DI	350	C110
16	14	620	15.00	0.70	15.00	0.66	DI	350	C110
16	16	650	15.00	0.70	15.00	0.70	DI	350	C110
18	6	590	13.00	0.75	15.50	0.55	DI	350	C110
18	8	605	13.00	0.75	15.50	0.60	DI	350	C110
18	10	620	13.00	0.75	15.50	0.68	DI	350	C110
18	12	640	13.00	0.75	15.50	0.75	DI	350	C110
18	14	755	16.50	0.75	16.50	0.66	DI	350	C110
18	16	785	16.50	0.75	16.50	0.70	DI	350	C110
18	18	820	16.50	0.75	16.50	0.75	DI	350	C110
20	6	725	14.00	0.80	17.00	0.55	DI	350	C110
20	8	735	14.00	0.80	17.00	0.60	DI	350	C110
20	10	755	14.00	0.80	17.00	0.68	DI	350	C110
20	12	775	14.00	0.80	17.00	0.75	DI	350	C110
20	14	795	14.00	0.80	17.00	0.66	DI	350	C110
20	16	945	18.00	0.80	18.00	0.70	DI	350	C110
20	18	985	18.00	0.80	18.00	0.75	DI	350	C110
20	20	1,020	18.00	0.80	18.00	0.80	DI	350	C110
24	6	985	15.00	0.89	19.00	0.55	DI	350	C110
24	8	1,000	15.00	0.89	19.00	0.60	DI	350	C110



MECHANICAL JOINT TEES

(CONTINUED)

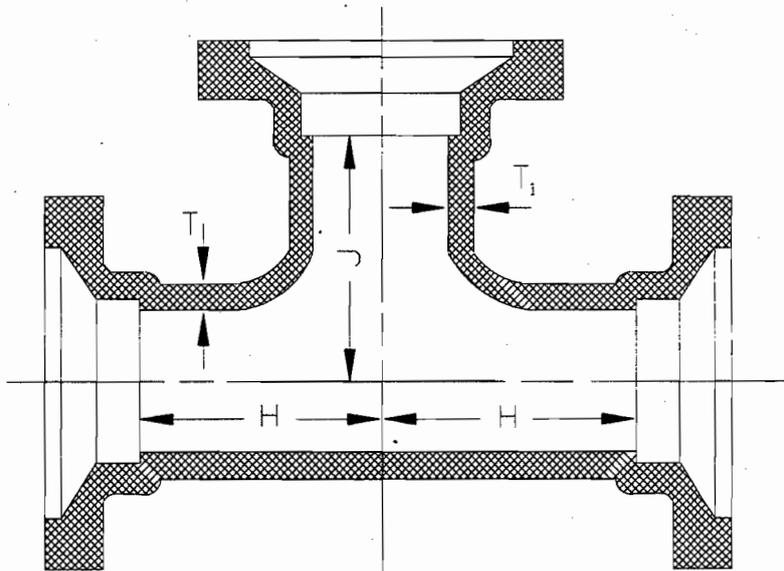
RUN in.	BRANCH in.	WEIGHT lbs.	"H" in.	"T" in.	"J" in.	"T1" in.	MATERIAL	RATING	SOURCE
24	10	1,020	15.00	0.89	19.00	0.68	DI	350	C110
24	12	1,030	15.00	0.89	19.00	0.75	DI	350	C110
24	14	1,055	15.00	0.89	19.00	0.66	DI	350	C110
24	16	1,075	15.00	0.89	19.00	0.70	DI	350	C110
24	18	1,400	22.00	0.89	22.00	0.75	DI	350	C110
24	20	1,450	22.00	0.89	22.00	0.80	DI	350	C110
24	24	1,535	22.00	0.89	22.00	0.89	DI	350	C110
30	6	1,730	18.00	1.03	23.00	0.55	DI	350	C110
30	8	1,745	18.00	1.03	23.00	0.60	DI	350	C110
30	10	1,760	18.00	1.03	23.00	0.68	DI	350	C110
30	12	1,780	18.00	1.03	23.00	0.75	DI	350	C110
30	14	1,800	18.00	1.03	23.00	0.66	DI	350	C110
30	16	1,820	18.00	1.03	23.00	0.70	DI	350	C110
30	18	1,845	18.00	1.03	23.00	0.75	DI	350	C110
30	20	1,875	18.00	1.03	23.00	0.80	DI	350	C110
30	24	2,400	25.00	1.03	25.00	0.89	DI	350	C110
30	30	2,595	25.00	1.03	25.00	1.03	DI	350	C110
36	8	2,520	20.00	1.15	20.00	0.60	DI	350	C110
36	10	2,535	20.00	1.15	20.00	0.68	DI	350	C110
36	12	2,550	20.00	1.15	20.00	0.75	DI	350	C110
36	14	2,570	20.00	1.15	20.00	0.66	DI	350	C110
36	16	2,585	20.00	1.15	20.00	0.70	DI	350	C110
36	18	2,610	20.00	1.15	20.00	0.75	DI	350	C110



MECHANICAL JOINT TEES

(CONTINUED)

RUN in.	BRANCH in.	WEIGHT lbs.	"H" in.	"T" in.	"J" in.	"TI" in.	MATERIAL	RATING psi	SOURCE
36	20	2,635	20.00	1.15	26.00	0.80	DI	250	C110
36	24	2,690	20.00	1.15	26.00	0.89	DI	250	C110
36	30	3,545	28.00	1.15	28.00	1.03	DI	250	C110
36	36	3,745	28.00	1.15	28.00	1.15	DI	250	C110
42	12	3,555	23.00	1.28	20.00	0.75	DI	250	C110
42	14	3,575	23.00	1.28	30.00	0.66	DI	250	C110
42	16	3,595	23.00	1.28	30.00	0.70	DI	250	C110
42	18	3,615	23.00	1.28	30.00	0.75	DI	250	C110
42	20	3,640	23.00	1.28	30.00	0.80	DI	250	C110
42	24	3,690	23.00	1.28	30.00	0.89	DI	250	C110
42	30	4,650	31.00	1.28	31.00	1.03	DI	250	C110
42	36	6,075	31.00	1.78	31.00	1.58	DI	250	C110
42	42	6,320	31.00	1.78	31.00	1.78	DI	250	C110
48	12	4,870	26.00	1.42	34.00	0.75	DI	250	C110
48	14	4,855	26.00	1.42	34.00	0.66	DI	250	C110
48	16	4,905	26.00	1.42	34.00	0.70	DI	250	C110
48	18	4,925	26.00	1.42	34.00	0.75	DI	250	C110
48	20	4,950	26.00	1.42	34.00	0.80	DI	250	C110
48	24	4,995	26.00	1.42	34.0	0.89	DI	250	C110
48	30	5,140	26.00	1.42	34.00	1.03	DI	250	C110
48	36	6,280	34.00	1.42	34.00	1.15	DI	250	C110
48	42	8,130	34.00	1.96	34.00	1.78	DI	250	C110
48	48	8,420	34.00	1.96	34.00	1.96	DI	250	C110





Velocities & Flow Capacities for Pipe Sewers

APPENDIX VIII

VELOCITY & CAPACITY TABLES

FOR

PIPE SEWERS

AT

VARIOUS GRADES

**DESIGN BRANCH
WATER – SEWER SECTION
FEBRUARY 15, 2011**

Velocity and Capacity for 10" VC Pipe									
N= 0.013		A= 0.545			HR= 0.208				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	1.274	0.695	0.449	312	5.1%	9.096	4.961	3.206	2,227
0.2%	1.801	0.982	0.635	441	5.2%	9.185	5.010	3.238	2,248
0.3%	2.206	1.203	0.778	540	5.3%	9.273	5.058	3.269	2,270
0.4%	2.547	1.389	0.898	624	5.4%	9.360	5.105	3.299	2,291
0.5%	2.848	1.553	1.004	697	5.5%	9.446	5.152	3.330	2,312
0.6%	3.120	1.702	1.100	764	5.6%	9.532	5.199	3.360	2,333
0.7%	3.370	1.838	1.188	825	5.7%	9.617	5.245	3.390	2,354
0.8%	3.603	1.965	1.270	882	5.8%	9.701	5.291	3.419	2,375
0.9%	3.821	2.084	1.347	935	5.9%	9.784	5.336	3.449	2,395
1.0%	4.028	2.197	1.420	986	6.0%	9.866	5.381	3.478	2,415
1.1%	4.225	2.304	1.489	1,034	6.1%	9.948	5.426	3.507	2,435
1.2%	4.412	2.407	1.555	1,080	6.2%	10.029	5.470	3.535	2,455
1.3%	4.593	2.505	1.619	1,124	6.3%	10.110	5.514	3.564	2,475
1.4%	4.766	2.599	1.680	1,167	6.4%	10.190	5.558	3.592	2,494
1.5%	4.933	2.691	1.739	1,208	6.5%	10.269	5.601	3.620	2,514
1.6%	5.095	2.779	1.796	1,247	6.6%	10.348	5.644	3.648	2,533
1.7%	5.252	2.864	1.851	1,286	6.7%	10.426	5.687	3.675	2,552
1.8%	5.404	2.947	1.905	1,323	6.8%	10.504	5.729	3.702	2,571
1.9%	5.552	3.028	1.957	1,359	6.9%	10.581	5.771	3.729	2,590
2.0%	5.696	3.107	2.008	1,394	7.0%	10.657	5.812	3.756	2,609
2.1%	5.837	3.184	2.057	1,429	7.1%	10.733	5.854	3.783	2,627
2.2%	5.974	3.259	2.106	1,462	7.2%	10.808	5.895	3.810	2,646
2.3%	6.109	3.332	2.153	1,495	7.3%	10.883	5.936	3.836	2,664
2.4%	6.240	3.403	2.200	1,527	7.4%	10.957	5.976	3.862	2,682
2.5%	6.369	3.474	2.245	1,559	7.5%	11.031	6.016	3.888	2,700
2.6%	6.495	3.542	2.289	1,590	7.6%	11.104	6.056	3.914	2,718
2.7%	6.619	3.610	2.333	1,620	7.7%	11.177	6.096	3.940	2,736
2.8%	6.740	3.676	2.376	1,650	7.8%	11.249	6.136	3.965	2,754
2.9%	6.859	3.741	2.418	1,679	7.9%	11.321	6.175	3.991	2,771
3.0%	6.977	3.805	2.459	1,708	8.0%	11.393	6.214	4.016	2,789
3.1%	7.092	3.868	2.500	1,736	8.1%	11.464	6.252	4.041	2,806
3.2%	7.205	3.930	2.540	1,764	8.2%	11.534	6.291	4.066	2,823
3.3%	7.317	3.991	2.579	1,791	8.3%	11.604	6.329	4.090	2,841
3.4%	7.427	4.051	2.618	1,818	8.4%	11.674	6.367	4.115	2,858
3.5%	7.536	4.110	2.656	1,845	8.5%	11.743	6.405	4.139	2,875
3.6%	7.642	4.168	2.694	1,871	8.6%	11.812	6.443	4.164	2,891
3.7%	7.748	4.226	2.731	1,897	8.7%	11.881	6.480	4.188	2,908
3.8%	7.852	4.283	2.768	1,922	8.8%	11.949	6.517	4.212	2,925
3.9%	7.955	4.339	2.804	1,947	8.9%	12.016	6.554	4.236	2,941
4.0%	8.056	4.394	2.840	1,972	9.0%	12.084	6.591	4.259	2,958
4.1%	8.156	4.448	2.875	1,996	9.1%	12.151	6.627	4.283	2,974
4.2%	8.255	4.502	2.910	2,021	9.2%	12.217	6.664	4.306	2,991
4.3%	8.352	4.556	2.944	2,045	9.3%	12.284	6.700	4.330	3,007
4.4%	8.449	4.608	2.978	2,068	9.4%	12.349	6.736	4.353	3,023
4.5%	8.545	4.660	3.012	2,092	9.5%	12.415	6.771	4.376	3,039
4.6%	8.639	4.712	3.045	2,115	9.6%	12.480	6.807	4.399	3,055
4.7%	8.732	4.763	3.078	2,138	9.7%	12.545	6.842	4.422	3,071
4.8%	8.825	4.813	3.111	2,160	9.8%	12.609	6.877	4.445	3,087
4.9%	8.916	4.863	3.143	2,183	9.9%	12.674	6.912	4.467	3,102
5.0%	9.007	4.912	3.175	2,205	10.0%	12.737	6.947	4.490	3,118

Velocity and Capacity for 12" VC Pipe									
N= 0.013		A= 0.785			HR= 0.250				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	1.438	1.130	0.730	507	5.1%	10.272	8.068	5.214	3,621
0.2%	2.034	1.598	1.032	717	5.2%	10.372	8.146	5.265	3,656
0.3%	2.491	1.957	1.265	878	5.3%	10.471	8.224	5.315	3,691
0.4%	2.877	2.259	1.460	1,014	5.4%	10.570	8.301	5.365	3,726
0.5%	3.216	2.526	1.633	1,134	5.5%	10.667	8.378	5.414	3,760
0.6%	3.523	2.767	1.788	1,242	5.6%	10.764	8.454	5.463	3,794
0.7%	3.806	2.989	1.932	1,341	5.7%	10.859	8.529	5.512	3,828
0.8%	4.068	3.195	2.065	1,434	5.8%	10.954	8.603	5.560	3,861
0.9%	4.315	3.389	2.190	1,521	5.9%	11.048	8.677	5.608	3,894
1.0%	4.549	3.572	2.309	1,603	6.0%	11.142	8.751	5.655	3,927
1.1%	4.771	3.747	2.421	1,682	6.1%	11.234	8.823	5.702	3,960
1.2%	4.983	3.913	2.529	1,756	6.2%	11.326	8.895	5.749	3,992
1.3%	5.186	4.073	2.632	1,828	6.3%	11.417	8.967	5.795	4,024
1.4%	5.382	4.227	2.732	1,897	6.4%	11.507	9.038	5.841	4,056
1.5%	5.571	4.375	2.828	1,964	6.5%	11.596	9.108	5.886	4,088
1.6%	5.753	4.519	2.920	2,028	6.6%	11.685	9.178	5.931	4,119
1.7%	5.931	4.658	3.010	2,090	6.7%	11.774	9.247	5.976	4,150
1.8%	6.102	4.793	3.097	2,151	6.8%	11.861	9.316	6.020	4,181
1.9%	6.270	4.924	3.182	2,210	6.9%	11.948	9.384	6.065	4,212
2.0%	6.433	5.052	3.265	2,267	7.0%	12.034	9.452	6.108	4,242
2.1%	6.591	5.177	3.346	2,323	7.1%	12.120	9.519	6.152	4,272
2.2%	6.747	5.299	3.424	2,378	7.2%	12.205	9.586	6.195	4,302
2.3%	6.898	5.418	3.501	2,432	7.3%	12.289	9.652	6.238	4,332
2.4%	7.047	5.534	3.577	2,484	7.4%	12.373	9.718	6.280	4,361
2.5%	7.192	5.648	3.650	2,535	7.5%	12.457	9.783	6.323	4,391
2.6%	7.334	5.760	3.723	2,585	7.6%	12.539	9.848	6.365	4,420
2.7%	7.474	5.870	3.794	2,634	7.7%	12.622	9.913	6.406	4,449
2.8%	7.611	5.978	3.863	2,683	7.8%	12.703	9.977	6.448	4,478
2.9%	7.746	6.084	3.932	2,730	7.9%	12.784	10.041	6.489	4,506
3.0%	7.878	6.188	3.999	2,777	8.0%	12.865	10.104	6.530	4,535
3.1%	8.008	6.290	4.065	2,823	8.1%	12.945	10.167	6.571	4,563
3.2%	8.137	6.390	4.130	2,868	8.2%	13.025	10.230	6.611	4,591
3.3%	8.263	6.490	4.194	2,913	8.3%	13.104	10.292	6.651	4,619
3.4%	8.387	6.587	4.257	2,956	8.4%	13.183	10.354	6.691	4,647
3.5%	8.509	6.683	4.319	2,999	8.5%	13.261	10.415	6.731	4,674
3.6%	8.630	6.778	4.381	3,042	8.6%	13.339	10.476	6.771	4,702
3.7%	8.749	6.872	4.441	3,084	8.7%	13.416	10.537	6.810	4,729
3.8%	8.867	6.964	4.501	3,125	8.8%	13.493	10.597	6.849	4,756
3.9%	8.983	7.055	4.559	3,166	8.9%	13.570	10.657	6.888	4,783
4.0%	9.097	7.145	4.617	3,207	9.0%	13.646	10.717	6.926	4,810
4.1%	9.210	7.234	4.675	3,246	9.1%	13.721	10.777	6.965	4,837
4.2%	9.322	7.321	4.732	3,286	9.2%	13.796	10.836	7.003	4,863
4.3%	9.432	7.408	4.788	3,325	9.3%	13.871	10.894	7.041	4,889
4.4%	9.541	7.494	4.843	3,363	9.4%	13.945	10.953	7.078	4,916
4.5%	9.649	7.578	4.898	3,401	9.5%	14.019	11.011	7.116	4,942
4.6%	9.755	7.662	4.952	3,439	9.6%	14.093	11.069	7.153	4,968
4.7%	9.861	7.745	5.005	3,476	9.7%	14.166	11.126	7.191	4,993
4.8%	9.965	7.827	5.058	3,513	9.8%	14.239	11.183	7.227	5,019
4.9%	10.069	7.908	5.111	3,549	9.9%	14.312	11.240	7.264	5,045
5.0%	10.171	7.988	5.162	3,585	10.0%	14.384	11.297	7.301	5,070

Velocity and Capacity for 15" VC Pipe									
N= 0.013		A= 1.227			HR= 0.313				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	1.669	2.048	1.324	919	5.1%	11.920	14.628	9.453	6,565
0.2%	2.360	2.897	1.872	1,300	5.2%	12.036	14.770	9.546	6,629
0.3%	2.891	3.548	2.293	1,592	5.3%	12.151	14.912	9.637	6,692
0.4%	3.338	4.097	2.647	1,839	5.4%	12.265	15.052	9.727	6,755
0.5%	3.732	4.580	2.960	2,056	5.5%	12.378	15.190	9.817	6,817
0.6%	4.088	5.017	3.242	2,252	5.6%	12.490	15.328	9.906	6,879
0.7%	4.416	5.419	3.502	2,432	5.7%	12.601	15.464	9.994	6,940
0.8%	4.721	5.793	3.744	2,600	5.8%	12.711	15.599	10.081	7,001
0.9%	5.007	6.145	3.971	2,758	5.9%	12.820	15.733	10.168	7,061
1.0%	5.278	6.477	4.186	2,907	6.0%	12.929	15.866	10.254	7,121
1.1%	5.536	6.793	4.390	3,049	6.1%	13.036	15.997	10.339	7,180
1.2%	5.782	7.095	4.586	3,184	6.2%	13.142	16.128	10.423	7,238
1.3%	6.018	7.385	4.773	3,314	6.3%	13.248	16.258	10.507	7,296
1.4%	6.245	7.664	4.953	3,440	6.4%	13.353	16.386	10.590	7,354
1.5%	6.464	7.933	5.127	3,560	6.5%	13.457	16.514	10.672	7,411
1.6%	6.676	8.193	5.295	3,677	6.6%	13.560	16.640	10.754	7,468
1.7%	6.882	8.445	5.458	3,790	6.7%	13.662	16.766	10.835	7,524
1.8%	7.081	8.690	5.616	3,900	6.8%	13.764	16.890	10.916	7,580
1.9%	7.275	8.928	5.770	4,007	6.9%	13.864	17.014	10.996	7,636
2.0%	7.464	9.160	5.920	4,111	7.0%	13.964	17.137	11.075	7,691
2.1%	7.649	9.386	6.066	4,213	7.1%	14.064	17.259	11.154	7,746
2.2%	7.829	9.607	6.209	4,312	7.2%	14.163	17.380	11.232	7,800
2.3%	8.005	9.823	6.348	4,409	7.3%	14.261	17.500	11.310	7,854
2.4%	8.177	10.034	6.485	4,503	7.4%	14.358	17.620	11.387	7,908
2.5%	8.345	10.241	6.619	4,596	7.5%	14.455	17.738	11.464	7,961
2.6%	8.511	10.444	6.750	4,687	7.6%	14.551	17.856	11.540	8,014
2.7%	8.673	10.643	6.878	4,777	7.7%	14.646	17.973	11.616	8,066
2.8%	8.832	10.838	7.005	4,864	7.8%	14.741	18.090	11.691	8,119
2.9%	8.988	11.030	7.129	4,950	7.9%	14.835	18.205	11.766	8,171
3.0%	9.142	11.219	7.250	5,035	8.0%	14.929	18.320	11.840	8,222
3.1%	9.293	11.404	7.370	5,118	8.1%	15.022	18.434	11.914	8,273
3.2%	9.442	11.587	7.488	5,200	8.2%	15.114	18.548	11.987	8,324
3.3%	9.588	11.766	7.604	5,281	8.3%	15.206	18.661	12.060	8,375
3.4%	9.732	11.943	7.719	5,360	8.4%	15.297	18.773	12.132	8,425
3.5%	9.874	12.118	7.831	5,438	8.5%	15.388	18.884	12.204	8,475
3.6%	10.014	12.290	7.942	5,516	8.6%	15.478	18.995	12.276	8,525
3.7%	10.153	12.459	8.052	5,592	8.7%	15.568	19.105	12.347	8,574
3.8%	10.289	12.626	8.160	5,667	8.8%	15.657	19.214	12.418	8,623
3.9%	10.423	12.791	8.267	5,741	8.9%	15.746	19.323	12.488	8,672
4.0%	10.556	12.954	8.372	5,814	9.0%	15.834	19.432	12.558	8,721
4.1%	10.687	13.115	8.476	5,886	9.1%	15.922	19.539	12.628	8,769
4.2%	10.817	13.274	8.579	5,957	9.2%	16.009	19.646	12.697	8,817
4.3%	10.945	13.431	8.680	6,028	9.3%	16.096	19.753	12.766	8,865
4.4%	11.071	13.587	8.781	6,098	9.4%	16.182	19.859	12.834	8,913
4.5%	11.197	13.740	8.880	6,167	9.5%	16.268	19.964	12.902	8,960
4.6%	11.320	13.892	8.978	6,235	9.6%	16.354	20.069	12.970	9,007
4.7%	11.443	14.042	9.075	6,302	9.7%	16.438	20.173	13.037	9,054
4.8%	11.564	14.191	9.171	6,369	9.8%	16.523	20.277	13.104	9,100
4.9%	11.684	14.338	9.266	6,435	9.9%	16.607	20.380	13.171	9,147
5.0%	11.802	14.483	9.360	6,500	10.0%	16.691	20.483	13.237	9,193

Velocity and Capacity for 18" RC Pipe									
N= 0.015		A= 1.767			HR= 0.375				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	1.633	2.887	1.866	1,296	5.1%	11.665	20.615	13.323	9,252
0.2%	2.310	4.082	2.638	1,832	5.2%	11.779	20.816	13.453	9,342
0.3%	2.829	5.000	3.231	2,244	5.3%	11.892	21.015	13.581	9,431
0.4%	3.267	5.773	3.731	2,591	5.4%	12.004	21.212	13.709	9,520
0.5%	3.653	6.455	4.171	2,897	5.5%	12.114	21.408	13.835	9,608
0.6%	4.001	7.071	4.570	3,173	5.6%	12.224	21.601	13.960	9,695
0.7%	4.322	7.637	4.936	3,428	5.7%	12.333	21.793	14.084	9,781
0.8%	4.620	8.165	5.277	3,664	5.8%	12.440	21.984	14.207	9,866
0.9%	4.900	8.660	5.597	3,887	5.9%	12.547	22.172	14.329	9,951
1.0%	5.166	9.128	5.899	4,097	6.0%	12.653	22.360	14.450	10,035
1.1%	5.418	9.574	6.187	4,297	6.1%	12.758	22.545	14.570	10,118
1.2%	5.659	10.000	6.462	4,488	6.2%	12.862	22.729	14.689	10,201
1.3%	5.890	10.408	6.726	4,671	6.3%	12.965	22.912	14.807	10,283
1.4%	6.112	10.801	6.980	4,847	6.4%	13.068	23.093	14.924	10,364
1.5%	6.326	11.180	7.225	5,017	6.5%	13.170	23.273	15.040	10,445
1.6%	6.534	11.546	7.462	5,182	6.6%	13.271	23.451	15.156	10,525
1.7%	6.735	11.902	7.692	5,342	6.7%	13.371	23.628	15.270	10,604
1.8%	6.930	12.247	7.915	5,496	6.8%	13.470	23.804	15.384	10,683
1.9%	7.120	12.582	8.132	5,647	6.9%	13.569	23.978	15.496	10,761
2.0%	7.305	12.909	8.343	5,794	7.0%	13.667	24.151	15.608	10,839
2.1%	7.486	13.228	8.549	5,937	7.1%	13.764	24.323	15.719	10,916
2.2%	7.662	13.539	8.750	6,076	7.2%	13.861	24.494	15.830	10,993
2.3%	7.834	13.844	8.947	6,213	7.3%	13.957	24.663	15.939	11,069
2.4%	8.002	14.141	9.139	6,347	7.4%	14.052	24.832	16.048	11,144
2.5%	8.167	14.433	9.328	6,478	7.5%	14.146	24.999	16.156	11,219
2.6%	8.329	14.719	9.512	6,606	7.6%	14.240	25.165	16.263	11,294
2.7%	8.488	14.999	9.694	6,732	7.7%	14.334	25.330	16.370	11,368
2.8%	8.644	15.275	9.871	6,855	7.8%	14.427	25.494	16.476	11,442
2.9%	8.797	15.545	10.046	6,977	7.9%	14.519	25.657	16.581	11,515
3.0%	8.947	15.811	10.218	7,096	8.0%	14.610	25.819	16.686	11,587
3.1%	9.095	16.072	10.387	7,213	8.1%	14.701	25.979	16.790	11,660
3.2%	9.240	16.329	10.553	7,329	8.2%	14.792	26.139	16.893	11,731
3.3%	9.384	16.582	10.717	7,442	8.3%	14.882	26.298	16.996	11,803
3.4%	9.525	16.832	10.878	7,554	8.4%	14.971	26.456	17.098	11,874
3.5%	9.664	17.077	11.037	7,664	8.5%	15.060	26.613	17.199	11,944
3.6%	9.801	17.320	11.193	7,773	8.6%	15.148	26.769	17.300	12,014
3.7%	9.936	17.559	11.348	7,880	8.7%	15.236	26.925	17.401	12,084
3.8%	10.069	17.794	11.500	7,986	8.8%	15.323	27.079	17.500	12,153
3.9%	10.201	18.027	11.650	8,090	8.9%	15.410	27.232	17.599	12,222
4.0%	10.331	18.257	11.799	8,194	9.0%	15.497	27.385	17.698	12,290
4.1%	10.459	18.483	11.945	8,295	9.1%	15.582	27.537	17.796	12,358
4.2%	10.586	18.707	12.090	8,396	9.2%	15.668	27.687	17.894	12,426
4.3%	10.711	18.929	12.233	8,495	9.3%	15.753	27.837	17.991	12,493
4.4%	10.835	19.148	12.375	8,593	9.4%	15.837	27.987	18.087	12,560
4.5%	10.958	19.364	12.514	8,691	9.5%	15.921	28.135	18.183	12,627
4.6%	11.079	19.578	12.653	8,787	9.6%	16.005	28.283	18.278	12,693
4.7%	11.199	19.790	12.789	8,882	9.7%	16.088	28.430	18.373	12,759
4.8%	11.317	19.999	12.925	8,976	9.8%	16.171	28.576	18.468	12,825
4.9%	11.434	20.206	13.059	9,069	9.9%	16.253	28.721	18.562	12,890
5.0%	11.551	20.411	13.191	9,161	10.0%	16.335	28.866	18.655	12,955

Velocity and Capacity for 21" RC Pipe									
N= 0.015		A= 2.405			HR= 0.438				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	1.810	4.354	2.814	1,954	5.1%	12.928	31.096	20.096	13,956
0.2%	2.560	6.158	3.980	2,764	5.2%	13.054	31.399	20.292	14,092
0.3%	3.136	7.542	4.874	3,385	5.3%	13.179	31.699	20.486	14,227
0.4%	3.621	8.708	5.628	3,908	5.4%	13.303	31.997	20.679	14,360
0.5%	4.048	9.736	6.292	4,370	5.5%	13.425	32.292	20.869	14,493
0.6%	4.434	10.666	6.893	4,787	5.6%	13.547	32.584	21.058	14,624
0.7%	4.790	11.520	7.445	5,170	5.7%	13.667	32.874	21.245	14,754
0.8%	5.120	12.316	7.959	5,527	5.8%	13.787	33.161	21.431	14,883
0.9%	5.431	13.063	8.442	5,863	5.9%	13.905	33.446	21.615	15,010
1.0%	5.725	13.769	8.899	6,180	6.0%	14.022	33.728	21.797	15,137
1.1%	6.004	14.441	9.333	6,481	6.1%	14.139	34.008	21.978	15,263
1.2%	6.271	15.084	9.748	6,769	6.2%	14.254	34.285	22.158	15,387
1.3%	6.527	15.699	10.146	7,046	6.3%	14.369	34.561	22.336	15,511
1.4%	6.773	16.292	10.529	7,312	6.4%	14.482	34.834	22.512	15,633
1.5%	7.011	16.864	10.899	7,569	6.5%	14.595	35.105	22.687	15,755
1.6%	7.241	17.417	11.256	7,817	6.6%	14.707	35.374	22.861	15,876
1.7%	7.464	17.953	11.603	8,057	6.7%	14.818	35.641	23.034	15,996
1.8%	7.680	18.474	11.939	8,291	6.8%	14.928	35.906	23.205	16,115
1.9%	7.891	18.980	12.266	8,518	6.9%	15.037	36.169	23.375	16,233
2.0%	8.096	19.473	12.585	8,739	7.0%	15.146	36.430	23.544	16,350
2.1%	8.296	19.954	12.895	8,955	7.1%	15.254	36.690	23.711	16,466
2.2%	8.491	20.423	13.199	9,166	7.2%	15.361	36.947	23.878	16,582
2.3%	8.682	20.882	13.496	9,372	7.3%	15.467	37.203	24.043	16,697
2.4%	8.869	21.331	13.786	9,574	7.4%	15.573	37.457	24.207	16,811
2.5%	9.051	21.771	14.070	9,771	7.5%	15.678	37.709	24.370	16,924
2.6%	9.231	22.202	14.349	9,964	7.6%	15.782	37.959	24.532	17,036
2.7%	9.407	22.625	14.622	10,154	7.7%	15.885	38.208	24.693	17,148
2.8%	9.579	23.041	14.890	10,341	7.8%	15.988	38.456	24.853	17,259
2.9%	9.749	23.448	15.154	10,524	7.9%	16.090	38.701	25.012	17,369
3.0%	9.915	23.849	15.413	10,704	8.0%	16.192	38.946	25.169	17,479
3.1%	10.079	24.243	15.668	10,880	8.1%	16.293	39.188	25.326	17,588
3.2%	10.241	24.631	15.919	11,055	8.2%	16.393	39.429	25.482	17,696
3.3%	10.399	25.013	16.165	11,226	8.3%	16.492	39.669	25.637	17,803
3.4%	10.556	25.389	16.408	11,395	8.4%	16.592	39.907	25.791	17,910
3.5%	10.710	25.760	16.648	11,561	8.5%	16.690	40.144	25.944	18,017
3.6%	10.862	26.125	16.884	11,725	8.6%	16.788	40.380	26.096	18,122
3.7%	11.012	26.486	17.117	11,887	8.7%	16.885	40.614	26.248	18,227
3.8%	11.159	26.841	17.347	12,046	8.8%	16.982	40.846	26.398	18,332
3.9%	11.305	27.192	17.574	12,204	8.9%	17.078	41.078	26.547	18,436
4.0%	11.449	27.539	17.797	12,359	9.0%	17.174	41.308	26.696	18,539
4.1%	11.591	27.881	18.019	12,513	9.1%	17.269	41.537	26.844	18,642
4.2%	11.732	28.219	18.237	12,665	9.2%	17.364	41.764	26.991	18,744
4.3%	11.871	28.553	18.453	12,814	9.3%	17.458	41.991	27.138	18,845
4.4%	12.008	28.883	18.666	12,963	9.4%	17.551	42.216	27.283	18,947
4.5%	12.144	29.209	18.877	13,109	9.5%	17.644	42.440	27.428	19,047
4.6%	12.278	29.532	19.086	13,254	9.6%	17.737	42.663	27.572	19,147
4.7%	12.411	29.851	19.292	13,397	9.7%	17.829	42.884	27.715	19,246
4.8%	12.542	30.167	19.496	13,539	9.8%	17.921	43.105	27.857	19,345
4.9%	12.672	30.480	19.698	13,679	9.9%	18.012	43.324	27.999	19,444
5.0%	12.801	30.789	19.898	13,818	10.0%	18.103	43.542	28.140	19,542

Velocity and Capacity for 24" RC Pipe									
N= 0.015		A= 3.142			HR= 0.500				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	1.979	6.217	4.018	2,790	5.1%	14.132	44.396	28.692	19,925
0.2%	2.798	8.792	5.682	3,946	5.2%	14.270	44.829	28.972	20,119
0.3%	3.427	10.768	6.959	4,832	5.3%	14.406	45.258	29.249	20,312
0.4%	3.958	12.433	8.035	5,580	5.4%	14.541	45.683	29.524	20,503
0.5%	4.425	13.901	8.984	6,239	5.5%	14.675	46.104	29.796	20,692
0.6%	4.847	15.228	9.841	6,834	5.6%	14.808	46.521	30.065	20,879
0.7%	5.235	16.448	10.630	7,382	5.7%	14.940	46.935	30.333	21,064
0.8%	5.597	17.583	11.364	7,891	5.8%	15.070	47.345	30.598	21,248
0.9%	5.936	18.650	12.053	8,370	5.9%	15.200	47.751	30.860	21,431
1.0%	6.258	19.659	12.705	8,823	6.0%	15.328	48.154	31.121	21,612
1.1%	6.563	20.618	13.325	9,254	6.1%	15.455	48.554	31.379	21,791
1.2%	6.855	21.535	13.918	9,665	6.2%	15.581	48.950	31.635	21,969
1.3%	7.135	22.415	14.486	10,060	6.3%	15.706	49.343	31.889	22,145
1.4%	7.404	23.261	15.033	10,439	6.4%	15.831	49.733	32.141	22,320
1.5%	7.664	24.077	15.560	10,806	6.5%	15.954	50.120	32.391	22,494
1.6%	7.915	24.867	16.071	11,160	6.6%	16.076	50.505	32.640	22,666
1.7%	8.159	25.632	16.565	11,504	6.7%	16.197	50.886	32.886	22,837
1.8%	8.395	26.375	17.046	11,837	6.8%	16.318	51.264	33.131	23,007
1.9%	8.626	27.098	17.513	12,162	6.9%	16.437	51.640	33.373	23,176
2.0%	8.850	27.802	17.968	12,477	7.0%	16.556	52.012	33.614	23,343
2.1%	9.068	28.488	18.411	12,786	7.1%	16.674	52.383	33.853	23,509
2.2%	9.282	29.159	18.845	13,086	7.2%	16.791	52.750	34.091	23,674
2.3%	9.490	29.814	19.268	13,381	7.3%	16.907	53.115	34.327	23,838
2.4%	9.694	30.455	19.682	13,668	7.4%	17.023	53.478	34.561	24,001
2.5%	9.894	31.083	20.088	13,950	7.5%	17.137	53.838	34.794	24,162
2.6%	10.090	31.699	20.486	14,226	7.6%	17.251	54.196	35.025	24,323
2.7%	10.282	32.303	20.876	14,497	7.7%	17.364	54.551	35.255	24,483
2.8%	10.471	32.896	21.259	14,764	7.8%	17.477	54.904	35.483	24,641
2.9%	10.656	33.478	21.636	15,025	7.9%	17.588	55.255	35.710	24,798
3.0%	10.838	34.050	22.006	15,282	8.0%	17.699	55.604	35.935	24,955
3.1%	11.018	34.613	22.369	15,534	8.1%	17.809	55.950	36.159	25,110
3.2%	11.194	35.167	22.727	15,783	8.2%	17.919	56.294	36.381	25,265
3.3%	11.368	35.712	23.080	16,028	8.3%	18.028	56.637	36.603	25,419
3.4%	11.538	36.249	23.427	16,269	8.4%	18.136	56.977	36.822	25,571
3.5%	11.707	36.778	23.769	16,506	8.5%	18.244	57.315	37.041	25,723
3.6%	11.873	37.300	24.106	16,740	8.6%	18.351	57.651	37.258	25,874
3.7%	12.037	37.815	24.438	16,971	8.7%	18.457	57.985	37.474	26,024
3.8%	12.198	38.322	24.767	17,199	8.8%	18.563	58.318	37.689	26,173
3.9%	12.358	38.823	25.090	17,424	8.9%	18.668	58.648	37.903	26,321
4.0%	12.515	39.318	25.410	17,646	9.0%	18.773	58.977	38.115	26,469
4.1%	12.671	39.806	25.726	17,865	9.1%	18.877	59.303	38.326	26,615
4.2%	12.824	40.289	26.037	18,082	9.2%	18.980	59.628	38.536	26,761
4.3%	12.976	40.765	26.346	18,296	9.3%	19.083	59.951	38.745	26,906
4.4%	13.126	41.237	26.650	18,507	9.4%	19.185	60.273	38.953	27,050
4.5%	13.274	41.703	26.951	18,716	9.5%	19.287	60.593	39.159	27,194
4.6%	13.421	42.164	27.249	18,923	9.6%	19.388	60.911	39.365	27,337
4.7%	13.566	42.619	27.544	19,128	9.7%	19.489	61.227	39.569	27,479
4.8%	13.710	43.070	27.835	19,330	9.8%	19.589	61.542	39.773	27,620
4.9%	13.852	43.517	28.124	19,530	9.9%	19.689	61.855	39.975	27,761
5.0%	13.992	43.959	28.409	19,729	10.0%	19.788	62.167	40.177	27,900

Velocity and Capacity for 27" RC Pipe									
N= 0.013		A= 3.976			HR= 0.563				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	2.470	9.820	6.346	4,407	5.1%	17.638	70.129	45.322	31,474
0.2%	3.493	13.888	8.975	6,233	5.2%	17.810	70.813	45.765	31,781
0.3%	4.278	17.009	10.992	7,634	5.3%	17.980	71.491	46.203	32,085
0.4%	4.940	19.640	12.693	8,814	5.4%	18.149	72.162	46.636	32,386
0.5%	5.523	21.958	14.191	9,855	5.5%	18.316	72.827	47.066	32,685
0.6%	6.050	24.054	15.545	10,795	5.6%	18.482	73.486	47.492	32,981
0.7%	6.534	25.981	16.791	11,660	5.7%	18.646	74.140	47.914	33,274
0.8%	6.986	27.775	17.950	12,466	5.8%	18.809	74.787	48.333	33,564
0.9%	7.409	29.460	19.039	13,222	5.9%	18.971	75.429	48.748	33,853
1.0%	7.810	31.054	20.069	13,937	6.0%	19.131	76.066	49.159	34,138
1.1%	8.191	32.569	21.049	14,617	6.1%	19.290	76.697	49.567	34,422
1.2%	8.556	34.018	21.985	15,267	6.2%	19.447	77.323	49.972	34,703
1.3%	8.905	35.407	22.882	15,890	6.3%	19.603	77.944	50.373	34,981
1.4%	9.241	36.743	23.746	16,490	6.4%	19.758	78.560	50.771	35,258
1.5%	9.565	38.033	24.580	17,069	6.5%	19.912	79.172	51.166	35,532
1.6%	9.879	39.280	25.386	17,629	6.6%	20.065	79.778	51.558	35,805
1.7%	10.183	40.489	26.167	18,171	6.7%	20.216	80.380	51.948	36,075
1.8%	10.478	41.663	26.926	18,698	6.8%	20.366	80.978	52.334	36,343
1.9%	10.766	42.805	27.663	19,211	6.9%	20.516	81.571	52.717	36,609
2.0%	11.045	43.917	28.382	19,710	7.0%	20.664	82.160	53.098	36,874
2.1%	11.318	45.001	29.083	20,196	7.1%	20.811	82.745	53.476	37,136
2.2%	11.584	46.060	29.767	20,672	7.2%	20.957	83.326	53.851	37,397
2.3%	11.845	47.095	30.436	21,136	7.3%	21.102	83.902	54.224	37,655
2.4%	12.099	48.108	31.091	21,591	7.4%	21.246	84.475	54.594	37,912
2.5%	12.349	49.100	31.732	22,036	7.5%	21.389	85.044	54.962	38,168
2.6%	12.593	50.073	32.360	22,473	7.6%	21.531	85.609	55.327	38,421
2.7%	12.833	51.026	32.977	22,901	7.7%	21.672	86.170	55.690	38,673
2.8%	13.069	51.963	33.582	23,321	7.8%	21.812	86.728	56.050	38,924
2.9%	13.300	52.882	34.176	23,734	7.9%	21.952	87.282	56.408	39,172
3.0%	13.528	53.787	34.761	24,139	8.0%	22.090	87.833	56.764	39,419
3.1%	13.751	54.676	35.335	24,538	8.1%	22.228	88.380	57.118	39,665
3.2%	13.971	55.550	35.901	24,931	8.2%	22.365	88.924	57.469	39,909
3.3%	14.188	56.412	36.457	25,318	8.3%	22.501	89.465	57.819	40,152
3.4%	14.401	57.260	37.006	25,698	8.4%	22.636	90.002	58.166	40,393
3.5%	14.611	58.096	37.546	26,074	8.5%	22.770	90.536	58.511	40,633
3.6%	14.819	58.920	38.078	26,443	8.6%	22.904	91.067	58.854	40,871
3.7%	15.023	59.733	38.604	26,808	8.7%	23.037	91.595	59.195	41,108
3.8%	15.225	60.535	39.122	27,168	8.8%	23.169	92.120	59.535	41,343
3.9%	15.424	61.326	39.633	27,523	8.9%	23.300	92.642	59.872	41,578
4.0%	15.620	62.107	40.138	27,874	9.0%	23.430	93.161	60.207	41,811
4.1%	15.814	62.879	40.637	28,220	9.1%	23.560	93.677	60.541	42,042
4.2%	16.006	63.641	41.129	28,562	9.2%	23.689	94.190	60.873	42,273
4.3%	16.195	64.394	41.616	28,900	9.3%	23.818	94.701	61.203	42,502
4.4%	16.383	65.139	42.097	29,234	9.4%	23.945	95.209	61.531	42,730
4.5%	16.568	65.875	42.573	29,565	9.5%	24.072	95.714	61.857	42,956
4.6%	16.751	66.603	43.043	29,891	9.6%	24.199	96.216	62.182	43,182
4.7%	16.932	67.323	43.509	30,214	9.7%	24.324	96.716	62.505	43,406
4.8%	17.111	68.035	43.969	30,534	9.8%	24.450	97.213	62.826	43,629
4.9%	17.288	68.740	44.425	30,851	9.9%	24.574	97.708	63.146	43,851
5.0%	17.464	69.438	44.876	31,164	10.0%	24.698	98.200	63.464	44,072

Velocity and Capacity for 30" RC Pipe									
N= 0.013		A= 4.909			HR= 0.625				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	2.649	13.006	8.405	5,837	5.1%	18.921	92.879	60.025	41,684
0.2%	3.747	18.393	11.887	8,255	5.2%	19.106	93.785	60.611	42,091
0.3%	4.589	22.526	14.558	10,110	5.3%	19.289	94.683	61.191	42,494
0.4%	5.299	26.011	16.810	11,674	5.4%	19.470	95.572	61.765	42,893
0.5%	5.924	29.082	18.795	13,052	5.5%	19.649	96.453	62.335	43,288
0.6%	6.490	31.857	20.588	14,298	5.6%	19.827	97.326	62.899	43,680
0.7%	7.010	34.410	22.238	15,443	5.7%	20.003	98.191	63.458	44,068
0.8%	7.494	36.786	23.774	16,509	5.8%	20.178	99.048	64.012	44,453
0.9%	7.948	39.017	25.216	17,511	5.9%	20.351	99.898	64.562	44,834
1.0%	8.378	41.128	26.580	18,458	6.0%	20.523	100.742	65.106	45,213
1.1%	8.787	43.135	27.877	19,359	6.1%	20.693	101.578	65.647	45,588
1.2%	9.178	45.053	29.116	20,220	6.2%	20.862	102.407	66.183	45,960
1.3%	9.553	46.893	30.305	21,045	6.3%	21.030	103.229	66.714	46,329
1.4%	9.913	48.663	31.449	21,840	6.4%	21.196	104.045	67.242	46,696
1.5%	10.261	50.371	32.553	22,606	6.5%	21.361	104.855	67.765	47,059
1.6%	10.598	52.023	33.621	23,348	6.6%	21.525	105.659	68.284	47,420
1.7%	10.924	53.624	34.656	24,066	6.7%	21.687	106.456	68.800	47,777
1.8%	11.241	55.178	35.660	24,764	6.8%	21.848	107.248	69.311	48,133
1.9%	11.549	56.690	36.637	25,443	6.9%	22.008	108.033	69.819	48,485
2.0%	11.849	58.163	37.589	26,104	7.0%	22.167	108.813	70.323	48,835
2.1%	12.142	59.599	38.517	26,748	7.1%	22.325	109.588	70.823	49,183
2.2%	12.427	61.002	39.424	27,378	7.2%	22.482	110.357	71.321	49,528
2.3%	12.707	62.373	40.310	27,993	7.3%	22.637	111.121	71.814	49,871
2.4%	12.980	63.715	41.177	28,595	7.4%	22.792	111.879	72.304	50,211
2.5%	13.247	65.028	42.026	29,185	7.5%	22.945	112.632	72.791	50,549
2.6%	13.510	66.316	42.858	29,763	7.6%	23.098	113.381	73.275	50,885
2.7%	13.767	67.579	43.675	30,330	7.7%	23.249	114.124	73.755	51,219
2.8%	14.020	68.820	44.476	30,886	7.8%	23.400	114.863	74.233	51,551
2.9%	14.268	70.038	45.263	31,433	7.9%	23.549	115.597	74.707	51,880
3.0%	14.512	71.235	46.037	31,970	8.0%	23.698	116.326	75.178	52,207
3.1%	14.752	72.413	46.798	32,499	8.1%	23.845	117.051	75.647	52,533
3.2%	14.988	73.571	47.547	33,019	8.2%	23.992	117.771	76.112	52,856
3.3%	15.220	74.712	48.284	33,531	8.3%	24.138	118.487	76.575	53,177
3.4%	15.449	75.835	49.010	34,035	8.4%	24.283	119.199	77.035	53,496
3.5%	15.675	76.943	49.726	34,532	8.5%	24.427	119.906	77.492	53,814
3.6%	15.897	78.034	50.431	35,022	8.6%	24.570	120.610	77.947	54,130
3.7%	16.116	79.110	51.127	35,505	8.7%	24.713	121.309	78.399	54,443
3.8%	16.333	80.172	51.813	35,981	8.8%	24.854	122.004	78.848	54,755
3.9%	16.546	81.220	52.490	36,452	8.9%	24.995	122.695	79.295	55,066
4.0%	16.757	82.255	53.159	36,916	9.0%	25.135	123.383	79.739	55,374
4.1%	16.965	83.277	53.820	37,375	9.1%	25.275	124.066	80.181	55,681
4.2%	17.171	84.286	54.472	37,828	9.2%	25.413	124.746	80.620	55,986
4.3%	17.374	85.284	55.117	38,275	9.3%	25.551	125.422	81.057	56,289
4.4%	17.575	86.270	55.754	38,718	9.4%	25.688	126.095	81.491	56,591
4.5%	17.773	87.245	56.384	39,155	9.5%	25.824	126.764	81.924	56,892
4.6%	17.970	88.209	57.007	39,588	9.6%	25.960	127.429	82.354	57,190
4.7%	18.164	89.162	57.623	40,016	9.7%	26.094	128.091	82.782	57,487
4.8%	18.356	90.106	58.233	40,440	9.8%	26.229	128.750	83.207	57,783
4.9%	18.546	91.040	58.836	40,859	9.9%	26.362	129.405	83.631	58,077
5.0%	18.735	91.964	59.434	41,273	10.0%	26.495	130.057	84.052	58,369

Velocity and Capacity for 36" RC Pipe									
N= 0.013		A= 7.069			HR= 0.750				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	2.992	21.149	13.668	9,492	5.1%	21.367	151.032	97.608	67,783
0.2%	4.231	29.909	19.329	13,423	5.2%	21.575	152.505	98.560	68,444
0.3%	5.182	36.631	23.673	16,440	5.3%	21.782	153.965	99.503	69,099
0.4%	5.984	42.297	27.336	18,983	5.4%	21.986	155.410	100.437	69,748
0.5%	6.690	47.290	30.562	21,224	5.5%	22.189	156.843	101.363	70,391
0.6%	7.329	51.803	33.479	23,249	5.6%	22.390	158.262	102.280	71,028
0.7%	7.916	55.954	36.162	25,112	5.7%	22.589	159.669	103.190	71,659
0.8%	8.462	59.817	38.658	26,846	5.8%	22.786	161.063	104.091	72,285
0.9%	8.976	63.446	41.003	28,475	5.9%	22.981	162.446	104.984	72,906
1.0%	9.461	66.878	43.221	30,015	6.0%	23.175	163.817	105.870	73,521
1.1%	9.923	70.142	45.331	31,480	6.1%	23.368	165.176	106.749	74,131
1.2%	10.364	73.261	47.347	32,880	6.2%	23.558	166.525	107.620	74,736
1.3%	10.788	76.253	49.280	34,222	6.3%	23.748	167.862	108.485	75,337
1.4%	11.195	79.131	51.140	35,514	6.4%	23.935	169.189	109.342	75,932
1.5%	11.588	81.908	52.935	36,760	6.5%	24.122	170.506	110.193	76,523
1.6%	11.968	84.595	54.671	37,966	6.6%	24.306	171.813	111.038	77,109
1.7%	12.336	87.198	56.354	39,135	6.7%	24.490	173.109	111.876	77,691
1.8%	12.694	89.726	57.988	40,269	6.8%	24.672	174.396	112.707	78,269
1.9%	13.041	92.185	59.576	41,373	6.9%	24.853	175.674	113.533	78,842
2.0%	13.380	94.580	61.124	42,447	7.0%	25.032	176.942	114.353	79,412
2.1%	13.711	96.915	62.634	43,496	7.1%	25.210	178.202	115.167	79,977
2.2%	14.033	99.196	64.108	44,519	7.2%	25.387	179.452	115.975	80,538
2.3%	14.349	101.425	65.548	45,520	7.3%	25.563	180.694	116.778	81,096
2.4%	14.657	103.607	66.958	46,499	7.4%	25.737	181.928	117.575	81,649
2.5%	14.960	105.743	68.339	47,458	7.5%	25.911	183.153	118.366	82,199
2.6%	15.256	107.837	69.692	48,397	7.6%	26.083	184.370	119.153	82,745
2.7%	15.546	109.892	71.020	49,319	7.7%	26.254	185.579	119.934	83,288
2.8%	15.832	111.908	72.323	50,224	7.8%	26.424	186.780	120.711	83,827
2.9%	16.112	113.889	73.603	51,113	7.9%	26.593	187.973	121.482	84,362
3.0%	16.387	115.836	74.862	51,987	8.0%	26.761	189.159	122.248	84,895
3.1%	16.658	117.751	76.099	52,847	8.1%	26.927	190.338	123.010	85,424
3.2%	16.925	119.635	77.317	53,692	8.2%	27.093	191.509	123.767	85,949
3.3%	17.187	121.490	78.515	54,525	8.3%	27.258	192.673	124.519	86,472
3.4%	17.446	123.317	79.696	55,345	8.4%	27.421	193.831	125.267	86,991
3.5%	17.700	125.117	80.860	56,153	8.5%	27.584	194.981	126.011	87,507
3.6%	17.952	126.892	82.007	56,949	8.6%	27.746	196.125	126.750	88,021
3.7%	18.199	128.642	83.138	57,735	8.7%	27.907	197.262	127.485	88,531
3.8%	18.443	130.369	84.254	58,510	8.8%	28.067	198.392	128.215	89,038
3.9%	18.685	132.073	85.355	59,275	8.9%	28.226	199.516	128.942	89,543
4.0%	18.923	133.756	86.443	60,030	9.0%	28.384	200.634	129.664	90,044
4.1%	19.158	135.417	87.517	60,775	9.1%	28.541	201.745	130.382	90,543
4.2%	19.390	137.059	88.577	61,512	9.2%	28.698	202.851	131.097	91,039
4.3%	19.619	138.681	89.626	62,240	9.3%	28.853	203.950	131.807	91,533
4.4%	19.846	140.284	90.662	62,960	9.4%	29.008	205.044	132.514	92,024
4.5%	20.070	141.870	91.686	63,671	9.5%	29.162	206.132	133.217	92,512
4.6%	20.292	143.437	92.699	64,375	9.6%	29.315	207.214	133.916	92,998
4.7%	20.512	144.988	93.702	65,071	9.7%	29.467	208.290	134.612	93,481
4.8%	20.729	146.522	94.693	65,759	9.8%	29.619	209.361	135.304	93,961
4.9%	20.943	148.041	95.674	66,441	9.9%	29.769	210.426	135.993	94,439
5.0%	21.156	149.544	96.646	67,115	10.0%	29.919	211.487	136.678	94,915

Velocity and Capacity for 42" RC Pipe									
N= 0.013		A= 9.621			HR= 0.875				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	3.316	31.901	20.617	14,317	5.1%	23.679	227.820	147.234	102,246
0.2%	4.689	45.115	29.157	20,248	5.2%	23.910	230.043	148.670	103,243
0.3%	5.743	55.255	35.709	24,798	5.3%	24.139	232.245	150.093	104,231
0.4%	6.631	63.802	41.234	28,635	5.4%	24.366	234.425	151.503	105,210
0.5%	7.414	71.333	46.101	32,014	5.5%	24.590	236.586	152.899	106,180
0.6%	8.122	78.142	50.501	35,070	5.6%	24.813	238.727	154.283	107,141
0.7%	8.773	84.403	54.547	37,880	5.7%	25.033	240.849	155.654	108,093
0.8%	9.378	90.230	58.313	40,495	5.8%	25.252	242.953	157.013	109,037
0.9%	9.947	95.704	61.851	42,952	5.9%	25.469	245.038	158.361	109,973
1.0%	10.485	100.881	65.196	45,275	6.0%	25.684	247.106	159.698	110,901
1.1%	10.997	105.804	68.378	47,485	6.1%	25.897	249.157	161.023	111,822
1.2%	11.486	110.509	71.419	49,597	6.2%	26.108	251.191	162.337	112,734
1.3%	11.955	115.022	74.335	51,622	6.3%	26.318	253.208	163.641	113,640
1.4%	12.406	119.364	77.141	53,570	6.4%	26.526	255.210	164.935	114,538
1.5%	12.842	123.553	79.849	55,451	6.5%	26.732	257.196	166.219	115,430
1.6%	13.263	127.605	82.468	57,269	6.6%	26.937	259.167	167.492	116,314
1.7%	13.671	131.532	85.006	59,032	6.7%	27.141	261.123	168.756	117,192
1.8%	14.068	135.346	87.470	60,743	6.8%	27.342	263.064	170.011	118,063
1.9%	14.453	139.054	89.867	62,408	6.9%	27.543	264.992	171.257	118,928
2.0%	14.828	142.667	92.201	64,029	7.0%	27.742	266.905	172.493	119,787
2.1%	15.195	146.190	94.478	65,610	7.1%	27.939	268.805	173.721	120,640
2.2%	15.552	149.630	96.702	67,154	7.2%	28.135	270.691	174.940	121,486
2.3%	15.902	152.993	98.875	68,663	7.3%	28.330	272.564	176.151	122,327
2.4%	16.244	156.284	101.002	70,140	7.4%	28.523	274.425	177.353	123,162
2.5%	16.579	159.506	103.084	71,586	7.5%	28.715	276.273	178.547	123,991
2.6%	16.907	162.665	105.126	73,004	7.6%	28.906	278.109	179.734	124,815
2.7%	17.229	165.764	107.128	74,395	7.7%	29.096	279.932	180.912	125,634
2.8%	17.545	168.806	109.094	75,760	7.8%	29.284	281.744	182.083	126,447
2.9%	17.856	171.793	111.025	77,101	7.9%	29.471	283.544	183.247	127,255
3.0%	18.161	174.730	112.923	78,419	8.0%	29.657	285.333	184.403	128,058
3.1%	18.461	177.619	114.790	79,715	8.1%	29.842	287.111	185.552	128,855
3.2%	18.757	180.461	116.627	80,991	8.2%	30.025	288.878	186.694	129,648
3.3%	19.048	183.259	118.435	82,246	8.3%	30.208	290.634	187.829	130,437
3.4%	19.334	186.015	120.216	83,483	8.4%	30.389	292.380	188.957	131,220
3.5%	19.616	188.730	121.971	84,702	8.5%	30.570	294.115	190.078	131,999
3.6%	19.894	191.407	123.701	85,904	8.6%	30.749	295.840	191.193	132,773
3.7%	20.169	194.048	125.408	87,089	8.7%	30.927	297.555	192.301	133,543
3.8%	20.440	196.652	127.091	88,258	8.8%	31.104	299.260	193.403	134,308
3.9%	20.707	199.223	128.752	89,411	8.9%	31.281	300.956	194.499	135,069
4.0%	20.971	201.761	130.393	90,550	9.0%	31.456	302.642	195.589	135,826
4.1%	21.231	204.268	132.012	91,675	9.1%	31.630	304.318	196.672	136,578
4.2%	21.489	206.744	133.613	92,787	9.2%	31.804	305.986	197.750	137,326
4.3%	21.743	209.190	135.194	93,885	9.3%	31.976	307.644	198.822	138,071
4.4%	21.994	211.609	136.757	94,970	9.4%	32.147	309.294	199.888	138,811
4.5%	22.243	214.000	138.302	96,043	9.5%	32.318	310.935	200.948	139,548
4.6%	22.489	216.365	139.830	97,104	9.6%	32.488	312.567	202.003	140,280
4.7%	22.732	218.704	141.342	98,154	9.7%	32.656	314.191	203.053	141,009
4.8%	22.972	221.018	142.838	99,193	9.8%	32.824	315.806	204.097	141,734
4.9%	23.210	223.309	144.318	100,221	9.9%	32.991	317.413	205.135	142,455
5.0%	23.446	225.576	145.783	101,238	10.0%	33.157	319.012	206.169	143,173

Velocity and Capacity for 48" RC Pipe									
N= 0.013		A= 12.566			HR= 1.000				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	3.624	45.546	29.435	20,441	5.1%	25.884	325.265	210.210	145,979
0.2%	5.126	64.412	41.628	28,908	5.2%	26.136	328.439	212.261	147,403
0.3%	6.278	78.888	50.983	35,405	5.3%	26.386	331.582	214.292	148,814
0.4%	7.249	91.093	58.871	40,882	5.4%	26.634	334.695	216.304	150,211
0.5%	8.105	101.845	65.819	45,708	5.5%	26.880	337.780	218.298	151,596
0.6%	8.878	111.565	72.101	50,070	5.6%	27.123	340.837	220.273	152,968
0.7%	9.589	120.504	77.878	54,082	5.7%	27.364	343.867	222.231	154,327
0.8%	10.252	128.824	83.256	57,816	5.8%	27.603	346.870	224.172	155,675
0.9%	10.873	136.639	88.306	61,323	5.9%	27.840	349.848	226.097	157,012
1.0%	11.462	144.030	93.083	64,641	6.0%	28.075	352.800	228.005	158,337
1.1%	12.021	151.060	97.626	67,796	6.1%	28.308	355.728	229.897	159,651
1.2%	12.555	157.777	101.967	70,810	6.2%	28.539	358.632	231.774	160,954
1.3%	13.068	164.219	106.130	73,702	6.3%	28.768	361.512	233.635	162,247
1.4%	13.561	170.419	110.137	76,484	6.4%	28.996	364.370	235.482	163,529
1.5%	14.037	176.400	114.002	79,168	6.5%	29.221	367.206	237.315	164,802
1.6%	14.498	182.185	117.741	81,765	6.6%	29.445	370.020	239.133	166,065
1.7%	14.944	187.792	121.365	84,281	6.7%	29.667	372.812	240.938	167,318
1.8%	15.377	193.236	124.883	86,725	6.8%	29.888	375.584	242.730	168,562
1.9%	15.799	198.532	128.305	89,101	6.9%	30.107	378.336	244.508	169,797
2.0%	16.209	203.689	131.639	91,416	7.0%	30.324	381.067	246.273	171,023
2.1%	16.609	208.719	134.889	93,673	7.1%	30.540	383.780	248.026	172,240
2.2%	17.000	213.631	138.064	95,878	7.2%	30.755	386.473	249.767	173,449
2.3%	17.382	218.432	141.167	98,032	7.3%	30.967	389.147	251.495	174,649
2.4%	17.756	223.130	144.203	100,141	7.4%	31.179	391.804	253.212	175,842
2.5%	18.122	227.731	147.176	102,206	7.5%	31.389	394.442	254.917	177,026
2.6%	18.481	232.241	150.091	104,230	7.6%	31.597	397.063	256.611	178,202
2.7%	18.833	236.665	152.950	106,215	7.7%	31.804	399.667	258.294	179,370
2.8%	19.179	241.008	155.757	108,164	7.8%	32.010	402.254	259.965	180,531
2.9%	19.518	245.274	158.514	110,079	7.9%	32.215	404.824	261.626	181,685
3.0%	19.852	249.467	161.224	111,961	8.0%	32.418	407.378	263.277	182,831
3.1%	20.180	253.591	163.889	113,812	8.1%	32.620	409.916	264.917	183,970
3.2%	20.503	257.649	166.511	115,633	8.2%	32.821	412.439	266.548	185,103
3.3%	20.821	261.643	169.093	117,426	8.3%	33.020	414.946	268.168	186,228
3.4%	21.134	265.578	171.636	119,191	8.4%	33.219	417.438	269.779	187,346
3.5%	21.443	269.455	174.141	120,932	8.5%	33.416	419.916	271.380	188,458
3.6%	21.747	273.278	176.612	122,647	8.6%	33.612	422.379	272.972	189,564
3.7%	22.047	277.047	179.048	124,339	8.7%	33.807	424.827	274.554	190,662
3.8%	22.343	280.766	181.451	126,008	8.8%	34.000	427.262	276.127	191,755
3.9%	22.635	284.436	183.823	127,655	8.9%	34.193	429.683	277.692	192,842
4.0%	22.923	288.060	186.165	129,281	9.0%	34.385	432.090	279.248	193,922
4.1%	23.208	291.638	188.478	130,887	9.1%	34.575	434.484	280.795	194,996
4.2%	23.489	295.174	190.762	132,474	9.2%	34.765	436.864	282.333	196,065
4.3%	23.767	298.667	193.020	134,042	9.3%	34.953	439.232	283.864	197,127
4.4%	24.042	302.120	195.252	135,591	9.4%	35.140	441.587	285.386	198,184
4.5%	24.314	305.534	197.458	137,123	9.5%	35.327	443.930	286.900	199,236
4.6%	24.582	308.910	199.640	138,639	9.6%	35.512	446.260	288.406	200,282
4.7%	24.848	312.249	201.798	140,138	9.7%	35.697	448.579	289.904	201,322
4.8%	25.111	315.554	203.934	141,621	9.8%	35.880	450.885	291.394	202,357
4.9%	25.371	318.824	206.047	143,088	9.9%	36.063	453.180	292.877	203,387
5.0%	25.629	322.061	208.139	144,541	10.0%	36.245	455.463	294.353	204,412

Velocity and Capacity for 54" RC Pipe									
N= 0.013		A= 15.904			HR= 1.125				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	3.921	62.353	40.297	27,984	5.1%	27.998	445.292	287.780	199,847
0.2%	5.544	88.181	56.989	39,576	5.2%	28.271	449.636	290.587	201,797
0.3%	6.791	107.999	69.797	48,470	5.3%	28.542	453.939	293.368	203,728
0.4%	7.841	124.707	80.594	55,968	5.4%	28.810	458.201	296.123	205,641
0.5%	8.767	139.426	90.107	62,574	5.5%	29.075	462.425	298.852	207,536
0.6%	9.603	152.734	98.708	68,547	5.6%	29.339	466.609	301.557	209,414
0.7%	10.373	164.971	106.616	74,039	5.7%	29.599	470.757	304.237	211,276
0.8%	11.089	176.362	113.978	79,151	5.8%	29.858	474.869	306.894	213,121
0.9%	11.762	187.060	120.892	83,952	5.9%	30.114	478.945	309.529	214,950
1.0%	12.398	197.178	127.431	88,494	6.0%	30.368	482.987	312.141	216,764
1.1%	13.003	206.803	133.651	92,813	6.1%	30.620	486.995	314.731	218,563
1.2%	13.581	215.998	139.594	96,940	6.2%	30.870	490.970	317.300	220,348
1.3%	14.136	224.818	145.294	100,898	6.3%	31.118	494.914	319.849	222,117
1.4%	14.669	233.305	150.778	104,707	6.4%	31.364	498.826	322.378	223,873
1.5%	15.184	241.493	156.070	108,382	6.5%	31.608	502.708	324.886	225,616
1.6%	15.682	249.413	161.189	111,937	6.6%	31.851	506.561	327.376	227,344
1.7%	16.165	257.089	166.150	115,382	6.7%	32.091	510.384	329.847	229,060
1.8%	16.633	264.543	170.967	118,727	6.8%	32.330	514.179	332.299	230,763
1.9%	17.089	271.792	175.651	121,980	6.9%	32.566	517.945	334.734	232,454
2.0%	17.533	278.852	180.215	125,149	7.0%	32.801	521.685	337.151	234,132
2.1%	17.966	285.739	184.665	128,240	7.1%	33.035	525.398	339.550	235,799
2.2%	18.389	292.463	189.011	131,257	7.2%	33.267	529.085	341.933	237,454
2.3%	18.802	299.036	193.259	134,207	7.3%	33.497	532.747	344.299	239,097
2.4%	19.207	305.468	197.415	137,094	7.4%	33.726	536.383	346.650	240,729
2.5%	19.603	311.767	201.486	139,921	7.5%	33.953	539.995	348.984	242,350
2.6%	19.991	317.941	205.476	142,692	7.6%	34.178	543.584	351.303	243,960
2.7%	20.372	323.997	209.390	145,410	7.7%	34.402	547.148	353.606	245,560
2.8%	20.745	329.943	213.233	148,078	7.8%	34.625	550.690	355.895	247,149
2.9%	21.113	335.783	217.007	150,699	7.9%	34.846	554.208	358.169	248,729
3.0%	21.474	341.523	220.717	153,276	8.0%	35.066	557.705	360.429	250,298
3.1%	21.829	347.169	224.365	155,809	8.1%	35.285	561.180	362.675	251,857
3.2%	22.178	352.724	227.955	158,302	8.2%	35.502	564.633	364.907	253,407
3.3%	22.522	358.192	231.490	160,757	8.3%	35.718	568.066	367.125	254,948
3.4%	22.860	363.579	234.971	163,174	8.4%	35.932	571.478	369.330	256,479
3.5%	23.194	368.887	238.401	165,557	8.5%	36.145	574.869	371.522	258,001
3.6%	23.523	374.120	241.783	167,905	8.6%	36.357	578.241	373.701	259,514
3.7%	23.848	379.280	245.118	170,221	8.7%	36.568	581.593	375.867	261,019
3.8%	24.168	384.372	248.409	172,506	8.8%	36.778	584.926	378.021	262,515
3.9%	24.484	389.396	251.656	174,761	8.9%	36.986	588.240	380.163	264,002
4.0%	24.796	394.357	254.862	176,987	9.0%	37.193	591.535	382.293	265,481
4.1%	25.104	399.256	258.028	179,186	9.1%	37.399	594.813	384.411	266,952
4.2%	25.408	404.096	261.156	181,358	9.2%	37.604	598.072	386.517	268,415
4.3%	25.709	408.878	264.246	183,504	9.3%	37.808	601.314	388.612	269,870
4.4%	26.006	413.605	267.301	185,626	9.4%	38.011	604.538	390.696	271,317
4.5%	26.300	418.279	270.322	187,723	9.5%	38.213	607.745	392.768	272,756
4.6%	26.590	422.901	273.309	189,798	9.6%	38.413	610.935	394.830	274,188
4.7%	26.878	427.473	276.264	191,850	9.7%	38.613	614.109	396.881	275,612
4.8%	27.162	431.996	279.187	193,880	9.8%	38.811	617.266	398.922	277,029
4.9%	27.444	436.473	282.080	195,889	9.9%	39.009	620.408	400.952	278,439
5.0%	27.722	440.904	284.944	197,878	10.0%	39.205	623.533	402.972	279,842

Velocity and Capacity for 60" RC Pipe									
N= 0.013		A= 19.635			HR= 1.250				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	4.206	82.581	53.370	37,062	5.1%	30.035	589.745	381.136	264,678
0.2%	5.948	116.787	75.476	52,414	5.2%	30.329	595.499	384.854	267,260
0.3%	7.285	143.034	92.439	64,194	5.3%	30.619	601.198	388.537	269,818
0.4%	8.412	165.162	106.739	74,125	5.4%	30.906	606.843	392.186	272,351
0.5%	9.404	184.656	119.338	82,874	5.5%	31.191	612.436	395.800	274,861
0.6%	10.302	202.281	130.729	90,784	5.6%	31.473	617.979	399.382	277,349
0.7%	11.128	218.488	141.203	98,058	5.7%	31.753	623.472	402.932	279,814
0.8%	11.896	233.574	150.952	104,828	5.8%	32.030	628.917	406.452	282,258
0.9%	12.617	247.743	160.109	111,187	5.9%	32.305	634.316	409.941	284,681
1.0%	13.300	261.144	168.770	117,201	6.0%	32.578	639.669	413.400	287,083
1.1%	13.949	273.890	177.007	122,922	6.1%	32.848	644.977	416.831	289,466
1.2%	14.569	286.069	184.878	128,388	6.2%	33.117	650.242	420.233	291,829
1.3%	15.164	297.750	192.427	133,630	6.3%	33.383	655.465	423.609	294,173
1.4%	15.737	308.989	199.691	138,674	6.4%	33.646	660.647	426.958	296,498
1.5%	16.289	319.834	206.700	143,542	6.5%	33.908	665.788	430.280	298,806
1.6%	16.823	330.324	213.479	148,249	6.6%	34.168	670.890	433.578	301,096
1.7%	17.341	340.490	220.049	152,812	6.7%	34.426	675.954	436.850	303,368
1.8%	17.844	350.361	226.428	157,242	6.8%	34.682	680.979	440.098	305,624
1.9%	18.333	359.962	232.633	161,551	6.9%	34.936	685.968	443.322	307,863
2.0%	18.809	369.313	238.677	165,748	7.0%	35.188	690.921	446.523	310,085
2.1%	19.273	378.433	244.571	169,841	7.1%	35.439	695.839	449.701	312,292
2.2%	19.727	387.339	250.326	173,838	7.2%	35.687	700.722	452.857	314,484
2.3%	20.170	396.044	255.952	177,745	7.3%	35.934	705.571	455.991	316,660
2.4%	20.604	404.562	261.457	181,567	7.4%	36.180	710.388	459.104	318,822
2.5%	21.029	412.904	266.849	185,311	7.5%	36.423	715.171	462.195	320,969
2.6%	21.446	421.081	272.133	188,981	7.6%	36.665	719.923	465.266	323,102
2.7%	21.854	429.103	277.317	192,581	7.7%	36.906	724.644	468.317	325,220
2.8%	22.255	436.977	282.406	196,115	7.8%	37.145	729.335	471.348	327,325
2.9%	22.649	444.712	287.405	199,587	7.9%	37.382	733.995	474.360	329,417
3.0%	23.036	452.314	292.318	202,999	8.0%	37.618	738.626	477.353	331,495
3.1%	23.417	459.791	297.150	206,354	8.1%	37.852	743.228	480.327	333,561
3.2%	23.792	467.148	301.905	209,656	8.2%	38.085	747.802	483.283	335,613
3.3%	24.161	474.391	306.586	212,907	8.3%	38.317	752.348	486.221	337,654
3.4%	24.524	481.525	311.196	216,108	8.4%	38.547	756.866	489.141	339,682
3.5%	24.882	488.555	315.739	219,264	8.5%	38.776	761.358	492.044	341,697
3.6%	25.235	495.485	320.218	222,374	8.6%	39.003	765.824	494.930	343,702
3.7%	25.583	502.320	324.635	225,441	8.7%	39.229	770.263	497.799	345,694
3.8%	25.926	509.063	328.993	228,467	8.8%	39.454	774.677	500.652	347,675
3.9%	26.265	515.717	333.294	231,454	8.9%	39.678	779.066	503.489	349,645
4.0%	26.600	522.287	337.540	234,403	9.0%	39.900	783.431	506.310	351,604
4.1%	26.930	528.776	341.733	237,314	9.1%	40.121	787.771	509.115	353,552
4.2%	27.257	535.185	345.875	240,191	9.2%	40.341	792.088	511.904	355,489
4.3%	27.579	541.519	349.969	243,034	9.3%	40.559	796.381	514.679	357,416
4.4%	27.898	547.780	354.015	245,843	9.4%	40.777	800.651	517.439	359,332
4.5%	28.213	553.969	358.015	248,621	9.5%	40.993	804.899	520.184	361,239
4.6%	28.525	560.091	361.971	251,369	9.6%	41.208	809.124	522.914	363,135
4.7%	28.834	566.146	365.884	254,086	9.7%	41.422	813.327	525.631	365,021
4.8%	29.139	572.137	369.756	256,775	9.8%	41.635	817.509	528.333	366,898
4.9%	29.441	578.066	373.588	259,436	9.9%	41.847	821.669	531.022	368,765
5.0%	29.740	583.935	377.381	262,070	10.0%	42.058	825.809	533.697	370,623

Velocity and Capacity for 66" RC Pipe									
N= 0.013		A= 23.758			HR= 1.375				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	4.482	106.478	68.814	47,787	5.1%	32.006	760.405	491.429	341,270
0.2%	6.338	150.583	97.317	67,581	5.2%	32.318	767.824	496.223	344,599
0.3%	7.763	184.425	119.189	82,770	5.3%	32.627	775.172	500.972	347,897
0.4%	8.963	212.956	137.628	95,575	5.4%	32.934	782.450	505.676	351,164
0.5%	10.021	238.092	153.872	106,856	5.5%	33.237	789.662	510.337	354,400
0.6%	10.978	260.817	168.559	117,055	5.6%	33.538	796.809	514.955	357,608
0.7%	11.858	281.714	182.064	126,433	5.7%	33.836	803.891	519.533	360,786
0.8%	12.676	301.165	194.635	135,163	5.8%	34.132	810.912	524.070	363,938
0.9%	13.445	319.434	206.441	143,362	5.9%	34.425	817.873	528.569	367,061
1.0%	14.172	336.713	217.608	151,117	6.0%	34.715	824.775	533.029	370,159
1.1%	14.864	353.148	228.229	158,493	6.1%	35.003	831.620	537.453	373,231
1.2%	15.525	368.851	238.378	165,540	6.2%	35.289	838.409	541.840	376,278
1.3%	16.159	383.912	248.112	172,300	6.3%	35.573	845.143	546.192	379,300
1.4%	16.769	398.404	257.478	178,804	6.4%	35.854	851.824	550.510	382,299
1.5%	17.358	412.388	266.515	185,080	6.5%	36.133	858.453	554.794	385,274
1.6%	17.927	425.912	275.255	191,149	6.6%	36.410	865.032	559.046	388,226
1.7%	18.479	439.020	283.726	197,032	6.7%	36.684	871.560	563.265	391,156
1.8%	19.014	451.748	291.952	202,744	6.8%	36.957	878.040	567.453	394,064
1.9%	19.535	464.127	299.952	208,300	6.9%	37.228	884.473	571.610	396,951
2.0%	20.043	476.184	307.745	213,711	7.0%	37.497	890.859	575.737	399,818
2.1%	20.538	487.944	315.344	218,989	7.1%	37.764	897.200	579.835	402,663
2.2%	21.021	499.426	322.765	224,142	7.2%	38.029	903.496	583.904	405,489
2.3%	21.494	510.651	330.019	229,180	7.3%	38.292	909.749	587.945	408,295
2.4%	21.956	521.634	337.117	234,109	7.4%	38.553	915.959	591.958	411,082
2.5%	22.409	532.390	344.069	238,937	7.5%	38.813	922.127	595.945	413,850
2.6%	22.852	542.934	350.883	243,669	7.6%	39.071	928.254	599.904	416,600
2.7%	23.288	553.276	357.567	248,310	7.7%	39.327	934.341	603.838	419,332
2.8%	23.715	563.429	364.128	252,867	7.8%	39.581	940.388	607.747	422,046
2.9%	24.135	573.402	370.573	257,343	7.9%	39.834	946.397	611.630	424,743
3.0%	24.547	583.204	376.909	261,742	8.0%	40.086	952.368	615.489	427,423
3.1%	24.953	592.845	383.139	266,069	8.1%	40.335	958.302	619.324	430,086
3.2%	25.352	602.331	389.269	270,326	8.2%	40.584	964.199	623.135	432,733
3.3%	25.746	611.670	395.305	274,517	8.3%	40.830	970.061	626.923	435,363
3.4%	26.133	620.868	401.250	278,646	8.4%	41.076	975.887	630.689	437,978
3.5%	26.514	629.932	407.108	282,714	8.5%	41.319	981.679	634.432	440,577
3.6%	26.890	638.868	412.883	286,724	8.6%	41.562	987.437	638.153	443,162
3.7%	27.261	647.681	418.578	290,679	8.7%	41.803	993.161	641.852	445,731
3.8%	27.627	656.375	424.197	294,581	8.8%	42.042	998.852	645.530	448,285
3.9%	27.988	664.955	429.742	298,432	8.9%	42.280	1,004.512	649.188	450,825
4.0%	28.345	673.426	435.216	302,234	9.0%	42.517	1,010.139	652.825	453,350
4.1%	28.697	681.792	440.623	305,988	9.1%	42.753	1,015.736	656.441	455,862
4.2%	29.045	690.056	445.964	309,697	9.2%	42.987	1,021.301	660.038	458,360
4.3%	29.389	698.223	451.242	313,363	9.3%	43.220	1,026.837	663.616	460,844
4.4%	29.728	706.295	456.459	316,985	9.4%	43.452	1,032.343	667.174	463,315
4.5%	30.064	714.276	461.617	320,567	9.5%	43.682	1,037.819	670.714	465,773
4.6%	30.397	722.169	466.718	324,109	9.6%	43.912	1,043.267	674.234	468,218
4.7%	30.725	729.977	471.763	327,613	9.7%	44.140	1,048.687	677.737	470,651
4.8%	31.050	737.701	476.756	331,080	9.8%	44.367	1,054.079	681.222	473,070
4.9%	31.372	745.346	481.696	334,511	9.9%	44.593	1,059.443	684.688	475,478
5.0%	31.691	752.913	486.587	337,907	10.0%	44.817	1,064.780	688.138	477,873

Velocity and Capacity for 72" RC Pipe									
N= 0.013		A= 28.274			HR= 1.500				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	4.749	134.286	86.785	60,267	5.1%	33.917	958.991	619.769	430,395
0.2%	6.717	189.909	122.733	85,231	5.2%	34.248	968.347	625.816	434,594
0.3%	8.226	232.589	150.316	104,386	5.3%	34.576	977.614	631.805	438,753
0.4%	9.499	268.571	173.570	120,535	5.4%	34.901	986.794	637.737	442,873
0.5%	10.620	300.272	194.057	134,762	5.5%	35.222	995.889	643.615	446,955
0.6%	11.634	328.931	212.579	147,624	5.6%	35.541	1,004.901	649.440	451,000
0.7%	12.566	355.286	229.612	159,453	5.7%	35.857	1,013.834	655.213	455,009
0.8%	13.433	379.817	245.465	170,462	5.8%	36.170	1,022.689	660.935	458,983
0.9%	14.248	402.857	260.355	180,802	5.9%	36.481	1,031.467	666.608	462,923
1.0%	15.019	424.648	274.438	190,582	6.0%	36.789	1,040.172	672.234	466,829
1.1%	15.752	445.375	287.833	199,884	6.1%	37.094	1,048.804	677.813	470,703
1.2%	16.452	465.179	300.632	208,772	6.2%	37.397	1,057.366	683.346	474,546
1.3%	17.124	484.174	312.908	217,297	6.3%	37.697	1,065.859	688.835	478,358
1.4%	17.771	502.451	324.720	225,500	6.4%	37.995	1,074.285	694.280	482,139
1.5%	18.394	520.086	336.117	233,415	6.5%	38.291	1,082.645	699.683	485,891
1.6%	18.998	537.142	347.140	241,070	6.6%	38.584	1,090.941	705.045	489,615
1.7%	19.582	553.674	357.824	248,489	6.7%	38.875	1,099.175	710.366	493,310
1.8%	20.150	569.726	368.198	255,693	6.8%	39.164	1,107.347	715.648	496,978
1.9%	20.702	585.337	378.287	262,699	6.9%	39.451	1,115.460	720.891	500,618
2.0%	21.240	600.543	388.114	269,524	7.0%	39.736	1,123.514	726.096	504,233
2.1%	21.764	615.374	397.699	276,180	7.1%	40.019	1,131.511	731.264	507,822
2.2%	22.277	629.855	407.058	282,679	7.2%	40.300	1,139.451	736.395	511,386
2.3%	22.777	644.011	416.206	289,032	7.3%	40.579	1,147.337	741.492	514,925
2.4%	23.267	657.862	425.158	295,249	7.4%	40.856	1,155.168	746.553	518,440
2.5%	23.747	671.428	433.925	301,337	7.5%	41.131	1,162.947	751.580	521,931
2.6%	24.217	684.725	442.519	307,305	7.6%	41.404	1,170.675	756.574	525,399
2.7%	24.679	697.768	450.948	313,158	7.7%	41.676	1,178.351	761.536	528,844
2.8%	25.131	710.573	459.223	318,905	7.8%	41.945	1,185.978	766.465	532,267
2.9%	25.576	723.150	467.352	324,550	7.9%	42.213	1,193.557	771.362	535,668
3.0%	26.013	735.513	475.341	330,098	8.0%	42.480	1,201.087	776.229	539,048
3.1%	26.443	747.671	483.199	335,555	8.1%	42.744	1,208.570	781.065	542,406
3.2%	26.867	759.634	490.930	340,924	8.2%	43.007	1,216.008	785.872	545,744
3.3%	27.283	771.412	498.542	346,210	8.3%	43.269	1,223.400	790.649	549,062
3.4%	27.693	783.013	506.039	351,416	8.4%	43.529	1,230.748	795.398	552,360
3.5%	28.098	794.444	513.427	356,547	8.5%	43.787	1,238.052	800.118	555,638
3.6%	28.496	805.714	520.710	361,604	8.6%	44.044	1,245.314	804.811	558,897
3.7%	28.889	816.827	527.893	366,592	8.7%	44.299	1,252.533	809.477	562,137
3.8%	29.277	827.792	534.979	371,513	8.8%	44.553	1,259.711	814.116	565,358
3.9%	29.660	838.613	541.972	376,370	8.9%	44.806	1,266.848	818.728	568,561
4.0%	30.038	849.297	548.877	381,164	9.0%	45.057	1,273.945	823.315	571,747
4.1%	30.411	859.847	555.695	385,900	9.1%	45.306	1,281.003	827.876	574,914
4.2%	30.780	870.270	562.431	390,577	9.2%	45.554	1,288.022	832.413	578,064
4.3%	31.144	880.570	569.087	395,200	9.3%	45.801	1,295.004	836.925	581,198
4.4%	31.504	890.750	575.667	399,769	9.4%	46.047	1,301.947	841.412	584,314
4.5%	31.860	900.815	582.172	404,286	9.5%	46.291	1,308.854	845.876	587,414
4.6%	32.212	910.769	588.605	408,753	9.6%	46.534	1,315.725	850.316	590,497
4.7%	32.560	920.616	594.968	413,172	9.7%	46.776	1,322.560	854.733	593,565
4.8%	32.905	930.358	601.264	417,545	9.8%	47.016	1,329.360	859.128	596,617
4.9%	33.246	939.999	607.495	421,872	9.9%	47.256	1,336.125	863.500	599,653
5.0%	33.583	949.543	613.663	426,155	10.0%	47.494	1,342.856	867.850	602,674

Velocity and Capacity for 78" RC Pipe									
N= 0.013		A= 33.183			HR= 1.625				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	5.010	166.237	107.434	74,607	5.1%	35.776	1,187.172	767.236	532,803
0.2%	7.085	235.095	151.935	105,511	5.2%	36.125	1,198.754	774.721	538,001
0.3%	8.677	287.931	186.082	129,224	5.3%	36.471	1,210.226	782.135	543,149
0.4%	10.019	332.475	214.869	149,215	5.4%	36.814	1,221.590	789.479	548,249
0.5%	11.202	371.718	240.231	166,827	5.5%	37.153	1,232.849	796.756	553,302
0.6%	12.271	407.197	263.160	182,750	5.6%	37.489	1,244.006	803.966	558,310
0.7%	13.254	439.822	284.245	197,392	5.7%	37.822	1,255.064	811.113	563,273
0.8%	14.170	470.190	303.871	211,021	5.8%	38.153	1,266.025	818.197	568,192
0.9%	15.029	498.712	322.303	223,822	5.9%	38.480	1,276.893	825.220	573,069
1.0%	15.842	525.688	339.738	235,929	6.0%	38.805	1,287.668	832.184	577,906
1.1%	16.615	551.347	356.320	247,444	6.1%	39.127	1,298.355	839.090	582,702
1.2%	17.354	575.863	372.164	258,447	6.2%	39.446	1,308.954	845.940	587,458
1.3%	18.063	599.377	387.361	269,000	6.3%	39.763	1,319.467	852.735	592,177
1.4%	18.745	622.003	401.983	279,155	6.4%	40.078	1,329.898	859.476	596,858
1.5%	19.402	643.834	416.092	288,953	6.5%	40.390	1,340.248	866.165	601,503
1.6%	20.039	664.949	429.738	298,429	6.6%	40.699	1,350.518	872.802	606,112
1.7%	20.656	685.414	442.964	307,614	6.7%	41.006	1,360.711	879.389	610,687
1.8%	21.254	705.285	455.806	316,532	6.8%	41.311	1,370.828	885.928	615,227
1.9%	21.837	724.611	468.296	325,206	6.9%	41.614	1,380.871	892.418	619,735
2.0%	22.404	743.436	480.462	333,654	7.0%	41.914	1,390.841	898.862	624,209
2.1%	22.957	761.795	492.327	341,894	7.1%	42.212	1,400.740	905.259	628,652
2.2%	23.498	779.722	503.912	349,939	7.2%	42.509	1,410.570	911.612	633,064
2.3%	24.026	797.246	515.238	357,804	7.3%	42.803	1,420.332	917.921	637,445
2.4%	24.542	814.393	526.319	365,500	7.4%	43.095	1,430.027	924.187	641,796
2.5%	25.049	831.186	537.172	373,036	7.5%	43.385	1,439.657	930.410	646,118
2.6%	25.545	847.647	547.811	380,424	7.6%	43.674	1,449.223	936.592	650,411
2.7%	26.031	863.794	558.246	387,671	7.7%	43.960	1,458.726	942.734	654,676
2.8%	26.509	879.645	568.490	394,785	7.8%	44.244	1,468.168	948.836	658,914
2.9%	26.978	895.215	578.552	401,773	7.9%	44.527	1,477.549	954.899	663,124
3.0%	27.439	910.519	588.443	408,641	8.0%	44.808	1,486.871	960.923	667,308
3.1%	27.893	925.570	598.170	415,396	8.1%	45.087	1,496.136	966.910	671,466
3.2%	28.339	940.380	607.741	422,043	8.2%	45.365	1,505.343	972.861	675,598
3.3%	28.779	954.960	617.164	428,586	8.3%	45.641	1,514.494	978.775	679,705
3.4%	29.211	969.322	626.445	435,032	8.4%	45.915	1,523.590	984.653	683,787
3.5%	29.638	983.473	635.591	441,383	8.5%	46.187	1,532.632	990.497	687,845
3.6%	30.058	997.424	644.607	447,644	8.6%	46.458	1,541.621	996.307	691,880
3.7%	30.473	1,011.182	653.499	453,818	8.7%	46.727	1,550.558	1,002.082	695,890
3.8%	30.882	1,024.755	662.271	459,910	8.8%	46.995	1,559.444	1,007.825	699,878
3.9%	31.286	1,038.151	670.928	465,922	8.9%	47.261	1,568.279	1,013.535	703,844
4.0%	31.684	1,051.377	679.475	471,858	9.0%	47.526	1,577.065	1,019.213	707,787
4.1%	32.078	1,064.438	687.916	477,720	9.1%	47.790	1,585.803	1,024.860	711,708
4.2%	32.467	1,077.341	696.255	483,511	9.2%	48.051	1,594.492	1,030.476	715,608
4.3%	32.851	1,090.091	704.495	489,233	9.3%	48.312	1,603.134	1,036.061	719,487
4.4%	33.231	1,102.693	712.640	494,889	9.4%	48.571	1,611.730	1,041.616	723,345
4.5%	33.606	1,115.154	720.693	500,481	9.5%	48.829	1,620.281	1,047.142	727,182
4.6%	33.977	1,127.476	728.656	506,011	9.6%	49.085	1,628.786	1,052.639	730,999
4.7%	34.345	1,139.665	736.534	511,482	9.7%	49.340	1,637.247	1,058.107	734,797
4.8%	34.708	1,151.726	744.328	516,894	9.8%	49.594	1,645.665	1,063.547	738,574
4.9%	35.068	1,163.661	752.041	522,251	9.9%	49.846	1,654.040	1,068.960	742,333
5.0%	35.424	1,175.475	759.677	527,553	10.0%	50.097	1,662.373	1,074.345	746,073

Velocity and Capacity for 84" RC Pipe									
N= 0.013		A= 38.485			HR= 1.750				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	5.263	202.560	130.909	90,909	5.1%	37.588	1,446.570	934.877	649,220
0.2%	7.444	286.463	185.133	128,565	5.2%	37.955	1,460.683	943.998	655,554
0.3%	9.117	350.845	226.741	157,459	5.3%	38.318	1,474.661	953.032	661,828
0.4%	10.527	405.121	261.818	181,818	5.4%	38.678	1,488.508	961.981	668,042
0.5%	11.769	452.939	292.721	203,279	5.5%	39.035	1,502.227	970.847	674,200
0.6%	12.893	496.169	320.660	222,681	5.6%	39.388	1,515.822	979.633	680,301
0.7%	13.926	535.924	346.353	240,523	5.7%	39.738	1,529.296	988.341	686,348
0.8%	14.887	572.927	370.267	257,130	5.8%	40.085	1,542.653	996.973	692,343
0.9%	15.790	607.681	392.727	272,727	5.9%	40.429	1,555.895	1,005.531	698,286
1.0%	16.644	640.552	413.971	287,480	6.0%	40.770	1,569.025	1,014.017	704,178
1.1%	17.457	671.816	434.176	301,511	6.1%	41.109	1,582.046	1,022.432	710,022
1.2%	18.233	701.689	453.482	314,918	6.2%	41.444	1,594.961	1,030.779	715,819
1.3%	18.978	730.341	471.999	327,777	6.3%	41.777	1,607.772	1,039.058	721,568
1.4%	19.694	757.911	489.817	340,150	6.4%	42.107	1,620.482	1,047.272	727,272
1.5%	20.385	784.513	507.008	352,089	6.5%	42.435	1,633.093	1,055.422	732,932
1.6%	21.054	810.241	523.636	363,636	6.6%	42.760	1,645.607	1,063.510	738,549
1.7%	21.702	835.177	539.752	374,828	6.7%	43.083	1,658.027	1,071.537	744,123
1.8%	22.331	859.390	555.400	385,694	6.8%	43.403	1,670.355	1,079.503	749,655
1.9%	22.943	882.940	570.619	396,263	6.9%	43.721	1,682.592	1,087.412	755,147
2.0%	23.539	905.877	585.443	406,558	7.0%	44.037	1,694.741	1,095.263	760,600
2.1%	24.120	928.248	599.901	416,598	7.1%	44.350	1,706.803	1,103.059	766,013
2.2%	24.688	950.092	614.018	426,401	7.2%	44.662	1,718.781	1,110.800	771,389
2.3%	25.242	971.445	627.818	435,984	7.3%	44.971	1,730.676	1,118.487	776,727
2.4%	25.785	992.339	641.321	445,362	7.4%	45.278	1,742.489	1,126.122	782,029
2.5%	26.317	1,012.801	654.545	454,545	7.5%	45.583	1,754.223	1,133.705	787,295
2.6%	26.838	1,032.859	667.508	463,547	7.6%	45.885	1,765.879	1,141.238	792,527
2.7%	27.350	1,052.534	680.223	472,377	7.7%	46.186	1,777.459	1,148.722	797,724
2.8%	27.851	1,071.848	692.705	481,045	7.8%	46.485	1,788.964	1,156.157	802,887
2.9%	28.344	1,090.820	704.967	489,560	7.9%	46.782	1,800.395	1,163.545	808,017
3.0%	28.829	1,109.468	717.018	497,929	8.0%	47.077	1,811.754	1,170.886	813,115
3.1%	29.305	1,127.808	728.871	506,160	8.1%	47.371	1,823.042	1,178.181	818,181
3.2%	29.774	1,145.854	740.533	514,259	8.2%	47.662	1,834.261	1,185.432	823,216
3.3%	30.236	1,163.620	752.015	522,233	8.3%	47.952	1,845.412	1,192.638	828,221
3.4%	30.691	1,181.119	763.324	530,086	8.4%	48.240	1,856.495	1,199.801	833,195
3.5%	31.139	1,198.363	774.468	537,825	8.5%	48.526	1,867.513	1,206.922	838,140
3.6%	31.581	1,215.362	785.454	545,454	8.6%	48.811	1,878.467	1,214.000	843,056
3.7%	32.016	1,232.126	796.289	552,978	8.7%	49.094	1,889.356	1,221.038	847,943
3.8%	32.446	1,248.665	806.977	560,401	8.8%	49.375	1,900.184	1,228.035	852,802
3.9%	32.870	1,264.988	817.527	567,727	8.9%	49.655	1,910.950	1,234.993	857,634
4.0%	33.289	1,281.104	827.941	574,959	9.0%	49.933	1,921.655	1,241.912	862,439
4.1%	33.702	1,297.019	838.227	582,102	9.1%	50.210	1,932.302	1,248.792	867,217
4.2%	34.111	1,312.741	848.387	589,158	9.2%	50.485	1,942.890	1,255.635	871,969
4.3%	34.515	1,328.276	858.428	596,130	9.3%	50.759	1,953.420	1,262.441	876,695
4.4%	34.914	1,343.633	868.352	603,022	9.4%	51.031	1,963.895	1,269.210	881,396
4.5%	35.308	1,358.816	878.164	609,836	9.5%	51.302	1,974.313	1,275.943	886,072
4.6%	35.698	1,373.831	887.868	616,575	9.6%	51.571	1,984.677	1,282.641	890,723
4.7%	36.084	1,388.683	897.467	623,241	9.7%	51.839	1,994.987	1,289.304	895,350
4.8%	36.466	1,403.379	906.964	629,836	9.8%	52.105	2,005.244	1,295.933	899,954
4.9%	36.844	1,417.922	916.363	636,363	9.9%	52.370	2,015.449	1,302.528	904,534
5.0%	37.218	1,432.317	925.667	642,824	10.0%	52.634	2,025.603	1,309.090	909,090

Velocity and Capacity for 90" RC Pipe									
N= 0.013		A= 44.179			HR= 1.875				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	5.511	243.476	157.352	109,272	5.1%	39.358	1,738.766	1,123.716	780,358
0.2%	7.794	344.327	222.529	154,534	5.2%	39.742	1,755.730	1,134.679	787,972
0.3%	9.546	421.713	272.541	189,265	5.3%	40.122	1,772.532	1,145.538	795,512
0.4%	11.022	486.952	314.703	218,544	5.4%	40.499	1,789.176	1,156.294	802,982
0.5%	12.323	544.429	351.849	244,340	5.5%	40.872	1,805.666	1,166.952	810,383
0.6%	13.500	596.392	385.431	267,661	5.6%	41.242	1,822.008	1,177.513	817,717
0.7%	14.581	644.177	416.314	289,107	5.7%	41.608	1,838.204	1,187.979	824,986
0.8%	15.588	688.654	445.058	309,068	5.8%	41.972	1,854.258	1,198.355	832,191
0.9%	16.534	730.428	472.055	327,816	5.9%	42.332	1,870.175	1,208.642	839,334
1.0%	17.428	769.939	497.590	345,549	6.0%	42.689	1,885.957	1,218.841	846,418
1.1%	18.278	807.519	521.877	362,414	6.1%	43.044	1,901.608	1,228.956	853,442
1.2%	19.091	843.426	545.082	378,529	6.2%	43.395	1,917.132	1,238.989	860,409
1.3%	19.871	877.865	567.340	393,986	6.3%	43.744	1,932.531	1,248.941	867,320
1.4%	20.621	911.004	588.756	408,859	6.4%	44.089	1,947.808	1,258.814	874,176
1.5%	21.345	942.979	609.421	423,209	6.5%	44.432	1,962.966	1,268.610	880,979
1.6%	22.045	973.904	629.407	437,088	6.6%	44.773	1,978.008	1,278.331	887,730
1.7%	22.723	1,003.877	648.778	450,540	6.7%	45.111	1,992.937	1,287.979	894,430
1.8%	23.382	1,032.981	667.587	463,602	6.8%	45.446	2,007.755	1,297.556	901,080
1.9%	24.023	1,061.287	685.880	476,306	6.9%	45.779	2,022.464	1,307.062	907,682
2.0%	24.647	1,088.858	703.698	488,679	7.0%	46.110	2,037.066	1,316.499	914,235
2.1%	25.255	1,115.747	721.076	500,747	7.1%	46.438	2,051.565	1,325.869	920,743
2.2%	25.850	1,142.004	738.045	512,531	7.2%	46.764	2,065.962	1,335.174	927,204
2.3%	26.431	1,167.670	754.632	524,050	7.3%	47.087	2,080.260	1,344.414	933,621
2.4%	26.999	1,192.784	770.863	535,321	7.4%	47.409	2,094.460	1,353.591	939,994
2.5%	27.556	1,217.380	786.759	546,360	7.5%	47.728	2,108.564	1,362.706	946,324
2.6%	28.102	1,241.489	802.340	557,180	7.6%	48.045	2,122.575	1,371.761	952,611
2.7%	28.637	1,265.138	817.624	567,794	7.7%	48.360	2,136.493	1,380.756	958,858
2.8%	29.162	1,288.354	832.627	578,213	7.8%	48.673	2,150.322	1,389.693	965,064
2.9%	29.679	1,311.158	847.365	588,448	7.9%	48.984	2,164.062	1,398.573	971,231
3.0%	30.186	1,333.573	861.851	598,508	8.0%	49.293	2,177.716	1,407.397	977,359
3.1%	30.685	1,355.617	876.097	608,401	8.1%	49.601	2,191.284	1,416.166	983,448
3.2%	31.176	1,377.308	890.116	618,136	8.2%	49.906	2,204.769	1,424.880	989,500
3.3%	31.659	1,398.663	903.917	627,720	8.3%	50.209	2,218.172	1,433.542	995,516
3.4%	32.135	1,419.697	917.510	637,160	8.4%	50.511	2,231.494	1,442.152	1,001,495
3.5%	32.605	1,440.423	930.905	646,462	8.5%	50.810	2,244.738	1,450.711	1,007,438
3.6%	33.067	1,460.856	944.110	655,632	8.6%	51.108	2,257.904	1,459.220	1,013,347
3.7%	33.523	1,481.007	957.133	664,676	8.7%	51.405	2,270.993	1,467.679	1,019,222
3.8%	33.973	1,500.887	969.981	673,598	8.8%	51.699	2,284.007	1,476.090	1,025,063
3.9%	34.417	1,520.507	982.661	682,404	8.9%	51.992	2,296.948	1,484.453	1,030,870
4.0%	34.856	1,539.877	995.180	691,097	9.0%	52.284	2,309.816	1,492.770	1,036,646
4.1%	35.289	1,559.007	1,007.543	699,682	9.1%	52.573	2,322.613	1,501.040	1,042,389
4.2%	35.716	1,577.905	1,019.756	708,164	9.2%	52.861	2,335.340	1,509.265	1,048,101
4.3%	36.139	1,596.579	1,031.824	716,545	9.3%	53.148	2,347.998	1,517.445	1,053,781
4.4%	36.557	1,615.037	1,043.753	724,829	9.4%	53.433	2,360.587	1,525.582	1,059,432
4.5%	36.970	1,633.287	1,055.547	733,019	9.5%	53.716	2,373.111	1,533.675	1,065,052
4.6%	37.379	1,651.335	1,067.211	741,119	9.6%	53.998	2,385.568	1,541.726	1,070,643
4.7%	37.783	1,669.187	1,078.749	749,131	9.7%	54.279	2,397.961	1,549.735	1,076,205
4.8%	38.183	1,686.851	1,090.165	757,059	9.8%	54.558	2,410.290	1,557.703	1,081,738
4.9%	38.578	1,704.332	1,101.462	764,904	9.9%	54.835	2,422.556	1,565.630	1,087,243
5.0%	38.970	1,721.635	1,112.645	772,670	10.0%	55.112	2,434.760	1,573.517	1,092,720

Velocity and Capacity for 96" RC Pipe									
N= 0.013		A= 50.265			HR= 2.000				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	5.753	289.201	186.902	129,793	5.1%	41.088	2,065.307	1,334.750	926,910
0.2%	8.137	408.992	264.320	183,555	5.2%	41.489	2,085.456	1,347.772	935,953
0.3%	9.965	500.910	323.724	224,809	5.3%	41.886	2,105.413	1,360.670	944,910
0.4%	11.507	578.402	373.805	259,587	5.4%	42.279	2,125.183	1,373.446	953,782
0.5%	12.865	646.673	417.926	290,227	5.5%	42.669	2,144.770	1,386.105	962,573
0.6%	14.093	708.394	457.815	317,927	5.6%	43.055	2,164.180	1,398.649	971,284
0.7%	15.222	765.153	494.497	343,401	5.7%	43.438	2,183.418	1,411.082	979,918
0.8%	16.273	817.983	528.640	367,111	5.8%	43.817	2,202.487	1,423.406	988,476
0.9%	17.260	867.602	560.707	389,380	5.9%	44.193	2,221.393	1,435.624	996,961
1.0%	18.194	914.533	591.037	410,442	6.0%	44.566	2,240.139	1,447.739	1,005,375
1.1%	19.082	959.170	619.885	430,476	6.1%	44.936	2,258.730	1,459.754	1,013,718
1.2%	19.931	1,001.821	647.449	449,617	6.2%	45.303	2,277.169	1,471.671	1,021,993
1.3%	20.744	1,042.728	673.886	467,976	6.3%	45.667	2,295.460	1,483.491	1,030,202
1.4%	21.527	1,082.090	699.325	485,642	6.4%	46.028	2,313.606	1,495.219	1,038,346
1.5%	22.283	1,120.070	723.870	502,687	6.5%	46.386	2,331.611	1,506.855	1,046,427
1.6%	23.014	1,156.803	747.609	519,173	6.6%	46.741	2,349.478	1,518.402	1,054,446
1.7%	23.722	1,192.405	770.618	535,151	6.7%	47.094	2,367.210	1,529.862	1,062,404
1.8%	24.410	1,226.975	792.960	550,666	6.8%	47.444	2,384.811	1,541.236	1,070,303
1.9%	25.079	1,260.597	814.688	565,756	6.9%	47.792	2,402.282	1,552.528	1,078,144
2.0%	25.730	1,293.345	835.853	580,453	7.0%	48.137	2,419.627	1,563.737	1,085,929
2.1%	26.366	1,325.284	856.494	594,788	7.1%	48.480	2,436.849	1,574.867	1,093,658
2.2%	26.986	1,356.472	876.650	608,785	7.2%	48.820	2,453.950	1,585.919	1,101,333
2.3%	27.593	1,386.958	896.352	622,467	7.3%	49.158	2,470.932	1,596.894	1,108,954
2.4%	28.186	1,416.789	915.631	635,855	7.4%	49.493	2,487.799	1,607.795	1,116,524
2.5%	28.767	1,446.004	934.512	648,967	7.5%	49.826	2,504.552	1,618.622	1,124,043
2.6%	29.337	1,474.640	953.019	661,819	7.6%	50.158	2,521.194	1,629.377	1,131,512
2.7%	29.896	1,502.731	971.173	674,426	7.7%	50.486	2,537.726	1,640.062	1,138,932
2.8%	30.444	1,530.307	988.994	686,802	7.8%	50.813	2,554.152	1,650.677	1,146,303
2.9%	30.983	1,557.394	1,006.500	698,958	7.9%	51.138	2,570.473	1,661.224	1,153,628
3.0%	31.513	1,584.018	1,023.706	710,907	8.0%	51.461	2,586.690	1,671.705	1,160,907
3.1%	32.034	1,610.202	1,040.628	722,659	8.1%	51.781	2,602.807	1,682.121	1,168,140
3.2%	32.547	1,635.967	1,057.279	734,222	8.2%	52.100	2,618.824	1,692.473	1,175,328
3.3%	33.051	1,661.332	1,073.672	745,606	8.3%	52.417	2,634.744	1,702.761	1,182,473
3.4%	33.548	1,686.316	1,089.819	756,819	8.4%	52.731	2,650.569	1,712.988	1,189,575
3.5%	34.038	1,710.935	1,105.729	767,868	8.5%	53.044	2,666.299	1,723.155	1,196,635
3.6%	34.521	1,735.205	1,121.414	778,760	8.6%	53.355	2,681.938	1,733.261	1,203,654
3.7%	34.997	1,759.140	1,136.883	789,502	8.7%	53.665	2,697.485	1,743.309	1,210,631
3.8%	35.467	1,782.753	1,152.143	800,100	8.8%	53.972	2,712.944	1,753.300	1,217,569
3.9%	35.930	1,806.058	1,167.205	810,559	8.9%	54.278	2,728.315	1,763.233	1,224,468
4.0%	36.388	1,829.066	1,182.074	820,885	9.0%	54.582	2,743.599	1,773.111	1,231,327
4.1%	36.840	1,851.788	1,196.759	831,083	9.1%	54.885	2,758.799	1,782.935	1,238,149
4.2%	37.287	1,874.235	1,211.266	841,157	9.2%	55.185	2,773.916	1,792.704	1,244,934
4.3%	37.728	1,896.416	1,225.601	851,112	9.3%	55.484	2,788.951	1,802.421	1,251,681
4.4%	38.164	1,918.341	1,239.770	860,951	9.4%	55.782	2,803.905	1,812.086	1,258,393
4.5%	38.595	1,940.018	1,253.779	870,680	9.5%	56.078	2,818.780	1,821.699	1,265,069
4.6%	39.022	1,961.455	1,267.633	880,301	9.6%	56.372	2,833.577	1,831.262	1,271,709
4.7%	39.444	1,982.661	1,281.338	889,818	9.7%	56.665	2,848.297	1,840.775	1,278,316
4.8%	39.861	2,003.642	1,294.898	899,234	9.8%	56.956	2,862.941	1,850.239	1,284,888
4.9%	40.274	2,024.405	1,308.316	908,553	9.9%	57.246	2,877.511	1,859.655	1,291,427
5.0%	40.683	2,044.958	1,321.599	917,777	10.0%	57.535	2,892.008	1,869.024	1,297,933

Velocity and Capacity for 102" RC Pipe									
N= 0.013		A= 56.745			HR= 2.125				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	5.991	339.946	219.698	152,568	5.1%	42.783	2,427.700	1,568.955	1,089,552
0.2%	8.472	480.756	310.699	215,763	5.2%	43.200	2,451.385	1,584.262	1,100,182
0.3%	10.376	588.804	380.527	264,255	5.3%	43.613	2,474.844	1,599.423	1,110,710
0.4%	11.982	679.892	439.395	305,136	5.4%	44.023	2,498.083	1,614.441	1,121,140
0.5%	13.396	760.142	491.259	341,152	5.5%	44.429	2,521.107	1,629.321	1,131,473
0.6%	14.674	832.694	538.147	373,713	5.6%	44.831	2,543.923	1,644.066	1,141,713
0.7%	15.850	899.413	581.265	403,656	5.7%	45.229	2,566.536	1,658.680	1,151,861
0.8%	16.944	961.512	621.399	431,527	5.8%	45.624	2,588.952	1,673.167	1,161,921
0.9%	17.972	1,019.838	659.093	457,703	5.9%	46.016	2,611.175	1,687.529	1,171,895
1.0%	18.944	1,075.004	694.745	482,462	6.0%	46.404	2,633.210	1,701.770	1,181,785
1.1%	19.869	1,127.473	728.654	506,010	6.1%	46.789	2,655.063	1,715.893	1,191,592
1.2%	20.753	1,177.607	761.055	528,510	6.2%	47.171	2,676.737	1,729.900	1,201,320
1.3%	21.600	1,225.693	792.131	550,091	6.3%	47.550	2,698.238	1,743.796	1,210,969
1.4%	22.415	1,271.961	822.033	570,856	6.4%	47.926	2,719.568	1,757.581	1,220,542
1.5%	23.202	1,316.605	850.885	590,892	6.5%	48.299	2,740.732	1,771.259	1,230,041
1.6%	23.963	1,359.784	878.790	610,271	6.6%	48.669	2,761.734	1,784.832	1,239,466
1.7%	24.701	1,401.633	905.836	629,053	6.7%	49.037	2,782.578	1,798.302	1,248,821
1.8%	25.417	1,442.269	932.098	647,290	6.8%	49.401	2,803.267	1,811.673	1,258,106
1.9%	26.113	1,481.790	957.640	665,027	6.9%	49.763	2,823.804	1,824.945	1,267,323
2.0%	26.792	1,520.285	982.517	682,304	7.0%	50.122	2,844.192	1,838.122	1,276,474
2.1%	27.453	1,557.828	1,006.781	699,153	7.1%	50.479	2,864.436	1,851.205	1,285,559
2.2%	28.099	1,594.488	1,030.473	715,606	7.2%	50.833	2,884.537	1,864.196	1,294,580
2.3%	28.731	1,630.324	1,053.633	731,689	7.3%	51.185	2,904.500	1,877.097	1,303,540
2.4%	29.349	1,665.388	1,076.294	747,426	7.4%	51.534	2,924.326	1,889.910	1,312,438
2.5%	29.954	1,699.730	1,098.488	762,839	7.5%	51.882	2,944.019	1,902.637	1,321,276
2.6%	30.547	1,733.391	1,120.242	777,946	7.6%	52.226	2,963.581	1,915.279	1,330,055
2.7%	31.129	1,766.411	1,141.582	792,765	7.7%	52.569	2,983.014	1,927.838	1,338,777
2.8%	31.700	1,798.825	1,162.530	807,313	7.8%	52.909	3,002.322	1,940.317	1,347,442
2.9%	32.261	1,830.665	1,183.108	821,603	7.9%	53.247	3,021.506	1,952.715	1,356,052
3.0%	32.813	1,861.961	1,203.333	835,648	8.0%	53.583	3,040.569	1,965.035	1,364,608
3.1%	33.355	1,892.739	1,223.224	849,461	8.1%	53.917	3,059.514	1,977.278	1,373,110
3.2%	33.889	1,923.025	1,242.797	863,054	8.2%	54.249	3,078.342	1,989.446	1,381,560
3.3%	34.414	1,952.841	1,262.067	876,435	8.3%	54.578	3,097.055	2,001.540	1,389,958
3.4%	34.932	1,982.209	1,281.046	889,615	8.4%	54.906	3,115.657	2,013.562	1,398,307
3.5%	35.442	2,011.148	1,299.748	902,603	8.5%	55.232	3,134.147	2,025.512	1,406,605
3.6%	35.945	2,039.676	1,318.185	915,407	8.6%	55.556	3,152.530	2,037.392	1,414,855
3.7%	36.440	2,067.811	1,336.368	928,033	8.7%	55.878	3,170.805	2,049.203	1,423,057
3.8%	36.930	2,095.568	1,354.307	940,491	8.8%	56.198	3,188.976	2,060.946	1,431,213
3.9%	37.412	2,122.962	1,372.011	952,785	8.9%	56.517	3,207.044	2,072.623	1,439,321
4.0%	37.889	2,150.007	1,389.490	964,923	9.0%	56.833	3,225.011	2,084.234	1,447,385
4.1%	38.360	2,176.716	1,406.751	976,910	9.1%	57.148	3,242.878	2,095.781	1,455,404
4.2%	38.825	2,203.102	1,423.803	988,752	9.2%	57.461	3,260.648	2,107.265	1,463,379
4.3%	39.284	2,229.175	1,440.653	1,000,454	9.3%	57.773	3,278.321	2,118.687	1,471,310
4.4%	39.738	2,254.947	1,457.309	1,012,020	9.4%	58.083	3,295.899	2,130.047	1,479,199
4.5%	40.187	2,280.427	1,473.776	1,023,456	9.5%	58.391	3,313.384	2,141.347	1,487,047
4.6%	40.631	2,305.626	1,490.062	1,034,765	9.6%	58.697	3,330.777	2,152.588	1,494,853
4.7%	41.071	2,330.552	1,506.171	1,045,952	9.7%	59.002	3,348.080	2,163.770	1,502,618
4.8%	41.505	2,355.215	1,522.110	1,057,020	9.8%	59.306	3,365.294	2,174.895	1,510,344
4.9%	41.935	2,379.622	1,537.883	1,067,974	9.9%	59.607	3,382.420	2,185.963	1,518,030
5.0%	42.361	2,403.781	1,553.497	1,078,817	10.0%	59.908	3,399.460	2,196.976	1,525,678

Velocity and Capacity for 108" RC Pipe									
N= 0.013		A= 63.617			HR= 2.250				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	6.223	395.919	255.871	177,688	5.1%	44.444	2,827.426	1,827.286	1,268,949
0.2%	8.801	559.914	361.857	251,289	5.2%	44.878	2,855.011	1,845.114	1,281,329
0.3%	10.779	685.752	443.182	307,765	5.3%	45.307	2,882.333	1,862.771	1,293,591
0.4%	12.447	791.838	511.743	355,377	5.4%	45.733	2,909.397	1,880.262	1,305,738
0.5%	13.916	885.301	572.146	397,323	5.5%	46.154	2,936.213	1,897.592	1,317,772
0.6%	15.244	969.799	626.754	435,246	5.6%	46.572	2,962.785	1,914.765	1,329,698
0.7%	16.466	1,047.503	676.972	470,119	5.7%	46.986	2,989.122	1,931.786	1,341,518
0.8%	17.603	1,119.828	723.713	502,579	5.8%	47.396	3,015.228	1,948.657	1,353,234
0.9%	18.670	1,187.757	767.614	533,065	5.9%	47.803	3,041.110	1,965.384	1,364,850
1.0%	19.680	1,252.005	809.136	561,900	6.0%	48.207	3,066.774	1,981.970	1,376,368
1.1%	20.641	1,313.114	848.629	589,326	6.1%	48.607	3,092.225	1,998.418	1,387,791
1.2%	21.559	1,371.503	886.364	615,531	6.2%	49.004	3,117.468	2,014.732	1,399,120
1.3%	22.439	1,427.506	922.557	640,665	6.3%	49.397	3,142.508	2,030.915	1,410,358
1.4%	23.286	1,481.393	957.383	664,849	6.4%	49.788	3,167.351	2,046.970	1,421,507
1.5%	24.103	1,533.387	990.985	688,184	6.5%	50.175	3,192.000	2,062.900	1,432,569
1.6%	24.894	1,583.675	1,023.485	710,753	6.6%	50.560	3,216.460	2,078.708	1,443,547
1.7%	25.660	1,632.415	1,054.984	732,628	6.7%	50.941	3,240.735	2,094.397	1,454,442
1.8%	26.404	1,679.741	1,085.570	753,868	6.8%	51.320	3,264.830	2,109.968	1,465,256
1.9%	27.127	1,725.770	1,115.317	774,526	6.9%	51.696	3,288.749	2,125.426	1,475,990
2.0%	27.832	1,770.603	1,144.291	794,647	7.0%	52.069	3,312.495	2,140.773	1,486,648
2.1%	28.519	1,814.328	1,172.549	814,270	7.1%	52.440	3,336.071	2,156.010	1,497,229
2.2%	29.191	1,857.024	1,200.143	833,432	7.2%	52.808	3,359.483	2,171.140	1,507,736
2.3%	29.847	1,898.760	1,227.115	852,163	7.3%	53.173	3,382.732	2,186.165	1,518,170
2.4%	30.489	1,939.598	1,253.508	870,492	7.4%	53.536	3,405.823	2,201.088	1,528,533
2.5%	31.117	1,979.594	1,279.356	888,442	7.5%	53.897	3,428.758	2,215.910	1,538,826
2.6%	31.733	2,018.798	1,304.693	906,036	7.6%	54.255	3,451.540	2,230.634	1,549,051
2.7%	32.338	2,057.255	1,329.546	923,296	7.7%	54.611	3,474.174	2,245.261	1,559,209
2.8%	32.931	2,095.006	1,353.943	940,238	7.8%	54.964	3,496.660	2,259.794	1,569,301
2.9%	33.514	2,132.088	1,377.909	956,881	7.9%	55.315	3,519.004	2,274.233	1,579,329
3.0%	34.087	2,168.537	1,401.465	973,239	8.0%	55.664	3,541.206	2,288.582	1,589,293
3.1%	34.651	2,204.383	1,424.631	989,327	8.1%	56.011	3,563.270	2,302.841	1,599,195
3.2%	35.205	2,239.655	1,447.426	1,005,157	8.2%	56.356	3,585.198	2,317.013	1,609,037
3.3%	35.751	2,274.381	1,469.868	1,020,742	8.3%	56.698	3,606.992	2,331.098	1,618,818
3.4%	36.289	2,308.584	1,491.973	1,036,092	8.4%	57.039	3,628.656	2,345.099	1,628,541
3.5%	36.818	2,342.287	1,513.755	1,051,219	8.5%	57.377	3,650.191	2,359.016	1,638,206
3.6%	37.341	2,375.513	1,535.228	1,066,130	8.6%	57.714	3,671.600	2,372.852	1,647,814
3.7%	37.856	2,408.280	1,556.404	1,080,836	8.7%	58.048	3,692.885	2,386.608	1,657,367
3.8%	38.364	2,440.608	1,577.296	1,095,345	8.8%	58.381	3,714.048	2,400.285	1,666,865
3.9%	38.865	2,472.512	1,597.915	1,109,664	8.9%	58.712	3,735.091	2,413.885	1,676,309
4.0%	39.361	2,504.011	1,618.272	1,123,800	9.0%	59.041	3,756.016	2,427.408	1,685,700
4.1%	39.850	2,535.117	1,638.375	1,137,761	9.1%	59.368	3,776.825	2,440.856	1,695,039
4.2%	40.333	2,565.847	1,658.235	1,151,552	9.2%	59.693	3,797.520	2,454.231	1,704,327
4.3%	40.810	2,596.213	1,677.860	1,165,181	9.3%	60.017	3,818.103	2,467.533	1,713,565
4.4%	41.282	2,626.228	1,697.258	1,178,651	9.4%	60.339	3,838.576	2,480.764	1,722,753
4.5%	41.748	2,655.904	1,716.437	1,191,970	9.5%	60.659	3,858.939	2,493.925	1,731,892
4.6%	42.209	2,685.252	1,735.403	1,205,141	9.6%	60.977	3,879.196	2,507.016	1,740,983
4.7%	42.666	2,714.283	1,754.165	1,218,170	9.7%	61.294	3,899.348	2,520.040	1,750,028
4.8%	43.117	2,743.006	1,772.728	1,231,061	9.8%	61.609	3,919.396	2,532.996	1,759,025
4.9%	43.564	2,771.432	1,791.099	1,243,819	9.9%	61.923	3,939.343	2,545.887	1,767,977
5.0%	44.006	2,799.569	1,809.283	1,256,447	10.0%	62.235	3,959.188	2,558.713	1,776,884

Velocity and Capacity for 114" RC Pipe									
N= 0.013		A= 70.882			HR= 2.375				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	6.452	457.322	295.555	205,246	5.1%	46.076	3,265.935	2,110.682	1,465,752
0.2%	9.124	646.751	417.977	290,262	5.2%	46.525	3,297.798	2,131.275	1,480,052
0.3%	11.175	792.106	511.916	355,497	5.3%	46.970	3,329.357	2,151.670	1,494,215
0.4%	12.904	914.645	591.109	410,493	5.4%	47.411	3,360.619	2,171.874	1,508,246
0.5%	14.427	1,022.604	660.880	458,945	5.5%	47.848	3,391.593	2,191.892	1,522,147
0.6%	15.804	1,120.206	723.958	502,749	5.6%	48.281	3,422.287	2,211.728	1,535,922
0.7%	17.070	1,209.961	781.964	543,031	5.7%	48.711	3,452.708	2,231.388	1,549,575
0.8%	18.249	1,293.503	835.955	580,524	5.8%	49.136	3,482.863	2,250.877	1,563,109
0.9%	19.356	1,371.967	886.664	615,739	5.9%	49.558	3,512.760	2,270.198	1,576,526
1.0%	20.403	1,446.180	934.626	649,046	6.0%	49.976	3,542.404	2,289.356	1,589,831
1.1%	21.398	1,516.767	980.244	680,725	6.1%	50.391	3,571.802	2,308.355	1,603,025
1.2%	22.350	1,584.211	1,023.831	710,994	6.2%	50.802	3,600.960	2,327.199	1,616,111
1.3%	23.263	1,648.899	1,065.637	740,026	6.3%	51.210	3,629.884	2,345.892	1,629,092
1.4%	24.141	1,711.144	1,105.864	767,961	6.4%	51.615	3,658.579	2,364.437	1,641,970
1.5%	24.988	1,771.202	1,144.678	794,915	6.5%	52.017	3,687.051	2,382.838	1,654,748
1.6%	25.807	1,829.289	1,182.218	820,985	6.6%	52.415	3,715.304	2,401.097	1,667,429
1.7%	26.602	1,885.588	1,218.603	846,252	6.7%	52.811	3,743.345	2,419.219	1,680,013
1.8%	27.373	1,940.254	1,253.932	870,786	6.8%	53.203	3,771.177	2,437.206	1,692,504
1.9%	28.123	1,993.422	1,288.293	894,648	6.9%	53.593	3,798.805	2,455.061	1,704,904
2.0%	28.854	2,045.208	1,321.760	917,889	7.0%	53.980	3,826.233	2,472.787	1,717,213
2.1%	29.566	2,095.714	1,354.401	940,557	7.1%	54.364	3,853.467	2,490.388	1,729,436
2.2%	30.262	2,145.032	1,386.274	962,690	7.2%	54.746	3,880.509	2,507.864	1,741,572
2.3%	30.942	2,193.241	1,417.430	984,327	7.3%	55.125	3,907.364	2,525.220	1,753,625
2.4%	31.608	2,240.413	1,447.916	1,005,497	7.4%	55.501	3,934.036	2,542.457	1,765,595
2.5%	32.259	2,286.612	1,477.773	1,026,231	7.5%	55.875	3,960.528	2,559.578	1,777,485
2.6%	32.898	2,331.896	1,507.039	1,046,555	7.6%	56.246	3,986.844	2,576.585	1,789,295
2.7%	33.525	2,376.317	1,535.747	1,066,491	7.7%	56.615	4,012.987	2,593.481	1,801,029
2.8%	34.140	2,419.922	1,563.928	1,086,061	7.8%	56.981	4,038.962	2,610.268	1,812,686
2.9%	34.744	2,462.756	1,591.610	1,105,285	7.9%	57.345	4,064.770	2,626.947	1,824,269
3.0%	35.338	2,504.858	1,618.819	1,124,180	8.0%	57.707	4,090.415	2,643.521	1,835,778
3.1%	35.922	2,546.263	1,645.579	1,142,763	8.1%	58.067	4,115.901	2,659.992	1,847,216
3.2%	36.497	2,587.006	1,671.909	1,161,048	8.2%	58.424	4,141.230	2,676.361	1,858,584
3.3%	37.063	2,627.117	1,697.832	1,179,050	8.3%	58.779	4,166.405	2,692.631	1,869,882
3.4%	37.621	2,666.625	1,723.365	1,196,781	8.4%	59.132	4,191.428	2,708.803	1,881,113
3.5%	38.170	2,705.555	1,748.525	1,214,253	8.5%	59.483	4,216.304	2,724.879	1,892,277
3.6%	38.711	2,743.934	1,773.328	1,231,478	8.6%	59.832	4,241.033	2,740.861	1,903,376
3.7%	39.245	2,781.783	1,797.789	1,248,464	8.7%	60.179	4,265.619	2,756.750	1,914,410
3.8%	39.772	2,819.124	1,821.921	1,265,223	8.8%	60.524	4,290.064	2,772.548	1,925,381
3.9%	40.292	2,855.977	1,845.738	1,281,763	8.9%	60.867	4,314.370	2,788.257	1,936,289
4.0%	40.805	2,892.360	1,869.252	1,298,091	9.0%	61.208	4,338.541	2,803.877	1,947,137
4.1%	41.312	2,928.292	1,892.473	1,314,217	9.1%	61.547	4,362.577	2,819.411	1,957,925
4.2%	41.813	2,963.788	1,915.413	1,330,148	9.2%	61.884	4,386.482	2,834.860	1,968,653
4.3%	42.308	2,998.863	1,938.081	1,345,890	9.3%	62.220	4,410.257	2,850.226	1,979,323
4.4%	42.797	3,033.533	1,960.488	1,361,450	9.4%	62.553	4,433.905	2,865.508	1,989,936
4.5%	43.280	3,067.812	1,982.641	1,376,834	9.5%	62.885	4,457.427	2,880.710	2,000,493
4.6%	43.759	3,101.711	2,004.549	1,392,048	9.6%	63.215	4,480.826	2,895.832	2,010,994
4.7%	44.232	3,135.244	2,026.220	1,407,098	9.7%	63.544	4,504.103	2,910.875	2,021,441
4.8%	44.700	3,168.422	2,047.662	1,421,988	9.8%	63.870	4,527.260	2,925.841	2,031,834
4.9%	45.163	3,201.256	2,068.882	1,436,724	9.9%	64.195	4,550.300	2,940.731	2,042,175
5.0%	45.622	3,233.757	2,089.887	1,451,310	10.0%	64.519	4,573.223	2,955.546	2,052,463

Velocity and Capacity for 120" RC Pipe									
N= 0.013		A= 78.540			HR= 2.500				
GRA %	VEL. FT/SEC	CAPACITY			GRA %	VEL. FT/SEC	CAPACITY		
		(CFS)	(MGD)	(GPM)			(CFS)	(MGD)	(GPM)
0.1%	6.676	524.356	338.877	235,331	5.1%	47.678	3,744.650	2,420.062	1,680,599
0.2%	9.442	741.551	479.244	332,808	5.2%	48.144	3,781.184	2,443.673	1,696,995
0.3%	11.564	908.211	586.951	407,605	5.3%	48.604	3,817.368	2,467.058	1,713,235
0.4%	13.353	1,048.712	677.753	470,662	5.4%	49.061	3,853.213	2,490.224	1,729,322
0.5%	14.929	1,172.495	757.751	526,216	5.5%	49.513	3,888.727	2,513.176	1,745,261
0.6%	16.354	1,284.404	830.075	576,441	5.6%	49.961	3,923.920	2,535.920	1,761,055
0.7%	17.664	1,387.315	896.583	622,627	5.7%	50.405	3,958.800	2,558.462	1,776,709
0.8%	18.883	1,483.102	958.488	665,616	5.8%	50.845	3,993.375	2,580.807	1,792,227
0.9%	20.029	1,573.068	1,016.630	705,993	5.9%	51.282	4,027.654	2,602.960	1,807,611
1.0%	21.112	1,658.159	1,071.622	744,182	6.0%	51.714	4,061.643	2,624.926	1,822,865
1.1%	22.143	1,739.092	1,123.926	780,504	6.1%	52.144	4,095.350	2,646.710	1,837,993
1.2%	23.127	1,816.422	1,173.903	815,210	6.2%	52.569	4,128.782	2,668.316	1,852,997
1.3%	24.072	1,890.592	1,221.837	848,498	6.3%	52.992	4,161.946	2,689.749	1,867,881
1.4%	24.980	1,961.960	1,267.960	880,528	6.4%	53.410	4,194.847	2,711.012	1,882,647
1.5%	25.857	2,030.822	1,312.463	911,433	6.5%	53.826	4,227.492	2,732.110	1,897,298
1.6%	26.705	2,097.423	1,355.506	941,324	6.6%	54.239	4,259.887	2,753.046	1,911,837
1.7%	27.527	2,161.975	1,397.224	970,294	6.7%	54.648	4,292.038	2,773.824	1,926,267
1.8%	28.325	2,224.654	1,437.731	998,425	6.8%	55.054	4,323.949	2,794.447	1,940,588
1.9%	29.101	2,285.614	1,477.128	1,025,784	6.9%	55.458	4,355.627	2,814.920	1,954,805
2.0%	29.857	2,344.991	1,515.502	1,052,432	7.0%	55.858	4,387.076	2,835.244	1,968,920
2.1%	30.595	2,402.900	1,552.927	1,078,422	7.1%	56.256	4,418.301	2,855.424	1,982,934
2.2%	31.315	2,459.447	1,589.472	1,103,800	7.2%	56.650	4,449.307	2,875.463	1,996,849
2.3%	32.018	2,514.722	1,625.195	1,128,607	7.3%	57.042	4,480.099	2,895.362	2,010,668
2.4%	32.707	2,568.809	1,660.149	1,152,881	7.4%	57.432	4,510.680	2,915.126	2,024,393
2.5%	33.382	2,621.779	1,694.383	1,176,655	7.5%	57.819	4,541.055	2,934.757	2,038,026
2.6%	34.043	2,673.701	1,727.938	1,199,957	7.6%	58.203	4,571.229	2,954.257	2,051,567
2.7%	34.691	2,724.633	1,760.854	1,222,815	7.7%	58.584	4,601.204	2,973.629	2,065,020
2.8%	35.328	2,774.630	1,793.166	1,245,254	7.8%	58.964	4,630.986	2,992.876	2,078,386
2.9%	35.953	2,823.743	1,824.906	1,267,296	7.9%	59.340	4,660.577	3,012.000	2,091,667
3.0%	36.568	2,872.015	1,856.103	1,288,961	8.0%	59.715	4,689.982	3,031.004	2,104,864
3.1%	37.172	2,919.490	1,886.785	1,310,267	8.1%	60.087	4,719.203	3,049.889	2,117,978
3.2%	37.767	2,966.205	1,916.975	1,331,233	8.2%	60.457	4,748.244	3,068.657	2,131,012
3.3%	38.352	3,012.195	1,946.697	1,351,873	8.3%	60.824	4,777.109	3,087.312	2,143,967
3.4%	38.929	3,057.494	1,975.973	1,372,203	8.4%	61.189	4,805.801	3,105.855	2,156,843
3.5%	39.498	3,102.131	2,004.821	1,392,236	8.5%	61.553	4,834.322	3,124.287	2,169,644
3.6%	40.058	3,146.135	2,033.259	1,411,985	8.6%	61.914	4,862.676	3,142.612	2,182,369
3.7%	40.610	3,189.532	2,061.305	1,431,462	8.7%	62.272	4,890.866	3,160.830	2,195,021
3.8%	41.156	3,232.347	2,088.975	1,450,677	8.8%	62.629	4,918.894	3,178.944	2,207,600
3.9%	41.694	3,274.601	2,116.283	1,469,641	8.9%	62.984	4,946.763	3,196.955	2,220,107
4.0%	42.225	3,316.318	2,143.243	1,488,363	9.0%	63.337	4,974.477	3,214.865	2,232,545
4.1%	42.749	3,357.516	2,169.868	1,506,853	9.1%	63.688	5,002.036	3,232.676	2,244,914
4.2%	43.267	3,398.214	2,196.171	1,525,119	9.2%	64.037	5,029.445	3,250.389	2,257,215
4.3%	43.779	3,438.431	2,222.162	1,543,168	9.3%	64.384	5,056.705	3,268.007	2,269,449
4.4%	44.286	3,478.183	2,247.853	1,561,009	9.4%	64.729	5,083.819	3,285.530	2,281,618
4.5%	44.786	3,517.486	2,273.253	1,578,648	9.5%	65.073	5,110.789	3,302.960	2,293,722
4.6%	45.281	3,556.355	2,298.372	1,596,092	9.6%	65.414	5,137.617	3,320.298	2,305,763
4.7%	45.770	3,594.803	2,323.220	1,613,347	9.7%	65.754	5,164.306	3,337.547	2,317,741
4.8%	46.255	3,632.844	2,347.805	1,630,420	9.8%	66.092	5,190.858	3,354.706	2,329,657
4.9%	46.734	3,670.491	2,372.136	1,647,316	9.9%	66.428	5,217.275	3,371.779	2,341,513
5.0%	47.209	3,707.756	2,396.219	1,664,041	10.0%	66.763	5,243.559	3,388.765	2,353,309



Guidelines for Preparing Addendums

PHILADELPHIA WATER DEPARTMENT - DESIGN BRANCH

PROCEDURES FOR PREPARING ADDENDA TO CONTRACTS

A. DEFINITIONS

1. Addendum: A written instrument which changes the Bidding Documents and which is issued prior to opening of bids.
2. Bidding Documents: The book of written requirements containing the Instructions to Bidders, Bid Forms, Special Specifications, Standard Contract Requirements, and any miscellaneous documents bound therewith (e.g., sketches on letter size paper, Soil Erosion and Sedimentation Control Narrative), plus the Contract and Reference Drawings.
3. Changes: Revisions, additions, deletions, clarifications of ambiguities, and resolutions of conflicts and errors.

B. COORDINATION

1. Notify Projects Control as soon as the need for an addendum becomes apparent. They need advance warning to begin their procedures.
2. Provide Specifications personnel with the necessary addendum changes on paper or on compact disc (e.g. bid form quantities or items, technical or boiler plate specifications, etc.) so they can update their records and prepare the necessary addendum pages.

C. MAKING THE CHANGES

1. The two basic methods of making changes to the Bidding Documents are the narrative method and the revised page method.
 - 1a. Narrative Method: The narrative method involves a series of instructions to the bidder, telling him how to alter the original Bidding Documents.
 - 1b. Revised Page Method: The revised page method involves issuing revised pages (or entire sections, or drawings) to be inserted by the bidder into the Bidding Documents in place of the original pages (or sections, or drawings).
2. Narrative Method:
 - 2a. The narrative method is satisfactory for making a few, small changes; extensive or numerous changes should be made by the revised page method. Where it would take longer to explain the changes than to make them, use the revised page method. The governing principle is "emphasize the changes".
 - 2b. When using the narrative method, include enough of the original specification text to make each change reasonably self-explanatory. Remember, however, that the addendum must contain instructions, not explanations. The altered documents should read as original documents.

3. Revised Page Method:
 - 3a. When using the revised page method, make sure that each revised page is clearly marked as an addendum page.
 - 3b. Make sure that each revised drawing or sketch is marked "Revised", and dated. Do not erase anything from the original drawing; use hatching to indicate deletion.
 - 3c. When changing part of a section by the revised page method:
 - a. If the number of pages is reduced, insert dummy pages with the note "This Page Intentionally Blank".
 - b. If the number of pages is increased, insert additional pages with suffixed page numbers (e.g.,..., 02660-4, 02660-4 A, 02660-5, ...).
 - c. If this approach would become confusing, replace the entire section.
4. When modifying Bid Form, do not make partial changes (e.g., one or two quantities). Issue a revised Bid Form page or the entire Bid Form, to minimize confusion and discourage the submission of informal bids.
5. Be sure that the changes do not make some other part of the work impossible to accomplish.
6. When resolving a conflict, delete the inappropriate material; do not say that one requirement is preferred over another requirement, or should govern over another requirement.
7. Write addendum instructions in the present tense.

D. ASSEMBLING AND SUBMITTING THE ADDENDUM

1. The Construction Specifications Institute (CSI) recommends the following sequence of information within the addendum:
 - 1a. Introduction.
 - 1b. Changes to Prior Addenda.
 - 1c. Changes to Bidding Requirements:
 - a. Instruction to Bidders.
 - b. Bid Forms.
 - 1d. Changes to Special Specifications:
 - a. Changes to Supplementary Conditions.
 - b. Changes to list of Drawings and Schedules
 - c. Changes to General Requirements Sections -- in sequence.
 - d. Changes to Technical Specifications -- in sequence.
 - 1e. Changes to Appendices (e.g. sketches on 8-1/2" x 11" paper bound with the specifications).
 - 1f. Changes to Contract Drawings -- in sequence.
 - 1g. Changes to Reference Drawings.
 - 1h. Addendum Acknowledgment.
 - 1i. Attachments -- same order as changes.
2. At the end of the Introduction, indicate the number of pages in addendum and list all attachments (i.e., by page numbers, section numbers and titles, titles of sketches on 8-1/2" x 11" paper, drawing numbers and titles).
3. Use a simple numbering system for items within the addendum to permit future cross referencing.
4. Proofread the addendum carefully for typographical errors.

5. Make copies for Contract file folder and for specifications files. Hand deliver original to Projects Control for processing. No transmittal letter is necessary. Processing through Design Branch front office is not necessary.

ADDENDUM ACKNOWLEDGMENT

ADDENDUM NO. 1

Dated:

Bid No.: XXXX

Opening Date: Month/Day/Year

SAMPLE ADDENDUM

NOTICE

It is the sole responsibility of the bidder to ensure that it has received any and all addenda and the Procurement Commissioner may in his/her sole discretion reject any bid for which all addenda have not been executed and returned.

PROPOSAL FOR

Project No. XXXXXXXXXXXXXXXX

Description XXXXXXXXXXXXXXXX

IS AMENDED AS FOLLOWS:

XX

Please sign, date and return this addendum with your bid as it now becomes a part of the proposal

Firm Name (typed or printed): _____

Authorized Signature: _____ **Title:** _____

Name (typed or printed): _____ **Date:** _____

Appendix

X

Contact Information for City Departments and City and Private Utilities

June 9, 2010

Company	Contact	Address/Email	Telephone/Fax/Cell
Abovenet Communications	Jack Howells	170 Robbins Road Dowjingtown, PA 19335 jhowells@above.net	T: (484) 696-3904 F: (484) 696-3910 C: (610) 476-1634
GPIS Email: GPIS.Abovenet@above.net			
	Chris Ricciuti	170 Robbins Road Downingtown, PA 19335 cricciuti@above.net	T: (484) 696-3903 F: (484) 696-3910 C: (215) 651-4904
Cavalier Telephone	Ed Furlong	18 Shea Way, Suite 114 Newark, DE 19713 efurlong@cavtel.com	T: (302) 224-7083 F: (302) 224-7155 C: (302) 218-3696
GPIS Email:			
Center City District	Hal Welch	660 Chestnut Street Philadelphia, PA 19107 hwelch@centercityphila.org	T: (215) 440-5528 F: (215) 922-7672
GPIS Email:			
	Nancy Goldenberg	660 Chestnut Street Philadelphia, PA 19107 ngoldenberg@centercityphila.org	T: (215) 440-5548
Comcast	Jack Clayton	4400 Wayne Avenue Philadelphia, PA 19140 jack_clayton@cable.comcast.com	T: (267) 339-7912 F: (267) 339-7971 C: (215) 920-2233
GPIS Email: philadelphia_construction@cable.comcast.com			
	Pat Lavin	4400 Wayne Avenue Philadelphia, PA 19140 patrick_lavin@cable.comcast.com	T: (267) 339-7942 F: (215) 329-6757
acquired Time Warner Cable			
Drexel University	Jack Murtaugh	Trades & Facilities Management 3300 Market Street - 16th Floor Philadelphia, PA 19104 murtauji@drexel.edu	T: (215) 895-6901 C: (215) 768-1521
GPIS Email:			
Fibertech Networks	Allan Lane	rocky31944@aol.com	C: (215) 802-8674
GPIS Email: chs@fibertech.com			
Level 3 Communications	Timothy Eskridge	1 Belmont Ave, 711 Bala Cynwyd, PA 19004 tim.eskridge@level3.com	T: (610) 785-1469 F: (267) 246-0405 C: (610) 785-1776
GPIS Email: DL-GPIS@level3.com			
acquired WiTel			

June 9, 2010

Company	Contact	Address/Email	Telephone/Fax/Cell
MCI Worldcom aka Verizon Business GPIS Email: -----	Tom Roberts	tom.h.roberts@verizonbusiness.com	T: (917) 295-3050
	Donald Lugg	donald.lugg@verizonbusiness.com	T: (610) 656-1252
PECO Energy GPIS Email: PECOGPIS@exeloncorp.com -----	Bette McGourn	830 S. Schyulkill Avenue Philadelphia, PA 19146 elizabeth.mcgourn@exeloncorp.com	T: (215) 731-3093 T: (215) 965-8829 F: (215) 731-3195
	Michael Keller	830 S. Schyulkill Avenue Philadelphia, PA 19146 michael.keller@exeloncorp.com	T: (215) 731-3095 F: (215) 731-3231
	Doug Dale	830 S. Schyulkill Avenue Philadelphia, PA 19146 douglas.dale@exeloncorp.com	T: (215) 731-3254
PennDot GPIS Email: -----	William Rosetti	1901 Ruffner Street Philadelphia, PA 19140 wrosetti@state.pa.us	T: (215) 225-1415 C: (610) 960-1289
	Alex Morrone	7000 Geerdes Blvd King of Prussia, PA 19406 amorrone@state.pa.us	T: (610) 205-6790
	Rich Avicolti	7000 Geerdes Blvd King of Prussia, PA 19406 ravicolti@state.pa.us	T: (610) 205-6795 F: (610) 205-6599
Philadelphia Gas Works GPIS Email: permits@pgworks.com -----	John Lennon	800 W. Montgomery Avenue Philadelphia, PA 19122 john.lennon@pgworks.com	T: (215) 684-6369 F: (215) 684-6853
	Abe Awad	800 W. Montgomery Avenue Philadelphia, PA 19122 burhan.awad@pgworks.com	T: (215) 684-6812 F: (215) 684-6853

June 9, 2010

Company	Contact	Address/Email	Telephone/Fax/Cell
Philadelphia Water Department	Nikunj Karumsi	1101 Market St, Aramark Tower, 2nd Floor Philadelphia, PA 19107 nikunj.karumsi@phila.gov	T: (215) 685-6309 F: (215) 685-6318
GPIS Email: GPIS.Apps@Phila.gov			
	Rich Williams	1101 Market St, Aramark Tower, 2nd Floor Philadelphia, PA 19107 richard.williams@phila.com	T: (215) 685-6270 F: (215) 685-6318
Construction Unit	Lennart Rustam	1101 Market St, Aramark Tower, 2nd Floor Philadelphia, PA 19107 lennart.rustham@phila.gov	T: (215) 685-6352
Construction Unit	William Connors	1101 Market St, Aramark Tower, 2nd Floor Philadelphia, PA 19107 william.connors@phila.gov	T: (215) 685-6372
Qwest Communications Company	George McElvain	1801 California Street, 26th Floor Denver, Colorado 80202 george.mcelvain@qwest.com	T: (303) 299-0170 F: (303) 299-9273 C: (720) 260-2514
GPIS Email: _____			
RCN Telecom SVCS	Kevin Cochran	110 S. 69th St Upper Darby kevin.cochran@rcn.net	T: (484) 461-6020
GPIS Email: RCNPhillypermit@rcn.net			
	Michael Kane	110 S. 69th St Upper Darby michael.kane@rcn.net	T: (484) 461-6047
SEPTA	Amanda Dilks	1234 Market Street, 13th Floor Philadelphia, PA 19107 adilks@septa.org	T: (215) 580-8315 F: (215) 580-8282
GPIS Email: SPISAppa@septa.org			
Sunesys	Scott Schlitte	202 Titus Avenue Warrington, PA 18976 sschlitte@sunesys.com	T: (267) 927-2035 F: (267) 927-2090
GPIS Email: row@sunesys.com			
	Jason When	202 Titus Avenue Warrington, PA 18976 jwehn@sunesys.com	T: (267) 927-2040

June 9, 2010

Company	Contact	Address/Email	Telephone/Fax/Cell
Teleport Communications Group (AT&T Local Services)	Kurt Scholz	175 W. Main Street Room 1 Freehold, NJ 07728 ks1484@att.com	T: (732) 394-4454
GPIS Email: -----			
	John Warfield	215 N. Orange St Wilmington, DE 19805 jwarfield@att.com	T: (302) 656-0368 M: (205) 299-0061
Trigen Philadelphia Energy	Howard Sellers	2600 Christian Street Philadelphia, PA 19146 hsellers@trigen.com	T: (215) 875-6900 ext. 5848 F: (215) 875-6910
GPIS Email: -----			
University on Pennsylvania	Richard Russell	3101 Walnut Street Philadelphia, PA 19104 russell1@upenn.edu	T: (215) 898-5835 F: (215) 898-2040
GPIS Email: GPIS@ EXCHANGE.UPENN.EDU -----			
Verizon Communications	Brian M. Magee	900 Race Street, 6th Floor Philadelphia, PA 19107 brian.n.magee@verizon.com	T: (215) 351-6051
GPIS Email: Verizon.phila.osp@verizon.com -----			
	Jim Conti	jampes.p.conti@verizon.com	T: (215) 351-8947
	Suzette Walker	suzette.e.walker@verizon.com	T: (215) 351-6042
XO Communications	Mike Harrison	1220 Broadcasting Road Wyomissing, PA 19610 mike.harrison@xo.com	T: (610) 288-5644 F: (610) 288-6721 C: (610) 842-0043
GPIS Email: -----			
	Scott Dreiling	1220 Broadcasting Road Wyomissing, PA 19610 scott.j.dreiling@xo.com	T: (610) 288-5329 F: (610) 288-0577 C: (610) 842-4323

June 9, 2010

City Departments/Agencies/Authorities

Company	Contact	Address/Email	Telephone/Fax/Cell
City Planing Commission	William T. Erickson	1515 Arch Street, One Parkway, 13th Floor Philadelphia, PA 19102 bill.erickson@phila.gov	T: (215) 683-4646 F: (215) 683-4630
GPIS Email: GPIS.Apps@phila.gov -----			
PIDC	Edward W. Duffy	2600 Center Square West, 1500 Market St Philadelphia, PA 19102-2126 edd@pdia-pa.org	T: (215) 496-8172
GPIS Email: -----			
Philadelphia Department of Commerce	Vincent J. Dougherty	One Parkway, 1515 Arch Street, 12th Floor Philadelphia, PA 19102 vincent.dougherty@phila.gov	T: (215) 683-2021 F: (215) 557-8538
GPIS Email: -----			
Philadelphia Housing Authority	Clarence Mosely	12 S. 23rd Street 5th Fl Philadelphia, PA 19103 clarence.mosely@pha.phila.gov	T: (215) 684-5760
GPIS Email: -----			
Police (Traffic Division)	Captian Helker	police.co_traffic@phila.gov	T: (215) 685-1554
	Lieutenant Anderson	police.co_traffic@phila.gov	T: (215) 685-1554
Public Property		1000 Municipal Services Building 1401 John F. Kennedy Boulevard	T: (215) 686-4443 F: (215) 686-4428
GPIS Email: GPIS.Apps@phila.gov -----			
Cable Franchise Manager	Mark McLaughlin	Room 632 City Hall Philadelphia, PA 19107 mark.mclaughlin@phila.gov	T: (215) 686-9950 F: (215) 686-4958
Cable Franchise Manager	James Napier	Room 632 City Hall Philadelphia, PA 19107 james.napier@phila.gov	T: (215) 686-9946 F: (215) 686-4958
Capital Program Office	Monique Vincent	1515 Arch Street, 11th Floor Philadelphia, PA 19107 monique.vincent@phila.gov	T: (215) 683-4440 F: (215) 683-4498
GPIS Email: GPIS.Apps@phila.gov -----			

June 9, 2010

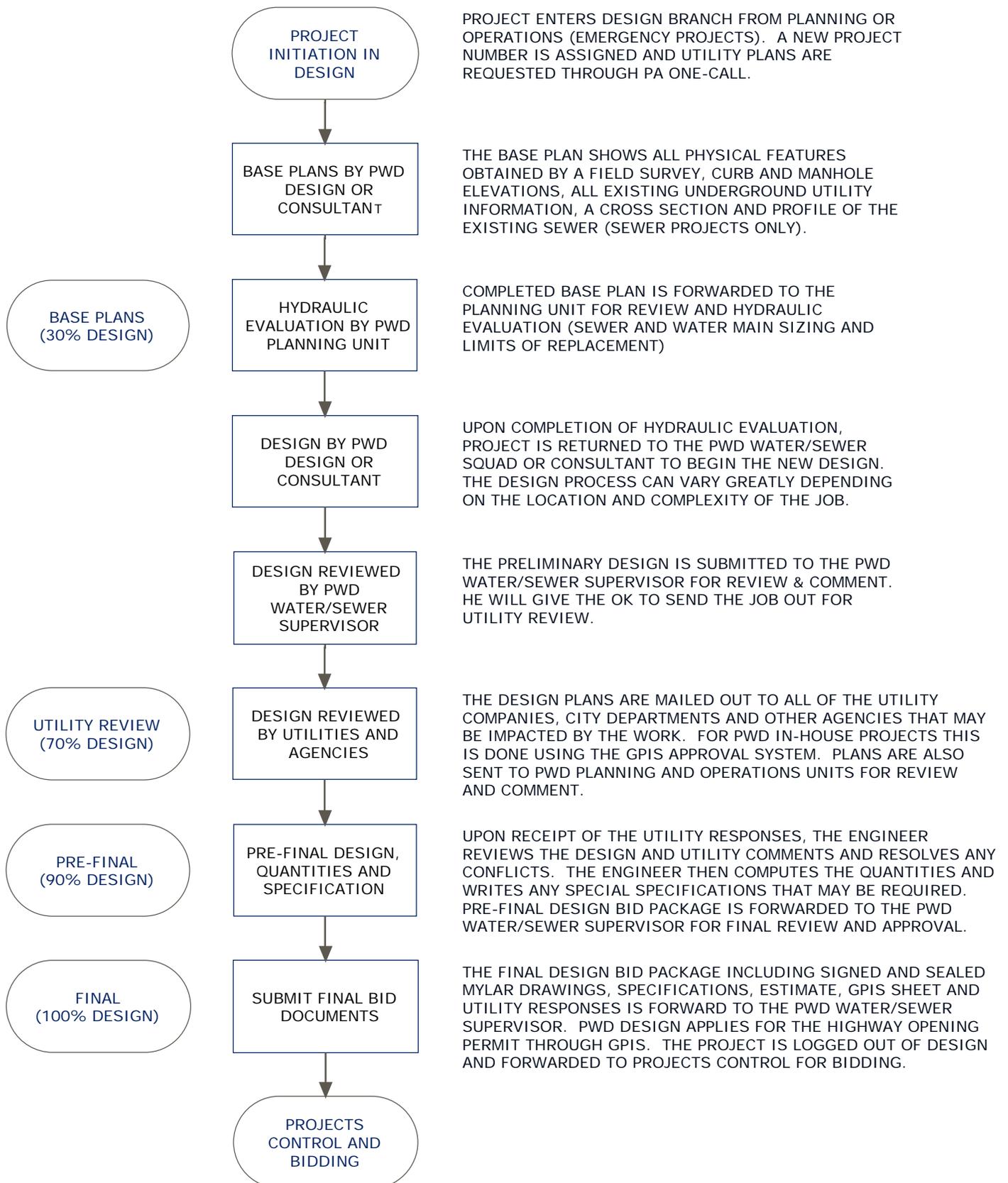
City Departments/Agencies/Authorities

Company	Contact	Address/Email	Telephone/Fax/Cell
Redevelopment Authority	Wayne King	1234 Market Street, 16th Floor Philadelphia, PA 19170 wayne.king@rda.phila.gov	T: (215) 209-8660 F: (215) 854-6532
GPIS Email: <hr/>			
Bridge Section	Chris Menna	1401 John F. Kennedy Boulevard Philadelphia, PA 19102 christopher.menna@phila.gov	T: (215) 686-5573 F: (215) 686-5059
GPIS Email: GPIS.Apps@phila.gov <hr/>			
Right-Of-Way Unit	Joe Kisiel	1401 John F. Kennedy Boulevard, Room 940 Philadelphia, PA 19102 joseph.kisiel@phila.gov	T: (215) 686-5097 F: (215) 686-5062
GPIS Email: GPIS.Apps@phila.gov <hr/>			
	Patrick O'Donnell	980 Municipal Services Building 1401 John F. Kennedy Boulevard patrick.o'donnell@phila.gov	T: (215) 686-5524 F: (215) 686-5062
Street Lighting	Luke Hogan	840 Municipal Services Building 1401 John F. Kennedy Boulevard luke.hogan@phila.gov	T: (215) 686-5518 F: (215) 686-5613 C: (215) 906-1598
GPIS Email: GPIS.Apps@phila.gov <hr/>			
Transport. Eng. & Planning Section (TEPS)	Darrin Gatti	830 Municipal Services Building 1401 John F. Kennedy Boulevard darrin.gatti@phila.gov	T: (215) 686-5537
GPIS Email: GPIS.Apps@phila.gov <hr/>			
	Vadim Fleysh	830 Municipal Services Building 1401 John F. Kennedy Boulevard	T: (215) 686-5514
Transportation, Planning, and Analysis	Nancy Sen	1401 John F. Kennedy Boulevard, Room 940 Philadelphia, PA 19102 nancy.sen@phila.gov	T: (215) 686-5507 F: (215) 686-5064
GPIS Email: GPIS.Apps@phila.gov <hr/>			
	Michelle Brisbon	1401 John F. Kennedy Boulevard, Room 940 Philadelphia, PA 19102 michelle.brisbon@phila.gov	T: (215) 686-5621 F: (215) 686-5064
Traffic Engineering	Patrick O'Donnell	980 Municipal Services Building 1401 John F. Kennedy Boulevard patrick.o'donnell@phila.gov	T: (215) 686-5524 F: (215) 686-5067
GPIS Email: GPIS.Apps@phila.gov <hr/>			

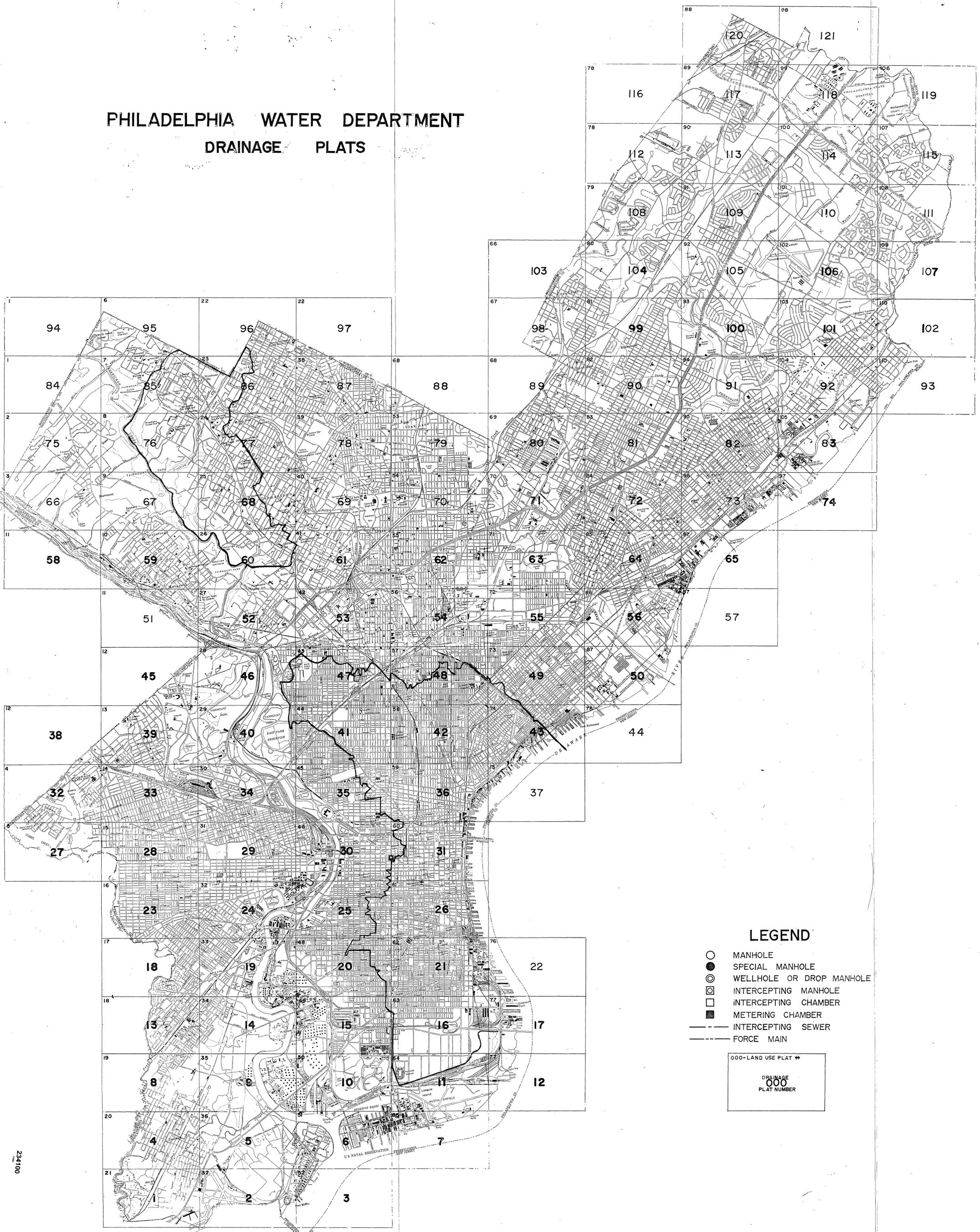
Enclosures

Final Design Package Checklist
Water and Sewer Project Flow Chart
Drainage Plat Map
Water Plate Map
1907 Sewer Standard Details for Sewers
Sample Water Drawing
Sample Combined Sewer Drawing
Sample Separate Sewer Drawing
Sample Box Sewer Drawing
Sample Box Sewer Details
Sample Sewer Lining Drawing

WATER & SEWER CONTRACT PROGRESSION FLOW CHART



PHILADELPHIA WATER DEPARTMENT DRAINAGE PLATS



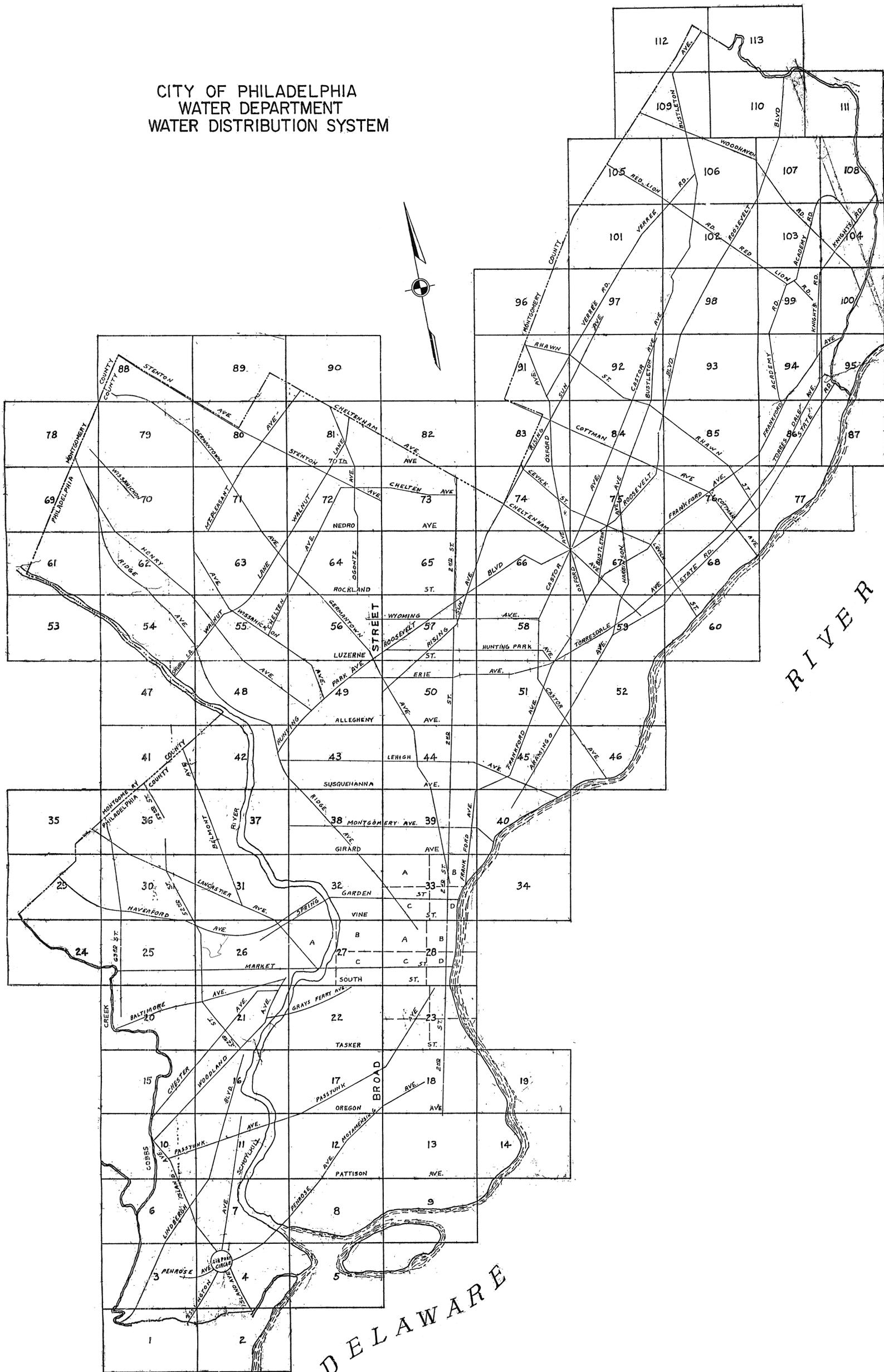
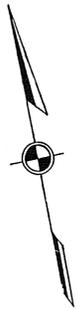
LEGEND

- MANHOLE
- SPECIAL MANHOLE
- ⊙ WELLHOLE OR DROP MANHOLE
- ⊠ INTERCEPTING MANHOLE
- INTERCEPTING CHAMBER
- METERING CHAMBER
- INTERCEPTING SEWER
- FORCE MAIN

000-LAND USE PLAT **

DRAINAGE
000
PLAT NUMBER

CITY OF PHILADELPHIA
WATER DEPARTMENT
WATER DISTRIBUTION SYSTEM



RIVER

DELAWARE

STANDARD DETAILS

for

SEWERS

**DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA**

1907

**GEORGE S WEBSTER,
CHIEF ENGINEER**

GENERAL SECTIONS OF CIRCULAR SEWERS

Scale

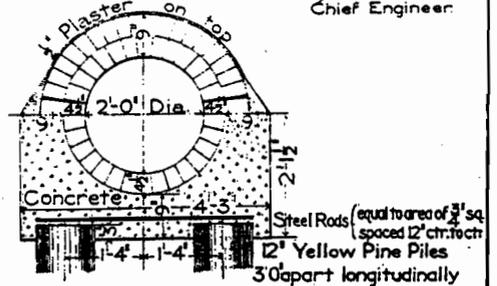

DEPARTMENT OF PUBLIC WORKS
 BUREAU OF SURVEYS
 PHILADELPHIA
 1906

L. C. Webster
 Chief Engineer

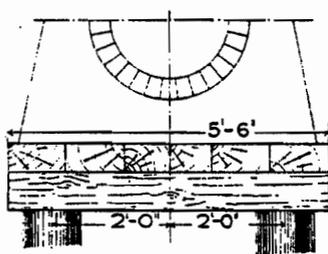


MINIMUM SECTION

All Slants for inlet connections to be
 15" dia. for N^o1 and N^o2 Inlets.
 12" dia. for N^o3 Inlets, and
 8" dia. for N^o4 Inlets.



SECTION IN REDUCED CRADLE

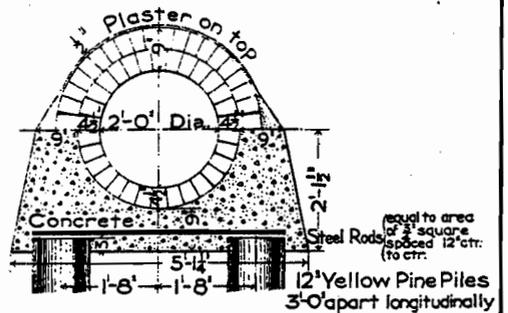


SECTION SHOWING PLATFORM and PILES



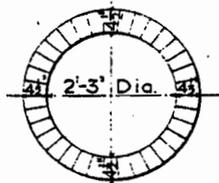
VITRIFIED SHALE BRICK INVERT

6" Yellow Pine Planking laid close
 8" x 8" Yellow Pine Stringers
 3'-0" apart longitudinally
 12" Yellow Pine Piles
 3'-0" apart longitudinally.



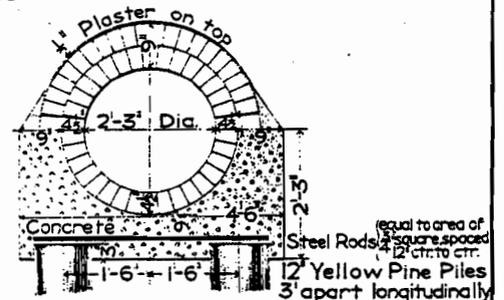
SECTION IN MAXIMUM CRADLE

Steel Rods (equal to area of $\frac{3}{4}$ " square) and
 Piles, or Piles and Platform, if required,
 will be paid for at the price in the
 contract when ordered by the
 Chief Engineer.

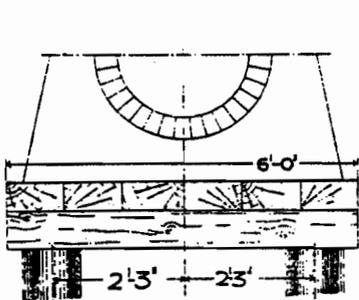


MINIMUM SECTION

Filling over top of Sewer to be
 at least 3 feet deep and with
 a slope not less than $\frac{1}{2}$ ft. horizontal
 over 1 ft. vertical extending to the
 surface of the ground



SECTION IN REDUCED CRADLE

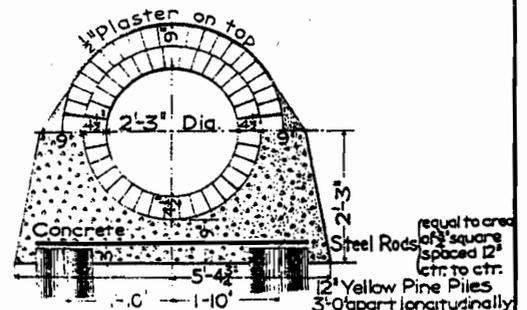


SECTION SHOWING PLATFORM and PILES



VITRIFIED SHALE BRICK INVERT

6" Yellow Pine Planking laid close
 8" x 8" Yellow Pine Stringers
 3'-0" apart longitudinally
 12" Yellow Pine Piles
 3'-0" apart longitudinally



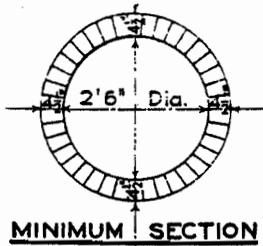
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GENERAL SECTIONS OF CIRCULAR SEWERS

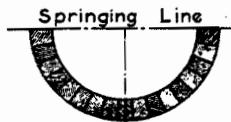
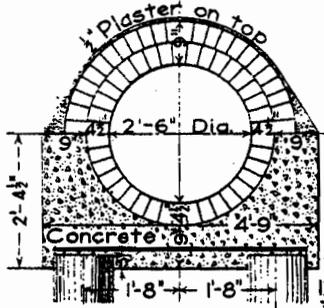
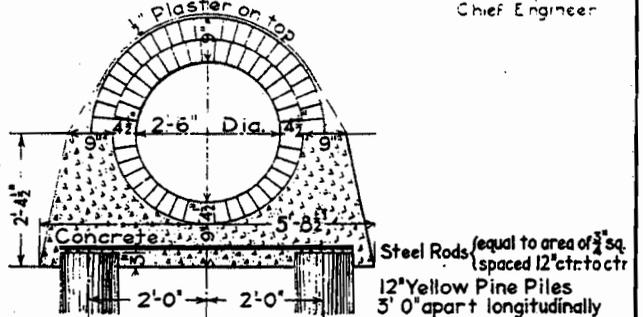
DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA
1906

E. J. Hester
Chief Engineer

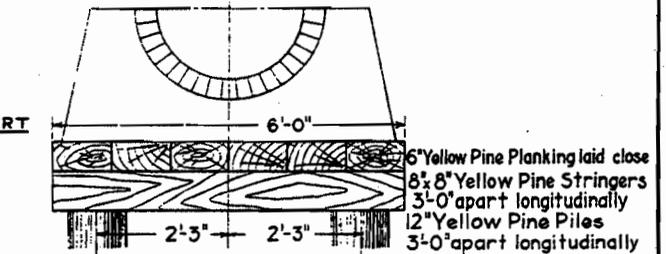
Scale



All Slants for Inlet connections to be 15" dia, for N^o1 and N^o2 Inlets, 12" dia for N^o3 Inlets, and 8" dia, for N^o4 Inlets.

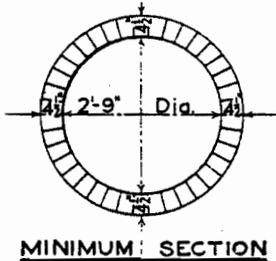


VITRIFIED SHALE BRICK INVERT

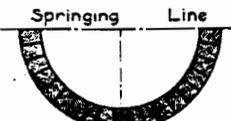
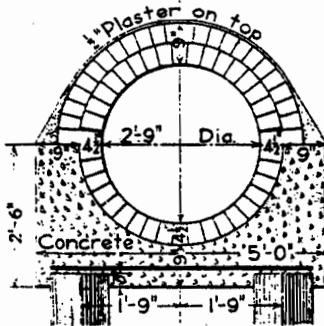
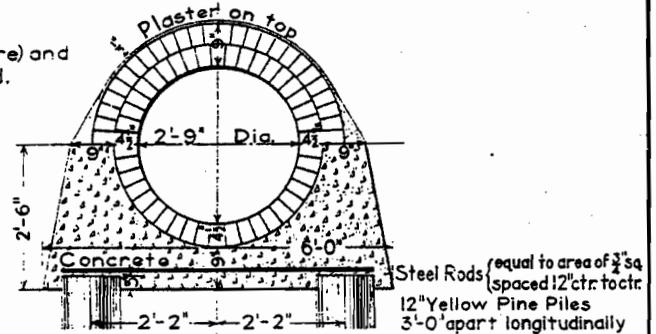


SECTION IN REDUCED CRADLE

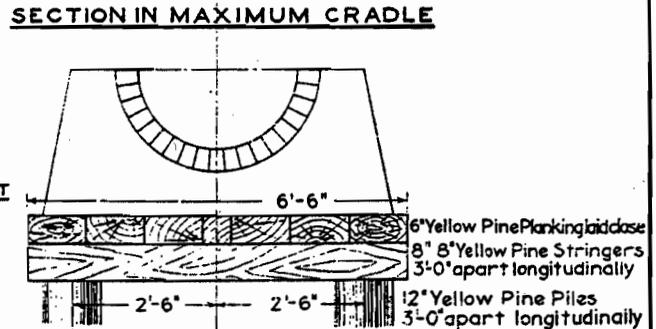
Steel Rods (equal to area of $\frac{3}{4}$ " square) and Piles, or Piles and Platform, if required, will be paid for at the price in the contract when ordered by the Chief Engineer.



Filling over top of Sewer to be at least 3 feet deep and with a slope not less than $1\frac{1}{2}$ ft. horizontal over 1 ft. vertical extending to the surface of the ground.



VITRIFIED SHALE BRICK INVERT



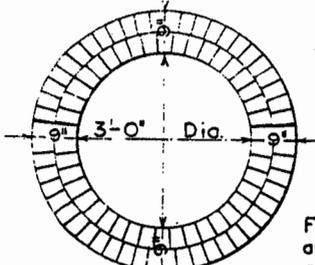
SECTION IN REDUCED CRADLE

GENERAL SECTIONS OF CIRCULAR SEWERS

Scale

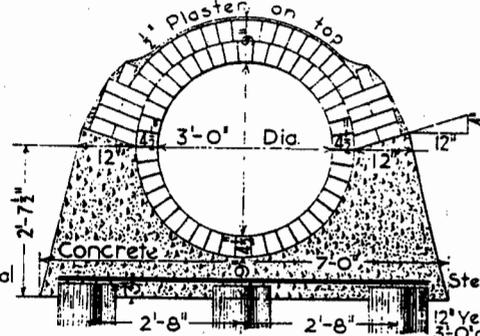
DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA
1906

E. C. Minter
Chief Engineer



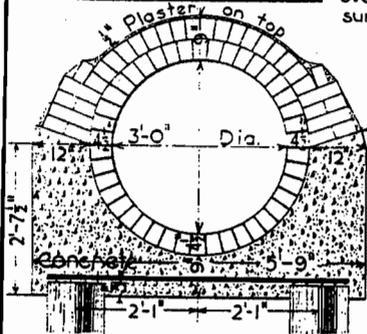
MINIMUM SECTION

Filling over top of Sewer to be at least 3 feet deep and with a slope not less than 12 ft. horizontal over 1 ft. vertical extending to the surface of the ground.

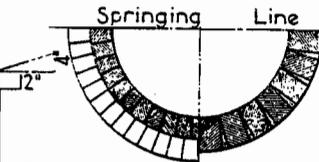


SECTION IN MAXIMUM CRADLE

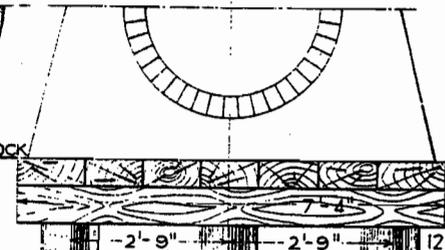
Steel Rods (equal to area of $\frac{3}{4}$ sq. spaced 12" ctr. to ctr.)
12" Yellow Pine Piles
3'-0" apart longitudinally.



SECTION IN REDUCED CRADLE



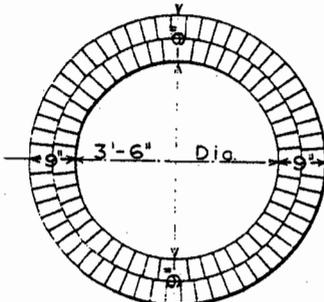
VITRIFIED SHALE BRICK INVERT
STONE BLOCK INVERT
Steel Rods (equal to area of $\frac{3}{4}$ sq. spaced 12" ctr. to ctr.)
12" Yellow Pine Piles
3'-0" apart longitudinally.



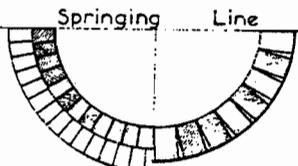
SECTION SHOWING PLATFORM and PILES

close
6" Yellow Pine Planking laid
8" x 8" Yellow Pine Stringers
3'-0" apart longitudinally
12" Yellow Pine Piles
3'-0" apart longitudinally.

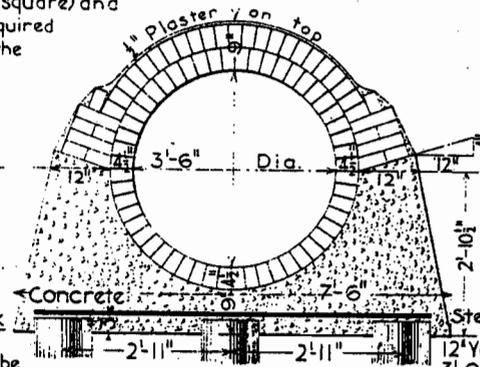
Steel Rods (equal to area of $\frac{3}{4}$ square) and Piles, or Piles and Platform, if required will be paid for at the price in the contract when ordered by the Chief Engineer.



MINIMUM SECTION

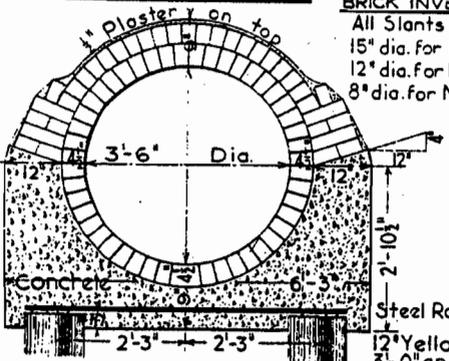


VITRIFIED SHALE BRICK INVERT
STONE BLOCK INVERT
All Slants for Inlet connections to be 15" dia. for No 1 and No 2 Inlets, 12" dia. for No 3 Inlets, and 8" dia. for No 4 Inlets.



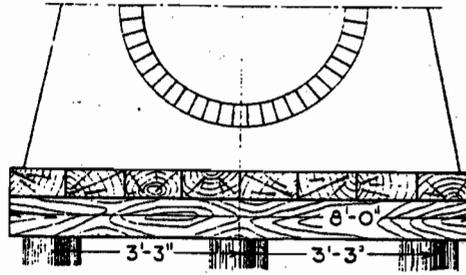
SECTION IN MAXIMUM CRADLE

Steel Rods (equal to area of $\frac{3}{4}$ sq. spaced 12" ctr. to ctr.)
12" Yellow Pine Piles
3'-0" apart longitudinally.



SECTION IN REDUCED CRADLE

Steel Rods (equal to area of $\frac{3}{4}$ sq. spaced 12" ctr. to ctr.)
12" Yellow Pine Piles
3'-0" apart longitudinally.



SECTION SHOWING PLATFORM and PILES

close
6" Yellow Pine Planking laid
8" x 8" Yellow Pine Stringers
3'-0" apart longitudinally
12" Yellow Pine Piles
3'-0" apart longitudinally.

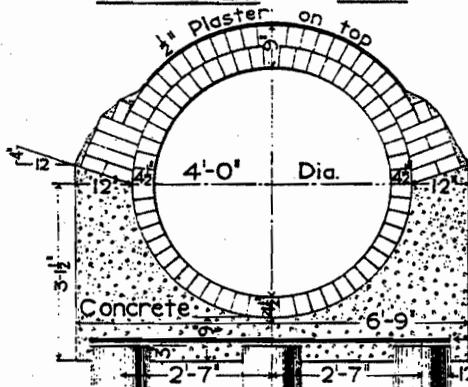
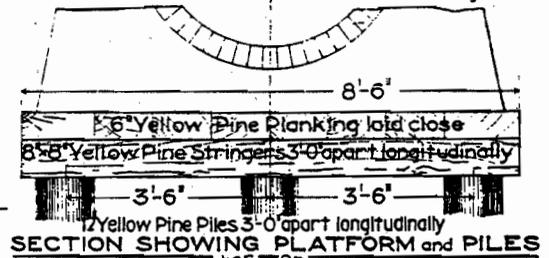
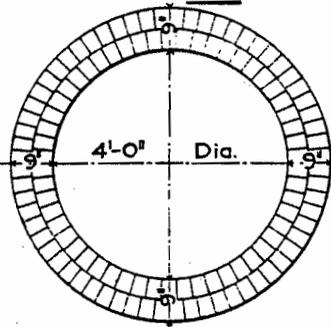
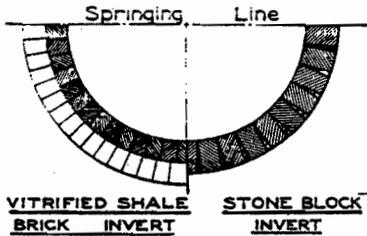
GENERAL SECTIONS OF CIRCULAR SEWERS

DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS

PHILADELPHIA
1906

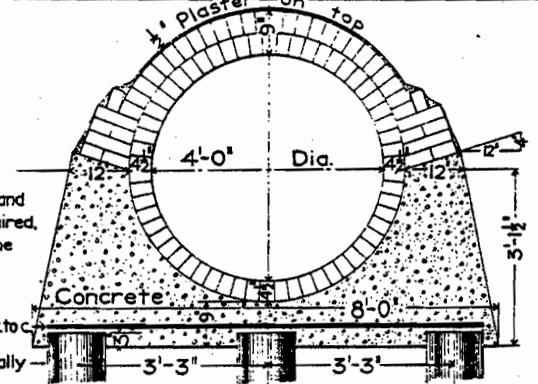
W. H. Miller
Chief Engineer

Scale
0' 6" 1' 2' 3'



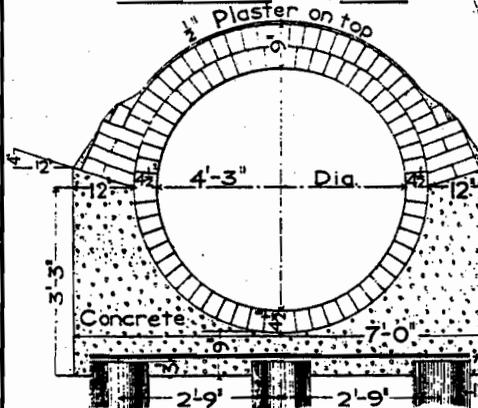
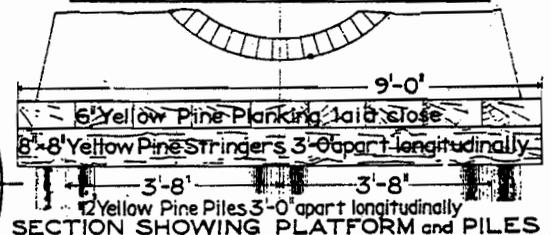
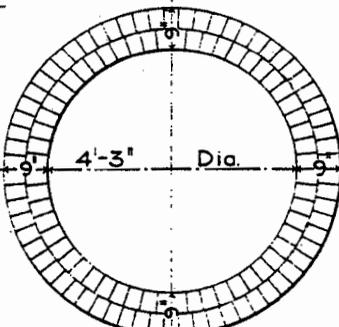
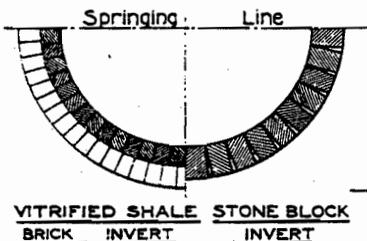
MINIMUM SECTION

Steel Rods (equal to area of 2 1/2" square) and Piles, or Piles and Platform, if required, will be paid for at the price in the contract when ordered by the Chief Engineer.



SECTION IN REDUCED CRADLE

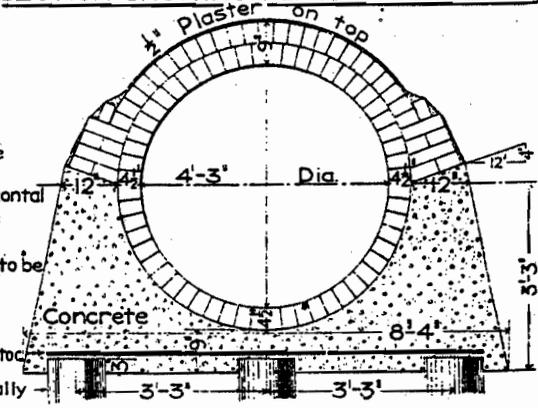
SECTION IN MAXIMUM CRADLE



MINIMUM SECTION

Filling over top of Sewer to be at least 3 feet deep and with a slope not less than 1/2 ft. horizontal over 1 ft. vertical extending to the surface of the ground.

All Slants for Inlet connections to be 15" dia. for N^o1 and N^o2 Inlets, 12" dia. for N^o3 Inlets, and 8" dia. for N^o4 Inlets.



SECTION IN REDUCED CRADLE

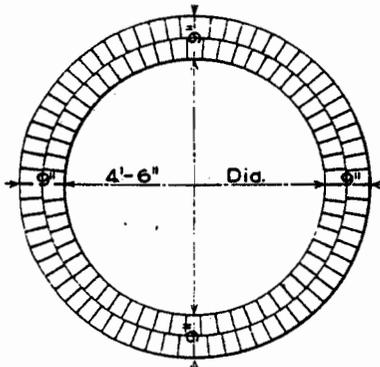
SECTION IN MAXIMUM CRADLE

GENERAL SECTIONS OF CIRCULAR SEWERS

1" = 3' 6" 3" 0" 1 FT. 2 FT.
Scale

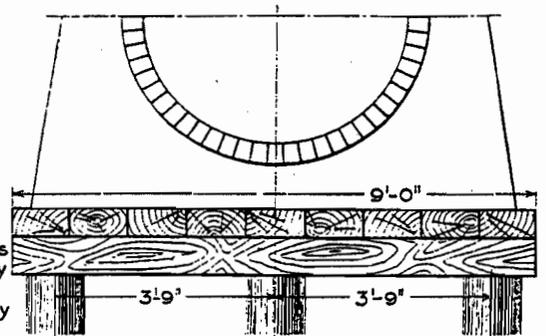
DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA
1906

E. H. Whittier
Chief Engineer



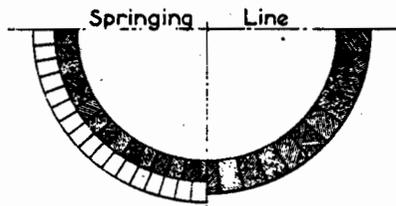
MINIMUM SECTION

6" Yellow Pine Planking laid close
8" x 8" Yellow Pine Stringers
3'-0" apart longitudinally
12" Yellow Pine Piles
3'-0" apart longitudinally



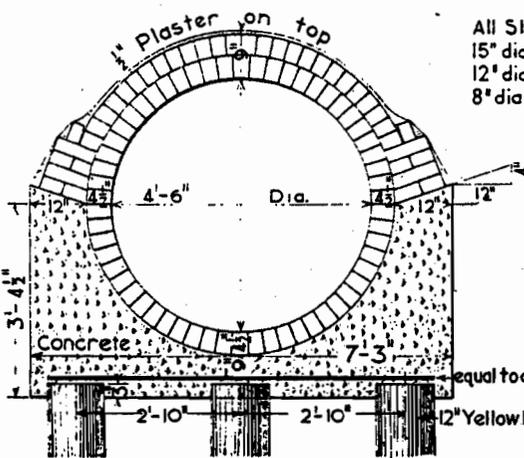
SECTION SHOWING PLATFORM and PILES

Filling over top of Sewer to be at least 3 feet deep and with a slope not less than 1/2 ft. horizontal over 1 ft. vertical extending to the surface of the ground.



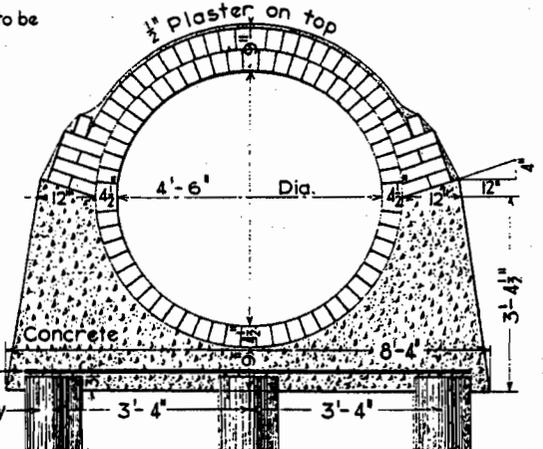
Steel Rods (equal to area of $\frac{3}{4}$ " square) and Piles, or Piles and Platform, if required, will be paid for at the price in the contract when ordered by the Chief Engineer.

VITRIFIED SHALE STONE BLOCK
BRICK INVERT INVERT



SECTION IN REDUCED CRADLE

All Slants for Inlet connections to be 15" dia. for N°1 and N°2 Inlets, 12" dia. for N°3 Inlets, and 8" dia. for N°4 Inlets.



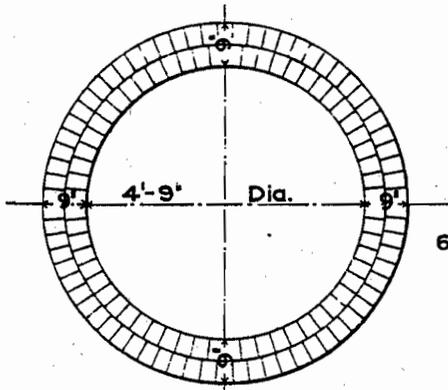
SECTION IN MAXIMUM CRADLE

GENERAL SECTIONS OF CIRCULAR SEWERS

Scale

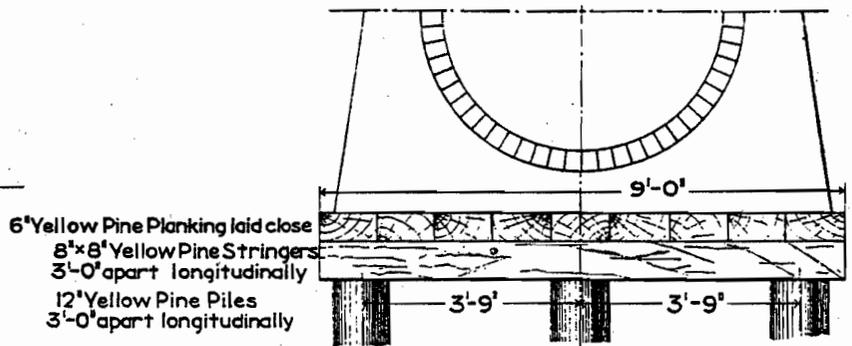
DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA
1906

E. C. Walker
Chief Engineer



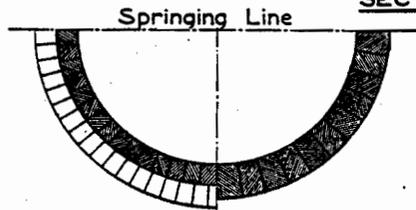
MINIMUM SECTION

Filling over top of Sewer to be at least 3 feet deep and with a slope not less than 1/2 ft. horizontal over 1 ft. vertical, extending to the surface of the ground.



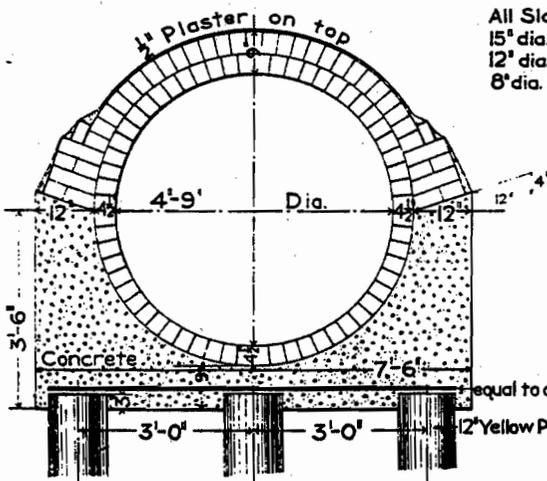
SECTION SHOWING PLATFORM and PILES

6" Yellow Pine Planking laid close
8" x 8" Yellow Pine Stringers
3'-0" apart longitudinally
12" Yellow Pine Piles
3'-0" apart longitudinally



VITRIFIED SHALE STONE BLOCK
BRICK INVERT INVERT

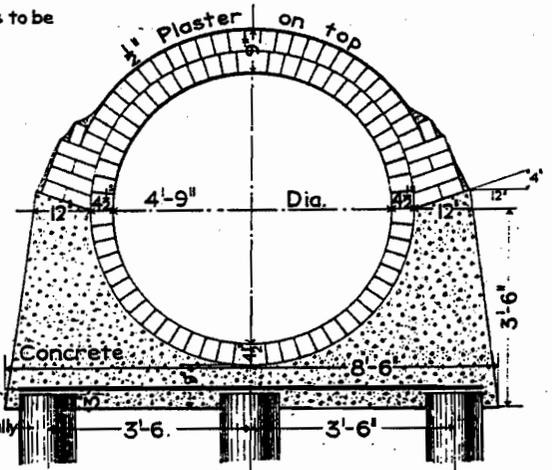
Steel Rods (equal to area of 3/4" square) and Piles, or Piles and Platform, if required, will be paid for at the price in the contract when ordered by the Chief Engineer.



SECTION IN REDUCED CRADLE

All Slants for Inlet connections to be 15° dia. for N°1 and N°2 Inlets, 12° dia. for N°3 Inlets, and 8° dia. for N°4 Inlets.

Steel Rods equal to area of 3/4" sq spaced 12" c. to c.
12" Yellow Pine Piles 3'-0" apart longitudinally



SECTION IN MAXIMUM CRADLE

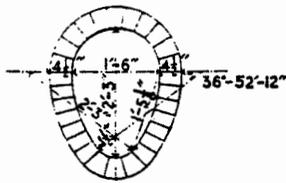
GENERAL SECTIONS OF EGG-SHAPED SEWERS

12" 9'-6" 3'-0" 18" 2'-0"

Scale

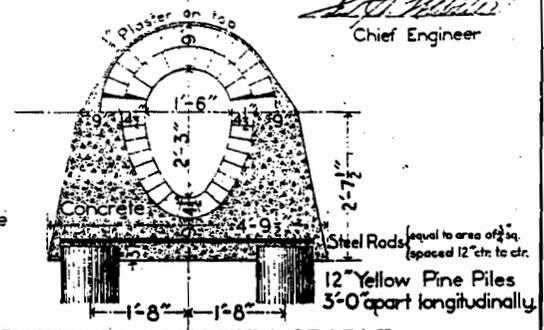
DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA
1906

E. C. White
Chief Engineer

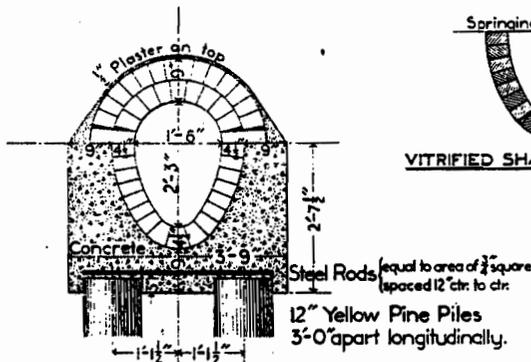


MINIMUM SECTION

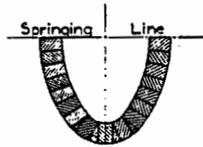
All Slants for Inlet Connections to be 15" dia for N^o 1 and N^o 2 Inlets, 12" dia for N^o 3 Inlets, and 8" dia for N^o 4 Inlets.



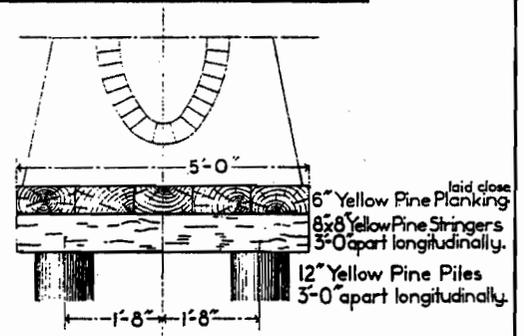
SECTION IN MAXIMUM CRADLE



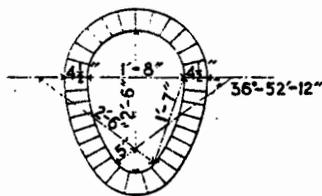
SECTION IN REDUCED CRADLE



VITRIFIED SHALE BRICK INVERT.



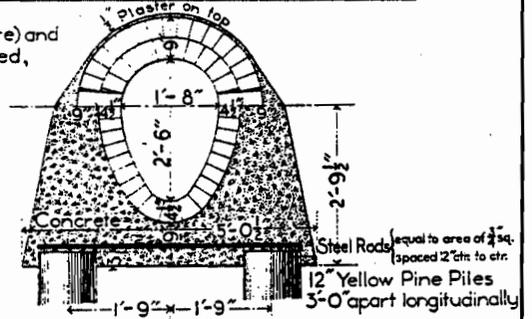
SECTION SHOWING PLATFORM AND PILES



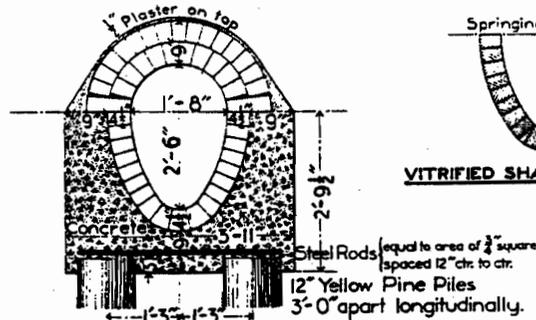
MINIMUM SECTION

Steel Rods (equal to area of $\frac{3}{4}$ " square) and Piles, or Piles and Platform, if required, will be paid for at the price in the contract when ordered by the Chief Engineer.

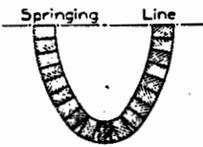
Filling over top of Sewer to be at least 3 feet deep and with a slope not less than $\frac{1}{2}$ ft. horizontal over 1 ft. vertical, extending to the surface of the ground.



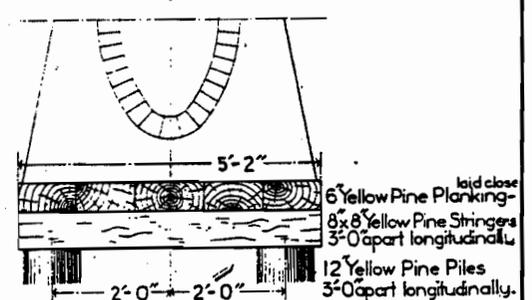
SECTION IN MAXIMUM CRADLE



SECTION IN REDUCED CRADLE



VITRIFIED SHALE BRICK INVERT



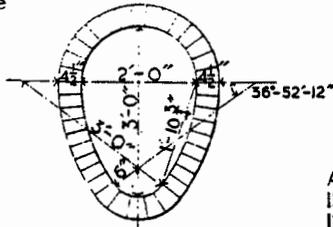
SECTION SHOWING PLATFORM AND PILES

GENERAL SECTIONS OF EGG-SHAPED SEWERS

DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA
1906

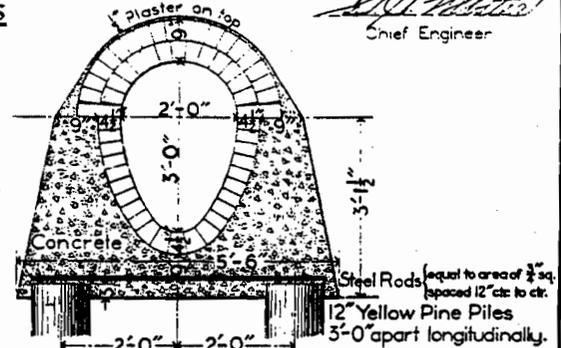
E. C. Whitely
Chief Engineer

Scale
1" = 2'-0"

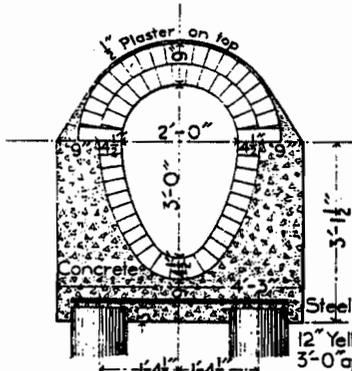


MINIMUM SECTION

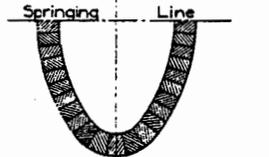
All Slants for Inlet Connections to be 15" dia. for No 1 and No 2 Inlets, 12" dia. for No 3 Inlets, and 8" dia. for No 4 Inlets.



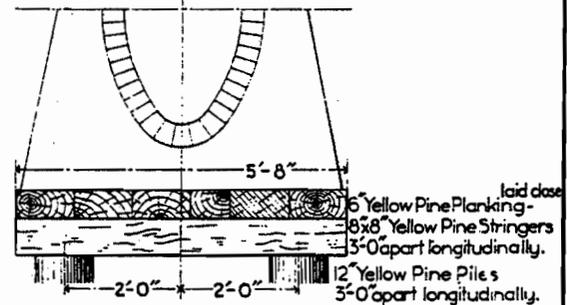
SECTION IN MAXIMUM CRADLE



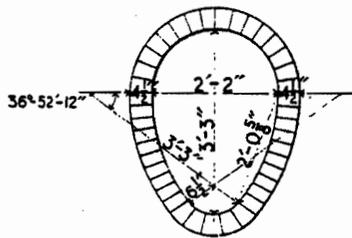
SECTION IN REDUCED CRADLE



VITRIFIED SHALE BRICK INVERT



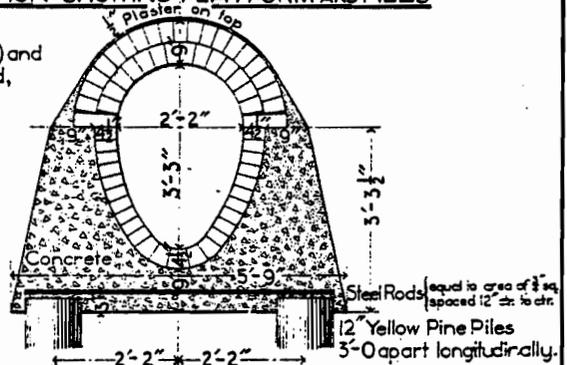
SECTION SHOWING PLATFORM AND PILES



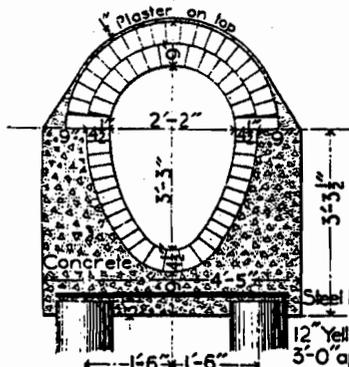
MINIMUM SECTION

Steel Rods (equal to area of $\frac{3}{4}$ square) and Piles, or Piles and Platform, if required, will be paid for at the price in the contract when ordered by the Chief Engineer.

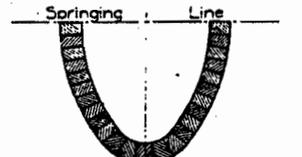
Filling over top of Sewer to be at least 3 feet deep and with a slope not less than $\frac{1}{2}$ ft. horizontal over 1 ft. vertical, extending to the surface of the ground.



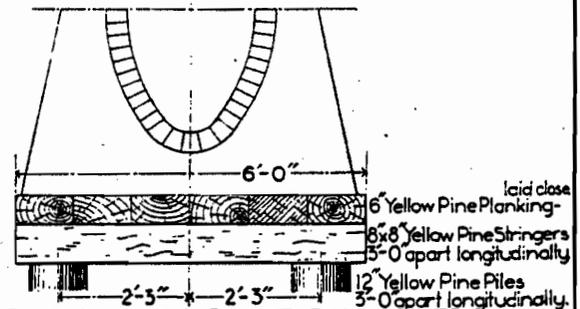
SECTION IN MAXIMUM CRADLE



SECTION IN REDUCED CRADLE



VITRIFIED SHALE BRICK INVERT

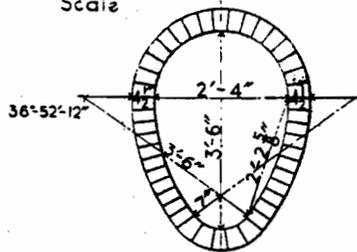
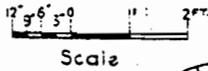


SECTION SHOWING PLATFORM AND PILES

GENERAL SECTIONS OF EGG-SHAPED SEWERS

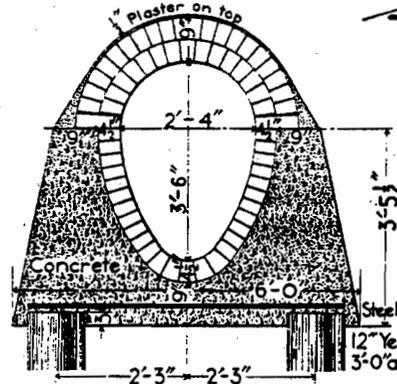
DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA
1906

E. H. Whitte
Chief Engineer



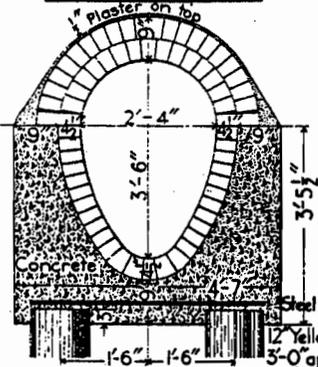
MINIMUM SECTION

All Sants for Inlet Connections to be 15" dia. for No 1 and No 2 Inlets, 12" dia. for No 3 Inlets, and 8" dia. for No 4 Inlets.

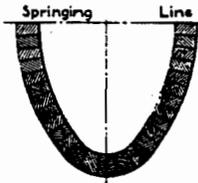


SECTION IN MAXIMUM CRADLE

Steel Rods (equal to area of $\frac{1}{4}$ sq. spaced 12" ctr. to ctr.)
12" Yellow Pine Piles
3'-0" apart longitudinally.

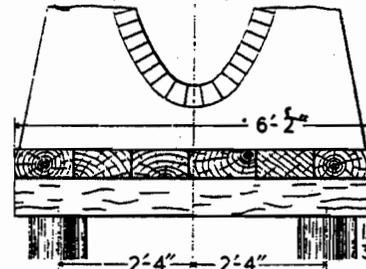


SECTION IN REDUCED CRADLE



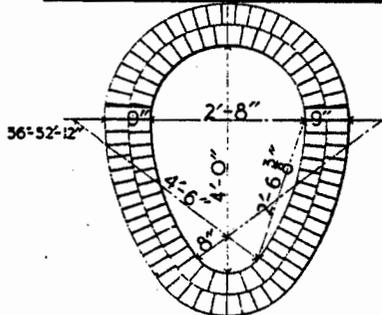
VITRIFIED SHALE BRICK INVERT.

Steel Rods (equal to area of $\frac{1}{4}$ square spaced 12" ctr. to ctr.)
12" Yellow Pine Piles
3'-0" apart longitudinally.



SECTION SHOWING PLATFORM AND PILES

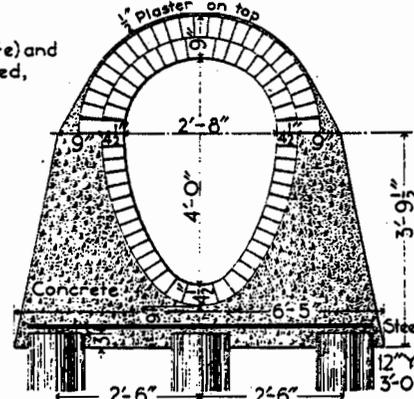
6" Yellow Pine Planking laid close
8" x 8" Yellow Pine Stringers
3'-0" apart longitudinally.
12" Yellow Pine Piles
3'-0" apart longitudinally.



MINIMUM SECTION

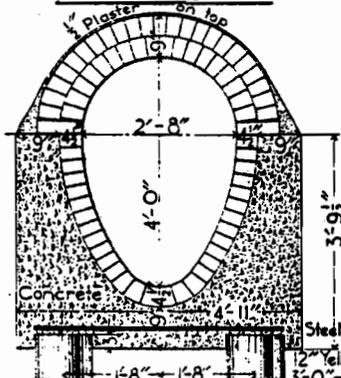
Steel Rods (equal to area of $\frac{3}{4}$ square) and Piles, or Piles and Platform, if required, will be paid for at the price in the contract when ordered by the Chief Engineer.

Filling over top of Sewer to be at least 3 feet deep and with a slope not less than $\frac{1}{2}$ ft. horizontal over 1 ft. vertical, extending to the surface of the ground.

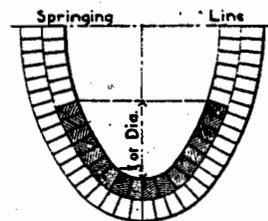


SECTION IN MAXIMUM CRADLE

Steel Rods (equal to area of $\frac{3}{4}$ sq. spaced 12" ctr. to ctr.)
12" Yellow Pine Piles
3'-0" apart longitudinally.

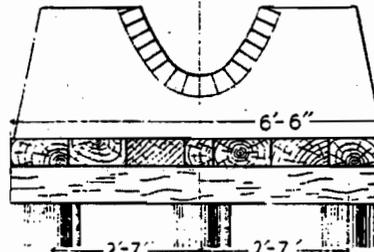


SECTION IN REDUCED CRADLE



VITRIFIED SHALE BRICK INVERT

Steel Rods (equal to area of $\frac{3}{4}$ square spaced 12" ctr. to ctr.)
12" Yellow Pine Piles
3'-0" apart longitudinally.



SECTION SHOWING PLATFORM AND PILES

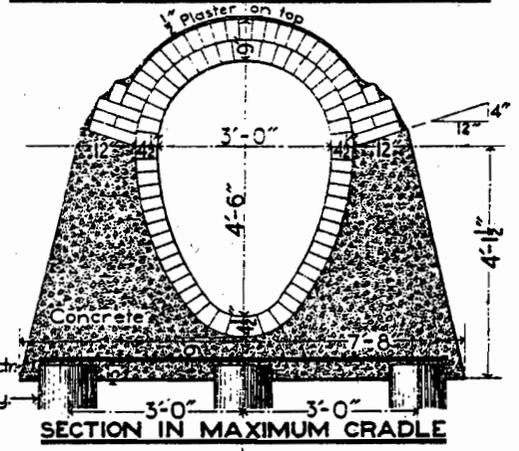
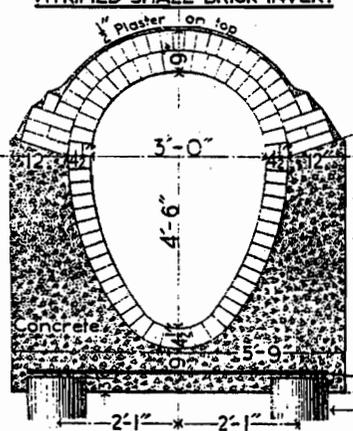
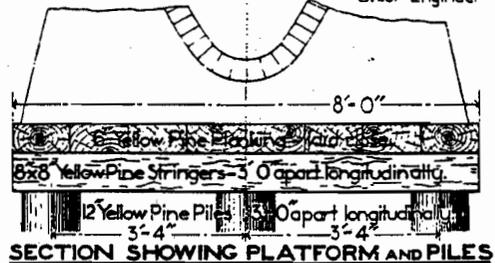
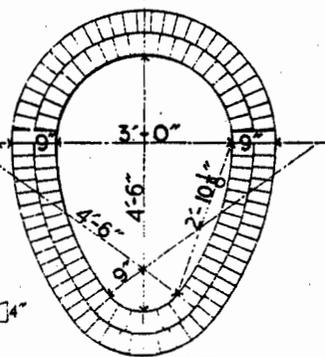
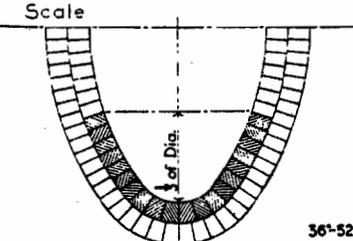
6" Yellow Pine Planking laid close
8" x 8" Yellow Pine Stringers
3'-0" apart longitudinally.
12" Yellow Pine Piles
3'-0" apart longitudinally.

GENERAL SECTIONS OF EGG-SHAPED SEWERS

DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA
1906

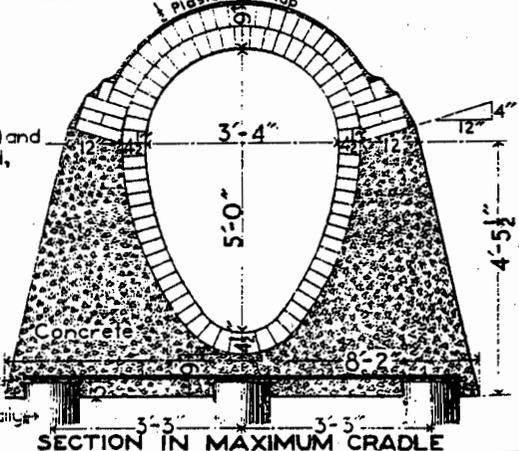
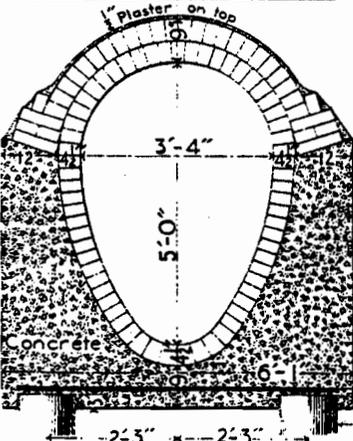
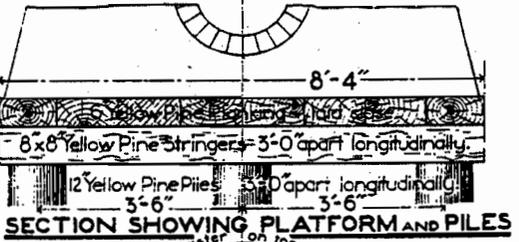
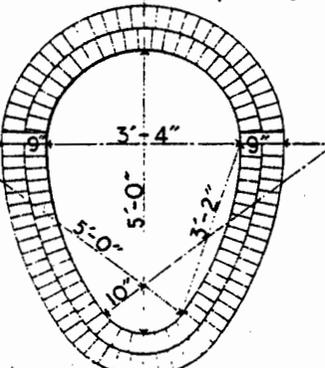
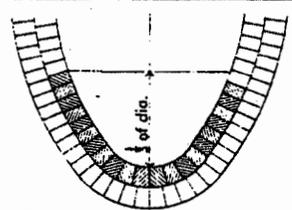
C. S. Whitely
Chief Engineer

Scale
12" = 3'-6" = 3'-0" 1 FT. 2 FT.



All Slants for Inlet Connections to be 15" dia. for N^o 1 and N^o 2 Inlets, 12" dia. for N^o 3 Inlets, and 8" dia. for N^o 4 Inlets.

Steel Rods—equal to area of $\frac{3}{4}$ sq. — spaced 12" ctr. to chr.



Steel Rods (equal to area of $\frac{3}{4}$ square) and Piles, or Piles and Platform, if required, will be paid for at the price in the contract when ordered by the Chief Engineer.

Filling over top of Sewer to be at least 3 feet deep and with a slope not less than $1\frac{1}{2}$ ft. horizontal over 1 ft. vertical, extending to the surface of the ground.

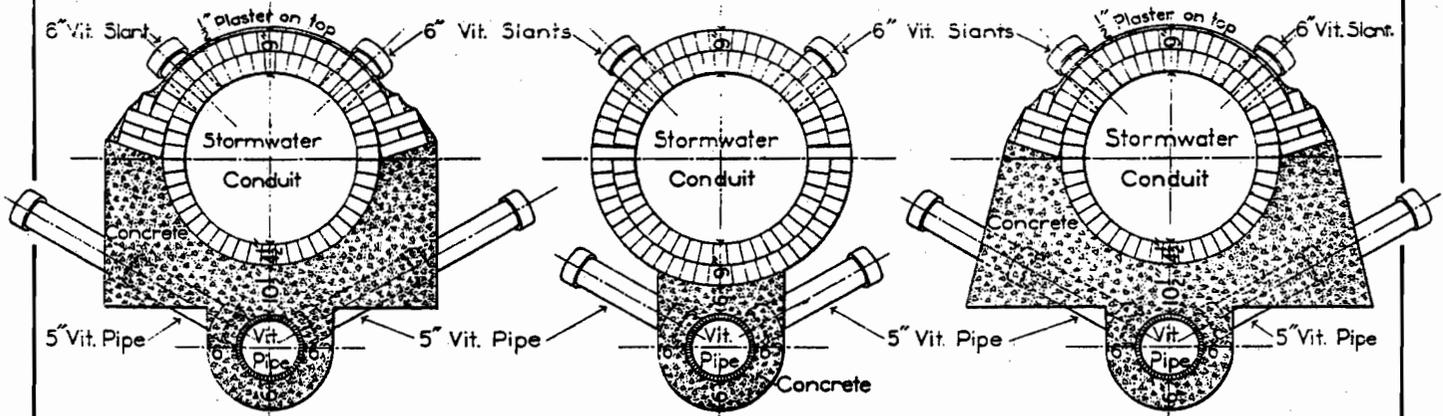
Steel Rods—equal to area of $\frac{3}{4}$ sq. — spaced 12" to chr.

GENERAL SECTIONS FOR SEPARATE SYSTEM

DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA
1906

W. H. H. H. H.
Chief Engineer

Scale
12" = 3' 0" 1" = 2 FT.

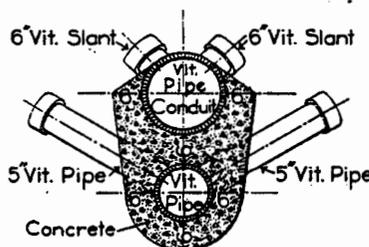


SECTION IN REDUCED CRADLE MINIMUM SECTION SECTION IN MAXIMUM CRADLE
RELATIVE POSITION FOR ALL CONDUITS OVER 2'-9" DIA.

6" dia. Vit. Slants for stormwater, and 5" dia. Vit. Slants and Pipes for house connections, as shown on sections, to be built every 15 feet, and included in price per linear foot of sewer.

All Slants for Inlet Connections to be 15" dia. for N^o 1 and N^o 2 Inlets, 12" dia. for N^o 3 Inlets, and 8" dia. for N^o 4 Inlets, to connect to stormwater conduit only.

The Cross Sections of the Separate System must conform in all respects to the General Details of Brick and Pipe Sewers.

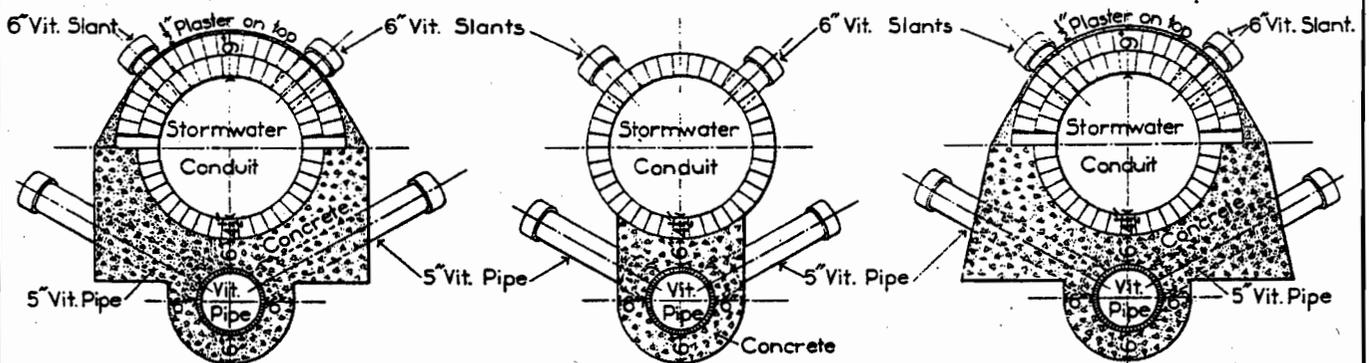


RELATIVE POSITION OF PIPE SEWERS

Concrete to be not less than 6" between outsides of Conduit and Pipe, but may be increased in special cases when required.

Concrete may be reduced in rock excavation only, as per specifications.

Filling over top of sewer to be at least 3 feet deep and with a slope not less than 1 1/2 ft. horizontal over 1 ft. vertical, extending to the surface of the ground.



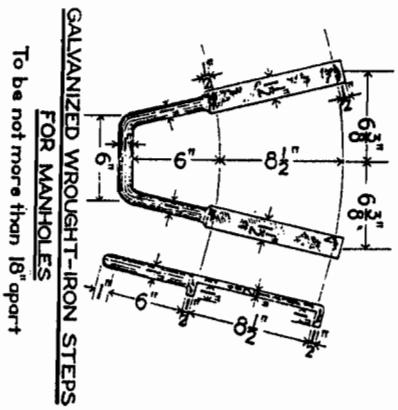
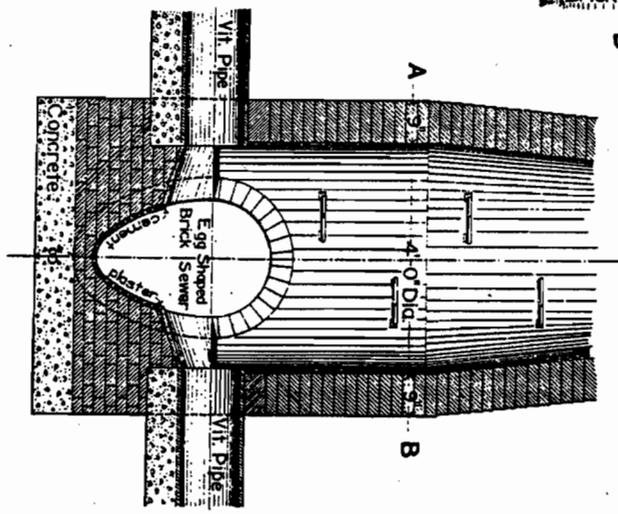
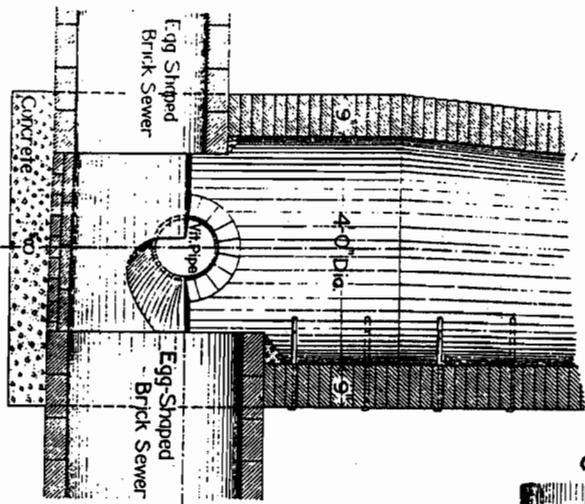
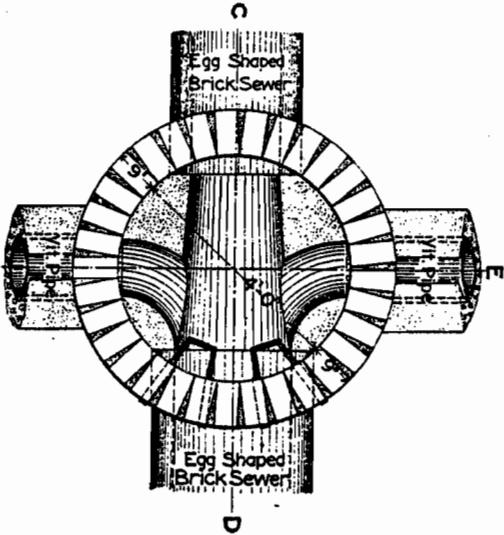
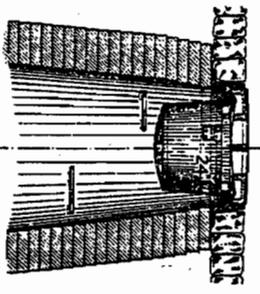
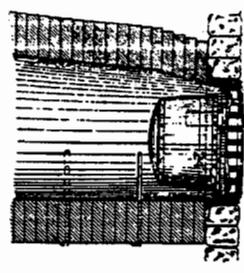
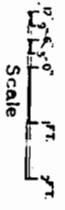
SECTION IN REDUCED CRADLE MINIMUM SECTION SECTION IN MAXIMUM CRADLE
RELATIVE POSITION FOR ALL CONDUITS UNDER 3'-0" DIA.

MANHOLE FOR JUNCTIONS

DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA

1906

E. P. Mather
Chief Engineer



General Details for Egg-shaped Sewers, City of Philadelphia

DEPT. OF PUBLIC WORKS,
BUREAU OF SURVEYS,
FEB. 1895.

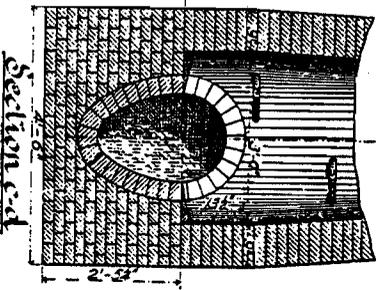
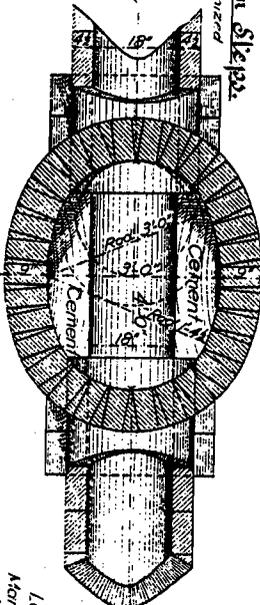
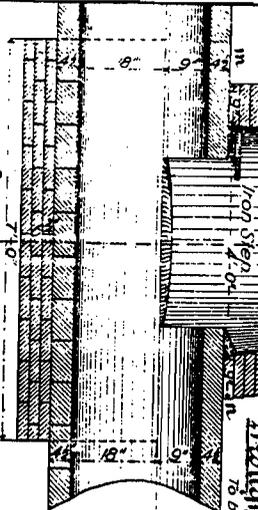
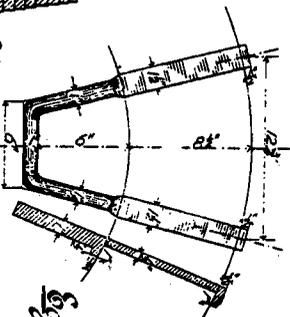
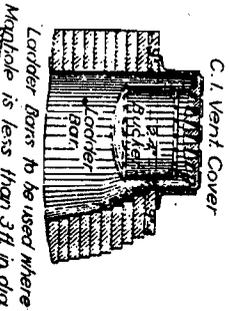
Revised Jan. 1907

Edw. M. Allen
CHIEF ENGINEER

SCALE
1" = 3'

Manholes
See

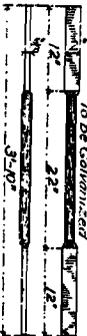
Egg-shaped Sewers 10' x 24' x 36'



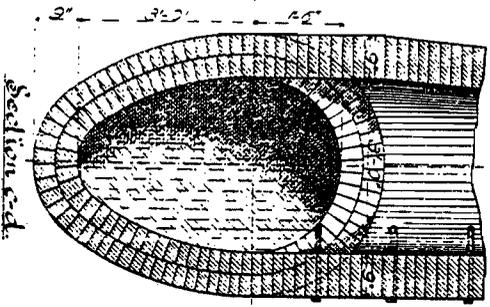
Foundation of concrete under brickwork where directed

Section a-b

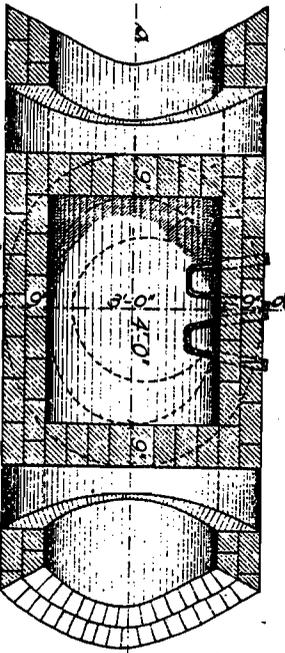
Straight-iron Ladder Bars
To be galvanized



Plan View



Manholes for egg-shaped Sewers



Foundation of concrete under brickwork where directed

Section a-b

Edw. M. Allen

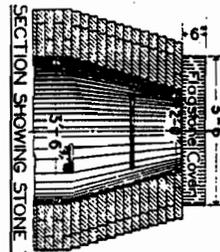
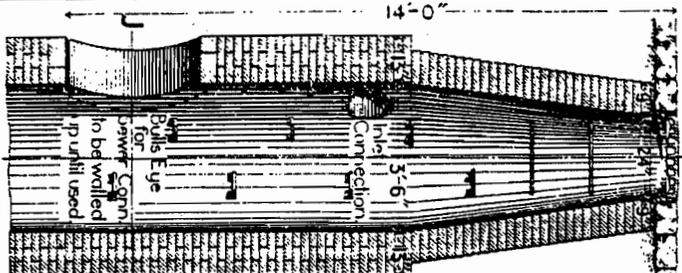
STANDARD WELLHOLE DETAILS

DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA

1906

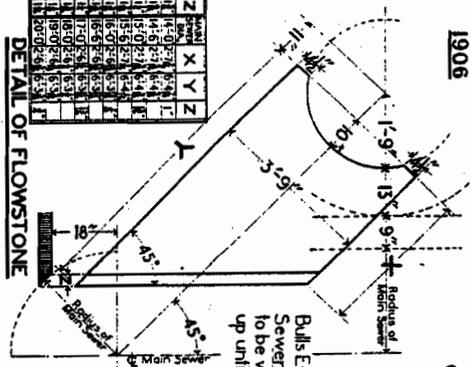
W. M. ...
Chief Engineer

1" = 6'-0"
1" = 3'-0"
1" = 1'-0"
SCALE

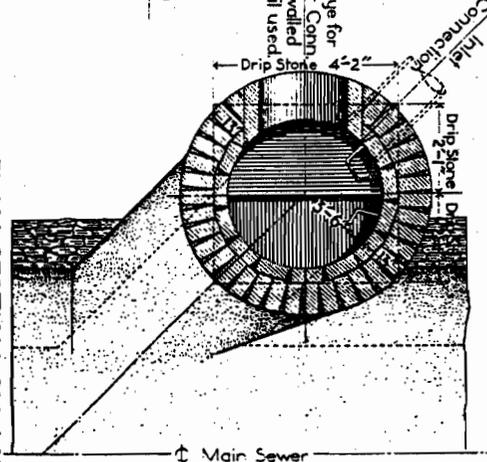


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1	2	1	2	1	2	1	2
1	3	1	3	1	3	1	3
1	4	1	4	1	4	1	4
1	5	1	5	1	5	1	5
2	0	2	0	2	0	2	0
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2	2	2	2	2	2	2	2
2	3	2	3	2	3	2	3
2	4	2	4	2	4	2	4
2	5	2	5	2	5	2	5
3	0	3	0	3	0	3	0
3	1	3	1	3	1	3	1
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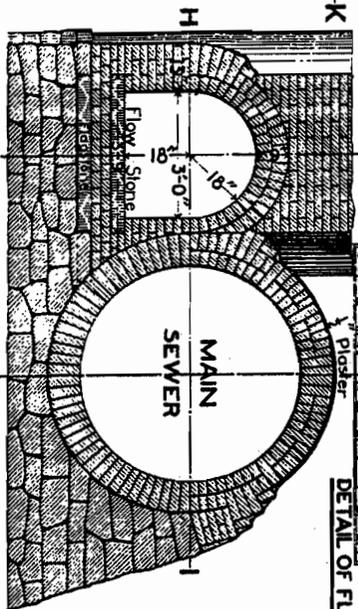
DETAIL OF FLOWSTONE



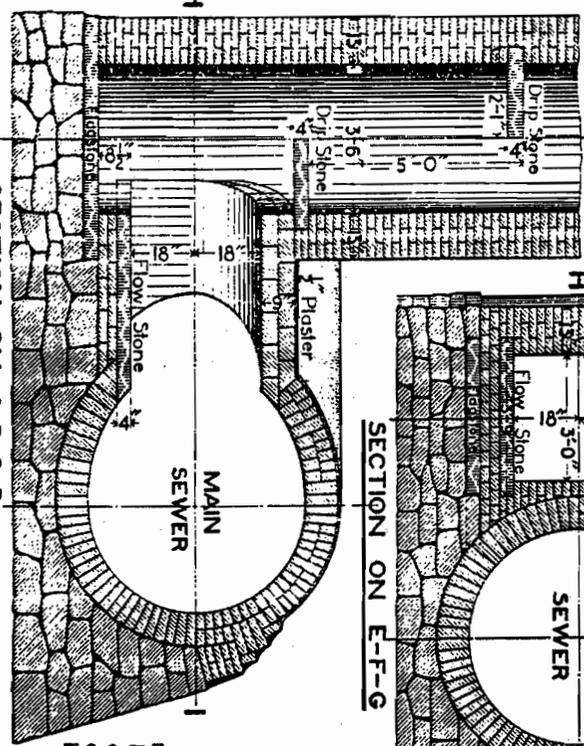
PLAN SECTION ON J-K



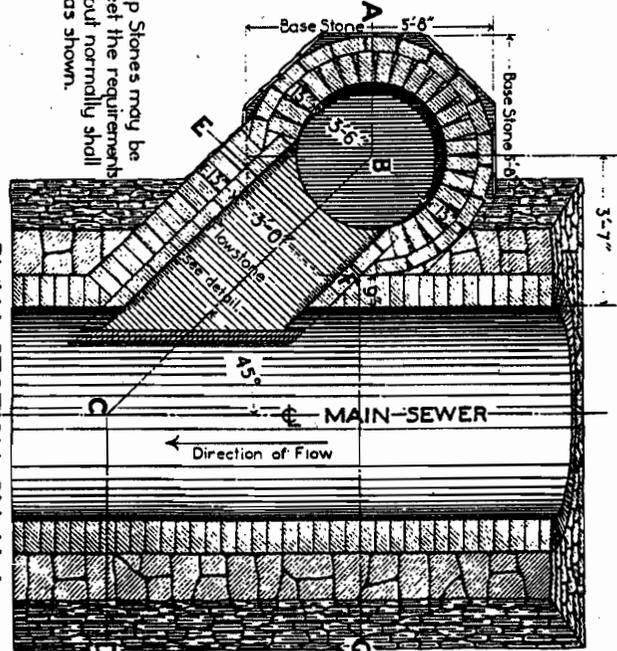
SECTION ON E-F-G



SECTION ON A-B-C-D



PLAN SECTION ON H-I



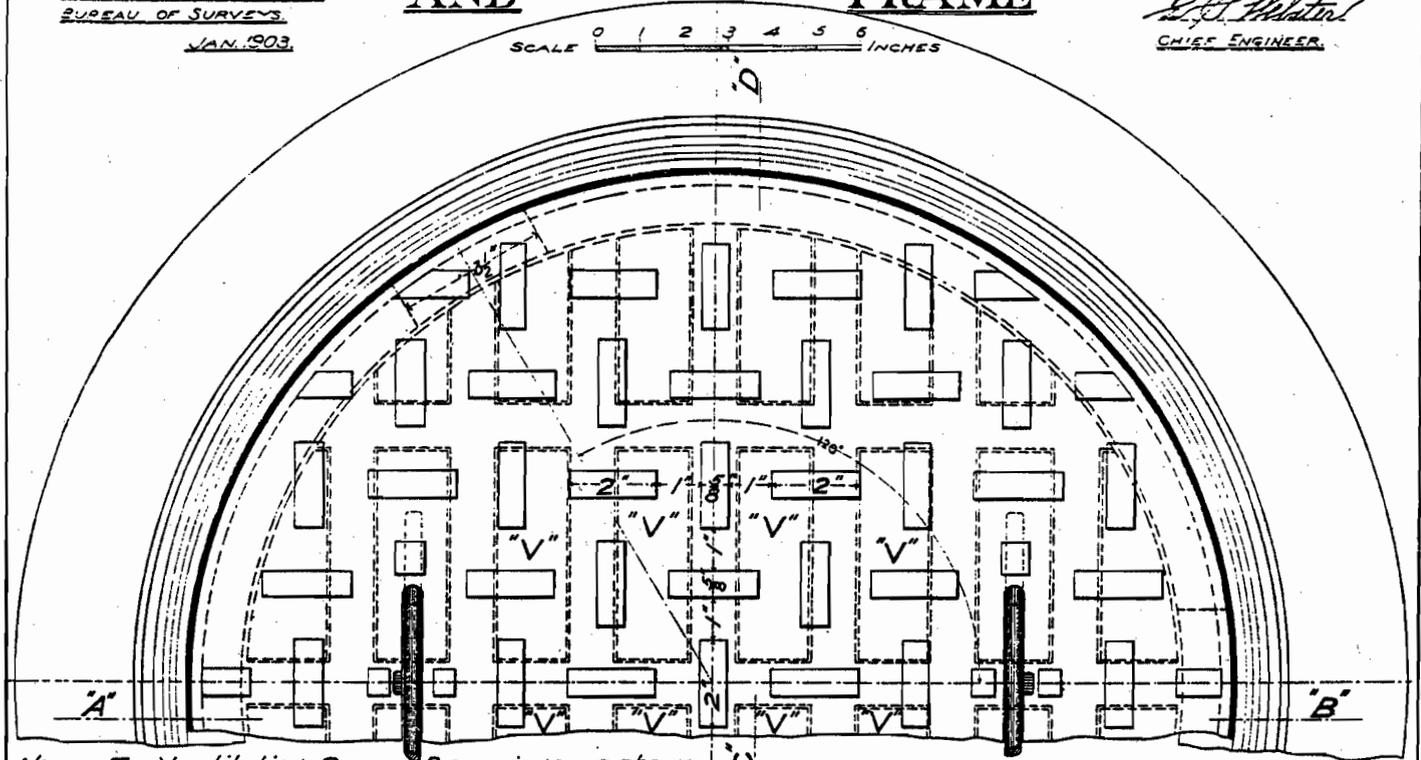
NOTE
Location of Drip Stones may be adjusted to meet the requirements of each case, but normally shall be 5'-0" apart as shown.

CAST IRON MANHOLE COVER AND FRAME

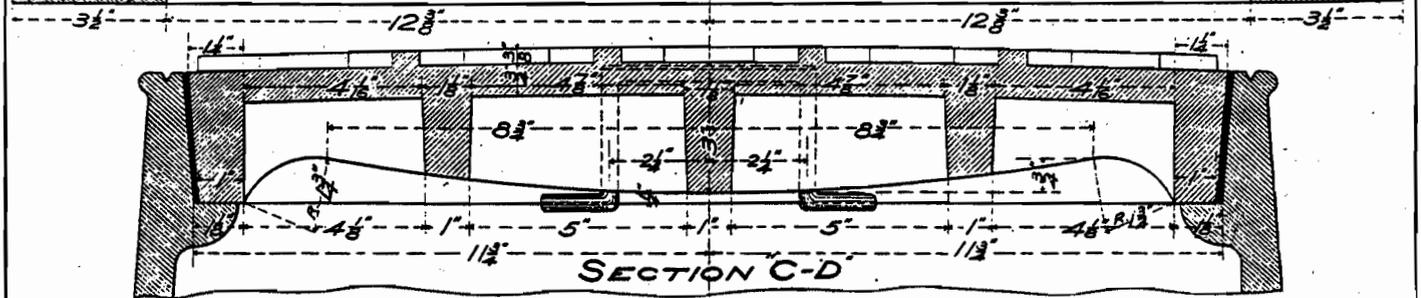
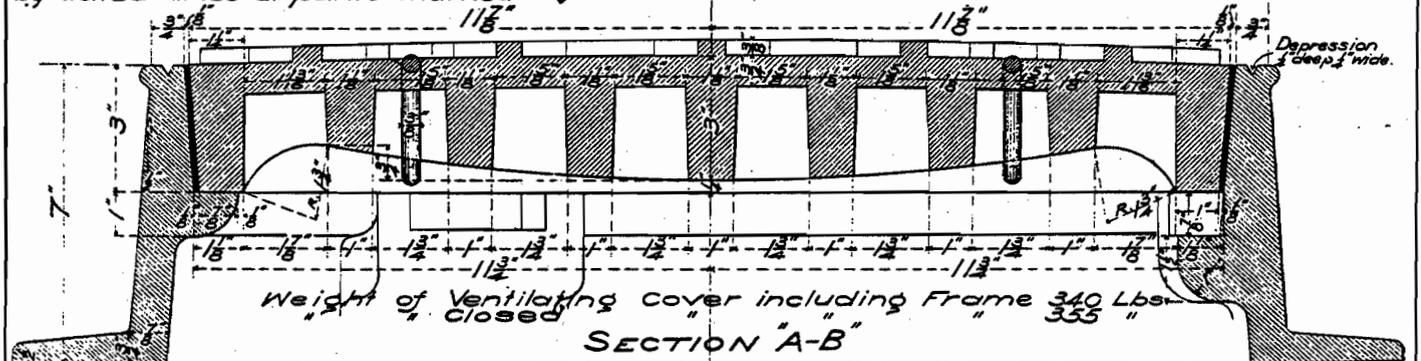
DEPT OF PUBLIC WORKS
BUREAU OF SURVEYS
JAN. 1903.

R. H. Whitford
CHIEF ENGINEER.

SCALE 0 1 2 3 4 5 6 INCHES



Note: For Ventilating Covers, 8 openings as shown by dotted lines at points marked "V".



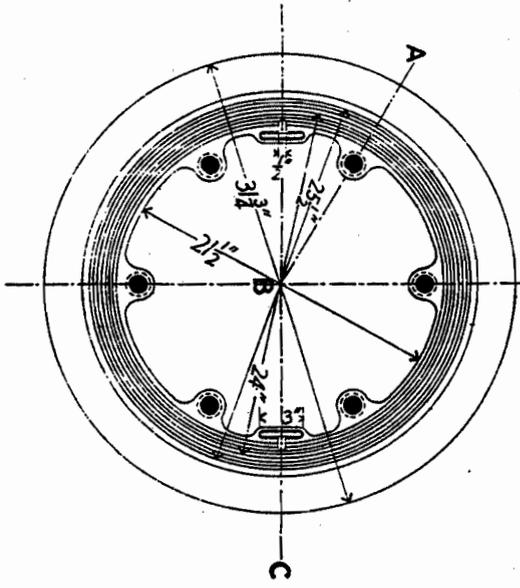
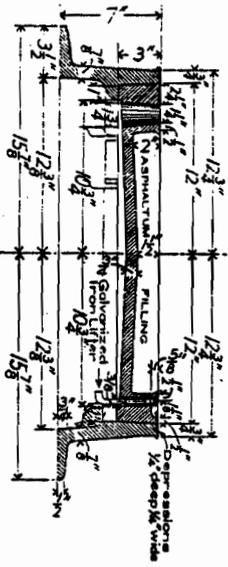
ASPHALTUM FILLED CAST IRON MANHOLE COVERS AND FRAMES



DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
JANUARY 1900

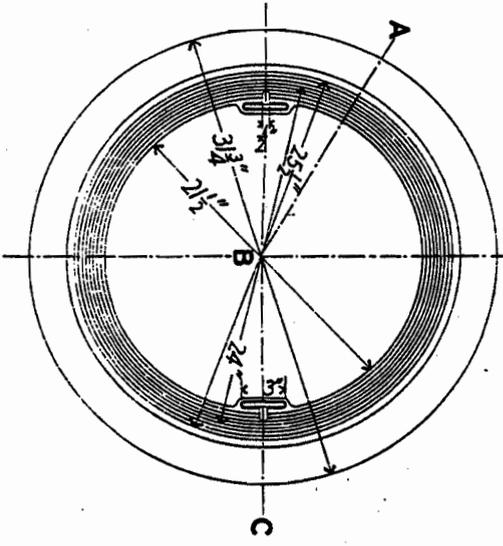
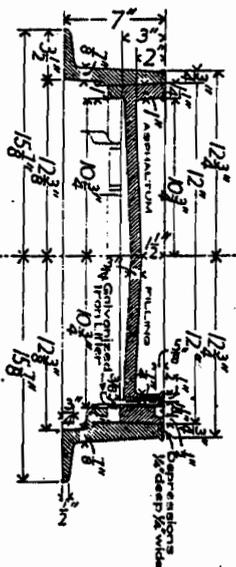
W. H. Miller
CHIEF ENGINEER

SECTION A-B-C



VENTILATING COVER AND FRAME

SECTION A-B-C



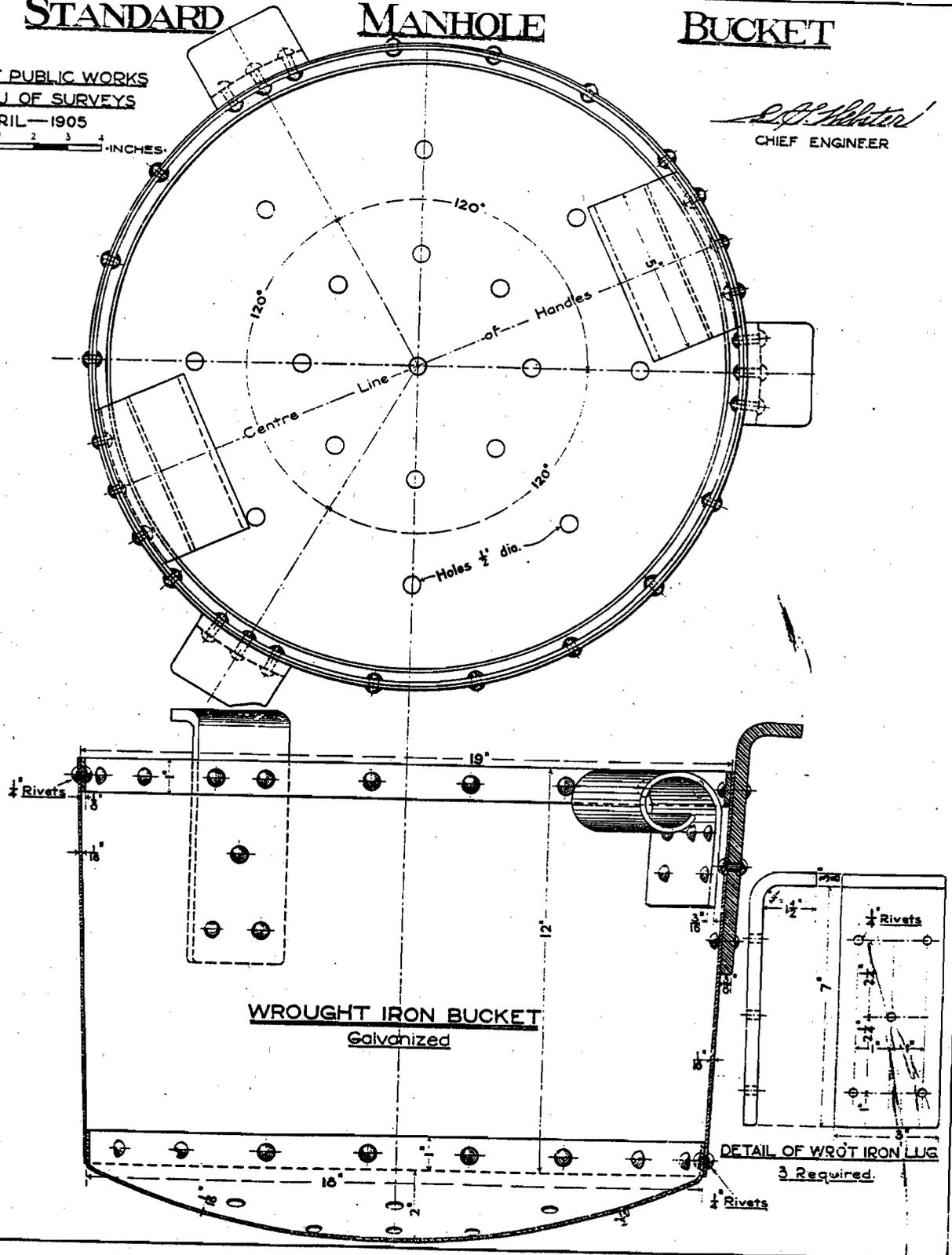
CLOSED COVER AND FRAME

STANDARD MANHOLE BUCKET

DEPT. OF PUBLIC WORKS
BUREAU OF SURVEYS
APRIL—1905

SCALE 0 1 2 3 4 INCHES

E. C. Walker
CHIEF ENGINEER

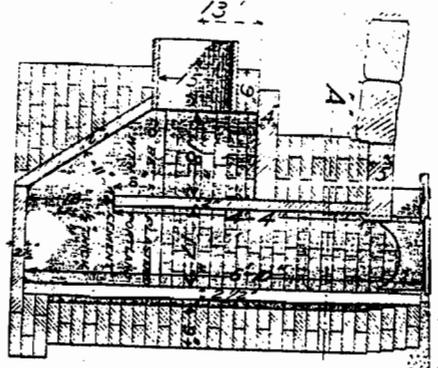


No 1. OPEN MOUTH BRICK AND STONE INLET.

Dept. of Public Works Bureau of Surveys

Philadelphia, Jan. 1893
Revised Jan. 1903

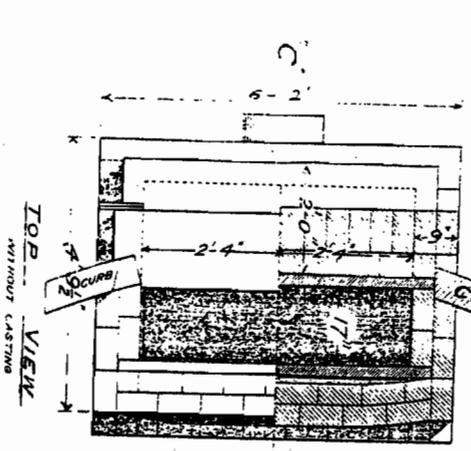
Chief Engineer



SECTION C-D



SECTION A-B

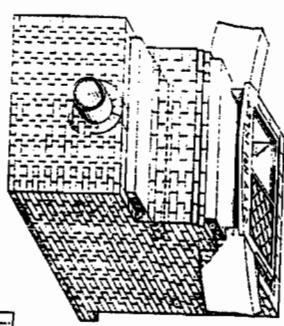


TOP VIEW WITHOUT CASTING

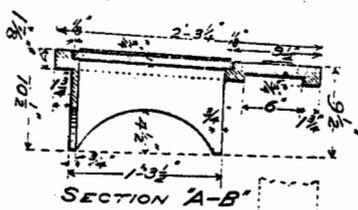
Bill of Lading for Inlet

Div. Stone	1-1/2 x 5-8 x 5-1/2	5'
Top	4-4 x 5-4 x 2-1/2	2'
Back	6-10 x 5-4 x 2-1/2	2'
Cover	2-0 x 5-4 x 2-1/2	4'
Inclined	2-10 x 5-4 x 2-1/2	2'
Bottom	2-9 x 5-4 x 2-1/2	2 1/2'

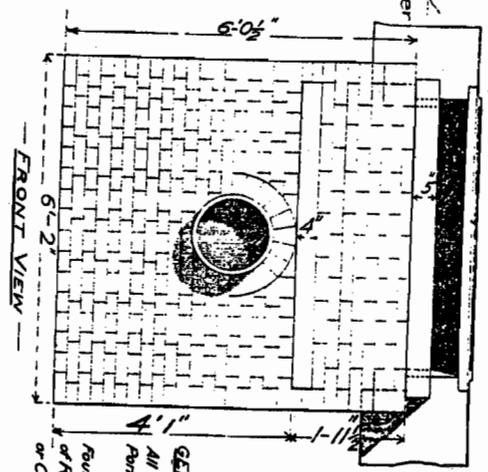
WEIGHT OF CASTINGS
FOR STRAIGHT CURB 550 LBS
FOR CURVED CURB 650 LBS



ISOMETRICAL VIEW



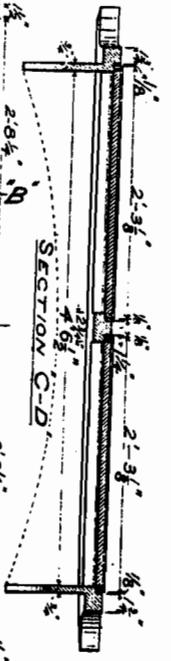
SECTION A-B



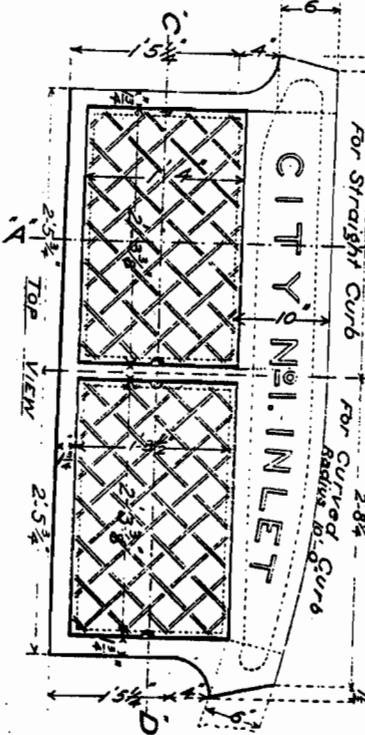
FRONT VIEW

GENERAL NOTES
All Brickwork to be laid in Portland Cement Mortar.
Foundation of Inlet to be of Rubble Masonry, Timber or Concrete as directed.

DETAILS FOR CASTING



SECTION C-D



TOP VIEW

No 2 & 3. OPEN MOUTH

BRICK AND STONE INLETS

Dept. of Public Works Bureau of Surveys

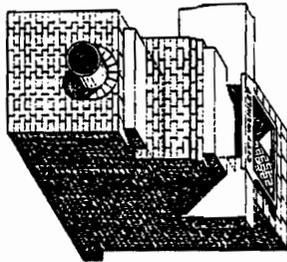
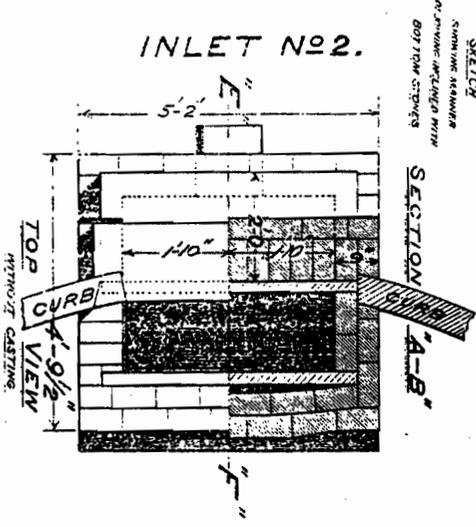
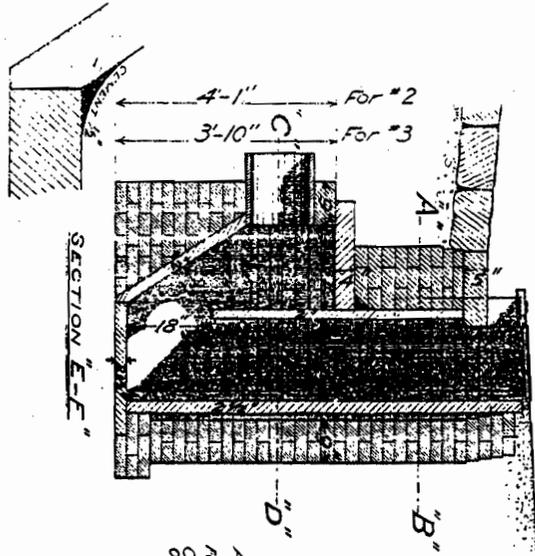
Phila. Jan. 1899.
Revised Jan. 1903.

E. P. McMichael
Chief Engineer



GENERAL NOTES

All Brickwork to be laid in Portland Cement Mortar.
Foundation of Inlet to be of Rubble Masonry Timber or Concrete as directed.
Outlet pipes for No 3 Inlets 12" dia.

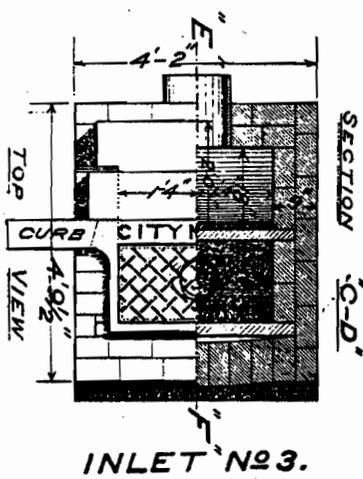
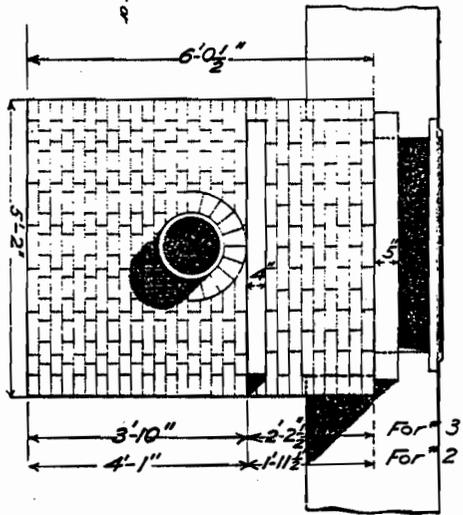


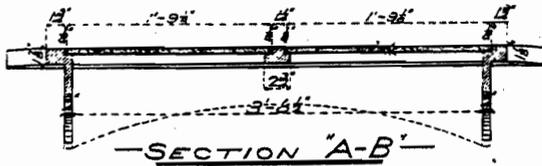
BILL OF FLAGGING FOR INLET NO 2.

Dry Stone	7'-4" x 4'-8" x 5"
Flag	4'-4" x 4'-4" x 2 1/2"
Cover	5'-0" x 4'-4" x 2 1/2"
Inclined "	2'-0" x 4'-4" x 2 1/2"
Bottom "	2'-3" x 4'-4" x 2 1/2"

BILL OF FLAGGING FOR INLET NO 3.

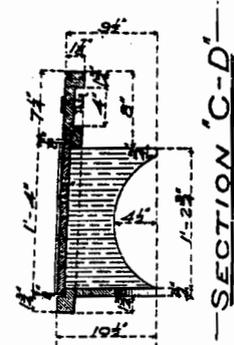
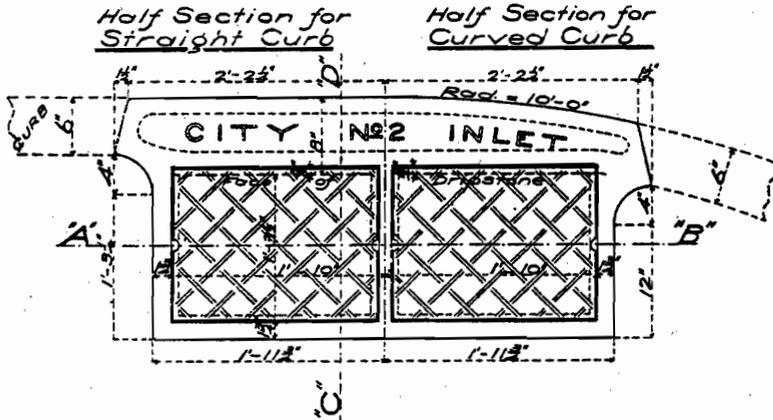
Dry Stone	7'-4" x 3'-8" x 5"
Flag	4'-4" x 3'-8" x 2 1/2"
Cover	5'-0" x 3'-8" x 2 1/2"
Inclined "	2'-0" x 3'-8" x 2 1/2"
Bottom "	2'-3" x 3'-8" x 2 1/2"





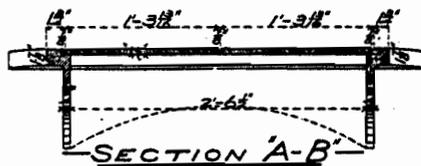
WEIGHTS OF CASTINGS

No. 2	Curved	Curb	485 Lbs.
	Straight		495 "
No. 3	Curved		340 "
	Straight		345 "

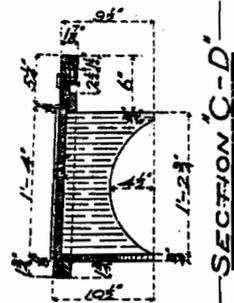
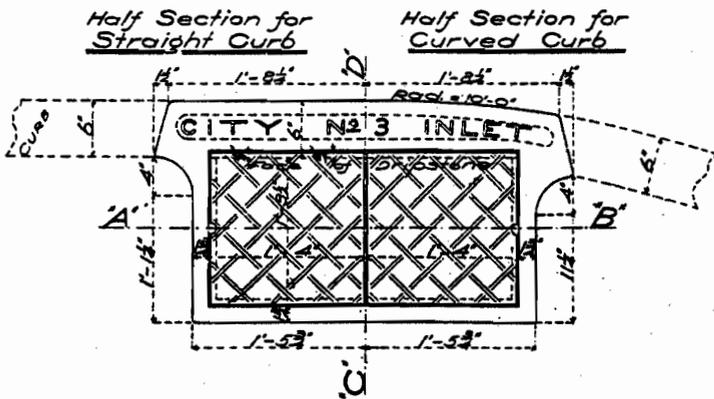


DETAILS OF CASTINGS FOR NO. 2 AND NO. 3 OPEN MOUTH INLETS

Dept of Public Works—Bureau of Surveys—
Phila. Jan. 1897



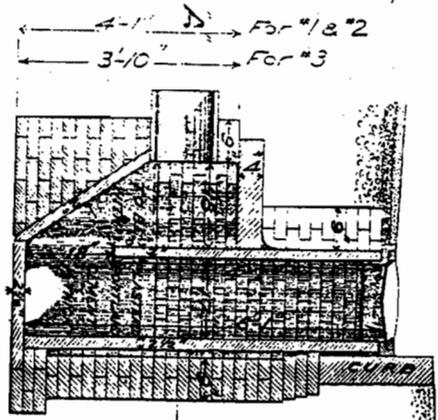
W. H. H. H.
Chief Engineer



No. 1, 2 & 3. GRATE TOP BRICK AND STONE INLETS.

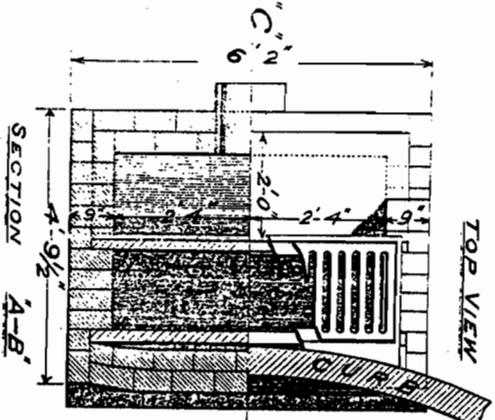
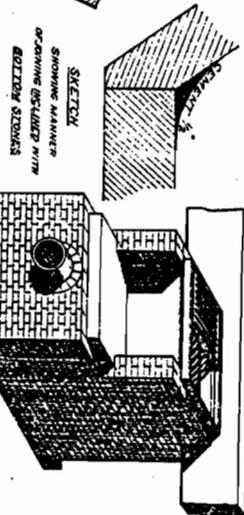
Dept. of Public Works Bureau of Surveys
 Phila. Jan. 1899

E. J. Mendenhall
 Chief Engineer



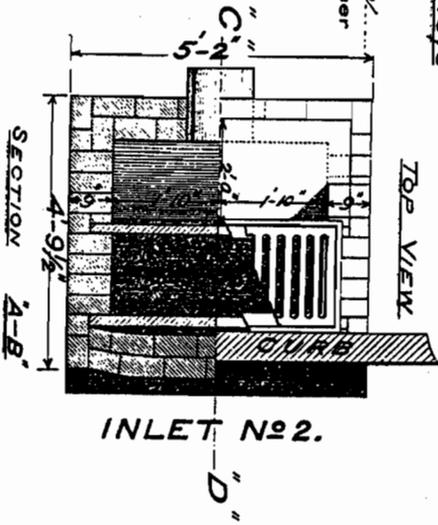
BILL OF FLAGGING FOR INLET NO. 1.

Top Stone	4'-7" x 5'-4" x 2"
Back "	6'-7" x 5'-4" x 2 1/2"
Cover "	2'-0" x 5'-4" x 4"
Inclined "	2'-10" x 5'-4" x 2"
Bottom "	2'-3" x 5'-4" x 2 1/2"



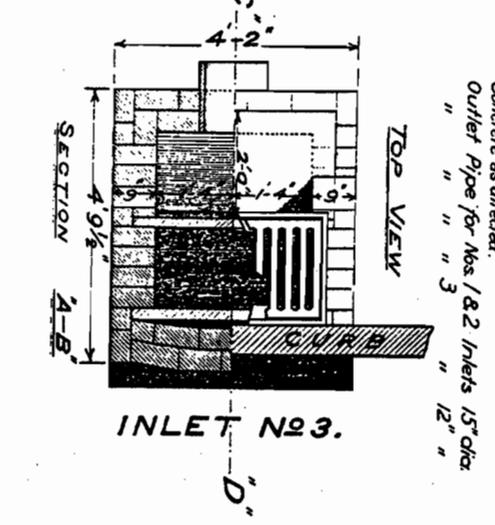
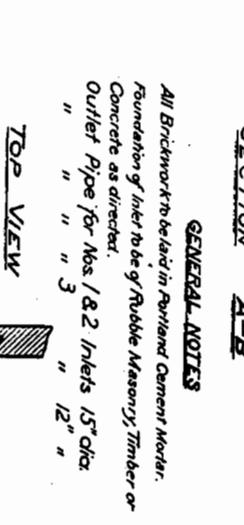
BILL OF FLAGGING FOR INLET NO. 2.

Top Stone	4'-7" x 4'-4" x 2"
Back "	6'-7" x 3'-4" x 2 1/2"
Cover "	2'-0" x 3'-4" x 4"
Inclined "	2'-10" x 3'-4" x 2"
Bottom "	2'-3" x 3'-4" x 2 1/2"



BILL OF FLAGGING FOR INLET NO. 2.

Top Stone	4'-7" x 4'-4" x 2"
Back "	6'-7" x 3'-4" x 2 1/2"
Cover "	2'-0" x 3'-4" x 4"
Inclined "	2'-10" x 3'-4" x 2"
Bottom "	2'-3" x 3'-4" x 2 1/2"



BILL OF FLAGGING FOR INLET NO. 3.

Top Stone	4'-7" x 3'-4" x 2"
Back "	6'-7" x 3'-4" x 2 1/2"
Cover "	2'-0" x 3'-4" x 4"
Inclined "	2'-10" x 3'-4" x 2"
Bottom "	2'-3" x 3'-4" x 2 1/2"

GENERAL NOTES

All Brickwork to be laid in Portland Cement Mortar.
 Foundation of Inlet to be of Rubble Masonry, Timber or
 Concrete as directed.
 Outlet Pipe for Nos. 1 & 2 Inlets 15" dia
 " " " 3 " 12" "

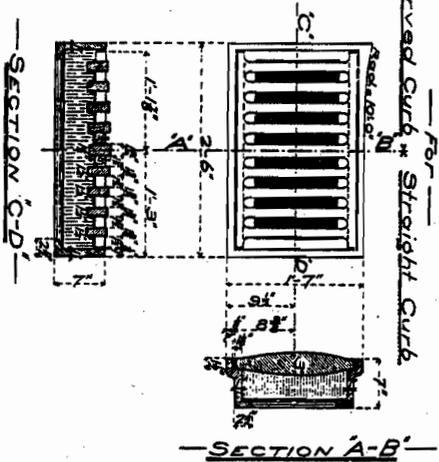
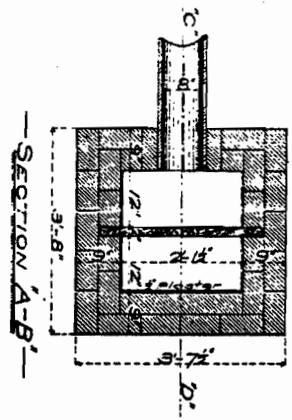
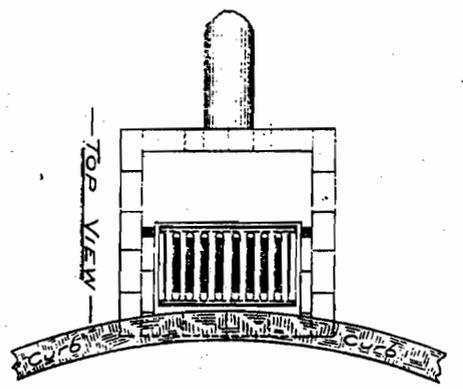
No. 4 GRATE TOP BRICK AND STONE INLET

— Dept. of Public Works — Bureau of Surveys —
— Phila. Jan. 1897 —

J. P. Miller
Chief Engineer

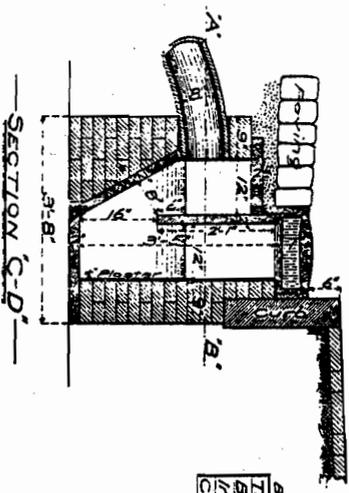
Scale: Inlet 1/2" = 1 ft.
Casting 1/2" = 1 ft.

For ———
Curved Curb * Straight Curb



SECTION A-B

GENERAL NOTES —
All Brickwork to be laid in Portland Cement Mortar
All Brickwork inside of Inlet to be Plastered with Portland Cement Mortar
Foundation of Inlet to be Rubble Masonry, Timbers, or Concrete when Directed.

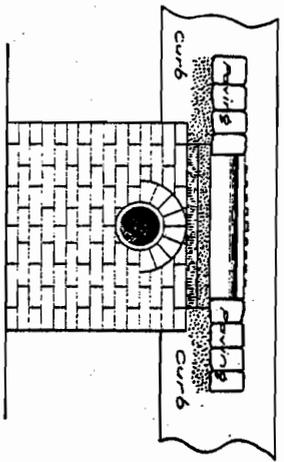


SECTION C-D

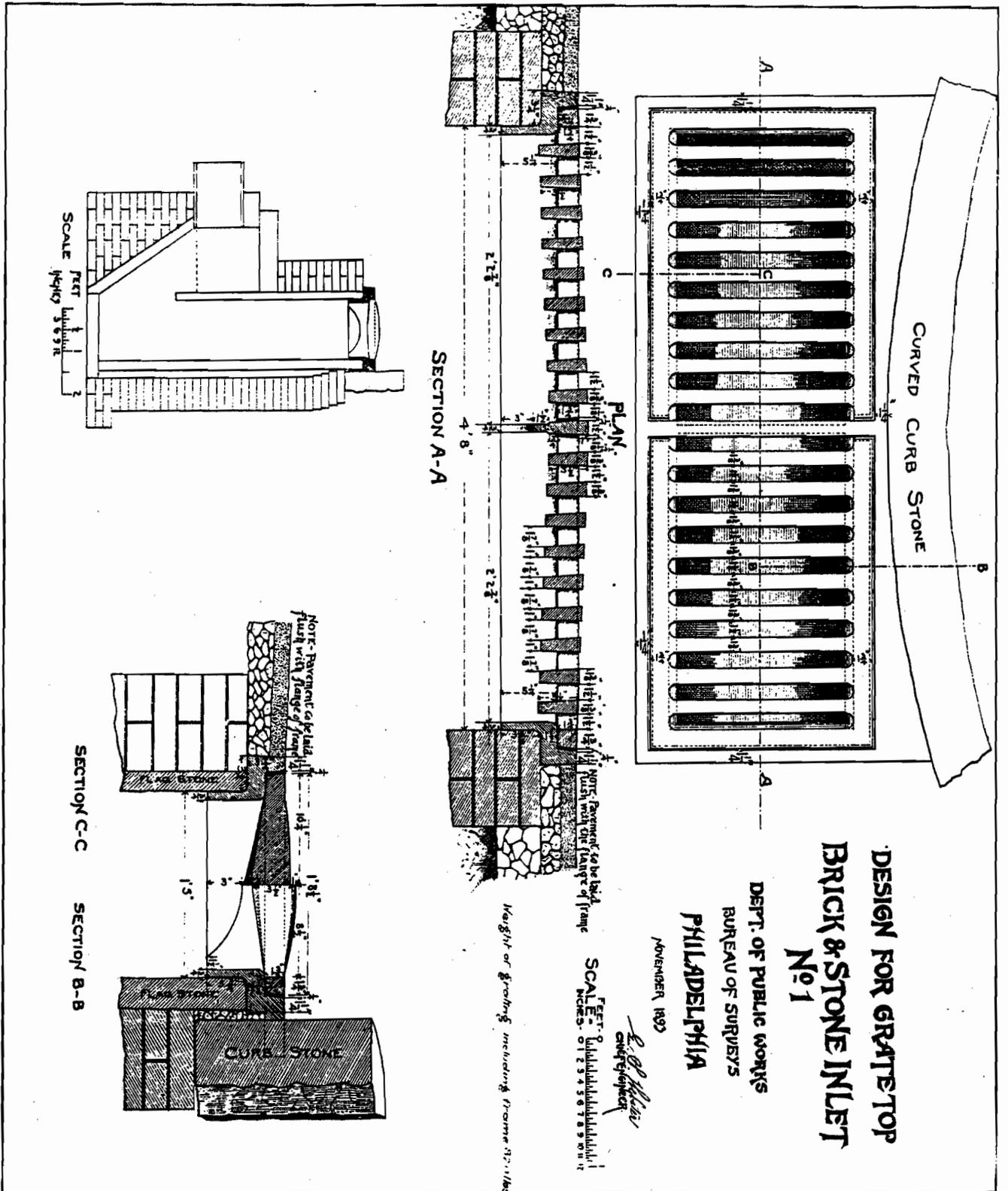
BILL OF MATERIALS FOR INLET

Top Stone	2' x 2'-7" x 2'-10"
Bottom	2' x 2'-0" x 3'-7"
Inclined	2' x 2'-5" x 2'-10"
Cover	2' x 1'-4" x 2'-10"

WEIGHT OF GRATING INCLUDING GRATE
315 LBS.



FRONT VIEW

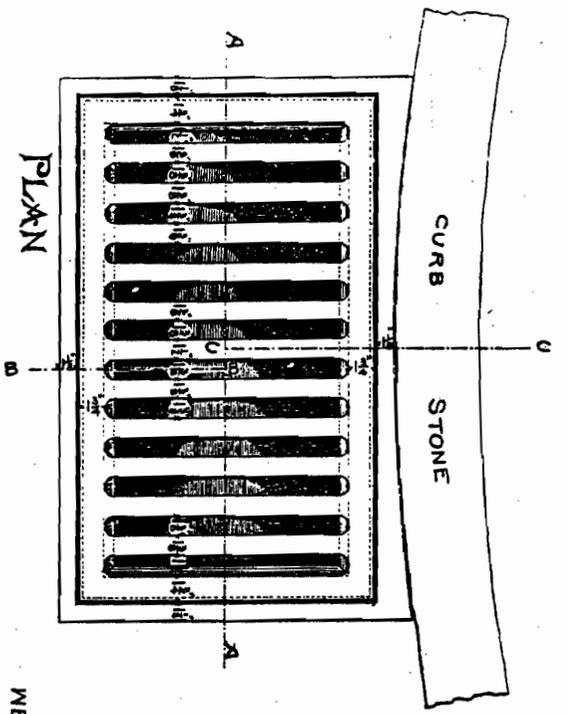


**DESIGN FOR GRATE TOP
BRICK & STONE INLET
No 1**

DEPT. OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA

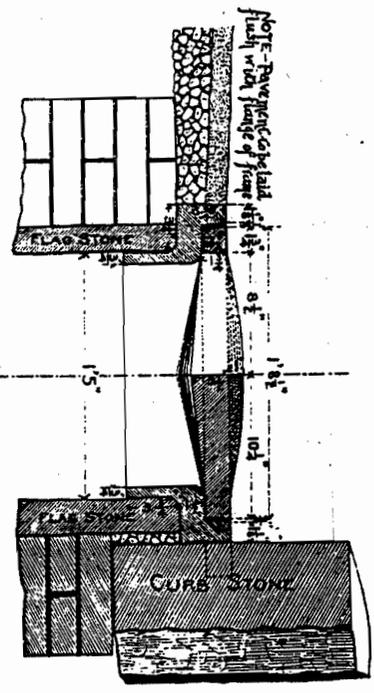
NOVEMBER 1893

E. P. Allen
Chief Engineer

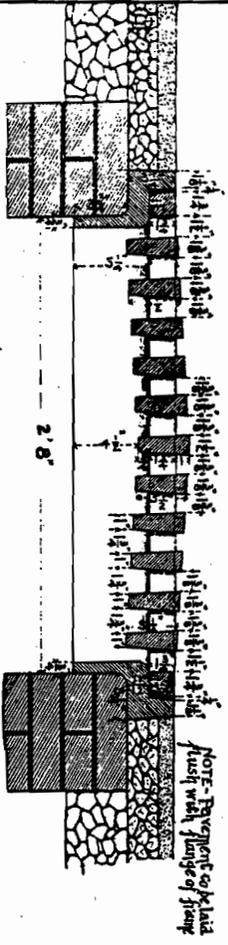


WEIGHT OF GRATING INCLUDING FRAME COMPLETE 490 LBS.

SECTION B-B SECTION C-C



SECTION A-A



DESIGN FOR GRATE TOP
BRICK & STONE INLET
No 3

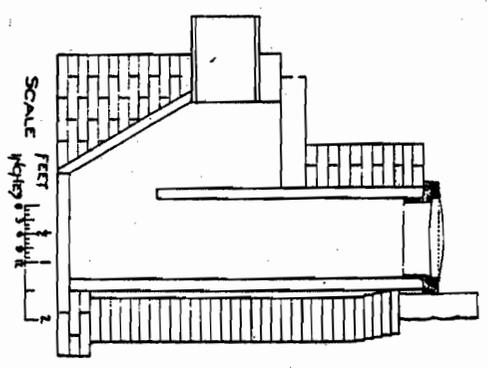
DEPT. OF PUBLIC WORKS
BUREAU OF SURVEYS
PHILADELPHIA

SCALE

0 1 2 3 4 5 6 7 8 9 10 11

DECEMBER 1899

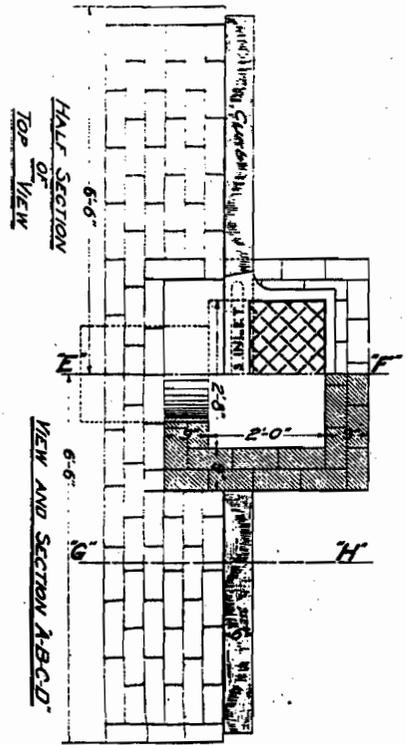
J. G. Miller
Chief Engineer



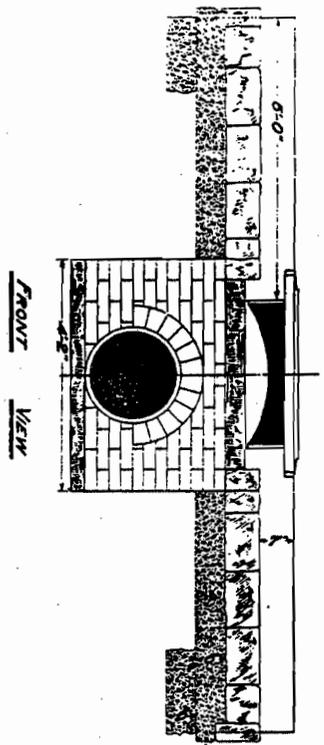
COUNTRY ROAD INLET NO. 3B.

Dept. of Public Works Bureau of Surveys
 Phila. July 1904.

E. D. Miller
 Chief Engineer

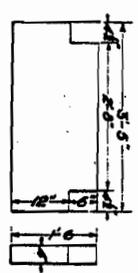
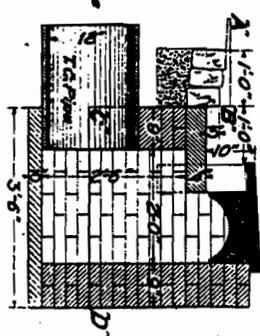


VIEW AND SECTION A-B-C-D.

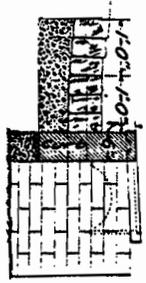
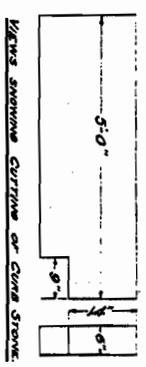


GENERAL NOTES

All Brickwork to be laid in Portland Cement Mortar.
 Foundation of inlet to be Rubble Masonry or concrete when directed.
 The Casting shall be that of a Standard No. 3 Open Mouth Inlet.
 The price for inlet shall include a Belgian Block for turn distance of 5'-6" on each side from the center line of the inlet, as shown.



Rate of Laying Curb Inlet
 Brick Stone 3'-6" x 3'-6" x 1'-0"

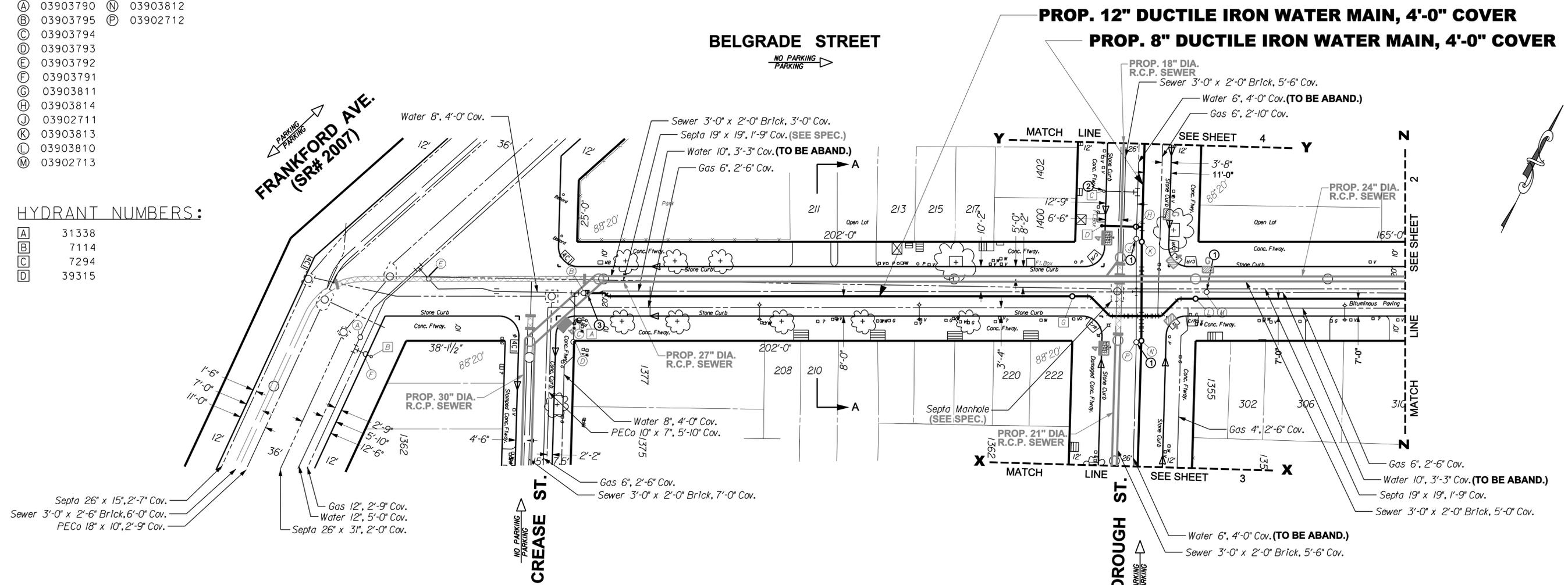


VALVE NUMBERS:

- (A) 03903790 (N) 03903812
- (B) 03903795 (P) 03902712
- (C) 03903794
- (D) 03903793
- (E) 03903792
- (F) 03903791
- (G) 03903811
- (H) 03903814
- (J) 03902711
- (K) 03903813
- (L) 03903810
- (M) 03902713

HYDRANT NUMBERS:

- (A) 31338
- (B) 7114
- (C) 7294
- (D) 39315



BILL OF MATERIALS

- 1 - Fire Hydrants W/CCL's
- 2 - 12" Gate Valve
- 2 - 8" Gate Valve
- 1 - 6" Gate Valve
- 1 - 8"x6" Hydrant Anchor Tee
- 1 - 12"x8" CROSS
- 10 - 12" - 1/8 Bend (4 Vert.)
- 4 - 8" - 1/8 Bend Vert.
- 1 - 12" D.I. Sleeve

PIPE TOTALS (THIS SHEET)

340'	+/-	12"	DUCTILE IRON WATER MAIN
130'	+/-	8"	DUCTILE IRON WATER MAIN
20'	+/-	6"	DUCTILE IRON WATER MAIN

PIPE TOTALS (ALL SHEETS)

815'	+/-	12"	DUCTILE IRON WATER MAIN
5'	+/-	10"	DUCTILE IRON WATER MAIN
875'	+/-	8"	DUCTILE IRON WATER MAIN
55'	+/-	6"	DUCTILE IRON WATER MAIN

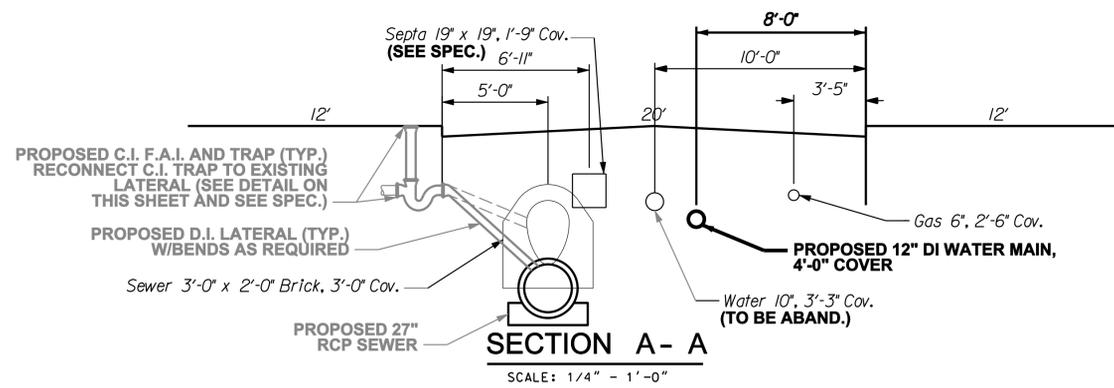
NOTICE:
 PURSUANT TO THE REQUIREMENTS OF PENNSYLVANIA ACT 287 OF 1974 (THE UNDERGROUND UTILITY LINE PROTECTION ACT), AS AMENDED BY PA ACT 199 OF 2004, THE CONTRACTOR SHALL CONTACT THE PENNSYLVANIA ONE CALL SYSTEM AT 1-800-242-1776, AT LEAST 3 DAYS PRIOR TO EXCAVATION.
 HIGHWAY DISTRICT NO. 3 WARD NO. 18
 SURVEY DISTRICT NO. 5 WATER PLAT NO. 39
 ONE CALL SERIAL NO. 1036047

WATER MAIN RELAY PROJECT

BELGRADE STREET
 FROM
CREASE ST. TO MARLBOROUGH ST.

- NOTES:**
- 1 REMOVE FRAME & COVER - SEE SPEC'S.
 - 2 REMOVE FIRE HYDRANT - SEE SPEC'S.
 - 3 REMOVE PIPE AND/OR FITTING & RECONNECT.
 - 4 ROTATE FITTINGS AS REQUIRED.

- GENERAL NOTES:**
- EXISTING WATER MAINS SHALL BE CUT & PLUGGED AS APPROVED BY THE CITY ENGINEER.
 - THE CONTRACTOR SHALL MAINTAIN A MINIMUM 6-INCH CLEARANCE BETWEEN ALL UNDERGROUND STRUCTURES AND THE NEW WATER MAINS.
 - BILLS OF MATERIAL AND PIPE TOTALS ARE FOR THE CONVENIENCE OF THE CONTRACTOR ONLY AND PAYMENT WILL BE MADE ONLY FOR THE ACTUAL AMOUNT OF PIPE AND APPURTENANCES INSTALLED.
 - FIRE HYDRANTS SHALL NOT BE CONSTRUCTED OR RELOCATED UNTIL SUCH LOCATIONS HAVE BEEN APPROVED BY THE WATER DEPARTMENT CONSTRUCTION DIVISION IN THE FIELD.
 - ALL DISTANCES SHOWN ARE IN DISTRICT STANDARD MEASUREMENT.



APPROVED CHIEF, DESIGN BRANCH, ENGINEERING DIVISION
APPROVED GENERAL MANAGER, PLANNING AND ENGINEERING
APPROVED WATER COMMISSIONER

CITY OF PHILADELPHIA WATER DEPARTMENT

SCALES:
 PLAN 1" = 20'
 AND AS NOTED

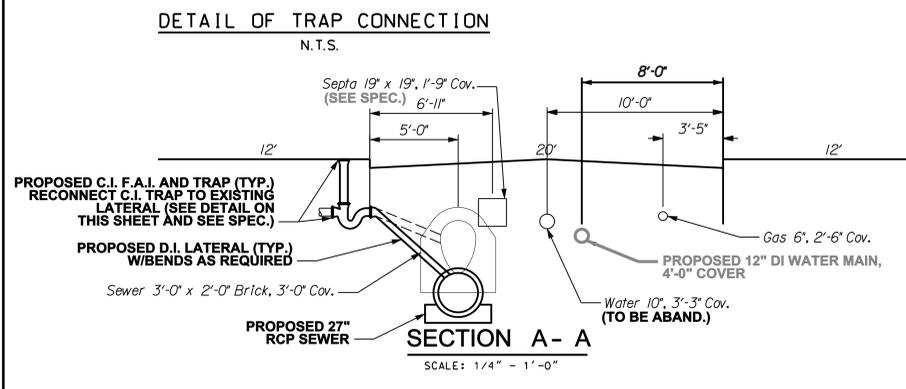
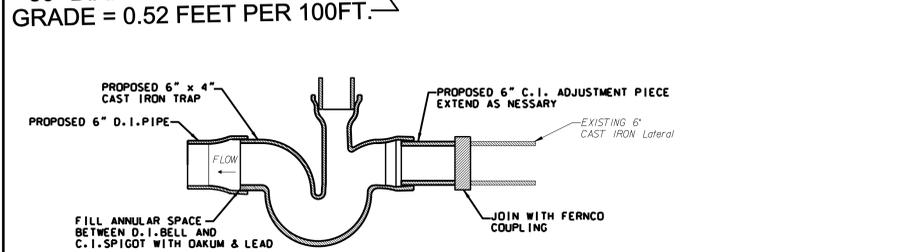
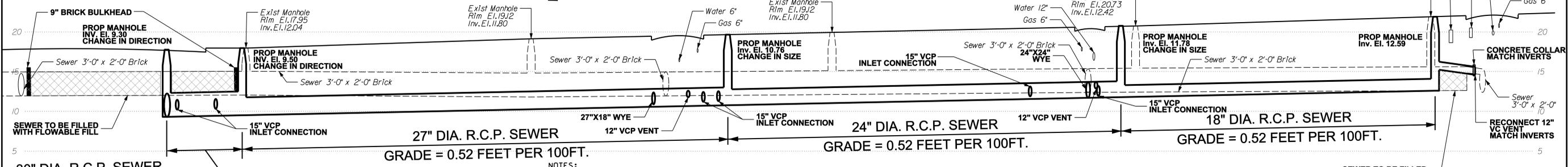
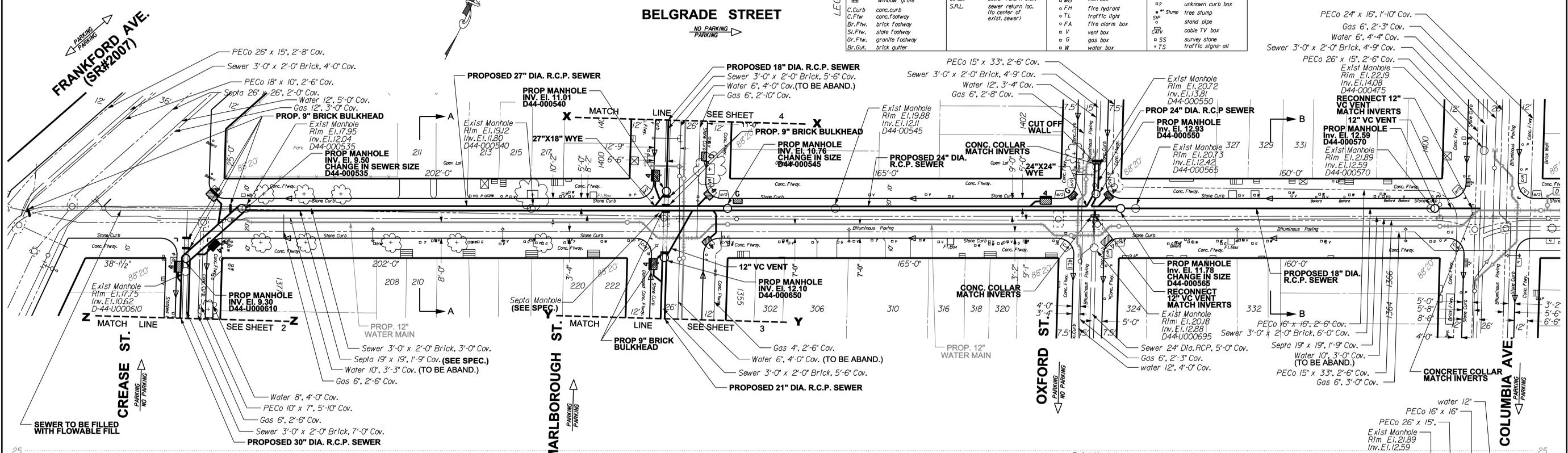
WORK NO. S-40599RD
SHEET NO. W-1 OF 8 SHEETS

DRAWN BY	CW	1/13/2011
PROJECT ENGR.	W. EL-MORSHEDY	2/11/2011
SUPERVISOR		DATE

CONTROLLING BENCHMARK:
Marble Plinth on Northeast Corner of
Palmer and Thompson ST. 1301 Palmer
Elev. 21.27

BELGRADE STREET

steps	C.D.	conc. driveway	PM	Iron post
ceiling doors	Br. Dr.	brick driveway	tree" diameter	SEPTA pole
porch	Dep. Curb	depressed curb	trunk size	electrolysis test station
exist. grate inlet	Gr. Curb	granite curb	cool chute	P.E. Pole
exist. city inlet	Bl. St. Curb	blue stone curb	o P	P.E. Pole W/ Light
old open mouth inlet	St. Wall	stone wall	o LP	Lamp Post
window grate	Br. Wall	brick wall	o MB	mail box
	H/R	handicap ramp	o FH	fire hydrant
	S.R.E.	sewer return elev.	o TL	traffic light
	S.R.L.	sewer return loc. (to center of exist. sewer)	o FA	fire alarm box
			o V	vent box
			o G	gas box
			o W	water box
			o TS	traffic signs-all

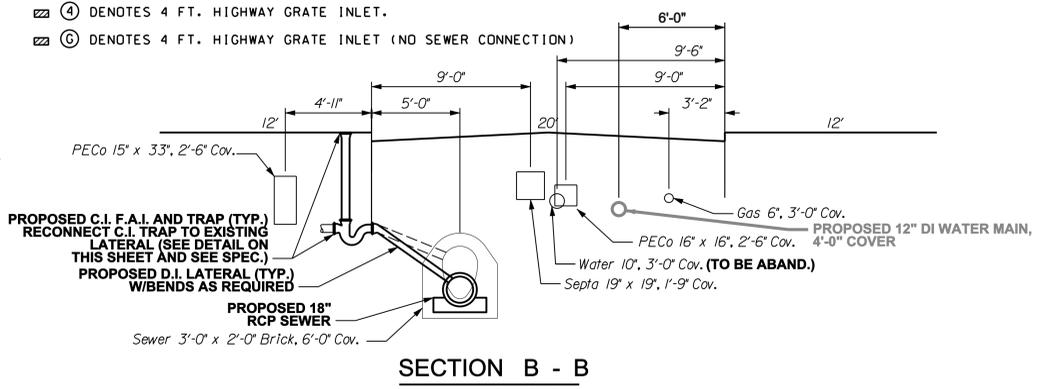


NOTES:

ALL DISTANCES SHOWN ARE IN DISTRICT STANDARD MEASUREMENT. PAYMENT FOR ALL WORK WILL BE BASED UPON THAT STANDARD.

THE LOCATIONS AND ELEVATIONS OF THE EXISTING SEWERS ARE APPROXIMATE. THE ELEVATIONS OF THE EXISTING SEWER AT THE TERMINATING CONNECTION POINTS TO THE PROPOSED SEWER MUST BE FIELD CHECKED PRIOR TO CONSTRUCTING THE NEW SEWER.

THE THICKNESS OF THE ARCHES AND THE CHARACTER AND THE EXTENT OF THE CRADLES OF THE EXISTING SEWERS ARE UNKNOWN.



NOTICE:
PURSUANT TO THE REQUIREMENTS OF PENNSYLVANIA ACT 287 OF 1974 (THE UNDERGROUND UTILITY LINE PROTECTION ACT), AS AMENDED BY PA ACT 199 OF 2004, THE CONTRACTOR SHALL CONTACT THE PENNSYLVANIA ONE CALL SYSTEM AT 1-800-242-1776, AT LEAST 3 DAYS PRIOR TO EXCAVATION.

HIGHWAY DISTRICT NO. 3 WARD NO. 18
SURVEY DISTRICT NO. 5 DRAINAGE SHT. NO. 42 OUTFALL NO. D-44
ONE CALL SERIAL NO. 1036047.1036056

SEWER REHABILITATION PROJECT

BELGRADE STREET

FROM
FRANKFORD AVE. TO **COLUMBIA AVE.**

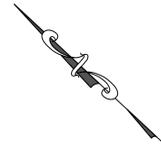
CITY OF PHILADELPHIA
WATER DEPARTMENT

APPROVED: CHIEF, DESIGN BRANCH, ENGINEERING DIVISION
APPROVED: GENERAL MANAGER, PLANNING AND ENGINEERING
APPROVED: WATER COMMISSIONER

PLAN SCALE: 1" = 20'
PROFILE SCALE: 1" = 20'
VERT. SCALE: 1" = 5'

WORK NO. S-40599RD
SHEET NO. S-1 OF 4 SHEETS

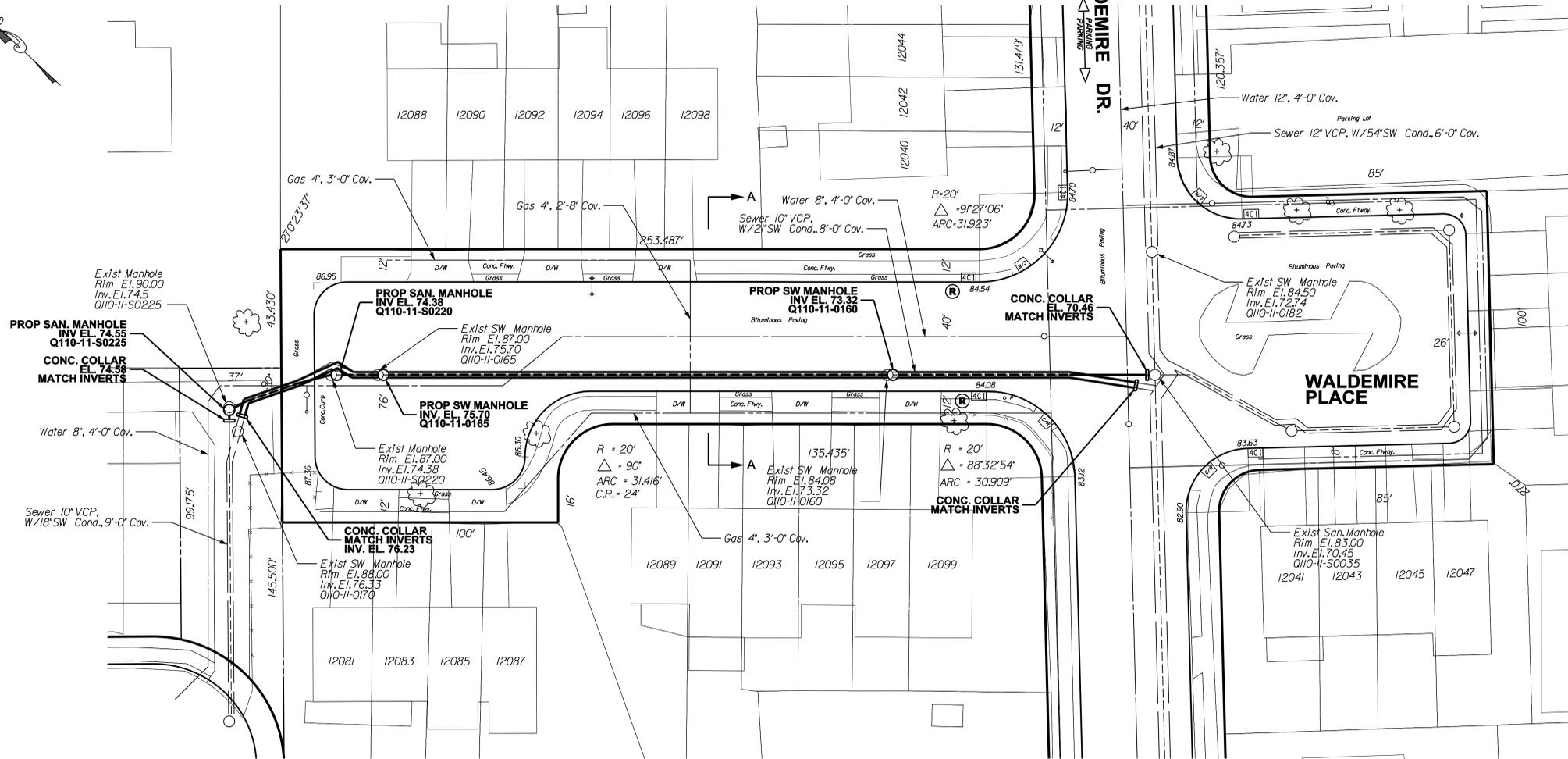
DRAWN BY: CW 1/13/2011
PROJECT ENGR.: W. EL-MORSHEDY 2/11/2011
SUPERVISOR: DATE



LEGION STREET



WALDEMIRE DR.



LEGEND

PM	parking meter
⊙	tree - denotes trunk size
○	cool chute
—X—	fence
P	pole
LP	Lamp Post
MB	mail box
FH	fire hydrant
TL	traffic light
FA	fire alarm box
V	vent box
G	gas box
W	water box
IP	iron post
SP	SEPTA pole
⊙	electrolysis test station
+	P.E. Pole
→	P.E. Pole W/ Light
○DS	downspout
□?	Unknown Curb Box
•••	Tree Slump
SP	stand pipe
○TV	cable TV box
○SS	survey stake
×TS	traffic signs - all
steps	steps
cellar doors	cellar doors
parch	parch
exist.grate Inlet	exist.grate Inlet
exist.city Inlet	exist.city Inlet
* to denote size	* to denote size
exist.CMGJ	exist.CMGJ
winrow grate	winrow grate
concrete curb	concrete curb
concrete footway	concrete footway
brick footway	brick footway
slate footway	slate footway
granite footway	granite footway
brick gutter	brick gutter
concrete driveway	concrete driveway
handicap ramp	handicap ramp
Sewer Return Loc.	Sewer Return Loc.
(to center of exist.sewer)	(to center of exist.sewer)
S.R.E.	Sewer Return Elev.
Dep.Curb	Depressed curb
Gr.Curb	Granite curb
Bl.St.Curb	Blue stone curb
St.Wall	Stone wall
Br.Wall	Brick wall

NOTES:

ALL DISTANCES SHOWN ARE IN DISTRICT STANDARD MEASUREMENT. PAYMENT FOR ALL WORK WILL BE BASED UPON THAT STANDARD.

THE LOCATIONS AND ELEVATIONS OF THE EXISTING SEWERS ARE APPROXIMATE. THE ELEVATIONS OF THE EXISTING SEWER AT THE TERMINATING CONNECTION POINTS TO THE PROPOSED SEWER MUST BE FIELD CHECKED PRIOR TO CONSTRUCTING THE NEW SEWER.

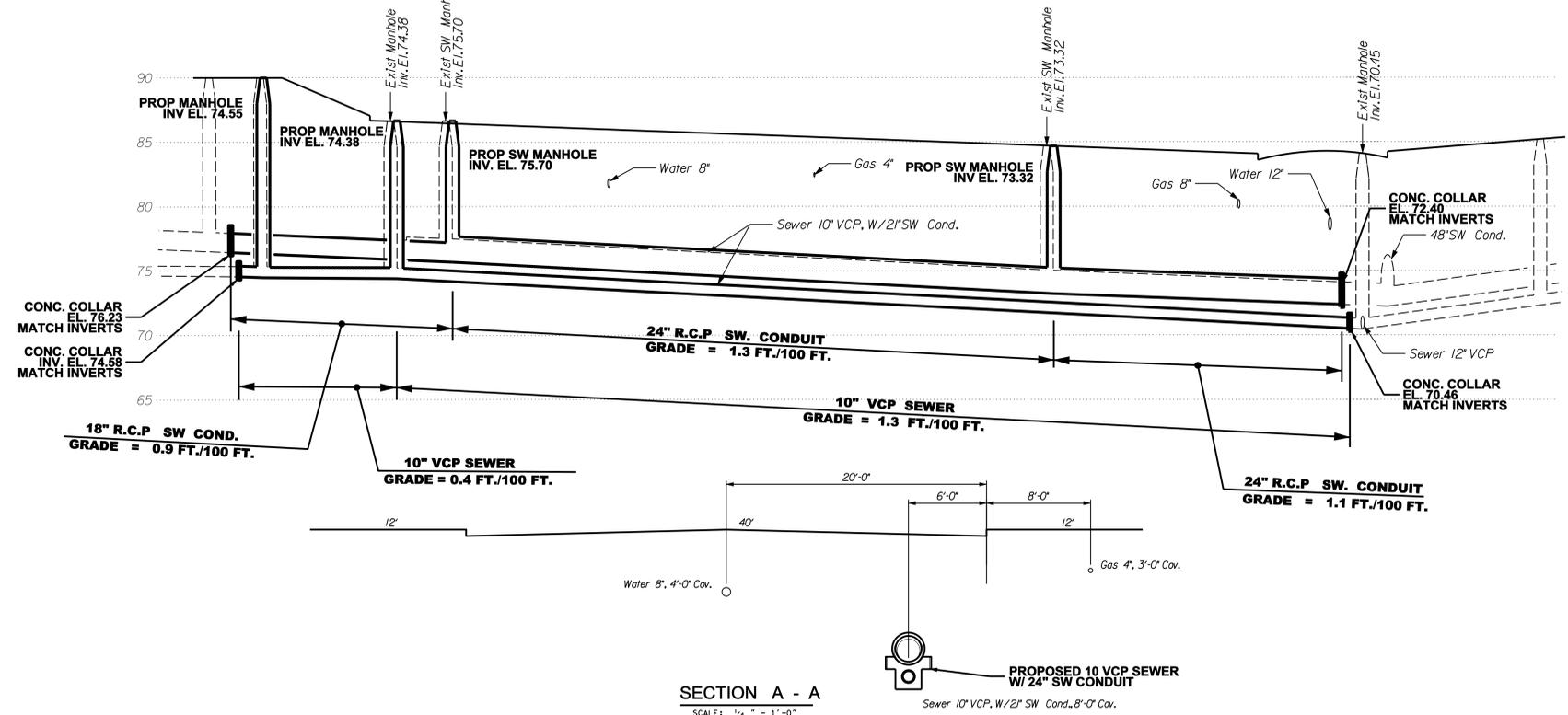
THE THICKNESS OF THE ARCHES AND THE CHARACTER AND THE EXTENT OF THE CRADLES OF THE EXISTING SEWERS ARE UNKNOWN

Ⓡ DENOTES EXISTING INLET TO BE RECONNECTED.

NOTICE:

PURSUANT TO THE REQUIREMENTS OF PENNSYLVANIA ACT 287 OF 1974 (THE UNDERGROUND UTILITY LINE PROTECTION ACT), AS AMENDED BY PA ACT 199 OF 2004, THE CONTRACTOR SHALL CONTACT THE PENNSYLVANIA ONE CALL SYSTEM AT 1-800-242-1776, AT LEAST 3 DAYS PRIOR TO EXCAVATION.

HIGHWAY DISTRICT NO. 6 WARD NO. 66
 SURVEY DISTRICT NO. 4 DRAINAGE SH. NO. 111 OUTFALL NO. 0-110
 ONE CALL SERIAL NO. 20103021162



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

SEWER REHABILITATION PROJECT

LEGION STREET
 FROM
 ABBY RD TO WALDEMIRE DR.

APPROVED _____ CHIEF, DESIGN BRANCH, ENGINEERING DIVISION

CITY OF PHILADELPHIA
 WATER DEPARTMENT

SCALES:
 PLAN 1" = 20'
 PROFILE HORZ. 1" = 20'
 VERT. 1" = 5'

WORK NO. S-40740-R
 SHEET NO. S-3 OF 3 SHEETS

DRAWN BY	TK
PROJECT ENGR.	
SUPERVISOR	
DATE	

CONTROLLING BENCH MARK

Southwest corner of Harmony & Wharton Sts. point on northwest corner of "H" beam base 65' ± 25.50

Field Book 236-A

NOTE: High power electrical lines and ductwork running above wire mesh fence on west side of Schuylkill Ave.

30" R.C. PIPE SEWER GRADE = 1.17' PER 100'

Exist. Manhole Rim El. +11.40 Inv. El. -1.88 Crown El. +3.24

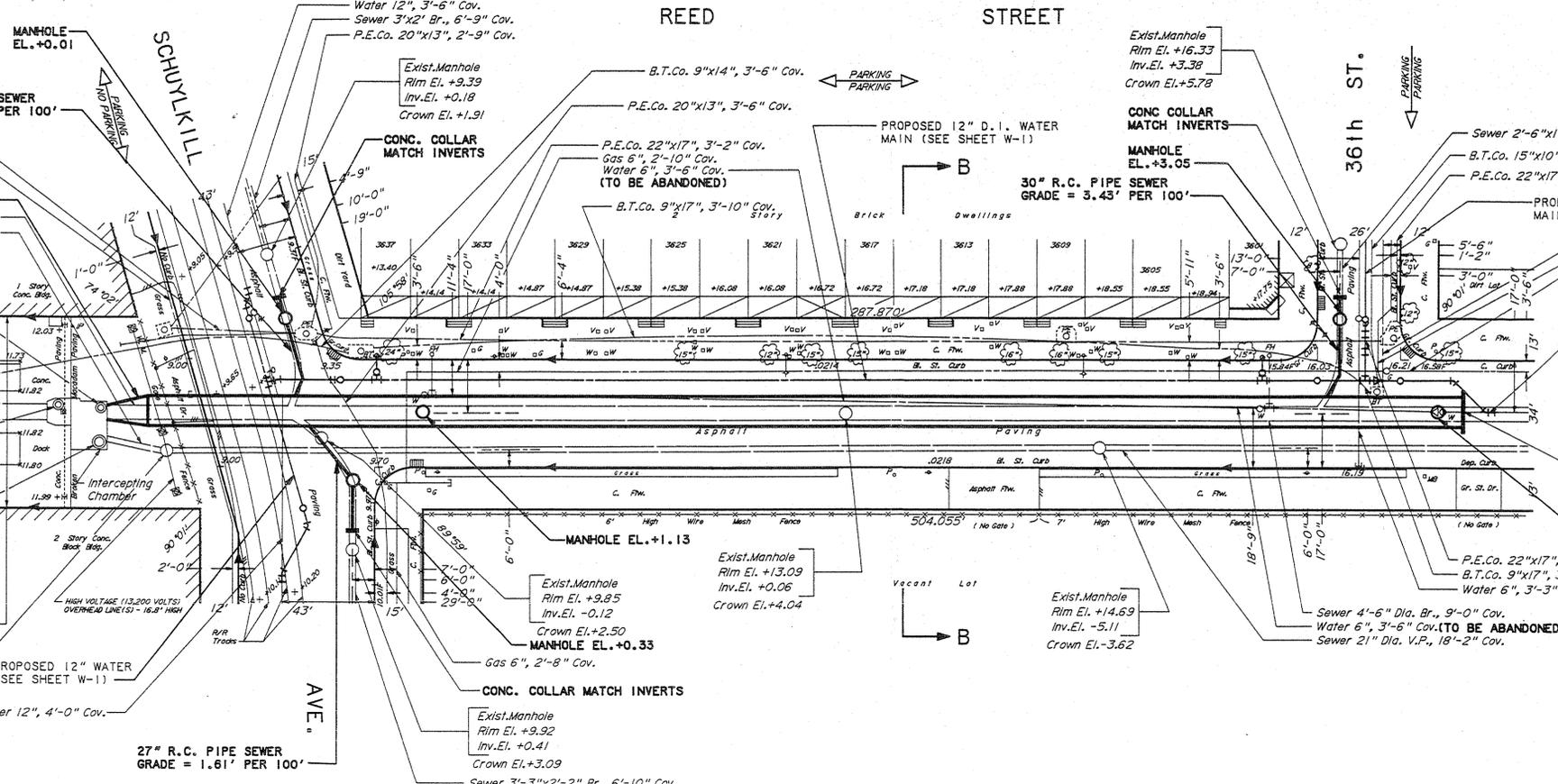
SEE SHEET S-1 FOR CONTINUATION OF WORK UNDER THIS CONTRACT

Exist. Manhole Rim El. +11.88 Inv. El. -2.06 Crown El. +3.18

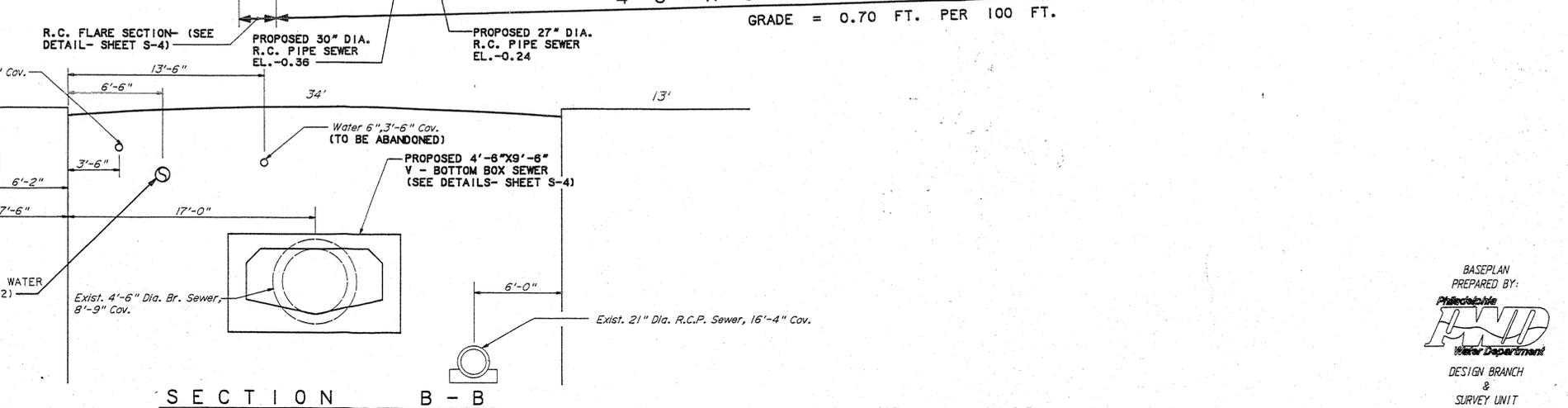
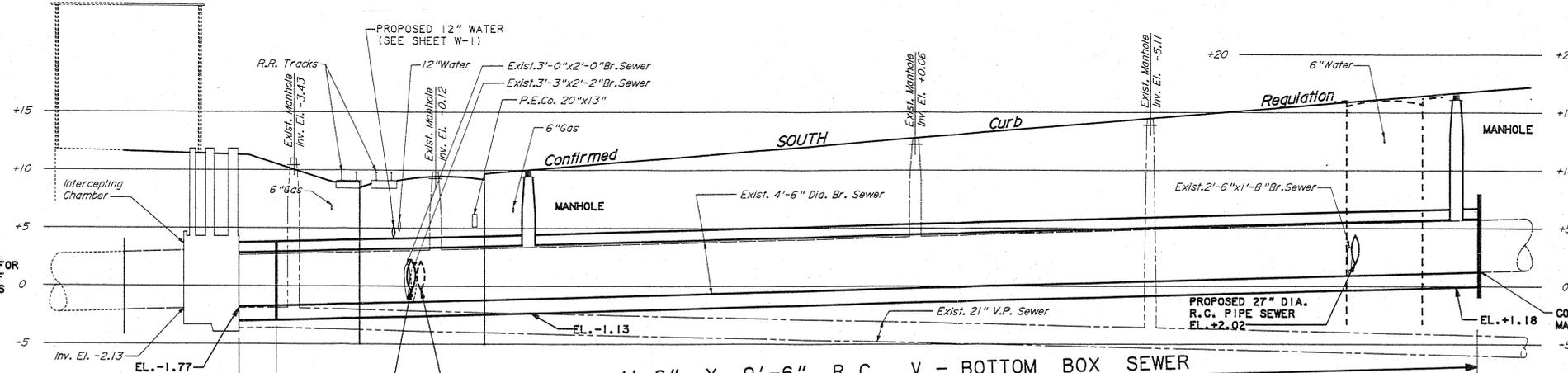
Exist. Manhole Rim El. +11.46 Inv. El. -3.60 Crown El. +5.39

RIGHT TO CONSTRUCT & MAINTAIN SEWER

Exist. Manhole Rim El. +10.92 Inv. El. -3.43 Crown El. -1.96



LEGEND table with symbols for steps, cellar doors, existing grate inlets, etc., and their corresponding descriptions.

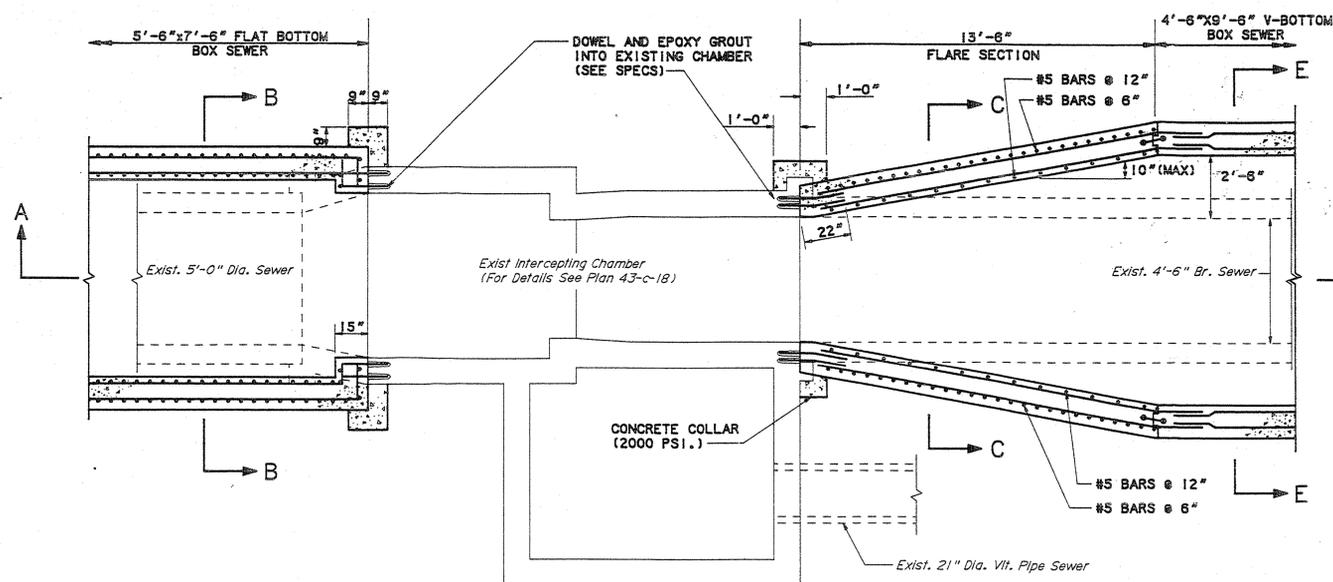


NOTES: FOR NOTES SEE SHEET S-1. NOTICE: PURSUANT TO THE REQUIREMENTS OF PENNSYLVANIA ACT 172 (1988), THE CONTRACTOR SHALL CONTACT THE PENNSYLVANIA ONE CALL SYSTEM AT 1-800-242-1776, AT LEAST 3 DAYS PRIOR TO EXCAVATION.

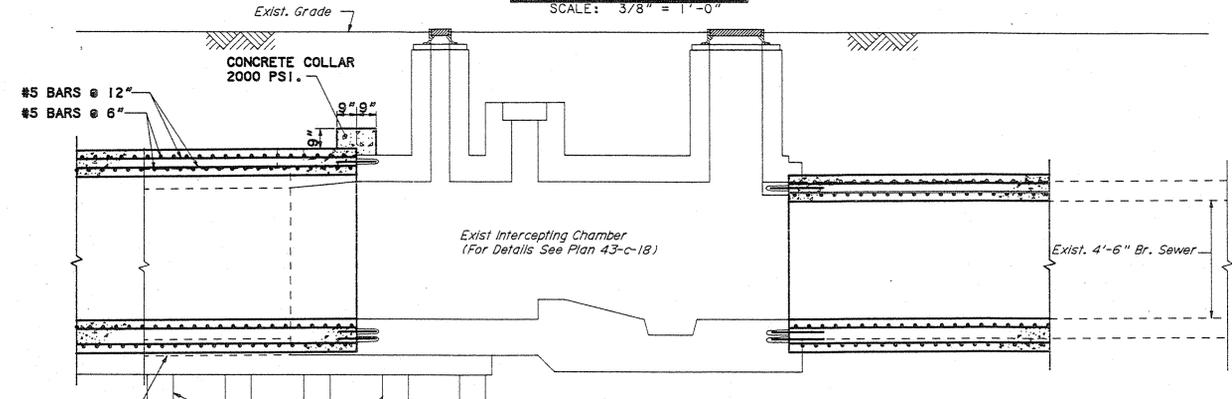
HIGHWAY DISTRICT NO. 2 WARD NO. 36 SURVEY DISTRICT NO. 2 DRAINAGE SHT. NO. 24 SEWER RECONSTRUCTION PROJECT

Approval and project information block including 'REED STREET FROM SCHUYLKILL RIVER TO 36th STREET', 'APPROVED' stamp, 'CITY OF PHILADELPHIA WATER DEPARTMENT', scales, and project number 'WORK NO. S-5157RD (SHEETS) SHEET NO. S-3 OF SHEETS'.

Sample of R.C. BOX SEWER SYSTEM



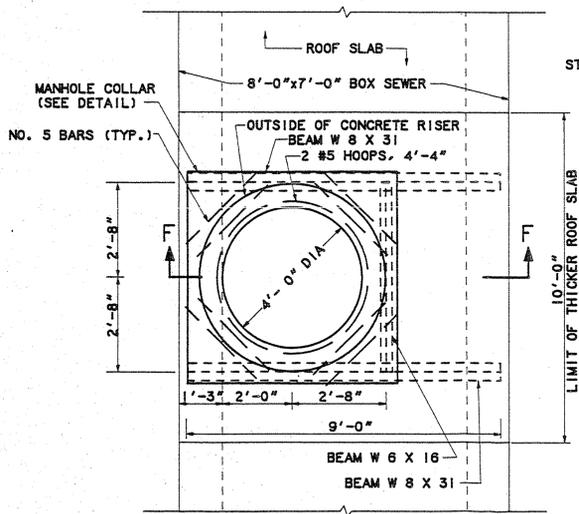
PLAN
SCALE: 3/8" = 1'-0"



SECTION A - A
SCALE: 3/8" = 1'-0"

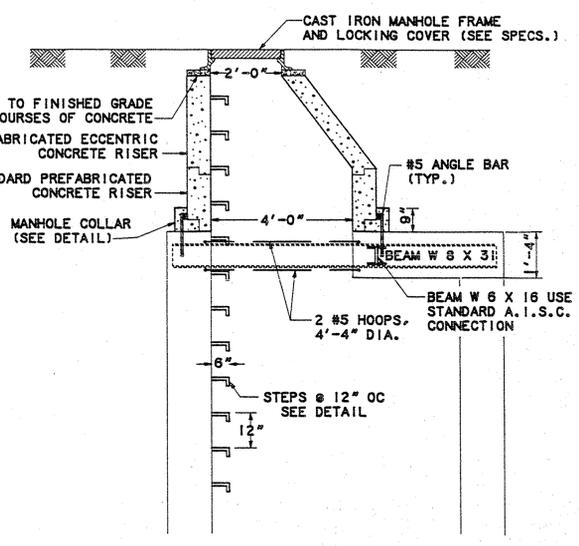
Exist. 5'-0" Dia. Sewer on Piles and Platform. (See Plan 5B-236-1899)

NOTE:
ANY ADDITIONAL MATERIAL NECESSARY BETWEEN SEWER AND EXISTING PLATFORM SHALL BE 3500 PSI. CONCRETE AND SHALL BE INCLUDED IN THE COST FOR S.W. BOX CONDUIT.

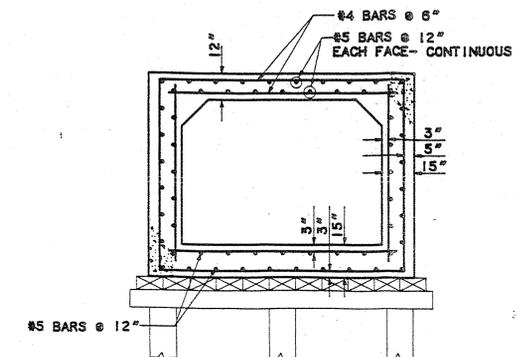


PLAN

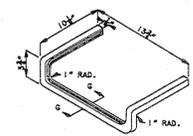
TYPICAL MANHOLE DETAIL
SCALE: 1/2" = 1'-0"



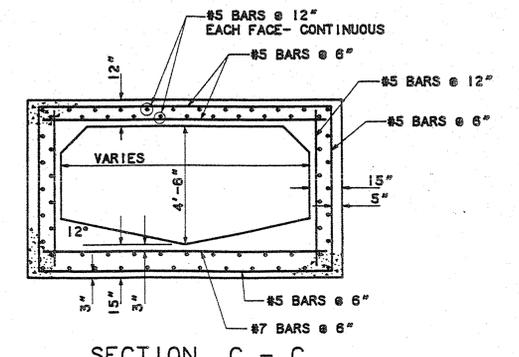
SECTION F-F



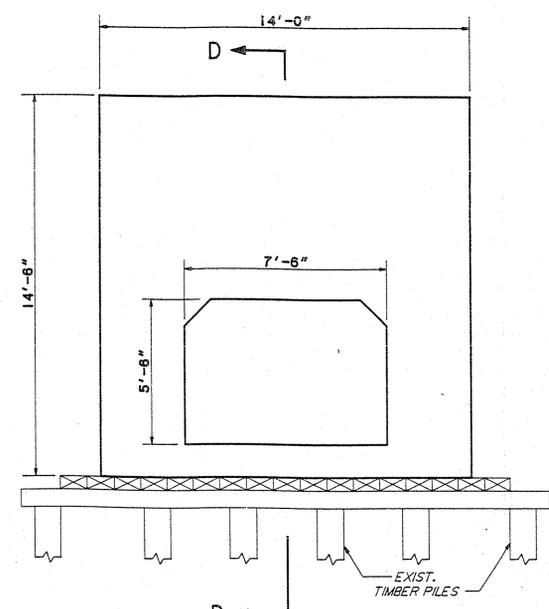
SECTION B - B
SCALE: 3/8" = 1'-0"



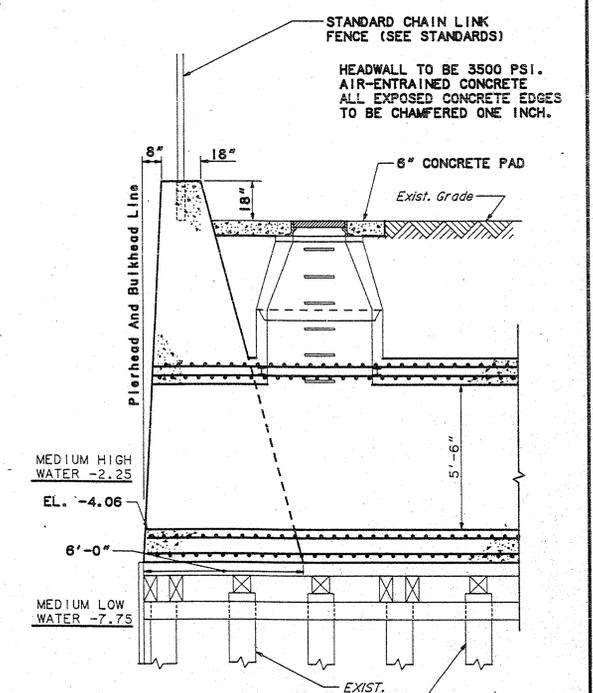
MANHOLE STEP DETAIL
N.T.S.



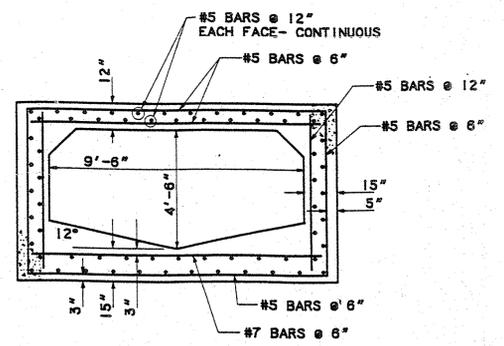
SECTION C - C
SCALE: 3/8" = 1'-0"



SUREKILL RIVER HEADWALL
SCALE: 3/8" = 1'-0"



SECTION D - D
SCALE: 3/8" = 1'-0"



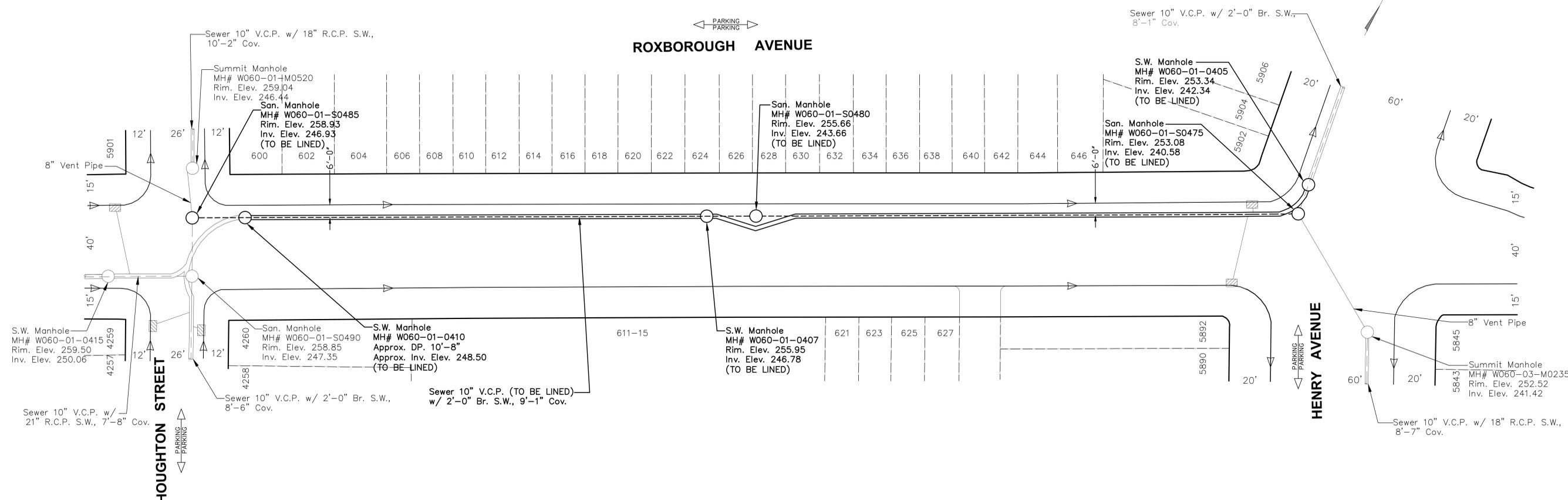
SECTION E - E
SCALE: 3/8" = 1'-0"

SEWER RECONSTRUCTION PROJECT

REED STREET
FROM
SCHUYLKILL RIVER TO 36th STREET
DETAILS FOR CONSTRUCTION

APPROVED: CHIEF, DESIGN BRANCH, ENGINEERING DIVISION
CITY OF PHILADELPHIA
WATER DEPARTMENT
SCALE: AS NOTED

WORK NO. S-5157RD (SHEETS)
SHEET NO. S-4 OF SHEETS
DRAWN BY: PROJECT ENGR.
SUPERVISOR: DATE:



NOTICE:
 PURSUANT TO THE REQUIREMENTS OF PENNSYLVANIA ACT 38 (1991), THE CONTRACTOR SHALL CONTACT THE PENNSYLVANIA ONE CALL SYSTEM AT 1-800-242-1776, AT LEAST 3 DAYS PRIOR TO EXCAVATION.

HIGHWAY DISTRICT NO. 04 WARD NO. 26
 SURVEY DISTRICT NO. 06 DRAINAGE SHT. NO. 59, 60 OUTFALL NO. S-051-08
 ONE CALL SERIAL NO. XXXXX

SIZE	LENGTH	LINER THICKNESS (mm)
10" VC	535'	6.0 mm
2'-0" BRICK	525'	13.0 mm

SEWER LINING PROJECT

ROXBOROUGH AVENUE
 FROM
 HENRY AVENUE TO HOUGHTON STREET

APPROVED _____
 CHIEF, DESIGN BRANCH, ENGINEERING DIVISION

CITY OF PHILADELPHIA
 WATER DEPARTMENT

PLAN _____
 SCALES: 1"=20'

WORK NO. S-40706-R
 SHEET NO. S-10 OF 13 SHEETS

DRAWN BY	S. DONAHUE	9/15/09
PROJECT ENGR.	W. EL-MORSHEDEY	9/15/09
SUPERVISOR		DATE