

**BLAIR TOWNSHIP  
TECHNICAL SPECIFICATIONS  
2015**

TECHNICAL SPECIFICATIONS  
FOR SANITARY SEWER AND  
WATER MAIN CONSTRUCTION IN THE  
TOWNSHIP OF BLAIR, GRAND TRAVERSE COUNTY

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1.01 PROJECT DESCRIPTION

Work includes the following major items:

1.02 DEFINITIONS

The intent of this section is to identify certain persons involved in the project.

DPW	The agency performing the system operations and maintenance typically identified as a Department of Public Works.
Township Engineer	Engineer whose services are procured by the Township to review sanitary sewage and/or water system plans and installation methods. When the Township is the owner, the engineer will function as the owner's engineer.
Design or Owner's Engineer	Engineer who provided the sanitary sewage and/or water system design, plans and specifications for the owner.
Owner	Project developer or Township who is having sanitary sewage and/or water facilities installed.
Contractor	Contractor is prime Contractor who is so identified by the Owner and is responsible for the sanitary sewage and/or water system facilities installation.
Township	The governing Township of Blair that the work is being performed in.

1.03 PRECONSTRUCTION CONFERENCE

Prior to commencement of any construction activities involving the sanitary sewer system and/or water system, a principal member representing the Owner, the Contractor, the Design Engineer, the Township Engineer and the Township Water Department shall meet at a pre-determined location and time to discuss the project. It shall be the responsibility of the Owner or his/her Design Engineer to organize this meeting. At that time, the Contractor schedule, as well as the Township Engineer's requirements, will be discussed to obtain a mutual understanding of the project and the Township's inspection process.

1.04 LINES AND GRADES FOR CONSTRUCTION

The Owner (his Contractor and/or Engineer) shall provide adequate lines and grades for construction of the sanitary sewer and/or watermain prior to installing the utilities. The Township Engineer shall be given 48 hours notice for review of these lines and grades prior to the start of construction.

1.05 PROGRESS SCHEDULE

The Owner shall, as soon as practical, prepare and submit to the Township Engineer three (3) copies of the Progress Schedule regarding sanitary sewer and/or watermain construction. This schedule shall show in a clear, graphical manner the proposed date for commencement, progress and completion of the work.

1.06 INTERFERENCE WITH EXISTING SEWAGE TREATMENT WORKS

No bypassing of untreated sewage will be allowed during the construction of this project other than that which normally takes place due to stormwater overflows, etc. The Contractor shall provide a plan of work to the Township Engineer for approval before starting work on any phases of the project which might involve existing sewage facilities.

1.07 RELATIONS TO OTHER CONTRACTORS AND UTILITY FORCES

The Contractor shall so conduct his operations as not to interfere with or injure the work of other contractors or adjacent force account work, and he shall promptly make good any injury or damage which may be done to such work by him or his employees or agents.

The Contractor shall grant to other contractors and forces necessary means of access to their work.

1.08 PERMITTING AGENCIES

The Contractor shall perform all work in accordance with any and all applicable permit requirements. The Owner or his Design Engineer shall present the Township Engineer with a copy of all documentation and calculations for the permit process. The Township, with the assistance of the Township Engineer, will obtain the necessary permit for construction/installation prior to commencement of any work.

1.09 ACCESS TO WORK

The Township Engineer or Township Resident Project Representative shall have access maintained to all sanitary sewer or watermain work at all times. Proper notification (48 hours) shall be given to the Township Engineer prior to the start of any construction or testing.

1.10 SHOP DRAWINGS

Shop drawings of all equipment shall be issued to the Design Engineer during the shop drawing review stage for his approval. The Design Engineer shall forward these (2 copies) to the Township Engineer for his review regarding compliance with the Township requirements. The Township Engineer will not perform a technical review. That shall remain the responsibility of the Design Engineer. The Contractor should supply a minimum of six (6) copies of all equipment shop drawings to the Design Engineer. Final record shop drawings shall be issued to the Township Engineer as part of the close-out procedure in accordance with the close-out section of these specifications.

1.11 STREAM CROSSINGS

Stream crossings shall be performed in accordance with all permit requirements of the regulatory agencies (P.A. 346 or 98 requirements). Casings shall be provided for all sanitary sewer crossings under streams.

1.12 DUST AND NOISE REDUCTION

The Contractor shall keep dust and noise from construction operations to a minimum. A dust palliative shall be used on disturbed road sections prior to surfacing if so determined by the Township Engineer.

1.13 MATERIAL CERTIFICATION

Manufacturer's certification slips shall be submitted to the Township Engineer for all pipe, manholes, fittings, etc. used in the installation of sanitary sewer or watermains. This is to verify that the product meets applicable standard specifications required.

1.14 MAINTENANCE BOND REQUIREMENTS

The Contractor shall supply the Owner and Township with a maintenance bond for 50% of the cost of the installation of the sanitary sewer and/or water system that is to be turned over to the Township. The maintenance bond shall be effective from the date of Township acceptance for a period of two (2) years.

1.15 INSURANCE REQUIREMENTS

Where the contract involves construction in a public right-of-way, the Contractor shall provide proof of insurance in the type and amounts required by the Township prior to start of the construction. In addition to the Township, the Grand Traverse County DPW and Township Engineer shall be named as additional insured.

1.16 ESCROW FOR TELEMETRY REQUIREMENTS

When telemetry equipment is required, the owner of the project will be required to provide an account above and beyond the construction contract price in the amount of \$10,500.00 for standard telemetry equipment. This equipment will be integrated into the Grand Traverse County DPW network of monitoring systems. The types of units this may apply to include submersible lift stations, well houses, water booster stations, and pressure reducing valve vaults.

2.01 REFERENCE STANDARDS

- A. Throughout these specifications, reference is made to various standard specifications. Such reference gives the serial designation. The latest revised specification shall apply in all cases. These standard specifications, where applicable, shall be binding on all construction activities.
- B. The following specifications and standards form part of this specification to the extent indicated by reference thereto or for quality of workmanship and materials required under the contract.

American Society of Testing Materials	(ASTM)
American Water Works Association	(AWWA)
American National Standards Institute, Inc.	(ANSI)
Michigan Department of Transportation	(MDOT)
American Concrete Institute	(ACI)
National Concrete Masonry Association	(NCMA)
Truss Plate Institute	(TPI)
National Electrical Code	(NEC)
Michigan Department of Environmental Quality	(MDEQ)

2.02 REGULATORY REQUIREMENTS

- A. All construction work, alterations, repairs or mechanical installations and appliances connected herewith shall comply with all the State Rules and Regulations and local ordinances and such other statutory provisions pertaining to this class of work. Such Rules and Regulations and local ordinances are to be considered a part of these specifications by reference.
- B. All electrical work shall be in accordance with the latest edition of the National Electrical Code, the National Electrical Safety Code and applicable state and local codes. This shall not be construed to permit a lower grade of construction where the plans and specifications require workmanship or materials in excess of code requirements. All electrical equipment, wiring, cable, pre-assembled electrical panels, and materials shall be listed by Underwriters Laboratories, Inc.



3.01 CLEANUP

Before final acceptance of the sanitary sewer system or watermain system work, the Contractor shall remove all false work, excavated or useless materials, and rubbish, and restore to presentable condition per the restoration specifications and satisfactory to the Township Engineer, all property, both public and private, which may have been used or damaged during the installation of the sanitary sewer or water system work.

3.02 OPERATING AND MAINTENANCE DATA

The Contractor shall furnish written instructions for the operation and maintenance of the equipment furnished at the time of submittal of shop drawings. The instructions shall be short, easy to understand, with directions specifically written for this project, describing the various possible methods of operating the equipment. The instructions shall include procedures for tests required, adjustments to be made and safety precautions to be taken with the equipment. Maintenance instructions shall include test and calibration charts, exploded views of assembled components and spare parts lists. At least six (6) instruction booklets shall be furnished for each separate piece of equipment. These shall be transmitted to the Township Engineer as part of the close out of the project. Record drawings (1 set of reproducible mylars or vellums and one (1) digital copy in AutoCad format) shall be submitted to the Township along with hydrant and valve reports, water service lead reports, and sanitary sewer lead reports, as applicable to the project.

A. Pumps

Include the manufacturer's technical specification of the pump along with the application for the pump, the manufacturer's warranty certificate, installation instructions, serial numbers for all pumps, pump performance curve, pump trouble shooting guide and the pump efficiency rating.

B. Control Panel Operation and Maintenance Manual

Include the electrical panel legend, bill of material report, catalog cut sheets indicating make and model of all general accessories, installation instructions for the control panel, recommended spare parts, installation instructions for general accessories and a maintenance frequency chart.

C. Electrical Wiring

A color coded drawing of the as-installed electrical schematic shall be submitted for all electrical work performed as part of the project.

3.03 GUARANTEE

The Contractor shall guarantee all materials and equipment furnished and work performed for a period of one (1) year from the date of Township Acceptance. The Contractor shall warrant and guarantee for a period of one (1) year from the date of Township Acceptance of the system that the completed system is free from all defects due to faulty materials or workmanship. The Contractor shall promptly make such corrections, as may be necessary including the repairs of any damage to other parts of the system resulting from such defects. The Owner or Township, if they have taken over the system, will give notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make such repairs, adjustments or other work that may be made necessary by such defects, the Owner or Township may do so and charge the Contractor the cost thereby incurred. Refer to the form Letter of Guarantee to be included with final close-out documents.

The Contractor shall supply a two (2) year maintenance bond per the "General" section of these specifications.

3.04 FINAL COMPLETION/ACCEPTANCE OF PROJECT BY TOWNSHIP

A. Township Projects

Final payment will not be made to the Contractor until all close out documents have been received and approved by the Township Engineer. These items are listed below:

1. Punch list items satisfactorily completed.
2. Maintenance bond.
3. Letter of guarantee (format provided by Township Engineer).
4. Affidavit of completion/consent of surety.

B. Private Projects

The Township will not accept the facility or allow connections to or use of the facilities until the following items have been received by the Township:

1. Punch list items satisfactorily completed.
2. Maintenance bond. (Valid for a period of two years from the date of Township acceptance of the system).
3. Letter of guarantee (format provided by Township Engineer).
4. Easement descriptions.
5. Descriptions of the facilities for a bill of sale.
6. Certification by the Engineer reviewing the installation.
7. Sanitary Sewer Lead Reports (as applicable).

8. Water Service Lead Reports (as applicable).
9. Water Valve Reports (as applicable).
10. Hydrant Reports (as applicable).
11. Operation and Maintenance Manuals
12. Record Drawings
- 12A. Record Drawings (as-constructed) must include a reproducible set of 24" x 36" mylars or vellums and a digital copy (formats listed below) including a .pdf copy of each sheet.

Digital Submittal Format Requirements: The developer shall submit to the Township a digital copy of the Record Drawings (as described in Section 3.04.B Item 12B of the Technical Specifications) in one of the following formats:

- a. Drawing Interchange File (.DXF)
- b. AutoCAD (.DWG) release 2000 or higher
- c. ArcView GIS format (.SHP)

- 12B. Record Drawings: Record drawings shall consist of plan and profile. Sanitary sewer leads and water service leads shall be re-drawn in the new location along with the mainline structures and piping. Hydrant, valve and manhole numbering sequences shall be obtained from the Township Engineer. Each structure installed, such as manholes, water service leads, hydrants, valves, sewer leads, bends, tees, or other structures placed shall have 3 physical measurements from structures which are shown on the plans and apparently not to be changed. Lead measurements are to be placed on the individual reports. Sanitary sewer profiles shall include manhole number, rim and invert elevations, distances between structures, size and type of pipe. Watermain profiles shall include hydrant and valve numbers, all fittings, horizontal/vertical, and the accurate depth of placement. All profiles shall show conflict with existing utilities. Sanitary sewer lead and water service lead information shall be placed in a table format on the record drawings. Each plan sheet shall have a separate table for the type of lead shown on that sheet. See Table 3.1 and Table 3.2 for examples.

**SECTION 3**  
**PROJECT CLOSE OUT**

**Table 3.1**

SEWER LEAD NUMBER	DISTANCE FROM DOWNSTREAM MANHOLE	DISTANCE FROM SEWER TO END OF LEAD AT PROPERTY LINE OR EASEMENT LINE	DEPTH BELOW GRADE

**Table 3.2**

WATER SERVICE LEAD NUMBER	DISTANCE FROM GATE VALVE OR FIRE HYDRANT. INCLUDE VALVE OR HYDRANT NUMBERS	DISTANCE FROM WATER MAIN TO END OF LEAD AT PROPERTY LINE OR EASEMENT LINE

4.01 SCOPE OF WORK

The work covered by this section shall consist of furnishing all materials, equipment and labor for the excavating, trenching, backfilling, and bore and jack required to install or repair sanitary sewers, watermains and other structures as shown on the plans and referred to in these specifications.

4.02 MATERIALS

A. Backfill Material

All backfill material shall be free from cinders, ashes, refuse, sod, frozen lumps, vegetable or organic material, boulders, rocks or stones or other material which, in the opinion of the Design Engineer, is unsuitable. However, from one foot above the top of the pipe to the subgrade of the pavement, material containing stones up to three (3) inches in their greatest dimension may be used.

Where the type of backfill material is not specified, the Contractor may backfill with the excavated material provided that such material meets the requirements described above. Where excavated material is to be used for backfill and there is a deficiency due to a rejection of part thereof, the Contractor shall furnish the required amount of sand, gravel or other approved material at no additional cost.

B. Bore and Jack Materials

1. Steel Pipe

Jacked in place steel pipe shall meet the requirements of either ASTM A53, Type E or S, Grade B or ASTM A139, Grade B.

The ends of all steel pipe to be jacked shall be prepared for field welding at joints.

The nominal outside diameter and minimum wall thicknesses of steel pipe to be jacked in place shall be as shown below. Minimum wall thickness for railroad crossings may be reduced by 0.063 inch if cathodic protection is provided per railroad specifications.

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Nominal Size	Nominal Outside Diameter (inches)	Minimum Wall Thickness Required (inches)	
		M.D.O.T.	Railroads
2"	2.375	0.154	0.251
4"	4.500	0.188	0.251
6"	6.625	0.188	0.251
8"	8.625	0.188	0.251
10"	10.750	0.188	0.251
12"	12.750	0.188	0.251
14"	14.000	0.250	0.282
16"	16.000	0.250	0.282
18"	18.000	0.250	0.313
20"	20.000	0.250	0.344
22"	22.000	0.250	0.375
24"	24.000	0.250	0.407
26"	26.000	0.312	0.438
28"	28.000	0.312	0.469
30"	30.000	0.312	0.469
34"	34.000	0.312	0.532

2. Grout:

Grout shall consist of a mixture of Portland cement and sand in any proportion which does not have more than 50 percent sand by volume.

4.03 EXECUTION

A. Excavation

Excavation includes clearing the site of the proposed work and removal of all materials to a depth which is sufficient to permit the construction of the structure or utility in accordance with the plans. Excavated materials may be temporarily stored along the trench in a manner that will not cause damage to trees, shrubbery, or other properties and that will not endanger the banks of the trench by imposing too great a load thereon.

B. Length and Width of Trench

Not more than 200 feet of open trench will be permitted at a time without approval from the Design Engineer and Township Engineer, unless pedestrian bridges are maintained at 200-foot intervals and vehicular

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crossings of at least one lane are maintained at 300 foot intervals. Streets shall not be completely blocked without written permission from the Design Engineer and roadway officials. All fire alarm boxes and fire hydrants must be kept clear and accessible at all times.

The width of the trench shall be ample to permit the pipe to be laid and joined properly and the backfill to be placed and compacted as specified. In order to limit excessive loads on the pipe, the maximum width of trench shall not be more than two feet greater than the nominal inside diameter of the pipe. This limitation shall apply to the width of the trench at the top of the pipe. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting and bracing and handling of special conditions.

C. Bracing, Sheeting and Shoring

Open cut trenches shall be sheeted and braced as required by any governing federal or state laws and municipal ordinances and as may be necessary to protect life, property or the work. When close sheeting is required, it shall be so driven as to prevent adjacent soil from entering the trench either below or through such sheeting. Where sheeting and bracing are used, the trench width shall be increased accordingly. An approved pipe laying trench box may be used in lieu of sheeting where safety of the workmen and/or protection of the work is the sole consideration, if allowed by governing authorities.

Sheeting and bracing left in place must be removed for a depth of three (3) feet below the established finish grade or the existing surface, whichever is lower.

Trench bracing, except that which must be left in place, may be removed when the backfilling has reached the respective levels of such bracing. Sheeting, except that which has been ordered left in place, shall be removed as the backfilling progresses.

D. Pumping, Bailing and Draining

The Contractor shall provide and maintain adequate pumping and draining facilities for removal and disposal of water from trenches or other excavations. He shall provide pumping and draining facilities for bulkheaded sewer sections and shall operate same until bulkheads have been removed or construction is completed, if bulkheads are to be left in place. The drainage system must be maintained until the pipe has been covered with sufficient backfill material to prevent floating of the installed pipe sections.

Where work is in ground containing an excessive amount of water, the Contractor shall provide, install and maintain a suitable dewatering system and shall so operate it to insure proper construction of the work. The determination of whether an excessive groundwater condition exists, that is, or might be detrimental to the sewer or watermain construction will be made by the Design Engineer. Proper disposal of the dewatering discharge (necessary easements, permits, erosion control, etc.) shall be the responsibility of the Contractor. Contractor shall not discharge or allow any groundwater to enter existing sanitary sewage system. Any water which does enter the existing sewage system shall be the Contractor's responsibility and he will pay any and all transporting and treatment costs involved with this water according to the local municipal authority. Cost of pumping, bailing and draining shall be incidental to and included in the price of the pipe or structure placed in the excavation.

E. Excavation to Grade

The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe barrel. The Contractor shall excavate the last four inches of depth to grade using hand tools.

Any part of the bottom of the trench excavated below the specified grade shall be refilled with approved materials and thoroughly compacted to a minimum of 95% of the maximum dry density as determined by ASTM D698 or the Michigan Cone Method. The finished subgrade shall be prepared accurately by means of hand tools. Blocking to bring the pipe to grade will not be permitted. Bell holes in the subgrade must be provided to allow for continuous support of the pipe barrel when bell type pipe is used.

If, in the opinion of the Design Engineer (with concurrence of the Township Engineer), subgrade pipe support conditions at some locations are found to be unsatisfactory, he shall have the authority to order subgrade preparation at these locations in accordance with the provisions for special foundations in clay, rock or poor soils.

F. Special Foundation in Clay or Rock

Subgrade consisting of clay or rock shall be excavated to at least four inches and not more than six (6) inches below the specified grade. Before the pipe is laid, the subgrade shall be prepared by backfilling with an approved granular material in three inch compacted layers. The layers shall be thoroughly tamped as directed by the Design Engineer so as to provide a uniform and continuous bearing and support for the pipe barrel



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with a minimum compaction of 95% of the herein defined maximum dry density. The Contractor will not be allowed extra compensation for this work.

G. Special Foundations in Poor Soil

Where the bottom of the trench at subgrade is found to consist of unstable material which will, in the opinion of the Design Engineer, not provide adequate pipe support, the Design Engineer shall have authority to require either the removal of the unstable material and replacement with approved materials or require the Contractor to construct a foundation for the pipe consisting of piling timber or other materials in accordance with plans prepared by the Design Engineer. The use of stone bedding by the Contractor to reduce dewatering requirements will not be paid as an extra.

H. Backfilling around Pipes

From the bottom of the trench to a depth of one (1) foot above the top of the pipe, the trench shall be backfilled by hand with sand or approved excavated materials and tamped to a minimum of 95% of the herein defined maximum dry density.

The Contractor shall use care in placing this portion of the backfill so as to make sure sufficient material has been worked under the pipe and also avoid injuring or moving the pipe. Backfilling around PVC pipe shall be done in accordance with ASTM D2321 "Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe".

I. Backfilling to Natural Grade

From one (1) foot above the pipe to the grade shown on the drawing or specified herein, the trench shall be backfilled by mechanical methods approved by the Design Engineer. A minimum compaction of 85% of maximum unit weight is required, unless otherwise noted.

Provide 30 inches of cover above the top of the pipe before application of wheel loading and 48 inches before use of heavy compactors.

J. Backfill under Structures

Where the excavation is made through or under existing or proposed pavement, curb, shoulders, driveways or sidewalks or where such structures are undercut by the excavation or where noted on the plans, the entire backfill to the subgrade of the structure shall be made with granular material. The granular material backfill shall be placed in layers and

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compacted to 95% of the herein defined maximum dry density throughout. This requirement shall apply to any trench that is within a one-on-three slope beneath the road from the shoulder point or back of curb line. Extra compensation will not be allowed for this work.

Granular material is defined as a material meeting granular material Class II as defined in M.D.O.T. Standard Specifications.

K. Special Backfilling Requirements

The Contractor will be required to comply with the regulations of the State Highway, Municipal or County Road Engineering Departments with regard to backfilling in their respective right-of-ways and beneath the roads, and shall be responsible for determining these regulations prior to bidding.

L. Compaction Testing

Compaction testing may be periodically performed by a source and method approved by the Township Engineer to insure that compaction requirements are being met. Compaction percentage is based on the maximum dry density as determined by ASTM D1557 or the Michigan Cone Method.

M. Boring and Jacking

The following provisions apply to the construction of sewers, forcemains, watermains and house leads which cross pavements under the control of the Michigan Department of Transportation, County Road Commission, or under railroads.

1. General

Steel pipes shall be jacked in place under highways as specified in the current standards published by the Michigan Department of Transportation. Pipe jacked in place under railroads shall meet the current standards established by the affected railroad. The Design Engineer shall incorporate bore and jack requirements into the contract documents. After the pipe has been installed in the steel casing pipe, the casing pipe shall be pressure grouted with an MDOT approved flowable fill or blown full of pea stone and the ends sealed with concrete.

2. Location of Jacking Pits:
  - a. State Highways

The minimum distance of the jacking pit to the edge of pavement will be specified by the M.D.O.T. and placed on the plans or contract documents by the Design Engineer.
  - b. County Roads

On all highways, a minimum distance of 15 feet shall be provided from edge of pavement to the face of boring pits. Any variances from these distances will require tight sheeting and if a traffic hazard, permanent guard rail will be required.
  - c. Railroads

The location of the jacking pit will be specified by the Railroad and/or the Design Engineer.
  
3. The boring machine shall be capable of assuring a crossing with no voids.
  - a. In solid clay soils the cutting head or the auger, if no head is used, may be allowed to within one inch of the front of the casing.
  - b. In sandy soils the cutting head or the auger, if no head is used, must be inside the casing at least 1/2 the diameter of the casing.
  - c. If the soil is both clay and sand, the same procedure as for sand shall apply.
  - d. In wet, sandy or gravelly type soils that have a tendency to move or run, the cutting head and/or auger shall be pulled back to at least three feet from the front of the casing.
  - e. When boring is used to facilitate jacking pipe in place, the minimum diameter of the lead auger section shall be 1/2 inch smaller than the inside diameter of the pipe being jacked.
  - f. Trenchless pipe placement - methods such as trenchless pneumatic piercing tools utilized to perform horizontal bores must be approved by the Township Engineer prior to its use.

5.01 SCOPE OF WORK

The work under this section shall include all materials, labor and equipment necessary to achieve a finished product, including but not limited to the items in these specifications and those shown on the working drawings. Work includes, but is not limited to building footings, floor slabs, sidewalks, curb and gutter, driveways, etc.

All procedures and materials under this section, where not specifically stated, shall be in accordance with standards and recommendations of the American Concrete Institute's Building Code Requirements for reinforced concrete (ACI 318 - latest edition).

5.02 MATERIALS

- A. Cement: Portland cement shall conform to "Standard Specifications for Portland Cement" (ASTM C150 - latest edition) and shall be Type I, IA, III or IIIA.
- B. Aggregates: Concrete aggregates shall conform to "Standard Specifications for Concrete Aggregates" (ASTM C33 - latest edition). Maximum coarse aggregate size for all members less than eight (8) inches in thickness shall be 3/4 inch. For members with thicknesses greater than or equal to eight (8) inches, the maximum coarse aggregate size shall be 1-1/2 inches.
- C. Mixing Water: All water used in concrete shall be from a potable water supply.
- D. Admixtures: Air-entraining admixtures shall conform to "Standard Specifications for Air-Entrained Admixtures for Concrete" (ASTM C260 - latest edition).
- E. Concrete Mix Proportions

Section 4.3.1. (ACI-318) shall be used for developing mixture portions. The Contractor shall furnish, for the Engineer's approval, all records to show that his concrete supplier is in compliance with all provisions of Section 4.3.1. If the concrete supplier is unable to furnish all records to comply with Section 4.3.1, Sections 4.3.1.2 and 4.3.2.2 can be used. If no records are available for any of the above ACI Sections, Section 4.3.3.2 shall be used to develop a concrete mix design.

5.03 EXECUTION

A. Concrete Quality

All concrete shown on the working drawings or referred to in the specifications shall be from an approved batch plant and shall have a minimum compressive strength of 2500 psi and a maximum water-cement ratio of 0.64.

Air entrainment shall be 5%, more or less, 1% for concrete with maximum aggregate size of 1-1/2 inches and shall be 6%, more or less, 1% for concrete with a maximum aggregate size of 3/4 inch.

The concrete shall be of a consistency to work easily into corners, angles of forms and around reinforcement. The slump shall not exceed 4 inches.

B. Mixing And Placing Concrete

1. Preparation of Equipment and Place of Deposit:

- a. Before placement, all equipment for mixing and transporting the concrete shall be cleaned and 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).
- b. Water shall be removed from place of deposit before concrete is placed unless otherwise permitted by the Engineer. All latents and other unsound material shall be removed from hardened concrete before additional concrete is added.
- c. Expansion joint material shall be placed at all locations where concrete is placed against a structure.

2. Mixing:
  - a. Ready mixed concrete shall be mixed and delivered in accordance with "Standard Specification for Ready Mixed Concrete (ASTM C94 - latest edition). Mixing and transporting equipment shall be capable of providing concrete which meets the ASTM C94 requirements for uniformity.
  - b. For job mixed concrete, the mixer shall be rotated at a speed recommended by the manufacturer. If mixer performance tests are not made, each batch of 1 cubic yard or less shall be mixed for at least 1 minute after all materials are in the mixer. The mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof. The entire batch shall be discharged before the mixer is recharged.
3. Conveying:
  - a. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent separation or loss of materials.
  - b. Equipment for chuting, pumping and pneumatically conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete at the delivery end without separation of materials.
4. Placing:
  - a. Concrete shall be deposited, as nearly as practicable, in its final position to avoid segregation due to rehandling or flowing. Concrete shall be placed at such a rate that it is at all times plastic and flows readily. No concrete contaminated by foreign material shall be used nor shall retempered concrete be used unless approved by the Engineer.
  - b. When placing is started, it shall be carried on as a continuous operation until placement is completed.
  - c. All concrete shall be thoroughly consolidated during placement. It shall be thoroughly worked around embedded fixtures and into the corners of the forms.

5. Cold Weather Requirements:
- a. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. No frozen materials or materials containing snow or ice shall be used.
  - b. All reinforcement, forms, fillers and ground with which the concrete is to come in contact shall be free from snow and ice.
  - c. Construction during cold weather shall be performed in accordance with ACI 306, "Recommended Practice for Cold Weather Concreting", or as directed by the Engineer.

6.01 SCOPE

The work covered by this section of the specifications consists of the furnishing of all plant, labor, materials, equipment and supervision and performing all operations involved in the construction of sanitary sewer mains in accordance with the provisions of the Plans and Specifications and subject to the terms and conditions of the Contract Documents.

Sanitary sewer leads and sewer appurtenances are covered under Section 7 of these specifications.

6.02 MATERIALS

A. Sewer Pipe

1. General

- a. Sewer pipe, unless otherwise indicated on the plans or authorized in writing by the Township, shall be new, unused material of the size and type shown on the plans and shall conform to the requirements of these specifications.
- b. Pipe, materials and accessories offered by the Contractor shall be the standard products of reputable manufacturers normally engaged in the manufacturing of the particular item in question. The Township Engineer shall have the final approval of a pipe manufacturer.

2. Sewer Pipe Selection

The sanitary sewer pipe used at a particular location shall be based on depth of bury as shown in Table 6-1.

If the depth of cover over the sewer changes during construction or is different than the depths shown on the approved project plans, it shall be the responsibility of the Design Engineer to ensure that the correct material is utilized.



**TABLE 6-1 Determination of Sanitary Sewer Pipe Material**

Depth of Bury	Sanitary Sewer Pipe Allowed
0' to 16.00'	PVC SDR 35, Truss Pipe, Ductile Iron
16.01' & over	Truss Pipe, Ductile Iron

An entire sewer segment must be constructed of the same pipe material. If greater than 50% of the sewer pipe in a given segment has a depth of bury of 16.01' or greater, then the heavier pipe material shall be used.

3. PVC Sewer Pipe

PVC sanitary sewer pipe 15 inches in diameter and smaller shall meet the requirements of ASTM Designation D-3034 (latest edition), "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings". The minimum wall thickness shall conform to SDR-35. Sewer lead pipe shall be Schedule 40 PVC.

PVC sanitary sewer pipe 18 inches to 27 inches in diameter shall meet the requirements of ASTM Designation F-679 (latest edition), "Standard Specification for Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings". The minimum wall thickness shall conform to ASTM Designation T-1.

The use of PVC sewer pipe requires special attention to proper subgrade and backfilling procedures. Failure of the Contractor to provide proper construction will result in probable excessive deflection of the PVC pipe and require replacement by the Contractor at no additional cost to the Owner.

4. Ductile Iron Pipe

Ductile iron pipe shall meet the requirements of ANSI A21-50 A21-51, and AWWA C151, and shall be of the design thickness classification as indicated on the plans.

5. Composite Sewer Pipe (Truss Pipe)

Composite sanitary sewer pipe shall meet the requirements of ASTM Designation D 2680 (latest edition). The thermoplastic linings may be ABS or PVC.

B. Pipe Joints

1. For PVC Sewer Pipe: PVC sewer pipe joints may be either solvent cement or elastomeric gasket type, in accordance with ASTM D3212 (elastomeric gasket type) and/or in accordance with ASTM D2855 (for PVC pipe solvent cemented joints). Only chemical solvents approved by the pipe manufacturer shall be used.
2. For Ductile Iron Pipe: Ductile iron pipe joints shall conform to the following:
  - a. Flange joints shall meet ANSI B 16.1, Class 125.
  - b. Mechanical joints shall meet ANSI A21.11, and AWWA C111, or Federal Specification WW-P-421.
  - c. Rubber gasket joints shall be of a bell and spigot type "TYTON", "SUPER BELL-TITE" or equal.
3. For Composite Sewer Pipe (Truss Pipe): Composite Sewer Pipe (Truss Pipe) joints shall be bell and spigot type gasketed joints meeting ASTM D3212.

C. Pipe Fittings

Pipe fittings in sewer lines shall correspond in type, size, class, joints and all other respects with the type of pipe used as specified above including the applicable ASTM requirements. Where linings and coatings are specified for pipe, the fittings to be used in conjunction therewith shall have the same lining and coating.

Fittings shall be used in ductile iron pipe lines as required, whether specifically called for or not, according to the best practice in installation of these lines. A manhole water stop shall be provided at each manhole connection as shown in the standard details.

As approved by the Township Engineer, specifically designed adapters shall be used to connect pipes of different diameter or materials of construction. The adapters shall be constructed of flexible materials and clamped onto the pipe with stainless steel bands. Use mastic, solvent weld or rubber gasket seals and encase in concrete to prevent displacement.

6.03 EXECUTION

A. Excavation

As specified in "Excavation, Trenching and Backfilling".

B. Laying Sewer Main

Thermoplastic sewer pipe shall be installed per ASTM designation D 2321 (latest edition) unless otherwise indicated in these specifications. Rigid pipe types (DIP) shall conform to ASTM C12. Embedment material shall conform to ASTM D2321 standards unless otherwise indicated herein, or in the standard details.

Pipes located inside structures or above ground shall be rigidly supported as shown on the plans or as specified herein. The full length of each section of underground pipe shall rest solidly upon the prepared bed of undisturbed earth or compacted backfill with recesses only to accommodate pipe bells and joints. Any pipe which has its grade, alignment or joints disturbed after laying shall be taken up and re-laid.

The interior of all pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during laying operations.

The pipe shall not be laid in water or when trench or weather conditions are unsuitable for work. Water shall be kept out of the trench until the joints and backfilling are completed. When the work is not in progress, open ends of pipe and fittings shall be securely closed so that no water, earth or other foreign substances can enter the line.

All sanitary sewer main shall be laid using a pipe laser for alignment and grade. The Contractor shall be responsible for checking their work using the hubs, stakes, and/or benchmarks provided by the Owner and/or Design Engineer. Any sewer found to have a grade or alignment that varies by more than 10% from the plan grade or elevation will be considered deficient. Variations up to 10% will not be accepted if this variation results in a pipe that is below the minimum slope as defined for that pipe diameter in the latest version of Recommended Standards for Wastewater Facilities (Ten State Standards). The Design Engineer and

Township Engineer will determine if the deficiency is serious enough to affect the objective of the project. The Contractor shall remove and re-lay

any deficient sewer, if directed by the Design Engineer or Township Engineer, at no additional cost to the Owner or Township.

Any section of pipe found to be defective, either before or after laying, shall be replaced with new pipe at the Contractor's expense. If repairs are necessary, Fernco adaptors will not be allowed for main line pipe. Similar material shall be utilized.

The Township Engineer shall be notified at least 48 hours prior to the start of laying sewer main.

C. Placement within Easements

Where sewer lines are shown crossing private property, the alignment of the sewers shall be as shown on the plans and as directed by the Engineer and extra care must be taken to ensure that the work is done within the construction easements.

D. Handling

The sewer pipe shall be handled at all times in such a manner as to ensure delivery to the site and installation in a sound, undamaged condition. Any damaged or defective pipe or other materials will not be accepted. PVC pipe shall not be stored or handled in a manner which will permit exposure to sunlight for extended periods of time.

E. Horizontal and Vertical Separation

Sewers shall be laid at least 10 feet horizontally from any existing or proposed watermains. This distance shall be measured edge to edge. Should local conditions exist which do not allow for this separation, the crown of the sewer pipe shall be laid at least 18 inches below the invert of the watermain - with the approval of the Township Engineer and the Michigan Department of Environmental Quality, Drinking Water division.

Sewers crossing watermains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the pipes. This shall be the case where the watermain is either above or below the sewer. The crossing shall be arranged so that one full length of sewer pipe shall be centered with respect to the water pipe. Where a watermain crosses a sewer, adequate structural support shall be provided to prevent damage. If the 18-inch isolation distance cannot be maintained due to site constraints, then approval from the MDEQ Water Division will be required for the special construction method proposed (casing, sleeving, etc.)

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe and shall be pressure tested to assure watertightness prior to backfilling.

In all cases, state and local permit requirements shall be adhered to.

F. Placement of Sewer Pipe

The pipe shall be placed as soon as possible after the trench excavation has been made. The pipe shall be carefully laid to the required grade in a prepared trench, up-grade from structure to structure, with the bell or groove end of the pipe up-grade. Each section shall have a firm bearing throughout its length with recesses only to accommodate pipe bells and joints. Any pipe which has its alignment, grade or joints disturbed after laying shall be removed and re-laid. The joints and interior of all pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during the laying operations. Starting sewer construction in the middle of a project must be approved in writing by the Township Engineer.

Water shall be kept out of the trench until the material of the joints has hardened and the trench partially backfilled to prevent floating of the pipe. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other foreign substance can enter the line.

G. Joints

Joints shall be of the material specified and shall be placed in accordance with the manufacturer's specifications.

H. Backfilling

As specified in "Excavation, Trenching and Backfilling".

I. Cleaning Sewers

The sanitary sewer main must be clean at the time of acceptance. If, at any time, there is an accumulation of earth or silt in the pipe, the Contractor shall clean out and remove such deposits at their own expense.

J. Acceptance Tests

1. Air Testing

All new sewers shall be subjected to air, infiltration or exfiltration tests or a combination of same prior to acceptance by the Owner. All tests for acceptance of the sewer line shall be witnessed by the Township Engineer. All sewers where the groundwater level above the crown of the sewer at the upstream manhole is over seven (7) feet shall be subjected to air tests or infiltration tests. If an exfiltration test is performed, the maximum exfiltration rate shall be the same as that permitted from infiltration. For the purposes of exfiltration testing, the internal water level shall be equal to the external water level plus seven (7) feet as measured from the crown of the pipe at the upstream manhole.

No sewer lines will be accepted until testing has been satisfactorily completed and approved. Testing shall be completed within 30 days of laying operations.

Where groundwater conditions require dewatering operations in order to construct sewers, the Contractor may, at his option, perform preliminary air tests after backfilling and while the dewatering equipment is still operating. After dewatering operations have ceased and the groundwater has stabilized at its normal level seven (7) feet or less above the sewer and if the preliminary air test was satisfactory, the preliminary air test may be accepted as final.

Maximum allowable infiltration shall not exceed 100 gallons per inch of diameter per mile of pipe per 24 hours for any individual run between manholes.

The procedure for air testing of rigid pipes such as DIP must conform to ASTM C828 (VCP) or ASTM C924 (concrete) as determined and approved by the engineer or as otherwise recommended by the pipe manufacturer.

The procedure for air testing of PVC (flexible/plastic pipe) sewers shall conform to ASTM F1417 and be as follows:

The sewer line shall be tested in increments between manholes. All leads and wyes shown on the plans must be in place prior to testing. The lines shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure, be braced in place, and shall provide an air tight seal. There shall be

SECTION 6  
SANITARY SEWER MAIN

no standing water in the pipe during testing operations. One of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of 3-1/2 inches and a range of 0-10 PSIG. The gauge shall have minimum divisions of 0.10 PSIG and an accuracy of  $\pm 0.04$  PSIG.

The sewer shall be pressurized to 4 PSIG greater than the greatest back pressure caused by groundwater over the top of the sewer pipe. Greatest back pressure is determined by averaging groundwater depth over the top of the pipe averaged at each manhole and multiplying by 0.433 to obtain psi. At least two (2) minutes shall be allowed for the air pressure to stabilize between 3.5 and 4 PSIG. If necessary, air shall be added to the sewer to maintain a minimum pressure of 3.5 PSIG during the stabilization period.

After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than 3.5 PSIG or such other pressure as is necessary to compensate for groundwater level.

The air test shall be performed for the duration shown in Table 6-2. The air pressure shall not drop over 1.0 psi during this test period.

**TABLE 6-2 Required Test Time for Air Pressure Testing**

Pipe Diameter In Inches	Duration of Air Test in Minutes per 100 ft. of Sewer Pipe Length
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.5
24	11.5

If a sewer segment fails to pass the air pressure test, the

Contractor shall determine the location of the deficiency, repair them and retest the sewer. The sewer will not be accepted until satisfactory results are obtained.

The actual groundwater level for sanitary sewers subject to air tests shall be determined by the Township Engineer or Resident Project Representative.

The air test pressure shall be adjusted to compensate for the maximum probable groundwater level above the top of the sewer pipe that is being tested.

The method of testing and measurement shall be approved by the Township Engineer. The Contractor shall provide the necessary equipment and labor for making tests and the cost of same shall be included in the unit price bid for completed sewer.

Chemical grouting will be considered an acceptable method of repairing leaking pipe joints. Before this type of repair is undertaken, the Contractor shall obtain approval of the Township Engineer to hire a pipe grouting firm for making such repairs. Additionally, if chemical grouting of pipe joints is necessary, this operation must be performed under the observation of the Township Engineer and a complete report of all grouting operations shall be furnished to the Township Engineer upon completion.

2. Deflection Testing of Thermoplastic Sewer Pipe

Thermoplastic sewer pipe shall be tested for vertical deflection. **Deflection tests shall be performed on 100 percent of the total footage of PVC sewer.**

Truss sewer pipe will also require testing for deflection.

This testing shall be carried out under the observation of the Township Engineer using a Go-No-Go device approved by the Township Engineer and furnished by the Contractor. The deflection testing shall be performed at least thirty (30) days after final backfill of the trench. The maximum allowable vertical deflection of the cross section of the pipe will be five percent (5%) of the actual internal pipe diameter. If the results show the deflection of any sewer to be in excess of allowable, then the Contractor shall make repairs by re-excavation and compaction or replacement prior to acceptance.



The deflection testing must be satisfactorily completed prior to final acceptance of the sewer. There will be no additional payment for deflection testing performed while the sanitary sewer is in service if the Township executes their right to utilize the sewer upon Substantial Completion. The Township Engineer shall be notified at least 24 hours prior to air testing of the sewer.

3. Television Inspection

All new sewers shall be inspected after installation by means of closed circuit television. Video taping equipment shall have a running footage indication for aiding in locating all wyes, defects, etc. which is displayed and permanently recorded on the video tape of the section being filmed. The complete system shall be permanently recorded using video tape along with handwritten documentation indicating all information such as wye location, defects, infiltration and cleanliness. Immediately upon completion of the filming, the finished video tapes shall be turned over to the Township Engineer in cassette style (VHS Format). Wyes and laterals shall be in place prior to the television inspection. This television inspection work will be done under the direction and observation of the Township Engineer. The Contractor shall notify the Township Engineer at least 24 hours prior to the television inspection.

The television inspection shall be completed prior to the final acceptance of the sewer section. The Township may exercise their option to use the sewer upon substantial completion. No additional payment will be made for televising the sewer under live conditions.

Any defect in the sewer construction observed during the television inspection such as poor grade, cracked or leaking pipe sections or excessive amounts of debris shall be corrected by the Contractor immediately. Sections with defects will have to be retelevised after the repairs are made.

4. Visual Observation

Any observed defects in the sewer or groundwater flowing in the sewer shall be repaired by the Contractor prior to final acceptance.

K. Certification

The manufacturer of pipe and fittings shall furnish a certification statement that all pipe and fittings furnished to the project have been inspected and tested in accordance with the applicable specifications. Pipe will be subject to inspection and approval upon delivery and no cracked, broken, damaged or defective pipe or fitting shall be laid in the work. Any piece that is found to be defective after it has been laid shall be removed by the Contractor and replaced by a sound and perfect piece. Material certifications must be received prior to final acceptance and/or final payment for the work.

7.01 SCOPE OF WORK

The work covered in this section of the specifications consists in the furnishing of all plant, labor, materials, equipment and performing all operations involved in the construction of sewer appurtenances as shown on the Project Plans or Standard Details. This work includes, but is not limited to, the following items:

1. Sewer Manholes
2. Connection to Existing Sewers
3. Sewer Wyes and Leads

A. General

The following provisions apply to this section of the specifications:

1. All materials, unless otherwise indicated on the plans or authorized in writing by the Township Engineer, shall be new and unused materials of the size and type shown on the plans and standard details and shall conform to the requirements of the specifications.
2. All materials offered by the Contractor shall be the standard products of reputable manufacturers normally engaged in the manufacturing of such materials. Certifications shall be provided on all materials prior to final acceptances.
3. The foundations of all structures shall be rigidly supported by undisturbed earth or compacted backfill. The interiors of all appurtenances shall be thoroughly cleaned of all foreign materials.
4. Where appurtenances are shown to be constructed on private property, the location of the structure shall be as shown on the plans. All work done within private property shall have an easement provided to the Township by the Owner prior to turnover.

7.02 MATERIALS

A. Sanitary Sewer Manholes

Sanitary Sewer Manholes shall be constructed of pre-cast manhole units in accordance with ASTM C478. Unless otherwise indicated, all manholes shall be four (4) feet in diameter. Manholes shall be delivered to the project in an un-damaged condition. Any manhole, which shows visible signs of damage, will not be accepted. Manholes shall be constructed to meet the dimensions shown on the Standard Details.

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SANITARY SEWER APPURTENANCES

1. Manhole Waterstops: All manhole connections will be fitted with a waterstop assembly. The waterstop shall be of a design acceptable to the Engineer and the pipe manufacturer. Waterstops shall be KOR-N-SEAL as manufactured by National Pollution Control Systems; PRESS WEDGE II as manufactured by the Press-Seal Gasket Corporation; RES-SEAL as manufactured by Scales Manufacturing Corporation or equal.

The joint between the pipe and the manhole wall shall be flexible. Mortar and grout shall not be used to fill the space between the manhole wall and the pipe, except to form an adequate flow channel.

2. Manhole Waterproofing Material: All manholes shall be waterproofed on the interior or the exterior.
  - a. Interior Manhole Waterproofing Material: The materials to be used for interior manhole waterproofing shall be "Drycon" as manufactured by IPA Systems, Inc., "Thoroseal" as manufactured by Standard Dry Wall Products Company or equal.
  - b. Exterior Manhole Waterproofing Material: The material to be used for exterior manhole waterproofing shall be a heavy fibered type waterproofing mastic conforming to Federal Specification SS-C-153 Type 1 or CS-206. The mastic shall be A.C. Horn (Grace), Flink Kote 710-23 or equal.
3. Manhole Steps: Manhole steps shall be ~~cast iron~~ or steel reinforced plastic. Steps shall not be aligned over the pipe.
  - ~~b.~~ a. Plastic: Polypropylene plastic, steel reinforced, manholes steps may also be furnished, minimum width 14". They shall be #PS2 manhole steps as manufactured by M.A. Industries, Inc., of Peachtree City, Georgia or equal.
4. Cast Iron Frames and Covers: Manhole frames and covers shall be cast iron. Cast iron frames and covers for sanitary sewer manholes shall be a self-sealing lid with no holes extending all the way through the lid. The self-sealing lid shall fit into a precisely machined groove. A rubber gasket shall make contact with the frame to create a leak proof seal. The self-sealing lid shall include a concealed pickhole to facilitate the removal of the lid, but not allow any water to enter the manhole.

Manholes shall have a 24" opening similar to an EJIW#1040 with Type A solid cover or equal. Manholes located within existing or proposed pavement areas shall also be installed with a 3" metal adjusting ring between the frame and cover. Metal adjustment rings shall be tack welded in at least 6 locations inside and out to secure the ring to the frame.

B. Sewer Wyes and Sewer Leads

Sewer leads shall be Schedule 40 Polyvinyl Chloride (PVC) with solvent welded joints as defined in ASTM D-3034 or Extra Strength Solid Wall, SDR 23.5 ABS as defined in ASTM D-1788. Sewer wye fittings shall be of the same material as the pipe, unless otherwise approved by the Township Engineer.

The fitting between the SDR 35 wye and the SCH 40 PVC lead shall be a 35/40 adapter. SDR joint shall utilize a slip joint (no rigid glue joint will be allowed).

C. Clean-Outs

Clean-outs shall consist of pipe and fittings of the same type as the sewer main materials they connect to as required to provide a clean-out installation as shown in the standard details. The maximum distance between clean-outs is 75 lineal feet.

7.03 CONSTRUCTION METHODS

A. Excavation, Bedding and Backfilling

Excavation, bedding and backfilling for sewer manholes and clean-outs shall be in accordance with the Section 4, "Excavation, Trenching and Backfilling" of these specifications and applicable standard details.

B. Manholes and Pre-cast Structures

Manholes and precast structures shall be constructed only when the temperature is above 32 F. All work shall be protected against freezing.

Water shall be removed from the excavation during construction of the structure and during the time required for the concrete or mortar to develop sufficient strength to resist rupture by groundwater pressure.

Pre-cast O-ring sections shall be joined by first applying a lubricant as approved by the concrete manufacturer. The lubricant shall be placed on the O-ring and both faces of the sections to be joined. The pre-cast sections shall then be set evenly to provide a full seating of the O-ring within the grooves in the concrete sections. After the pre-cast sections have been placed, the interior joint surface shall be grouted smooth. Additional methods for joining two-barrel sections must be approved by the Engineer.

C. Manhole Flow Channels

Manhole flow channels shall be formed as shown on the Standard Detail Plans by laying pipe through and cutting out the top portion before completion of the base of the manholes. Cut edges of pipe laid through the manhole shall be fully covered by concrete when the manhole invert is complete. The finished invert shall be smooth and true to grade. No mortar or broken pieces of pipe shall be allowed to enter the sewers.

D. Drop Structures

All sanitary manholes with an invert drop in excess of 24 inches shall have a drop structure. The drop structure shall be built as shown on the Standard Detail Plans.

E. Manhole Waterstops

The joint between the pipe and the manhole wall shall be flexible. Mortar and grout shall not be used to fill the space between the manhole wall and the pipe, except to form an adequate flow channel.

F. Placing Castings

Castings with adjustment rings, if applicable, shall be set to the required elevation in full mortar beds. No more than nine inches (9") of adjusting concrete rings, or mortar shall be used on any manhole between the precast top section and the casting.

G. Connection to Existing Sanitary Sewer Systems

Connection to existing sanitary sewer systems shall be made in such a manner as to minimize the interruption of flow in those systems. The connection to an existing manhole shall be made by coring and installing a waterstop.

When a new manhole is to be installed over an existing line, it shall be initially placed without damaging the existing pipe. The existing pipe shall not be damaged until the new lines are ready to be placed in operation and the new flow channel is ready to be formed to connect with the existing flow lines.

H. Sewer Wyes and Leads

The wyes and sewer leads shall be constructed as shown on the Sanitary Sewer Standard Details in the plans.

The sewer lead is defined as the sewer pipe between the wye installation and 5 feet outside the building limits or to the property/easement line in the case of installation to an undeveloped parcel as indicated on the Standard Details for sewers. The sewer lead shall be brought to the property/easement line at a grade and location established before construction commences, based on a location document (provided by the Design Engineer) or as staked in the field by the Design Engineer or Resident Project Representative. If the proposed location of a sewer lead is not identified, it is the Contractor's responsibility to obtain the information from the Design Engineer/Resident Project Representative prior to the installation. If the lead location is not as per directed by the Resident Project Representative, Design Engineer, or Township Engineer the relocation of the sewer lead shall be performed at the Contractor's expense.

After each sewer lead is installed, it shall be permanently marked in two locations at its termination (the property line or easement line) and at the plug (see the Standard Detail) with a treated wood post 0.40 penetration for underground purposes. The post at the 45° bend shall be 12 feet long ± 1/2 inch, installed vertically and cut and painted as directed by the Design Engineer after record elevations off the top of the post have been obtained. For the post at the end of the stub it must be installed from the bottom of the stub to 18" above grade and approximately 4 1/2' deep. For leads deeper than 12 feet, use wood post that provides an 18-inch (±) projection above ground. Should the post location fall in a driveway or other area where its above ground projection might cause problems, the Contractor shall pre-cut the 12-foot post to some convenient full foot dimension below grade level and attach 3-1/2" x 3-1/2" x 1/4" metal plate to the top of the post. The Contractor shall immediately report same to the Resident Project Representative. The Contractor shall allow the Resident

Project Representative to obtain necessary record measurements on the lead installation prior to backfilling. If the sewer leads are backfilled without notification to a Resident Project Representative, the sewer lead shall be

excavated, clearly showing the newly placed pipe, at the Contractor's expense. Sanitary sewer saddles shall be SDR-25 wye assembly with stainless steel straps and shall meet ASTM 3034 specifications. Use of saddles shall require approval by the Township prior to installation.

I. Sewer Cleanouts

Sewer cleanouts, if required, shall be constructed as shown on the Sanitary Sewer Standard Detail Sheet. Placement shall be as required by site conditions and local plumbing codes. Sanitary sewer cleanouts for sewer leads shall be placed every 75 feet.

J. Cleaning

All manholes, sewer leads and cleanouts shall be kept thoroughly clean of silt, debris and foreign matter and shall be free from such accumulations at the time of final acceptance.

K. Sanitary Sewer Manhole Waterproofing

The Contractor shall apply a waterproofing system to the inside or outside of all manhole walls. The material to be used for this operation shall be as specified in these specifications.

The waterproofing system shall be applied and allowed to dry in accordance with the manufacturer's directions. All steps, lids, frames and castings and sewer pipe entering or leaving the manhole shall be protected during application to prevent their being coated.

Interior Waterproofing

If any leaks in the manhole walls are detected twenty-four (24) hours after application of the first coat of the waterproofing system, they shall be sealed by application of a quick-set sealer. This sealer shall be a mixture of Portland Cement - Type One and "Ipanex R", "Waterplug", "Preco" or equal. The quick-set sealer shall be applied in accordance with the manufacturer's directions. After the patched areas dry, they shall be covered with another coat of the waterproofing and allowed to dry. If any leaks are apparent after that time, the Contractor shall repatch them. The above steps shall be repeated until all leaks are sealed.

After all leaks are stopped and there are no leaks apparent after twentyfour (24) hours upon application of the first coat of the waterproofing system or twelve (12) hours after application of a patch, the Contractor shall apply over the dry surface a finish coat.



Exterior Waterproofing

The Contractor may elect to provide an exterior rather than interior manhole waterproofing to the manhole sections before installation.

The exterior surfaces of all manholes shall be thoroughly covered with mastic at a rate of one (1) gallon per twenty-five (25) square feet. The exterior surfaces shall be thoroughly cleaned before application of the mastic. The mastic shall be as specified in these specifications.

Should the exterior waterproofing fail to provide an adequate seal then the Contractor shall seal the interior of the manhole as specified above.

L. Defective Manholes

Any manhole that is defective, due to manufacturer or realignment of the pipe openings, should be returned to the manufacturer.

M. Acceptance Tests

1. Sanitary sewer manholes shall be visually inspected for leaks prior to acceptance of the manhole. There shall be no visible leakage of groundwater into the manhole. Patching, if required, shall be accomplished via the methods indicated in 7.03K.
2. Sanitary sewer wyes and sewer leads shall be tested for leakage after completion of construction. The testing shall occur in conjunction with the overall main sewer testing. Should it be necessary to test sewer wyes and leads independently after the main sewer has been tested it shall be performed using air and following the procedure outlined in Section 6.03J of these specifications.

8.01 SCOPE OF WORK

The work covered by this section of the specifications consists in the furnishing of all plant, labor, materials, equipment and/or in performing all operations necessary for the installation of the forcemains, valves and fittings, complete, in accordance with these specifications and applicable drawings.

8.02 MATERIALS

A. Pipe Materials

1. Ductile Iron Pipe and Fittings shall be designed in accordance with the latest revision of ANSI specifications A 21.50 and A 21.51 and AWWA C151. The pipe shall be designed to withstand a minimum working pressure of 150 psi and a minimum hydrostatic test pressure of 300 psi. The pipe shall also be designed for a minimum laying depth of six feet.

All ductile iron pipe and fittings shall be coated on the outside with a bituminous coating of either coal tar or asphalt base one mil thick at the point of manufacture in accordance with the specifications of the American Water Works Association. All ductile iron pipe shall be cement lined, standard thickness, in accordance with ANSI A 21.4. The spigot ends of all pipe lengths which have been cut in the field shall be ground to a smooth surface, tapered back about 1/8 inch at an angle of 30° with the pipe centerline, and painted with two coats of asphaltum metal protective paint.

Ductile iron pipe shall conform to the dimensions set forth in the table below. Tolerances permitted in ANSI specifications listed above will apply. Pipe classes shown on the plans shall control.

Pipe Size Nominal Inside Diameter in Inches	Outside Diameter In Inches	Pipe Barrel Thickness in Inches	Thickness Class
4"	4.80	0.26	51
6"	6.90	0.25	50
8"	9.05	0.27	50
10"	11.10	0.29	50
12"	13.20	0.31	50
14"	15.30	0.36	51
16"	17.40	0.37	51
18"	19.50	0.41	52
20"	21.60	0.42	52

2. Polyvinyl chloride (PVC) pipe shall meet the requirements for Type 1, Grade 1 (PVC 1120) of ASTM Specification D-1784 and ASTM D-2241, Standard Specification for PVC pipe (SDR-PR). PVC pipe shall be a minimum rating of Class 200, SDR 21.

B. Pipe Joints

1. Flanged joints shall be made with flanges, bolts, nuts, washers and gaskets, conforming to ANSI Standard B 16.1, Class 125.
2. Mechanical joints for cast and ductile iron pipe shall conform to ANSI Standard A21.11 and AWWA C111 or to Federal Specifications WW-P-421.
3. Rubber gasket joints for cast and ductile iron pipe shall be of a bell and spigot type conforming to ANSI Standard A21.11. These joints shall be similar to "TYTON" as manufactured by the U.S. Pipe and Foundry Co., "SUPER BELL TITE" as manufactured by James B. Clow & Sons, Inc. or equal.
4. Rubber gasket joints for PVC pipe shall be of bell and spigot type meeting ASTM D3139 requirements. The pipe shall be jointed by the means of rubber ring, which shall be an integral and homogeneous part of the pipe barrel.

C. Valves and Appurtenances

1. Gate valves shall meet the requirements of AWWA C515 of the American Water Works Association. Valves shall be designed for not less than 150 psi working pressure and shall be tested for leakage and distortion under a hydraulic pressure of not less than 150 psi. Under such pressure, the valves shall show no leakage or distortion.

All gate valves shall be ductile iron body, fully bronze mounted, bronze stem double disc gate valves or resilient seated gate valves. Each valve shall have a clear waterway equivalent in area, when open, to that of the connecting pipe. Valves shall be made to close when turned to the right or clockwise. All valves shall be operated by non-rising stems and shall have square wrench nuts, or hand-wheel operators with an opening arrow cast in the metal.

Valves shall be EJIW Flowmaster.

2. Plug valves shall be lubricated round port valves. Valves shall be 100% port area type with semi-steel body. Valve bodies shall be suitably marked to indicate whether the valve is open or closed.

The seating surface of the rotating element shall be of material recommended by the manufacturer for sewage sludge service. Bearings at the top and bottom supporting the rotating element shall be permanently lubricated corrosion-resistant type, suitable for sewage plant service. Stem seals shall be O-ring type of the same material as the seating surface and designed so replacement can be accomplished without disassembly of the valve.

All plug valves shall be designed to operate with a pressure of 150 psi on either side of the valve without leakage.

3. Check valves shall be designed for a minimum working pressure of 150 pounds per square inch or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. Distinctly cast on the body of each valve shall be the manufacturer's name or initials or trademark by which he can be readily identified and the size of the valve, working pressure and the direction of flow.

Check valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends and shall be the non-slam type. Flanges shall be the 125-pound type conforming to ANSI Standard B16.1. All check valves shall be supplied with an external lever and weight. Springs shall be applied to lever, if necessary, to create a non-slam condition.

4. Valve operators shall be provided for all sewage and sludge valves of a type as indicated on the plans. Valve operators shall be of sufficient size and strength to overcome expected maximum operating torque. Valve operators found to be inadequate strength will be replaced by the Contractor at no expense to the Owner or the Township.

All valves 8 inches and larger are to have a crank, handwheel, chain wheel or square nut for buried service, totally enclosed, weatherproof worm gear or traveling screw-type operators with indicators. For automatic (if required by the drawings) operation, cylinder, rotary or similar types of electric or pneumatic actuators may be used regardless of valve size. Various accessories shall be used, depending on the application, such as positioners, limit switches, solenoid valves, speed controls and failsafe assemblies.

5. Valve boxes shall be cast-iron, three piece, adjustable type with a 5-1/4 inch shaft. Covers shall be furnished with fingerholes and marked "SEWER". Valve boxes shall be similar to that as manufactured by the East Jordan Iron Works, Clow Corporation or equal.
6. Pipe supports, where required, shall be of the adjustable type made to support cast iron type pipe.

#### 8.03 INSTALLATION OF PIPE AND FITTINGS FOR FORCEMAIN

All pipe and fittings shall be installed in strict accordance with the recommendations of the manufacturer. Piping and fittings for forcemains shall be of the types and materials hereinbefore specified. The pipe and accessories shall be new and unused.

The interior of the pipe and fittings shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging the ends or other approved methods. When work is not in

progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, animals or other substance will enter the pipes.

No pipe or fittings shall be laid in water or when the trench or weather conditions are unsuitable for work, except by permission of the Township Engineer.

The full length of each section of pipe shall rest solidly upon the pipe bed with recesses provided to accommodate the bells and joints. Deflections from a straight line or grade, as required by vertical curves, horizontal curves or offsets, shall not exceed one inch per lineal foot of pipe for pipe less than 10 inches in diameter between the centerlines extended of any two connecting pipes. If the alignment requires deflections in excess of these limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide the angular deflection required.

When pipe is cut in the field, the outside of the cut end shall be tapered back about 1/8 inch at an angle of 30 with the centerline of pipe to remove any sharp, rough edges and painted with two coats of asphaltum metal protective paint.

Fittings at bends in the pipeline shall be firmly wedged against the undisturbed, vertical face of the trench to prevent the fittings from being blown off the lines when under pressure. Concrete thrust blocks shall be installed at all deflections as shown on the drawings or as directed by the Township Engineer.

Where pipe ends are left for future connections, they shall be valved, plugged or capped as called for on the drawings. Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings required to suit the actual conditions.

#### 8.04 HYDROSTATIC TESTS FOR FORCEMAIN

The forcemain or sections thereof shall be tested by the Contractor in the presence of the Township Resident Project Representative and all leaks shall be made tight to meet the requirements below. The Contractor shall furnish all piping, bulkheads, pumps, gauges and other equipment required to carry out the testing.

The section of main to be tested shall be filled with water at least 24 hours prior to starting the test.

At the start of testing, the main shall be pumped up to a pressure of 150 psi and the test period shall start immediately thereafter. The line shall then be maintained under this test pressure for a continuous period of two hours by pumping water into the line at frequent intervals. The volume of water so added

shall be measured and considered to represent the leakage from the line under test during the interval. In calculating leakage, the Township Engineer will make allowance for added joints in the line over the normal for unit lengths of pipe. The leakage per hour under the conditions of test shall not exceed the values shown in the following table:

Size of Pipe	Maximum Leakage Gallons Per Hour Per 100 Joints
2"	0.34
3"	0.50
4"	0.67
6"	1.00
8"	1.35
10"	1.66
12"	2.00
14"	2.34
16"	2.65
18"	3.02
20"	3.32

In the event that the leakage exceeds the specified amount, the joints in the line shall be carefully inspected for leaks and repaired where necessary. Any pipes or special casting found to be cracked shall be removed and replaced by new pieces by the Contractor. After this work has been done, the test shall be repeated. Final acceptance of the lines will not be made until satisfactory tests have been passed.

#### 8.05 MARKING PIPE

Each piece of cast iron pipe and each cast iron fitting shall have its weight and class designation conspicuously painted or cast on it. All other pipe materials shall have the class designation painted thereon. Where required, other designation marks shall be painted on the pipe or fittings to indicate correct location of the pipe section in conformity to a detailed layout plan.

#### 8.06 PAINTING

All pipe, valves, bolts and any other portions of forcemain exposed inside manholes and other structures shall be painted per the table below. If necessary, heat shall be provided to maintain good drying conditions. All items to be painted shall be dry and clean before application of the paint. Any rust or scale shall be removed by wire brushing or scraping. All piping must be painted prior to operating the system.

1 Coat - "Kopper's Plug Primer" or equal  
(350 S.F./Gal.)  
2 Coats - "Kopper's Rustamor 500" or equal  
(500 S.F./Gal.)

8.07 THRUST BLOCKS

Concrete thrust blocks shall be poured on hand excavated, undisturbed soil bearing surfaces, of a minimum size as shown on the Standard Details, or increased in size according to the actual bearing values of the soil in each location, or as directed by the Township Engineer.

Thrust blocks shall be made of 3,000 psi concrete, wet mix. Concrete thrust blocks shall be placed at all 22-1/2 degree bends or greater, dead ends, tees, reducers, hydrants, and crosses as required. Pre-cast thrust blocks may be utilized for certain applications if approved by the Township Engineer. Retainer glands shall be utilized on all mechanical joint fittings.

8.08 EXCAVATION, TRENCHING AND BACKFILLING

Excavation, trenching and backfilling shall conform to these specifications.

8.09 PIPE LOCATOR

A continuous, insulated 10-gauge wire shall be laid in the trench along with the plastic pipe. Contractor shall verify continuity of the locator wire prior to acceptance by the engineer. The 10 gauge wire shall be looped at 400' intervals and installed within a tracer wire access box. This tracer wire box shall be made of cast iron with a permanently attached 3"x12" ABS tube with a flared end to secure it in the ground. It shall be tamper resistant, with a cast iron locking lid and stainless steel terminal connections on the bottom side to which the tracer wires are attached. Lid will open using a standard AWWA pentagon key. Tracer wire access box as distributed by USA Blue Book shall be utilized or equal. Located at each tracer wire access box a flexible rebounding marking post must be installed. This marking post must be able to snap back to its normal position when hit. It must extend at least 3' above ground for visibility and have a width of 4". This flexible green rebounding marking post must have a permanent decal applied indicating "Warning Forcemain Pipeline". This marker size and type must be approved by the Township Engineer.



A 2" wide metallic lined marking tape, which meets the latest APWA specifications, similar to Seton Detection Tape Type 2 SEW, is to be installed. The detection tape shall be buried for the full length of the forcemain at a depth prescribed by the manufacturer.

8.10 AIR RELEASE VALVES AND MANHOLES

Air release valves and manholes shall be constructed as detailed on the detail drawings.

8.11 FORCEMAIN CLEANOUTS

Forcemain cleanouts shall be constructed as shown on the detail drawings.

8.12 CERTIFICATION

The manufacturer of pipe and fittings shall furnish a certified statement that all pipe and fittings furnished by him have been inspected and tested in accordance with the applicable specifications. Pipe will be subject to inspection and approval upon delivery and no cracked, broken, damaged or defective pipe or fittings shall be laid in the work. Any piece that is found to be defective after it has been laid shall be removed by the Contractor and replaced by a sound and perfect piece at no additional cost to the Owner or Township.

9.01 SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all plant, labor, materials, and equipment and in performing all operations for the installation of the watermains and appurtenances in strict accordance with these specifications and applicable contract drawings.

9.02 MATERIALS

A. Pipe Materials

1. PVC Pipe and Fittings: shall be designed in accordance with American Water Works Association (AWWA) Standards C900 (latest edition). The pipe shall be designed to withstand a minimum working pressure of 150 psi. Pipe shall be a minimum thickness of DR18. Joints shall be in accordance with ASTM D3139 (latest edition). PVC pipe must meet the requirements of NSF Standard 14 and NSF Standard 61 to be used for potable water systems.

Fittings for PVC pipe shall be the same as for Ductile Iron Pipe.

2. Ductile Iron Pipe and Fittings shall be designed in accordance with American Water Works Association (AWWA) Standards C150 (latest edition) and C151 (latest edition) also ANSI Standards A21.50 (latest edition) and A21.51 (latest edition). The pipe shall be designed to withstand a minimum working pressure of 200 psi and a minimum hydrostatic test pressure of 300 psi. The pipe shall also be designed for a laying depth of a minimum of six feet. All ductile iron pipe shall meet the requirements of NSF International (NSF) Standard 61.

All ductile iron pipe and fittings shall be coated on the outside with an asphaltic coating of asphalt base one mil thick at the point of manufacture in accordance with the specifications of the AWWA Standard C151 (latest edition) and ANSI Standard A21.51.02. Cement lining requirement shall conform to AWWA Standard C104 (latest edition) and ANSI Standard A21.4 (latest edition). The spigot ends of all pipe lengths which have been cut in the field shall be ground to a smooth surface, tapered back about 1/8 inch at an angle of 30° with the pipe centerline, and painted with two coats of asphaltum metal protective paint.

Ductile iron pipe shall conform to the dimensions set forth in the table below (Design Engineer shall verify expected pressure range with Township Engineer during design phase).

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Pipe Size Nominal Inside Diameter in Inches	Outside Diameter in Inches	Pipe Barrel Thickness in Inches	Thickness Class
6"	6.90	.31	52
8"	9.05	.33	52
10"	11.10	.35	52
12"	13.20	.37	52
16"	17.40	.40	52
20"	21.60	.42	52

3. High Density Polyethylene Pipe (HDPE) for river crossings or wetland crossings shall be DR 9, Class 3408 as supplied by Driscoplex PW 4000 by Performance Pipe or equal, and meet the following conditions.

Pipe Size Standard	Dimension Ratio (DR)	Working Pressure	Working Pressure + Surge Pressure
DIPS	9	200 psi	300 psi

All HDPE pipe shall be joined by heat fusion per manufacturer's requirements. HDPE pipe must meet the requirements of NSF Standard 14 and NSF Standard 61 and AWWA C906 (latest edition). The exterior wall print line of all HDPE pipe proposed for installation and potable use must bear the NSF-PW identification. River crossing section shall be pressure tested independently of other watermain. See Section 9.07 of these specifications. This method and locations must be approved by the Township Engineer. Refer to standard details for the connection of ductile iron pipe to HDPE. This connection, a mechanical joint (gate or butterfly valve, and corporations on the ductile iron) shall be enclosed in a pre-cast concrete manhole. The size of the manhole will be determined by the Engineer and a standard EJIW 1040 shall be utilized for this structure and shown in the standard detail.

Refer to MDOT specification BJ-2D, Special Provisions for Directionally Bored Pipe.

HDPE pipe shall be inspected prior to installation by a qualified person or by the Township Engineer. If damage is found to be unacceptable according to the manufacturer, then suitable efforts shall be made to repair the damaged pipe or the pipe shall be rejected from use.

The pipe should all be approved by the Township.

4. Fusible Polyvinylchloride (PVC) Pipe for directional drills shall conform to AWWA C900 or C905, ASTM D1784, and cell classification 12454. Pipe shall be in accordance with ASTM D2241 for IPS standard dimensions as indicated in these specifications. Compound formulation shall be in accordance with PPI TR-2/2006. Fusible PVC shall meet the same pressure class as specified in 9.02.A.1.

Pipe shall be manufactured with 100% virgin resin.

Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

Fusible polyvinylchloride pipe shall be manufactured in a standard 20', 30' or 40' nominal lengths.

Fusible polyvinylchloride pipe shall be blue in color.

Pipe shall be marked per AWWA C900 or AWWA C905, and shall include as a minimum:

1. Nominal size
2. Dimension Ratio, Standard Dimension Ratio or Schedule
3. AWWA pressure class or rating
4. AWWA Standard designation number
5. All pipe shall be stamped to indicate compliance with NSF Standard pw.
6. Extrusion production-record code
7. Trademark or trade name
8. Cell Classification 12454 and/or PVC material code 1120 may also be included.

Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.

- B. Joints for Watermain pipe shall conform to the following:
1. Flanged joints for ductile iron pipe shall be made with flanges, bolts, nuts, washers and gaskets conforming to AWWA Standard C110 (latest edition) and ANSI Standard A21.10 (latest edition).
  2. Mechanical joints shall conform to AWWA Standards C110 (latest edition) and C111 (latest edition) along with ANSI Standards A21.10 (latest edition) and A21.11 (latest edition). Rubber gaskets shall conform to manufacturer's standards.
    - a. Retainer glands shall be utilized on all mechanical joint fittings.
    - b. Lead tip gaskets will not be allowed for providing metal to metal contact at joints.
  3. Rubber gasket joints for ductile iron pipe shall be of a bell and spigot type which employs a single rubber gasket to effect the joint seal. These joints shall conform to AWWA Standard C111 (latest edition) and ANSI Standard A21.11 (latest edition). These joints shall be similar to "Tyton" as manufactured by U.S. Pipe and Foundry Co., "Bell-Tite" as manufactured by James B. Clow and Sons, Inc. or approved equal.
  4. Bell joints shall be cast iron, mechanical, flexible joint tube designed to withstand a working pressure of 200 pounds and a hydrostatic test pressure of 300 pounds. Joints shall be similar to "Molox" as manufactured by the American Cast Iron Pipe Company, "Usiflex" as manufactured by U.S. Pipe and Foundry Co., "River Crossing Pipe" James B. Clow & Sons, Inc. or an approved equal.
  5. Field-Loc gaskets/Fast-Grip or equal are accepted for the use of Tyton push on joints for fittings.
  6. Ductile sleeves shall have "cookie" piece inserted between two pipes if there is any separation between the two pipes.
  7. PVC pipe specified in 9.02.A.1 may be used for directional drill pipe, with approval of engineer, using a Diamond Loc-21 restraint joint.

C. Gate Valves

Gate valves shall meet the requirements of AWWA Standard C500 (latest edition) or C515 (latest edition). Valves shall be designed for not less than 150 psi working pressure and shall be tested for leakage and distortion under a hydraulic pressure of not less than 300 psi. Under such pressure, the valves shall show no leakage or distortion.

All gate valves shall be EJIW Flowmaster resilient wedge gate valves. The wedge casting shall be of a solid design and 100% encapsulated with nitrile rubber. Hollow wedges are not allowed and no epoxy coating is allowed in wedge. There shall be 3 stem seal o-rings; two in the seal plate which shall be replaceable with the valve in the full open position at rated working pressure, and one under the stem thrust collar. All gaskets shall be o-ring seals. O-rings set in a cartridge shall not be allowed. Each valve shall have a clear waterway equivalent in area, when open, to that of the connecting pipe. Valves shall be made to open left (counter-clockwise). All valves shall be connected to the pipeline by mechanical joints. All valves shall be operated by non-rising stems and shall have square wrench nuts.

All valves shall be furnished with a three piece adjustable valve box as specified herein unless the valve is housed in a manhole. Valves intended to be specifically used in fire line shall be designed and tested at minimum pressure of 200 psi.

The operating nut on all valves including hydrant valves will be located with five feet of the finished grade. If the valves operating nuts are greater than five feet below finished grade a fixed stationary rod shall be required in the valve box to allow the valve to be operated with a standard valve wrench.

D. Butterfly Valves

Butterfly valves, as called out on the plans, shall be so designed and fabricated that they will conform to AWWA Standard C504 (latest edition) for Class 150B valves. The rubber valve seat shall cover the entire interior surface of the valve body and the face of the body. The valve disc shall be streamlined, free of external ribs, keyed to the shaft, provided with suitable means for positioning and shall utilize wedge type closing against the rubber liner at a full close seating angle of 90° to the axis of the pipe. Valves shall be as manufactured by Dresser Manufacturing Division, Keystone International, Inc. or an approved equal.

All Butterfly valves shall be installed in a manhole per the Standard Detail Sheet.

E. Valve Boxes

Valve boxes shall be cast iron, three-piece, adjustable type, with a 5-1/4 inch shaft. Covers shall be furnished with finger holes and marked "WATER". Valve boxes shall be similar to that as manufactured by the East Jordan Iron Works or an approved equal. Contractors shall be responsible for adjusting valve boxes to meet finish grades once finish grades are established.

F. Fire Hydrants

At the points indicated on the drawings, there shall be installed a hydrant assembly consisting of a hydrant, a six-inch gate valve, a cast iron valve box and all piping and fittings necessary for a complete job. Gate valves shall be as specified above. Valves shall be located three feet, plus or minus, from the hydrant as shown on typical hydrant setting on drawings.

1. Hydrant barrel inside dimension to be 8-inches I.D. from top to bottom.
2. Nozzles to be on a removable head so that they may be rotated by changing the position of the top flange without removing the barrel.
3. Hydrant to be fully bronze mounted including top of operating stem where it passes through the double "O" ring seal in the bronze packing gland. Operating stem in base and valve seat shall be made of bronze. No "V" type threads are allowed for the operating stem or nut.
4. The drain valve shall be plugged in all locations.
5. Hydrant nozzle shall be located 3'-0" to 3'-6" above breakaway flange.

Hydrants furnished for this work shall meet the requirements of AWWA Standard C502 (latest edition) and any revision thereof. They shall be East Jordan Iron Works Model 5BR250 Water Master. Hydrants shall be designed for installation with six feet of cover over the connection. The diameter of the valve port in the hydrant shall be at least five inches. The hydrant shall be equipped with two four (4) inch pumper connections. Threads shall conform to national standard threads. Hydrant stems shall be built to open left (counter clockwise).

Hydrants shall be of the "break flange" type. The hydrant shall be so designed that all working parts, including valve and drip mechanism, may be removed from the hydrant through the barrel without the necessity of excavation. The hydrant shall be designed for a working pressure of 150 psi. Operating nuts shall be pentagon 1½" size, as measured point to opposite flat.

G. Water Service Connections

Water service connections are the water line connections which extend from the watermain to the property line or easement line of water system customers. A water service connection shall consist of a corporation stop in the watermain, a small diameter water line to the property line, a curb stop at the property line and curb box and cover. The Contractor shall place the water service connections where directed by the Design Engineer. The service line piping and fittings shall be either 1" or 2" size as called out on the plans.

1. Service Line Pipe and Fittings

Pipe material shall be Type K Copper, annealed and soft temper ASTM B.88. Joints shall be flared or compression type. Must conform to AWWA Standard C800 (latest edition). All new service lines which are laid under a road, parking lot or driveway shall be covered in 2" Polystyrene Insulation a minimum of 24" in width centered over the top of the pipe, and to run the full length of the service line where it is laying under the road, driveway or parking lot.

New service lines which are to be installed under existing paved areas of road, parking lot driveway where a bore and jack method of installation is required is exempt from this requirement.

2. Corporation Stops

One-inch and two-inch corporation stops shall be Mueller series H-15000, Ford F600, McDonald 4701, Mueller P15008, Ford F100, McDonald 4701-22 or equal, for copper service pipe. Corporation stops shall be in the "open" position after the service connection is complete. Must conform to AWWA Standard C800 (latest edition).

3. Curb Stops

Curb stops shall be Mueller Oriseal curb valves series H-25204, Ford B22, McDonald 6100, Mueller P25209, Ford B44, McDonald



6100-22 or equal. Curb stops shall be of the quarter turn, positive shut-off type. Must conform to AWWA Standard C800 (latest edition). A solid copper disc, Mueller series H-15535, shall be installed on the outlet valve of any curb stop valves which will not be connected to a service line and active within 6 (six) months of the install.

4. Curb Boxes

Curb boxes shall be adjustable in height to allow for variable grade elevations. Curb boxes shall be all cast iron construction and coated inside and out with tar base enamel. A cast iron lid shall be furnished with finger holes, or plug in center (with rod) and shall have "WATER" permanently stamped.

Curb boxes for one-inch services shall be furnished with a stationary operating rod inside the box and arch pattern base equal to Mueller series H-10334-02, Ford EA2, or McDonald 5602 w/R.

Curb boxes for one and a half inch and two-inch services shall be the arched pattern base with rod, equal to Mueller series H-10386. Must conform to AWWA Standard C800 (latest edition).

5. Tapping Saddles

Tapping saddles shall be required for all PVC or HDPE watermains and service connections to ductile iron watermain larger than 1". Materials shall be ASTM B62 Brass, with optional stainless steel double straps. Saddles shall be in accordance with AWWA C800 (latest edition).

Saddles shall be manufactured by Mueller BR2S or A.Y. McDonald.

H. Tapping Sleeve and Valve

Where shown on the plans or where a tee and valve are to be installed on an existing main under pressure, a tapping sleeve and drilling machine shall be used. After installing the sleeve and prior to drilling, the sleeve shall be pressure tested at 150 psi for five minutes. The Township Resident Project Representative and the Township Water Department Operator shall be given 48 hours notice of all watermain live taps. Tapping sleeves for taps smaller than the main line, ex: 8"x10", 10"x12" utilize a stainless steel (vega type) wrap around sleeve. For taps which are size on size ex: 12"x12", 10"x10", use class 250 EJIW cast iron sleeves. Tapping

sleeve and valve shall be mechanical joint, class 250, as manufactured by East Jordan Iron Works, or an approved equal.

I. Watermain Stubs

At the end of a stub, the last three (3) pipe joints shall have Field-Loc gaskets/Fast-Grip gaskets or equal. No galvanized pipe materials shall be allowed. A corporation shall be placed for the use of flushing and sampling.

J. Tracer Wire Box

Tracer wire box shall have a cast iron cover conforming to ASTM-48 Class 25 or higher and a plastic standpipe made of acrylonitrile butadiene styrene (ABS) in accordance with ASTE D-1788. Acceptable manufacturer shall be VALVCO, Inc., Mini Test Station.

9.03 INSTALLATION OF PIPE AND FITTINGS FOR WATERMANS

All pipe and fittings shall be installed in strict accordance with the recommendations of the manufacturer and AWWA Standard C600, or AWWA C605 (latest edition). Piping and fittings for watermains shall be of the types and materials hereinbefore specified. The pipe and accessories shall be new and unused. Before installation, the pipe shall be inspected for defects and any section of pipe or fittings found to be defective, before or after laying, will be rejected and replaced with sound pipe without additional expense to the Owner.

All curb stop and boxes shall be placed a minimum of 5 feet from electrical, cable or other above ground boxes to allow the Township to locate curb stops. In no circumstances shall curb stop and boxes be placed in driveway areas.

All watermain shall be placed with a depth of bury, measured from the top of the pipe to final finished grade, with a minimum of six (6) feet of cover. Depth of cover greater than six (6) feet of cover may require additional easement width be granted to the Township and/or may require developer to assume some future restoration costs.

Watermain along private roads shall not be placed in the foreslope of ditches and shall be a minimum of 23 feet from the centerline of the road.

All watermain shall be laid with a 10 gage tracer wire. Tracer wire shall be laid six (6) inches above watermain. Tracer wire shall terminate in a tracer wire box. Tracer wire box shall be placed at each hydrant or approximately every four hundred (400) feet.

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The interior of the pipe and fittings shall be thoroughly cleaned of foreign matter before being lowered into the trench with an approved method and shall be kept clean during laying operations by plugging the ends or other approved methods. The plug shall be fitted with a means for venting. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, animals or other substance will enter the pipes. When practical, the plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe floatation, if the trench fills with water. No pipe or fittings shall be laid in water or when the trench or weather conditions are unsuitable for work except by permission of the Township Engineer. Valves shall be installed in the closed position.

Ductile iron pipe and fittings used on ductile iron (except flanged pipe) shall be provided with three brass wedges at each joint, Fastite conductive (American Pipe) or equal, "Electro-bond" strips of "Cadweld" connectors or other means of providing metal-to-metal contact at the joint to allow an electric current to flow through the joint.

Trench widths shall meet all standards, such as OSHA and AWWA Standard C600 or AWWA C605 (latest edition). The full length of each section of pipe shall rest solidly upon the pipe bed with recesses provided to accommodate the bells and joints. Refer to AWWA Standard C600 or C605 (latest edition) for maximum allowable joint deflection.

When pipe is cut in the field, the outside of the cut end shall be tapered back about  $\frac{1}{8}$  inch at an angle of 30° with the centerline of the pipe to remove any sharp, rough edges. Exposed edges shall be coated with two coats of asphaltum metal protective paint.

Fittings at bends in the pipe line shall be firmly wedged against the undisturbed vertical face of the trench to prevent the fittings from being blown off the lines when under pressure. Concrete thrust blocks shall be provided as shown in the standard details or directed by the Township Engineer.

Where pipe ends are left for future connections, they shall be valved, plugged, or capped as called for on the drawings. Where connections are made between new work and existing mains, the connections shall be made by using special pipes and fittings as required to suit the actual conditions.

All temporary and permanent watermain stubs shall be restrained with Field-Loc gaskets/Fast-Grip or equal for at least three (3) pipe joints prior to the stub end, including mechanical fittings. This will allow for a connection to the main without removing or reducing the existing water pressure. It is recommended that a gate valve be installed at the end of the stub.

9.04 SETTING HYDRANTS

Under each hydrant the ground shall be excavated to a depth of at least one (1) foot below the hydrant base and over an area approximately three (3) feet square. This excavation shall be filled up to the elevation of the hydrant base with well compacted, clean, coarse gravel or crushed stone. Refer to the standard details.

The length of a hydrant lead shall not exceed one half (  $\frac{1}{2}$  ) of the Road right of way width or twenty (20) feet if watermain is located within a private easement. Each hydrant shall be set truly plumb and held firmly braced in this position. The connection of the hydrant to the branch shall be made by mechanical joint as herein specified under jointing. After the joining has been made, a concrete thrust block shall be poured on the side opposite the branch connection, from the hydrant to the solid undisturbed earth of the excavation wall.

When the concrete has become sufficiently hard, an additional one foot depth of gravel shall be spread and tamped around the hydrant. When this has been done, the remaining backfill shall be placed and compacted, taking care at all times to avoid jarring the hydrant.

Wherever it is necessary to adjust the length of the barrel to meet variations in elevation of the ground surface over the watermain and at the hydrant location, suitable extensions shall be provided for the hydrant barrel and operating stem. In all cases, the break flange shall be located at grade.

Contractor shall remove all water from fire hydrants. Water left remaining in each fire hydrant assembly will be removed by pumping prior to acceptance by the Township. Thawing and/or repair of frozen hydrants shall be performed by the Contractor at no additional expenses to the Owner.

In addition to pumping any new hydrant prior to Township acceptance the Contractor shall winterize any new hydrant installed or existing hydrant used during construction, if work done between October 1 and March 31.

9.05 CONNECTING TO EXISTING WATERMANS

Where connections are made between new work and existing watermains, the connections shall be made by using special pipes and fittings as required to suit the actual conditions. No connections to existing mains shall be made until the new main has been pressure tested and chlorinated and is ready to be placed into service. When making the connection, swab pipe and fittings with four percent chlorine solution. The Township Engineer shall witness all connections and shall be notified 48 hours prior to the connection of new pipe to existing pipe. Bacteriological samples shall be taken after connection to existing is completed

to provide a record for determining the procedures effectiveness per AWWA Standard C651 (latest edition). Conform to AWWA Standards C600 (latest edition) and C651 (latest edition).

9.06 DIRECTIONALLY DRILLED WATERMAIN

A. Description

This work shall consist of constructing underground crossings of a wetland using the directional drilling method of placing pipe to serve as carrier pipe. Refer to Michigan Department of Environmental Quality Water Division Procedure and Policy DWRP-03-009.

B. Depth of Bore

The minimum depth of drill using this method shall be six feet (6') of cover below existing grade, and a minimum depth of three feet (3') under any existing stream.

C. Materials

Plastic Pipe: Section 9.02 A.2. High Density Polyethylene Pipe.

D. Construction Method

This method consists of auguring or jacking a steerable rod under the wetland; then pulling back a cone that expands the soil or a wing cutter, which cuts a hole big enough to obtain the desired diameter. The diameter of the reamer or wing cutter is not to exceed the diameter of the pipe being placed plus two inches (2").

A drilling fluid of water and bentonite may be used in all operations of a directional drill. The use of a polymer for lubrication in the drilling fluid is acceptable.

Connection to HDPE Pipe shall not be made immediately after the pipe has been installed. It is recommended to wait overnight so that the pipe can approach an equilibrium temperature with its surrounding environments. Linear dimensions will vary with temperature changes. A tracer wire adequate for future location of the pipe shall be installed with all HDPE projects.

9.07 ACCEPTANCE TESTING WATERMAIN

A. General

Prior to connecting the new watermain to an existing watermain, the new main shall be flushed, chlorinated, and pressure tested as outlined herein.

The Township Engineer shall be notified 48 hours prior to the start of a pressure test. All acceptance testing shall be witnessed by the Township Engineer or Township Resident Project Representative.

A physical gap of at least three (3) feet must be left between the existing and new watermain until all testing results are satisfactory. The testing sequence shall be: 1) flushing, 2) pressure test, and 3) chlorination. Water for testing may be taken from a nearby hydrant or tee connection by using fittings to accommodate a standard fire hose connection. A reduced pressure principle backflow prevention assembly must be used on the 2-1/2 inch connection to the main being tested.

B. Flushing of Mains

The watermain shall be flushed clean of sand and debris. Flushing shall be done using the "poly-pig" method of flushing. The Contractor shall furnish the brand new, unused, foam "poly-pig" swabs to be used. Prior to pigging and flushing the watermain must be charged with water.

Contractor shall insert "poly-pig" swab in the end of the new main nearest the existing watermain (or where shown on the plans). The swab shall be passed through the new main using water pressure. The swab shall be recovered at the end of the main through the blow-off assembly.

C. Hydrostatic Testing

The watermain or sections thereof shall be tested by the Contractor in the presence of the Township Engineer and all leaks shall be made tight to meet the requirements below. The Contractor shall furnish all piping, bulkheads, pumps, gauges and other equipment required to carry out the test and shall obtain Township Engineer's approval of same prior to testing.

The section of main to be tested shall be slowly filled with water at least 24 hours prior to starting the test. Expel air through corporation stops installed at high points in line. All service curb stops shall be left exposed so they can be checked for leaks. Only after the curb stops have been checked and any leaks made tight, the Contractor may backfill curb stops

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and proceed with hydrostatic testing. The Contractor shall make arrangements with the operation/maintenance personnel for obtaining water for testing.

All water used shall be metered and quantities reported to the operation/maintenance personnel.

At the start of testing, the main shall be pumped up to a pressure of 150 psi and the test period shall start immediately thereafter. Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section. The line shall then be maintained under this test pressure for a continuous period of two hours by pumping water into the line at frequent intervals. The test pressure shall not vary by more than +5 psi for the duration of the test. The volume of water so added shall be measured and considered to represent the leakage from the line under test during the intervals. All water service leads shall be tested with the mainline pipe. Conform to AWWA standard C600 or C605 (latest edition).

Testing allowance. No pipe installation will be accepted if the amount of makeup water is greater than that determined by the following formula:

In inch-pound units,

$$Q = \frac{LDP^{0.5}}{148,000}$$

Where:

Q=Testing allowance (makeup water), in gallons per hour

L=Length of pipe tested, in feet

D=Nominal diameter of the pipe, in inches

P=average test pressure during the hydrostatic test, in pounds per square inch (gauge)

Hydrostatic testing allowance per 1,000 ft of pipeline-gph

Test Pressure 150 psi

Nominal Pipe diameter	Maximum Leakage Gallons Per Hour Per 1,000 Feet of Pipeline
6"	0.50
8"	0.66
10"	0.83
12"	0.99
14"	1.16
16"	1.32
18"	1.49
20"	1.66
24"	1.99

In the event that the leakage exceeds the specified amount, the joints in the line shall be carefully inspected for leaks and repaired where necessary. Any pipes or special casting found to be cracked shall be removed and replaced with new pieces by the Contractor. No repair clamps or bell clamps can be utilized for repairs on new construction. After this work has been done, the tests shall be repeated. Final acceptance of the lines will not be made until satisfactory tests have been passed.

Water service leads installed with mainline pipe will be included in the watermain pressure test. Installed water service leads shall have a riser (extension of water service) placed at the downstream side of the curb box. For flushing, testing, and sampling, once all tests are completed, this riser must be removed or buried 6' below grade.

Not more than 2,500 LF of watermain shall be tested at one time. If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.

Where there is a considerable elevation difference in the section of watermain being tested, the test pressure shall average 150 psi over the length of main, but shall be not less than 140 psi at the highest elevation.

All main line valves and hydrant lead valves within the test section shall remain open during the pressure test.

After completion of the two hour pressure test, each valve shall be checked against test pressure.

D. Disinfecting Watermains

After completion of pressure testing and flushing of the watermain, the disinfection of the watermain shall be carried out in accordance with AWWA Standard C651 (latest edition).

The method of chlorination chosen shall be one of the three methods specified under Section 4.4 of AWWA Standard C651 (latest edition). Sampling requirements stipulated by the City of Traverse City Water Treatment Department shall also be followed for new construction or extensive repair for all water systems that are operated and maintained by the Grand Traverse County Department of Public Works. This procedure is as follows:



- a) After disinfecting, flush the system until the chlorine residual equals the source water and then allow the water to remain static for 24 hours before drawing the first sample. Submit the first sample which will then be tested using the Colilert procedure.
- b) Twenty four or more hours after the first sample has been drawn and has passed the Colilert test, submit two samples from the same sample point, one of which will be tested using the Colilert procedure and the other using the Membrane Filter procedure. If both of the second samples are negative, authorization will be given to use the new construction or repair. If the second Colilert sample is negative but the Membrane Filter sample produces background growth, resampling for the Membrane Filter testing shall only be required until no growth occurs on the Membrane Filter sample.

Note: If the system is re-chlorinated or re-pigged the sampling procedure shall be started over as listed above in paragraphs a & b. When no growth occurs on the Membrane Filter, approval will be given to activate the system.

The Contractor shall discuss his proposed disinfection procedure with the Township Engineer and have it approved prior to beginning the process.

The Contractor shall supply the chlorine, all necessary equipment and labor necessary for its application. The Contractor shall make suitable arrangements with the Township Engineer for bacteriological analysis and shall be responsible for all cost incurred from bacteriological testing. Bacteriological analysis shall conform to the requirements of the Michigan Safe Drinking Water Act and be performed by a State approved drinking water testing laboratory.

#### 9.08 TRANSFER OF WATER SERVICES

Where water services are to be transferred from an existing watermain to a new watermain, as shown on the plans, Contractor shall provide corporation stop and necessary pipe and fittings. Work shall be scheduled in such manners that transfer of service to any residence or water customer will result in the least possible interruption of water supply service. All services are 1 inch unless otherwise shown on the plans.

9.09 TRANSFER OF EXISTING HYDRANTS

Where indicated, existing hydrants are to be transferred from an existing main to a new main, as shown on the plans. Contractor shall excavate and reset the hydrant, as shown on Hydrant Assembly Detail, provide new 6-inch hydrant gate valve, 6-inch hydrant lead to new main and all fittings required for a complete installation.

9.10 HANDLING PIPE

All pipes and special castings shall be unloaded and distributed along the line of work in such a manner and with such care as will effectively avoid the cracking of any pipe or casting. Dropping directly from the truck will not be permitted. Care must also be exercised on the inside of the pipe. Wherever the outside coating may be found to have rubbed off, the part shall be thoroughly cleaned by brushing and shall then be recoated with an approved asphaltic paint or as may be required by the nature of the pipe coating. The Contractor shall keep on hand a supply of paint for such purposes.

9.11 MARKING PIPE

Each cast iron fitting shall have its weight and class designation conspicuously painted or cast on it. All other pipe materials shall have the class designation painted thereon. Where required, other designation marks shall be painted on the pipe or fittings to indicate correct location in the pipe section in conformity to a detailed layout plan.

All PVC pipe shall be marked as required by AWWA C900 (latest edition) and shall be stamped to indicate compliance with NSF Standard pw.

9.12 PIPE TAPS

Pipe lines shall be tapped for corporation cocks where shown or required for testing of completed watermains. For ductile iron or steel pipe, cocks shall be threaded directly into the pipe.

9.13 BLOWOFF

All dead-end mains shall terminate with a valve and hydrant as shown on the standard detail plan. The valve shall be restrained back to the main a minimum of three joints with mega-lug or equivalent method.

9.14 THRUST BLOCKS

Concrete thrust blocks shall be poured on hand-excavated, undisturbed soil bearing surfaces of a minimum size as shown on the standard details or

increased in size according to the actual bearing values of the soil in each location, in accordance with the instructions of the Design Engineer.

Thrust blocks shall be made of 3,000 psi concrete, wet mix. Concrete thrust blocks shall be placed at all 22-½ ° bends or greater, deadends, tees, reducers, hydrants and crosses, as required. Pre-cast thrust blocks may be utilized for certain applications, if approved by the Township Engineer. Retainer glands and/or mega lugs shall be utilized on all mechanical joint fittings.

9.15 PAINTING

All pipe, valves, bolts and any other portions of watermain exposed inside manholes and other structures shall be painted. If necessary, heat shall be provided to maintain good drying conditions. All items to be painted shall be dry and clean before application of the paint. Any rust or scale shall be removed by wire brushing or scraping.

9.16 FIRE HYDRANT SIGNS

The sign and its post shall be installed directly behind the hydrant. The sign shall be parallel to the street, and within the road right-of-way or easement. There shall be 2' (two feet) distance from the center of the top nut of the hydrant to the front face of the sign. The finish elevation of the sign shall not be less than 5' (five feet) to the top of the sign from grade at the base of the post and no more than 6' (six feet) to the top of the sign from grade at the base of the post. The post shall extend into the ground a minimum of 2' (two feet) below grade at the base of the post. Signs shall be constructed according to the Grand Traverse Fire Department Standards for Fire Hydrants. Signs and posts are available to be picked up at the Township Water Department for a nominal fee.

9.17 WATERMAIN VALVES

Contractor shall place a 4" wide fiberglass blue marking post at each main line valve. Marking posts shall be Rhino Fibercurve or approved equal. Valve marking post are available to be picked up at the Township Water Department for a nominal fee.

9.18 SHOP DRAWINGS

The Contractor shall furnish, as prescribed under Section "General Requirements" dimension and erection drawings and details of the watermain, valves, and other appurtenances furnished under this section. Complete details of all pipe deflections and ties to adjoining pipe shall be submitted to the Township Engineer for approval.

9.19 CERTIFICATION

The manufacturer of pipe and fittings shall furnish a certified statement that all pipe and fittings furnished by him have been inspected and tested in accordance with the applicable specifications. Pipe will be subject to inspection and approval upon delivery and no cracked, broken, damaged or defective pipe or fittings shall be laid in the work. Any piece that is found to be defective after it has been laid shall be removed by the Contractor and replaced by a sound and perfect piece.

10.01 SCOPE OF WORK

The work covered by this section of the specifications consists in furnishing all labor, equipment and material necessary to perform the installation of a Type I water supply well per these specifications, and most current Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and the Administrative Rules promulgated thereunder (SDWA) and the Michigan Water Well Construction and Pump Installation Code, Part 127, of 1978 PA 368, as amended, and the Administrative Rules promulgated thereunder (Well Construction Code).

10.02 CONSTRUCTION OF NEW WELL

- A. Construct \_\_\_\_\_ new \_\_\_\_\_ well(s) capable of producing \_\_\_\_\_ gallons per minute at above ground discharge head of \_\_\_\_\_ feet. The well(s) shall be constructed where shown on the plans. This shall be well number(s) \_\_\_\_\_. The well construction shall strictly adhere to the requirements of the Michigan Department of Environmental Quality for public water systems and shall be performed by a state certified well driller.

The well pump assembly proposed by the well driller to be installed shall first be approved by the Design Engineer (with concurrence of the Township Engineer). Contractor shall submit performance curves and other related technical information per specifications Section 1.10.

B. Well Casing

The well casing(s) shall consist of steel with a minimum inside diameter of \_\_\_\_\_ inches and shall meet the requirements set forth in the most current Safe Drinking Water Act (P.A. 399) and the Well Construction Code. Pipe shall meet the standard thickness requirements according to the Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers Recommended Standards for Water Works as amended (Ten States Standards). The casing must meet the requirements of NSF International (NSF) Standard 61 and shall be new and watertight throughout its length and shall have welded or threaded joints in accordance with all applicable codes and standards.

C. Pitless Adapter

The pitless adapter(s) shall be new, shop fabricated from the point of connection with the well casing to the unit cap or cover, constructed of materials and weight equivalent and compatible with the casing, be of watertight construction, frost proof, threaded or welded to the casing and utilize a contamination-proof entrance connection for electrical supply and

conform to SDWA and the Well Construction Code. For well casings up to and including 12-inches in diameter, the pitless adapter shall possess an inside diameter equal to the inside diameter of the well casing. The pitless adapter shall be as manufactured by Baker, or approved equal.

- D. Well construction shall be performed in accordance with the Michigan Water Well Construction and Pump Installation code utilizing rotary boring or other approved method. The required open annular space outside of the outer casing shall be completely sealed with a neat cement grout or by an equivalent method.
- E. Grouting shall be neat cement weighing at least 15 pounds per gallon and shall be placed under pressure starting at the bottom of the casing. Grouting shall conform to the Department of Environmental Quality (DEQ) Water Division's (WD) Policy and Procedure DWRP-03-016, "Grouting of Community Water Supply Wells" and the Well Construction Code. Grouting shall be a continuous operation stopping only after the grout material flows from the ground at the top of the casing.
- F. Well Screen: The well screen shall be new, stainless steel as manufactured by Johnson Screen or approved equal. The slot size and configuration shall be determined by a recognized well screen manufacturer from soil samples extracted during the well drilling operation. The screen manufacturer shall submit his recommendations to the Design Engineer for approval.
- G. Disinfection: After the well has been completely constructed, it shall be thoroughly cleaned of all foreign substances, including tools, timbers, rope, debris of any kind, cement, oil, grease, joint dope and scum. The casing pipe shall be thoroughly swabbed using alkalis, if necessary, to remove oil, grease or joint dope. The well shall then be disinfected with a chlorine solution, and conform to the American Water Works Association (AWWA) Standard C645-97 and the Well Construction Code.

The chlorine solution used for disinfecting the well shall be of such volume and strength and shall be so applied that a concentration of at least 50 ppm of chlorine shall be obtained in all parts of the well. Chlorine solution shall be prepared and applied in accordance with the directions of, and to the satisfaction of the Township Engineer, but for at least two (2) hours.

In the event that the test pump is installed after the well has been disinfected, all exterior parts of the test pump coming in contact with the water shall be disinfected with chlorine solution.

After the contact period, the well shall be flushed until the chlorine residual is eliminated. Chlorinated water shall be disposed of in a manner that will not damage vegetation, wildlife, or aquatic life. Under no circumstances shall chlorinated water be discharged into a natural waterway.

After flushing of the chlorine from the well is complete, the well shall be allowed to stand for 24 hours. Samples will then be drawn from the well sample tap for bacteriological analysis. The well shall be allowed to stand for an additional 24 hours at which time a second sample shall be analyzed. Bacteriological analysis shall be performed by a state approved drinking water testing laboratory. Two consecutive negative (clean) samples are required for acceptance.

- H. Samples and Records: The Contractor shall keep an accurate record of the location of the top and bottom of each stratum penetrated. An accurate copy of the "Driller's Log" shall be submitted to the Township Engineer.

#### 10.03 WELL TEST PUMPING FOR NEW WELL

- A. Well Development: The test well shall be thoroughly developed to remove all appreciable amounts of loose material from the formation. Development shall be done by the use of a close fitting surge block mounted on a drilling tool or pipe heavy enough to cause the surge block to sink rapidly. This assembly shall be operated in an up-and-down drilling motion by means of the well drilling machine at the rate of 30 to 40 strokes per minute. The material pulled into the well shall be bailed out periodically. The development operation shall continue until only a negligible amount of sand is pulled into the well.

The Contractor shall establish, by trial, the maximum pumping rate possible at or below the required maximum value, which can be maintained throughout test period without breaking suction.

- B. Test Pumping: Each proposed production well shall be test pumped separately for a period as outlined in 10.03C of these specifications. Test pumping shall conform to the DEQ WD's Policy and Procedure DWRP-03-003, Rev. #1 – 06/2002, "Aquifer Test Requirements for Public Water Supply Wells." The test pump measurements shall be taken and recorded per 10.03G of these specifications. The test pump shall be capable of producing at least the maximum gallon-per-minute rate specified. The pump test must start at a full condition of rest in the system; to achieve this it is advisable not to pump for one day prior to the test. The withdrawal rate should be held constant throughout the test.

- C. Duration of Pump Test: The duration of the pump test shall be twenty-four hours at a continuous and unvarying rate of flow unless otherwise specified. The pump test shall be monitored by the Contractor with reports filed with the Design Engineer and Township Engineer.
- D. Water Disposal: If the production formation has 10 feet of clay cover, there is no concern regarding water entering the well. If less than 10 feet, the waste water should be carried to the nearest body of open water, or to a distance of 350 feet from the well making use of any slope which will carry the water further from the well or its observation points. In all cases, water shall be disposed of in a manner so as to guard against damage to property.
- E. Determination of Flow: The rate of flow during the test shall be measured by the use of a circular orifice weir. A glass tube will be used to determine the head in the discharge pipe.

Other methods for measuring the rate of flow can be used only on approval of the Township Engineer.

- F. Procedure in Determining the Water Level in the Well: A water sensing electrode-type of water level indicator shall be used for this purpose.
- G. Test Pump Measurement Intervals: During the pump test referenced in 10.03B and 10.03C of these specifications, simultaneous readings of the pump rate and drawdown measurements in the observation wells and production well, to the nearest 0.01 feet, shall be made and recorded at the following intervals:

<u>ELAPSED TIME</u>	<u>FREQUENCY OF MEASUREMENT</u>
0 to 10 minutes	1 per minute
10 to 20 minutes	Every 2 minutes
20 to 60 minutes	Every 5 minutes
60 to 180 minutes	Every 15 minutes
180 to 360 minutes	Every 30 minutes
360 to completion	Every 60 minutes

(Elapsed time shall be from the beginning of the test pumping)



During the recovery period, which shall be 1/3 as long as the pumping test period, water level reading shall be taken in each observation well and the production well according to the schedule above.

H. Remarks:

1. If there is a nearby lake or stream, hourly readings of its level should be made throughout the test.
2. Breakdowns – Water Table Conditions: If a breakdown occurs during the first hour of pumping, rest one hour before starting again. Continue to take water levels during down period. Breakdown during second hour: 5 minutes may be tolerated – third hour: 10 minutes – fourth hour: 15 minutes. Add 5 minutes for each hour of pumpage thereafter for a maximum of 30 minutes. For more than 30 minutes, start over.
3. Breakdowns – Artesian Conditions: Not over 5 minutes permissible during first 3 hours, nor more than 10 minutes for remainder of test.

I. Observation Well: At least two (2) observation wells are required per P.A.399 requirements. A production well may be used as one of the observation wells during the pump testing of another well as approved by the Township Engineer. Sections 10.03F and 10.03G shall apply to the observation wells.

J. Water Samples: A one (1) gallon water sample shall be collected at six (6) hour intervals during the end of the pumping test (well efficiency test). These samples must be analyzed for organic and inorganic chemicals, including Phase II/V compounds (nitrates, nitrites, certain metals, organic chemicals, and radiochemicals), per MDEQ WD's requirements. The Contractor shall have a complete chemical analysis run on the last sample taken by a laboratory acceptable to both the Township Engineer and the Contractor. The remainder of the samples shall be retained by the Contractor for safekeeping.

10.04 NEW PUMP FOR EXISTING WELL

A. The pump in the existing \_\_\_\_\_ inch well shall be removed and a new well pump shall be installed. The new well pump shall be capable of producing \_\_\_\_\_ gallons per minute at above ground discharge head of \_\_\_\_\_ feet. Depth of pump setting shall be at least \_\_\_\_\_ feet as shown on the attached drawing.

- B. Well driller shall submit data, performance curves, etc. on pump assembly he intends to install to the Design Engineer prior to proceeding.

The Design Engineer shall issue a set of this information to the Township Engineer for his review and approval.

- C. Turbine pumps shall be utilized for wells with proposed production rates greater than 1,000 GPM. No submersible turbine pumps will be allowed for this condition.

#### 10.05 TURNOVER PACKAGE FOR WELLS

Upon completion of production well test pumping, the Contractor shall submit to the Design Engineer the following items:

- A. Water Well and Pump Record (Driller's Log) for each well.
- B. Copies of shop drawings, including pump characteristic curves, for the production pump installed in each well.
- C. Copies of the measurements recorded, to the nearest 0.01 feet, taken during the test pumping and recovery of each well (in tabular form).
- D. Copies of the complete chemical analysis for each water sample tested.
- E. Within thirty (30) days of receiving the Contractor's information, the Design Engineer shall submit to the Township Engineer for review the following information in a bound format:
  - 1. Well Logs for the production well(s).
  - 2. A drawdown vs. time plot of the test pumping data for each production well on semi-log paper including recovery.
  - 3. A summary of aquifer analysis results based on the information from each observation well obtained during the pump test for each production well. This summary shall include computations for coefficient of storage along with the average of these for each production well.
  - 4. A plot of the system head curve and pump curve for each production well.

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5. A location map showing each production well and the well cross section based on the well driller's log.
6. Water quality analysis results from the requirements of Section 10.03J of these specifications.
7. An overall water system map for the piping system utilizing the production wells.

### 11.01 SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all plant, labor, materials and appliances and performing all operations for the installation of piping and equipment as shown on the drawings and hereinafter specified.

### 11.02 PIPING AND FITTINGS

This work consists of furnishing all plant, labor, equipment and materials in performing all operations necessary to install the piping within the well house building or room as shown on the plans. All work to be performed as shown on the drawings and specified.

- A. National Electrical Code:  
All electrical work.
  
- B. American Society for Testing Materials:
  - A-72 Welded Wrought Iron Pipe.
  - A-120 Black and Hot-dipped Zinc-coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses.
  
- C. Materials

The following items of materials installed within the well house or room shall be furnished by the Contractor and shall conform to the various requirements as hereinafter specified.

1. Ductile Iron Pipe: Conform to the requirements of ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, Class 150. Inside surfaces of pipe to be cement mortar lined per the requirements of ANSI/AWWA C104/A21.4. No exterior coating.
  
2. Ductile Iron Fittings: Standard fittings shall conform to the requirements of ANSI/AWWA C110/A21.10, Class 150. Compact or short body fittings shall conform to the requirements of ANSI/AWWA C153/A21.53, Class 150. All fittings to be cement mortar lined per ANSI/AWWA C104/A21.4. No exterior coatings.
  
3. Galvanized Steel Pipe: Conform to ASTM A538.
  
4. Gate Valves: Conform to AWWA C515, Class 150. All valves shall open right, or clockwise. All valves shall be equipped with hand wheel operators.

5. Butterfly Valves: Shall be so designed and fabricated that they will conform to AWWA Standard C504-00 for Class 150B valves. The rubber valve seat shall cover the entire interior surface of the valve body and the face of the body. The valve disc shall be streamlined, free of external ribs, keyed to the shaft, provided with suitable means for positioning and shall utilize wedge type closing against the rubber liner at a full close seating angle of 90° to the axis of the pipe. Valves shall be manufactured by Dresser Manufacturing Division Keystone International, Inc. or an approved equal.
  
6. Wafer Check Valves
  - a) Valves 3" and larger shall have a cast iron body with a minimum non-shock W.O.G. working pressure of 150 psi. Seats shall be Buna-N mounted on the disc and shall provide leak-proof closing. The disc shall consist of one bronze disc which is springloaded to prevent slam, pivoting at a stainless steel hinge pin. The spring shall be 316 S.S.
  
  - b) Valves shall be wafer type for mounting between ANSI 125 pound standard drill flat faced flanges unless otherwise specified or shown on the drawings.
  
7. Wall Castings and Sleeves shall be installed in all concrete work where pipes, wires, or other equipment pass through. Wall castings for 4-inch diameter or larger pipe shall be of cast iron having an anchor flange located in the center of the concrete wall or floor. Castings and sleeves shall be similar to those as manufactured by the East Jordan Iron Works or approved equal. Joint between pipe and sleeves shall be sealed with "Link-Seal" fittings or approved equal.

D. Installation of Piping Valves and Fittings

1. Cement Lined Ductile Iron Class 52 or Cast Iron Valves and Fittings shall be used for all piping 4-inch diameter and larger. Flanged piping, valves and fittings shall be used for all interior exposed piping unless otherwise approved by the Township Engineer. Pipe, valves and fittings shall be carefully laid to line and grade. Care shall be taken to keep the pipe clean and free from dirt and other foreign materials. "Victaulic" fittings shall be considered as an acceptable equivalent, subject to the approval of the Engineer.

Piping laid in the ground shall have bearing over its entire length. Piping along floors, walls, or ceiling shall be adequately supported by saddles, posts, wall brackets, pipe hangers, or other approved devices. The exact location, number and design thereof shall be subject to the approval of the Design Engineer. "Uni-Flange" type fittings shall be rodded.

2. Galvanized Steel Pipe shall be used for all interior piping less than 4 inches in diameter or as approved by the Township Engineer.

E. Pipe Taps

Wherever indicated or required, pipe or fittings shall be tapped to receive a small pipe or special fittings.

F. Disinfection

All piping and equipment shall be disinfected in accordance with AWWA C651, and Section 9.07 of these specifications.

### 11.03 PRESSURE TANKS

A. General

The Contractor shall furnish and install pressure tanks as shown on the plans and as hereinafter specified.

B. Pressurized Bladder Vessels

The Pressurized Bladder Vessels shall have a fiberglass-wound and epoxy resin sealed outer tank, one-piece high density polyethylene inner cell, heavy mil ethyl-vinyl-acetate (EVA) air cell, reinforced polypropylene upper and lower flanges, reinforced polypropylene base, stainless steel service steel, brass body, Schrader core assembly air valve, and high density polyethylene weather cap. The air cell shall be capable of being removed and replaced while the tank is installed.

C. Hydro-Pneumatic Tank

The hydro-pneumatic tank shall be designed and constructed in accordance with "A.S.M.E. Code for Unfired Pressure Vessels" for 150 psi working pressure. The tank shall be enclosed within the well house or as approved by the Township Engineer.

The tank shall be equipped with a water level sight gauge mounted on the end of the tank as shown on the plans.

The tank shall also be equipped with a pressure gauge, air pressure relief valve and air volume control mechanism and all tank couplings required to install these items.

The tank shall be coated on the inside with enamel application as appropriate for potable water systems. Outside of tank shall be coated with factory primer prior to delivery.

D. Air Volume Control

The air volume control mechanism for the pressure tank shall utilize an air compressor, mounted within the well house, liquid level probe and pressure switches for operation. This unit shall operate automatically and independently from the pumps and shall maintain a constant air charge in the tank. See Section 11.06 for coordination with pump operating sequence.

11.04 FLOW METER

A. Flow meter shall be a electromagnet flow meter (Mag-Meter) where Primary unit to be a minimum ANSI 150 carbon steel flange sized to match pipe diameter. Mag-Meter shall be supplied with two properly sized Hastalloy-C grounding rings.

1. Liner material shall be manufactured of Tefzel and to be compatible with Sodium Hypo Chlorite.
2. Electrodes shall be manufactured of Titanium and to be compatible with Sodium Hypo Chlorite.
3. Classification shall be non-hazardous NEMA 4X.
4. Primary shall be rated for temporary submergence for a minimum of 30 minutes if installed above grade, and total submergence if installed below grade.
5. Grounding rings shall be used on all applications and connected electrically to the Mag-Meter per manufactures specifications.

B. Flow meter converter shall be a remotely mounted unit with the following specifications.

1. Converter shall be type rated NEMA 4X die-cast Aluminum enclosure.

2. Converter shall be UL or FM listed
  3. Converter shall operate on 120Volts AC 1Ø power.
  4. Converter shall supply a minimum of 2 dry contact outputs rated at a minimum of 3 VA. One for scaleable pulsed flow output, one for reverse flow.
  5. Converter shall supply one 4-20 ma signal output, scalable to current flow rate.
  6. Meter shall have a scalable display where current flow and total flow can be displayed simultaneously.
  7. Total flow display must be scalable so as to read in kgl while current flow can be read in gpm.
  8. Meters under 12 inches in diameter shall have an accuracy of 0.25% of rate from 0.67 feet per second to 30 feet per second.
- C. Meter shall be installed according to the manufactures specifications and in a direction so as to measure forward flow in the normal flow direction when water is moving through the line under normal flow conditions.
1. Converter shall be mounted in a location where meter production data can be easily accessed and seen.
  2. Electrical connections shall be made in accordance with manufactures specifications.
  3. Electrical connections shall be a minimum of NEMA 4 to the meter utilizing manufactures seals and compounds to form necessary water tight connections.
  4. Supplier shall provide proper start up and calibration services.
  5. Supplier shall provide a minimum of one year warranty on all parts and labor.
  6. Supplier shall provide a minimum of 50 feet of manufactures meter cable or as specified on drawings where there shall be no splices between converter and primary unit. All cable shall be protected in conduit unless specified differently by manufacture.



D. Acceptable Manufacture:

ABB Part Number 10DX3111 with 50XM1000 converter or approved equal.

11.05 PRESSURE RELIEF VALVE/SURGE ANTICIPATOR

A. The valve shall be hydraulically operated, single diaphragm-actuated and globe or angle pattern, flanged. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed and the diaphragm assembly.

1. Diaphragm Assembly: The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.
2. Main Valve Body: No separate chambers shall be allowed between the main valve cover and body. Valve body and cover shall be ductile iron. The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and onehalf sides by a disc retainer, forming a tight seal against a single removable seat insert. The main valve seat and the stem bearing in the valve cover shall be removable.
3. Pilot Control System: The pressure relief pilot shall be an adjustable, spring-loaded, normally closed diaphragm control designed to permit flow when upstream pressure exceeds the control setting. The low-pressure pilot shall be an adjustable, spring-loaded, normally open diaphragm control designed to open when the sensed pressure falls below the control setting and close when pressures are normal. The pilot system shall contain an adjustable hydraulic limiter to limit valve travel during low-pressure opening without affecting high-pressure relief valve travel. The contractor shall connect the sensing/pilot supply connection to the main discharge header with minimum 3/4" pipe or tubing.
4. Products: Subject to compliance with requirements, provide from the following manufacturer:
  - a. Cla-Val Model No. 52-03

## 11.06 PUMP OPERATIONAL CONTROLS

### A. General

The Contractor shall furnish and install pressure switches, complete, as outlined herein. Pressure switches shall be mounted in the well house to operate the well pump based on the water pressure. The pressure switches shall be adjustable from \_\_\_ to \_\_\_ psi. The operation of the well pump(s) shall be controlled based on the pressure within the system and, in the case of a hydro-pneumatic tank, the water level within the tank. The operating sequence shall be as follows:

#### **USING A PRESSURIZED BLADDER VESSEL**

The lead pump shall operate until the pressure at the well house reaches PSIG. Should the pressure continue to drop with the lead pump operating, and the pressure reaches PSIG, the lag pump shall engage. Both pumps shall operate until the pressure at the well house reaches PSIG.

#### **USING A HYDRO-PNEUMATIC TANK**

The lead pump shall operate until one of two (2) conditions are met:

1. The pressure at the well house reaches PSIG.
2. The tank water level reaches the high water probe.

If the tank water reaches the high water probe prior to achieving a pressure of PSIG, the compressor will engage and operate until the pressure increases to PSIG and the pressure switch is reset.

Should the pressure continue to drop with the lead pump operating, and the pressure fall to PSIG, the lag pump shall engage. Both pumps shall operate until one of the two (2) conditions listed above are met.

The alternating sequence shall be accomplished by means of an alternator in the electrical circuitry at the well house. A selector switch shall be located at the well house pump panel to allow manual selection of the pumps to be included in the alternating sequence.

All pumps shall be capable of being operated manually as well as automatically by lever selection of a hand-off-automatic switch at the well house. If one (1) pump is switched off for repairs, the other pump(s) shall be able to operate normally in an automatic mode.

Each pump shall have its own completely independent control system so that the failure of any components in one (1) pump will not affect the automatic or manual operation of the other pump(s).

Each well pump shall be equipped with an hour run meter mounted in the pump control panel.

#### 11.07 EQUIPMENT INSTALLATIONS AND START UP

##### A. General

All equipment shall be installed in a neat, workmanlike manner, acceptable to the Design Engineer with concurrence of the Township Engineer and in conformance with all applicable Local, State and Federal codes and requirements.

##### B. Factory Trained Start-Up Personnel

The Contractor shall furnish the services of an experienced factory trained field representative to start up all equipment. He shall be employed by the Contractor in such capacity to interpret the manufacturer's installation guide and instructions, to supervise the installation and start-up of such equipment and to instruct the operating and maintenance personnel for a reasonable period of time. (A minimum of four (4) hours of instruction.)

The representative of the equipment supplier shall be responsible to insure that all equipment, controls, alarms, wiring, flow meter and all associated components are properly installed and functioning properly.

##### C. Systems Start Up

It shall be the Contractor's responsibility to coordinate work between his subcontractors, equipment suppliers and utility companies to insure that all components of the system function properly as described herein.

When the system or a major component of the system is entirely installed and ready for testing, the Contractor shall notify the Township Engineer and operation/maintenance personnel, in writing, of the time and date the start-up testing will be done. The Contractor, subcontractor, and equipment supplier's representatives shall be present for final start-up

testing. During the start-up test, the Contractor shall operate all equipment in such a manner to demonstrate that all components are functioning properly.

If the equipment fails to perform, it will be the responsibility of the Contractor to arrange for repair or replacement of the defective parts and scheduling of a new start-up session.

Should the equipment pass its initial start-up testing but fails during the one-year guarantee period, the Contractor shall coordinate the necessary repairs or replacements with the subcontractors and suppliers.

#### 11.08 SHOP DRAWINGS

The Contractor shall submit, as prescribed under "General Requirements" section, complete shop drawings and details of all equipment to be furnished under this section. These shop drawings shall be submitted and approved by the Design Engineer with concurrence of the Township Engineer prior to installation.

#### 11.09 RECORD DRAWINGS

Any changes that are made in equipment, controls, wiring, etc. from that shown in the plans and specifications shall be made only by approved shop drawings. After such changes are made, the Contractor shall submit to the Design Engineer and Township Engineer, record drawings which show these changes in equipment installation. Contractor shall supply "record" electrical schematic drawing to Design Engineer to be included in final close-out package delivered to the Township.

#### 11.10 GUARANTEE

The Contractor shall furnish a manufacturer's guarantee covering all material and equipment that he furnishes. He shall guarantee his workmanship and material for a period of one year from the date of acceptance. Such guarantee shall provide for the replacement of defective workmanship, together with the restoration of any related materials or workmanship that are disturbed as a result of such imperfections in the work. All such replacements or repairs shall be done without expense to the Owner. All guarantees shall be in written form and submitted to the Owner in triplicate.

11.11 PAINING

All pipes, valves, flow meters, and any other portions of watermain or ferrous metals exposed inside of the well house shall be painted. If installed, the hydropneumatic tank shall be painted. If necessary, heat shall be provided to maintain good drying conditions. All items to be painted shall be dry and clean before application of the paint. Any rust or scale shall be removed by wire brushing or scraping. Painting system shall be:

- 1 coat (350 sf/g) Pug Primer
- 2 coats (500 sf/g) Rustamor 500

11.12 TELEMETRY

A dry contact strip shall be supplied within the wellhouse with the following inputs:

1. Well Pump No. 1 on.\*
2. Well Pump No. 2 on.\*
3. Low pressure.
4. High pressure.
5. Security.
6. Flow meter.

\*Additional contacts shall be installed for additional wells.

### 12.01 SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all parts, labor, materials and appliances and performing all operations for the installation of \_\_\_\_\_ submersible sewage pumping station(s), the details of which are shown on the Standard Plans.

### 12.02 GENERAL

The Contractor shall furnish a duplex heavy duty submersible non-clog sewage pumping system as manufactured by Hydr-O-Matic, Flygt, or an approved equal. The principal items of equipment shall include submersible, motor driven, nonclog sewage pumps, valves, internal piping, central control panels with circuit breakers, motor starters, liquid level control with explosion proof relays, all internal and external wiring, alarm controls, concrete wet well, concrete pad and electric service as hereinafter specified. All pumping stations furnished shall be of the same manufacturer. Backfilling around pumping stations shall be in accordance with these specifications.

### 12.03 SUBMERSIBLE SEWAGE PUMPS

Each pump shall be motor driven, heavy duty, ball bearing, non-clog sewage and trash pump. All openings must be large enough to permit the passage of a sphere of three inches in diameter.

Pumps furnished shall be so designed to accommodate a larger impeller in order to meet the future pumping condition indicated. Two pump impellers shall be furnished, one shall enable the pump to meet the initial condition and one to meet the future pumping condition. The pump casing, pump and motor shaft, conduit, wiring and controls shall be sized to meet the future condition. The pump motors shall be designed to be non-overloading throughout the entire pump range for the future pumping condition.

Each pump shall have the necessary characteristics and be properly selected to perform under the following conditions:

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SUBMERSIBLE SEWAGE PUMPING STATION

<u>Initial Condition</u>	<u>Pump Station #</u>
Pump Capacity (GPM)	_____
Total Dynamic Head (Ft.)	_____
Pump Speed (RPM)	_____
Minimum Pump Efficiency (%)	_____
 <u>Future Condition</u>	
Pump Capacity (GPM)	_____
Total Dynamic Head (Ft.)	_____
Pump Speed (RPM)	_____
Minimum Pump Efficiency (%)	_____
Minimum Horsepower	_____
Maximum Horsepower	_____
Motor Voltage	_____ V _____/

Note: If the pump horsepower proposed by Contractor is greater than the maximum specified, then the cost to increase the electrical system of the pump station shall be borne by the Contractor.

A. Impeller

The impeller is to be corrosion resistant and of the enclosed type. The impeller is to be made of close-grained cast iron and be dynamically and hydraulically balanced before assembling in the pump. A wear ring shall be installed at the inlet of the pump to provide protection against wear to the impeller.

B. Casing

The casing shall be made of high strength cast iron and shall be large enough at all points to pass any size of solid which can pass through the impeller. Wear rings shall be installed.

C. Shaft

The pump shaft shall be constructed of solid 31655 or 17-4 PH (high grade stainless steel). Shaft sleeves are not acceptable.

D. Seals

Each pump shall be provided with a tandem double mechanical seal. The seals shall require neither maintenance nor adjustment and shall be easily replaceable. The lower mechanical seal shall be protected by a minimal shaft over-hang and pressure reducing vanes on the back of the impeller.

E. Base

The volute casing shall have feet to support the impeller entrance the proper distance above the bottom of the wet well unless otherwise approved by the Design Engineer.

F. Finish

The pump shall have a painted or enamel finish as standard with the manufacturer.

G. Nameplates

Each pump shall have a standard nameplate securely affixed thereto in a conspicuous place and also mounted in the electrical panel showing the serial number and the name of the manufacturer. In addition, the nameplate for each pump shall show the model or figure number, the capacity in gallons per minute at rates of speed in revolutions per minute and total dynamic head in feet. Care shall be taken to be legible at all times.

H. Guiding Rail Connection System

A guiding bracket shall be an integral part of the pump itself. This bracket will slide along a guide rail(s). The guide rails will be furnished and shall be of standard weight Sch 40 stainless steel pipe. The pump shall have a machined connecting flange which will connect to a discharge flange mounted on the wet well floor. Sealing of the connecting flange to the discharge flange is to be accomplished by a guided downward motion, without the use of nuts or bolts. Guiding rail connection system shall allow pump removal and replacement without personnel entering or dewatering the wet well or disconnecting any piping in the wet well. Individual pump and motor removal shall not interfere with continued operation of remaining pump(s).



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I. Motor

The pump motor shall be housed in an oil or air filled, watertight casing and shall have Class F insulated squirrel cage windings. Pump motors shall have a cooling system capable to allow for continuous operation in even non-submerged condition. The pump should be able to run dry under full load continuously for extended periods of time without damage.

The motor cable shall be properly sealed at its entry into the motor so as to allow no moisture into the motor housing. The pump motor shall be capable of at least 10 starts per hour on the average. The pump motor shall be supplied with a moisture sensing device capable of relaying its signal to the control panel. The pump motors and power supply must be explosion proof and suitable for use in NEC—Class 1, Division 1, Group D locations.

J. Tools

For the pumps, special tools necessary for maintenance and repair of pumps shall be furnished by the Contractor.

K. Pump Characteristic Curves

Pump characteristic curves shall be furnished showing capacities, heads, efficiencies, and brake horsepower throughout the entire range of pumping. These shall be submitted as part of the shop drawing submitted to the Design Engineer.

L. Spare Pump and Motor

The Contractor shall supply one pump and one motor in addition to the two supplied for the installation into the wet well for each pumping station.

The pump and motor shall be the same make, model, and size as those supplied for installation into the wet well for each pumping station.

12.04 WET WELL

A. General

A concrete wet well shall be built in conjunction with each pump station as shown on the plans.

B. Pre-cast Concrete Units

The wet well structure shall be made of pre-cast reinforced concrete pipe of the size shown on the plans and shall conform to ASTM C-76, Class 2. Joints shall be of the rubber "O-Ring" design and provide integral (one piece) pre-cast bottom section.

C. Sanitary Sewer Wetwell Waterproofing

The Contractor shall apply a waterproofing system to the inside and outside of the concrete wet well. The material to be used for this operation shall be as specified in these specifications.

The waterproofing system shall be applied and allowed to dry in accordance with the manufacturer's directions. All steps, lids, frames and castings and sewer pipe entering or leaving the wet well shall be protected during application to prevent their being coated.

Interior Waterproofing

If any leaks in the wet well walls are detected twenty-four (24) hours after application of the first coat of the waterproofing system, they shall be sealed by application of a quick-set sealer. This sealer shall be a mixture of Portland Cement - Type One and "Ipanex R", "Waterplug" or equal. The quick-set sealer shall be applied in accordance with the manufacturer's directions. After the patched areas dry, they shall be covered with another coat of the waterproofing and allowed to dry. If any leaks are apparent after that time, the Contractor shall repatch them. The above steps shall be repeated until all leaks are sealed.

After all leaks are stopped and there are no leaks apparent after twenty-four (24) hours upon application of the first coat of the waterproofing system or twelve (12) hours after application of a patch, the Contractor shall apply over the dry surface a finish coat.

Exterior Waterproofing

The exterior surfaces of the wet well shall be thoroughly covered with mastic at a rate of one (1) gallon per twenty-five (25) square feet. The exterior surfaces shall be thoroughly cleaned before application of the mastic. The mastic shall be as specified in Section 7.02 A2 of these specifications.

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SUBMERSIBLE SEWAGE PUMPING STATION

D. Waterstops

A waterstop shall be installed in the wall of the wet well for all piping connections. This includes inlet sewer piping and outlet discharge piping. The waterstops shall be a Kor-N-Seal as manufactured by National Pollution Control Systems or equal.

E. Vents

The intake and outlet vents shall be cast iron or ductile iron pipe constructed as detailed on the plans.

F. Electrical

The electrical components of the wet well level control and alarm system shall be 24 volts, corrosion proof, water proof and explosion proof.

G. Hatch

- a. Material: Aluminum
- b. Nominal dimensions as indicated on plans.
- c. Suitable for H-20 highway loading.
- d. Lockable with safety cage
- e. Torsion bar assist
- f. Positive lock at 90 degree opening

12.05 PUMPING STATION PIPING, VALVES AND FITTINGS

A. The piping shall conform to the sizes and configurations shown on the plans and the following materials specifications.

1. Cast Iron Fittings

Cast iron fittings shall be designed in accordance with the standards set forth in ASA Specifications A21.2, A21.6, A21.8 or to Federal Specification WW-P-421.a. The pipe shall be designed to withstand a minimum working pressure of 150 psi and a minimum hydrostatic test pressure of 300 psi. The pipe shall also be designed for a laying depth of six feet.

2. Ductile Iron Pipe and Fittings

Ductile iron pipe shall be in accordance with the latest revision of ASA Specifications A21.50 and A21.51. The pipe and fittings shall

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SUBMERSIBLE SEWAGE PUMPING STATION

be designed to withstand a minimum working pressure of 150 psi and a minimum hydrostatic test pressure of 300 psi.

3. Galvanized Steel Pipe

Galvanized steel pipe shall meet the requirements of ASTM Specification A120. Standard weight galvanized pipe and standard weight malleable iron fittings or American Standard 125 pound cast iron fittings shall be furnished unless otherwise specified.

4. Valves

The specification for gate valves, knife valves, plug valves, ball valves, butterfly valves, pinch valves and standard check valves is located under Section 8, Forcemains.

5. Valve Operators and Valve Boxes

The specification for valve operators and boxes is located under Section 8, Forcemains.

6. Pipe Supports

Pipe supports shall be used to support all piping and valves. Pipe supports shall be of the adjustable type designed to support cast iron pipe.

7. Pressure Gauges

Pressure gauges shall be installed in the discharge line of each pump within the valve chamber. The gauges shall be 3-inch diameter (minimum) and read pump discharge pressure in "feet of water". Liquid filled gauges shall incorporate a flexible diaphragm seal between the sewage discharge line and the pressure gauge. The diaphragm seal shall be either the inline-saddle type design with a minimum diaphragm surface of 5 square inches or the complete flow-thru type design with flange connection. Inline saddle diaphragms and housing parts exposed to the sewage shall be 316 ss. The flexible cylinder protecting the sensing liquid on the flow-thru design shall be Buna N and the flanges shall be 316 ss. The inside diameter of the flow-thru assembly shall be the same as the adjacent discharge piping. Use Model R or RP by Ametek, Model Iso-Spool (flanged) or Iso-Ring (wafer) by Ronninger-Peter or equal. Gauge shall be mounted on a tap equipped with a valve to

allow complete isolation and removal of the gauge without station shut down.

B. Installation of Piping, Valves and Fittings

1. Cast Iron or Ductile Iron Piping, Valves and Fittings

Cast iron or ductile iron piping, valves and fittings shall be used for all piping larger than 4-inch diameter from the pumps until the pipe exits the valve chamber. Cast iron flanged piping, valves, and fittings shall be used for all interior exposed piping unless otherwise approved by the Engineer. Pipe, valves and fittings shall be carefully laid to line and grade. Care shall be taken to keep the pipe clean and free from dirt and other foreign materials. Piping laid in the ground shall have bearing over its entire length. Piping along floors, walls or ceilings shall be adequately supported by saddles, posts, wall brackets, pipe hangers or other approved devices. The exact location, number and design thereof shall be subject to the approval of the Engineer.

2. Galvanized or Wrought Iron Piping

Galvanized steel pipe fittings shall be used for all interior piping less than 4 inches in diameter.

3. Pipe Taps

Wherever indicated or required, pipe or fittings shall be tapped to receive small pipe or special fittings.

12.06 SEWAGE FLOW METER

A. Scope of Work

The Contractor shall furnish and install where shown on the plans and in accordance with these specifications, an ultrasonic flow measuring device complete with flow transmitter, indicating, recording and totalizing capable of 4-20 milliamp output. The flow meter must be suitable for use in NEC, Class 1, and Division 1 locations. The ultrasonic level measuring device flow meter shall be installed through the top of the wet well. The ultrasonic level measuring device shall be capable of providing pump on/off signals to the control panel and be manufactured by Milltronics.

12.07 ELECTRICAL WORK

A. Factory Wiring and Equipment

1. General

The pumping station control panel shall be completely wired at the factory except for the power feeder lines in accordance with National Electrical Code and carry an Underwriters Laboratory certification upon delivery. It shall be adjusted and ready for operation. All wiring in the station shall be color coded and numbered as indicated on the wiring diagram portion of the shop drawings. All wiring outside the panel shall be in rigid conduit. It is the Contractor's responsibility to ensure that electrical equipment complies with all federal, state, and local requirements. (A large, clear, color coded and numbered wiring diagram shall be provided in triplicate with each unit. Wiring diagram shall comply with the latest Township requirements).

All conduit ends are to be sealed to eliminate water and/or gases moving from one section of the pump station system to another; i.e., wet well to pump control panel.

2. Pump Motors

Pump motors shall be supplied with the pump by the pump manufacturer as an integral part of the pump assembly. The horsepower shall be such that the motor will be non-overloading throughout the entire pump range. The motors shall have squirrel cage windings and rated at 240 volts, 60 cycle, 3 phase and shall be NEMA Code "G" design or better. Motors shall be as manufactured by U.S. Motors, General Electric, Westinghouse or equal. Each motor shall have a nameplate showing the motor serial and identification numbers, manufacturer's name, horsepower, voltage, etc.

3. Pump Controls and Alarms

a. Control Panel

The electrical control equipment shall be mounted within a NEMA 4 dead front enclosure.

The control panel shall include a circuit breaker and magnetic starter for each pump motor actuated by the

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ultrasonic level control system. The magnetic starters shall be Square "D" and have thermal overload protection on all three phases. The control assembly shall provide a convenient means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle.

Control panel shall be equipped with a step-down transformer to supply 120/240 volts for control and auxiliary circuits. Primary side of auxiliary power transformers shall be protected by a thermal/magnetic air circuit breaker specifically sized to meet power requirements of the transformer. A 120-volt, 20-amp, duplex receptacle shall be provided with ground fault circuit interruption.

Pump run indicator lights shall be mounted on the control panel.

The control panel shall also incorporate an hour meter to register the elapsed running time for each pump. Meters shall be resettable and utilize a digital readout.

A time delay relay shall be provided for the pump motor controls to insure that both motors will not start at the same time.

Controls for the pump motors shall be designed to protect the electric motors from low line voltage, single phase startup and phase reversal. A phase sequence and under voltage relay shall be installed in the control panel. The unit shall be connected to the pump station alarm circuitry to provide a 0.5 second time delay to prevent nuisance tripping of the relay caused by a momentary transient drop in the line voltage. Upon resumption of normal line conditions, the unit shall automatically restore the motors to a running condition.

b. Wet Well Level Control and Alarm System

Controls for pump operation for wet well level control and alarm system shall be furnished and installed to perform as described herein. The Wet Well Level Control and Alarm System is required to meet Class 1, Division 1, Group D requirements.

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At the normal High Water Level, one of the two pumps will start. Pumping will continue until the fluid level has lowered to the normal Low Water Level when the pumps will stop.

When the fluid level has again reached the normal High Water Level, the other pump will start and complete its cycle in the same manner as the first pump. In the case of suction, lift stations pump alteration shall be conducted automatically on a daily cycle not every pump cycle.

If the fluid level continues to rise above the normal High Water Level and reaches the Standby Pump On Level, the second or standby pump will start and both pumps will continue to run until the fluid level descends to the normal Low Water Level. If the fluid level continues to rise above the Standby Pump On Level, a High Water Alarm Level will indicate an abnormal condition. High Water Level, Low Water Level, and Standby Pump On Level shall utilize the ultrasonic level control system. The High Water Alarm Level shall utilize the ultrasonic level control system with a backup signal actuated by a mercury float type switch.

Conversely, if the pumps should continue to run so as to drop the fluid level below the Low Water Level, the Low Water Alarm Level will indicate the abnormal condition and the operating pump(s) will stop. The pump controls will automatically be restored to normal operation if the fluid level again rises. The Low Water Alarm Level shall utilize the ultrasonic level control system with a backup signal actuated by a mercury float type switch.

The mercury float type switches shall consist of suspended plastic watertight casings, each containing a mercury switch, so arranged that the buoyancy of the rising fluid causes them to lie on their sides thus activating the mercury switch. All level control circuits in the wet well shall be 24 volt and in explosion-proof housings.

4. Alarm Contacts for Rapid Telemetry (or Alarm Monitoring) and Exterior Alarm Light



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The pump station shall be provided with alarm contacts terminal board control panel by the pump station manufacturer for energizing of the telemetering and alarm light relays.

- a. Telemetering (dry) contacts shall be provided for the following conditions:

High Water Alarm Level  
Low Water Alarm Level  
Water in the Pump Motor  
Power Failure  
Sewage Pump No. 1 On  
Sewage Pump No. 2 On  
Security

- b. Exterior alarm light and horn contacts shall be provided and the light and horn energized for the following conditions:

High Water Alarm Level  
Low Water Alarm Level

5. Electric Heater

A single-phase electric strip heater shall be provided in the pump panel with an adjustable thermostat.

6. Telemetry Equipment

Telemetry equipment will be supplied and installed by the agency performing operation and maintenance for the facility. Battery back-up must be included.

B. Site Electrical Requirements

1. General

The Contractor shall supply and install all site electrical wiring and equipment necessary to operate the facilities of the sewage pumping station in accordance with all federal, state, and local requirements and as described in these specifications and shown on the plans.

2. Contractor Responsibility

It shall be the Contractor's responsibility to have utility installations and hookups for electrical service.

3. Exterior Station Alarm

An exterior station alarm shall be supplied to provide a visual alarm indication activated by contacts in the lift station control panel. It shall be mounted within the exterior electrical enclosure. A vapor tight, 100-watt light fixture with red globe and guard shall be mounted on the top of the exterior electrical enclosure to indicate visually when an alarm condition exists.

12.08 FACTORY TESTS

The submersible sewage pumps shall be given running tests to check for proper motor and pump operation, correct shaft and impeller rotation and watertightness. Pump shall be run submerged for 30 minutes, simulating actual service conditions after which the motor housing will be checked for moisture either visually if plugs are present, or through the use of a moisture probe, if plugs are not present.

A certificate of factory testing shall be provided to the Design Engineer and Township Engineer.

12.09 SHOP DRAWINGS

The Contractor shall submit, as prescribed under Section "General Requirements", six (6) copies of complete shop drawings including the shop drawing for the control panel and color coded electrical schematic drawings (ladder diagrams) for all electrical components and details of all equipment to be furnished under this section. These shop drawings shall be submitted and approved by concurrence of Township Engineer before installation of these items.

12.10 OPERATION AND MAINTENANCE INSTRUCTIONS

Written instructions for the operation and maintenance of the pump station equipment shall be furnished in quadruplicate for each piece of equipment in this section. The instructions shall be easy to understand with directions specifically written for this project describing the various possible methods of operating the equipment.

The instructions shall include procedures for tests required, pump curves, adjustments to be made, and trouble and safety precautions to be taken with the equipment.

Maintenance instructions shall include test and calibration charts, exploded views of assembled components, spare parts lists and wiring diagrams.

These instructions shall be submitted to the Design Engineer and Township Engineer for approval at the same time the shop drawings are submitted.

#### 12.11 RECORD DRAWINGS

Any changes that are made in equipment, controls, wiring, etc. from that shown in the plans and specifications shall be made only by approved shop drawings. After such changes are made, the Contractor shall submit to the Township Engineer record drawings which show these changes in equipment installation.

#### 12.12 AS-BUILT WIRING DIAGRAM

A large, clear, color coded and numbered wiring diagram shall be prepared showing the as-built wiring of the complete pump station installation including all control and alarm wiring. Provide four (4) copies for each pump station.

#### 12.13 EQUIPMENT INSTALLATION AND START UP FOR SEWAGE PUMP STATIONS

##### A. General

All equipment shall be installed in a neat, workmanlike manner, acceptable to the Design Engineer with concurrence of the Township Engineer and in conformance with all applicable local, State and Federal codes and requirements.

##### B. Factory Trained Start-Up Personnel

The Contractor shall furnish the services of an experienced factory trained field engineer representing the pump station supplier to start up all equipment. He shall be employed by the Contractor in such capacity to interpret the manufacturer's installation guide and instructions, to supervise the installation and start-up of such equipment and to instruct the operating and maintenance personnel for a reasonable period of time. (A minimum of four (4) hours of instruction per pump station.) The representative of the pump station supplier shall be responsible to insure that all pumps, motors, equipment, controls, alarms, wiring, flow meter and all associated components are properly installed and functioning properly.

C. Systems Start Up

It shall be the Contractor's responsibility to coordinate work between his subcontractors, equipment suppliers and utility companies to insure that all components of the system function properly as described herein.

When the system or a major component of the system is entirely installed and ready for testing, the Contractor shall notify the Township Engineer and operating/maintenance personnel, in writing, of the time and date the start-up testing will be done. The Contractor, subcontractor, and equipment supplier's representatives shall be present for final start-up testing. During the start-up test, the Contractor shall operate all equipment in such a manner to demonstrate that all components are functioning properly.

If the equipment fails to perform, it will be the responsibility of the Contractor to arrange for repair or replacement of the defective parts and scheduling of a new start-up session.

Should the equipment pass its initial start-up testing but fails during the one year guarantee period, the Contractor shall coordinate the necessary repairs or replacements with the subcontractors and suppliers.

12.14 GUARANTEE

In addition to the Contractor's guarantee, the Contractor shall also furnish the manufacturer's guarantee(s) covering all material and equipment furnished. Such guarantees shall be in written form and furnished to the Owner. The guarantees shall be for a one year period commencing on the date of acceptance of the completed sewage pumping station(s) as determined by the Design Engineer with concurrence of the Township Engineer. The guarantee(s) shall cover the structure and all equipment, materials and workmanship of the pump station and all associated components as specified herein. The guarantee shall provide for the replacement of defective materials and/or workmanship, together with the restoration of any related materials or workmanship that are disturbed as a result of such imperfections in the work. All guarantees shall be submitted in triplicate.

13.01 SCOPE OF WORK

Under this item, the Contractor will restore all lawns, trees, gardens, landscape plantings, sidewalks, ramps, trails, fences, commercial signs, water courses and sand, gravel, dirt, asphalt and concrete roads, catch basins, storm sewers, building sewers, water services, water valve boxes, meter vaults, property markers (such as concrete monuments, irons, stakes, pipes, etc.), mailboxes and other items which may be damaged during the course of construction. All replacement and cleanup work will be incidental to the project except those items of work that are delineated in the bid proposal.

All restoration work shall attempt to return the existing facilities to their original condition. Substitutions, such as gravel instead of grass, will not be allowable.

The Contractor shall pay special attention to the requirements of Act 347, "Soil Erosion and Sedimentation Control". In all construction work the Contractor shall take all precautions necessary to prevent erosion and to conform to the requirements of Act 347. Should erosion occur within the guarantee period, the Contractor shall regrade and reseed the disturbed area at no additional cost to the Owner.

Replacement and cleanup operations shall follow immediately behind the construction work. The Contractor shall make every effort to keep the job site clean and free of trash and miscellaneous building materials. The Contractor shall pay special attention in order to restore commercial signs, fences, etc. and to patch and repair pavement, driveways and sidewalks immediately after the construction work. In the event that replacement and cleanup work does not proceed in a satisfactory manner, the Owner may withhold periodic payments or close the construction area until such time as the replacement and cleanup is satisfactory. An exception may be made if there are physical limitations which do not allow for immediate replacement and cleanup.

13.02 PAVEMENT RESTORATION

A. General

All permanent pavement restoration shall be done over compacted backfill and a minimum six (6) inches thick compacted M.D.O.T. 22A gravel base. The gravel base shall be placed and maintained in accordance with the M.D.O.T. Standard Specifications. All patches shall have square, neat, saw cut edges regardless of the final surfacing method planned for that section of the pavement restoration.

No patching work shall be started until the subgrade has been properly prepared. Prior to laying the bituminous patch, the adjacent road surfaces shall be swept clean of all foreign materials and the patch area and pavement primed with Michigan Department of Transportation's approved prime coat.

A bituminous bond coat shall be placed between successive lifts of the bituminous patch and bituminous surfacing. Each lift shall be thoroughly compacted before adding the next lift. This includes running the compaction roller longitudinally along the entire length of the joints between the patch and the existing pavement.

The bituminous mixture to be furnished under these specifications shall be delivered to the paver at a temperature no lower than 285 F. Any mixture that has a temperature below 285 F at the time of "laying" shall be rejected and hauled from the project.

Temporary road patches shall be gravel or bituminous cold patch. The patches shall be maintained in a smooth condition until final repairs are made.

The Design Engineer, Township Engineer and the County Road Commission shall be notified at least two (2) working days prior to the placement of any and all final pavement overlays.

Aggregate for mixes shall conform to Grand Traverse County Road Commission/Leelanau County Road Commission current standards where applicable.

B. Bituminous Patching

Existing asphalt roads and driveways shall be patched using the current Road Commission standards. All patches shall be placed in two lifts of 165 pounds per square yard for the first course and 110 pounds per square yard for the second course or match existing thickness. A bituminous prime coat of 0.25 gallons per square yard and a tack coat of 0.10 gallons per square yard shall be used for all bituminous patches. Shoulders shall be restored to their original width and depth in accordance with M.D.O.T. Standard Specifications using M.D.O.T. 23A gravel.

C. Gravel Roads, Driveways and Shoulders

All gravel roads shall be restored in accordance with M.D.O.T. Standard Specifications using six (6) inches of M.D.O.T. 22A gravel. Shoulders shall

be restored to their original width and depth in accordance with 1984 M.D.O.T. Standard Specification 3.09 using M.D.O.T. 23A gravel.

Shoulders shall be raised on the side opposite of sewer construction to match new pavement surfaces.

D. Concrete Pavement, Sidewalk and Driveways

Concrete for restoring pavement, sidewalks, and driveways shall attain a 28-day strength of 3,500 pounds per square inch. Neat edges of patch areas shall be obtained by the use of a concrete saw. Concrete mixing aggregates and curing methods shall conform to Concrete section.

Concrete patches shall match the original width and depth and in no case, a depth less than four (4) inches. Sidewalks shall have contraction joints a distance apart equal to the width of the slab.

13.03 GRASS AREA

Grass areas shall be considered as two types: A) Type 1, areas which had lawns before construction, and B) Type 2, open fields or ditches not adjacent to established lawns. The plans may specifically call for Type 1 mixtures in which case the plans will govern. If there is a question as to which mixture to use, the Design Engineer shall make the final decision.

Terraces, lawns, ditches, open fields and other grassy areas shall be topsoiled, fertilized, seeded and mulched in such a manner that a grass approximately equal in type and density of the original is obtained. Slopes between 1:3 and 1:2 shall be sodded and staked or receive seed with mulch blankets.

A. Topsoil

Topsoil furnished shall consist of dark brown or black loam, clay loam, silt loam, or sandy loam surface of fertile, friable humus soil of mineral organics, not including peat or muck. Soil shall be screened topsoil, free of stones, roots, sticks and any other extraneous materials. All topsoil furnished shall be approved by the Design Engineer. Type 1 areas shall be topsoiled to a depth of four (4) inches and Type 2 areas to a depth of two (2) inches.

B. Seeding and Fertilizing

Areas to be seeded and fertilized shall be carefully raked to even surfaces and all stones, sticks and other debris removed.

The area to be seeded shall be fertilized with agricultural fertilizer 12-12-12 analysis, Davco or Agrico or equal, applied on the prepared surface at the rate of 20 pounds per 1,000 square feet. Fertilizer shall be harrowed or raked into the soil to a depth of not less than one (1) inch.

Seeds shall be furnished in durable bags. On each bag of seed, the vendor shall attach a tag giving name, lot number, net weight of contents, purity and germination. All seed shall be thoroughly mixed and sown in a method which will ensure uniform distribution. Seeding during high winds or inclement weather will not be permitted. All seed is to be raked in and compacted. The seed shall be sown at the rate of five (5) pounds per 1,000 feet. The seeding mixtures shall be composed of certified seed of the purity, germination and proportions by weight as specified in the following table:

Kind	SEEDS		MIXTURES	
	Minimum Purity	Minimum Germination	Type 1	Type 2
Perennial Rye Grass	98%	90%	20%	50%
Kentucky Blue Grass	90%	75%	60%	15%
Creeping Red Fescue	98%	80%	20%	35%

C. Mulching

Immediately after seeding all seeded areas, Type 1 and Type 2 shall be mulched with unweathered small grain straw or hay spread uniformly at a rate of 100 pounds per 100 square feet (two tons per acre). Hydroseeding method with similar application rate will be allowed.

D. Mulching Anchoring

All mulch shall be anchored using one of the following methods. The Contractor may use either method unless otherwise shown on the plans.

1. Method "A": The straw mulch shall be anchored by applying one of the following asphalt products at the rate shown. The asphalt may be blown on with the mulch or sprayed on immediately after the mulch is spread.



<u>Asphalt Product</u>	<u>Application Rate</u>
Liquid Asphalt R.C. 1, 2 or 3; M.C. 2 or 3	0.10 gal. per S.Y.
Emulsified Asphalt R.S. 1 or 2; M.S. 2; or S.S. 1	0.04 gal. per S.Y.

2. Method "B": A "Terra-Tak" mulch binder may be used in lieu of asphalt. Mixing and application shall be done in accordance with the manufacturer's recommendations.
3. Method "C": In areas with slopes greater than 10% or where shown on the plans, the Contractor shall place mulch netting or excelsior blanket mulch.
  - a. Mulch Netting: Mulch shall be anchored by the use of mulch netting. The light weight fibrous netting shall be properly placed over the mulch and secured to the ground using wire staples, spaced per manufacturer's recommendations.
  - b. Excelsior Blanket Mulch: An excelsior blanket shall be used in lieu of other mulch. The excelsior blanket shall be a consistent thickness of evenly distributed wood excelsior fibers, 80% of which are six (6) inches or more in length. The top side of the blanket shall be covered with a coarse net of twisted Kraft paper or biodegradable extruded plastic mesh. Ends and sides shall be securely butted and stapled with U-shaped wire staples of a size and length suited to the soil conditions.

#### 13.04 DITCHES

Ditches which have been grassed and maintained by the abutting property owner shall be restored to the current Grand Traverse County/Leelanau County (where applicable) specifications.

Ditches in which culverts or drain tile have been installed shall have the same tile replaced, if in good condition, or a tile satisfactory to the Design Engineer installed in its place at the original line and grade.

Catch basins shall be reconstructed, if removed or damaged.

13.05 FENCE REPLACEMENT

- A. Chain Link Fence shall be replaced according to M.D.O.T. specifications.
- B. Other Fences shall be replaced equal to and of the same type as existing.
- C. Salvaged material, if approved by the Engineer, may be used for replacement.

13.06 COMMERCIAL SIGNS

Commercial signs, which must be removed by the Contractor in order for work to proceed, shall be replaced and reconstructed to original condition. It is very important that replacement follow immediately behind the construction work.

13.07 BUILDING SEWERS

Building sewers shall include any and all parts of private residential, commercial or industrial sewage disposal system such as sewer pipe, septic tanks, drainfield, etc. Whenever the service of any such facility is interrupted because of the Contractor's operations, he shall provide such interim methods of sewage disposal as are required to maintain a safe, nuisance free, non-polluting construction operation.

13.08 OTHER DEBRIS

The Contractor shall remove, at his own expense from the site, any and all broken pipe, bricks, blocks, lumps of concrete, broken machinery, cans, containers, and other trash and debris.

13.09 TREES

The Contractor shall endeavor to save as many trees as possible. Cut trees, including stumps, shall be disposed of by the Contractor. Any elm tree which is removed must be burned. Tree branches which become broken shall be removed by cutting off flush with trunk and the cut on the trunk shall be painted with an approved tree paint. Where removal of a stump would result in damage to existing utilities, the stump may be removed by chipping to a depth of at least one foot below the finished ground surface.

Trees removed by the Contractor and where approved by the Engineer shall be replaced with a reasonably sized tree of the same variety. Trees along the State Highways and County Roads that fall on the property line or in the road right-of-way shall be replaced at a new location off the right-of-way.

SECTION 13  
REPLACEMENT AND CLEANUP

Replacement trees of the deciduous or hardwood type shall be furnished from nursery stock, at least 2 to 2½ inches in diameter, and shall have the roots contained in a ball of soil and wrapped in burlap.

Replacement trees of the evergreen type may be furnished from either nursery or native stock, at least 8-10 feet in height, and shall have roots contained in a ball of soil and wrapped in burlap.

14.01 SCOPE

The work covered by this section of the Specifications consists of furnishing all plant, labor, material and appliances and performing all operations for the installation of piping and equipment as shown on the drawings and hereinafter specified.

14.02 PIPING AND FITTINGS:

This work consists in furnishing all plant, labor, equipment and materials and in performing all operations necessary to install the piping within the pressure reducing valve chamber as shown on the plans. All work to be performed as shown on the drawings and specifications.

A. Applicable Specifications

The following specifications and standards of the latest issue form a part of this specification to the extent indicated by reference thereto:

1. American Water Works Association Standards:  
AWWA C-505 Resilient wedge gate valves.
  
2. American Standards Association Standards:  
  
A21.2 Cast iron pit cast pipe for water and other liquids.  
  
A21.4 Cement-mortar lining for cast iron pipe and fittings for water.  
  
A21.6 Cast iron pipe centrifugally cast in metal molds for water and other liquids.  
  
A21.8 Cast iron pipe centrifugally cast in sand-lined molds for water and other liquids.  
  
A21.10 Short body, cast iron fittings, 3 inch to 48 inch for 250 psi.  
  
A21.11 Rubber gasket joints for cast iron pressure pipe and fittings.  
  
A21.12 Cast iron pipe, 2 inch and 2-1/4 inch centrifugally cast for water and other liquids.

SECTION 14  
PRESSURE REDUCING VALVE STATION EQUIPMENT

- A21.50 Thickness design for ductile iron pipe.
- A21.51 Ductile iron pipe, centrifugally cast in metal molds or sand-lined molds for water or other liquids.
- B16.1 Cast iron pipe flange and flanged fittings, Class 125.

3. National Electrical Code:

All electrical work.

4. American Society for Testing Materials:

A-72 Welded wrought iron pipe.

A-120 Black and hot-dipped zinc-coated (galvanized) welded and seamless steel pipe for ordinary uses.

B. Materials

The following items of material installed within the well house or room shall be furnished by the Contractor and shall conform to the various requirements as hereinafter specified.

1. Ductile Iron Pipe

Shall be used for all interior pressure reducing valve station piping 4-inch diameter and larger. Ductile iron pipe shall be designed in accordance with the latest revision of ASA specifications A21.50 and A21.51. The pipe shall be designed to withstand a minimum working pressure of 200 psi and a minimum hydrostatic test pressure of 300 psi.

2. Interior Joints

Interior joints within the pressure reducing valve station shall be flanged and constructed with flanges, bolts, nuts, washers and gaskets conforming to AWWA standard C110 and ANSI Standard B16.1. Uni-flange joints will be accepted if rodded.

3. Gate Valves:

- a) Valves 2-1/2" through 12" within the pressure reducing valve station shall have a cast or ductile iron body and bonnet with a minimum non-shock W.O.G. working pressure of 200 psi.

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Gate valves shall be resilient wedge gate valves and shall meet the requirements of AWWA C-505. Gate valves within the pressure reducing valve station shall be flanged and have handwheel operators.

- b) Valves 2" and smaller shall have a bronze body and union bonnet with a minimum non-shock W.O.G. working pressure of 200 psi. Seats shall be integral with the valve body and shall be machined for leakproof shut-off with the disc. The disc shall be a solid bronze wedge. The stem shall be bronze and shall be packed with TFE impregnated asbestos packing. Valves shall have screwed ends and handwheel operators unless otherwise specified or shown on the drawings.

- 4. Wall Castings and Sleeves shall be installed in all concrete work where pipes, wires or other equipment pass through. Wall castings for 4-inch diameter or larger pipe shall be cast iron having an anchor flange located in the center of the concrete wall or floor. Castings and sleeves shall be similar to those as manufactured by the East Jordan Iron Works or approved equal. Joint between pipe and sleeves shall utilize a link-seal fitting or approved equal.

C. Installation of Piping Valves and Fittings

- 1. Ductile Iron Piping, Valves and Fittings shall be used for all piping 4-inch diameter and larger. Ductile iron flanged piping, valves and fittings shall be used for all interior exposed piping unless otherwise approved by the Township Engineer. Pipe, valves and fittings shall be carefully laid to line and grade. Care shall be taken to keep the pipe clean and free from dirt and other foreign materials. Piping laid in the ground shall have bearing over its entire length. Piping along floors, walls, or ceiling shall be adequately supported by saddles, posts, wall brackets, pipe hangers, or other approved devices. The exact location, number and design thereof shall be subject to the approval of the Design Engineer.

14.03 Pressure Reducing Valves

Pressure reducing valves of the size and type indicated shall be installed as shown on the drawings. This valve shall maintain a constant downstream pressure regardless of varying inlet pressures. It shall be a hydraulically operated, pilot-controlled, diaphragm-type globe valve. The main valve shall have a single removable seat and a resilient disc. The stem shall be guided at both

SECTION 14  
PRESSURE REDUCING VALVE STATION EQUIPMENT

ends by a bearing in the valve cover and an integral bearing in the valve seat. No external packing glands are permitted and there shall be no pistons operating the main valve or any pilot controls.

Pressure reducing valves shall have a pressure rating of 250 psi, with an adjustment range of 30 to 300 psi. Valves shall be constructed of cast iron with brass trim.

The pilot control shall be a direct-acting, adjustable, spring-loaded, normally open diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The control system shall include a fixed orifice.

Pressure reducing valves shall meet the requirements of a Clayton 90G-01 AB (Adjustment Range 30-300 psi) Pressure Reducing Valve as manufactured by Cla-Val Company.

14.04 Pressure Gauges

Pressure gauges, as shown on the plans, shall have a 2-1/2 inch diameter dial with a steel case and a bronze or stainless steel tube. The accuracy of each gauge shall meet or exceed ANSI Grade B, 3-2-3 percent and have a pressure range of 0-200 psi, with a maximum increment of five psi. Pressure gauges shall be as manufactured by Omega Commercial Grade, or approved equal.

14.05 Sump Pump

See standard detail for location of portable pump (supplied by others).

14.06 Equipment Installation and Start-Up

A. General

All equipment shall be installed in a neat, workmanlike manner, acceptable to the Owner and the Engineer and in conformance with all applicable local, state and federal codes and requirements.

B. The contractor shall submit operation and maintenance manuals for the following:

- 1) Pressure reducing valves
- 2) Sump pump

- C. The contractor shall submit parts lists and/or names of suppliers for any equipment requested by the Township.

#### 14.07 Shop Drawings

The Contractor shall submit, as prescribed under "General Requirements" section, complete shop drawings and details of all equipment to be furnished under this section. These shop drawings shall be submitted and approved by the Design Engineer with concurrence of the Township Engineer before installation of these items.

#### 14.08 Record Drawings

Any changes that are made in equipment, controls, wiring, etc. from that shown in the plans and specifications shall be made only by approved shop drawings.

After such changes are made, the Contractor shall submit to the Design Engineer and Township Engineer, record drawings which show these changes in equipment installation.

#### 14.09 Guarantee

The Contractor shall furnish a manufacturer's guarantee covering all material and equipment that he furnishes. He shall guarantee his workmanship and material for a period of one year from the date of acceptance. Such guarantee shall provide for the replacement of defective workmanship, together with the restoration of any related materials or workmanship that are disturbed as a result of such imperfections in the work. All such replacements or repairs shall be done without expense to the Owner. All guarantees shall be in written form and submitted to the Owner in triplicate.

#### 14.10 Painting

All pipes, valves, flow meters and any other portions of watermain or ferrous metals exposed inside of the well house shall be painted. If necessary, heat shall be provided to maintain good drying conditions. All items to be painted shall be dry and clean before application of the paint. Any rust or scale shall be removed by wire brushing or scraping. Painting system shall be:

- 1 coat (350 sf/g) Pug Primer (Kopper's or equal)
- 2 coats (500 sf/g) Rustamor 500 (Kopper's or equal)



15.01 :

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