LORAIN COUNTY COMMISSIONERS
Matt Lundy Ted Kalo Lori Kokoski

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Elyria, OH 44035
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RF
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RECEIVED
2018 JUN -7 PM 2:24
KEN CARNEY
LORAIN COUNTY ENGINEER

County Administrator
James R. Cordes
440-329-5760

Clerk of Board of Commissioners
Theresa Upton
440-329-5103

Animal Control Officer
Timothy Pihlblad
440-326-5997

Budget Director
Lisa Hobart
440-329-5201

Charles Berry Bridge Superintendant
Al Zocchi
440-244-2137

Children & Family Council Director
Melissa Meyer-Fischer
440-284-4467

Community Development Director
Don Romancak
440-328-2323

E-9-1-1 Director
Tracy Slagle
440-329-5444

Emergency Management & Homeland Security Director
Thomas Kelley
440-[illegible]5117

Facilities Management Director
Karen Davis
440-329-5102

Human Resources Department
440-329-5150

IT Director
Ernie Smith
440-329-5786

Lorain County Crime/Drug Lab Director
Emmanuel de Leon
440-329-5636

Lorain County Transit
440-329-5525

Office of Sustainability Coordinator
Michael Challender
440-328-2361

Purchasing
440-329-5240

Records Center Supervisor
Denise Lindak
440-326-4866

Solid Waste Director
Keith Bailey
440-329-5442

Visit Lorain County
440-984-5282

Workforce Development Director
Mike Longo
440-[illegible]1834

June 7, 2018

Ken Carney
LC Sanitary Engineer
247 Hadaway Street
Elyria, Ohio 44035

Dear Mr. Carney:

Enclosed is Resolution No. 18-373, adopted by the Lorain County Board of Commissioners on June 6, 2018 adopting Union Standards for Sewerage Improvements dated October 2013 along with the Uniform Standard Sewer Details as prepared by the City of Cleveland, the Northeast Ohio Regional Sewer District, the Cuyahoga County Department of Public Works and the Municipal Engineers Association of Northeast Ohio.

This is being forwarded for your information and files.

Sincerely,

Theresa Upton
Clerk

Enclosure

Cc; File

c.11 RESOLUTION NO. 18-373

In the matter of adopting Union Standards for Sewerage Improvements dated October 2013 along with the Uniform Standard Sewer Details as prepared by the City of Cleveland, the Northeast Ohio Regional Sewer District, the Cuyahoga County Department of Public Works and the Municipal Engineers Association of Northeast Ohio

June 6, 2018

WHEREAS, Ken Carney, Lorain County Sanitary Engineer submitted a letter dated May 29, 2018 as follows:

"In February of 2014, the Lorain County Board of Commissioners adopted Resolution No. 14-117 which established the Lorain County Sanitary Engineer Building Sewers and Connections Rules and Regulations. These rules and regulations established contractor licensing requirements, permit procedures and specifications for materials and methods of construction associated with individual sanitary connections.

With the continued expansion of sewerage facilities in the unincorporated areas of Lorain County, it has become necessary to establish Uniform Standards for Sewerage Improvements along with Uniform Standard Sewer Details. In October of 2013, the most recent version of UNIFORM STANDARDS FOR SEWERAGE IMPROVEMENTS and UNIFORM STANDARD SEWER DETAILS were developed by the City of Cleveland, the Northeast Ohio Regional Sewer District, the Cuyahoga County Department of Public Works and the Municipal Engineers Association of Northeast Ohio. As a member of the Municipal Engineers Association of Northeast Ohio, these standards and details are available to the Lorain County Highway and Sanitary Engineer. Additionally, a good portion of the sewer system owned and operated by Lorain County is tributary to the Northeast Ohio Regional Sewer District.

In lieu of developing a set of individual standards for the Lorain County Highway and Sanitary Engineer, County Engineer and Sanitary Engineer Ken Carney is respectfully requesting that the Board adopt the UNIFORM STANDARDS FOR SEWERAGE IMPROVEMENTS dated October 2013 along with the UNIFORM STANDARD SEWER DETAILS as prepared by the City of Cleveland, the Northeast Ohio Regional Sewer District, the Cuyahoga County Department of Public Works and the Municipal Engineers Association of Northeast Ohio.

Thank you for your consideration and please feel free to contact Robert Klaiber or myself if you should have any additional questions or comments.";

NOW, THEREFORE, BE IT RESOLVED, by the Lorain County Board of Commissioners that based upon the request of the Lorain County Sanitary Engineer by letter dated May 29, 2018 we do hereby accept and adopt the "UNIFORM STANDARDS FOR SEWERAGE IMPROVEMENTS dated October 2013 along with the UNIFORM STANDARD SEWER DETAILS " as prepared by the City of Cleveland, the Northeast Ohio Regional Sewer District, the Cuyahoga County Department of Public Works and the Municipal Engineers Association of Northeast Ohio.

Motion by Kalo, seconded by Lundy to adopt Resolution. Upon roll call the vote taken thereon, resulted as: Ayes: Kalo, Lundy & Kokoski / Nays: None

Motion carried.

I, Theresa L. Upton, Clerk to the Lorain County Board of Commissioners do hereby certify that the above Resolution No. 18-373 is a true copy as it appears in Journal No. 18 on date of June 6, 2018

Theresa L. Upton, Clerk

UNIFORM STANDARD SEWER DETAILS

CITY OF CLEVELAND - CUYAHOGA COUNTY

NORTHEAST OHIO REGIONAL SEWER DISTRICT

MUNICIPAL ENGINEERS ASSOCIATION OF NORTHEAST OHIO

INDEX OF SHEETS

GENERAL NOTES

UNIFORM STANDARD
RECOMMENDED FRAME CASTINGS
CAST IRON UNLESS OTHERWISE SPECIFIED

STANDARD SHEET NO.	TITLE	NEENAH NO.	EAST JORDAN NUMBER
4	Precast Concrete Manhole for 42" Pipe or Smaller		
	Frame and Solid Cover	R- 1729	1700
	Frame and Grate Cover	R- 2650	1700 Type "M" Grate
5	Precast Concrete Manhole for 48" Pipe or Larger		
	Frame and Solid Cover	R- 1729	1700
6	Precast Concrete Drop Manhole		
	Frame and Solid Cover	R- 1729	1700
7	Brick Manhole for Storm		
	Frame and Solid Cover	R- 1729	1700
8	Brick Drop Manhole for Storm Sewer		
	Frame and Solid Cover	R- 1729	1700
15	Test Tee Cover w/out Lift Hole	R-4055-6	6306
16	Trench Drain Sump Grate "C" Bolted		
	Frame w/End Pieces Bolted	R-4999-DX	6954 Bolted M-2
16	Trench Drain Sump Grate Type "C" Bolted	R-4999-FX	6956 Bolted M-2

INDEX OF SHEETS AND GENERAL NOTES

REVISIONS:

SCALE
NO SCALE

DATE: DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

GENERAL NOTES

UNIFORM STANDARD RECOMMENDED FRAME AND CASTINGS CAST IRON UNLESS OTHERWISE SPECIFIED

STANDARD SHEET NO.	TITLE	NEENAH NO.	EAST JORDAN NUMBER
16	Trench Drain Catch Basin Trap Cast or Ductile Iron	R-3701	5954 C.I.
17	Special Inlet Frame, and Grate	R-3339-I	5130M-2
17	Cleanout Cover w/out Lift Hole	R-4055-B	6308
18	Yard Type Catch Basin Grate and Frame	R-4353	2800 - 02
19	Rectangular Precast Concrete Catch Basin Vertical Curb	R-3246-CL	7035-Z1.M6.T6 Grate
	Mountable Curb	R-3501-H	7390 M-3
20	Rectangular Precast Concrete Inlet Basin Vertical Curb	R-3246-CL	7035-Z1.M6.T6 Grate
	Mountable Curb	R-3501-H4	7390 M-3
21	Round Precast Concrete Catch Basin Vertical Curb (36" Dia. Basin)	R-3246-F	7037 Z-M-6
	Mountable Curb (36" Dia. Basin)	R-3514-F w/ Round Base Flange	7395 Z-M-3
	Catch Basin Trap	R-3707-12.15	5964-12.15

UNIFORM STANDARD RECOMMENDED FRAME AND CASTINGS CAST IRON UNLESS OTHERWISE SPECIFIED

STANDARD SHEET NO.	TITLE	NEENAH NO.	EAST JORDAN NUMBER
22	Round Precast Concrete Inlet Basin Vertical Curb (36" Dia. Basin)	R-3246-F	7037 Z-M-6
	Mountable Curb (36" Dia. Basin)	R-3514-F w/ Round Base Flange	7395 Z-M-3
23	Force Main Air Release Valve Chamber, Frame and Solid Cover	R-6052-F	2870 Type "A"
24	Standard Grease Trap, Frame and Solid Cover 30" Diameter	R-6052-J	2880 Type "A" Cover
	18" Diameter	R-6052-A	V-1810-4
	Manhole Steps for Masonary and Formed Concrete - Ductile Iron	R-1981-I R-1981-S	8518 8514
	Manhole Steps - Plastic Meeting the Requirements of ATSM 2146-66 Type II Grade 49108 and ODOT S.S. #941		
	Survey Monument Boxes	R-1968-368	8371

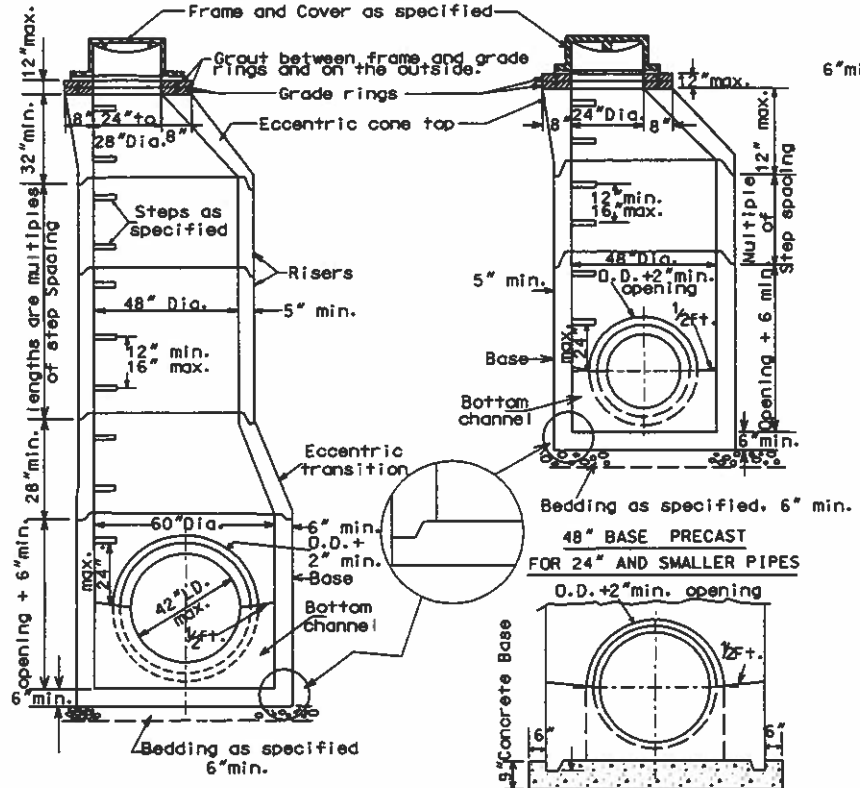
GENERAL NOTES

REVISIONS:

SCALE NO SCALE

DATE : DEC. 1998

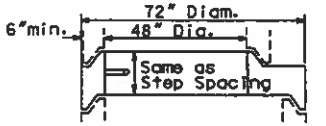
UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



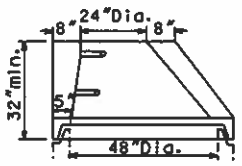
60" BASE FOR PRECAST
42" AND SMALLER PIPES

60" BASE FOR CAST IN PLACE
36" AND SMALLER PIPES

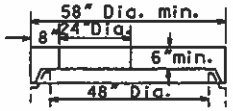
48" BASE FOR CAST IN PLACE
18" AND SMALLER PIPES



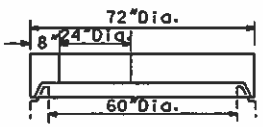
FLAT SLAB
TRANSITION



ALTERNATE
ECCENTRIC CONE TOP



FLAT SLAB TOP



FLAT SLAB TOP

NOTES

Sections of the precast manhole shall be cast and assembled with either all tongue or all groove ends up. Lift holes may be provided in each section for handling.

TOP AND TRANSITION /or reducer/
Sections may be either eccentric cone, concentric cone or flat slab.
BASES for Manholes are shown with monolithic floor and riser which may be cast in one or two operations. A permissible alternate is to cast and ship the floor and barrel separately. Openings for inlet and outlet pipes shall be provided, either when the unit is cast or later, to meet project requirements. Bottom channels may be formed of concrete precast in the base or by field construction. Bases may also be poured in place.

OPENINGS IN RISER SECTIONS for 18" and smaller inlet pipes shall be prefabricated. Flexible connections shall be provided for sanitary and combined sewers. Premium seals shall meet A.S.T.M C-923.

JOINT SEALS between precast manhole sections and sewers shall be resilient and flexible gasket joints shall meet A.S.T.M C-443. FEDERAL SPECIFICATIONS SS-S-00210 (210 A) and AASHTO M-198

MANHOLE JOINTS and GRADE RINGS shall be sealed externally and between the grade rings with a layer of mastic compound such as Faberlite, Kent Seal or equal.

MATERIALS for bases and presections, including reinforcement not specified hereon, shall comply with the specifications.

PRECAST MANHOLES shall conform to the requirements of A.S.T.M C-478.

SEAL all lift holes with approved concrete plugs.

LANDING PLATFORMS as shown on the LANDING DETAILS shall be installed in manholes that are over 28 feet deep to the invert with a maximum vertical spacing of 20 feet.

MANHOLE FRAMES - chimney seals will be required on all new sanitary manholes

SANITARY MANHOLES shall have a minimum 3" vertical drop from casting elevation.

PRECAST CONCRETE MANHOLE

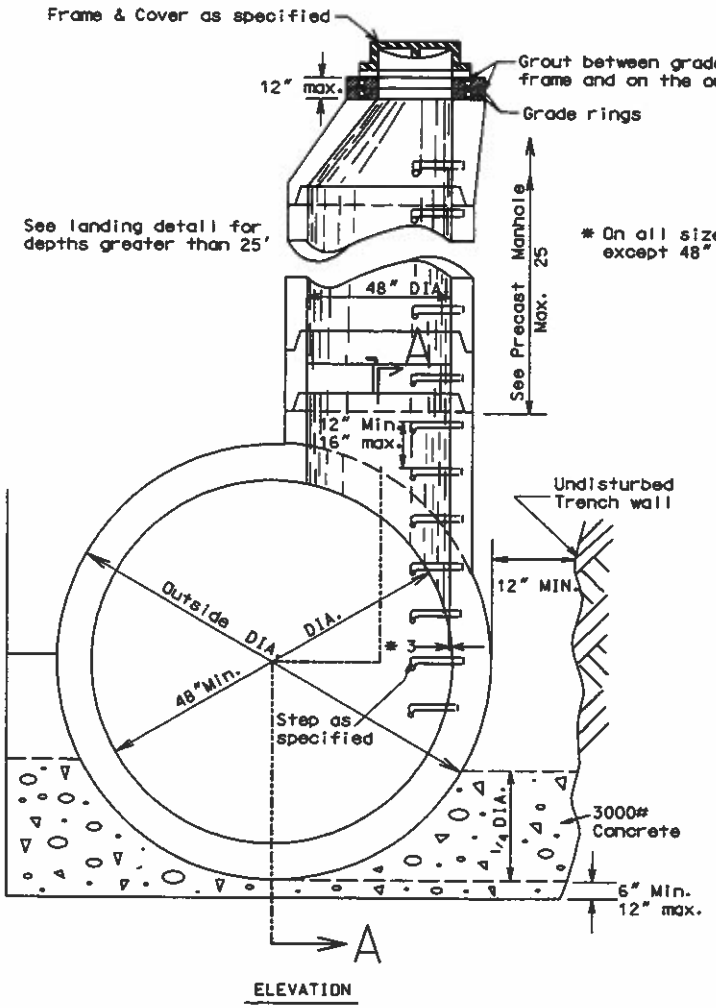
42" PIPE OR SMALLER

REVISIONS:

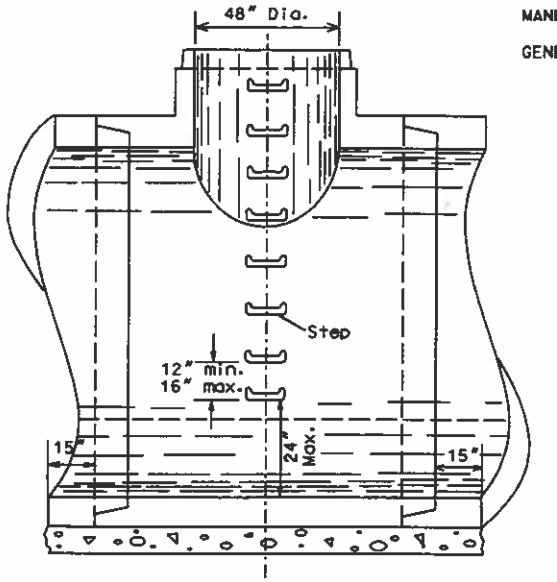
SCALE NO SCALE

DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



ELEVATION



SECTION A - A

NOTES

MANHOLE shall consist of the design shown hereon with precast base materials. Other manole components above the base shall be as detailed or specified.

THIS MANHOLE is not designed for static or dynamic highway loads. In case of highway loads, a special detail wil be required.

BEDDING shall be the same as is used under the adjoining conduits.

MORTAR to be PORTLAND CEMENT as specified.

MANHOLE STEPS conform to O.S.H.A. standards.

GENERAL MANHOLE DETAILS refer to sheet 4-27.

PRECAST CONCRETE MANHOLE

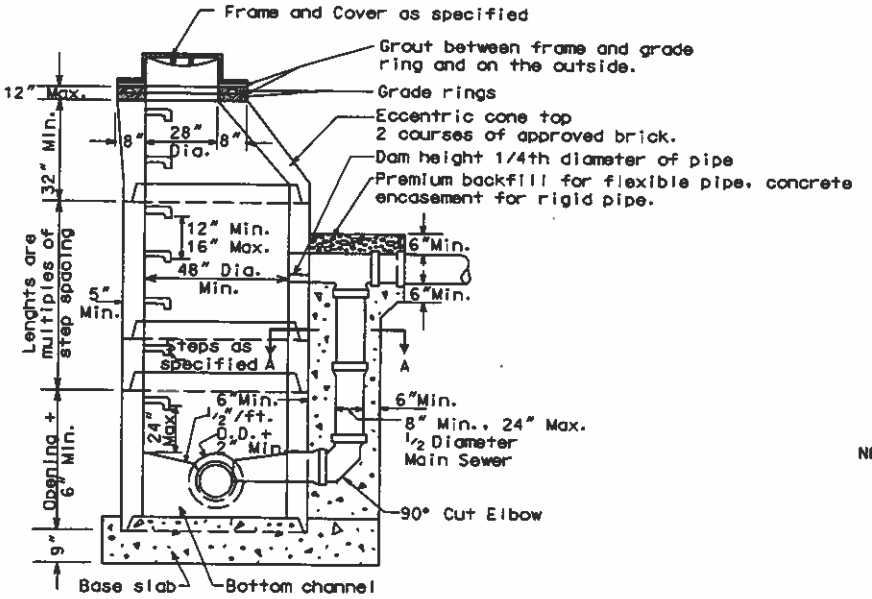
48" PIPE OR LARGER

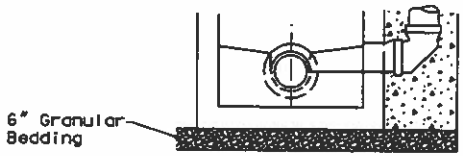
REVISIONS:

SCALE NO SCALE

DATE : DEC. 1998

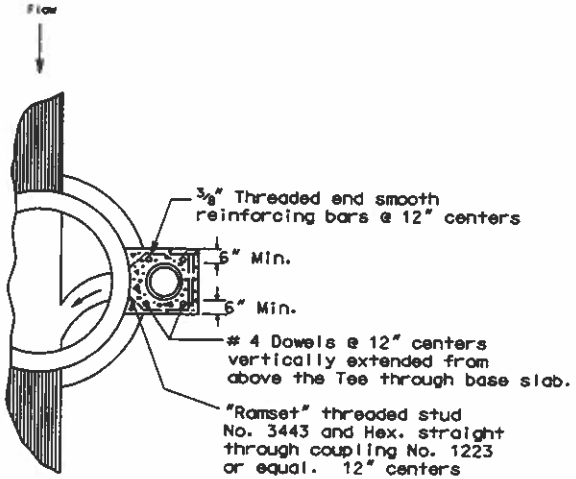
UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT





ALTERNATE

NOTE: This bedding with precast base on manhole.



SECTION A - A.

NOTES: A drop manhole shall be constructed in sanitary sewers wherever the distance between the inferts is 2.0 ft. or greater. General manhole details reger to sheet no. 4-27.

The Following notes on the Precast Concrete manholes shall pertain to the Drop Manhole: Top or Tansition Openings in riser sections. Joint Seal, Materials and Landing Platforms.

Poured in place concrete shall be 3000# Concrete. Core bore seals shall meet ASTM C-923 and C-167.

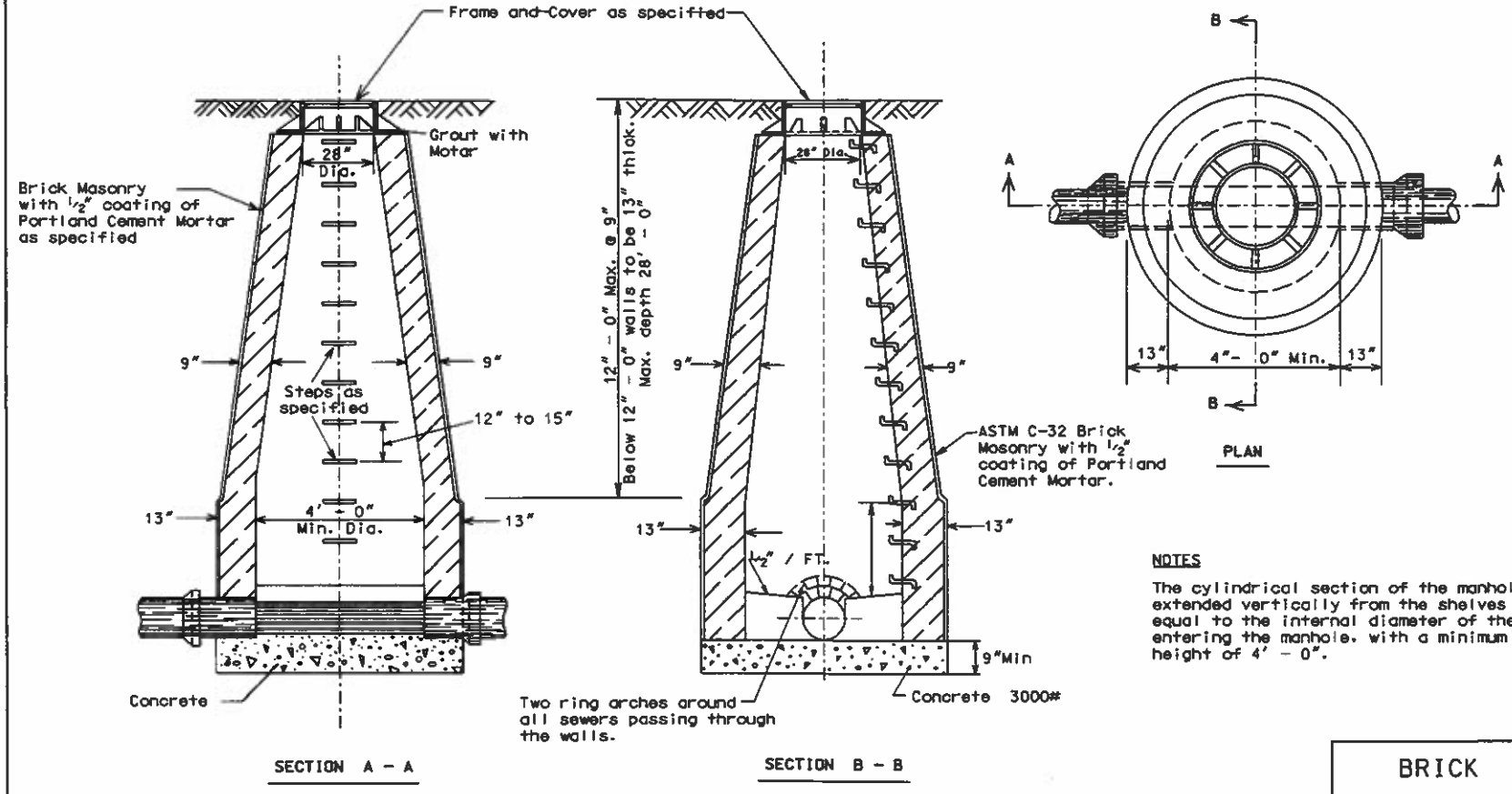
PRECAST CONCRETE DROP MANHOLE

REVISIONS:

SCALE NO SCALE

DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



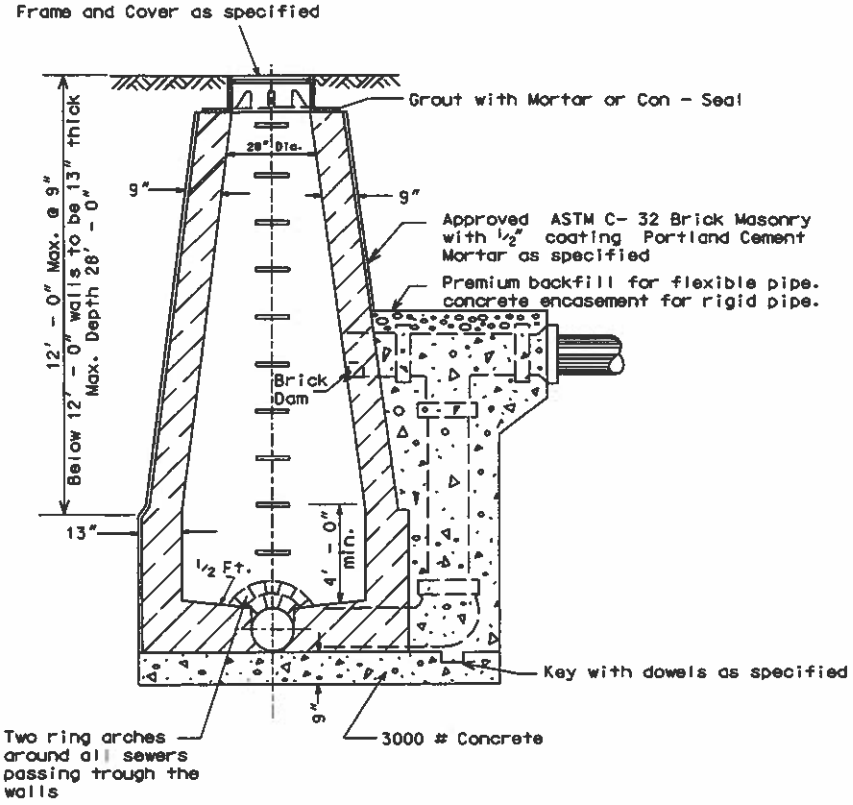
NOTES

The cylindrical section of the manholes shall be extended vertically from the shelves for a distance equal to the internal diameter of the largest pipe entering the manhole. with a minimum vertical height of 4' - 0".

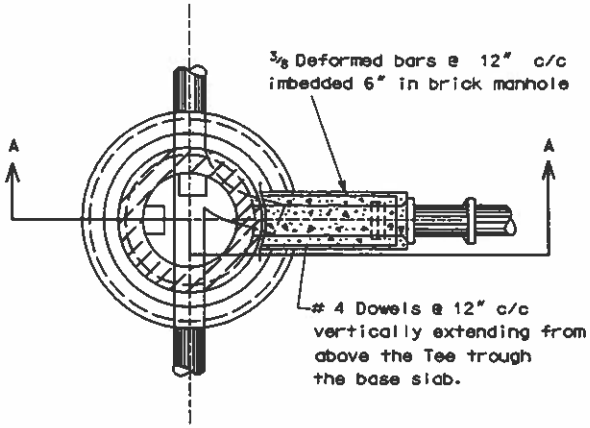
BRICK MANHOLE FOR STORM SEWER

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



SECTION A - A



PLAN

NOTES: The cylindrical section of the Manhole shall be extended vertically from the shelves for the distance equal to the internal diameter of the Largest Pipe entering the Manhole, with a minimum vertical height of 4' - 0".

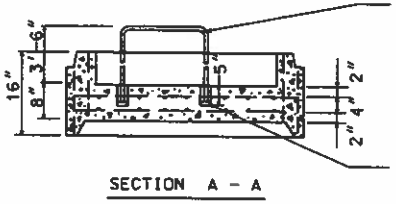
BRICK DROP MANHOLE FOR STORM SEWER

REVISIONS:

SCALE NO SCALE

DATE : DEC. 1998

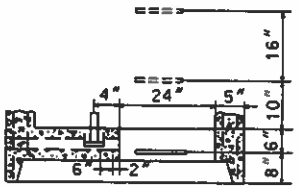
UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



SECTION A - A

$1\frac{1}{2}$ Dia. Solid steel bar Hand Rail

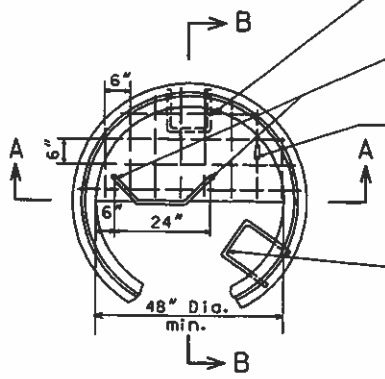
$2\frac{1}{4}$ Dia. Steel plate $\frac{3}{4}$" thick welded to both ends of 11/2" steel bar with two passes of $\frac{1}{4}$" fillet weld.



SECTION B - B

NOTE:

Landing Platforms as shown on the Landing Details shall be installed in manholes that are over 28 feet deep to the invert with a maximum vertical spacing of 20 feet.



PLAN VIEW

Manhole steps start 12" to 16" above landing platform floor and continue vertically above to the next landing platform or top outlet

Two $2\frac{1}{2}$" Dia. Precast openings 5" deep.

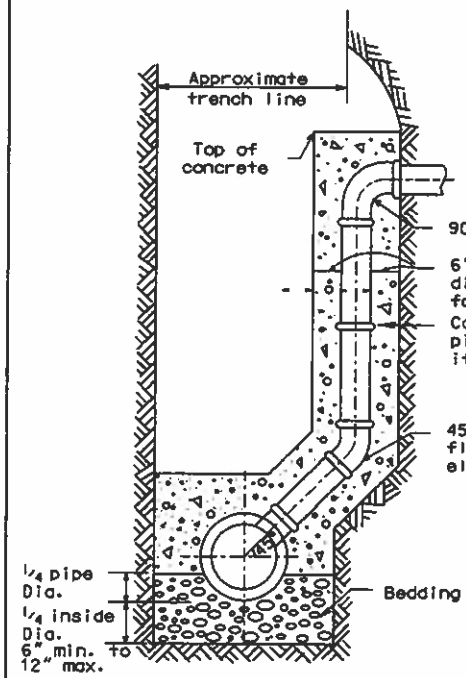
Typical bar placement in landing riser - #4 Rebar.

If multiple landings are required rotate adjacent landings 90° A 90° clear opening must be seen from top to bottom of manhole.

Manhole steps stop 4' above top of landing platform.

16" LANDING RISER DETAIL FOR PRECAST MANHOLE

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998



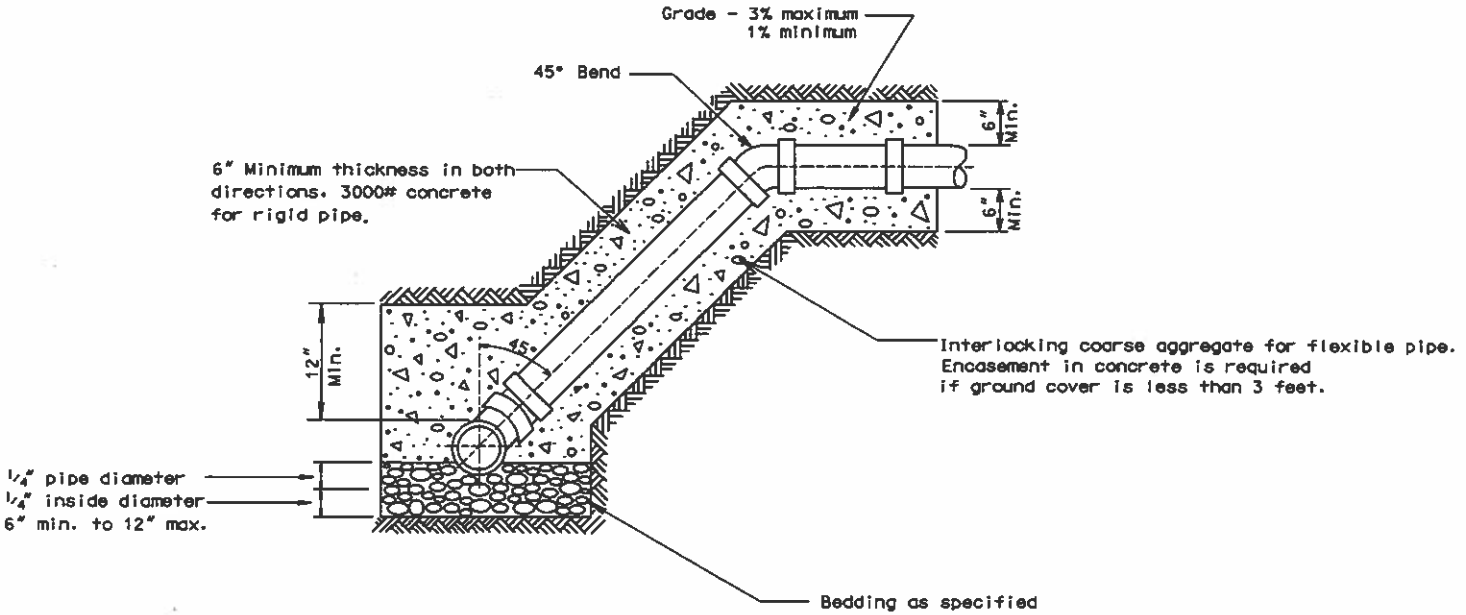
The pipe shall be plugged with approved stopper. Stopper shall be painted yellow for the sanitary sewer connection.

TYPICAL RISER DETAIL

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

The pipe shall be plugged with approved stopper. Stopper shall be painted yellow for the sanitary service connection.



Rigid pipe - Concrete shall extend 24" each way from the service connection. for flexible pipe 12". Properly compacted interlocking coarse aggregate for flexible pipe.

RISER DETAIL ALTERNATIVE

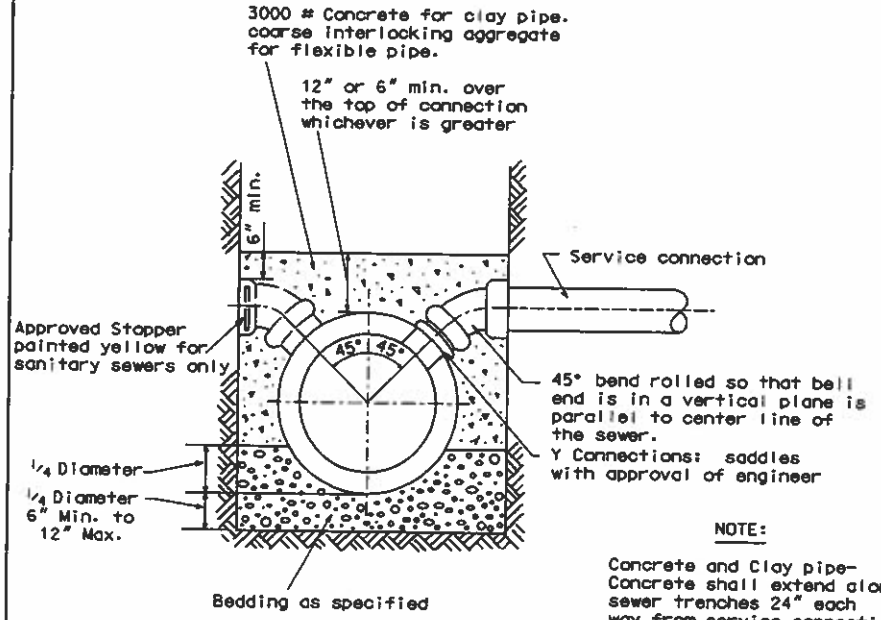
REVISIONS:

SCALE
NO SCALE

DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

Sheet No. 9-8/27

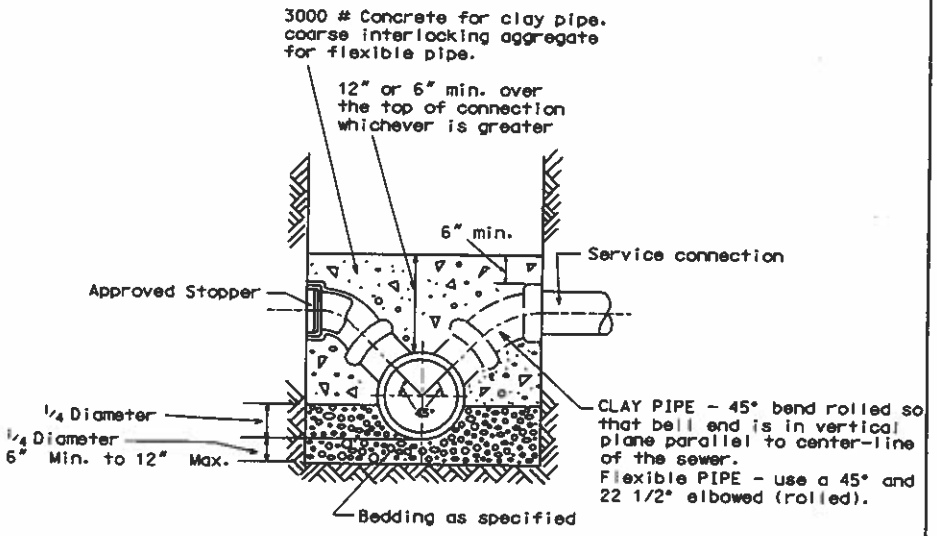


TYPICAL SLANT DETAIL

NOTE:

Concrete and Clay pipe-
Concrete shall extend along
sewer trenches 24" each
way from service connection.

Core Bore seal shall meet
ASTM C - 923 and ASTM C- 167



TYPICAL Y - BRANCH DETAIL

Encasement in concrete is required if ground
cover is less than 3 feet for all pipes.

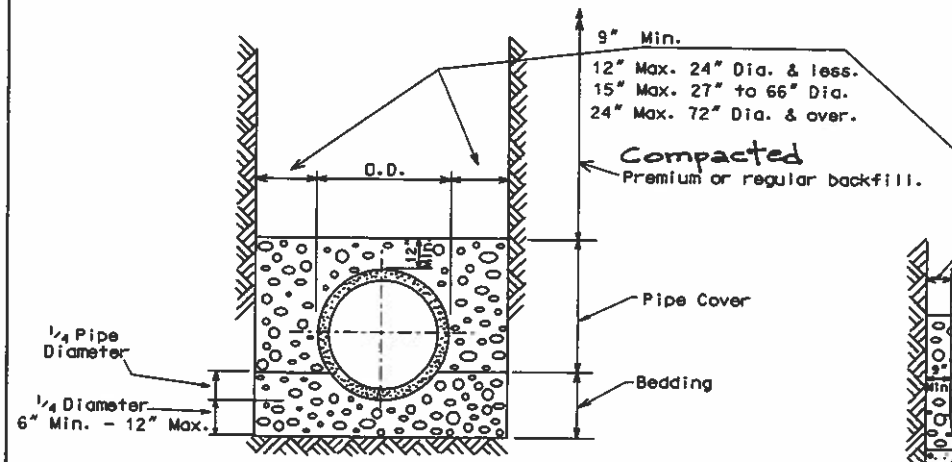
SLANT AND Y - BRANCH DETAILS

REVISIONS:

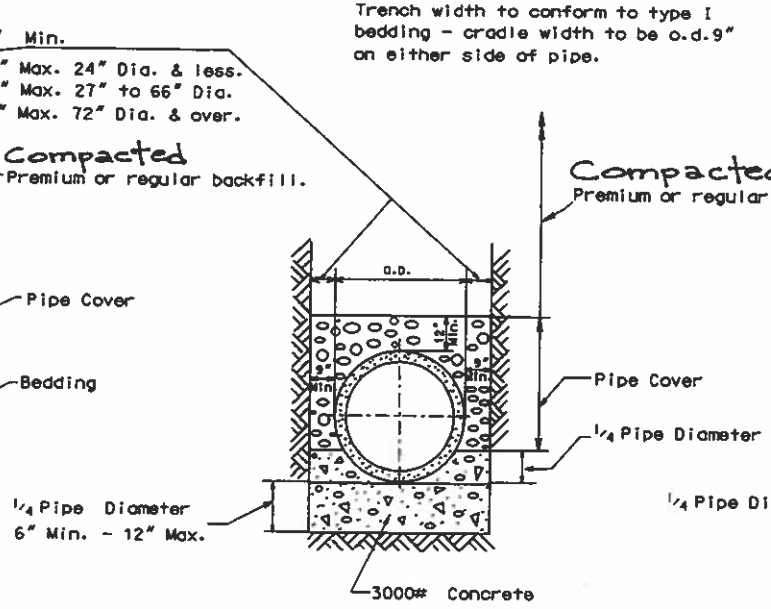
SCALE
NO SCALE

DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

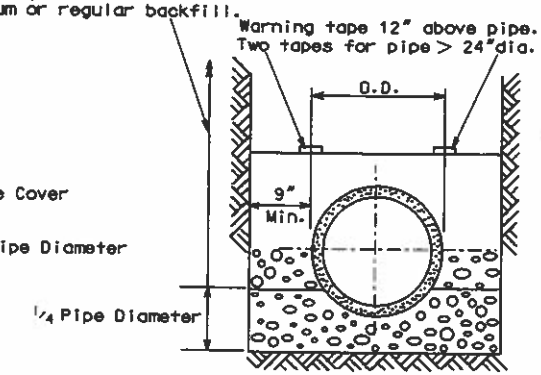


TYPICAL TRENCH DETAIL
(FLEXIBLE PIPE)



TYPICAL TRENCH DETAIL
WITH CONCRETE CRADLE

NOTE:
Lateral connections to have a minimum bedding depth of 3" coarse aggregate.



TYPICAL TRENCH DETAIL
FOR CONCRETE OR DUCTILE IRON PIPE

Pipe Cover shall consist of coarse interlocking aggregate no. 57,6,67,68,7,78,or8.

Bedding shall consist of coarse interlocking aggregate no.57,6,67, 68, 7, 78, or 8 for 60" or smaller diameter pipe. For 66" or larger diameter pipe no. 4 aggregate may also be used.

Premium Backfill shall consist of coarse interlocking aggregate no. 57,6,67,68,7,78,8,304, also limestone screenings.

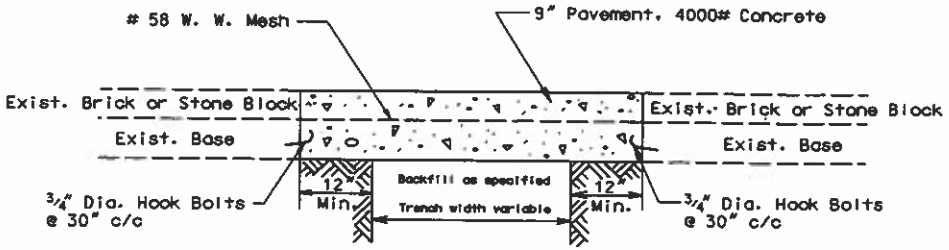
For concrete and ductile iron pipe, pipe cover is to the springline or greater.

In paved areas course interlocking aggregate to the top of the trench on all types of pipe.

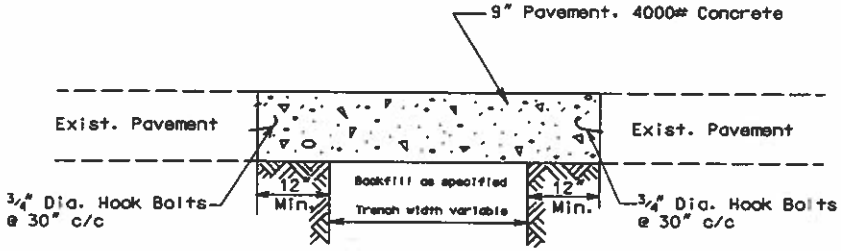
TYPICAL TRENCH DETAILS

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

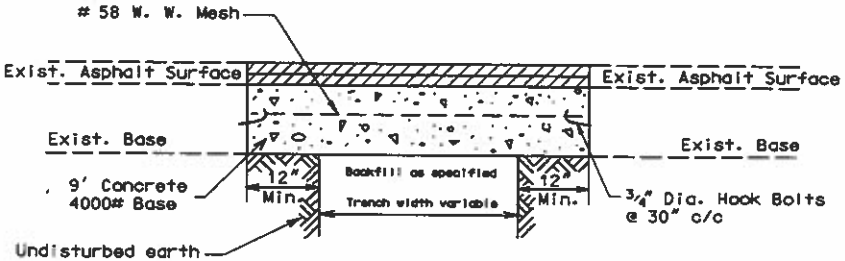
UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



TYPICAL SECTION
REPAVING OVER SEWER TRENCH
IN BRICK OR STONE BLOCK PAVEMENTS WITH BASES



TYPICAL SECTION
REPAVING OVER SEWER TRENCH
IN PAVEMENTS WITHOUT BASES



TYPICAL SECTION
REPAVING OVER SEWER TRENCH
IN ASPHALT PAVEMENT

NOTE:

Hook bolts shall be required when existing pavement or base is concrete.

REPAVING OVER SEWER TRENCH

REVISIONS:

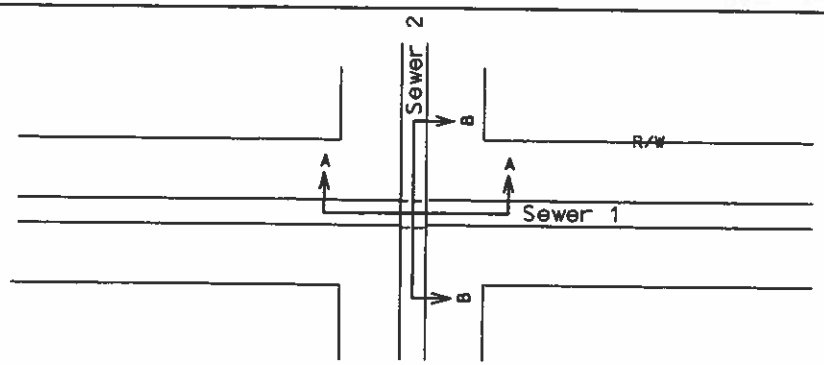
SCALE
NO SCALE

DATE : DEC. 1998

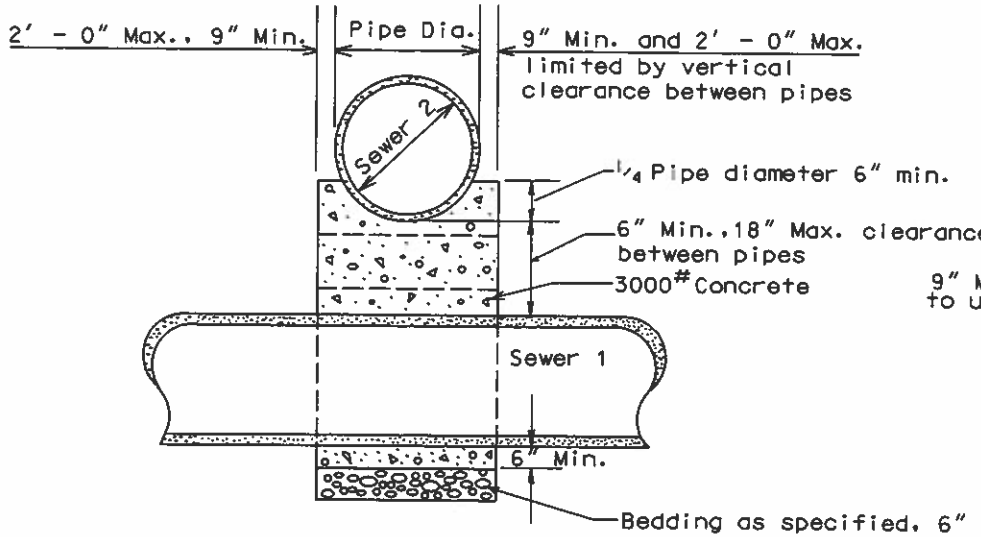
UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

NOTE:

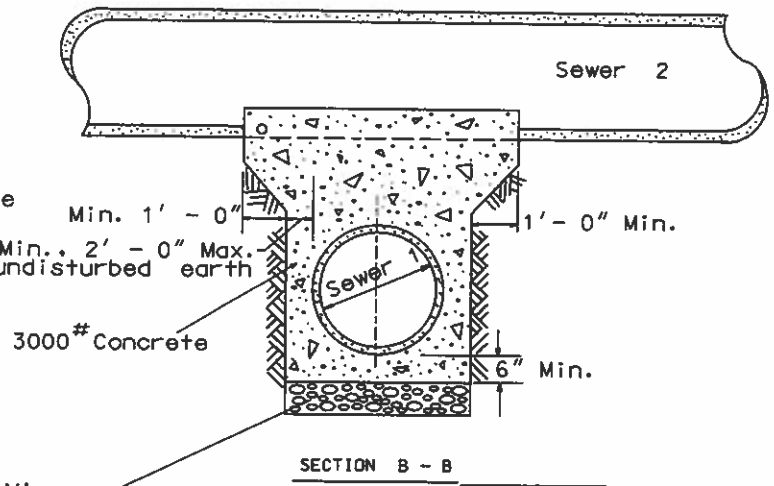
Encasement required when pipe clearance is less than 18"



PLAN VIEW



SECTION A - A



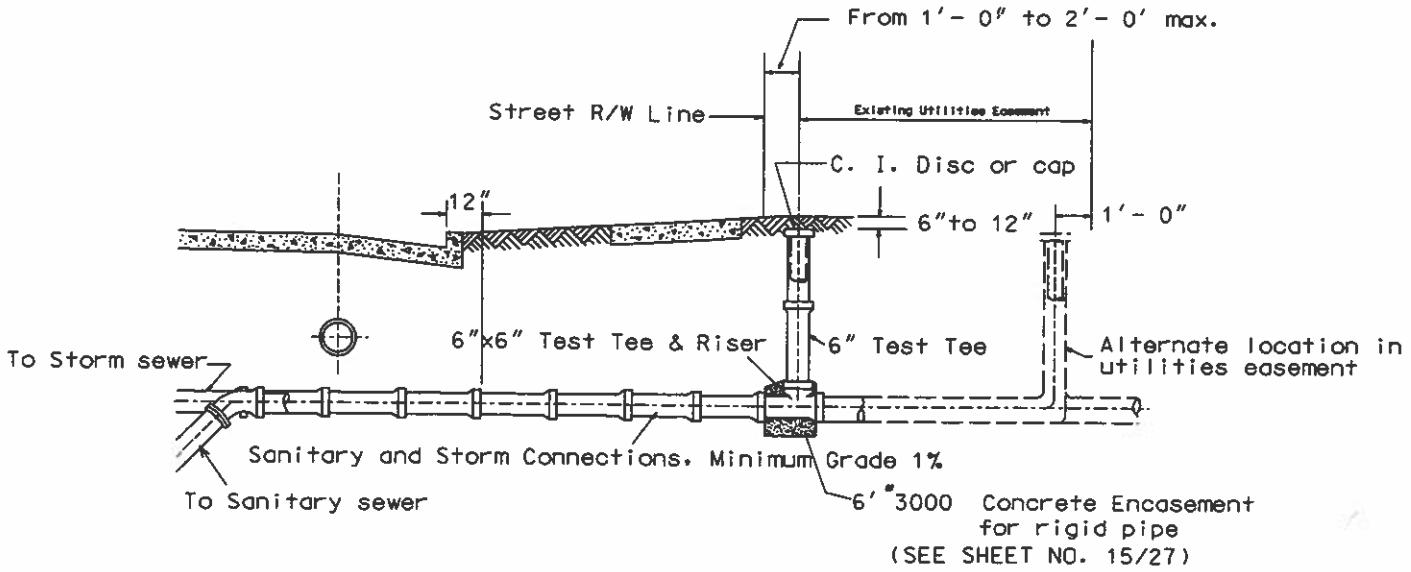
SECTION B - B

CONCRETE ENCASEMENT

MONOLITHIC CRADLING OF UPPER PIPE

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



NOTE:

House connections shell be connected into the top half of the sewer pipe.

6 inch. class 200. cast iron pipe is required for all bored sewer service connections including slip on rubber joints with an ANSI thicness classification No.25. also 6 inch. ductile iron cement lined pipe may be used including slip on rubber joints with an ANSI thickness classification No. 53.

LATERAL CONNECTIONS

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

Sheet No.14/27

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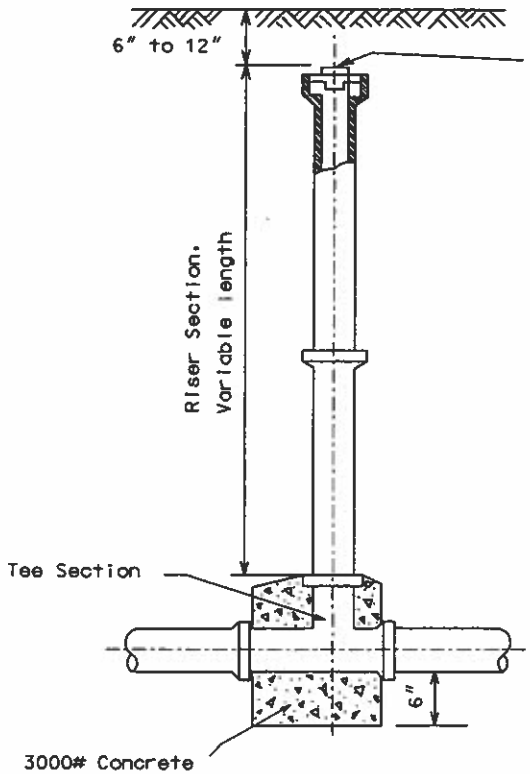


D.I. or C.I. Disc or Cap with a magnetic element imbedded

In pavement top of TEE shall be flush with finished grade.

2' x 2' x 4" pad is required in pavement.

for rigid pipe. coarse interlocking aggregate for flexible pipe.

6" X 6" TEST TEE & 6" RISER STORM SEWERS AND SANITARY SEWERS

NOTES:

The test tee riser section shall be installed when the connection is extended to the building.
Risers shall be furnished with stoppers upon which shall be placed a cast or ductile iron disc.
Cast or ductile iron disc shall be painted yellow on sanitary sewers.
Concrete encasement for Test Tees is required if ground cover to "T" elevation is less than 3' - 0". If greater than 3' - 0" use coarse interlocking aggregates.

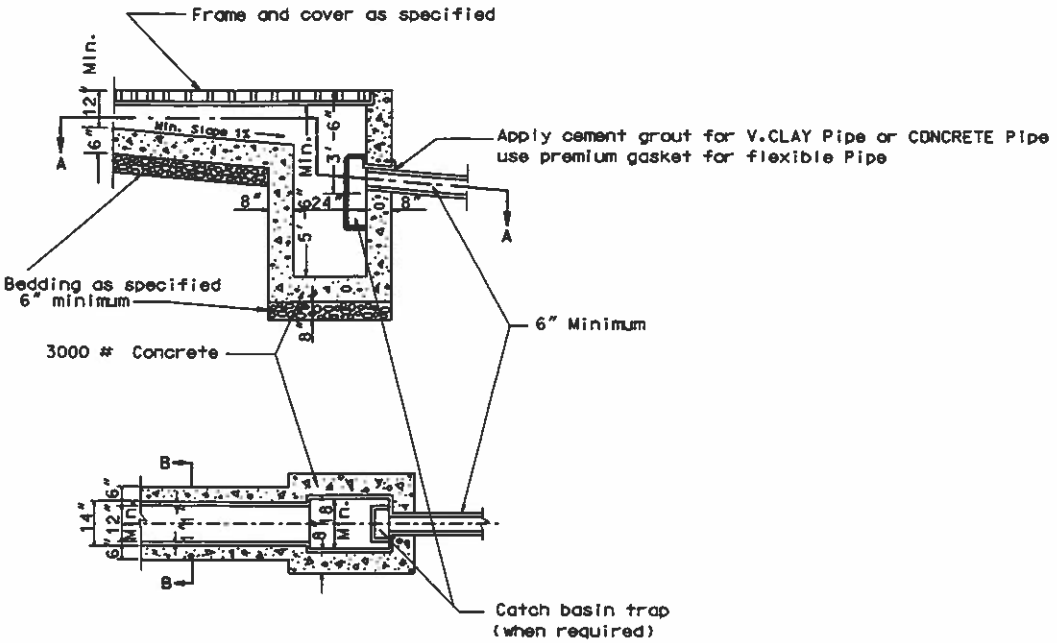
TEST TEE

REVISIONS:

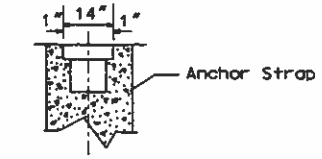
SCALE NO SCALE

DATE: DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



SECTION A – A



SECTION B – B

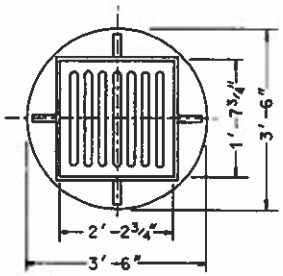
TRENCH DRAIN

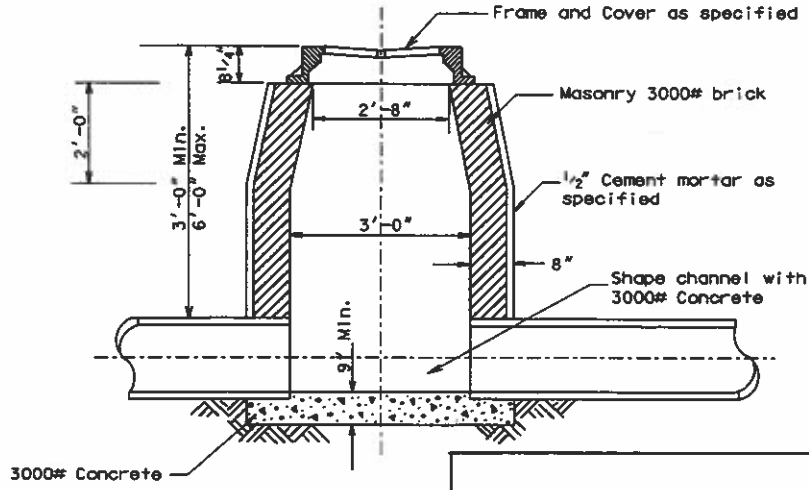
REVISIONS:

SCALE
NO SCALE

DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

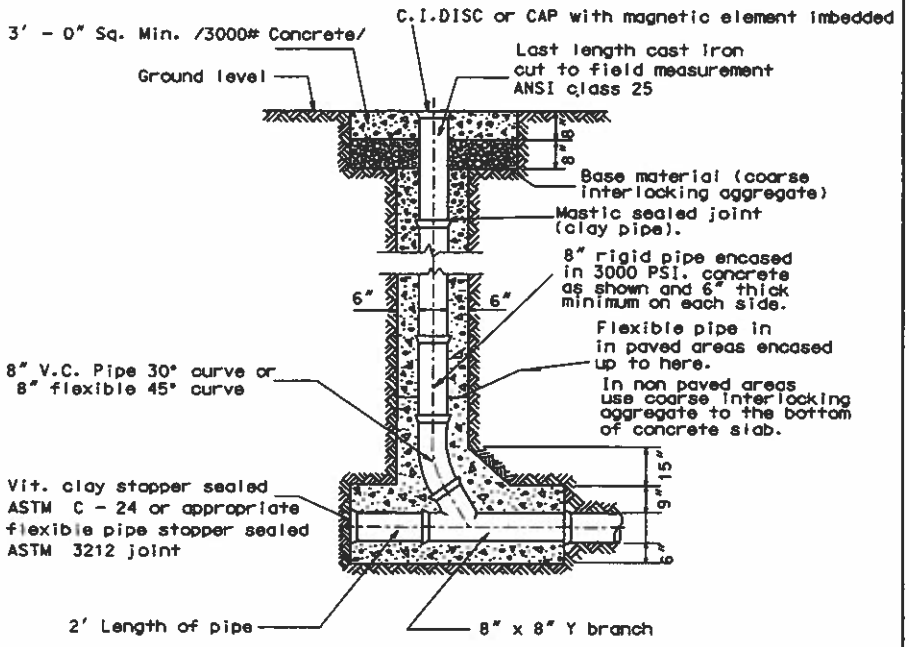




SPECIAL INLET

NOTE:

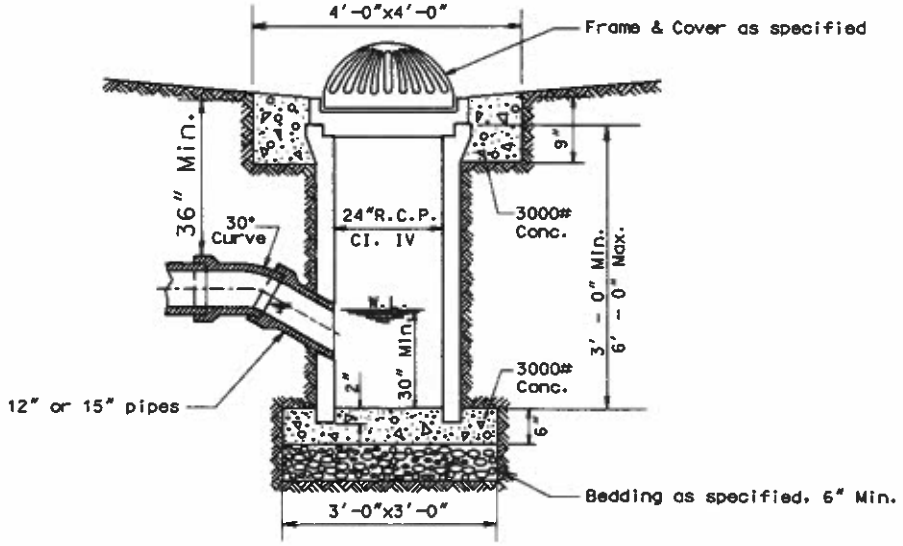
8" Clean out shall be used for 8" sewer and larger
Smaller size sewers and lamp holes shall have same size pipe.



CLEANOUT

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998	REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



SECTION

NOTE:

Grout pipe opening with cement mortar mix 1:2 if pipe is either CLAY or CONCRETE.use premium joint if pipe is flexible.

Locations where the 3' minimum is not possible lesser depths are acceptable.

Square catch basins will be accepted as an alternative. Catch basin will be constructed per O.D.O.T. item No. 604 and 706.13. PRECAST will have a minimum of 4" reinforced wall.

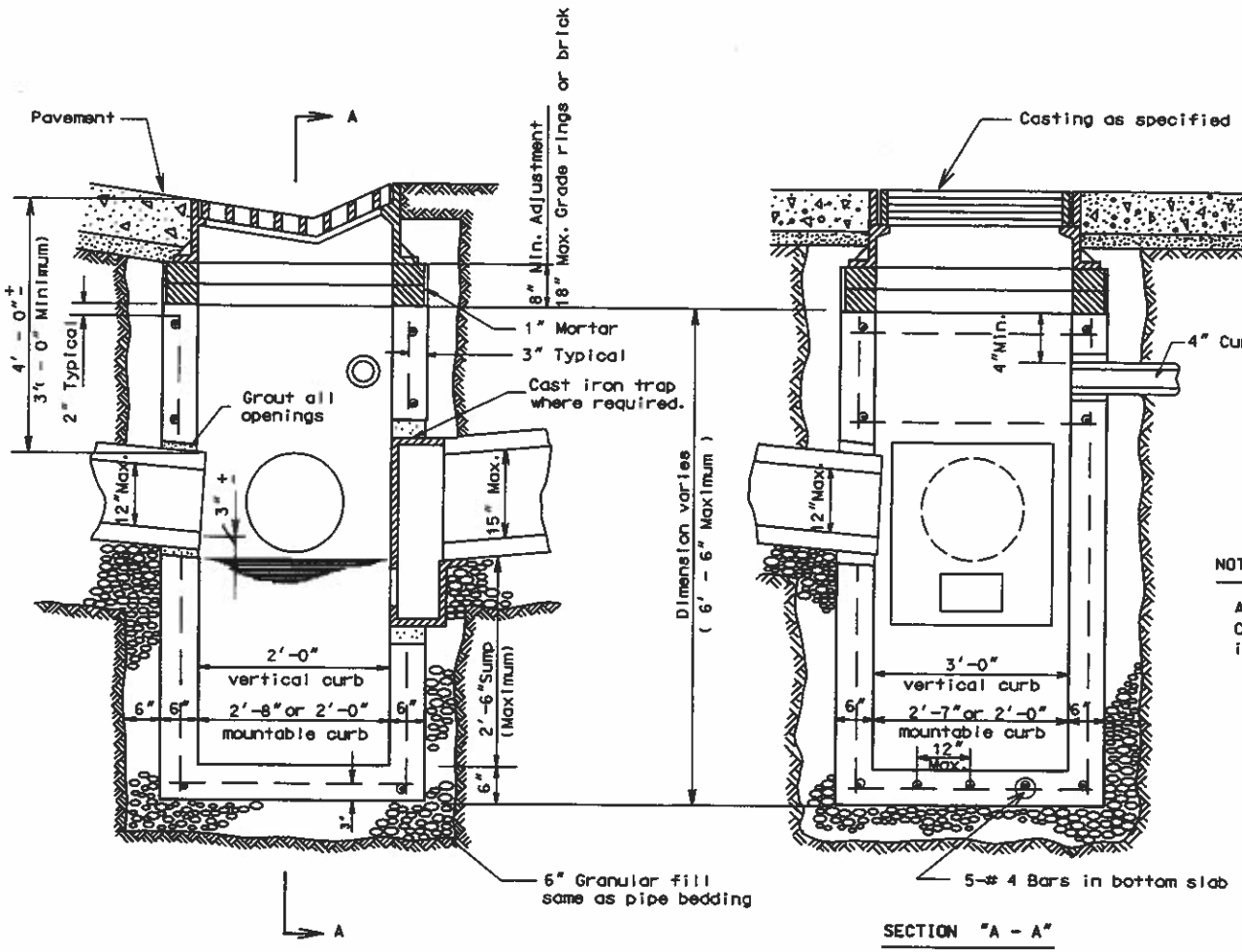
SQUARE CATCH BASIN CASTINGS - EAST JORDAN No. 5110 sinusoidal grate type M-3 or NEENAH R-4859-C.

All grates shall be bicycle safe.

YARD TYPE CATCH BASIN

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



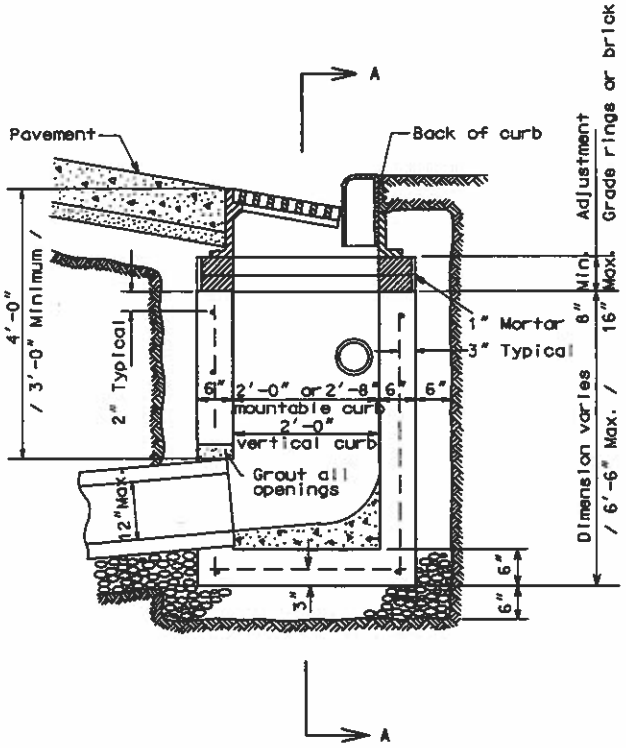
NOTE:

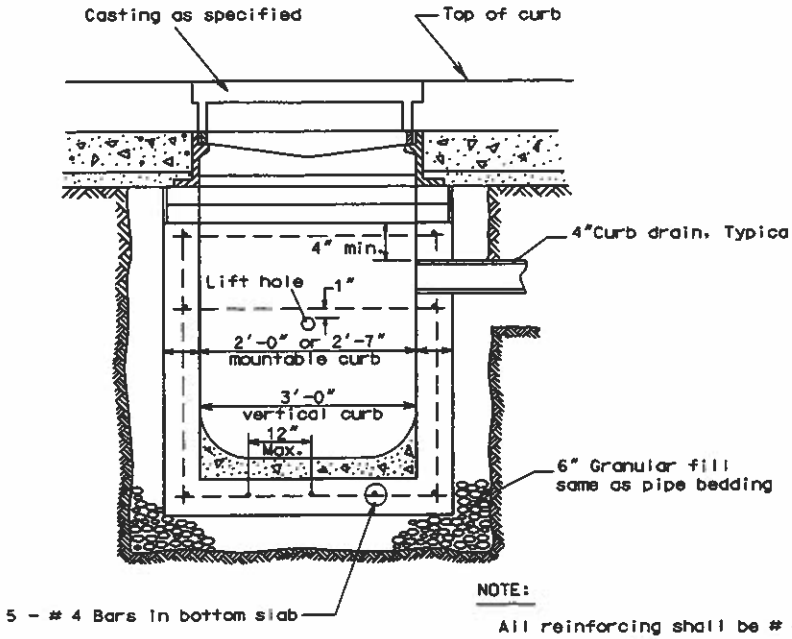
All reinforcing shall be # 4 deformed bars. Concrete shall be ODOT class "C" #4000 PSI in 28 days.

RECTANGULAR PRECAST CONCRETE CATCH BASIN

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT





SECTION "A - A"

NOTE:

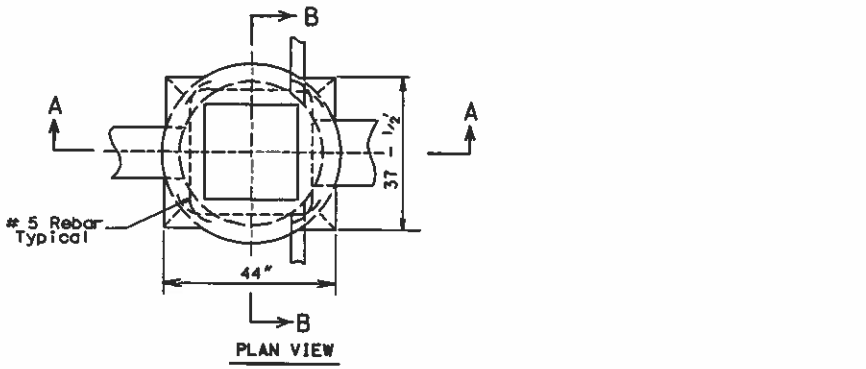
All reinforcing shall be # 4 deformed bars
Concrete shall be ODOT class "C" #4000 PSI in 28 days.

RECTANGULAR PRECAST CONCRETE INLET BASIN

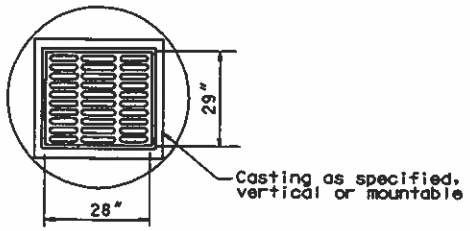
REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

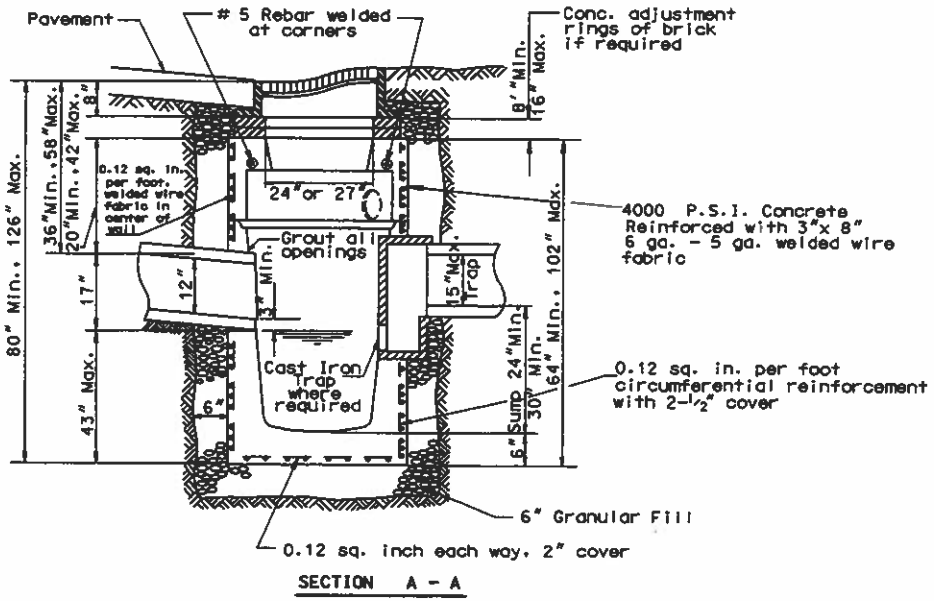
Sheet No.20/27



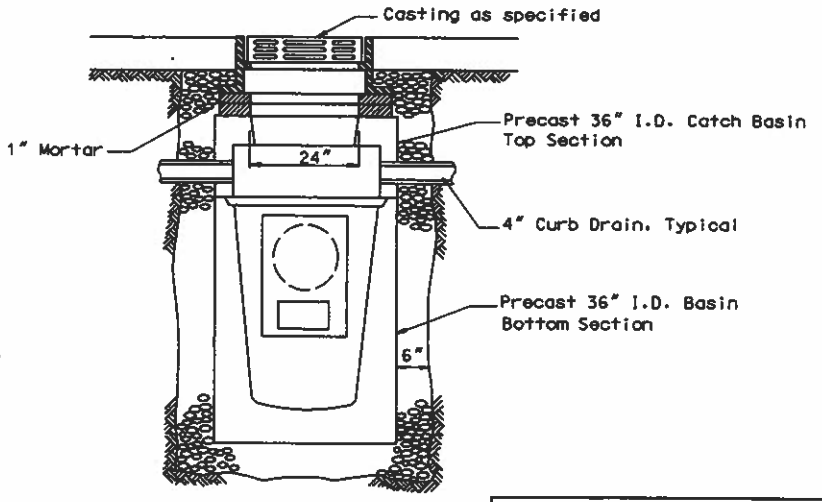
PLAN VIEW



CASTING DETAIL



SECTION A - A

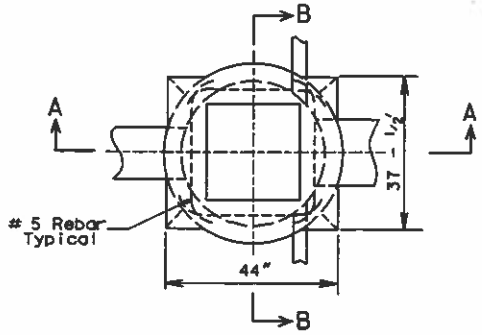


SECTION B - B

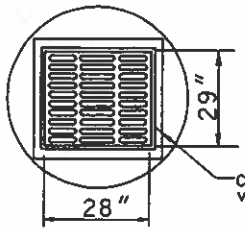
ROUND PRECAST CONCRETE CATCH BASIN

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

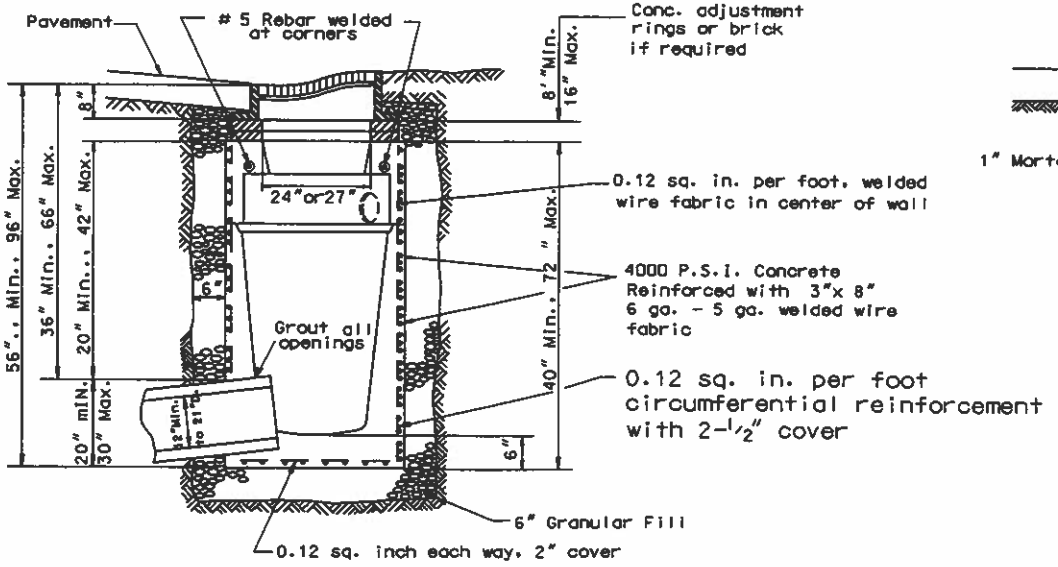
UNIFORM STANDARDS: CLEVELAND —— CUYAHOGA COUNTY —— NORTHEAST OHIO REGIONAL SEWER DISTRICT



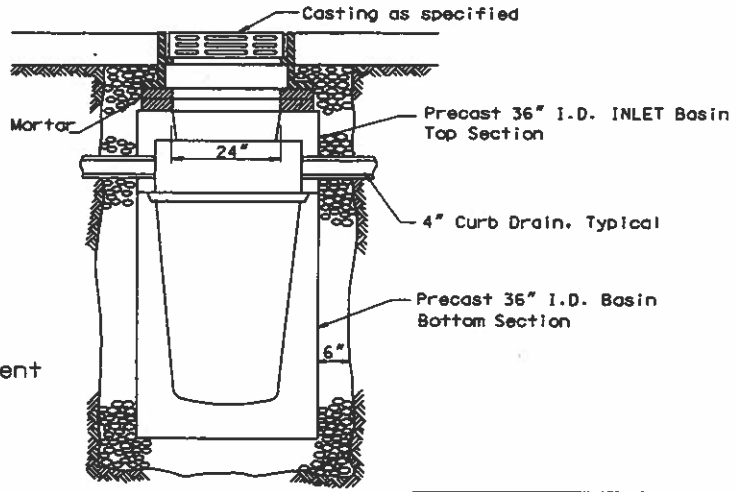
PLAN VIEW



CASTING DETAIL



SECTION A - A



SECTION B - B

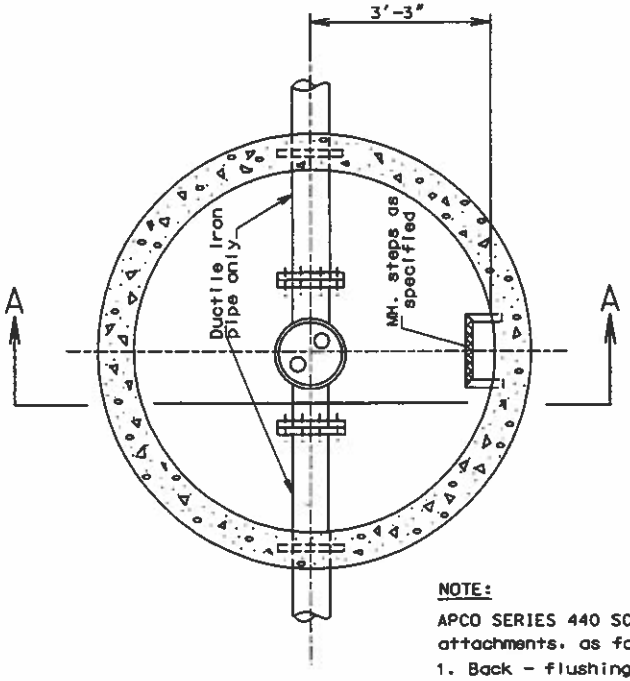
ROUND PRECAST CONCRETE INLET BASIN

REVISIONS:

SCALE NO SCALE

DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



PLAN

NOTE:

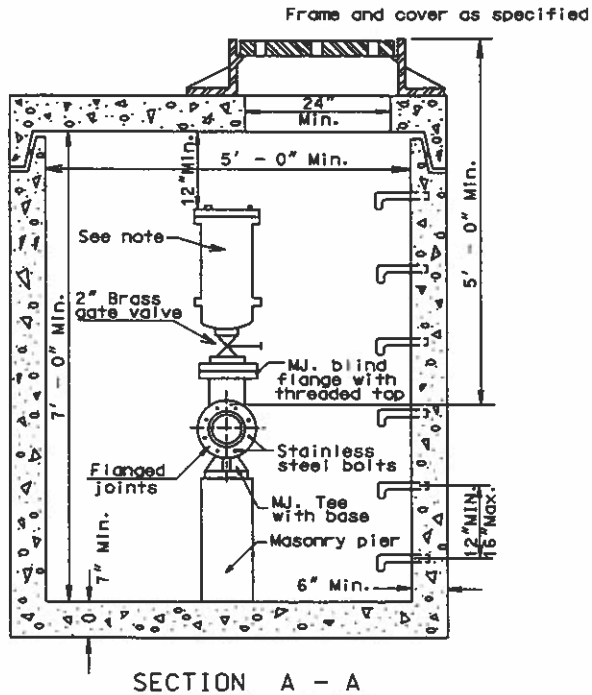
APCO SERIES 440 SCAV. MODEL 443 attachments. as follows :

1. Back - flushing attachments.
2. 2" Brass gate valve or approved equivalent.

Precast manholes (see sheet No. 4/27)

Install a drain when sewers are available.

Waterproof outside walls.

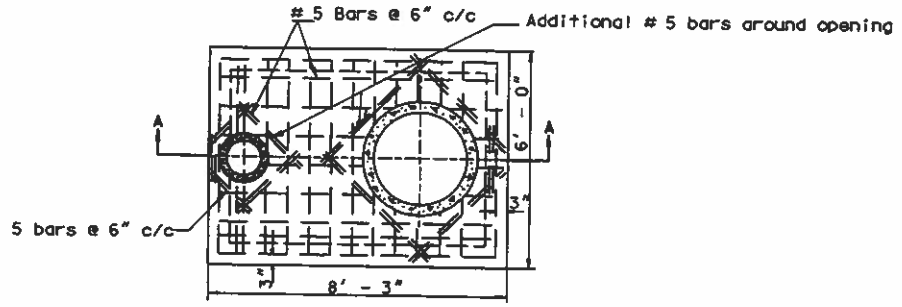


SECTION A - A

SANITARY FORCE MAIN AIR RELEASE VALVE CHAMBER

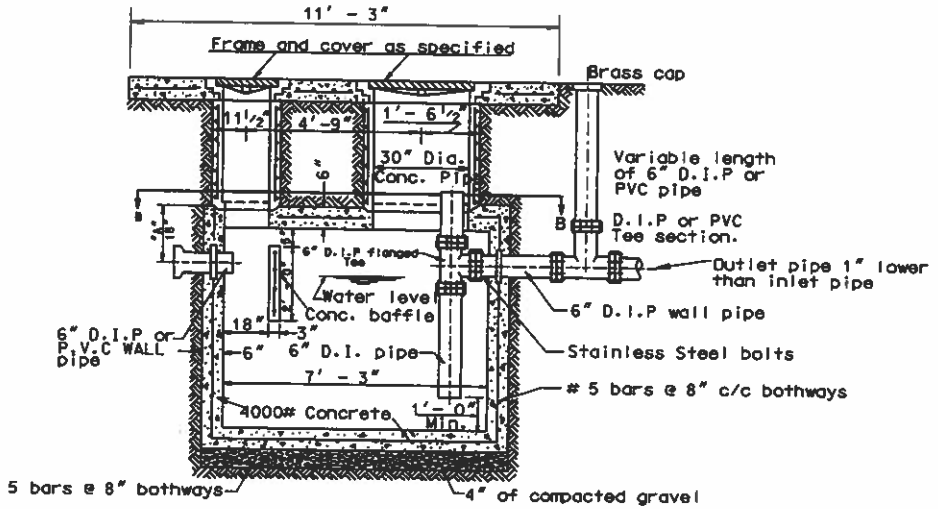
REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

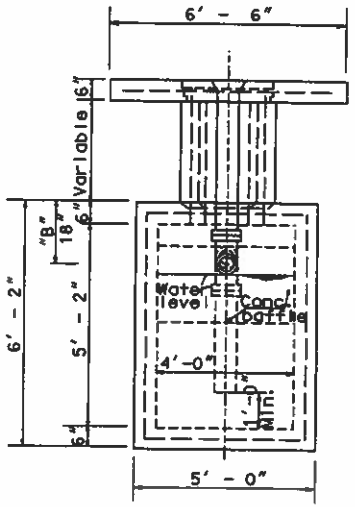


SECTION B - B

SHOWING REINFORCING LAYOUT



SECTION A - A



END VIEW

NOTE:

Approximate capacity is 1120 gallons

4000# concrete pad - 4" when grease trap is not in the street.

4000# concrete pad - 6" (H - 20 loading) when grease trap is in paved areas.

Bedding under piping thoroughly compacted.

TYPICAL STANDARD GREASE TRAP

REVISIONS:

SCALE NO SCALE

DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

Sheet No. 24/27

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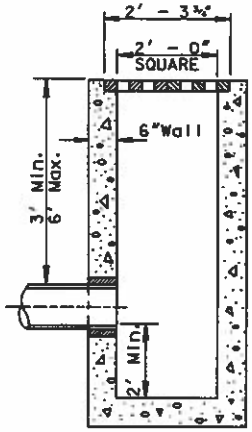
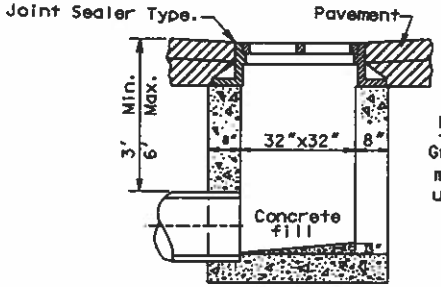


All precast concrete shall meet O.D.O.T. 706.13 requirement.



NOTE:
Grout pipe opening with cement mortar mix 1:2 if pipe is either CLAY or CONCRETE. use premium joint if pipe is PVC.

CATCH BASIN CASTINGS - East Jordan frame No. 8313 grate No. 8313 M - 2 or Neenah R - 1878 A9L and grate No. R - 1878 A9G.

INLET BASIN CASTINGS - East Jordan frame and grate No.5110 type or Neenah R - 4859 C with R - 4899 angle frame.

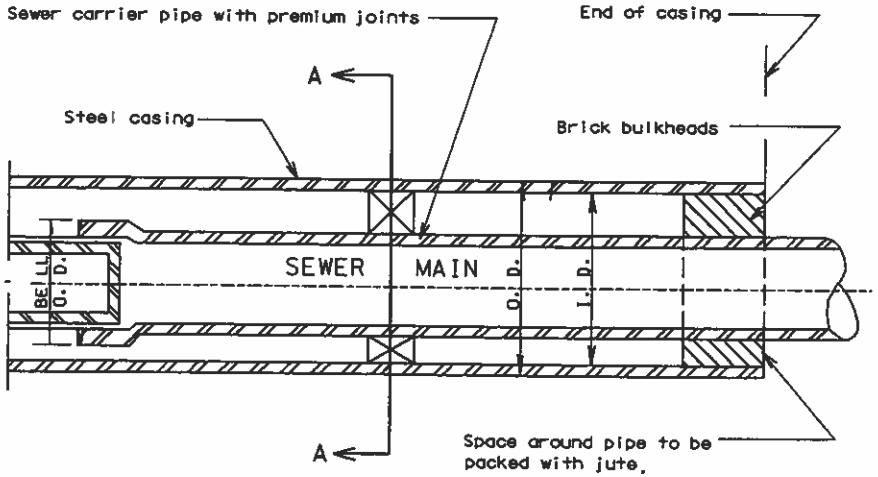
NOTE:

Locations where the 3' minimum is not possible lesser depths are acceptable.
Round catch basins will be accepted as an alternative.
Catch basins will be constructed per O.D.O.T. ITEM No. 604. CAST - IN - PLACE will have a minimum of 8" reinforced walls. Precast shall have a minimum of 6" reinforced concrete walls.
All grates shall be bicycle safe.

CATCH BASINS FOR PAVED AREAS

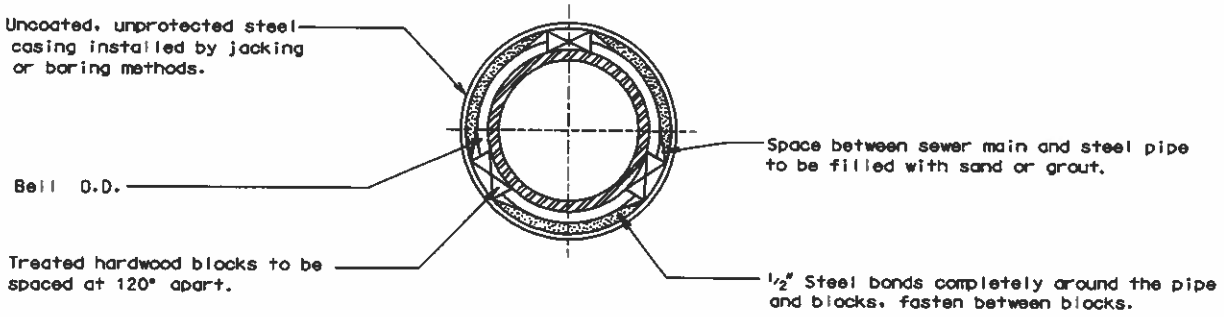
REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



NOTE:
Casing pipe to have I.D. minimum of 2" larger than bell O.D. of carrier pipe. Casing pipe to have a minimum wall thickness of 0.250.

BLOCKS:
3 sets of treared hardwood blocks per 18' lenghts of pipe.
4 sets of treated hardwood blocks per 20' lenghts of pipe.
Two blocks apaced 30" from jointe. Additional blocks evenly spaced.



SECTION A – A

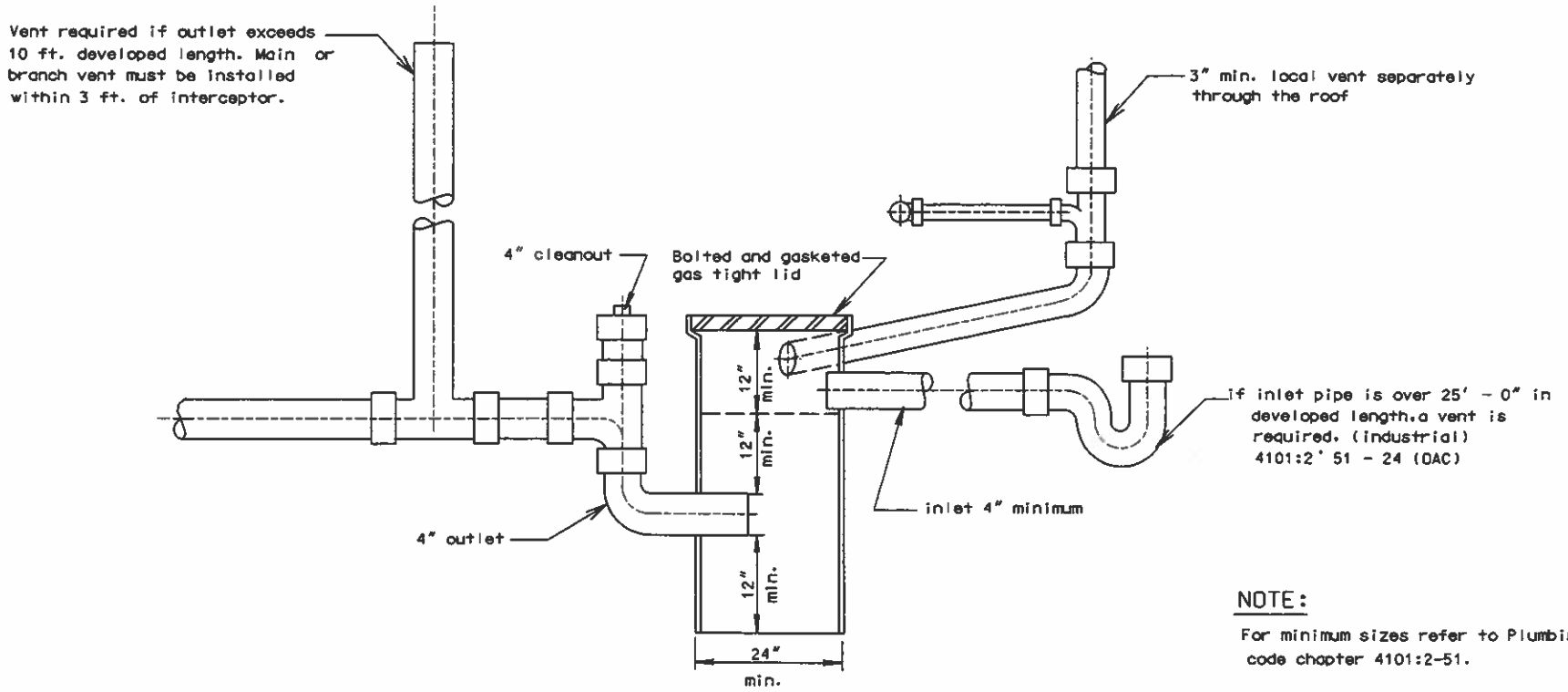
BORING DETAILS FOR PAVED AREAS

REVISIONS:

SCALE NO SCALE

DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT



NOTE:

For minimum sizes refer to Plumbing code chapter 4101:2-51.

TYPICAL GARAGE OIL INTERCEPTOR

REVISIONS:	SCALE NO SCALE	DATE : DEC. 1998

UNIFORM STANDARDS: CLEVELAND --- CUYAHOGA COUNTY --- NORTHEAST OHIO REGIONAL SEWER DISTRICT

UNIFORM STANDARDS FOR SEWERAGE IMPROVEMENTS

Standards

October 2013

City of Cleveland
Northeast Ohio Regional Sewer District
Cuyahoga County Department of Public Works
Municipal Engineers Association of Northeast Ohio

UNIFORM STANDARDS FOR SEWERAGE IMPROVEMENTS

CITY OF CLEVELAND

NORTHEAST OHIO REGIONAL SEWER DISTRICT

CUYAHOGA COUNTY DEPARTMENT OF PUBLIC WORKS

MUNICIPAL ENGINEERS ASSOCIATION OF NORTHEAST OHIO

We, the regular members of the Committee on Uniform Standards for Sewerage Improvements, have prepared these Standards and recommend their adoption and use by all governmental entities, agencies, and consulting engineers in Cuyahoga County and all areas serviced by the Northeast Ohio Regional Sewer District.

Bonita G. Teeuwen, P.E.	Cuyahoga County Department of Public Works Director
Richard S. Wasosky, P.E., P.S., Chairman	Municipal Engineers Association of NE Ohio
Charles Althoff, P.E.	Municipal Engineers Association of NE Ohio
Joseph Schaller, P.E.	Municipal Engineers Association of NE Ohio
	Division of Water Pollution Control City of Cleveland
	Ohio EPA Northeast District Office Twinsburg, Ohio
	Northeast Ohio Regional Sewer District Cleveland, Ohio

GENERAL OUTLINE OF THE RULES, REGULATIONS, AND STANDARDS FOR INSTALLATION OF SEWERAGE IMPROVEMENTS

TABLE OF CONTENTS

PART 1 - GENERAL INFORMATION

PART 2 - PERMIT REQUIREMENTS

PART 3 - STANDARDS FOR SEWERAGE FACILITIES

PART 4 - SEWER USE REGULATIONS

PART 5 - STANDARD SPECIFICATIONS

PART 6 - STANDARD DESIGN AND CALCULATION FORMS

PART 7 – UNIFORM STANDARD SEWER DETAILS

PART 1 - GENERAL INFORMATION

1.1 PURPOSE

The Uniform Standards for Sewerage Improvements aka the "Standards" are intended for use as a guide in the design and construction of sewerage facilities. These Standards are minimum requirements for design and construction of sewerage and storm water facilities in Cuyahoga County and areas outside of Cuyahoga County that adopt these Standards for their municipalities. Adherence to the Standards does not guarantee proper design and/or construction. Designers must use engineering judgment in the application of these Standards and are ultimately responsible for a design which 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

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 shall mean the latest version available.

1.3 AUTHORITY

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

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

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

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

4. Construction, inspection, 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.

A list of authorized agencies and municipalities which can be contacted for information or required approvals is provided on page 1-3. This list serves as a guide in identifying agencies with potential review, approval or permit authority.

Ohio Environmental Protection Agency (OEPA), Cuyahoga County Department of Public Works, Northeast Ohio Regional Sewer District (NEORSD) where applicable, and the municipality's approval is required on all sanitary sewers, combined sewers, wastewater pumping stations, wastewater treatment plants, and wastewater sludge handling and disposal facilities.

Additional approval requirements will be identified by any responsible agency upon receipt of plans and/or specifications for review.

AGENCIES EXERCISING JURISDICTION OR RESPONSIBILITY FOR REVIEW AND/OR APPROVAL

Incorporated Municipalities

Cuyahoga County Department of Public Works
2100 Superior Viaduct
Cleveland, Ohio 44113

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

PART 2 - PERMIT REQUIREMENTS

2.1 PROCEDURE

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

B. The permit will be issued when the plans and specifications have been approved by the appropriate authorities.

C. 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 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 storm or sanitary service connections are required for all facilities or structures desiring use of a public sewer. The issuing authorities for the permits are listed on Page 1-3 of these Specifications.

D. 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 local permits and/or utility company approvals.

E. For cities and villages with contracts with the Cuyahoga County Department of Public Works for maintaining and operating the sanitary sewer system, approval of new sanitary sewer and sanitary service connection plans and specifications must be obtained from both the municipality and the Cuyahoga County Department of Public Works prior to submitting to NEORSD and Ohio EPA for approvals.

For cities and/or villages without contracts with the Cuyahoga County Department of Public Works for maintaining and operating the sanitary sewer system, approval of new sanitary sewer and sanitary service connections shall only need to be obtained from the municipality prior to submitting to NEORSD and Ohio EPA for approval.

F. 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, 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.

G. 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. For NEORSD Title V Member Communities, Stormwater Management Plans, stormwater construction project plans and hydrology and hydraulic reports shall be submitted to NEORSD for all stormwater development activities that require approval by the municipality to verify they are in conformance with the Regional Stormwater Management Program.

2.2 PERMIT APPLICATIONS

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

PART 3 - STANDARDS FOR SEWERAGE FACILITIES

3.1 - ENGINEERING

3.101 Preparation of Drawings, Specifications, and Designer's Reports

A. General Information

B. Designer's Reports

3.102 Plans of Sewerage Facilities

A. General Information

B. Detailed Plans

3.103 Plans of Sewers

A. General Information

B. Boring Location Plans

C. Detailed Plans and Profiles

D. Special Detail Drawings

3.104 Plans of Sewage Pumping Stations

A. Location Plan

B. Detailed Plans

3.105 Plans of Sewage Treatment Plants

A. Location Plan

B. General Layout

C. Detailed Plans

3.106 Specifications

A. General Information

B. Construction Requirements

3.107 Revisions to Approved Plans

3.108 Operation During Construction

3.101 PREPARATION OF DRAWINGS, SPECIFICATIONS AND DESIGNER'S REPORT

A. General Information

All drawings, specifications, and designer's reports submitted for approval shall be prepared by or under the supervision of a Registered Professional Engineer 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 Engineer by or under whom it was prepared.

B. Designer's Reports

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 are necessary in checking the functional operation. Copies of a report consisting of the appropriate required information shall be submitted to the approving agency.

3.102 PLANS OF SEWERAGE FACILITIES

A. General Information

All plans for sewerage facilities shall bear a suitable title sheet showing the name of the municipality, sewer district or institution, and show a graphical scale, original lot number and tract, the north point, date, name of the engineer or company preparing the plans and date, signature of the engineer and imprint of the registration seal. The plans shall be clear and legible.

All plans shall be drawn to a scale which will permit all necessary information to be plainly shown. The maximum plan size shall be no larger than 24 inches by 36

inches. Datum used shall be USGS only.

B. Detailed Plans

Detailed plans shall consist of plan views, elevations, sections and supplementary views and miscellaneous details which, together with the specifications and general layouts, provide the working information for the contract and construction of the works. Dimensions and relative elevations of structures, the location and outline of form of equipment, location and size of piping, water levels, ground elevations, and any other pertinent data shall be included. All plans shall include complete general notes and applicable standard sewer details pertaining to the project.

3.103 PLANS OF SEWERS

A. General Information

A comprehensive plan of the existing and/or proposed sewers shall be submitted for projects involving new sewer systems or substantial additions to existing systems. This plan shall show the following:

1. Topography and Elevations

   Existing or proposed streets and all streams, water courses, or water surfaces shall be clearly shown.

2. Contour Lines

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

3. Streams

   The direction of flow in all streams, and high and low water elevations of all water surfaces at sewer outlets and overflows shall be shown. Where necessary, cross sections shall be provided.

4. Boundaries

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

5. Sewers

   The plan shall show the location, size, slope and direction of flow of all existing and proposed sanitary, storm, and combined sewers associated with the proposed project.

6. Wetlands or Flood Plains

   The location of all wetlands 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).

7. Retention or Detention Plans

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

B. **Boring Location Plans**

Boring location plan and profile sheets and boring log sheets shall be supplied when required by the reviewing agency for major sewer projects.

C. **Detailed Plans and Profiles**

Detailed plans and profiles must be submitted for sewer construction projects. Projects should have a horizontal scale of not more than fifty (50) feet to the inch. Profiles shall have an appropriate vertical scale of not more than ten (10) feet to the inch. Plans and profile shall show:

1. Location of streets.

2. 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. All manholes shall be numbered and stationed on the plan and correspondingly numbered on the profile.

3. Where there is any question of the sewer being sufficiently deep to serve any existing or proposed building, the elevation and location of the basement floor shall be plotted on the profile and plan of the sewer which 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.

4. Locations of all special features such as inverted siphons, concrete encasements, elevated sewers, bored and jacked or tunneled sewers, etc.

5. 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, underground electric and telephone facilities, overhead transmission lines, bottom of bridge beams, etc.

D. **Special Detailed Drawings**

Special detailed drawings, made to a scale to clearly show the nature of the design, shall be furnished to show the following particulars:

1. All stream crossings and sewer outlets, with elevations of the stream bed normal water surface elevation and extreme high and low water levels.

2. Details of all special sewer joints and cross-sections.

3. Details of all sewer appurtenances such as, but not limited to, manholes, catch basins, inlets, inspection chambers, inverted siphons, regulators, headwalls and elevated sewers.

4. Details of special bedding or trench construction requirements.

3.104 PLANS OF SEWAGE PUMPING STATIONS

A. Location Plan

A plan shall be submitted for projects involving construction or modification of pumping stations. This plan shall show the following:

1. The location and extent of the tributary area.

2. Any municipal or township boundaries within the tributary area.

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

4. Location and capacity of existing outlet sewer or treatment facility.

5. The general topography using a maximum contour interval of ten (10) feet and pertinent elevations.

6. Location of any wetlands or flood plain.

B. Detailed Plans

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

1. A topographic map of the property to be used for the pump station. Contour intervals shall be not more than two (2) feet.

2. Existing pumping station.

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

4. Elevation of high water at the site, and maximum elevation of sewage in the collection system upon occasion of power failure.

5. Test borings and ground water elevations.

3.105 PLANS OF SEWAGE TREATMENT PLANTS

A. Location Plan

A plan shall be submitted showing the sewage 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 sewage treatment plant shall be submitted showing:

1. Topography of the site.

2. Size and location of plant structures.

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

4. Piping, including any arrangements for bypassing individuals units.

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

6. Hydraulic profiles showing the flow of sewage, supernatant and sludge, including hydraulic and energy gradients.

7. Test borings and ground water elevations.

8. Location of existing streams, ditches, floodplains and wetlands.

9. 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.

3. Type, size, pertinent features, and manufacturer's rated capacity of all pumps, blowers, motors and other mechanical devices.

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

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

3.106 SPECIFICATIONS

A. **General Information**

Complete technical specifications for the material and construction of sewers, stormwater or sewage pumping stations, force mains, sewage 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 which is necessary to inform the builder in detail of the construction requirements as follows in Section 3.106 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. Best Management Practices and Stormwater Pollution Prevention Practices.

3.107 REVISIONS TO APPROVED PLANS

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 ORC 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. Any deviations from approved plans or specifications affecting 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 which will be affected by such changes to permit sufficient time for review and approval. "As Built" plans, prepared by the design engineer, clearly showing any alterations shall be placed on file with the responsible agency at the completion of the work.

3.108 OPERATION DURING CONSTRUCTION

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.

PART 3 - STANDARDS FOR SEWERAGE FACILITIES

3.2 - DESIGN OF SANITARY SEWERS

3.201 Investigations and Surveys

A. General Information
B. Information Required
C. Investigations
D. Special Projects
E. Manhole Access

3.202 Quantity of Sanitary Sewage

A. General Information
B. Design Basis
C. Infiltration
D. Additional Design Factors

3.203 Design Criteria for Sanitary Sewers

A. Energy Concept
B. Flow Formulas
C. Mannings Formula Flow Tables
D. Hydraulic Properties of Circular Sewers
E. Minimum Size
F. Bouyancy

3.204 Sewer Materials

A. General Information
B. Types of Sanitary Sewer Pipe
C. Sanitary Sewer Joints

3.205 Force Mains

A. General Information
B. Materials
C. Fittings
D. Thrust Blocks

3.206 Layout of Sewers

A. General Information
B. Curved Sewers
C. Lateral Connections
D. Test Tee
E. Manholes Frames and Castings
F. Depth of Sanitary Sewers
G. Velocities

3.207 Organization of Computations

3.201 INVESTIGATIONS AND SURVEYS

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 sanitary sewers in areas with existing or projected hydrogen sulfide problems.

B. Information Required

Each project shall be identified by name, municipality within which it is to be constructed, original lot number and tract. A general description of the project shall be provided. The description shall indicate the approximate site size, zoning, probable upstream tributary area of future system expansion and any special factors to be considered in the system design.

C. Investigations

Information on all existing conditions shall be listed. The designer shall list the existing capacity and capacity available of the receiving sewer and the sewage treatment facility which 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.

D. 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 agency 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 Specifications.

E. 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 reviewing 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.

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.

B. **Design Basis**

1. Ultimate Population Density is based on existing zoning.

2. Sewage Flow Guide Table 3.1.

3. For undeveloped commercial property, use fifteen hundred (1,500) gallons per acre per day average daily flow.

Sewage Flow Guide

Table 3-1 for Design Flow Requirements [g]			
Place	**Notes**	**Design Flow (gallons per day)**	**Waste Strength Range BOD_5 (mg/l)**
Airport	b, i, 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	3 per seat w/o kitchen facilities 7 per seat w/ kitchen facilities 15 per employee	200 to 280 [r, s, t]
Banquet hall	b, i, j	3 per seat w/o kitchen facilities 7 per seat w/ kitchen facilities 15 per employee	400 ppm BOD
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	i, q	Sewer Connection Required/Contact District Office	
Campground or recreational park	a, i, j, m, n, p	30 per primitive camp site (w/o showers) 60 per primitive camp site (w/showers) 60 per site without water hook-up 90 per site with water hook-up	200 to 280 [r, s, t]
Church (less than 200 sanctuary seats)	a, h, j, k, o, p	3 per sanctuary seat w/o 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 w/o kitchen 7 per sanctuary seat with kitchen	200 to 280 [r, s]
Coffee shop	a, i, j	5 per seat plus 15 per employee	200 to 280 [r, s, t]
Convenience store (a convenience store with gas sales must be designed for a minimum of 500 gpd)	a, d, i, j, p, q	15 per employee 5 per parking space If gas sales, 500 per pump island	200 to 280 [r, s, t]
Country club, sportsman club or gun club	b, i, j, m, n, o, p	50 per member	200 to 280 [r, s, t]
Dance hall	a, i, j, p	3 per patron w/o kitchen facilities 7 per patron w/ kitchen facilities 15 per employee	200 to 280 [r, s, t]
Daycare facility	a, i, j, p	35 per employee plus 10 per student	200 to 280 [r, s, t]

Note: Design Flow from Ohio Revised Code 3745-42-05

Table 3-1 for Design Flow Requirements [g] (Cont.)			
Place	**Notes**	**Design Flow (gallons per day)**	**Waste Strength Range BOD_5 (mg/l)**
Dentist office	i	35 per employee plus 10 per patient plus 75 per dentist	200 to 280 [s]
Doctor office	i	35 per employee plus 10 per patient plus 75 per doctor	200 to 280 [s]
Dry cleaner	i	Consult Local District Office [1]	200 to 280 [s]
Factory	i, q	25 per employee without showers 35 per employee with showers	200 to 280 [r, s, t]
Food-Service Operation/Restaurant 1. ordinary restaurant (not 24 hours) 2. 24-hour restaurant 3. restaurant along freeway 4. tavern (very little food service) or bar (full food service) 5. curb service (drive-in) 6. vending machine	c, i, j, p c, i, j, p c, i, j, p c, i, j, p c, i, j, p c, i, j, p	1. 35 per seat 2. 60 per seat 3. 100 per seat 4. 35 per seat 5. 40 per car space 6. 100 per machine	400 to 600
Homes in subdivision	b, l	120 per bedroom	200 to 280 [r, s]
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 machine	200 to 280 [s]
Marina (restrooms and showers only)	a, i	20 per boat mooring or slip	200 to 280 [r, s, t]
Migrant 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

Note: Design Flow from Ohio Revised Code 3745-42-05

Table 3-1 for Design Flow Requirements [g] (Cont.)			
Place	**Notes**	**Design Flow (gallons per day)**	**Waste Strength Range BOD_5 (mg/l)**
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]
Retail store	a, 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 pupil for elementary schools 20 per pupil for jr. & high schools 85 per pupil for boarding schools	200 to 280 [r, s, t]
Service station or gas station	a, d, i, q	500 per pump island 500 per service bay minimum of 750	200 to 280 [r, s, t]
Shopping center	a, f, l, p, q	15 per employee plus 2 per parking space w/o food service 5 per parking with food service	200 to 280 [r, s, t]
Swimming pool	a, i, m, n	5 per swimmer without hot showers 10 per swimmer with hot showers	200 to 280 [r, s, t].
Theater	a, i, j, p	5 per seat for indoor auditorium 10 per car for drive-in	200 to 280 [r, s, t].
Vacation cottage	b, i, j, p	50 per person without kitchen 75 per person with kitchen	200 to 280 [r, s,] t.

Note: Design Flow from Ohio Revised Code 3745-42-05

Notes for Table 3-1

Note a: Food service waste not included.

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

Note c: Aeration tanks for these 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 g.p.d. if 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: Assumes no garbage grinders 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 mg/l obtained from U.S. EPA (EPA Manual EPA/625/R-00/008). This manual, titled "Onsite Wastewater Treatment Systems Manual, February 2002" is available on the U.S. EPA website (http://www.epa.gov/ncepihom/), and can be ordered 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, facilities that may handle pet wastes.

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 which 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.

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 $h_f = V^2 / 2\,g$.

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 roughness coefficient for smooth interior pipe i.e. concrete, clay, PVC, ductile iron, and polypropylene 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.

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.

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**

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

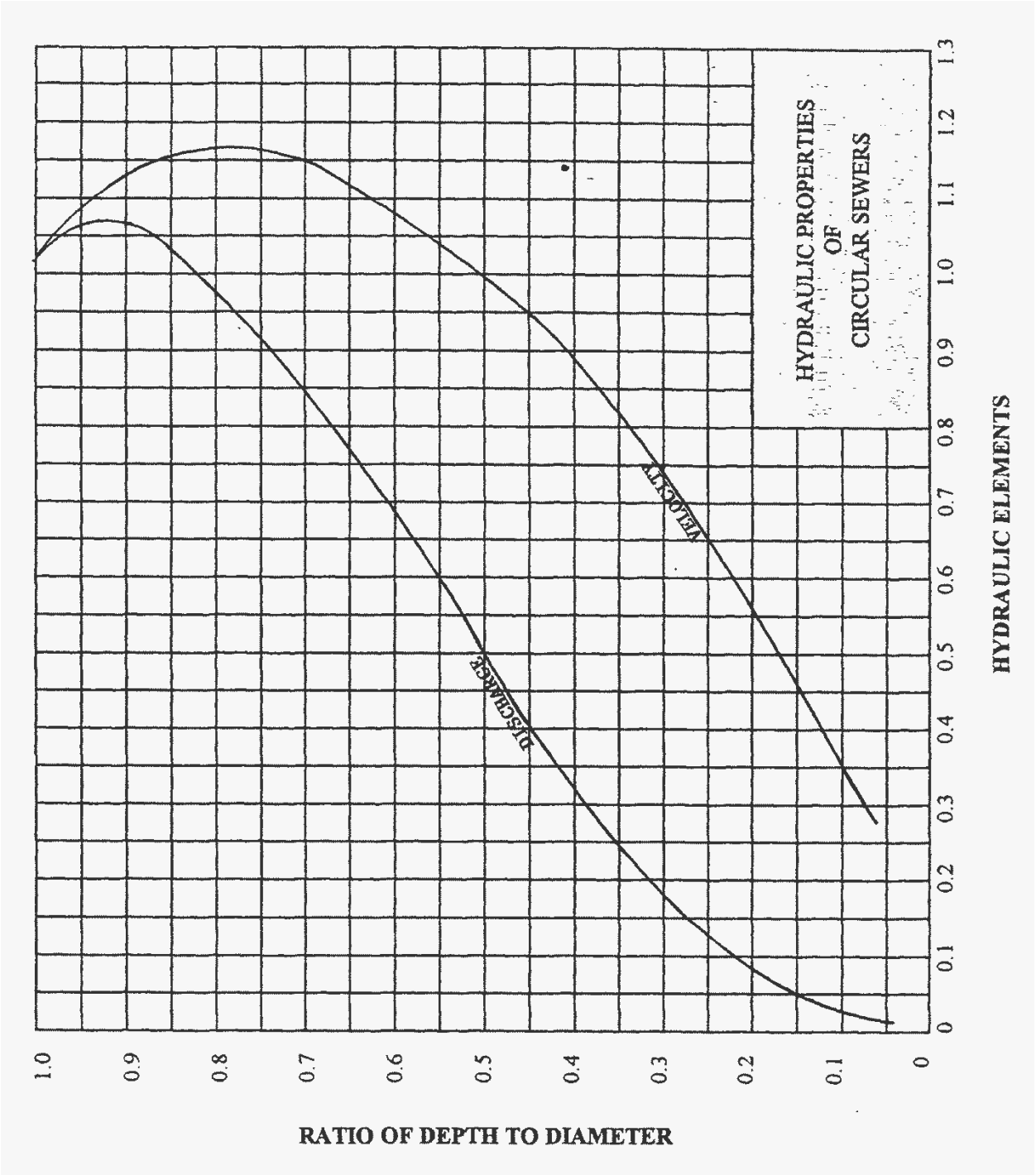
	DIAMETER (IN)	CAP. @ 1% (cfs)	AREA (ft.²)	CAP. @ 1% (MGD)
n = 0.015	5	0.321	0.139	0.207
	6	0.485	0.196	0.313
	8	1.061	0.349	0.686
	10	1.906	0.545	1.232
	12	3.087	0.785	1.995
	15	5.567	1.227	3.598
	16	6.604	1.389	4.266
	18	9.105	1.767	5.884
	21	13.73	2.405	8.870
	24	19.61	3.142	12.67
	27	26.75	3.977	17.29
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 %.

Note: "n" factors are higher than manufacturer's suggested values to account for losses in manholes, joint misalignment, slime and debris in pipe, etc. Chart is for smooth interior pipe only.

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 connecting separate 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.

F. Buoyancy

Buoyancy of the sewers shall be considered and the floatation of the pipe shall be prevented with appropriate construction methods when high groundwater levels are anticipated.

3.204 SEWER MATERIALS

A. General Information

All piping materials, manholes, and appurtenances furnished for public sanitary sewers shall comply with the latest applicable national standards, such as the 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) or other representative standards organizations. Some products are specified with more than one applicable reference standard for such items as testing, installation, or supplementary material specifications. Type, depth, and existing soil conditions shall be considered in the selection of the pipe materials.

B. 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 6" to 30" diameter and Polypropylene Corrugated Triple Wall Pipe, ASTM F2764 for 30" to 60" diameter.

For depths of cover less than 15 feet where ASTM Class I bedding is used and thermoplastic piping, PVC composite sewer pipe, fiberglass, polyethylene or polypropylene storm or sanitary sewer pipe is used, the minimum pipe stiffness of 46 PSI or SDR-35 shall be utilized and a maximum 5.0 percent in place deflection at the base inside diameter of the pipe shall be provided. For depths of cover between 15 feet and 50 feet with ASTM Class I bedding, when thermoplastic piping, PVC composite sewer pipe, fiberglass, polyethylene or polypropylene storm or sanitary sewer pipe is used the Developer or Applicant shall provide calculations 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. Pipe minimum wall thickness shall be calculated using the Modified Iowa Formula:

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

Δy = vertical deflection(inches)

DL = lag factor(1.5 maximum)

K = bedding factor

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 $\left(lb/in^2\right)$

W = earth load/ $\left(lb/in\right)$ t = minimum wall thickness

r = mean radius $\left(\frac{OD-t}{2}\right)$ (i n)

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 E′ values provide a factor of safety over the original Bureau of Reclamation E′ 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. All sewer pipe within a manhole to manhole increment shall be one type and class. In the case of lateral connections, proper watertight transition connections of differing materials may be permitted. Lateral connections to building sites shall be a minimum of six (6) inches in diameter. Only wye branch fittings will be accepted for service connections for flexible sewer pipes up to and including 18" diameter. For flexible sewer pipe 21" and larger and for concrete sewer pipe 12" and larger, tee connections are permitted. Deflection test is required on all storm and sanitary 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 sewers less than 36" diameter, and for all concrete pipe 24" and less in diameter.

C. **Sanitary Sewer Joints**

All sanitary sewers shall be installed with premium water tight joints of the bell and spigot type to insure maximum durability, flexibility, strength and water-tightness. All sewer materials listed above provide for joint water-tightness tests in their specifications. All sanitary sewer joints in the public right-of-way shall conform to ASTM C425 for clay pipe, ASTM C443 for concrete pipe, ASTM D-3212 for plastic pipe, AWWA C111 for Ductile Iron Pipe, ASTM D4161 for fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe, and ASTM D3212 for polypropylene pipe.

Joints for PVC pipe shall be elastomeric O-ring, except solvent cement joints for PVC pipes six (6) inches or under is acceptable. If the joint is of the solvent cement type, it shall be installed per ASTM D2855 and the manufacturer's recommendations. Elastomeric qualities of joint gaskets or O-rings shall meet ASTM F477. Solvent cement for PVC piping and fittings shall conform to ASTM D2564. Welded joints shall be air tested 24 hours after installation.

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 four (4) feet shall be used on force mains. All force mains crossing under a stream shall have 6 inches of concrete (3000 PSI) encasement.

Whenever a sewage force main and water line 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 water line or the bottom of the force main is at least 18” above the top of the waterline while maintaining 4 feet of cover. The sewage force main shall have a minimum 10 feet separation with a water main.

B. **Materials**

The force main material shall be either polyvinyl chloride (PVC) pipe SDR-21 ASTM D 2241, Push-on-Joints ASTM D3139; Polyvinyl Chloride (PVC) pipe AWWA C900, Class 150 meeting requirements of DR18 with rubber gaskets or O-Rings conforming to the requirements of ASTM D3139 and ASTM F477; high density polyethylene (HDPE) DR11 (160 psi); or Push on Joints or Mechanical Joints Ductile Iron Pipe ANSI/AWWA C151/A21.51. All ductile iron pipe shall be cement lined and designed for thickness in accordance with ANSI/AWWA C150/A21.50. Minimum thickness shall be Class 52. Cement lining for ductile iron pipe shall be in accordance with ANSI/AWWA C104/21.4. Other materials which are rated as pressure piping by national standards organizations such as ASTM, AWWA or ANSI are acceptable.

Sanitary Sewer Force Main HDPE Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will 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 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 restrain type such as the megalugs 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.

3.206 LAYOUT OF SEWERS

A. General Information

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 storm and sanitary sewers by six (6) feet barrel to barrel. Both the storm and sanitary sewers shall be constructed using a premium jointed conduit throughout.

Sanitary sewers and waterlines should be separated horizontally by ten (10) feet and vertically by 18" barrel to barrel wherever possible. If it is impossible to maintain the 18 inch vertical separation when the water line is less than 10 feet from the sanitary sewer, the sanitary sewer shall be encased in concrete or be constructed of waterline type materials which will withstand 50 psi pressure test.

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 which are 150 feet or more in length, and at any change of line, grade or size of sewer. A full size clean-out may be provided in lieu of a manhole at the end of sewer runs less than 150 feet.

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 appropriate agencies.

The design engineer should consider providing thermal insulation around any sewer or force main 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.

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. When a larger sewer discharges into a smaller one, the invert of the smaller sewer should not be raised to maintain the same energy gradient.

B. **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 radius be less than 200 feet. Sewers curved vertically or in combination with horizontal curves shall be considered a special project.

C. **Lateral Connections**

Lateral connections to building sites shall be a minimum of six inches (6") in diameter and 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. Only one building shall be permitted to be connected to each building lateral unless approval is obtained for the authorized agency for additional connections. For new works, when flexible pipe is utilized, all lateral connections to the main public

sanitary sewer, up to and including 18 inch in size, shall be made through use of manufactured fittings. Direct connection of laterals to manholes shall not be permitted unless authorized by the responsible agency. Neatly cored holes with core bore seals and special fittings as recommended by the Manufacturer Trade Association of the flexible piping material involved are acceptable for repair works, or for sewer larger than 18 inch in size. 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. Generally the sewer lateral nominal diameter shall be no greater than 2/5 the diameter of the main sewer. Lateral connections shall be installed utilizing a laser or grade bar devices. Minimum pipe slope for lateral connections shall be 1.0 percent.

D. **Test Tee**

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 Lateral Connection Detail on Uniform Standard Sewer Details Sheet 14/27. Test tee caps shall be cast or ductile iron, and shall be marked STM for storm sewers and SAN for sanitary sewers. Double gasketed plastic caps with a minimum 2 ounces of 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 on Sheet 15/27). 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 and 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.

E. **Manholes Frames and Castings**

Standard manholes frames and castings are as indicated in the Uniform Standard Sewer Details Index of Sheets and General Notes, Sheets 2/27 and 3/27. 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.

F. **Depth of Sanitary Sewers**

In general, the top of the pipe of sanitary sewers shall be at least 10 feet below the average finished grade at the building line in residential districts and 12 feet below the building line 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.

G. **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	0.10
27	0.09
30	0.058
33	0.050
36	0.046

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 agency, 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.

PART 3 - STANDARDS FOR SEWERAGE FACILITIES

3.3 - DESIGN OF STORM SEWERS

3.301 Design of Storm Sewers

A. General Information
B. Investigations and Surveys
C. Special Projects

3.302 Design Criteria for Storm Sewers

A. General Information
B. Design Storm Frequency
C. Rainfall Intensity-Duration
D. Runoff Coefficient
E. Concentration Times
F. Standard Rainfall Intensity-Duration Tables
G. Hydraulic Properties of Horizontal Elliptical Concrete Pipe
H. Horizontal Elliptical Reinforced Concrete Pipe Flowing Full
I. Flow Formulas

3.303 Layout of Sewers

A. General Information
B. Minimum Size
C. Types of Storm Sewer Conduits
D. Lateral Connections
E. Storm Sewer Joints
F. Depths of Sewers
G. Velocities
H. Open Channel and Culvert Design
I. Concrete Anchorage

3.304 Stormwater Management and Sediment Control

3.305 Detention/Retention Basins

3.306 Culverts

3.307 Headwalls

3.308 Organization of Computations

3.301 DESIGN OF STORM SEWERS

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.

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.

B. Investigations and Surveys

1. Information Required

   Each project shall be identified by name, municipality within which it is to be constructed and original lot number and tract. A general description of the project shall be included indicating approximate project size, zoning, ground cover, soil type (s), general description of discharge points, off site tributary area drainage area maps, and any special factors to be considered in the design.

2. Investigations

   Information on all existing conditions shall be listed. This information shall include capacity of receiving sewers or downstream culverts and the ability of receiving waterways to provide an adequate outlet with respect to both depth and capacity in vicinity of storm outlet. All FEMA floodplain areas, wetlands, and riparian setbacks shall be delineated on the drainage area maps and project site plans. Special analysis will be required for known flooding areas.

   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 agency 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 SEWERS

A. **General Information**

In general, all sewers shall be designed using the following criteria. Variation from such would constitute special projects.

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 top of the grate of any catch basin on 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**

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

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 is based on the precipitation at the center of Cuyahoga County which is located at (41.433858 N, -81.6665173W).

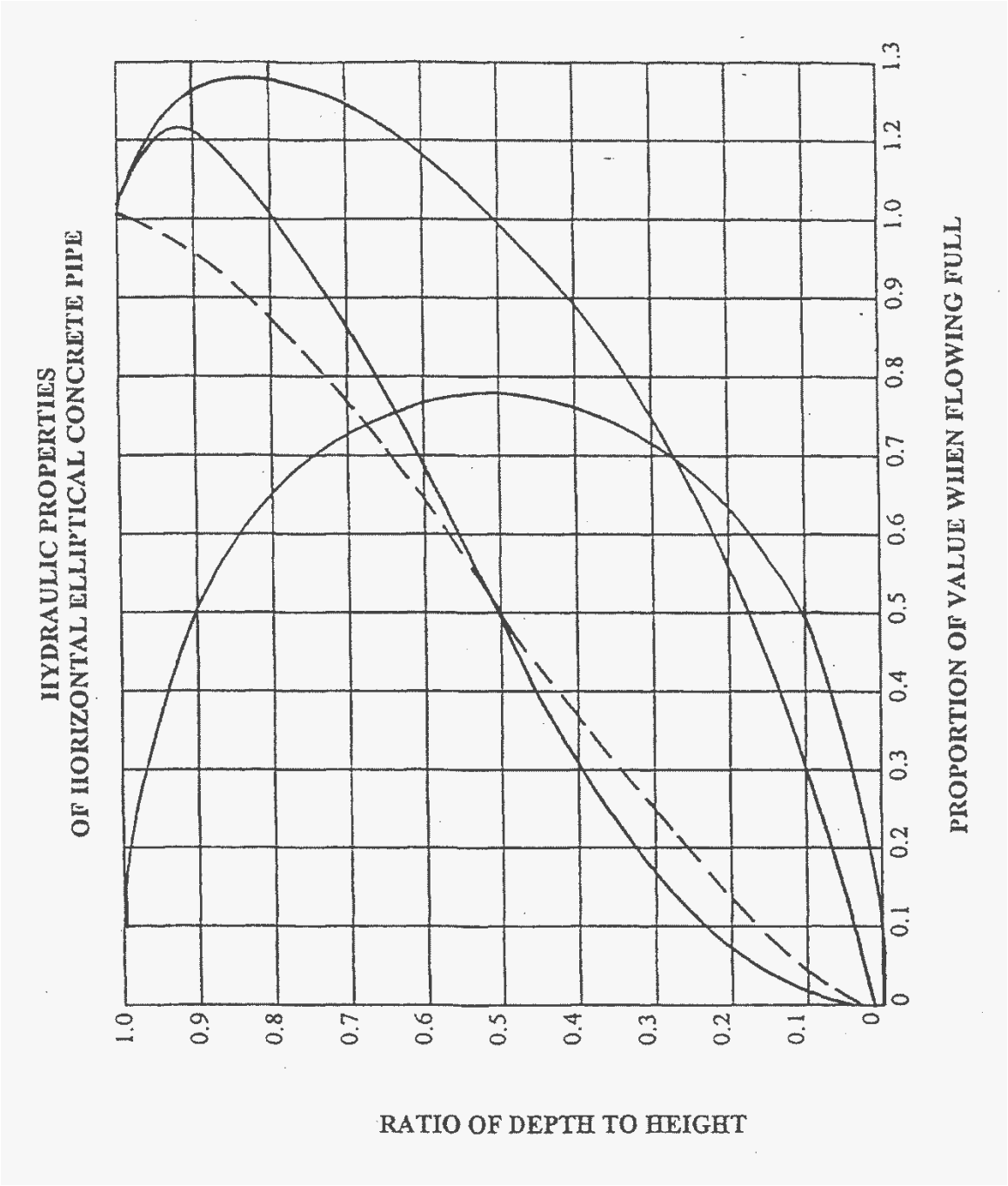
Site specific NOAA Atlas 14, Volume 2, Version 3 rainfall data shall be used for the design of retention basins and detention basins.

STANDARD RAINFALL INTENSITY-DURATION TABLES

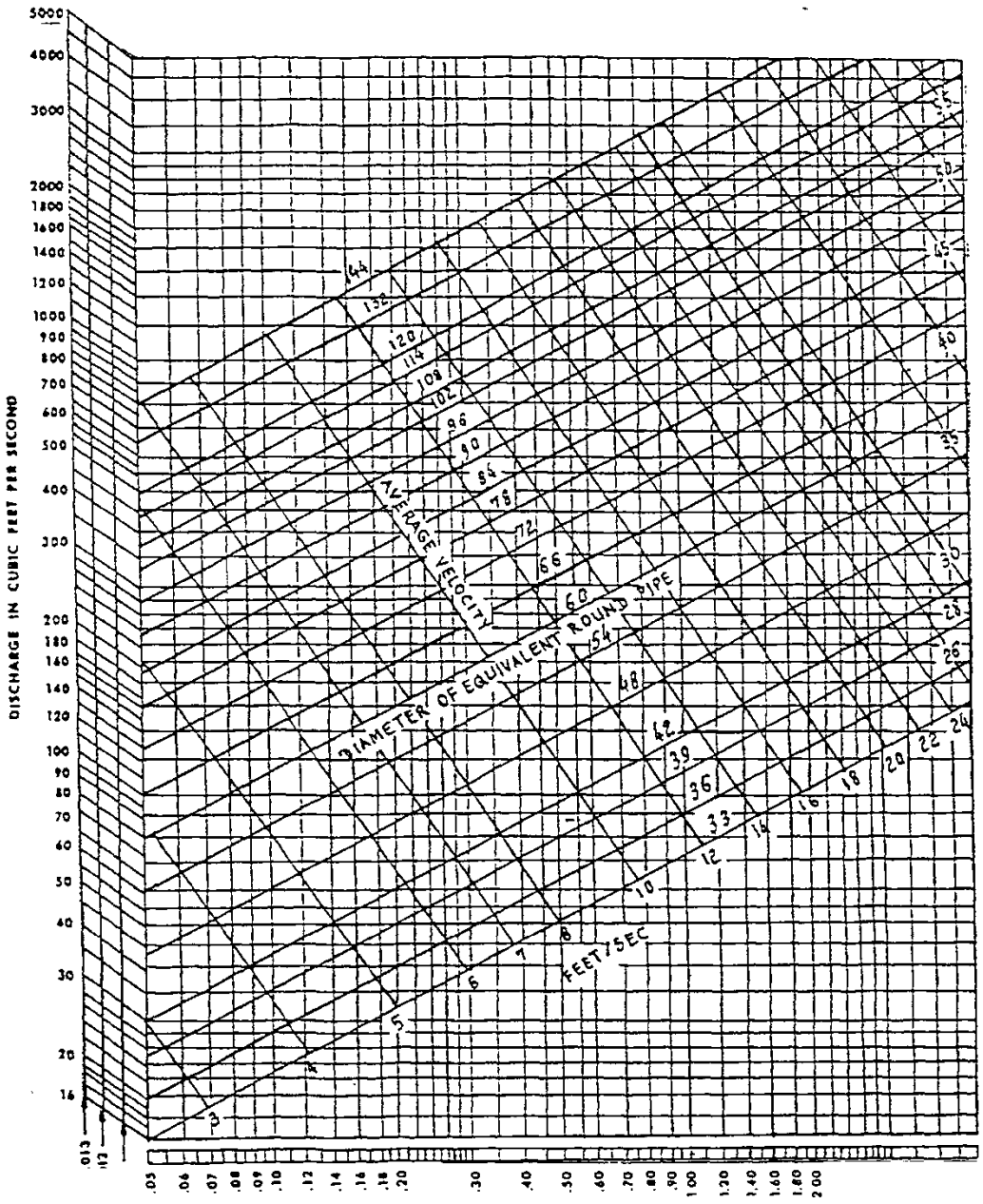
Rainfall Intensity in Inches per Hour

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 station, 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 station, 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 agency.

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 agency.

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.

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

The layout of the storm system shall place the storm and sanitary sewers on opposite sides of roadways and within the tree lawn areas where practical. Where opposite side construction is not practical, every effort shall be made to separate the storm and sanitary sewers by six (6') feet barrel to barrel. Vertical and horizontal alignment of storm sewers shall be in general conformance with Section 3.206. Manhole spacing shall be also as described in Section 3.206. 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.

B. **Minimum Size**

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.

C. **Types of Storm Sewer Conduits**

In addition to conduits recommended 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.

    Pipe shall be installed in accordance with Uniform Standard Sewer Details. Only wye branch fittings will be accepted for service connections for flexible sewers up to and including 18" diameter. For flexible sewers 21” and larger and concrete sewers 12” and larger, tee connections are permitted.

    Deflection testing and televising is required a minimum of 60 days after installation on all PVC , fiberglass , PVC composite wall , high density polyethylene , and polypropylene corrugated wall storm sewer pipe with a pipe stiffness less than 200 PSI. Air testing is not required for storm sewers.

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

D. **Lateral Connections**

Lateral connections to building sites shall be a minimum of six inches in diameter and of the materials listed in Section 3.303 Part C.

E. **Storm Sewer Joints**

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 have premium joints conforming 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. Exceptions may be allowed upon approval of the Municipal Engineer where work is being performed.

F. **Depths of Sewers**

In general, the storm sewer crown shall be at least 8 1/2 feet below the finished grade at the building line in residential districts with basements and 10 1/2 feet below the finished grade at the building line in all other areas with basements, measured to the crown of the conduit in order to eliminate the need for basement sump pumps. Conduits shallower than this requirement shall be considered as a special project, unless the development area will have houses and buildings without basements.

G. **Velocities**

Storm sewers should have a minimum flowing full velocity of three feet per second and a maximum velocity of 15 feet per second.

H. **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.

I. **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 36 feet center to center (maximum)

35% to 50% slope-anchorage shall be 24 feet center to center (maximum) over 50% slope-anchorage shall be 16 feet center to center (maximum) Concrete anchorage will be installed on the down side of each bell.

3.304 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 owner and/or the 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 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 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.

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 owner and/or the 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 Best Management Practices (BMPs) 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 BMPs to the municipality/village/township in accordance with their requirements. In addition to the storm water management regulations, the owner/developer shall adhere to all the requirements of any local municipality's Riparian ordinances.

3.305 DETENTION/RETENTION BASINS

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 retention/detention basin 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 Northeast Ohio Regional Sewer District for review and comment only.

Maximum storm water discharge from any project may be established by the responsible agency 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 or permanent detention/retention basins as per Ohio EPA requirements.

3.306 CULVERTS

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 head water 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 stream bed or enclosing an existing stream.

3.307 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-2 or ODOT HW-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 may be used at the end of outlet pipes with flows greater than 18 feet per second.

3.308 ORGANIZATION OF COMPUTATIONS

The Standard Computation Sheet contained in Part 6, shall be filled out for each project and submitted to the approving governmental agency 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.

PART 3 – STANDARDS FOR SEWERAGE FACILITIES

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. 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 which 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 a man 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.

PART 3 - STANDARDS FOR SEWERAGE FACILITIES

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.

PART 3 – STANDARDS FOR SEWERAGE FACILITIES

3.6 - DESIGN OF GREASE TRAPS/INTERCEPTORS

3.601 Grease Trap/Interceptor Sizing

A. General

B. General Sizing Requirements

C. Grease Trap/Interceptor Sizing Formulas

1. Method 1 – Uniform Plumbing Code
2. Method 2 – United States Environmental Protection Agency Method

D. Mechanical Grease Trap Sizing

3.602 Waste Generator's Responsibilities

3.603 Grease Trap/Interceptor Materials

3.604 Grease Trap/Interceptor Layout

3.605 Other Types of Interceptors and Sizing Requirements

A. Laundries

B. Car Washes

C. Automobile Repair Facilities (Garages and Service Stations)

3.601 GREASE TRAP/INTERCEPTOR SIZING

A. General

Grease trap/interceptor requirements and sizing are based on standard industry practices found in both the 1997 International Plumbing Code (IPC) commentary and the Uniform Plumbing Code (UPC). These grease traps/interceptors requirements are applicable to all commercial food service establishments including 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 trap/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 agency 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 generator, to provide the appropriated level of treatment necessary to be in compliance with local, state and federal wastewater regulations.

Minimum acceptable grease interceptor sizing shall be accomplished as follows.

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

2. Where sizing formulas result in determination of a grease interceptor less that 1500 gallons in capacity, the minimum size of 1500 gallons is required.

3. In instances where it is physically impossible to install an outside grease trap, a letter must be submitted to the Municipal Engineer or responsible agency indicating the reasons the grease trap/interceptor cannot be installed outside and requesting a variance from the standards.

4. 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 is 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 3.605). Grease trap will be sized as per section 3.601.D – Mechanical Grease Trap Sizing.

C. Grease Trap/Interceptor Sizing Formulas

Grease trap/interceptor design and sizing will be performed using either Method 1 or Method 2 formulas shown below. The designer may choose either method for sizing the facility.

The formulas below are applicable for restaurant type establishments. Grease trap/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.

1. Method 1 – Uniform Plumbing Code

   (# of meals/per peak hour) x (waste flow Rate) x (retention) x (storage) = size

   (1) (2) (3) (4)

Factors:

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

b. Waste Flow Rate:
   1) with dishwasher…… 6 gallon flow
   2) without dishwasher…….. 5 gallon flow
   3) single service kitchen…… 2 gallon flow
   4) Food waste disposer……. 1 gallon flow

c. Retention times
   1) Commercial kitchen waste/dishwasher…….. 2.5 hours
   2) Single service kitchen/single serving……. 1.5 hours

d. Storage factors
   1) Fully equipped commercial kitchen…….. 8 hr. operation = 1
   2) Fully equipped commercial kitchen…….. 16 hr. operation = 2

3) Fully equipped commercial kitchen…….. 24 hr. operation = 3

4) Single service kitchen…… = 1.5

2. Method 2 - United States Environmental Protection Agency Method

(# seats)(gal/meal)(storage factor)(hours open/2)(loading factor) = size requirement

a. # gallons/meal = 5

b. Storage factor = 1.7

c. Loading factor = 1.25 for an interstate highway

= 1.0 for other freeways and recreational areas

= 0.8 for main highways

= 0.5 for other roadways

D. Mechanical Grease Trap Sizing

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.

Table 3-4	
Capacity of Grease Traps	
Total Flow Through Rating (GPM)	Grease Retention Capacity (Pounds)
4	8
6	12
7	14
9	18
10	20
12	24
14	28
15	30
18	36
20	40
25	50
35	70
50	100
-Proper sizing to be approved by Municipal Engineer or Responsible Agency	

3.602 WASTE GENERATOR'S RESPONSIBILITY

It is the responsibility of the waste generator to insure 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 or grit traps. 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.

Waste generators are responsible for maintaining grease interceptors in continuous proper working condition, by removing the oil and grease 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, or installing apparatus and equipment as necessary to ensure proper operations and function of grease interceptors and compliance with discharge limitations at all times.

Grease trap/interceptor maintenance records shall be maintained by the waste generator on site for review and inspection by the responsible agency for the life of the system.

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

3.603 GREASE TRAP/INTERCEPTOR MATERIALS

Grease traps may be constructed of reinforced 4000 psi concrete, high density polyethylene, or fiberglass.

3.604 GREASE TRAP/INTERCEPTOR LAYOUT

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

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

2. The grease interceptor shall be constructed with a minimum of one baffle.

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

4. All grease bearing waste streams should 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 station may be plumbed to the sanitary system without passing through the grease interceptor with the condition that the receiving drain is a minimum of two inches above the finished floor.

5. All concrete grease interceptors will be equipped with a minimum of one 24 inch diameter access hole, and additional access holes at the inlet and outlet sides of the tank to ease cleaning. All interceptors shall be vented.

3.605 OTHER TYPES OF INTERCEPTORS AND SIZING REQUIREMENTS

Interceptors are required for oil, grease, sand and other substances harmful or hazardous to the building drainage system, the public sewer or sewage treatment plant. A licensed plumbing contractor or professional engineer must submit the design, size, and location of pretreatment devices to the responsible agency for review and approval.

A. Laundries

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 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 comprises 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 HS-20 traffic loading specifications. Lint traps in traffic areas require a concrete driving surface over piping with structural backfill around piping.

1. Maintenance. The lint interceptor should be cleaned or pumped out routinely to prevent the escape of appreciable quantities of grease. 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, and 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.

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.

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.

An effluent sampling well shall be required.

C. <u>Automotive Repair Facilities (Garages and Service Stations)</u>

Automotive repair shops which include a floor drain in its areas of operation shall be required to design, install and maintain a grit trap/oil separator, with a minimum capacity of 50 gallons for the first 100 square feet of area to be drained, plus 1 cu. ft (7.5 gals) for each additional 100 sq. foot of area to be drained into the separator.

PART 4 - SEWER USE REGULATIONS

4.1 General Limitations

4.2 Discharge Quality Standards

A. Toxic Materials

B. Solids or Viscous Materials

C. Other Harmful Wastes

D. Maximum Concentration of Harmful Materials

4.3 Owner's Responsibilities

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.

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 which 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.

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 involvement

3. Illicit discharge detention and elimination

4. Construction site runoff control

5. Post construction stormwater management in new development and redevelopment

6. Pollution prevention and good housekeeping of municipal operations

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, any waters or wastes containing toxic solids, liquids, or gases in sufficient quantity either single 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 quantities or of such size capable of causing obstruction to the flow in sewers, or 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, and 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

No person shall discharge or cause to be discharged in accordance with the local municipality and/or Ohio EPA regulations the following described substances, materials, waters, or wastes if it appears, in the opinion of the responsible agency, that such wastes can harm either the sewers, sewer system or equipment, sewage treatment process or equipment, or have an adverse effect on the receiving stream, or can otherwise endanger life, limb, public property, or constitute a nuisance. In forming their opinion as to the acceptability of these wastes, the responsible agency will give consideration to such

factors as the quantities of subject wastes in relation to flows and velocities in the sewers, materials or construction of the sewers, nature of the sewage treatment process, capacity of the sewage treatment plant, and other pertinent factors. The substances prohibited are:

1. Solid or viscous substances which will or may cause obstruction to the flow in a sewer or other interference with the operation of the wastewater system.

2. Any wastewater having a pH less than 5.0 or higher than 12.5 or having any other corrosive property capable of causing damage or hazard to structures, equipment, or personnel of the system.

3. Any noxious or malodorous liquids, gases, or solids which either singly or by interaction are capable of creating a public nuisance or hazard to life or are sufficient to prevent entry into sewers for maintenance and repair.

4. Any substance that may cause the sewage treatment plant's treatment residues, sludges, or scums, to be unsuitable for reclamation and reuse or to interfere with the reclamation process.

5. Any substance that may cause the municipal or NEORSD facilities to violate its NPDES and/or other Disposal System Permits.

6. Any substance with color not removed in the treatment process, such as, but not limited to, dye wastes and vegetable tanning solutions.

7. Any wastewater having a temperature which will inhibit biological activity in the municipality's or NEORSD treatment plant or otherwise result in interference, but in no case wastewater with a temperature at the introduction into the POTW which exceeds 40 degrees Centigrade (104 degrees Fahrenheit).

8. Any slug load, which shall mean any pollutant, including oxygen demanding

pollutants (BOD, etc.), released in a single extraordinary discharge episode of such volume or strength as may cause interference to the municipality's or NEORSD facilities.

9. Any unpolluted water including, but not limited to non-contact cooling water in areas of the municipality or NEORSD service area serviced by separate storm and sanitary sewers.

10. Any wastewater containing any radioactive wastes or isotopes of such half-life or concentration as exceed limits established by NEORSD in compliance with applicable Local, State, or Federal regulations.

11. Any wastewater that causes a hazard to human life or creates a public nuisance.

12. Any water or waste containing petroleum oil, non-biodegradable cutting oil or products of mineral origin in sufficient quantities as may pass through or interfere with municipal or NEORSD operations, or, at the discretion of the NEORSD Executive Director, water or wastes containing fats, wax, grease, or oils regardless of origin, and whether emulsified or not, in excess of 250 mg/L or containing substances which may solidify or become viscous at temperatures between 33 degrees and 150 degrees Fahrenheit (1 degree and 65 degrees Centigrade).

13. Discharges of trucked or hauled waste are prohibited except at specific discharge points designated in Title I, Chapters 7 and 10 of the NEORSD Code of Regulations.

14. Any water or wastes that are derived from the manufacture or blending of products containing certain bioaccumulative chemicals of concern (BCCs) or that are brought into a facility for the purpose of reclamation, recovery, or treatment of these chemicals, which include but may not be limited to: chlordane, 4,4'-DDD

(p,p'-DDD, 4,4'-TDE), 4,4'-DDE (p, p'-DDE), 4,4'-DDT (p, p'-DDT), dieldrin, hexachlorobenzene, hexachlorobutadiene (hexachlor-1, 3-butadience), hexachlorocyclohexanes (BHCs), alpha-hexachlorocyclohexane (alpha-BHC), beta-hexachlorocyclohexane (beta-BHC), delta-hexachlorocyclohexane (delta-BHC), lindane (gamma-hexachlorocyclohexane, gamma-BHC), mirex, octachlorostyrene, PCBs (polychlorinated biphenyls), pentachlorobenzene, photomirex, 2, 3, 7, 8-TCDD (dioxin), 1, 2, 3, 4-tetrachlorobenzene, 1, 2, 4, 5-tetrachlorobenzene, toxaphene.

D. **Maximum Concentration of Harmful Materials**

No discharger shall discharge wastewater containing concentrations of the following concentrations of the following enumerated materials, exceeding the following values, at any time:

Substance or Material		Concentration
Metals		
Cadmium		2 mg/L
Chromium Hexavalent		10 mg/L
Chromium Total		25 mg/L
Copper		3 mg/L
Nickel		10 mg/L
Iron		50 mg/L
Zinc		15 mg/L
Lead		2 mg/L
Cyanide		
Cyanide (Cl_2 amenable)		2 mg/L
Total Cyanide		10 mg/L
Phenols		50 mg/L
Solvents		
Carbon Tetrachloride	Maximum	
Tetrachloroethylene	Combined	1 mg/L

Trichloroethylene	Concentration
Methylene Chloride	25 mg/L
1, 1, 1, Trichloroethane	25 mg/L
Chlorobenzene	25 mg/L
O-Chlorobenzene	25 mg/L
Creosols	25 mg/L
Cresylic acid	25 mg/L
Nitrobenzene	25 mg/L
Toluene	25 mg/L
Carbon Disulfide	25 mg/L
Isobutanol	25 mg/L
Spent Chlorofluorocarbon solvents	25 mg/L
Methyl Ethyl Ketone	250 mg/L
Maximum combined solvent limitation is	250 mg/L

Mercury

Except where application of the most sensitive analytical method approved under Code of Federal Regulations 40 CFR part 136 for mercury in wastewater demonstrates to the NEORSD's satisfaction that no mercury is detectable in the user's discharge to the system, all Industrial Users are, for the purpose of this section, sources of mercury. All Industrial Users that are sources of mercury shall implement best management practices (BMPs), as defined under Section 2.0209 of NEORSD Code of Regulation, Title II-Pretreatment Regulation to minimize discharges of mercury to the system. Certain Industrial Users and/or classes of Industrial Users identified by the NEORSD as significant sources of mercury shall comply with NEORSD issued administrative orders requiring submittal and implementation of BMPs in a manner and to an extent satisfactory to the NEORSD and/or failing to fully comply with requirements in an administrative order shall be subject to charges as indicated under Section 2.0701 of NEORSD Code of Regulation, Title II-Pretreatment Regulation and/or refusal of service as indicated under

Section 1.0907 of Title I-Sewer Code of the NEORSD Code of Regulations.

4.3 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 owner at his expense.

Any wastes prohibited by these Regulations which 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 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.

PART 5 - STANDARD SPECIFICATIONS

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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), or 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.

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.

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 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 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 same in the work. It is the responsibility of the contractor to arrange for laboratory or field testing by a certified laboratory, and the cost of such samples shall be included in the unit prices bid for the various items of work. The cost of the actual testing of the material shall be at the expense of the responsible agency, unless otherwise specified in the contract. The Municipal Engineer or responsible agency may require the laboratory or field testing of cement, sand, brick, stone, and concrete supplied to the project.

B. **Certified Mill Tests**

Certificates of tests at mill by manufacturer shall be furnished for the following materials:

1. Ductile Iron Pipe, Fittings and Cast Iron Castings:
   Furnish certificates of tests by 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.

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 nonreinforced concrete sewer pipe furnished under these Specifications shall conform to all the latest requirements of Class 3 pipe in “Standard Specification for Nonreinforced Concrete Sewer, Storm Drain and Culvert Pipe”, ASTM Designation C14. Nonreinforced 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 I cement unless there is indication that sulfates may be a problem, in which case the pipe shall be manufactured with 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 an 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 300^{o} 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" to 15" diameter. All pipe and fittings shall have elastomeric seal joints. All pipe and fittings shall be marked or stenciled with the appropriate classification. All PVC composite pipe shall be televised and

deflection tested after being installed at least 60 days.

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" to 15" diameter; "Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-rated Pipe (SDR Series), ASTM D2241 for 4" to 36" diameter; "Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings", ASTM F949 for 4" to 36" diameter; "Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter", ASTM F794 for 4" to 48" diameter; "Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings", ASTM F679 for 18" to 36" diameter; "Standard Specification for Poly (Vinyl Chloride) (PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter", ASTM F1803 for 18" to 60" diameter; "Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter", AASHTO M304 for 4" to 48" diameter. All pipes and fittings shall be marked or stenciled with the appropriate classification. All PVC pipe shall be televised and deflection tested after being installed at least 60 days.

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" to 144" diameter. All fiberglass pipe shall be televised and deflection tested after being installed at least 60 days.

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 to 60in. (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" to 60" diameter. HDPE pipe may be used for pressure storm sewers only with the approval of the Municipal Engineer or responsible agency. All HDPE pipe shall be televised and deflection tested after being installed at least 60 days.

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" to 30" diameter and for non-pressure storm sewers from 12" to 30". 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" to 60" diameter.

All polypropylene corrugated double wall sanitary sewer pipe shall conform to the latest requirements of "Standards Specification for 6 to 30in. (152 to 762mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe", ASTM F2736.

All Polypropylene corrugated triple wall sanitary sewer pipe shall conform to the latest requirements of "Standard Specification for 30 to 60in. (750 to 1500mm) Polypropylene (PP) Corrugated 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 Corrugatted Polypropylene Pipe:, AASHTO M330 for 300 mm to 1500 mm (12 in – 60 in) 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.

All polypropylene corrugated double wall or triple wall pipe shall be televised and deflection tested after being installed at least 60 days. 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" to 120" 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. **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. 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. 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. For Polyvinyl Chloride (PVC) Composite Wall Pipe

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

E. For Fiberglass (Glass Fiber Reinforced Thermosetting) Pipe

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

F. 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. For Steel Sheet Aluminized Coated Type 2 for Corrugated Steel Pipe

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

H. 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 water tight joints cannot be obtained. All joints shall conform to ASTM A760/A760M and ASTM A798/A798M.

I. 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. 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 water tight and meet the requirements of ASTM D3212 and each spigot shall have two gaskets meeting the requirements of ASTM F477.

K. 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. 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 from3/4 inch diameter to 27 inch diameter. Stainless steel clamps shall be used to secure the couplings. The couplings may be Fernco, Pasco or approved equal.

M. **For Connecting Laterals to Cored Pipe**

Resilient rubber material with stainless steel clamps may be used to connect lateral sewer pipes to mainline sewers for concrete sewers 12 inches in diameter and larger with lateral sizes of 4 inches to 15 inches in diameter. For PVC pipe and other smooth wall pipe greater than 18 inches in diameter and less than 33 inches in diameter, 4, 6 or 8 inch diameter saddles may be used. The resilient rubber material shall meet and be constructed in accordance with ASTM C923 and shall provide a watertight seal. The stainless steel clamps shall meet the requirements of ASTM C923, ASTM A666 and ASTM A240.

The resilient rubber connection 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.

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

sheets 2 and 3 of the Uniform Standard Sewer Details. 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 casting 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.

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

They 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 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 Sheets. 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 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 “Standards 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.

Landing platforms shall be installed in manholes over 28 feet deep to the invert. The maximum vertical spacing for landing platforms shall be 20 feet. A minimum 3 inch

vertical wall on all new sanitary sewers shall be required below the casting for the installation of chimney seals.

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 added shall be at mixer.

Cement for job-mixed concrete shall be furnished in unbroken 94 pound bags marked with the brand of the manufacturer and 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. Cost of water shall be included in the unit prices

bid for the various items of work unless otherwise designated by the responsible agency.

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” length by 4” width by 2 ½” 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 Specifications.

All shale brick furnished or used under these Specifications 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. Furnish bricks that 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" diameter pipe or smaller. For 66" 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 bedding.

5.125 PREMIUM BACKFILL

A. Limestone Aggregate

Premium backfill shall be used for backfilling trenches under pavement, sidewalks, and driveways. Premium backfill shall consist of coarse interlocking limestone aggregate No. 57, 6, 67, 68, 7, 78, 8, ODOT CMS Item 304 limestone, or limestone screenings. Slag, river gravel, and foundry sand shall not be permitted.

Sandstone, meeting the gradation requirements of limestone premium backfill, and recycled concrete may only be used for backfill in special projects provided it is approved by the Municipal Engineer or the responsible agency.

B. Cleveland Low Strength Mortar Backfill

Cleveland Low Strength Mortar (LSM) Backfill may be used in lieu of limestone aggregate provided it is approved by the Municipal Engineer or responsible agency.

Cleveland Low Strength Mortar Backfill shall use ASTM C150 Type I cement. 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.

The compressive strength for the mix shall be between 50 and 80 psi at 28 days.

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 conforming to ODOT CMS 748.07. All joints in clay pipe in the trench shall be covered with polyethylene material before placing the LSM fill.

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.

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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. The full cost of bypassing and maintaining sewage flow shall be included in the prices bid for other items of work and no additional compensation will be allowed unless otherwise specified in the contract.

B. Replacing, Moving and Repairing of Existing Structures

The contractor shall be responsible for the replacement, movement or repair and maintenance of all sewers, drains, catch basins, manholes, culverts, water lines, steam lines, air or gas lines, wire conduit(s) and any other appurtenances or structures encountered in the performance of said work, together in conjunction with all house connections 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. Water lines, sewers, and drainage structures disturbed by the contractor shall be fixed by the contractor, at the contractor's costs. Written permission from the owner must be obtained prior to initiating any construction on privately owned lines, equipment or appurtenances.

Unless otherwise specified in the contract by the responsible agency, the contractor shall have the responsibility of paying to replace, move or repair and maintain all pipes for water, steam, air or gas, and all wire conduit(s), and all other structures encountered in the work and 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, restore all existing utilities and structures to the full satisfaction of the responsible agency engineer.

The full cost of replacing, moving, supporting or repairing all damage done to any of the said structures encountered in excavation, whether or not shown on the plans, shall be included in the unit prices bid for other items of work, and no additional compensation will be allowed therefore, unless otherwise specified in the contract.

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 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 such items to prevent breakage and shall include the entire cost of sandfilling, Cleveland low strength mortar backfill, bulkheading and removal and backfilling of existing sewers and appurtenances in the unit prices bid for sewers in place unless otherwise specified in the contract.

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

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. The full cost of such work shall be included in the unit prices bid for sewers in place unless otherwise specified in the contract. 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 Ohio EPA. 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 City Arborist and Owner shall be notified of tree removals or tree trimming. The entire cost of removing all sizes of trees and tree trimming shall be included in the prices bid for other items of work and no additional compensation will be allowed therefore, unless otherwise specified in the contract.

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 before and during grading and repeat as needed, 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 will 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 may 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 may 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 as needed, utilizing a street vacuum or bucket-type endloader or scraper.

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

The full cost of this work shall be included in the unit prices bid for other items of work, and no additional compensation will be allowed therefore, unless otherwise specified in the contract.

G. **Equipment**

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.

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

provision 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 relates to the work. Prior to excavation, exploratory test pits shall be coordinated with the Municipal Engineer or responsible agency and the property owner. The cost of such work shall be included in the unit prices bid for sewers in place, unless otherwise specified in the contract.

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 responsible agency shall establish all base lines and bench marks 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 responsible agency's surveyor. The end of laterals and all "Y" branches shall be staked by the contractor and the maximum placement of hubs shall be fifty (50) feet. All manholes and inlet basins shall be set to grade by the contractor. The final 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. Areas, in which lasers are used, must be posted with standard laser warning placards and 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, except for the project baseline layout and

benchmarks which shall be set by the Municipal Engineer or responsible agency, for the complete layout and performance of the work under this Contract shall be done by the contractor 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.

   Unless otherwise specified, the responsible agency 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 the information provided by the responsible agency 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 will verify the responsible agency's benchmark survey and shall notify the responsible agency's engineer of any discrepancies in the agency's survey 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 Specifications. 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 provided, all excavation shall be unclassified and shall include the removal and disposal of all material encountered in excavation, including pavement surface, pavement base, rock, peat, foundry sand, and any other materials. It shall also include the placing and removal of the sheeting and bracing, and removing water encountered. All excavated materials shall be stored in convenient piles near the construction work sites or removed from the site 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" 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" 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. When Type I bedding is used, the cost of all bedding, as described above, shall be included in the price bid for the various pipe items unless otherwise shown.

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.

When Type II bedding or capping of pipe is used, the cost of all bedding, as described above, shall be included in the price bid for the various pipe items.

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.

   The cost of concrete anchorage shall be included in the contract unit price for the sewer complete in place and no additional compensation will be allowed therefore, unless otherwise specified in the contract.

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 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 of blast vibration monitoring equipment by certified professionals may be required by the Municipal Engineer or responsible agency. The survey and monitoring shall be included in the unit price bid for sewer, by size and type, and no additional payment shall be made for this item.

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. In case tunneling is permitted under pavements, or specifically called for on the plans, the work shall be done in accordance with the supplemental specifications. The contractor must take out the necessary permits and make the necessary deposits for the proper replacing of pavement support or the breaking down and 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 "Boring Details for Paved Areas" Sheet No. 26 in the Uniform Standards Sewer Details. Material, equipment and construction procedures shall comply with the contract documents and shall be in accordance with the supplemental specifications. 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 or 1:6 grout. Brick bulkheads or wrap around rubber end seals shall be provided at each end of the casing pipe.

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

At the locations shown on the contract documents, the 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. 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, and subsoil water 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 and it will be paid for at the unit price bid for underdrains, unless otherwise specified.

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. Unless otherwise specified, the full cost of such shall be included in other items of work and no additional compensation will be provided therefore, unless otherwise specified in the contract.

J. **Paved Surfaces**

The contractor shall remove all pavements, road surfaces, curbing, driveways, and sidewalks within the lines of excavation. The contractor shall clean saw cut the pavement and base the width of trench without undue shattering. After the sewer pipe is installed and backfilled the contractor shall saw cut the existing pavement again on both sides of the trench 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. The full cost of such work shall be included in the unit prices bid for sewers in place, unless otherwise specified.

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

The use of track mounted excavation machinery will be permitted in all unpavement 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 mats in all pavement areas. The full cost of such work shall be included in the unit prices bid for sewers in place, unless otherwise specified.

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 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. The full cost of such shall be included in the unit prices bid for sewers in place, unless otherwise specified.

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 Detail Drawings.

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 insure 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.

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 provision of Section 5.115.

G. **Joints for Ductile Iron Pipe**

Joints for Ductile Iron Pipe shall be watertight and shall conform to the provision 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 provision 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. **Extent of Backfill**

The backfill includes furnishing suitable backfill material, placing all backfill in lifts 12 inches or less loose depth, compacting the backfill to a minimum 98% maximum dry density as measured by the Standard Proctor Test or as required by the Municipal Engineer or responsible agency, the regrading of adjacent disturbed areas, the replacing or repairing of drains and other surface and subsurface structures, the placing and maintaining of temporary sidewalks and driveways and all appurtenant work incidental thereto. Puddling of backfill material will not be permitted. Compaction shall be done using either a sheep foot roller, vibrating plate tamper or mechanical tampers.

B. **Backfill Material**

If approved by the responsible agency, material excavated from the trench shall be suitable for backfill except in areas under pavement and within the zone of influence which is the area which is at a 45 degree angle from the bottom of pavement base or back of curb. The contractor shall secure suitable material from other sources if

required. 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. 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 within a trench with flexible pipes shall be tested for compaction and 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. All testing shall be done at the contractor's expense and included in the unit price bid per linear foot of sewer, unless otherwise specified.

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.

C. **Premium Backfill**

At all locations where existing pavement, driveways, concrete gutters, and sidewalks are removed in the sewer construction and/at proposed locations of new pavement, driveways, concrete gutters and sidewalks, all backfilling of the sewer trench shall be made with approved premium coarse limestone aggregate or limestone screenings. Cleveland low strength mortar backfill, if approved by the Municipal Engineer or responsible agency, may also be used for premium backfill. The contractor shall take additional care to monitor the moisture content, maximum depth of each lift and compaction requirements whenever limestone screenings are used for backfill within the road right of way. The premium backfill shall be brought up evenly and placed in maximum 12 inch horizontal layers and compacted to a minimum 98% maximum dry density as measured by the Standard Proctor Test. Premium backfill shall extend to four (4') feet beyond the edge of pavement for transverse sewers. For sewers parallel to the roadway the depth of premium backfill behind the edge of pavement shall be determined by the width of the zone of influence which is a line drawn at a 45 degree angle from the bottom of pavement base or back of curb.

Recycled concrete or sandstone backfill shall only be permitted to be used for backfill as a special project with the approval of the Municipal Engineer or responsible agency.

The pipe bedding and cover shall be in accordance with Sections 5.122 and 5.123 of the Standard Specifications and the "Typical Trench Details" Sheet No. 11 of the Uniform Standard Sewer Details.

D. **Additional Premium Backfill**

Where ordered by the responsible agency, sections of the trench, other than those specified above or called for on the plans, shall also be backfilled with premium material. All such additional premium backfilling ordered by the responsible agency will be paid for at the contract unit price bid for "Additional Premium Backfill Material" unless otherwise specified. It is the contractor's responsibility that the pipe bedding and cover is in accordance with the "Typical Trench Details" Sheet No. 11/27 of Uniform Standard Sewer Details.

5.206 DISPOSAL OF SURPLUS EXCAVATED MATERIAL

All surplus excavated material shall be removed and disposed of by the contractor. The cost of this work shall be included in the contract unit price bid for sewers and no additional compensation will be allowed, therefore, unless otherwise specified. Hazardous materials, as defined by Ohio EPA that is removed from the trench or project shall be disposed of in accordance with Ohio EPA regulations. Removal and disposal of hazardous material, including all testing of the material, will be compensated for at a separate negotiated or change order item, unless specifically included in the contract bid items. The contractor shall be responsible for providing all documentation that the hazardous material has been 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. Branch connections and risers shall be included in the contract unit price unless otherwise specified. All pipe joints shall be carefully made and shall conform to the requirements in these Specifications 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.

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 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 5.118. 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 5.118. All manholes shall be a minimum of 48 inches in diameter.

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. 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.

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 sewer.

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. 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 equal. 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. The contractor shall furnish and set in mortar, upon the top of each manhole, a cast iron manhole ring and cover.

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. Sanitary manhole covers shall have the notation "SANITARY" on the covers. 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 and grade rings shall be sealed externally and between grade rings with a layer of mastic compound such as Fabertite, Kent Seal, Conseal or equal. Where the pipe passes through the outside face of manhole walls, a pipe joint 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 and combined sewers entering manholes. The top section of the precast manhole may be eccentric cone, concentric cone or flat slab. A urethane mastic shall be used to seal the casting to the grade rings, and the contractor shall grout around the outside of all grade rings. Joint seals between precast manhole sections shall be flexible gasketed joints meeting the requirements of ASTM C443.

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 shall be installed in manholes that are over 28 feet deep to the invert with a maximum vertical spacing of 20 feet.

New sanitary sewer manholes shall be equipped with chimney seals. Chimney seals can either be installed internally or externally. 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 and adjustable and 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". The rubber portion of the seal shall have a minimum thickness of 3/16" 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" 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.

Sanitary manholes shall be vacuum tested as per Section 5.211B.6 of these

specifications.

All costs for furnishing and installing the seal shall be included in the unit price bid for sanitary manholes.

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" 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 will be required for manholes in traffic areas. A traffic rated HS-20 loading frame and cover will also be required in traffic areas. Calculation for the design of the concrete pad 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. Special interior drop manholes shall be used when the sewer entering the manhole is two (2) feet or greater above the manhole invert. New manholes receiving discharge from force mains shall have an internal drop connection. New manholes which have force main discharge lines should have an internal epoxy coating to prevent concrete corrosion and deterioration. The exterior drop pipe 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. The cost of the drop and such encasement shall be included in the contract unit price for the drop manhole, complete, in place, unless otherwise specified.

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. 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" wide by 1/8" 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 existing manhole wall shall be field cored and a watertight boot connection made with the influent pipe. The interval drop pipe shall be constructed as shown on the Inside Drop Added to Existing Manhole detail shown in the Uniform Standards Sewer Details. 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.

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, cementitous-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

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 a vacuum test that is done in accordance with ASTM C1244. Upon plugging/securing all projecting and connecting pipes, the vacuum equipment shall be sealed in place and a vacuum of 10 inches of mercury shall be drawn into the manhole and the pump shut off. With the valve closed, the time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole

shall pass the test if the time expired is greater than 60 seconds for a 48 inch diameter manhole. Manholes failing the test shall be repaired at the contractor's expense and retested until they pass.

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 cementatious 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. The placement time for the material shall be 5 to 10 minutes and the set time shall be 15 to 30 minutes.

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.

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 -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 alkalies. The seal material shall have a minimal tensile strength of 54 lbs./ square inch; 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. Minimally, 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 10000 psi; a minimum flexural strength of 4000 psi; a minimum tensile strength of 2200 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 accepted.

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 per the Standard Cuyahoga Department of Public Works Standard Details or State of Ohio Department of Transportation Standard Construction Drawings, depending on the responsible agency's requirements. 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 gates 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 or H-10 loading for pedestrian traffic. 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 will be poured under the grate and frame as recommended by the manufacturer.

PVC surface drainage inlets maybe 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 coarses of brick nine inches (9) thick, unless otherwise specified, and with a one-half inch (1/2) coating of 1 to 2 cement mortar. The cost of constructing bulkheads shall be included in the contract price bid for various sewer items and no additional compensation will be allowed, therefore, unless otherwise specified.

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. The cost of frost and dampness protection of masonry shall be included in the contract price bid for various sewer items and no additional compensation will be allowed, therefore, unless otherwise specified.

B. Mortar

Mortar shall be composed of one (1) part, Portland cement, 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 Specifications 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, inspection and testing, 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 Specifications.

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 C31/31M. 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 40^{o} 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/C39M39.

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 test 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 which 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 bars. No concrete that has partially hardened or been contaminated by foreign material shall be deposited on 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

Provision shall be made for maintaining concrete in a moist condition for at least seven (7) days after the placement of the concrete, except 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 atmosphere temperature is 40^{o} F or less. No frozen 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 40^{o} F, all concrete in the forms shall have temperatures of between 50^{o} F and 80^{o} F, and adequate means shall be provided for maintaining a temperature of not less than 50^{o} F for five (5) days, except, when high-early-strength concrete is used, the temperature shall be maintained at not less than 50^{o} 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 should 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, and shall be substantial and sufficiently tight to prevent leakage of cement. They 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 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 support safely 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 to be epoxy coated for all cast-in place headwalls, box culverts, inlets, catch basins, reinforced concrete channels and all other areas 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 inches (3). Where concrete is exposed to the weather, or exposed to the ground but placed in forms, not less than two inches (2) 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.

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 mark each service connection by witness signs cut into the sidewalk or curb. 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 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 should 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 which 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 4.0 psig internal pressure. 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 back pressure 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 Length, s	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	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53

Minimum Test Time for Concrete and Clay Pipes		
Nominal Pipe Size (in.)	**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 workership and then re-test the installation for compliance with these Specifications 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; Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe, ASTM D3262; 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 relaid 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.

The Municipal Engineer or responsible agency may require air test or weir test on storm sewers.

3. Weir Test

Weir test 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, wiers, 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 and video inspected 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 locating area 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 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 north arrow and scale, manhole numbers, street names, project name, developer's name if applicable, municipality name, 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 shall indicate the project name, video recording company's name, municipality, date of recording, size and type of pipe material, beginning and end manhole identification numbers and stationing, if applicable, total footage of sewer run, location of all wye or tee connections by footage distance and either by left or right designation or by an "o'clock" description, location and description of open, partially open, cracked or leaking pipe joints, location description of cracked, deflected, leaking or damaged pipe, location and description of standing water beginning and end points and maximum depth, obstructions such as stones, mud or soil, leaves, etc., submerged camera locations, water vapor, block pipe preventing camera travel, changes in pipe material type, or any other unusual features.

Prior to video inspecting and recording the sewer shall be cleaned of all silt, rock, and debris. All video inspection shall be included in the unit price bid per linear foot of sewer unless otherwise indicated in the contract

5. Visual Inspection

All storm sewers and sanitary sewers 48 inch diameter and larger constructed

under these Standards shall be subjected to visual inspection and an inspection report detailing the condition of the pipe and pipe joints shall be made prior to acceptance of the sewer. Costs of the inspection and report shall be included in the unit price bid per linear feet of sewer, unless otherwise provided for in the specifications. The responsible agency shall retain ownership of all inspection records.

Whenever storm sewer or sanitary sewer work is adjacent to a water main, test 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.

In case 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 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 to 9" Hg**
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 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 pipe lines 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. All testing and repairs shall be included in the unit price bid for sewers and force mains in place and no additional compensation will be provided, therefore, unless otherwise specified.

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 which 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 0^{o} F. At temperatures between 32^{o} F and 0^{o} 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.

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.

The Municipal Engineer or responsible agency shall minimally require the

manufacturer's technical data for the lining material and resin with installation instructions and curing details, 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 and any other project related submittals shall be submitted to the Municipal Engineer or responsible agency for approval.

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" to 144" 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. A pre-lining video of the host pipe 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. 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 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 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.

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 minimally require the manufacturer’s technical data and installation instructions and curing details, 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 and any other project related submittals 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 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" to 18" 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. A pre-lining video of the host pipe 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 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. Complete sealing work shall be done immediately after the liner is cured. 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.

Symmetrical reduction can be done by either 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 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 it 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. Bypassing of the flow 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 using closed circuit TV. No infiltration of ground water should be observed.

The Municipal Engineer or responsible agency shall minimally 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, and contractor certification and history of lining. The Municipal Engineer or responsible agency shall be required to approve the method of

flow bypass, pipe line cleaning, CCTV inspection and any other site specific needs.

5.217 PIPE REHABILITATION USING PIPE LINER

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 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. 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 methods for sewer flow control, sewer line cleaning, pre- and post- sewer television inspection, manhole rehabilitation, 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 to ensure it is clean, dry and stable. The TV inspection may be augmented by visual 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. Place flowable fill as directed by the Municipal Engineer or responsible agency to maintain the stability of the host pipe.

Install the pipe liner using one of the following methods: Slip lining, spiral winding or paneling. 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.

Use either polyethylene, high density polyethylene, polyvinyl chloride, fiberglass, or aluminum pipe liner. Install the liner 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 to 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 internal diameters. 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 not approved by the Municipal Engineer or responsible agency. Mixes 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, such as heavy solids, dropped joints, or collapsed pipe, in the existing 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 be CCTV. 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 minimally require the manufacturer's technical data for the lining material and annular grout with installation instructions and 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, and any other project related submittals requested by the Municipal Engineer or responsible agency.

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" to 12" diameter pipe and two pipe sizes for pipes greater than 12" 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 performed by trained personnel.

Prior to beginning the pipe bursting the pipe shall be inspected by closed circuit television 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 meet the maximums 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 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" 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.

Non-reinforced cement mortar spray on linings adds 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 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 the thickness of the lining varying 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 mixed well in proper consistency to obtain 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 specification.

Prior to cement lining the pipe, the pipe shall be inspected using CCTV 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 use a remote control or winch powered lining machine. For pipes 24 inches in diameter or larger use a remote control or man operated machine. Cement mortar shall be supplied either by 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 lining shall be inspected using 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 honey combing and irregularities. The contractor shall repair any damaged or cracked areas using hand applied and troweled cement mortar.

The Municipal Engineer or responsible agency shall minimally require to approve the contractor's method of flow bypass, pipe line cleaning, CCTV inspection, installation procedure, and any other site specific needs.

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 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 a 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” on the radius without approval of the Municipal Engineer or responsible agency. The annular space created by the overcut shall be filled with the lubricant that is suitable for the soil type encountered. The tunneling system must be capable of maintaining line and grade to 1” 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 with 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, the public and adjacent property, whether public or private. All damage to property shall be restored to equal or better condition than prior to construction. All shafts and jacking pits shall conform with 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 will not be permitted. The tunnel machine operator shall be 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 completed pipe section. Any pipe which 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 following is the minimum of details which 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.

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 closed circuit television and a copy of the video tape 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" to 48" 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.

Drilling operations must not interfere with, interrupt or endanger either surface or subsurface developments. The contractor must comply with all applicable OSHA requirements.

Pipe used shall be either High Density Polyethylene Pipe (HDPE) 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. Drilling fluid returns caused by fracturing of formations at locations other than the entry and exit points shall be minimized. The contractor will 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 pass 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, fusion technicians, 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. Test shall consist of a low-pressure air test of the sewer pipe before any service connections to the new 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 sewer pipe installation shall be internally inspected with a television camera and videotape. Finished tape 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 BMPs. 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 for the work, the contractor shall, as directed by the responsible agency, clear the sewers of any mortar, dirt, asphalt, roadway base material of 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 contract 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 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 be1 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 Seedings

Seedings 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 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

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 should be temporary seeded or covered with a tarp.

b) Spreading the Topsoil

Prior to applying topsoil, the topsoil should 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 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. The full cost of all clean-up, repairs, seeding, sodding, reseeding and resodding shall be included in the unit prices bid for other items or work, unless otherwise specified.

C. Protection of Trees and Shrubs During Construction

Roots two inches or larger that are severed by trenching should 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 that are damaged during construction and all appurtenant work incidental thereto, unless otherwise provided for in the plans and specifications. The full cost of this shall be included in the unit prices for sewers in place.

E. **Measurement for Payment**

1. General

The contract price per unit of storm sewer, sanitary sewer, manholes, catch basins, inlets, curb connections and other items, is for the work complete in place as shown on the plans and specifications regardless of the character of the

material encountered in the excavation, except for hazardous materials as defined by the EPA, or contingencies of any other nature, unless otherwise specified. Removal and disposal of hazardous waste material from the trench shall be paid as a separate item. Unit and lump sum prices for such work complete in place shall include the furnishing of all labor, materials, tools and equipment necessary for its proper performance, unless otherwise specified. All costs such as excavation, backfill, relocation, repair or replacement of existing structures, sheeting and bracing of excavations, clean-up and repairs, erosion and sediment control practices, such as BMPs, and all other operations required in the construction shall be included in the contract unit or lump sum prices, and no additional compensation will be allowed thereof unless otherwise specified. No additional payment will be made for excavation of rock, peat or foundry sand.

It is the intent of these Specifications that the cost of the work which does not have specific pay items provided for, shall be included in the contract unit or lump sum prices for items shown on the bid proposal.

2. Sewers

The number of linear feet of sewers to be paid for under their respective items, shall be the actual number of linear feet of each class and size, measured continuously along the center line of the sewer through manholes, "T"s and "Y" branches.

Such payment shall include the furnishing, laying, connecting, cleaning and televising and testing of the sewer; the excavation, sheeting and bracing, concrete encasement or cradling of the pipe, backfilling, including premium backfill; the replacement of all structures and pavements; repairing, reseeding or resodding all disturbed seeded or sodded areas; and the furnishing of all labor, materials, tools and equipment to complete the work as specified in the contract document or ordered by the responsible agency. Such payment shall include all items of expense except such items as are stated in the specifications to have separate payments.

When a sewer begins or ends at a manhole, measurement shall be made to the center of the manhole. At all points where sewers change size, the measurement for each size shall be made to the center of the manhole where the change is made.

3. Manholes

   The number of manholes of each type and diameter to be paid for under their respective items shall be the actual number of manholes of each type and diameter installed in the work, including excavation, backfill, masonry, stubs, cast iron and ductile iron frames, covers, steps, pipe drops, landing platforms, concrete, riser rings, chimney seals, testing, repairing all disturbed paved areas and seeding or sodding all areas disturbed by the installation, and all other required appurtenances, except such items as are stated in these specifications to have separate pay items.

4. Catch Basins and Inlets

   The number of catch basins and inlets to be paid for at the respective contract prices shall be the actual number of each type installed in the work, including excavation, backfill, masonry or reinforced concrete, cast iron and ductile iron frames, grates, steps, traps, stubs repairing any disturbed pavement or grassed areas, and all other required appurtenances.

5. Y-Branches, "T's, Y-Connections and Slants

   The number of branches, connections of each type and size to be paid for under their respective items shall be the actual number of such connections installed in the work. When Y-branches, "T"s, or slants require extensions to clear the sides of the concrete bedding and encasement, but no risers are necessary, the cost of such extensions shall be included in the price bid for each Y-branch, "T" or slant. There will be no deduction for these specials from the length of pipe to which they are connected.

6. Risers

   The number of linear feet of pipe riser to be paid for at the contract price, shall be the actual number of linear feet of each size of vertical risers furnished, laid and connected, measured from the bell end of the branch or slant at the sewer, along the center line of the riser pipe, including any intermediate bends. The cost of concrete or masonry encasements and excavation and regular or premium backfill shall be included in the contract unit price per linear foot of riser.

7. Lateral Connections

   Clay, PVC Composite Wall, Polyvinyl Chloride (PVC), polypropylene double wall, and ductile iron pipe lateral connections will be paid for at their respective contract unit prices per linear foot of each size of lateral connection installed from the branch connections or risers to the end of the lateral connection, regardless of kind of pipe or excavation or installation procedure used, unless otherwise specified.

   The prices bid shall include furnishing, laying and connecting pipe; the excavation by boring and jacking, or tunneling for ductile iron pipe and open cut for clay, PVC, PVC Composite Wall or polypropylene double wall pipe; concrete encasement where specified; sheeting and bracing; backfilling; replacement or repairing all structures, utilities, seeded, sodded or paved surfaces; and the furnishing of all labor, materials tools and equipment to complete the work as shown on the contract documents or ordered by the responsible agency. Lateral connections shown on the plans and details to be installed as six (6) inch clay pipe, six (6) inch ductile iron pipe, six (6) inch PVC Composite Wall Pipe, six (6) inch PVC and six (6) inch polypropylene double wall pipe all of which will be paid for at the same contract unit price bid per linear foot of lateral connection pipe whether installed by the open cut, boring, jacking or tunneling methods. Bends, increasers, and adapters will be included in the contract unit price bid.

8. Test Tee

   The number of test tees to be paid for shall be the actual number installed in the

work including all excavation, backfill, tee, riser pipe, cap with metal detector, concrete encasement, repairing all disturbed paved areas, seeding or sodding all areas disturbed by the installation and all required appurtenances.

9. Catch Basin and Inlet Connections

   The number of linear feet of each class and size of catch basin or inlet pipe connections to be paid for at the contract unit price shall be the actual number or linear feet of such pipe connections installed, measured from the center of the manhole, catch basin or inlet to the center of catch basin, inlet, or manhole, including concrete cradling or bedding for all catch basins and inlet connection pipe, and repairing all disturbed pavement and seeded or sodded areas.

   The contract unit price shall include all costs as described under other parts of Section 5.214 B of these Specifications including the cost of concrete cradling or bedding for all catch basins and inlet connections pipe.

10. Sheeting Ordered Left in Place

    The amount of sheeting in thousand feet board measure to be paid for at the contract unit price shall be the amount actually left in place by the contractor upon written order of the responsible agency. In no case will capping, bracing or sheeting used in tunnel construction be paid for as sheeting.

11. Tile Underdrain

    The number of linear feet of tile underdrain to be paid for at the contract unit price, shall be the number of linear feet of such underdrain actually installed in the work as shown in the contract plans or upon written order of the responsible agency. The cost of additional excavation, furnishing and placing of stone screening, tile and filter fabric wrap, if specified, shall be included in the contract unit price.

12. Additional Excavation

    The number of cubic yards of additional excavation to be paid for at the contract

unit price shall be the amount of additional excavation required by reason of increase in depths of the excavation, over and above that shown on the plans or excavation made necessary due to poor soil conditions encountered during construction that are not shown in the contract documents.

The number of cubic yards of excavation to be paid for at the contract unit price shall be established by computing the actual volume of material excavated by measuring the trench width, length of trench and depth below the normal bottom of trench bedding, unless otherwise specified.

13. Additional Premium Backfill

The number of cubic yards of additional premium backfill to be paid for at the contract prices shall be the actual amount of the respective materials installed in the work upon written order of the responsible agency, over and above that called for in the contract documents.

14. Additional Structural Concrete

The number of cubic yards of additional structural concrete to be paid for at the contract unit prices for plain and reinforced concrete respectively shall be the actual number of cubic yards installed in the work upon written order of the responsible agency, over and above that called for in the contract documents. Additional structural concrete does not include concrete used for bedding, cradling or fill.

The contract unit price shall include all cost of furnishing and placing of concrete and the form work. Reinforced concrete shall include the cost of steel in place, including epoxy coated reinforcing steel.

15. Additional Concrete Bedding, Cradling or Fill

The number of cubic yards of additional concrete bedding, cradling or fill to be paid for at the contract unit price shall be the actual number of cubic yards of such concrete installed in the work upon written order of the responsible agency, exclusive of quantities

which are specified to be included and paid for under other items of the work. The contract unit price shall include all cost of furnishing and placing of such concrete.

16. Sewers in Tunnel Construction

The number of linear feet of sewers in tunnel construction to be paid for under their respective items shall be the actual number of linear feet of each class and size, measured continuously along the center line of the sewer to the inside face of manholes, in shafts at the invert but not through them, and to the end of the tunnel construction wherever it is terminated.

Such payment shall include the proper construction of sewers in tunnel, including excavation, its disposal, sheeting, bracing and lining of the tunnel excavation, cement grouting, crane rails or channels, sewer pipe, concrete backfill, plain or reinforced, or encasements, connecting, cleaning and televising and testing of the sewer, the replacement of all disturbed structures and pavements and seeded or sodded areas and the furnishing of all labor, materials, tools and equipment to complete the work, as shown in the contract documents or ordered in writing by the responsible agency. Such payment shall include all items of expense except such items as are stated in the contract documents to have separate payments.

When sewer in tunnel construction ends at a manhole in a shaft, measurement shall be made to the nearest inside face of the wall of the manhole at the invert. At all points where sewers in tunnel construction change size, the measurement for each size shall be made to the nearest inside face of the wall of the manhole where the change is made.

17. Manholes in Shaft Construction

The number of manholes constructed in shafts of each type to be paid for under their respective items shall be the actual number of manholes in shafts of each type installed in the work, including the entire cost of the shafts, excavation, its disposal, sheeting, bracing ribs and lining of the shaft excavation, cement

grouting, masonry, concrete, reinforced and plain, or encasements, backfill, connecting of the sewer, steps and/or elevator for the full depth of the shaft, landing platforms, stubs, cast iron or ductile iron frames, covers, pipe drops, chimney seals, riser rings, testing, replacement of all disturbed structures, pavements, seeded or sodded areas and the furnishing of all labor, materials, tools and equipment to complete the work as specified and as shown in the contract documents. Such payment shall include all items of expense except such items as are stated in the contract documents to have separate payments.

18. Sewers in Bored or Jacked Casing Pipe

The number of linear feet of sewers in jacked or bored casing pipe construction to be paid for under their respective items shall be the actual number of linear feet of each class and size, measured continuously along the center line of the sewer to manholes in shafts, but not through them, and to the end of the jacked or bored casing pipe construction wherever it is terminated. Such payment shall include the proper construction of sewers in jacked or bored casing pipe, including excavation, its disposal, sheeting, bracing and casing of the excavation, cement grouting, crane rails, channels or hardwood blocking, sewer pipe, concrete backfill, plain or reinforced or encasements, connecting, cleaning and televising and testing of the sewer, the replacement of all disturbed structures, pavements and seeded and sodded areas, and the furnishing of all labor, materials, tools and equipment to complete the work as specified and as shown in the contract documents or ordered in writing by the responsible agency. Such payment shall include all items of expense except such items as are stated in the contract documents to have separate payments.

When a sewer in jacked or bored casing pipe construction ends at a manhole in a shaft, measurement shall be made to the nearest inside face of the wall of the manhole at the invert and will not be paid through the manhole inside diameter dimensions as it is a special structure. At all points where sewers in jacked or bored casing pipe construction change size, the measurement for each size shall be made to the nearest inside face of the wall of the manhole where the change is

made.

19. Bored and Jacked Sewers

The number of linear feet of bored and jacked sewer construction to be paid for under their respective items shall be the actual number of linear feet of each class and size, measured continuously along the centerline of the sewer to the inside face of manholes, but not through them, and to the end of the bored and jacked sewer construction wherever it is terminated. In the event that the ends of the construction of this section are not visible, the linear feet of such construction shall be verified before the backfill covers the ends. Such payment shall include the proper construction of bored and jacked sewers including excavation, its disposal, sheeting and bracing of the excavation, sewer pipe, connecting, cleaning and televising and testing of the sewer, the replacement of all disturbed structures, pavements and seeded and sodded areas, and the furnishing of all labor, materials, tools and equipment to complete the work as shown in the contract documents or as ordered in writing by the responsible agency. Such payment shall include all items as are stated in the contract documents to have separate payments.

20. Pipe Rehabilitation

Pipe rehabilitation by cured-in-place (CIPP) mainline lining, fold and form pipe method, symmetrical reduction method for close-fit liner, pipe bursting and cement mortar spray-on lining shall be paid for under their respective items by the actual number of linear feet of each size of existing pipe rehabilitated, measured continuously along the centerline of the sewer or pipe to the inside face of manholes, but not through them.

Payment shall include all of the work outlined in the detailed specification for each work item including furnishing all labor, material, equipment, testing, and incidentals necessary for a complete installation. Bypassing of flow, pre and post construction CCTV and cleaning the existing host pipe are included in the unit price bid per linear foot, by size, of the pipe rehabilitation work items, and no separate payments will be made for these items, unless otherwise specified in the

contract.

21. Pipe Rehabilitation Using Pipe Liner

Pipe rehabilitation using pipe liner by either slip lining, spiral winding or paneling shall be paid for by the actual number of linear feet of each different method and per each size of existing pipe lined, measured continuously along the centerline of the sewer or pipe to the inside face of manhole, but not through them. In case of pipe culverts measurement shall be face of headwall to face of endwall.

Payment shall include all of work outlined in the detailed specification, except for grouting the annular space used to stabilize the host pipe. Payments shall include furnishing all labor, material, equipment and incidentals necessary for the complete installation. By passing of flow, pre and post construction CCTV, cleaning the existing host pipe and testing are included in the unit price bid per linear foot, by size of the pipe lined, and no separate payments shall be made for these items, unless otherwise specified in the contract.

Grouting of the annular space between the liner and host pipe shall be paid for by the actual cubic feet of grout placed and measured. Payment shall include all labor, equipment, material and incidentals required to furnish and place the grout.

Cleveland low strength mortar backfill placed to stabilize the host pipe shall be paid for by the actual cubic yards of material placed and measured. Payments shall include all labor, equipment, material and incidentals required to furnish and place the Cleveland low strength mortar backfill.

22. Microtunneling

The number of linear feet of sewers installed by microtunneling to be paid for under their respective items shall be the actual number of linear feet of each size, class and type measured continuously along the centerline of the sewer to the inside face of manholes or shafts at the invert but not through them and to the end of the microtunnel construction wherever it is terminated. When sewers in

microtunnels end at a manhole in a shaft, measurement shall be made to the inside face of the wall of the manhole at the invert.

Payment shall include all of the work outlined in the detailed specification for each work item including furnishing all labor, material, equipment and incidentals necessary for a complete installation, which includes but not limited to, all shafts, jacking pits, microtunneling equipment, sewer pipe, CCTV and sewer testing.

23. Horizontal Directional Drilling

The number of linear feet of sewers installed by horizontal directional drilling to be paid for under their respective items shall be the actual linear feet of each size, class and type measured continuously along the centerline of the sewer to the inside face of manholes, but not through them.

Payment shall include all of the work outlined in the detailed specification for each work item including furnishing all labor, material, equipment and incidentals necessary for a complete installation, which includes, but not limited to, all launching pits, drilling operation, sewer pipe, grouting of annular space between sewer pipe and drilled hole, CCTV, sewer testing and site restoration.

24. Rehabilitation of Manholes

Payment for rehabilitation of manholes shall be divided into the following items: Manhole Sealing; Manhole Patching; Manhole Plugging; Manhole Chimney Seal; and Chimney Seal Filler. Manhole Sealing shall be paid per square foot of surface area sealed. Manhole Patching shall be paid by pound of dry weight of product used for patching. Manhole Plugging shall be paid per pound of dry weight of product used. Chimney Seals installed in existing manholes shall be paid per each. Chimney Seal Filler used in existing manholes shall be paid per pound of dry weight of product used. Payment shall include all labor, equipment, materials and incidentals required to provide a complete installation of each item.

PART 6 - STANDARD DESIGN AND CALCULATION FORMS

6.1 Sanitary Sewer Data Sheets

6.2 Sanitary Sewer Design Calculation Sheet

6.3 Storm Sewer Data Sheets

6.4 Storm Sewer Design Calculation Sheet

6.5 Pump Station Data Sheets

6.6 Pump Station Design Calculation Sheets

6.7 Wastewater Treatment Plant Data Sheets

6.8 Wastewater Treatment Plant Design Calculation Sheets

6.1 SANITARY SEWER DATA SHEETS

Name of Municipality or Sewer District

_____

Name of Project _____

Original Township and Lot Number _____

Name of Engineer and Firm Preparing Plans

_____

Address _____ Telephone _____

Name and Address of Governmental Authority to Whom Plan Approval Should be Sent:

_____

Brief description of project. Include information as to (a) the location, size and development of the area to be served, (b) longitude and latitude 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 receiving wastes, (g) and other data pertinent to the project. (Use attachment if necessary).

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Indicate type(s) of sewer proposed (check all that is applicable)

___ Conventional Gravity ___ Small Diameter Gravity (w/septic tanks) ___ Pressure

___ Vacuum ___ Siphon ___ Force Main

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

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, exfiltration _____ gallons per inch of pipe diameter. Tested under Supervision of an Engineer? YES _____ NO _____

b. Deflection limit specified _____ % (applies only for flexible pipe). Tested under Supervision of an Engineer? YES _____ NO _____
Name of Engineer _____

c. Specify type of manhole testing to be performed. _____
Tested under supervision of an Engineer? YES _____ NO _____

d. Specifications include provision for inspection of all construction by an engineer or qualified inspector? YES _____ NO _____
Name of Engineer or Inspector _____

e. Name of Treatment Facility 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 previous Year).
Present Capacity of Treatment Facility _____ MGD (average daily flow).
Does Treatment Facility have the capacity to treat additional flow from new sanitary sewer?
YES _____ NO _____

If proposed sewer is to be connected to an existing sanitary sewer, give the capacity of the Existing sewer available for additional loading at point of connection _____ MGD (based on calculations on basis of peak flows).

Estimated hydraulic loading of proposed sewer at point of connection to plant or existing sewer:

Initial: _____ Average Daily Flow: _____ Peak Flow
Startup flow (based on existing homes to be served)

Design: _____ Average Daily Flow: _____ Peak Flow
(design on immediate area served)

Ultimate: _____ Average Daily Flow: _____ Peak Flow
(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 hydraulic loading to an acceptable value.

g. Are the proposed sewers deep enough to serve all adjacent basements?
YES _____ NO _____ If no, explain: _____

_____

_____

_____

h. Are the sewers at least 10 feet horizontally from water lines and when crossing water lines at least 18 inches below the water line? YES _____ NO _____ If no, why? _____

_____

i. Are existing public water supply sources located within 200 feet of the sewers or private wells within 50 feet of the sewer? YES _____ NO _____ If yes, will sewers be Encased or 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? 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 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?

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 Question V or W, specify plan sheet(s) where shown. _____

_____

y. Will this project include any pump stations? YES NO
If Yes, please complete 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 pumping station. _____

_____

_____

aa. Are force mains designed to withstand water hammer pressure?
YES _____ NO _____

bb. Plans for the proposed install 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 date NOI for coverage was submitted. _____

dd. Will wetlands be disturbed during the construction of this project?
YES _____ NO _____ If Yes, enter 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: A statement that **"roof drains, foundation drains, and other clean water connections to the sanitary sewer system are prohibited"** must be shown on the plans.

THE FOREGOING DATA IS A TRUE STATEMENT OF FACTS PERTAINING TO THIS PROPOSED SANITARY SEWER INSTALLATION.

DATE: _____ SIGNED: _____

Professional Engineer
Registered in the State of Ohio

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)

6.3 STORM SEWER DATA SHEETS

Name of Municipality or Sewer District

Name of Project

Original Township and Lot Number

Name of Engineer and Firm Preparing Plans

Address Telephone

Name and Address of Governmental Authority to Whom Plan Approval Should be Sent:

Brief description of project. Include information as to (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) and other data pertinent to the project.

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

a. Deflection limit specified _____ % (applies only for flexible pipe). Tested under Supervision of an Engineer? YES _____ NO _____
Name of Engineer or Inspector _____

b. Specifications include provision for inspection of all construction by an engineer or qualified Inspector? YES _____ NO _____
Name of Engineer or Inspector _____

c. Estimated hydraulic loading of proposed sewer; flows full, no head. Are manholes provided at all changes in size, grade, alignment, and sewer intersections?
YES _____ NO _____

d. 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 _____

e. Have provisions been made to protect sewers at velocities of over 15 feet per second?
YES _____ NO _____ N/A _____

f. Are sewers with slopes greater than 20 percent secured with concrete anchors (or equal) spaced as required?
YES _____ NO _____ N/A _____

g. Building sewers shall be constructed in accordance with specifications equal to those indicated in the chart above.
YES _____ NO _____

h. Plans for the proposed install of a County, Village or Municipal sewer that connects to a sewer connection in another political entity must be accomplished by a written consent of both entities.

i. If applicable to this project, written consent agreement is attached?
YES _____ NO _____

j. 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?

_____

k. What is the minimum difference in elevation between the lowest floor elevation of any existing or proposed structure and the crown of the sewer? _____

l. Estimated Cost of Project $ _____

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 Project)

Name of Municipality or Sewer District

Name of Project _____

Original Township and Lot Number _____

Name of Engineer and Firm Preparing Plans

Address _____

Name and Address of Governmental Authority to Whom Plan Approval Should be Sent:

Pump Station Type (Check All Applicable Items)

Concrete ___ Metal ___ Fiberglass ___ Factory Built ___

Built in Place ___ Submersible ___ Suction Lift ___ Screw Pump ___

Does pump station have the capacity to handle design flow without creating or worsening any overflows, bypasses or operation problems downstream of the pump station?

YES _____ NO _____

SITE		**YES**	**NO**
(a)	Accessible at all times?		
(b)	Graded around station to provide positive flow drainage away from the station?		
(c)	Protected to prevent vandalism and entrance by unauthorized persons or animals?		
(d)	Is potable water provided at the pump station?		
(e)	Sit subject to flooding?		
(f)	100 Year Flood Elevation at the Site		
(g)	Distance to Nearest Residence		
(h)	Distance to Nearest Building		

Estimated average daily startup flow tributary to this station _____ GPD (Provide Separate Flow Calculation Sheets)

Estimated peak hourly startup flow tributary to this station _____ GPD (Provide Separate Flow Calculation Sheets)

Estimated average daily ultimate design flow to pump station _____ GPD

Estimated peak hourly ultimate design flow to pump station _____ GPD

Hydraulic capacity of sewer downstream of pump station _____ GPD

TYPE OF WASTE TO BE PUMPED

_____ (a) Sanitary

_____ (b) Combined (Sanitary & Storm)

_____ (c) Commercial

_____ (d) Industrial

Source of Industrial Waste _____

PNEUMATIC EJECTORS

(a) Make and Model Number _____

(b) Operating Conditions _____ GPM @ _____ T.D.H.

(c) Number of Compressors _____

(d) Number of Pots _____

(e) Capacity of Pot _____

PUMPS

(a) Number _____

(b) Make, Model # and Type (Suction Lift, Positive Displacement, Centrifugal, Horizontal Centrifugal)

Make _____

Model _____

Type _____

(c) Materials (Cast Iron, Stainless Steel, Etc.)

Casting _____

Impeller _____

(d) Operating Conditions _____ GPM @ _____ T.D.H.

(e) Maximum allowable speed _____ RPM

(f) Motor Type (Variable or Constant Speed) _____

		YES	NO
(g)	Are high/premium efficiency motors specified?		
(h)	Will pass 3" sphere?		
(i)	Water seal unit air gapped?		

DRY WELL

		YES	NO
(a)	Is dry well completely separated from wet well?		
(b)	Type of construction?		
(c)	Corrosion protection?		

		YES	NO
(d)	Stairway or access ladder with treads of non-slip material?		
	Stairway or safety landings provided every 10'?		
(e)	Ventilation-Positive?		
	Outside Controls?		
	Number of air changes per hour?		

		YES	NO
	Is the dry well ventilation system separate from the wet well system?		
(f)	Dehumidifier and heating to insure a dry atmosphere for protection of motors and control system?		
(g)	Lighting - Explosion Proof		
	- Outside Controls		
(h)	Sump pump to handle floor drainage – discharge line air gapped above high water alarm elevation?		

WET WELL

Type of Construction

(a) ASTM C-443 joints between precast concrete section? YES _____ NO _____

(b) Effective Capacity _____ gal. between shut off and first level pump on Design _____ at flow

(c) Elevations: Suction Line Invert _____

Discharge Line Invert _____

Bottom of Wet Well _____

Low Shut Well _____

No. 1 Start _____

No. 2 Start _____

No. 3 Start _____

High Water Alarm _____

Bypass or Overflow _____

If Yes, is treatment provided? YES _____ NO _____

Explain: _____

_____

Elevation of Outflow Invert _____

Are inlets to wet well located below the minimum wet well water surface?

YES _____ NO _____

Lowest Basement _____

(d) High Water Alarm: Make _____

Model _____

Type _____

(d) Operating Conditions _____ GPM @ _____ T.D.H.

	YES	NO
Audio Visual Battery Operated Alarm?	_____	_____
Telemetered Alarm?	_____	_____
Provisions for Retaining Overflow Waste On-Site?	_____	_____

Type of Ventilation Provided _____ Continuous _____ Intermittent _____ Portable
Number of Air Changes Per Hour _____ At _____ cfm
Ventilation Controls Locations _____ Inside _____ Outside

Is all the equipment located in 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	____ 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 for portable pumps provided?
YES _____ NO _____

Does pump station operator have portable pumps needed?
YES _____ NO _____

	YES	**NO**
Is flow measuring device provided?	_____	_____

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.

DATE: _____ SIGNED: _____

Engineer (Preparing Plans)

6.6 PUMP STATION DESIGN CALCULATION SHEETS

Name of Municipality or Sewer District _____

Original Lot, Township and Tract _____

For: _____ By: _____

Location: _____ Date: _____

WET WELL CALCULATIONS:

(a) Pumping Station No. _____

(b) Average Daily Flow into Station Excluding Infiltration _____ GPD.

(c) Peak Factor = _____
Drainage Area = _____
Average Daily Flow X Peak Hour Factor = _____ GPD.
Infiltration = Drainage Area X 375 Gal./Acre/Day = _____ GPD.

(d) Present Flow:
Peak Flow into Station: _____ GPD.
Estimated Ultimate Peak Flow into Station: _____ GPD.

(e) Rated Pump Delivery: _____ GPM.

(f) Storage Volume between High and Low Levels = _____ Gallons

(g) Wet Well Diameter = _____ Ft. & _____ Gal/Ft.

(h) Total Time at Pump Station Startup Between Successive Pump Starts = _____ Min.

$$\frac{\text{Line (f)}}{\text{Line (e)} - \text{Line (d)}} + \frac{\text{Line (f)}}{\text{Line (d)}} = \text{Line (h)}$$

(i) Total Time at Ultimate Development Flow Between Successive Pump Starts = _____ Min.

TOTAL DYNAMIC HEAD CALCULATIONS:

External Loss (Dynamic)

(a) Force Main Size = _____ Inches

(b) Friction Loss at Initial Startup = _____ Ft./100 Feet of Pipe
Friction Loss at End of Design Life = _____ Ft./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 _____ Feet

(f) Total Friction Loss = _____ Feet (Initially) _____ Feet (Ultimate)

Internal Loss (Dynamic)

(a) 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 74º 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 (Center Line of Pump Suction to _____ Feet

BUOYANCY CALCULATIONS:

(a) Type of Soil over Station _____

(b) Weight of Soil _____ Lbs./Cu. Ft.

(c) Downward Force of Soil on Top Area of Station _____ Lbs.

(d) Water Table Elevation _____ Feet

(e) Upward Buoyant Force at Center of Buoyancy _____ Lbs.

(f) Weight of Station Exerted at Center of Gravity _____ Lbs.

(g) 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

6.7 WASTEWATER TREATMENT PLANT DATA SHEETS

Name of Municipality or Sewer District _____

Name of Project _____

Original Lot and Tract No. _____

Name of Engineer and Firm Preparing Plans _____

Address _____

Name and Address of Municipal or County Official to Whom Plan Approval Should Be Sent:

_____

SITE:

(a) Subject to Flooding? _____ YES _____ NO

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 & 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 pass 3" 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 inlet 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 and method and location of sludge disposal:

_____

_____

_____

Are baffles to be 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 33.90 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. N/A

A mechanical sludge collecting device will be installed?

YES _____ NO _____ If Yes, Type _____

Froth control equipment will be installed? YES _____ NO _____

Hosing facilities for routine flushing of walls and walkways will be installed?

YES _____ NO _____

Sludge handling facilities will be installed: YES _____ NO _____

What mode of advanced treatment or effluent disposal is to be installed?

_____

_____

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 _____

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 works?

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:

Check and Provide Completed Copy of Additional EPA Form(s) Required for Construction of the Treatment Facilities

_____ Sewer and Pump Station Construction – Form B1

_____ Onsite Sewage Treatment Systems – Form B2

_____ Wastewater Treatment Plants Less Than 100,000 GPD – Form B3

_____ Wastewater Treatment Plants Greater Than or Equal to 100,000 GPD and all Pond Systems – Form B4

_____ Industrial Direct Discharge Facility – Form B5

_____ Industrial Indirect Discharge Facility – Form B6

_____ Underground Storage Tank Remediation – Form B7

_____ Holding Tanks – Form B8

_____ Industrial Impoundment Ponds – Form B9

_____ Land Application Management Plan for Sludge or Waste Other Than Treated Sewage – Form C1

_____ Treated Sewage Land Application Management Plan – Form C2

_____ Sewage Holding Tank Management Plan – Form C3

6.8 WASTEWATER TREATMENT PLANT DESIGN CALCULATION SHEETS

Name of Municipality or Sewer District _____

Name of Project _____

Original Lot and Tract No. _____

Name of Engineer and Firm Preparing Plans _____

Address _____

Name and Address of Municipal or County Official 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):

$$\frac{\text{ADDF Gal./Day X PF}}{\text{SRP Hours X 60 Min.}} = \text{Gal./Min.}$$

If an equalization basin is to be used, its volume will be _____ gal.

Air to be supplied: _____ cu. ft./min. (with largest blower out of service)

Plant influent pumping station: YES _____ NO _____

Number of pumps _____ Type of pumps

Influent Pumping Rate (IPR): _____ Gal./min. (with 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 calcuations 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 flow division where parallel aeration unit arrangements are planned. Describe:

_____

_____

Aeration Chamber Volume: (based on 80 cu. ft./lb. BOD_5)

_____ lb. BOD_5/day x 80 cu. ft. x 7.48 gal./cu. ft. = _____ Gal.

_____ gallons supplied

Aeration Detention Time:

Chamber Volume gal. x 24 Hours

_____ = _____ hours

ADDF _____ gal./day

Are the dimensions and proportions of the aeration tanks such as to maintain effective mixture and utilization of air, to prevent unaerated sections and noticeable channeling, and to maintain velocities sufficient to prevent deposition of solids?

YES _____ NO _____

Are inlet 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 reasonable 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)

$$\frac{\text{lbs. } BOD_5\text{/day x 2600 cu. ft.}}{\text{1440 min./day}} = \text{_____ cu. ft./min}$$

Amount of air supplied: _____ cu. ft./min. (with 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 replacement without de-watering the tank?

YES _____ NO _____ N/A _____

If mechanical aerators are to be used, the oxygen required will be:

_____ lb. BOD_5/day x 2 = _____ 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 Detention Time:

Chamber Volume gal. x 24 Hours
_____ = _____ hours

ADDF _____ gal./day

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
_____ = _____ GPD/sq. ft.

Surface Area _____ sq. ft.

At Peak Flow:

PIR gal./min. x 1400
_____ = _____ GPD/sq. ft.

Surface Area _____ 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:

$$\frac{\text{PIR}}{\text{Total Weir Length}} \quad \frac{\text{gal./min. x 1400}}{\text{feet}} = \text{GPD/lin. ft.}$$

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 method of scum removal and disposal: _____

Scum storage capacity: _____

Describe method and frequency of sludge removal and 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 design loading).

$$\frac{\text{Design } BOD_5 \text{ Loading lbs./day x 100 x 10\%}}{\text{0.167 lbs. } BOD_5\text{/population equivalent}} = \text{_____ gal. (minimum)}$$

Aeration tank vol. x 10% _____ gallons supplied

(a) Air supply: _____ cu. ft./min. (with largest blower out of service

NOTE: A minimum storage volume of 1,000 gallons will 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) will be: (based on three cubic feet per population equivalent).

$$\frac{\text{Design } BOD_5 \text{ Loading lbs./day x 3 x 7.48}}{\text{0.167 lbs. } BOD_5\text{/population equivalent}} = \underline{\qquad} \text{ gal. (minimum)}$$

$\underline{\qquad}$ gallons supplied

(a) Air Supply: (based on 20 cu. ft./min. per 100 cu. ft. of volume)

$$\frac{\text{gallons supplied x 20 cu. ft./min}}{\text{7.48 gal./cu. ft. x 1,000 cu. ft.}} = \underline{\qquad} \text{ cu. ft./min.}$$

Air supplied: $\underline{\qquad}$ cu. ft./min. (with largest blower out of service)

If anaerobic digestion of sludge is to be utilized, the volume of the tank(s) will be:
$\underline{\qquad}$ 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 will be: (based on one square foot per population equivalent).

$$\frac{\text{Design } BOD_5 \text{ Loading lbs./day}}{\text{0.167 lbs./population equivalent}} = \underline{\qquad} \text{ sq. ft.}$$

$\underline{\qquad}$ square feet provided $\underline{\qquad}$ 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 fo the following modes of advanced treatment of effluent disposal are to be installed:

_____ Surface Slow Sand Filter

_____ Rapid Sand Gravit 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
11.5 gal./sq. ft./day = _____ sq. ft.

_____ square feet provided _____ number of beds

(a) Capacity of dosing chamber shall be: _____ gallons

(b) Size of dosing pumps: _____ Gal./min. (with largest pump out of service)

NOTE: Dosing chamber and pumps must be sized to dose half of the total filter to dpeth of three (3) inches within 10 to 15 minutes.

(c) Dosing siphon height above sand beds: _____ feet

If rapid sand gravity filters are to be installed, the area provided shall be: (based on 3.33 gpm/sq. ft. at the peak flow rate)

Peak Flow Rate* _____ gal./min.
3.33 gpm/sq. ft. = _____ sq. ft.

_____ square feet provided _____ number of cells

***NOTE:** The peak flow rate shall be equal to the maximum rate of the pumping facilities preceeding filtering.

(a) Clearwell Capacity: _____ gallons

(b) Rate of Backwash: _____ gpm/sq. ft.

(c) Duration of Backwash: _____ Minutes

(d) Number of Backwash Pumps _____ @ _____ gal./min.

(e) 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)

$$\frac{\text{Peak Flow Rate* gal./min.}}{\text{3.33 gpm/sq. ft.}} = \text{_____ sq. ft.}$$

_____ Submerged Square Feet Provided

_____ Total Square Feet Provided

_____ Number of Microstrainers

***NOTE:** The peak flow rate shall be equal to the maximum rate of the pumping facilities preceeding the microstrainers.

(a) Continuous Backwash Rate: _____ gal./min./ft. of microstrainer length

(b) Number of Backwash Pumps: _____ @ _____ gal./min.

NOTE: Please refer to Ohio EPA's Procedures and Design Guidelines in designing microstrainers.

If lagoons are to be utilized, their total volume will be: (based on five (5) days detention)

Design Hydraulic Flow _____ gal./day x 5 _____ 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 preceeding the contact chamber.

Are the tank(s) baffled or so constructed as to reduce short circuiting of flow to a minimum?
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 run the proposed treatment works?
YES _____ NO _____ If Yes: Full Time _____
Part Time _____

Grade Certification 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 provisions, if any, will be made to provide standby power for electrical equipment?

Describe, including capacity: _____