RESOLUTION ARB2020-0002

Approval of Uniform Standards for Sewerage Improvements 2019

Whereas, County entities may adopt, amend, rescind, and administer rules on matters within their respective jurisdictions, as established by the County Charter, the County Code, or general law; and

Whereas, per Section 5.05 of the County Charter, the Director of Public Works has all powers vested in or imposed upon county sanitary engineers by general law; and

Whereas, per Chapter 6117.01(D) of the Ohio Revised Code, establishes the County's authority to adopt, public, administer, and enforce rules for the construction, maintenance, protection, and use of sanitary and drainage facilities; and

Whereas, per section 113.02(A) of the Cuyahoga County Code, a county entity seeking to adopt, amend, or rescind a rule shall submit a request, including the specific language or the rule, to the Clerk of the Administrative Rules Board in accordance with the procedures and deadlines established by the Board for such submissions; and

Whereas, per section 113.02(G) of the Cuyahoga County Code, the Administrative Rules Board is given approval authority over rules promulgated by County entities based on a determination of: (1) whether the requesting entity has the authority to adopt, amend, or rescind the rule and (2) whether the proposed rule conflicts with the County Code; and

NOW, THEREFORE, BE IT RESOLVED BY THE ADMINISTRATIVE RULES BOARD OF CUYAHOGA COUNTY, OHIO:

Section 1. The Uniform Standards for Sewerage Improvements 2019, as attached, are hereby enacted as part of the Cuyahoga County Administrative Code.

Section 2. This Resolution shall go into immediate effect and remain in full force and effect until rescinded by the Administrative Rules Board.

Section 3. It is found and determined that all formal actions of this Board concerning and relating to the passage of this Resolution were passed in an open meeting of this Board and that all deliberations of this Board that resulted in such formal actions were in meetings open to the public and in compliance with all legal requirements, including Section 121.22 of the Ohio Revised Code.

The foregoing resolution was duly adopted on January 8, 2020.

Clerk of the Board

CUYAHOGA COUNTY, OHIO

UNIFORM STANDARDS FOR SEWERAGE IMPROVEMENTS

2019 Update

Cuyahoga County Department of Public Works (CCDPW)
Municipal Engineers Association of Northeast Ohio (MEANO)

December 2019

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We, the members of the Municipal Engineers Association of Northeast Ohio and the Cuyahoga County Department of Public Works, have prepared these Uniform Standards. We recommend their adoption and use by all governmental entities, agencies, and consulting engineers in Cuyahoga County.

Municipal Engineers Association of Northeast Ohio
Richard S. Wasosky, P.E., P.S., Chairman

Municipal Engineers Association of Northeast Ohio
Thomas Cappello, P.E., P.S.

Cuyahoga County Sanitary Engineer
David E. Marquard, P.E., P.S.

Cuyahoga County Department of Public Works
Michael W. Dever, MPA, Director

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UNIFORM STANDARDS FOR SEWERAGE IMPROVEMENTS

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(Note that the initial requirements of this Section 3.2, Design of Sanitary Sewer Systems, Letters A through U, shall apply to the design of all sanitary sewer systems and storm sewer systems. The remainder of Section 3.2 contains additional requirements specific to sanitary sewer systems design; including sewer design, force main design, grease interceptor design, etc. Section 3.3, Design of Storm Sewer Systems, has additional requirements which shall apply to storm sewer systems design.)

3-12 3.2

A. Manhole Access
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S. Curved Sewers
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Page	Section	Part 3, Standards for Sewerage Facilities

3.3 Design of Storm Sewer Systems

Note that the initial requirements of Section 3.2, Design of Sanitary Sewer Systems, Letters A through U, shall apply to the design of all sanitary sewer systems and storm sewer systems. Section 3.3, Design of Storm Sewer Systems, contains additional requirements specific to storm sewer systems design.

Page	Section	Part 5, Standard Specifications 5.1, Materials (continued)
5-15	5.123	Pipe Bedding Material
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PART 1 - GENERAL INFORMATION

1.1 PURPOSE

One Instrument. The following documents (latest editions) shall all be taken together, and shall constitute one instrument:

- Cuyahoga County Department of Public Works (CCDPW) Rules and Regulations,
- CCDPW Uniform Standards for Sewerage Improvements (Uniform Standards),
- CCDPW Uniform Standard Sewer Details, and
- CCDPW General County Sewer Notes (General Notes),
- CCDPW Contractor Instructions and Information Packet/License Application Instructions and Bond Requirements/License Application Forms

Wherever one of these terms is used, it shall mean to include all of the documents as applicable. Thus, the terms "Uniform Standards" or "Rules and Regulations" shall generally be taken to mean any or all of these documents. If there are any discrepancies, contradictions, errors, or inadequacies within these documents, the decision of the CCDPW shall be final. It shall be noted that these documents shall be modified or updated from time to time as necessary by the County and, once approved by the Director and the County Sanitary Engineer, these actions constitute full incorporation of these revised documents into the Uniform Standards without the necessity of any further legislative actions.

Uniform Standards. The Uniform Standards for Sewerage Improvements, aka the "Standards", are intended for use as a guide in the design and construction of sewerage facilities. For those municipalities that adopt these Standards, these Standards are minimum requirements for the design and construction of sewerage and storm water facilities in Cuyahoga County and areas outside of Cuyahoga County. Adherence to the Standards does not guarantee proper design and/or construction. Designers must use engineering judgment in the application of these Standards and the Designers are ultimately responsible for a design that will result in satisfactory performance of all structures and systems.

Adherence to the Standards does not guarantee compliance with Federal, State and Municipal regulations, laws or ordinances. In cases where the Standards conflict with Federal, State, and/or Municipal standards, regulations, laws or ordinances, whichever is more restrictive, shall apply.

1.2 DEFINITIONS AND ABBREVIATIONS

Definitions. The following definitions shall be used:
Definition of terms and their use in the Standards are in accordance with the GLOSSARY-WATER AND WASTEWATER CONTROL ENGINEERING, published by American Public Health Association (APHA), American Society of Civil Engineers (ASCE), American Water Works Association (AWWA) and Water Environment Association

(WEF), formerly Water Pollution Control Federation (WPCF). The units of expression used are in accordance with those recommended in International Standard Units for Water & Wastewater Processes, MOP-6, published by the WEF, AWWA and International Water Association (IWA).
Reference to Standards or Specifications (including, but not limited to, ASTM, ODOT, etc.) shall mean the latest version available, unless specifically noted otherwise herein or as directed by the responsible agency.

County. Cuyahoga County

Contract Documents (or Contract, or Plans). The documents including, but not limited to, any and all designated documents that are required to complete the Work in an acceptable manner. Together, all of the Contract Documents constitute one instrument.

Department. The Cuyahoga County Department of Public Works.

Design Engineer (or Designer). A Professional Engineer (see definition herein) who is the Engineer of Record for the design of a specific Project.

Director. The Cuyahoga County Director of Public Works or his/her duly authorized agent.

Engineer. A representative of the Cuyahoga County Department of Public Works acting within the scope of his/her authority for purposes of engineering and administration of the Contract. For cities and villages without contracts for sewer services with the Cuyahoga County Department of Public Works, the Engineer, as used in these Standards, shall be a representative of the city or village acting within the scope of his/her authority for the purpose of engineering and administration of the city or village contract.

Ohio Department of Transportation (ODOT). The Ohio Department of Transportation.

Professional Architect (or Registered Architect). An architect registered with the Ohio Architects Board for Professional Architects to practice professional architecture in the State of Ohio.

Professional Engineer (or Registered Engineer). An engineer registered with the Ohio State Board of Registration for Professional Engineers and Surveyors to practice professional engineering in the State of Ohio.

Professional Surveyor (or Registered Surveyor). A surveyor registered with the Ohio State Board of Registration for Professional Engineers and Surveyors to practice professional surveying in the State of Ohio.

Project. The specific venture and/or components, together with all appurtenances and Work to be performed thereon, for a specific enterprise or undertaking.

Responsible Authority or Responsible Agency. The responsible authority or responsible agency may be any one of, or all of, the following including, but not limited to:

- Municipality (city, village, township, etc.; note that these terms may be used as synonyms herein these Uniform Standards to mean the pertinent municipality.)
- Cuyahoga County
- Cuyahoga County Department of Public Works (CCDPW)
- Cuyahoga County Board of Health (CCBH)
- NEORSD
- EPA

Rules and Regulations. The Cuyahoga County Department of Public Works Rules and Regulations.

Sanitary Engineer. The Cuyahoga County Sanitary Engineer is a representative of the Cuyahoga County Department of Public Works, duly appointed and authorized by the Cuyahoga County Director of Public Works, acting for purposes of engineering and administration of the Cuyahoga County Department of Public Works, within the scope of his/her authority.

Shop Drawings. The drawings provided by the Contractor or Supplier that describe any portion of the Work that will remain in place permanently.

Structures. Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, headwalls, endwalls, buildings, sewers, service pipes, underdrains, foundation drains, and other features that may be encountered in the Work and not otherwise classed herein.

Uniform Standards (or Standards). The Cuyahoga County Department of Public Works Uniform Standards for Sewerage Improvements and the Uniform Standard Sewer Details.

Waters of the United States. Waters that are under the jurisdiction of the Corps of Engineers under the Clean Water Act as defined by 33 CFR Ch. II Part 328, which, as applied to Ohio, means: the Ohio River and Lake Erie and any other river, stream, creek, lake, pond, or wetland that drains directly or indirectly into the Ohio River or Lake Erie.

Work. All labor, materials, equipment, tools, transportation, supplies, and other incidentals and all tasks that comprise the Project or any portion thereof, as described by the Contract Documents.

Abbreviations. The following abbreviations shall be used:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute

APHA	American Public Health Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
BUSTR	Bureau of Underground Storage Tank Regulations (Division of Fire Marshal)
CCDPW	Cuyahoga County Department of Public Works
CFR	Code of Federal Regulations
CMS	Construction and Material Specifications of the Ohio Department of Transportation
CPESC	Certified Professional in Erosion and Sediment Control
CRSI	Concrete Reinforcing Steel Institute
DIP	Ductile Iron Pipe
DNR	Department of Natural Resources
EDA	Earth Disturbing Activity
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration, Department of Transportation
HDPE	High Density Polyethylene Pipe
IEEE	Institute of Electrical and Electronic Engineers
MEANO	Municipal Engineers Association of Northeast Ohio
MSDS	Material Safety Data Sheets
NEMA	National Electrical Manufacturers Association
NEORSD	Northeast Ohio Regional Sewer District
NHI	National Highway Institute
NOACA	Northeast Ohio Areawide Coordinating Agency
NPDES	National Pollutant Discharge Elimination System
OAC	Ohio Administrative Code
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
OMUTCD	Ohio Manual of Uniform Traffic Control Devices
ORC	Ohio Revised Code
OSHA	Occupational Safety and Health Administration
OWPCA	Ohio Water Pollution Control Act

PE	Polyethylene Pipe
PVC	Polyvinyl Chloride Pipe
RCP	Reinforced Concrete Pipe
SCD	Standard Construction Drawing
SCM	Stormwater Control Measure
UL	Underwriters' Laboratories, Inc.
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USSD	Cuyahoga County Department of Public Works Uniform Standard Sewer Details
VCP	Vitrified Clay Pipe
WEF	Water Environment Federation
WWTP	Wastewater Treatment Plant

1.3 AUTHORITY

Plans for new or modified sanitary sewerage facilities must be in compliance with the NOACA 208 Water Quality Management Plan.

Plans for new or modified stormwater drainage facilities must be in compliance with any applicable established regional stormwater management plan.

Approvals. Approvals pursuant to these Standards shall be obtained from those responsible agencies exercising jurisdiction or responsibility for any or all of the following functions:

1. Construction, observation, operation and maintenance of the storm or drainage system;

2. Construction, observation, operation and maintenance of the sanitary wastewater collection system;

3. Construction, observation, operation and maintenance of stormwater or wastewater pumping stations;

4. Construction, observation, operation and maintenance of the stormwater or wastewater treatment facilities.

It should be recognized that approvals may be required by more than one local, county, regional, state, federal and/or special purpose agency.

Authorized Agencies and Responsible Authorities. A list of authorized agencies and municipalities that can be contacted for information or required approvals is provided following Section 1.4 below. This list serves as a guide in identifying agencies with potential review, approval or permit authority. The approval of the municipality is required on all public and/or private facilities.

1.4 ORDER OF PRECEDENCE

The Uniform Standards contains references to other standards; mainly NASSCO and ODOT. The County will resolve discrepancies, if any, using the following descending Order of Precedence:

1. The following (latest editions of each) are considered first:
   - Cuyahoga County Department of Public Works (CCDPW) Rules and Regulations,
   - CCDPW Uniform Standards for Sewerage Improvements (Uniform Standards),
   - CCDPW Uniform Standard Sewer Details, and
   - CCDPW General County Sewer Notes (General Notes),
   - CCDPW Contractor Instructions and Information Packet/License Application Instructions and Bond Requirements/License Application Forms

2. National Association of Sewer Service Companies (NASSCO) requirements, standards, and specifications including, but not limited to PACP, MACP, LACP requirements and standards

3. Latest Standard Specifications (ODOT Itemized *Construction and Material Specifications*)

Thus, in the descending Order of Precedence, the ODOT CMS Manual is the lowest precedence in the list and thus applies only when the pertinent and specific requirements are not fully covered in other items of higher ranking in the Order of Precedence.

If there are discrepancies with these or other standards, the decision of the County shall be final.

AGENCIES EXERCISING JURISDICTION OR RESPONSIBILITY FOR REVIEW AND/OR APPROVAL

Incorporated Municipalities

Cuyahoga County Department of Public Works
2079 E. 9th Street, 5th Floor
Cleveland, Ohio 44115

Telephone: (216) 348-3800

Northeast Ohio Regional Sewer District
3900 Euclid Avenue
Cleveland, Ohio 44115

Telephone: (216) 881-6600

Ohio Environmental Protection Agency
Northeast Ohio District Office
2110 East Aurora Road
Twinsburg, Ohio 44087

Telephone: (330) 425-9171

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PART 2 - PERMIT REQUIREMENTS

2.1 PROCEDURE

A. Sewer Permit Required. No unauthorized person shall uncover, make any connections with or opening into, use, alter or disturb any public or private sewer or appurtenance thereof without first obtaining a written Sewer Permit from all appropriate authorities.

B. Performance Bond and Liability Insurance Required. A Sewer Permit will be issued to the sewer contractor after the plans and specifications have been approved by the appropriate authorities. The contractor to whom the permit is issued must be registered with the CCDPW. A Surety Bond in an amount not to exceed Twenty-Five Thousand Dollars ($25,000) shall be required unless ordered otherwise by the CCDPW. Proof of minimum Commercial Liability Insurance of $100,000/$500,000 shall be provided by the sewer builder performing the work, and submitted to the CCDPW.

C. Permits and Permit to Install. Approval of plans and specifications for storm and/or sanitary sewers within the public right-of-way by the responsible agencies will serve as authority to obtain a permit to construct those facilities. In addition, a Permit to Install must be obtained from Ohio EPA for all new sanitary sewers prior to beginning construction. Permits for sewer lateral service connections and private sewers are required for all facilities or structures desiring use of a public sewer. The issuing authorities for the permits are listed following Section 1.4 (on page 1-7) of these Standards.

Approvals with signatures are to be obtained in the following order:

1) Design Engineer
2) Municipal/City/Village Engineer
3) Cuyahoga County Department of Public Works (CCDPW)
4) Northeast Ohio Regional Sewer District NEORSD (and/or other applicable wastewater treatment authority)
5) Ohio Environmental Protection Agency (OEPA)
6) Any other responsible agency.

Approvals for all sanitary sewerage facilities including, but not limited to, all sanitary sewers, combined sewers, sewer laterals/connections, wastewater pumping stations, wastewater treatment plants, wastewater sludge handling and disposal facilities are to be obtained from:

- Municipality
- CCDPW
- Where applicable, NEORSD (and/or other applicable wastewater treatment authority)
- OEPA
- Any other responsible agency.

Approvals for all storm sewerage facilities including, but not limited to, all storm sewers, sewer laterals/connections, stormwater pumping stations, stormwater management facilities are to be obtained from:

- Municipality
- Where applicable, CCDPW
- Where applicable, NEORSD (and/or other applicable wastewater treatment authority)
- Any other responsible agency.

Additional approvals. Additional approval requirements may be identified by any responsible agency upon receipt of plans and/or specifications for review. However, the lack of identification of approval requirements does not negate the requirements for approval.

D. Other required permits. Obtaining the required plan approvals and service connection permits from the Cuyahoga County Department of Public Works does not relieve a contractor from the responsibility to obtain any other required permits, including local permits and/or utility company approvals.

E. Approvals for Municipalities with CCDPW Agreements. For cities and villages with agreements with the Cuyahoga County Department of Public Works for maintaining and operating the sanitary and/or storm sewer system, approval of new public and private sanitary/storm sewer and sanitary/storm service connection plans and specifications must be obtained from both the municipality and the Cuyahoga County Department of Public Works prior to submitting to the NEORSD (or other applicable treatment authority) and Ohio EPA for approvals.

Approvals for Municipalities without CCDPW Agreements. For cities and/or villages without agreements with the Cuyahoga County Department of Public Works for maintaining and operating the sanitary and/or storm sewer system, approval of new public or private sanitary/storm sewer and sanitary/storm service connections shall only need to be obtained from the municipality prior to submitting to the NEORSD (or other applicable treatment authority) and Ohio EPA for approval.

F. NEORSD Capacity Approval. In order to obtain the NEORSD approval letter indicating there is adequate capacity at the receiving NEORSD Wastewater Treatment Plant to treat the additional sewage from a proposed project, plans and a copy of the Ohio EPA Permit to Install Application must be submitted to NEORSD for approval for all new sanitary sewers prior to submitting to Ohio EPA. Similar procedures are to be followed for sewerage facilities tributary to non-NEORSD facilities.

G. OEPA Approval. The plans and specifications that have been approved by the municipality, the Cuyahoga County Department of Public Works, if applicable, and the NEORSD approval letter must be sent along with the Ohio EPA Permit to Install Application to the Ohio EPA for final approval of any new sanitary sewer.

H. NEORSD Title IV Communities. For NEORSD member communities tributary to the combined sewer system (Title IV communities), a stormwater management plan is required for all new development and re-development activities in order to ensure that post-development peak flows do not exceed existing condition peak flows. Plans and calculations supporting the stormwater management plan must be submitted to the NEORSD for review and approval. Submissions must demonstrate compliance with NEORSD requirements regarding connection methods, post-development peak flows and water quality treatment. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

I. NEORSD Title V Communities. For NEORSD Title V Member Communities, Stormwater Management Plans, stormwater construction project plans and hydrology and hydraulic reports shall be submitted to the NEORSD for all stormwater development activities that require approval by the municipality to verify they are in conformance with the Regional Stormwater Management Program. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

2.2 REVIEW, APPROVAL, AND CONSTRUCTION

The procedure for the review and approval of sewers, sewage facilities, treatment facilities, pump stations, and other sewage improvement works shall be as follows:

1. **Standards and recommendations.** The Design Engineer shall contact and obtain recommendations from the County, Municipality, and other responsible agencies, regarding local procedures, design standards (such as the CCDPW Rules and Regulations, and Uniform Standards), construction standards, rules and regulations, easements, rights-of-way, utilities, etc. The Design Engineer shall coordinate all proposed improvements and submittals with abutting existing, and/or planned, improvements.

2. **Project Agreement Required.** The Project Owner and Design Engineer shall discuss and develop with the Municipal Engineer or responsible agency a Project Agreement, if appropriate, between the Project Owner and the Municipal Engineer or responsible agency regarding tap-in fees, assessments, operation and maintenance of the facility after construction, etc.

3. **Reviews.** Reviews shall be made by the Municipal Engineer, CCDPW, or responsible agency of submittals by the Design Engineer of design documents such as reports, plans, specifications, design data, OEPA requirements, Stormwater Management Report, etc. The Stormwater Management Plan may also require review by the NEORSD through its Stormwater Management Program; please contact the Municipality's Engineer for details and requirements.

4. **Plumbing Plans Required.** One set of interior plumbing plans and specifications of all commercial and industrial buildings shall be submitted for review for each site to ascertain the proper separation of storm and sanitary service connections. The

plumbing plans are to show all fixture connections and piping.

5. **OEPA and Other Approvals.** After the Municipal Engineer or responsible agency's approval for OEPA submittal, the Design Engineer shall submit plans, specifications, etc. to the OEPA and other appropriate agencies for review and approval.

6. **CCDPW Permit and Construction Inspection Required.** After the review and approval of the design documents by the Municipality's Engineer, the CCDPW, OEPA, and other responsible agencies, the Project Owner/Design Engineer/Contractor shall obtain a permit from the County. Construction may then commence. Note that a CCDPW Construction Inspector must be present at all times at the job site during construction, testing, monitoring, and all other activities, unless otherwise previously agreed upon by the affected parties. The Project Owner/Design Engineer/Contractor shall make arrangements for the CCDPW Construction Inspector prior to the beginning of construction.

   Fine for Lack of CCDPW Inspection. If any sewer system construction is done without a CCDPW Construction Inspector present, the contractor shall be fined double the County Construction Inspection Fee for each day of work that has been done without the required Construction Inspection. Furthermore, the County reserves the right to require that the contractor excavate and uncover any such work for CCDPW inspection. Any and all work found to be inadequate or sub-standard in any regard, as determined by the County, shall be removed and replaced at the contractor's expense. In addition, the County may require any work to be CCTV inspected and the videos submitted to the County for review and approval.

7. **Shop Drawings.** Prior to construction, shop drawings shall be reviewed and approved by the Design Engineer, and then submitted to the Municipal Engineer and the responsible agency for review and approval.

8. **Changes or Revisions.** Any proposed significant changes, deviations, or modifications from the plans, specifications, or the actual construction shall require approval by, and a revised submittal by, the Design Engineer. The revised submittal shall require review and approval by the Municipal Engineer, the responsible agency, and, if necessary, the OEPA, in the same manner as required for the original plans, prior to the actual construction of the change.

   Whenever there is any change in the field, regardless of the reason for the change, the responsible agency reserves the right to stop the work until the owner/designer submits a revised drawing(s) to the responsible agency for review and approval. The work shall not resume until the revised drawing(s) are reviewed and approved by the responsible agency. Any work done after the responsible agency requires work be stopped, shall be at the sole risk of the contractor/project owner. Furthermore, the responsible agency reserves the right to require that the contractor excavate and uncover any such work for responsible agency inspection. Any and all work found to be inadequate or sub-standard in any regard, or that does not conform to the revised drawing(s), as determined by the responsible agency, shall be

removed and replaced at the contractor's expense. In addition, the responsible agency may require any work to be CCTV inspected and the videos submitted to the responsible agency for review and approval.

2.3 PERMIT APPLICATIONS

Service Connection Permit Forms. Service Connection Permit forms may be obtained from the issuing municipal authority and/or the Cuyahoga County Department of Public Works.

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PART 3 - STANDARDS FOR SEWERAGE FACILITIES

3.1 - ENGINEERING

3.101 PREPARATION OF DRAWINGS, SPECIFICATIONS, AND DESIGNER'S REPORT

A. Registered Professional Required

All drawings, specifications, and designer's reports submitted for approval shall be prepared by or under the supervision of a Registered Professional Engineer or Registered Professional Architect (as per the requirements of the County Rules and Regulations), legally licensed to practice in Ohio. The front cover or fly leaf of each set of such drawings, of each copy of the Designer's reports, and of the specifications submitted, shall bear the date, signature, and imprint of the seal of the Registered Professional by, or under whom, it was prepared. For all projects (commercial, industrial, or residential), the Property Owner and Designer are responsible for the accuracy of all plans, specifications, and designer's reports.

B. Designer Report Required

The purpose of the report is to record in form for convenient and permanent reference the controlling assumptions made, and factors used in the functional design of the sewerage works as a whole and of each of the component units. Data on structural, mechanical, and electrical designs may be excluded except to the extent that reference to such elements is necessary in checking the functional operation. Copies of a report consisting of the appropriate required information shall be submitted to the approving authority.

Calculations. The Designer is to submit design calculations for the sanitary sewer system, storm sewer system (including drainage map), and storm water management system. The calculations shall show specifically the tributary areas (sanitary and storm), and how the flows were developed.

The sanitary flows shall be based on the guidance found in the Uniform Standards, Section 3, Quantity of Sanitary Sewage. The Uniform Standards also requires an I/I allowance of 375 gallons per acre day, which shall be included in the calculations.

The stormwater management calculations (including storm sewer sizing) are reviewed by the Municipality and the NEORSD. The Stormwater Management Plan may also require review by the NEORSD through its Stormwater Management Program, contact the Municipal Engineer for details and requirements.

Per the Cuyahoga County Rules and Regulations, all calculations shall be signed and stamped by an Ohio Registered Professional Engineer or they will not be approved. A PDF submittal is sufficient.

3.102 PLANS OF SEWERAGE FACILITIES

A. Plan Size and Scales

All plans shall be clear and legible and shall be drawn to a scale that will permit all necessary information to be plainly shown. The horizontal plan scale shall be 1" = 20', or 1" = 30'. The vertical plan scale shall be 1" = 5'. The maximum plan size shall be no larger than 24 inches by 36 inches.

B. Detailed Plan Requirements

Title Sheet. The Title Sheet shall show:

- The name of the municipality,
- Sewer district or institution,
- Project name,
- Project owner's name,
- General description of the project,
- The graphical scales,
- Original lot number and tract,
- Parcel Number,
- Zoning,
- A north arrow,
- Survey datum,
- Date,
- Names of the engineer and company preparing the plans,
- Site location plan,
- Index to plan sheets,
- OUPS note,
- Signature blank for the Municipal Engineer,
- Stamp and signature of the design engineer,
- A list of all Utility Providers (gas, water, cable, phone, electricity, etc.), their addresses, and contact information,
- A note stating that: Roof drains, foundation drains, and other clean water connections to the sanitary sewer are prohibited,

Comprehensive Plans. Comprehensive plans of project, including the existing and/or proposed sewers, shall be submitted for projects involving new sewer systems or substantial additions to existing systems. The plans shall show the following:

1. **Views.** Detailed plans shall consist of plan views, elevations, sections, supplementary views, and miscellaneous details that, together with the specifications and general layouts, provide the working information for the contract and construction of the works. All plans shall include complete general notes and applicable standard and special details pertaining to the project.

2. **Required Survey Information.** Horizontal Datum used shall be NGS North American Datum of 1983 State Plane Coordinate System (NAD 83), and Vertical Datum used shall be NGS North American Vertical Datum of 1988 (NAVD 88). All reference monumentation used for the survey shall be shown on the plans and shall be horizontally referenced to the North American Datum of 1983 State Plane Coordinate System (NAD 83), and shall be vertically referenced to the North American Vertical Datum of 1988 (NAVD 88). Any Cuyahoga County Monumentation within the vicinity of the survey shall be referenced both vertically and horizontally on the current datum, and any original monument horizontal or vertical datum information shall be referenced with the monument. All existing and proposed right-of-way lines, parcel lines, property lines, easement lines, project size, etc., shall be clearly shown. Include a topographic map of the area and/or site. Show survey centerline and stationing of all streets. A certified survey by a State of Ohio Registered Professional Surveyor (stamped, signed, and dated as such) may be required by the responsible authority.

3. **Location Information.** Show the street names, street addresses, permanent parcel numbers, sublot numbers, and property owner's names.

4. **Plans of existing or proposed** features, such as all streets, all buildings, roadways, bridges, driveways, sidewalks, sublot numbers, property owners' names, offsite tributary areas, points of discharge, etc.

5. **Profiles** of all streets and utilities. Show centerline elevations, rim elevations, invert elevations, basement and first floor elevations, and (where necessary or when required by the responsible authority) proposed grade over the proposed sewers.

6. **Dimensions and relative elevations** of structures, the location and outline of form of equipment, location and size of piping, water levels, topography, ground elevations, and any other pertinent data shall be shown.

7. **Contour Lines**
   General contour lines of not more than two (2) feet intervals shall be included.

8. **Streams and Drainage**
   Show all streams and watercourses, including the direction of flow, as well as high

and low water elevations of all water surfaces at sewer outlets and overflows. Show all stream crossings and sewer outlets, with elevations of the streambed, normal water surface elevation, and extreme high and low water levels. Where necessary, cross sections shall be provided. Show drainage ditches, culverts, bridges.

9. Boundaries

The boundary lines of the municipality or township and the sewer district or area to be sewered by project shall be shown

10. Sewers and Manholes

The plan shall show the location, size, slope and direction of flow of all existing and proposed sanitary, storm, and combined sewers and manholes associated with the proposed project. Show existing and proposed ground surface, elevations, size, material and type of pipe, existing or proposed locations of any storm or sanitary service connections, length between manholes, invert and top of casting elevation at each manhole, invert elevations of all sewers entering and exiting manhole, and grade of sewer between each two (2) adjacent manholes as well as the size and elevations of the sewer into which the flow of the sewer under consideration is to discharge. <u>All manholes shall be numbered and stationed on the plan and correspondingly numbered on the profile.</u> Show details of all special sewer joints and cross-sections.

11. Wetlands or Flood Plains

The location of all wetlands, riparian setbacks, and FEMA floodplains shall be shown along with their type and the designated Flood Insurance Rate Map (Firm) Zone Classification of the site, as defined in the current FEMA Flood Insurance Rate Map (FIRM). Special analysis shall be required for known flooding areas.

12. Retention or Detention Plans

The location, size, water surface elevations, and controlling hydrologic and hydraulic data, if known, shall be shown on the plans.

13. Boring Location Plans

Boring location plan, profile sheets, boring log sheets, and ground water elevations, etc., shall be supplied, when required by the reviewing authority, for major projects.

14. Construction Inspection. The Plans shall require and make provisions for the necessary inspection of the work by the CCDPW (and the responsible authority) in accordance with the requirements of the CCDPW Rules and Regulations.

15. Testing. The Designer is to specify that the sewers and manholes are to be tested in accordance with the CCDPW (and the responsible authority) requirements per the CCDPW General Notes. All sanitary sewer videos and reports shall be submitted to the CCDPW for review.

16. Basement Elevations. Where there is any question of the sewer being sufficiently deep to serve any existing or proposed building, or as required by the responsible

authority, the elevation and location of the basement floor shall be plotted on the profile and plan of the sewer that is to serve the building in question. The design engineer shall state that all sewers are sufficiently deep to serve existing adjacent basements and future normal depth basements except where otherwise noted on the plans.

17. **Special Features.** Locations of all special features such as ground cover, soil types, catch basins, inverted siphons, observation chambers, concrete encasements, detention basins, retention basins, regulators, headwalls, elevated sewers, bored and jacked or tunneled sewers, discharge points, etc. Show details of special bedding or trench construction requirements.

18. **Existing Conditions, Structures, and Utilities.** Information on all existing conditions shall be provided. Show all known existing structures and vegetation both above and below ground which might interfere with the proposed construction, particularly water mains, storm sewers, sanitary sewers, combined sewers, gas mains, force mains, underground electric, cable, conduit, and telephone facilities, overhead transmission lines, bottom of bridge beams, etc.

19. **Special Detailed Drawings**

    Special detailed drawings, drawn to a scale to clearly show the nature of the design, shall be furnished to show any necessary details.

20. **Traffic Control and Detours, etc.**

    Notes and details shall be shown as necessary. The Plans shall comply with the provisions of "State of Ohio, Manual of Uniform Traffic Control Devices" and the Ohio Department of Transportation Construction and Materials Specification Item 614, and any local or applicable regulations for all traffic devices erected on County construction projects.

21. **Stormwater Management and Sediment Control**

    In order to prevent flooding of adjacent land, reduce stream channel erosion, and to protect water resources from degradation, the project owner/developer and/or the project owner's representative shall be responsible for developing and adhering to a pre-approved Storm Water Pollution Prevention Plan (SWP3). Prior to any earth disturbing activities, the project owner shall obtain approval from the municipality/village/township. The SWP3 shall meet the requirements of the municipality/village/township in which the work is being undertaken and the Ohio EPA, whichever is more stringent. The project owner/developer owner shall be required to meet the requirements for Controlling Construction Site Soil Erosion, Sediment, and Other Wastes and Storm Water Runoff and for Controlling Post-Construction Water Quality Runoff. The municipality may require SWP3 submittal and approval from the County Soil and Water Conservation District, and/or the NEORSD.

    An abbreviated SWP3 shall be required for projects with a disturbed earth area of less than one (1) acre as required by the municipality/village/township. Projects with a disturbed earth area of one (1) or more acres shall be required to submit a Notice of Intent (NOI) with the Ohio EPA.

The project owner/developer and/or the project owner's representative shall be responsible for:
1) obtaining all local, state and federal approvals;
2) the plan submittal shall include the Ohio EPA's letter of approval of coverage under the General Permit and the issued Ohio EPA Facility Permit Number for the site;
3) maintenance of all Stormwater Control Measures (SCMs) during and after construction including long-term maintenance and maintenance agreement;
4) inspections during construction by a Certified Professional in Erosion and Sediment Control (CPESC) and/or knowledgeable inspector;
5) submittal of the Notice of Termination (NOT); and,
6) annual reporting of SCMs to the municipality/village/township in accordance with their requirements.

In addition to the storm water management regulations, the project owner/developer and designer shall adhere to all the requirements of any local municipality's Riparian ordinances.

22. Clean Water Connections Prohibited. Per the Ohio EPA, clean water connections to the sanitary sewer are prohibited including, but not limited to, storm water drains, yard drains, driveway drains, roof drains, exterior footer drains, foundation drains, including by gravity or sump pump discharge. For buildings with sump pumps, demonstrated proof by the property owner/contractor that the structure shall not discharge any clean water flows to the sanitary sewer is required. The responsible authority will observe at the exterior foundation wall of the building each sewer pipe to be connected to the new connection while the sump pump is operated. The municipality requires that any clean water flows shall be separated from the sanitary sewer system. Any construction work required to separate clean water and sanitary flows is the responsibility of the property owner. Enforcement of this rule will be by the responsible authority acting as the agent of the receiving wastewater treatment facility or by the wastewater treatment plant agencies themselves.

Testing Requirements. After construction is completed, the contractor/property owner shall verify by that there are no "clean water" connections to the sanitary sewer, and shall perform any other testing (including, but not limited to, dye water, smoke, mandrel, CCTV inspection, etc.) as required by the responsible authority, all at the expense of the contractor/property owner.

23. Uniform Standards. It shall be specified on the plans that the project shall conform to the requirements (latest editions) of:

- Cuyahoga County Department of Public Works (CCDPW) Rules and Regulations,
- CCDPW Uniform Standards for Sewerage Improvements (Uniform Standards),
- CCDPW Uniform Standard Sewer Details, and
- CCDPW General County Sewer Notes (General Notes),
- CCDPW Contractor Instructions and Information Packet/License Application

The references listed above can be found at (include this link on the plans):
http://publicworks.cuyahogacounty.us/en-US/SanitaryDrawings-Standards.aspx
The pertinent Uniform Standard Drawings and General County Sewer Notes shall be included in the plans.

24. Other Requirements. All plans shall also take into consideration any special factors pertaining to the specific project, including, but not limited to, future system expansion, etc.
The design, construction, and installation of all water mains and water service connections shall meet the requirements of the Cleveland Department of Public Utilities - Cleveland Division of Water. See www.clevelandwater.com for more information.

3.103 PLANS OF SEWAGE PUMPING STATIONS

In addition to the requirements delineated in Section 3.101, Preparation of Drawings, Specifications, and Designer's Report, and Section 3.102, Plans of Sewerage Facilities, the following shall be submitted for projects involving construction or modification of pumping stations:

A. Location Plan

This plan shall show the following:

1. The location of the pumping station, force main, and gravity sewers.

2. Location and capacity of the existing outlet sewer and/or treatment facility.

B. Detailed Plans

Detailed plans shall be submitted showing the following, where applicable:

1. Existing pumping station.

2. Proposed pumping station, including provision for installation of future pumps or ejectors, standby power, telemetry equipment, removal of pumps, and maintenance access drive.

3. Maximum elevation of sewage in the collection system upon occasion of power failure. Identification and delineation of the 50-year and 100-year flood plain, and the corresponding high-water level elevations.

3.104 PLANS OF WASTEWATER TREATMENT PLANTS

In addition to the requirements delineated in Section 3.101, Preparation of Drawings, Specifications, and Designer's Report, and Section 3.102, Plans of Sewerage Facilities, the following shall be submitted for projects involving construction or modification of Wastewater Treatment Plants:

A. Location Plan

A plan shall be submitted showing the wastewater treatment plant in relation to the remainder of the system. A USGS Topographic Map (7.5-minute series where available) shall be included to indicate its location with relation to streams and the point of discharge of treated effluent.

B. General Layout

Layouts of the proposed wastewater treatment plant shall be submitted showing:

1. Size and location of plant structures.

2. Schematic flow diagram showing the flow through various plant units.

3. Piping, including any arrangements for bypassing individual units.

4. Materials handled and direction of flow through pipes shall be shown.

5. Hydraulic profiles showing the flow of sewage, supernatant, and sludge, including hydraulic and energy gradients. The hydraulic profiles shall be based on the body of water to which the plant effluent is to be discharged, including the 50-year and 100-year storm high water level elevations.

6. Treatment Plant capacity

C. Detailed Plans

Detailed plans shall show the following:

1. Location, dimensions and elevations of all existing and proposed plant facilities.

2. Elevations of high and low water level of the body of water to which the plant effluent is to be discharged, including the 50-year and 100-year storm high water level elevations.

3. Type, size, pertinent features, and manufacturer's rated capacity of all pumps, blowers, motors, and other mechanical devices, including provisions for future structures and equipment.

4. Type, size, slope, and material of all piping and open conduits.

5. Adequate description of any features not otherwise covered by specifications.

3.105 SPECIFICATIONS

A. General Information

Complete technical specifications for the material and construction of sanitary sewers, storm sewers, stormwater or sewage pumping stations, force mains, wastewater treatment plants, and all appurtenances, shall accompany the detailed plans.

The specifications shall include, but not be limited to, all construction information not shown on the drawings that is necessary to inform the builder in detail of the construction requirements as follows in Section 3.105 Part B.

B. Construction Requirements

1. Quality of materials, workmanship, fabrication, and the type, size, strength, operating characteristics, requirements and rating of all mechanical and electrical equipment.
2. Allowable infiltration.
3. Valves, piping and jointing of pipe.
4. Wiring.
5. Meters.
6. Laboratory fixtures and equipment.
7. Operating tools.
8. Construction materials.
9. Special filter materials such as stone, sand or gravel.
10. Miscellaneous appurtenances.
11. Chemicals when used.
12. Instructions for testing materials, equipment and installation as necessary to meet design standards.
13. Operating tests for the complete works and component units.
14. Requirement for instructions, warranties and Operation and Maintenance manuals.
15. Traffic control.
16. Permit requirements, including location, county, state and federal requirements.

17. Stormwater Control Measures and Stormwater Pollution Prevention Practices.

18. Other information as necessary, required, or requested by the responsible authority.

3.106 REVISIONS TO APPROVED PLANS

Professional Design and Construction Inspection. The facilities shall be constructed under supervision of the Contract Administrator appointed by the municipality or the Cuyahoga County Department of Public Works, where applicable, in accordance with the approved plans, reports, and specifications. As per OAC 4733.17, all public works projects costing $5,000.00 or more shall have plans, specifications and estimates made by and construction inspected by a licensed professional engineer or professional surveyor.

Field Changes or Revisions. Any deviations from approved plans or specifications affecting the capacity, flow, or operation of units shall be approved in writing before such changes are made. Plans or specifications so revised should therefore be submitted well in advance of any construction work that will be affected by such changes to permit sufficient time for review and approval.

Whenever there is any change in the field, regardless of the reason for the change, the responsible agency reserves the right to stop the work until the owner/designer submits a revised drawing(s) to the responsible agency for review and approval. The work shall not resume until the revised drawing(s) are reviewed and approved by the responsible agency. Any work done after the responsible agency requires work be stopped, shall be at the sole risk of the contractor/project owner. Furthermore, the responsible agency reserves the right to require that the contractor excavate and uncover any such work for responsible agency inspection. Any and all work found to be inadequate or sub-standard in any regard, or that does not conform to the revised drawing(s), as determined by the responsible agency, shall be removed and replaced at the contractor's expense. In addition, the responsible agency may require any work to be CCTV inspected and the videos submitted to the responsible agency for review and approval.

As-Built Drawings. After construction is completed, "As-Built" plans and specifications shall be prepared, reviewed, and approved by the Design Engineer. These As-Built plans and specifications shall clearly show any and all alterations. One (1) hard copy set and one (1) pdf set of the As-Built documents shall be submitted to the Municipal Engineer and the CCDPW within 30 days following completion of the work. The As-Built information shall clearly and accurately represent the final constructed location of the sewerage improvements including, but not limited to, the principal structures, manholes, catch basins, pipes, fittings, lateral connections, and appurtenances. Accurate locations (by station and offset, and by Grid Northing and Easting of the State Plane Corrdinate System) and elevations including, but not limited to, rim and invert elevations, shall be referenced to the control survey done for the Project. The accuracy and completeness of the As-Built Drawings shall be attested to by the design engineer, and shall include his stamp and signature with the following attestation: "I hereby attest that these As-Built Drawings are a thorough, complete, and accurate record of the facilities as constructed."

3.107 OPERATION DURING CONSTRUCTION

The Specifications shall contain a program or require the contractor to provide an approved plan for keeping existing sewers, pumping stations, and/or treatment plant units in operation during construction of the improvements.

3.2 - DESIGN OF SANITARY SEWER SYSTEMS

Note that the initial requirements of this Section 3.2, Design of Sanitary Sewer Systems, Letters A through U, shall apply to the design of all sanitary sewer systems and storm sewer systems. The remainder of Section 3.2 contains additional requirements specific to sanitary sewer systems design; including sewer design, force main design, grease interceptor design, etc. (Section 3.3, Design of Storm Sewer Systems, has additional requirements which shall apply to storm sewer systems design.)

A. Manhole Access

When designing new sewers, the design engineer will ensure that access for service vehicles is provided to at least every other manhole along the alignment of the sewer line. If difficulty in ensuring access is encountered, the design engineer will bring the potential problem to the attention of the responsible authority prior to finalizing the design.

If a road is constructed for the access, it shall be a minimum of 12 feet wide with a limestone aggregate base of 8 inches minimum thickness.

B. Buoyancy

Buoyancy of the sewers, manholes, and other sewerage structures shall be considered. The floatation of all sewerage structures shall be prevented with appropriate design and construction methods when high groundwater levels are anticipated. If requested or required, the design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer. See Section 3.204 for additional information.

C. Structural

The pipe strength, class, stiffness, and wall thickness shall be appropriate for all loads; including, but not limited to, live loads, dead loads, bedding, and cover loads. If requested or required, the design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

D. Sewer Design

The design of the sanitary sewer shall comply with the CCDPW Uniform Standards. The design calculations for sewer sizing shall be submitted to the responsible authority for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

E. Easements

All public sewer permanent sewer easements shall be a minimum of twenty (20) feet in width. All easements shall be officially recorded or platted. The easements shall restrict and preclude the construction of any buildings or structures of any kind and of a temporary or permanent nature within the easement area; any alteration or deviation of this requirement shall require the review and approval of the CCDPW and the responsible authority. All easements shall be prepared by a Registered Professional

Surveyor and shall be recorded. Suitable maintenance vehicle access to all sewers and manholes shall be provided.

F. Sewer Materials - General Information

All piping materials, manholes, and appurtenances furnished for public sanitary and storm sewerage facilities shall comply with the latest applicable national standards, including, but not limited to:

- American Society for Testing and Materials (ASTM),
- American National Standards Institute (ANSI),
- American Water Works Association (AWWA),
- American Association of State Highway and Transportation Officials (AASHTO),
- CCDPW Uniform Standards for Sewerage Improvements,
- Or other representative standards organizations.

The characteristics of the sanitary or storm sewerage, as well as the existing soil conditions (e.g., type, depth, etc.) shall be considered in the selection of the pipe materials.

All material and all equipment shall be subject to visual inspection and acceptance or rejection after delivery to the site of the work. All rejected materials shall immediately be removed from the site. All pipes shall be stamped bearing manufacture's name, date, type of pipe (class if concrete), and applicable ASTM and/or AASHTO numbers. No pipe over two (2) years old, or pipe older than the manufacturer's recommended storage period, whichever is shorter, shall be used.

All sanitary and storm sewer pipes between manhole increments shall be one type and class of pipe. In case of lateral connections, transition connections of different materials may be permitted.

G. Pipe Stiffness

In the use of sanitary or storm sewer piping, with ASTM Class I bedding, of the following materials:

- thermoplastic piping,
- PVC,
- PVC composite sewer pipe,
- fiberglass,
- polyethylene, or
- polypropylene

1. For depths of cover less than 13 feet, the minimum pipe stiffness of 46 PSI or SDR-35 shall be utilized, with a maximum allowable 5.0 percent in place deflection at the base inside diameter of the pipe.

2. For depths of cover between 13 feet and 50 feet, the Developer or Applicant shall provide calculations (see below) signed, sealed, and dated by an

Engineer Registered by the State of Ohio to determine the pipe minimum wall thickness based upon a maximum pipe deflection of 5.0 percent of the base inside diameter of the pipe. A minimum stiffness of 115 psi or SDR-26 is required.

Pipe minimum wall thickness shall be calculated using the Modified Iowa Formula:

$$\Delta y = \frac{(K)(DL)(W)(r^3)}{(El) + (.061)(E^1)(r^3)}$$

ζy = vertical deflection(inches)

DL = lag factor (1.5 maximum)

K = bedding factor

W = earth load/ $\left(lb/in\right)$

r = mean radius $\frac{OD\ Zt}{2}$ (in)

E = pipe material modulus of elasticity $\left(lb/in^2\right)$

L = moment of inertia $t^3/12\ \left(in^2\right)$

E' = Soil Modulus $\left(lb/in^2\right)$

t = minimum wall thickness

Note: It is recommended the Engineer use E'=750 lb/in^2 for ASTM Class I bedding with shovel slicing or rodding compaction under the pipe haunch and E'=500 lb/in^2 for loose dumping of the bedding material and no shovel slicing or rodding of the bedding material under the pipe haunch. The lower η' values provide a factor of safety over the original Bureau of Reclamation η' value of 1000 lb/in^2. It should be noted that the accuracy in terms of deflection of the Modified Iowa Formula for loose dumping of Class I bedding is ±2%; therefore, a predicted deflection of 3% could produce an actual deflection of between 1% and 5%.

The base inside diameter is equal to the average inside diameter minus the manufacturer's tolerances. A table showing base inside diameter for PVC pipe is shown in Section 5.211 Section B.2. Deflection Testing. Deflection testing, per Section 5.211, is required on all storm and sanitary PVC, thermoplastic pipe, fiberglass pipe, high-density polyethylene pipe, and polypropylene pipe with a pipe stiffness less than 200 PSI. Air testing shall be required for all PVC, VCP, fiberglass, polypropylene, and thermoplastic sanitary and storm sewers less than 36" diameter, and for all concrete pipe 24" and less in diameter.

H. Re-use of Existing Sewers and/or Laterals

If existing sewer systems (including existing laterals) on a site are to be re-used for a project, is it the responsibility of the project owner/designer to verify, and submit documentation to the responsible authority for review, that the existing sewer system is hydraulically adequate, structurally adequate, and functionally adequate for the intended purpose. For sanitary systems, proof of a watertight existing system shall be submitted. The existing system shall also be CCTV inspected and the videos/reports are to be submitted to the responsible authority for review. If the existing sewer and/or lateral is found to be unacceptable, it shall be replaced in its entirety and for the full length from the structure to the outlet at the mainline public sewer, per the requirements of the Uniform Standards.

I. Layout – Opposite Sides

In general, the layout of the sewerage systems shall be such that the storm and sanitary sewers shall be on opposite sides of the roadways and within the tree lawn areas where practical. Where opposite side construction is not practical, every effort shall be made to separate the sanitary sewers, storm sewers, and watermains as listed below; in which case, both the storm and sanitary sewers shall be constructed using premium jointed conduits throughout.

J. Minimum Clearances for Utilities

The following separation requirements (minimum clearances) shall apply, both in the right-of-way and on private property.

Mainline and Force Main Minimum Horizontal Clearances (barrel to barrel) shall be:

- Sanitary and water of ten (10) feet,
- Sanitary and storm of ten (10) feet,
- Storm and water of ten (10) feet.

Service Lateral Minimum Horizontal Clearances (barrel to barrel) shall be:

- Sanitary and water of five (5) feet,
- Sanitary and storm of five (5) feet,
- Storm and water of five (5) feet.
- Laterals shall be laid out in this horizontal order: water, storm, sanitary, such that there is minimum 10 feet between the water lateral and the sanitary lateral.

Mainline and Service Lateral Minimum Vertical Clearances (barrel to barrel) shall be:

- Sanitary and water of eighteen (18) inches,
- Sanitary and storm of eighteen (18) inches,
- Storm and water of eighteen (18) inches.

These separation requirements apply regardless of which pipe is crossing over or under the others. Deviation from these requirements must be approved in writing by the responsible authority.

Note that premium joints are required on all sanitary and storm sewers. When it is

impossible to maintain the proper horizontal and vertical separation as stipulated, the sewer shall be encased in concrete or be constructed of water main type materials that shall withstand a 150-psi pressure test. The crossing shall be arranged such that the sewer joints will be as far as possible from the water joints. All piping shall be properly supported at all crossings to prevent damage.

K. Minimum Cover

All sewers and service connections shall have a minimum of three (3) feet of cover to the pavement subgrade within each site. Any variation shall require the review and approval of the responsible authority. The design engineer should consider providing thermal insulation around any sewer with less than 42 inches between the sewer flowline and the top of finished ground in order to prevent possible freezing in the pipe. Insulation material may be Witcolite, Gilsulate 500, Protexutate or approved equal. The insulation shall be applied in accordance with the manufacturer's recommendations. See also, 3.2 R. Concrete Encasement Requirements.

L. Energy Gradient and Continuity of Size

When a smaller sewer discharges into a larger one, the invert of the larger sewer should **be lowered sufficiently to maintain the same energy gradient. An approximate method** for securing this result is to place the 0.8 depth point of both sewers at the same elevation. Sewer systems shall be designed such that larger sewers shall not discharge into smaller sewers regardless of the relative sewer slopes and/or capacities involved.

M. Manholes

Spacing. For sewers size 36 inches in diameter and less, manholes shall be spaced at not over 400 feet. For sewers 42 inches through 60 inches in diameter and larger, manholes shall be spaced at not over 600 feet. For sewer sizes larger than 60 inches in diameter, manhole spacing up to 1,000 feet will be considered. Tunnels shall be considered special projects. Manholes shall be placed at the end of all sewer runs that are 150 feet or more in length, and at any change of line, grade or size of sewer. For small diameter mainline sewers, a full-size test tee may be provided in lieu of a manhole at the end of sewer runs of less than 150 feet, if approved by the responsible authority.

Friction Losses and Turbulence. All manholes shall have a properly constructed channel. Where a proposed sewer pipe is to enter an existing manhole at any angle (e.g., 30 degrees, 90 degrees, etc.) to the main flow, the invert elevation of the proposed sewer shall be raised sufficiently so that the influent flow "falls" into the main flow to minimize turbulence in the manhole. Where a steeply sloped sewer enters a manhole for which the outlet sewer is at a flatter slope, the invert elevation of the influent sewer shall be raised sufficiently so that the influent flow "falls" into the manhole to minimize the conditions for a hydraulic jump, and the resulting turbulence, to occur.

Resilient Connectors. Resilient connectors, meeting the requirements of ASTM C 923, shall be required on all sanitary, storm, and combined manholes for all piping connections, of all sizes, including drop connections.

N. Manhole Frames and Castings

Standard manholes frames and castings are as indicated in the Uniform Standard Sewer Details Index of Sheets and General Notes sheet. Manholes in pavement areas shall have solid lid castings and, where such conditions occur in excess of 1,000 feet of sewer, special non-flooding venting shall be provided. Manhole castings shall be stamped "Sanitary" for sanitary manholes and "Storm" for storm manholes, unless another casting is required by the responsible authority.

O. Lateral Connections

On public sewers, the Designer shall provide service lateral sewers to all properties in areas served by the sewers.

Pipe Materials. Laterals shall be constructed of:

- Vitrified Clay ASTM C700, extra strength only;
- Ductile Iron ANSI/AWWA C 151/A21.51 Cement Lined (Class 52);
- PVC Composite ASTM D2680; Polyvinyl Chloride (PVC) ASTM F679, ASTM F794, ASTM F949, ASTM D3034 (SDR35) or
- Polypropylene Corrugated Double Wall, ASTM F2736 Pipe.
- All laterals, fittings, and appurtenances shall have watertight, gasketed joints.

Lateral Connections to Manholes. Direct connection of laterals to manholes shall not be permitted unless authorized by the responsible authority. Residential service connections shall generally tie into the mainline (street) sewer, and not into manholes. If this is not possible at the end of a cul-de-sac, then the connection may be tied into the manhole if approved by the responsible authority.

Installation. Lateral connections shall be installed utilizing a laser or grade bar devices.

Minimum Size. Lateral connections to building sites shall be a minimum of six (6) inches in diameter. The designer is required to properly size each lateral for the anticipated design flows. If requested or required, the design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

Wye Branches and Saddles. In no case will the connections for other than six (6) inch lateral connections exceed the standard manufacturer's fabrication connection size or recommended core bore seal size. Wye fittings are to be provided for all sewer laterals on main sewers 18-inch and smaller. Saddles, Inserta-Tees, or approved equal, are to be provided for sewer mains 21-inches and larger, or as required by the responsible agency.

Resilient rubber material shall meet and be constructed in accordance with ASTM C923 and shall provide a watertight seal. Stainless-steel clamps shall meet the requirements of ASTM C923, ASTM A666 and ASTM A240.

Resilient rubber connections shall prohibit the protrusion of the lateral pipe into the

mainline sewer pipe. The connection shall be provided by Kor-N-Tee, Inserta Tee or approved equal. The connection shall meet the requirements of the most current version of ASTM F2946.

The lateral shall be constructed to the right-of-way line and a test-tee shall be provided at the right-of-way line, per the requirements of USSD Lateral Connections, and Typical Riser Detail (where necessary). See also 5.115M Jointing Materials For Connecting Laterals to Cored Pipe.

Slope. Minimum pipe slope for lateral connections shall be one (1.0) percent. Maximum slope shall be ten (10) percent; however, a much lesser slope than ten percent is preferred.

Bends. Service laterals shall not have any bends other than 45-degree or 22.5-degree bends. Ninety-degree bends are not acceptable. Test tees are to be installed behind (i.e., upstream of) all bends greater than 22.5 degrees, and between two closely spaced 45-degree bends. On long runs of sewer laterals, test tees shall be provided every 100 linear feet.

Separate Connections. All lateral connections to the main public sanitary sewer, up to and including 15 inches in size, shall be made through use of manufactured fittings. Separate sanitary sewer laterals shall be provided for each unit on a site including, but not limited to, the following examples, or as required by the responsible authority:

- If there are multiple condominium units attached to each other in one building, then multiple sanitary sewer laterals, one from each unit, from the building to the main sanitary sewer, are required.
- If there are multiple office buildings on a site, then a minimum of one sanitary sewer lateral from each building to the main sanitary sewer, is required.
- It is not acceptable to bring multiple laterals from multiple buildings or multiple units together into one lateral pipe to the main sewer.

Re-use of Existing Sewers and/or Laterals. If existing sewer systems (including existing laterals) on a site are to be re-used for a project, is it the responsibility of the project owner/designer to verify, and submit documentation to the responsible authority for review, that the existing sewer system is hydraulically adequate, structurally adequate, and functionally adequate for the intended purpose. For sanitary systems, proof of a watertight existing system shall be submitted. The existing system shall also be CCTV inspected and the videos/reports are to be submitted to the responsible authority for review. If the existing sewer and/or lateral is found to be unacceptable, it shall be replaced in its entirety and for the full length from the structure to the outlet at the mainline public sewer, per the requirements of the Uniform Standards.

Industrial and Commercial Service Connections. Industrial/Commercial service connections shall be tied into a standard manhole at the mainline (street) sewer. (See Article IV of the Rules and Regulations for requirements for Industrial/Commercial discharges to the sewer system.)

Testing Requirements. If required by the responsible authority, the contractor/property owner shall verify that there are no "clean water" connections to the sanitary sewer, and shall perform any other testing (dye water, smoke, etc.) required by the responsible authority, all at the expense of the contractor/property owner. At the discretion of the CCDPW or the responsible authority, dye testing of new construction may be required.

Deflection testing, per Section 5.211, is required on all storm and sanitary PVC, thermoplastic pipe, fiberglass pipe, high-density polyethylene pipe, and polypropylene pipe with a pipe stiffness less than 200 PSI. Air testing shall be required for all PVC, VCP, fiberglass, polypropylene, and thermoplastic sanitary and storm sewers less than 36" diameter, and for all concrete pipe 24" and less in diameter.

See also 3.2P, Test Tees.

P. Test Tees

Test tees shall be as required by the Uniform Standard Sewer Details Test Tee detail and, where located in pavements, the Test Tee/Cleanout Cover in Pavement detail. Test tees are required in the following locations:

- Each lateral connection to building sites shall have a test-tee of full size constructed one foot outside of the right-of-way line, or one foot within the utility easement line where such are encountered, as per the Uniform Standard Sewer Details Lateral Connection Detail.
- Service laterals for commercial/industrial buildings shall have a full-sized test tee installed within five (5) feet of the building foundation exterior, and at the right-of-way line (as above).
- Full-sized test tees are to be installed behind (upstream) all bends of greater than 22.5-degrees, and between two closely spaced 45-degree bends.

- On long runs of sewer laterals, full-sized test tees shall be provided every 100 linear feet.
- For small sewer pipe sizes, a full-sized test tee may be provided in lieu of a manhole at the end of sewer runs less of than 150 feet, with the approval of the responsible authority.
- In other locations as directed by the responsible authority.

Test tee caps shall be cast or ductile iron, and shall be marked STM for storm sewers and SAN for sanitary sewers, and color coded as the "Markers" are required below. Double gasketed plastic caps with a minimum of 2 ounces of a metallic element either imbedded or screwed to the top of the cap are acceptable in non-paved areas (see Uniform Standard Sewer Detail Test Tee Detail). The double gasketed cap provides a slip type continuous settlement joint that permits a maximum 5 ½-inch axial movement of the riser with forces of 500 lbs. per foot.

The PVC test tee shall be non-pressure rated PVC SDR 26, SDR 28, or SDR 35, shall be 6-inch diameter, and shall meet ASTM D3034 specifications. Gaskets shall be manufactured in accordance with ASTM F477 or ASTM F913. The double gasket connection shall inhibit penetration of the test tee through the lateral connection.

Markers in lieu of Test Tees. At the discretion of the responsible authority, in developments where connection to a service lateral will not occur for more than 30 days, in lieu of a test tee, the contractor shall install a watertight cap. Caps shall be specifically designed for use with the pipe, shall be for use as a permanent or temporary plug, shall be watertight, and shall be removable without damaging the pipe. In all cases, the installation of a test tee or a cap shall be accompanied by the installation of a 2-inch by 4-inch hardwood marker. The markers shall extend vertically from the end of the connection to three (3) feet above finished grade and shall include a metal rod, so the ends of the laterals can be located by a metal detector if the markers are shortened to grade. Markers shall be color coded as follows (See also 5.211A, Service Markings):

- Sanitary red
- Storm green
- Water blue

Q. Future Stub

Where sewer mainlines are being built with the intention that the mainline may or will be extended in the future, the sewer shall have a stub out of the last manhole for the future extension. The stub shall extend in the right-of-way to a point ten (10) feet behind the projection of the end property line

R. Concrete Encasement Requirements

All sewers (storm and sanitary) crossing a creek shall have six (6) inches of concrete (3000 PSI) encasement. All clay, PVC, fiberglass (glass fiber reinforced thermo setting resin), high density polyethylene and corrugated polypropylene pipes (storm and sanitary) under pavement areas shall be encased in six (6) inches of concrete (3000 PSI) if cover is less than three (3) feet between top of pavement and top of pipe. Concrete and ductile

iron pipe with less than two (2) feet of cover shall be encased in six inches of concrete. Variations shall be approved by the responsible authority.
See also, 3.2 K, Minimum Cover.

S. Curved Sewers

In general, all sanitary sewers shall be constructed to straight lines and grades. Curved sanitary sewers less than 36 inches in diameter shall be considered a special project. Sanitary sewers over 36 inches may be laid in horizontal curves as long as the joint deflection is limited to a maximum of 80% of the pipe manufacturer's recommended maximum deflection or 80% of the ASTM maximum recommended deflection, whichever is less. In no case shall the pipe curve radius be less than 200 feet. Radial sewer pipe alignment radius shall be a minimum of ten (10) times the internal pipe diameter. Variations require approval by the responsible authority.

T. Concrete Anchorage

Unless otherwise specified, concrete anchorage will be utilized when sewer slopes fall within the following limits:

20% to 35%, slope-anchorage shall be a maximum 36 feet center to center.
35% to 50%, slope-anchorage shall be a maximum 24 feet center to center.
Over 50%, slope-anchorage shall be a maximum 16 feet center to center.
Concrete anchorage shall be installed on the down side of each bell.

U. Premium Backfill

See Section 5.205C, Premium Backfill.

3.201 INVESTIGATIONS AND SURVEYS

The remainder of Section 3.2 applies to sanitary sewer systems design.

A. General Information

Sanitary sewers shall be designed for conveyance in a separate gravity system at such depths that all structures within the tributary area may be served at full basement depths so that the estimated ultimate tributary population and area is served. Type II cement shall be used for concrete sewerage facilities in areas with existing or projected hydrogen sulfide problems or as required by the facility owner.

B. Investigations

The designer shall list the existing capacity and capacity available of the receiving sewer and the sewage treatment facility that will ultimately accept the predicted hydraulic load. Consideration shall be given to potential overall development of tributary area, how such future development will affect the design of the project under consideration, and any existing onsite facilities that will be eliminated, incorporated within or modified by the proposed project. Special analysis shall be required for known areas with high inflow and infiltration.

C. Special Projects

Variation from a separate gravity sanitary sewerage system or from the normal depth required to serve the entire tributary area shall be considered a special project. Special projects shall require that the approving governmental authority review and approve the variation in concept prior to final design. Variations shall include shallow depth, materials of construction, methods of construction, pressure sewer systems, quantity of sewage generated, alternative collection systems and other variations not included in the Standards.

D. Nursing Homes, Residential Care Facilities, and Veterans' Homes, etc.

See the general requirements of Section 3.6, Design of Interceptors, Traps, and Separators, and the specific requirements of Section 3.605, Other Types of Interceptors and Sizing Requirements; D. Nursing Homes, Residential Care Facilities, and Veterans' Homes, etc.

E. Commercial Food Service Providers and/or Establishments – Grease Interceptors Required

Grease Interceptors are required by these Standards and by the CCDPW Rules and Regulations for all facilities which provide food services of any kind. See Section 3.6, Design of Grease Interceptors. Location of grease interceptors shall be outside of the building and provide easy access for cleaning and inspection. These grease interceptor requirements are applicable to all commercial food service providers and/or establishments including, but not limited to, those that are undergoing:

1. New construction.

2. Interior remodeling to accommodate expansion or operational modifications.

3. Changes of ownership/occupancy.

4. Any facility which may be experiencing difficulty achieving compliance with maintenance and/or wastewater discharge limitations.

5. Any facility going through major changes in their menu.

3.202 QUANTITY OF SANITARY SEWAGE

A. General Information

Sanitary sewers shall be designed for peak flow plus infiltration allowance basis. See Table 3.2 RATIO OF AVERAGE TO PEAK FLOWS. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

B. Design Basis

1. Ultimate Population Density is based on existing zoning.
2. Sewage Flow Guide Table A-1.
3. For undeveloped commercial property, use fifteen hundred (1,500) gallons per acre per day average daily flow.

Sewage Flow Guide

Table A-1 for Design Flow and Waste Strength Requirements [g]

Place	Notes	Design flow (gallons per day)	Waste strength range BOD_5 (milligrams per liter)
Airport	b, l, j, p, r, t	15 per employee plus 4 per parking space	200 to 280 [r, s, t]
Apartment	b, l	120 per bedroom	200 to 280 [r, s, t]
Assembly hall	a, i, j	15 per employee plus 3 per seat without kitchen facilities or 7 per seat with kitchen facilities	200 to 280 [r, s, t]
Banquet hall	b i, j	15 per employee plus 3 per seat without kitchen facilities or 7 per seat with kitchen facilities	400
Barber shop	i, j	80 per basin	200 to 280 [s]
Beauty shop, styling salon	i, j	200 per basin	200 to 280 [s]
Bowling alley	a, i, j, p	75 per lane	200 to 280 [r, s, t]
Car wash		Sewer connection required; contact district office	
Campground or recreational vehicle park	a, i, j, m, n, p	30 per tent camp site without showers; 60 per tent camp site with showers; 60 per RV camp site without water hookup; 90 per RV camp site with water hookup	200 to 280 [r, s, t]
Church (less than 200 sanctuary seats)	a, h, j, k, o, p	3 per sanctuary seat without kitchen; 5 per sanctuary seat with kitchen	200 to 280 [r, s, t]
Church (greater than 200 sanctuary seats)	b h, j, k, o, p	5 per sanctuary seat without kitchen; 7 per sanctuary seat with kitchen	200 to 280 [r, s, t]
Coffee shop	a i, j	15 per employee plus 5 per seat	200 to 280 [r, s, t]
Convenience store, service station or gas station (add all flows that apply)	a, d, i, j, p, q	500 per pump island; 500 per service bay; 250 per shower; 15 per employee	200 to 280 [r, s, t, u]
Country club, sportsman club or gun club	b i, j, m, n, o, p	50 per individual based on occupancy capacity	200 to 280 [r, s, t]
Dance hall	a, i, j, p	15 per employee plus 3 per patron without kitchen facilities or 7 per patron with kitchen facilities	200 to 280 [r, s, t]
Daycare facility	a, i, j, p	35 per employee plus 10 per student or child	200 to 280 [r, s, t]
Dentist office	i	35 per employee plus 10 per patient that can be scheduled to be seen in a given day plus 75 per dentist	200 to 280 [s]
Doctor office	i	35 per employee plus 10 per patient that can be scheduled to be seen in a given day plus 75 per doctor	200 to 280 [s]
Dry cleaner	i	Contact district office [1]	200 to 280 [s]

Notes: Design Flow from Ohio Administrative Code 3745-42-05, Effective 8/1/18 (or latest edition)
"District Office" refers to Ohio EPA
See "Notes for Table A-1" below.

Table A-1 for Design Flow and Waste Strength Requirements [g]

Factory or manufacturing facility	i, q	25 per employee without showers; 35 per employee with showers	200 to 280 [r, s, t]
Food service operation/restaurant categories (as noted below)			
-Ordinary restaurant (not open 24 hours)	c, i, j, p	35 per seat	400 to 600
- 24-hour restaurant	c, i, j, p	60 per seat	400 to 600
-Restaurant along freeway	c, i, j, p	100 per seat	400 to 600
-Tavern (very little food service) or bar (full food service)	c, i, j, p	35 per seat	400 to 600
-Curb service (drive-in)	c, i, j, p	40 per car space	400 to 600
-Vending machine	c, i, j, p	100 per machine	400 to 600
*** End of food service operation/restaurant categories **********	*** End of food service operation/restaurant categories **********	*** End of food service operation/restaurant categories **********	*** End of food service operation/restaurant categories **********
Homes in subdivision	b, l	120 per bedroom	200 to 280 [r, s]
Horse stable	a, j	120 for outdoor living quarters if present on property plus 120 per wash stall plus 50 per horse stall for boarding	200 to 280
Hospital	b, i, j, p	300 per bed plus 35 per employee	200 to 280 [r, s, t]
Hotel or motel	a, i, j, p	100 per room	200 to 280 [r, s, t]
Institution (such as psychiatric hospitals or prisons)	b, i, j, p	100 per bed plus 35 per employee	300
Laundromat	i, q	15 per employee plus 400 per washing machine	200 to 280 [s]
Marina (restrooms and showers only)	a, l	20 per boat mooring or slip	200 to 280 [r, s, t]
Labor camp	e, i, j, p	50 per employee	200 to 280 [r, s, t]
Mobile home park	b, i, j, p	300 per mobile home space	200 to 280 [r, s, t]
Nursing and rest homes	b, i, j, p	200 per bed plus 100 per resident employee plus 50 per non-resident employee	300
Office building	a, i, j, k	20 per employee	200 to 280 [r, s, t]
Playground or day park	a, i, k, p	15 per employee plus 12 per parking space	200 to 280 [s]

Notes: Design Flow from Ohio Administrative Code 3745-42-05, Effective 8/1/18 (or latest edition)
"District Office" refers to Ohio EPA
See "Notes for Table A-1" below.

Table A-1 for Design Flow and Waste Strength Requirements [g]

Stand alone retail store	e, i, j, p	15 per employee plus 12 per parking space	200 to 280 [r, s, t]
School	b, i, j, k, p, t	15 per employee plus 15 per student for elementary schools; 20 per student for junior and high schools; 85 per student for boarding schools	200 to 280 [r, s, t]
Service station or convenience store or gas station (add all flows that apply)	a, d,l, 1, p, q, u, v	500 per pump island; 500 per service bay; 250 per shower; 15 per employee	200 to 280 [r, s, t, u]
Shopping center	e, f, l, p, q	15 per employee plus 2 per parking space without food service or 5 per parking space with food service	200 to 280 [r, s, t]
Swimming pool	a, i, j, m, n	5 per swimmer without hot showers or 10 per swimmer with hot showers, based on permitted capacity	200 to 280 [r, s, t]
Theater	a, l, 1, p	5 per seat for indoor auditorium or 10 per car space for drive-in	200 to 280 [r, s, t]
Vacation cottage	b, i, j, p	50 per person without kitchen or 75 per person with kitchen	200 to 280 [r, s, t]
Veterinarian office and animal hospital	i, l, j	15 per employee plus 100 per doctor plus 20 per run and cage	200 to 280 [r, s, t]
Youth and recreation camps	b, i, j, p	15 per employee for day camp plus 15 per camper for day camp with food service or 10 per camper for day camp without food service; 50 per employee for overnight camp plus 50 per camper for overnight camp, based upon occupancy capacity	200 to 280 [r, s, t]

Notes: Design Flow from Ohio Administrative Code 3745-42-05, Effective 8/1/18 (or latest edition)
"District Office" refers to Ohio EPA
See "Notes for Table A-1" below.

Notes for Table A-1

Note a: Food service waste not included.

Note b: Food service waste included, but without garbage grinders.

Note c: Aeration tanks for these systems require forty-eight-hour detention periods. Garbage grinders not permitted.

Note d: Truck parking areas will require consideration for treatment of runoff at large truck stops.

Note e: Twenty gallons per day of a vault latrine is used for toilet wastes.

Note f: Assume manual hosing of dog runs and solids (food droppings, etc.) removal prior to hosing.

Note g: Year round disinfection of all wastewater may be required before discharge to waters of the state or to any other surface or subsurface disposal systems.

Note h: Lower per seat estimate assumes a maximum of one church service per day, higher per seat estimate assumes a maximum of three church services per day. Weddings and funerals shall be counted as services.

Note i: Non-domestic or industrial wastes are prohibited from being discharged to soil based treatment systems.

Note j: Total capacity for number of persons should be confirmed by occupancy license or total occupancy capacity.

Note k: Higher flows shall be estimated when showers are available.

Note l: Deviating from this estimated design flow will require the director's approval, prior to applicant submitting the permit to install.

Note m: Pools cannot discharge pool filter backwash into soil based treatment systems.

Note n: Pool de-watering is prohibited from discharging to soil based treatment systems.

Note o: Flow estimates do not consider daycare facilities. If a daycare is present, the flow requirements for a daycare facility must be included.

Note p: An external grease trap is required for facilities with food service for soil based treatment systems.

Note q: Assume one working shift of not more than eight hours. Assume higher flows for two or three shift operations.

Note r: Assume no garbage grinder and normal domestic waste. If garbage grinders are present, the waste strength should be increased from twenty to sixty-five per cent.

Note s: Data for regular strength waste range of 200 to 280 milligrams per liter was obtained from U.S. EPA's manual "Onsite Wastewater Treatment Systems Manual, Revised 2002 (EPA/625/R-00/008)." This manual is available on the internet at www.epa.gov/ncepihom/ and can be ordered by telephone by calling (800) 490-9198.

Note t: Waste strength should be twenty to sixty-five per cent higher for facilities that include food service operations, such as cafeterias, service stations and for facilities that may handle pet wastes.

Note u: Sewer connection is required for a car wash. Please contact your district office.

Effective: 8/1/2018

Notes: Design Flow from Ohio Administrative Code 3745-42-05, Effective 8/1/18 (or latest edition)
"District Office" refers to Ohio EPA

RATIO OF AVERAGE TO PEAK FLOWS

TABLE 3.2

AVER. 24 HOUR FLOW IN M.G.D.	CONVERSION FACTOR	PEAK FLOW IN M.G.D.
0.1	3.70	0.37
0.2	3.66	0.73
0.3	3.63	1.09
0.4	3.59	1.44
0.5	3.55	1.78
0.6	3.52	2.11
0.7	3.48	2.44
0.8	3.45	2.76
0.9	3.42	3.08
1.0	3.38	3.38
1.5	3.23	4.85
2.0	3.09	6.18
2.5	2.97	7.43
3.0	2.86	8.58
3.5	2.76	9.66
4.0	2.66	10.64
4.5	2.58	11.61
5.0	2.51	12.55
5.5	2.44	13.42
6.0	2.38	14.28
6.5	2.32	15.08
7.0	2.27	15.89
7.5	2.23	16.73
8.0	2.19	17.52
8.5	2.15	18.28
9.0	2.11	18.99
9.5	2.08	19.76
10.0	2.06	20.60
11.0	2.00	22.00

For flows in excess of eleven (11) mgd, a conversion factor of 2.00 shall be used.

When designing pump stations and force mains in service areas with less than 0.1 mgd average 24-hour flow use a peak conversion factor of 5.55. The peak sanitary sewer design daily flow for areas that do not have a 24-hour run-off period shall be calculated as follows:

$$\text{Peak Factor} = \frac{3.70 \times 24(\text{hours})}{\text{Run-off period (hours)}}$$

Peak daily design flow (gpd) = peak factor x average daily flow

Entity	Runoff Period
Municipality	24 hours
Factories	Length of work day
Subdivisions ≥ 250 homes	24 hours
Subdivisions < 250 homes	16 hours*
Hospitals, Nursing and Rest Homes	16 hours*
Camps	16 hours*
Public Schools	8 hours*
Restaurants	8 to 12 hours*
Boarding Schools	16 hours*
Mobile Home Parks	16 hours*
Apartments	16 hours*
Motels	16 hours*

* All entities with runoff periods 16 hours or less shall have flow equalization. (Other runoff periods must be documented.)

C. Infiltration

For new systems, allowance shall be 375 gallons per acre day for the upstream tributary acreage.

D. Additional Design Factors

These include additional requirements such as maximum sewage or waste flow from industrial plants, pumping requirements, excessive inflow/infiltration from existing sewer systems, and other situations that may exist but are not included in these Standards.

3.203 DESIGN CRITERIA FOR SANITARY SEWERS

In general, all sewers shall be designed using the following criteria, with variations from such to create a special project.

The sanitary sewers shall be used for all water-borne wastes from the following, including but not limited to:

All interior plumbing,
Bathtubs,
Cellar floor drains,
Drinking fountains,
Laundry tubs,
Lavatories,
Refrigerator drips,
Showers,
Sinks,
Slop sinks,
Soda fountains,
Stable floor drains,
Water closets,
Elevator sumps,
Public or private swimming pools,

or other sources of sanitary waste, whether from residences, factories, business buildings, schools, public buildings wherever or however located, or other purposes provided by the Revised Code of Ohio, and for no other purpose except by special written permission of the CCDPW. No wastes from such sources shall be permitted to enter the storm sewers, and no connection shall be permitted to be made from such sources to the storm sewers, nor shall sanitary wastes be discharged to any creek, stream, or any body of water. No water or waste of the character described in this section shall be admitted to the sanitary sewers except by special written permission of the CCDPW.

A. Energy Concept

The energy concept of hydraulic design shall be used on all projects, with the energy line occurring above the free water surface by an amount equal to the velocity head of $h_f = V^2/2g$.

B. Flow Formulas

Mannings Formula $V = \frac{1.486}{n}(R)^{2/3}(S)^{1/2}$ where S is slope in feet per foot;

R is the hydraulic radius; and *n* is roughness coefficient. The design roughness coefficient for all smooth interior pipe shall be *n* = 0.015 for sizes up to and including 27 inches; *n* = 0.013 for sizes including 30 inches through 84 inches and *n* = 0.011 for 90

inches or larger. Mannings Formula and Tables are provided in Table 3.3. The quantity of flow, Q = AV, where A is the cross sectional area of the conduit developed by the nominal conduit diameter is included in the Table. Where other than circular pipe is proposed, the actual cross-sectional area developed may be used.

The "*n*" factors used are higher than the manufacturer's suggested values to account for losses in manholes, joint misalignment, slime, and debris in pipe, etc.

TABLE 3.3

C. Mannings Formula Flow Tables

$$Q = AV \qquad V = \frac{1.486}{n} (R)^{2/3} \quad (S)^{1/2}$$

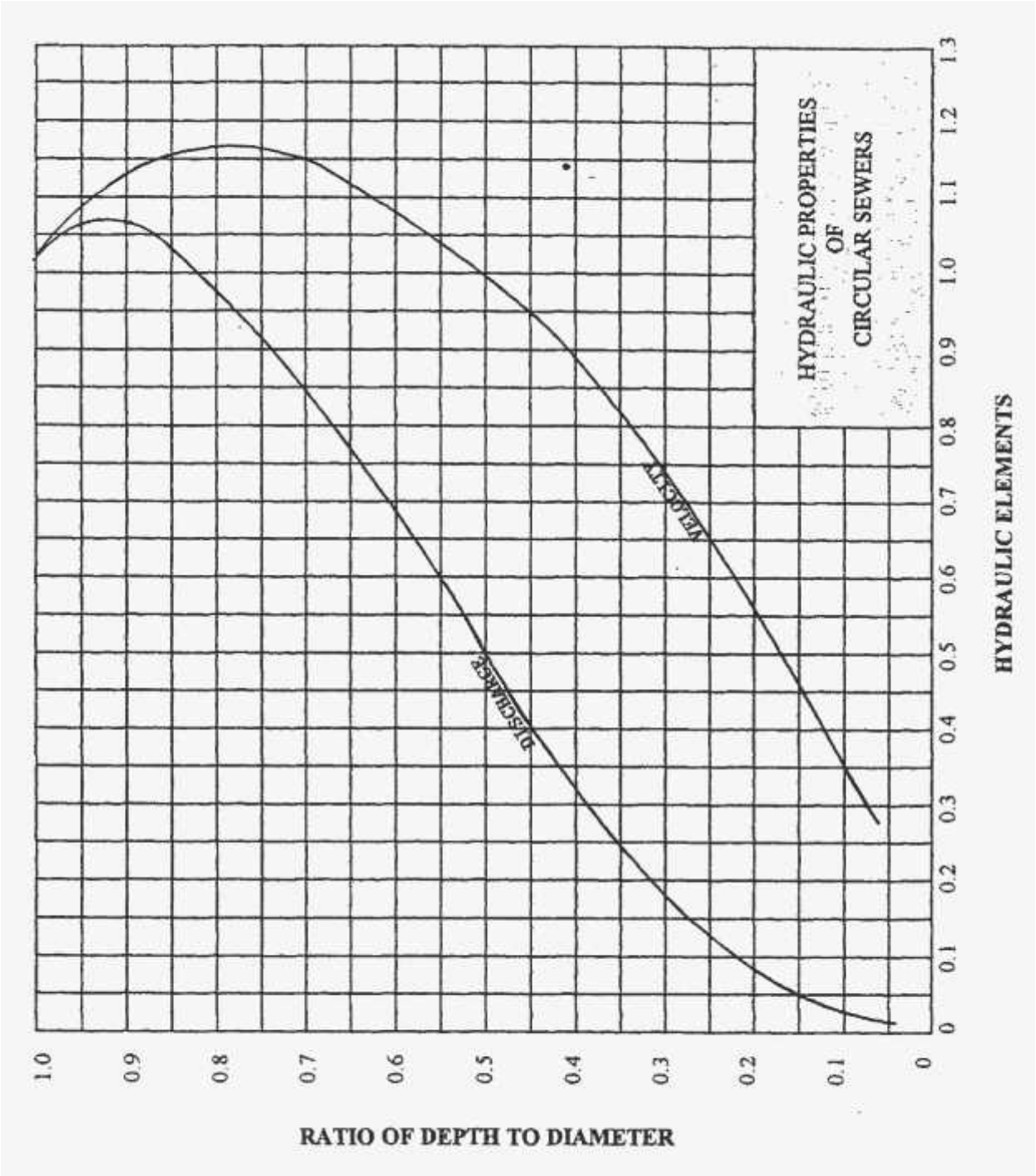
	DIAMETER (IN)	CAPACITY @ 1% (cfs)	AREA ($ft.^2$)	CAPACITY @ 1%
n = 0.015	5	0.321	0.139	0.207
	6	0.485	0.196	0.313
	8	1.061	0.349	0.686
	10	1.906	0.545	1.232
	12	3.087	0.785	1.995
	15	5.567	1.227	3.598
	16	6.604	1.389	4.266
	18	9.105	1.767	5.884
	21	13.73	2.405	8.870
	24	19.61	3.142	12.67
	27	26.75	3.977	17.29
n = 0.013	30	40.79	4.909	26.37
	33	53.03	5.940	34.28
	36	66.67	7.069	43.09
	39	82.41	8.296	53.26
	42	100.20	9.621	64.76
	48	143.60	12.570	92.84
	54	196.00	15.900	126.70
	60	260.40	19.640	168.30
	66	334.80	23.760	216.40
	72	423.40	28.270	273.70
	78	523.10	33.180	338.10
	84	638.80	38.490	412.90
n = 0.011	90	906.00	44.180	585.60
	96	1077.70	50.270	696.50
	102	1264.90	56.750	817.50
	108	1475.60	63.620	953.70
	120	1954.40	78.540	1263.20
	132	2520.20	95.030	1628.80
	144	3177.90	113.100	2053.90

TO FIND CAPACITY AT ANY SLOPE

MULTIPLY; CAPACITY LISTED @ 1% BY (S) $^{1/2}$ in %.

D. Hydraulic Properties of Circular Sewers

The hydraulic properties for partially full circular sections of pipe may be derived from the following graph:



E. Minimum Size

The minimum nominal size of all sanitary sewers, excluding lateral connections, shall be eight inches (8") in diameter; however, six (6") inch sanitary sewer may be used for apartment buildings, camps, schools, restaurants, and other semi-public operations on the same parcel provided their hydraulic capacity is not exceeded during peak flow periods and the sewer meets with Ohio EPA approval.

3.204 SEWER MATERIALS

A. Types of Sanitary Sewer Pipe

Product description, materials testing, field-testing, and installation techniques shall be governed by the documents cited below unless otherwise specified.

1. Vitrified Clay Sewer Pipe, ASTM C700 Extra Strength Only, may be used up to 15 inches in diameter in normal soil and effluent conditions. Vitrified Clay Sewer Pipe, ASTM C700 Extra Strength Only, Sizes 18 inches to 36 inches in diameter may be used for special projects for corrosive effluent or when installing in corrosive soils such as in brown field applications.

2. Polyvinyl Chloride (PVC) Composite Sewer Pipe ASTM D2680 may be used up to 15 inches in diameter.

3. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings conforming to ASTM D3034, SDR35, SDR23.5, SDR26, up to 15 inches in diameter; ASTM F949 up to 36 inches in diameter; ASTM F794 up to 48 inches in diameter; and ASTM F679 up to 36 inches in diameter.

4. Reinforced Concrete Pipe ASTM C76 or C507 may be used for 12 inches in diameter or larger.

5. Fiberglass (Glass Fiber Reinforced Thermosetting Resin) sewer pipe ASTM D3262 may be used for 8 inches to 144 inches in diameter.

6. Ductile Iron Pipe, ANSI/AWWA C151/A21.51-09 (Class 52 Cement Lined) may be used for 6 inches to 64 inches in diameter.

7. Polypropylene Corrugated Double Wall Pipe, ASTM F2736 for 12-inch to 30-inch diameter and Polypropylene Corrugated Triple Wall Pipe, ASTM F2764 for 30-inch to 60-inch diameter.

8. Polyethylene Pipe for 4-inch to 60-inch diameter, ASTM F2306 and AASHTO M294 Type S. Gaskets shall meet ASTM F477.

B. Sanitary Sewer Joints

All sanitary sewers in the right-of-way, easements, private property, under pavement, driveways, and sidewalks, and any other storm sewer tributary to public storm sewers shall be installed with premium watertight joints to insure maximum durability, flexibility, strength and water-tightness. **All joints shall be designed to meet Ohio EPA joint testing criteria.** All sewer materials listed herein provide for joint water-tightness tests in their specifications. All sewer joints in the public right-of-way shall conform to:

Clay pipe	ASTM C425,
Concrete pipe	ASTM C443,
Plastic pipe	ASTM D-3212,
Ductile Iron pipe	AWWA C111 for Ductile Iron Pipe,
Fiberglass pipe	ASTM D4161 (Glass Fiber Reinforced Thermosetting Resin) Pipe,
Polypropylene pipe	ASTM D3212

Joints for PVC pipe shall be elastomeric O-ring. Elastomeric qualities of joint gaskets or O-rings shall meet ASTM F477. **Solvent cement (glued) type joints are not permitted, except by written permission of the responsible authority.** If the joint is of the solvent cement type, it shall be installed per ASTM D2855 and the manufacturer's recommendations. Solvent cement for PVC piping and fittings shall conform to ASTM D2564. Welded joints shall be air tested 24 hours after installation. In repair situations, and on approval of the responsible authority, joints may be made using no-hub couplings for PVC pipe or Fernco Strong Back (or approved equal) couplings for other pipe materials as directed by the responsible authority.

3.205 FORCE MAINS

A. General Information

All materials for the force main shall comply with the latest applicable national organizations standards identified in Section 3.204A. Minimum cover of six (6) feet shall be used on force mains. All open cut force mains crossing under a stream shall have 6 inches of concrete (3000 PSI) encasement. All creek crossings shall meet applicable Ohio EPA standards, as well as the standards of any other responsible authority.

Whenever a sewage force main and watermain must cross, the sewage force main shall be placed at such an elevation that the crown at the sewage force main is at least 18" below the bottom of the watermain or the bottom of the force main is at least 18" above the top of the watermain while maintaining six (6) feet of cover. The sewage force main shall have a minimum 10 feet (barrel to barrel) of horizontal separation with a water main. These separation requirements shall also apply to all crossings of sewage force mains and water service lateral connections to residences, businesses, etc.

B. Materials

The force main material shall be polyvinyl chloride (PVC) pressure pipe, ductile iron pipe (DIP), or high-density polyethylene pipe. Other materials that are rated as pressure piping by ASTM, AWWA, or ANSI are acceptable. All pipe and fittings shall be designed for the applicable service requirements. The PVC pipe shall be SDR-21, meeting ASTM D2241, with push-on joints meeting ASTM D3139 or AWWA C-900, Class 150 meeting the requirements of DR-18 with rubber gaskets or O-rings conforming to ASTM D3139 and ASTM F477.

Ductile Iron Pipe (DIP) shall be cement lined and designed for wall thickness in accordance with ANSI/AWWA C150/A21.50. The minimum thickness shall be Class 52. Cement lining shall be in accordance with AWWA/ANSI C104/21.4.

Joints for ductile iron pipe shall be Push-On Joints or Mechanical Joints per the requirements of ANSI/AWWA C151/A21.51. All bolts and nuts on all retained mechanical joints shall have field applied one (1) coat of bitumastic painting. Where Push-On Joints are used, the joints shall be approved Type I or Type II boltless restrained Push-On Joints. The joints shall be installed as per the most current revision of AWWA C600.

Sanitary Sewer Force Main HDPE Pipe shall be minimum DR-11 (160 psi) with fused joints. The pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D3350 with a cell classification of PE: 345464C. Pipe 3" to 24" diameter shall have a manufacturing standard of ASTM F714. Pipe shall be a minimum DR 11 (160psi WPR) unless otherwise specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. Outside diameters shall be based on iron pipe size (IPS) for 3" to 24" diameter, and shall be based on copper tube size (CTS) for ¾" to 2" diameter.

Butt Fusion Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded and fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans.

Electrofusion Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans.

For pipe sizes ¾" to 1 ¼" diameter, socket joints may be used. For pipe sizes 1 ½" and larger only butt fusion or electrofusion joints may be used.

Joints between the main and branch fittings shall be made using saddle fusion or

electrofusion.

C. Fittings

For force mains 4" or larger, only ductile iron fittings are allowed. ANSI/AWWA C153/A21.53 fittings shall be cast from ductile iron ASTM A536 grade 70-50-05 with minimum tensile strength of 7,000 PSI in accordance with ANSI/AWWA C110/A21.10. Fittings and accessories shall be mechanical joints in accordance with ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11, with the exception of the manufacturer's proprietary design dimensions and weights. The wall thickness of ductile iron fittings shall be the equivalent of ductile iron Class 54. The working pressure rating shall be 350 PSI for ductile iron fittings up to 24" in diameter. Fittings shall have a bituminous outside coating in accordance with ANSI/AWWA C110/A21.10. Fittings shall be cement lined and seal coated with bituminous material in accordance with ANSI/AWWA C104/A21.4.

D. Thrust Blocks

All thrust blocks can be either 4,000 PSI concrete or of the pipe restraining type such as Megalugs (or approved equal) or retaining glands. The concrete blocking must have its entire face bearing against undisturbed soil. Blocking design shall be based on combined working pressures plus water hammer of 240 PSI minimum and bearing capacity values of 500 psf for soft clay; 1,000 psf for sand and gravel; 3,000 psf for shale; 5,000 psf for rock. No welding of bends will be permitted on the force main. Pipe bedding and trench details shall conform to the contract drawings.

Design calculations for the thrust blocks shall be submitted by the design engineer for review and approval. Other means of joint and fitting restraint shall be submitted by the design engineer for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

E. **Air Relief Valves and Vacuum Relief Valves**

Air relief valves shall be placed at high points in the force main to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions shall be evaluated by the design engineer as to the need and placement of air relief and vacuum relief valves. The design engineer shall also consider the effect of water hammer in his design. If requested or required, the design calculations shall be submitted for review. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

3.206 LAYOUT OF SANITARY SEWER SYSTEMS

A. General Information

In general, the layout of sanitary sewers shall follow all the pertinent requirements of Part 3 - Standards For Sewerage Facilities.

B. Depth of Sewers

In general, the top of the pipe of sanitary sewers shall be at least 10 feet below the building finished grade elevation in residential districts and 12 feet below the building finished grade elevation in all other areas. Conduits shallower than this requirement shall be considered a special project.

The top of the sanitary lateral sewer at the building line shall be checked to verify it is lower than the bottom of all basement floor slabs. All sewers and service connections shall have a minimum of three (3) feet of cover to the pavement subgrade within each site, and a minimum of nine (9) feet of cover in street sewers. Any variation shall require the review and approval of the responsible authority.

C. Minimum Size of Mainline

The minimum size for mainline sanitary sewers shall be 8-inches.

D. Drop Manholes

A drop manhole shall be constructed in sewers wherever the distance between the inverts is 24-inches or greater. The drop connection shall be an outside drop connection and shall be constructed per the requirements of Uniform Standard Sewer Details, Precast Concrete Drop Manhole.

An inside drop connection shall be considered a special case and shall require approval by the Municipal Engineer or responsible authority. If approved by the Municipal Engineer or responsible authority, the inside drop shall be as per Reliner/Duran Inc., drop bowels and details for inside drop connections, or approved equal.

E. Velocities

All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second. The following are the minimum slopes which should be provided; however, slopes greater than these are desirable, with maximum velocity of 15.0 feet per second. Velocities greater or less shall be considered special projects.

SEWER SIZE (INCH)	MIN. SLOPE IN %
6	1.00
8	0.44
10	0.33
12	0.26
15	0.20
16	0.18
18	0.15
21	0.12
24 and larger	0.10

F. Nursing Homes, Residential Care Facilities, and Veterans' Homes, etc.

See the general requirements of Section 3.6, Design of Interceptors, Traps, and Separators, and the specific requirements of Section 3.605, Other Types of Interceptors and Sizing Requirements; D. Nursing Homes, Residential Care Facilities, and Veterans' Homes, etc.

3.207 ORGANIZATION OF COMPUTATIONS

The Standard Sanitary Sewer Data Sheets and Sanitary Sewer Design Calculation Sheets, contained in Part 6, shall be filled out for each project and submitted to the approving governmental authority, along with a sewerage design drainage area map of such scale as to reasonably relate both on and off-site areas incorporated within the design.

3.3 - DESIGN OF STORM SEWER SYSTEMS

Note that the initial requirements of Section 3.2, Design of Sanitary Sewer Systems, Letters A through U, shall apply to the design of all sanitary sewer systems and storm sewer systems. Section 3.3, Design of Storm Sewer Systems, contains additional requirements specific to storm sewer systems design.

3.301 DESIGN OF STORM SEWER SYSTEMS

A. General Information

These guidelines apply to storm sewers in the public right-of-way. Storm sewers on private property fall under the jurisdiction of the Municipal Engineer where work is being performed. Storm drainage shall be designed for conveyance in a separate gravity system at such depths that all structures within the tributary area may be served to full foundation footer drain depths, wherever possible, and no violations of a natural drainage area are generated.

All storm sewer design and stormwater management plans must comply with, and be integrated into, any Regional Watershed Management Plan applicable to a given community drainage basin or watershed.

B. Investigations and Surveys

Investigations

Information on all existing conditions shall be listed. This information shall include capacity of receiving sewers or downstream ditches, culverts, streams, and the ability of receiving waterways to provide an adequate outlet with respect to both depth and capacity in vicinity of storm outlet.

All existing retention/detention basins in the drainage basin which may influence the proposed sewer design shall be investigated.

C. Special Projects

Variation from a separate gravity storm sewerage system of normal depth shall be considered a special project. The approving governmental authority shall review and approve the proposed variation in concept prior to final design. Variations requiring review and approval will include shallow depth, materials of construction, methods of construction, controlled discharge systems, combination conduit-overland flow system, and others.

3.302 DESIGN CRITERIA FOR STORM SEWER SYSTEMS

A. General Information

In general, all storm sewers shall be designed using the following criteria, with variations from such to create a special project.

Connections with storm sewers shall be for the removal of clean water including, but not limited to,
Cistern overflows,
Cooling waters waste,
Downspouts from roofs,
Exterior loading dock floor drains,
Foundations,
Ground water from surface inlets and catch basins,
Roof water,
Subsoil drains,
Surface water,
Yard drains,
and for no other purpose, unless by special written permission of the CCDPW.

No water or waste of the character described in this section shall be admitted to the storm sewers except by special written permission of the CCDPW.

If requested or required, the design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

In the design of storm sewers, topography maps shall be furnished. The topography maps shall show all drainage and sub-drainage for the project, direction of the drainage, paved and lawn areas (impervious and pervious areas), and area increments.

The design of the storm sewer shall comply with the CCDPW Uniform Standards. The design calculations for sewer sizing shall be submitted to the responsible authority for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

B. Design Storm Frequency

Residential	10 Year
Multifamily	10 Year
Schools	10 Year
Industrial/Commercial	25 Year
Major Urban Business Area	25 Year

In addition, the hydraulic grade line for the 25-year storm shall not exceed the elevation of the top of the grate of any catch basin or the top of casting of any manhole.

Additional Minimum Criteria

Flow between	0 cfs -	500 cfs	10 Year Frequency
Flow between	500 cfs -	1500 cfs	25 Year Frequency
Flow between	1500 cfs -	and over	50 Year Frequency

C. Rainfall Intensity – Duration for Use in Design of Inlets and Storm Sewers

	Inches/hour	Inches/24 hours
2 - Year Storm	i = 1.21	i = 2.36
5 - Year Storm	i = 1.52	i = 2.94
10 - Year Storm	i = 1.76	i = 3.42
25 - Year Storm	i = 2.09	i = 4.10
50 - Year Storm	i = 2.34	i = 4.67
100 - Year Storm	i = 2.61	i = 5.28

Note: Site specific NOAA Atlas 14 rainfall data shall be used for design of retention basins and detention basins.

D. Runoff Coefficient

Zoning	**Lot Area (ft^2)**	**c =**
Residential	0 – 5,000	0.70
	5,000 – 10,000	0.60
	10,000 – 25,000	0.50
	25,000 And Over	0.40
Multifamily and Schools		0.75
Industrial/Commercial		0.90
Shopping Centers		0.90
Major Urban		0.90
Business Area		0.90
Wooded Areas		0.30
Cultivated Areas (dependent on soil type and plant cover)		0.30 to 0.60

The above runoff coefficients assume typical ground cover and average slope.

E. Concentration Times

1. Residential Areas.
   The concentration times to the critical inlet varies between 12 and 20 minutes with 15 minutes to be used as the average case based upon full development of the land.

2. Industrial - Multifamily - School Areas.
   The concentration time to the critical inlet varies between 10 and 15 minutes with 12.5 minutes to be used as the average case based upon full development of the land.

3. Major Urban Business Areas and Shopping Centers.
   The concentration time to the critical inlet varies between 5 and 12 minutes with 10 minutes used as the average case based upon full development of the land.

F. Standard Rainfall Intensity-Duration Tables

The Standard Rainfall Intensity-Duration Tables shall be used for inlet and storm sewer design to determine the rainfall intensity occurring at the time of concentration to the inlet under consideration. The Standard Rainfall Duration Tables were obtained from precipitation frequency data in the NOAA Atlas 14, Volume 2, Version 3 and are based on the precipitation at the center of Cuyahoga County which is located at (41.433858 N, -81.6665173W).

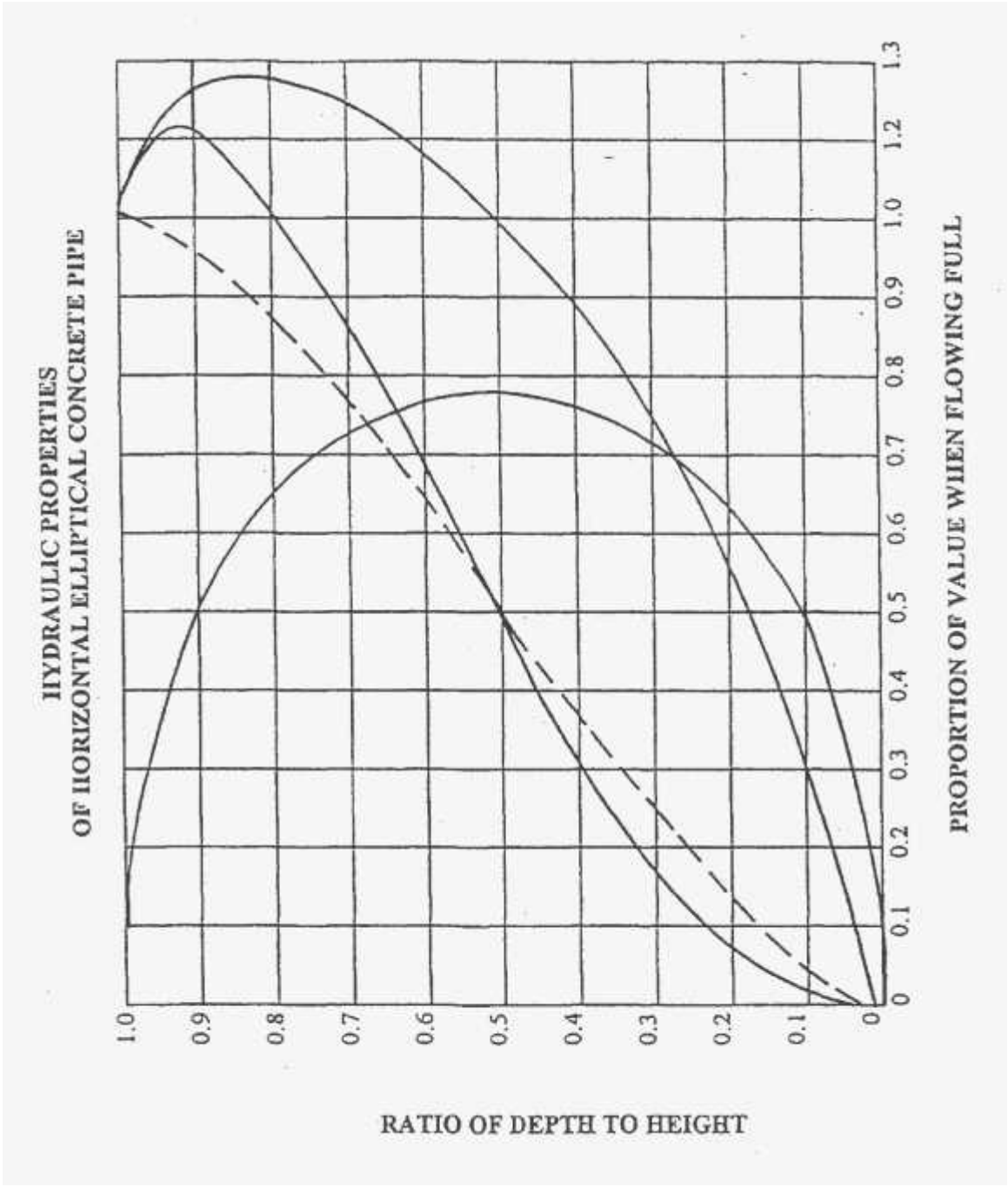
Site-specific NOAA Atlas 14, Volume 2, Version 3 rainfall data shall be used for the design of retention basins and detention basins.

STANDARD RAINFALL INTENSITY-DURATION TABLES

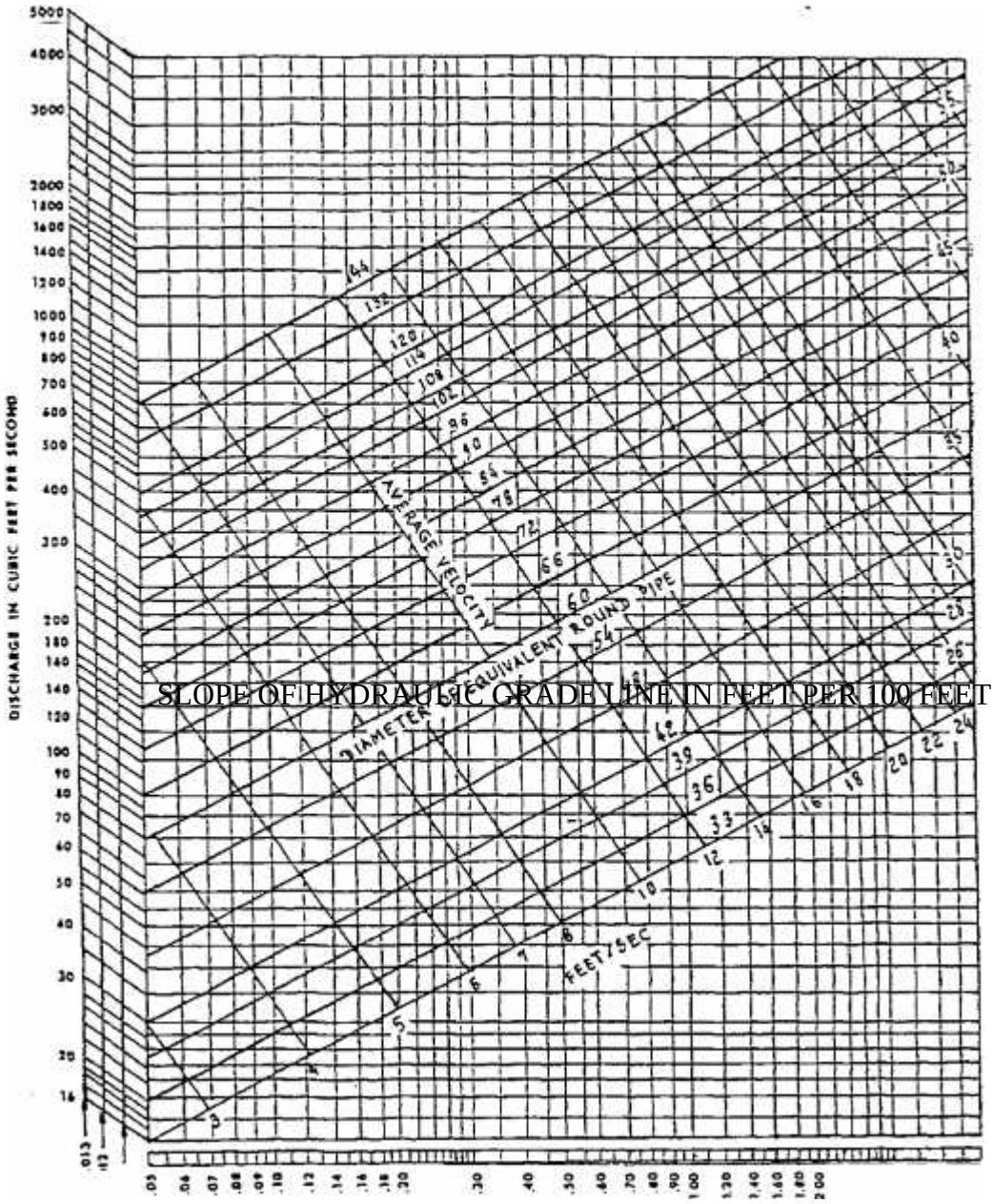
Rainfall Intensity in Inches per Hour

Time of Concentration In Minutes	2 Yr.	5 Yr.	10 Yr.	25 Yr.	50 Yr.	100 Yr.
	Design Storm Frequency					
	1.21"/Hr.	1.52"/Hr.	1.76"/Hr.	2.09"/Hr.	2.34"/Hr.	2.61"/Hr.
5	4.60	5.55	6.28	7.24	7.95	8.64
6	4.35	5.25	5.94	6.84	7.50	8.15
7	4.12	4.99	5.63	6.49	7.11	7.72
8	3.92	4.75	5.36	6.18	6.77	7.34
9	3.74	4.53	5.12	5.90	6.46	7.00
10	3.58	4.34	4.90	5.65	6.19	6.71
11	3.43	4.16	4.70	5.42	5.94	6.44
12	3.29	4.00	4.52	5.21	5.72	6.20
13	3.17	3.85	4.36	5.02	5.51	5.97
14	3.05	3.72	4.20	4.85	5.32	5.77
15	2.94	3.59	4.06	4.69	5.15	5.59
16	2.85	3.47	3.93	4.54	4.99	5.42
17	2.75	3.37	3.81	4.41	4.84	5.26
18	2.67	3.26	3.70	4.28	4.70	5.11
19	2.59	3.17	3.59	4.16	4.57	4.97
20	2.51	3.08	3.49	4.05	4.45	4.84
21	2.44	3.00	3.40	3.94	4.34	4.72
22	2.38	2.92	3.31	3.84	4.23	4.61
23	2.31	2.84	3.23	3.75	4.13	4.50
24	2.26	2.77	3.15	3.66	4.03	4.40
25	2.20	2.71	3.08	3.58	3.95	4.31
26	2.15	2.64	3.01	3.50	3.86	4.22
27	2.10	2.58	2.94	3.42	3.78	4.13
28	2.05	2.53	2.88	3.35	3.70	4.05
29	2.00	2.47	2.82	3.29	3.63	3.97
30	1.96	2.42	2.76	3.22	3.56	3.90
35	1.77	2.19	2.51	2.94	3.25	3.58
40	1.62	2.01	2.30	2.71	3.01	3.31
45	1.49	1.86	2.13	2.51	2.80	3.10
50	1.38	1.73	1.99	2.35	2.62	2.91
55	1.29	1.62	1.87	2.21	2.47	2.75
60	1.21	1.52	1.76	2.09	2.34	2.61
70	1.10	1.36	1.57	1.89	2.11	2.34
80	1.01	1.23	1.41	1.73	1.88	2.14
90	0.94	1.13	1.28	1.54	1.75	1.96
100	0.83	1.02	1.17	1.43	1.62	1.83
110	0.75	0.95	1.09	1.33	1.51	1.70
120	0.70	0.89	1.03	1.24	1.41	1.59

G. Hydraulic Properties of Horizontal Elliptical Concrete Pipe



H. Horizontal Elliptical Reinforced Concrete Pipe Flowing Full



I. Flow Formulas

1. For design of pavement inlet, roadway ditches and small storm sewers and where no natural well-defined channels exist and sheet flow prevails determine, quantity of runoff by Rational Method for areas up to 100 Acres.

   Q = CIA in cubic feet per second where A is the area to be drained in acres, C is the runoff coefficient for the area under consideration and I is the rainfall intensity derived from the Standard Rainfall Intensity-Duration Tables for the concentration time to the inlet or ditch under consideration.

2. For design of culverts, stormwater pump stations, large storm sewers, and large open channels in urban areas with drainage areas greater than 100 acres and less than 6.5 square miles, use method presented in USGS Open File Report 93-135 "Estimation of Peak-Frequency Relations, Flood Hydrographs, and Volume-Duration-Frequency Relations of ungaged small streams in Ohio" or the method presented in the Soil Conservation Service Technical Release No. 55 (TR-55) or Technical Release No. 20 (TR-20).

3. For design of culverts, stormwater pump stations, large storm sewers, and large open channels in urban areas with water drainage areas greater than 6.5 square miles, use the Soil Conservation Service Technical Release No.55 (TR-55), or Technical Release No. 20 (TR-20), or other design methods approved by the responsible authority.

4. For design of retention or detention basins use the Soil Conservation Services Technical Release No. 55 (TR-55), or Technical Release No. 20 (TR-20), or other design methods approved by the responsible authority.

5. Manning's Formula

   $$V = \frac{1.486}{n} (R)^{2/3} (S)^{1/2}$$ where S is slope in feet per foot; R is hydraulic radius; and n is the roughness coefficient. The roughness coefficient for smooth interior pipe such as concrete, clay, PVC, ductile iron, smooth inner wall polyethylene or polypropylene pipes shall be n = 0.015 for sizes up to and including 27 inches; n = 0.013 for sizes including 30 inches through 84 inches and n = 0.011 for 90 inches and larger. The roughness coefficients take into account head losses through manholes and catch basins, joint misalignment, slime and debris. Flow values for the Manning Formula are provided in Table 3.3. This Table is based on Quantity of flow Q = Av where A is the cross-sectional area of the conduit developed by the nominal conduit diameter. Where other than circular pipe is proposed, the actual cross-sectional area developed may be used.

   Corrugated metal pipe and corrugated inner wall polyethylene pipe shall only be used for storm sewers. The formula for the Hydraulic Radius is R = A/p where p is the wetted perimeter developed by the nominal pipe diameter and/or the actual

wetted perimeter developed may be used. The roughness coefficient for corrugated interior metal storm sewer pipe varies from 0.027 for small diameter pipe (12" or less) to 0.022 for large diameter pipe (120" or greater). For design purposes, *n* = 0.024 should be used for all non-paved standard corrugated metal storm sewer pipes. Spiral ribbed metal storm sewer pipe shall have the same *n* values as concrete pipe. The roughness coefficient used for design for corrugated polyethylene storm sewer pipe with corrugated inner walls shall be 0.018 for 6" diameter, 0.019 for 8" diameter, 0.020 for 10" diameter, 0.022 for 12" to 15" diameter, and 0.024 for 18" to 24" diameter.

6. Hydraulic Radius
   The formula for the hydraulic radius is R = A/p where p is wetted perimeter developed by the nominal pipe diameter. Where other than circular pipe is proposed, the actual wetted perimeter developed may be used.

3.303 LAYOUT OF SEWERS

A. General Information

In general, the layout of storm sewers shall follow all the pertinent requirements of Part 3 - Standards For Sewerage Facilities.

B. Depth of Sewers

For storm sewers, in general, the top of the pipe shall be at least eight and one-half (8-1/2) feet below the building finished grade elevation in residential districts and ten and one-half (10-1/2) feet below the building finished grade line elevation in all other areas. Conduits shallower than this requirement shall be considered a special project.

C. Minimum Size of Mainline

The minimum size of all storm sewers, excluding connections and yard drains, shall be 12 inches in diameter. The minimum yard drain outlet pipe is recommended to be 8" in diameter; however, 6" yard drain outlet pipes may be used for draining small areas.

D. Drop Manholes

On a case by case basis, the responsible authority may require that a drop manhole shall be constructed in storm sewers wherever the distance between the inverts is 24-inches or greater. The drop connection shall be an outside drop connection and shall be constructed per the requirements of Uniform Standard Sewer Details, Precast Concrete Drop Manhole detail.

An inside drop connection shall be considered a special case and shall require approval by the Municipal Engineer or responsible authority. If approved by the Municipal Engineer or responsible authority, the inside drop shall be as per Reliner/Duran Inc., drop bowls and details for inside drop connections, or approved equal.

E. Velocities

All storm sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 3.0 feet per second, with a maximum velocity of 15.0 feet per second. Velocities greater or less shall be considered special projects.

F. Catch Basins with Traps

Consideration should be given to installing catch basins with traps prior to the connection of inlets into the main storm sewer system to control the release of floatable debris into the sewer system. Catch basin and inlet spacing should be determined by the municipality's maximum allowable gutter spread and design year gutter storm. For municipalities without gutter-spread guidelines it is recommended a minimum design should be a 2-year storm with a maximum of 4 feet of spread into the traveled lane. A dedicated 2-foot wide gutter is not considered part of the traveled lane.

G. Trench Drains

Trench (or strip) drains are required across all service station drives and comparable installations behind sidewalks. A small basin shall be installed at the end of the trench drain such that the drainpipe shall have a minimum of three (3) feet of cover. Trench frames and grates shall be as required in the Uniform Standards.

H. Drainage Through Buildings

Yards and/or parking areas shall not be drained through, nor under, buildings, but shall be independently sewered around buildings. The building drains may be connected into the independent sewer.

I. Open Channel and Culvert Design

Open channels and culverts shall be designed in accordance with the methods presented in the ODOT Location and Design Manual Volume Two – Drainage Design, latest edition.

Channel and slope protection shall be provided as indicated in the ODOT Design Manual Volume Two – Drainage Design, latest edition and as per local County Soil and Water Conservation District's guidelines. The more stringent of the two agencies guidelines and recommendations shall apply.

Culverts under all roads with minimum traffic volumes of 2000 vehicles per day shall be designed for a minimum of a 25-year storm flow with headwater of one (1) foot below the edge of the roadway. All culverts shall also be designed to keep the 100-year storm headwater a minimum of 1.0 feet below the elevation of any occupied upstream building. In addition, culverts within FEMA flood plains and floodways shall be designed in accordance with FEMA regulations. The requirements and regulations of the U.S. Army Corps of Engineers and Ohio EPA shall be adhered to whenever placing a culvert in an existing streambed or enclosing an existing stream.

J. Sump Pumps

Basement sump pumps shall be provided in areas where the receiving stream or downstream sewer is higher than the basement floor or footer drains and gravity flow is not possible between the footer drains and the outlet sewer or ditch. Basement sump pumps shall also be provided in areas where a high groundwater level is anticipated. Basement sump pumps draining footer drains and/or downspouts shall not be connected to sanitary laterals or sanitary mainline sewers.

K. Types of Storm Sewer Conduits

All piping materials, manholes, and appurtenances furnished for public storm sewerage facilities shall comply with the latest applicable national standards, including, but not limited to:

- American Society for Testing and Materials (ASTM),
- American National Standards Institute (ANSI),
- American Water Works Association (AWWA),
- American Association of State Highway and Transportation Officials (AASHTO),
- CCDPW Uniform Standards for Sewerage Improvements,
- Or other representative standards organizations.

The characteristics of the storm sewerage, as well as the existing soil conditions (e.g., type, depth, etc.) shall be considered in the selection of the pipe materials.

In addition to conduits accepted for sanitary sewers, the following conduits may be utilized for public storm sewers:

1. Reinforced Concrete Arch Culvert ASTM C506

2. Reinforced Concrete Elliptical Pipe ASTM C507

3. Reinforced Concrete Box Culvert ASTM C1433

4. Uncased bored and jacked sewer conduit up to 100 feet in length and under 18 inches shall be Ductile Iron Pipe ANSI A21.51 Push-Pipe Class 52. Pipe 18 inches and greater shall be Reinforced Concrete Pipe ASTM C76 and designed in accordance with requirements of Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction (ASCE 27-00).

5. Polyvinyl Chloride (PVC) Profile Wall Drain Pipe ASTM F949 or AASHTO M304. Pipe cell classification must be stamped on pipe. When required by the Municipal Engineer, certification of long term properties of design shall be provided.

6. Steel Sheet Aluminized Coated Type 2 for Corrugated Steel Pipe, 46 PSI minimum pipe stiffness conforming to ASTM A929/A929M and AASHTO M274 is acceptable for

installation where such pipe is approved by the Municipal Engineer, and where soils pH are in the range of 5-9.

7. High Density Polyethylene for 12" to 60" diameter storm sewer pipe; bell and spigot type, with rubber gaskets, smooth interior, conforming to the latest AASHTO M294 specifications.

8. Steel Reinforced Polyethylene Pipe (SRPE) with smooth inner wall for 24" to 120" diameter storm sewers with bell and spigot gasketed water tight joints. Pipe shall conform to ASTM F2562/F2562M.

9. Corrugated Metal Pipe for driveway culverts only in areas where the depth of cover is 4 feet or less. CMP shall conform to the requirements of ASTM 760/A760M.

10. Polypropylene double or triple wall pipe for 12" to 60" diameter storm sewers, bell and spigot type, with rubber gaskets, smooth interior, conforming to the latest AASHTO M330 Specification, except for calculation of minimum pipe wall thickness which shall be done in accordance to the Modified Iowa Formula for pipe depths of cover 15 feet or greater.

11. Deflection testing, per Section 5.211, is required on all storm and sanitary PVC, thermoplastic pipe, fiberglass pipe, high-density polyethylene pipe, and polypropylene pipe with a pipe stiffness less than 200 PSI. Air testing shall be required for all PVC, VCP, fiberglass, polypropylene, and thermoplastic sanitary and storm sewers less than 36" diameter, and for all concrete pipe 24" and less in diameter.

L. <u>Storm Sewer Joints</u>

All storm sewers in the right-of-way, easements, private property, under pavement, driveways, and sidewalks, and any other storm sewer tributary to public storm sewers shall be installed with premium watertight joints to insure maximum durability, flexibility, strength and water-tightness. **All joints shall be designed to meet Ohio EPA joint testing criteria.** All sewer materials listed herein provide for joint water-tightness tests in their specifications. All sewer joints in the public right-of-way shall conform to:

ASTM D3212 for plastic pipes,
ASTM D3212 elastomeric gasket push-on type joint for PVC composite wall pipes,
ASTM C425 for clay pipes,
ASTM C443 for concrete pipes,
ASTM A798/A798M for aluminized steel pipes (where pipe is approved by Municipal Engineer),
ASTM F477 for high density polyethylene pipes,
ASTM D3212 for polypropylene pipes, and
AASHTO M36 coupling bands for corrugated metal pipes (where pipe is approved by Municipal Engineer).

Exceptions may be allowed upon approval of the responsible authority.

Joints for PVC pipe shall be elastomeric O-ring. Elastomeric qualities of joint gaskets or O-rings shall meet ASTM F477. **Solvent cement (glued) type joints are not permitted, except by written permission of the responsible authority.** If the joint is of the solvent cement type, it shall be installed per ASTM D2855 and the manufacturer's recommendations. Solvent cement for PVC piping and fittings shall conform to ASTM D2564. Welded joints shall be air tested 24 hours after installation. In repair situations, and on approval of the responsible authority, joints may be made using no-hub couplings for PVC pipe or Fernco Strong Back (or approved equal) couplings for other pipe materials as directed by the responsible authority.

3.304 DETENTION/RETENTION BASINS AND OTHER STORMWATER CONTROL MEASURES

In general, storage basins are considered to be special projects with the design criteria to be that of the local city/village/township ordinances and as recommended by the County Soil and Water Conservation District Model Ordinance. In general, the post construction storm water runoff exiting the detention basin for the 1, 2, 5, 10, 25, 50 and 100 year storms must be less than or equal to the preconstruction undeveloped runoff. In addition, local municipalities may require the retention/detention basin to be designed for the critical storm. All retention/detention basin plans and construction must be approved by the local municipality. Approvals may also be required from the local County Soil and Water Conservation District if required by the local municipality. In addition, all stormwater management plans shall be submitted to the designated stormwater management authority having jurisdiction for review and approval.

Maximum storm water discharge from any project may be established by the responsible authority for the purpose of minimizing downstream flooding, erosion control or protection of downstream structures.

During construction, surface dewatering devices, such as skimmers, shall be required in temporary detention/retention basins as per Ohio EPA requirements.

Other stormwater control measures as contained in the Ohio Department of Natural Resources Rainwater and Land Development Manual may be considered on a case-by-case basis by the responsible authority.

3.305 HEADWALLS

The design engineer shall consider the earth pressure and surcharge pressures exerted behind the headwall during design. The headwalls shall be designed to resist overturning.

In areas with steep backslopes, the use of an ODOT HW-1.1 headwall shall be considered. In areas with gradual backslopes, an ODOT HW-2.1 or HW-2.2 headwall shall be considered. Outlet channel protection, consisting of limestone dumped rock and sized per ODOT Design Manual Volume Two-Drainage Design requirements or alternative methods of erosion protection approved by the local municipality shall be placed in areas with erodible soils. A filter fabric or 6-inch deep layer of No. 3 or No. 4 limestone shall be used below the limestone dumped rock. Grouted riprap, energy dissipaters, or stilling basins shall be used at the end of outlet pipes having flow velocities greater than 18 feet per second.

3.306 ORGANIZATION OF COMPUTATIONS

The Standard Computation Sheet contained in Part 6, shall be filled out for each project and submitted to the approving governmental authority along with a drainage area map of such scale as to reasonably relate both on and off-site areas incorporated within the design.

Any special treatment, such as stilling basins, energy dissipator, downstream channel improvements, erosion control or other treatment shall be taken into consideration by the design engineer.

3.4 - DESIGN OF WASTEWATER AND STORM WATER PUMPING STATIONS

The design engineer shall refer to the latest revision of the Recommended Standards for Wastewater Facilities (aka Ten State Standards) for the design of wastewater and storm water pumping stations.

Pump stations should only be proposed after careful consideration has been given to alternative sewer planning. All pump stations require operation and maintenance, the cost of which, when capitalized, frequently will justify a considerable first-cost expenditure to build a gravity sewer. Therefore, an economic analysis report (Facility Report) shall be done by the design engineer in which the initial costs of a pump station plus the costs for the operation and maintenance (O&M) of the pump station for a 20-year period shall be compared to the initial costs of a gravity sewer plus O&M for a 20-year period. This analysis shall be reviewed and approved by the responsible authority.

Frequently, the use of a pump station can be avoided by placing the sewers at a shallow depth. When shallow sewers are used, the wastewater generated on the floors of buildings that are located below grade may need to be pumped. Sound designs call for serving the majority of the service area by gravity with only limited low areas served by pump stations. All raw sewage pump stations must include at least two pumps in each wet or dry well with motors, dual controls, automatic alternators, and alarm. Each pump in a two-pump station shall be capable of handling flows in excess of the expected maximum flow. The alarm system shall be activated when the standby pump comes on. Alternate sources of power or standby pumping or generating equipment may be required. No overflows or bypass will be permitted.

All raw sewage pump stations shall be equipped with rails, hoists, and other means for lifting the pump, motor, or pump motor units above ground without entering the wet well. All raw sewage pumps other than grinder pumps shall be capable of passing three-inch (3") solids. Grinder pumps are an acceptable type of submersible pump for raw sewage pump stations. Wet well, dry well, and submersible pumps are acceptable.

Submersible pumps will be approved provided that:

1. Pump and motor unit can be removed and installed from above ground without dewatering or having personnel work in the sewage wet well;

2. Valves are installed in an enclosure outside the wet well. Valves shall be located in a separate valve pit. Valve pits may be dewatered to a wet well through a check valve or other automatic closing valve without using a manually operated valve or liquid seal. Check valves that are integral to the pump need not be located in a separate valve pit provided that the valve can be removed from the wet well without entering the wet well;

3. Electrical controls are installed outside the wet well;

4. Access openings shall be provided, sized, and located to allow easy removal of pumps and

equipment; and

5. Explosion-proof submersible pumps shall be used for raw sewage unless a "pump off" switch is installed and maintained above the motor. A separate backup pump-off switch wired to the control panel shall be provided.

Pump Station and Force Main Design

1. The project owner's design engineer must submit a Facility Report for the review and approval of the CCDPW, and/or the responsible authority. As necessary, or as required by the responsible authority, the report shall cover all necessary information including, but not limited to:
    a. Maps showing the existing and proposed service areas
    b. Geographical location map
    c. Topographical maps and geological maps, including geotechnical investigation
    d. Location, size, and direction of all existing and proposed sanitary and storm sewers
    e. Existing development, existing facilities, existing flows
    f. Projected future flows, future development, flow characteristics, and required performance
    g. Computations utilized for the sizing of pumps, wet well, and piping
    h. Technical and economic evaluations of alternatives
    i. Profile of proposed force main showing necessary elevations
    j. Location and capacity of existing outlet sewer or treatment facility
    k. Evaluations of existing and future environmental alternatives
    l. Energy conservation program
    m. Technical and economic evaluations of alternatives
    n. Recommended alternatives and reasons for selection
    o. Financial requirements, such as preliminary cost estimates, assessments, etc.
    p. Institutional responsibilities
    q. Implementation steps
    r. Materials and equipment selections for the pump station, piping, and force main

2. Furthermore, the requirements of Section 3.5 - Design of Wastewater Treatment Plants shall apply as applicable and/or as required by the responsible authority including, but not limited to, submittal requirements, standby power requirements, etc.

3. Minimum size of force main for use with grinder pumps is two (2) inches in diameter. Grinder pumps shall be used only for one single-family residence or one duplex.

4. The Minimum Clearance requirements for sanitary sewers (including force mains), storm sewers, and water mains, as stated elsewhere herein, shall apply. Force mains shall be supported in accordance with good engineering practice.

5. Thrust blocks shall be placed at changes in direction. Thrust blocks shall be designed to

withstand normal pressures and pressure surges (water hammer) in the force main. If requested or required, the design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

6. Automatic air relief valves shall be placed at high points in the force main, and elsewhere as necessary, to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions shall be evaluated by the design engineer as to the need and placement of air relief and vacuum relief valves. The design engineer shall also consider the effect of water hammer in his design. Air relief valves shall be no less than ¾-inches and generally no more than 2-inches in size. Air relief valves shall be housed in a chamber, and shall meet the requirements of USSD Sanitary Force Main Air Release Valve Chamber. If requested or required, the design calculations shall be submitted for review. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

7. Cleanouts shall be placed at a distance of not more than every 500 feet on the force main.

8. Where possible, the crown of the force main outlet shall generally align with the crown of the sewer at the receiving manhole, in order to reduce turbulence and the resulting liberation of hydrogen sulfide (which may oxidize to sulfuric acid and cause structural damage in the manhole). If the velocity in the force main is more than 6.5 ft./sec., or if more than one force main is involved, it may be necessary to design a special entrance or to make provisions for energy dissipation in order to minimize turbulence.

9. Proper piping and joint support shall be provided for all aerial crossings of force mains. The support all of force mains shall be designed to prevent frost heave, overturning, and settlement, etc.

10. A minimum of six (6) feet of cover shall be used on all force mains. Precautions against freezing, such as insulation and increased cover, shall be provided.

11. The top of a force main entering or crossing a stream shall be at sufficient depth below the natural bottom of the streambed to protect it. If the cover of the force main crossing the streambed is not sufficient, six (6) inch concrete (3000 psi) encasement shall be provided.

12. Where appropriate, an odor control mechanism shall be provided at the pump station and the force main.

13. The design of the pump station control system and SCADA system shall be coordinated with the CCDPW or the appropriate responsible maintenance authority.

3.5 - DESIGN OF WASTEWATER TREATMENT PLANTS

The design engineer shall refer to the latest revisions of the Recommended Standards for Wastewater Facilities (aka Ten States Standards) for the design of wastewater treatment plants for plants over 100,000 GPD; and for plants under 100,000 GPD, use OEPA Guidelines.

General minimum requirements pertaining to sewage treatment facilities submittals for review and approval are as follows:

1. The basis of design of all types and sizes of wastewater treatment plant (WWTP) facilities shall be accordance with good engineering practice and conform to the current accepted design standards, waste load allocations, NPDES requirements of the OEPA, the requirements of the CCDPW, and the requirements of the responsible authority. The CCDPW, and/or the responsible authority, and the OEPA must review and approve the proposed facility site.

2. The project owner's design engineer must submit a facility report for the review and approval of the CCDPW, and/or the responsible authority. As necessary, or as required by the responsible authority, the report shall cover all necessary information including, but not limited to:

    a. Maps showing the existing and proposed service areas
    b. Boundary lines of the governmental entities
    c. Geographical location map
    d. Demography and land use
    e. Topographical maps and geological maps, including geotechnical investigation
    f. Location, size, and direction of all existing and proposed sanitary and storm sewers
    g. Collection system evaluation survey
    h. Existing development, existing facilities, and performance (flows, loadings, sludge, effluent, etc.)
    i. Projected future flows, future development, flow characteristics, and required performance (NPDES Permit requirements), design computations
    j. Proposed unit process flow diagrams and a preliminary hydraulic profile
    k. Location of the WWTP outfall, stream water quality monitoring, data, and where appropriate, subsurface water investigation
    l. Evaluations of existing and future environmental alternatives
    m. Energy conservation program
    n. Technical and economic evaluations of alternatives
    o. Recommended alternatives and reasons for selection
    p. Financial requirements, such as preliminary cost estimates, assessments, etc.
    q. Institutional responsibilities
    r. Implementation steps
    s. Materials and equipment selections

3. Upon acceptance of the proposed site feasibility plans and facility site plans, the project owner shall submit al necessary easements and deposits to the responsible authority, and/or the CCDPW.

4. The project owner's design engineer shall submit a minimum of six (6) copies of the detailed plans, specifications, and itemized estimates of cost to the responsible authority, and/or the CCDPW, and the OEPA for review and approval. One copy of OEPA approved plans and specifications shall be furnished to the CCDPW prior to construction.

5. After approval of the detailed plans and specifications, the project owner's design engineer shall also submit to the responsible authority and/or the CCDPW, a minimum of eight (8) copies of all shop drawings, equipment manufacturer's catalog data, performance curves, design calculations, etc., for review and approval. Equipment model numbers, equipment controls, design points, structural load requirements, process, electrical, structural, architectural, etc., must also be submitted. All shop drawings shall be submitted prior to the start of construction.

6. When construction is authorized to commence by the responsible party, it shall be under daily construction inspection by a Construction Inspector representing the responsible authority.

7. The responsible authority and/or the CCDPW will accept the facility for operation and maintenance only after construction is completed to the satisfaction of the responsible authority and/or the CCDPW. If there is a conditional acceptance pending completion of some minor portion of the work, the project owner/contractor shall be responsible for all operational costs related to the total operation of the facility until such time as all work is completed.

8. All tankage shall be cast in place concrete or precast concrete (except under certain circumstances to be determined by the responsible authority and/or the CCDPW), where metal tankage may be allowed. In general, all installations of tanks and buildings structures shall be either cast in place or precast reinforced concrete of approved design with masonry substructures. Superstructures shall be compatible with the surrounding areas.

9. All concrete structures below grade shall be waterproofed.

10. All tanks, stairs, bridges, etc., shall have suitable, corrosion resistant, OSHA approved handrails.

11. All outside door openings shall have thresholds. All operating windows shall have screens and all windows shall have window guards. All outside doors shall have a common key for locking. All such hardware shall be of corrosion resistant materials.

12. All buildings shall have heavy-duty hardware. All hardware shall be of corrosion resistant materials.

13. Sites shall be suitably fenced to satisfy local codes or as required by the responsible authority.

14. In all installations, appropriate standby blowers, compressors, and main pumps shall be furnished. Where the probability of electrical equipment failure would cause major health, safety, flooding, other problems or hazards, or as required by the responsible authority, a standby power source and spare electrical components shall be required.

15. All sites shall have adequate yard lighting within fifty (50) feet of the walls of all tanks, buildings, and major components. All roadways and walkways (including tankage walkways) shall have adequate lighting. Adequate interior lighting shall be provided in all building structures. Lighting shall be in conformance with the current edition of "The Lighting Handbook" as published by the Illuminating Engineering Society (IES).

16. All sites shall be furnished with required adequate and reliable utility services, including at least a minimum power of 208 volt, three phase, 60 Hertz. Lighting circuits shall be 110-120 volt single phase.

17. All sites shall have concrete walks and asphalt or concrete pavement on access roads to all tanks and building structures.

18. Potable water shall be prevented from mixing with non-potable water by approved means. Potable water with backflow preventers shall be provided. If water pressure is not great enough for water seal applications, seal water pumps may be used in addition to backflow preventers.

19. In all sites where piping lies in disturbed earth or around tank structures and/or buildings, adequate supports, including thrust blocking, shall be provided. Thrust block calculations shall be provided.

20. In all sites where buildings and/or tankage structures are to be constructed on fill, adequate foundations are to be provided to prevent settlement in accordance with accepted engineering practice.

21. All tankage shall be checked by the design engineer for buoyancy. Proper buoyancy prevention devices, such as pressure relief valves, etc., shall be incorporated as necessary into the design.

22. All sites shall be properly graded with adequate catch basins and/or inlets placed in all depressed areas. The catch basins and inlets shall be connected to properly designed outfalls. Downspouts from buildings shall be connected to storm sewers.

23. Where appropriate, or where required by the responsible authority, all tankage shall include at least one set of Uniform Standard Sewer Detail steps.

24. In all sewage treatment facilities, toilet rooms, wash facilities, and showers shall be provided.

25. In all installations, buildings shall be insulated and heated.

26. Detailed construction plans shall include landscaping plans.

27. Color coding of all piping in treatment plants shall be in accordance with the latest edition of Recommended Standards for Wastewater Facilities (aka Ten States Standards), and as required by the responsible authority.

28. In general, all materials including, but not limited to, piping, concrete, steel, etc., shall meet or exceed the requirements listed elsewhere in the Uniform Standards or as required by the responsible authority.

3.6 - DESIGN OF INTERCEPTORS, TRAPS, AND SEPARATORS

This section covers the design of several types of interceptors, traps, and separators including, but not limited to:

- Grease Interceptors
- Car Wash Interceptors
- Laundry Interceptors
- Automotive Repair Facilities
- Parking Facilities
- Nursing Home Trash Traps

Waste generators are responsible for maintaining all interceptors/traps/separators in continuous proper working condition, by removing the oil, grease, or other buildup in the interceptor at sufficient intervals to insure compliance with all local, state, and federal rules and regulations. Further, waste generators are responsible for inspecting, repairing, replacing, and/or installing apparatus and equipment as necessary to ensure the proper operation and function of all interceptors and compliance with discharge limitations at all times.

Interceptor/trap maintenance records shall be maintained by the waste generator on site for the life of the system(s) for review and inspection by the responsible authority.

In traffic areas, the interceptors/traps/separators (and all piping) shall be designed to have adequate structural integrity, and shall meet a minimum of HS-20 traffic loading requirements. Interceptors/traps/separators in traffic areas require a concrete driving surface over the unit and piping, with structural backfill around the unit and piping.

3.601 GREASE INTERCEPTOR SIZING, CONSTRUCTION, AND INSTALLATION

A. General

Grease Interceptors are required by these Standards and by the CCDPW Rules and Regulations for all facilities which provide food services of any kind. Grease interceptor requirements and sizing are based on standard industry practices found in both the most current editions of the International Plumbing Code (IPC) Commentary and the Uniform Plumbing Code (UPC). Location of grease interceptors shall be outside of the building and provide easy access for cleaning and inspection. These grease interceptor requirements are applicable to all commercial food service providers and/or establishments including, but not limited to, those that are undergoing:

1. New construction.

2. Interior remodeling to accommodate expansion or operational modifications.

3. Changes of ownership/occupancy.

4. Any facility which may be experiencing difficulty achieving compliance with maintenance and/or wastewater discharge limitations.

5. Any facility going through major changes in their menu.

B. General Sizing Requirements

Sizing methods described herein are intended to assist in determining grease interceptor sizes that will afford the sanitary sewer system a minimum degree of protection against grease and other obstructing materials. In approving a customer's plumbing or grease interceptor design, the responsible authority does not accept liability for the failure of a system to adequately treat wastewater to achieve the effluent quality requirements required. It is the responsibility of the waste generators, designers, and/or contractors to provide the appropriate level of treatment necessary to comply with local, state, and federal wastewater regulations. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

Minimum acceptable grease interceptor sizing shall be accomplished as follows.

1. Sizing according to formulas found in Section 3.601C.

2. Where sizing formulas result in determination of a grease interceptor less than 750 gallons in capacity, the minimum size of 750 gallons shall be required.

3. In instances where it is physically impossible to install an outside grease interceptor, a letter must be submitted to the Municipal Engineer or responsible authority indicating the reasons the grease interceptor cannot be installed outside and requesting a variance from the standards. A general review by the responsible authority will follow.

C. Grease Interceptor Sizing Formulas

It is the responsibility of the waste generators, and their designers and/or contractors, to provide the appropriate level of treatment necessary to comply with local, state, and federal wastewater regulations, and to ensure that the wastewater discharged from their facility is in compliance with the CCDPW's and the responsible authority's discharge limitations. For the purpose of plan review, a general assessment of grease interceptor design and size will be performed using the following formulas. These formulas have been demonstrated as industry standards capable of achieving the CCDPW's discharge criteria when systems are maintained in proper condition and proper working order. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

Grease interceptor design and sizing shall generally be performed using Method 1, or Method 2 shown below. The designer may choose either of these methods for sizing the facility. Alternative grease interceptor designs and sizing methodologies may be reviewed by the CCDPW on a case-by-case basis. (The Mechanical Grease Trap Sizing Method shown below shall be used only for Single Service Kitchens, as defined below.)

The formulas below are applicable for restaurant type establishments. Grease interceptor sizing for uses such as hospitals, schools, institutions, care facilities, butchers, bakeries, and food manufacturers must be conducted individually for each site and use.

Food service establishments that propose the use of alternate sizing techniques and/or procedures that result in specifications that differ from the calculated requirements must submit formulas and other certified data to support the proposed size grease interceptor (see Section 3.601B, General Sizing Requirements for the minimum required size). Also, certified documentation of ability to meet effluent quality requirements shall be submitted. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

1. Method 1 – Uniform Plumbing Code

(# of meals/per peak hour) x (waste flow rate) x (retention) x (storage) = size required
(1) (2) (3) (4) (liquid capacity)

Factors:

1. # of meals served at peak operating hour (Seating Capacity) x (Peak Factor)
   a. Peak Factor for Fast Food Restaurant is……. 1.33
   b. Peak Factor for all other food service types is…. 1.00

2. Waste Flow Rate:
   a. with dishwasher…… 6 gallon flow
   b. without dishwasher……. 5 gallon flow
   c. single service kitchen…… 2 gallon flow
   d. Food waste disposer……. 1 gallon flow

3. Retention times
   a. Commercial kitchen waste/dishwasher…….. 2.5 hours
   b. Single service kitchen/single serving……. 1.5 hours

4. Storage factors
   a. Fully equipped commercial kitchen…….. 8 hr. operation = 1
   b. Fully equipped commercial kitchen…….. 16 hr. operation = 2
   c. Fully equipped commercial kitchen…….. 24 hr. operation = 3
   d. Single service kitchen…… = 1.5

Method 1 Example: A 75-seat restaurant is open from 4:00 pm until midnight (12:00 am). It has a dishwasher and a fully equipped commercial kitchen on a normal street.

(Number of Meals) x (waste flow) x (retention) x (storage) = size requirement
(75x1) x (6 gallons) x (2.5 hours) x (1) = 1125 gallons

The Uniform Plumbing Code includes a built-in safety factor that can yield very large grease interceptor size requirements. At this time, unless specific conditions and/or situations dictate, grease interceptors larger than 4,000 gallons are generally not required.

2. Method 2 - American Society of Mechanical Engineers

High Capacity Hydromechanical Grease Interceptor shall be designed per ASME A112.14.3 Type C.

The minimum grease storage capacity shall be 600 pounds.

D. Mechanical Grease Trap Sizing (for single service kitchens only)

In the circumstance of "Single Service Kitchens" with no food preparation (heat/serve only) and which use only disposable paper and plastic service utensils or an approved variance, a mechanical grease trap with draw off may be used. The trap must meet the Plumbing and Drainage Institute, (PDI) G101 specifications. In these instances, the grease trap shall to be installed in an area separate from the food handling area and the trap must be readily accessible for cleaning and maintenance (See section 3.602). The capacity of the mechanical grease trap shall be as calculated below; however, the minimum size shall be 50 gallons per minute (gpm) flow rated, or minimum 100-pound grease retention. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

1. Determine the volume of all fixtures being drained (cubic inches).

2. Convert cubic inches into gallons.

3. Determine actual drainage load (75% of total content).

4. Determine flow rate for 2-minute drainage period.

5. Flow rate = actual drainage load | drainage period.

E. Construction and Installation

All permitting, construction, and inspection activities must be completed in accordance with the CCDPW Rules and Regulations, the Uniform Standards, and any

other requirements of the responsible authority. Additionally, the following specifications must be incorporated into grease interceptor design:

- The grease interceptor shall be constructed with a minimum of one baffle, unless the design is certified by testing to function properly without baffles.

- Grease interceptors are to be installed at a minimum distance of ten (10) feet from sinks and dishwashers to allow for adequate cooling of the wastewater. Water temperatures must be less than 120 degrees F prior to entering the grease interceptor.

- All grease bearing waste streams shall be routed through an appropriate grease interceptor.

3.602 WASTE GENERATOR'S RESPONSIBILITIES

It is the responsibility of the waste generator to ensure compliance with local, state, and federal discharge limitations.

Hazardous wastes, such as acids, strong cleaners, pesticides, herbicides, paint, solvents or gasoline shall not be disposed of where they would go through grease interceptors/traps, grit interceptors, and/or other types of interceptors (see Section 3.605, Other Types of Interceptors and Sizing Requirements). Care must be taken in system design where commercial dishwashers are discharged through a grease interceptor. Dishwashers use detergents and elevated water temperatures that will melt grease. If the interceptor is either too small or too close to the commercial dishwasher, grease may pass through the interceptor and into the collection system.

The use of enzymes, solvents, and emulsifiers are prohibited, as they will only change the form of grease, allowing it to be carried out of the interceptor/trap with the wastewater and deposited in the collection system.

Interceptor/trap maintenance records shall be maintained by the waste generator on site for a minimum of five (5) years for review and inspection by the responsible authority.

3.603 GREASE INTERCEPTOR/TRAP MATERIALS

Grease interceptors/traps shall be constructed of reinforced 4000 psi concrete, high density polyethylene, or fiberglass. Other materials of construction may be considered and reviewed on a case-by-case basis.

3.604 GREASE INTERCEPTOR LAYOUT

All permitting, construction, inspection, and maintenance activities must be completed in accordance with the Ordinances and Regulations of the responsible authority. Additionally, the following specifications must be incorporated into grease interceptor design.

1. Grease interceptors shall be located outside of the building in order to provide easy access for cleaning and inspection.

2. Standard grease interceptors shall be constructed with a minimum of one baffle.

3. Grease interceptors are to be installed at a minimum distance of 10 ft. from sinks and dishwashers to allow for adequate cooling of the wastewater. Water temperatures must be less than 140 degrees F prior to entering grease interceptor.

4. All grease bearing waste streams shall be routed through an appropriate grease interceptor, including:
   - three-compartment sinks,
   - pot/pan sinks,
   - soup kettles,
   - hand-washing sinks,
   - dishwashers,
   - mop sinks, and
   - floor drains.

   Notable exceptions: drains that receive "clear waste" only, such as:
   - from ice machines,
   - condensate from coils, and
   - drink stations

   may be plumbed to the sanitary system without passing through the grease interceptor, with the condition that the receiving drain is a "hub" type that is a minimum of two inches above the finished floor.

5. All grease interceptors shall be equipped with two 24-inch diameter manhole type rings and lids; on small units, a minimum of one 24-inch diameter manhole type ring and lid with two additional access holes at the inlet and outlet sides of the tank shall be provided to facilitate cleaning.

6. All grease interceptors shall be properly vented, with venting shown on the plans.

7. In traffic areas, the grease interceptor (and all piping) shall be designed to have adequate structural integrity, and shall meet a minimum of HS-20 traffic loading requirements. Grease interceptors in traffic areas require a concrete driving

surface over the unit and piping, with structural backfill around the unit and piping.

8. Influent and effluent piping shall generally be minimum 6-inch diameter pipe per the requirements of the Uniform Standard Details. Alternate pipe sizes shall be reviewed on a case-by-case basis.

9. Test tees shall be provided upstream and downstream of the grease interceptor units.

3.605 OTHER TYPES OF INTERCEPTORS, SIZING REQUIREMENTS, AND ADDITIONAL REQUIREMENTS

Interceptors are required for oil, grease, sand, and other substances harmful or hazardous to the building drainage system, the public sewer, or wastewater treatment plant. A licensed professional engineer must submit the design, size, and location of pretreatment devices to the responsible authority for review and approval. See also the requirements in Section 3.602, Waste Generator's Responsibility.

A. Laundries

Commercial Laundries, laundromats, and dry-cleaners shall be equipped with an interceptor in order to reduce the quantity of lint and silt that enter the collection system. The system must be of adequate size and design to allow for cool-down of wastewater so that separation can be more readily achieved. The interceptor much be installed with a wire basket or similar device, removable for cleaning that prevents passage into the drainage system of solids larger than ¼-inch in any dimension including, but not limited to, string, rags, buttons, or other materials detrimental to the public sewerage system.

Typical applications include commercial/institutional laundromats and dry-cleaners. A lint interceptor is commonly referred to as a "lint trap", typically located outside of the building and buried below grade. The principal advantage of this location is the cooling effect obtained by the earth. The buried interceptor is typically constructed of precast concrete; however high density polyethylene or fiberglass may be used as alternatives.

The interceptor contains several compartments where the lint will coagulate and float to the surface and heavier solids will sink to the bottom. The discharging effluent is comprised of the clearer water between these layers.

Inlet and outlet piping shall be a minimum of four (4) inches or the size of the building sewer whichever is greater. In traffic areas, the trap shall be designed to have adequate reinforcement and cover (including piping), meeting minimum HS-20 traffic loading specifications. Lint interceptors in traffic areas require a concrete driving surface over piping with structural backfill around the unit and all piping.

1) Maintenance. The lint interceptor should be cleaned or pumped out routinely to prevent the escape of appreciable quantities of lint. Cleaning should be performed when the interceptor is at 75% of lint/silt retention. The frequency of cleaning at any given installation will vary depending on use. Pumping frequencies for laundromats usually range from once a month, to once every six months.

2) Sizing criteria. The different variables include: number of washing machines, wastewater flow rate, wastewater detention time, storage factor, and detention time. Commercial laundries, laundromats, and dry-cleaners shall be equipped with an interceptor in order to reduce the quantity of lint and silt that enters the collection system. The system must be of adequate size and design to allow for cool-down of wastewater so that separation can be more readily achieved. In addition, the interceptor must be "equipped with a wire basket or similar device, removable for cleaning, that prevents passage into the drainage system of solids 0.5 inch or larger in size, string, rags, buttons or other materials detrimental to the public sewerage system". (1003.6 International Plumbing Code 2003).

   Sizing must be in accordance with guidance found in the Uniform Plumbing Code (UPC), Appendix H which uses the following formula:

   (TGC) x (CPH) x (RT) x (ST) = Size of Lint Interceptor (gallons)

   Where:
   TGC = Total Gallons per Cycle
   CPH = Cycles per hour
   RT = Retention time
   2.5 for Institutional Laundry
   2.0 for Standard Commercial Laundry
   1.5 Light Commercial Laundry
   ST = Storage Factor, based on hours of operation;
   1.0 for 8 hours of operation
   1.5 for 12 or more hours

   Currently, no effluent sample well is required for small commercial laundries. However, large and/or industrial laundries may be subject to Federal and/or local wastewater treatment plant regulations.

B. <u>Car Washes</u>

For commercial car washes, separators shall have a minimum capacity of 1000 gallons for the first bay, with an additional 500 gallons of capacity for each additional bay. An effluent sampling well shall be required.

Wash racks must be constructed to eliminate or minimize the impact of run-off from rain/storm events. Minimum requirements are roofed structures with at least two walls and appropriate grading to prevent stormwater infiltration into the sanitary sewer.

C. <u>Indoor Automotive/Vehicle Repair Facilities (Garages and Service Stations) and Vehicle Storage Facilities</u> (Note: This does not apply to outdoor repair facilities.)
Automotive repair shops which include a floor drain in their areas of operation, or where vehicles are serviced, greased, or repaired, or where gasoline is dispensed, shall be required to design, install, and maintain a grit interceptor/oil/water separator. The separator shall have a minimum capacity of 6 cubic feet for the first 100 square feet of area to be drained, plus a minimum of 1 cubic feet for each 100 square feet of area thereafter. An effluent sampling well may be required by the responsible authority.
Example: 4500 sf facility: 100 sf, gives 6 cu. ft.
4400 sf, gives <u>44 cu. ft.</u>
Total 50 cu. ft. = 374 gal.; USE min. 400 gal.

400 gal. (50 cf) is the minimum size required. For outdoor repair facilities, contact the responsible authority for requirements.

<u>Parking Garages</u>
Parking garages shall not require a grit separator unless vehicle servicing, repairing, washing, or gasoline dispensing occurs. Areas in commercial garages utilized only for storage of automobiles are not required to be drained through a grit separator.

In addition to all of the above requirements of this Section C, the following shall apply:
1. The roof level of multi-level parking garages, even if vehicles are parked on the roof level, shall be drained to the storm sewer.
2. Interior levels of multi-level parking garages shall be drained to the sanitary sewer.

D. <u>Nursing Homes, Residential Care Facilities, and Veterans' Homes, etc.</u>
"Nursing home" means an institution, residence, or facility that provides, for a period of more than twenty-four (24) hours, whether for a consideration or not, accommodations to three or more unrelated individuals who are dependent upon the services of others including, but not limited to, a nursing home, residential care facility, home for the aging, and/or a veterans' home operated under, or defined by, OAC 3721 or OAC 5907.

All such new or expanded Nursing Homes shall be required to install a trash trap on its sanitary sewer lateral in the downstream manhole just prior to the discharge to the public sewer, or at a location as directed by the responsible authority. The size of the trash trap shall be determined using the OEPA "Sewage: Collection, Treatment & Disposal Where Public Sewers Are Not Available" handbook, as amended from time to time, or in accordance with a similar publication by the OEPA, if said handbook is no longer in use.

The trash trap shall be similar to a Series B1A Trash Basket, as manufactured by Halliday Products, or approved equal, but shall be appropriately sized as required

above.

Where installed, all trash traps shall be maintained by the facility owner, at the owner's expense, in continuously efficient operation at all times. Trash traps shall be maintained to the satisfaction of the responsible authority. Trash traps shall be cleaned in accordance with the requirements of the responsible authority and at least every three months. The facility owner shall maintain written records as evidence of such cleaning. These records shall be made available to the responsible authority upon request.

E. Effluent Sampling Wells

If required by the responsible authority, an effluent sampling well shall be provided. Sampling wells shall have a minimum ten (10) inch diameter access cover and a minimum 6-inch drop from inlet to outlet piping through the sampling well. Mechanical grease traps and interceptors that are installed above ground must be equipped with an influent flow regulator and an effluent valve assembly that allows for sample collection.

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PART 4 - SEWER USE REGULATIONS

4.1 GENERAL LIMITATIONS

It shall be unlawful to discharge to any natural outlet within the area under the jurisdiction of the responsible agency, any sewage, industrial waste, or other polluted waters, except where suitable treatment has been provided in accordance with the provisions of these Regulations. All discharges to any outlet must meet the requirements of the NEORSD Code of Regulation Title II – Pretreatment Regulations, and 40CFR Protection of the Environment, Chapter I, Subchapter N, Part 403 – General Pretreatment Regulations for Existing and New Sources of Pollution.

Note: In non-NEORSD service areas, the sewer use regulations of the receiving wastewater treatment plant shall govern.

No person shall discharge or cause to be discharged any sewage, industrial waste, or other polluted waters to any sanitary sewer or wastewater treatment plant, except where suitable treatment has been provided in accordance with these Regulations.

Industries that fall under the USEPA Pretreatment Regulations shall meet the applicable discharge limits of those regulations. NEORSD is responsible for enforcing the pretreatment regulations. NEORSD samples industrial discharges, makes industries monitor themselves, and brings legal action against violators.

Where sewers are tributary to treatment facilities not owned and/or operated by the NEORSD, the requirements of the specific receiving facility and responsible agency shall govern.

No person shall discharge or cause to be discharged any storm water, surface water, groundwater, swimming pool water (except backwash), or unpolluted industrial process waters to any sanitary sewer. Roof drains, foundation drains and all other clean water connections to the sanitary sewer are prohibited. There shall be no physical connection between a public or private potable water system and a sewer or appurtenance thereto, which would permit the passage of any sewage or polluted water into the potable water supply.

Storm water and all other unpolluted drainage shall be discharged to such sewers as are specifically designed as combined sewers or storm sewers, or to a natural outlet approved by the responsible agency. Industrial cooling water or unpolluted process waters may be discharged, on approval of the responsible agency, to a storm sewer or natural outlet.

All municipalities and the County must follow all of the requirements of the Clean Water Act National Pollution Discharge Elimination System (NPDES Phase II) permit. NPDES Phase II permit includes the following six minimum pollution control measures:

1. Public Education and Outreach
2. Public Participation/Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-construction Runoff Control
6. Pollution Prevention/Good Housekeeping

4.2 DISCHARGE QUALITY STANDARDS

A. Toxic Materials

No person shall discharge or cause to be discharged any of the following described wastes or waters to any public sewers or NEORSD facilities: any gasoline, benzene, naphtha, fuel oil, or other flammable or explosive liquid, solid or gas; any waste stream with a closed cup flash point of less than 140° F as measured by Code of Federal Regulations test method 40CFR261.21.

Additionally, no person shall discharge or cause to be discharged any waters or wastes containing toxic solids, liquids, or gases in sufficient quantity, either singly or by interaction with other wastes, which may constitute a hazard to humans or animals or create any hazard in the receiving waters or any materials which may cause an upset, interference, inhibition, or pass through of the wastewater treatment plant or sewerage system.

B. Solids or Viscous Materials

No person shall discharge or cause to be discharged any solid or viscous substances in such quantities or of such size capable of causing obstruction to the flow in sewers, or capable of causing other interference with the proper operation of the sewage works such as, but not limited to: ashes, cinders, sand, mud, structural materials, straw, shavings, metal, glass, sludge, feathers, grease and fats, tar, plastics, wood, unground garbage, whole blood, paunch manure, hair and fleshings, entrails, paper dishes, cups, milk containers, chemical residues, paint residues, lime slurry, or cannery waste bulk, etc. (either whole or ground by garbage grinders).

C. Other Harmful Wastes

Discharges to the sanitary sewers shall meet all requirements of the NEORSD Code of Regulations, Title I through Title 5, and/or of the NPDES Permit limits as required in the respective NPDES permit for the specific receiving facility (wastewater treatment plant).

4.3 PROJECT OWNER'S RESPONSIBILITIES

Where preliminary treatment of flow-equalizing facilities are provided for any waters or wastes, they shall be maintained continuously in a satisfactory and effective operation by the project owner at his expense.

Any wastes prohibited by these Regulations that are discharged to the sewer system shall be

brought to the attention of the responsible agency at the time it occurs. For failure to report discharges at the time they occur, a fine may be levied for each occurrence. The amount of the fine shall be determined by appropriate agency(s).

It shall be understood that the above shall in no way relieve any individual, company, or industry of any liabilities for damage to any facilities, which damage can be shown to have been caused by the wastes discharged by said individual, company, or industry. All measurements, tests and analysis of the characteristics of waters and wastes to which reference is made in these Regulations shall be determined in accordance with latest edition of "Standard Methods for the Examination of Water and Wastewater", published jointly by the American Public Health Association, American Water Works Association and Water Environmental Federation; or Ohio Department of Health, Public Health Laboratory, or the Robert A. Taft Water Research Center, United States Department of the Interior, or ASTM, whichever method is applicable. Any measurements, tests, or analyses not covered in the tests must be described. No statement contained in these Regulation's shall preclude other agencies from initiating additional enforcement action such as levying of additional fines and/or criminal prosecution and/or removal of sewer service.

Where such facilities are provided for the treatment, pretreatment, control, or neutralization of waters or wastes, they shall be maintained continuously in a satisfactory and effective operation by the project owner at his expense and shall be subject to periodic inspection by the responsible agency. The owner shall maintain operating records and shall submit to the responsible agency, in a form prescribed by the responsible agency, a monthly summary report of the character of the influent and effluent to show the performance of the treatment facilities as determined.

An approval by the responsible agency of facilities does not, in any way, guarantee that these facilities will function in the manner described by a person or company; nor shall it relieve a person or company of the responsibility of revamping, enlarging, or otherwise modifying such facilities to accomplish the intended purpose.

No statement contained in the NEORSD's Regulations shall be construed as preventing any special agreement or arrangement between the responsible agency and any person whereby an industrial waste of unusual strength or character may be accepted by the responsible agency for treatment.

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PART 5 - STANDARD SPECIFICATIONS

5.1 - MATERIALS

5.101 GENERAL INFORMATION

Unless otherwise specified, all materials used in the work under these Regulations shall conform to the requirements of the latest revision of the applicable specifications of the American Society for Testing and Materials (ASTM), and shall be tested in accordance with the latest specifications or methods of testing that have been adopted, revised, or proposed for such materials.

It is further understood and agreed that wherever reference is made to the specifications and/or methods of testing adopted by other organizations or departments such as the American Concrete Institute (ACI), American National Standards Institute (ANSI), American Water Works Association (AWWA), American Welding Society (ASW), Ohio Department of Transportation (ODOT), American Association of State Highway and Transportation Officials (AASHTO), City of Cleveland Water Department, or other organization or department, it shall refer to the standards and requirements of that society or organization, bearing the latest date, unless specifically noted otherwise herein.

On private work outside of the public right-of-way and in easements, when conflicts arise on the type of materials to be specified for usage in a project, the responsibility will be with the Municipal Engineer or responsible agency.

5.102 INSPECTION

No material shall be used in the work until it has been inspected and approved on the site of the work. When required by the responsible agency, any or all materials entering into the construction of any work under this contract shall be tested by a reputable local testing laboratory. Such construction inspection shall not relieve the contractor of any obligations in this respect, and any defective material or workmanship shall be at all times liable to rejection when discovered, until the final completion and adjustment of the contract.

5.103 MILL, FACTORY AND FIELD TESTING OF MATERIALS

When required by the responsible agency or Municipal Engineer, materials to be incorporated in the work shall be sampled and tested in accordance with the latest applicable ASTM, ANSI, AWWA or AASHTO standards, as indicated in the material specification.

A. **Laboratory Testing**

The material supplier or contractor shall furnish all such samples of materials as may be required, and such materials shall be approved before permission is given to incorporate the same in the work. It is the responsibility of the contractor to arrange for laboratory or field-testing by a certified laboratory. The Municipal Engineer or responsible agency may require the laboratory or field testing of, including but not

limited to, cement, sand, brick, stone, and concrete supplied to the project.

B. **Certified Mill Tests**
Certificates of tests at the mill by the manufacturer shall be furnished for the following materials:

1. Ductile Iron Pipe, Fittings and Cast-Iron Castings:
Furnish certificates of tests by the foundry under ANSI, AWWA, or Federal Specifications. Make, weight, and year shall be stenciled, or cast on, all pipe, fittings and castings.

2. Structural Steel and Reinforcing Steel; furnish certified mill tests of steels.

3. Clay pipe, concrete pipe, PVC pipe, PVC composite pipe, aluminized steel pipe, corrugated metal pipe, fiberglass pipe, HDPE, polypropylene pipe, and steel reinforced polyethylene pipe; provide plant certification that pipe and joints meet the project specifications.

C. **Visual Inspection**
All material and all equipment shall be subject to visual inspection and acceptance or rejection after delivery to the site of the work. All rejected materials shall immediately be removed from the site. All pipes shall be stamped bearing manufacture's name, date, type of pipe (class if concrete), and applicable ASTM and/or AASHTO numbers. No pipe over two (2) years old, or pipe older than the manufacturer's recommended storage period, whichever is shorter, shall be used.

D. **Inspection and Testing Requirements**
All piping shall be inspected and tested per the requirements of Section 5.211, Inspection and Testing.

5.104 CLAY PIPE

All clay sewer pipe shall conform to the latest requirements stipulated in the "Standard Specifications for Vitrified Clay Pipe", ASTM Designation C700, Extra Strength only, as may be specifically identified on the plans or further specified. All clay pipe service laterals shall conform to ASTM Designation C700, Extra Strength only.

5.105 CONCRETE PIPE (Circular and Elliptical)

A. **Non-reinforced Concrete**
All non-reinforced concrete sewer pipe furnished under these Specifications shall conform to all the latest requirements of Class 3 pipe in "Standard Specification for Non-Reinforced Concrete Sewer, Storm Drain and Culvert Pipe", ASTM Designation C14. Non-reinforced concrete sewer pipe may only be used for storm sewers and only with the approval of the Municipal Engineer or responsible agency.

B. **Reinforced Circular Concrete**

All reinforced circular concrete sewer pipe furnished under these Specifications shall conform to all the latest requirements of "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe", ASTM Designation C76. Where designs for a given size and strength class of pipe are provided for under the provisions of the ODOT Specifications, such designs shall be permitted subject to the testing requirements of Section 5.103 as it applies to circular reinforced concrete pipe. Concrete pipes shall be manufactured utilizing Type I cement unless there is indication that sulfates may be a problem, in which case the pipe shall be manufactured with Type II cement.

C. **Reinforced Elliptical Concrete**

All reinforced elliptical concrete sewer pipe furnished under these Specifications shall conform to all the latest requirements of "Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe", ASTM Designation C507. Where designs for a given size and strength class of pipe are provided for under provisions of the ODOT Specifications, such designs shall be permitted subject to the test requirements of Section 5.103 as it applies to reinforced elliptical concrete pipe. Concrete pipe for shall be manufactured utilizing Type II cement.

5.106 DUCTILE IRON PIPE

A. **Form and Conditions**

All ductile iron pipe and special pipe castings shall be of superior quality of iron, tough and even grain, free from cracks, sand, holes, or defects of any nature.

Ductile iron pipe shown on the plans and contract document and used for sanitary sewers shall be cement lined Thickness Class "52" and shall conform to all the requirements of “ANSI/AWWA C151/A21.51-09 AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast”. Ductile iron pipe used for storm sewers shall meet the requirements of “Standard Specification for Ductile Iron Gravity Sewer Pipe”, ASTM A746. Every length of pipe delivered to the site shall have been previously tested and withstood the minimum hydraulic pressure required by the specifications under which it is furnished. All ductile iron pipe and special pipe castings used in pipe extensions must be numbered and inspected, said inspection to be made by a construction inspector from the responsible agency.

B. **Application of Coating**

All pipe and special pipe castings shall be thoroughly cleaned, and except for cement-mortar lined pipe, shall be coated inside and outside with an approved asphaltum or other approved impervious preparation meeting the requirements of AWWA C116 and applied at a temperature of 300º F. Pipe shall be handled in such a manner that a minimum amount of damage to the coating will result. All ductile iron pipe or fittings, the coating of which has been damaged in shipping or handling, shall have the damaged portion well cleaned and recoated as above specified before being placed in the work. The contractor shall thoroughly coat all exposed parts of nuts and bolts, as above specified, after the pipe has been placed and before backfilling has been placed. All

field coating shall be furnished and applied by the contractor and approved by the responsible agency. All cement mortar lining for deflection pipe and fittings shall be installed in accordance with ANSI A21.4.

5.107 STEEL SHEET ALUMINIZED COATED TYPE 2 FOR CORRUGATED STEEL PIPE

Aluminized coated corrugated steel pipe may be used for storm sewer only and only upon written approval of the Municipal Engineer or responsible agency. Aluminized steel Type 2 pipe shall conform to A929/A929A, AASHTO M-274 for materials, ASTM A796/A796M for design, and ASTM A798/A798M for installation.

5.108 CORRUGATED METAL PIPE

Corrugated metal pipe may be used for driveway culvert pipe where the depth of cover is 4 feet or less, upon approval of the Municipal Engineer or responsible agency. Where installation is applicable and accepted, all corrugated metal pipe shall be galvanized and shall conform to the requirements of the latest "Standard Specification for Corrugated Metal Pipe, Metallic Coated for Sewers and Drains" ASTM A760/A760M. The thickness of the base metal shall be shown on the plans.

When specified or called for on the plans, a bituminous paved invert and/or bituminous coating, or a smooth bituminous lining applied centrifugally shall be applied to the pipe after fabrication in accordance with ASTM A849 "Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe" upon approval of the Municipal Engineer or responsible agency.

5.109 POLYVINYL CHLORIDE (PVC) COMPOSITE WALL PIPE

All PVC composite wall pipe shall conform to the latest requirements specified in the "Standard Specification for Acrylonitrite-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping", ASTM Designation D2680 for 6-inch to 15-inch diameter. All pipe and fittings shall have elastomeric seal joints. All pipe and fittings shall be marked or stenciled with the appropriate classification.

5.110 POLYVINYL CHLORIDE (PVC) PIPE

All polyvinyl chloride pipe shall conform to the requirements specified in the latest

"Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings", ASTM D3034 for 4-inch to 15-inch diameter;

"Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-rated Pipe (SDR Series)", ASTM D2241 for 4-inch to 36-inch diameter;

"Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings", ASTM F949 for 4-inch to 36-inch diameter;

"Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter", ASTM F794 for 4-inch to 48-inch diameter;

"Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings", ASTM F679 for 18-inch to 36-inch diameter;

"Standard Specification for Poly (Vinyl Chloride) (PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter", ASTM F1803 for 18-inch to 60-inch diameter;

"Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter", AASHTO M304 for 4-inch to 48-inch diameter.

All pipes and fittings shall be marked or stenciled with the appropriate classification

5.111 FIBERGLASS (GLASS FIBER REINFORCED THERMOSETTING RESIN) PIPE

All fiberglass (glass fiber reinforced thermosetting resin) sewer pipe shall conform to the requirements specified in the latest Standard Specifications of ASTM D3262 for 8-inch to 144-inch diameter.

5.112 HIGH DENSITY POLYETHYLENE STORM SEWER PIPE

All high density polyethylene storm sewer pipe shall be bell and spigot type with rubber gaskets, smooth interior and shall conform to the requirements specified in the latest "Standard Specification for Corrugated Polyethylene Pipe", AASHTO M294 for 300 to 1500mm diameter and "Standard Specification for 12-inch to 60-inch (300 to 1500mm) Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications", ASTM F2306 for 12-inch to 60-inch diameter.

HDPE pipe may be used for pressure storm sewers only with the approval of the Municipal Engineer or responsible agency.

5.113 POLYPROPYLENE CORRUGATED DOUBLE WALL OR TRIPLE WALL SEWER PIPE

Polypropylene corrugated double wall sanitary sewer pipe may be used with the approval of the Municipal Engineer or responsible agencies for non-pressure sanitary sewers from 6-inch to 30-inch diameter and for non-pressure storm sewers from 12-inch to 30-inch. Polypropylene corrugated triple wall pipe may be used with the approval of the Municipal Engineer or other agencies for non-pressure sanitary sewers and non-pressure storm sewers from 30-inch to 60-inch diameter.

All polypropylene corrugated double wall and triple wall sanitary sewer pipe shall conform to the latest requirements of "Standard Specification for 6-inch to 60-inch (150 to 1500 mm) Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications ", ASTM F2764.

All polypropylene storm sewer pipe shall be bell and spigot type with rubber gaskets, smooth interior and shall conform to the requirements specified in the latest "Standard Specification for Corrugated Polypropylene Pipe", AASHTO M330 for 300 mm to 1500 mm (12-inch to 60-inch) diameter pipe.

Pipe and fittings shall be installed in accordance with ASTM D2321. Single wall polypropylene pipe is not permitted for sanitary and storm sewers. Double wall pipe shall have an essentially smooth interior wall and corrugated exterior wall. Triple wall pipe shall have an essentially smooth interior wall, an essentially smooth exterior wall and an annular corrugated middle wall.

It is the responsibility of the user of polypropylene pipe to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use of this product.

5.114 STEEL REINFORCED POLYETHYLENE PIPE (SRPE)

Steel reinforced polyethylene pipe (SRPE) may be used with the approval of the Municipal Engineer or responsible agency for 24-inch to 120-inch storm sewer pipe only. All SRPE shall have bell and spigot gasketed watertight joints and the pipe shall conform to Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage, ASTM F2562/F2562M.

5.115 JOINTING MATERIALS

Joint materials for all classifications of pipe shall be the same between any consecutive manholes.

A. Jointing Materials For Clay Pipe

Clay pipe for sanitary sewers and storm sewers installations shall be provided with compression joints meeting all performance requirements of ASTM Standard C425.

B. Jointing Materials For Concrete Pipe

1. Sanitary and Storm Circular Sewers
   Concrete pipe joints for sanitary and storm sewers shall conform to the requirements of ASTM C443 as it pertains to the use of a confined gasket. All joints shall consist of confined approved gaskets placed in grooves in the spigots of the pipe such that the gaskets will be enclosed on all sides when the pipe is laid, and the joints are completed.

2. Sanitary and Storm Elliptical Sewer
   All elliptical reinforced concrete pipe for sanitary and storm sewers shall have, if available, profile rubber confined gaskets meeting the requirements of ASTM C443. If profile rubber gaskets are not available, butyl rubber sealant flexible rope type gaskets meeting the requirements of ASTM C990 may be used if approved for storm sewers only by the Municipal Engineer and responsible agency.

C. Jointing Materials For Polyvinyl Chloride (PVC) Pipe

PVC pipe joints shall be integral with the body of the pipe, belled as illustrated in ASTM D3034 and shall utilize "0" ring gaskets meeting requirements of ASTM D3212. Gaskets shall conform to ASTM F477.

D. Jointing Materials For Polyvinyl Chloride (PVC) Composite Wall Pipe

All PVC Composite Wall Pipe Joints shall be an elastomeric seal as per ASTM D3212.

E. Jointing Materials For Fiberglass (Glass Fiber Reinforced Thermosetting) Pipe

Coupling joints shall be flexible elastomeric seals meeting the requirements of ASTM D4161.

F. Jointing Materials For Ductile Iron Pipe

Joints shall be rubber push on joints, meeting the requirements of AWWA C111 and comparable to the following: "Tyton" Joint, as manufactured by the U.S. Pipe; "Fastite" Joint, as manufactured by American Cast Iron Pipe Company or "Super Bell-Tite", as manufactured by Clow Corporation.

G. Jointing Materials For Steel Sheet Aluminized Coated Type 2 for Corrugated Steel Pipe

Joints for aluminized coated type 2 for corrugated steel pipe shall be silt tight and conform to the requirements of ASTM A798/A798M specifications.

H. Jointing Materials For Corrugated Metal Pipe

Joints for corrugated metal pipes shall be made using coupling bands with either annular or helical corrugations or with smooth sleeve-type couplers. Silt tight joints are recommended for all special projects since watertight joints cannot be obtained. All joints shall conform to ASTM A760/A760M and ASTM A798/A798M.

I. Jointing Materials For High Density Polyethylene and Polypropylene Storm Sewer Pipe

Joints for high-density polyethylene and polypropylene storm sewer pipe shall be elastomeric seal and meet the requirements of AASHTO M294 and ASTM D3212. Joints shall be installed in accordance with the manufacturer's instructions.

J. Jointing Materials For Polypropylene Corrugated Double Wall or Triple Wall Sanitary Sewer Pipe

Joints shall be a gasketed integral bell and spigot joint meeting the requirements of ASTM 2736 for corrugated double wall pipe and ASTM F2764 for corrugated triple wall pipe. The joints shall be watertight and meet the requirements of ASTM D3212 and each spigot shall have two gaskets meeting the requirements of ASTM F477.

K. Jointing Materials For Steel Reinforced Polyethylene Pipe

Joints shall be steel reinforced, watertight integral bell and spigot with flexible gasket meeting the requirements of ASTM D3212. An alternative electrofusion joint may be used if approved by the responsible agency. Electrofusion joints can only be installed when the pipe is dry and gaps between pipe ends do not exceed 1 inch. The pipes must also not be out of alignment by more than 0.25 inch.

L. Jointing Materials For Joining Different Pipe Materials or Pipe Sizes

Flexible, leak proof, watertight, gastight, root proof, resistant to chemicals, sewer gases, and UV rays, couplings made of elastomeric resins and meeting specifications ASTM D5926 or ASTM C1173 shall be used to join pipes of different materials or sizes. The couplings can be used to join ductile iron, vitrified clay, PVC, or concrete pipe in sizes ranging from 3/4-inch diameter to 27-inch diameter. Stainless steel clamps shall be used to secure the couplings. The couplings shall be Fernco Strong Back, Pasco or approved equal.

M. Jointing Materials For Connecting Laterals to Cored Pipe

Wye Branches and Saddles. In no case will the connections for other than six (6) inch lateral connections exceed the standard manufacturer's fabrication connection size or recommended core bore seal size. Wye fittings are to be provided for all sewer laterals on main sewers 18-inch and smaller. Saddles, Inserta-Tees, or approved equal, are to be provided for sewer mains 21-inches and larger, or as required by the responsible agency.

Resilient rubber material shall meet and be constructed in accordance with ASTM C923 and shall provide a watertight seal. Stainless-steel clamps shall meet the requirements of ASTM C923, ASTM A666 and ASTM A240.

Resilient rubber connections shall prohibit the protrusion of the lateral pipe into the

mainline sewer pipe. The connection shall be provided by Kor-N-Tee, Inserta Tee or approved equal. The connection shall meet the requirements of the most current version of ASTM F2946.
The lateral shall be constructed to the right-of-way line and a test-tee shall be provided at the right-of-way line, per the requirements of USSD Lateral Connections detail, and Typical Riser Detail (where necessary).

The following requirements shall apply:

Mainline Sewer Size inches	Maximum Lateral Size inches	Pre-formed wye fitting required	Saddle, Inserta-Tee, or equal, required
8	6	x	
10	6	x	
12	6	x	
15	6	x	
18	6	x	
21	6		x
24	8		x
30	10		x
33	12		x
36 and larger	12		x
	*		
*Laterals larger than 12-inches require a manhole.			

5.116 CASTINGS

Castings within public right of ways and easement areas for manholes, inlets and catch basins recommended under these Specifications shall conform in design to the standard Neenah Foundry or East Jordan Iron Works castings and shall be the type specified on Uniform Standard Sewer Details Index of Sheets and General Notes sheet. Castings specified by the City of Cleveland, Cuyahoga County Department of Public Works, NEORSD, or Ohio Department of Transportation may also be used if approved by the Municipal Engineer or responsible agency. All castings shall be true to pattern and free from cracks, gas holes, flaws and excessive shrinkage. Surfaces shall be free from burnt-on sand and shall be reasonably smooth. Runners, fins, risers and other cast-on pieces shall be removed.

Manhole, inlet, and catch basin cast iron frames and grates shall conform to all the requirements of Class No. 30B (30,000 psi tensile strength) for Gray Iron Castings meeting the requirements of "Standards Specification for Gray Iron Castings", ASTM Designation A48/A48M.

Light duty castings may be used in non-traffic areas, but only heavy duty or extra heavy-duty castings may be used in areas subject to vehicular traffic. All castings shall be commercially machineable and, in the case of manholes, inlets and catch basins, the frame

and cover shall, if necessary, be so machined that it will be impossible to rock the cover after it has been seated in the proper position in the frame.

Special castings for manhole, inlets and catch basins, located outside of public right of way or public easements, may be used if approved by the Municipal Engineer or responsible agency. Manhole castings shall be stamped "Sanitary" for sanitary manholes and "Storm" for storm manholes, unless another casting is required by the responsible authority.

5.117 MANHOLE STEPS

A. **General Information**
All steps shall be a minimum of 12 inches in width with, safety side lugs to prevent slipping, and shall conform to the latest OSHA requirements.

B. **Ductile Iron Steps**
All steps shall be true to pattern and surfaces shall be free from cracks, flaws, fins, and burnt-on sand, and shall be reasonably smooth. They shall be coated with an approved asphaltum or other impervious preparation. The ductile iron shall conform to all of the requirements of Grade 65-45-12, ASTM Designation A536.

C. **Plastic-Steel Manhole Steps**
The plastic steps shall be a Reinforced Polypropylene Plastic and shall conform to the requirements of ASTM D4101 Table B33430. The steel shall conform to ASTM A496/A496M, D20 or ASTM A615/A615M Grade 60. The steel shall be epoxy-coated per ASTM A934/A934M. All steps shall conform to ASTM C478-12A section 16, with safety side legs to prevent slipping, and shall conform to the latest OSHA requirements.

5.118 CONCRETE AND MASONRY

A. **Precast Concrete Manholes**
For Precast Concrete Manholes, see Section 5.127.

B. **Portland Cement**
All cement used in the work shall be of an approved brand and shall meet the requirements of the following ASTM Designation:

Standard Portland Cement	C150 Type I
* Standard Portland Cement w/air entraining admixture:	C150 Type IA
High Early Strength Portland Cement	C150 Type III
* High Early Strength Portland Cement w/air entraining admixture	C150 Type IIIA

* Air entraining admixture shall conform to "Standard Specification for Air-Entraining

Admixtures for Concrete", AASHTO M154M/M154 and shall be added at the mixer. All other admixtures shall require the approval of the responsible authority.
Note that all concrete that will be in contact with wastewater (including, but not limited to, manholes, etc.) shall require Type II or Type V cement.

Cement for job-mixed concrete shall be furnished in unbroken 94-pound bags marked with the brand of the manufacturer. The bags shall show no signs of damage from moisture, such as the formation of cakes or lumps, or of damage of any other character.

C. **Water**

All water required in the execution of the contract must be provided by the Contractor. It shall be free from organic matter, acids and strong alkalis and shall be of potable quality. Water may be obtained from fire hydrants of the municipality wherever available, after obtaining a permit for such services.

D. **Fine Aggregates**

The fine aggregates shall consist of natural or manufactured sand composed of clean, strong, hard, durable, uncoated particles of stone. It shall be well graded from coarse to fine and shall be free from lumps of clay, shale, loam, soft and flaky particles, and all organic matter. The sand shall conform to the following grading:

SIEVE NO. (U.S. STANDARD SIEVE SERIES)	TOTAL PERCENT BY WEIGHT PASSING
3/8"	100
No. 4	95-100
No. 8	70-100
No. 16	38-80
No. 30	18-60
No. 50	5-30
No. 100	0-10
No. 200	0-5

The gradation of the sand from any one source shall be reasonably uniform and not subject to extreme variations within the above specified limits. Sand from any one source exhibiting a variation in fineness modules of more than 0.20 percent may be rejected.

In addition to the grading requirements, the fine aggregate shall pass the color test for organic matter, ASTM C40/C40M; soundness test, ASTM C33/C33M; and the compressive tests of cement sand mortar, ASTM C109/C109M.

E. **Mortar Sand**

With the exception of grading, the specifications for the fine aggregate shall govern. Grading shall be as follows:

Sieve No. (U.S. Standard Sieve Series)	Natural Sand Total Percent By Weight Passing	Manufactured Sand Total Percent By Weight Passing
No. 4	100	100
No. 8	95-100	95-100
No. 50	10-40	20-40
No. 100	0-15	10-25
No. 200	0-5	0-10

F. **Coarse Aggregates**

The coarse aggregate shall consist of clean, strong, hard, durable, uncoated particles of crushed limestone, or crushed granite. It shall be reasonably uniform in density and free from an excess of thin, elongated, or laminated pieces and also free from organic material.

Recycled concrete within public right of way is highly discouraged and shall only be used in special projects with the approval of both the design engineer and Municipal Engineer or responsible agency. Recycled concrete may be used on private property only with the approval of the Municipal Engineer or responsible agency.

The amounts of deleterious substances contained in the aggregate shall not exceed the following limits:

	Percent by Weight
Dust (Passing No. 200 Sieve)	2.2
Shale and Shaly Material	1.0
Coal	1.0
Pieces having a Length Greater Than 5 Times the Average Thickness	15.0
Clay Lumps	0.25
Soft Fragments	3.0
Miscellaneous Substances such as Chert, Alkali, Metallic Particles or Limonitic Connections	1.0

The coarse aggregate shall conform to the appropriate AASHTO M43 sizes of aggregate grading.

Light weight aggregates will not be permitted and all coarse aggregates shall weigh at least 65 pounds per cubic foot.

All coarse aggregates shall meet the specifications in regard to soundness, ASTM C88; and abrasion losses, ASTM C131.

G. **Mortar**
Mortar shall be as per Section 5.210 Part B. of these specifications.

5.119 BRICK

A. **Shale Sewer Brick**
All sewer brick shall be made from shale sewer brick and shall be smooth, sound, hard, tough, and thoroughly vitrified. They shall be true in form with straight sharp edges and flat surfaces, and shall be uniform in quality, cross section, and dimensions. Shale sewer brick furnished or used shall conform with the Standard Specification for Sewer or Manhole Brick (Made from Clay or Shale), ASTM C32 and shall be grade S.S. Shale brick shall only be used to rebuild the top 4 feet of existing manholes.

The preferred sewer brick size shall be nominal 8-inch length by 4-inch width by 2 ½-inch depth.

Alternative shale brick sizes shall be as follows:

DEPTH	WIDTH	LENGTH
1 ½”	4”	8 ½”
3”	4”	8 ½”
3 ½”	4”	8 ½”

Not more than two percent (2%) of the brick shall vary more than one-eighth inch (1/8") in depth or width, or one-quarter inch (1/4") in length from the specified dimensions.

Lugged brick, cored brick or brick having recessed or openings extending through or partially through the body of the brick in any direction will not be accepted under these Standards.

All shale brick furnished or used under these Standards shall comply with the following physical test requirements:

ABSORPTION LIMIT (5 Hour Boiling)

Mean of five (5) tests ----------Not to exceed 6%
Individual Maximum----------Not to exceed 9%
Minimum Compressive Strength (lbs. per sq. inch)
Mean of five (5) tests----8000
Individual Minimum--------6000

B. **Concrete Brick**
Brick used in catch basins, inlet basins, and storm junction chambers may be concrete sewer brick conforming to ASTM Designation C55, Grade S-1, Type I. Bricks shall have a rectangular cross section with square corners.

5.120 REINFORCING STEEL

Reinforcing steel shall conform to the "Standard Specifications for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement", ASTM A615/A615M or to the "Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement", ASTM A996/A996M. Bars shall be round as indicated on the drawings, and shall be of the deformed type.

Bars shall be of new stock and free from scale, rust, oil, paint or coating of any kind, except epoxy coatings. All steel reinforcing bars in cast in place concrete box culverts, inlets, catch basins, reinforced concrete channels and headwalls shall be epoxy coated in accordance with "Standard Specification for Epoxy-Coated Steel Reinforcing Bars", ASTM A775/A775M. Welded wire fabric shall conform to the latest requirements of "Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete", ASTM A185/A185M.

5.121 STRUCTURAL STEEL

All structural steel shall meet the requirements of the "Standard Specifications for Carbon Structural Steel", ASTM Designation A36/A36M.

5.122 LUMBER

Lumber for sheeting, sheet piling, forms, bracing or bridging must be of good quality and of sizes and strength suitable for protecting the work and workers from danger, and for securing the best possible condition for construction. Any material deemed unsuitable or unsafe by the responsible agency must be removed at once from the work.

5.123 PIPE BEDDING MATERIAL

Pipe bedding material shall be limited to course interlocking limestone aggregate No. 57, 6, 67, 68, 7, 78, or 8 for 60-inch diameter pipe or smaller. For 66-inch or larger diameter pipe No. 4 aggregate may also be used. No slag, river gravel, foundry sand or recycled concrete shall be permitted for pipe bedding.

5.124 PIPE COVER MATERIAL

Pipe cover material shall consist of course interlocking limestone aggregate No. 57, 6, 67, 68, 7, 78 or 8. No slag, river gravel, foundry sand or recycled concrete shall be permitted for pipe cover.

5.125 PREMIUM BACKFILL

See Section 5.205B, Backfill Operation.

5.126 ASPHALT FOR ROAD RECONSTRUCTION

Asphalt concrete surface coarse and asphalt concrete intermediate coarse shall meet the requirements of the Ohio Department of Transportation (ODOT) Construction and Material Specifications (CMS) Item 448 or Item 446, as specified by Municipal Engineer and responsible agency. Thickness and type of asphalt shall be designated by the Municipal Engineer or responsible agency. Asphalt concrete for the base course shall meet the requirements of ODOT CMS Item 301, Asphalt Concrete Base. Thickness of base coarse shall be designated by the Municipal Engineer or responsible agency.

5.127 PRECAST CONCRETE MANHOLES

All precast concrete manhole sections furnished under these Specifications shall conform to all the requirements of "Standard Specification for Precast Reinforced Concrete Manhole Sections", ASTM Designation C478 and as per details shown in the Uniform Standard Sewer Details.

All manhole joints and grade rings shall be sealed externally with a trowelable, flexible, moisture resistant mastic compound such as Fabertite, Kent Seal, Conseal, or approved equal. Joint seals between precast manhole sections and sewers shall be resilient and flexible gasket joints meeting the requirements of ASTM C443 and AASHTO M198.

Precast manhole "tee" sections, where used on storm sewers 48 inches in diameter and larger in non-highway load areas, shall conform in design to the Uniform Standard Sewer Details.

Approved flexible water-stop gaskets meeting the requirements of “Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and

Laterals", ASTM C923 shall be utilized for all sanitary and combined sewer connections made into a masonry or precast structure.

In manholes less than 28 feet deep to the invert, landing platforms are not required. In manholes over 28 feet deep to the invert, the requirement for landing platforms shall be addressed on a case by case basis by the design engineer, shall meet all OSHA requirements, and shall require the approval of the responsible authority. If landing platforms are required, the platforms shall be installed in manholes over 28 feet deep to the invert, and the maximum vertical spacing for landing platforms shall be 20 feet. The landings shall conform to the Uniform Standards Landing Riser Detail and all OSHA requirements.

Chimney Seals shall be required and installed on all new and existing sanitary manholes. A minimum three (3) inch vertical wall on all new sanitary sewers shall be required below the casting for the installation of chimney seals.

PART 5 - STANDARD SPECIFICATIONS

5.2 - CONSTRUCTION

5.201 SITE WORK

A. **Maintaining Sewage Flow**

The contractor shall be required to bypass and maintain the flow in all existing live sanitary and storm sewers during construction and the method employed shall be approved by the responsible agency. No sanitary flow shall be permitted to be bypassed into a clean water system such as a ditch, stream or storm sewer, and no storm flow will be permitted to be bypassed into a sanitary sewer system.

B. **Replacing, Moving and Repairing of Existing Structures**

The contractor shall be responsible for the replacement, movement, repair, and/or maintenance of all sewers, drains, catch basins, manholes, culverts, watermains, steam lines, air or gas lines, wire conduit(s), all service connections of any type or utility, and any other appurtenances or structures encountered in the performance of said work, whether or not they are shown on the plans, unless otherwise specified by the Municipal Engineer or responsible agency.

The actual repair, relocation, support or replacement of all communication, electric, telephone, steam lines, cable television or gas lines/poles and appurtenances disturbed by the contractor shall be done by the respective utility company and the cost shall be paid by the contractor, unless otherwise specified in the contract. Watermains, sewers, and drainage structures disturbed by the contractor shall be fixed by the contractor, at the contractor's expense. Written permission from the owner of privately owned lines, equipment or appurtenances must be obtained prior to initiating any construction involving these.

The contractor shall have the responsibility, at his expense, to replace, move, repair, and/or maintain all pipes for water, steam, air, gas, and all wire conduit(s), and all other structures encountered in the work, whether or not they are shown on the plans, and to repair of all damage done to any of the said pipes and structures through acts or negligence, and shall keep them in repair during the life of this contract.

The contractor shall, in all cases and at his expense, restore or replace with new materials all existing utilities and structures to the full satisfaction of the responsible agency engineer.

C. **Removal of Existing Sewers and Appurtenances**

Where required to clear the new construction, or when shown on the plans, existing sewers, manholes, catch basins and other appurtenances shall be removed by the contractor. All abandoned sewers, when required by the Municipal Engineer or responsible agency, shall be filled with sand or flowable materials such as Cleveland low strength mortar backfill and bulkheaded with brick masonry bulkheads at all points where they are cut.

Manholes and drainage structures shall be demolished a minimum of two (2) feet below grade and filled with suitable materials approved by the Municipal Engineer or the responsible agency. All demolished structures in pavement areas shall be backfilled with premium backfill. Any materials removed in the progress of the work which are deemed to be salvageable by the responsible agency, shall be removed to storage points designated by the Municipal Engineer or responsible agency and shall remain the property of the responsible agency. The contractor shall use reasonable care in removing and transporting such items to prevent damage or breakage.

Replacement of removed appurtenances is covered under Section 5.201 B.

D. **Restoration of Pavement, Curbing, Concrete Gutters, Driveways, Sidewalks, Retaining Walls, Headwalls, Piers, Abutments, Fence, and Miscellaneous Structures**

All pavements, road surfaces, curbing, concrete gutters, underdrain, driveways, driveway culvert pipes, sidewalks, retaining walls, piers, headwalls, abutments, fencing, newspaper boxes, and mailboxes removed or damaged during the course of the work shall be reinstalled if in good condition or replaced if damaged by the contractor. All such items shall be reinstalled or replaced in the same manner, and be at least of equal quality and dimensions as existed before the commencement of the work. All such reinstallment or replacement shall be performed as soon as practicable. All replacement work done on County, Municipal or State roads shall be approved by the appropriate agency or agencies.

E. **Removal of Trees/Tree Trimming**

Only those trees which are directly in the line of excavation, or those which are designated for removal by the responsible agency, shall be removed. Tree removal shall be done in accordance with the municipality's requirements. Removal of any tree designated as a breeding habitat for endangered species, such as the Indiana Bat, shall be removed only when approved by the U.S. Fish and Wildlife Service.

Tree limbs which may interfere with the contractor's work may be trimmed by a Professional Landscape Network (PLANET) Certified Landscape Technician (CLT) or under the direction of a Certified Arborist. Prior to the work, the Municipality Arborist and the responsible party shall be notified of tree removals or tree trimming.

All other trees within the vicinity of the work shall be protected from all damage and/or harm including, but not limited to, protection of the critical root zone, trunk, limbs, etc. The contractor shall provide all protective requirements as required by the PLANET CLT, the Municipality's Arborist, the responsible agency, and/or as necessary to fully protect the trees.

F. **Dust and Erosion Control**

The contractor shall keep the entire construction site reasonably clean and clear of excessive dust and erosion. The contractor shall immediately control the dust and erosion in the project area to the full satisfaction of the responsible agency using the following control measures:

1. Vegetative Cover and/mulch – Apply temporary or permanent seeding and mulch to areas that will remain idle for over 14 days. Saving existing trees and large shrubs will also reduce soil and air movement across disturbed areas.

2. Watering – Spray site with water until the surface is wet and repeat as needed, particularly before and during grading operations, and especially on haul roads and other heavy traffic routes. Watering shall be done at a rate that prevents dust but does not cause soil erosion. Wetting agents shall be utilized according to manufacturer's instructions.

3. Spray-On Adhesives – Apply adhesive according to the following table or manufacturers' instructions.

Adhesive	Water Dilution (Adhesive Water)	Nozzle Type	Application Rate Gal./Ac.
Latex Emulsion	12.5:1	Fine	235
Resin in Water Acrylic Emulsion (No-traffic)	4:1	Fine	300
Acrylic Emulsion (No-traffic)	7:1	Coarse	450
Acrylic Emulsion (Traffic)	3.5:1	Coarse	350

4. Stone – Graded roadways and other suitable areas shall be stabilized using crushed stone or coarse gravel as soon as practicable after reaching an interim or final grade. Crushed stone or coarse gravel can be used as a permanent cover to provide control of soil emissions.

5. Barriers – Existing windbreak vegetation shall be marked and preserved. Snow fencing, or other suitable barrier, shall be placed perpendicular to prevailing air currents at intervals of about 15 times the barrier height to control air currents and blowing soil.

6. Calcium Chloride – This chemical shall be applied by mechanical spreader as loose, dry granules or flakes at a rate that keeps the surface moist but not so high as to cause water pollution or plant damage. Application rates should be strictly in accordance with suppliers' specified rates.

7. Operation and Maintenance – When Temporary Dust Control measures are used; repetitive treatment should be applied as needed to accomplish control.

8. Street Cleaning – Paved areas that have accumulated sediment from construction should be cleaned daily, or more often as needed, utilizing a street vacuum or bucket-type endloader or scraper. All sweepings and/or materials collected shall be properly disposed of by the contractor.

9. Dust Control or dust suppressants shall be used to prevent nuisance conditions, in accordance with the manufacturer's specifications and in a manner to prevent a discharge to waters of the State. Sufficient distance must be provided between application locations and nearby bridges, catch basins, and/or other means of potential access to waterways. Applications (excluding water) may not occur when rain is imminent as noted in the short-term weather forecast. Used oil may not be applied for dust control.

G. **Equipment**

To prevent damage, the contractor shall use rubber tired or rubber track equipment on all pavements. Alternatively, sheeting and mats may be approved by the Municipal Engineer or responsible agency. All pavements damaged by the contractor's operations shall be fully repaired or replaced by the contractor at his expense, and to the full satisfaction of the responsible agency.

5.202 EXCAVATING

A. Test Pits

The contractor shall dig such exploratory test pits as necessary, in advance of excavation operations, to determine the exact location of subsurface pipe lines, conduits, and structures which are likely to be encountered, and shall make acceptable provisions for their protection, support, and maintenance in operation. Exploratory test pits may also be excavated to determine the subsurface soils, subsurface rock conditions, and groundwater conditions as they relate to the work. Prior to excavation, exploratory test pits shall be coordinated with the Municipal Engineer or responsible agency and the property owner.

B. **Alignment and Grade**

Alignment and grade shall be established by means of a laser beam or grade bars.

1. Laser Beam

   Unless otherwise specified, the project design engineer and his Registered Professional Surveyor shall establish all base lines and benchmarks for the project. The contractor shall furnish all material and labor to establish line and grade of the generated laser beam from the benchmarks and control points established by the contractor's Registered Professional Surveyor. The end of laterals and all "Y" branches shall be staked by the contractor and the maximum spacing of hub placement shall be fifty (50) feet.

   All manholes and inlet basins shall be set to grade by the contractor. The final construction inspection approval and acceptance of the sewer system shall be

contingent upon the final adjustment of the castings. At final grade, the surface of the ground shall slope away from the manhole covers. The laser shall be securely anchored and checked at least twice daily to insure that OSHA Regulations are met. Strict adherence to the manufacturer's operation procedure shall be observed. Only qualified and trained employees may be assigned to install, adjust, or operate laser equipment, and proof of qualifications of the equipment operator must be available at all times. The area in which lasers are used must be posted with standard laser warning placards. The laser beam shall be turned off when not needed.

During rain, snow, dust, excessive heat, or fog, the operation of laser systems shall be prohibited if beam scatter occurs.

All horizontal and vertical control required for the complete layout and performance of the work under this Contract shall be done by the contractor's Registered Professional Surveyor at the contractor's expense, and any approvals by the Municipal Engineer or responsible agency of the contractor's methods will not relieve the contractor of responsibility for providing correct locations, elevations and grades for all project work items.

2. Open Cut

All sewers in open cut shall be laid and maintained to the required lines and grades.

The project design engineer and his Registered Professional Surveyor shall establish all base lines for the location of the principal component parts of the work together with a suitable number of benchmarks adjacent to the work. Based upon this information, the contractor shall employ and retain a State of Ohio Registered Professional Surveyor to develop and make all detail surveys necessary for construction, including slope stake, cut stakes, batter boards, stakes for pile locations and other working points, lines and elevations.

The contractor's surveyor shall verify the design benchmark survey and shall notify the design engineer of any discrepancies prior to the contractor beginning work on the project. The contractor shall have the responsibility to carefully preserve benchmarks, reference points and stakes, and in case of the destruction thereof, the contractor shall be charged with the expense and damage resulting there from and shall be responsible for any mistakes that may be caused by the loss or disturbance of such benchmarks, reference points and stakes. The contractor shall notify the responsible agency at least 72 hours prior to starting survey work.

3. Tunnel

In tunnel construction, the contractor shall furnish all labor and equipment required to transfer line and grade from the benchmarks and control points at ground level indicated on the plans into the tunnel section at each shaft. The method employed by the contractor shall be approved by the Municipal Engineer or responsible agency. The control of vertical and horizontal alignment in the tunnel sections shall be accomplished by the use of a laser beam instrument, unless another method is approved in writing by the Municipal Engineer or responsible agency.

Prior to submitting the estimate for partial payment for tunnel work, the contractor shall submit to the Municipal Engineer or responsible agency a plan and profile of all work performed during the preceding month. The plan and profile shall indicate thereon the survey indication of adherence to the design alignment and grade, as well as conformity to the requirements of these Standards. The survey notes and drawings to be submitted shall be certified and stamped by a Registered Surveyor, licensed to practice in the State of Ohio. The surveyor shall be a specialist in tunnel work.

C. **Excavation and Preparation of Trench**

1. General

   Unless otherwise specified, all excavation shall be unclassified and shall include the removal and proper disposal of all material encountered in the excavation, including pavement surface, pavement base, rock, peat, foundry sand, and any other materials. It shall also include the placing and removal of sheeting and bracing, and/or trench boxes, and removing water encountered. All excavated materials shall be stored in convenient piles near the construction work sites or removed from the site and properly disposed of, unless otherwise specified.

2. Width

   The maximum width of unsheeted trench shall not exceed 12 inches on each side of the pipe for pipe diameters or spans of 24 inches or less, and not exceed 15 inches on each side of the pipe for diameters or spans greater than 24 inches and less than 72 inches, and not exceed 24 inches on each side of the pipe for pipe diameters or spans 72 inches and larger. The minimum width of unsheeted trench shall be at least nine (9) inches wider on each side than the outside diameter of pipe at the spring line.

3. Bedding

   Type I. All pipe 60-inch diameter and less shall have a bedding of AASHTO M43 No. 57, 6, 67, 68, 7, 78 or 8 limestone aggregate extending the width of the trench excavation with depth in conformance with the construction drawings. Pipes 66" diameter or greater may also use No. 4 aggregate for bedding in addition to the aggregate sizes permitted for 60-inch diameter or smaller pipe. Pipe bedding shall extend one fourth (¼) of the pipe inside diameter but not less than 6" minimum and not more than 12" maximum below the bottom of the pipe and extend up the side of the pipe trench ¼ of the pipe outside diameter.

   Type II. Where shown on the drawings, pipe shall be bedded in a monolithic cradle of plain concrete having a minimum thickness below the bottom of the pipe of one-fourth (1/4) the vertical inside pipe diameter or rise but not less than six (6) inches and not more than 12 inches and extending up the sides of the trench for a height equal to one-fourth (1/4) the vertical outside diameter or rise. The cradle shall have a width at least equal to that of the excavated trench. 3000 psi concrete mix shall be used for the above bedding purposes. Care shall be taken so that the concrete strength does not exceed 3000 psi, unless a positive method of breaking bond between the pipe and the concrete is provided for.

When a non-rigid sewer (PVC, Polyethylene, Polypropylene, Fiberglass) is under pavement, and the top of the pipe has less than three (3) feet of cover, it is recommended that the pipe be encased with a minimum six (6) inches of 3,000 psi concrete. The pipe shall be bedded as specified in the drawings. The encasement of sewers shall be the decision of the design engineer.

All space within the width of the trench excavation, inside or outside the authorized limits, shall be filled between the elevation limits with the same material as specified for the type of bedding to be used and as shown on the applicable standard drawings.

4. Pipe Cover
   Only coarse limestone aggregate AASHTO M43 No. 57, 6, 67, 68, 7, 78 or 8 shall be used for filling above the pipe bedding along the sides of the sewer and to a height of 12 inches over the top of the sewers, except for concrete pipes. For concrete pipe, the minimum cover shall be to the spring line of the pipe; however, the Municipal Engineer or responsible agency may specify the pipe cover extend to 12 inches above the top of concrete pipe. The pipe cover material shall be brought up evenly on both sides of the sewers and shall be thoroughly compacted by tamping or ramming. Care shall be taken to spade the aggregate under the pipe haunch below the spring line.

5. Concrete Anchorage
   Concrete anchorages will be used when sewer slopes fall within the following limits, unless otherwise specified:

   20% to 35% slope – anchorage 36 feet center to center (maximum)
   35% to 50% slope – anchorage 24 feet center to center (maximum)
   Over 50% slope – anchorage 16 feet center to center (maximum).

   Concrete anchorages shall extend a minimum of 18 inches below the bottom of the pipe and 6 inches over the top of the pipe, and shall be a minimum of 12 inches thick, and as wide as the excavated trench.

D. **Blasting**

Blasting will not be permitted under and near buildings, bridges, railroad tracks and major underground structures and utilities. Elsewhere, blasting may be permitted, but only upon the written approval of the responsible agency and of the municipality in which work is being done. The contractor shall use all possible precautions against accidents or damage due to explosions or in the use or storage of explosives. The contractor shall assume all risk and responsibility for the blasting. The contractor shall promptly settle all damage claims due to the blasting; and save and hold harmless the responsible agency from any claims resulting from all blasting activities. A blaster licensed by the State of Ohio shall be employed to supervise the drilling and blasting operations.

The Municipal Engineer or responsible agency shall fix the time during which the blasting operations may be carried on. Explosives shall be used, handled and stored as prescribed by the laws and regulations of OSHA, the State of Ohio Fire Code and local municipality's fire code official. A permit from the State of Ohio Department of Commerce Division of State Fire Marshall is required for explosive storage and explosive material storage as per the Ohio Fire Code. A separate blasting permit is required from the local sheriff's department. All explosives shall be kept in a safe place, at a sufficient distance from the work, so that in case of accident, no damage will occur to any part of the work or adjacent property.

Explosives shall be so stored and secured that they are not accessible to unauthorized persons. Blasting shall be conducted so as not to endanger persons or property and, whenever required, the blast shall be covered with mats or otherwise satisfactorily confined. The contractor shall be held responsible for and shall make good, any damage caused by blasting or accidental discharge. A supplemental blasting insurance policy or a rider to an existing liability insurance policy must be obtained by the contractor prior to any blasting. The policy shall be a minimum of $2,000,000 or as specified by the responsible agency.

Blasting in tunnel sections and elsewhere, when permitted, shall be done in accordance with the provision of all regulations of Section 1501:13-19-06 of the Ohio Administrative Code, as amended, and all applicable Local and Federal Laws. A pre-blast survey, using blast vibration monitoring equipment by certified professionals, may be required by the Municipal Engineer or responsible agency.

E. **Tunnel**

All excavation shall be open cut from the surface and no tunneling will be allowed except when written permission has been previously obtained from the Municipal Engineer or responsible agency or it is specifically called for on the contract documents. Where tunneling is permitted under pavements, or specifically called for on the plans, the work shall be done in accordance with the contract documents. The contractor shall be responsible for the proper replacing of pavement support and/or repairing of the pavement.

F. **Sewers Within Jacked or Bored Casing Pipe**

At the locations shown on the plans, the sewer pipe shall be installed in an uncoated steel casing pipe with wood blocks or stainless steel or polymer coated carbon steel casing spacers supporting the sewer pipe as shown on the Uniform Standards Sewer Details Boring Details for Paved Areas. Material, equipment and construction procedures shall comply with the contract documents. Carrier pipe shall be blocked top and bottom to prevent floating. The annular space between the carrier pipe and the steel casing pipe shall be filled with either sand, 1:6 grout, or flowable fill as required by the responsible agency. Brick bulkheads or wrap around rubber end seals shall be provided at each end of the casing pipe.

For all public sanitary and storm sewer lines, a minimum of one manhole on each end of the cased bored sewer shall be provided for all railroads, multilane highways, and non-residential roadways.

G. **Bored and Jacked or Tunneled Service Connections**

At the locations shown on the contract documents, a ductile iron sewer pipe service connection shall be jacked into a bored hole as herein specified. A sufficiently large boring pit shall be excavated to allow for proper alignment of the drilling equipment and to allow the pipe to be pushed through the drilled hole. The alignment of pipe will not be allowed to vary more than two (2) feet horizontally at the upstream end of the house connection from a line drawn at right angles from the sanitary sewer at the wye or riser. Other piping materials may be used if approved by the responsible agency. The responsible agency may require the use of a casing pipe. See the Uniform Standard Boring Details.

The lateral connection shall be laid on a grade of not less than one percent (1%) but not more than three percent (3%), and the top of the upstream end of the pipe shall be not less than nine (9) feet below the elevation for homes with basements of the average finished grade of the building line in residential areas and 11 feet for commercial and industrial areas. The upstream end of the pipe shall be fitted with a stopper painted yellow for sanitary (natural color for storm) and an increaser and adapter, if necessary.

In cases where local ordinances or governmental agencies prohibit the cutting of pavements, and the subsurface consists of rock or other hard material that does not lend itself to boring, the sewer shall, upon the order of the Municipal Engineer or responsible agency, be installed by tunneling under the pavement.

H. **Bracing and Sheeting of Excavation**

All trench and excavation bracing and sheeting shall be in conformance with the latest available OSHA Requirements.

I. **Drainage**

The contractor shall, when ordered by the Municipal Engineer or responsible agency, construct tight bulkheads across the trench and provide pumps suitable for the removal of any water which may be encountered, or which may accumulate in the trenches. Unless otherwise provided for in the contract documents, drainage water will not be permitted to flood the trench or flow through the sewer.

1. Drainage of Trenches and Underdrains

   The sewer trench shall be kept free from storm, surface, subsoil water, and/or sewage. No joints shall be made under water. If necessary, the contractor shall install an underdrain embedded on both sides of the trench in crushed stone. This work shall be done only upon the written order of the responsible agency.

2. Existing Water Courses

   In open water courses, ditches or drains, and drain pipes encountered during the progress of work, the contractor shall provide for protection and securing of a continuous flow in such courses or drains and shall repair any damage that may be done by reason of them.

J. **Paved Surfaces**

The contractor shall remove all pavements, road surfaces, curbing, driveways, and sidewalks within the lines of excavation. The contractor shall cleanly saw cut the pavement and base for the width of the trench without undue shattering. After the sewer pipe is installed and backfilled, the contractor shall cleanly saw cut the existing pavement again on both sides of the trench, as shown in the Uniform Standard Sewer Details, in order to obtain a clean edge for the trench paving. All concrete curbing, driveways or sidewalks within the lines of excavation shall be broken up and removed by the contractor. All such work shall be done in accordance with the rules and regulations of the municipality in which the work is done.

The use of pneumatic or hydraulic backhoe boom mounted pavement breakers or weights dropped on pavement for breaking will not be allowed except by permission of the responsible agency.

K. **Excavation by Machine or by Hand**

The use of track mounted excavation machinery will be permitted in all unpaved areas, except in places where hand excavation or rubber tire mounted machinery is called for in the contract documents. The contractor shall use rubber tired or rubber tread equipment or protective mats in all pavement areas.

L. **Barricades, Guards and Safety Provisions**

Temporary traffic control devices and facilities shall be furnished, erected and maintained in accordance with the latest edition of the Manual on Uniform Traffic Control Devices for Streets and Highways prepared by the National Joint Committee on Uniform Traffic Control Devices. The work shall be conducted so that the least interference with traffic will result. Suitable steel plate bridges, properly recessed and anchored, shall be provided over open trenches in pavements and driveways. The contractor shall be responsible for determining the thickness of the steel plate required for the trench bridging; however, in no case shall the steel plate be less than 0.75 inches thick.

5.203 PIPE INSTALLATION

A. **General Information**

All pipe for use in sanitary or storm sewers shall conform to the specifications for pipe in Sections 5.104, 5.105, 5.106, 5.107, 5.108, 5.109, 5.110, 5.111, 5.112, 5.113 and 5.114.

Only one (1) type and strength of pipe shall be used between any two (2) consecutive manholes, unless otherwise shown on the contract drawings and specifications.

Where ASTM, ANSI or other national organizations have published recommended practices for installation, such recommendations shall be followed.

Clay pipe shall be installed in full compliance with ASTM C12, "Standard Practice for Installing Vitrified Clay Pipe Lines."

Concrete pipe, as specified by the American Concrete Pipe Association, Design Data 40 and ASTM C12.

PVC Composite Wall pipe, PVC pipe, polyethylene pipe, and polypropylene pipe shall be installed in full compliance with ASTM D2321, "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications".

Fiberglass (Glass-Fiber Reinforced Thermosetting Resin) pipe shall be installed per ASTM D-3839. Ductile iron pipe shall be installed per AWWA C111.

Corrugated metal pipe and Steel Sheet Aluminized Coated Type 2 for corrugated Steel Pipe shall be installed per ASTM A798/A798M.

Steel reinforced polyethylene pipe shall be installed per ASTM D2321. All pipe shall also be installed as shown in the Uniform Standard Sewer Details.

B. **Construction**

After the trench has been excavated and the pipe bedded as specified in Section 5.202-C-3, the pipe shall be laid to the line and grade as specified. All joints shall be made as hereinafter specified. In no case shall material, except bedding material, be placed under the bell of the pipe to secure proper grade.

Previous to being lowered into the trench, each pipe shall be carefully inspected and those not meeting the specified requirements shall be rejected, clearly marked, and immediately removed from the site of the work. Satisfactory means shall be used to hold the pipe in line while the pipe is being jointed, and due precautions shall be taken to ensure that the spigot end of the pipe being laid is pushed to the proper depth into the bell of the proceeding pipe.

All sanitary and storm sewer lateral connections shall be a minimum of six (6") inches I.D. and installed at a minimum of 1% grade. Variations from these requirements shall be approved by the proper responsible agencies.

Pipe shall be laid with the socket end upstream.

No pipe shall be laid within ten (10) feet of the machine excavating the trench nor within 40 feet of any place where blasting is being done. In no case shall more than 200 feet of trench be opened in advance of the pipe laying operations.

In sanitary sewer construction, no drainage shall run through the newly laid pipe. All sewers shall be tightly sealed at open ends at the completion of each day's work and no drainage water shall be permitted to flow through the sewer.

No storm water which accumulates in excavated basement areas is to be discharged into the sanitary sewerage system. Roof drains, foundation drains or any other clean water connections to the sanitary sewer system are prohibited.

All trenches and excavations shall, in general, be backfilled as soon as possible after the pipe is laid and jointed. Pipe cover zone shall be compacted to the Municipal Engineer's or responsible agency's specifications. Pipe backfill shall be compacted to a minimum 98% Standard Proctor. Where concrete encasement or cradle is used, pipe shall not be backfilled for at least 24 hours after placing concrete except that pipe may be covered to a depth of, not to exceed, 16 inches over the top of the pipe. The method employed in depositing the backfill shall be such as to prevent damage to the sewer or other structures.

5.204 PIPE JOINTS

A. **General Information**

The pipes shall be very carefully stored and handled to prevent any damage, and no pipes shall be connected if the jointing rings have been deformed or damaged from any cause. Unless otherwise specified by the Municipal Engineer or responsible agency or directed or indicated on the plans, the following types of joints shall be used.

All sanitary sewer piping shall be subject to the required low-pressure air testing. The low-pressure air testing shall follow the procedures outlined in ASTM C-828 for clay pipe, ASTM C-924 for concrete pipe, or ASTM F-1417 for plastic pipe (this also applies to other non-rigid pipe).

B. **Joints for Clay Pipe**

The joints for clay pipe shall conform to the provisions of Section 5.115 of these Standards.

When jointing pipe using a compression watertight type joint, a lubricant, as furnished or recommended by the pipe manufacturer, shall be applied in the manner prescribed by the pipe manufacturer. No jute or other caulking will be permitted. The spigot shall then be entered into the socket and the pipe shoved home in an approved manner to fully complete the particular type of joint which is being used. The socket and spigot shall be free of any foreign matter which may prevent proper jointing of the pipe. When laying the pipe in concrete bedding, care shall be exercised to prevent the joint materials from coming in contact with the fresh concrete until after the joint has been completed.

C. **Joints for Concrete Pipe**

The joints for concrete pipe shall conform to the provisions of Section 5.115 of these Specifications.

When jointing pipe using a compression watertight type joint, a lubricant, as furnished or recommended by the pipe manufacturer, shall be applied in the manner prescribed by the pipe manufacturer. No jute or other caulking will be permitted. The spigot shall then be entered into the socket and the pipe shoved home in an approved manner to fully complete the particular type of joint which is being used. The socket and spigot shall be free of any foreign matter which may prevent proper jointing of the pipe. When laying the pipe in concrete, care shall be exercised to prevent the gasket from coming in contact with the fresh concrete until after the joint has been completed.

D. **Joints for Polyvinyl Chloride (PVC) Pipe**

The joints for PVC pipe shall be watertight and conform to the provisions of Section 5.115. When jointing pipe using the required 0-ring compression type joint, a lubricant recommended by the gasket manufacturer shall be used. The socket and spigot shall be free of any foreign matter such as twigs, sand particles, or other material that might prevent closure of the joint. Lubricant shall be applied to the bevel of the spigot end and approximately mid-way back to the insertion line. Do not apply lubricant inside the bell.

E. **Joints for Polyvinyl Chloride (PVC) Composite Wall Pipe**

Joints for PVC Composite wall pipe shall be watertight and shall conform to the provisions of Section 5.115.

F. **Joints for Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe**

Joints for fiberglass (glass fiber reinforced thermosetting resin) pipe shall conform to the provisions of Section 5.115.

G. **Joints for Ductile Iron Pipe**

Joints for Ductile Iron Pipe shall be watertight and shall conform to the provisions of Section 5.115. The socket and spigot shall be free of any foreign matter. The gasket shall be thoroughly lubricated allowing free rotation as the spigot is pushed into the socket.

1. Rubber Slip Joints

   All ductile pipe, shall be laid with rubber slip joints, comparable to one (1) of the following:

   "Tyton" joint, as manufactured by the U.S. Pipe.
   "Fastite" joint, as manufactured by the American Cast Iron Pipe Company.
   "Bell-Tite" joint, as manufactured by Clow Corporation.

2. Bolted Joints

   Where specified or called for on the plans, bolted or special type mechanical joints shall be used for ductile iron and shall meet the requirements of ANSI/AWWA C111/A21.11. Such joints shall be made in a manner satisfactory to the responsible agency and in accordance with the manufacturer's instructions.

H. **Joints for Steel Sheet Aluminized Coated Type 2 for Corrugated Steel Pipe (where applicable and accepted)**

Joints for steel sheet aluminized coated type 2 for corrugated steel pipe shall be silt tight and shall conform to the provisions of 5.115.

I. **Joints for Corrugated Metal Pipe**

Joints for corrugated metal pipe shall be silt tight and shall conform to the provision of section 5.115.

J. **Joints for High Density Polyethylene and Polypropylene Storm Sewer Pipe**
Joints for high density polyethylene and polypropylene storm sewer pipe shall be silt tight and shall conform to the provision of section 5.115.

K. **Joints for Polypropylene Corrugated Double Wall or Triple Wall Sanitary Sewer Pipe**
Joints for Polypropylene corrugated double wall or triple wall sewer pipe shall be watertight and shall conform to the provisions of section 5.115.

L. **Joints for Steel Reinforced Polyethylene Pipe (SRPE)**
Joints for Steel Reinforced Polyethylene Pipe shall be elastomeric gasket and silt tight conforming to ASTM F477.

5.205 BACKFILLING

A. **General**
The backfill includes furnishing suitable backfill material, proper placing all backfill, the regrading of adjacent disturbed areas, the replacing or repairing of drains and other surface and subsurface structures, the placing and maintaining of temporary facilities (including, but not limited to, sidewalks, driveways, etc.), and all appurtenant work incidental thereto. The Contractor shall maintain all temporary facilities, at his expense, until such time as the permanent facilities are placed.

No backfilling shall be made during freezing weather except by written permission of the responsible agency, and no fill shall be made when the material already in the trench is frozen, nor shall frozen material be used in backfilling.

Materials including, but not limited to, recycled concrete, slag (of any kind), sandstone, river gravel, and foundry sand, shall not be permitted for bedding, cover, or backfill.

Note: Bedding and cover shall be in accordance with Sections 5.123 and 5.124 of the Uniform Standards and the "Typical Trench Details" of the Uniform Standard Sewer Details.

B. **Backfill Operation**

a. Under Pavement or within the Street Right-of-Way

At all locations within an existing right-of-way (including, but not limited to, where existing pavement, driveways, concrete gutters, sidewalks, treelawns, lawns, etc., are removed in the sewer and utility construction) all backfilling of the sewer trench shall be made with Cleveland Low Strength Mortar Backfill (LSM).

Cleveland Low Strength Mortar Backfill shall use ASTM C150 Type I cement and conform to the requirements of ODOT CMS 613, Type 2. The fine aggregate shall conform to ODOT CMS 703.03 “Fine Aggregate for Mortar of Grout.” The use of foundry sand, core sand or fly ash is strictly prohibited. An air enhancing

admixture shall be incorporated in the mix in order to have the effect of lowering the water/cement ratio to between 95 and 105 lbs./cubic foot. Air entrained content of the mix shall be 30%. Permissible admixtures shall be as follows: 1) Rheofill by Master Builders, 2) Flow Air by Axim, or 3) Darafill by W.R. Grace.

The LSM Mix Design shall be as follows:

Cement (Type I)	50 lbs./cu. yd.
Sand (SSD)	2475 lbs./cu.yd.
Water	25 gal./cu. yd.
Admixture	3 oz./cu.yd.

Variation of the mix design is strictly prohibited. A mix design shall be submitted to the responsible agency for review and approval, if required or requested. The compressive strength for the mix shall be between 50 and 80 psi at 28 days.

Placing. The LSM fill should begin at 12 inches above the top of the pipe and continue to the bottom of the pavement base material or to 36 inches below the top of ground in unpaved areas. All exposed bolts or valves within the trench shall be wrapped in polyethylene material, and all joints in clay pipe in the trench shall be covered with polyethylene material, before placing the LSM fill. The polyethylene material shall conform to ODOT CMS 748.07.

Premium "stone" backfill, in lieu of LSM, shall be used when directed by the Municipal Engineer or responsible agency. Premium "stone" backfill shall consist of coarse interlocking limestone aggregate No. 57, 6, 67, 68, 7, 78, 8, ODOT CMS Item 304 limestone, or limestone screenings. Materials including, but not limited to, recycled concrete, slag (of any kind), sandstone, river gravel, and foundry sand, shall not be permitted to be used for premium backfill. The backfill shall be placed and compacted as required in c. Placement and Compaction of Backfill below.

b. <u>Outside of Pavement or Outside of the Street Right-of-Way</u>

If approved by the responsible agency, material excavated from the trench shall be suitable for backfill. The contractor shall secure suitable material from other sources if required; however, this material shall require the approval of the responsible agency. The backfill shall be placed and compacted as required in c. Placement and Compaction of Backfill below.

For work not within a public right-of-way, premium backfill shall be used under all pavements (including, but not limited to, driveways, parking lots, etc.) for the full depth of excavation to the subgrade. Premium backfill shall extend to five (5') feet beyond the edge of pavements for transverse sewers. The backfill shall be placed and compacted as required in c. Placement and Compaction of Backfill below.

c. Placement and Compaction of Backfill

No backfilling shall be made during freezing weather except by written permission of the responsible agency, and no fill shall be made when the material already in the trench is frozen, nor shall frozen material be used in backfilling. Puddling shall not be allowed. Additional water added to the trench backfill shall be limited to achieving optimum moisture content for tamping procedures.

All backfill material shall be carefully placed so as not to damage the joints or displace the pipe. Backfilling shall immediately follow trenching and pipe laying operations to reduce the possibility of damage to pavements and utilities.

The backfill material shall be brought up evenly and must be placed in maximum 12-inch horizontal layers with minimum 98% maximum dry density compaction as measured by the Standard Proctor Test or as required by the Municipal Engineer or responsible agency. Compaction shall be done using either a sheep's foot roller, vibrating plate tamper, or mechanical tampers.

All backfill shall be tested for compaction, approved, and certified by a certified soil testing laboratory that it meets the compaction requirements, unless otherwise specified by the Municipal Engineer or responsible agency. Each and every lift shall be tested by the approved testing company and the reports provided to the responsible agency. All testing shall be done at the contractor's expense.

5.206 DISPOSAL OF SURPLUS EXCAVATED MATERIAL

All surplus excavated material shall be removed and properly disposed of by the contractor. Hazardous materials, as defined by Ohio EPA, that are removed from the trench or project shall be disposed of in accordance with Ohio EPA regulations. The contractor shall be responsible for providing all documentation that the hazardous material has been properly disposed of at an approved EPA site(s).

5.207 BRANCH CONNECTIONS AND RISERS

Branches, "Y"s or "T"s of the size specified, shall be installed at the locations shown on the plans and shall be standard fittings. Openings at the outer ends of the branches shall be closed and sealed with approved stoppers. When required, on account on depth of the sewer, branches shall be built up vertically with riser pipes to a point nine (9) feet below the top of the building line ground elevation as shown on the drawings, using bends whenever necessary per the requirements of the Uniform Standard Sewer Details. All pipe joints shall be carefully made and shall conform to the requirements in these Standards for the type of pipe used.

5.208 LATERAL CONNECTIONS

Sewer service street connections shall be constructed as shown on the plans and shall be laid in accordance with Section 5.203 from the lateral sewer or risers to a point designated on the plans.

All street connections shall be closed and sealed at the outer end with approved premium stoppers, or as required by the responsible agency. See also 5.211A, Service Markings.

All lateral connections crossing under existing pavements shall be constructed of ductile iron and be installed by boring and pushing the ductile iron pipe through the excavated hole unless the contract specifies otherwise, or written permission is granted by the responsible agency to use the open trench method.

5.209 DRAINAGE STRUCTURES

A. **Standard Manholes**

All manholes shall be built in accordance with the plans and Uniform Standard Sewer Details. Sanitary manholes shall be constructed of precast concrete manhole sections conforming to Section 5.127. High density polyethylene manholes may be permitted in areas with hydrogen sulfide problems if approved by the Municipal Engineer or responsible agency. Storm manholes shall be constructed of precast concrete manhole sections and concrete grade rings conforming to Section 5.127. All manholes shall be a minimum of 48 inches in diameter.

Brick Reconstruction

Brick shall only be used to rebuild the top 4 feet of existing brick manholes. New brick manholes shall not be permitted for either storm or sanitary sewers. All brick used in manhole reconstruction shall be shale brick conforming to Section 5.119A and shall be laid in full mortar beds with no mortar joint appearing on the inner surface of the manhole exceeding three-eighths inches (3/8) thick. When sewer brick is used for manhole reconstruction, they shall be laid in 1 to 2 Portland Cement mortar with bricks arranged radially as headers, forming a wall nine inches (9) thick.

The entire outer surface of the sewer brick reconstructed section of the manhole shall be plastered with a smooth coating of 1 to 2 Portland Cement mortar at least one-half inch (1/2) in thickness. The top of the walls of manholes shall be properly leveled off with mortar so as to form a flat surface upon which the cast iron manhole cover ring is to rest and the manhole shall be carried to proper height above the sewer.

Cones and Tops

The top section of the precast manhole may be eccentric cone, concentric cone, or flat slab.

Grade Rings

In precast manholes, provisions shall be made for a minimum of four inches (4) and a maximum of 12 inches of grade rings between the uppermost precast section and the bottom of the cast iron manhole cover ring.

Manhole grade rings shall be sealed externally and between grade rings with a layer of mastic compound such as Fabertite, Kent Seal, Conseal, or approved equal.

Chimney Seals

New sanitary sewer manholes shall be equipped with chimney seals. Chimney seals can be installed either internally or externally. Sanitary sewer manholes shall have a four (4) inch minimum vertical distance from the bottom of the casting to the top of the conical section for the installation of chimney seals. Chimney seals shall be resistant to puncturing or tearing and shall create a mechanical seal that does not depend on chemical bonding. The seal shall be reusable, adjustable, shall be of a pleated configuration, and shall provide a watertight seal. Chimney seals shall be installed per manufacturer's specifications.

If internal, the seal shall remain flexible throughout a 50-year design life, allowing repeated vertical movement of the frame of not less than two (2) inches and/or repeated horizontal movement of not less than ½-inch. The rubber portion of the seal shall have a minimum thickness of 3/16-inch and be available in 20-inch to 36-inch diameters and be made from a high-quality rubber compound conforming to the applicable requirements of ASTM C923 with a minimum 1500 psi tensile strength, a maximum 18% compression set and a hardness (durometer) of 48± 5. The bands shall be formed from 16-gauge stainless steel conforming to ASTM A240, type 304 and shall have a positive locking mechanism. Any screws, bolts or nuts used for this mechanism shall be stainless steel, conforming to ASTM F593 and 594, Type 304.

External chimney seals shall consist of a flexible external rubber sleeve, extension and stainless steel compression bands. The material utilized for external seals shall be of the same quality as the material utilized for internal seals. The flexible sleeve shall be corrugated with a minimum thickness of 3/16 inches with an unexpanded vertical height of 9 inches. The sleeves shall be available in 32-inch to 40-inch diameters. The tightening mechanism on both compression bands shall have the capacity to make a watertight seal.

If external seals are used, cement mortar shall be used in the joint between the manhole frame and grade rings. This joint shall be ¾-inch thick. Butyl rubber caulk, conforming to AASHTO M198 Type B may be applied to the lower sealing surface of the sleeve to fill any minor irregularities in the masonry surface.

Frames and Covers

The contractor shall furnish and set upon the top of each manhole, a cast iron manhole ring and cover per the requirements of the Uniform Standard Details.
A urethane mastic shall be used to seal the casting to the grade rings.

Sanitary manhole covers shall be solid in all street and residential areas and all areas subject to flooding or ponding. Watertight manhole covers shall be used for sanitary sewers wherever the manhole top may be flooded by street runoff or high water. Vented covers with holes may be used in all other areas.

Manhole castings shall be stamped "Sanitary" for sanitary manholes and "Storm" for storm manholes, unless another casting is required by the responsible authority.
All storm manholes shall have vented covers. Locked manhole covers may be specified by the responsible agency for use in isolated easement locations or where vandalism may be a problem.

Manhole Joints

Manhole joints shall be sealed externally with a layer of mastic compound such as Fabertite, Kent Seal, Conseal or approved equal.
Joint seals between precast manhole sections shall be flexible gasketed joints meeting the requirements of ASTM C443.

Steps

Manhole steps, as specified in Section 5.117, shall be built into each manhole in accordance with the Uniform Standard Sewer Details and shall be continued downward along the interior side of the manhole spaced not less than 12 inches apart nor more than 16 inches apart.

Landing Platforms

See the Landing Platform requirements in 5.127 Precast Concrete Manholes.

Resilient Connectors

Pipe penetrations for sewer applications shall incorporate a watertight flexible pipe connector or ring-type seal according to the method of manhole construction. Precast manholes shall utilize either an integrally cast embedded pipe connector, or a boot-type connector installed in a circular block out opening in accordance with ASTM C923. Connections to existing manholes shall utilize a boot-type connector per ASTM C923 installed in a cored opening. Cast-in-place bases shall incorporate a ring-type seal on the pipe to be embedded in the concrete.

Where pipes pass through the outside face of manhole walls, a flexible connector, such as KorNSeal, or approved equal, shall be provided so that a slight flexing or motion can take place in the plane of the wall face without shearing the sewer pipe. Flexible connections meeting ASTM C923 shall be provided for all sanitary, storm, and combined sewers entering manholes.

Lift Holes

Lift holes may be provided in each manhole section for handling. All manhole lift holes shall be sealed water tight with approved concrete plugs, or a non-shrink grout, or an expanding Portland Cement mixture such as Octoplug, Quikrete, Parsons Quick Plug or approved equal.

Testing

All manholes shall be vacuum tested as per Section 5.211B.6 of these specifications.

B. **HDPE Manholes**

HDPE manholes shall be chemically and corrosion resistant and may be used in areas of high hydrogen sulfide concentrations when approved by the Municipal Engineer or responsible agency. Manhole widths shall be a minimum of 48 inches in diameter. The manhole design shall meet the requirements of "Standard Practice for Design of High-Density Polyethylene (HDPE) Manholes for Subsurface Applications", ASTM F1759.

All manhole connections larger than 4-inch OD pipe shall be butt fusion welded, electrofusion welded, or flanged connections. All butt fusion welds shall be made in accordance with ASTM F2620. Ladders within the manhole shall meet OSHA requirements. Reinforced concrete pads spanning the width of the manhole and traffic rated HS-20 loading frame and cover shall be required in traffic areas. Calculations, stamped by a Registered Professional Engineer, for the design of the concrete pad, as well as calculations for floatation, shall be submitted to the responsible agency for approval. Anti-flotation and/or anti-settling anchor collars, if required, shall be included as an integral part of the manhole by the fabricator/manufacturer. The HDPE material shall meet the requirements of ASTM D3350. All HDPE manholes shall be vacuum tested as per Section 5.211B.6 of these specifications. HDPE manholes shall be watertight.

C. **Drop Manholes**

Where shown on the plans, drop manholes shall be built in accordance with the Uniform Standard Sewer Details. The use of drop manholes is discouraged where hydrogen sulfide is present or predicted in the wastewater. Exterior drop pipes shall be one-half of the main sewer diameter, eight (8) inch minimum and a 24-inch maximum diameter and shall be encased in reinforced concrete to the dimensions shown on the Standard Details.

D. **Inside Drop Manholes**

Where accepted by the Municipal Engineer or responsible agency, internal drop pipes may be provided and installed when connecting new sewer(s) into existing manholes. New manholes receiving discharge from force mains shall have an internal drop connection. New manholes that have force main discharge lines shall have an internal epoxy coating to prevent concrete corrosion and deterioration.

The internal drop pipe shall be PVC SDR 26 and shall be ½ the diameter of the influent pipe(s) with a minimum size of internal drop pipe of 8-inch diameter and a maximum size of 24 inches. The internal drop pipe shall be anchored to the inside wall of the manhole using 1½-inch wide by 1/8-inch thick stainless-steel straps bolted around the

pipe and connected to 2”x4”x6” to 10” wolmanized blocking mounted horizontally between the pipe and the manhole wall a maximum of 3’-0” apart including blocking at the top and bottom of the drop pipe. All nuts and bolts used for making the connections shall be stainless steel.

The manhole wall shall be field cored, and a watertight boot connection made with the influent pipe. The internal drop pipe system shall be as manufactured by Reliner/Duran, Inc., (including drop bowel) or approved equal. The minimum existing manhole size for installing an internal drop pipe is 60-inch diameter.

E. Rehabilitation of Manholes

Manhole rehabilitation shall consist of the following work items:

1) Manhole Sealing,
2) Manhole Patching,
3) Manhole Plugging,
4) Manhole Chimney Seal Filler, and Manhole Chimney Seals on existing sanitary manholes,
5) Raising manhole castings to grade,
6) Replacement of existing frames and covers (including solid covers)

1) Manhole Sealing

Manhole Sealing shall consist of sealing existing manhole walls and base. The purpose of the work is to rehabilitate the manhole such that the sealing will stop inflow, infiltration and exfiltration, and will restore the structural integrity of the manhole.

A monolithic, fiber reinforced, structurally enhanced, cementitious-based liner material shall be applied by spraying methods to cover the invert/bench and wall surfaces of the manhole in applications where the pH is 3.0 or greater. The liner material shall be made of Type I Portland Cement that is reinforced with alkaline resistant fiberglass rods not less than ½ inch in length. The liner material shall have 28 day minimum compressive strength of 9000 psi; 28 day minimum tensile strength of 800 psi; 28 day minimum flexural strength of 1200 psi; and 28 day minimum bonding strength of 2000 psi, or as required by the responsible agency.

The sealing item shall include the removal and disposal of any debris within the manhole. All debris removed shall be considered sanitary waste and shall be properly disposed in accordance with Ohio EPA regulations. The bench and wall surfaces shall be prepared using high-pressure water spray with a minimum of 3000 psi pressure. The applied surface shall be prepared such that it is free of oil, grease, water loose material, and other contaminants that may inhibit bonding. Loose and protruding brick, mortar, cement, concrete, deposits, and any foreign debris shall be removed by the contractor.

Prior to the application of the liner material all voids greater than 2 inches shall be filled or patched, and all active leaks within the walls or base shall be plugged. The liner material shall be applied in accordance with the manufacturer’s recommendations and with manufacturer’s approved equipment at a minimum thickness of ½ inch.

No application of the liner material shall be made to frozen surfaces or if freezing is expected to occur within the substrate within 24 hours after application. The liner mix temperature at the time of the application shall be less than 90 degrees F. The surfaces shall be totally saturated and damp prior to the spray application. The equipment shall contain working gauges to measure the pumping pressures. The lining material shall also be applied to the invert and bench of the manhole such that the finished surface maintains positive flow. A brush finish shall be applied after troweling. Upon sealing the manhole, the area around the manhole shall be protected from the traffic for a minimum of 24 hours.

The work will be accepted after passing testing per Section 5.211B.6. Manholes failing the test shall be repaired at the contractor's expense and retested until they pass.

2) Manhole Patching

Manhole patching shall consist of filling voids greater than two (2) inches prior to manhole wall sealing. The purpose is to fill the voids and provide a suitable surface for the manhole wall sealing. The surface to which the material is to be applied shall be prepared in accordance with the manufacturer's recommendations such that it is free of oil, grease, water, loose material, and other contaminants that may inhibit bonding. The patch material shall be stored and installed in accordance with the manufacturer's recommendations. The patching material shall be a quick setting fiber reinforced calcium aluminate corrosion resistant cementitious material. The patching material shall have a minimum compressive strength of 800 psi at 1 hour and 1800 psi at 24 hours and a minimum bonding strength of 1600 psi at 28 days, or as required by the responsible agency. The placement time for the material shall be 5 to 10 minutes and the set time shall be 15 to 30 minutes.

3) Manhole Plugging

Manhole plugging shall consist of stopping active leaks prior to manhole wall sealing. The plug material shall be stored and installed in accordance with the manufacturer's recommendations. The plugging material shall be a rapid setting cementitious product specifically formulated for leak control and shall be used to stop minor water infiltration. The plugging material shall have a minimum compressive strength of 1000 psi after 1 hour and 2500 psi after 24 hours and a minimum pull strength of 14000 lbs. The material shall be sulfate resistant with no weight loss after 15 cycles at 2000 ppm as tested by ASTM C267 methods. The product set time shall be less than 1.0 minutes.

4) Manhole Chimney Sealing

Manhole chimney sealing for existing manhole shall consist of sealing the chimney portion of an existing sanitary manhole. The purpose of the chimney seal is to reduce infiltration of surface water into the manhole at the interface of the casting and the manhole structure. The chimney seal shall be an elastomeric lining composed of fiber reinforced asphalt modified urethane. The material shall remain flexible from minus 30 degrees F to 250 degrees F. The material shall be suitable for applications on metal, brick and concrete surfaces and shall be resistant to acids and alkalis. The seal material shall have a minimal tensile strength of 1,500 psi per ASTM D412 and a minimum hardness of 45 lbs. per square inch per ASTM D2240; a maximum water absorption rate of 0.05% as measured by ASTM D570; a maximum elongation of 130%, as

measured by ASTM D638; and a maximum abrasion of 550 mg/1000 cycles.

The work shall be performed during a period when air temperatures are 60 to 80 degrees F. The surface to which the material is to be applied shall be prepared in accordance with the manufacturer's recommendations such that it is free of oil, grease, water, loose material, and other contaminants that may inhibit bonding. Prior to installing the chimney seal, all voids encountered shall be filled with chimney seal filler.

As a minimum, the vertical height of the chimney seal shall include the bottom four (4) inches of the metal casting and the top eight (8) inches of the manhole brick or concrete structure. The date of manufacture of the material being placed shall be provided to the Municipal Engineer or responsible agency. Product older than one (1) year shall not be acceptable. Upon placement of the seal, the area shall be protected from traffic for a minimum of two (2) hours.

Manhole chimney seal filler shall consist of filling voids prior to placing the chimney sealing. The purpose is to provide a suitable surface for the chimney seal. The chimney seal filler shall be a three-part epoxy specifically formulated to fill voids, irregularities and air pockets in concrete, brick or steel and shall be suitable for application over damp or dry concrete surfaces. The filler shall have a working time of 15 minutes and a minimum cure time of 3 hours prior to topcoating. The filler shall have a minimum compressive strength of 10,000 psi; a minimum flexural strength of 4,000 psi; a minimum tensile strength of 2,200 psi; shrinkage of less than 2%; and a maximum service temperature of 150 degrees F.

The work shall be performed during air temperatures of 60 to 80 degrees F. The surface to which the material is to be applied shall be prepared in accordance with the manufacturer's recommendations such that it is free of oil, grease, loose material, and other contaminants that may inhibit bonding. The date of manufacture of the material being place shall be provided to the Municipal Engineer or responsible agency. Products older than one (1) year shall not be acceptable.

5) Raising Manhole Castings to Grade

This work shall consist of adjusting to grade manholes at the project plan locations or as directed by the Engineer. All material and work shall meet the requirements of ODOT Item 611.

The Contractor is cautioned to use extreme care when adjusting existing castings to grade. Any castings damaged by the Contractor's negligent operations, as determined by the Engineer, shall be replaced with the proper new casting by the Contractor, at no expense to the responsible agency. Manhole castings shall be stamped "Sanitary" for sanitary manholes and "Storm" for storm manholes, unless another casting is required by the responsible authority.

6) Replacement of Existing Frames and Covers (Including Solid Covers)

This work shall consist of furnishing new castings, or parts of castings, where an existing casting is damaged and cannot be salvaged, as determined by the Engineer.

It shall be the Contractor's responsibility to provide the castings of the required type, size and strength to meet the requirements of Item 611 in the ODOT Specifications, and the USSD General Notes. Manhole castings shall be stamped "Sanitary" for sanitary manholes and "Storm" for storm manholes, unless another casting is required by the responsible authority.

All castings shall be coated with asphaltic paint meeting the requirements of AWWA C115/A21.15-88 and shall be 1 mil thick.

F. **Inlets and Catch Basins**

Inlets, catch basins and trench drains in public right of way shall be built in accordance with plans and the Uniform Standard Sewer Details or State of Ohio Department of Transportation Standard Construction Drawings, depending on the responsible agency's requirements. Knock-out panels are not acceptable. In lieu of the concrete trench drain shown on the Uniform Standards Sewer Details, precast polymer concrete trench drain types (rated for H-20 loading, complying with ASTM C579 testing for polymer concrete and ASTM A536 for ductile iron frame and grate) are acceptable upon approval from Municipal Engineer where work is being performed.

Outside of public right of way, PVC surface drainage inlets may be used if approved by the responsible agency. PVC surface drainage inlets shall be of the inline drain type. The cast iron or ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer.

The PVC inline drain shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals.

The pipe bell spigot shall be joined to the inline drain body by use of a mechanical joint. The pipe stock used to manufacture the inline drain body and pipe bell spigot of the surface drainage inlets shall meet the mechanical property requirements for fabricated fittings as described by ASTM D3034, Standard for Sewer PVC Pipe and Fittings; ASTM F1336, Standard for PVC Gasketed Sewer Fittings.

The grates furnished for all surface PVC drainage inlets shall be either cast iron or ductile iron grates for sizes 8", 10", 12", 15", 18", 24", and 30" shall be made specifically for each fitting so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for inline drains shall be capable of supporting H-20 wheel loading for heavy-duty traffic locations or H-10 loading for pedestrian traffic locations. 12" and 15" will be hinged to the frame using pins. Metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron and ASTM A-48-83 Class 30B for 12" and 15" cast iron frames. Grates shall be provided painted black.

The specified PVC surface drainage inlet shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material shall be coarse interlocking limestone aggregate material meeting the requirements of Premium Backfill Section 5.125. The surface drainage inlets shall be bedded and backfilled uniformly in accordance with ASTM D2321. For H-20 Load rated installations, an 8" to 10" thick concrete ring shall be poured under the grate and frame as recommended by the manufacturer.

PVC surface drainage inlets may include measures for sediment and erosion control for inlet protection purposes. Corrosion resistant zinc plated or galvanized steel inlet filter suspension systems with replaceable sediment filter bags may be inserted in the PVC drainage inlets for sediment control.

G. **Bulkheads**

The contractor shall construct masonry bulkheads in all existing sewers which are cut and abandoned, in all stub sewers in new sewer construction, at all locations shown on the plans, and at all other locations where so directed by the responsible agency. Bulkheads shall be built with 2 courses of brick nine inches (9) thick, unless otherwise specified, and with a one-half inch (1/2) coating of 1 to 2 cement mortar.

5.210 CONCRETE AND MASONRY

A. **Frost and Dampness Protection of Masonry**

All masonry work shall be carried on under dry conditions and be properly protected from cold weather and dampness. Such work shall be protected from frost to the extent and equivalent to what is required for concrete as specified under Section 5.210-D-6 of these Specifications.

All material and all work in progress shall be adequately covered during periods of precipitation.

B. **Mortar**

Mortar shall be composed of one (1) part Portland cement, and two (2) parts mortar sand by volume. Mortar sand shall conform to Section 5.118E of these Specifications. All mortar shall be mixed in tight boxes or mixers furnished by the contractor. In mixing the mortar, the contractor shall accurately measure the sand and cement. Shovel measurements will not be permitted. In no case shall mortar be used that has once begun to set; retempering will not be allowed. No lime or other admixtures of any description shall be used unless so specified or permitted by the responsible agency.

C. **Concrete**

1. General Information

   Concrete shall consist of a mixture of Portland Cement, fine aggregates, coarse aggregates, and water; proportioned and mixed as provided in these Standards and constructed as shown on the plans. In proportioning concrete materials, one (1) sack of cement shall be considered as being one (1) cubic foot volume and 94 pounds weight. Total maximum water shall be considered as that including added water and surface water in the aggregates. Batch weights shall be based on surface dried materials and shall be corrected to take into account the weight of surface water contained in the aggregate.

2. Unit Stresses

   All structural concrete, both plain and reinforced, shall develop a minimum ultimate compressive stress of 4000 psi at 28 days. Unless otherwise noted on plans or in other areas of the specifications, all concrete shall be taken to be 4000 psi. Admixtures shall not be used unless approved by the responsible agency.

   Concrete for bedding, encasement of pipe and general fill purposes shall have a minimum concrete mix strength of 3000 psi at 28 days. Admixtures shall not be used unless approved by the responsible agency.

3. Portions of Aggregates

   Before starting any concrete work, the contractor shall inform the Municipal Engineer or responsible agency as to the source of the aggregates. A testing laboratory will then test representative samples of coarse and fine aggregates and establish the weights of each aggregate to be used in the concrete mixes.

The responsible agency may change the relative proportions of fine and coarse aggregate at any time during construction to conform to variations in the character of the material used, at the same time maintaining the water-cement ratio and the specified slumps.

4. Quality Control

It is the intent of these Specifications that all concrete construction shall be monitored by a testing laboratory approved by the responsible agency. This includes the testing of materials, establishment of batch weights, construction inspection and testing, all per the latest ASTM Specifications.

ASSUMED STRENGTH OF CONCRETE MIXTURES

Water Content U.S. Gal., Per 94 lb. Sack of Cement	Assumed Compressive Strength At 28 Days Lb. Per Square Inch
7 ¼	2,500
6 ½	3,000
5 ¾	3,500
5	4,000

NOTE: In interpreting this table, surface water contained in the aggregate must be included as part of the mixture water in computing the water content.

In all cases, the materials used in concrete shall conform to their respective sections of these Standards.

No concrete exposed to the action of freezing weather shall have a water content exceeding six (6) gallons per sack of cement.

5. Storage of Materials

The contractor shall provide suitable means of storing and protecting the cement against dampness. Different grades or brands of cement shall be stored separately. Sacks of cement, which for any reason have become partially set, or which contain lumps or caked cement, shall not be used.

Each size and type of aggregate shall be stored separately and kept in such a manner as to avoid the inclusion of all foreign matter. Aggregates containing lumps of frozen or partially cemented material shall not be used in the concrete.

Coarse aggregates shall be stored in such a manner as to avoid segregation of particles and to maintain a reasonably uniform moisture content.

6. Consistency of Concrete

The proportions of aggregate to cement shall be such as to produce concrete that can be worked readily into the corners and angles of the forms and around the reinforcement without excessive spading and without segregation or accumulation of water on the surface. In no case shall concrete be placed which shows a slump outside the following limits:

TYPE OF CONSTRUCTION	**SLUMP IN INCHES**	
	Maximum	**Minimum**
Reinforced Footings and Headwalls	4	2
Reinforced Beams, Columns, Slabs & Walls	5	3
Pipe Cradling, Encasement & Fill	5	3

7. Water-Cement Ratio & Air Entrainment

Inasmuch as the strength of concrete is a function of water-cement ratio, it is imperative that this ratio, as established by the testing laboratory approved by the responsible agency, not be exceeded under any circumstances.

In the event that the given water-cement ratio does not produce the proper consistency and workability of the concrete mixes, the testing laboratory will change the relative proportions of the aggregates with the written approval and permission of the responsible agency. Free moisture held by the aggregates must be included in determining the water-cement ratio.

Exterior concrete or concrete subject to freeze thaw cycles shall be air entrained 6%+/-2%. Air entrainment field tests shall be performed as directed by the Municipal Engineer or responsible agency as per ASTM C231 or ASTM A173.

8. Tests on Concrete

a. During the progress of the work, compression test specimens shall be made and cured in accordance with the "Standard Practice for Making and Curing Concrete Compression and Flexure Test Specimens in the Field", ASTM Designation C31/C31M. Not less than three (3) specimens shall be made for each test, or less than one (1) test for each 200 cu. yd. of concrete of each class. Specimens shall be cured under laboratory conditions except that when there is a possibility of the surrounding air temperature falling below 40º F, additional specimens may be required to be cured under job conditions unless otherwise specified.

b. Specimens shall be tested in accordance with the "Standard Test Method for Compressive Strength of Molded Concrete Cylinders", ASTM Designation C39/C39M.

c. The standard age of test shall be 28 days. Seven-day (7) tests shall be made to provide the relationship between the 7 and 28-day strengths of the concrete as established by testing for the materials and proportions used.

d. All concrete that does not meet the specified strength requirements as indicated by compression test cylinders, shall be retested by taking cores from the completed structures and testing them. If the concrete fails to meet the minimum strength requirements on this second test, the responsible agency shall order its removal in writing. Any such removal and replacement shall be done at the contractor's expense.

D. **Mixing and Placing Concrete**

1. Preparation of Equipment and Place of Deposit
   a. Before placing concrete, all equipment for mixing and transporting the concrete shall be cleaned, all debris and ice shall be removed from the places to be occupied by the concrete, forms shall be thoroughly wetted (except in freezing weather) or oiled, and masonry filler units that will be in contact with concrete shall be well drenched (except in freezing weather), and the reinforcement shall be thoroughly cleaned of ice and other coatings.

   b. Water shall be removed from place of deposit before concrete is placed unless otherwise permitted by the responsible agency.

2. Mixing of Concrete
   a. The concrete shall be mixed until there is a uniform distribution of the materials and shall be discharged completely before the mixer is recharged.

   b. For job-mixed concrete, the mixer shall be rotated at a speed recommended by the manufacturer and mixing shall be continued for at least one (1) minute after all materials are in the mixer.

   c. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements set forth in the "Standard Specification for Ready-Mixed Concrete", ASTM Designation C94/C94M.

   d. Mixing concrete by hand will not be permitted except when approved by the responsible agency.

3. Conveying
   a. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent the separation or loss of the materials.

   b. Equipment for chuting, pumping and pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of the materials.

4. Depositing
   a. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the space between the reinforcing bars. No concrete that has partially hardened or been contaminated by foreign material shall be deposited in the work, nor shall retempered concrete be

used. The maximum free fall height of concrete shall be 4 feet. Tremie or pumping methods shall be employed for drops in excess of 4 feet.

b. When concreting is once started, it shall be carried on as a continuous operation until the placing of the panel or section is completed. The top surface shall be generally level.

When construction joints are necessary, they shall be made in accordance with Section 5.210-E-7.

c. All concrete shall be thoroughly compacted by suitable means during the operation of placing and shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms.

5. Curing
Provisions shall be made for maintaining concrete in a moist condition for at least seven (7) days after the placement of the concrete. For high-early-strength concretes, moist curing shall be provided for at least the first 72 hours. Any fast set concrete shall be kept in a moist condition for at least four (4) hours. Either liquid membrane forming compounds for curing concrete meeting the requirements of ASTM C309 or ASTM C1315, moistened sheet material for curing concrete meeting the requirements of ASTM C171, or burlap or curing blankets may be used.

6. Cold Weather Requirements
   a. Adequate equipment shall be provided for heating the concrete materials and protecting the concrete when the atmospheric temperature is 40º F or less. No frozen materials, or materials containing ice, shall be used.

   b. All concrete materials and all reinforcement, forms, fillers, and ground with which the concrete is to come in contact, shall be free from frost. Whenever the temperature of the surrounding air is below 40º F, all concrete in the forms shall have temperatures of between 50º F and 80º F, and adequate means shall be provided for maintaining a temperature of not less than 50º F for five (5) days. When high-early-strength concrete is used, the temperature shall be maintained at not less than 50º F for 72 hours or for as much more time as is necessary to insure proper curing of the concrete. The housing, covering, or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing. No concrete exposed to the action of freezing weather shall have a water content exceeding six (6) gallons per sack of cement.

7. Hot Weather Requirements
Placing concrete in hot weather can lead to rapid evaporation of moisture and cause plastic shrinkage cracks in concrete. The combination of high ambient temperature, low relative humidity, wind velocity, and solar radiation can cause the following problems: 1) increased water demand, 2) rate of slump loss, 3) tendency for retempering, 4) rate of settling, 5) difficulty in handling, placing, compacting, and

finishing, 6) plastic shrinkage cracking, 7) amount of air entraining admixtures needed, and 8) need for early curing.

In order to minimize problems, the design engineer shall follow the guidelines of ACI 305.1-06 "Specification for Hot Weather Concreting."

E. **Concrete Forms and Construction Details**

1. Design of Forms
   Forms shall conform to the shape, lines, and dimensions of the members as called for on the plans. Forms shall be substantial and sufficiently tight to prevent leakage of cement. Forms shall be properly braced or tied together so as to maintain position and shape and to prevent bulging of the forms.

2. Removal of Forms
   Forms shall be removed in such a manner as to insure the complete safety of the structure. Where the structure as a whole is supported on shoring, the removable floor forms, beams and girder sides, column forms, and similar vertical forms may be removed after 72 hours or with written approval from the responsible agency, providing the concrete is sufficiently hard not to be injured thereby. In no case shall the supporting forms or shoring be removed until the members have acquired sufficient strength to safely support their weight and the load thereon.

3. Cleaning and Bending Reinforcement
   Steel reinforcement, at the time concrete is placed, shall be free from rust, scale or other coatings that will destroy or reduce the bond. All bending shall be done in accordance with current ACI requirements. Steel reinforcement is to be epoxy coated for all cast-in-place headwalls, box culverts, inlets, catch basins, reinforced concrete channels, and all other areas as required by the Municipal Engineer or responsible agency.

4. Placing Reinforcement
   Steel reinforcement shall be accurately placed in accordance with the plans and shall be adequately secured in position by concrete or metal chairs and spacers.

5. Splices and Offsets in Reinforcement
   a. In slabs, beams, and girders, splices of reinforcement at points of maximum stress shall be avoided. Splices shall provide sufficient lap to transfer the stress between bars by bond and shear.

   b. Where changes in the cross section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion shall not be more than one (1) to six (6), and in case of tied columns, the ties shall be spaced not more than three inches (3) on center for a distance of one foot (1) below the below the actual point of offset.

6. Concrete Protection for Reinforcement
   a. The steel reinforcement shall be protected by the thickness of concrete indicated on the plans. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

      Where concrete is deposited against the ground without the use of forms, not less than three (3) inches.

      Where concrete is exposed to the weather, or exposed to the ground but placed in forms, not less than two (2) inches for bars more than five-eighths inch (5/8) in diameter; and one and one-half inches (1½) for bars five-eighths inch (5/8) or less in diameter.

      In slabs and walls not exposed to the ground or to the weather, not less than three-fourths inch (3/4).

      In beams, girders, and columns not exposed to the ground or to the weather, not less than one and one-half inches (1½).

      In all cases, the thickness of concrete over the reinforcement shall be at least equal to the diameter of round bars. No reinforcement shall be placed directly against the ground, but instead, shall be properly supported above the ground.

   b. Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion by concrete or other adequate covering.

7. Construction Joints
   Joints not indicated on the plans shall be so made and located as to least impair the strength of the structure. Where a joint is to be made, the surface of the concrete shall be thoroughly cleaned and all debris removed. In addition, vertical joints shall be thoroughly wetted and slushed with a coat of neat cement grout immediately before the placing of new concrete.

5.211 INSPECTION AND TESTING

A. Service Markings

Whenever a stone or concrete sidewalk or curb exists, the municipality may require that the contractor mark each service connection by witness signs cut into the sidewalk or curb. The contractor shall mark the location of Test Tees at two points on the pavement and/or curb such that their location can be determined by intersecting the points. They shall be marked as follows: for Storm Test Tees "+" and for Sanitary Test Tees "Δ".

B. Line Acceptance Tests for Sewers and Manholes

1. Air Testing

   All concrete sanitary sewers 24-inches in diameter and under, all clay sanitary sewers 33-inches in diameter and under, and all sanitary PVC pipe, polyethylene pipe, polypropylene pipe, fiberglass reinforced thermosetting resin pipe and PVC composite wall pipe 33-inches in diameter and under shall be tested for leakage by air testing.

   For safety reasons do not air test concrete pipes greater than 24 inches in diameter. Concrete pipes larger than 24-inch diameter and clay pipe, thermoplastic pipe and all other pipe greater than 33-inches shall be tested by the infiltration method per ASTM C969.

   If the ground water level is 2 feet or more above the top of the pipe at the upstream end, or if the air pressure required for the test is greater than 9 psi gage (i.e. the pressure in excess of the atmosphere pressure), the air test should not be used. In that event, the infiltration test, ASTM C969, for concrete pipe shall be used.

   After a reasonable section of sewer and manholes have been completed, the contractor shall furnish all equipment, material and personnel to conduct a "line acceptance" test using low pressure air. The equipment to be used shall have prior approval, and the test shall be conducted under the supervision of the responsible agency. The line acceptance test shall be conducted after backfilling has been completed.

   All wyes, tees or end of lateral stubs shall be suitably capped and braced to withstand the internal test pressures. Such caps shall be a type that is easily removable for future lateral connections or extensions. No personnel are permitted in the manhole while the test is being conducted. After a manhole-to-manhole section of the line has been cleaned, it shall be plugged at each manhole with pneumatic plugs inflated to sufficient pressure such that they will hold against the line test pressure without failing, and without damaging the manhole or pipe.

   The design of the plugs shall be such that they will hold against the line test pressure without requiring external blocking or bracing; however, external blocking or bracing shall be used for extra protection. Each pneumatic plug shall have a sealing length equal to or greater than the diameter of the pipe in which it is to be used so that effective sealing will always take place around any nodule or lump that may

be on the inner surface of the pipe.

One (1) pneumatic plug used in this testing procedure shall have two (2) factory equipped hose connections in addition to that hose connection used only for the inflation of the pneumatic plug. One (1) of the additional hose connections shall be used for continuously reading the air pressure rise in the sealed line. The second additional hose connection shall be used only for introducing low-pressure air into the sealed line.

There shall be a 0-10 psig gauge supplied for reading the internal pressure of the line being tested.

Calibrations from the 0-10 psig range shall be in tenths of pounds and this 0-10 portion shall cover 90% of the complete dial range.

Low-pressure air shall be introduced into the sealed line until the internal pressure reaches 4.0 psig greater than the average backpressure of any ground water pressure that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize between 3.5 and 4.0 psig. After the stabilization period, the hose for introducing low-pressure air into the sealed line shall be disconnected from the air source in such a manner as to retain the pressure in the sealed line. The pressure in the pipe shall not exceed 9.0 psi under any circumstances.

The portion of line being tested shall be accepted if the portion under test has the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig greater than the average back pressure of any ground water that may be over the pipe shall not be less than the time shown for the given diameter in the following table:

Minimum Specified Time Required for a 1.0 psig Pressure Drop in Size and Length of Flexible Pipe Indicated

Pipe Diameter in.	Minimum Time, mins	Length for Minimum Time, ft	Time for Longer Lengths	Specification Time for Length (L) Shown, mins							
				100ft	150ft	200ft	250ft	300ft	350ft	400ft	450ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:2	11:2	11:2	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:1	14:1	17:4	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:0	19:1	25:3	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470	19:5	26:1	34:5	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674	22:4	34:1	45:3	56:58	68:22	79:46	91:10	102:3
27	25:30	88	17.306	28:5	43:1	57:4	72:07	86:32	100:5	115:2	129:4
30	28:20	80	21.366	35:3	53:2	71:1	89:02	106:5	124:3	142:2	160:1
33	31:10	72	25.852	43:0	64:3	86:1	107:4	129:1	150:4	172:2	193:5

Minimum Test Time for Concrete and Clay Pipes		
Nominal Pipe Size	**Time (min./100 ft)**	
4	0.3	
6	0.7	
8	1.2	
10	1.5	
12	1.8	
15	2.1	
18	2.4	
21	3.0	
24	3.6	Max. Dia. of Conc. Pipe to be Tested
27	4.2	
30	4.8	
33	5.4	Max. Dia. of Clay Pipe to be Tested

Where high ground water is known to exist, the height in feet of ground water above the invert of the sewer shall be divided by 2.3 to establish the pounds of pressure that will be added to the internal air pressure used for the line acceptance test in determining the time in minutes for the air pressure to decrease 1.0 psig.

If the installation fails to meet the requirements of this test, the contractor shall determine at his own expense the source of leakage. The contractor shall repair or

replace all defective materials and/or workmanship and then re-test the installation for compliance with these Standards for the line acceptance test.

For specific reference on these tests, refer to ASTM C924 for Concrete Pipe, ASTM F1417 for Plastic Pipe, ASTM C828 for Clay Pipe. Air testing shall be performed by a certified independent agency.

2. Deflection Testing

All Polyvinyl Chloride (PVC), PVC Composite Wall pipe, High Density Polyethylene, Polyproylene and Fiberglass sanitary and storm pipe having a pipe stiffness less than 200 psi shall be tested for proper installation by means of deflection attainment. Deflection testing is not required for Polyvinyl Chloride (PVC), PVC Composite Wall pipe, High Density Polyethylene, Polypropylene and Fiberglass pipe with a pipe stiffness of 200 psi or greater.

In addition to material tests, construction compaction, and leakage tests required elsewhere in these Standards, the contractor is required to install the pipe in such a manner that the diametric deflection shall not exceed five percent (5%) of the pipe base inside diameter. The base inside diameter is the average pipe diameter minus the manufacturer's tolerance. To attain this requirement, the backfill materials surrounding the pipe and the trench backfill above the pipe shall be compacted to the required Standard Densities called out in ASTM D2321.

Deflection tests shall be performed no sooner than 60 days following completion of backfill. Final deflection tests shall be performed for the responsible agency or Municipal Engineer by an accredited, independent testing laboratory that shall submit verification records of results and dates tested.

Maximum ring deflection of the pipe under load shall be limited to five percent (5%) of the base inside diameter listed in ASTM D2680 for PVC Composite Wall Pipe.

For Polyvinyl Chloride (PVC) Pipe use Base Inside Diameter as per ASTM D3034, ASTM F679, ASTM F794, ASTM F949, and AASHTO M304;

for Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe, ASTM D3262;

for High Density Polyethylene Storm Sewer Pipe, AASHTO M294; and

for Polypropylene Corrugated Double Wall, ASTM F2736 or Triple Wall Pipe, ASTM F2764.

PVC Pipe Base Inside Diameter and Mandrel Size to be used for Deflection Test

		SDR35/PS46		SDR26/PS115
		5% Deflection		5% Deflection
Nominal Size	**Base ID**	**Mandrel Size**	**Base ID**	**Mandrel Size**
4”	3.895	3.70	3.811	3.62
6”	5.742	5.45	5.612	5.33
8”	7.665	7.28	7.488	7.11
10”	9.563	9.08	9.342	8.87
12”	11.361	10.79	11.102	10.55
15”	13.898	13.20	13.575	12.90
18”	16.976	16.13	16.586	15.76
21”	20.004	19.00	19.545	18.57
24”	22.48	21.36	21.964	20.87
27”	25.327	24.06	24.744	23.51
30”	29.132	27.68	28.461	27.04
36”	34.869	33.13	34.120	32.41

All pipe failing to maintain the five percent (5%) maximum deflection diameter for the applicable type of pipe shall be considered to have been improperly installed and shall be re-laid or replaced by the contractor at no cost to the responsible agency. Deflection testing shall be accomplished by pulling a mandrel through the pipe. Mandrels must be approved by the responsible agency prior to testing. If mandrel testing cannot be used for any reasons, or as an alternate to mandrel testing, laser profiling shall be used. Laser profiling shall be per the requirements of ODOT 611.13, ODOT 902.02, and the five percent (5%) maximum deflection diameter for the applicable type of pipe (or requirements as directed by the responsible agency). The responsible agency may require air testing or weir testing on storm sewers.

3. Weir Test

   Weir testing shall be performed on all thermoplastic and clay sanitary sewers in pipe sizes 36 inches in diameter and larger and all concrete pipes 27 inches in diameter and larger as specified herein. The maximum permissible leakage shall be 100 gallons/per inch of diameter/per mile/per day when field tested by actual infiltration conditions. Where low ground water conditions exist, exfiltration tests shall be used. All infiltration/exfiltration testing shall meet the requirements of ASTM C969.

   The contractor shall provide all bulkheads, plugs, pipe stoppers, pumps, weirs, water, incidentals, and all labor and equipment necessary to perform the infiltration or exfiltration testing. All sewers failing the test shall be either repaired or replaced and the sewer retested until it passes the test. All testing shall be done under the supervision of the responsible agency, and testing shall only be performed by companies experienced in infiltration or exfiltration testing of sewers and approved by the responsible agency. Sewers that do not pass the infiltration or exfiltration tests will be rejected by the responsible agency, and no payment will be made for any of the sewer work between manhole sections of the failed sewer.

4. Video Inspection

All new storm sewers and sanitary sewers between 8-inch and 42-inch diameter shall be cleaned, video inspected; and recorded by qualified persons or companies that are approved by the responsible agency. All video recording shall be done in color and recorded on a DVD. The video recording shall show continuous coverage of the sewer from manhole to manhole. The recording shall have adequate, but not excessive, lighting and have good focus and be free of "snow", streaks or migrating color.

The video recording shall include the actual footage from the manhole of each sewer run, and the picture recorded shall be clear of any dirt or condensation on the camera lens or water vapor in the sewer line. All video inspection DVD's shall also contain a voice recording delineating the type of sewer system, pipe material and size, manhole conditions, wye locations, areas of debris, mud, standing water, bad joints, cracked or damaged pipe, misaligned joints and fittings and any other unusual or unexpected condition or object found in the pipe.

At each manhole the DVD recording shall identify the manhole number, the nearest street address adjacent to the manhole, the direction of travel and manhole to which the camera is going, the construction project name, the name of the street the sewer is under, the size and material type of the sewer and the date and time of the recording.

Each DVD shall be identified with the following: Project name, name of city, village, or township where project is located, name of sewer contractor and video inspection company, name of developer if applicable, date of video recording(s) and names of all street sewers video recorded.

In addition to the DVD, a written report shall be submitted describing all sewers video inspected. The report shall contain a map of the streets or easement areas showing the general layout of the sewers. The map shall contain a north arrow, scale, manhole numbers, street names, project name, developer's name if applicable, municipality name, and flow arrows on each sewer segment. The report itself shall be 8 ½ inches x 11 inches and shall contain separate sheets for each sewer run.

Each sewer run sheet in the report shall indicate, as a minimum (and in NASSCO PACP format):

a. project name,
b. video recording company's name,
c. municipality,
d. date of recording,
e. size of pipe,
f. type of pipe material,
g. beginning and end manhole identification numbers and stationing, if applicable, total footage of sewer run,
h. location of all wye or tee connections by footage distance and either by left or right designation or by an "o'clock" description,

i. location and description of open, partially open, cracked or leaking pipe joints, location description of cracked, deflected, leaking or damaged pipe,
j. location and description of standing water, with beginning and end points and maximum depth,
k. obstructions such as stones, mud or soil, leaves, etc.,
l. submerged camera locations,
m. water vapor,
n. blocked pipe preventing camera travel,
o. changes in pipe material type, or
p. any other unusual features.

Prior to video inspecting and recording, the sewer shall be cleaned of all silt, rock, and debris.

5. Visual Inspection

All storm sewers and sanitary sewers 48-inch diameter and larger constructed under these Standards shall be subjected to visual inspection. An inspection report detailing the condition of the pipe and pipe joints shall be made prior to acceptance of the sewer. The responsible agency shall retain ownership of all construction inspection records.

Whenever storm sewer or sanitary sewer work is adjacent to a water main, testing of the watermain may be required upon completion of the sewer work along each section of water main between line valves to determine if any leakage has been caused by the contractor's operations.

If leakage is shown by the test, the contractor shall be responsible for any repairs. After completion of the contract, a final test of the entire main shall be made and approved by the responsible water authority.

6. Manhole Testing

All sanitary manholes shall be vacuumed tested in accordance with ASTM C1244.

Sanitary sewer manholes may be tested either prior to backfilling or after backfilling. The contractor shall furnish all labor, tools and equipment necessary to perform any testing. If the sanitary sewer manhole fails the test, the sanitary manhole shall be repaired by the Contractor and retested. This procedure shall be repeated until the sanitary sewer manhole passes the required test. The responsible agency may also require a sanitary sewer manhole to be retested using this method after backfilling if there is reason to suspect that the sanitary sewer manhole has been disturbed during the backfilling operation, or at other times during construction.

In order to prepare a manhole for this test, the following shall be completed:

1) All lift holes shall be plugged.
2) All pipes entering the sewer manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the sewer manhole.

3) All inside and outside joints shall be sealed.

The test procedure shall be as follows:

1) The test head shall be placed at the inside of the top of the cone section of the sewer manhole and the seal inflated in accordance with the manufacturer's recommendations. In the case of flat top manholes, the test head shall be placed at the top surface of the flat top.

2) A vacuum of ten inches (10") of mercury shall be drawn on the sewer manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured (and recorded) for the vacuum to drop to nine inches (9") of mercury.

3) The sewer manhole will pass the test if the time for the vacuum to drop from ten (10") to nine inches (9") of mercury meets or exceeds the values indicated below with the following constraint: a minimum of nine inches (9") of mercury shall be held for a minimum of one (1) minute.

Minimum Vacuum Pass Times	
Manhole Size (inches)	**Minimum Time (seconds) to Drop**
48	60
54	67
60	75
72	90
84	105
96	120

The vacuum gauge used for this test shall be supplied by the Contractor and have a maximum scale divisions of 0.1 psi and an accuracy of 0.04 psi. Accuracy and calibration of the gauge shall be certified by a reliable testing firm at six (6) month intervals, or when requested by the responsible agency. In addition, the responsible agency may compare the Contractor's gauge with the responsible agency's gauge at any time. During testing, the vacuum gauge shall be located such that it is readily visible.

C. **Leakage Tests for Force Mains**

1. Methodology

   All pipes, valves, fittings, etc., shall be laid in such a manner as to assure that all joints are watertight. After the pipe is laid and before backfill is placed around the joints, such lengths of the force main, as determined by the responsible agency, shall be tested under a hydrostatic pressure of 75 pounds per square inch above the maximum pump head, but, in no case, shall such force mains be tested at less than 100 pounds per square inch.

   The test shall be conducted under the direction of the responsible agency or the agency's appointed agent. The contractor may obtain water for testing by observing the rules and regulations enforced in the municipality or township in which the work is being done. The contractor shall furnish pressure gauges, suitable pump or pumps, pipes, test heads, and all equipment, appliances, labor, fuel, and other appurtenances necessary to make the test.

   The test pressure shall be maintained for a length of time determined by the responsible agency to allow for a thorough examination of joints and elimination of leaks if any should be discovered. Minimum time duration without pressure drop shall be one (1) hour. The pipelines shall be made absolutely tight under the test pressure.

   After the test has been completed, the contractor shall drain all pipes and surrounding areas. The contractor shall open all valves, air cocks, bypasses, and drains in the section of the installation tested immediately after the test to prevent damage to the force main and appurtenances due to freezing weather.

2. Alternative Method

   The force main shall be tested under the same hydrostatic pressure as above. The test pressure shall be maintained for a period of two (2) hours by pumping additional water into the main, if necessary. The quantity of water thus pumped into the main multiplied by 12 shall be taken as the leakage per 24 hours.

   The permitted leakage shall not exceed a rate of 75 gallons per 24 hours, per mile of pipe, per inch of nominal diameter.

   In using this method of testing, the contractor may backfill the pipe except at joints immediately following the laying and before the actual test has been made. In case the leakage is in excess of the permissible 75 gallons/mile/inch of diameter/day, the contractor shall locate and repair the leak. The contractor shall furnish suitable means for determining the quantity of water lost by leakage during the test.

   The method of testing any force mains shall be approved by the responsible agency. Additional testing and/or different test conditions may be specified in the contract specifications or contract drawings.

3. All force mains shall be subject to deflection testing and photographic inspection as required elsewhere in these Standards, or as required by the responsible agency.

5.212 FABRICATION AND ERECTION OF STEEL

A. **Structural Steel**

In general, the fabrication of steel and the erection thereof shall be in accordance with the latest "Specifications for the Design, Fabrication & Erection of Structural Steel for Buildings" and the "Code of Standard Practice for Steel Buildings and Bridges" of the American Institute of Steel Construction, Inc..

In the event that work is done on land under the jurisdiction of railroads, highway departments, or other similar agencies, the specifications will be subject to the approval of such agencies.

B. **Reinforcing Steel**

Fabrication and erection of reinforcing steel shall conform to the current edition of the "Code of Standard Practice and Specifications for Placing Reinforcement" of the Concrete Reinforcing Steel Institute.

5.213 WELDING

Welding of iron and steel shall be done by operators who have been previously qualified by tests as prescribed in the American Welding Society's "Specification for Welding Procedure and Performance Qualification" AWS B2.1/B2.1M to perform the type of work required. All equipment shall be of a type that will produce proper current so that the operator may produce satisfactory welds. The welding machine shall be 200-400 ampere, 25-40-volt capacity. Electrodes shall be of classification numbers E-6011, E-6012, E-6013, or E-6020, and shall be suitable for positions and other conditions of intended use in accordance with the instructions with each container.

Field welding shall be done by direct current.

The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work, shall conform to the current edition of American Welding Society "Code for Arc Welding in Building Construction", AWS D1.0, Section 4, Workmanship.

Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except that mill scale which withstands vigorous wire brushing may remain. A light film of linseed oil may likewise be disregarded. Joint surfaces shall be free from fins and tears.

No welding shall be done when the base metal temperature is lower than 0º F. At temperatures between 32º F and 0º F, the surface of all areas within three inches (3) of a point where a weld is started shall be heated until they are too hot to touch before welding is started.

Finished members shall be true to line and free from twists, bends, and open joints.

5.214 PIPE REHABILITATION BY CURED-IN-PLACE PIPE (CIPP) MAINLINE LINING – INVERSION METHOD

The contractor may reline and rehabilitate sewer lines with continuous tight-fitting, structurally sound, watertight liner extending over the entire length between manhole sections utilizing trenchless methods where excavations are not permitted. The installation shall include the complete interior relining of the existing sewer piping and shall result in a smooth, hard, strong and chemically inert interior finish and closely follow the contours of the existing pipe. The contractor shall provide a completed system with watertight mainline sewer and all active lateral connections in operable condition. Contractor and their employees shall be certified by the lining manufacturer to install the product.

The Municipal Engineer or responsible agency shall be required to approve the contractor's methods for sewer flow control, sewer line cleaning, sewer lining, pre- and post- sewer television inspection, manhole rehabilitation, re-establishment of lateral services, maintenance of traffic, notifications to sewer users, and any other site-specific needs.

Thermosetting resin shall be specifically blended for use with CIPP process with light colored or white felt tubing complying with ASTM D5813-04(2012) Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems. The proposed rehabilitation liner system may reduce the flow-carrying capacity of the existing sewer, but in no case shall the system reduce capacity by more than 16 percent. The contractor shall employ a registered Professional Engineer to design the CIPP liner thickness. The minimum thickness of the liner shall be 6mm and the design life shall be 50 years. All design specifications shall require the approval of the responsible agency.

The Municipal Engineer or responsible agency shall, as a minimum, require the manufacturer's technical data for the lining material and resin with installation instructions, curing details, and Material Safety Data Sheets for all products contemplated, certified test reports from an approved independent laboratory for the material properties of the subject liner and resin, design calculations for the material thickness of the sewer lining material for each section of pipe to be rehabilitated, method of flow bypassing, contractor certifications, and any other project related submittals, which shall be submitted to the Municipal Engineer or responsible agency for approval. The manufacturer shall certify that the liner has been properly sized to avoid wrinkles or folds. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

CIPP shall be installed per ASTM F1216-09 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube. The host pipe size shall range from 3-inch to 144-inch diameter. Installation equipment shall be equipped with working pressure and temperature gauges to properly monitor the CIPP installation.

Prior to each entrance, all access points shall be tested for toxic vapors, flammable vapors, and the lack of oxygen in accordance with local, State, and Federal safety regulations. The contractor shall prepare the host pipe per the manufacturer's recommendations. The contractor shall provide the services of an approved video inspection company to obtain a

pre-lining video of the host pipe, which shall be recorded within 48 hours of lining and provided to the Municipal Engineer or responsible agency. All service connection locations shall be recorded prior to lining in preparation to re-establish lateral services upon completion. Any point repairs required, or removal of silt, debris and non-root obstructions, shall be made by the contractor and approved by the Municipal Engineer or responsible agency.

The existing flow shall be bypassed around the sewer section to be rehabilitated. The contractor shall transport, store, handle, control temperature, control pressure, install, cure, trim, finish, and seal the lining per the manufacturer's recommendations. After the new liner is completely rounded, it shall be cooled to the temperature specified by manufacturer prior to relieving internal pressure. In no case shall this temperature be in excess of 100°F (38°C).

The contractor shall seal both ends of the CIPP in accordance with the manufacturer's recommendations. If a tight seal is not obtained, resin mixture compatible with the CIPP shall be applied to create a tight seal. The contractor shall re-establish all lateral services per the manufacturers' recommended methods. The contractor shall provide the services of an approved video inspection company to obtain a post-lining video of the finished product shall be recorded and provided to the Municipal Engineer or responsible agency.

The contractor shall provide the responsible agency samples of the lining material from the trimmed ends of the cured lining material for independent laboratory testing and approval. Samples shall be prepared in accordance with ASTM D5813-04(2012) and shall comply with the material properties provided therein and shall meet the design thickness.

5.215 PIPE REHABILITATION BY FOLD AND FORM PIPE METHOD

The contractor may reline and rehabilitate sewer lines with a continuous tight-fitting, structurally sound, watertight liner extending over the entire length between manhole sections, utilizing trenchless methods where excavations are not permitted. The installation shall include the complete interior relining of the existing sewer piping and shall result in a smooth, hard, strong and chemically inert interior finish and closely follow the contours of the existing pipe. The contractor shall provide a completed system with watertight mainline sewer and all active lateral connections in operable condition. Contractor and their employees shall be certified by the lining manufacturer to install the product.

The Municipal Engineer or responsible agency shall be required to approve the contractor's methods for sewer flow control, sewer line cleaning, sewer lining, pre- and post- sewer television inspection, manhole rehabilitation, re-establishment of lateral services, maintenance of traffic, notification to sewer users, and any other site-specific needs.
The liner shall conform to the following:

Light colored or white Folded Poly Vinyl Chloride (PVC) Pipe Liner complying with ASTM F1504, Standard Specification for Folded Poly (Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation and/or ASTM F1871, Standard Specification for Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and

Conduit Rehabilitation and minimum material requirements of ASTM D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compound, Cell Class 13223-B or 12344-B.

The proposed rehabilitation liner system may reduce the flow-carrying capacity of existing sewer, but in no case shall the system reduce capacity by more than 16 percent. The contractor shall employ a Registered Professional Engineer to design the liner thickness. The minimum thickness of the liner shall be 6mm and the design life shall be 50 years.

The Municipal Engineer or responsible agency shall, as a minimum, require the manufacturer's technical data and installation instructions, curing details, and Material Safety Data Sheets for all products contemplated, certified test reports from an approved independent laboratory for the material properties of the subject liner, design calculations for the material thickness of the sewer lining material for each section of pipe to be rehabilitated, method of flow bypassing, contractor certification, and any other project related submittals, which shall be submitted to the Municipal Engineer or responsible agency for approval. The manufacturer shall certify that the liner has been properly sized to avoid wrinkles or folds. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

The PVC lining shall be installed per ASTM F1867, Standard Practice for Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation or ASTM 1947, Standard Practice for Installation of Folded Poly (Vinyl Chloride) (PVC) Pipe into Existing Sewers and Conduit as required by the product used, pipe size, and pipe being lined. The host pipe size can range from 4-inch to 18-inch diameter.

Installation equipment shall be equipped with working pressure and temperature gauges to properly monitor the lining installation. Prior to each entrance, all access points shall be tested for toxic vapors, flammable vapors, and the lack of oxygen in accordance with local, State, and Federal safety regulations.

The contractor shall prepare the host pipe per the manufacturer's recommendations. The contractor shall provide the services of an approved video inspection company to obtain a pre-lining video of the host pipe, which shall be recorded within 48 hours of lining and provided to the Municipal Engineer or responsible agency. All service connection locations shall be recorded prior to lining in preparation to re-establish lateral services upon completion. Any point repairs, or removal of silt, debris and non-root obstructions shall be made by the contractor and approved by the Municipal Engineer or responsible agency. The existing flow shall be bypassed by the contractor around the sewer section to be rehabilitated. The contractor shall transport, store, handle, control temperature, control pressure, install, cure, trim, finish, and seal the lining per the manufacturer's recommendations. After the new liner is completely rounded, it shall be cooled to the temperature specified by manufacturer prior to relieving internal pressure. In no case shall this temperature be in excess of 100°F (38°C).

No measurable continuous annular space is permitted between the outside diameter of the new liner and existing host pipe. The liner shall provide for a tight seal between the liner and host pipe at the pipe penetrations. The contractor shall seal the annular space with a ½-inch diameter Oakum band soaked in chemical sealant, and seal any annular spaces greater than ½-inch with manhole wall repair material.

The contractor shall finish off sealing with a non-shrink grout or cementitious liner material placed around the pipe opening from inside the manhole in a band at least 4 inches wide. The sealing work shall be done immediately after the liner is cured. The contractor shall re-establish all lateral services per the manufacturer's recommended methods. The contractor shall provide the services of an approved video inspection company to obtain a post-lining video of the finished product shall be recorded and provided to the Municipal Engineer or responsible agency.

The contractor shall provide the owner samples of the lining material from the trimmed ends of the cured lining material for independent laboratory testing. Samples shall be prepared in accordance with ASTM D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings and shall comply with the material properties provided in ASTM F1871 and meet the design thickness.

5.216 PIPE REHABILITATION BY SYMMETRICAL REDUCTION METHOD FOR CLOSE-FIT LINING

Symmetrical reduction, also referred to as modified slip lining, is the process of modifying the pipe's cross sectional profile so that the liner can be extruded through an existing pipe. Prior to installing the pipe liner, the host pipe shall be inspected by closed circuit television to ensure it is clean, dry and stable. The contractor shall furnish all equipment necessary to inspect, remove silt and other debris and dewater the host pipe. The liner is then expanded to conform to the existing pipe size. The liner shall be a thermoplastic pipe with a diameter the same or slightly larger than the host pipe.

Once the liner is winched into place and reformed/rerounded, no grouting is necessary due to the tight fit. The contractor and their employees shall be certified by the lining manufacturer to install the product. The Municipal Engineer or responsible agency shall be required to approve the contractor's methods for sewer flow control, sewer line clearing, sewer lining, pre- and post- sewer television inspection, manhole rehabilitation, re-establishment of lateral services, maintenance of traffic, notification to sewer users, and any other site-specific needs.

Symmetrical reduction can be done either by the swagelining/drawdown method or by the rolldown method. The swagelining/drawdown method uses a heat and a static-diameter reduction die to reduce the diameter by 7 to 15 percent of the liner directly before insertion. During insertion, a winch system is used to maintain tension in the liner as it is pulled through the section to be lined. After the full length of the liner is pulled through, the tension is released and the liner cools and the liner rapidly reverts to its original diameter, forming a close-fit with the host conduit. Due to the limited reduction in diameter size that is provided by the swagelining/drawdown method, the technique is best suited for pressure

pipelines, but can be used in certain gravity applications.

The rolldown method is similar to the swagelining/drawdown method for close-fit lining except that a cold-rolling machine or series of rollers, instead of a die, is used to temporarily reduce the diameter of the liner. Molecular structure of the liner is rearranged in the cold-rolling machine to form a small diameter pipe with thicker walls and minimal elongation. Unlike the swagelining/drawdown method for close-fit lining, this process is not dependent upon tension or other mechanical means to prevent the liner from reverting to its original size during insertion. Once the diameter has been reduced, a winch is used to pull the liner into place and the liner reverts to its original diameter using pressurized water at ambient temperature. Similar to the swagelining/drawdown method for close-fit lining, the rolldown method is better suited for pressure pipelines.

Both symmetrical reduction methods liner pipe shall be high density polyethylene (HDPE) meeting the requirements of ASTM D3035 or ASTM F714 and shall range in size from 3-inch diameter to 60-inch diameter. The maximum continuous run shall be 5,000 feet. Both reduction methods shall not be used in structurally deteriorated host pipes. The host pipe must be longitudinally uniform without diameter changes or discontinuous sections and should not contain bends greater than 11 degrees. The contractor shall provide for the bypassing of the flow that is required to install the liner. Both methods use butt-fusion joining of pipe sections. The manufacturer's construction and installation standards shall be used by the contractor.

All installations shall be inspected visually both before and after installation by the contractor using closed circuit TV, performed by an approved video inspection company. The video records shall be submitted to the responsible agency for review. No infiltration of ground water should be observed.

The Municipal Engineer or responsible agency shall, as a minimum, require the manufacturer's technical data for the lining material, installation instructions, Material Safety Data Sheets, design calculations for the material thickness of the sewer liner material, method of flow bypassing, contractor certification, and history of lining. The Municipal Engineer or responsible agency shall be required to approve the method of flow bypass, pipeline cleaning, CCTV inspection and any other site-specific needs. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

5.217 PIPE REHABILITATION USING PIPE LINER (SLIP LINING, SPIRAL WINDING, OR PANELING)

The contractor may rehabilitate sewer pipe by installing a pipe liner where excavations are not permitted, in accordance with the requirements of this section. Host pipe sizes shall range between 4-inches and 108-inches in diameter. The plans shall indicate the location of the pipe to be rehabilitated, the material composition and the alternate liner types that may be used to rehabilitate the pipe, and the method of liner installation.

The installation shall affect the complete interior relining of the existing sewer piping and shall result in a smooth, hard, strong, and chemically inert interior finish, and closely follow the contours of the existing pipe. The contractor shall provide a completed system with watertight mainline sewer and all active lateral connections in operable condition. The contractor and their employees shall be certified by the lining manufacturer to install the product.

The Municipal Engineer or responsible agency shall be required to approve the contractor's methods for sewer flow control, sewer line cleaning, sewer lining, pre- and post- sewer television inspection, manhole rehabilitation, re-establishment of lateral services, maintenance of traffic, notification to sewer users, and any other site-specific needs.

Prior to installing the pipe liner, the host pipe shall be inspected by closed circuit television by an approved video inspection company to ensure it is clean, dry and stable. The TV inspection may be augmented by visual construction inspection. The contractor shall furnish all equipment necessary to inspect, remove silt and other debris, and dewater the host pipe to the satisfaction of the engineer. The contractor shall place flowable fill as directed by the Municipal Engineer or responsible agency to maintain the stability of the host pipe.

The contractor shall install the pipe liner using one of the following methods: Slip lining, spiral winding, or paneling. The contractor shall seal or grout the annular space between the interior of the host pipe and the exterior of the liner pipe in accordance with the pipe liner manufacturer's written instructions.

The contractor shall use either polyethylene, high density polyethylene, polyvinyl chloride, fiberglass, or aluminum pipe liner. The liner shall be installed by joining discrete lengths, panels or segments of the pipe liner in a manhole or other access point and inserting the liner into the host pipe by pulling and pushing with a winch cable attached to the front of the liner pipe.

Polyethylene pipe liner and high-density polyethylene pipe liner shall be installed in accordance with ASTM F585, Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers.

Polyvinyl Chloride pipe liner shall be installed in accordance with ASTM F1698, Standard Practice for Installation of Poly (Vinyl Chloride) (PVC) Profile Strip Liner and Cementious Grout for Rehabilitation of Existing Man-Entry Sewers and Conduits.

Fiberglass and aluminum pipe liners shall be installed in accordance with the manufacturer's written instructions.

Spiral winding of the pipe liner shall be done in accordance with ASTM F1698 or ASTM F1741, Standard Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride) (PVC) Liner Pipe for Rehabilitation or Existing Sewers and Conduits.

Installation of the pipe liner by paneling shall be done in accordance with the manufacturer's written instructions. Paneling shall be limited to host pipes 90-inches or greater in internal diameter. Panels shall not be placed where a liner joint will lie along or near the crown of the host pipe.

Closed Profile PVC Slip Liner Pipe shall be manufactured to meet the requirements of ASTM F1803. Joints shall meet the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Pipe shall have a minimum long-term pipe stiffness of 46 psi. The joint shall be of the tongue and groove coupling type.

Solid Wall PVC Slip Liner Pipe shall be manufactured to meet the requirements of ASTM F679. Joints shall meet the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Pipe shall have a minimum long-term pipe stiffness of 46 psi. The joint shall be of the bell and spigot lap joint type.

Closed Profile HDPE Slip Liner Pipe shall be manufactured to meet the requirements of ASTM F894. Joints shall meet the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Pipe shall have a minimum long-term pipe stiffness of 46 psi. Tensile modulus of elasticity used in design of pipe shall be 28,250 psi. Pipe shall have a smooth exterior and interior. The bell and spigot joint shall neither increase the O.D. of the pipe, nor decrease the I.D. of the liner pipe at the joint.

Solid Wall HDPE Slip Liner Pipe shall be manufactured to meet the requirements of ASTM F714. Fusing of pipe joints shall meet the requirements of ASTM D2657. Pipe shall have minimum wall thickness of SDR 17. The roll over bead at the point of fusion shall be removed from the interior and exterior of pipe before inserting into the host pipe.

Fiberglass Reinforced Polymer (FRP) Pipe shall be manufactured to meet the requirements of ASTM D3262 and AWWA M45. Joints shall meet the requirements of ASTM D4161. Gaskets shall meet the requirements of ASTM F477. Pipe shall have a minimum long-term pipe stiffness of 46 psi. The joint shall be low-profile fiberglass bell and spigot type or flush fiberglass bell and spigot type, where the fit requires.

The contractor shall establish proposed grout material and mixes, equipment, placement procedures, applicator, set-up, and criteria that the grouting operations shall meet. The grouting system shall have sufficient gauges, monitoring devices, and tests to determine the effectiveness of the grouting operation. The grouting operation shall be modified if the grouting does not perform as submitted and/or if it is not approved by the Municipal Engineer or responsible agency. Mix designs shall be developed to completely fill the annular space between the host pipe and the slip liner pipe.

If a pre-installation inspection with a mandrel reveals an obstruction in the existing pipe, such as heavy solids, dropped joints, or collapsed pipe, that cannot be removed by sewer cleaning equipment, a point repair must be performed prior to slip lining as approved by the Municipal Engineer or responsible agency.

All sewer service connections shall be identified, located, excavated, and disconnected prior to the slip line pipe insertion. The complete list of service laterals, including relevant footage and diameter of lateral, shall be submitted to the Municipal Engineer or responsible agency prior to slip lining, for informational purposes only. Upon completion of insertion of the slip line pipe and pipe relaxation period, the contractor shall expedite the reconnection of services, to minimize any inconvenience to the customers.

If the slip line pipe is HDPE, the installed pipe shall be allowed to relax and cool following installation in accordance with manufacturer's recommended time, but not less than four (4) hours, prior to any reconnection of service lines, grouting of the annulus, or backfilling of the insertion pit.

Testing shall be performed by a low-pressure air test in accordance with ASTM F1417. The contractor and the Municipal Engineer or responsible agency shall inspect each installation visually by CCTV. The CCTV inspection shall be done by an approved video inspection company. No infiltration of groundwater should be observed. All service entrances should be accounted for and be fully functional, unless otherwise directed by the Municipal Engineer or responsible agency in writing.

The Municipal Engineer or responsible agency shall, as a minimum, require the manufacturer's technical data for the lining material and annular grout with installation instructions, curing details. Material Safety Data Sheets shall be provided for all products contemplated, certified test reports from an approved independent laboratory for the material properties of the subject liner and grout, design calculations for the material thickness of the sewer lining material for each section of pipe to be rehabilitated, method of flow bypassing, contractor certification, and any other project related submittals requested by the Municipal Engineer or responsible agency. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

5.218 PIPE REHABILITATION BY PIPE BURSTING

The contractor may rehabilitate the existing sanitary sewer using a pipe bursting system between manhole sections utilizing trenchless methods where excavations are not permitted. Pipe bursting is a process by which the bursting unit splits and/or fractures the existing pipe while simultaneously installing a new high-density polyethylene pipe (HDPE) of the same or larger size into the annulus created by the forward movement of the bursting tool. The existing host pipe may be upsized one pipe size for 4-inch to 12-inch diameter pipe and two pipe sizes for pipes greater than 12-inch diameter.

Pipe bursting can be either static, pneumatic or hydraulic. Static pipe bursting uses static forces that are generated using potential energy. A pulling force is applied to a tapered or blunt nose bursting head through the rods, chain or cable and is simply pulled through the old pipe. Pneumatic pipe bursting is done by creating an impact load in the pipe by applying a "hoop" stress into the pipe causing it to burst in tension. This technique uses a pneumatic bursting head with a properly sized expander, and relies on percussive hammering action to break out the old pipe in which the tool travels. Hydraulic pipe bursting uses a bursting head that expands and fragments the pipe from inside. Hydraulic pipe bursting is primarily used for on-line replacement of sewers and gravity pipelines 6-inches to 20-inches in diameter or larger.

Pipe bursting may be used for bursting vitrified clay pipe, both plain concrete and reinforced concrete pipe, cast iron pipe, PVC pipe, polyethylene pipe and polypropylene pipe. Cast iron pipes and plastic pipes require special cutting blades or lead equipment.

The contractor shall be certified by the pipe bursting system manufacturer as a fully trained user of the pipe bursting system. Operation of the pipe bursting system shall be performed by trained personnel.

The Municipal Engineer or responsible agency shall be required to approve the contractor's methods for sewer flow control, sewer line cleaning, sewer lining, pre-and post- sewer television inspection, manhole rehabilitation, re-establishment of lateral services, maintenance of traffic, notification to sewer users, and any other site-specific needs.

Prior to beginning the pipe bursting the pipe shall be inspected by closed circuit television by an approved video inspection company to locate all sewer connections. The existing flow shall be bypassed around the pipe section that is to be rehabilitated.

The pipe bursting tool shall be designed and manufactured to force its way through existing pipe materials by fragmenting the pipe and compressing the old pipe sections into the surrounding soil as it progresses. The bursting unit shall generate sufficient force to burst and compact the existing pipeline. The pipe bursting tool shall be pulled through the sewer by a winch or rod located at the upstream manhole. The bursting unit shall pull the polyethylene (PE) pipe with it as it moves forward. The bursting head shall incorporate a shield/expander to prevent collapse of the hole ahead of the new pipe insertion. The pipe bursting unit shall be remotely controlled. Replacement pipe that is sectional shall be pushed as well as pulled behind the bursting head. The bursting action of the tool shall increase the external dimensions sufficiently, causing breakage of the existing pipe at the

same time expanding the surrounding ground sufficiently to pull or pull/push in the new pipe.

The pipe pulled through the pipe bursting area shall be butt-fused high-density polyethylene pipe (HDPE) and meet the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter or AWWA C906, ASTM D1248 and ASTM D3350. The new pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

Polyethylene pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and the recommended methods for new pipe connections. The polyethylene pipe (HDPE) shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted.

The contractor shall cut out and replace defective joints. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness (ASTM 585), shall not be used and must be removed from the site.

The contractor shall locate and expose all sewer service connections prior to pipe insertion to expedite reconnection. The contractor, after a suitable pipe relaxation period, shall reconnect all service connections. The installed pipe shall be allowed the manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing prior to any reconnection of service lines. Service connections shall be reconnected to the pipe by using connectors approved by the pipe manufacturer and in conformance with the specified installation procedure. Service connections shall be wrap-around-type saddle connections. Connections to the existing service pipe shall be made using flexible couplings. All flexible couplings shall conform to ASTM C425. Joint deflection limits and lateral connections shall conform to the requirements indicated in ASTM C12 and C425.

The contractor shall submit the following items for review and approval of the Municipal Engineer or responsible agency:

1) Certificates of training by pipe bursting systems manufacturer.

2) Certificates of training by pipe fusion equipment manufacturer.

3) Manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of the new pipe and fittings and the engineering calculations for the pipe liner thickness.

4) Manufacturer's recommendations for transport, handling, storage, and repair of pipe and fittings shall be included.

5) Detailed construction procedures, and layout plans including sequence of construction.

6) Locations, sizes and construction methods for the service reconnection pits.

7) Methods of construction, reconnection and restoration of existing service laterals.

8) Detailed descriptions of the methods of modifying existing manholes.

9) Detailed procedures for the installation and bedding of the new pipe in the launching and receiving pits.

The Municipal Engineer or responsible agency shall, as a minimum, require the manufacturer's technical data for the lining material and with installation instructions, curing details. Material Safety Data Sheets shall be provided for all products contemplated, certified test reports from an approved independent laboratory for the material properties of the subject liner, design calculations for the material thickness of the sewer lining material for each section of pipe to be rehabilitated, method of flow bypassing, contractor certification, and any other project related submittals requested by the Municipal Engineer or responsible agency. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

The contractor shall be responsible for televising the sewer both prior to reconstruction, to verify the condition of the existing pipe, and after work is completed, including reinstatement of all sewer services. The Municipal Engineer or responsible agency may use the televising to either accept or deny the work performed, and the Municipal Engineer or responsible agency shall keep the televising for its records. The rehabilitated sewer shall be air tested in accordance with ASTM F1417, and shall have deflection testing by pulling through a mandrel.

5.219 PIPE REHABILITATION USING CEMENT MORTAR SPRAY-ON LINING

Cement mortar spray-on lining may be applied to existing ductile iron, cast iron or steel culverts or force mains to provide protection against corrosion and to repair small point leaks. For man-entry culverts (pipe diameters 24-inch and greater) reinforced sprayed mortars may be used. Non-man entry pipes require non-reinforced lining to be applied with a centrifugal lining machine. The lining material shall be pumped to a high speed, rotating application head of the centrifugal lining machine. A uniform thickness layer is applied as the machine moves through the existing pipe at a constant speed. After the liner has been applied, rotating or conical drag towels provide a smooth troweled finish.

The Municipal Engineer or responsible agency shall be required to approve the contractor's methods for sewer flow control, sewer line cleaning, sewer lining, pre- and post- sewer television inspection, manhole rehabilitation, re-establishment of lateral services, maintenance of traffic, notification to sewer users, and any other site-specific needs. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

Non-reinforced cement mortar spray-on linings add little or no structural integrity to an existing culvert. Installations of spray-on linings may be limited by pipe diameter, valve locations, bends, and length of supply hose. Spray-on linings also have long curing times (up to 7 days) and may reduce the pipe flow capacity. The existing host pipe must be dry prior to applying the cement mortar and flow bypassing by the contractor of the section of pipe to be lined is required. Problems may occur on steep slope pipes due to the difficulty in maintaining a constant rate of speed through the pipe, which results in variations of the thickness of the lining, which could lead to problems of cracking or tear-off, or slumping.

Cement mortar spray-on linings can be used for gravity or pressure pipes with diameters of 3-inches to 168-inches. The maximum length of each run is 1,500 feet.

All work required for cement mortar spray-on lining shall conform to AWWA C602-Standards for Cement-Mortar Lining of Water Pipelines in Place – 4 inch and larger and AWWA M28 – Rehabilitation of Water Mains. The minimum design life of the cement mortar spray-on lining shall be 50 years.

Cement used for the mortar preparation shall be Portland pozzolona cement conforming to ASTM 150 type I or Type II with pozzolona materials as per ASTM C618. Sand shall consist of inert granular materials and grains shall be strong, durable, and uncoated. Sand shall be clean and free from injurious amount of dust, clay, flaky particles, oil, alkali, mica, and other deleterious materials. Water shall be clean and free from injurious materials like organic matter, alkali, salt etc. Cement mortar shall be composed of cement, sand, and water; and be mixed well in proper consistency to obtain a dense homogenous lining that will adhere firmly to the pipe surface. The cement sand surface shall be 1:1.5 by volume up to ¼-inch thick lining and 1:1 by volume above ¼-inch thickness of lining. Water cement ratio shall be between 0.3 to 0.4. Water absorption shall not exceed 10%.

The thickness of the spray-on lining shall be as follows:

Ductile Iron or Cast Iron Pipe	**Steel Pipe**
4 to 10-inch diameter – 1/8 inch	1/4 inch
12 to 36-inch diameter – 3/16 inch	5/16 inch
Greater than 36-inch diameter – 1/4 inch	3/8 inch
Greater than 60-inch diameter – N/A	1/3 inch

Prior to the application of cement lining, the contractor shall perform a procedure test to demonstrate that he is able to produce cement lining in accordance with the requirements.

Prior to cement lining the pipe, the contractor shall provide for the pipe to be inspected using CCTV by an approved video inspection company and the interior of the pipe shall be cleaned of any grease, oil, mill scale, loose rust, etc, and the pipe shall be allowed to dry prior to lining. For pipes less than 24-inches in diameter, the contractor shall use a remote control or winch powered lining machine. For pipes 24-inches in diameter or larger, the contractor shall use a remote control or man operated machine. Cement mortar shall be supplied by either high-pressure hoses or other mechanical means. The cement lining shall be capped and cured with either non-pressurized water or low-pressure steam until the mortar is set, but in no case longer than seven days.

After curing is complete, the contractor shall provide for the lining to be inspected using approved closed-circuit TV, or manually, if the diameter permits man-entry. The lining surface shall be smooth and free of cracks up to 0.8 mm in width and less than 12 inches in length. The trough to crest height shall not exceed 1.0mm. The finished surface shall be free from honeycombing and irregularities. The contractor shall repair any damaged or cracked areas using hand applied and troweled cement mortar at his/her expense.

5.220 MICROTUNNELING

Microtunneling is a trenchless method of installing pipe by jacking the pipe behind a microtunnel boring machine which is connected to, and shoved forward by, the pipe being installed. Microtunneling generally precludes man entry. Microtunneling may be done for sewers 36-inches in diameter and smaller. The microtunneling pipe shall have a minimum design life of 50 years.

The Municipal Engineer or responsible agency shall be required to approve the contractor's methods for sewer flow control, sewer line cleaning, sewer lining, pre- and post- sewer television inspection, manhole rehabilitation, re-establishment of lateral services, maintenance of traffic, notification to sewer users, and any other site-specific needs.

If the NEORSD is the responsible agency, the designer shall coordinate all microtunneling requirements and specifications directly with the NEORSD.

The tunnel shield shall be remotely controlled, steerable, articulated, and laser guided. The minimum depth of cover for microtunneling shall be 6 feet or 1.5 times the outside diameter of the pipe being installed, whichever is greater.

The microtunneling system shall have four major components: 1) tunnel shield and cutting head, 2) soil transport system, 3) jacking system, and 4) control equipment. The tunnel shield may be driven either electronically or hydraulically. Line and grade shall be controlled by a laser beam transmitted from the drive shaft. The soil transport system may be either an auger system or slurry system. The jacking system shall have the main jacks located in the drive shaft and must be able to successfully push the tunneling shield along with a string of connected pipes. The control equipment integrates the system of excavation and removal of soil and its simultaneous replacement with pipe.

Jacking and receiving shafts shall be constructed as small as practical. The jacking pit area in pavement shall be limited and confined to one traffic lane or one-half of the roadway, whichever is less. The distance between the shafts is a function of the pipe size, depth of cover, and soil condition. The microtunneling equipment manufacturer shall be consulted when determining the distances between shafts.

All microtunneling equipment shall be remotely controlled. No persons shall be directly in the tunneling shield. The tunnel shield shall be full-faced, with the capability of supporting the face both during excavation and during shutdown. The system shall be laser controlled and monitored by the operator at all times. The jacking system, including any intermediate jacks used, shall be capable of continuously monitoring the jacking pressure,

the rate of advancement, and the distance jacked.

The tunnel shield must be capable of removing cobbles and boulders. The excavation system shall be fully capable of excavating all material that it will encounter. The tunnel shield must be articulated to enable accurate control of line and grade. A lubrication system shall be provided that injects an approved lubricant at the rear of the tunneling shield to lower the friction developed on the exterior of the pipe during jacking. The overcut on the tunneling shield shall not exceed 1-inch on the radius without approval of the Municipal Engineer or responsible agency. The annular space created by the overcut shall be filled with a lubricant that is suitable for the soil type encountered. The tunneling system must be capable of maintaining line and grade to 1-inch plus or minus over the distance of the drive.

Pipes used for microtunneling must be capable of withstanding all forces imposed upon them during the construction phase as well as the final in-place loading conditions. All pipe must be able to withstand a compressive loading greater than the jacking load anticipated. Pipe that does not have an allowable safe jacking load, with a minimum safety factor of 2.5, are not acceptable.

Allowable pipes used in microtunneling include the following:

A. **Vitrified Clay Pipe**
Vitrified clay pipe shall meet the requirement of ASTM C1208, Standard Specification for Vitrified Clay Pipe and Joints for use in jacking, sliplining, and tunnels, latest revision. The pipe shall have a minimum compressive strength of 7000 psi. The pipe joint collar shall be manufactured using 316 stainless steel or better. Pipe shall have equalizer compression rings.

B. **Reinforced Concrete Pipe**
The pipes will be jointed by stainless steel, or better, collar or joint ring. The joint ring must fully comply with the hydrostatic requirements. The RCP shall conform to ASTM C76 and C361 and have a minimum compressive strength of 6000 psi. Pipe joints shall meet the requirements of ASTM C443 and have plain ends, i.e. not tongue and groove or bell and spigot. The pipe shall not deviate from straight by more than 0.05 inches per linear foot when the maximum offset is measured from the concave side of the pipe. The joints between pipes will be protected by the installation of compression rings to distribute the jacking load evenly.

C. Glass Fiber Reinforced Thermosetting Resin Pipe (FRP)
FRP pipe shall be centrifugally cast fiberglass reinforced vinyl ester resin manufactured in accordance with the requirements of ASTM D3262 latest revision. Pipe shall not deviate from straight by more than 0.05 inches per linear foot. Reinforcing glass fiber shall be E-glass filaments with binder and sizing compatible with the resins. Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.

Methods of construction for the shafts, jacking pits or other components of the construction shall be such as to ensure the safety of the work, contractor's employees, as well as the public and adjacent property, whether public or private. All damage to property shall be

restored to equal or better conditions than prior to construction. All shafts and jacking pits shall conform to applicable OSHA excavation, trenching, and shoring standards, which are contained in the Code of Federal Regulations 29 (CFR) 1926.650-1926.653.

Shafts and jacking pit shall be adequately ventilated. All work of excavating, shoring and bracing, and tunneling shall be so executed that settlement is minimized. Blasting shall not be permitted. The tunnel machine operator shall have been fully trained on other tunneling projects on the use of the machinery on this project. The machine shall be operated so as to prevent either surface heave or loss of ground during tunneling. The pipe shall be jacked in place without damaging the pipe joints or the completed pipe section. Any pipe that has been damaged during installation shall be replaced by the contractor.

The Municipal Engineer or responsible agency shall require the contractor to submit for review complete working drawings showing details of the proposed method of construction and the sequence of operations to be performed during construction. The submittal shall include the method of microtunneling, including the microtunneling system to be used, location of working shafts, including method of excavation, shoring and bracing, and de-watering techniques that are proposed to be used. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

The following is the minimum of details that also must be included in the submittal:

1) Manufacturer's literature describing in detail the microtunneling system to be used.

2) Method of muck disposal.

3) Method of controlling ground water.

4) Shaft dimensions, locations, surface construction, profile, depth, method of excavation, and shoring and bracing.

5) Details and design calculations for the microtunneling pipe to be used on the project. The design calculations shall include allowable safe jacking loads with a safety factor of 2.5. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

After the completion of each line segment, before the jacking frame has been removed, each completed drive section shall either be low-pressure air tested or hydrostatically tested. In addition, all lines shall be televised by an approved video inspection company by closed circuit television and a copy of the DVD provided to the Municipal Engineer or responsible agency. Vitrified clay pipe shall be air tested in accordance with ASTM C828 or hydrostatically tested in accordance with ASTM C1091.

When reinforced concrete pipe is installed, the pipe shall be air tested after it is in its final position, but prior to any grouting. Concrete pipe shall be air tested in accordance with ASTM C924 or hydrostatically tested in accordance with ASTM C969. FRP pipe shall be

air tested in accordance with ASTM F1417.

5.221 HORIZONTAL DIRECTIONAL DRILLING

Horizontal directional drilling involves the controlled directional drilling of a pilot bore/hole, back reaming/hole, enlargement, and pull back of the specified sewer pipe to line and grade as shown on the drawings. Pipe sizes can range from 3-inch to 48-inch diameter. The drilling process utilizes drill pipes, drill bits, and reamers in conjunction with an engineered drilling fluid solution. The size of the drilling equipment and required support equipment shall be determined by the contractor based on the diameter and length of pipe to be installed.

Before directional drilling work may commence, the contractor shall submit to the Municipal Engineer for approval working drawings and written procedures describing in detail the proposed method of installation. This will include, but not be limited to, size, capacity and setup requirements of equipment, location and siting of drilling and receiving pits and method of monitoring and controlling line and grade. The contractor shall submit the following information pertaining to the bentonite drilling products; Material Safety Data Sheet(s), any necessary safety precautions and methods of removing spoils. The design calculations shall be submitted for review and approval. All submittals shall be dated, signed, and stamped by an Ohio Registered Professional Engineer.

Drilling operations must not interfere with, interrupt, or endanger either surface or subsurface developments. The contractor must comply with all applicable OSHA requirements. Existing structures, foundations, utilities, and sewers shall be protected. Any damage shall be repaired by the Contractor at his cost. Structure and utility locations shown on the plans are approximate and may be incomplete. Contractor is responsible for physically verifying depth and locations of all existing structures and utilities, as well as all service connections, laterals, and service lines. Where the proposed force main crosses culverts with foundations, the Contractor shall verify bottom of footer elevations and maintain the clearances shown on the Contract Drawings or denoted in the Contract Documents, prior to drilling operations. In general, the force main shall have a minimum of six (6) feet of cover, or depth as shown on the Contract Drawings. If existing structures, utilities, etc., do not allow the force main to be installed per plan design, the Contractor shall notify the Engineer immediately. All dewatering and rock excavation, if necessary, shall be included in this item of work, and no separate payment shall be made for this work.

Pipe used shall be either High Density Polyethylene Pipe (HDPE) AWWA C906 or ASTM F714, SDR 17 for gravity sewers and DR11 for sanitary force mains; PVC restrained joint pipe AWWA C900 SDR 21 for gravity sewers and DR14 for sanitary force mains; or Ductile Iron class 350 cement lined pipe AWWA/ANSI C151/A21.51 with ANSI/AWWA C153/A21.53 fittings and restrained flexible joints and smooth contoured bells.

Drilling fluid shall be a mixture of water and bentonite clay, unless otherwise specified by the Municipal Engineer. Information regarding other proposed drilling fluids shall be submitted to the Municipal Engineer for approval. Disposal of excess drilling fluid and spoils shall be the responsibility of the contractor. Excess drilling fluid and spoils will be disposed at a location approved by the Municipal Engineer or responsible agency. Drilling

fluid returns caused by fracturing of formations at locations other than the entry and exit points shall be minimized. The contractor shall immediately clean up any drilling fluid that is exposed through fractures.

The drilling equipment must be capable of placing the specified pipe at the planned line and grade without inverted slopes or deflection. The equipment must be capable of pulling pipe from either the downstream or upstream manhole location. The number of pits shall be kept to a minimum. The equipment must be capable of boring the specified lengths, from manhole to manhole, in a single bore.

Throughout the insertion process, the contractor shall constantly measure and record axial tension force readings on the pipe material, the insertion velocity, the mud flow circulation and exit rates, and the length of pipe installed. Furthermore, the equipment must have a guidance system that has the capability of measuring inclination and azimuth. The guidance system must have an independent means of ensuring the accuracy of the installation.

Gravity sewer pipe (in the plan direction of flow) shall be a maximum deviation of 6 inches in downward vertical alignment for any 100-foot section from plan grade but no more than 12 inches (1 foot) down in a 500-foot section. Deviation of grade (in the plan direction of flow) in the upward direction is allowed only for corrective means; however, a minimum absolute grade of 0.15% in the downward direction must be maintained. Gravity sewer pipe deviations in horizontal line shall be a maximum of ± 12 inches in any 100-foot section but no more that ± 24 inches in 500 linear feet. Horizontal offsets from plan line must be corrected at manholes.

In the event of difficulties encountered during boring operations that require the withdrawal of the directional drilling equipment from the pilot hole, the contractor shall be allowed to withdraw and abandon the boring and begin a second attempt.

The sizing of the pilot hole reamed to facilitate the insertion of the specified pipe shall be minimized to maximize support for the pipe. Reaming diameter shall not exceed 120% to 150% of the outside diameter of the pipe being installed. The pipe being pulled into the tunnel will be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation.

The contractor will allow sufficient lengths of product pipe to extend past the termination points to allow for contraction. Pulled HDPE pipe shall be allowed forty-eight (48) hours of stabilization prior to making any connections.

Unless otherwise specified by the Municipal Engineer, connections of pipe installed by use of directional drilling methods to new manholes shall be made using press-seal boots.

A tracer wire shall be installed with the pipe, regardless of pipe material. The tracer wire shall be either a solid hard drawn copper conductor or an annealed stranded stainless-steel conductor. The conductor shall be insulated with high density polyethylene (HDPE) in accordance with the physical and electrical properties per ASTM D1248. The contractor

shall appropriately size and install a tracer wire compatible with the pullback rating of the equipment being used, but in no case, shall the wire be smaller than ten (10) gage. The tracer wire shall be brought to the surface within a six (6) inch PVC riser. The riser shall have a cast iron cap.

HDPE pipe shall be assembled and joined at the site using either the butt-fusion or electro-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as a fusion technician, by a manufacturer of polyethylene pipe and/or fusing equipment.

Restrained joint PVC shall be assembled and joined at the site using non-metallic couplings designed with the pipe as an integral system. Pipe and coupling shall be restrained using high-strength, flexible thermoplastic splines inserted into mating precision-machined grooves in the pipe and coupling. Threaded or solvent-cement joints and connections shall not be permitted.

Once installation of sewer pipe has been completed, the contractor shall reconnect existing live service connections. These services shall be reconnected by mechanical saddles or Inserta-Tee.

Testing will be required after the pipe has been installed between manholes. The test shall consist of a low-pressure air test of the sewer pipe before any service connections to the newly installed pipe have been made. The purpose of this test is to check the integrity of the pipe and to verify that the pipe has not been damaged during operations when pulling it through the borehole space created by directional drilling.

The contractor shall provide for the sewer pipe installation to be internally inspected with a television camera and recorded onto DVD by an approved video inspection company. The DVDs shall be submitted to the responsible agency for review. Finished recording shall be continuous over the entire length of the sewer between two manholes. The sewer pipe shall be free of visual defects.

5.222 MISCELLANEOUS

A. Clean-up and Repairs

As the work progresses, the contractor shall keep the site reasonably free of debris, discarded materials and equipment. He shall maintain streets, access drives, and sidewalks in a safe and convenient condition for travel as well as providing vehicular access to the abutting properties.

Upon 70% vegetation established or at the direction of the Municipal Engineer or responsible agency, the contractor shall remove all temporary Stormwater control measures (SCMs). Upon completion of the work, the contractor shall remove all surplus excavated materials, tools, equipment, portable sanitary facilities, and temporary buildings from the site and restore all pavements, road surfaces, curbing, gutters, driveways, driveway culvert pipes, sidewalks, retaining walls, guard rails, utility and service lines, mail boxes, newspaper boxes and all other items affected by the construction operations.

All restoration work shall be equal to or better than the original condition of the items disturbed by the construction, and the quality and dimensions of the restoration shall be approved by the responsible agency. All disturbed driveway culvert pipes shall be replaced with new pipe. Replacement driveway pipes shall be the same type of material and same diameter and length as the original pipes, except that pipes with diameters less than 12 inches shall be replaced with 12-inch diameter pipes. All steel corrugated metal pipes shall be a minimum of 14 gauge.

The contractor shall perform such replacements as soon as practicable after completion of the sewer and shall save the responsible agency free and harmless from all suits for damages to persons or property arising from or caused by this construction.

Before final acceptance of the work, the contractor shall, as directed by the responsible agency, clear the sewers of any mortar, dirt, asphalt, roadway base material or other refuse that may have been left or accumulated in the sewers. All manholes, inlets, catch basins, and other structures shall be cleared of all forms, scaffolding, bulkheads, construction debris, surplus mortar, rubbish or dirt, and left in a clean and proper condition.

B. Seeding and Sodding

1. General

   The contractor shall restore to original grade, and seed and/or sod, all lawn and grass areas disturbed by construction. All areas adjacent to residences or commercial buildings shall be sodded unless otherwise specified by the responsible agency. Areas in easements away from residences or commercial buildings shall be seeded. The contractor, at his/her option and with prior approval of the responsible agency, may substitute sod for the areas specified for seed, all at no change in price.

2. Material
   a. Sod

      Sod shall be well rooted Kentucky Blue Grass, (Poa pratensis) or Canadian Blue Grass (Poa compressa) with not more than 30% of other grasses and clover and free of noxious weeds and reasonably free from dandelions and crabgrass. It shall be mowed to a height not to exceed three (3) inches before cutting and lifting and shall be of uniform thickness. Furnish sod cut to a depth equal to the growth of the fibrous roots but in no case less than one inch (1) of soil. Sod shall be delivered within 24 hours after being cut and shall be installed within 48 hours after cutting.

   b. Grass

      Grass seed shall be furnished and vendor-mixed by dealers or growers who are registered or licensed by the State of Ohio, Department of Agriculture, and delivered to the site in sealed bags and guaranteed by the dealer. Mix shall be ODOT Roadside Mixture and shall consist of the following:

      Kentucky Bluegrass (Poa pratensis) – 1.5 lbs. per 1000 Ft^2
      Kentucky 31 Fescue (Festuca arundinacca - KY31) – 2.0 lbs. per 1000 Ft^2
      Perennial Ryegrass (Lolium perenne) – 1.5 lbs. per 1000 Ft^2

      The percent purity, percent weed seed and percent germination in the seed mixture shall meet the latest requirements of the Ohio Department of Transportation. All seeds shall be sown within 9 months of the testing date.

3. Method of Installation
   a. Sodding

      The subgrade material shall be loosened and mixed to a depth of two (2) inches. All sticks, stone over two (2) inches and rubbish shall be removed and the whole area compacted so that it will be parallel to the finished grade. A commercial fertilizer formula 10-20-10 shall be applied to the top of the soil at the rate of twenty (20) pounds per 1000 square feet and thoroughly raked into the soil.

      Sod shall be laid by hand with close joints and no overlapping so that no voids occur. After laying, the sod shall be thoroughly watered and tamped to bring the sod into close contact with the sod-bed to ensure tight joints between the sod strips. The complete surface should be true to finished grades.

      Sod on slopes steeper than 3 to 1, but flatter than 2 to 1, shall have the long edge of the sod strips parallel to the contour starting at the bottom of the slope. All sod strip joints shall be staggered by at least 12 inches. Sod placed 6 feet or greater in height shall be staked and securely fastened along all sides with stakes not more than two (2) feet apart.

      Sod on slopes steeper than two to one (2:1) shall be placed on galvanized minimum 20 gage poultry netting or equivalent and held in place by ½ x ¾ x 12 inches long wooden stakes or by 18-inch-long by ¼ inch diameter x 3 inch tee pins. The contractor shall drive wooden stakes so that the last 1 inch remains

above the top of the sod, and drive pins shall be 1 inch below the top of the grass. The contractor shall stake each strip or roll of sod securely along all sides with either wooden stakes or pins not more than two (2) feet apart or by other methods approved by the responsible agency.

b. Seeding

1) Seedbed Preparation

All disturbed areas not adjacent to residences or commercial buildings shall be repaired with seeding, fertilizing and mulching over a minimum of 4 inches of topsoil.

Agricultural ground limestone shall be applied to acid soil as recommended by a soil test. In lieu of a soil test, lime shall be applied at the rate of 100 lbs. per 1,000 Ft^2 or 2 tons per acre.

Fertilizer shall be applied as recommended by a soil test. In place of a soil test, fertilizer shall be applied at a rate of 25 lbs. per 1,000 Ft^2 or 1,000 lbs. per acre of a 10-10-10 or 12-12-12 analyses.

The lime and fertilizer shall be worked into the soil with a disk harrow, spring-tooth harrow, or other suitable field implement to a depth of 3 inches. On sloping land, the soil shall be worked on the contour.

2) Seeding Dates and Soil Conditions

Seeding should be done March 1 to May 31 or August 1 to September 30. If seeding occurs outside of the above specified dates, additional mulch and irrigation may be required to ensure minimum of 80% germination. Tillage for seedbed preparation should be done when the soil is dry enough to crumble and not form ribbons when compressed by hand. For winter seeding, see the following section on dormant seeding.

3) Dormant Seeding

Seeding should not be made from October 1 through November 20. During this period, the seeds are likely to germinate but probably will not be able to survive the winter.

The following methods may be used for dormant seeding: 1) from October 1 through November 20, prepare the seed-bed, add the required amounts of lime and fertilizer, then mulch and anchor; or 2) after November 20, and before March 15, broadcast the selected seed mixture, and increase the seeding rates by 50% for this type of seeding selected seed mixture and mulch and anchor.

Apply seed uniformly with a cyclone seeder, drill, cultipacker seeder, or hydro-seeder (slurry may include seed and fertilizer) on a firm, moist seedbed.

Where feasible, except when a cultipacker type seeder is used, the seedbed should be firmed following seeding operations with a cultipacker, roller, or light drag. On sloping land, seeding operations should be on the contour where feasible.

4) Mulching
   a) General
      Mulch material shall be applied immediately after seeding. Dormant seeding shall be mulched, and 100% of the ground surface shall be covered with an approved material.

   b) Materials
      If straw is used it shall be unrotted, small-grain straw applied at the rate of 2 tons per acre or 90lbs. (two to three bales) per 1,000Ft². The mulch shall be spread uniformly by hand or mechanically applied so that the soil surface is covered. For uniform distribution of hand-spread mulch, divide area into approximately 1,000Ft² sections and spread two 45 lb. bales of straw in each section.

      If wood cellulose fiber is used for hydroseeding, it shall be applied at 2,000lbs. /acre or 43lbs. /1,000 Ft².

      Other acceptable mulches include rolled erosion control mattings, or blankets applied according to manufacturer's recommendations, or wood chips applied at 10 to 20 tons per acre.

      Straw mulch shall be anchored immediately to minimize loss by wind or water.

      A disk, crimper, or similar mechanical type tool shall be set straight to punch or anchor the mulch material into the soil. Straw mechanically anchored shall not be finely chopped but, generally, be left longer than 6 inches.

      Mulch netting shall be used according to the manufacturer's recommendations. Netting may be necessary to hold mulch in place in areas of concentrated runoff and on critical slopes.

      Asphalt emulsion shall be applied as recommended by the manufacturer or at the rate of 160 gallons per acre.

      Synthetic binders such as acrylic dlr (Agri-tac), DCA-70, Petroset, Terra tack or equivalent may be used at rates specified by the manufacturer.

      Wood cellulose fiber shall be applied at a net dry weight of 750 lbs. per acre. The wood cellulose fiber shall be mixed with water with the mixture containing a maximum of 50lbs. cellulose per 100 gallons of water.

5) Irrigation

Permanent seeding shall include irrigation provided by the contractor to establish vegetation during dry weather or on adverse site conditions, which require adequate moisture for seed germination and plant growth.

Irrigation rates shall be monitored to prevent erosion and damage to seeded areas from excessive runoff.

6) Topsoiling

a) Salvaging and Stockpiling

The contractor shall determine the depth and suitability of topsoil at the site. (For help, contact the local SCS office to obtain a County Soil Survey Report). Prior to stripping topsoil, install appropriate downslope erosion and sedimentation controls such as sediment traps and basins. Remove the soil material no deeper than what the County Soil Survey describes as "surface soil" (ie. A or Ap horizon). Construct stockpiles in accessible locations that do not interfere with natural drainage. Install appropriate sediment controls to trap sediment, such as silt fence, immediately adjacent to the stockpile, or sediment traps or basins downstream of the stockpile. Stockpile side slopes shall not exceed a ratio of 2:1. If topsoil is stored for more than 21 days, it shall be temporary seeded or covered with a tarp.

b) Spreading the Topsoil

Prior to applying topsoil, the topsoil shall be pulverized. To ensure bonding, grade the subsoil and roughen the top 3-4 inches by disking. Do not apply when site is wet, muddy, or frozen. Apply topsoil evenly to a depth of at least 4 inches and compact slightly to improve contact with subsoil. After spreading, grade and stabilize with seeding or appropriate vegetation.

7) Maintenance of Seeding and Sodding

All seeded and sodded areas shall be protected and maintained by the contractor by watering, mowing, and replanting until an even dense growth is started. Dead sod or non-growing seeded areas shall be repaired or reseeded or resodded at the direction of the Municipal Engineer or responsible agency.

C. Protection of Trees and Shrubs During Construction

Roots two inches or larger that are severed by trenching shall be sawn off neatly in order to encourage new growth and discourage decay. Soil excavated during trenching shall be piled on the side away from the tree or shrub. Roots shall be kept moist while trenches are open and refilled immediately after sewers or utilities are installed or repaired.

D. Replacement of Trees and Shrubs

The contractor shall be responsible for replacing trees, shrubbery, and sprinkler systems that are not specified to be removed and that are damaged during construction, and all appurtenant work incidental thereto, unless otherwise provided for in the plans and specifications.

E. Bentonite Clay Dams

The installation of Bentonite Clay Dams (per the Uniform Standard Detail) on sanitary sewers, storm sewers, and sanitary and storm laterals may be required by the responsible authority during the review process. Where sewers and laterals cross creeks and/or ditches, two additional Dams may be required on every pipe, one on either side of the crossing.

In Olmsted Township, the installation of Bentonite Clay Dams shall be required on all sanitary and storm laterals, with the specific locations on the laterals (e.g., at the right of way line, etc.) as directed by the CCDPW. In Olmsted Township, where sewer laterals cross creeks and/or ditches, a two additional Dams shall be required on every pipe, one Dam on either side of the crossing.

PART 6 - STANDARD DESIGN AND CALCULATION FORMS

6.1 SANITARY SEWER DATA SHEETS

1. Date _____
2. Name of Municipality or Sewer District: _____
3. Name of Project: _____
4. Original Township and Lot Number: _____
5. Name of Engineer Preparing Plans: _____
6. Name of Firm Preparing Plans: _____
7. Address: _____
8. Telephone: _____
9. Email Address: _____
10. Name and address of governmental authority to whom plan approval should be sent:

    _____

11. Brief description of project. Include the following info (use attachments as necessary):

    (a) the location, size, and development of the area to be served: _____

    _____

    (b) latitude and longitude of center of sewer run: _____

    (c) total length of sewer to be installed: _____

    (d) possibility of future extensions: _____

    (e) exact location of connections to existing sewers: _____

    (f) treatment plant to receive wastes: _____

    (g) other data pertinent to the project: _____

12. Indicate type(s) of sewer proposed (check all that apply):

    _____ Conventional Gravity Sewers _____ Small Diameter Gravity (with septic tanks)

    _____ Pressure Sewers _____ Vacuum Sewers

    _____ Siphon _____ Force Main

Sanitary Sewer Data Chart

PIPE SIZE	PIPE MATERIAL	MATERIAL SPEC.*	JOINT SPEC.*	BEDDING CLASS.	PIPE LENGTH	MINIMUM SLOPE	MAX M.H. SPACING	TYPE MANHOLE & MATERIAL	M.H. JOINT SPEC.*

* List ASTM, AWWA, ANSI, Specification Number

6.1 SANITARY SEWER DATA SHEETS (continued)

a) Specify the type of leakage test (air, infiltration, and/or exfiltration) and the limit to be used: _____

Air _____ time for 1 psi drop in pressure

Infiltration and/or exfiltration; gallons per inch of pipe diameter: _____

Tested under the supervision of an Engineer or Inspector? Yes No (Circle one)

Name of Engineer or Inspector: _____

b) Flexible pipe deflection limit specified: _____%

Tested under the supervision of an Engineer or Inspector? Yes No

Name of Engineer or Inspector: _____

c) Specify type of manhole testing to be performed: _____

Tested under the supervision of an Engineer or Inspector? Yes No

Name of Engineer or Inspector: _____

d) Do the Specifications include a provision for construction inspection of all construction by an Engineer or a qualified inspector? Yes No

Name of Engineer or Inspector: _____

e) Name and address/location of the Treatment Plant that will receive the sanitary flow:

_____

f) Capacity of existing system and/or plant to which connected:

Present treatment facility loading _____ mgd (based on average daily flow from the previous year)

Does the treatment plant have the capacity to treat additional flow from the new sanitary facilities? Yes No

If the proposed sewer is to be connected to an existing sanitary sewer, give the total capacity of the existing sewer, and the capacity of the existing sewer that is available for additional loading at the point of connection (base calculations on peak flows):

Total capacity of the existing sewer at the point of connection _____ mgd

Capacity of the existing sewer that is available for additional loading at point of

Connection _____ mgd

Estimated hydraulic loading of proposed sewer at the point of connection to the plant or to the existing sewer:

Startup flow: Average Daily Flow: _____ mgd Peak Flow _____ mgd (based on existing homes to be served)

Design flow: Average Daily Flow: _____ mgd Peak Flow _____ mgd (design on immediate area served)

Ultimate flow: Average Daily Flow: _____ mgd Peak Flow _____ mgd (based on immediate area and extension)

If the flow figures indicate a hydraulic loading over the design capacity of the sewer or treatment plant, explain what steps are being taken to eliminate or reduce the or reduce the hydraulic loading to an acceptable value.

g) Are the proposed sewers deep enough to serve all basements?

Yes No

If no, explain: _____

_____

_____

h) Are the sewers at least ten (10) feet horizontally from water lines and, when crossing water lines, are the sewers at least 18 inches below the water line?

Yes No

If no, explain: _____

_____

_____

i) Are existing public water supply sources located within 200 feet of the sewers or private wells within 50 feet of the sewers?

Yes No

If yes, will sewers be constructed with watertight pipe? _____

j) Are there any physical connections between the sewer and a public or private potable water supply or appurtenances?

Yes No

k) Are sewers of sufficient depth to prevent freezing (3' minimum cover)? Yes No

l) Are sewers in streams constructed to remain watertight and sufficiently deep to protect the sewer line?

Yes No N/A

m) Are sewer crossings perpendicular to the stream? Yes No

n) Are watertight covers used where manholes are subject to flooding by street runoff or high water?

Yes No

o) Are manholes provided at all changes in size, grade, alignment, and sewer intersections?

Yes No

p) Are drop manholes provided where the entrance sewer invert is 24 inches or more above the manhole invert?

Yes No

q) Are manholes provided at upstream end of each sewer line?

Yes No

r) Where small sewers join larger ones, have the inverts of the larger sewers been lowered sufficiently to maintain the same energy gradient?

Yes No N/A

s) Are inlet/outlet pipes connected with gasketed flexible watertight connections?

Yes No

t) Have provisions been made to protect sewers at velocities of over 15 feet per second?

Yes No

u) Are sewers with slopes over 20 percent secured with concrete anchors (or equal), spaced as required?

Yes No N/A

v) Are there any overflows or bypasses upstream of the connection point that may be impacted by the flows in the new sewer?

Yes No

w) Are there any sanitary overflows or bypasses downstream of the point of connection?

Yes No

x) If "Yes" to Questions v or w, specify plan sheet(s) where shown: _____

_____

y) Will this project include any pump stations?

Yes No If "Yes", please complete the Pump Station Data Sheet.

z) Will there be a pump station involved in receiving sewage from the sewer extension?

Yes No N/A If "Yes", specify present and design flows of the pump station:

_____

_____

aa) Are force mains designed to withstand water hammer pressure?

Yes No N/A

bb) Plans for the proposed installation of a County, Village, or Municipal sewer that is tributary to a sewage treatment plant or sewer connection to another political entity must be accomplished by a written consent of both entities.

Is a written inter-municipal agreement attached?

Yes No N/A

cc) Will one or more acres be disturbed during construction of this project?

Yes No

If "Yes", enter the date the application for NOI coverage was submitted. _____

dd) Will wetlands be disturbed during the construction of this project?

Yes No

If "Yes", enter the date the 401/404 Permit application was submitted. _____

ee) Does the project conform to the 208/201 plan for the area?

Yes No

ff) Is the project located within 1,000 feet of a designated wild, scenic, and recreational river?

Yes No

Estimated Cost of Project $_____

NOTE: The following statement must be shown on the plans:

Roof drains, foundation drains, and other clean water connections to the sanitary sewer system are prohibited.

THE FOREGOING IS A TRUE STATEMENT OF FACTS PERTAINING TO THIS PROPOSED SANITARY SEWER INSTALLATION.

Signed: _____ Date: _____
Professional Engineer Registered in the State of Ohio

Engineer's Stamp required below:

6.2 SANITARY SEWER DESIGN CALCULATION SHEET

MUNICIPALITY OR
SEWER DISTRICT _____ DATE _____

PROJECT _____ ENGINEERING COMPANY _____ BY _____

hv $\frac{V^2}{2g}$	STREET	FROM MANHOLE	TO MANHOLE	LENGTH (FEET)	Area Acres		AVERAGE FLOW PER ACRE (G.P.D.)	AVERAGE FLOW TOTAL ACCUMULATED (G.P.D.)	PEAK FACTOR	PEAK FLOW (M.G.D.)	INFILT. (M.G.D.) AT 375 G/A/D	INFILTRATION (ACCUMULATED) (G.P.D.)	TOTAL PEAK FLOW M.G.D. INCLUDING INFILTRATION	n =				
					INCREMENT	ACCUM. TOTAL								PIPE DIAMETER (INCHES)	SLOPE %	CAPACITY FULL (M.G.D.)	VELOCITY FULL (F.P.S.)	VELOCITY ACTUAL (F.P.S.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)

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6.3 STORM SEWER DATA SHEETS

1. Date _____
2. Name of Municipality or Sewer District: _____
3. Name of Project: _____
4. Original Township and Lot Number: _____
5. Name of Engineer Preparing Plans: _____
6. Name of Firm Preparing Plans: _____
7. Address: _____
8. Telephone: _____
9. Email Address: _____
10. Name and address of governmental authority to whom plan approval should be sent:

    _____

11. Brief description of project. Include the following info (use attachments as necessary):

    (a) the location, size, and development of the area to be served: _____

    _____

    (b) total length of sewer to be installed: _____

    (c) possibility of future extensions: _____

    (d) exact location of connections to existing sewers: _____

    (e) conditions affecting natural drainage: _____

    (f) type of ground cover and average slope: _____

    (g) other data pertinent to the project: _____

    _____

    _____

    _____

Storm Sewer Data Chart

PIPE SIZE	PIPE MATERIAL	MATERIAL SPEC.*	JOINT SPEC.*	BEDDING CLASS. (1,2)	PIPE LENGTH	MINIMUM SLOPE	MAX M.H. SPACING	TYPE MANHOLE & MATERIAL	M.H. JOINT SPEC.*

* List ASTM, AWWA, ANSI, Specification Number

6.3 STORM SEWER DATA SHEETS (continued)

a) Flexible pipe deflection limit specified: _____%

Tested under the supervision of an Engineer or Inspector? Yes No

Name of Engineer or Inspector: _____

b) Do the Specifications include a provision for construction inspection of all construction by an Engineer or a qualified inspector? Yes No

Name of Engineer or Inspector: _____

c) Capacity of existing system to which connected: If the proposed sewer is to be connected to an existing storm sewer, give the total capacity of the existing sewer flowing full (no head), and the capacity of the existing sewer that is available for additional loading at the point of connection (base calculations on peak flows):

Total capacity of the existing sewer at the point of connection _____ cfs

Capacity of the existing sewer that is available for additional loading at point of

connection _____ cfs

Estimated hydraulic loading of proposed sewer at the point of connection to the existing sewer:

Design flow: Peak Flow _____ mgd

If the flow figures indicate a hydraulic loading over the design capacity of the sewer, explain what steps are being taken to eliminate or reduce the or reduce the hydraulic loading to an acceptable value.

_____

d) Are the sewers at least ten (10) feet horizontally from water lines and, when crossing water lines, are the sewers at least 18 inches below the water line?

Yes No

If no, explain: _____

_____

e) Are there any physical connections between the sewer and a public or private potable water supply or appurtenances?

Yes No

f) Are sewers of sufficient depth to prevent freezing (3' minimum cover)? Yes No

g) Are sewer crossings perpendicular to the stream? Yes No

h) Are manholes provided at all changes in size, grade, alignment, and sewer intersections?

Yes No

i) Are drop manholes provided where the entrance sewer invert is 24 inches or more above the manhole invert?

Yes No

j) Are manholes provided at upstream end of each sewer line?

Yes No

k) Where small sewers join larger ones, have the inverts of the larger sewers been lowered sufficiently to maintain the same energy gradient?

Yes No N/A

l) Are inlet/outlet pipes connected with gasketed flexible watertight connections?

Yes No

m) Have provisions been made to protect sewers at velocities of over 15 feet per second?

Yes No

n) Are sewers with slopes over 20 percent secured with concrete anchors (or equal), spaced as required?

Yes No N/A

o) Are there any overflows or bypasses upstream of the connection point that may be impacted by the flows in the new sewer?

Yes No

p) If "Yes" to Question o, specify plan sheet(s) where shown: _____

_____

q) Will this project include any stormwater pump stations?

Yes No If "Yes", please complete the Pump Station Data Sheet.

r) Will there be a pump station involved in receiving storm flow from the sewer extension?

Yes No N/A If "Yes", specify present and design flows of the pump station:

_____

_____

s) Are force mains designed to withstand water hammer pressure?

Yes No N/A

t) Plans for the proposed installation of a County, Village, or Municipal sewer that is tributary to a sewer connection to another political entity must be accomplished by a written consent of both entities.

Is a written inter-municipal agreement attached?

Yes No N/A

u) Will one or more acres be disturbed during construction of this project?

Yes No

If "Yes", enter the date the application for NOI coverage was submitted. _____

v) Will wetlands be disturbed during the construction of this project?

Yes No

If "Yes", enter the date the 401/404 Permit application was submitted. _____

w) Does the project conform to the 208/201 plan for the area?

Yes No

x) Is the project located within 1,000 feet of a designated wild, scenic, and recreational river?

Yes No

y) Building sewers shall be constructed in accordance with specifications equal to those indicated in the preceding chart.

Yes No

z) What is the minimum difference in elevation between the bottom of any existing or proposed footings and the crown of the storm sewer at the point of connection of the lateral?

_____

aa) What is the minimum difference in elevation between the lowest floor elevation of any existing or proposed footings and the crown of the storm sewer?

_____

Estimated Cost of Project $_____

NOTE: The following statement must be shown on the plans:

> Roof drains, foundation drains, and other clean water connections to the sanitary sewer system are prohibited.

THE FOREGOING IS A TRUE STATEMENT OF FACTS PERTAINING TO THIS PROPOSED STORM SEWER INSTALLATION.

Signed: _____ Date: _____
Professional Engineer Registered in the State of Ohio

Engineer's Stamp required below:

6.4 STORM SEWER DESIGN CALCULATION SHEET

MUNICIPALITY OR SEWER DISTRICT _____ DATE _____ DESIGN YEAR STORM _____

PROJECT _____ ENGINEERING COMPANY _____ BY _____

STREET	FROM MANHOLE	TO MANHOLE	AREA ACRES		TIME OF FLOW (MINUTES)			C (RUNOFF COEFFICIENT)	I (RAINFALL INTENSITY)	Q (C.F.S.)	DESIGN n				PROFILE				
			INCREMENT	TOTAL AREA	TO INLET	IN PIPE	TIME OF CONCENTRATION				PIPE SIZE (IN.)	SLOPE %	CAPACITY FULL (C.F.S.)	VELOCITY (FT./SEC.)	LENGTH (FT.)	FALL (FT.)	OTHER LOSSES & FALL IN MH	INVERT ELEV. UPPER END	INVERT ELEV. LOWER END
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)

6.5 PUMP STATION DATA SHEETS

(To be completed for each pump station on the project.)

1. Date _____
2. Name of Municipality or Sewer District: _____
3. Name of Project: _____
4. Original Township and Lot Number: _____
5. Name of Engineer Preparing Plans: _____
6. Name of Firm Preparing Plans: _____
7. Address: _____
8. Telephone: _____
9. Email Address: _____
10. Name and address of governmental authority to whom plan approval should be sent:

    _____

11. Brief description of project. Include the following info (use attachments as necessary):

    (a) the location, size, and development of the area to be served: _____

    _____

    (b) latitude and longitude of center of pump station: _____

    (d) possibility of future extensions: _____

    (e) exact location of connection of force main to existing sewers: _____

    (f) treatment plant to receive wastes: _____

    (g) other data pertinent to the project: _____

    _____

    _____

<u>Pump Station Type</u> (check all applicable items):

_____ Poured in Place Concrete

_____ Precast Concrete

_____ Metal

_____ Fiberglass

_____ Factory Built

_____ Built in Place

_____ Submersible

_____ Suction Lift

_____ Screw Pump

Does the pump station have the capacity to handle the design flow without creating or worsening any overflows, bypasses, or operational problems downstream of the pump station?

Yes No (circle one)

<u>Site</u>

a) Is the Site accessible at all times? Yes No

b) Is the Site graded around the pump station to provide positive drainage away from the station?
Yes No

c) Is the Site protected to prevent vandalism, and to prevent entrance by unauthorized persons or animals?
Yes No

d) Is potable water provided at the pump station? Yes No

e) Is the Site subject to flooding? Yes No

f) 100-Year Flood Elevation at the Site: _____

g) Distance to the nearest residence: _____

h) Distance to the nearest building? _____

Flows

a) Estimated average daily startup flow tributary to this station: _____ gpd
(Provide separate flow calculation sheets.)

b) Estimated peak hourly startup flow tributary to this station: _____ gpd
(Provide separate flow calculation sheets.)

c) Estimated average daily ultimate design flow tributary to this station: _____ gpd

d) Estimated peak hourly ultimate design flow tributary to this station: _____ gpd

e) Hydraulic capacity of sewer downstream of this station: _____ gpd

Type of Waste to be Pumped

a) Sanitary _____

b) Combined (Sanitary and Storm) _____

c) Commercial _____

d) Industrial _____
Source of Industrial Waste _____

Pneumatic Ejectors

a) Make and model number _____

b) Operating conditions _____ gpm @ _____ TDH

c) Number of compressors _____

d) Number of pots _____

e) Capacity of pot _____

Pumps

a) Number of pumps

b) Pump info:

Make _____

Model Number _____

Type (suction lift, positive displacement, centrifugal, horizontal centrifugal, etc.):

_____

c) Pump Materials (cast iron, stainless steel, etc.):

Casting _____

Impeller _____

d) Operating conditions _____ gpm @ _____ TDH

e) Maximum allowable speed _____ rpm

f) Variable Speed Drive or Constant Speed Drive _____

g) Are high efficiency and/or premium efficiency motors specified? Yes No

h) Will the pumps pass a three-inch sphere? Yes No

i) Do the pumps require a water seal unit? Yes No

If so, is the water seal unit air-gapped? Yes No

Dry Well

a) Is the dry well completely separated from the wet well? Yes No

b) Type of construction? _____

c) Type of corrosion protection? _____

d) Stairway or access ladder with treads of non-slip material? Yes No

Stairway landings or safety landings provided every ten vertical feet? Yes No

e) Is positive ventilation provided? Yes No

Are there ventilation controls located outside of the dry well? Yes No

Number of air changes per hour: _____

Is the dry well ventilation system separate from the wet well system? Yes No

f) Are a dehumidifier and heating system in place to ensure a dry atmosphere for protection of motors and the control system?
Yes No

g) Is the lighting explosion proof? Yes No

Does the lighting have outside controls? Yes No

h) Has a sump and sump pump been provided to handle floor drainage? Yes No

Is the discharge line air gapped above the high-water alarm elevation? Yes No

Wet Well

Type of construction:

a) ASTM C-443 joints between precast concrete sections? Yes No

b) Effective capacity _____ gallons between shut off and first level pump on

Design detention time _____ at _____ flow

c) Elevations:

Suction Line Invert Elevation _____

Discharge Line Invert Elevation _____

Bottom Elevation of Wet Well _____

Low Shut Off Elevation in Wet Well _____

No. 1 Pump On Elevation _____

No. 2 Pump On Elevation _____

No. 3 Pump On Elevation _____

High Water Alarm Elevation _____

Is a bypass or overflow provided? Yes No

Bypass or Overflow Elevation _____

Is treatment provided? Yes No

Explain: _____

_____

Elevation of Outflow Invert _____

Are the inlets to the wet well located below the minimum wet well surface? Yes No

Lowest Basement Elevation _____

d) High Water Alarm: Make _____

Model _____

Type _____

e) Operating conditions _____ gpm @ _____ TDH

Audio Visual Battery-Operated Alarm? Yes No

Telemetered Alarm? Yes No

Provisions for retaining overflow waste on-site? Yes No

Type of ventilation provided:

_____ Continuous _____ Intermittent _____ Portable

Number of air changes per hour _____ at _____ cfm

Ventilation Controls Locations

_____ Inside _____ Outside

Is all the equipment in the wet well suitable for use under corrosive conditions?

Yes No

Controls

Make _____

Model _____

Type _____

Alternating Yes No

Enclosure _____

Emergency Operations

Type of emergency pumping capacity provided:

_____ Dual Substations

_____ Portable Generator

_____ Permanent Generator

_____ Portable Pumps

_____ (Quick Connect/Quick Disconnect)

_____ None

Does the standby system have sufficient capacity to startup and maintain the total pumping capacity of the pump station? Yes No

Is an electrical hookup for a portable generator provided? Yes No

Is a hookup to the force main (quick connect) for portable pumps provided? Yes No

Does the pump station operator have the portable pumps needed? Yes No

Is a flow measuring device provided? Yes No
Type of flow measuring:

_____ Indicating, Totalizing, and Recording

_____ Elapsed Time Meter

THE FOREGOING IS A TRUE STATEMENT OF FACTS PERTAINING TO THIS PROPOSED PUMP STATION INSTALLATION.

Signed: _____ Date: _____
Professional Engineer Registered in the State of Ohio

Engineer's Stamp required below:

6.6 PUMP STATION DESIGN CALCULATION SHEETS

1. Date _____
2. Name of Municipality or Sewer District: _____
3. Name of Project: _____
4. Location: _____
5. Original Township and Lot Number: _____
6. Name of Engineer Preparing Plans: _____
7. Name of Firm Preparing Plans: _____
8. Address: _____
9. Telephone: _____
10. Email Address: _____

Wet Well Calculations

a) Pumping Station No. _____

b) Average Daily Flow into the Station, excluding infiltration _____ gpd

c) Peak Factor: _____

Drainage Area: _____

(Average Daily Flow, _____ gpd) x (Peak Hour Factor, _____) = _____ gpd

Infiltration = (Drainage Area, _____ acres) x (375 gal./acre/day) = _____ gpd

d) Present Flow, peak flow into the Station: _____ gpd

Estimated ultimate peak flow into the Station: _____ gpd

e) Rated pump delivery: _____ gpm

f) Storage volume between High and Low Water Levels = _____ gallons

g) Wet Well diameter = _____ ft. and _____ gal./ft.

h) Total time between successive pump starts = _____ minutes

$$\frac{\text{(Line f, \_\_\_\_\_ gal.)}}{\text{(Line e, \_\_\_\_\_ gpm) – (Line d, \_\_\_\_\_ gpd)}} + \frac{\text{(Line f, \_\_\_\_\_ gal.)}}{\text{(Line d, \_\_\_\_\_ gpd)}}$$

= Line h, _____ minutes

i) Total time at ultimate development flow between successive pump starts = _____ minutes

Total Dynamic Head Calculations:

External Loss (Dynamic)

a) Force main size _____ Inches

b) Friction Loss at initial startup _____ feet/100 feet of pipe

Friction loss at end of design life _____ feet/100 feet of pipe

c) Length of force main _____ feet

d) Equivalent length of pipe due to bends, etc. _____ feet (initially)_____ feet (ultimate)

e) Total length of pipe (Actual & Equivalent) _____ feet (initially)_____ feet (ultimate)

f) Total friction loss _____ feet (initially)_____ feet (ultimate)

Internal Loss (Dynamic)

Pumping station losses _____ feet (initially)_____ feet (ultimate)

Static Head

a) Highest elevation of force main _____ feet

b) Elevation of suction _____ feet

c) Static Lift _____ feet

Total Dynamic Head _____ feet (initially)_____ feet (ultimate)

Net Positive Suction Head Calculations (when applicable)

a) Atmospheric Pressure at Sea Level _33.90_ feet

b) Atmospheric Pressure at Site _____ feet

c) Atmospheric pressure available at site _____ feet

d) Total Dynamic Suction Lift _____ feet

e) Vapor pressure 74° liquid _____ feet

f) Safety Factor _____ feet

g) N.P.S.H. Available _____ feet

h) N.P.S.H. Required by Pump _____ feet

i) Excess N.P.S.H. Available _____ feet

j) Priming Lift _____ feet
(Centerline of pump suction to lead pump on)

Buoyancy Calculations:

a) Type of soil over pump station _____

k) Weight of soil _____ lbs./cu. ft.

l) Downward force of soil on top area of station _____ lbs.

m) Water table elevation _____ feet

n) Upward buoyant force at center of buoyancy _____ lbs.

o) Weight of station exerted at center of gravity _____ lbs.

p) Resultant = Line (b) + Line (e) – Line (d) _____ lbs.

Pumps: (rated capacities)

Make _____

Model _____

Flow Rate _____ gpm at _____ ft. TDH

NOTE: PUMP RATING CURVES SHALL BE PROVIDED WITH PUMP STATION DESIGN CALCULATION SHEETS.

THE FOREGOING IS A TRUE STATEMENT OF FACTS PERTAINING TO THIS PROPOSED PUMP STATION INSTALLATION.

Signed: _____ Date: _____
Professional Engineer Registered in the State of Ohio

Engineer's Stamp required below:

6.7 WASTEWATER TREATMENT PLANT DATA SHEETS

1. Date _____
2. Name of Municipality or Sewer District: _____
3. Name of Project: _____
4. Original Township and Lot Number: _____
5. Name of Engineer Preparing Plans: _____
6. Name of Firm Preparing Plans: _____
7. Address: _____
8. Telephone: _____
9. Email Address: _____
10. Name and address of governmental authority to whom plan approval should be sent:

    _____

Site

a) Subject to flooding? Yes No (circle one)

   If yes, what measures will be taken to protect mechanical equipment?

   _____

b) Will treatment plant be located within a FEMA Designated Floodplain? Yes No

   If yes, provide FEMA Parcel Number and 100 Year Flood Elevation:

   _____

c) Distance to nearest dwelling _____

   Design Period _____ First Phase _____

   Ultimate _____

Average Daily Design Hydraulic Flow (ADDF) _____ gpd

Design BOD_5 Loading: _____ lbs. BOD_5/day

Type of Waste to be Treated

a) Sanitary _____

b) Combined (Sanitary and Storm) _____

c) Industrial _____

Source of Industrial Waste _____

Plant influent pumping station Yes No

Number of pumps _____

Type of pumps _____

Influent pumping rate (IPR) _____ gal/min (with largest pump out of service)

Will the pump pass a 3-inch sphere? Yes No

Operating conditions: _____ gpm @ _____ TDH

Maximum allowable speed _____ rpm

Pretreatment Devices

Trash Trap Yes No Capacity _____ gal.

Comminutor with bar screen bypass Yes No

Other _____

Design capacity of comminutor _____ gal./min.

Method of flow division where parallel aeration unit arrangements are planned. Describe:

_____

Are the inlets and outlets for each tank provided with valves, gates, stop-planks, weirs, or other devices to permit flexibility in controlling the flow to any unit to maintain a reasonably constant water level and to permit cleaning of individual units?

Yes No N/A

Describe method of scum removal and disposal:

_____

_____

_____

Describe method and frequency of sludge removal.
Also, describe method and location of sludge disposal.

_____

_____

_____

Are baffles provided at the inlet and within six (6) inches of the outlet to prevent turbulence and short-circuiting?

Yes No

Does each sludge hopper have an individually valved withdrawal line? Yes No N/A

a) Minimum diameter of withdrawal is _____ inches

b) Head for sludge withdrawal is _____ feet

c) The side walls of the hopper(s) will have a minimum slope of:

_____ vertical to _____ horizontal. or N/A

Will a mechanical sludge collecting device be installed? Yes No

If yes, what type? _____

Will froth control equipment be installed? Yes No

Will hosing facilities for routine flushing of walls and walkways be installed? Yes No

Will sludge handling facilities be installed? Yes No

What mode of advanced treatment or effluent disposal will be installed?

_____

_____

_____

What type of disinfection process will be employed?

Chlorination _____ Ozonation _____ Other _____

If chlorination is to be used, in what form will it be?

Gas _____ Powder _____ Tablet _____

Describe provision for cleaning tanks and for maintaining adequate disinfection during cleaning operations:

_____

_____

_____

What type of flow measurement device, if any, will be installed? Describe:

_____

_____

What laboratory facilities or other types of monitoring equipment will be provided? Describe:

_____

_____

What type of high water alarms, if any, are provided? Describe:

_____

_____

What is the estimated cost of the above proposed wastewater treatment facility? $_____

Will a certified operator be employed to use the proposed treatment facilities? Yes No

If yes, will the operator be:

Full time _____ Part time _____ What grade level? _____

What provision, if any, will be made to provide standby power for electrical equipment? Describe:

_____

_____

_____

_____

_____

Provide and check the completed copies of the following EPA forms required for the construction of the treatment facilities:

_____ Form B1, Sewer and Pump Station Construction

_____ Form B2, Onsite Sewage Treatment Systems

_____ Form B3, Wastewater Treatment Plants Less Than 100,000 GPD

_____ Form B4, Wastewater Treatment Plants Greater Than or Equal To 100,000 GPD and All Pond Systems

_____ Form B5, Industrial Direct Discharge Facility

_____ Form B6, Industrial Indirect Discharge Facility

_____ Form B7, Underground Storage Tank Remediation

_____ Form B8, Holding Tanks

_____ Form B9, Industrial Impoundment Ponds

_____ Form C1, Land Application Management Plan for Sludge or Waste Other Than Treated Sewage

_____ Form C2, Treated Sewage Land Application Management Plan

_____ Form C3, Sewage Holding Tank Management Plan

THE FOREGOING IS A TRUE STATEMENT OF FACTS PERTAINING TO THIS PROPOSED WASTEWATER TREATMENT PLANT INSTALLATION.

Signed: _____ Date: _____
Professional Engineer Registered in the State of Ohio

Engineer's Stamp required below:

6.8 WASTEWATER TREATMENT PLANT DESIGN CALCULATION SHEETS

1. Date _____
2. Name of Municipality or Sewer District: _____
3. Name of Project: _____
4. Original Township and Lot Number: _____
5. Name of Engineer Preparing Plans: _____
6. Name of Firm Preparing Plans: _____
7. Address: _____
8. Telephone: _____
9. Email Address: _____
10. Name and address of governmental authority to whom plan approval should be sent:

    _____

Design Period _____ First Phase _____

Ultimate _____

Average Daily Design Hydraulic Flow (ADDF) _____ gpd.

Design BOD_5 loading _____ lbs. BOD_5/day

Significant Runoff Period (SRP) _____ hours

Peak Factor (PF) _____ (unitless)

Peak Influent Flow Rate (PIR):

[(ADDF, _____ gal./day) x (PF _____)] ÷ [(SRP, _____ hours) x (60 min.)]

= _____ gal./min.

If an equalization basin is used, its volume will be _____ gal.

Air to be supplied: _____ cu. ft./min. (with the largest blower out of service)

Plant influent pumping station: Yes No (circle one)

Number of pumps _____ Type of pumps _____

Influent Pumping Rate (IPR): _____ gal./min. (with the largest pump out of service)

NOTE: Influent pumping facilities shall be capable of pumping the Peak Influent Rate (PIR) with the largest pump out of service, unless a flow equalization basin is installed. Include here the wet well calculations for the pumping station.

Pretreatment Devices

Trash Trap Yes No Capacity _____ gal.

Comminutor with bar screen bypass Yes No

Other _____

Design capacity of comminutor _____ gal./min.

Method of division where parallel aeration unit arrangements are planned. Describe:

_____

_____

Aeration Chamber volume (based on 80 cu. ft./lb. BOD_5)

(_____ lbs. BOD_5/day) x (80 cu. ft./lb. BOD_5) x (7.48 gal./cu. ft.) = _____ gal.

Gallons supplied _____

Aeration Detention Time:

(Chamber Volume, _____ gal.) x (24 hours/day) ÷ (ADDF, _____ gal./day)

= _____ hours

Are the dimensions and proportions of the aeration tanks such as to maintain effective mixture and utilization of air, to prevent un-aerated sections and noticeable channeling, and to maintain velocities sufficient to prevent disposition of solids?

Yes No

Are the inlets and outlets for each aeration tank provided with valves, gates, stop-planks, weirs, or other devices to permit flexibility in controlling the flow to any unit to maintain a reasonably constant water level and to permit cleaning of individual units?

Yes No

Amount of air required (based on 2600 cu. ft./lb. BOD_5/day):

$$\frac{(\_\_\_\_\_ \text{ lbs. } BOD_5/\text{day}) \times (2600 \text{ cu. ft./lb. } BOD_5/\text{day})}{1440 \text{ min./day}} = \_\_\_\_\_ \text{ cu. ft./min.}$$

Amount of air supplied: _____ cu. ft./min. (with the largest blower out of service)

NOTE: Additional capacity should be provided to operate airlifts and skimmers.

Are the aeration plates, tubes, or jets used for the introduction of air to mixed liquor removable for inspection, maintenance, and/or replacement without dewatering the tank?

Yes No N/A

If mechanical aerators are to be used, the oxygen required will be:

(_____ lbs. BOD_5/day) x (2 lbs. O_2/lb. BOD_5) = _____ lbs. O_2/day

NOTE: Calculations and data should be included to verify the O_2 transfer rate used to compute the supplied amount of O_2/day.

Settling Chamber Volume: _____ gallons

Settling Chamber Detention Time:

(Chamber Volume, _____ gal.) x (24 hours/day) ÷ (ADDF, _____ gal./day)

= _____ hours

NOTE: Non-mechanical hoppered tanks only may include the upper 1/3 (by height) of the hopper(s) in computing detention time.

Surface Settling Rate:

(ADDF, _____ gal./day) ÷ (Surface Area, _____ sq. ft.) = _____ gpd/sq. ft.

At Peak Flow:

(PIR, _____ gal./min.) x (1440 min./day) ÷ (Surface Area, _____ sq. ft.)

= _____ gpd/sq. ft.

Note: If the Influent Pumping Rate (IPR) exceeds the Peak Influent Flow Rate (PIR), then it should be substituted in the above equation for (PIR).

Weir Overflow Rate:

a) At peak flow:

(PIR, _____ gal./min.) x (1440 min./day) ÷ (Total Weir Length, _____ feet)

= _____ gpd/linear ft.

NOTE: If the Influent Pumping Rate (IPR) exceeds the Peak Influent Flow Rate (PIR), then it should be substituted in the above equation for (PIR).

b) Are the weirs adjustable? Yes No

Describe the method of scum removal and disposal: _____

_____

_____

_____

Scum storage capacity: _____

Describe the method and frequency of sludge removal.
Also, describe the method and location of sludge disposal.

_____

_____

_____

Amount of sludge to be removed _____ lbs./day

If a sludge storage tank is to be installed, the volume of the tank(s) will be (based on at least 10% of the design loading):

(Design BOD_5 Loading, _____ lbs./day) x 100 x 10% = _____ gal. (minimum)
(0.167 lbs. BOD_5/population equivalent)

Aeration tank volume x 10% = _____ gallons supplied

Air supply: _____ cu. ft./min. (with largest blower out of service)

NOTE: A minimum storage volume of 1,000 gallons shall be required for plants with a design flow of less than 10,000 gal./day.

If aerobic digestion of sludge is to be utilized, the volume of the tank(s) shall be (based on three cubic feet per population equivalent):

(Design BOD_5 Loading, _____ lbs./day) x 3 x 7.48 = _____ gal. (minimum)
(0.167 lbs. BOD_5/population equivalent)

Gallons supplied _____

Air supply (based on 20 cu. ft./min. per 100 cu. ft. of volume):

(_____ gallons supplied) x (20 cu. ft./min.) = _____ cu. ft./min.
(7.48 gal./cu. ft.) x (1,000 cu. ft.)

Air supplied: _____ cu. ft./min. (with the largest blower out of service)

If anaerobic digestion of sludge is to be utilized, the volume of the tank(s) will be: _____ gal.

NOTE: Basis of design and calculations must be submitted for the above volume.

If sludge drying beds are to be installed, the area provided shall be (based on one square foot per population equivalent):

(Design BOD_5 Loading, _____ lbs./day) = _____ sq. ft.
(0.167 lbs. BOD_5/population equivalent)

Square feet provided _____

Number of beds _____

NOTE: Where phosphate removal or other chemical treatment processes are to be utilized, design of sludge handling facilities must take into account possible increased sludge production.

Check which of the following modes of advanced treatment of effluent disposal are to be installed:

_____ Surface Slow Sand Filter

_____ Rapid Sand Gravity Filter

_____ Microstrainers

_____ Lagoons

_____ Other: _____

If surface slow sand filters are to be installed, the area provided shall be (based on 11.5 gallons per square foot per day):

ADDF _____ gal./day = _____ sq. ft.
11.5 gal./sq. ft./day

Square feet provided: _____ sq. ft. Number of beds: _____

a) Capacity of dosing chamber shall be: _____ gallons

b) Size of dosing pumps: _____ gal./min. (with the largest pump out of service)

NOTE: Dosing chamber and pumps must be sized to dose half of the total filter to depth of three (3) inches within 10 to 15 minutes.

c) Dosing siphon height above the sand beds: _____ feet

If rapid sand gravity filters are to be installed, the area provided shall be (based on 33.3 gpm/sq. ft. at the peak flow rate):

$$\frac{\text{Peak Flow Rate*} \_\_\_\_\_ \text{gal./min.}}{3.33 \text{ gpm/sq. ft.}} = \_\_\_\_\_ \text{ sq. ft.}$$

Square feet provided: _____ sq. ft. Number of cells: _____

*NOTE: The peak flow rate shall be equal to the maximum rate of the pumping facilities preceding filtering.

Clearwell Capacity: _____ gallons

Rate of Backwash: _____ gpm/sq. ft.

Duration of Backwash: _____ Minutes

Number of Backwash Pumps: _____ @ _____ gal./min.

Mudwell Capacity: _____ gallons.

NOTE: Please refer to Ohio EPA's Procedures and Design Guidelines in designing rapid sand gravity filters.

If microstrainers are to be installed, the net submerged effective area of the microstrainer fabric shall be (based on 3.33 gpm/sq. ft. at the peak flow rate).

Peak Flow Rate** _____ gal./min. = _____ sq. ft.
3.33 gpm/sq. ft.

Submerged Square Feet Provided _____ sq. ft.

Total Square Feet Provided _____ sq. ft.

Number of Microstrainers _____

**NOTE: The peak flow rate shall be equal to the maximum rate of the pumping facilities preceding the microstrainers.

Continuous Backwash Rate: _____ gal./min./ft. of microstrainer length

Number of Backwash Pumps: _____ @ _____ gal./min.

NOTE: Please refer to Ohio EPA's Procedure and Design Guidelines in designing microstrainers.

If lagoons are to be utilized, their total volume shall be (based on five (5) days detention):

Design Hydraulic Flow _____ gal./day x 5 days = _____ gal.

Gallons supplied _____

Average Design Flow Depth: _____ feet

Number of Cells: _____

Minimum freeboard of _____ feet will be provided.

The embankments of the lagoons shall be a minimum slope of:

Vertical _____ to Horizontal _____

Does the overflow structure provide flexible water depth control and operation of facilities?

Yes No

NOTE: Prior to designing tertiary lagoons, contact the Division of Waste Management and

Engineering in the appropriate District Office for information relative to the acceptability of the proposal.

What type of disinfection process will be employed?

Chlorination _____

Ozone _____

Other _____

If other, describe: _____

_____

_____

_____

If chlorination is to be used, in what form will it be?

Gas _____

Powder _____

Tablet _____

Volume of contact tank(s) (based on 15 minutes retention at the peak flow rate):

Peak Flow Rate*** _____ gal./min. x 15 min. = _____ gal.

Gallons supplied _____

***Note: The peak flow rate shall be equal to the maximum rate of the pumping facilities preceding the contact chamber.

Are the tank(s) baffled or so constructed as to reduce to a minimum short circuiting of flow?

Yes No

Describe provisions for cleaning tank(s) and for maintaining adequate disinfection during cleaning operations:

_____

_____

_____

Chlorine Dosage Rate: _____ mg/l (at peak flow rate)

Will duplicate chlorinators be provided? Yes No

Will the chlorinator be housed? Yes No

Describe: _____

_____

_____

What type of flow measurement device, if any, will be installed?

Describe (indicating, recording, totalizing, etc.): _____

_____

_____

What laboratory facilities or other types of monitoring equipment will be provided? Describe:

_____

_____

What is the estimated cost of the above proposed wastewater treatment facility? $_____

Will a certified operator be employed to use the proposed treatment facilities? Yes No

If yes, will the operator be:

Full time _____ Part time _____ What grade level? _____

Is the site for the proposed treatment works subject to flooding? Yes No

If yes, what measures will be taken to protect mechanical equipment? _____

_____

_____

What provision, if any, will be made to provide standby power for electrical equipment? Describe, including capacity:

_____

_____

_____

_____

_____

THE FOREGOING IS A TRUE STATEMENT OF FACTS PERTAINING TO THIS PROPOSED WASTEWATER TREATMENT PLANT INSTALLATION.

Signed: _____ Date: _____
Professional Engineer Registered in the State of Ohio

Engineer's Stamp required below:

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