

**CITY OF PLYMOUTH, INDIANA**

**STANDARDS**  
*FOR THE*  
**DESIGN AND CONSTRUCTION**  
*OF*  
**SANITARY SEWERS,**  
**STORM SEWERS**  
*AND*  
**SANITARY LIFT STATIONS**

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**CITY OF PLYMOUTH, INDIANA**  
**SANITARY SEWER**  
**DESIGN AND CONSTRUCTION STANDARDS**

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**SECTION 1**  
**INTRODUCTION**

# SECTION 1 INTRODUCTION

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**SECTION 1**  
**INTRODUCTION**

**1.01 General**

The City of Plymouth is responsible for ensuring the proper installation of all facilities as part of sanitary and storm sewers constructed in or connected to the existing City facilities. All facilities shall be designed and constructed in accordance with these Standards as well as applicable State and Federal regulations.

The purpose of these Standards is to establish a minimum criteria for design and workmanship. The jurisdiction of the Standards is as follows:

A. Sanitary Sewers

The entire sanitary system and appurtenances from the point of connection with the building plumbing to the final point of discharge at the treatment facility.

B. Sanitary Lift Stations

The entire arrangement of pumps, valves and controls that lift or convey wastewater to a higher elevation.

C. Storm Sewers

The entire storm sewer system from the public right of way to the final point of discharge.

It shall be the Owner's/Contractor's responsibility to comply with all requirements of the City or other authority having jurisdiction on work if such authority imposes greater requirements. Furthermore, the Owner shall be responsible for procuring all necessary permits and licenses, pay all charges and fees for acquiring and recording all easements, providing current Certificate of Insurance, and giving all notices necessary and incidental to the work. Permits required to be paid in full prior to construction are: 1) sewer tapping fees 2) street cuts, curb cuts and sidewalks.

Addenda and/or revisions to these Standards may be issued periodically and will be distributed and made available to the public and contractor at the City Hall, 124 N. Michigan Street or at the City's website: [www.plymouthin.com](http://www.plymouthin.com). Users shall be responsible to keep apprised of any changes and revisions to these Standards.

Any conflicts between these Standards and any applicable State laws shall be superseded by such law. If any conflict arises between these Standards and applicable City or County Ordinances, these Standards shall prevail. These Standards are approved and adopted by the City Council, City of Plymouth.

**SECTION 2**  
**DEFINITIONS AND TERMS**

SECTION 2  
DEFINITIONS AND TERMS

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## SECTION 2

### DEFINITIONS AND TERMS

#### 2.01 Definitions and Terms

Whenever in these Standards or in any documents the following terms, abbreviations, or definitions are used, the intent and meaning shall be interpreted as follows:

##### A. Abbreviations

IDOTSS	Indiana Department of Transportation Standard Specifications
MUTCD	Manual on Uniform Traffic Control Devices, latest edition
ADASS	American National Standards for Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People, latest edition
ASTM	American Society of Testing and Materials
AASHTO	American Association of State Highway and Transportation Officials
AWWA	American Water Works Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ACI	American Concrete Institute
NEMA	National Electrical Manufacturers Association
INDOT	Indiana Department of Transportation
OSHA	Federal Occupational Safety and Health Act
NSF	National Sanitation Foundation
IDEM	Indiana Department of Environmental Management
ISO	Insurance Services Office, State of Indiana

##### B. Definitions

1. **Acceptance:** The formal written acceptance by the City of Plymouth (City) of an entire project which has been completed in all respects in accordance with the approved Plans, Specifications and these Standards including any previously approved modifications thereof.
2. **Backfill:** Earth and/or other material used to replace material removed from trenches during construction which is above the pipe bedding.
3. **Bedding:** That portion of the trench backfill which encases the sewer or water pipe to a minimum depth above and below the bell/barrel of the pipe, as provided in the **Bedding** section of these Standards, for the purpose of properly supporting the pipe.



4. **Building Sewer (lateral):** The conduit for transporting waste discharged from the building to the public sewer commencing three (3) feet outside the building walls and ending at the City owned public sewer. Property owner is also responsible for the maintenance of the tap, per Ordinance No. 93 – 1581.
5. **City:** City of Plymouth, Indiana
6. **City Engineer:** Authorized Agent by the City of Plymouth
7. **City Representative:** The authorized agent of the City assigned to make detailed observation of any or all portions of the work.
8. **Contractor:** Any Contractor who meets the City’s requirements and is licensed to enter into contracts for and to perform the work of installing sewers.
9. **County:** The County of Marshall, State of Indiana.
10. **Easement:** Easements are areas along the line of all public sanitary and storm sewers and water lines which are outside of dedicated utility or road easements or rights-of-way, and are recorded and dedicated to the City granting rights along the line of the sewer. Easements shall be exclusively for sanitary and storm sewers. No other utilities shall be constructed or encroach upon the easement except with the expressed written approval of the City.
11. **Engineer:** The Engineer for the Owner.
12. **Infiltration/Inflow:** The total quantity of water from both infiltration and inflow without distinguishing the source.
13. **Inspector:** An agent of the City assigned to make detailed inspection of any or all portions of the work and materials. The inspector has full authority to reject materials and/or any portion of the work not supplied and installed in accordance with these Standards.
14. **Lift Station:** Any arrangement of pumps, valves and controls that lift and/or convey wastewater to a higher elevation.
15. **Other Specifications and Materials:** Wherever in these Standards other specifications or regulations are mentioned, it shall be understood that the materials and methods mentioned therewith shall conform to all requirements of the latest revision of the specifications so mentioned.
16. **Owner:** Any individual, partnership, firm, corporation or other entity who, as property owner, is initiating the work.

17. **Permits:** Clearance to perform specific work under specific conditions at specific locations. The Owner or his duly authorized representative shall furnish to the superintendent all necessary plans and documents required by the superintendent to make applications for permits.
18. **Plans:** Construction plans, including system maps, sewer plans and profiles, cross sections, utility plans, detailed drawings, etc., or reproductions thereof, approved or to be approved by the City Engineer which show location, character, dimensions and details of the work to be done.
19. **Project:** All work to be completed under the City's permit in accordance with the approved plans, specifications, these standards and the permit conditions.
20. **Record Drawing (As-Builts):** Plans certified, signed and dated by a professional engineer, surveyor or architect registered in the State of Indiana, indicating that the Plans have been reviewed and revised, if necessary, to accurately show all as-built construction and installation details including, but not limited to, key elevations, locations and distances.
21. **Right-of-Way:** All land or interest therein which by deed, conveyance, agreement, easement, dedication or process of law is reserved for or dedicated to the use of the general public, within which the City shall have the right to install and maintain sewers, water lines, and streets.
22. **Sewer:** A pipe or conduit for carrying wastewater (sanitary sewer) and storm water (storm sewer).
23. **Standard Drawings:** The drawings of structures, sanitary sewer or storm lines, or devices commonly used and referred to on the Plans and in these Standards.
24. **Standards:** The Standards for Public Works Projects Design and Construction within the City of Plymouth sewer system as contained herein and all subsequent additions, deletions or revisions.
25. **Street:** A street is an area within a right-of-way which affords the principal means of access to abutting property.
26. **Substantial Completion:** The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of the Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the project plans and specifications, so that the Work (or specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

27. **Superintendent:** Superintendent of the City Wastewater Department or his/her authorized representative.
28. **Ten State Standards (sewage works):** Recommended Standards for Sewage Works, latest edition, developed by the Committee of the Great Lakes - Upper Mississippi River Board of State Sanitary Engineers. Reference their website at: [www.hes.org](http://www.hes.org)
29. **Uniform Plumbing Code:** The Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials, current edition.
30. **Watercourse:** The meaning of watercourse shall include channel, creek, ditch, river or stream.
31. **Work:** All the work to be done, in accordance with the approved Plans, Specifications, these Standards and permit conditions.

**SECTION 3**

**GENERAL RULES  
AND REQUIREMENTS**

## SECTION 3 GENERAL RULES AND REQUIREMENTS

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## SECTION 3

### GENERAL RULES AND REQUIREMENTS

#### 3.01 General

This Section provides the general rules and policies, the construction of facilities as part of sanitary sewers and storm sewers, including permit requirements and inspection. The ordinances for sanitary and storm sewer systems governing these Standards are available for inspection at the City Hall or at the City's website at [www.plymouthin.com](http://www.plymouthin.com).

#### 3.02 Building Sewers (laterals)

The following paragraphs provide a highlight of the provisions contained in the applicable City Ordinances.

##### A. Prohibition Against Clean Water Discharges

No person shall discharge or cause to be discharged to any sanitary sewers either directly or indirectly:

- ! Storm Water
- ! Surface Water
- ! Ground Water
- ! Roof Runoff
- ! Subsurface Drainage (gravity or pumped)
- ! Uncontaminated Cooling Water
- ! Unpolluted Water
- ! Unpolluted Industrial Process Water

##### B. Mandatory Inspection of Building Connections

It shall be the responsibility of the Owner to notify the City that the sewer work is available for inspection. The City will conduct inspections on connections after not less than 24 hours notice has been given, from 7:00 AM to 3:00 PM Monday through Friday except on observed City holidays. The building sewer shall be fully exposed from the foundation to the point of connection with the public sewer.

The City may take a minimum of two (2) construction "as-built" photos for City record prior to backfilling.

The City and its authorized representative shall have the right of entry upon or through any premises for purpose of inspection of sewer work and any other construction activity performed on or associated with the connection of the building sewer to the City sewer, including inspection for clear water discharges into the sewer.

C. Building Sewer Responsibility

It shall be the responsibility of the property owner(s) whose property is benefited to provide for, install and make private connections for the use of their premises to an existing public sewer, including the tap connection. Further, it shall be the responsibility of the owner to make all necessary repairs, extensions, relocations, changes or replacements thereof and of any accessories thereto. These requirements may be altered, modified or waived at the discretion of the City when it is shown that compliance is not possible due to extenuating circumstances.

Exceeding specified deadlines results in a minimum \$100 assessed damages due to delay.

D. Demolition of Buildings and Retiring Building Connections (laterals)

Contractor shall locate the sanitary sewer services (laterals) in the buildings and direction of flow. Contractor shall excavate and expose sanitary sewer services (laterals) at a point approximately 10 feet on the building side of the property line. Cut pipe cleanly and square, install rubber coupling with stainless steel bands (fernco brand or equal) with SDR-35 PVC pipe plug.

Mark the end of pipe with 4"x4" pressure treated wood post starting at end of pipe and extending a minimum of 12" above finished grade. Contractor shall contact the City of Plymouth Wastewater department, giving not less than 48 hours' notice of when the Wastewater Department should be on site to inspect the exposed line and cap prior to backfilling. Failure to have City inspection will result in re-excavation at contractor expense.

**3.03 Design/Construction Approval for Development**

A. Requirements for Construction Permits

It shall be the responsibility of the Owner/Contractor to obtain a valid Construction Permit for the construction or modification of any facility as part of sewers from the Indiana Department of Environmental Management (IDEM), Indiana Department of Transportation, or any other applicable regulatory agency.

A copy of this permit shall be filed with the City.

B. Water Main Protection

1. Horizontal and Vertical Separation: Sewers and building services (laterals) shall be laid at least 10 feet (3 m) horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot (3 m) separation, the appropriate reviewing agency may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer or service lateral closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer or service lateral and at an

elevation so the bottom of the water main is at least 18 inches (460 mm) above the top of the sewer or service lateral.

If it is impossible to obtain proper horizontal and vertical separation as described above, both the water main and sewer or service lateral must be constructed of slip-on gasketed joint or mechanical joint pipe complying with public water supply design standards of the agency and be pressure tested to 150 psi (1034 kPa) to assure water tightness before backfilling. The water grade pipe utilized may be SDR-21 PVC, C900 PVC or Ductile iron class 150. Private laterals may utilize PVC SDR-26 pipe.

2. Crossings: Sewers and service laterals crossing water mains shall be laid to provide a minimum vertical distance of 18 inches (460 mm) between the outside of the water main and the outside of the sewer or lateral. This shall be the case where the water main is either above or below the sewer or lateral. The crossing shall be arranged so that the sewer or lateral joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer or lateral, adequate structural support shall be provided for the sewer or lateral to maintain line and grade.

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, one of the following methods must be specified:

- a. The sewer or lateral shall be designed and constructed equal to water pipe, and shall be pressure tested at 150 psi (1034 kPa) to assure water tightness prior to backfilling. The water grade pipe utilized may be SDR-21 PVC, C900 PVC or Ductile iron class 150. Private laterals may utilize PVC SDR-26 pipe.
- b. Either the water main or the sewer or lateral line may be encased in a watertight carrier pipe which extends 10 feet (3 m) on both sides of the crossing, measured perpendicular to the water main. The carrier pipe shall be of materials approved by the regulatory agency for use in water main construction.

C. Technical Review Committee (TRC)

The Owner/Contractor shall submit design drawings for review and approval to the City Engineer. For each project the Owner/Contractor shall request a presentation hearing before the TRT through the City of Plymouth's Clerk / Treasurers' office. During this meeting the TRC may recommend approval of the project or request formal revisions. Revised drawings and specifications shall be resubmitted to the City Engineer for final approval.

D. Posting of Bond

1. The City requires the posting of a performance bond from a company licensed by the State of Indiana to provide such surety. Such bond shall



be equal to 100% of the contract amount or an amount established by the City to provide surety for the satisfactory completion of the improvements and shall name the City of Plymouth who can enforce the obligations there under. The duration of the bond shall be through the date of substantial completion of the project. The City of Plymouth shall agree to the date of substantial completion.

2. The City requires the posting of a maintenance bond from a company licensed by the State of Indiana to provide such surety. Such bond shall be equal to 10% of the contract amount or an amount established by the City to provide surety for the satisfactory completion of the improvements and shall name the City of Plymouth who can enforce the obligations thereunder. The duration of the bond shall be one (1) year beyond the date of substantial completion.
3. The City may, as an alternative to the posting of such bond, accept other appropriate security such as properly conditioned irrevocable letter of credit which meets the same objective as the bonds described in this section, subject to approval of any other department or agency whose interests are protected by the same bonding requirement or cash. The bank issuing the letter of credit must be a bank situated in Indiana and must be an FDIC insured institution. The bank and letter of credit must be agreeable to the City of Plymouth, otherwise this method of guarantee will not be acceptable.
4. If the surety on any bond furnished to the City becomes a party to a supervision, liquidation, rehabilitation action pursuant to I.C. 27-9 et. seq. or its right to do business in the State of Indiana is terminated, it shall be required that, within ten days thereafter, a substitute bond and surety be provided, both of which must be acceptable to the City. Failure to obtain a substitute bond within the stated time frame shall be cause for revocation or suspension of the project approval until such time that the bond is furnished to the City.

E. Pre-Construction Inspection (Contract Projects)

The Owner/Contractor shall conduct a pre-construction, video taped, inspection of the construction site to serve as a permanent record of pre-construction conditions.

The product shall be high quality audio and video tape. The video portion shall present bright, sharp, clear pictures with accurate colors. The picture shall be free from distortion, tearing, rolls or other picture imperfection. The audio portion shall be proper volume, clarity and free of distortion. The audio commentary shall be precise and concise explanatory notes.

The recordings shall include coverage of all surface features located along the main route. The tape coverage shall include all existing cross streets, driveways, sidewalks, curbs, ditches, shrubbery or other structures located along the route.

F. Construction Inspection

Prior to issuance of the final project approval and commencement of any construction activities pertaining to the installation of any public works project, the Owner/Contractor shall execute an Agreement with the City, which will provide that:

1. The City may utilize its own personnel or contract for construction inspection service to insure that materials and workmanship meets the requirements of the approved plans and specifications.
2. The Owner/Contractor will be responsible for submitting and certifying air pressure or infiltration test results for all sewer pipe and deflection test results for all flexible and semi-rigid pipe, force main pressure tests, and all other testing as required.
3. The Owner/Contractor will reimburse the City for the cost of such services which shall be determined at the time of execution of the Agreement, and verified by the Owner or his representative throughout construction.
4. No action with regard to the acceptance of the construction and release of the improvement bond pursuant to this section shall be taken until the Owner/Contractor has reimbursed the City in full for the inspection services.
5. All construction of public works facilities intended for dedication to the City shall be observed and certified pursuant to the Agreement.
6. The Owner/Contractor shall furnish the City with three (3) copies of the approved construction plans and specifications at the time the Agreement is executed.

G. Requirements for Project Acceptance and Dedication

Sewage Works facilities will not be accepted until all documents, as required by the City, are submitted to and approved by the City Engineer and the Sanitary Board, including the following:

1. One (1) Year Maintenance Bond;
2. Recorded Covenant and Easement Documents;
3. The completion of a final inspection which confirms that the project has been constructed and tested in accordance with the City's Standards; and
4. As-Built/as-constructed drawings as described in Section 4-14.

**3.04 Submittals**

A. As-Built Drawings

The contractor shall keep one (1) copy of all project specifications, plans,

addenda, modifications, supplemental drawings, shop drawings, and change orders at the project site in good order and annotated to show all changes made during the construction process. In addition, the Contractor shall keep one set of "As-Built Drawings" for the Project. These "As-Built Drawings" shall show all final elevations, all final dimensions and tie downs for buried pipes, valves, fittings, structures, etc., all final dimensions and sizes for pipes and structures, and all other information as necessary to constitute as-built records. These documents shall be kept daily by the Contractor and routinely checked by the City Representative for completeness and accuracy based on the City Representative's daily records and notes. Upon completion of the project or beneficial occupancy, whichever comes first, these record As-Built Drawings together with any other annotated supplemental plans, drawing, sketches, etc. shall be delivered to the City Representative for his final review and approval. If approved, the documents will be delivered to the Owner within thirty (30) days of completion of the job. If disapproved, they will be returned to the Contractor for corrections, as necessary.

B. Literature

The Contractor shall furnish six (6) sets of equipment manufacturer's operation and maintenance manuals for each item of mechanical and electrical equipment furnished.

C. Manufacturer's Representative

The Contractor shall provide the services of the manufacturer's representative(s) to supervise the start-up and instruct City personnel in the operation and maintenance of equipment. The contractor shall make adjustment of all automatic controls and safety devices, balance and adjust all air and water flow, make proper setting of all valves, and perform all other necessary operations to make the equipment, systems, and facilities fully operable and where required, be oiled and greased with all grease cups, oilers, etc., left filled.

**3.05 Safety**

Neither the City nor its Engineer is responsible for safety on the job site. All codes, statutes and regulations relating to safety on the job site shall be followed by the Owner, Developer and Contractor. Direction by the Engineer, and inspections by the Engineer, is not designed to assure safety on the job, only that the sewer is built according to these standards and the drawings. The Contractor constructing the sewer shall advise each of its employees that the City and the Engineer are not responsible for safety on the site. All OSHA safety requirements shall be followed. Proof of a Confined Space Entry Program and practices, trenching and shoring program and practices, and any other applicable safety requirements shall be followed.

A. Confined Space Access

For projects which include construction activities within "confined spaces" as defined by Title 29 CFR Part 1926.21(b)(6), the Contractor is hereby advised that he must fully comply with all pertinent requirements as delineated in this regulation and as interpreted by OSHA. The Contractor shall have and maintain

all necessary safety and testing equipment at all times during the course of the construction activity.

B. Hazard Communication Standard

Pursuant to the Code of Federal Regulations, 29 CFR Part 1926, as may be amended, all Contractors, Subcontractors and materials suppliers on this Project shall provide access to all persons on the job site at all times, the Material Safety Data Sheets (MSDS) for all hazards of all chemicals per the Federal Regulations. In addition, Contractors, Subcontractors and material suppliers shall provide training to their employees on the MSDS pursuant to the Federal Regulations.

C. Excavation Safety Requirements

It shall be the duty and responsibility of the Contractor and all of its Subcontractors to be familiar and comply with all requirements of Public Law 91-596 29 U.S.C., Sections 651 et. seq., the Occupational Safety and Health Act of 1970 (OSHA) and all amendments thereto and to enforce and comply with all of the provisions of the Act. In addition and as required by Indiana State Law, HB 2071, Section 14. of IC 4-13.6-5-12, the Contractor and all of its Subcontractors shall comply with Subpart P of 29 CFR 1926 dated October 31, 1989 as may be amended.

**SECTION 4**

**GENERAL DESIGN STANDARDS**

## SECTION 4 GENERAL DESIGN STANDARDS

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## SECTION 4

### GENERAL DESIGN STANDARDS

#### 4.01 General

Sanitary Board shall issue final approval for the installation of all public works facilities. All facilities shall be designed and installed in accordance with these Standards as well as applicable State and Federal regulations.

#### 4.02 Sanitary Sewer Design Criteria

##### A. General

All sanitary sewers shall be designed and constructed in accordance with the City of Plymouth Design Standards and Specifications, INDOT specifications and the requirements of IDH, IDEM and Ten States Standards for Sewage Works Improvements.

All sanitary sewers shall be designed to carry the estimated flow from the area ultimately contributing to the respective service area of the sanitary sewer. The required capacity shall be established by City Engineer or at the City's option by means of a study conducted by the Owner/Contractor or his authorized representative engineer.

##### 1. Residential

For the purpose of design, the average family unit is considered to generate 310 gallons per day per single family home. Peak flows shall be determined by Ten States Standards.

##### 2. Commercial/Institutional

The average daily flow for these facilities shall be based on Bulletin S.E. 13 from the Indiana State Board of Health, latest edition. These documents shall be used as a general guideline. The City Engineer may allow modification of these guidelines based upon information submitted by the Owner/Contractor or developed by the City Engineer. The website for the Indiana State Board of Health Sanitary Engineering section is: <http://www.state.in.us/isdh/regsvcs/saneng/default.htm>

Peak flow shall be determined by multiplying the average flow by a factor of 4 and approved by the City Engineer.

##### 3. Industrial

For those industries which do not have any process wastewater discharge, flows shall be calculated as stated above in "Commercial/Institutional". For industries which will have a process discharge, the Owner shall submit detailed flow estimates for each

process, duration and frequency. Peak capacity shall be determined by multiplying the average discharge by a factor of 4 and approved by the City Engineer.

4. Infiltration

Sanitary sewer design capacity must include an allowance to carry unavoidable amounts of groundwater infiltration or seepage in addition to the peak sanitary flows. Collector and trunk sewers shall be designed to include an allowance of two hundred (200) gallons per day per inch diameter mile of pipe.

B. Pipe Capacities

1. Collector Sewers

Collector sewers shall be classified as any sewer ranging between 8" and 12". Peak design flow capacities shall be based upon sewer flowing full without head.

2. Trunk Sewers

Trunk sewers shall be classified as any sewer 15 inches and larger.

Peak design flow capacities for trunk or interceptor sewers shall be based on sewers flowing full, without head, using the design population density and appropriate land use determined by the City and City Engineer, and shall include an allowance for infiltration which will be reviewed on a case-by-case basis and is subject to the approval of the City Engineer.

C. Minimum Pipe Sizes and Standards

1. Pipe Diameter

The required diameter of gravity sewers shall be determined by Manning's formula using a roughness coefficient, "n", of 0.013 or required by the latest Ten States Standards. No main line gravity sewer conveying raw sewage shall be less than eight (8) inches (20 cm) in diameter.

2. Minimum Slopes and Velocities

Sanitary Sewers:

All sanitary collector and trunk sewers shall be designed and constructed to provide a minimum velocity when flowing full of two (2) feet per second. Sewers shall be laid with uniform slope between manholes with inline laser and target. Over ground rotating lasers are prohibited unless approved by superintendent. Failure to receive approval from the Superintendent will result in the sewer being removed and re-laid using in-line laser and target method. The slope of the pipe shall be such that these minimum velocity requirements are attained. The minimum



acceptable slopes for the design and construction of sanitary sewers are as follows:

<b><u>Pipe Size</u></b> <b><u>inches</u></b>	<b><u>Minimum Slope</u></b> <b><u>(ft. per 100 ft., %)</u></b>
4	1.20
6	0.63
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12
21	0.10
24	0.08
30	0.058
36	0.046

Where velocities are greater than ten (10) feet per second (3 m/s) are attained, special provisions shall be made to protect against displacement by erosion and shock.

Sewers on a 20% slope or greater shall be anchored securely with concrete anchors spaced as follows:

- a. Not over 36 feet (11 m) center to center on grades 20% and up to 35%
- b. Not over 24 feet (7.3 m) center to center on grades 35% and up to 50%
- c. Not over 16 feet (4.9 m) center to center on grades 50% and over.

Storm Sewers:

All storm sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than two and one-half (2.5) feet per second (0.30 m/s), based on Kutter's formula using an "n" value of 0.013. The following are the minimum slopes which should be provided; however, slopes greater than these are desirable:

<b><u>Pipe Size</u></b> <b><u>inches</u></b>	<b><u>Minimum Slope</u></b> <b><u>(ft. per 100 ft., %)</u></b>
4	2.60
6	1.45
8	0.90
10	0.65
12	0.48
15	0.34
18	0.25
24	0.17
30	0.13
36	0.095

These slopes may be modified by the approval of the City and/or the Indiana Department of Environmental Management (IDEM).

3. Minimum Depth

In general, sewers shall be sufficiently deep so as to receive sewage from the first floor of all places served by the sewers. The sanitary sewers shall have a minimum earthen cover of 3 feet unless waived by the Engineer or the Sewer Superintendent. In general, sewers shall be sufficiently deep to prevent freezing. Insulation and structural reinforcement shall be provided for sewers that cannot be placed below the frost line (3.5 feet). The pipe shall have minimum cover as established by Ten State Standards under small stream or ditch crossings. The developer shall construct the sanitary sewer at reasonable depths to avoid interference with other utilities or drainage structures.

4. Building Sewers

Building sewers shall conform to the latest edition of the Uniform Plumbing Code, these Standards, and City Ordinances.

The building sewer shall connect to the public sewer at a mainline fitting. When tapping a clay main, the only acceptable method is an Inserta Tee™ connection. Tapping a manhole structure is prohibited unless written approval is given by the sewer Superintendent. If permission is granted, the following guidelines must be followed:

- a. The tap shall not exceed 24" above the existing invert of the main line
- b. The tap shall not be made at the joint of a manhole section
- c. In precast manholes, core drilling of the structure is required. An Inserta Tee connection shall be made to the manhole. The manhole base shall be pre-formed with an Inserta Tee connection for the lateral line.
- d. The invert shall be formed at the flow line to accept the lateral sewer connection
- e. The manhole shall be grouted smooth on the inside and outside and concrete and debris will be immediately removed.

Four (4)-inch diameter building sewers for single family dwellings will be allowed. However, all commercial, industrial, and multi-family dwellings will continue to require six (6)-inch diameter laterals. Laterals four (4) inches in diameter will be installed at a 1/4" slope per foot and laterals six (6) inches in diameter will be installed at 1/8" slope per foot. Building sewers shall have a cleanout located within three (3) feet of the building's exterior wall and every hundred (100) feet and extended to grade. The cleanout shall be constructed such that it is located below the floor level serviced by the gravity sewer to serve as a relief point in the event the

municipal sanitary sewer backs up. Industrial building sewers shall have a suitable control manhole for observation, sampling, and measurement of the waste stream, as required by the City. Cleanouts installed under concrete or asphalt paving shall be made accessible by yard boxes or extended flush with paving with approved materials and be adequately protected.

Building sewers installed for future connections shall be terminated at the right-of-way or easement and plugged to ensure 100 percent water tightness. A 2" diameter PVC pipe shall be installed so that it extends 4" above grade. Additionally, a one-half (½) inch metal locator rod or a magnetic locator tape shall be installed at the end of the plugged line to within three (3) feet of the finished grade.

All service laterals shall have 1 continuous, green, #12 solid tracing wire buried in the trench no more than 6" above the pipe. Tracing wire shall be wrapped around the actual lateral connection to the mainline, following the lateral to the clean out, which is required to be 3' from the building, where the wire will then be required to proceed vertically to the top of the cleanout, where it can wrap around the top of the clean out and terminated.

**Connection of downspouts, sump pumps, and yard drains to the building lateral is strictly prohibited by local, state, and federal regulations and violators will be prosecuted. Violation of these illegal connections shall result in a fine of up to \$1,000 per connection.**

D. Sewer Structures

1. Manholes

a. General

Manholes shall be installed at the end of each line. Cleanouts will not be acceptable. Manholes shall also be installed at all changes in grade, size, materials or alignment, and at all sewer intersections. The interval between manholes shall not be greater than 400 feet (120 m) for sewers fifteen (15) inches or less, at distances not greater than 500 feet (150 m) for sewers eighteen (18) to thirty (30) inches at distances up to 500 feet is approved due to special circumstances approved by the City.

The minimum inside diameter of manholes shall be forty-eight (48) inches for sewers of eighteen (18) inch diameter or less. For sewers larger than eighteen (18) inches and equal to or less than thirty-six (36) inches, the minimum diameter shall be seventy-two (72) inches. A minimum access diameter of twenty-two (22) inches shall be provided.

Flow channels shall be shaped and formed in each manhole to provide a smooth transition of flow from all inlets to the outlet. The

bench wall shall be formed to the crown of the inlet and outlet pipes to form a "U" as shown in the Standard Details.

At changes in sewer alignment and/or sizes, the energy gradient elevation shall not increase. This shall be accomplished by keeping the crown elevation continuous where possible for changes in sewer sizes.

Manholes proposed to be installed in unpaved areas shall be designed and constructed such that the top of the casting is flush with the finished grade to prevent ponding of water over the casting. Positive drainage away from the manhole shall be provided.

Manholes must be made watertight at all points and if, after the work is completed, leaks are discovered, they must be caulked or otherwise stopped. Upon completion of the work, manholes are to be left clean and free from rubbish and kept so until acceptance of work.

Manholes receiving discharge from force mains shall have an external drop connection. Internal drop connections may be approved by the department by obtaining a waiver. Manholes which have force main discharge lines to them shall have an internal epoxy coating to prevent corrosion.

b. Outside Drop Connections

Outside drop pipe connections shall be provided for all sanitary sewers entering a manhole at an elevation greater than twenty-four (24) inches above the invert of the manhole. Where the difference in elevation between the incoming sewer and the manholes invert is less than twenty-four (24) inches, the invert should be filleted to prevent solids deposition.

In areas where future residential, commercial and/or industrial growth can occur, the City Engineer shall determine which new manholes 15 feet deep or deeper shall be equipped with outside drop connections of a size and at an elevation to be determined by the City Engineer at the time of design to allow for future connections at these points. The drops shall extend from the base to within 10 feet of the final graded surface elevation.

Due to the unequal earth pressures that would result from the backfilling operations in the vicinity of the manhole, the entire outside drop connection shall be anchored every three (3) feet by stainless steel anchors and or strapping. A minimum of two (2) anchor points are required.

E. Grease Traps

1. General

Grease traps shall be installed at any commercial kitchen or food service business which produces waste that may contain large amounts of grease, fat or oil. These traps shall remove the grease before it enters the sanitary sewer system. Wastes from sinks, dishwashers and kitchen floor drains should be combined and routed through the grease trap prior to entering the sanitary sewer system. The tank size shall be based on design criteria set forth in Bulletin S.E. 13 from the Indiana State Board of Health, latest edition.

Typical tank details are shown in **Appendix A**.

The recommended grease trap size may be calculated by using the City of Plymouth's "Grease Interceptor Sizing Worksheet", located in **Appendix B**.

F. Oil Separators

Oil Separators are devices used in sewer lines to remove oils and greases from wastewater. These separators utilize physical or chemical separation methods by means of gravity filters, coagulation, and flotation. These separators are recommended at businesses which produce a large amount of grease/oil based waste which include kitchens, car washes, machine shops, service stations, etc.

The developer shall provide the City and the City's Engineer all design data for the propose Oil separator and receive approval of the unit prior to installation.

**4.03 Lift Station and Force Main Design Criteria**

A. General

All lift stations shall be designed and constructed in accordance with IDEM and Ten States Standards for Sewage Works Improvements. All design criteria and calculations shall be submitted to the City for approval.

B. Pump Sizing Criteria

Lift station pumps shall be provided to accommodate peak hourly flow with the largest pump of service. A minimum of two (2) pumps shall be provided at each lift station.

All lift stations shall be designed to carry the estimated flow from the area ultimately contributing to the respective service area of the lift station. The

required capacity shall be calculated by the Owner/Contractor or his authorized representative engineer and submitted for approval to the City.

1. Residential

For the purpose of design, the average family unit is considered to generate 310 gallons per day per single family home. Peak flows shall be determined by Ten States Standards.

2. Commercial/Institutional

The average daily flow for these facilities shall, in general, be based on Bulletin S.E. 13 from the Indiana State Board of Health, latest edition. The City may allow modification of these guidelines based upon information submitted by the Owner/Contractor.

Peak flow shall be determined by multiplying the average flow by a factor of 4 and approved by the City.

3. Industrial

For those industries which do not have any process wastewater discharge, flows shall be calculated as stated above in "Commercial/Institutional". For industries which will have a process discharge, the Owner shall submit detailed flow estimates for each process, duration and frequency. Peak flow shall be determined by multiplying the average flow by a factor determined by the Owner/Contractor and approved by the City.

C. Force Main Sizing Criteria

Force mains shall be designed to maintain a minimum velocity of 2 feet per second in order to avoid solids deposition in the pipe. Minimum force main size shall be 4" diameter.

D. Lift Station Design

1. General

All lift stations shall be wet well/valve vault design utilizing submersible pumps in the wet well with a separate valve vault. Provisions for draining the valve vault into the wet well shall be made. Provisions shall be made also in the valve vault for connection to the City's portable pumping equipment.

2. Wet Well Sizing Criteria

The wet well storage below the lowest inlet shall be a minimum of 5'0" and shall also meet the following criteria:

- a. OFF level to be set at the pump manufacturer's recommended level but no less than 1'0" from the bottom of the wet well.
- b. The distance between the OFF level and the lead pump ON level shall be set to provide storage capacity equal to:

$$\frac{15 \times \text{Rated Pump GPM}}{4}$$

4

(i.e. 15 minute cycle minimum)

- c. The lag pump ON Level shall be set a minimum of 6" above the lead pump ON level and a minimum of 6" below the lowest inlet invert.
- d. The high-water alarm shall be set a minimum of 6" above the lag pump ON level and a minimum of 6" below the lowest inlet invert.
- e. All levels shall be set below the lowest inlet invert.

#### 4.04 Easements

##### A. General

All sanitary sewer lines shall be protected by a Restricted Public Utility Easement (RPUE). The use of this easement is restricted to the City of Plymouth Sanitary Sewer Utility and any other utilities supplying electricity, natural gas and potable water. Ingress and egress shall be available to the City at all times to perform installation, maintenance, enlargement, and repair of facilities. This easement is not available for use by any telecommunication facilities, surface drainage, and drainage ditching or storm sewers except for the purpose of crossing the easement approximately perpendicular thereto. Any fence, trees, overhanging branches, bushes, underbrush and obstructions located within the easement are subject to removal without liability by the City.

All lift stations shall be protected by a dedicated Sanitary Sewer Easement. Ingress and egress shall be available to the City at all times to perform installation, maintenance, enlargement, and repair of facilities. A minimum 30 foot by 30 foot easement shall be provided for all submersible lift stations with wet wells up to 30 feet deep.

The minimum easement shall be 12 feet wide for sanitary sewers up to 10 feet deep. For deeper sanitary sewers, the easement width should increase 2 feet for every vertical foot deeper than 10 feet. All easements shall be of uniform width; no variable width easements will be accepted. The Engineer may request wider easements if warranted.

All sanitary sewer easements shall extend to the far-reaching property line of a given parcel of land. All sewers shall be centered in the easement unless water main is present. In that case, maintain minimum 10 ft. separation between water

and sewer lines.

No sewer lines shall be placed in the public street rights-of-way unless specifically authorized by the City. The construction of sanitary sewer lines within drainage easements will not be permitted without the expressed written permission of the City.

All plan sheets shall clearly identify the easement and the location of all other proposed utilities. The horizontal and vertical plans shall identify all utilities proposed to cross the easement. Regulated drain limits shall be shown on all plans.

B. Right-of-Way Plan Sheet

1. Geographic location map showing the extent of the project and including where applicable:
  - a. Directional North Arrow and Scale;
  - b. County;
  - c. Civil City ship;
  - d. Section, City ship and Range Identification;
  - e. Subdivision Names, Recording Information and Lot Numbers;
  - f. Highway, Road and Street Identification;
  - g. Rivers, Creeks and Named Ditches;
  - h. Assigned Parcel Numbers Arranged in Ascending, Numerical Order from the Project Beginning to End; and
  - i. List of Apparent Owners (last deed of record) by Assigned Parcel Numbers.
2. In addition to the above, there should be sufficient information on the design drawings to properly correlate with the right-of-way plan sheet; i.e., property lines, subdivision information, parcel number or name, width of right-of-way, permanent or temporary and special conditions; for example, structures, trees, shrubs to be removed or replaced, sodding, riprap, etc.

C. Legal Description Sheets

The following shall be provided:

1. Parcel Number;
2. Project Number;
3. Project Name;
4. Identification as to permanent or temporary easement;
5. Separate descriptions on separate sheets are required where both permanent and temporary easements are to be taken;



6. Meets and bounds descriptions shall be clear, concise and complete with sufficient detail to positively establish from known and referenced points, monuments, lines, etc. Total area should be stated at end of description, in acres;
7. Descriptions of easements from platted subdivision lots, including strips off sides of lots should include name of subdivision and recording information for the subdivision as well as affected lot number(s). NOTE: These are usually small areas; therefore, area should be stated in square feet; and
8. Registered land surveyors licensed in the State of Indiana, seal and signature.

D. Property Plats

1. Parcel Number;
2. Project Number;
3. Project Name;
4. County;
5. Civil Township;
6. Section;
7. Township;
8. Range;
9. Owner;
10. Permanent or Temporary Legends;
11. Permanent or Temporary Easement Areas;
12. Total area of property out of which easement is to be taken;
13. Drawn By;
14. Directional North Arrow;
15. Scale;
16. Unplatted properties: complete boundaries of property description out of which easements are to be taken, including properly identified referenced corners, P.O.B.'s, monuments, roads, bearings, distances, etc.;

17. Platted subdivisions: dimensions of lot(s) as well as the lot number(s) and including the subdivision name and recording information;
18. Easement boundaries, including regulated drain boundaries, as described in Item A. of this subsection, including referenced bearings, distances, etc., and identified as in legend; and
19. Registered land surveyor seal and signature.

#### **4.05 Drafting Standards**

##### **A. General**

These Standards have been established for the purpose of ensuring uniformity in the design and drafting techniques of projects to be submitted for review and acceptance.

1. All projects submitted, having more than two (2) sheets, shall have a title sheet which will include:
  - a. General Overall Area Map;
  - b. Vicinity Location Map;
  - c. A Site Plan Map Detailing the Project;
  - d. Name/Title of Project, including Section Number if applicable;
  - e. Owner and Engineer's Name; and
  - f. Professional Engineer's Seal and Signature.
2. All plan and profile sheets are to be certified and dated by a professional engineer of the State of Indiana.
3. All sheets are to be numbered, with total number of sheets included.
4. Include detail sheet(s)/specification sheet(s), as applicable.
5. Design drawings shall be 24-inch by 36-inch.

##### **B. Scales**

The following scales for drawings are required:

1. Plan and Profile: Variable; Not to Exceed 1"=50' Horizontal and 1"=5' Vertical. A scale of 1"=30' is preferred for street and alley plans.
2. Cross Sections: 1"=5' Horizontal and Vertical

##### **C. Materials**

All as-built information shall be transmitted to the City in an electronic format compatible with the City of Plymouth's software. Additionally, all submittals shall be provided to the City in a hard copy version.

D. Plan and Profile Sheets

1. General

- a. A North Arrow;
- b. The Scales Used;
- c. Project Name and Number, Sheet Number, Date Drawn, Date and Nature of Revisions;
- d. All topography in the area affected by construction;
- e. Right-of-Way lines; property lines and easements;
- f. Locations of bench marks and their descriptions;
- g. Locations of all existing and proposed utilities in the project area;
- h. Match lines shall be easily identifiable.

2. Sewer Profile Drawings

All sewer profile drawings shall include the following, as a minimum:

- a. Existing and finished grade lines;
- b. Inverts at all manholes;
- c. Length and size of pipe between manholes;
- d. Slope of pipe in percent.
- e. Elevations to USGS datum;
- f. Top of casting elevations;
- g. Types of materials used;
- h. Profile of existing and proposed utilities; and
- i. Special construction required due to unfavorable soil conditions, jacked and bored casing pipe, etc.

3. Sanitary Sewer Lift Station Drawings

Lift station plans shall, at a minimum, contain the following:

- a. At least two views of the station, plan view and cross section;
- b. Electrical panel detail;
- c. Pump and alarm control elevations;
- d. Inlet and outlet pipe elevations;
- e. Finished grade and foundation elevations;
- f. Special construction required due to unfavorable soil conditions;
- g. Design pump capacity, rated horsepower, total dynamic head, manufacturer and model number;
- h. Sump capacity and cycle time;
- i. Also, the Owner's Engineer shall submit a copy of the head discharge curve and the complete design calculations for the lift station and force main; and
- j. Fence and access drive detail, if required.
- k. Control Building Detail

E. Record Drawings

All plans submitted as record ("as-built") drawings shall have all pertinent items shown on the plan view and properly scaled. This includes building laterals, manholes, valves, hydrants, inlets, etc. All sheets shall have the phrase "as-built" or "record drawing" boldly printed on them with the date, and shall be stamped and signed by a professional engineer, surveyor or architect registered in the State of Indiana.

In addition to hard copy paper as-built drawing, computer generated plans for the as-built sewer system shall also be submitted on CD computer disk(s). The plans shall be submitted in either vector format (DWG, DXF files) or Portable Document File format (PDF files).

**SECTION 5**  
**MATERIALS**

## SECTION 5 MATERIALS

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**SECTION 5**  
**MATERIALS**

**5.01 General**

This section provides a description of the materials acceptable for the construction of public works facilities. Use of other materials which are not specified herein shall only be permitted with the written approval by the City and City Engineer.

The Contractor shall furnish and lay, as required, sewer pipe, together with all bends, branches, or other specials as shown on the plans or specified and, necessary to complete the work, including necessary pieces of sewer pipe for purpose of physical tests. Sewers shall be constructed of the pipe materials as specified under the contract items.

The following specifications

**5.02 Gravity Sanitary and Storm Sewer**

A. General

The following materials are acceptable as noted for gravity sanitary and storm sewers:

- ! Ductile Iron Pipe (DIP) – Sanitary, Storm
- ! Polyvinyl Chloride Pipe (PVC) – Sanitary, Storm
- ! Reinforced Concrete Pipe (RCP) – Storm only
- ! High Density Polyethylene (HDPE) – Storm only

All pipes shall be the bell and spigot type with elastomeric seal joints.

All pipes shall be required to withstand a hydrostatic pressure of twenty (20) feet of water (8.6 psi) for two (2) hours while being deflected to the maximum amount recommended by manufacturer. Continuing the hydrostatic pressure, a shear load of one hundred (100) pounds per inch of nominal pipe diameter shall be applied to an unsupported spigot immediately adjacent to joint. During testing period, there shall be no visible leakage at joint.

B. Pipe Materials

1. Ductile Iron Pipe (DIP)

All ductile iron pipes shall conform to the ANSI A21.51 or Federal Specification WWP-421c Type II, Class 50, and shall be Class 2 with push-on joints.

Fittings shall be standardized for the type of pipe and joint specified and shall comply with ANSI A21.10 and AWWA C110. Fittings shall be either mechanical joint or push-on type. Pipe joints shall use O-ring gaskets in accordance with ANSI 21.11 and AWWA C 111.

2. Polyvinyl Chloride Pipe (PVC)

a. Smooth Wall PVC

All pipe shall meet or exceed the requirements of ASTM Designation 3034 Type PSM (SDR-35) pipe or ASTM Designation 3033 (SDR-35).

All PVC pipe shall be tested in accordance with Standard Method of Test for External Loading Properties of Plastic Pipe by Parallel - Plate Loading, ASTM Designation 2412. Minimum pipe stiffness shall be 115 psi.

3. Reinforced Concrete Pipe (RCP)

The drainpipe may be Reinforced Concrete Pipe (RCP), of various diameters. The pipe shall be Class III and Wall Type B, except where otherwise indicated. All RCP shall be considered "rigid" and shall be installed as such. The joint shall be tongue and groove or bell and spigot. The manufacturer's recommendation to provide a water-tight joint shall be followed.

Fittings shall be of the same class as the pipe they are installed along and shall be manufactured by the pipe manufacturer. Fittings shall meet the same ASTM requirements as the pipe. Plain end joints will not be allowed.

Reinforced Concrete Pipe shall only be used for storm sewers.

4. HDPE Pipe

General

All HDPE pipe shall be considered "flexible" and shall be installed as such. HDPE pipe shall not be installed where exposed to sunlight unless current material certifications guarantee that it will not be subject to ultraviolet degradation.

The drain pipe for the various pipe diameters may be "Sure-Lok" High Density Polyethylene (HDPE) pipe as manufactured by Hancor of Findlay, Ohio or N-12 High Density Polyethylene Pipe (HDPE) as manufactured by ADS, Inc. of Columbus, Ohio. Bedding shall be Class I or II only as described in ASTM D-2321.

Production and Material Standards for HDPE

Corrugated High Density Polyethylene (HDPE) pipe shall be manufactured in accordance with AASHTO M 294 Type S. Pipe manufactured under this specification shall have a minimum cell class of 335420C in accordance with ASTM D-3350.



Ribbed Polyethylene pipe shall be in accordance with ASTM F-894 for the specified sizes, meeting the requirements for RSC 160. Pipe manufactured under this specification shall have a minimum cell class of 335420C in accordance with ASTM D-3350.

Smooth wall Polyethylene pipe shall be in accordance with ASTM F-714 for the specified sizes. Pipe manufactured under this specification shall have a minimum cell class of 335420C in accordance with ASTM D-3350.

All polyethylene pipe and fittings shall be made from high molecular weight high density polyethylene material meeting the application cell class requirements. All polyethylene material used in drain pipe manufacture shall be virgin resin.

#### HDPE Joints

High-density polyethylene pipe shall possess male and female pipe ends or molded HDPE or PVC couplers that allow the construction of overlapping, gasketed pipe joints in accordance with the requirements of ASTM D-3212 for a gasketed joint. The gasket material shall conform to all requirements of ASTM F-477.

#### Rejection of Damaged HDPE Pipe and Fittings

High density polyethylene pipe and fittings possessing the following defects may be rejected for installation: variations from straight centerline; elliptical shape in pipe intended to be round; illegible or improper markings as required herein; deep or excessive gouges or scratches on the pipe wall; fractures, punctures, or cracks; damaged or cracked ends where such damage would prevent making a satisfactory joint.

#### HDPE Pipe Markings

For high density polyethylene pipe products, each length of pipe shall be clearly marked with the following information as a minimum: manufacturer's name or identification symbol; nominal pipe size; and production/extrusion code.

### C. End Sections

End sections shall be precast concrete or as indicated by the Detail Specifications or Drawings unless otherwise approved by the Engineer. Where differing materials are used, an appropriate water-tight connection shall be made to join the pipe to the end section.

### D. Depth Restrictions on Pipe Materials

1. The depth limitations for the installation of the different pipe materials, unless a variance is approved by the Engineer, shall be as follows:
  - a. PVC Rubber Gasketed Pipe - 3' to 15'

- b. Ductile Iron Pipe Class 50 - 3' to 28'
  - c. PVC C900 DR14 - 3' to 28'
- 2. Within each depth range, special pipe bedding requirements may be requested by the Engineer to insure adequate pipe support.
  - 3. Depths of bury varies depending on soil types and bedding methods. Manufacturer's recommendations shall always be utilized.

### 5.03 **Force Mains**

#### A. **General**

The following materials are acceptable for sanitary sewer force mains:

- ! Ductile Iron Pipe

#### B. **Air/Vacuum Relief Valves**

The design of sanitary force mains shall include the need for air vacuum relief / air relief valves. If high points cannot be eliminated an air relief valve shall be installed at each point. Each valve shall be installed in a minimum 5' diameter precast concrete structure with a minimum depth of 5'. See detail on Figure WW-7 in Appendix A

#### C. **Force Main Materials**

##### 1. **Ductile Iron**

All provisions of Section 5.02(B) (1) for Ductile Iron pipe for gravity sanitary sewers shall be the minimum criteria for material and specifications of Ductile Iron Force Main.

Joints for ductile iron pipe as well as all underground pipes shall be push-on gasketed or mechanical joints and fittings shall be mechanical joints.

#### D. **Locator Tape & Wire**

Locator wire shall be #12 solid standard copper wire with thermoplastic insulation and capable of carrying 600 volts.

Marking tape shall be pigmented polyolefin film, three (3) inches wide, with a printed message on one side. Tape shall be a minimum of four (4) mils thick with a minimum tensile strength of thirty-five (35) pounds per three (3) inch wide strip. Tape shall bear a continuous printed message every sixteen (16) to thirty-six (36) inches reading "Caution - Buried Sewer Line Below". Color of plastic film shall conform to the latest edition of the "Recommended Standards for Wastewater Facilities" for color coding. Tape shall be "Terra Tape Standard 250" as manufactured by Reef Industries, Inc., Tape Products Division, Houston, Texas or approved equal.

E. Alternate Utility Location System

For “Cross Country” runs of force main, an alternate location system may be proposed. This system shall be an OMNI Marker Utility marking System or equal.

**5.04 Building Sewers/Service Laterals**

Building services shall be SDR 35, bell and spigot type PVC pipe. Four (4) inch or six (6) inch diameter building sewers for single family dwellings will be allowed. The size of building sewer used for a particular development shall be consistent throughout. The installation four- and six-inch building sewers within the same development is prohibited. Any commercial, industrial, and multi-family dwellings will require six (6)-inch diameter laterals. Joints shall be gasket push-on, compression type conforming to ASTM D 3212. Gaskets shall conform to ASTM F 477. Factory made wye connections shall be provided at connection with municipal sewer line. Vitrified Clay Pipe (VCP) shall not be permitted for building sewer construction. Materials used outside the building foundation must be SDR-35, gasketed sewer pipe. Glue joints outside the building are prohibited. Connection of the building lateral to an existing mainline sewer shall be accomplished with an Inserta- Tee.

Where required on a service lateral, a cleanout shall be provided that is the same diameter as the lateral and is made of the same material as the main line pipe. Said cleanout shall include a watertight, detachable lid and conform to the Service Connection detail.

Locator Tape & Wire

All building sewers are required to have a locating wire attached to the sewer lateral from the tap connection at the city’s mainline sewer running continuous to the cleanout closest to the building. The end of the wire shall be attached to the cleanout and terminated above ground for ease of locating service.

Locator wire shall be #12 solid standard copper wire with thermoplastic insulation and capable of carrying 600 volts.

Marking tape shall be pigmented polyolefin film, three (3) inches wide, with a printed message on one side. Tape shall be a minimum of four (4) mils thick with a minimum tensile strength of thirty-five (35) pounds per three (3) inch wide strip. Tape shall bear a continuous printed message every sixteen (16) to thirty-six (36) inches reading “Caution - Buried Sewer Line Below”. Color of plastic film shall conform to the latest edition of the “Recommended Standards for Wastewater Facilities” for color coding. Tape shall be “Terra Tape Standard 250” as manufactured by Reef Industries, Inc., Tape Products Division, Houston, Texas or approved equal.

**5.05 Manholes/Wet Wells & Valve Pits**

A. General

Location of manholes shall be as required in Section 4.02(D) (1).

B. Types of Manholes

Manholes shall be either monolithic (cast-in-place) or precast. If monolithic manholes are to be used, the Contractor shall submit drawings showing all reinforcement, dimensions, and connections for City approval. All drawings shall be certified by a registered Professional Engineer.

C. Precast Manholes

Manholes shall be constructed in accordance with the ASTM Specifications for "Precast Reinforced Concrete Manhole Risers and Tops", Designation C 478. The minimum wall thickness shall be five (5) inches for manholes four (4) feet in diameter. When the depth of the manhole exceeds twelve (12) feet, then the depth in excess of twelve (12) feet shall be reinforced with two cages of reinforcement the same as required for reinforced concrete sewer pipe of same diameter as the riser of the manhole per ASTM Specification Designation C 76 for Class III Pipe. The precast tops shall be of the eccentric cone type. Precast flat covers shall be not less than eight (8) inches thick and reinforced with two layers of steel with a minimum area of 0.39 square inches per linear foot in both directions in each layer. Precast flat bottoms of manholes shall also be reinforced the same as specified herein for precast flat top. Hoisting lugs or hooks shall be cast in place for handling and setting of the rings. Openings of proper sizes and suitable design shall be cast in place for receiving the sewer and/or drop pipes and connections. Adjusting riser rings shall be provided as approved by the City.

No "see through" lift holes shall be allowed on precast concrete manholes 48 inches in diameter or less. All lift holes shall be thoroughly wetted and completely filled with non-shrink mortar or epoxy grout; then smoothed and covered, both inside and out, with a trowelable grade butyl rubber base backplaster material to ensure water tightness.

The exterior surface of all manholes shall be coated with a non-asbestos, asphalt primer that meets Federal Specification SS-A-701B and ASTM D-41.

All manhole joints shall be tongue and groove and they shall be sealed with an O-ring conforming to ASTM C-443 or bitumastic strip.

D. Manhole Steps

For manholes 10' deep or less, (as measured from bench to top of casting), steps shall be provided. The steps shall be manufactured of reinforced plastic and shall be twelve (12) inches wide and one (1) inch square.

E. Manhole Bases

Manhole bases shall be of cast-in-place monolithic concrete or precast concrete. Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semi-circular in cross section and may be formed directly in the concrete of the manhole base, may be half tile laid in the concrete, or may be

constructed by laying the sewer lines continuously through the manhole and break-hardened and neatly trimming the edges. Changes of direction of flow within the manholes shall be made with a smooth curve with as long a radius as possible. The floor of the manhole outside the channels shall be smooth and slope toward the channel not less than one (1) inch per foot.

No mortar or concrete shall be placed in water, and no water shall be allowed to flow over or against the concrete before it has set for a period of time deemed sufficient by the City to prevent damage to the structure. The invert channel through manholes should be made to conform in shape and slope to that of the sewer. All invert channels are to have a properly mortared apron on either side, sloped to prevent solids deposition.

F. Adjusting Rings

Where one (1) solid riser or barrel section cannot be used, final adjustments in elevation of the frame and cover shall only be accomplished by the use of precast concrete adjusting rings conforming to ASTM C 478.

Rings shall be of a nominal thickness of not less than two (2) inches and maximum of six (6) inches. More than twelve (12) inches total of adjusting rings will not be allowed for adjustment of the manhole frame and cover to required elevation. Distance shall be no more than Twenty-four (24) inches from top of casting at finished grade to first step.

G. Sewer Pipe to Manhole Connections

To connect a sanitary sewer to a manhole, either a flexible boot KOR-N-SEAL 1 or 2, flexible connector, cast-in-place Dura-Seal gasket, "A"-lock gasket or an approved equal shall be used. Connections to an existing manhole shall be a flexible boot KOR-N-SEAL or approved equal.

If the flexible boot connection is used, it shall be placed in the reinforced concrete manhole base and secured to the pipe by a stainless steel clamp. Flexible connectors shall conform to ASTM C 923.

The cast-in-place inflatable gasket shall conform to ASTM C 923.

All connections shall provide for a watertight seal between the pipe and manhole. The connector shall be the sole element relied upon to assure a flexible watertight seal of the pipe to the manhole.

The rubber for the connector shall comply with ASTM C 923 and shall be resistant to ozone, weather elements, chemicals, including acids and alkalis, animal and vegetable fats, oils and petroleum products.

The stainless-steel elements of the connector shall be totally non-magnetic Series 305 stainless steel. The stainless-steel clamp shall be capable of sustaining applied torque in excess of eighty (80) inch-pounds. It shall be the responsibility of the Contractor to submit details of the proposed connection to the City for approval. Connections not approved by the City shall be subject to

removal and replacement with an approved adapter.

Pipe shall be grouted smooth on the inside and outside of the manhole as to prevent debris build up.

H. Castings

Standard manholes shall have the following frame and lid:

In traffic and grass:	Frame	Lid
East Jordan	1022-1 Ex. HD	1022-1 Ex. HD
Neenah	R-1772-C	R-1772-C

Material shall be in compliance with ASYM A 48, CL 35B. Each lid shall have two (2) inch high letters indicating "Sanitary Sewer" or "Storm Sewer".

Watertight manhole covers shall be used wherever the manhole tops may be flooded. Where watertight castings are required, the manholes shall have the following frame and lid:

In traffic and grass:	Frame	Lid
East Jordan	1022-1 PT Ex. HD	1020 PT Type A Ex. HD
Neenah	R-1916-F	R-1916-F

The frame shall be anchored through the riser rings (if provided) to the cone section with four (4) galvanized rods. Each lid shall have two (2) inch high letters indicating "Sanitary Sewer" or "Storm Sewer".

All grates on storm sewer are required to have information cast in them which indicates "No Dumping. This Drains Directly to River".

Locked manhole covers may be desirable in isolated locations or where vandalism may be a problem. The Sewer Superintendent will identify locations where this is required.

I. Plug Valves

Ballcentric and/or Eccentric Valves

1. Ballcentric and/or Eccentric Valves shall be the non-lubricated resilient seating type. The valve manufacturer shall have completed proof of design test for two (2) way valves as specified under AWWA C504 and shall furnish or have on file with the engineers, certified copies of these tests. The design of two (2) way valves shall be such that they shall be capable of providing drip tight shut-off with pressure applied from either direction with proper torque applied to maintain the rotating element (plug) in the seated position. The laying length of flanged two (2) way valves twelve (12") inches and smaller shall be as listed in MSS Specification SP-70, for valves fourteen inches (14") and larger shall be manufactured standard. The laying length of three (3) way and four (4) way valves shall be as listed in ANSI Specifications B16.1, Class 125,

Table 6, for tees, crosses, and rotating element (plug) shall be single or double style as required for the service.

2. The valve body, bonnet and rotating element (plug) shall be fabricated of cast iron ASTM A126 Class B unless noted otherwise. Valve body and bonnet thickness and flanged end connection shall conform to ANSI B16.1 Class 125 or 250 or be Victaulic grooved as required for the service. The body port area of all valves shall be not less than eighty one percent (81%) of the area of the nominal pipe size, and valves twenty inches (20") in diameter and smaller shall be capable of passing a hard sphere whose diameter is equal to eighty one percent (81%) of the nominal valve size. Valve body seats shall be corrosion resistant nickel welded or mechanically retained in the body. The body and bonnet shall be provided with permanently lubricated, radial journal bearing of porous series 316 stainless steel. Thrust bearing shall be provided to support the closure element fabricated of Series 300 stainless steel and a Teflon backing ring at the operating shaft journal. The rotating element shall be of Buna N unless noted otherwise for the service. The stem seal shall be replaceable without removal of the valve bonnet and shall be the self-adjusting wear compensating multiple U cups, Chevron type of Buna N or double O-Ring. Thrust bearings of Teflon and stainless steel shall be provided.
3. "O" rings shall be contained in a replaceable cartridge.
4. The body port area of rectangular and/or oval ported eccentric seating valves shall be equal to or greater than the nominal connecting pipe area and be capable of passing a hard solid sphere with an outside diameter equal to seventy-five (75%) percent of the nominal pipe diameter without interference from the closure element.
5. Each lever operated valve shall be furnished with a standard length lever or wrench which is removable except that the lever for valves three (3) inch size and smaller may be of non-removable type. Each chain operated valve shall be furnished with double end chain wrench and galvanized iron chain of sufficient length to fit the installation conditions for valves 7 ft. or more above finished floor. Buried valves shall have operating stem to ground level.
6. All plug valves 8-inches and larger shall have an enclosed rotary gear actuator. All plug valves smaller than 8-inches shall have an integral lever or a square nut for wrench or chain lever operation. The actuators shall comply with the latest revision of the applicable AWWA Specification and the following specifications:
  - a) Enclosed Rotary Gear Actuator and Gearing
    - 1) The actuator shall be a worm and gear, single reduction design with provision for input, spur or bevel gear assemblies to meet the given rim pull or input torque requirement. The input shaft of the manual shall be hardened alloy steel. The worm shall also be hardened

alloy steel, and the mating worm gear shall be alloy bronze, accurately cut by hobbing machines, and the combination of these shall be self-locking. All gearing shall be grease lubricated at the factory. Ball or roller bearings shall be used to provide smooth rotation of the worm shaft.

- 2) The gear actuator shall be sized to provide bi-directional shut-off at the maximum operating pressure with a maximum pull of eighty pounds (80 lbs) on the rim of the hand wheel or chain wheel, or a maximum input torque of one hundred fifty foot-pounds (150 lbs) at the operating nut.
- 3) All actuators shall be provided with a pointer assembly for valve position indication, except when used for buried service.
- 4) All actuators shall be readily field adaptable to motor operation without disassembly of the manual actuator.

b) Enclosures

- 1) The actuators shall meet weatherproof, submersible, or buried service conditions as required. In no case shall actuators designed for submersible service be rated for less than 50 feet of head for 72 hours. Buried service and submersible actuators shall be built with corrosion resistant input shaft and hardware.

c) Mechanical Stops

- 1) An integral adjustable mechanical stop device shall be provided to prevent over-travel. The stops shall allow valve travel of 90 degrees, with a minimum adjustability of  $\pm 5$  degrees at each end of travel. All stops shall be of steel material.

J. Check Valves

Flapper shall be easily removed without need to remove valve from line.

The valve shall be designed for 175 PSI working pressure and shall be provided with an external lever and weight to facilitate back flushing.

K. Air Relief Valves

The minimum air relief valve shall be the APCO air relief valve Model No. 400 or approved equal.

**5.06 Pavement Materials**



A. General

All materials shall be obtained from a source(s) which currently supply similar approved materials for the Indiana Department of Transportation projects.

B. Concrete Pavement

All concrete pavements shall be composed of portland cement concrete, with or without reinforcement as may be specified, constructed on a prepared and compacted base course in close conformance with the INDOT Standard Specifications, Section 500, latest edition. Concrete pavements shall contain air entrainment and be finished with a broom-type finish. Concrete pavement is only acceptable with written approval from the City of Plymouth Street Department Superintendent.

C. Bituminous Pavement

Bituminous material for wedge and leveling, approaches, base, binder and surface shall be furnished in accordance with INDOT Standard Specifications, Sections 300, 400 and 610, as applicable.

Bituminous surface and base courses shall be Hot Asphaltic Concrete. Unless otherwise directed or permitted by the City, the base mixture shall be No. 5LV with 4.3 percent asphalt or shall be Compacted Aggregate No. 53. Unless otherwise directed or permitted by the City, the surface mixture shall be size No. 11LV with 6.0 percent asphalt or No. 12 LV with 6.2 percent asphalt.

Bituminous binder shall be Hot Asphaltic Concrete, and unless otherwise directed or permitted by the City, the binder mixture shall be size No. 9 LV with 4.8 percent asphalt or No. 11 LV with 5.0 percent asphalt.

Bituminous material for wedge and leveling shall consist of bituminous binder as set out above. Such material shall meet all requirements of Bituminous Binder as set out in the Standard Specifications Section 400.

Cover aggregate for type 2 or Type 5 seal coat shall be limestone chips.

Bituminous mixtures for approaches shall meet all the applicable requirements of Sections 400 and 600 of the Standard Specifications.

## **SECTION 6**

### Sanitary Lift Stations

**SECTION 6  
SANITARY LIFT STATION**

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## SECTION 6

### SANITARY LIFT STATIONS

#### 6.01 General

This section pertains to the requirement for sanitary lift stations designed and constructed by an Owner/Contractor. The City shall review and approve the use of any lift station. The Owner must show that it is not physically possible or economically feasible to provide gravity service into a public sewer.

All stations shall be submersible type, including a minimum of two (2) pumps (duplex station) each with a minimum four inch force main. Voltage shall be 230 volt, 3 phase.

#### 6.02 General Requirements

- A. All of the mechanical and control equipment shall be an integral package supplied by the pump manufacturer with local representation so as to provide undivided responsibility. Pump manufacturer shall be F.E. Myers, or approved equal.
- B. The Contractor shall submit to the Superintendent/City Engineer for review and approval two (2) sets of shop drawings, detailed specifications, pump warranty and performance characteristics for all of the equipment and fixtures to be furnished and installed. The shop drawings and equipment data shall be submitted with a cover letter or Contractor's stamp of approval, indicating that he has reviewed, checked and approved the data submitted. The Superintendent and City Engineer will review the submittal and render a decision in writing as to the acceptability of the equipment.
- C. The Contractor shall provide the services of a factory service engineer to inspect the installation and alignment of all equipment and materials provided under this section. Upon completion of the installation and alignment, the service engineer shall certify to the Superintendent/City Engineer, in writing, that the equipment furnished has been installed and aligned in accordance with all requirements, recommendations, and advisory instructions of the equipment manufacturer.

After the installation and alignment is complete, the factory service engineer shall operate the equipment for such a period as to assure proper functioning of same. All auxiliary equipment shall be operated to demonstrate that it is functioning properly. Any adjustments deemed necessary to place the equipment in proper operating condition will be made. Such adjustments shall be made at the Contractor's expense.

- D. The Contractor shall supply the services of factory service engineer for one (1) day in addition to the time described above to provide on-site instruction to the Owner's personnel in the operation, routine maintenance, and "trouble shooting" for each piece of equipment furnished under this Section.

The manufacturer shall provide ten (10) bound copies of a manual fully explaining the operation, routine maintenance and "trouble shooting" for all equipment provided under this Section. The manual shall include copies of all approved shop drawings with all required revisions. This manual must be submitted to the Superintendent/City Engineer for approval prior to acceptance.

- E. Any exceptions to this Standard or associated approved Plans shall be submitted in writing and clearly stated. The exceptions must be approved by the Superintendent/City Engineer prior to proceeding with the work.
- F. All components of the lift station that are exposed to weather or which may come into contact with wastewater or corrosive atmosphere shall be constructed of material that is resistant to corrosion and will not require surface protection throughout the expected life of the lift station. In general, these materials are stainless steel, aluminum, fiberglass reinforced polyester (FRP) and ultraviolet stabilized PVC. **Galvanized material is not acceptable.**

### **6.03 Submittals**

Prior to installation the Contractor shall submit the following information for each pump to the Superintendent/City Engineer for review and approval:

- A. Pump Capacity in Gallons Per Minute;
- B. Total Dynamic Head (TDH) and Operating RPM;
- C. Motor Horsepower;
- D. Motor RPM;
- E. Motor Voltage, Phase and Cycle;
- F. Make and Model Number; and
- G. Pump Curves for the Pumps to be Provided.
- H. Materials of Construction
- I. Dimensional Prints
- J. Installation Guide
- K. Parts List
- L. Technical Manuals

### **6.04 Pump Design**

- A. General

The pumps shall be capable of handling raw unscreened sewage, stormwater, and other similar solids-laden fluids without clogging. The discharge base and elbow shall be permanently installed in the wet well and connected to the discharge piping. The pump(s) shall connect to the guide rail base automatically when lowered into place. There shall be no need for personnel to enter the wet well to remove or reinstall the pump(s). Connecting of the pumping unit to the guide rail base shall be accomplished by a simple linear downward motion of the pump. The sliding guide bracket shall not be an integral part to the pumping unit and shall be a standard ASA flange dimension so that the base is interchangeable with other pumps and not limited to a specific pump. Sealing of the pump to the guide rail base shall be accomplished by a profile gasket mechanically held in place between the pump and the sliding guide bracket. No portion of the pump shall bear directly on the floor of the sump. The pump with its appurtenances and cable shall be capable of continuous submergence to a depth of 65 feet.

B. Pump / Motor Inspection

The following inspections shall be performed as a routine quality check on each unit:

1. Check for proper impeller size, motor rating, voltage and phase to see if all is in compliance with customer purchase order and specifications.
2. A motor and cable insulation check to test for an defects.
3. Pressurize the motor with an environmentally safe gas and use a sniffer device to check for leaks at all joints and seals.
4. Dry run the unit to check for proper amp readings.

A quality control check sheet showing that the above has been accomplished shall be supplied with each pump/motor.

C. Certified Performance Tests

The following procedures are to be followed:

1. Connect motor to power supply and check for proper rotation.
2. The pump shall be installed in the wet pit on the proper guide rail base.
3. Starting at shut off record the flow, head, amps, power factor and input KW at 6 equally spaced points. Run one point at or near the design duty point.
4. Submit copies of all raw data as well as a plotted performance curve.

All test procedures and test tolerances shall be in accordance with the Hydraulics Institute Test Standards.

## 6.05 Pump Construction

### A. Pump

#### 1. Impeller

The impeller shall be made of gray iron equal to ASTM A48, Class 30 and shall be of the two (2) vane or recessed, non-clogging dynamically balanced design.

#### 2. Wear Ring

The two (2) vane impeller shall be equipped with a brass wear ring to reduce leakage and wear. The wear rings shall be replaceable to restore original running clearances and pump efficiencies. Both the recessed and the two (2) vane impellers shall have pump out vanes to keep trash from seal and reduce pressure at seal faces.

#### 3. Pump Volute

The pump volute shall be made of gray cast iron equal to ASTM A48 Class 30. The volute shall be cast with smooth internal surfaces free from rough spots or flashing. The volute shall be a one-piece casting. The volute shall have a centerline discharge to permit use with guide rails.

#### 4. Rotating Assembly

The rotating assembly (impeller, shaft and rotor) shall be statically and dynamically balanced such that undue vibration or other unsatisfactory characteristics will not result when the pump is in operation.

#### 5. Shaft

Each pump shaft and motor shaft shall be an integral unit. Each shaft shall be of 416 stainless steel material and adequately designed to meet the maximum torque required at any start-up condition or operating point in the system. Maximum deflection shall not exceed .002" at the lower seal. Each pump shaft shall have a polished finish and have accurately machined shoulders to accommodate bearings, seals and impeller.

#### 6. Mechanical Seals

Each pump shall be equipped with a tandem double mechanical seal, type 21 carbon and ceramic. The lower pump seal shall be mounted behind the impeller. The upper seal shall be mounted in the oil chamber

that acts as a barrier between pump and motor.

Each seal shall require neither routine maintenance nor adjustment and shall not be damaged when the pump is run dry. When required, seal oil inspection shall be achieved without disassembly of the pump. The seal shall not require the pumped liquid as a lubricant.

7. Bearings

Each pump shaft shall rotate on permanently lubricated bearings. The upper bearings shall be deep grooved ball bearing and the lower bearings shall consist of a minimum of two heavy duty single row, angular contact ball bearings. Bearing shall be of sufficient size and properly spaced to transfer all radial and axial loads to the pump housing and minimize shaft deflection. B-10 bearing life shall be a minimum of 50,000 hours at design conditions.

8. O-Rings and Fasteners

All mating surfaces of the pump and motor shall be machined and fitted with Buna N O-rings where watertight sealing is required. Sealing shall be accomplished by the proper fitting of the parts and not by compression or special torque requirements. All external screws and fasteners shall be made of stainless steel. All surfaces coming in contact with the liquid media other than stainless steel, shall be protected by a corrosion resistant coating.

B. Motor

The motor shall be of the squirrel-cage induction shell type design. The motor housing shall be gray iron equal to ASTM A48 Class 40. The motor shall be designed for continuous duty, completely submerged or unsubmerged. For dry pit applications a water jacket must be able to be fitted to the motor to allow the pumped fluid to be circulated around the motor for cooling. Motors that develop more than 100EC skin temperatures in dry pit applications will not be permitted. The motor shall be capable of sustaining ten (10) evenly spaced starts per hour. Stator windings and leads shall be insulated with moisture resistant Class H insulation rated for 180EC. Motor service factor shall be 1.2.

1. Thermal Protection-Motor

Each phase of the motor shall contain a bimetallic temperature monitor in the upper portion of the stator windings. The monitors shall be connected in series and shall be coupled to the motor contactor coil such that any one switch opening will shut down the motor. The temperature setting shall be 120EC and shall automatically reset once the stator temperature returns to normal.

2. Seal Failure Warning System



An electrical probe shall be provided in the oil chamber for detecting the presence of water. A solid-state device mounted in the pump control panel or in a separate enclosure shall send a low voltage, low amperage signal to the probe. If water enters the oil chamber the probe shall close an electrical circuit and energize a warning light on the face of the control panel.

3. Cable

The pump motor cable shall be of type SOW-A, SOW, or P122-MSHA as required. The cable sizing shall conform to NEC, ICEA and CSA specifications.

4. Power Cable

Power cord and control cable shall be double sealed. The power and control conductor shall be single strand sealed with epoxy potting compound and then clamped in place with rubber seal bushing to seal outer jacket against leakage and to provide for strain pull. Cords shall withstand a pull of 300 pounds to meet U.L. requirements.

Insulation of power and control cords shall be type SOW/SOW-A. Both control and power cords shall have a green carrier ground conductor that attaches to the motor frame.

## 6.06 Pump Installation

The pump discharges shall be provided with a guide rail system so there will be no need for personnel to enter the wet well for pump removal.

Where the guide rail system is used, the pumps shall automatically connect to discharge connections when lowered into place on a guide rail system, requiring no bolts, nuts or fasteners to effect proper sealing. Each system shall consist of guide rail supported at the top by an upper guide bracket and at the bottom by the discharge connection.

## 6.07 Control Panels

1) The scope of work for this project shall be to provide a Duplex Pump Control Panel.

1) The Duplex Pump Control Panel:

- (a) Type 4x stainless steel enclosure
- (b) Dead-front swingout panel
- (c) Generator plug
- (d) Power distribution block
- (e) TVSS
- (f) Phase monitor

- (g) Motor circuit protectors
- (h) NEMA rated motor starters
- (i) Control power transformer
- (j) Allen Bradley PLC controller
- (k) Vega Radar WL61 Level Controller
- (l) LED display to show wet well level
- (m) Cal Amp Viper SC 136-174 MHZ
- (n) Elapsed time meters for each pump
- (o) H/O/A switches and status lights for each pump
- (p) Misc. devices required to make a complete working system

2) Control Panel Construction:

- 1) All control panels shall be constructed in a UL 508A/498 listed facility. All control panels shall be UL 508A/498 listed. Control panels shall be made available to the Owner and Engineer during factory testing.
- 2) Control panels to be manufactured by:
  - a) Toric Engineering Incorporated.

3) Enclosures:

- 1) Enclosures shall be Hoffman, Rittal, or equal.
- 2) All panels to be NEMA 4X Enclosures.
  - a) NEMA 4X enclosures shall be fabricated from 14 gauge (minimum) stainless steel.
  - b) Enclosure door shall be provided with neoprene gasket, which shall be attached to the enclosure with oil-resistant adhesive, and held in place with stainless steel retaining strips.
  - c) Door clamps shall be provided on three sides of the enclosure door. Clamps shall be quarter-turn or similar tool-less means.
  - d) A hasp and staple shall be provided for padlocking.
  - e) Swing out panel kit shall be provided to mount operators and VFD keypad.
  - f) Panel heaters, corrosion inhibitors and breather drains shall be furnished for condensation and corrosion control inside the panel. Panel heaters shall be of the

forced air types provided with integral thermostat control, Hoffman type D-AH, or equal.

- 3) Panels shall be constructed using factory-fabricated enclosures. Install instruments and devices, plumb, and wire panels at panel shop or other facility prior to shipment to job-site.
- 4) Standard Signal Interfaces: Unless otherwise specified, discrete input and output signals shall conform to the following:
  - 1) Isolated non-powered (dry) contact closure.
  - 2) Power contact from panel or device receiving signal.
  - 3) Unless otherwise specified, input and output analog signals shall conform to the following:
    - a) 4-20 mAdc.
    - b) For 2-wire transmitter, provide isolated type and power with 24 or 48 Vdc at panel or device receiving signal.
    - c) Where isolation required for interface with particular equipment supplied, provide necessary I/I converters.
- 5) Wiring:
  - 1) In addition to NEC and NEMA requirements, wiring shall conform to following:
    - a) Power: 12 AWG stranded minimum, type MTW, 600 V.
    - b) Control: 16 AWG stranded minimum, type MTW, 600 V.
    - c) Analog Signal: Twisted pair, 18 AWG, Beldon 8760 or equal.
  - 2) Wire color code:
    - 1) AC neutral conductor: White.
    - 2) AC hot conductor: Black.
    - 3) Grounding conductor: Green.
    - 4) AC control conductor, powered from within panel: Red.
    - 5) AC control conductor, powered from remote source: Yellow.
    - 6) DC (+) power conductor: Blue.
    - 7) DC (-) power conductor: Blue.
    - 8) DC control conductor: Blue.
    - 9) Twisted pair cable (-) signal conductor: White.

- 10) Twisted pair cable (+) signal conductor: Black.
- 3) Design control panels shall keep 120-vac power and discrete signals, and analog and other low voltage signals separated. Do not run 120-vac power and discrete signals, or analog or other low voltage signals in the same conduit or wire-duct. Where 120-vac power and discrete signals, or analog or other low voltage signals must cross, they shall do so at right angles.
- 4) Wiring Within Wire Duct:

Wherever feasible plastic wire duct with cover shall be used for routing of wire within control panel. Size wire duct to be no more than 50% full. Maintain 2" clearance between wire duct and terminals. Wiring outside of ducts shall be restrained by use of plastic wire-ties. Restrain wiring a minimum of every six inches. Provide abrasion protection for wires passing through holes or across abrasive metal edges. Adhesive type wire fasteners shall not be used. Hard screw type shall be employed. Wire duct shall be Panduit.

- 5) Terminations:

Wiring within control panel shall be continuous and terminated only at terminal blocks or equipment terminals. Splices or butt connectors shall not be used within panel. No more than two wires shall be terminated at any one terminal. Make external connections by way of numbered terminal blocks on numbered terminal strips. When signals are powered from remote location, switched terminal blocks shall be used where conductors enter or leave panel. When signals are powered from within panel, fused terminal blocks shall be used where conductors enter or leave panel. Include provisions for grounding of shields on shielded twisted pair cables entering or leaving panel. Cable shields shall be grounded at terminal block end only. Provide separate terminal strips for each of the following types of signals:

- a) 120-vac UPS power circuits,
- b) 120-vac utility power circuits,
- c) 120 Vac discrete signals,
- d) 24 or 48 Vdc discrete signals,
- e) Analog signals,
- f) Serial or parallel digital communication signals,
- g) Intrinsically safe circuits.

h) Each conductor or twisted pair cable shall be labeled near its termination point. Color-coded multi-conductor cable or multi-pair cable shall be labeled on overall jacket near its point of fan-out. Each pair of a multi-pair cable, when not color-coded, shall be labeled at its termination point in addition to the overall jacket. Labels shall be machine-printed wrap-around types with tag visible from front without removal of wire from termination. Wire labels shall be Panduit.

6) Power Distribution:

Panels having 120 vac power supply. Provide circuit breaker on power supply(s) entering panel. Provide separately fused power supply to each major panel component. Panels using modular or solid state I/O devices. Provide separately fused power circuit for panel powered I/O signals entering panel from field devices. Provide separate circuit for each module. Include digital output surge suppressor installed at terminal strip for each output signal driving an inductive load including:

- 1) Relays,
- 2) Solenoids,
- 3) Motor starters.

7) Front of panel mounted devices:

Provide nameplate for each front of panel device with descriptive phrase using nomenclature as listed in Specifications. Laminated white plastic with 3/16-in. high black characters.

Rear of panel mounted devices. Provide nameplate for each rear of panel device with labels used on panel drawings. Laminated white plastic with 1/8-in. high black characters.

8) Panel Finish:

Remove mill scale, grease, and oil. Primer thickness shall be 0.8 mil. minimum.

Finish coat shall be two-part epoxy or baked dry powder, 3 mil. minimum dry film thickness. Color shall be selected by Owner. Nema 4X panels are not to be painted.

9) Pilot Devices:

- 1) Pilot devices shall be 30mm NEMA 4X. Pilot lights will be of the LED type 24VAC. A master push to test button will be incorporated on the face of the panel to illuminate all pilot lights at one time for testing. Switches will incorporate 3

across design allowing 3 N.O. or 3 N.C. switches or a combination of.

- 2) Pilot devices identification plates shall be white background with black lettering and be provided with adhesive backing. Identification plate material shall be Gravograph Gravoply. Provide UV resistant material as needed. Provide data sheet with control panel submittal.

10) Panel Grounding:

Where noted or specified, provide a ground bus tied to the facility grounding system. Ground busbars shall be of nickel-plated copper, rated for at least 100 amperes, the busbar shall be provided with two (2) screw clamp terminal blocks, which shall be capable of accepting conductors up to #2 AWG. The busbar shall be provided with a minimum of fourteen (14) screw clamp terminal blocks, which shall be capable of accepting conductors up to #4 AWG. Blocks shall be Penn-Union Type N70, Isco type IL-D-167, or equal.

11) Panel Wiring:

- 1) Wiring within the enclosure shall be continuous and shall be terminated only at terminal blocks or equipment terminals.
- 2) Not more than two wires shall be terminated at any terminal.
- 3) Wiring splices and wire nuts will not be permitted within the enclosure.
- 4) Each enclosure shall be provided with internal panel LED lights, which shall be provided with and actuated through a door light switch. The lights shall turn on automatically when the enclosure door is opened and turn off automatically when the enclosure door is closed. The panel lights shall be strategically placed to provide maximum possible illumination coverage of the panel enclosure interior.
- 5) The enclosure vendor shall be responsible for all interposing relays which may be necessary to interface all field-mounted equipment with the programmable controller system, to provide a complete functional system.
- 6) Thermostats for panel temperature sensing or room temperature sensing shall have an operating range from 300 F to 1400 F. Contacts shall be N.O. or N.C. as required, rated for 15 amps at 120 VAC. Units shall be Vynckier type VESNx,

Hammond type SKTO1 I4x9xx, Hoffman type A-TEMNx, or equal.

12) Phase Monitor:

Solid state, phase sequence/failure and under voltage release relay shall be provided to ensure additional running protection for the pump motors. The relay shall be complete with an LED to indicate proper phase sequence, all phases in operation and voltage within limits. The relay shall also include an adjustable voltage monitor, be UL and CSA certified and be complete with automatic reset feature.

13) Circuit Breaker:

A thermal magnetic circuit breaker shall be supplied as branch circuit protection for each motor. The circuit breaker must have a minimum ampere interrupting capacity of (10,000 – 250 volt / 14,000 – 480 volt) symmetrical RMS amps. The circuit breakers shall be operable through the operator's door of the enclosure. The circuit breaker shall be properly sized to protect the control circuit conductors, motor starter and the motor against overcurrent due to short circuit or grounds.

14) Motor Starters:

Motor starters are to be manufactured by Allen Bradley with appropriately sized integral circuit breakers. Starters with integral breakers are to be Allen Bradley 190E series, Square D, ABB or equal.

15) Programmable Logic Controller (PLC):

Provide microprocessor-based Programmable Logic Controllers (PLC) as detailed in this specification and on the applicable plan sheets. The PLC shall be capable of use in a stand-alone configuration and also be capable of being networked into a larger system. It shall be specifically suitable for use in a SCADA system as an intelligent remote telemetry unit. The PLC shall be programmable in standard ladder logic.

The PLC Central Processing Unit (CPU) shall be programmable in standard ladder logic. The CPU shall have a minimum of 12,000 bytes of RAM memory and also include a non-volatile Electrically Erasable Programmable Read Only Memory (EEPROM) unit that shall store the program and setpoints.

The PLC CPU shall have the capability to have "On-Line" programming modifications made.

The PLC shall have integral to it at least two (2) communication ports, one (1) of which shall be capable of RS-232 (DF-1) communications to serial devices such as modems and the other shall be used for connection to Ethernet network communications or to accessories communicating with Ethernet. The communications operations shall include the capability of report by exception polling. There shall be standard cards available that can be placed in the rack in order to provide additional communication ports as required.

The PLC and I/O cards shall all be U.L. listed.

I/O cards shall be interchangeable in any slot in the rack. The quantity and type of I/O cards required for this project are detailed in this specification and plans. It shall be the responsibility of the SCADA system manufacturer to ensure that at least 20% spare of each type of I/O is provided. The following describes the requirements for each type of I/O card:

1. Discrete Input Cards:  
Discrete input cards shall be available in 4, 8 and 16 channel configurations. The cards shall accept 20-48 VDC, 100-240 VAC signals. The cards shall have easily visible LED indicators showing the status of each input channel. (LED ON = INPUT PRESENT). Cards shall have a removable terminal strip.
2. Relay Output Cards:  
Relay output cards shall be available in 4, 8 and 16 channel versions. Cards shall be rated for 5-265 VAC and 5-125 VDC voltages. The cards shall have an LED indication for each channel showing the relay is closed. Cards shall have a removable terminal strip.
3. Analog Input Cards:  
Analog input cards shall be available in 4 and 8 channel configurations. The cards shall be rated for input signals between -20 mA and 20 mA. The cards shall employ a 16-bit twos compliment type analog to digital conversion chip. Cards shall have a removable terminal strip.
4. Analog Output Card:  
Analog output cards shall be available in 2 (combination 2 input and 2 output) and 4 output channel configurations. Outputs shall be either 0-10 VDC or 0-21 mA DC. The output digital to analog converter shall have 16-bit resolution. The cards shall source the loop with 24 VDC. The cards shall have a removable terminal strip.

THE PLC, INCLUDING ALL CARDS AND ACCESSORIES AS DETAILED IN THIS SPECIFICATION, SHALL BE AS MANUFACTURED BY ALLEN-BRADLEY CO., OF 1201 SOUTH SECOND STREET, MILWAUKEE, WI 53204, MODEL



MicroLogix 1400

- G. All PLC equipment supplied on this project shall be programmable in standard ladder logic. The ladder logic development and configuration software shall be the same for all PLC's listed in this specification. Equipment requiring separate program development and configuration software for each product is not acceptable.

The software program shall be Windows based and be Microsoft certified for use with Windows NT, Windows 98, Windows XP, Windows 7, Windows 10, and future versions.

The software shall be able to develop the ladder logic programs, provide equipment configurations, diagnostics for both equipment and software, upload programs, download programs, and edit programs "on-line" where applicable.

THE SOFTWARE SHALL BE AS MANUFACTURED BY ROCKWELL SOFTWARE, A DIVISION OF ROCKWELL AUTOMATION, MODEL RSLOGIX 500.

## 6.08 Station Construction

### A. Wet Well and Valve Pit

The walls of the lift station and valve pit structures shall be constructed of reinforced concrete pipe which shall conform to the latest ASTM Specifications C-76, with a minimum compressive strength of concrete equal to 4000 psi. Reinforcement of the pipes shall be of the circular type. All of the pipe for the pump chambers and the access tubes shall be Class III and of the diameter shown on the plans. Handling or lifting lugs and/or devices shall be provided in the pipe shells for ease of unloading and setting in place. All joints between pipes and between ends of pipes and concrete slabs shall be made watertight.

Precast manhole sections shall also be allowed for the wet well and valve pit which meet the requirements of ASTM C478.

The pipes utilized for the lift station wet well or valve pit shall be jointed with a rubber O-ring type seal conforming to the A.S.T.M. Standard C-443 (latest revision). The joint shall be designed to provide a maximum infiltration-exfiltration limit of .158 gallons per inch of pipe diameter per 100 feet of length per hour (200 gpd/in-mile). The interior and exterior joint spaces shall be grouted to a smooth surface using a sand-cement mixture mortar. The mortar-grout shall have one part cement to two parts sand mix ratios. The completed interior and exterior joints shall have a smooth troweled waterproof finish.

The top concrete slab of the lift station and valve pit shall have cast into it a socket for receiving the end of each concrete pipe. The joint shall be made watertight. No see-through holes shall be accepted. An access ladder shall be provided with rungs spaced 12 inches on center from top to bottom of the station and shall be of steel reinforced plastic construction.

Concrete for the foundation and roof slabs shall be made of Class A concrete.

All interior exposed concrete surfaces of the lift station wet well shall be cleaned and sealed with two coats of polyamidoamine epoxy to a total dry film thickness of 8.0 mils.

Where metal or cast-iron pipes are shown or required to pass through the walls, the Contractor shall require the pipe manufacturer to provide preformed openings, or cut openings in the concrete pipe of just sufficient diameter to receive the smaller pipes and shall then solidly fill or patch around the pipe with non-shrink type cement mortar to watertight fit.

B. Access Hatches

The Contractor shall furnish and install as shown for both the wet well and valve pit lockable aluminum access covers rated for H-20 loading. The doors shall have a lifting handle and safety locking handle in the open position. The hatch shall have hardware to provide for padlocking. Manufacturer shall be Halliday Products or equal.

C. Portable Hoist

The Contractor shall furnish and install a stainless steel adjustable portable hoist. The hoist shall have a loading capacity of 1000 lbs, and shall come complete with stainless steel cable, a hand winch and stainless steel embed socket. The hoist shall be Model No. D2B36B as manufactured by "Halliday Products", or equal.

D. Pipe, Valves, and Fittings

All wet well and valve pit pipe and fittings shall be ductile iron. Piping shall be supported independent of the sewage flanges. All inside plug valves shall be lever operated. One lever shall be provided for each plug valve. All check valves shall have external swing arm with weight or spring control for tension.

All valves and piping coming in contact with sewage or installed in the pump or valve chambers shall be coated as follows:

1. Primer — Aromatic Urethane Zinc Rich - 2.5 to 3.5 mils
2. Field Coats — Aliphatic Acrylic Polyurethane (2 coats) 2.0 to 4.0 mils

per coat

E. Electrical

These Standards are intended to cover all the electrical work necessary to complete the wiring system for the lift station which is not furnished as a part of the pumping equipment and/or factory-built controls. It is not the intent to give every detail in these Standards.

The Contractor shall furnish and install all electrical equipment, apparatus, and appurtenances required and also any additional equipment and apparatus which are necessary to make a complete working electrical installation. Any detail which is necessary for completion of the work shall be considered a portion of the work, even though not directly specified. This includes all hangers, bolts, supports, grounding and other miscellaneous items.

All workmanship and materials shall conform to the provisions of the Contract Documents and to all other Sections of the specifications pertinent thereto, the State and local electrical code, and the National Electrical Code.

The Contractor shall furnish and install the electrical service entrance including the service pole, weather head, meter socket, main disconnect switch, manual transfer switch, and all conduit and wiring necessary to connect to the control panels and to the individual pump motors from these panels as indicated on the Drawings.

The main disconnect shall be fused type in a stainless steel NEMA Type 4X enclosure. Provide padlock for disconnect switch with keys to match all electric control locks. The main disconnect for the lift station shall be mounted on a service pole. The Contractor shall furnish the conduit and wiring for the high-water audio-visual alarm system between the lift station control panel and its respective red warning light and horn mounted at the pump control panel.

F. Earthwork and Site Drainage

1. Description

The Contractor shall furnish all labor, materials, equipment, tools and do all work necessary for all excavations and backfilling, fills and embankments, final grading entrance drives and other work as required or as specified for the construction of the structures, conduits, channels, piping and sewers.

2. Work Included

The work includes grubbing, stripping and clearing all areas on which

work is to be done; protection of all new structures, piping, conduits, excavation, stockpiling, disposal of excavated material; sheeting, shoring and bracing, cofferdams, dikes, draining, pumping, handling and disposal of water from the excavations; backfilling; making fills and embankments; final grading; providing topsoil over final graded areas; and other operations as specified and required to complete the earthwork.

The work includes the removal and disposal of all ground water, seepage and storm water necessary to properly place the concrete and carry out the entire construction in an efficient and orderly manner, and to provide and maintain means of preventing water from entering the new structures, and to keep them dewatered as necessary to prevent floatation and damage and to complete all work under this Contract.

Excavated materials shall be stockpiled and used to make the fills and embankments as shown on the plans. Backfilling shall be done in a manner to avoid any undue structural loading on new structures. The work shall be performed in such a manner so as to prevent damage to existing structures that are to be retained.

Any shortage of excavated materials to complete the backfilling, fills, and embankments shall be obtained from borrow as a part of the work under this Section at the Contractor's expense. All borrow pit sites to be utilized by the Contractor must be approved by the Engineer. In the event that the Owner should authorize a borrow from some location on the site to obtain selected backfill or embankment materials, any excess materials from other excavations shall be used to fill the borrow site to the contours shown on the Plans or to its original contours as and when directed by the City at the Contractor's expense.

In the event of a surplus of excavated material which is not needed for backfilling, grading, or filling a borrow site, the Contractor shall dispose of such surplus material away from the site at his expense.

The final graded areas of all new work, including the slopes of embankments and borrow sites shall be covered to a depth of 3 to 4 inches with topsoil which is suitable for growing lawn grass. The Contractor may strip and stockpile available topsoil from the areas to be excavated, or areas to be covered with embankments as a source of suitable material. Otherwise, all topsoil shall be obtained from outside of the site at the Contractor's expense. The topsoil shall consist of loose, friable topsoil, free from subsoil, debris and stones. It shall have demonstrated by the occurrence upon it of healthy vegetation, its ability to grown lawn grass and not contain noxious weeds. All of the areas to be seeded shall be brought to a subgrade level 3 to 4 inches below the finished grade before placement of the

topsoil. Wherever the surface of the subgrade is in a hard or compacted rutted condition due to traffic or other causes, it shall be scarified and harrowed to a loose condition with even surface. If weeds should appear in the seeded areas within the warranty period, the Contractor shall, at his own expense, apply suitable herbicides so as to destroy the weeds without harming the grass.

### 3. Backfilling Requirements

All backfill shall be Class I or II as defined by ASTM.

Backfill shall be placed in lifts not exceeding 9 inches in loose thickness. Fill placed in foundation excavations and under slabs shall be compacted to a minimum of 100% of the maximum dry density as determined in accordance with ASTM Standard D-698 (Standard Proctor). Fill placed around underground walls shall be compacted between 95 and 98% of the maximum dry density as determined in accordance with ASTM Standard D-698 (Standard Proctor). For sand fill, vibrating plates and rollers may provide adequate compaction. The size of compaction equipment shall be limited to approximately 500 pounds within 10 feet of walls. Optimum moisture shall be monitored to maintain the moisture within workable limits. Compaction of the fill by water flooding methods is not recommended. Material on the site may be used as fill upon approval by the City. Depending on the time of construction some aeration of fill material may be required before it can be placed and satisfactorily compacted.

### 4. Underground Construction

Granular backfill around the perimeter of underground structures shall be used. The granular backfill shall be a minimum width of two feet abutting the walls and shall be capped with about an 18 inch clay cover to minimize surface infiltration.

5. Subsurface Conditions

Borings and other investigations that have been made apply only to conditions encountered at the indicated locations and to the depths shown. The Contractor shall examine the site personally and make such additional investigations as he may deem necessary for estimating costs, planning and execution of the work. It shall be the Contractor's responsibility to perform all work in such a manner so as to prevent damage to new or existing structures which are to be retained. All damaged structures shall be repaired or replaced as necessary to the satisfaction of the City.

G. Access Road and Site Work

1. General

The Contractor shall construct each access road, auto parking areas and related appurtenances as required.

2. Work Included

This Section shall include all work necessary to:

- ! Strip topsoil from areas of pavements and embankments.
- ! Furnish and install any culverts with matching end sections. Fine grade the access road, auto parking, and turn-around areas. Culverts shall be RCP.
- ! Furnish, spread, shape, and compact the 8" limestone aggregate pavement for the access road, parking and turn-around areas as shown on the Plans.
- ! Spread topsoil on shoulder and ditch areas.

3. Materials and Construction Methods

Sub-Grade Preparation

- ! All embankment and sub-grade material shall be compacted to not less than 95% Standard Proctor density. All earth materials needed for embankment construction may be obtained from the work site.

Aggregate Pavement

- ! The crushed limestone for the 8" aggregate pavement shall be 4" Class B, Type "O", Size 53-B, installed over 4" of Size No. 2 as shown

on the Drawings.

#### Pipe Culverts

! Culvert shall be minimum 12" RCP with matching end sections.

#### 4. Site Work

The Contractor shall perform all site work as required and make all restoration work necessary.

### H. Laying of Ductile Iron Force Main

#### 1. Installation of Buried Ductile Iron Pipe

In general, the installation of buried or ductile iron force mains shall conform to the requirements of the manufacturer or the AWWA Standard for the pipe being installed.

Ductile iron pipe shall generally be installed to conform with Laying Condition Type I described in ANSI/AWWA C150/A21.50 and conform with the backfilling and trench maintenance requirements as specified under these specifications.

All ductile iron pipe shall be bedded in compacted Class I or II material, placed on a flat trench bottom. The bedding shall have a minimum thickness of 4" or one-fourth (1/4) the outside pipe diameter below the pipe and shall extend halfway up the pipe barrel at the sides. All material shall be placed in the trench in approximately six (6) inch layers. Each layer shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the pipe and shall be thoroughly compacted. When Class I or II materials are used compaction may be accomplished by hand or mechanical tamping or by "walking" the material in. Bedding from the halfway point on the pipe to a point twelve (12) inches above the top of the pipe shall be a Class I, II, III, or IV material placed in six (6) inch layers and thoroughly compacted to prevent settlement. Class III and IV material shall not be used when the trench is located in an area subject to vehicular traffic.

**SECTION 7**  
**INSTALLATION/CONSTRUCTION**



## SECTION 7 INSTALLATION/CONSTRUCTION

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## SECTION 7

### INSTALLATION/CONSTRUCTION

#### 7.01 General

This section shall provide general, minimum requirements for the installation and construction for City of Plymouth Public Works projects.

#### 7.02 Excavation

##### A. Dewatering and Control of Surface Water

Where groundwater is encountered, the Contractor shall make every effort necessary to secure a dry trench bottom before laying pipe. The Contractor shall provide, install and operate sufficient trenches, sumps, pumps, hose, piping, well points, etc. necessary to depress and maintain the groundwater level below the base of the excavation. If the Contractor is unable to remove the standing water in the trench, the Contractor shall over-excavate the proposed bottom grade of the sewer bedding, and place not less than three (3) inches of Class No. 2 crushed stone (Indiana Department of Transportation aggregate Classification) in the over-excavated area.

The Contractor shall keep the site free of surface water at all times and shall install drainage ditches, dikes, pumps and perform other work necessary to divert or remove rainfall and other accumulation of surface water from excavations. The diversion and removal of surface and/or groundwater shall be performed in a manner which will prevent the accumulation of water within the construction area.

**UNDER NO CIRCUMSTANCES SHALL SURFACE WATER AND/OR GROUNDWATER BE DISCHARGED TO, DISPOSED OF, OR ALLOWED TO FLOW INTO THE CITY'S SANITARY SEWER SYSTEM.**

**Penalties consisting of \$500.00 per day per violation may be applied if deemed necessary according to Sewer Use Ordinance 1440.**

##### B. Excavation

##### 1. Clearing

Preparatory to excavation, the site of all open cut excavations, embankments, and fills shall be first cleared of obstructions and existing facilities (except those which must remain temporarily or permanently in service). On all public or private property where grants or easements have been obtained, and on the property of the City, the Contractor shall remove and keep separate the top soil, and shall carefully replace it after the backfilling is completed.

2. Pavement Cutting

Prior to excavating paved areas all excavation edges falling within the pavement shall be saw cut in a neat, straight manner. Cutting shall be performed with a saw designed specifically for this purpose. The cut shall penetrate the entire pavement thickness where possible. If the existing pavement is more than 6 inches thick, then a cut of not less than 6 inch depth shall be made. If pavement cuts are made in streets which are opened to traffic prior to excavation, then the cuts shall be thoroughly filled with sand and maintained full until the excavation is performed.

3. Protection of Existing Improvements

Before any excavation is started, adequate protection shall be provided for all existing utilities and City structures.

4. Protection of Trees and Shrubs

No existing trees or shrubs in street right-of-ways and easements shall be damaged or destroyed. Where branches of trees or shrubs interfere with the Contractor's operations, they shall be protected by tying back wherever possible. No limbs or branches shall be cut. If his operations will not permit saving certain trees, the Contractor shall be wholly responsible for satisfying all claims for restoration or restitution resulting from their damage or removal.

If small trees and shrubs are moved or pruned to permit more working space, pruning shall be done in accordance with Home and Garden Bulletin No. 83, U.S. Department of Agriculture, "Pruning Shade Trees and Repairing Their Injuries". However, the Contractor shall obtain, in writing, the City's permission to move or prune trees or shrubs.

5. Maintenance of Public Travel

The Contractor shall carry on the work in a manner which will cause a minimum of interruption to traffic, and may close to through travel not more than two (2) consecutive blocks, including the cross street intersected. Where traffic must cross open trenches, the Contractor shall provide suitable bridges to street intersections and driveways. The Contractor shall post suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Prior to closing of any streets the Contractor shall notify responsible municipal authorities.

All traffic control shall be in accordance with the latest edition of the Indiana Manual on Uniform Traffic Control Devices (MUTCD). Refer to the following website:

<http://www.in.gov/legislative/ic/code/title9/ar21/ch1.html>

6. Utility Interruption

The Contractor shall proceed with caution in the excavation and preparation of the trench or pit so that the exact location of underground structures may be determined. Prior to proceeding with trench excavation the Contractor shall contact all utility companies in the area to aid in locating their underground services.

The Contractor shall take all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer or underground cable, he shall immediately notify the responsible official of the organization operating the utility interrupted. The Contractor shall lend all possible assistance in restoring services and shall assume all costs, charges, or claims connected with the interruption and repair of such services. Existing drainage tile will be reconnected to original condition using rubber coupling with stainless steel bands.

7. Open Cut Excavation

Open cut excavation shall be safely supported and of sufficient width and depth (and only to such width and depth) to provide adequate room for the construction or installation of the work to the lines, grades and dimensions.

a. Trench Dimensions

The bottom width of the trench at and below the top of the pipe and inside the sheeting and bracing, if used, shall not exceed the recommendations as contained in the applicable ASTM Standard for the pipe being used.

Trench sheeting and bracing or a trench shield or box shall be used as required by the rules and regulations of OSHA. The bottom of the trench shall still meet the above standards.

If the trench widths are exceeded with the written permission of the City, the pipe shall be installed with a concrete cradle or with concrete encasement or other ASTM approved methods as approved by the City Engineer or the City.

b. Excavations With Sloping Sides, Limited

The Contractor may, at his option, where working conditions and right of way permit (as determined by the City Engineer), excavate pipe line trenches and pits for structures with sloping sides, but with the following limitations:

- (1) In general, only braces and vertical trenches will be permitted in traveled streets, alleys, narrow easements and for pit excavations more than 10 feet deep.

- (2) Where pipe line trenches with sloping sides are permitted, the slopes shall not extend below the top of the pipe, and trench excavations below this point shall be made with near vertical sides with widths not exceeding those specified herein before.
- (3) Slopes shall conform to all OSHA regulations.

8. Earth Excavation

Earth materials shall be excavated so that the open cuts conform with the required lines, grades and dimensions.

- a. Unsuitable Foundation: When the bottom of the excavation is unsuitable as a foundation, it shall be excavated below grade and then refilled with concrete or crushed stone to the grade as the City or its representative may direct. The crushed stone refill shall be mechanically compacted in six (6) inch layers or as directed by the City.
- b. Unauthorized Excavation: Unauthorized excavation below grade shall be filled with crushed stone or concrete and compacted as ordered and directed by the City Engineer or its representative.
- c. Excavated Earth For Backfill: Excavated earth materials may be used for backfill subject to the approval of the City Engineer. Such material may be used only where its class is allowed.

9. Boring and Jacking

Construction of the pipeline by boring and jacking methods under highways, railroads, and streams will be permitted unless otherwise specified on the plans.

- a. Backstop: The backstop shall be of sufficient strength and positioned to support the thrust of the boring equipment without incurring any vertical or horizontal displacement during such boring operations.
- b. Guide Rails: The guide rails for the boring equipment may be of either timber or steel. They shall be laid accurately to line and grade and maintained in this position until completion of the boring operations.
- c. Casing Pipe: Steel casing pipe shall be new, conform to ASTM A 139 and shall be of the size (diameter) sufficient to install and support the carrier pipe. The lengths of pipe shall be welded as they are installed. Where lengths of casing pipe are joined during the boring operations, care shall be taken to insure that the proper line and grade is maintained.

The minimum wall thickness for casing pipes under highways, railroads and streams shall be 0.375 inches. Steel shall be Grade B under railroads and Grade A at all other locations. Stream crossings shall be a minimum of 3 feet from the stream bottom (as defined by the regulating agency) and the top of the casing pipe.

10. Water Line Protection

- (a) Horizontal and Vertical Separation - Sewers and service laterals shall be laid at least 10 feet (3 m) horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot (3 m) separation, the appropriate reviewing agency may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer or lateral closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer or lateral and at an elevation so the bottom of the water main is at least 18 inches (460 mm) above the top of the sewer or lateral.

If it is impossible to obtain proper horizontal and vertical separation as described above, both the water main and sewer or lateral must be constructed of slip-on or mechanical joint pipe complying with public water supply design standards of the agency and be pressure tested to 150 psi (1034 kPa) to assure watertightness before backfilling. Acceptable pipe materials would include PVC SDR-21, PVC C900 or Ductile Iron

- (b) Crossings - Sewers and service laterals crossing water mains shall be laid to provide a minimum vertical distance of 18 inches (460 mm) between the outside of the water main and the outside of the sewer or lateral. This shall be the case where the water main is either above or below the sewer or lateral. The crossing shall be arranged so that the sewer or lateral joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer or lateral, adequate structural support shall be provided for the sewer or lateral to maintain line and grade.

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, one of the following methods must be specified:

- (1) The sewer or lateral shall be designed and constructed equal to water pipe, and shall be pressure tested at 150 psi (1034 kPa) to assure water tightness prior to backfilling.
- (2) Either the water main or the sewer or lateral line may be encased in a watertight carrier pipe which extends 10 feet (3m) on both sides of the crossing, measured

perpendicular to the water main. The carrier pipe shall be of materials approved by the regulatory agency for use in water main construction.

### **7.03 Bedding and Backfill**

#### **A. General**

All trenches or excavations shall be backfilled to the original surface of the ground or such other grades as required or directed. In general the backfilling shall be carried along as speedily as possible and as soon as the concrete, mortar, and/or other masonry work and pipe joints have sufficient strength to resist the imposed load without damage.

#### **B. Backfill Materials**

The following materials shall be used for backfill in accordance with and in the manner indicated by the requirements specified herein.

Class I - Angular, 6 to 40 mm (1/4 to 1 ½ inch), graded stone such as crushed stone.

Class II - Coarse sands and gravel with maximum particle size of 40 mm (1 ½ inch), including various grades of sands and gravel containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.

Class III - Fine sand and clayey gravel including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.

Class IV - Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not recommended for bedding. This class shall also include any excavated material free from rock (3 inches and larger), concrete, roots, stumps, rubbish, frozen material and other similar articles whose presence in the backfill would cause excessive settlement.

#### **C. Backfill of Trench Excavations for Pipes and Conduits**

Bedding and Backfill materials samples shall be submitted to the City prior to start of construction.

#### **D. Bedding**

##### **1. Rigid Pipe and Conduit Bedding**

For purposes of this specification, rigid pipe and conduits shall include those made of steel, ductile iron, concrete, RCP, and other materials as determined by the City.

All rigid conduit and pipe shall be laid to the lines and grades unless otherwise directed by the City. All rigid conduit and pipe shall be bedded in compacted Class I material (#8 stone), placed on a flat trench bottom. The bedding shall have a minimum thickness of 4" or one-fourth (1/4) the outside pipe diameter below the pipe and shall extend halfway up the pipe barrel at the sides. All material shall be placed in the trench in approximately six (6) inch layers. Each layer shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the pipe and shall be thoroughly compacted. When Class I materials are used compaction may be accomplished by hand or mechanical tamping or by "walking" the material in. Bedding from the halfway point on the pipe (spring line) to a point twelve (12) inches above the top of the pipe shall be a Class I, II, III, or IV material placed in six (6) inch layers and thoroughly compacted to prevent settlement. Class III and IV material shall not be used when the trench is located in an area subject to vehicular traffic.

## 2. Backfilling Around Structures

The backfill around manhole structures other than pipes shall be made with Class I or II materials, shall be done in a manner to prevent after-settlement, shall be tamped/compacted in a satisfactory manner and shall be left at the proper grade with a smooth even surface. If the required excavation for any new structure has been carried below the level of any existing or new pipe lines or conduits which are located within the limits of the excavation, the Contractor shall take special precautions in compacting the backfill as it is placed beneath the level of the pipes or shall provide compacted granular fill or suitable pipe supports to prevent any damaging stress or strain to the pipe due to earth backfill and superimposed live loads.

As an alternative to utilizing Class I or II materials, flowable fill may also be used.

## 2. Flexible and Semi rigid Conduit Bedding

For purposes of this specification, flexible and semi rigid conduits and pipes shall include those made of PVC, HDPE, PVC Truss, and other materials as determined by the City Engineer.

All flexible and semi rigid pipe shall be laid to the lines and grades unless otherwise directed by the City. All flexible and semi rigid conduit shall be bedded in compacted Class I material (#8 stone), placed on a flat trench bottom. The bedding shall have a minimum 4" thickness or one-fourth (1/4) the outside pipe diameter below the pipe and shall extend to twelve (12) inches above the top of the pipe level the full width of the trench. All material shall be placed in the trench in a maximum of six (6) inch layers



(before compaction). Each layer, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the pipe and shall be adequately compacted. When Class I materials are used, compaction may be accomplished by hand or mechanical tamping or by "walking" the material in.

E. Backfill Above Pipe

1. Method A Backfill in Areas Not Subject to Vehicular Traffic

For purposes of this specification, trenches shall be considered subject to vehicular traffic if all or any portion of the excavation is located within four (4) feet of a roadway or alley which is routinely traveled by powered vehicles. In the event of any question regarding the susceptibility of an area to traffic, the City's decision shall govern.

The trench between a level twelve (12) inches above the top of the pipe and the ground surface shall be backfilled with Class I, II, III or IV materials, as described above, deposited with mechanical equipment in such a manner that it will "flow" onto the bedding and not free fall. The Contractor shall consolidate the backfill by the back and forth travel of a suitable roller, wheeled device or other similar heavy equipment until no further settlement is obtained. Heavy equipment shall not be used until there is a cover of not less than three (3) feet over the pipes. To assist in promoting maximum settlement, the surface of the trench shall be left in a slightly rounded condition. Periodical dressing of the backfill in the trench to promote the drainage and safety conditions shall be made during the course of the work.

A six (6) inch depth shall be filled with good top soil and seeded in accordance with these specifications. Existing top soil and sod may be used if properly separated and preserved. In the event of any question regarding the susceptibility of an area to traffic, the City Representative's decision will govern.

During the construction, no ground water, dirt, mud, gravel, etc. shall be allowed to enter the newly constructed conduits or structures or existing parts of the collection system.

2. Method B Backfill in Areas Subject to Vehicular Traffic (Mechanical Compaction)

The trench between a level of twelve (12) inches above the top of the pipe and the surface, which are located in areas subject to or possibly subject to vehicular traffic (five (5) feet off pavement area), shall be backfilled with Class I or II materials, deposited in uniform layers of one

(1) foot six (6) inches. The initial lift of backfill shall be placed in a manner to minimize lumps and voids, but not requiring mechanical tampers. Equipment for compaction shall be used on backfill after there are two (2) feet of backfill over pipe barrel. Each layer shall be thoroughly compacted by mechanical tamping utilizing a crane mounted hydraulic vibratory compactor or jumping jack type compactor. Additional lifts of no more than six (6) inches in depth shall be placed and compacted with compaction equipment to a depth of twelve (12) inches below finished grade. Completion of backfill to finished grade shall be done with compacted aggregate. Compacted aggregate shall conform to the Indiana Department of Transportation Standard Specifications for Compacted Aggregate Base. The aggregate shall be thoroughly compacted by means of compaction equipment. The compacted aggregate is intended to serve as the base for the permanent pavement replacement. In the event that suitable granular material capable of compaction of obtainable from the trench excavations and can be satisfactorily segregated, then upon approval of the City Representative, the material may be used for the top layer of compacted base over the surface of the backfill in lieu of the specified Compacted Aggregate Base material. Any settlement that occurs shall be immediately refilled and compacted with aggregate. The Contractor shall apply an approved dust preventative as necessary to avoid or eliminate dust complaints from nearby residents.

Crane mounted vibratory compactors shall be capable of producing 1900 cycles per minute and having a compaction plate with minimum dimensions of twenty-three (23) inches by thirty-one (31) inches. The compactor shall be similar to those as manufactured by Allied or HoPac.

Jumping jack compactors shall have a compaction plate with maximum dimension of twelve (12) inches by twelve (12) inches. Manufacture recommendation shall be supplied for verification.

When Class I or II materials do not contain sufficient moisture to obtain proper compaction in the opinion of the City Representative, the materials shall be moistened or wetted as directed by the City Representative.

The surface of the trench shall be left twelve (12) inches below finish grade if the surface is subject to traffic. This twelve (12) inch depth shall be filled with two (2) six (6) inch layers of compacted #53 limestone base material, shaped, graded, and compacted. In either case, the Contractor shall maintain the surface until the permanent pavement is placed.

All backfill placed under this Method B shall be tested in accordance with AASHTO-7-99 and immediately prior to permanent pavement replacement. Compaction shall not be less than ninety-five percent (95%) Standard Proctor Density.

Density testing shall be performed immediately prior to permanent pavement replacement and after the upper three (3) to five (5) inches of the compacted aggregate base or temporary pavement is removed to

allow paving. When backfill has been placed using vibratory compaction, testing shall be made at the exposed surface every four hundred (400) feet. All test locations shall be determined by the City Representative. In the event that the density test results show a compaction of less than one hundred (100) percent Standard Proctor Density AASHTO T-99, the area (s) represented by such test (s) shall be immediately re-compacted using Method C. Paving shall not proceed until all areas to be paved have met the density requirements.

2. Method C Backfill in Areas Subject to Vehicular Traffic – Jetting and Watersoaking

Class I or II materials may be compacted by jetting. The trench compaction shall be started at the point of lowest elevation of the trench and continued along the trench. Jetting shall not begin until the trench has been backfilled to within twelve (12) inches of the finished surface. The holes through which water is injected into the backfill shall be centered over the trench backfill and at longitudinal intervals of not more than (6) feet. Additional holes shall be provided if deemed necessary by the City Representative to secure adequate settlement. All holes shall be jetted and shall be carried to a point one (1) foot above the top of the pipe. Drilling the holes by means of augers or other mechanical jetting so to prevent contact with or otherwise disturb the pipe. The water shall be injected at a pressure and rate just sufficient to sink the holes at a moderate rate. After a hole has been jetted to the required depth, the water shall continue to be injected until it begins to overflow the surface. The Contractor shall bore test holes at such locations as the effectiveness of the water soaking. An approved soil auger shall be used for boring test holes. As soon as the jetting and soaking has been completed, all holes shall be filled with soil and compacted by tamping or rolling to the satisfaction of the City Representative. The Contractor shall provide all piping, fittings, etc. necessary to deliver the water along the site of work and shall arrange with the Plymouth Water Works for the necessary taps and metering. All costs of water is the responsibility of the Contractor.

F. Temporary Surfaces Subject to Traffic

The Contractor shall open streets to traffic immediately after completing the backfill operation. He shall accomplish this by installing the compacted aggregate base immediately after granular backfill. The use of class II backfill as a temporary surface is specifically prohibited.

G. Maintaining Trench Surfaces

All surface settlement of the backfill along trenches located beneath streets, roads, alleys, driveways and parking lots which are subject to traffic shall be kept filled level with or slightly above the original paved surface at all times with compacted aggregate base material until the permanent pavement is satisfactorily restored. When temporary asphalt pavement is used, depressions and "pot holes" shall be promptly filled with the temporary asphalt material. Special attention shall be given by the Contractor to the timely and proper

maintenance, leveling and grading of the surface of all backfilled trenches, especially those subject to traffic and especially following rains. The surface of streets, roads and alleys shall be maintained smooth and free of ruts and water trapping depressions by periodic power blading, scarifying; and/or filling settled areas, ruts, pockets, or holes with compacted aggregate base material or temporary asphalt where used.

As a dust preventive, the Contractor shall apply, calcium chloride over the surface of the compacted aggregate base in such amounts and at such times as are necessary to avoid or eliminate dust complaints from nearby residents. In event of any question regarding the existence or nonexistence of a dust nuisance, the City's decision on the matter will govern. The material used shall be Regular Flake Calcium Chloride having a minimum chemical content of Calcium Chloride of seventy-seven percent (77%). Unless otherwise specified or ordered by the City, the rate of application shall be one and one half (1 ½) pounds per square yard of surface covered.

Wherever surface settlement is not important, unless otherwise specified or directed, the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation. Just prior to the completion of all work under the contract, any surface settlement below original ground surface shall be refilled in a satisfactory manner, and reseeded as specified if required.

#### **8.04 Laying of Sewers**

##### **A. General**

This section on the Laying of Sewers shall be divided into two (2) classifications - rigid and non-rigid conduit. Pipe materials such as reinforced concrete, steel, and ductile iron pipe are considered rigid conduits. Thermoplastic (PVC) pipe, corrugated metal pipe, HDPE, and PVC truss pipe shall be considered non-rigid or flexible conduits.

##### **B. Rigid Conduit Installation**

All rigid conduit for sewer pipe shall be laid to the lines and grades, unless otherwise directed by the City Engineer. All rigid pipe shall be laid in accordance with the details for the First Class Pipe Laying Method. This First Class Pipe Laying Method may be achieved by Class B bedding methods as shown in the ASCE Manual of Practice No. 37, latest edition. Under this Class B bedding Method, the pipe shall be bedded in compacted granular material (Class I or Class II) placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth (1/4) the outside pipe diameter below the pipe and shall extend halfway up the pipe barrel at the sides. All granular bedding material shall be placed in the trench in approximately six (6) inch layers. Compaction shall be accomplished by hand or mechanical tamping or by "walking" the granular material in. From the halfway point on the pipe (Spring line) to a point twelve (12) inches above the top of the pipe, backfilling methods A or B or C shall be used depending on the trench location. In addition, all rigid conduit shall be installed in accordance with "Standard Recommended Practice for Installing Vitrified Clay

Sewer Pipe" (ASTM Designation C 12 and ASTM D2321).

The laying of pipe in finished trenches shall be commenced at the lowest point, proceeding upstream, with the spigot ends pointing the direction of flow. No blocking under pipes will be permitted, except as approved by the City for pipe to be encased in concrete or laid in concrete cradles.

The practice of blocking pipe up to grade with bedding material, then backfilling under is prohibited. The entire length of the bed section is to be at proper grade before installing pipe.

The supporting strength of the pipe is dependent upon its foundation and trench width. To develop normal strength, the pipe shall have a firm uniform foundation under the entire lower quadrant of the barrel. No weight should be supported by the bell. The maximum trench width as recommended by ASTM at the level of the top of the pipe shall be maintained as narrow as possible, taking into consideration the limitation of the excavation equipment except as may be permitted by the City Engineer upon investigation of the soil conditions, laying methods and earth loadings.

All pipes shall be carefully inspected before being laid, and no cracked, broken or defective pipe or special shall be used in the work. All pipe shall be carefully inserted in the bell in such a manner that there will be no unevenness of any kind along the bottom half of the pipes and so that there is a uniform joint space all around.

All pipe that is field cut shall have the homing-marks reestablished, insuring for proper seating depths. Pipes that are field cut shall have the cut ends re-tapered, by grinding or filing, as close to the original taper provided by the manufacturer as possible. When homing pipe with a spud-bar or other mechanical equipment, other than by hand, place a piece of wood between pipe and tool to prevent damage to bell end-section.

Pipe laid in open cut shall have all trench spaces and voids solidly and completely filled with suitable earth materials from the excavations which shall be thoroughly and solidly rammed into place, unless otherwise specified.

The ends of the pipes shall be protected to prevent the entrance of dirt or other foreign substances. Such protection shall be placed at night or whenever pipe laying is stopped for any reason. Suitable plugs designed for use with the pipe material shall be provided and properly secured and used to cap all slants and branches.

C. Flexible Conduit Installation

Plastic sewer pipe (PVC) and other flexible pipe shall be carefully installed in accordance with the above specification for Rigid Conduit Installation, except where the following paragraphs modify those specifications.

Flexible conduit for sewer pipe shall be installed in accordance with "Underground installation of Flexible Thermoplastic Sewer Pipe" ASTM

Designation C 2321.

The Contractor shall take special precautions when joining PVC pipe not to over-seat past the home-marks. The pipe installation must include adequate bedding to hold its proper placement, prior to installing the next section.

The Contractor shall use caution when stringing thermoplastic pipe. Excessive spans, in sunlight, will cause bowing damage; and said damaged spans will be rejected.

In addition to the construction and testing procedures outlined in other sections of these specifications, the Contractor shall be required to install the flexible pipe in such a manner so that the diameter deflection of the pipe shall not exceed five percent (5%) when tested in accordance with the Final Acceptance Test. Bedding materials surrounding the pipe shall be compacted to the densities required to meet the five percent (5%) maximum deflection requirement. The area requiring compaction shall be included in the bed and side fill material and also the material placed above the pipe for a distance of twelve (12) inches over the top of the pipe.

The First Class Pipe Laying Method for Flexible conduit may be achieved by Class B Bedding Methods as shown in the ASCE Manual of Practice No. 37, latest edition. Under this class B Bedding Method, the pipe shall be bedded in compacted granular material (Class I or II) placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth (1/4) the outside pipe diameter below the pipe and shall extend twelve (12) inches above the top of the pipe level and full width of the trench. All granular bedding material shall be placed in the trench in approximately six (6) inch layers. Conduits shall not be laid-in more than one (1) inch of water above the stone bedding base. If more than one (1) inch is present, it shall be the Contractors responsibility to dewater the construction area and discharge to an approved area.

Compaction shall be accomplished by hand or Mechanical Tamping or by "Walking" the granular material in for Class I materials only. When Class II materials are used compaction shall be accomplished by hand or mechanical tamping only to a minimum eighty-five percent (85%) Standard Proctor Density. Backfill from a point twelve (12) inches above the top of the pipe to the trench surface shall be in accordance with "backfilling Methods A or B or C" depending on the trench location.

Plastic pipe shall not be blocked, except where the plans or specifications call for concrete encasement or concrete cradles for the pipe. Blocks shall be encased in concrete also, or removed. Where plastic pipe is to be installed below maximum ground water table, adequate weights shall be provided to prevent flotation of the pipe.

Pipe and fittings shall be carefully inspected before being installed. Cracked, broken or otherwise defective pipe, shall not be used.

## **7.05 Structure Installation**

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All manholes, inlets and catch basins shall be installed on a minimum of a 6" No. 8 stone base. This material shall be compacted.

Exterior joint collar installation shall be as follows:

The collar shall be designed so that when it is applied around the joint the ends shall overlap at least 6" and when the straps are secured a layer shall completely cover the strap protecting them from moisture and rust. After removing the protective paper, the band shall be placed around the manhole, mastic side to the pipe and spanning the joint. The steel straps shall be secured with the proper tools. The closing flap shall cover all remaining exposed strap.

Installation of preformed gasket material:

The installation of the preformed gasket material used in the installation of the adjustment rings and/or casting shall include the use of a compatible primer or solvent as recommended by manufacturer of butyl base material to prepare surfaces prior to application of butyl base material.

## **7.06 Pavement Installation**

### **A. Subgrades**

Subgrades for all pavements shall be compacted no less than 95 percent of their maximum density at optimum moisture based on the modified Proctor compaction test (modified AASHTO [1978], Designation T-180, and ASTM [1980], Designation D 1557).

### **B. Concrete Pavement**

Concrete pavement and base course shall be constructed in close conformance with the Indiana Department of Transportation Standard Specification, Section 500, latest edition. Pavement shall be broom finished.

### **C. Bituminous Pavement**

Bituminous pavement, including base course, shall be placed and compacted in accordance with the INDOT Standard Specification Sections 300, 400, and 600 as applicable.

### **D. Traffic Control**

The Contractor shall plan construction activities to minimize impact to traffic. Local traffic access must be maintained at all times. The Contractor shall so schedule his work whenever possible and make suitable provisions for access by local residents, school buses, police, and emergency, fire and mail delivery vehicles. The Contractor shall keep fire hydrants and other public utility valves accessible at all times. To maintain traffic movement, appropriate traffic control devices shall be used. Such traffic control devices shall comply with the latest edition of the Indiana Manual on Uniform Traffic Control Devices and Sections 104.04, 107, and 801 of the Standard Specifications.

## **7.07 Installation of Building Sewers (laterals)**

### **A. Connection to Sanitary Sewers**

Connections to new sanitary sewers shall only be made at the manufactured fitting. Connections to existing sanitary sewers shall be made at existing manufactured fitting, as shown on the approved record drawings. In the event that no manufactured fitting exists in an existing sanitary sewer, a service connection shall be made utilizing an Inserta Tee.

### **B. Connections to Sanitary Manholes**

Connections to sanitary manholes shall not be made without the prior approval of the City. Building sewers shall connect to the manhole, when approved, at the manhole invert. Under these circumstances, the manhole base shall be pre-formed with an Inserta Tee connection for the lateral line. The invert shall also be formed at the flow line to accept the lateral sewer connection. No inside drop connections shall be allowed without the prior approval of the City.

### **C. Bedding and Backfill**

Bedding and backfill per the specification of PVC flexible pipe shall be required. Reference standard drawings WW -3 for bedding, haunching, and initial backfill requirements.



D. Laying of PVC Building Sewer

The point of commencement for laying of the building sewer pipe shall be at the connection to the sanitary sewer and shall be laid with the bell end pointing upgrade.

Whenever a service lateral has to go under street pavement to get to the building served, an additional cleanout shall be installed at the edge of the right-of-way, on the building private property. This cleanout shall be the same size as the lateral. It is a requirement of the Plymouth Sewer Department that cleanouts be installed at intervals not to exceed 100 feet.

Bedding requirements as specified in paragraph C above shall be applicable to all lateral lines, whether located in public easement/right-of-way or private property.

**SECTION 8**  
**RESTORATION OF SURFACES**

**SECTION 8  
RESTORATION OF SURFACES**

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## SECTION 8

### RESTORATION OF SURFACES

#### 8.01 General

Restoration of surfaces within the public right-of-way and easements shall include the removal of the existing surface, the disposal of the surplus material and the construction of new surfaces and adjusting all new and existing structures for proper grade prior to paving as indicated on the plans and/or as specified in these Standards.

#### 8.02 Restoration of Paved Surfaces

##### A. Restoration

After all excavations within the limits of paved surfaces have been properly backfilled and compacted, the paved surfaces shall be restored to a condition as good as or better than existed prior to the beginning of the work, in accordance with the following specifications.

Paved Surfaces: Streets, alleys, sidewalks, driveways, curbs and gutters, not constructed or maintained by the State Highway Department, but paved with asphalt, concrete, cinders, crushed stone, waterbound macadam, oil-bound macadam, or heterogeneous paving materials, which are wholly or partially removed, damaged, or disturbed by the Contractor's operations, shall be restored with like or better materials, acceptable to the City, to a condition as good as or better than existed prior to the beginning of the work, so that movement of traffic, both vehicular and pedestrian, through the restored way shall be as free, safe and unimpeded as before.

##### B. Temporary Surface

Temporary trench surfaces shall be installed and maintained in accordance with these specifications. This temporary surface shall be maintained by the Contractor until the permanent pavement is placed. Before placing permanent pavement, all or parts of the temporary surface shall be removed, as necessary, and hauled from the site of the work.

##### C. Temporary Pavement Replacement

Trench surfaces of highly traveled streets and roads may be, at the direction of the City, required to receive a temporary pavement replacement of cold mixed bituminous pavement. This temporary pavement shall be surface mixture Class A or B prepared and placed in accordance with Section 406 Cold Mixed Bituminous Pavement of the latest edition of the Indiana Department of Transportation Standard Specifications. Prime and tack coats shall not be required. All temporary pavements shall be maintained by the Contractor to proper grade so as not to impede the safe flow of traffic until the permanent pavement replacement is made.

D. Permanent Paving

Permanent paved surfaces shall be restored in accordance with the following requirements, unless otherwise set forth by the City Engineer, in all cases, the methods and materials of restoration shall meet the requirements of the Indiana Department of Transportation, as applicable.

1. Class "B" Concrete Pavement

Existing local streets, roads, alleys, driveways and parking areas consisting of concrete pavement shall be restored according to the following requirements.

Areas subjected to excavation or damage by the Contractor are to be replaced as a whole. Sidewalks to be replaced in complete sections, streets and driveways as complete sections or replaced with sections that coincide with the original pattern, and to the City's satisfaction.

Prior to placing concrete, the existing edges are to be saw-cut in a neat straight manner, sub-base compacted, wetted down and edges swept clean. The use of flexible joint material is required as needed. All chunks of existing material larger than three by three (3 x 3) inches are to be removed.

Class "B" concrete pavement shall consist of a cast in place, layer of Class A concrete with one (1) layer of woven wire fabric (6 x 6 \_ W1.4 x W1.4) meeting ASTM Designation 497. The concrete layer shall be six (6) inches thick. All rigid concrete pavement work and materials shall meet the latest specifications of the Indiana Department of Transportation.

2. Class "C" Asphalt Pavement

Existing local streets and roads consisting of asphalt paving shall be restored with binder and surface of the thickness specified and as follows:

Areas subject to Class C asphalt pavement replacement shall have the existing edges (those created by cutting prior to excavation) re-cut in a neat straight manner as to remove irregularities and damaged areas. Manholes, service line trenches and existing valve areas are to be boxed out in a neat manner. All cuts shall be parallel or perpendicular to the trench. Curved or diagonal cuts shall not be allowed. All chunks of existing material larger than three by three (3 x 3) inches are to be removed.

The aggregate base course, including the previously placed temporary surface or pavement, shall have the upper portions removed to allow placement of the binder and surface. After the base is cutback, it shall be re-compacted with a ten (10) ton roller or other suitable equipment if approved by the City Engineer. Care shall be taken to assure that not less than six (6) inches of compacted aggregate base remains below the permanent pavement.

A tack coat shall be applied to the cleaned and patched surface at a rate of 0.05 to 0.10 gallons per square yard immediately prior to placing of bituminous mixtures.

The binder course(s) shall consist of compacted Hot Asphaltic Concrete, Type A, Size No. 9LV or 11LV as defined by the latest edition of the Indiana Department of Transportation Standard Specifications. Compaction shall be accomplished with suitable smooth wheel rollers. Generally, conventional self-propelled rollers of not less than 10 tons gross weight shall be used. The City Engineer may allow other specialized rollers for narrow trenches or lighter rollers with vibratory action. The City Engineer shall consider alternate equipment only if Contractor requests same in writing and includes technical data on the specific equipment to be considered.

The quantity and thickness of binder courses required shall match the existing pavement, but not less than one (1) course, three (3) inches in thickness.

When the existing pavement surface is granular material, or a new granular base is placed, the surface shall be fine graded and compacted by rolling to produce a smooth uniform surface free of voids and depressions. A prime coat, if specified, shall be applied to the graded and compacted granular surface at the rate of 0.30 to 0.50 gallons per square yard prior to the placing of bituminous mixtures or surface seal coats.

The surface course shall consist of compacted Hot Asphaltic Concrete Surface Type A (Size No. 11LV or 12LV), as defined by the latest edition of the Indiana Department of Transportation Specifications and placed in the same manner as described above for binder. The surface thickness shall match the existing pavement, but not less than one (1) inch.

3. Adjustments of Shoulders Necessitated by Resurfacing

The shoulders of the road shall be adjusted to the elevation of the resurfacing with all materials (i.e., earth, sod, gravel, crushed stone, asphalt, etc.) necessary. The transition may be made within a distance of one (1) foot to one and one-half (1 & ½) feet from the edge of paving except in unusual cases where a greater distance is required. Existing

driveways shall be primed and wedged from a featheredge to the final height of the resurfaced street paving.

### **8.03 Restoration of Ground Surfaces**

All ground surfaces in public Rights of Way and easements that have been damaged or destroyed by the Contractor's operations shall be restored in accordance with the following specifications. All surplus material, rock, trees, shrubs, concrete pipe, asphalt, crushed stone, etc., not to be used in the Contractor's restoration operations shall be removed from the site and disposed of in an acceptable manner.

#### **A. Restoration of Grassed Areas with Sod**

Where shown or required by the City, established grassed areas shall be restored with sod containing grasses of comparable quality. Sod shall be placed and rolled so that the final elevations of the area being restored are the same as existed prior to the beginning of construction. Sod shall be pegged where necessary, and shall be watered and cared for to assure its survival.

#### **B. Restoration of Grassed Areas with Seed and Mulch**

The Contractor shall seed and mulch in one of the following manners:

1. The ground shall be loosened approximately three (3) inches deep with a disc or a harrow and fertilized with twenty-five (25) pounds of 10\_10\_10, or equivalent, and one hundred (100) pounds of agricultural lime per one thousand (1,000) square feet.

The mixture of seed applied shall be as follows:

35% Kentucky Bluegrass  
30% Perennial Rye Grass (Lolium Perenne)  
30% Kentucky 31 Fescue  
5% Inert Matter

The seed shall be applied at a rate of four (4) pounds per one thousand (1,000) square feet and shall be well raked or boarded into the soil and mulched with straw of sufficient thickness to hold the seed until it has germinated.

2. Mulching Material: Materials for mulching shall be wheat, oats, barley or rye straw only. All materials shall be reasonably free from weed seeds, foreign material, and other grasses and chaff, and shall contain no Johnson Grass. The straw shall be reasonably bright in color and shall not be musty, moldy, caked, or of otherwise low quality. The straw shall be dry on delivery, and spread evenly.

Mulch net may be required on special areas designated by the City to hold mulch in place until turf is established. The net shall be made of a tightly twisted craft paper yarn, leno woven with a wrap count of one (1) pair of yarns per two (2) inches and a filling count of two (2) per inch. Salvage edges and center shall be reinforced with polyethylene filament. The material shall have a minimum width of forty-five (45) inches.



**SECTION 9**  
**EROSION CONTROL**

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EROSION CONTROL**

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**SECTION 9**  
**EROSION CONTROL**

**9.01 General**

This section provides the general guidelines for the control of erosion and sediment for construction sites. Control of sedimentation for construction site may be accomplished through utilization of a variety of control practices. The complexity of the erosion and sediment control plan will vary depending upon individual site conditions. The goal of such a plan is to limit the quantity of sediment leaving the construction site. The Contractor's plan must be approved by the City.

In addition, the Contractor must also comply with Rule 5 327 IAC 15-5 or Rule 13 327 IAC 15-13 for land alteration which disturbs 1 acre or more.

If the project disturbs less than 1 acre; Best Management Practices (BMP's) erosion control measures still must be instituted to prevent erosion and sedimentation from leaving the construction site. If the project necessitates the preparation of a Stormwater Drainage Plan as per the current Storm Drainage and Sediment Control Ordinance; the BMP's shall be identified and addressed in the Stormwater Drainage Plan.

**9.02 Permitting Requirements**

If the Owner/Contractor is required to submit a soil erosion control plan to the State under Rule 5 (327 IAC 15-5) or Rule 13 (327 IAC 15-13), such plan shall be deemed in compliance with City requirements. In this case all applicable State and Federal permits or notices for land disturbing activities shall be obtained or filed prior to beginning land disturbing activities.

The City of Plymouth is an MS4 Community and is in transition between Rule 5 327 IAC 15-5 and Rule 13 327 IAC 15-13. Hence, the contractor shall provide the City of Plymouth Department of Stormwater Management with copies of all applications, plan narratives, submittals; plan and other erosion and sediment control related information shall be submitted to the city. This includes but is not limited to Notice of Intent (NOI), Stormwater Pollution Protection Plan (SWPPP), and the Notice of Termination (NOT) for all projects with land alteration which disturbs 1 acre or more.

**9.03 Design Guidelines**

In order to fully achieve an acceptable level of erosion and sediment control on the construction site, the following design principles shall be fully adhered to during site analysis and development of the erosion and sediment control plan:

- A. Existing site contours should be followed as close as reasonably possible in order to minimize cut and fill.
- B. Existing natural vegetation should remain undisturbed for as long as possible

during the construction activities. Naturally vegetated areas along property lines, jurisdictional wetlands, lakes, and watercourses, both natural and man-made, should be left undisturbed during all phases of the site construction. These vegetative filter strips will be required at the discretion of the City.

- C. A logical sequencing of site construction activities must be provided in order to minimize the size of exposed land areas, and the length of time land areas are left without some form of temporary or permanent soil protection.
- D. Soil stockpiles shall be stabilized utilizing either vegetative establishment, sediment trapping barriers, or erosion control measures such as tarping or mulching, singly or in combination.
- E. Storm sewer inlets which are made operable either before or during the construction phase of development shall be provided with protection from siltation.
- F. Stable, properly maintained construction traffic access routes and stream crossings shall be identified on the site erosion and sediment control plan as needed. These construction access routes shall be installed as part of the site perimeter sediment control barriers, prior to the initiation of on-site land alteration activities. Where sediment is transported onto public street or road surfaces, these streets or roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed by either scraping, shoveling or sweeping and be transported to a controlled fill area. Street washing will be allowed only if wash water flows to a controlled sediment trapping area.
- G. Runoff velocities shall be kept as low as possible.
- H. A thorough maintenance and follow-up program, and identification of the person(s) responsible for its implementation will be required.

The latest edition of the Indiana Handbook for Erosion Control in Developing Areas (HECDA) [being updated to the Indiana Stormwater Quality Manual] shall be used for detailed technical guidance for all erosion and sediment control practices. The following general practice guidance applies to the development of all control plans:

- A. Perimeter Control - Perimeter control measures shall be installed as specified on the approved plan, including: construction access drives, straw bale dams and fabric fencing, temporary sediment traps, sediment basins, and diversions.
- B. Vegetative Control - Disturbed areas which are at finish grade shall be permanent seeded within seven (7) days. At the discretion of the City; barren areas to be rough graded and left undisturbed for more than thirty (30) days shall be established with temporary vegetation; and dormant seeding will be required during seasonal periods (October through February) for those barren areas to be left undisturbed for one hundred and twenty (120) days or longer.
- C. Slope Protection - Slope protection shall be provided by use of temporary and

permanent diversion levees, vegetative cover, and slope drains. Concentrated storm water flows shall not be allowed to flow down cut or fill slopes without proper slope stabilization.

- D. Sediment Trapping - To achieve the goal of preventing sediment from leaving the construction site, the City will require the use of sediment barriers such as fabric fencing, straw bale dams, and sediment basins.
- E. Protection of Outlet Channel - Concentrated storm water runoff leaving a development site shall be outletted to an open channel, storm sewer pipe or culvert which is capable of receiving this discharge. Runoff velocities shall be controlled during all storm events so that the peak runoff velocity during and after the completion of the land alteration approximates existing conditions.

The principles and practices provided by the State in Rule 5 or Rule 13 are to be followed in the development of all control plans. Rule 5 or Rule 13 does not give specific requirements for use of various practices leaving that to the localities. Individual practices can be modified or waived upon request to the City based on special site characteristics and conditions.

The designer should rely on the Indiana Handbook for Erosion Control in Developing Areas (HECDA) [being updated to the Indiana Stormwater Quality Manual] for detailed design, construction and maintenance criteria for all erosion control practices. Such criteria shall be required by the City unless waived in writing. The manual can be obtained from:

Urban Conservation Program  
Division of Soil Conservation  
Indiana Department of Natural Resources  
402 West Washington Street, Rm. W-265  
Indianapolis, Indiana 46204-2748

Local information may be received from:

City of Plymouth  
Department of Stormwater Management  
900 Oakhill Ave.  
Plymouth, IN 46563  
Phone: 574-936-3614  
Fax: 574-936-3017  
E-mail: [publicworks@plymouthin.com](mailto:publicworks@plymouthin.com)

**SECTION 10**

**INSPECTION, TESTING  
AND ACCEPTANCE**

**SECTION 10  
INSPECTION, TESTING AND ACCEPTANCE**

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## SECTION 10

### INSPECTION, TESTING AND ACCEPTANCE

#### 10.01 General

This section describes the minimum requirement and general procedures for the inspection, testing and acceptance of systems dedicated to the City of Plymouth.

#### 10.02 Inspection

Inspection of the construction shall occur for the duration of the project, including the installation of service connections.

##### A. General Requirements

1. Contractor and/or Owner shall provide notice to the City and his representative of the planned commencement of construction thirty (30) days prior to such commencement.
2. Once the construction starts, the Contractor shall be responsible for informing and/or notifying the inspection representative assigned of the following. (NOTE: The City may require as much as five (5) working days to provide inspection services during construction.):
  - a. Daily work schedule, including any changes in schedule;
  - b. Prior notification if work is to be performed on weekends and/or holidays;
  - c. Date tests are to be performed; and
  - d. Date as-built verification is to be performed.
3. The City, upon request of the Contractor and/or Owner, will schedule the Final Inspection.

All testing required shall be paid for by the Contractor and performed under the observation of the City or City's representative. It shall be the Contractor's responsibility to schedule the testing with the City representative and/or City. Test results obtained in the absence of the presence of the City will not be accepted.

#### 10.03 Sewer System Testing

##### A. Leakage Testing

##### 1. General

All sanitary sewers shall be tested for infiltration and exfiltration.

Contractor shall furnish all labor, materials and equipment required for making tests. Tests shall be made at times arranged with the City and his representative. Sections of sewers shall be isolated and measurements of



infiltration and exfiltration shall be made by approved means. The City or his representative must be present during all final tests.

Sewers whose crowns are below ground water level at time of testing shall be tested for infiltration. Where crown of pipe is above ground water level, sewer shall be tested for exfiltration. If ground water level varies during period of construction, sewers may be tested for both. Spans are not to be tested for Final Acceptance until complete.

All pipe and joints shall be capable of withstanding a hydrostatic pressure of 20 feet of water (8.6 psi) for two hours with no visible leakage.

Immediately preceding all leakage tests (exfiltration, infiltration and air) the sewer to be tested shall be cleaned by flushing a ball through the pipe. The Contractor shall furnish an inflatable rubber ball of a size that will inflate to fit snugly into the pipe to be tested. The ball may, at the option of the Contractor, be used without a tag line; or a rope or cord may be fastened to the ball to enable the Contractor to know and control its position at all times. The ball shall be placed in the last cleanout or manhole on the pipe to be cleaned, and water shall be introduced behind it. The ball shall pass through the pipe with only the pressure of the water impelling it. All debris flushed out ahead of the ball shall be removed at the first manhole where its presence is noted. In the event cemented or wedged debris or a damaged pipe shall stop the ball, the Contractor shall remove the obstruction.

## 2. Infiltration Tests

Sanitary sewers which are constructed with ground water level above crown of pipe shall be tested for infiltration after sewers have been installed and backfilling has been substantially completed. A convenient section of sewer shall be selected between manholes. The upper section of sewer shall be plugged watertight with temporary bulkhead. A suitable measuring device shall be installed at the lower end.

The amount of water flowing through the outlet shall be measured periodically through the next twenty-four (24) hours. The flow thus measured shall then be converted by gallons per day per inch diameter per mile and compared with the maximum allowable limit of two hundred (200) gpd/in./mile.

## 3. Exfiltration Tests

A section or sections of sanitary sewer between manholes shall be isolated by watertight bulkheading. Isolated sections shall then be filled with water to a level three (3) feet above the crown of the pipe at the upstream end of the section; water level at the downstream end of the section shall not be more than six (6) feet above the crown of the pipe. After allowing the system to stabilize overnight, the section shall be refilled with water to the original level. After one (1) hour more, the volume of

water lost in the section shall be determined by measuring the drop in the water level.

4. Allowable Leakage

Infiltration or exfiltration of any given segment of sewer pipe shall not be permitted to exceed a rate of two hundred (200) gallons per twenty-four (24) hours per mile of sewer per inch of pipe diameter (0.158 gph/in./100 ft.).

5. Low Pressure Air Testing

For gravity sanitary sewers installed with the pipe crown above the ground water level, air pressure testing may be used in lieu of the exfiltration test. Low pressure air testing is used to determine the existence of pipe leaks; however, it does not indicate water leakage limits.

Prior to the low pressure air testing, all wyes, tees, or end of side sewer stubs shall be plugged with flexible-joint caps, or acceptable alternate, securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible-jointed lateral connection or extension.

All plugs shall be securely braced to prevent possible blowout due to internal air pressure. One plug shall have an inlet tap, or other provision for connecting a hose to a portable air supply source. Air hose shall be connected to the inlet tap and a portable air supply source.

Air equipment shall consist of all necessary valves and pressure gages to control rate of air flow into the test section and to enable monitoring of air pressure within the test section. Testing apparatus shall also be equipped with pressure relief device to prevent the possibility of loading test section with full capacity of compressor.

Air shall be slowly added to test section until pressure inside pipe is raised to 4.0 psig. After a pressure of 4.0 psig is obtained, air supply shall be regulated such that pressure is maintained between 3.5 and 4.0 psig for a period of two (2) minutes, to allow air temperature to stabilize in equilibrium with temperature of pipe walls. Pressure will normally drop slightly until equilibrium is obtained. During this period, all plugs shall be checked with soap solution to detect any plug leak.

After this two (2) minute air stabilization period, air supply shall be disconnected and test pressure allowed to decrease. Time required for test pressure to drop from 3.5 psig to 2.5 psig is determined by means of stop watch, and this time interval is then compared with required time to determine if rate of air loss is within the allowable limit. Required time to arrive at the allowable air loss is calculated by means of following formula:

$$T = \frac{0.0850 DK}{Q}$$

Where: T = time in seconds  
K = .000419 DL but not less than 1.0  
Q = Rate of loss (=0.003 cfm/sq. ft. of internal surface)  
D = Diameter of pipe in inches  
L = length of pipe tested in feet

Upon completion of test, the bleeder valve shall be opened and all air allowed to escape. Plugs shall not be removed until all air pressure in test section has been released. Also, no one shall be allowed in trench or manhole while test is being conducted.

All pipe lines thirty (30) inch diameter and over shall be tested one joint at a time with joint testing apparatus. Joint shall be isolated with an expanding shield equipped with gaskets which fit tightly against pipe walls on each side of joint to be tested. Allowable leakage for such a test is equal to that which would occur on the basis of allowable leakage for one length of pipe.

If measured time interval for the pressure to drop from 3.5 psig to 2.5 psig is less than the required time as calculated, sewer section shall be deemed to have failed test. Contractor shall then proceed to repair pipe at his cost as necessary until the sewer section passes the test. All testing shall be conducted in presence of the City's representative (inspector).

#### 6. Excessive Leakage

If infiltration or exfiltration rate of sewer exceeds maximum rate specified, contractor shall make all necessary repairs to reduce leakage below the allowable. Such repairs shall be made at Contractor's expense. Under no circumstances will grouting be considered an acceptable means of repair. When repairs have been completed, but not more than thirty (30) days after first test, sewer section shall be subjected to a second leakage test as specified above.

If the second test should again indicate leakage in excess of the allowable amount, the Contractor shall, at his own expense, provide complete internal inspection of entire section in question, by means of videotape recording of television inspection or by color photography with exposures every two (2) to four (4) feet along the sewer. Contractor shall employ an independent sewer testing service to inspect pipe. Inspection service shall prepare a written report and shall review videotape or films with the City, Contractor, and City's representative. Contractor shall then submit a written plan for correction of leakage. Contractor, City, and City's representative shall meet as necessary to develop actual program for inspection and repair. Contractor shall not proceed to repair line until he receives written authorization to proceed from City or City's representative.

All inspections, reports, repair, replacement, and compensation for additional professional expense shall be paid by the Owner/Contractor.

Assembled joint tests shall be required if the infiltration/exfiltration tests have failed or if the joint system and assembly is unsatisfactory to the City Representative.

Assembled joint tests shall be performed by an independent testing laboratory approved by on not more than one (1) percent of the total length of the pipe of each class, size, and type utilized, except that least two specimens shall be used for each test. The expense of the test shall be borne solely by the Contractor. Testing shall conform to the applicable procedures of the ASTM specifications for the joint under test.

Storm sewers:

Storm sewer pipe and joints shall meet the same requirements as sanitary sewers, except when unusual site conditions exist and special permission is granted by the Department Superintendent.

B. Deflection Testing and Inspection of Installed Flexible Plastic Pipe

1. Final Acceptance Test

a. Lamping

Prior to the final deflection test, the City or his representative may, at his option, order the lamping of certain or all sections. Lamping must show a "full moon" and no excessive puddling effects in the span. If excessive water is present in the line, the City may require a television inspection for the section of line found deficient.

b. Television Inspection

The Contractor shall produce a video tape using a pan-and-tilt, radial viewing, pipe inspection camera that pans 275° and rotates 360°. The television camera used for the inspection shall be specifically designed and constructed for such inspection. The camera shall be operative in 100% humidity conditions. The Contractor shall use a camera with an accurate footage counter that displays on the monitor the exact distance of the camera from the centerline of the starting manhole. The Contractor shall use a camera with camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe being televised. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipe. The video camera shall be capable of showing on the tape the City name, Project name, Contractor name, date, line size and material, line identification (City's manhole numbers at both ends) and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the

satisfaction of the Owner; and if unsatisfactory, equipment shall be removed and replaced with adequate equipment. The expense for unsatisfactory inspections will be incurred by the contractor.

Extra High Grade T-120 VHS video tapes shall be supplied for all television surveys. All taping shall be performed at SP (Standard Play, 2 hrs/tape). All video tapes shall be submitted to the Owner and will become the property of the Owner. The tape shall be turned over to the City after taping is complete. The contractor may retain a copy for his files. Additional copies of the tape will be at the contractor's expense.

An additional option would be to use DVD's which would be compatible to the City's viewing equipment.

The City, or its representative, shall be notified 48 hours prior to taping.

Two video tape labels are required. One label shall be placed on the spine of the video tape and the other on the face of the video tape. Permanently label each tape with the following information:

Spine of Tape

<b>City Name:</b>		<b>Contractor's Name:</b>		<b>Project Name:</b>	
<b>Inspection Type:</b>			<input type="checkbox"/> Survey	<input type="checkbox"/> Pre-Installation	<input type="checkbox"/> Post-Installation
<b>Tape No:</b>		<b>Date Televised:</b>		<b>Date Submitted:</b>	
<b>Basin No:</b>					

Face of Tape

Manhole No. From	Manhole No. To	Pipe Diameter	Pipe Length	Street

### c. Deflection Mandrel Test

The main line shall be flushed prior to the vertical ring deflection tests. The vertical ring deflection tests shall not be performed prior to successful completion of leakage testing requirements.

All main line plastic pipe sewers eight (8) inch in diameter and greater shall be measured for vertical ring deflection at least thirty (30) days after installation, but no later than thirty (30) days prior to final acceptance of the project. Maximum ring deflection of the pipeline under load shall be limited to five percent (5%) of the vertical internal pipe diameter. All pipe exceeding this deflection shall be considered to have reached the limit of this serviceability and shall be re-laid or replaced by the Owner/Contractor.

The cost of all deflection testing shall be borne by the Contractor and shall be accomplished by using a deflectometer, which will produce a continuous record of pipe deflection, or by pulling a mandrel, sphere, or pin-type go/no-go device through the pipeline. The diameter of the go/no-go device shall be ninety-five percent (95%) of the undeflected inside diameter of the flexible pipe. The mandrel shall be pulled through the sewers by one man, by hand and specifically without the aid of mechanical devices. The mandrel shall have no less than (9) vanes.

### C. Sanitary Manhole Testing

All manhole vacuum tests shall be conducted in the presence of a representative of the City.

The vacuum test equipment shall consist of: inflatable plugs for all incoming and outgoing sewer lines; an inflatable test collar to seal the manhole at the manhole frame; and a vacuum pump. A vacuum gauge shall be located in-line between the test collar and the pump to accurately indicate the vacuum in inches of mercury within the manhole. The vacuum gauge shall have a range to no more than thirty (30) inches of mercury, with scale markings of no greater than one-half ( $\frac{1}{2}$ ) inch of mercury vacuum and an accuracy to within  $\pm$  two percent (2%) of true vacuum.

The vacuum test shall be conducted by plugging all incoming and outgoing sewer lines in the manhole at a location beyond the connection of the sewer pipe with the manhole. All plugs shall be blocked in place so as not to move during the test. The vacuum testing collar shall be inflated in the frame in accordance with the equipment manufacturer's recommendations. A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump turned off and the valve between the vacuum pump and the vacuum gauge shall be turned off.

The time period which is taken for the vacuum to fall from ten inches (10") of mercury to nine inches (9") of mercury shall be determined. If the time

taken for the vacuum to reduce the ten inches (10") of mercury to nine inches (9") of mercury is less than the time indicated in the following Table, then the manhole work shall be considered not acceptable and shall be rejected. If the time is equal to or exceeds the time indicated below, the manhole work shall be accepted. This Table is from ASTM C 1244-93 which is "Standard Test method for Concrete Sewer Manholes by the Negative Air Pressure Test".

**Minimum Test Times for Various Manhole Diameters**

Depth (ft.)	Diameter =								
	30"	33"	36"	42"	48"	54"	60"	69"	72"
8	11	12	14	17	20	23	26	28	33
10	12	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	23	30	35	41	46	51	57
16	22	24	30	34	40	46	52	58	65
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	59	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	35	42	51	59	69	78	87	97
26	36	39	45	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	109	121

Contractor shall submit to the City the results of each manhole vacuum test. Such reports shall include a description of the location of the manhole, the time, date and weather of the test, a list of all persons present, the diameter and depth of the manhole and the allowable test results, and the actual test results.

All manholes shall be repaired by Contractor and retested as described above until a successful test is made. After each test, the temporary plugs shall be removed.

Once all manholes have been tested, the manholes will be given a field visual inspection. The inspection shall be performed at the discretion of the City during the warranty period following a rainfall sufficient enough to raise the groundwater table above the problem areas. All leakage problems determined by this inspection shall be corrected by the Contractor within an agreed upon time to the satisfaction of the City.

Where necessary to complete the work, the Contractor shall be responsible for the bypassing and/or blocking of the flow in the manholes and must have prior approval by the City. It will be the Contractor's responsibility to supply his own traffic control as required by the particular location and/or jurisdiction.

D. Force Main Testing

1. General

After the pipe has been laid and partially backfilled, all newly laid pipe or any valved sections of it shall be subjected to a hydrostatic pressure tests. The duration of each pressure test shall be for a period of not less than two hours and not more than six hours. The basic provisions of AWWA C-600, Section 4 shall be followed for all pressure testing.

The test pressure shall not exceed pipe and/or thrust resistant design pressures. The test pressure shall not vary by more than plus or minus 5 psi for the duration of the test.

All newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing or 50 psig whichever is greater.

2. Pressurization

Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City. The pump pipe connection and all necessary apparatus, including gauges and meters shall be furnished by the Contractor. Before applying the specified test pressure, air shall be expelled completely from the test section.

Any exposed pipe, fittings, valves, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or joints that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the City or his representative.

3. Leakage Test

After the completion of the pressure test a leakage test shall be conducted to determine the quantity of water lost by leakage under the specified test pressure. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the



specified test pressure after the pipe has been filled with water and the air has been expelled.

Leakage shall be measured by a drop in pressure in a test section over a period of time.

For sanitary pressure lines, no leakage shall be permitted during the 2 hour test period.

E. Lift Station Pump Testing

Lift station pump test will be performed by the City or his representative during the lift station's final inspection. The Contractor shall be responsible for providing the clean water to run the pumps and perform the test(s).

1. Manufacturer's Start-Up

Prior to the City's final inspection of the lift station equipment, the Contractor shall be responsible for coordinating start-up activities with the pump manufacturer's representative in accordance with the manufacturer's requirements. The City or his representative must be present at the time of manufacturer's start-up.

Any deficiencies in equipment and/or workmanship noted during the manufacturer's start-up shall be remedied by the Contractor prior to final inspection.

Upon successful completion of the manufacturer's start-up, the manufacturer shall deliver to the Contractor:

- a. Three (3) copies of a letter certifying that all pumping and electrical equipment has been installed and is operating in accordance with manufacturer's requirements;
- b. Two (2) sets of Operation and Maintenance Manuals; and
- c. One (1) complete set of Spare Parts as specified.

2. Final Inspection

The Contractor shall provide the following pump test equipment and materials:

- a. Water to conduct test;
- b. Amp/volt meter;
- c. Stop watch;
- d. Calibrated test gauge to measure operating head. The gauge shall be calibrated in feet of water from 0 to 100 feet in one foot increments; and
- e. Manufacturer's pump performance curves.

The City's representatives attending the final inspection shall re-check any deficiencies. The City's representatives shall then complete a cursory final

inspection checklist and perform pump down tests which shall include the following:

- a. Manual check of all level ON-OFF operation, alarm and run lights;
- b. Determination of inflow rate (if any);
- c. Determination of pump capacity for each pump individually and both/all pumps simultaneously;
- d. Determination of pump capacity with force main full. Verification of full force main shall be determined by pressure gauge provided by Contractor. Force main shall be considered full when the line pressure stabilizes; and
- e. Plot performance of each pump or pump curves provided by Contractor.

Contractor shall provide all water necessary to conduct the pumping tests, and shall provide a connection for the test gauge on the blind flanged tee in the valve vault. The stem connection shall be equipped with a plug valve to close the connection after testing is complete. The connection shall be left in place and shall be suitable for use as an air bleed off.

The pumping test results must meet or exceed the design pumping criteria approved by the City to successfully pass the final inspection. Any deficiencies noted during the final inspection shall be repaired/replaced by the Contractor to the satisfaction of the City and reinspected/retested prior to final acceptance.

#### **10.04 Testing of Pavement Materials**

##### **A. Subgrade Testing**

The Contractor shall be responsible for providing soil Proctor analyses for all soils to be tested on the project. All test results shall be reviewed and a recommendation given by a qualified and licensed geotechnical engineer or geologist. At least one copy of each geotechnical report shall be submitted to the City. The AASHTO Method T-99 (Standard Proctor Analysis) is to be the preferred test used.

Should subgrades not meet minimum compaction requirements (minimum 95%); other forms of soil modification shall be employed. This shall include but not be limited to scarifying and aerating, undercutting and aeration, total replacement of soils, or the installation of geotextiles such as woven or non-woven filter fabrics or geogrid soil reinforcing systems. A qualified and licensed geotechnical engineer or geologist shall be provided by the Contractor to give such recommendations.

##### **B. Pavement Materials Testing**

The Contractor shall furnish evidence to the City as necessary to show that the materials to be furnished for a project conform to the requirements specified.

In addition, the City may have any of the materials tested at any time to show compliance with the specifications. In connection with this requirement, the Contractor shall provide such facilities as the City may require for collecting and forwarding samples and shall hold the materials represented by the samples until tests have been made and such materials found to have qualities required by the specifications. All samples required shall be furnished and tested by the Contractor utilizing the services of a qualified and licensed geotechnical engineer or geologist without charge to the City of Plymouth.

The frequency of sampling and testing shall be based on the number of tests required for each quantity of materials placed for a particular item of work as specified by the City. Where no criteria for sampling and testing is given for a particular item or items of work by the City, the Contractor shall adhere with the schedules and instructions specified in the Indiana Department of Transportation, Division of Materials and Tests Manual For Frequency of Sampling and Testing and Basis for Use of Materials, latest edition.

## **10.05 Documentation, Dedication and Acceptance Procedures**

### **A. Documentation Requirements**

In order for the City Council to accept dedicated facilities, the following items shall be completed and on file:

1. Copies of all testing reports and data;
2. Copies of all O&M Manuals and lift station(s) (if applicable);
3. Pump manufacturer's certification letter (if applicable);
4. Lift station final inspection checklist (if applicable);
5. Final payment for inspection services;
6. As-built drawings;
7. Performance and/or maintenance bonds (if required);
8. Daily inspection reports;
9. Legal description of the land to be dedicated to the City;
10. Copy of final recorded easements executed by the property owner(s), if easements are required; and
11. A written statement of facilities present on those lands. The written statement shall include:
  - a. Identification of the type and nature of facilities present
  - b. Dimensions of the facilities present
  - c. Statement of actual cost of construction, breaking out the cost of easements and cost of facilities.

### **B. Dedication**

The City Engineer shall review the above mentioned requirements and prepare a document stating that the work has been completed, the requirements have been met, and all items are in proper form. The City

Engineer shall include in the statement a recommendation on acceptance/denial of the facilities and may also include comments regarding the project. The City Engineer shall present to the City Council its findings in a public meeting for their consideration.

C. Acceptance of Facilities

The City will assume responsibility of the sanitary sewer when construction is fully completed in accordance with the plans and specifications and when all requirements in these standards are met.

The City shall receive the recommendation from the City Engineer, and upon review by the City Attorney, Wastewater Superintendent, and City's Director of Public Works, shall make a determination as to acceptance of the facilities. A majority approval of the Board members present at the meeting is required for acceptance. The City shall accept dedicated facilities by motion.

Sewer taps will not be issued until the sewer main at the tap location is substantially complete, including all testing.

Proposed sanitary sewer construction shall be bonded by the owner at 100% of the projected cost to construct the proposed system. The City's engineers must approve the cost estimate. "Bond" shall mean corporate surety bond, approved letter of credit or such other instrument as is acceptable to the City. Upon acceptance of the sewer system by the City, the owner shall bond the one year post acceptance period at 10% of the original cost to construct the system. The owner is responsible to assure that its bond instrument is current and shall request extensions of time before the instrument expiration date. Bonds shall be called before their date of expiration.

**SECTION 11**  
**CITY CHECKLISTS**

**SECTION 11  
CITY CHECKLISTS**

<b><u>Description</u></b>	<b><u>Page</u></b>
City of Plymouth Construction Procedural Checklist .....	11- 1
Engineer's Plan & Specification Review Checklist.....	11- 3
Certificate of Substantial Completion .....	11- 5
Lift Station Inspection Form .....	11- 7

**CITY OF PLYMOUTH**

**SANITARY SEWER LINES  
PROCEDURES FOR CONSTRUCTION (CHECK LIST)**

Date  
Received/  
Requested

Date  
Appr./  
Sent

PROJECT NO.: \_\_\_\_\_

PROJECT NAME: \_\_\_\_\_

- |       |       |  |
|-------|-------|--|
| _____ | _____ | 1. Developer submits preliminary plans of proposed development with estimated capacity demand to Sewer Department office located at 900 Oakhill Avenue, for preliminary review and response, and application for a sewer contract. These plans shall contain the following information:<br><br>A. Schematic of the proposed system.<br>B. Total number of lots.<br>C. Projected flow rate.<br>D. Point of connection to the existing system.<br><br>Plans will be forwarded to the Sewer Superintendent for approval. Once approved, the Superintendent will notify the Sewer Department office that a capacity letter can be sent to the Plan Commission. |
| _____ | _____ | 2. Developer submits three (3) sets construction plans, construction permit application, and contract application to Sewer Department office.  |
| _____ | _____ | 3. Sewer Department will forward construction plans and permit application to the City's Engineer for review, and application for a contract to the City's Attorney.   |
| _____ | _____ | 4. Sewer Department will notify IDEM that a construction permit application has been received.   |
| _____ | _____ | 5. City's Engineer and/or Sewer Superintendent will review the plans and permit application for completeness, conformance with the City standards, and evaluate whether the existing collection system can accommodate the sewage generated by this project. The City's Engineer will request the developer's engineer to make any needed changes in the plans.  |
| _____ | _____ | 6. The City's Sewer Superintendent will recommend (not recommend) approval of the plans for construction to the Plymouth City Council.   |
| _____ | _____ | 7. Sewer contract is executed by City and Developer and recorded by the City. City approves issuance of construction permit.   |

Date  
Received/  
Requested

Date  
Appr./  
Sent

- |       |       |   |
|-------|-------|---|
| _____ | _____ | 8. Developer transmits bond and insurance certificate.  |
| _____ | _____ | 9. The developer receives Construction Permit from the City.  |
| _____ | _____ | 10. Sewer Department will notify IDEM that a construction permit was issued.  |
| _____ | _____ | 11. Sewer Department notifies City engineer that project is ready for construction inspection.  |
| _____ | _____ | 12. The developer's contractor begins construction by notifying the City at least 48 hours in advance of beginning work and on a daily basis during construction so location of existing taps or the location of the City's main line can be made.  |
| _____ | _____ | 13. The sewer system is air tested and mandrel tested. Manholes are vacuum tested.  |
| _____ | _____ | 14. The developer's engineer submits two (2) sets of proposed record drawings (prints) and any easements required to the City's Engineer for review.  |
| _____ | _____ | 15. The City or its Agent prepares a punch list for the project.  |
| _____ | _____ | 16. The developer's contractor/engineer completes punch list.   |
| _____ | _____ | 17. The City or its Agent re-inspects the project.  |
| _____ | _____ | 18. The developer's engineer submits three (3) sets of prints and one (1) set of reproducible mylars of the approved record drawings for the City's files. As-built drawings shall also be submitted on 3 1/2" computer disk or compact disk in either vector format (DWG, DXF files) or Portable Document File format (PDF files). |
| _____ | _____ | 19. The City's Engineer recommends approval for acceptance for maintenance to the Plymouth City Council.  |
| _____ | _____ | 20. All easements are accepted and recorded by the Developer with notice provide to the City of Plymouth.   |
| _____ | _____ | 21. The City Council approves the sewer system for acceptance for maintenance and issues a Letter of Acceptance to the Developer.   |

**CITY OF PLYMOUTH**



**PLAN & SPECIFICATION REVIEW CHECKLIST**

NAME OF PROJECT: \_\_\_\_\_

DESIGN ENGINEER: \_\_\_\_\_

**I. Completeness and Conformance With City Standards**

- A. Manholes & Cleanouts
  - 1. Manhole Numbers, Rim & Invert Elevations ..... \_\_\_\_\_
  - 2. Manhole/Cleanout Materials & Construction ..... \_\_\_\_\_
  - 3. Spaced Max. Of 400' Apart..... \_\_\_\_\_
  - 4. Standard Manhole: 5' Deep or Greater..... \_\_\_\_\_
  - 5. Shallow, flat top, Manholes: Less than 6' ..... \_\_\_\_\_
  - 6. Drop Manhole: 2' Drop or Greater ..... \_\_\_\_\_
  - 7. Manholes at Finish Grade ..... \_\_\_\_\_
  - 8. Details Complete ..... \_\_\_\_\_
  - 9. Specs Complete ..... \_\_\_\_\_
  
- B. Gravity Sewer Pipe
  - 1. Pipe Numbers, Lengths, Sizes (8" Min.), and Slopes..... \_\_\_\_\_
  - 2. All Sewer Lines Planned and Profiles..... \_\_\_\_\_
  - 3. Depth: 3' Min. to Top of Pipe ..... \_\_\_\_\_
  - 4. Pipe Materials..... \_\_\_\_\_
  - 5. Pipe Bedding & Backfill Materials & Construction ..... \_\_\_\_\_
  - 6. Depth Restrictions ..... \_\_\_\_\_
  - 7. Details Complete ..... \_\_\_\_\_
  - 8. Specs Complete ..... \_\_\_\_\_
  
- C. Laterals & Wyes
  - 1. Wyes Connected to Sewer, Not Manholes..... \_\_\_\_\_
  - 2. Basement Connection Requirements (See Specs)..... \_\_\_\_\_
  - 3. Pipe Size: 4" Min for Single Family, 6" Min for All Other Installations ..... \_\_\_\_\_
  - 4. Lateral Provided for All Lots ..... \_\_\_\_\_
  - 5. Pipe Material..... \_\_\_\_\_
  - 6. Lateral Locations, Length Indicated on Plans..... \_\_\_\_\_
  - 7. Pipe Slope: Min. 1% ..... \_\_\_\_\_
  - 8. Details Complete ..... \_\_\_\_\_
  - 9. Specs Complete ..... \_\_\_\_\_
  
- D. Force Main
  - 1. Pipe and Fitting Material..... \_\_\_\_\_
  - 2. Valve Types & Materials..... \_\_\_\_\_
  - 3. Pipe Size: 4-Inch Min. (10-States)..... \_\_\_\_\_
  - 4. Depth: 5' Min. to Top of Pipe ..... \_\_\_\_\_
  - 5. Pipe Bedding & Backfill Materials & Construction ..... \_\_\_\_\_
  - 6. Specs Complete ..... \_\_\_\_\_
  - 7. Details Complete ..... \_\_\_\_\_
  - 8. Air/Vacuum Release Stations..... \_\_\_\_\_
  
- E. Pump Stations
  - 1. Wet Well Size: Min. 15 Minute Detention Time ..... \_\_\_\_\_
  - 2. Pump Capacity: Min. 300 GPM ..... \_\_\_\_\_

- 3. Pump Able to Pass 3-inch Sphere..... \_\_\_\_\_
- 4. Double Mechanical Seals ..... \_\_\_\_\_
- 5. Piping Inside Station: D.I. Class 50 ..... \_\_\_\_\_
- 6. NEMA 4X Enclosure for Controls ..... \_\_\_\_\_
- 7. Access Road ..... \_\_\_\_\_
- 8. Specs Complete ..... \_\_\_\_\_
- 9. Details Complete ..... \_\_\_\_\_
  
- F. Connections To Existing Sewers
  - 1. Details of Connections..... \_\_\_\_\_
  - 2. Existing Sewer Sizes & Materials Indicated ..... \_\_\_\_\_
  - 3. Compare Existing Sewers to City Sewer Map ..... \_\_\_\_\_
  - 4. Connection to Existing Sewer Made Using New Manhole Over Line ..... \_\_\_\_\_
  
- G. Other Utility Conflicts
  - 1. Horizontal Separation of 10' Min. To Water Lines ..... \_\_\_\_\_
  - 2. Vertical Separation of 18" to Water Lines..... \_\_\_\_\_
  - 3. Horizontal & Vertical Separation Between Other Utilities ..... \_\_\_\_\_
  
- H. Miscellaneous
  - 1. Easement Widths: 12' up to 10' Deep, 2' More for Every 1' Deeper..... \_\_\_\_\_
  - 2. Engineer's Seal & Signature..... \_\_\_\_\_
  - 3. Page Numbers, Set Complete..... \_\_\_\_\_
  - 4. Specs Complete ..... \_\_\_\_\_
  - 5. North Arrow on Each Sheet..... \_\_\_\_\_
  - 6. Benchmark Indicated on Plans..... \_\_\_\_\_
  - 7. Scale Indicated on Plans ..... \_\_\_\_\_
  - 8. Roads Labeled ..... \_\_\_\_\_
  - 9. Contours Labeled ..... \_\_\_\_\_
  - 10. Existing & Final Grade Shown on Profiles..... \_\_\_\_\_
  - 11. Check Additional Notes, Details, Spec. Sections ..... \_\_\_\_\_

II. Calculations

- A. Design Flow
  - 1. 100 Gallons Per Capita Per Day or 310 Per House Per Day ..... \_\_\_\_\_
  - 2. Use 10-States Peaking Factors..... \_\_\_\_\_

III. Cost Estimate

PLAN REVIEW DATE:  
 LETTER SENT:  
 PLANS RESUBMITTED:  
 APPROVAL DATE:

**CERTIFICATE OF SUBSTANTIAL COMPLETION**

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---

OWNER's Project No.: \_\_\_\_\_ .....  
ENGINEER's Project No.: \_\_\_\_\_

Project: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

Contract for: City of Plymouth.....  
Contract Date: \_\_\_\_\_

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**This Certificate of Substantial Completion applies to all Work under the Contract Documents, or to the following specified parts thereof:**

To: \_\_\_\_\_ **City of Plymouth, Indiana** \_\_\_\_\_  
OWNER

And To: \_\_\_\_\_  
CONTRACTOR

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**The work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR, and ENGINEER, and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on**

\_\_\_\_\_  
DATE OF SUBSTANTIAL COMPLETION

**A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all**

the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR with \_\_\_ days of the above date of Substantial Completion.

The responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as follows:

**RESPONSIBILITIES:**

**OWNER:** \_\_\_\_\_

**CONTRACTOR:** \_\_\_\_\_

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR's obligation to complete the Work in accordance with the Contract Documents.

Executed by ENGINEER ON \_\_\_\_\_, 20\_\_

\_\_\_\_\_  
ENGINEER

BY: \_\_\_\_\_

CONTRACTOR accepts this Certificate of Substantial Completion on \_\_\_\_\_, 20\_\_

\_\_\_\_\_  
CONTRACTOR

BY: \_\_\_\_\_

OWNER accepts this Certificate of Substantial Completion on \_\_\_\_\_, 20\_\_

\_\_\_\_\_  
OWNER

BY: \_\_\_\_\_

**City of Plymouth, Indiana  
Submersible Lift Station  
Final Inspection Checklist**

Date: \_\_\_\_\_ Location: \_\_\_\_\_

Lift Station ID: \_\_\_\_\_ KW Meter Number: \_\_\_\_\_

Pump Manufacturer: \_\_\_\_\_ Pump Supplier: \_\_\_\_\_

Pump Model: \_\_\_\_\_ Serial number: \_\_\_\_\_

Voltage: \_\_\_\_\_ Phase: \_\_\_\_\_

Hertz: \_\_\_\_\_ Horsepower: \_\_\_\_\_

Control Panel model: \_\_\_\_\_ Control Panel Supplier: \_\_\_\_\_

Contractor: \_\_\_\_\_ Engineer: \_\_\_\_\_

**I. ELECTRIC**

- A. Is the power system 3 phase or 1 phase? \_\_\_\_\_
- B. If 3 phase, is grounded neutral power provided?       Yes       No
- C. If above answer is "No" is transformer installed?       Yes       No
- D. Voltage readings
1. Between phases:    L1, L2 \_\_\_\_\_    L1, L3 \_\_\_\_\_    L2, L3 \_\_\_\_\_
2. High phase to ground \_\_\_\_\_
3. Other legs to ground \_\_\_\_\_
- E. High Leg (L3) is connected to motor only and not connected to any auxiliary circuits.       Yes       No
- F. Do latches on control panel work smoothly?       Yes       No

**II. PUMP AND MOTOR CONTROLS**

- A. Breaker switches operate properly:
1. Pump #       Yes       No
2. Pump #2       Yes       No
3. Pump #3       Yes       No
4. Control Circuit       Yes       No
5. Remote Control Monitor       Yes       No

- B. Hand-Off-Automatic switches:
- |  |                          |     |                          |    |
|--|--------------------------|-----|--------------------------|----|
| 1. Pump #1 hand position operates  | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 2. Pump #2 hand position operates  | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 3. Pump #3 hand position operates  | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 5. Pump #2 Auto position operates  | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 6. Pump #3 Auto position operates  | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 7. Do the floats sequence all pumps with relation to lead, lag, and alternation? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
- C. Amperage:
- |   |                          |     |                          |    |
|---|--------------------------|-----|--------------------------|----|
| 1. Name Plate Rating (amps) Pump #1 Motor | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 2. Amps pulled by Pump #1 Motor           | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 3. Name Plate Rating (amps) Pump #2 Motor | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 4. Amps pulled by Pump #2 Motor           | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 5. Name Plate Rating (amps) Pump #3 Motor | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 6. Amps pulled by Pump #3 Motor           | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
- D. Seal Failure/Heat Sensor:
- |   |                          |     |                          |    |
|---|--------------------------|-----|--------------------------|----|
| 1. Seal failure wires connected properly to seal failure circuit? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 2. Test seal failure circuit OK?                                  | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 3. Heat sensor wires connected properly to heat sensor circuit?   | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 4. Test heat sensor circuit OK?                                   | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
- E. Control Components:
- |   |                          |     |                          |    |
|---|--------------------------|-----|--------------------------|----|
| 1. Verify all electrical components are locally available | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
|---|--------------------------|-----|--------------------------|----|
- F. Alarms:
- |   |                          |     |                          |    |
|---|--------------------------|-----|--------------------------|----|
| 1. High water alarm light and horn activate with the test button. | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 2. Horn silences with silence button.                             | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 3. High water alarm light and horn activate with float.           | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
- G. Float Settings:
- |   |                      |
|---|----------------------|
| 1. Lead pump kicks on at Elv. _____ ( _____ ' _____ ")                | from wet well bottom |
| 2. Lead pump kicks off at Elv. _____ ( _____ ' _____ ")               | from wet well bottom |
| 3. Lag pump kicks on at Elv. _____ ( _____ ' _____ ")                 | from wet well bottom |
| 4. Lag pump kicks off at Elv. _____ ( _____ ' _____ ")                | from wet well bottom |
| 5. Back up pump kicks on at Elv. _____ ( _____ ' _____ ")             | from wet well bottom |
| 6. Back up pump kicks off at Elv. _____ ( _____ ' _____ ")            | from wet well bottom |
| 7. Height of influent sewer above floor of wet well _____ ' _____ "   |                      |
| 8. Height of high water alarm above floor of wet well _____ ' _____ " |                      |
| 9. Top of basin Elv. _____  |                      |
| 10. Total basin depth _____ ' _____ "                                 |                      |

Remarks:

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**III. PUMPS AND MOTORS**

**A. Operation:**

- 1. Are pumps running quietly?
  - a. Pump #1  Yes  No
  - b. Pump #2  Yes  No
  - c. Pump #3  Yes  No
- 2. Are motors running quietly?
  - a. Pump #1  Yes  No
  - b. Pump #2  Yes  No
  - c. Pump #3  Yes  No
- 3. Is excessive vibration noted?
  - a. Pump #1  Yes  No
  - b. Pump #2  Yes  No
  - c. Pump #3  Yes  No

**B. Installation:**

- 1. Are guide rails exactly vertical (plumb)?
- 2. Is base elbow installed level?

**Remarks:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**IV. REMOTE MONITOR PANEL**

- A. Verify start-up procedure completed properly and put "On-Line" with the Wastewater Plant by remote monitor panel supplier.  Yes  No

**V. VALVES**

**A. Check valves:**

- 1. Do clappers swing freely?  Yes  No
- 2. Does packing leak?  Yes  No
- 3. Are counter weights adjusted properly?  Yes  No

**B. Plug valves:**

- 1. Do valves open and close freely?  Yes  No
- 2. Does packing leak?  Yes  No
- 3. During operation, are all gates completely open?  Yes  No

**Remarks:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**VI. PUMP STATION TESTING**

A. Draw Down Test

Diameter of wet well \_\_\_\_\_ ‘ \_\_\_\_\_ “  
 (5'-0" = 150 gal/ft      6'-0" = 212 gal/ft      7'-0" = 288 gal/ft      8'-0" = 376 gal/ft)

	<b>Time</b>	<b>Depth</b>	<b>Vol. per Unit Depth</b>	<b>Total Vol.</b>	<b>Pump Capacity</b>
Pump #1 On	_____	_____			
Pump #1 Off	_____	_____	_____	_____	_____
Pump #2 On	_____	_____			
Pump #2 Off	_____	_____	_____	_____	_____
Pump #3 On	_____	_____			
Pump #3 Off	_____	_____	_____	_____	_____
Pump #4 On	_____	_____			
Pump #4 Off	_____	_____	_____	_____	_____
Pump #1,2 On	_____	_____			
Pump #1,2 Off	_____	_____	_____	_____	_____
Pump #1,3 On	_____	_____			
Pump #1,3 Off	_____	_____	_____	_____	_____
Pump #2,3 On	_____	_____			
Pump #2,3 Off	_____	_____	_____	_____	_____
Pump #1,4 On	_____	_____			
Pump #1,4 Off	_____	_____	_____	_____	_____
Pump #2,4 On	_____	_____			
Pump #2,4 Off	_____	_____	_____	_____	_____
Pump #3,4 On	_____	_____			
Pump #3,4 Off	_____	_____	_____	_____	_____



- B. Pressure Test
  - 1. No Pumps Running - Static Back Pressure: \_\_\_\_\_
  - 2. Pump No. 1 Operating - Pressure: \_\_\_\_\_
  - 3. Pump No. 2 Operating - Pressure: \_\_\_\_\_
  - 4. Pump No. 3 Operating - Pressure: \_\_\_\_\_
  - 5. Pump Nos. 1 & 2 Running - Pressure: \_\_\_\_\_
  - 6. Pump Nos. 2 & 3 Running - Pressure: \_\_\_\_\_
  - 7. Pump Nos. 1 & 3 Running - Pressure: \_\_\_\_\_

**Remarks:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**VII. EQUIPMENT**

- A. Pumps
- B. Motors
- C. Pump Circuit Breaker
- D. Starters
- E. Heaters
- F. Control Circuit Breaker
- G. Remote Monitor Circuit Breaker
- H. Alternator
- I. H-O-A Switches
- J. Plug Valves
- K. Check Valves
- L. Pressure Gauge
- M. Transducer
- N. Floats
- O. Other

**Remarks:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**VIII. COVERT ALARM SYSTEM**

- A. Do latches on control panel work smoothly?  Yes  No
  
- B. Code indication functioning
  - 1. Pump overload trip  Yes  No
  - 2. Crew on site key switch  Yes  No
  - 3. Wet well high water  Yes  No
  - 4. Dry pit high water or submersible seal failure  Yes  No
  - 5. Power failure  Yes  No
  - 6. Open  Yes  No
  - 7. Restore to normal  Yes  No
  - 8. Low battery  Yes  No

**Remarks:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

---

***I CERTIFY THIS REPORT IS ACCURATE***

\_\_\_\_\_  
Start-up date/time

\_\_\_\_\_  
Start-up Coordinator

\_\_\_\_\_  
Factory Representative

\_\_\_\_\_  
Wastewater Utility Superintendent

\_\_\_\_\_  
Wastewater Utility Operator

\_\_\_\_\_  
Engineer

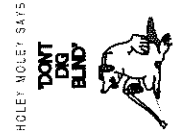
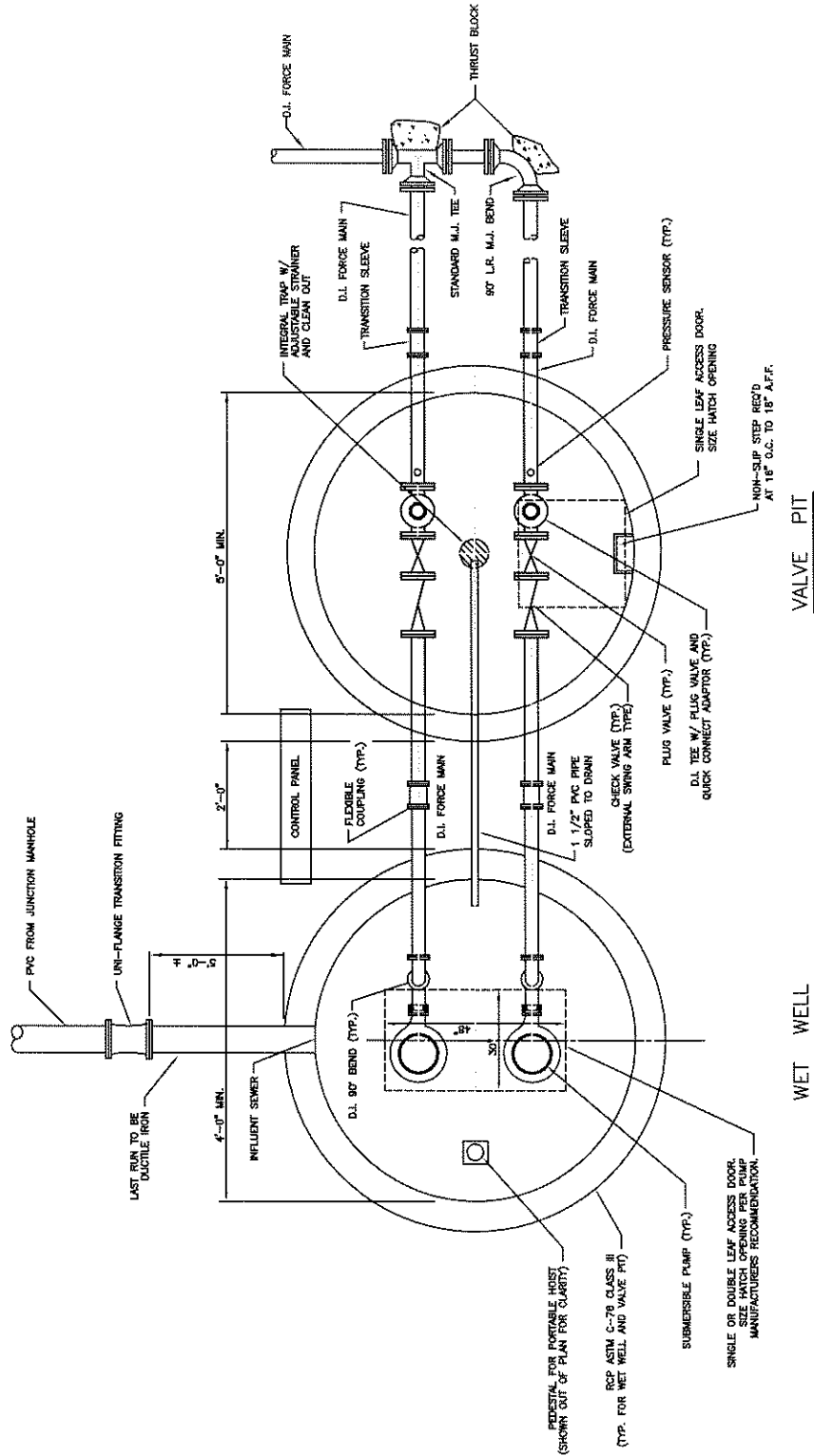
\_\_\_\_\_  
Contractor

**APPENDIX “A”**

**STANDARD**

**DETAILS**





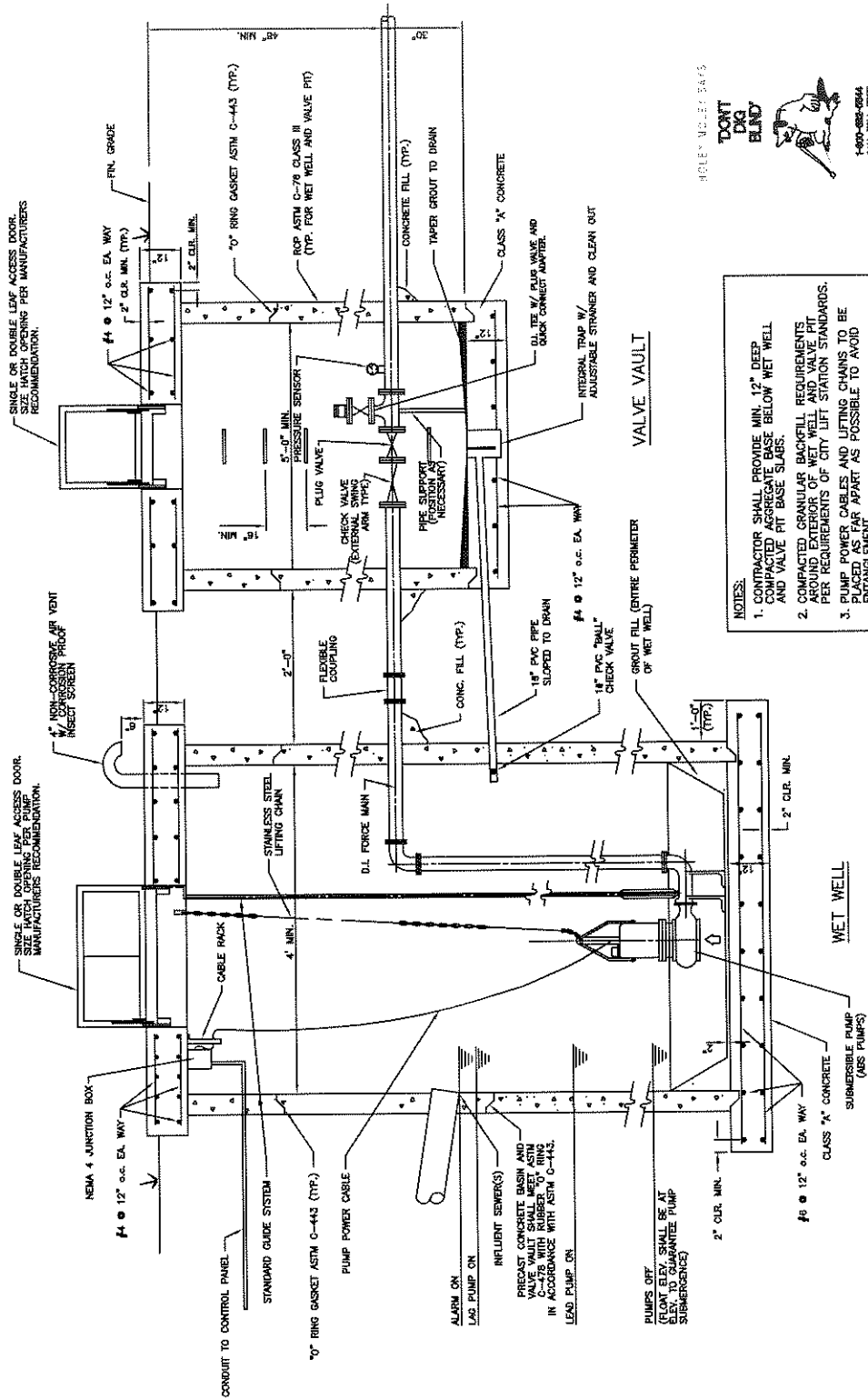
HOLEY MOLEY SAYS  
**DON'T DIG BLIND**  
 1-800-888-8844  
 CALL TOLL FREE  
 CALL 2 WORKING DAYS BEFORE YOU DIG

## TYPICAL LIFT STATION PLAN (SUBMERSIBLE PUMP)

NO.	REVISION	DATE

CITY of PLYMOUTH, INDIANA

DRAWING NO.  
  
LS-1



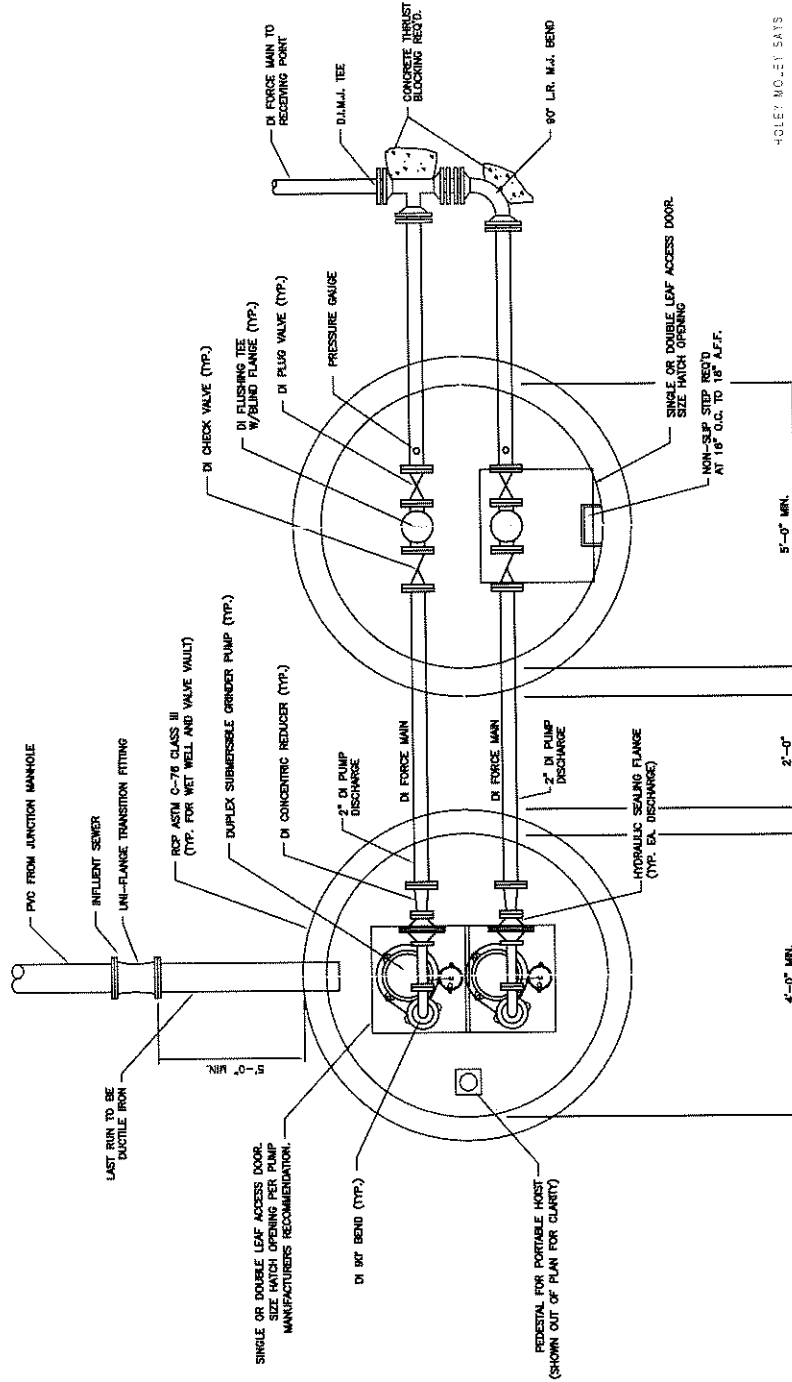
- NOTES:**
1. CONTRACTOR SHALL PROVIDE MIN. 12" DEEP GROUT FILL AT EACH PUMP AND VALVE PIT BASE SLABS.
  2. COMPACTED GRANULAR BACKFILL REQUIREMENTS PER REQUIREMENTS OF CITY LIFT STATION STANDARDS.
  3. PUMP POWER CABLES AND LIFTING CHAINS TO BE KEPT SEPARATE AS POSSIBLE TO AVOID ENTANGLEMENT.

## TYPICAL LIFT STATION SECTION (SUBMERSIBLE PUMP)

NO.	REVISION	DATE

CITY of PLYMOUTH, INDIANA

DRAWING NO.  
  
LS-2



40157 MOLEY SAYS  
**“DON'T  
 DO  
 BLIND”**  
 1. ALWAYS WEAR YOUR  
 SAFETY GEAR  
 2. ALWAYS CALL THE  
 CITY ENGINEERING  
 DEPARTMENT  
 3. CALL 2 WORKING DAYS BEFORE YOU DO

## TYPICAL LIFT STATION PLAN (GRINDER PUMP)

NO.	REVISION	DATE

CITY of PLYMOUTH, INDIANA

DRAWING NO.

LS-3

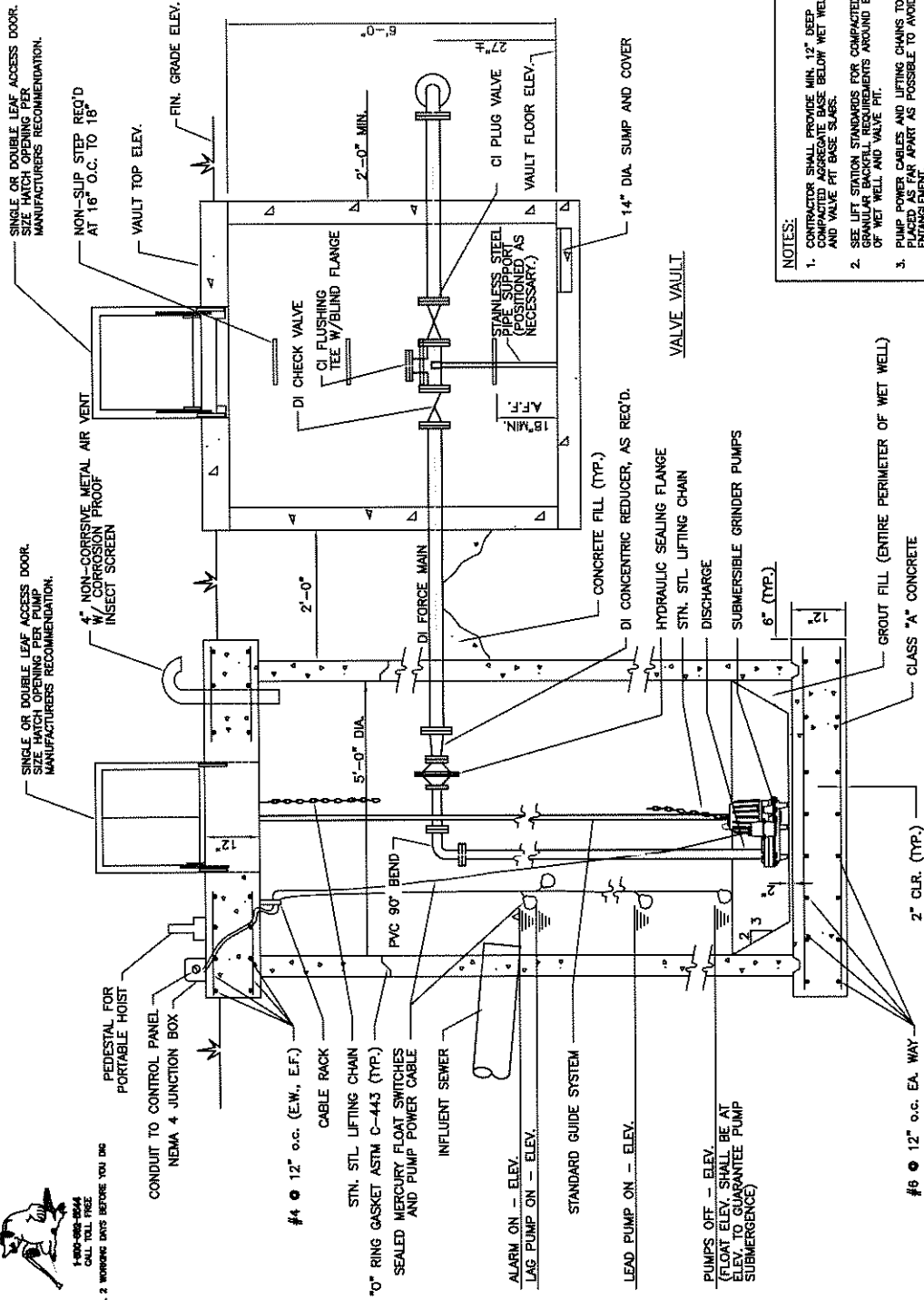
HOLEY MOLEY SAYS

**DON'T  
DIG  
BLIND**



1-800-886-2644  
CALL TOLL FREE

CALL 2 WORKING DAYS BEFORE YOU DIG



- NOTES:**
1. COMPACTOR SHALL PROVIDE MIN. 12" DEEP COMPACTED AGGREGATE BASE BELOW WET WELL AND VALVE PIT BASE SLABS.
  2. SEE LIFT STATION STANDARDS FOR COMPACTED MATERIALS AND DIMENSIONS AROUND EXTERIOR OF WET WELL AND VALVE PIT.
  3. PUMP POWER CABLES AND LIFTING CHAINS TO BE ENCASED IN CONCRETE AS POSSIBLE TO AVOID ENTRAPMENT.

## TYPICAL LIFT STATION PLAN (GRINDER PUMP)

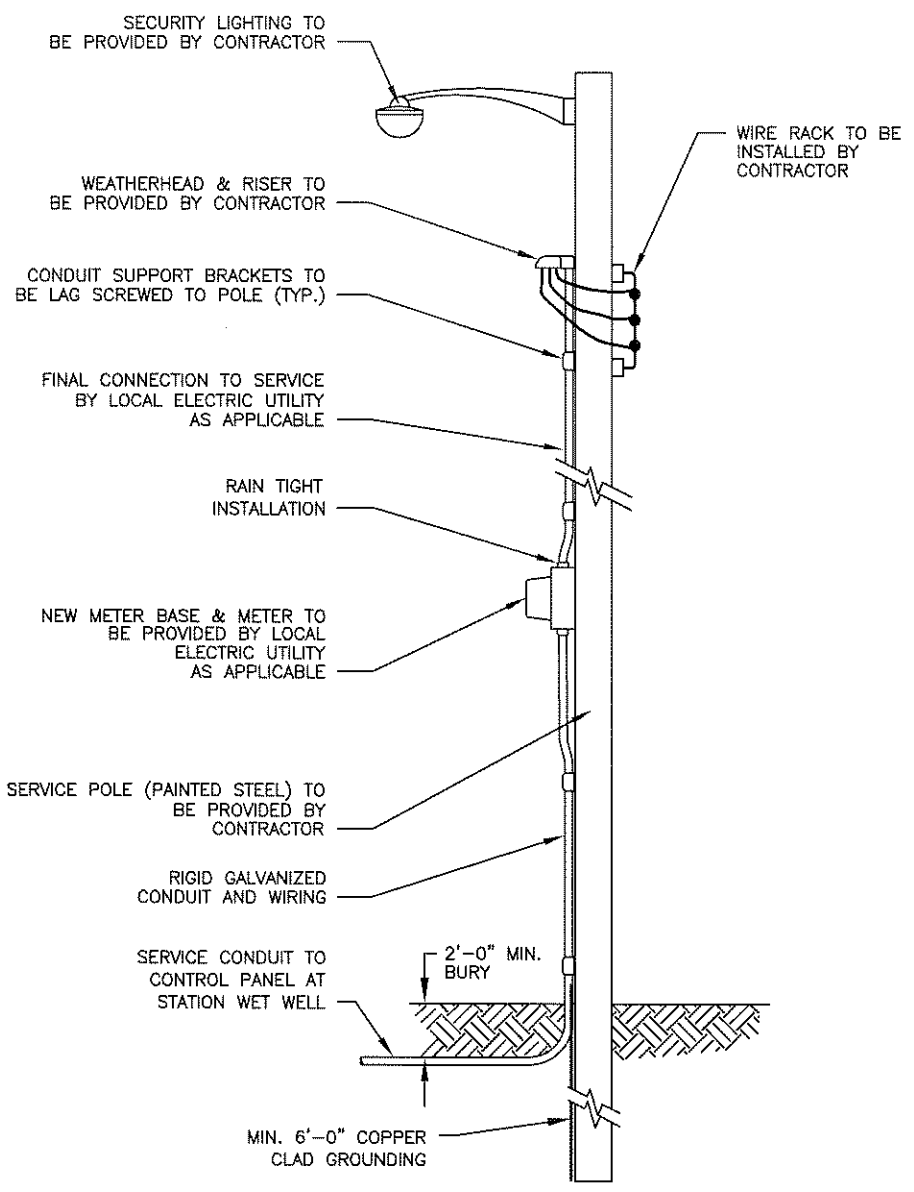
NO.	REVISION	DATE

CITY of PLYMOUTH, INDIANA

DRAWING NO.

LS-4





LIFT STATION SERVICE POLE ELECTRIC DETAIL

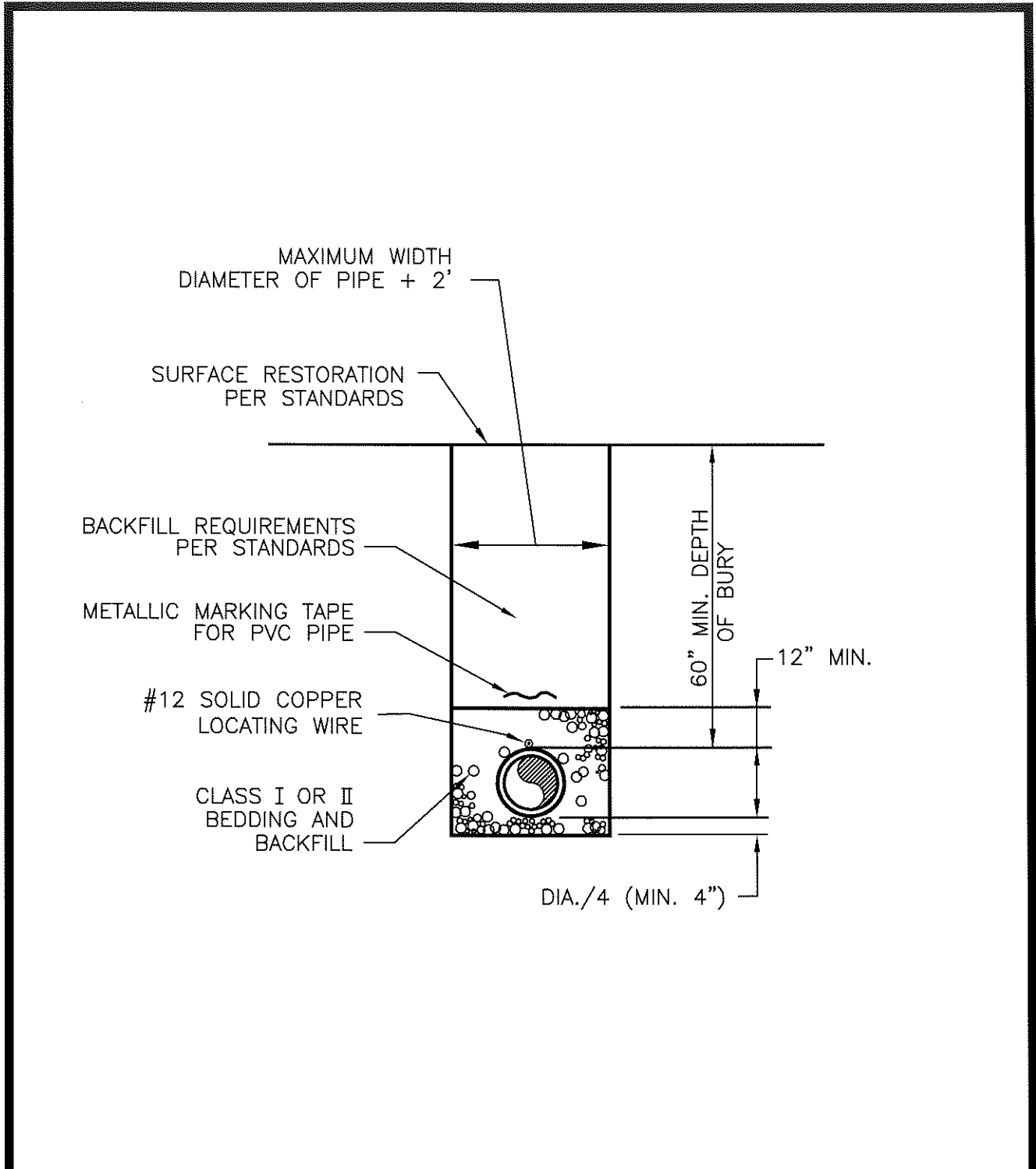
NO.	REVISION	DATE

CITY of PLYMOUTH, INDIANA

DRAWING NO.

LS-5

ELECPOLE.DWG



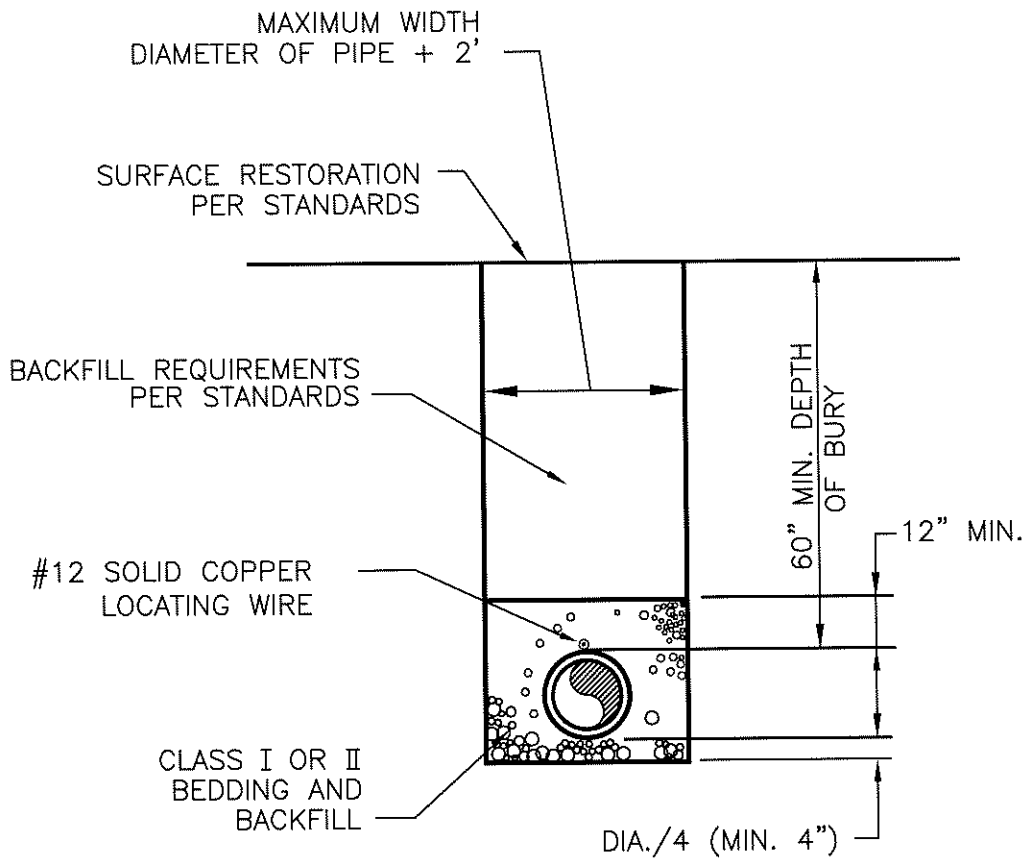
**FORCE MAIN PIPE TRENCH DETAIL  
PVC PIPE**

NO.	REVISION	DATE

**CITY of PLYMOUTH, INDIANA**

DRAWING NO.  
**LS-6**

FMREN.DWG



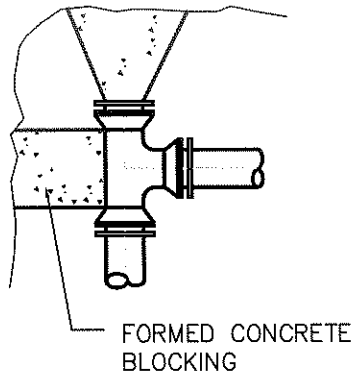
**FORCE MAIN PIPE TRENCH DETAIL  
DUCTILE IRON PIPE**

NO.	REVISION	DATE

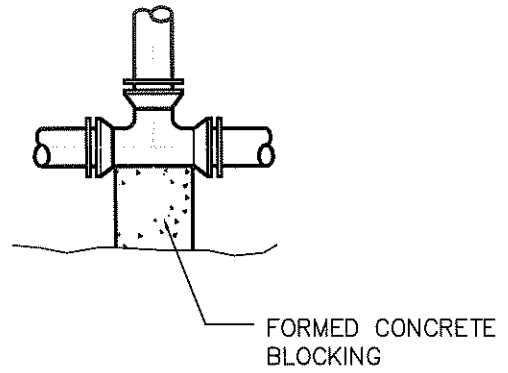
**CITY of PLYMOUTH, INDIANA**

DRAWING NO.  
**LS-6A**

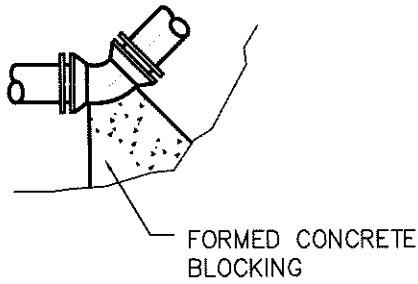
FMTRENA.DWG



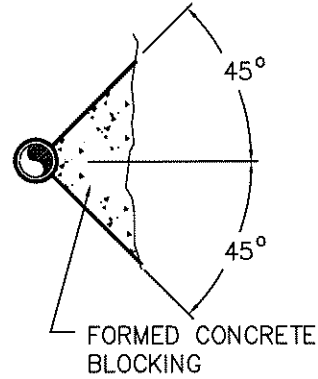
DETAIL A



DETAIL B



DETAIL C



DETAIL D

AREA IN SQUARE FEET REQUIRED FOR CONCRETE THRUST BLOCKING					
SIZE	TEE & PLUG	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND
4"	2.0	2.5	1.5	1.0	1.0
6"	4.0	5.5	3.0	1.5	1.0
8"	6.5	9.0	5.0	2.5	1.5
10"	10.0	14.0	7.5	4.0	2.0
12"	14.0	20.0	11.0	5.5	3.0

NOTES:

- THRUST BLOCK AREAS ARE BASED ON A SOIL BEARING LOAD OF 2,000 lb./SQ. FT.
- GREASE ALL PIPE SURFACES OR WRAP WITH POLYETHYLENE SHEETS PRIOR TO PLACEMENT OF CONCRETE

THRUST BLOCKING DETAILS FOR PRESSURE MAIN

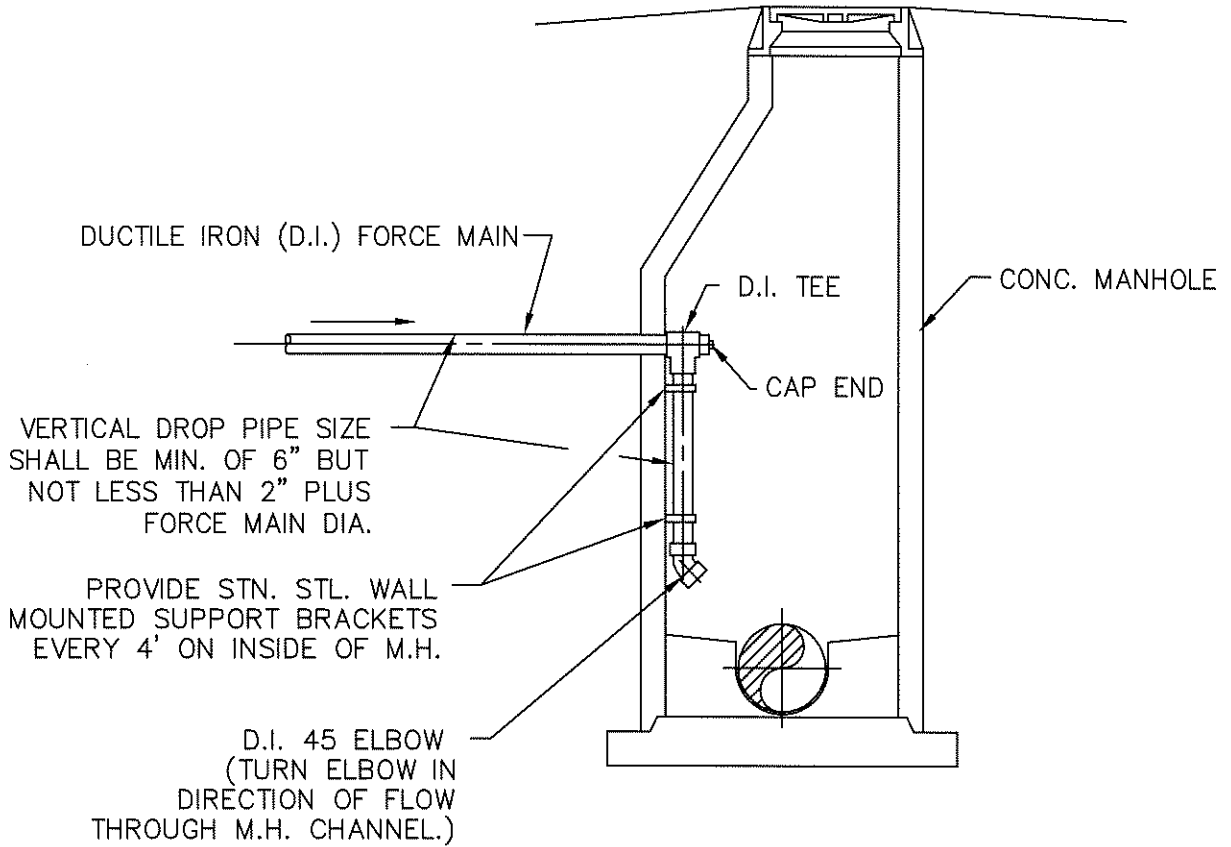
THRUST.DWG

NO.	REVISION	DATE

CITY of PLYMOUTH, INDIANA

DRAWING NO.
LS-7

NOTE: INTERNAL DROP MUST HAVE WRITTEN APPROVAL BY CITY OF PLYMOUTH



**FORCE MAIN DROP INTO MANHOLE**

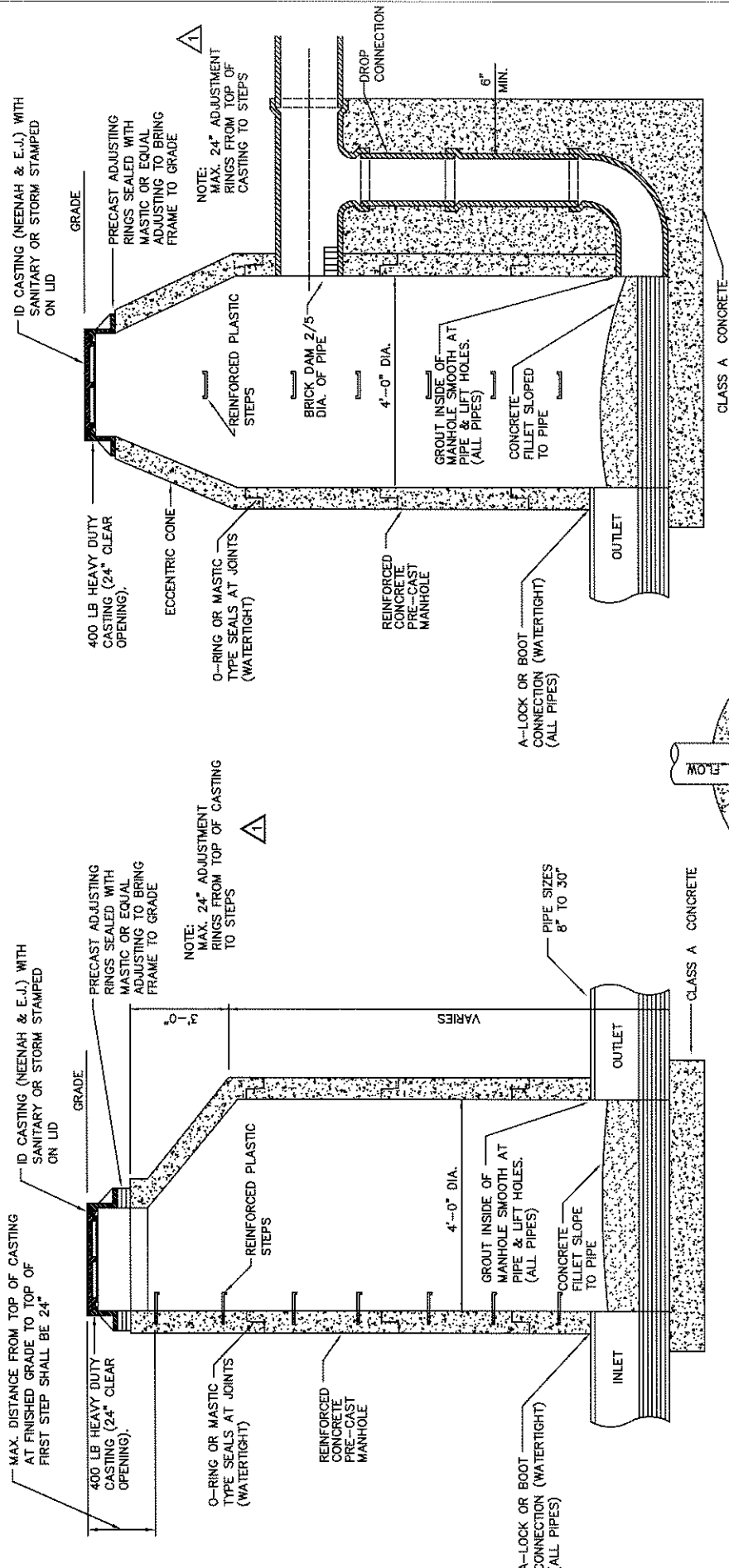
FMDROP.MH.DWG

NO.	REVISION	DATE

**CITY of PLYMOUTH, INDIANA**

DRAWING NO.

**LS-8**



STANDARD PRE-CAST MANHOLE

STANDARD DROP MANHOLE

SYMBOL	DATE	REVISION RECORD	REV. BY	CHK. BY
△1	11/12/02	24" MAX. ADJUSTMENT RING NOTE.	C.J.M.	M.R.S.
△2	6/24/04	ADDED NEW DETAIL OF MANHOLE CONE, CASTING, AND STEP ORIENTATION.	C.J.M.	M.R.S.

MANHOLE CONE, CASTING, AND STEPS TO BE CENTERED OVER INLET PIPE.

MANHOLE CONE, CASTING, AND STEP ORIENTATION

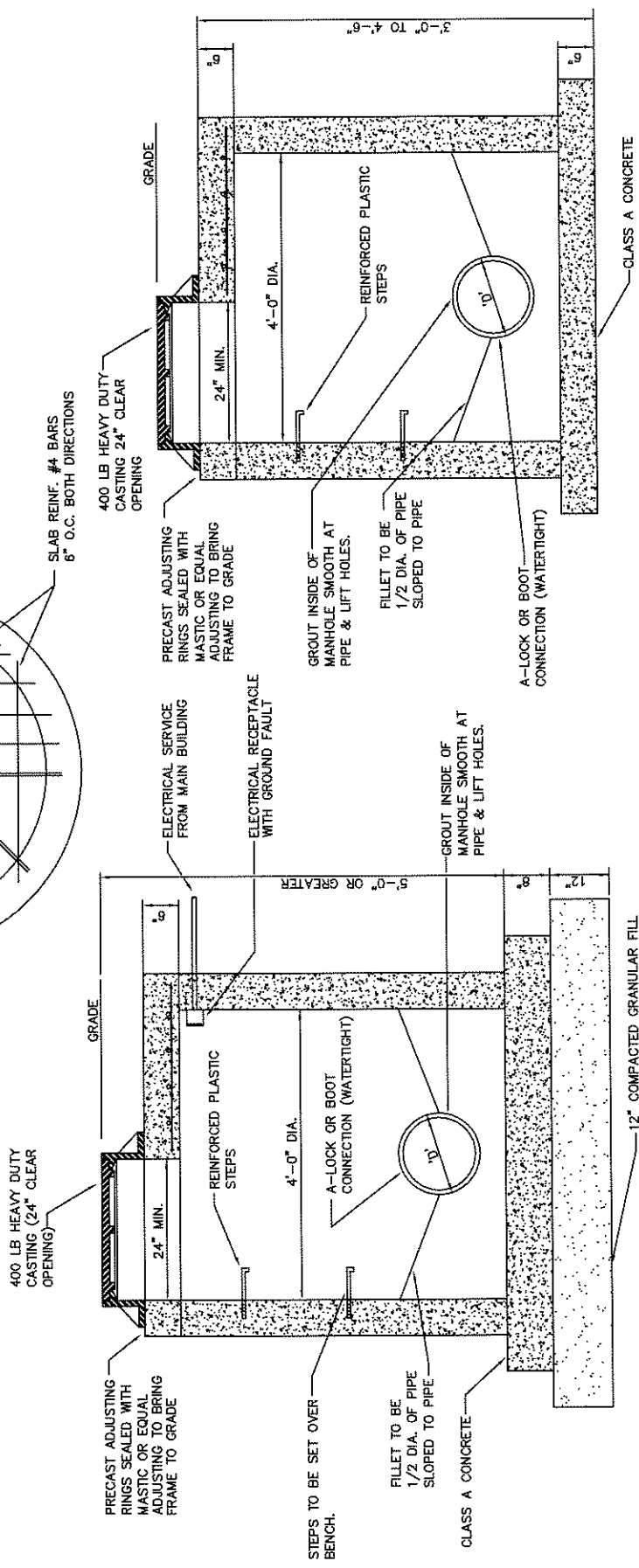
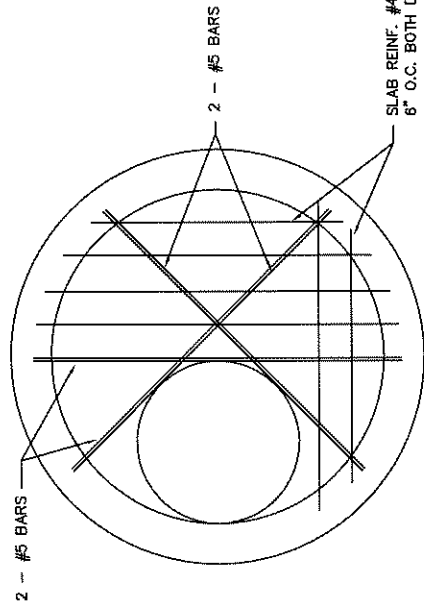
DATE: 5-5-97  
 DRAWN: C.J.M.  
 CHECKED: M.R.S.  
 APRVD: D.E.D.  
 SCALE: NONE

DESIGN STANDARDS  
 CITY OF PLYMOUTH, INDIANA

DEPARTMENT
<input checked="" type="checkbox"/> SANITARY SEWER
<input checked="" type="checkbox"/> STORM SEWER
<input type="checkbox"/> STREET
<input type="checkbox"/> WATER

DROP AND STANDARD MANHOLES

STANDARD DRAWING  
 DRAWING NO. WW-1



STANDARD METERING MANHOLE

STANDARD METERING MANHOLE

No.	BY	DATE	REVISION

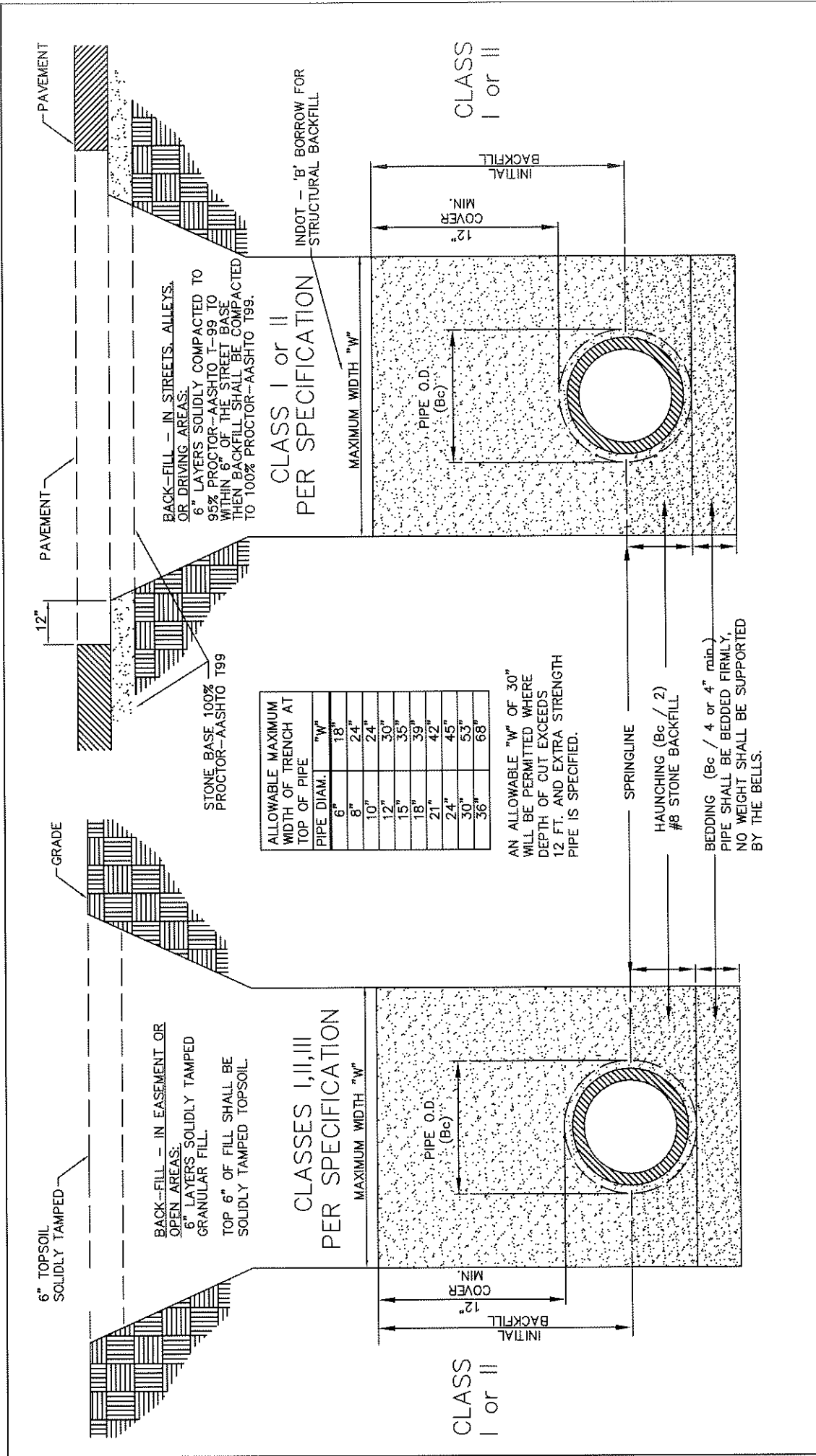
DEPARTMENT
<input checked="" type="checkbox"/> SANITARY SEWER
<input checked="" type="checkbox"/> STORM SEWER
<input type="checkbox"/> STREET
<input type="checkbox"/> WATER

STANDARD DRAWING	DRAWING NO.
	WW-2

DESIGN STANDARDS  
CITY OF PLYMOUTH, INDIANA

METERING AND SHALLOW MANHOLES

DATE: 5-5-97
DRAWN: C.J.M.
CHECKED: M.R.S.
APRVD: D.E.D.
SCALE: NONE



No.	BY	DATE	REVISION
		11/12/02	SPRINGLINE CORRECTION
		4/11/03	REVISED BACKFILL LAYERS TO 6" P/O 18"

DATE:	3-6-96
DRAWN:	C.J.M.
CHECKED:	M.R.S.
APRVD:	D.E.D.
SCALE:	NONE

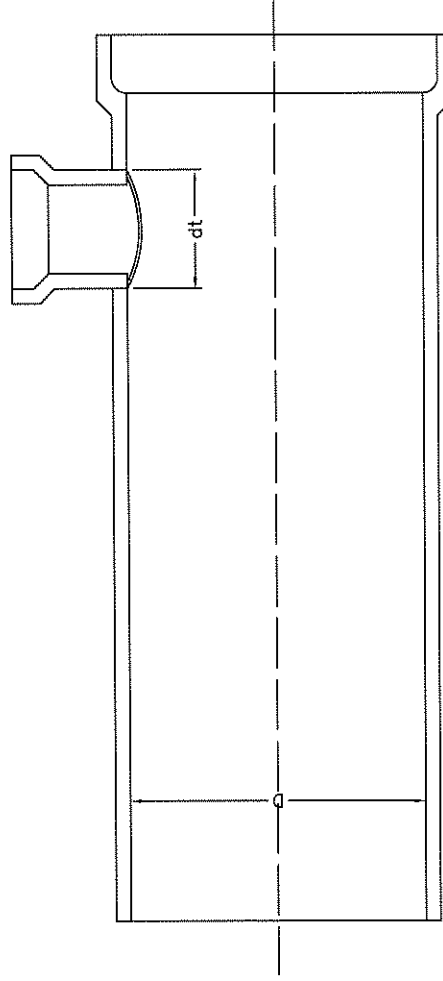
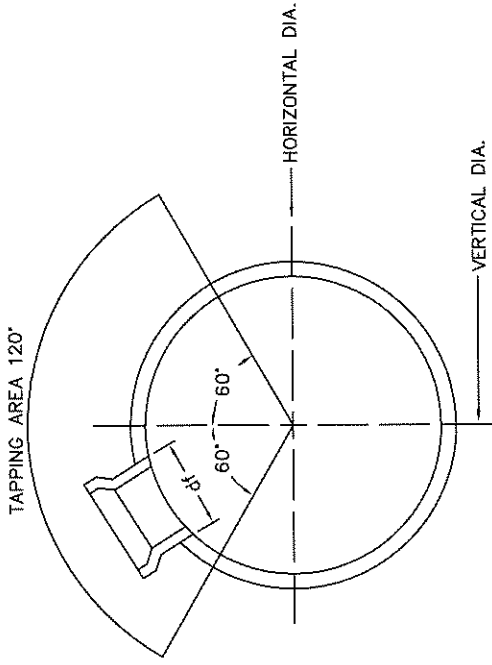
  

DEPARTMENT	SANITARY SEWER	STORM SEWER	STREET	WATER
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

DESIGN STANDARDS	CITY OF PLYMOUTH, INDIANA
PIPE BEDDING DETAIL	
STANDARD DRAWING	WW-3
DRAWING NO.	WW-3





NOTE:  
 WHEN  $df > 1/3 D$  USE WYE OR MANHOLE  
 WHEN  $df \leq 1/3 D$  USE MANUFACTURED SADDLE OR  
 IF NOT AVAILABLE CUT TAP PIPE PER SKETCH.

No.	BY	DATE	REVISION

DATE: 3-5-96  
 DRAWN: C.J.M.  
 CHECKED: M.R.S.  
 APRVD: D.E.D.  
 SCALE: NONE

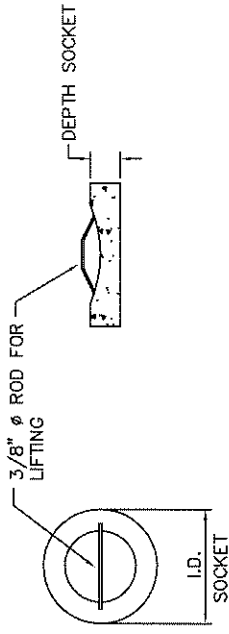
DESIGN STANDARDS  
 CITY OF PLYMOUTH, INDIANA

DEPARTMENT	
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<input type="checkbox"/>	STORM SEWER
<input type="checkbox"/>	STREET
<input type="checkbox"/>	WATER
<input type="checkbox"/>	

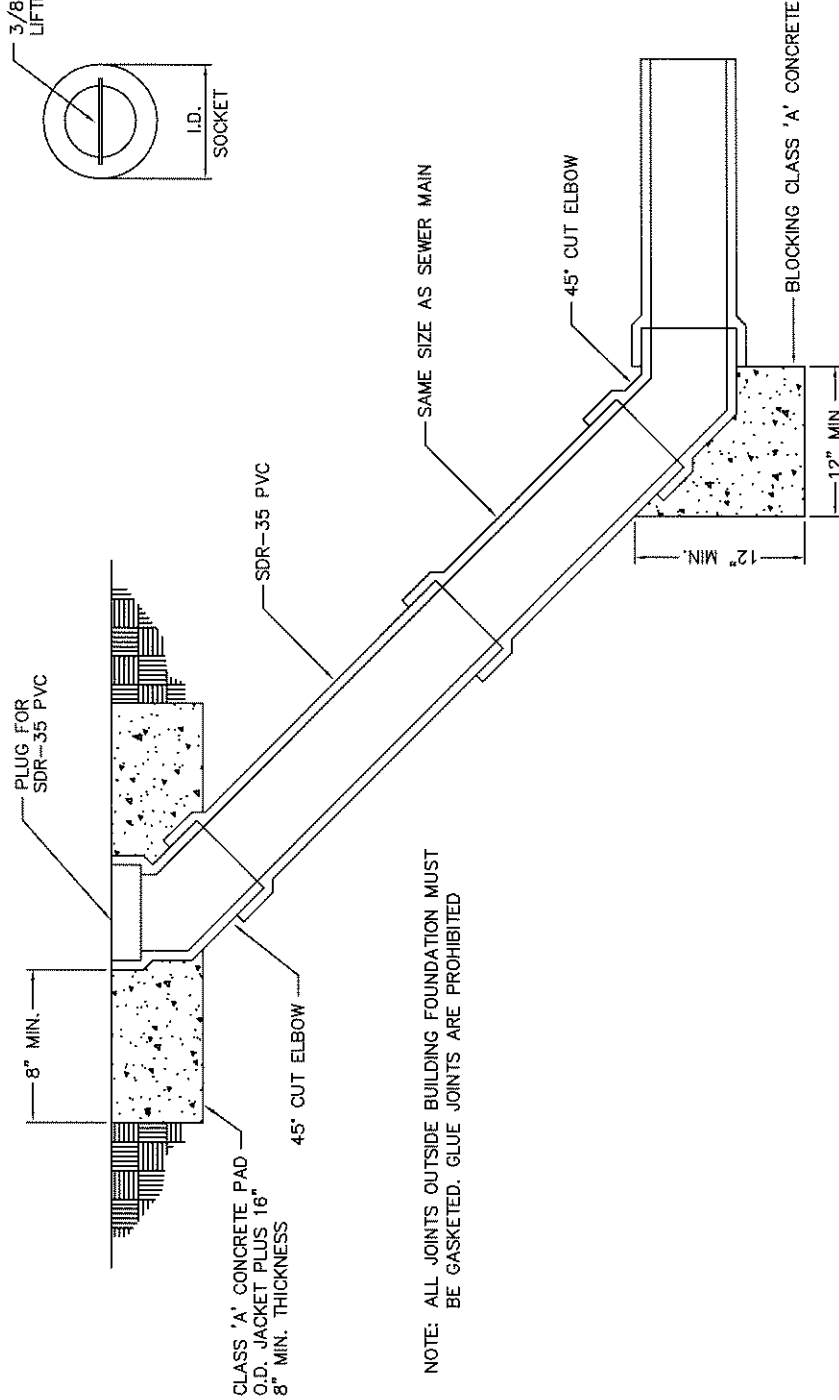
SEWER  
 TAPPING  
 STANDARD

STANDARD  
 DRAWING  
 DRAWING NO.  
 WW - 4





PLUG

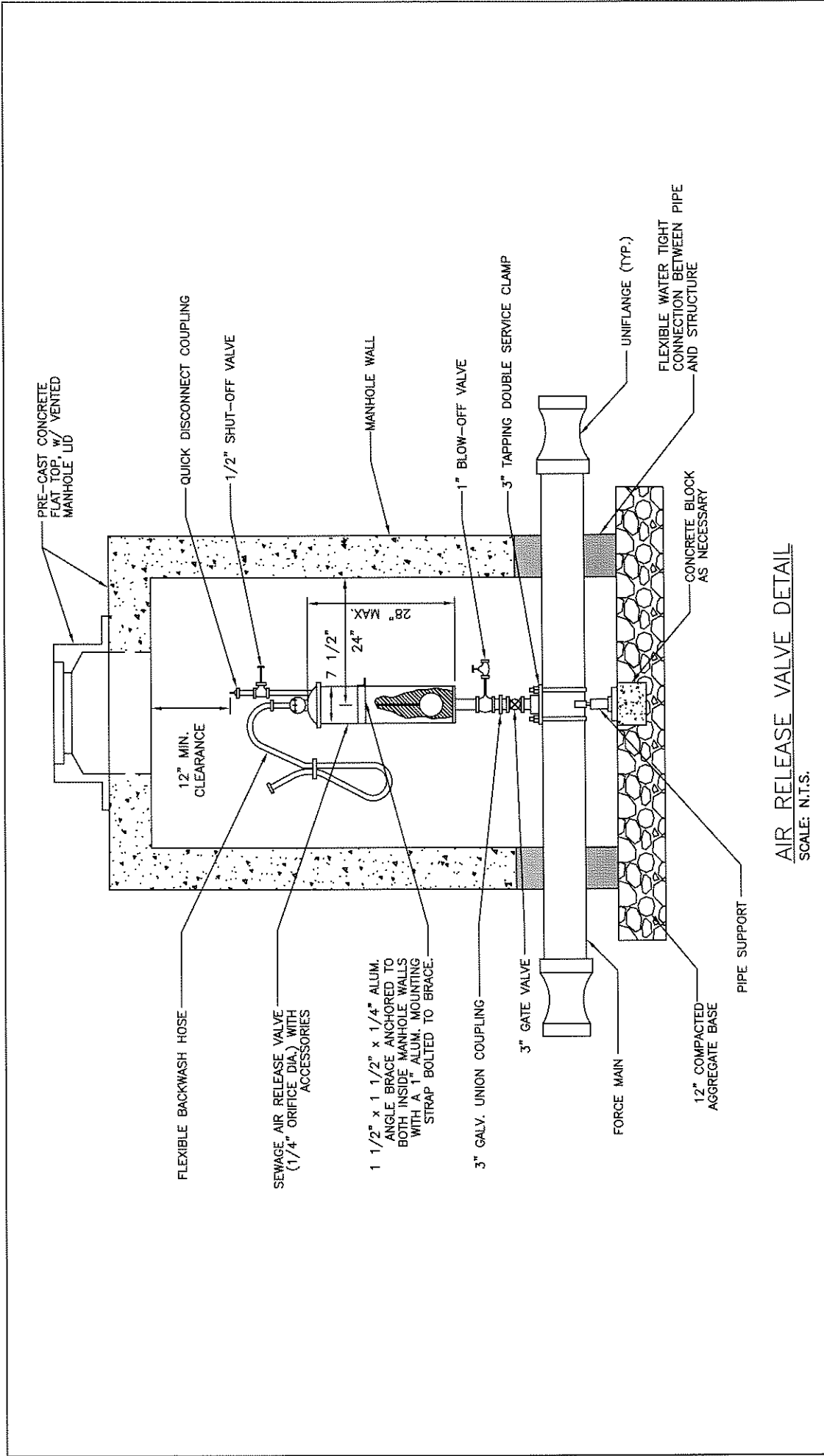


NOTE: ALL JOINTS OUTSIDE BUILDING FOUNDATION MUST BE GASKETED. GLUE JOINTS ARE PROHIBITED

- NOTE:
- 1) FOR USE WITH PRIVATE LATERALS ONLY.
  - 2) CITY MAINS WILL NOT HAVE CLEAN OUTS MANHOLES ONLY.

DETAIL TYPICAL CLEAN-OUT

No.	BY	DATE	REVISION	DATE: 3-5-96	DEPARTMENT	STANDARD DRAWING
				DRAWN: C.J.M.	<input checked="" type="checkbox"/> SANITARY SEWER	DRAWING NO. WW-6
				CHECKED: M.R.S.	<input type="checkbox"/> STORM SEWER	
				APRVD: D.E.D.	<input type="checkbox"/> STREET	
				SCALE: NONE	<input type="checkbox"/> WATER	
				DESIGN STANDARDS		
				CITY OF PLYMOUTH, INDIANA		
				PRIVATE LATERAL CLEAN-OUT		



AIR RELEASE VALVE DETAIL  
SCALE: N.T.S.

No.	BY	DATE	REVISION

DATE: 3-5-96
DRAWN: C.J.M.
CHECKED: M.R.S.
APRVD:
SCALE: NONE

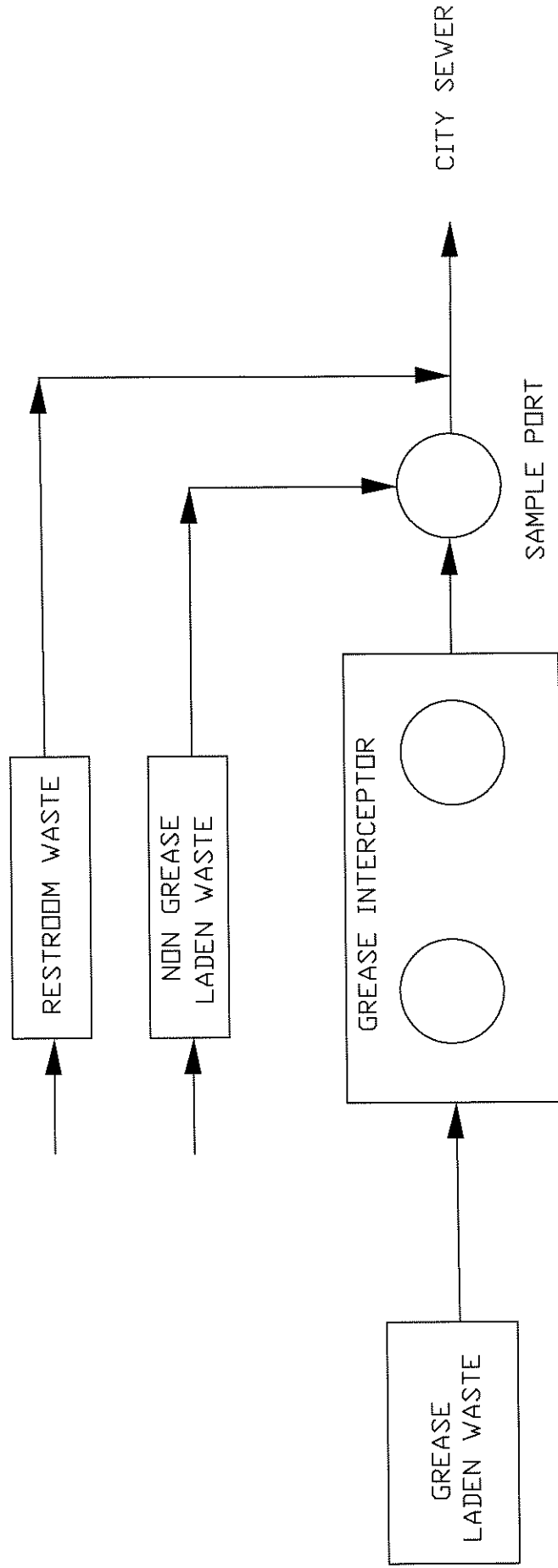
DEPARTMENT	<input checked="" type="checkbox"/> SANITARY SEWER <input type="checkbox"/> STORM SEWER <input type="checkbox"/> STREET <input type="checkbox"/> WATER
------------	---

STANDARD DRAWING	AIR RELEASE VALVE DETAIL
DRAWING NO.	WW-7

DESIGN STANDARDS  
CITY OF PLYMOUTH, INDIANA

# TYPICAL GREASE INTERCEPTOR & SAMPLE PORT PIPING LAYOUT



**NOTES:**

1. The Grease Laden Wastewater line must include a minimum six inch vertical drop in the sample port.
2. The Non Grease Laden Wastewater line must flow through the bottom of the sample port.
3. All wastewater except restroom waste may flow through the grease interceptor.
4. The Sample Port cannot hold water

DATE: 8-29-07
DRAWN: L.E.H
CHECKED: D.E.D.
APRVD: D.E.D.
SCALE: NONE

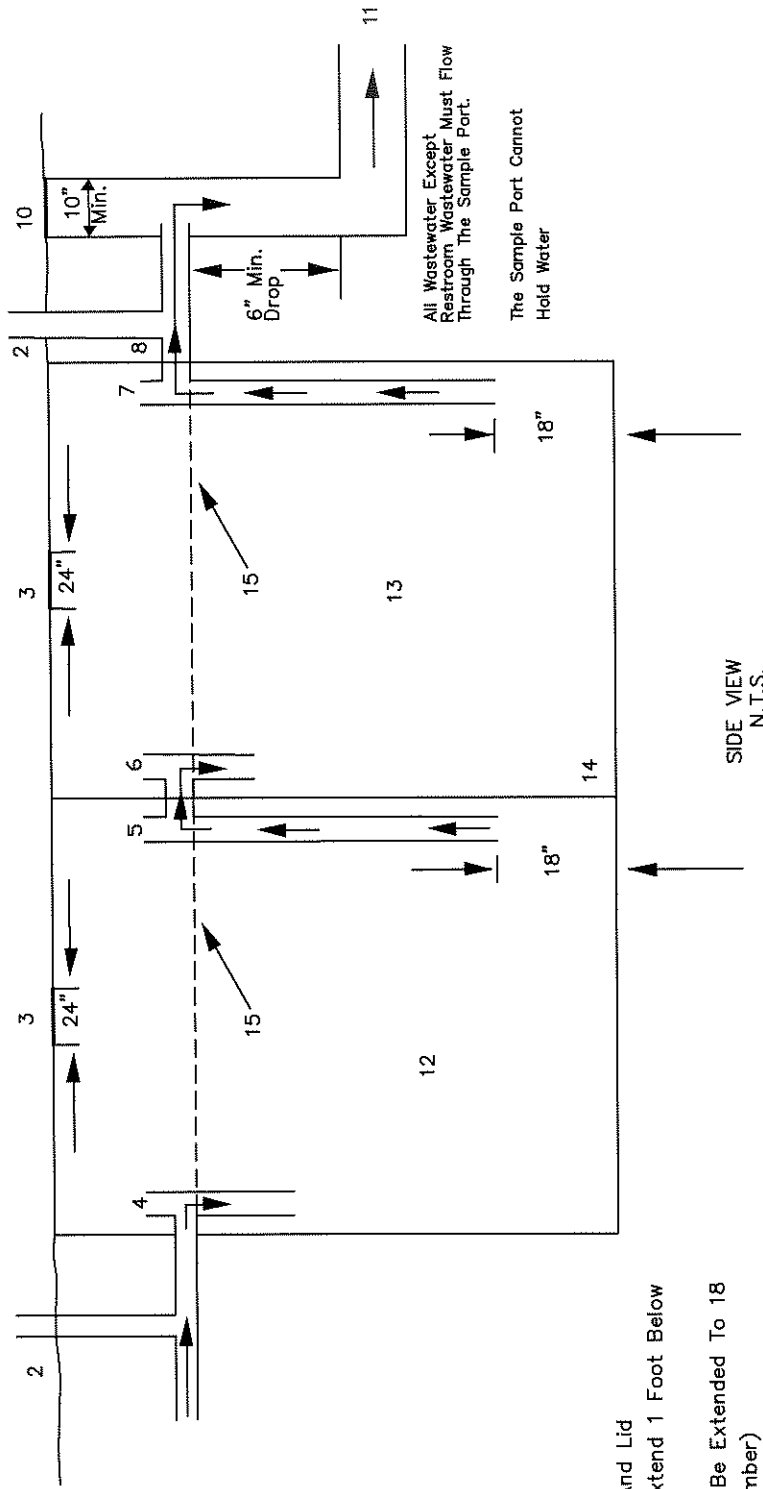
DESIGN STANDARDS  
CITY OF PLYMOUTH, INDIANA

DEPARTMENT
<input checked="" type="checkbox"/> SANITARY SEWER
<input type="checkbox"/> STORM SEWER
<input type="checkbox"/> STREET
<input type="checkbox"/> WATER

STANDARD  
DETAIL FOR  
GREASE INTERCEPTOR  
& SAMPLE PORT

STANDARD DRAWING
DRAWING NO. WW-8

# TYPICAL GREASE INTERCEPTOR & SAMPLE PORT INSTALLATION



All Wastewater Except Restroom Wastewater Must Flow Through The Sample Port.  
The Sample Port Cannot Hold Water

1. Influent Line
2. Vents
3. Minimum 24 Inch Opening With Ring And Lid
4. Primary Chamber Inlet Piping (Must Extend 1 Foot Below The Operating Level)
5. Primary Chamber Outlet Piping (Must Be Extended To 18 Inches From The Bottom Of The Chamber)
6. Secondary Chamber Inlet Piping (Must Extend 1 Foot Below The Operating Level)
7. Secondary Chamber Outlet Piping (Must Be Extended To 18 Inches From The Bottom Of The Chamber)
8. Grease Interceptor Discharge Line
9. Sample Port (Minimum 10 Inch Diameter, Provide At Least a 6 Inch Vertical Drop For The Grease Interceptor Discharge)
10. Sample Port Ring And Lid
11. Sample Port Discharge Line To The City Sewer
12. Primary Chamber
13. Secondary Chamber
14. Baffle (Must Be Sealed)
15. Grease Interceptor Operating Level

SIDE VIEW  
N.T.S.

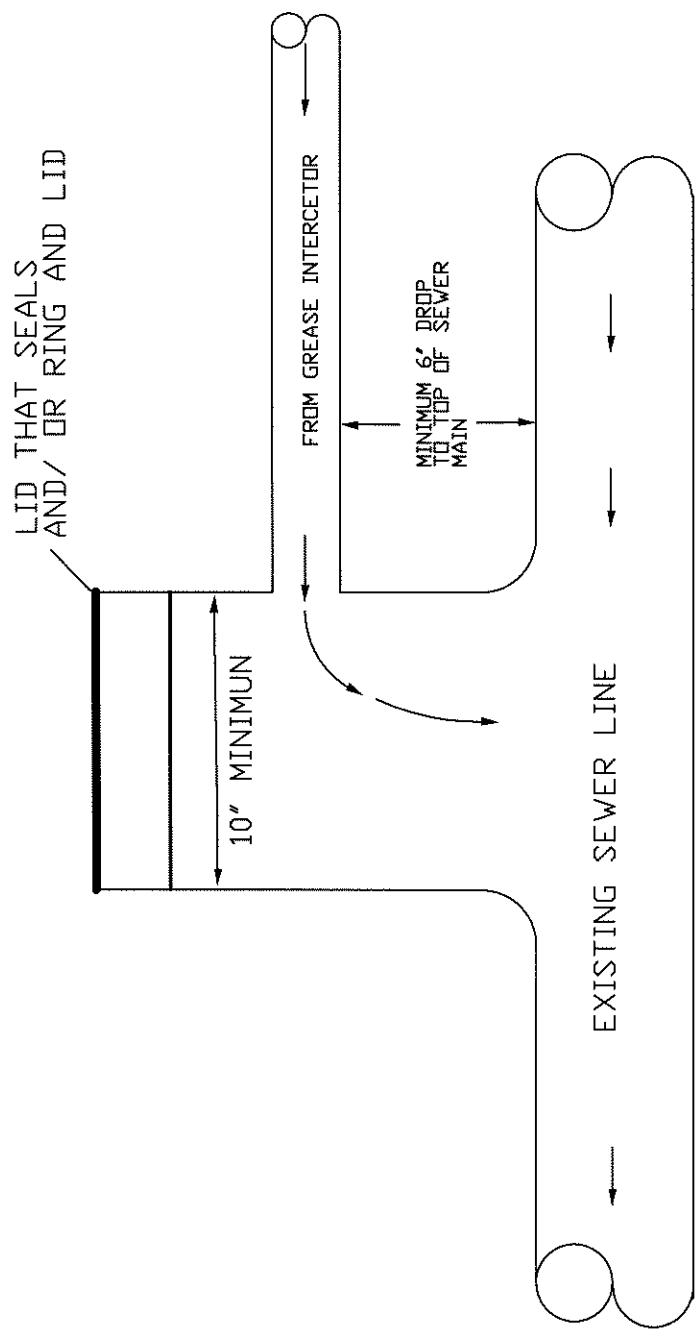
No.	BY	DATE	REVISION	DATE: 8-28-07
				DRAWN: L.E.H
				CHECKED: D.E.D.
				APRVD: D.E.D.
				SCALE: NONE

DEPARTMENT	DESIGN STANDARDS CITY OF PLYMOUTH, INDIANA
<input checked="" type="checkbox"/> SANITARY SEWER	
<input type="checkbox"/> STORM SEWER	
<input type="checkbox"/> STREET	
<input type="checkbox"/> WATER	

STANDARD	STANDARD DRAWING
DETAIL FOR GREASE INTERCEPTOR & SAMPLE PORT	DRAWING NO. WW-9



STANDARD DRAWING  
DRAWING NO.  
WW-10

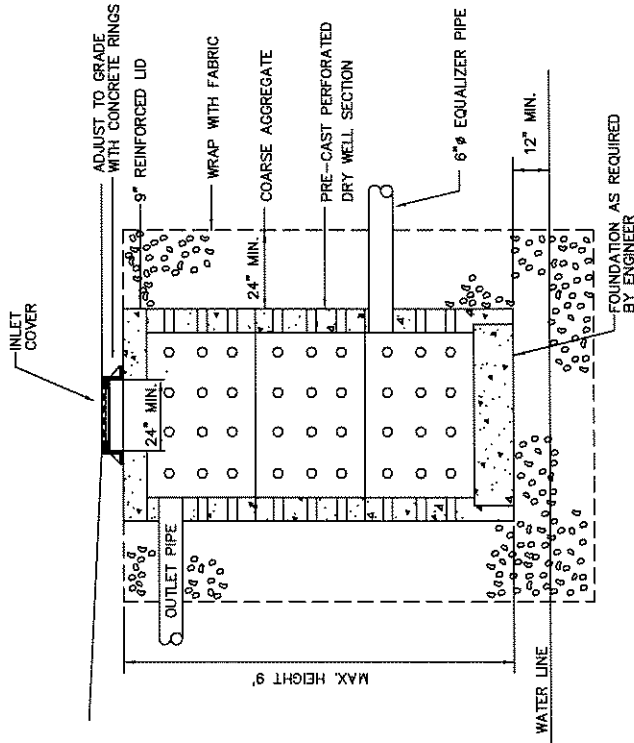
STANDARD DETAIL FOR  
SAMPLE PORT

DEPARTMENT	
<input checked="" type="checkbox"/>	SANITARY SEWER
<input type="checkbox"/>	STORM SEWER
<input type="checkbox"/>	STREET
<input type="checkbox"/>	WATER

DESIGN STANDARDS  
CITY OF PLYMOUTH, INDIANA

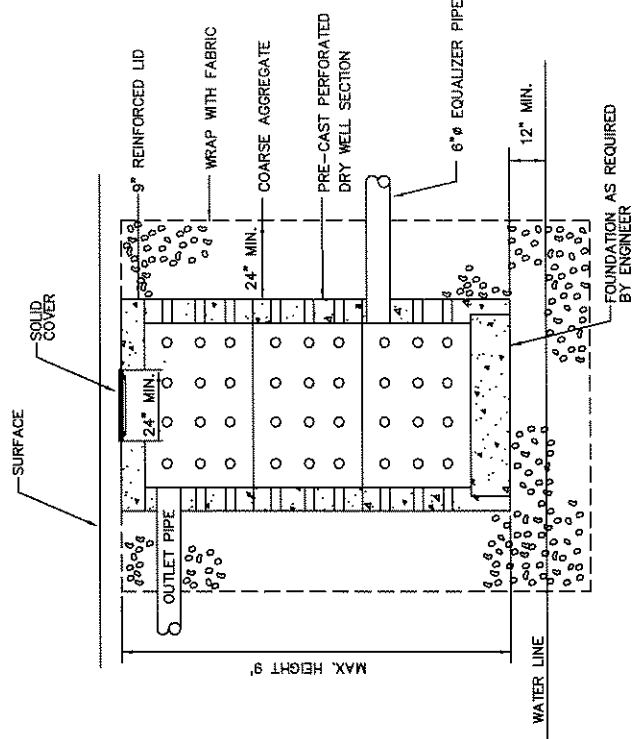
DATE:	8-23-07
DRAWN:	LE.H
CHECKED:	D.E.D.
APPROVED:	D.E.D.
SCALE:	NONE

No.	BY	DATE	REVISION



**PERFORATED DRY WELL INLET**

NOTE: STORAGE CAPACITY 25 GAL. PER 100 SQ. FT. OF HARD SURFACE AREA

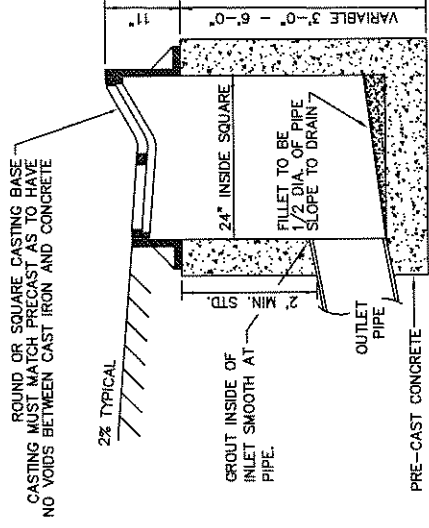


**PERFORATED DRY WELL**

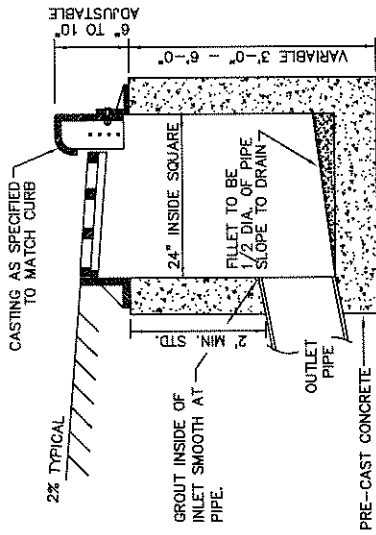
NOTE: STORAGE CAPACITY 25 GAL. PER 100 SQ. FT. OF HARD SURFACE AREA

No.	BY	DATE	REVISION	DESIGN STANDARDS			DEPARTMENT	PRE-CAST DRYWELL AND INLET	STANDARD DRAWING
				CITY OF PLYMOUTH, INDIANA			<input type="checkbox"/> SANITARY SEWER <input checked="" type="checkbox"/> STORM SEWER <input checked="" type="checkbox"/> STREET <input type="checkbox"/> WATER		
		3/6/03	REVISED SHEET NUMBER FROM D-1 TO WW-7	DATE: 3-5-96					
				DRAWN: C.J.M.					
				CHECKED: M.R.S.					
				APRVD: D.E.D.					
				SCALE: NONE					

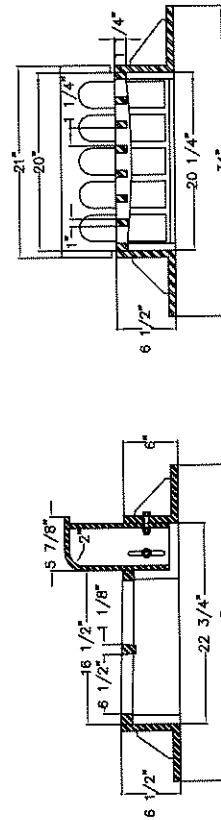




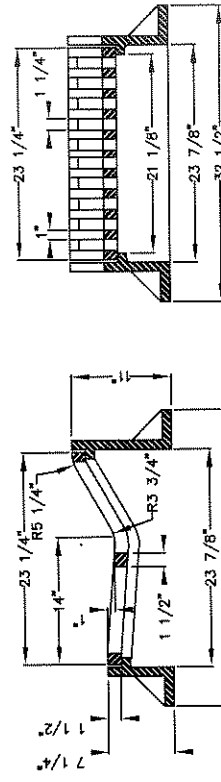
STANDARD INLET



STANDARD INLET



STANDARD CASTING  
NEENAH R-3080



STANDARD CASTING  
NEENAH R-3501-N

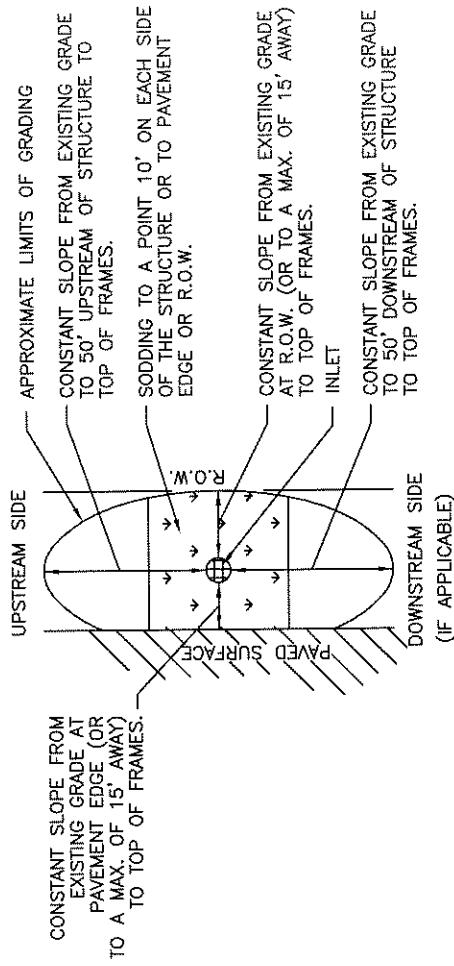
No.	BY	DATE	REVISION
		1/12/02	TEXT CORRECTION
		3/6/03	REVISED SHEET NUMBER FROM D-2 TO WW-8
		4/11/03	REVISED DIM. OF INLET TO SQUARE P/O DIA.

DATE: 5-5-97	C.J.M.
DRAWN: C.J.M.	CHECKED: M.R.S.
	APRVD: D.E.D.
	SCALE: NONE

DESIGN STANDARDS  
CITY OF PLYMOUTH, INDIANA

DEPARTMENT	
<input type="checkbox"/> SANITARY SEWER	
<input type="checkbox"/> STORM SEWER	
<input type="checkbox"/> STREET	
<input type="checkbox"/> WATER	

PRE-CAST CURB INLET  
STANDARD DRAWING  
DRAWING NO. ST-2



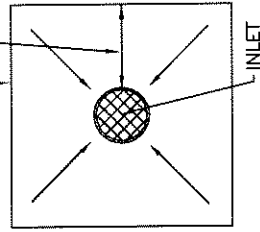
**NOTES:**

DURING CONSTRUCTION USE SILT FENCE IN THE EXISTING DITCHES TO HELP CONTROL EROSION AND RUNOFF. ALL STRUCTURES ARE TO HAVE SOD PLACED AROUND THEM.

SHRUBS OR TREES WITHIN GRADING LIMITS ARE TO BE LEFT UNDISTURBED, UNLESS OTHERWISE NOTED.

GENERAL GRADING AND SODDING DETAIL FOR STORM SEWER STRUCTURES  
N.T.S.

ALL PAVEMENT TO BE SAW CUT IN STRAIGHT LINES  
CONSTANT SLOPE FROM EXISTING PAVEMENT, CURB, OR EDGE OF PAVEMENT TO NEW T.O.C. (TYP. ALL SIDES) MAXIMUM SLOPE 10:1



GENERAL DETAIL FOR SLOPING PAVEMENT TO STORM SEWER STRUCTURES  
N.T.S.

No.	BY	DATE	REVISION

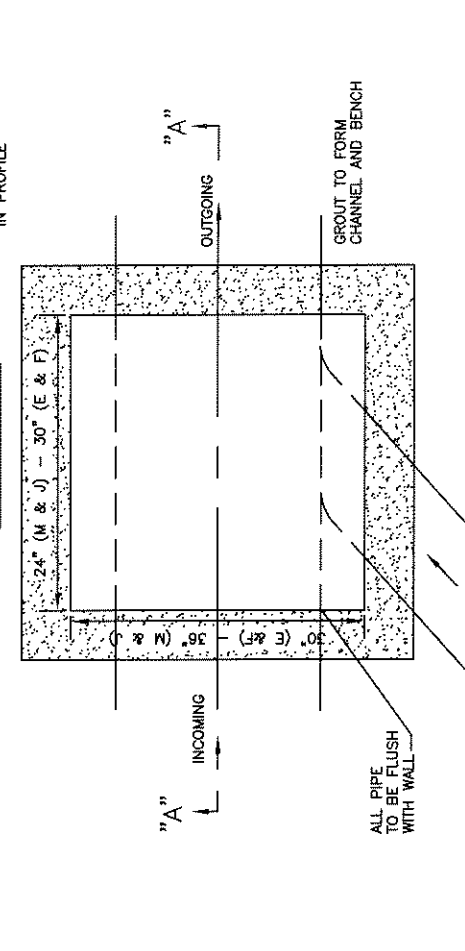
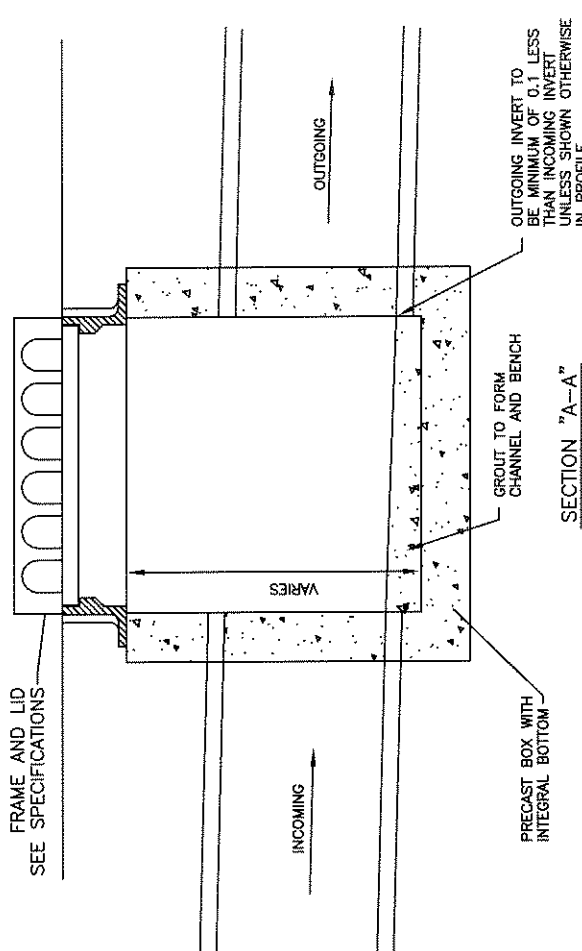
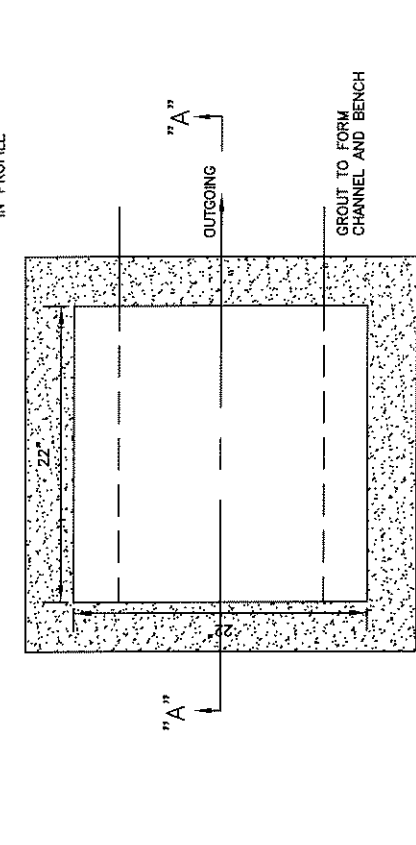
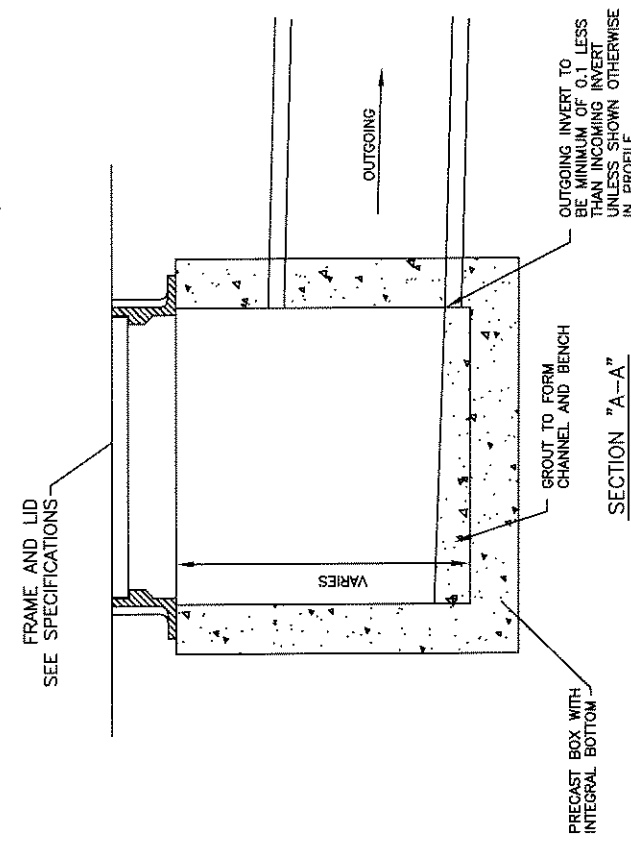
DATE: 3-5-96  
DRAWN: C.J.M.  
CHECKED: M.R.S.  
APRVD:             
SCALE: NONE

**DESIGN STANDARDS  
CITY OF PLYMOUTH, INDIANA**

DEPARTMENT	
<input type="checkbox"/>	SANITARY SEWER
<input checked="" type="checkbox"/>	STORM SEWER
<input type="checkbox"/>	STREET
<input type="checkbox"/>	WATER

**GENERAL  
STORM  
SURFACING  
DETAILS**

STANDARD DRAWING  
DRAWING NO.  
**ST-3**



STANDARD CURB INLET - TYPE "A"  
N.T.S.

STANDARD CURB INLET - TYPE "E", "F", "J" AND "M"  
N.T.S.

No.	BY	DATE	REVISION

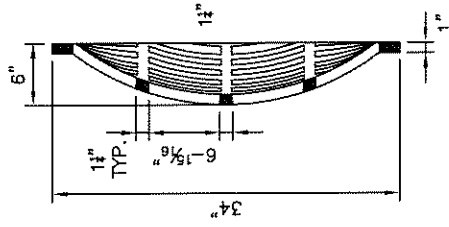
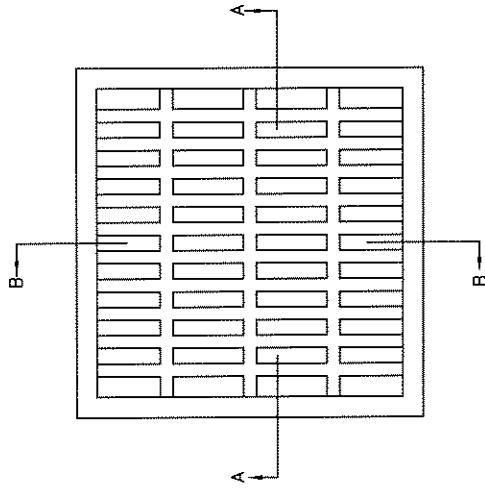
DATE:	3-5-96
DRAWN:	C.J.M.
CHECKED:	M.R.S.
APPRD:	
SCALE:	NONE

DESIGN STANDARDS  
CITY OF PLYMOUTH, INDIANA

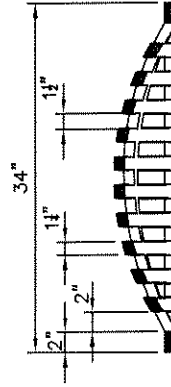
DEPARTMENT
<input type="checkbox"/> SANITARY SEWER
<input checked="" type="checkbox"/> STORM SEWER
<input type="checkbox"/> STREET
<input type="checkbox"/> WATER

CURB INLET  
STRUCTURE  
DETAILS

STANDARD  
DRAWING  
DRAWING NO.  
ST-4



SECTION "B-B"



SECTION "A-A"

EARTH DITCH CASTING TYPE 7

No.	BY	DATE	REVISION

DATE: 3-5-96  
 DRAWN: C.J.M.  
 CHECKED: M.R.S.  
 APRVD:  
 SCALE: NONE

DESIGN STANDARDS  
 CITY OF PLYMOUTH, INDIANA

DEPARTMENT
<input type="checkbox"/> SANITARY SEWER
<input checked="" type="checkbox"/> STORM SEWER
<input type="checkbox"/> STREET
<input type="checkbox"/> WATER
<input type="checkbox"/>

EARTH  
 DITCH  
 CASTING  
 DETAIL

STANDARD  
 DRAWING  
 DRAWING NO.  
 ST-5

**APPENDIX “B”**

**WORKSHEETS**

**&**

**FORMS**

**GREASE INTERCEPTOR SIZING WORKSHEET  
CITY OF PLYMOUTH WASTEWATER**

**Company:**   
**Project:**

**Calculated By:**   
**Location:**

**Date:**

*Follow these six simple steps to determine grease interceptor size*

Enter Calculations > Here	No. of Meals Per Peak Hours	Waste Flow Rate	Retention Time	Storage Factor	Calculated Interceptor Size	
	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
<b>1</b>	<b>Number of Meals Per Peak Hour (Recommended Formula):</b> Seating Capacity <input type="text"/> X Meal Factor <input type="text"/> = Meals per Peak Hour <input type="text"/>				<b>Notes:</b>	
	<b>Establishment Type:</b> Fast Food (45 min.)                      1.33 Restaurant (60 min.)                      1.00 Leisure Dining (90 min.)                      0.67 Dinner Club 120 min.)                      0.5				<b>Meal Factor</b>	
<b>2</b>	<b>Waste Flow Rate Condition:</b> With a Dishwashing Machine              6 Gallons Without a Dishwashing Machine              5 Gallons Single Service Kitchen                      2 Gallons Food Waste Disposer Only                      1 Gallon				<b>Flow Rate</b>	
<b>3</b>	<b>Retention Time</b> Commercial Kitchen Waste Dishwasher              2.5 Hours Single Service Kitchen                      1.5 Hours Single Serving				<b>Hours</b>	
<b>4</b>	<b>Storage Factor</b> <b>Kitchen Type</b> Fully Equipped Commercial Hours of Operation 8 Hours    1.00 12 Hours    1.50 16 Hours    2.00 24 Hours    3.00 Single Service Kitchen                      1.50				<b>Storage Factor</b>	
<b>5</b>	<b>Calculate Liquid Capacity</b> Multiply the values obtained from step 1, 2, 3, and 4. The result is the approximate grease interceptor size for this application.				<b>Notes:</b>	
<b>6</b>	<b>Select Grease Interceptor</b> Using the approximate required liquid capacity from step 5, select an appropriate size as recommended by the manufacturer.				<b>Notes:</b>	