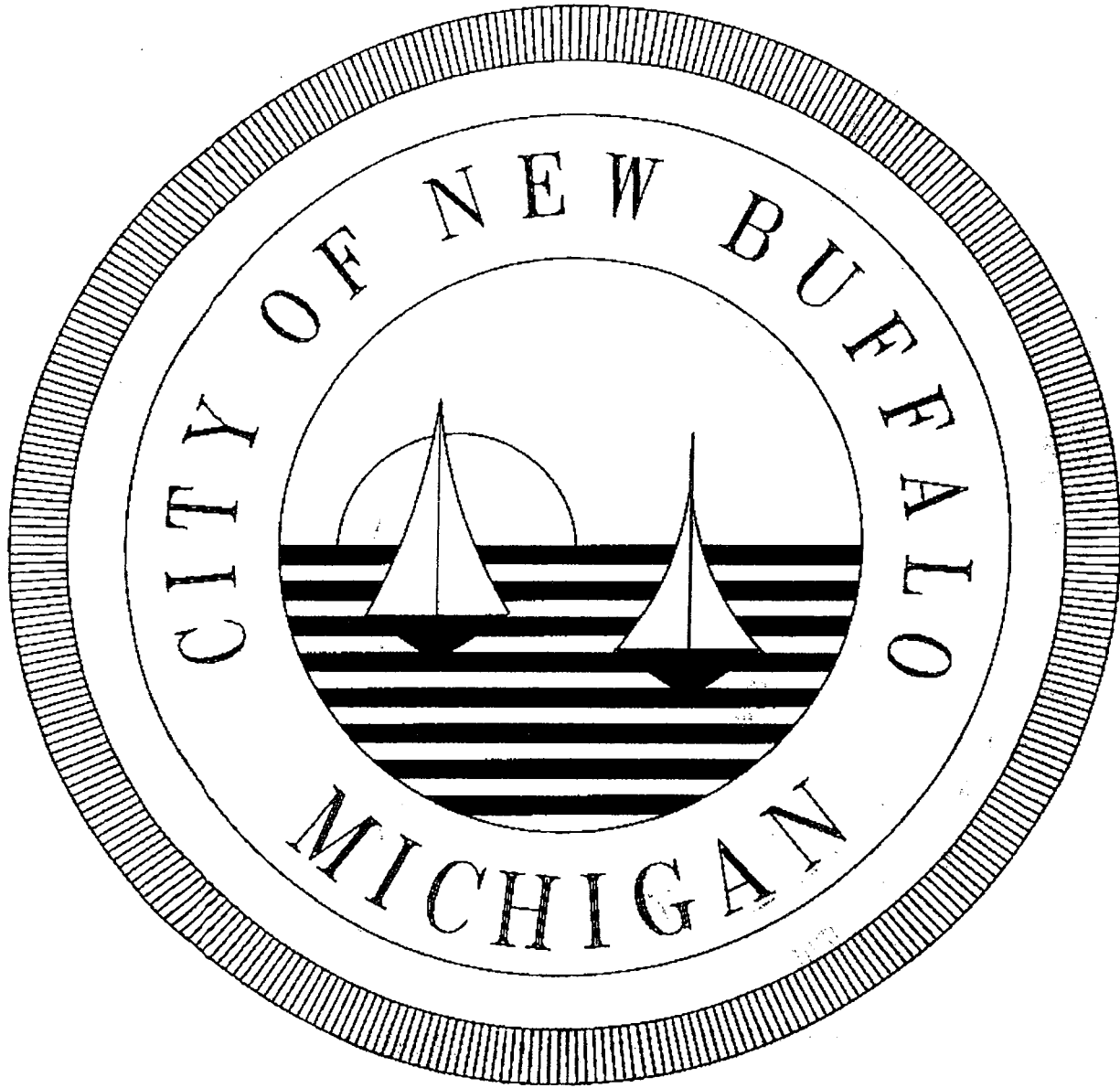


CITY OF NEW BUFFALO, MICHIGAN



**STANDARDS
FOR THE
DESIGN AND CONSTRUCTION
OF
PUBLIC WORKS PROJECTS**

JULY, 2001

SECTION 1 INTRODUCTION

	<u>Description</u>	<u>Page</u>
1.01	General	1- 1
	A. Sanitary Sewers	1- 1
	B. Storm Sewers	1- 1
	C. Water Distribution System	1- 1
	D. Streets and Alleys	1- 1
1.02	Index	<u>Page</u>
	Introduction	1- 1
	City Ordinances.....	2- 0
	Definition and Terms	3- 0

SECTION 1

INTRODUCTION

1.01 General

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

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

- A. Sanitary Sewers
The entire sanitary system and appurtenances from the point of connection with the building plumbing to the final point of discharge at the treatment facility.
- B. Storm Sewers
The entire storm sewer system and appurtenances within City right-of-ways and easements to the final point of discharge.
- C. Water Distribution System
The entire water distribution system from the point of connection with the building service line to the point of connection with the supply, treatment and storage facilities.
- D. Streets and Alleys
All street and alley construction within or abutting City right-of-ways, including pavement, curbs, gutters, sidewalks, and all street appurtenances.

It shall be the Owner's/Contractor's responsibility to comply with all requirements of the City or other authority having jurisdiction on work if such authority imposes greater requirements. Furthermore, the owner shall be responsible for procuring all necessary permits and licenses, pay all charges and fees for acquiring and recording all easements, and giving all notices necessary and incidental to the work.

Addenda and/or revisions to these Standards may be issued periodically and will be distributed and made available to the public and contractor at the City Hall and the Department of Public Works. Users shall be responsible to keep apprised of any changes and revisions to these Standards.

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

SECTION 2 CITY ORDINANCES

NO.	<u>Description</u>	<u>Page</u>
16	City of New Buffalo Sewers and Sewage Disposal Ordinance...	2-2
19	City of New Buffalo Water Ordinance.....	2-9

SECTION 3
DEFINITION AND TERMS

	<u>Description</u>	<u>Page</u>
3.01	Definitions and Terms	3-1
	A. Abbreviations	3-1
	B. Definitions	3-1

SECTION 3

DEFINITIONS AND TERMS

3.01 Definitions and Terms

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

A. Abbreviations

MDOTSS	Michigan Department of Transportation Standard Specifications
MUTCD	Manual on Uniform Traffic Control Devices, latest edition
ADASS	American National Standards for Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People, latest Edition
ASTM	American Society of Testing and Materials
AASHTO	American Association of State Highway and Transportation Officials
AWWA	American Water Works Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
GRSSA	GRS Sewer Authority
NEMA	National Electrical Manufacturers Association
MDOT	Michigan Department of Transportation
CONB	City of New Buffalo
NBWD	New Buffalo Water Department
OSHA	Federal Occupational Safety and Health Act
NSF	National Sanitation Foundation
DEQ	Michigan Department of Environmental Quality
DPW	Department of Public Works, City of New Buffalo

B. Definitions

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

4. **Building Sewer (lateral):** The conduit for transporting waste discharged from the building to the public sewer commencing three (3) feet outside the building walls and ending at the wye or tee fitting at the connection to the public sewer.
5. **City:** City of New Buffalo, Michigan
6. **Contractor:** Any Contractor who meets the DPW requirements and is licensed to enter into contracts for and to perform the work of installing utilities.
7. **County:** The county of Berrien, State of Michigan
8. **Cross-Walkway:** A strip of land dedicated to public use, which is reserved across a block to provide pedestrian access to adjacent areas.
9. **Cul-de-Sac:** A street having one open end and being permanently terminated by a vehicle turnaround.
10. **Director:** Director of the Department of Public Works or his/her authorized representatives.
11. **DPW Representative:** The authorized agent of the DPW assigned to make detailed observation of any or all portions of the work.
12. **Easement:** Easements are areas along the line of all public sanitary and storm sewers and water lines which are outside of dedicated utility or road easements or rights-of-way, and are recorded and dedicated to the City granting rights along the line of the sewer. Easements shall be exclusively for sanitary and storm sewers and water lines. No other utilities shall be constructed or encroach upon the easement except with the expressed written approval of the City.
13. **Engineer:** The Engineer for the Owner.
14. **Infiltration/Inflow:** The total quantity of water from both infiltration and inflow without distinguishing the source.
15. **Inspector:** A direct employee of the DPW assigned to make detailed inspection of any or all portions of the work and materials. The inspector has full authority to reject materials and/or any portion of the work not supplied and installed in accordance with these Standards.
16. **Lift Station:** Any arrangement of pumps, valves and controls that lift and/or convey wastewater to a higher elevation.

17. **Minor (local) street:** A street serving primarily access to abutting properties, not intended as major arteries carrying through traffic.
18. **Other Specifications and Materials:** Wherever in these Standards other specifications or regulations are mentioned, it shall be understood that the materials and methods mentioned therewith shall conform to all requirements of the latest revision of the specifications so mentioned.
19. **Owner:** Any individual, partnership, firm, corporations or other entity who, as property owner, is initiating the work.
20. **Permits:** clearance to perform specific work under specific conditions at specific locations. The owner or his duly authorized representative shall furnish to the Director all necessary plans and documents required by the Director to make application for permits.
21. **Plans:** Construction plans, including system maps, sewer and water plans and profiles, street plan and profile, cross sections, utility plans, detailed drawings, etc., or reproductions thereof, approved or to be approved by the Director an/or City Engineer which show location, character, dimensions and details of the work to be done.
22. **Primary (arterial) Street:** A street of considerable continuity which serves or is intended to serve as a major traffic artery connecting large areas.
23. **Project:** All work to be completed under the Cities permit in accordance with the approved plans, specifications, these standards and the permit conditions.
24. **Record Drawing (as-builts):** Plans certified, signed and dated by a professional engineer registered in the State of Michigan, indicating that the Plans have been reviewed and revised, if necessary, to accurately show all as-built construction and installation details including, but not limited to, key elevations, locations and distances.
25. **Right-of-Way:** All land or interest therein which by deed, conveyance, agreement, easement, dedication or process of law is reserved for or dedicated to the use of the general public, within which the CONB shall have the right to install and maintain sewers, water lines, and streets.
26. **Secondary (collector) Street:** A street which carries traffic from minor streets to the primary street system, including the principal entrance streets of residence development and streets for circulation within such a development.

27. **Sewer:** A pipe or conduit for carrying wastewater (sanitary sewer) and storm water (storm sewer).
28. **Standard Drawings:** The drawings of structures, sanitary and storm lines, water lines, streets or devices commonly used and referred to on the Plans and in these Standards.
29. **Standards:** The Standards for Public Works Projects Design and Construction within the City of New Buffalo as contained herein and all subsequent additions, deletions or revisions.
30. **Street:** A street is an area within a right-of-way which affords the principal means of access to abutting property.
31. **Ten State Standards (sewer works):** Recommended Standards for Sewage Works, latest edition, developed by the Committee of the Great Lakes – Upper Mississippi River Board of State Sanitary Engineers.
32. **Ten State Standards (water works):** Recommended Standards for Water Works, latest edition, developed by the Committee of the Great Lakes – Upper Mississippi River Board of State Public Health and Environmental Managers.
33. **City Engineer:** Authorized Agent by the City of New Buffalo.
34. **Tree Board:** City Board responsible for preservation of trees in public areas.
35. **Uniform Plumbing Code:** The Uniform Plumbing Code adopted by the International Associations of Plumbing and Mechanical Officials, current edition.
36. **Watercourse:** The meaning of watercourse shall include channel, creek, ditch, river or stream.
37. **Water Distribution Lines:** A pipe for carrying potable water.
38. **Work:** All the work to be done under CONB's permit, in accordance with the approved Plans, Specifications, these Standards and permit conditions.

Additional abbreviations and definitions are provided in Appendix A (Sewer Use Ordinance).

SECTION 4 GENERAL RULES AND REQUIREMENTS

<u>Description</u>	<u>Page</u>
4.01 General	4-1
4.02 Building Sewers (laterals)	4-1
A. Sewer Connection Permit	4-1
B. Permit Fee	4-1
C. Application for Connection Permit	4-1
D. Prohibition Against Clean Water Discharges	4-1
E. Mandatory Inspection of Building Connections	4-2
F. Building Sewer Responsibility	4-2
4.03 Permit Fees	4-2
4.04 Design/Construction Approval for Development	4-3
A. Requirements for Construction Permits	4-3
B. Technical Review Committee	4-3
C. Final Plan Approval	4-3
D. Posting of Bond	4-3
E. Construction Inspection	4-4
F. Requirements for Project Acceptance and Dedication	4-5

SECTION 4

GENERAL RULES AND REQUIREMENTS

4.01 General

This Section provides the general rules and policies, the construction of facilities as part of sanitary sewers, storm sewers, water distribution, and streets, including permit requirements and inspection. The ordinances for sanitary sewer systems governing these Standards are provided in Section 2 of these Standard Specifications.

4.02 Building Sewers (laterals)

The following paragraphs provide a highlight of the provisions contained in the applicable City Building Sewer Ordinances. If any conflicts arise between these Standards and the City Ordinances, it shall be superseded by the Ordinances.

A. Sewer Connection Permit

The DPW requires connection permits to be issued by the City of New Buffalo for connection for a building sewer to a public sewer.

Class 1: Residential and Commercial Service

B. Permit Fee

A permit fee per each connection to the sanitary sewer shall be charged for each new connection. Sewer connection charges are levied in addition to the permit fee as provided in the Sewer Rate Ordinance found in Section 2.

The fee schedule shall be as follows:

Class 1: \$1,555.00 minimum

C. Application for Connection Permit

An application for a Connection Permit shall be made on the Form provided by the City of New Buffalo and available from the Clerk's office, New Buffalo City Hall.

D. Prohibition Against Clean Water Discharges

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

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

E. Mandatory Inspection of Building Connections

It shall be the responsibility of the Holder of a Connection Permit to notify the GRS Sewer Authority Inspector that the sewer work is available for inspection. The Inspector will conduct inspections on connections from 7:00 AM to 4:00 PM Monday through Friday except on observed City holidays. The building sewer shall be fully exposed from the foundation to the point of connection with the public sewer.

The Inspector shall take a minimum of two (2) construction “as-built” photos for City record prior to backfilling.

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

F. Building Sewer Responsibility

It shall be the responsibility of the property owner(s) whose property is benefited to provide for, install and make private connections for the use of their premises to an existing public or building sewer. Further, it shall be the responsibility of the Owner to make all necessary repairs, extensions, relocations, changes or replacements thereof, and of any accessories thereto.

4.03 Design/Construction Approval for Development

A. Requirements for Construction Permits

It shall be the responsibility of the Owner/Contractor to obtain a valid construction Permit for the construction or modification of any facility as part of sewers, water distribution system, or streets from the Michigan Department of Environmental Quality (MDEQ), Michigan Department of Transportation, or any other applicable regulatory agency.

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

B. Technical Review Committee

The Owner/Contractor shall submit design drawings for review and approval of the City Technical Review Committee. For each project the Owner/Contractor shall request a presentation hearing before the Technical Review Committee through the City Manager. During this meeting the Committee may recommend approval of the project or request formal revisions. Revised drawings and specifications shall be resubmitted to the City Engineer and Technical Review Committee for final approval.

C. Final Plan Approval

The City Engineer and City Manager shall issue final approval for all projects after clearing the Technical Review Committee.

D. Posting of Bond

1. The City Manager and City Engineer may, as a prerequisite to the issuance of project approval, require the posting of a performance bond from a company licensed by the State of Michigan to provide such surety. Such bond shall be equal to 100% of the contract amount of an amount established by the City to provide surety for the satisfactory completion of the improvements required by the Construction Permit, and shall name the City of New Buffalo who can enforce the obligations thereunder. The duration of the bond shall be two (2) years.
2. The City Manager and City Engineer may as a prerequisite to acceptance of public works facilities require the posting of a maintenance bond in an amount designated by estimated cost to construct the facilities, subject to the approval by the City Engineer, provision for maintenance, for a period of one year from the date of acceptance by the City. Said bond shall name the City of New Buffalo who can enforce the obligations thereunder.
3. In instances where the City Manager and City Engineer have required a bond pursuant to this section, the City may, as an alternative to the postings of such bond, accept other appropriate security such as properly conditioned irrevocable letter of credit which meets the same objective as the bonds described in this section, subject to approval of any other department or agency whose interests are projected by the same bonding requirement.
4. If the surety on any bond furnished to the City becomes a party to a supervision, liquidation, rehabilitation action pursuant to law suit or its right to do business in the State of Michigan is terminated, it shall be required that, within thirty days thereafter, a substitute bond and surety be provided, both of which must be acceptable to the City. Failure to obtain a

substitute bond within the stated time frame shall be cause for revocation or suspension of the project approval until such time that the bond is furnished to the City Engineer.

E. Construction Inspection

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

1. The City may contract for construction inspection service to insure that materials and workmanship meets the requirements of the approved plans and specifications.
2. The City Engineer and/or NBWD will be responsible for submitting and certifying air pressure or infiltration test results for all sewer pipe and deflection test results for all flexible and semi-rigid pipe, water main and force main pressure tests, and all other testing as required and provided by the Contractor.
3. The Owner/Contractor will reimburse the City for the cost of such services which shall be determined at the time of execution of the Agreement, and verified by the Owner or his representative throughout construction.
4. Upon completion of construction, the City representative shall execute and file with the City a Certificate of Completion and Compliance certifying to the City and the Owner/Contractor as to the compliance of such construction with the requirements of the approved construction plans and approved change orders.
5. No action with regard to the acceptance of the construction and release of the improvement bond pursuant to this section shall be taken until the Owner/Contractor has reimbursed the City in full for the inspection services.

All construction of public works facilities intended for dedication to the City shall be observe and certified pursuant to the Agreement.

The Owner/Contractor shall furnish the City with three (3) copies of the approved construction plans and specifications at the time the Agreement is executed.

F. Requirements for Project Acceptance and Dedication

Public Works facilities will not be accepted and permits shall not be issued until all documents, as required by the City, are submitted to and approved by the City Engineer, including the following:

1. One (1) Year Maintenance Bond;
2. Recorded Covenant and Easement Documents;
3. Certificate of Completion and Compliance;
4. The completion of a final inspection which confirms that the project has been constructed and tested in accordance with the City's Standards; and
5. As-Built/as-constructed drawings on reproducible mylars. The record drawings shall be delivered in electronic format in the latest addition of AutoCad.

SECTION 5

GENERAL DESIGN STANDARDS AND DETAILS

<u>Description</u>	<u>Page</u>
5.01 General	5-2
5.02 Sanitary Sewer Design Criteria	5-2
A. General	5-2
B. Pipe Capacities	5-3
C. Minimum Pipe Sizes and Standards	5-4
D. Sewer Structures	5-5
5.03 Lift Station and Force Main Design Criteria	5-6
A. General	5-6
B. Pump Sizing Criteria	5-6
C. Force Main Sizing Criteria	5-6
D. Lift Station Design	5-6
5.04 Storm Sewer Design Criteria	5-7
A. General	5-7
B. Manning Equation	5-7
C. Minimum Size	5-8
D. Grade	5-8
E. Alignment	5-8
F. Manholes	5-8
G. Inlets	5-9
H. Computer Model	5-9
5.05 Water Distribution System Design Criteria	5-10
A. General	5-10
B. Mains	5-10
C. Hydrants	5-11
D. Valves	5-11
E. Air Relief Valves	5-11
F. Water Services and Plumbing	5-12
5.06 Street and Alley Design Criteria	5-13
A. General	5-13
B. Street Standards	5-13
C. Easement Standards	5-14
D. Storm Drainage Standards	5-15
E. Sidewalk Standards	5-16
F. Drive Entrance Standards	5-16
G. Curb Standards	5-17

H. Street Identification	5-17
5.07 Easements	5-17
A. General	5-17
B. Right-of-Way Plan Sheet	5-18
C. Legal Description Sheets	5-18
D. Property Plats	5-19
5.08 Drafting Standards	5-20
A. General	5-20
B. Scales	5-21
C. Materials	5-21
D. Plan and Profile Sheets	5-21
E. Record Drawings	5-23

SECTION 5

GENERAL DESIGN STANDARDS AND DETAILS

5.01 General

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

5.02 Sanitary Sewer Design Criteria

A. General

All sanitary sewers shall be designed and constructed in accordance with MDEQ and Ten States Standards for Sewage Works Improvements.

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

1. Residential

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

2. Commercial/Institutional

The average daily flow for these facilities shall be based on guidelines of MDEQ. These documents shall be used as a general guideline. The City Engineer may allow modifications of these guidelines based upon information submitted by the Owner/Contractor or developed by the City Engineer.

Peak flow shall be determined by multiplying the average flow by a factor determined by the Owner/Contractor and approved by the City Engineer.

3. Industrial

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

Peak capacity shall be determined by multiplying the average discharge by a factor determined by the Owner/Contractor and approved by the City Engineer.

4. Infiltration

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

B. Pipe Capacities

1. Collector Sewers

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

2. Trunk Sewers

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

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

C. Minimum Pipe Sizes and Standards

1. Pipe diameter

The required diameter of gravity sewers shall be determined by Manning's formula using a roughness coefficient, "n", of 0.013 or required by the latest Ten States Standards. The minimum pipe diameter for gravity sanitary sewers shall be eight (8) inches.

2. Minimum slopes and Velocities

All sanitary collector and trunk sewers shall be designed and constructed to provide a minimum velocity when flowing full of two (2) feet per second. The slope of the pipe shall be such that these minimum velocity requirements are attained. The minimum acceptable slopes for the design and construction of sanitary sewers are as follows:

Pipe Size <u>Inches</u>	Minimum Slope <u>(ft. per 100 ft., %)</u>
8	0.40
10	0.28
12	0.22
15	0.15
18	0.12

3. Minimum Depth

For the protection of the sanitary sewer lines from damage caused by utilities installed after the sanitary sewer has been constructed, the minimum depth to crown of all gravity sanitary sewers shall be 4.0 feet, and the minimum depth to crown of all force main sanitary sewers shall be 5.0 feet.

4. Building Sewers

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

The building sewer shall connect to the public sewer at a mainline fitting. Direct connections to manholes may be allowed upon review by the City Engineer.

Building sewers within the right-of-way or easement shall be a minimum of six (6) inches in diameter. Building sewers shall have a wye clean out located within three (3) feet of the building's exterior wall and extended to grade. Industrial building sewers shall have a suitable control manhole for observation, sampling, and measurement of the waste stream, as required by the City Engineer.

Clean outs installed under concrete or asphalt paving shall be made accessible by yard boxes or extended flush with paving with approved materials and adequately protected.

Building sewers installed for future connections shall be terminated at the right-of-way or easement and plugged to ensure 100 percent water tightness. A one-half (1/2) inch metal locator rod or magnetic locator tape shall be installed at the end of the plugged line to within three (3) feet of the finished grade.

If approved by GRS Sewer Authority, a service may be cut into a public sewer using a mainline fitting and fernco coupling.

D. Sewer Structures

1. Manholes

a. General

Manholes shall be installed at the end of each line; at all changes in grade, size, materials or alignment; at all sewer intersections. The interval between manholes shall not be greater than 300 feet, unless a greater distance is approved by the City Engineer.

The minimum inside diameter of manholes shall be 48 inches.

Flow channels shall be shaped and formed in each manhole to provide a smooth transition of flow from all inlets to the outlet. The bench wall shall be formed to the crown of the inlet and outlet pipes to form a "U" as shown in the Standard Details.

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

Manholes proposed to be installed in unpaved areas shall be designed and constructed such that the top of the casting is a minimum of two (2) inches above the finish grade to prevent ponding of water over the casting. Positive drainage away from the manholes shall be provided.

Manholes receiving discharge from force mains shall have an internal drop connection. Manholes which have force main discharge lines shall have an internal epoxy coating to prevent corrosion.

b. Outside Drop connections

Outside drop pipe connections shall be provided for all sanitary sewers entering a manhole at an elevation greater than twenty-four (24) inches above the invert of the manhole.

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

5.03 Lift Station and Force Main Design Criteria

A. General

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

No lift station shall be approved for a project unless a 50-year life cycle analysis is submitted to the City to demonstrate that it will be more cost-effective for the City in lieu of constructing a gravity sanitary sewer.

B. Pump Sizing Criteria

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

C. Force Main Sizing Criteria

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

D. Lift Station Design

1. General

All lift stations shall be wet well/ valve vault design utilizing submersible pumps in the wet well with a separate valve vault. Provisions for draining the valve vault into the wet well shall be made. Provisions shall be made

also in the valve vault for connection to the City's portable pumping equipment or the Galean River Sanitary District's.

2. Wet Well Sizing Criteria

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

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

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

(i.e. 15 minute cycle minimum)

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

5.04 Storm Sewer Design Criteria

A. General

All storm sewers shall be designed to carry the estimated flow from the drainage area(s) ultimately contributing to the respective storm sewer. The minimum return period which shall be used is 10 years. This may be reduced by the City Engineer based upon downstream hydraulic conditions identified by the Owner/Contractor. The Engineer shall be responsible for the adequacy of the design and shall be a registered Engineer or land surveyor licensed in the State of Michigan. This implies that the designer will be responsible for not only on-site drainage design, but also upstream and downstream impacts.

B. Manning Equation

The hydraulic capacity of storm sewers shall be determined by using Manning's Equation:

$$V = (1.486 / N) * R^{(2/3)} * S^{(1/2)}$$

V = Mean Velocity of Flow in Feet per Second (fps)

R = The Hydraulic Radius in Feet

S = The Slope of the Energy Grade Line in Feet/Feet

N = Roughness Coefficient

C. Minimum Size

The minimum size of all storm sewers shall be 12 inches.

D. Grade

Storm sewer grade shall be such that, in general, a minimum of three feet of cover is maintained over the top of pipe. If such condition occurs in a paved area, extra strength concrete pipe and granular backfill shall be used. Uniform slopes shall be maintained between inlets, manholes and inlets to manholes. Final grade shall be set with full consideration of the capacity required, sedimentation problems and other design parameters. Minimum and maximum allowable slopes shall be those capable of producing velocities of 2.0 and 10 feet per second, respectively, when the sewer is flowing full.

E. Alignment

Storm sewers shall be straight between manholes insofar as possible. Where long radius curves are necessary to conform to street layout, the minimum diameter of 24" diameter pipe will be allowed to be curved. Deflection of pipe sections shall not exceed the maximum deflection recommended by the pipe manufacturer. The deflection shall be uniform and finished installation shall follow a smooth curve.

F. Manholes

Manholes shall be installed to provide access to continuous underground storm sewers for the purpose of inspection and maintenance. Manholes shall be provided at the following locations:

1. Where two or more storm sewers converge;
2. At the point of beginning or at the end of a curve, and at the point of reverse curvature (PC, PT, PRC);
3. Where pipe size changes;
4. Where an abrupt change in alignment occurs;
5. Where a change in grade occurs; and

6. At suitable intervals in straight sections of sewer.

The maximum distance between storm sewer manholes shall be 350 feet, unless a greater distance is approved by the City Engineer.

G. Catch Basins

Catch Basins shall be utilized to collect surface water through grated openings and convey it to storm sewers, channels, or culverts shall be required where there is the potential for debris to enter the storm sewer. Inlet design and spacing shall be in accordance with the latest edition of the Michigan Department of Transportation's Road Design Manual or other approved design procedure. The inlet grate opening provided must be adequate to pass the design 10 year flow, unless there are adequate inlets downstream to accommodate any bypass flows.

H. Computer Model

1. Time of Concentration

All storm drainage projects shall be designed using the Time of Concentration Methodology outlines in the SCS TR20 Manual or the Stormwater Drainage Manual (H-94-6) by HERPICC. This includes the use of the updated Intensity-Duration-Frequency curves in the Manual.

2. Storm Sewer and Inlets

Storm sewer design shall utilize the Rational Method using time concentration curves of the Stormwater Drainage Manual (H-94-6) by HERPICC. Other methods may be considered on a case-by-case basis, but the method must be submitted for approval prior to its use in design.

3. Alternative Methods

If approved by the DPW, TR55 may be used for runoff calculations.

4. Storm Water Detention

The release rate from a project shall be no greater than the capacity of the downstream outlet whether it be a storm drainage structure, channel, or other and shall be no greater than that produced from a 2-year return event for predevelopment conditions of the project site. Detention storage shall be provided for flows exceeding the maximum release rate for at least a 100 year – for a duration up to 24 hours that creates the greatest detention requirements. The Engineer shall be responsible for determining if more extreme events must be analyzed.

5.05 Water Distribution System Design Criteria

A. General

All water mains shall be designed and constructed in accordance with MDEQ and Ten States Standards for Water Works requirements.

All water mains shall be designed to provide fire protection and sized by hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system shall be approximately 60 psi and not less than 35 psi. System design shall be such that fire flows facilities are in accordance with the requirements of the State Insurance Services Office.

All designs shall assume a peak hourly flow of no less than 1.0 gpm per residential customer and no less than 10.0 gpm for a minimum dead end flow analysis unless conditions warrant otherwise.

B. Mains

1. Pipe Capacities and Size

The minimum size of water mains for providing fire protection and serving fire hydrants shall be 6-inch diameter. Larger size mains will be required if necessary, to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure specified in section 5.05(A). Hydraulic calculations shall be prepared by the Owner/Contractor's Engineer and submitted to the NBWD and City Engineer for review and approval. Any departure from the minimum requirements shall be justified by hydraulic analysis and future water use, and will only be considered in special circumstances. If necessary, booster pump systems shall be supplied to maintain minimum pressure at the Owner/Contractor's expense.

2. Minimum Depth

The minimum depth for all water lines shall be 5.0 feet to the top of the pipe.

3. Dead Ends

In order to provided for additional reliability of service and reduce pressure loss, dead end mains shall be minimized by making appropriate tie-ins (looping) whenever possible. Where dead end mains occur, they shall be provided with a fire hydrant if flow and pressure are sufficient, or with an approved flushing hydrant or blow-off for flushing purposes as approved by the NBWD and City Engineer. Flushing devices should be sized to provide flows with a minimum velocity of 2.5 feet per second in the water mains being flushed. No flushing device shall be directly connected to any sewer.

C. Hydrants (Watrous Model VJB 67-City Std.)

1. Location and Spacing

Hydrants shall be provided at each street intersection and at intermediate points between intersections as recommended by the State ISO. In general, hydrant spacing shall range from 350 to 600 feet depending on the area being served.

2. Valves and Nozzles

Fire hydrants should have a bottom valve size of at least 5'-1/4", one 4-1/2 inch pumper nozzle and two 2-1/2 inch nozzles.

3. Hydrant Connection

The hydrant connection to the water main shall be a minimum of 6 inches in diameter. Auxiliary valves for hydrant isolation shall be installed in all hydrant connection lines.

4. Drainage

Hydrant drains should be provided with a suitable drain and plug. Hydrant drains shall not be connected to or located within 10 feet of sanitary sewers or storm drains.

D. Valves

Sufficient valves shall be provided on water mains to that mains can be isolated for repairs without inconvenience to water users or creating a sanitary hazard. Valves and tee fittings shall be provided at all locations where future mains will be installed to serve future development. Valves should be located at not more than 500 foot intervals in commercial districts and not more then one block or 800 foot intervals in other districts.

E. Air Relief Valves

1. Air Relief Valves

At high points in water mains, where air can accumulate, provisions shall be made to remove the air by means of hydrants or air relief valves. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur. Manual air relief valves or hydrants are to be used as approved by the DPW or City Engineer.

2. Air Relief Valve Piping

The open end of an air relief pipe from automatic valves shall be extended to at least one foot above grade and provided with a screened, downward facing elbow. The pipe from a manually operated valve should be extended to the top of the pit. The piping shall be approved by the City Engineer prior to construction.

3. Chamber Drainage

Chambers, pits, or manholes containing valves, blow-offs, etc. in a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or air relief valves be connected directly to any sewer. Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water, or to absorption pits underground.

F. Water Services and Plumbing

Water services shall conform to the latest edition of the Uniform Plumbing code and to these Standards.

The water service for individual users shall be connected to the water main with a service saddle and corporation stop.

All new water services shall be sized for the anticipated water usage at the service, but in no case shall be less than 1". All water services shall have backflow preventers installed as approved by the DPW.

Provisions shall be made for metering of water usage to each service connection either by use of a meter pit, or by a meter at the water service entrance to the building. If a service is metered at the building, a key curb stop shall be installed at the edge of the right-of-way or easement line.

Water services installed for future connections shall be terminated at the right-of-way or easement line and valved and capped to insure 100 percent water tightness.

Individual booster pumps shall not be allowed for any individual service connection from a water main unless prior approval is granted by the NBWD and City Engineer.

5.06 Street and Alley Design Criteria

A. General

All streets, intersections, driveways, curbs and sidewalks shall be designed and constructed in accordance with these Standards and in accordance with local ordinances, County requirements, and State and Federal regulations.

Where no Standards exist for a particular item of work, the City Engineer shall prepare a plan using the Michigan Department of Transportation Standards and Standard Specifications.

B. Street Standards

The City of New Buffalo shall not approve any project unless all streets shown on it shall be of sufficient width and proper grade and shall be so located as to accommodate the probable volume of traffic thereon, provide access of fire fighting equipment to buildings, and provide a coordinate system of streets.

1. Local streets shall be so planned as to discourage through traffic.
2. Wherever there exists a dedicated or platted portion of a street or ally along a boundary of the tract being subdivided, the remainder of that street or alley, to the prescribed width, shall be platted within the proposed subdivision.
3. Half streets shall not be provided, except where it is essential to the reasonable development of the subdivision in conformity the other requirements of these regulations, or where it becomes necessary to acquire the remaining half by condemnation so it may be approved in the public interest.
4. Cul-de-sacs shall not be longer than five hundred (500) feet, including a turnaround which shall be provided at the closed end with an outside curb radius of at least thirty-eight (38) feet and a right-of-way radius of not less then fifty (50) feet. The maximum grade of the turnaround portion of the cul-de-sac shall be five (5) percent.
5. Alleys shall not be provided in residential districts, but may be included in commercial and industrial areas where needed for loading and unloading or access purposes.

6. The minimum distance between centerlines of parallel or approximately parallel streets intersecting a cross street from opposite directions shall be one hundred twenty five (125) feet unless it is an in-line street intersection.
7. Intersections of more than two (2) streets at one point shall be avoided.
8. Temporary dead-end streets may be permitted where the approved preliminary plat shows that the street will be extended to conform to the provisions of these Standards, or to provide access to adjacent property where deemed necessary by the City of New Buffalo to provide for an adequate flow of future traffic, provided the length of that dead-end street shall not be greater than four hundred twenty (420) feet. A circular right-of-way in excess of the required street right-of-way at the terminus of the temporary dead-end street shall not be required.
9. City of New Buffalo may increase right-of-way requirements if it determines an increase to be required due to anticipated traffic flow or if drainage easements should reasonable parallel those thoroughfares.
10. Paving widths, and curb specifications, if curbs are required to be installed, shall be determined by the City of New Buffalo based upon factors, among others, of the overall design concept of the proposed subdivision, traffic patterns and densities, the availability of on or off-street parking, and those standards as adopted by the State and Local authorities. Minimum standards shall be in accordance with City Standards.
11. Subgrades may be stabilized by optional methods; however, the Owner/contractor's Engineer shall first obtain the services of a licensed geotechnical engineer or geologist to recommend such a method. In any event, soil stabilization must be acceptable to the City prior to acceptance of the design.

C. Easement Standards

All easements shall be platted and or recorded by the Owner upon project approval with proof of record submitted to the City. Utility easements shall have a minimum width of twenty (20) feet. See Section 5.07 for further requirements. Where located along interior lines, one-half (1/2) the width should be taken from each lot.

If a subdivision is traversed by a watercourse, the subdivider shall provide a storm water easement or drainage right-of-way.

Where paths and trails are proposed they shall not exceed fifteen (15) feet in width and shall be so designed and constructed as to result in the least removal and disruption of trees and shrubs and the minimum impairment of natural beauty.

All utility easements as described on the face of a plat or recorded shall be kept easement free from all permanent structures and the removal of any obstructions such as structures, trees, shrubbery, fences, or other installations thereon, whether temporary or permanent, by the DPW, shall in no way obligate the City for damages, or to restore the obstruction in its original form.

D. Storm Drainage Standards

1. If the area proposed to be platted is located with regard to an adequate public storm sewer system so that storm sewers can be provided, then adequate lateral and connecting installations to it from all portions of that area proposed to be platted shall be constructed and installed in accordance with the plans and specifications submitted by the Owner/Contractor.
2. If the area proposed to be platted is not located with regard to an adequate public storm sewer system, then all open ditches within the area proposed to be platted shall be graded and all pipes, culverts, intersectional drains, drop inlets, bridges, headwalls, and similar or related installations necessary to provide adequate surface water drainage of that area proposed to be platted, shall be designed, constructed and installed in accordance with these Standards and the plans and specifications submitted by the applicant.
3. Drainage ditches or channels shall have a minimum gradient of one half (0.50) percent. If paved with concrete, channels may be sloped at no less than one quarter (0.25) percent.
4. Streets not having curb and gutter, if approved by City Engineer, shall provide the following:
 - a. Side ditch swales measuring a minimum of 18 inches deep from the edge of the pavement with side slopes no steeper than 3:1 and at a point 5 feet inside the right-of-way line.
 - b. A minimum 12 inch diameter culvert pipe at all driveways when determined to be needed by the City/City Engineer. Culverts to be sized according to amount of storm water flow.
 - c. Culverts under the roadway as required and shown on the street improvement plans. Culverts to be sized by the Owner/Contractor through his Engineer and approved by the City Engineer according

to amount of storm water flow (12 inch diameter minimum). All culverts shall extend at least 5 feet beyond either edge of the paved roadway and shall have flared end Sections.

- d. Relief of side ditches and swales along roadways shall be through the use of off street retention basins or existing County drainage channels. Storm water retention using the roadside ditches will not be accepted.
- e. The Owner/Contractor shall provide an adequate storm water sewer system whenever the evidence available to the DPW indicates the natural surface drainage is inadequate. When the surface drainage is adequate, easement for such drainage shall be provided.
- f. If an Owner desires to fill a ravin/drainage ditch on his property, the Owner shall prepare a Plan showing drain size, material of pipe, structures, end sections, riprap, easements, etc. and submit to the City for its review and approval.

E. Sidewalk Standards

Sidewalks may be required to be constructed one (1) foot from the property line of the lots and at intersections along that line as extended. The DPW may require thoroughfares where heavier traffic volumes would present safety problems for pedestrians.

The minimum widths of sidewalks for thoroughfare streets and streets fronting on commercial, industrial, and multiple family development, where required, shall be five (5) feet. The minimum width of sidewalks for single family development shall be four (4) feet. The minimum thickness shall be four (4) inches along the frontage lots.

F. Drive Entrance Standards

1. General

Drive entrances shall be classified as residential or commercial which shall meet the following minimum standards.

2. Residential Drives

Residential drives shall be designed and constructed on minor (local) streets only and shall be a minimum of 10 feet in width. Drive shall be flared or radiused to the street. Minimum drive width at the street shall be 18 feet. Radius (if used) of the drive entrance shall be 10 feet. Drive

entrance shall be a maximum of 10% slope at the streets. The slope at the sidewalk (if provided) shall be ¼ inch per foot. Curbs, if provided, shall be depressed at the full width of the entrance.

3. Commercial Drives

Commercial drives shall be designed and constructed on secondary (collector) streets and primary (arterial) streets as approved by the DPW. Commercial drives shall be a minimum of 24 feet in width with 20 foot minimum radius approach at the street. Drive entrance shall be a maximum of 10% slope at the street. Curbs shall be depressed at the full width of the entrance using a one (1) inch high "lip" curb and gutter section when straight curbs are used.

G. Curb Standards

Curb shall be either straight type or combined curb and gutter as approved by the City Engineer.

H. Street Identification

Street name signs as approved by the New Buffalo Street Department Superintendent shall be provided at each intersection by the Owner/Contractor. Signs shall be uniform of a design to match the current street signs of the City of New Buffalo.

5.07 Easements

A. General

Whenever possible, sewers and water mains shall be constructed within the public right-of-way. Should the construction be outside the limits of the public right-of-way, recorded easements shall be acquired, dedicated and recorded by the Owner solely for the benefit of the City of New Buffalo.

The minimum permanent easement widths to be dedicated to the City are as follows:

<u>Depth of Sewer From finished Grade</u>	<u>Minimum Easement (ft.)</u>
Up to 15 feet	20
> 15 feet to 25 feet	25
Greater than 25 feet	30

All sewers shall be centered in the easement unless water main is present. In that case, maintain minimum 10 ft. separation between water and sewer lines. For those sewers constructed in the public right-of-way, the easement shall extend the distance outside of the right-of-way necessary to provide the required easement width.

A minimum 30 foot by 30 foot easement shall be provided for all submersible lift stations with wet wells up to 30 feet deep.
Regulated drain limits shall be shown on all plans.

The easements shall be exclusively under the discretion and control of the City Engineer. Ingress and Egress shall be available to the DPW's crew at all times. No utility companies are allowed to use the easements for installation of their utility lines without the expressed written permissions of the City Manager. All plan sheets shall clearly identify the easement and the location of all other proposed utilities. The horizontal and vertical plans shall identify all utilities proposed to cross the easement.

B. Right-of-Way Plan Sheet

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

C. Legal Description Sheets

The following shall be provided:

1. Parcel Number;
2. Project Number;
3. Project Name;
4. Identification as to permanent or temporary easement;
5. Separate descriptions on separate sheets are required where both permanent and temporary easements are to be taken;
6. Meets and bounds descriptions shall be clear, concise and complete with sufficient detail to positively establish from known and referenced points, monuments, lines, etc. Total area should be stated at end of description, in acres;
7. Descriptions of easements from platted subdivision lots, including strips off sides of lots should include name of subdivision and recording information for the subdivision as well as affected lot number(s). NOTE: These are usually small areas; therefore, area should be stated in square feet; and
8. Registered land surveyor's licensed in the State of Michigan, seal and signature.

D. Property Plats

1. Parcel Number;
2. Project Number;
3. Project Name;
4. County;
5. Civil Township;
6. Section;
7. Township;
8. Range;

9. Owner;
10. Permanent or Temporary Legends;
11. Permanent or Temporary Easement Areas;
12. Total area of property out of which easement is to be taken;
13. Drawn By;
14. Directional North Arrow;
15. Scale;
16. Unplatted properties: complete boundaries of property description out of which easements are to be taken, including properly identified referenced corners, P.O.B.'s monuments, roads, bearings, distances, etc.;
17. Platted subdivisions: dimensions of lot(s) as well as the lot number(s) and including the subdivisions name and recording information;
18. Easement boundaries, including regulated drain boundaries, including referenced bearings, distances, etc., and identified as in legend.
19. Registered land surveyor seal and signature.

5.08 Drafting Standards

A. General

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

1. All projects submitted having more than two (2) sheets shall have a title sheet which will include:
 - a. General Overall Area Map;
 - b. Vicinity Location Map;
 - c. A Site Plan map Detailing the Project;
 - d. Name/title of Project, including section Number if applicable;
 - e. Owner and Engineer's Name; and

- f. Professional Engineer's Seal and Signature.
- 2. All plan and profile sheets are to be certified and dated by a professional engineer of the State of Michigan.
- 3. All sheets are to be numbered, with total number of sheets included.
- 4. Include detail sheet(s)/specification sheet(s), as applicable.
- 5. Design drawings shall be 24-inch by 36 inch.

B. Scales

The following scales for drawings are required:

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

C. Material

Mylar type drafting film shall be used for all reproduction "originals" to be submitted as record drawings. They shall be of a quality suitable for blueline printing.

D. Plan and Profile Sheets

1. General

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

- h. Match lines shall be easily identifiable.

2. Sewer Profile Drawings

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

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

3. Sanitary Sewer Lift Station Drawings

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

- a. At least two views of the station, plan view and cross section;
- b. Electrical panel detail;
- c. Pump and alarm control elevations;
- d. Inlet and outlet pipe elevations;
- e. Finished grade and foundation elevations;
- f. Special construction required due to unfavorable soil conditions;
- g. Design pump capacity, rated horsepower, total dynamic head, manufacturer and model number;
- h. Sump capacity and cycle time;

- i. Also, the Owner's Engineer shall submit a copy of the head discharge curve and the complete design calculations for the lift station and force main; and
- j. Fence and access drive detail, if required.

4. Water Main Profile Drawings

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

- a. Existing and finished grade lines;
- b. Depth of burial to top of pipe;
- c. Elevations to USGS datum;
- d. Types of materials used;
- e. Profile of existing and proposed utilities; and
- f. Special construction required due to unfavorable soil conditions, jacked and bored casing pipe, etc.

5. Street and Alley Drawings

All street and alley drawings shall include the following, as a minimum:

- a. Location, width, and name of all streets;
- b. Turn angles and distances to nearest established street(s);
- c. Radius and angle of intersection, tangent length, length of curve, P.C.'s and P.T.'s radii, internal angles, points and curvatures, tangent bearings, and lengths of all arcs.
- d. Cross section showing road grade, pavement section, curbs, and gutters;
- e. Plan and profile of all drainage structures;
- f. Types of materials used;
- g. Traffic control details; and
- h. Special construction details.

E. Record Drawings

All plans submitted as record (“as-built”) drawings shall have all pertinent items shown on the plan view and properly scaled. This includes building laterals, manholes, valves, hydrants, inlets, etc. All sheets shall have the phrase “as-built” or “record drawing” boldly printed on them with the date, and shall be stamped and signed by a professional engineer registered in the State of Michigan. Said drawings shall be provided by the Owner upon completion of project. The plans shall be submitted in an electronic format in the latest addition of AutoCad.

SECTION 6 MATERIALS

	<u>Description</u>	<u>Page</u>
6.01	General	6-2
6.02	Gravity Sanitary Sewer	6-2
	A. General	6-2
	B. Sanitary Sewer Pipe Materials	6-2
6.03	Sanitary Sewer Force Mains	6-3
	A. General	6-3
	B. Air/Vacuum Relief Valves	6-3
	C. Force Main Materials	6-3
6.04	Building Services/Service Laterals	6-4
6.05	Sanitary Sewer Manholes	6-4
	A. General	6-4
	B. Types of Manholes	6-5
	C. Precast Manholes	6-5
	D. Manhole Steps	6-5
	E. Manhole Bases	6-5
	F. Adjusting Rings	6-6
	G. Sewer Pipe to Manhole Connections	6-6
	H. Castings	6-7
6.06	Storm Sewers	6-7
	A. General	6-7
	B. Material	6-7
	C. Material Standard References	6-7
6.07	Storm Manholes	6-8
6.08	Storm Inlets and Catch Basins	6-8
	A. General	6-8
	B. Materials	6-8
6.09	Pipe End Sections	6-9
	A. General	6-9
6.10	Water Mains	6-9
	A. General	6-9
	B. Water Main Materials	6-9

C.	Fittings	6-9
6.11	Gate Valves and Appurtenances	6-10
A.	Gate Valves	6-10
B.	Valve Boxes	6-10
C.	Valve Stem Extensions	6-10
D.	Butterfly Valves.....	6-11
6.12	Fire Hydrants and Flushing Hydrants	6-12
A.	Fire Hydrants	6-12
B.	Flushing Hydrants	6-13
6.13	Service Connections	6-13
A.	Service Saddles	6-13
B.	Corporation Stops	6-13
C.	Service Lines	6-14
D.	Curb Stops and Curb Boxes	6-14
E.	Metered Service Installations	6-14
6.14	Pavement Materials	6-15
A.	General	6-15
B.	Concrete Pavement	6-15
C.	Bituminous Pavement	6-15
D.	Subbase	6-15

SECTION 6

MATERIALS

6.01 General

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

6.02 Gravity Sanitary Sewer

A. General

The following materials are acceptable for gravity sanitary sewers:

- Ductile Iron Pipe (DIP)
- Polyvinyl Chloride Pipe (PVC)

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

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

B. Sanitary Sewer Pipe Materials

1. Ductile Iron Pipe (DIP)

All ductile iron pipe shall conform to the ANSI A21.51 and AWWA C 151, latest revisions. Ductile iron pipe shall be Class 350 for 8" through 12". For 14" through 18" Class shall be 250.

2. Polyvinyl Chloride Pipe (PVC)

a. Smooth Wall PVC

All PVC pipe 15 inches or less in diameter shall meet the requirements of ASTM Designation D3034. All PVC pipe greater than 15 inches in diameter shall meet or exceed the requirement of ASTM F679. For diameters 15 inches or less, the pipe shall have a minimum cell classification of 12454-B and for diameters greater than 15 inches, the pipe shall have a minimum cell classification of

12454-C with all pipe having a minimum tensile strength of 7000 psi as defined in ASTM D 1784

All PVC pipe shall be tested in accordance with Standard Method of Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading, ASTM Designation 2412. Minimum pipe stiffness shall be 46 psi.

6.03 Sanitary Sewer Force Mains

A. General

The following materials are acceptable for sanitary sewer force mains:

- Ductile Iron Pipe
- PVC Pipe (No size greater than 4")

B. Air/Vacuum Relief Valves

The design of sanitary force mains shall preclude the need for air vacuum relief valves. If high points cannot be eliminated an air relief valve shall be installed at each point. Each valve shall be installed in a precast concrete structure.

C. Force Main Materials

This pipe and fittings shall be PVC 1120 pressure pipe made from Class 12454-A or B material and conform with O.D. dimensions of steel pipe (IPS) or cast iron (C.I.) Pressure class and dimensions ratio shall be as follows:

Class 200 – DR 14

Type 2 PVC shall comply with AWWA Standard C 900

All plastic pipe and couplings shall bear identification markings in accordance with section 2.5.2 and 2.5.3 of AWWA C 900, which shall include the National Sanitation Foundation (NSF) seal of approval. In addition, the plain end of each pipe length shall have two (2) rings, one (1) inch apart, painted around the pipe at the proper location to allow field checking of the correct setting depth of the pipe in the bell or coupling.

The Push-On Joint for PVC and joint components shall meet the requirements for ASTM Specification D 3139, Joint for Plastic Pressure Pipe Using Flexible Elastomeric Seals. The joint shall be designed so as to provide for the thermal expansion and contraction experienced with a total temperature change of seventy-five degrees Fahrenheit (75F) in each

joint of pipe. Details of the joint design and assembly shall be in accordance with joint manufacturers standard practice.

Lubricant shall be non-toxic and shall not support the growth of bacteria and shall have no deteriorating effects on the gasket or the pipe. The lubricant containers shall be labeled with the manufacturer's name.

Gaskets shall meet all applicable requirements of ASA Standard A 21.11

Gasket dimensions shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be made of such size and shape as to provide an adequate compressive force against the spigot and socket after assembly to effect a positive seal under all combinations of joint and gasket tolerances. The trade name or trademark, size, mold number, gasket manufacturer's mark, and year of manufacture shall be molded in the rubber on the back of the gaskets.

Gaskets shall be vulcanized natural or vulcanized synthetic rubber. No reclaimed rubber shall be used. When two (2) hardnesses of rubber are included in a gasket, the soft and hard portions shall be integrally molded and joined in a strong vulcanized bond. They shall be free of porous areas, foreign material, and visible defects.

1. Ductile Iron

All provisions of Section 5.02(B)(1) for Ductile Iron pipe for gravity sanitary sewers shall be the minimum criteria for material and specifications of Ductile Iron Force Main. All joints and fittings shall be restrained as shown on the following table:

6.04 Building Services/Service Laterals

Building services shall be SDR 35 PVC pipe conforming to ASTM D 3034. Joints shall be gasket push-on, compression type conforming to ASTM D 3212. Gaskets shall conform to ASTM F 477.

6.05 Sanitary Sewer Manholes

A. General

Location of manholes shall be as required in Section 5.02(D)(1).

B. Type of Manholes

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

C. Precast Manholes

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

All manhole joints shall be tongue and groove and they shall be sealed with an O-ring and joint sealer conforming to Federal Specifications SS-S-00210 and similar to "Kent-Seal NO. 2" as manufactured by Hamilton Kent Manufacturing Co., of Kent, Ohio; "RAM-NEK" as manufactured by the K.T. Snyder Co. of Houston, Texas, or equal. Cracked or damaged barrel joints shall be rejected.

D. Manhole Steps

The steps provided shall be manufactured of reinforced plastic and shall be twelve (12) inches wide and one (1) inch square.

E. Manhole Bases

Manhole bases shall be of cast-in-place monolithic concrete or precast concrete. Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semi-circular in cross section and may be formed directly in the concrete of the manhole base, may be half tile laid in the concrete, or may be constructed by laying the sewer lines continuously through the manhole and break-hardened and neatly trimming the edges. Changes of direction of flow within the manholes shall be made with a smooth curve with as long a radius as possible. The floor of the manhole outside the channels shall be smooth and slope toward the channel not less than one (1) inch per foot.

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

F. Adjusting Rings

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

Rings shall be of a nominal thickness of not less than four (4) inches and not more than twelve (12) inches total of adjusting rings shall be allowed for adjustment of the manhole frame and cover to required elevation.

G. Sewer Pipe to Manhole Connections

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

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

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

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

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

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

H. Castings

Standard manholes shall have a R-1772 frame and self-sealing Type C lid by Neenah Foundry, 1875-3 by East Jordan Iron Works, or approved equal. Material shall be in compliance with ASTM A 48, CL 35B. Each lid shall have 2-inch high letters indicating "Sanitary Sewer". Sealand shall be applied between the casting and the concrete.

Where watertight castings are required, the manholes shall have a R-1916F frame and lid by Neenah Foundry, 1045 HD by East Jordan Iron Works, or approved equal. The frame shall be anchored to through the riser rings (if provided) to the cone section with four (4) galvanized rods.

6.06 Storm Sewers

A. General

The following materials are acceptable for storm sewers:

- Reinforced Concrete Pipe
- Reinforced Concrete Horizontal elliptical Pipe
- Precast Reinforced Concrete Box Sections
- High Density Polyethylene Pipe (HDPE), 12"-18"
- Polyvinyl Chloride Pipe (PVC), 12"-24"

B. Materials

All pipe shall be in conformance to these specifications and all applicable sections of the latest editions of the Michigan Department of Transportation Standard Specifications, American Association of State Highway and Transportation Officials (AASHTO), and American Society for Testing and Materials (ASTM). RCP shall be used at all road crossings. HDPE and PVC pipe shall be used in non-loading areas only with prior approval of the City Engineer.

C. Material Standard References

The following standard shall be used for materials used in the City:
(Note: Corrugated Steel Pipe shall be allowed under commercial and residential driveways only)

Corrugated Aluminized Steel Type 2 Culvert Pipe and Pipe Anchor	MDOTSS
Corrugated Aluminized Steel Type 2 Pipe, Pipe-Arch, or Underdrain.....	MDOTSS

Corrugated Aluminum Alloy Culvert Pipe and	
Pipe-Arches	908.04
Reinforced Concrete Pipe	907.02
.....	ASTM C 76 ASTM C 50
Type PSM SDR-35 PVC Sewer Pipe	907.19
Rubber Gaskets	906.04
Precast Reinforced Concrete Box Sections	907.05
High Density Polyethylene Pipe (HDPE)	AASHTO M294
.....	ASTM F 714 & ASTM F 894
Polyvinyl Chloride Pipe (PVC)	AASHTO M304
.....	ASTM F679

6.07 Storm Manholes

Storm manholes shall be in accordance with Section 6.05 (c), (d), (e), (f). Castings shall be R-1972CVIT by Neenah Foundry, 1875-3 by East Jordan Iron Works, or approved equal. Where more than five castings are required, each shall have 2 inch high letters indicating "Storm Sewer".

6.08 Storm Inlets and Catch Basins

A. General

All standard inlets shall be constructed of reinforced precast concrete sections. Joints between sewer pipe and inlet walls shall be sealed with non-shrink grout.

B. Materials

1. Inlets/Basins

Precast concrete inlets shall be constructed in accordance with ASTM Standard C 478. Adjustment to final grade of inlet castings shall be accomplished by utilizing precast concrete adjusting rings. Adjusting rings where required should be sized to adjust to final grade by using a maximum of three (3) adjusting rings. Adjusting rings shall be limited to less than one (1) foot in inlet depth.

All inlet joints, along with the adjusting rings and top casting are to be sealed with ½ inch extrudable gasket (Kent Seal, or equal) to produce soil-tight joint.

Precast box inlets shall be constructed in accordance with Michigan Department of Transportation (MDOT) Standard Specifications.

2. Castings

Inlet castings shall be Neenah Type R-3501-L1A, or equal for rolled curbs.

Inlet castings for vertical curb shall be Neenah Type R-3010, or equal.

Inlet casting for round catch basins shall be Neenah Type R-2502, or equal.

Manhole castings shall be Neenah Type R-1772

6.09 Pipe End Sections

A. General

Pipe end treatment shall be either precast concrete with end footings, or prefabricated galvanized steel.

6.10 Water Mains

A. General

The following materials are acceptable for water mains:

- Ductile Iron Pipe (DIP)
- HDPE Pipe (Prior Approval Required)

B. Water Main Materials

1. Ductile Iron Pipe (DIP) Water Main

Ductile iron pipe shall conform to the requirements of AWWA/ANSI Standard C151/A21.51, D.I. Pressure Class 350 for 4" through 12" and Class 250 for 14" and 16" with push-on joints. The pipe shall be cement lined in accordance with AWWA Standard C104. Cement lining shall be a standard thickness and have a bituminous seal coating. Fittings shall be mechanical joint and shall comply with ANSI A21.10 and AWWA C110. Fittings shall be lined as required for iron pipe. The radius and curvature of all bends, tees, and crosses shall be in accordance with AWWA Specification C110 and ASNI A21.10.

C. Fittings

Fittings shall have joints as specified below.

All fittings of 22 ½ degree bends and greater including tees shall be properly anchored by a restrained joint system such as field lock gasket(6" thru 12"), "TR FLEX" restrained joint pipe and fittings(U.S. Pipe), etc.. "Megalug" may be used if approved by the City Engineer.

6.11 Gate Valves, Butterfly Valves and Appurtenances

A. Gate Valves(6" thru 12")

Valves shall be designed for a water working pressure of not less than 200 pounds per square inch. Valves shall conform to the latest revision of American Water Works Association Standard C-509 covering resilient seat gate valves.

Valves shall have mechanical joint ends as required for the piping in which they are installed. Gate valves shall have a clear waterway free of pockets, cavities, and depressions and shall accept full size tapping cutters.

The wedge shall be of cast iron completely encapsulated with urethane rubber. The urethane sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests of rubber metal bond ASTM D429.

Valves shall be non-rising stem. Stems shall be cast bronze with integral collars in full compliance with AWWA. The stem stuffing box shall be o-ring seal type with two rings located above the trust collar. The two rings shall be replaceable with valve fully open and subject to full rated working pressure.

The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior. Each valve shall have Maker's name, Pressure rating, and year in which manufactured cast on the body. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to requirement of both AWWA and 400 PSI ULFM requirements.

B. Valve Boxes

Valve boxes shall be of cast iron, complete with pavement rings, as applicable, and covers. Cast iron boxes shall be of extension type with screw or slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16". The word "WATER" shall be cast in the cover. Boxes shall be installed over each outside gate valve unless otherwise shown on the drawings. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve location.

C. Valve Stem Extensions

Extension rods less than six feet (6') in length shall be made of at least Schedule 80 steel pipe. Extension rods six feet (6') in length or more shall be made of solid

steel pipe. All steel shall be of the highest quality capable of operating the valve under severe conditions without permanent distortion. The operation nut connector shall fit the operating nut closely, shall provide four (4) faces to the operating nut, shall be made of the same type of steel as the extension rod, shall be of welded manufacture, and shall be welded to the extension rod. An extension centering disk shall be located on the stem extension close to the top. An operating nut of the same steel as the extension rod and of the same size and shape as the valves operating nut shall be placed on the end of the stem extension. The operating nut on the stem extension shall be of welded manufacture and welded to the extension rod. The entire unit shall be painted immediately after manufacture and shall be free of rust or other defects.

D. Butterfly Valves for Water Service(16" and larger)

Butterfly valves shall be of the rubber-seated, tight-closing type. Butterfly valves and all accessories, including operators, shall meet the requirements of AWWA C504, except as otherwise specified. Valve bodies shall be short-body flanged type, faced and drilled to the 125-lb. ANSI Standard, as indicated on the Plans.

Short-body flanged valves shall be Pratt Model 2FII, Keystone Figure 504, or equivalent.

Butterfly valve pressure classes shall be not less than Class 150B.

Valves shall be constructed of materials resistant to corrosion for the required service. Valve materials shall be as specified below or as required for the service:

1. Valve bodies:
Cast Iron ASTM A 126, Class B
 ASTM A 48, Class 40
2. Valve shafts: ASTM A 276, Type 304, stainless steel
3. Valve discs:
Flanged Body Ductile iron w/316 Stainless Steel edge
4. Seats:
Flanged Body Synthetic Rubber

If stub shafts are furnished, the shafts shall extend a minimum of 1-1/2 diameters into the discs and the clearance between the shaft and discs shall not exceed the following:

<u>Shaft Diameter (Inches)</u>	<u>Maximum Radial Clearance (Inches)</u>
1/2 to 1-1/2	0.002
2 to 4	0.0025
5	0.003
6	0.004

The valve seat may be on the disc or on the body. Seats shall be mounted securely for complete immobility under all operating conditions. Seats shall be field replaceable.

The operator shall be considered an integral part of the valve. Manual operators shall be of the enclosed, handwheel worm-gear type, as shown, specified, or required.

Worm-gear type operators shall include a worm gear and matching drive worm. Bearings shall be provided for each rotating member.

The operator shall be designed to operate the valve with a maximum handwheel pull of 40 pounds. Stop-limiting devices shall be provided to prevent overtravel of the disc in either direction. The operator shall be designed to hold the disc in any position without flutter or wear on the valve or operator. The operator shall be housed in a watertight enclosure and shall be packed with grease or oil-filled.

Valve disc shall rotate 90 degrees from full open to tight shut position.

Each valve shall be equipped with a pointer and scale plate which will indicate the position of the valve disc at all times.

The shaft seal shall be a packing gland with a one-piece cast-iron gland follower; studs and nuts shall be bronze. Packing shall be self-adjusting split V-type. Seals shall be self-compensating and self-adjusting under pressure.

6.12 Fire Hydrants and Flushing Hydrants

A. Fire Hydrants

The fire hydrants shall be 5 ¼ inch (main valve opening) with 6-inch auxiliary valve and connection pipe. The fire hydrants shall have two (2) 2 ½" hose nozzles and one (1) 4 ½" pumper nozzle threaded to meet the requirements of the local fire department. Nozzle caps shall be equipped with chains. All fire hydrants shall be arranged for operation with operating nut of size and shape which is the same as that of the existing fire hydrants, or as approved by the DPW/City Engineer. Pumper nozzle shall have a nominal setting of twenty-two (22) inches above the curb or centerline of road and if necessary, furnish extensions. Hydrant color shall be per the NBWD's request.

Hydrants shall have 6" restrained joint inlets and auxiliary gate valves shall be restrained as well.

The hydrants shall be in accordance with the requirements of the NBWD.

All pipe, fittings, and valves shall conform to the applicable standards. Connecting pipe and gate valves shall be 6" size and shall have a minimum bury of 5-1/2' deep.

B. Flushing Hydrants

New flushing hydrants shall be 2-1/8" size with 3" connection. All working parts of the flushing hydrants shall be brass. Flushing hydrants shall be provided with one (1) 2 1/2" hose nozzle threaded to meet the requirements of the local fire department. Nozzle caps shall be equipped with chains. The flushing hydrant shall be self-draining with non-freeze barrel provided with cast iron top stock. Flushing hydrants shall be in accordance with the requirements of the NBWD.

Flushing hydrants shall have 3" mechanical joint inlets and shall be provided with auxiliary 3" M.J. gate valves with valve box.

Hydrant color shall be per the NBWD's request.

All pipe, fittings, and valves shall conform to the applicable standards. Connecting pipe and gate valves shall be 3" size.

6.13 Service Connections

A. Service Saddles

Service saddles shall be double strap type of all stainless construction with confined "O" ring seal and AWWA thread outlet. Service saddles shall be of a design which will accurately fit pipe (O.D) to provide a positive seal between main and saddle at the rated working pressure of the main. The saddle shall indicate on its face the range of O.D.'s for which it was designed. A positive sealing rubber or neoprene gasket shall be glued within the saddle, preferable with the cast inset of the saddle. The threading in the saddle for the installation of the corporation stop shall be female AWWA thread. All saddles must fit snugly and correctly on the pipe. Saddles for ductile iron pipe shall be of the durable stop type, made of ductile iron, coated with high quality epoxy paint and all other components made of stainless steel.

B. Corporation Stops

Corporation stops shall be brass, designed and manufactured in accordance with AWWA standard specifications C-800 and shall be individually inspected and tested for the leaks at the factory prior to shipment. Corporation stops shall be of a design which will permit use with drilling machines of current design.

Corporation stops shall be ball type furnished with AWWA inlet thread and pack joint outlet for copper pipe as manufactured by Ford Meter Box Co., Mueller Co, or as required by the NBWD/City Engineer.

C. Service Lines

Service lines shall be Type K seamless copper suitable for potable water service meeting the requirements of ASTM B-88. Service for copper tubing shall be tapped into the water main at 45 degrees above horizontal. The copper tubing will then be gently bent to the required elevation.

D. Curb Stops and Curb Boxes

1. Curb Stops

Curb stops shall be of the inverted key type with all parts cast from bronze, as manufacture by Ford Meter Box Co., Mueller Company, or as approved by the NBWD/City Engineer.

2. Curb Boxes

Curb boxes shall be of the telescopic type as manufactured by Ford Meter Box Co., Mueller Company, or as approved by the NBWD/City Engineer.

E. Metered Service Installations

1. Meter Setters

Meter setters shall be copper tube with integral inlet and outlet pack joints for service line. Meter inlet valve shall be brass of the inverted key, angle ball valve type, with "O" ring seal, smooth contour and unobstructed waterway on inlet. It shall have padlock wings, lock cap and seal wire hole. Setter shall be braced between inlet and outlet risers with a structural brass member which shall have a hole at the bottom to accept a ½" steel, brace pipe. Saddle nuts shall be provided for supporting meter. All setters shall be set and maintained in a vertical position.

Setters for meters shall be manufactured by A.Y. McDonald Mfg. Company or as approved by the NBWD/City Engineer.

2. Service Meter Enclosures

a. Enclosures for Meters

Meter enclosures for meter setters shall be twenty (20) inches in inner diameter by forty-eight (48) inches long with an inside flange at the enclosure base for strength and support. Enclosures shall be manufactured from concrete. Nominal wall thickness shall be not less than 2.0 inches. Enclosures shall include two (2) 2 ½" wide slots at the bottom to accommodate service tubing.

b. Covers for Enclosures

Covers shall be cast iron, Wabash Double Lid covers, four (4) inches deep with an 11 ½" diameter lid opening. Lid to have lifter worm lock with standard pentagon bolt. The words "WATER METER" shall be cast in the top of the lid. Covers shall be similar to Ford Meter Box Company, Model No. W3 and 3H for light vehicular traffic areas.

6.14 Pavement Materials

A. General

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

B. Concrete Pavement

All concrete pavement shall be composed of Portland cement concrete, with or without reinforcement as may be specified, constructed on a prepared and compacted base course in close conformance with the MDOT Standard Specifications, Division 6, latest edition. Concrete pavements shall contain air entrainment and be finished with a broom-type finish. Minimum compressive strength shall be 4,000 psi after 28 days.

C. Bituminous Pavement

Bituminous material for wedge and leveling, approaches, base, binder and surface shall be furnished in accordance with MDOT Standard Specifications, as applicable.

Bituminous surface, binder and base courses shall be Hot Asphaltic Concrete. Unless otherwise directed or permitted by the DPW, the materials shall meet the MDOTSS, Section 501.02 and 502 requirements.

Cover aggregate seal coat shall be limestone chips.

Bituminous mixtures for approaches shall meet all the applicable requirements of Sections 501.02 and 502 of the Standard Specifications.

D. Subbase

Subbase material shall meet the requirements of Section 902.06, Dense-Graded Aggregates for Base Coarse, Surface Course, Shoulders, Approaches and Patching, MDOT Standard Specifications For Construction.

SECTION 7 SANITARY LIFT STATIONS

<u>Description</u>	<u>Page</u>
7.01 General	7-1
7.02 General Requirements	7-1
7.03 Operating Conditions	7-2
7.04 Pump Design	7-3
A. Impeller	7-3
B. Pump Volute	7-3
C. Self-Cleaning Front Plate	7-3
D. Mechanical Seals	7-3
E. Shaft and Bearings	7-3
F. Motor and Cable	7-4
G. O-Rings and Fasteners	7-4
7.05 Pump Installation	7-4
7.06 Other Lift Station Work	7-4
7.07 Lift Station Pump Controls	7-5
A. Pump Controller	7-5
B. Float Switches	7-7
C. Disconnect Switch	7-7
7.08 Lift Station Guard Posts	7-7
7.09 Wet Well and Valve Pit	7-7
A. General	7-7
B. Access Hatches	7-8
C. Pipe, Valves and Fittings	7-8
7.10 Station Warranty	7-9

SECTION 7

SANITARY LIFT STATIONS

7.01 General

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

All stations shall be submersible type, including a minimum of two (2) pumps (duplex station) each with a minimum capacity of 100 GPM and a minimum four inch force main. Voltage shall be sufficient for pump horsepower.

If an alternate lift station design is proposed other than the general requirements shown shall be submitted for approval by GRSA/City Engineer.

7.02 General Requirements

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

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

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

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

- E. Any exceptions to this Standard or associated approved Plans shall be submitted in writing and clearly stated. The exceptions must be approved by the City Engineer prior to proceeding with the work.
- F. All components of the lift station that are exposed to weather shall be constructed of material that is resistant to corrosion and will not require surface protection throughout the expected life of the lift station. In general, these materials are stainless steel, aluminum, fiberglass reinforced polyester (FRP) and ultraviolet stabilized. PVC.
- G. All valves and piping coming in contact with sewage or installed in the pump or valve chambers shall be coated as follows:
1. Primer – Aromatic Urethane Zinc-Rich 2.5-3.5 mil
 2. Field Coats – Aliphatic Acrylic Polyurethane 2 coats @ 2.0-4.0 mil per coat.

7.03 Operating Conditions

Prior to installation the Contractor shall submit the following information for each pump to the DPW for review and approval.

- A. Pump Capacity in Gallons Per Minute;
- B. Total Dynamic Head (TDH);
- C. Motor Horsepower;
- D. Motor RPM
- E. Motor Voltage, Phase and Cycle
- F. Make and Model Number; and

G. Pump Curves for the Pumps to be Provided.

7.04 Pump Design

A. Impeller

The Impeller shall be made of erosion-resistant chilled gray cast iron (SJS) or polyamide (SJV) and shall be of the semi-open, double vane (SJS) or vortex (SJV), non-clogging, dynamically balanced design capable of passing a minimum of 3" diameter spherical solids. The impeller shall have a slip fit onto the motor shaft and drive key and shall be fastened to the shaft by a stainless steel bolt.

B. Pump Volute

The pump volute shall be made of gray cast iron with smooth internal surfaces free of rough spots or flashing. The volute shall have a centerline (either vertical or horizontal) discharge.

C. Self-Cleaning Front Plate

The pump shall be equipped with a gray cast iron front plate, mounted to the volute with four (4) stainless steel adjusting screws to permit close tolerance adjustment between the front plate and impeller for maximum pump efficiency. The front plate shall be designed with a wave shaped inlet and an outward spiraling V-shaped groove on the side facing the impeller, to shred and force stringy solids outward from the impeller and through the pump discharge (ABS Model SJS, only).

D. Mechanical Seals

Each pump shall be equipped with a lower mechanical seal having a carbon stationary seal face and a ceramic rotating face. Models 1.5 HP and larger shall have a separate oil changer separating the motor from the pump end. An angle mounted lip seal shall be fitted to the upper section of the oil chamber to seal the motor from the oil chamber.

E. Shaft and Bearings

The pump shaft shall be stainless steel supported by two (2) heavy duty single row ball bearings.

F. Motor and Cable

The pump motor shall be enclosed in a watertight housing of gray cast iron equal to ASTM A48 Class 401. The pump system including the pump, motor and cable shall be approved for use in areas classified as hazardous locations in accordance with the NEC Class 1, Div. 1, Group C and D service as determined and approved by a U.S. nationally recognized laboratory (U.L., F.M., CSA). As required by Factory Mutual (FM) the motor shall be capable of operating in pumped media up to 104 degrees F.

The motor shall have thermal protection and a seal failure warning system. The cable shall be of type SOW-A, SOOW, or MSHA as required. The cable sizing shall conform to NEC, ICEA and CSA specifications. Standard cable length shall be thirty feet.

G. O-Rings and Fasteners

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

7.05 Pump Installation

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

Where the guide rail system is used, the pumps shall automatically connect to discharge connections when lowered into place on a single guide rail system. Requiring no bolts, nuts or fasteners to effect proper sealing. Each system shall consist of not more than one guide rails supported at the top by an upper guide bracket and at the bottom by the discharge connection. The guide rail base shall be equipped with a vertical straightening vane which properly aligns the slot in the pump bracket and centers the pump just prior to final seating. Ease and quick removal of pumps from other than the vertical direction over the center of the pump shall be a requirement of the system.

7.06 Other Lift Station Work

Other work required to provide a complete and satisfactory installation shall include, but not be limited to:

1. Provide precast concrete wet well and valve vault (see Section 7.09)
2. Provide discharge piping as shown on the drawings (see Section 7.09)
3. Mount new disconnect, duplex control panel and light on new stand (see Section 7.07)
4. Provide wiring between utility power pole, new control panel and wet well

5. Provide temporary piping and wiring necessary to maintain existing service during construction activities (if applicable).
6. Provide VFD phase converter if 3 phase power is not available.

7.07 Lift Station Pump Controls

A. Pump Controller

The Contractor shall furnish, install and place in operation a pump controller designed to be utilized with a conventional direct acting float switch. It shall be designed for mounting on a wood utility pole with proper electrical characteristics.

1. Logic Control System

- a. The system consists of a control panel and chassis, connected by a multi-conductor cable. Both are made from corrosion resistant anodized aluminum. All components and terminals are permanently and clearly labeled with photo etched name or graphic symbol.
- b. All logic and alarm circuits are organized on the prewired logic control chassis which is mounted on the sub-panel. Eight (8) long life LED status indicators are provided to indicate pump logic and alarm conditions. The interchangeable interpose relays feature heavy duty epoxy encapsulated coils and 10 Amp 230 VAC rated contacts, for operating motor starter coils, alarm devices and remote annunciators. The pump alternator is a highly reliable electro-mechanical octal based plug-in unit. The lead pump selector is standard equipment.
- c. The chassis shall be electrically protected by two (2) control circuit breakers, one (1) for 120 volts and one (1) for 240 volts. Floats shall be operated on 24 VAC with intrinsically safe relays. A 120 VAC convenience receptacle shall be provided.

2. Logic Control Panel

- a. Logic control panel consists of the following requirements:
 - (1) Hand-Off-Auto selector switches for pumps
 - (2) Pump run pilot lights (green)
 - (3) 24 VAC power on indicator light (yellow)
 - (4) Start lag pump indicator light (yellow)
 - (5) Level alarm indicator light (red)
 - (6) Alarm silence push button
 - (7) Elapsed time indicators to indicate pump run time.

b. Logic Control Chassis

- (1) Square base plug-in relays 3PDT contacts rated at 10 Amp 230 VAC
- (2) LED indicator lights for relay function
- (3) Electromechanical alternator plug-in type
- (4) Power On-Off switch for 120 VAC power
- (5) 15 Amp circuit breaker for 120 VAC power
- (6) 3 Amp circuit breaker for 24 VAC power
- (7) Transformer 120 VAC input, 24 VAC output
- (8) Auto/Manual alternation sequence selector switch
- (9) Duplex receptacle 120 VAC
- (10) Simplex receptacle 120 VAC – convenience outlet
- (11) Three (3) point terminal block for supply power – 120 VA
- (12) Twelve (12) point terminal block for level control inputs
- (13) Twenty (20) point terminal block for all outputs including terminal for visual and audible (or telemetry) alarm, normal dim glow for external alarm light, power monitoring for moisture and temperature sensing also with motor lock out and indicating LED.

c. Sequence of Operations

Logic control sequence of operations is as follows (duplex station):

- 4th Level – High Level Alarm
- 3rd Level – Start Lag Pump
- 2nd Level – Start Lead Pump
- 1st Level – Stop Pumps

d. Motor Controls

- (1) Two (2) heavy duty E frame thermal magnetic circuit breakers with trip test button for short circuit protection
- (2) Two (2) NEMA rated motor starters rated for ten (10) million full-load electrical operations
- (3) Two (2) external reset buttons mounted on hinged dead front.

e. SCADA

The existing system uses Zetron RTU's at each lift station with Motorola or Kenwood radios communicating with a computer running Lookout SCADA software at the control room. Any new equipment must function with this existing setup.

Each lift station shall be configured with a Zetron Remote Terminal Unit (RTU) capable of reporting all aspects of operation to the control room via Motorola or Kenwood spread spectrum radio. The contractor shall furnish, install and configure for use all RTU's and all radios necessary for use. The contractor shall configure the software on the existing computer and the central radio to allow communication with the new RTU's. The contractor shall provide two spare RTU's and one spare radio.

3. Enclosure

The enclosure shall be a NEMA 3R Type 304 stainless steel enclosure with dead front inner door. All hardware shall be stainless steel. Enclosure shall have a NEMA 4X red Lexan alarm light mounted on top of the enclosure. The alarm light house shall have a flasher.

Also included shall be a float condition indicator light and float test switches. A complete control panel shall include UNDERWRITERS LABORATORY approval and shall be furnished with UL label.

The enclosure shall be adequately sized to include the automatic alarm monitor described below. The inner door shall be a cutout to provide viewing the monitor front panel while closed.

B. Float Switches

Provide direct acting type float switches in the number and location shown on the approved plans. The float body shall be a rigidly molded polypropylene shell containing a hermetically sealed mercury switch suspended from a three conductor cable with a heavy PVC sheath. The unit shall be abrasion and corrosion resistant, designed for immersion in domestic sewage. The mercury switch shall be oriented on a weighted cable such that the contacts remain open when the float body is not immersed and closed upon immersion to produce a repeatable and reliable electrical signal to the control panel.

C. Disconnect Switch

A single main fusible or breaker disconnect switch of adequate size to provide power for the pump controller and its related components shall be provided by the Contractor.

The disconnect switch shall be housed in a NEMA 4X stainless steel enclosure with an external operation handle capable of being locked in the ON position.

7.08 Lift Station Guard Posts

Each guard post must be made of a 6" diameter by .432" thick galvanized steel pipe fill with 3000 psi concrete.

Apply to constructed unit, 2 coats of MDOT Standard Highway Yellow.

7.09 Wet Well and Valve Pit

A. General

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

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

The top concrete slab of the pump station and valve pit shall have cast into it a socket for receiving the end of each concrete pipe. The joint shall be made watertight. An access ladder shall be provided with rungs spaced 12 inches on center from top to bottom of the station and shall be of welded steel construction, and hot dipped galvanized after fabrication or aluminum.

Concrete for the foundation and roof slabs shall be made of Grades HE or P1 concrete.

B. Access Hatches

The Contractor shall furnish and install for both the wet well and valve pit aluminum access doors complete with frames, hinged and hasp-equipped covers, upper guide holders, drain hole and cable holder. The frames shall be securely mounted above the pumps. The doors shall be torsion bar loaded for ease of lifting and shall have safety locking handles in the open position. The access doors shall be capable of withstanding a 300 lb. Live load per square foot. The

lift station wet wells are to be provided with two (2) separate access hatches or a two (2) door hatch. The valve pit access hatches are to be single door type.

C. Pipe, Valves and Fittings

The suction and discharge pipe and fittings shall be ductile iron class 150. Inside pipe and fittings shall be flanged. Bell end pipes or fittings with mechanical-joints shall be provided at or near the outside face of the station well. Piping shall be supported independent of the sewage flanges. All inside plug valves shall be provided with handwheels. All check valves shall be rubber flapper type.

All metal piping other than ductile iron and copper tubing shall be galvanized steel pipe.

7.10 Station Warranty

Station warranty shall be one (1) year from the date of acceptance per City maintenance bond requirements.

SECTION 8 INSTALLATION/CONSTRUCTION

<u>Description</u>	<u>Page</u>
8.01 General	8- 2
8.02 Excavation	8- 2
A. Dewatering and Control of Surface Water	8- 2
B. Excavation	8- 2
8.03 Bedding and Backfill	8- 6
A. General	8- 6
B. Backfill Materials	8- 6
C. Backfill of Trench Excavations for Pipes and Conduits	8- 7
D. Bedding	8- 7
E. Backfill Above Pipe	8- 8
F. Temporary Surfaces Subject to Traffic	8- 9
G. Maintaining Trench Surfaces	8- 9
8.04 Laying of Sewers	8- 10
A. General	8- 10
B. Rigid Conduit Installation	8- 10
C. Flexible Conduit Installation	8- 11
8.05 Laying of PVC Force Mains	8- 13
A. Installation of Buried PVC Pipe	8- 13
B. Fittings	8- 13
8.06 Structure Installation	8- 13
8.07 Water Main Installation	8- 14
A. General	8- 14
B. Depth of Cover for Water Mains	8- 14
C. Ductile Iron Pipe Water Main Installation	8- 15
8.08 Gate Valve and Valve Box Installation	8- 17
A. Installation	8- 17
B. Testing	8- 17
8.09 Hydrant Installation	8- 18
8.10 Service Meter Enclosure Installation	8- 18

8.11	Pavement Installation	8- 18
	A. Subgrades	8- 18
	B. Concrete Pavement	8- 19
	C. Bituminous Pavement	8- 19
	D. Subbase	8- 19
	E. Traffic Control	8- 19

SECTION 8

INSTALLATION/CONSTRUCTION

8.01 General

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

8.02 Excavation

A. Dewatering and Control of Surface Water

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

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

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

B. Excavation

1. Clearing

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

2. Pavement Cutting

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

3. Protection of Existing Improvements

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

4. Protection of Trees and Shrubs

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

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

5. Maintenance of Public Travel

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

All traffic control shall be in accordance with the latest edition of the MUTCD.

6. Utility Interruption

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

The Contractor shall take all reasonable precautions against damage to existing utilities. However, in the event of a break in an existing water main, gas main, sewer or underground cable, he shall immediately notify the responsible official of the organization operating the utility interrupted. The Contractor shall lend all possible assistance in restoring services and shall assume all costs, charges, or claims connected with the interruption and repair of such services.

7. Open Cut Excavation

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

a. Trench Dimensions

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

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

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

b. Excavations With Sloping Sides, Limited

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

- (1) In general, only braces and vertical trenches will be permitted in traveled streets, alleys, narrow easements and for pit excavations more than 10 feet deep.
- (2) Where pipe line trenches with sloping sides are permitted the slopes shall not extend below the top of the pipe, and trench excavations below this point shall be made with near-vertical sides with widths not exceeding those specified herein before.
- (3) Slopes shall conform to all OSHA regulations.

8. Earth Excavation

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

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

9. Boring and Jacking

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

- a. Backstop: The backstop shall be of sufficient strength and positioned to support the thrust of the boring equipment without incurring any vertical or horizontal displacement during such boring operations.

- b. Guide Rails: The guide rails for the boring equipment may be of either timber or steel. They shall be laid accurately to line and grade and maintained in this position until completion of the boring operations.
- c. Casing Pipe: Steel casing pipe shall be new, conform to ASTM A139 and shall be of the size (diameter) sufficient to install and support the carrier pipe. The lengths of pipe shall be welded as they are installed where lengths of casing pipe are joined during the boring operations, care shall be taken to insure that the proper line and grade is maintained.

The minimum wall thickness for casing pipes under highways, railroads and streams shall be 0.50 inches. Steel shall be grade B under railroads and Grade A at all other locations. Stream crossing shall be a minimum of 3 feet from the stream bottom (as defined by the regulating agency) and the top of the casing pipe.

8.03 Bedding and Backfill

A. General

All trenches or excavations shall be backfilled to the original surface of the ground or such other grades as required or directed. In general the backfilling shall be carried along as speedily as possible in order to avoid open excavations.

B. Backfill Materials

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

- Class I - Angular, 6 to 40 mm (1/4 to 1 1/2 inch), graded stone such as crushed stone.
- Class II - Coarse sands and gravel with maximum particle size of 40 mm (1 1/2 inch), including various grades of sands and gravel containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.
- Class III - Fine sand and clayey gravel including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.

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

C. Backfill of Trench Excavations for Pipes and Conduits

Bedding and Backfill material samples shall be submitted to the City Engineer and DPW prior to start of construction

D. Bedding

1. Rigid Pipe and Conduit Bedding

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

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

2. Flexible and Semirigid Conduit Bedding

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

All flexible and semirigid pipe shall be laid to the lines and grades unless otherwise directed by the City Engineer. All flexible and semirigid

conduit shall be bedded in compacted Class I or Class II material, placed on a flat trench bottom. The bedding shall have a minimum 4" thickness or one-fourth (1/4) the outside pipe diameter below the pipe and shall extend to twelve (12) inches above the top of the pipe level the full width of the trench. All material shall be placed in the trench in a maximum of six (6) inch layers (before compaction). Each layer, shall be leveled and evenly distributed on both sides of the pipe so as not to disturb, displace or damage the pipe and shall be adequately compacted. When Class I materials are used compaction may be accomplished by hand or mechanical tamping or by "walking" the material in. When Class II materials are used compaction shall be accomplished only by hand or mechanical tamping to a minimum of eighty-five percent (85%) Standard Proctor Density.

E. Backfill Above Pipe

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

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

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

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

The trench between a level of twelve (12) inches above the top of the pipe and the surface, which are located in areas subject to or possible subject to vehicular traffic shall be backfilled with Class I or II materials, deposited in uniform horizontal layers of two (2) feet +/- six (6) inches. Each layer shall be thoroughly compacted by mechanical tamping utilizing a crane mounted hydraulic vibratory compactors. Each layer shall be thoroughly

compacted before the next succeeding layer is placed. This procedure shall be followed where trench walls remain stable during compaction. If in the opinion of the City Engineer and DPW, and/or their representative (inspector), the trench walls become unstable during compaction, then the City Engineer, DPW, and/or the representative (inspector) may authorize the contractor to push from the back of the trench the class I or II material into the trench the full depth, not to exceed twenty (20) lineal feet horizontally along the trench bottom and compact using the vibratory compactor in two (2) foot diagonals lifts.

The crane mounted vibratory compactors shall be capable of producing 1900 cycles per minute and have a compaction plate with the minimum dimensions of twenty-three by thirty-one (23 x 31) inches. The compactor shall be similar to those manufactured by Allied, Ho-Pac, or equal.

When Class I or II materials do not contain sufficient moisture to obtain proper compaction, in the opinion of the City Engineer, and/or the City's representative, it shall be moistened or wetted as directed by this City Engineer, and/or the City's representative.

F. Temporary Surfaces Subject to Traffic

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

G. Maintaining Trench Surfaces

All surface settlement of the backfill along trenches located beneath streets, roads, alleys, driveways and parking lots which are subject to traffic shall be kept filled level with or slightly above the original paved surface at all times with compacted aggregate base material until the permanent pavement is satisfactorily restored. When temporary asphalt pavement is used, depressions and "pot holes" shall be promptly filled with the temporary asphalt material. Special attentions shall be given by the Contractor to the timely and proper maintenance, leveling and grading of the surface of all backfilled trenches. Especially those subject to traffic and especially following rains. The surface of streets, roads and alleys shall be maintained smooth and free of ruts and water trapping depressions by periodic power blading, scarifying; and/or filling settle areas, ruts, pockets, or holes with compacted aggregate base material or temporary asphalt where used.

As a dust preventive, the Contractor shall apply, calcium chloride over the surface of the compacted aggregate base in such amounts and at such times as are necessary to avoid or eliminate dust complaints from nearby residents. In the event of any question regarding the existence or nonexistence of a dust nuisance,

the City Engineer's decision on the matter will govern. The material used shall be Regular Flake Calcium Chloride having a minimum chemical content of Calcium Chloride of seventy-seven percent (77%). Unless otherwise specified or ordered by the City Engineer and DPW, the rate of application shall be one and one half (1 ½) pounds per square yard of surface covered.

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

8.04 Laying of Sewers

A. General

This section on Laying of Sewers shall be divided into two (2) classifications – rigid and nonrigid conduit. Pipe materials such as concrete, steel, PVC, and ductile iron pipe are considered rigid conduits. Thermoplastic (PVC) shall be considered nonrigid or flexible conduits.

B. Rigid conduit Installation

All rigid conduit for sewer pipe shall be laid to the lines and grades, unless otherwise directed by the City Engineer and DPW. All rigid pipe shall be laid in accordance with the details for the First Class Pipe Laying Method. This First Class Pipe Laying Method may be achieved by Class B bedding methods as shown in the ASCE Manual of Practice No. 37, latest edition. Under this Class B bedding Method, the pipe shall be bedded in compacted granular material (Class I or Class II) placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth (1/4) the outside diameter below the pipe and shall extend halfway up the pipe barrel at the sides. All granular bedding material shall be placed in the trench in approximately six (6) inch layers. Compaction shall be accomplished by hand or mechanical tamping or by "walking" the granular material in. From the halfway point on the pipe (Springline) to a point twelve (12) inches above the top of the pipe, backfilling methods A or B or C shall be used depending on the trench location. In addition, all rigid conduit shall be installed in accordance with "Standard Recommended Practice for Installing Vitrified Clay Sewer Pipe" (ASTM Designation C 12 and ASTM D2321).

The laying of pipe in finished trenches shall be commenced at the lowest point, proceeding upstream, with the spigot ends pointing the direction of flow.

No blocking under pipes will be permitted, except as approved by the City Engineer or DPW for pipe to be encased in concrete or laid in concrete cradles.

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

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

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

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

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

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

C. Flexible Conduit Installation

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

Flexible conduit for sewer pipe shall be installed in accordance with "Underground Installation of Flexible Thermoplastic Sewer Pipe" ASTM Designation C2321.

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

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

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

The First Class Pipe Laying Method for Flexible conduit may be achieved by Class B Bedding Methods as shown in the ASCE Manual of Practice No. 37, latest edition. Under this class B Bedding Method, the pipe shall be bedded in compacted granular material (Class I or II) placed on a flat trench bottom. The bedding shall have a minimum thickness of one-fourth (1/4) the outside pipe diameter below the pipe and shall extend twelve (12) inches above the top of the pipe level and full width of the trench. All granular bedding material shall be placed in the trench in approximately six (6) inch layers.

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

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

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

8.05 Laying of PVC Force Mains

A. Installation of Buried PVC Pipe

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

PVC pipe shall generally be installed to conform with laying conditions F as defined by ANSI A 21.1 and conform with the backfilling and trench maintenance requirements as specified under these specifications.

Plastic pipe shall be firmly bedded in Class II or Class II materials and the bedding thoroughly compacted. Bedding shall be carefully formed by hand to provide complete support of full length of pipe barrel and shall extend to a point 12 inches above the top of pipe. Bell holes shall be formed as necessary. No gravel or stones larger than three sixteenths (3/16) inch shall be permitted within three (3) inches of outer surface of pressurized plastic pipe. Plastic pipe fittings shall be blocked as required. Backfill above the bedding zone shall be as required.

Pipe and Fittings shall be carefully inspected before being installed. Cracked, broken, bent or otherwise defective pipe shall not be used in work. Exposure to sunlight will be avoided where possible.

Jointing of PVC pipe shall be performed in the ditch, in accordance with recommendations of manufacturer.

Where metal harnesses for thrust protection are necessary, only cast iron fittings with slotted hydrant lugs, specially made for use with plastic pipe shall be used.

B. Fittings

All fittings of 22½ degree bends and greater, including tees shall be properly anchored by concrete thrust blocks of sufficient size not to exceed a soil pressure of two (2) tons per square foot. This blocking shall be installed prior to backfilling and testing.

8.06 Structure Installation

All manholes, inlets and catch basins shall be installed on a minimum of 6" No. 22A base. This material shall be compacted.

8.07 Water Main Installation

A. General

In general, installation of buried water mains shall conform to the requirements of the manufacturer, the AWWA Standard for the type of pipe being installed, or as specifically indicated on the plans or specified herein.

Normal laying depth for all pipe shall be 60 inches from the grade to top of pipe. Where rock is encountered on the trench bottom at the normal laying depth, the pipe shall be protected by a 5-inch layer of stone bedding between the pipe and the rock surface. Where rock is encountered above the trench bottom elevation that would provide the normal laying depth, the rock shall be excavated to a depth such that the pipe will have a minimum of 36" of cover at its centerline and 5 inches of stone bedding below it.

Finished subgrade of trench shall be prepared accurately by means of hand tools. Bell holes shall be provided at each joint and pipe laid on undisturbed or thoroughly compacted subgrade. Any other excavation within a length of pipe shall be filled with an approved material and thoroughly compacted in not more than 3-inch layers.

Extreme care shall be taken in handling pipe to prevent damage. Pipe, fittings and valves shall not be dropped to ground or into trench; they shall be carefully lowered, piece by piece, using crane, backhoe, or other approved lifting device.

During cold weather, valves and hydrants shall not be stored where trapped moisture can freeze and damage fittings.

As individual pieces of pipe are lowered into trench, each shall be carefully inspected for defects. Defective, damaged or unsound pipe shall be rejected.

Where water is encountered in trench, Contractor shall furnish and operate suitable pumping equipment of capacity adequate to dewater trench, dispose of such water, and maintain drainage conditions, as approved by the NBWD/City Engineer. It is essential that discharge of trench dewatering pumps be conducted to natural drainage channels, drains or storm sewer. No pipe shall be laid in any water without the NBWD/City Engineer's approval.

Mains shall be laid and maintained to the indicated lines with fittings, valves and hydrants at required locations. All valve and hydrant stems shall be set plumb.

B. Depth of Cover for Water Mains

All water mains shall be constructed with a nominal earth cover of sixty (60) inches over the top of the pipe except as follows:

1. For purpose of avoiding direct interference with existing structure or utilities, the Engineer may authorize decreased depth of cover.
2. For purpose of making grade changes within tolerable limits, the depth may be increased.
3. Where the water main is to be constructed across, and under a stream, ditch or highway culvert. The minimum cover between the top of the pipe and the bottom of the stream, ditch or culvert shall be sixty (60) inches, unless otherwise noted or approved.
4. Unless otherwise shown on the plans or permitted by the NBWD or City Engineer, the new mains shall cross beneath the existing mains, except in cases where the specified cover can be maintained by crossing above the existing mains.
5. Where connections to existing mains dictates changes in the required depth of cover.

C. Ductile Iron Pipe Water Main Installation

The pipes shall be laid and maintained to the required lines and grades with fittings, valves and hydrants stems plumb.

Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plan is required, the NBWD/City Engineer shall have the authority to change the locations from the shown line and grade.

The excavations for construction of pipe lines shall be of sufficient width, and only of sufficient width to permit the work to be constructed in a workmanlike manner. Working space shall be provided in all pipe trenches to allow room all around for the proper making of joints and the drainage of water, if necessary. Sheeting shall be used where necessary to protect curb, walk, trees, and other utility lines. Except as otherwise specified, the excavations work for the pipes, valves and hydrants shall be performed in accordance with these Standards.

Bell holes shall be provided at each joint to permit the jointing to be made properly. The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of eighteen (18) inches near the middle of each length of pipe by the withdrawal of

pipe slings or other lifting tackle. Any part of the bottom of the trench excavated below the specified grade shall be corrected by filling with approved material, thoroughly compacted in three (3) inch layers. The finished subgrade shall be prepared accurately by means of hand tools. No blocking under pipes will be permitted except as approved by the City Engineer under special conditions.

Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, all types of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material which in the judgment of the City Engineer shall be removed the Contractor shall excavate, remove and satisfactorily dispose of such unsuitable material to the width and depth ordered by the Engineer. Before the pipe is laid, the subgrade shall then be made by backfilling with approved Class I or Class II material as defined in these Standards. The fill material shall then be thoroughly compacted by means of hand or mechanical tamping to a minimum 85% Standard Proctor Density.

In event of rock excavation or where ledge rock, boulders and large stones, or hard pan, shale or cemented gravel, are encountered in the bottom of the trench, then said materials shall be removed to provide a clearance of at least six (6) inches below and on each side of all pipe, valves and fittings. The space between the rock or other hard trench bottom and the pipe shall be filled with Class I or II material and hand or mechanically tamped as explained above.

Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient protection of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench piece by piece by derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped or dumped in to the trench. Before lowering and while suspended, the pipe shall be inspected for defects. Any defective, damaged or unsound pipe shall be rejected. All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench, and shall be kept clean by approved means during and after laying.

The spigot shall be centered in the bell, and the pipe brought into true alignment and secured there with earth carefully tamped on each side, excepting at the bell holes. Care should be taken to prevent dirt from entering the joint space. At times where pipe laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.

Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise directed, pipe shall be laid with bell ends facing in the direction of laying for lines on an appreciable slope, bells shall face upgrade. Wherever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid

obstructions, to plumb stems, or for other reasons, the degree of deflections shall be within permissible limitations as defined by the manufacturer.

No pipe shall be laid in water, or when the trench conditions or the weather is unsuitable for such work.

All plugs, caps, tees and bends shall be provided with thrust blocking or reaction backing of adequate strength (as approved by the NBWD/City Engineer) to prevent movement and shall consist of Class B concrete fill between the pipe and solid undisturbed ground. The backing shall be so placed that the pipe and fitting joints will be accessible for repair. Metal harness of tie rods or clamps of adequate strength to prevent movement may be used instead of concrete backing, as approved by the NBWD/City Engineer in places where satisfactory concrete thrust reaction blocking can not be provided. Steel rods or clamps shall be given a heavy paint coating of coal tar and epoxy resins. Gravity anchor blocks of concrete with steel tension tie rods and clamps shall be provided in places where the thrust can not be restrained by normal reaction backing against sufficient undisturbed ground.

All bedding and backfill material shall be placed and compacted in accordance with the applicable portions of these Standards (Section 8.03)

All pipe shall be laid with a nominal earth cover as specified under Section 8.07 (B).

8.08 Gate Valve, Butterfly Valve and Valve Box Installation

A. Installation

Valves and valve boxes shall be installed per the manufacturer's recommendations.

If stem extensions are required, the stem extensions shall sit solidly on the valve operating nut and shall turn freely. The extension shall be bolted to the valve operating nut in a manner such that the bolt prohibits the extension from being pulled off of the operating nut but does not transmit any force from the extension to the operating nut during operation of the valve, thus prohibiting the bolt from shearing.

The extension must be of such a length that the nut on the extension shall be between thirty inches (30") and thirty-six inches (36") below the finished grade.

B. Testing

Each valve stem extension shall be tested by closing the valve, reducing the pressure on one (1) side of the valve to zero (0), then opening the valve with the

use of the extensions. Any permanent distortion or damage to the valve stem extension is unacceptable.

8.09 Hydrant Installation

Hydrant barrels shall be constructed in such a manner that it is not necessary to cut off the water or to excavate to make repairs. The barrel of the hydrants shall be constructed in sections, which are to be jointed in such a manner that the upper section of the barrel extending above the ground may be separated from the lower section by impact without injury to the stem or the barrel.

The main valve construction at the bottom of the hydrant shall be such as to permit the water to drain from the hydrant barrel when the main valve is closed. The main valve stem seats and packing glands to be of bronze or approved rust resisting metal to be constructed in such a manner as to be easily replaced without excavating. The main valve facing shall be made of rubber.

Hydrants shall be located in such a manner as to provide complete accessibility, and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. When set in space between the curb and sidewalk or between the sidewalk and property line, no portion of the hydrant or nozzle cap shall be within six (6) inches of the sidewalk, unless approved by NBWD/City Engineer. All hydrants shall stand plumb and shall have their nozzles parallel or at right angles to the curb. They shall conform to the established grade, with nozzles at least twelve (12) inches above the ground.

Hydrants shall be thoroughly cleaned of dirt and other foreign matter before setting, and the bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with stone slabs or concrete backing, or it shall be tied to the pipe with suitable rods and clamps. All hydrants are to be properly supported and braces and surrounded with approximately five (5) cubic feet of washed gravel.

The Contractor shall furnish one (1) hydrant wrench for each project, and shall paint as required by the NBWD/City Engineer.

8.10 Service Meter Enclosure Installation

Enclosure shall be set vertically on a base of clean, washed gravel a minimum of one (1) foot deep and twelve (12) inches beyond outside of enclosure. Backfill shall be tamped in six (6) inch layers all around enclosures in excavated area to maintain stability and prevent settlement. Meter enclosure locations shall be as determined by the Owner/Contractor and approved by the NBWD/City Engineer. Generally, meters shall be placed in lawns as near as possible to be within right-of-way lines.

8.11 Pavement Installation

A. Subgrades

Subgrades for all pavement shall be compacted no less than 95 percent of their maximum density at optimum moisture based on the modified Proctor compaction test (modified AASHTO [1978], Designation T-180, and ASTM [1980], Designation D1557).

B. Concrete Pavement

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

C. Bituminous Pavement

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

D. Subbase

Aggregate subbase shall be furnished, placed and compacted in accordance with MDOT Standard Specifications Sections 301 and 902.

E. Traffic Control

The Contractor shall plan construction activities to minimize impact to traffic. Local traffic access must be maintained at all times. The Contractor shall so schedule his work whenever possible and make suitable provisions for access by local residents, school buses, police, emergency, fire and mail delivery vehicles. The Contractor shall keep fire hydrants and other public utility valves accessible at all times. To maintain traffic movement, appropriate traffic control devices shall be used. Such traffic control devices shall comply with the latest edition of the Michigan Manual on Uniform Traffic Control Devices and Section 103 of the Standard Specifications.

SECTION 9 RESTORATION OF SURFACES

<u>Description</u>	<u>Page</u>
9.01 General	9-1
9.02 Restoration of Paved Surfaces	9-1
A. Restoration	9-1
B. Temporary Surface	9-1
C. Temporary Pavement Replacement	9-1
D. Permanent Paving	9-2
9.03 Restoration of Ground Surfaces	9-4
A. Restoration of Grassed Areas with Sod	9-4
B. Restoration of Grassed areas with Seed and Mulch	9-4

SECTION 9

RESTORATION OF SURFACES

9.01 General

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

9.02 Restoration of Paved Surfaces

A. Restoration

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

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

The joint of the restoration area shall be saw cut to neat lines and the restoration shall be uniform and smooth between the existing and restored surfaces.

B. Temporary Surface

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

C. Temporary Pavement Replacement

Trench surfaces of highly traveled streets and roads shall be, at the direction of City Engineer, required to receive a temporary pavement replacement of cold mixed bituminous pavement. This temporary pavement shall be surfaced mixture

prepared and placed in accordance with Section 503 – Temporary Patching with Bituminous Mixture of the latest edition of the Michigan Department of Transportation Standard Specifications. Prime and tack coats shall not be required. All temporary pavements shall be maintained by the Contractor to proper grade so as not to impede the safe flow of traffic until the permanent pavement replacement is made.

D. Permanent Paving

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

1. Concrete Grades HE, P1 Pavement Repair (MDOTSS, Section 603)

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

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

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

Concrete pavement shall consist of a cast in place layer of concrete with one (1) layer of woven wire fabric (6 x 6 – W1.4 x W1.4) meeting ASTM Designation 497. The concrete layer shall be a minimum six (6) inches thick. All rigid concrete pavement work and materials shall meet the latest specifications of the Michigan Department of Transportation.

2. Asphalt Pavement Repair (MDOTSS, Division 5)

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

Areas subject to asphalt pavement replacement shall have the existing edges (those created by cutting prior to excavation) re-cut in a neat straight manner as to remove irregularities and damaged areas. Manholes, service

line trenches and existing valve areas are to be boxed out in a neat manner. All cuts shall be parallel or perpendicular to the trench. Curved or diagonal cuts shall not be allowed. All chunks of existing materials larger than three by three (3 x 3) inches are to be removed.

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

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

The binder course(s) shall consist of compacted Hot Asphaltic Concrete, as defined by the latest edition of the Michigan Department of Transportation Standard Specifications. Compaction shall be accomplished with suitable smooth wheel rollers. Generally, conventional self-propelled rollers of not less than 10 tons gross weight shall be used. The GRSA Engineer may allow other specialized rollers for narrow trenches or light rollers with vibratory action. The City Engineer shall consider alternate equipment only if Contractor requests same in writing and includes technical data on the specific equipment to be considered.

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

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

The surface source shall consist of compacted Hot Asphaltic Concrete Surface, as defined by the latest edition of the Michigan Department of Transportation Specifications and placed in the same manner as described for binder. The surface thickness shall match the existing pavement but not less than one (1 1/2") inch.

Testing for Pavement Materials shall be as required in 11.06, Testing of Pavement Materials.

3. Adjustments of Shoulders Necessitated by Resurfacing

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

9.03 Restoration of Ground Surfaces

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

A. Restoration of Grassed Areas with sod

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

B. Restoration of Grassed Areas with Seed and Mulch

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

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

The mixture of seed applied shall be as follows:

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

The seed shall be applied at a rate of four (4) pounds per one thousand (1,000) square feet and shall be well raked or boarded into the soil and

mulched with straw of sufficient thickness to hold the seed until it has germinated.

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

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

SECTION 10 EROSION CONTROL

<u>Description</u>	<u>Page</u>
10.01 General	10- 1
10.02 Permitting Requirements	10- 1
10.03 Design Guidelines	10- 1
10.04 Fee Schedule	10- 3

SECTION 10

EROSION CONTROL

10.01 General

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

In addition, the contractor must also comply with Michigan Administrative Act 451 (1994) for land alteration which disturbs 5 acres or more.

10.02 Permitting Requirements

If the Owner/Contractor is required to submit a soil erosion control plan under Michigan Administrative Act 451 (1994), such plan shall be deemed in compliance with DPW requirements. In this case all applicable State and Federal permits or notices for land disturbing activities shall be obtained or filed prior to beginning land-disturbing activities. Copies of all applications, letter of intent, submittals, plans and other erosion and sediment control related information shall be submitted to the DPW, City Engineer and City Enforcing Officer.

10.03 Design Guidelines

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

- A. Existing site contours should be followed as close as reasonable possible in order to minimize cut and fill.
- B. Existing natural vegetation should remain undisturbed for as long as possible during the construction activities. Naturally vegetated areas along property lines, jurisdictional wetlands, lakes, and watercourses, both natural and man-made, should be left undisturbed during all phases of the site construction. These vegetative filter strips will be required at the discretion of the DPW.
- C. A logical sequencing of site construction activities must be provided in order to minimize the size and exposed land area, and the length of time land areas are left without some form of temporary or permanent soil protection.

- D. Soil stockpiles shall be stabilized utilizing either vegetative establishment, sediment trapping barriers, or erosion control measures such as tarping or mulching, singly or in combination.
- E. Storm sewer inlets which are made operable either before or during the construction phase of development shall be provided with protection from siltation.
- F. Stable, properly maintained construction traffic access routes and stream crossing shall be identified on the site erosion and sediment control plan as needed. These construction access routes shall be installed as part of the site perimeter sediment control barriers, prior to the initiation of on-site land alteration activities. Where sediment is transported onto public street or road surfaces, these streets or roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed by either scraping, shoveling or sweeping and be transported to a controlled area. Street washing will be allowed only if wash water flows to a controlled sediment trapping area.
- G. Runoff velocities shall be kept as low as possible.
- H. A thorough maintenance and follow-up program, and identification of the person(s) responsible for its implementation will be required.

The latest edition of the Michigan Handbook for Erosion Control in Developing Areas shall be used for detailed technical guidance for all erosion and sediment control practices. The following general practice guidance applies to the development of all control plans:

- A. Perimeter Control – Perimeter control measures shall be installed as specified on the approved plan, including: construction access drives, straw bale dams and fabric fencing, temporary sediment traps, sediment basins, and diversions.
- B. Vegetative Control – Disturbed areas which are at finished grade shall be permanent seeded within seven (7) days. At the discretion of the DPW; barren areas to be rough graded and left undisturbed for more than thirty (30) days shall be established with temporary vegetation; and dormant seeding will be required during seasonal periods (October through February) for those barren areas to be left undisturbed for one hundred and twenty (120) days or longer.
- C. Slope Protection – Slope protection shall be provided by use of temporary and permanent diversions levees, vegetative cover, and slope drains. Concentrated storm water flows shall not be allowed to flow down cut or fill slopes without proper slope stabilization.

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

The designer should rely on the Michigan Handbook for Erosion Control in Developing areas for detailed design, construction and maintenance criteria for all erosion control practices. Such criteria shall be required by the DPW unless waived in writing. The manual can be obtained from:

ADDRESS OF PLACE TO GET MANUAL.....

Michigan Department of Environmental Quality
Land and Water Management Division
P.O. Box 30204
Lansing, MI 48909
(517)335-3178

10.04 Fee Schedule

The following fee schedule is required for a City soil erosion permit:

<u>Project Cost</u>	<u>Fee</u>
\$ 0 – 10,000	\$ 30.00
10,001 – 25,000	90.00
25,001 – 50,000	180.00
50,001 – 75,000	270.00
75,001 and higher	360.00

SECTION 11

INSPECTION, TESTING AND ACCEPTANCE

<u>Description</u>	<u>Page</u>
11.01 General	11- 1
11.02 Inspection	11- 1
A. Estimated Cost	11- 1
B. General Requirements	11- 2
11.03 Sewer System Testing	11- 2
A. Leakage Testing	11- 2
B. Deflection Testing of Installed Flexible Plastic Pipe ...	11- 6
C. Sanitary Manhole Testing	11- 6
D. Storm Sewer Testing	11- 8
E. Force Main Testing	11- 8
F. Lift Station Pump Testing	11- 9
G. Lateral Location Forms	11-11
11.04 Water Main Testing and Disinfection	11-11
A. General	11-11
B. Pressurization	11-11
C. Leakage Test	11-12
D. Acceptance	11-12
E. Chlorination of Water Mains	11-12
11.05 Fire Hydrant Testing	11-15
11.06 Testing of Pavement Materials	11-15
A. Subgrade Testing	11-15
B. Pavement Materials Testing	11-16
11.07 Documentation, Dedication & Acceptance Procedures	11-16
A. Documentation Requirements	11-16
B. Dedication	11-17
C. Acceptance	11-17

SECTION 11

INSPECTION, TESTING AND ACCEPTANCE

11.01 General

This section describes the minimum requirement and general procedures for the Inspection, testing and acceptance of systems dedicated to the City of New Buffalo, Michigan.

Connection Permits for utility service will not be issued until all the requirements of this section are fulfilled.

11.02 Inspection

Inspection of the construction shall occur for the duration of the project, including the installation of service connections. The Owner/Contractor shall execute the Agreement with the City for such services.

A. Estimated Cost

The City or it's representative shall send a letter to the Owner/Contractor stating the estimated manhours and amount of the inspection fee to be paid to the City for services performed by representatives of the DPW. The amount provided in the letter shall be the total estimated cost of the inspection services based upon the estimated payment manhours multiplied by the base hourly rate.

The estimated manhours for sewer and water project shall be based upon the following assumptions:

Average daily production = 250 ft./day
Final inspection + Verification of As-Builts = 8 hours
Inspection Time = 20-30 hrs/week

Where a lift station is required, additional time for the inspection during construction and final start-up shall be added.

Street projects shall be estimated in accordance with the particular requirements of each project.

The fee provided is a pre-construction estimate only. The actual inspection time may vary for project to project and may exceed or be less than the estimate based upon the actual project duration. Inspection time at the site shall be verified by the Owner/Contractor or his representative.

Seventy-five (75) percent of the total estimated cost of inspection services shall be paid prior to start of construction. The remaining cost shall be paid prior to final acceptance by the DPW.

B. General Requirements

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

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

11.03 Sewer System Testing

A. Leakage Testing

1. General

All sanitary sewers shall be tested for infiltration and exfiltration.

Contractor shall furnish all labor, materials and equipment required for making tests. Tests shall be made at times arranged with the DPW and his representative. Sections of sewers shall be isolated and measurements of infiltration and exfiltration shall be made by approved means. The City or his representative must be present during all final tests.

Sewers whose crowns are below ground water level at time of testing shall be tested for infiltration. Where crown of pipe is above ground water level, sewer shall be tested for exfiltration. If ground water level varies

during period of construction, sewers may be tested for both. Spans are not to be tested for Final Acceptance until complete.

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

2. Infiltration Tests

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

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

3. Exfiltration Tests

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

4. Allowable Leakage

Infiltration or exfiltration of any given segment of sewer pipe shall not be permitted to exceed a rate of two hundred (200) gallons per twenty-four (24) hours per mile of sewer per inch of pipe diameter (.158 gph/in./100ft)

5. Low Pressure Air Testing

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

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

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

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

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

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

$$T = \frac{.0850 DK}{Q}$$

Where T = time in seconds

K = .000419 DL but not less than 1.0

Q = Rate of loss (= .003 cfm/sq. ft. of internal surface.)

D = Diameter of pipe in Inches

L = Length of pipe tested in feet.

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

All pipelines thirty (3) inches in diameter and over shall be tested one joint at a time with joint testing apparatus. Joint shall be isolated with an expanding shield equipped with gaskets which fit tightly against pipe walls on each side of joint to be tested. Allowable leakage for such a test is equal to that which would occur on the basis allowable leakage for one length of pipe.

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

6. Excessive Leakage

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

If the second test should again indicate leakage in excess of the allowable amount, the Contractor shall, at his own expense, provide complete internal inspection of entire section in question, by means of videotape recording of television inspection or by color photography with exposures every two (2) to four (4) feet along the sewer. Contractor shall employ an independent sewer testing service to inspect pipe. Inspection service shall prepare a written report and shall review videotape or films with DPW, Contractor, and DPW's representative. Contractor shall then submit a written plan for correction of leakage. Contractor and the City's

representative shall meet as necessary to develop actual program for inspection and repair. Contractor shall not proceed to repair line until he receives written authorization to proceed from City Engineer, or City's representative. All inspections, reports, repair, replacement, and compensation for additional professional expense shall be paid by the Owner/Contractor.

B. Deflection Testing of Installed Flexible Plastic Pipe

1. Final Acceptance Test

Prior to the final deflection test, the City's representative may, at this option, order the lamping of certain or all sections. Lamping must show a "Full moon" and no excessive puddling effects in the span.

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

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

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

C. Sanitary Manhole Testing

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

The vacuum test equipment shall consist of: inflatable plugs for all incoming and outgoing sewer lines; an inflatable test collar to seal the manhole at the manhole frame; and a vacuum pump. A vacuum gauge shall be located in-line between the test collar and the pump to accurately indicate the vacuum in inches of mercury within the manhole. The vacuum gauge shall have a range to no more than thirty

(30) inches of mercury, with scale markings of no greater than one-half (1/2) inch of mercury vacuum and an accuracy to within +/- two percent (2%) of true vacuum.

The vacuum test shall be conducted by plugging all incoming and outgoing sewer lines in the manhole at a location beyond the connection of the sewer pipe with the manhole. All plugs shall be blocked in place so as not to move during the test. The vacuum testing collar shall be inflated in the frame in accordance with the equipment manufacturer's recommendations. A vacuum of ten (1) inches of mercury shall be drawn and the vacuum pump turned off and the valve between the vacuum pump and the vacuum gauge shall be turned off.

The time period which is taken for the vacuum to fall from ten inches (10") of mercury to nine inches (9") of mercury shall be determined. If the time taken for the vacuum to reduce the ten inches (10") of mercury to nine inches (9") of mercury is less than the time indicated in the following table, then the manhole work shall be considered not acceptable and shall be rejected. If the time is equal to or exceeds the time indicated below, the manhole work shall be accepted.

Manhole Depth (ft)	Diameter =	Time (sec)		
		48"	60"	72"
8		20	26	33
10		25	33	41
12		30	39	49
14		35	46	57
16		40	52	65
18		45	59	73
20		50	65	81
22		55	72	89
24		59	78	97
26		64	85	105
28		69	91	113
30		74	98	121
Each add'l 2' add:		5	7	8

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

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

Once all manholes have been tested, the manholes will be given a field visual inspection. The inspection shall be performed at the discretion of the City's representative during the warranty period following a rainfall sufficient enough to

raise the ground water table above the problem areas. All leakage problems determined by this inspection shall be corrected by the Contractor within an agreed upon time to the satisfaction of the City Engineer. Where necessary to complete the work, the Contractor shall be responsible for the bypassing and/or blocking of the flow in the manholes and must have prior approval by the City Engineer. It will be the Contractor's responsibility to supply his own traffic control as required by the particular location and/or jurisdiction.

D. Storm Sewer Testing

All rigid pipe shall be lamped; any misalignment shall be repaired.

All flexible pipe shall receive a deflection test as required by paragraph B. Deflection test shall be limited to 7% of the vertical, internal pipe diameter.

E. Force Main Testing

1. General

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

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

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

2. Pressurization

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

Any exposed pipe, fittings, valves, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or joints

that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the City's representative.

3. Leakage Test

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

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

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

F. Lift Station Pump Testing

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

1. Manufacturer's Startup

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

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

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

2. Final Inspection

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

- a. Water to conduct test;
- b. Amp/volt meter;
- c. Stop watch;
- d. Tape or level rod to measure float settings;
- e. Keel to mark float settings on lift station wall;
- f. Calibrated test gauge to measure operating head. The gauge shall be calibrated in feet of water from 0 to 100 feet in one foot increments; and
- g. Manufacturer's pump performance curves.

The City's and GRS Sewer Authority representatives attending the final inspection shall re-check any deficiencies. These representatives shall then complete a cursory final inspection checklist and perform pump down tests, which shall include the following:

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

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

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

G. Lateral Location Forms

The Owner/Contractor shall submit a lateral location form for each lot. The form shall be completed and signed by the Contractor, the DPW or his representative during lateral inspection. This form shall include one (1) Polaroid type photo taken from the point of connection to the public sewer looking back along the lateral to the building.

11.04 Water Main Testing and Disinfection

A. General

After the pipe has been laid and partially backfilled as specified under Section 8.03 Bedding and Backfill all newly laid pipes or any valved sections of it shall, unless otherwise expressly specified, be subjected to a hydrostatic pressure tests.

The duration of each pressure test shall be for a period of not less than two hours. The basic provisions of AWWA C-600, Section 4 shall be followed for all pressure testing.

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

All newly laid pipes or any valved section thereof shall be subjected to a hydrostatic pressure of at least 150 psig for a minimum of 2 hours.

B. Pressurization

Each valved section of pipe shall be slowly filled with water and specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to the pipe in a manner satisfactory to the NBWD/City Engineer. The pump pipe connection and all necessary apparatus, including gauges and meters shall be furnished by the Contractor. Before applying the specified test pressure, air shall be expelled completely from the test section. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at all points so that the air can be expelled as the section is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test the corporation cocks shall be removed and plugged or left in place at the direction of the NBWD/City Engineer.

Any exposed pipe, fittings, valves, hydrants and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants or joints that are discovered following the pressure test shall be repaired or replaced with

sound material approved by the NBWD/City Engineer and the test shall be repeated until it is satisfactory to the NBWD/City Engineer.

C. Leakage Test

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

Leakage shall not be measured by a drop in pressure in a test section over a period of time. Testing allowance is 11.65 gpd/mi/in at 150 psi.

No pipe installation will be accepted if the leakage is greater than the determined by the following formula:

$$L = \frac{SD \sqrt{P}}{133,200}$$

Where:

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

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

D. Acceptance

Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified, the Contractor shall at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.

All visible leaks are to be repaired regardless of the amount of leakage. All flanged pipe shall be "bottle-tight".

If section under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

E. Chlorination of Water Mains

1. Chlorination of New Water Mains

Before being placed in service, all new water distribution systems, or extensions to existing systems, or any valved section of such shall be

chlorinated. Prior to chlorination, all dirt remaining in the pipe after completion shall be removed by a through flushing through the hydrants, where available, other wise through other approved temporary connections to be provided by the Contractor for the purpose. This shall be done after the pressure test and may be done either before or after the trench has been backfilled. Each valved section of newly laid pipe shall be flushed independently. The flushing velocity shall be not less than 2.5 feet per second through the completed new main.

The water main shall be chlorinated according to the regulations of latest edition of AWWA C651, AWWA Standard for Disinfecting Water Mains.

2. Reconnection of Services

The reconnection of existing building services from existing water mains to new mains shall not be made until the water in the newly constructed mains has been disinfected and satisfactorily tested as specified herein under the heading of "Chlorination of New Water Mains".

3. Chlorination Procedure When cutting into Existing Mains

Under ideal trench and installation conditions with full time inspection by the NBWD, the Contractor may be permitted to make cuts into existing pipe lines for the insertion of valves, fittings, repairs or for other purposes by the following procedure of disinfection: Sprinkle the inside surfaces of the appurtenances to be installed with a dry hypochlorite (or apply a hypochlorite slurry) and place a small quantity of hypochlorite powder into the ends of the existing pipe on either side of the opening before the new pipe and fittings are installed.

At the discretion of the City Engineer or the NBWD and/or when the trench and installation conditions are not ideal for making the cuts into existing mains, the Contractor shall introduce the solution of chlorine or the suspension of hypochlorite into the isolated valve-off sections of mains through a tap in the main to be made for this special purpose.

In either of the two (2) above procedures, the chlorine introduced should be in sufficient amount to insure a high concentration, forty to fifty parts per million (40-50 ppm), reaching every part of the isolated section of mains. The maximum permissible contact period shall be used after which the water bearing strong chlorine solution shall be flushed out of the isolated section of mains before they are returned to service.

The Contractor shall schedule the making of all of the project cut-in connections to existing mains as close together, time wise, as is feasible. He shall notify the Water Works Superintendent at least seventy-two (72)

hours in advance, so arrangements can be made for inspection of the work and so the Owner can step up the system chlorination and notify the affected water customers.

All water customers who will be affected by the isolated section of mains for the purpose of making the cut-in connections and disinfection are to be given advance notification by the Water Works Department through the local newspaper or by personal notice to each customer.

4. NBWD's Responsibility for Temporary Step-Up of System Chlorination

At least eight (8) hours prior to the making of cuts into existing pipe lines for the insertion of valves, fittings, repairs and the connection of new mains to existing mains and prior to the placing of newly constructed water mains into service, the NBWD will increase the chlorine dosage of the water supply to the system to effect a free chlorine residual of at least .5 ppm, or a combined available chlorine residual of at least 1.0 ppm. The said chlorine residual shall be maintained by the NBWD for a sufficient period of time to establish a record of satisfactory bacteriological quality of the water throughout the distribution system. After at least two (2) successive sets of satisfactory bacteriological samples of water have been taken from the system at approximate twenty-four (24) hour intervals, the stepped-up chlorination may be cut back to the normal dosage.

11.05 Fire Hydrant Testing

Hydrants shall be flushed and flow/pressure tested after installation. Contractor shall submit test results to NBWD utilizing NBWD Fire Hydrant Data Sheet.

11.06 Testing of Pavement Materials

A. Subgrade Testing

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

Should subgrades not meet minimum compaction requirements (minimum 100%), other forms of soil modification shall be employed. This shall include but not be limited to scarifying and aerating, undercutting and aeration, total replacement of soils, or the installation of geotextiles such as woven or non-woven filter fabrics or geogrid soil reinforcing systems. A qualified and licensed geotechnical

engineer or geologist shall be provided by the Contractor to give such recommendations.

B. Pavement Materials Testing

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

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

The frequency of sampling and testing shall be based on the number of tests required for each quantity of materials placed for a particular item of work as specified by the City Engineer. The Contractor/Owner shall reimburse the City for the cost of the testing.

11.07 Documentation, Dedication and Acceptance Procedures

A. Documentation Requirements

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

1. Copies of all testing reports and data;
2. Copies of all O & M Manuals and lift station(s) (if applicable);
3. Pump manufacturer's certification letter (if applicable);
4. Lift station final inspection checklist (if applicable);
5. Final payment for inspection services;
6. As-built drawings including lateral locations;
7. Performance and/or maintenance bonds (if required);
8. Daily inspection reports;
9. Legal description of the land (street r-o-w, utility easements, drainage easement, lift station easements, etc.) to be dedicated to the City; and
10. A written statement of facilities present on those lands. The written statement shall include:
 - a. Identification of the type and nature of facilities present
 - b. Dimensions of the facilities present

- c. Totals for each type of facility present (example: 1,000 ft. of roadway, 1,000 ft. of sanitary sewer, 1,000 ft. of residential curbing, etc.)

B. Dedication

The City Engineer shall review the above mentioned requirements and prepare a document stating that the work has been completed, the requirements have been met, and all items are in proper form. The City Engineer shall include in the statement a recommendation on acceptance/denial of the facilities and may also include comments regarding the project. The City Engineer shall present to the City Council its findings in a public hearing for their consideration.

C. Acceptance

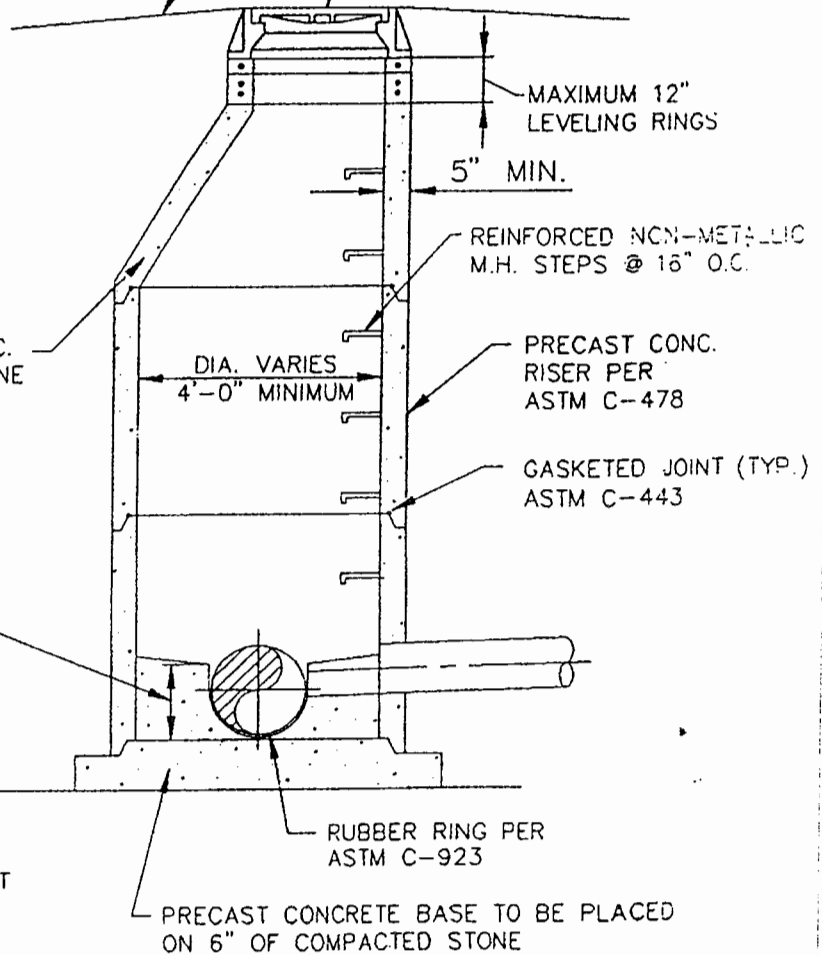
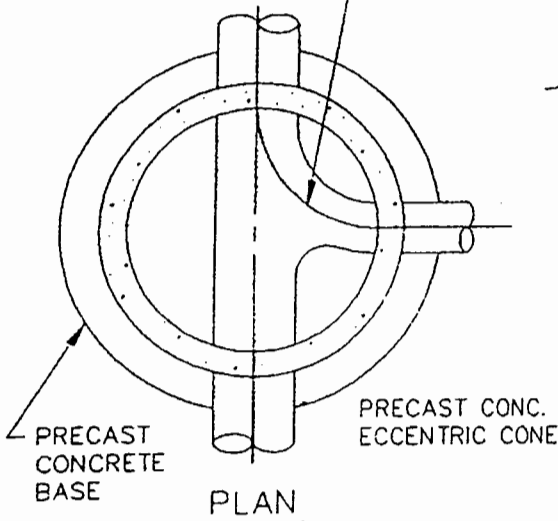
The City Council shall receive the recommendation from the City Engineer, and upon review by the City Attorney and City Manager, shall make a determination as to acceptance of the facilities. A majority approval to the Council members present at the meeting is required for acceptance. The City Council shall accept dedicated facilities by resolution.

END

RADIUS NOT LESS
THAN 1/2 MANHOLE I.D.

FINISHED GRADE (SLOPE
TO PREVENT STORM
DRAINAGE FROM
ENTERING MANHOLE)

MANHOLE FRAME AND LID
(SET FLUSH WITH FINISHED
GRADE UNLESS NOTED
OTHERWISE)



CONCRETE BENCH — SLOPE 1" PER
FOOT TO WALL, BENCH HEIGHT EQUAL
TO 0.8 PIPE DIAMETER (MINIMUM
CONCRETE STRENGTH OF 2500 PSI)

NOTE :

1. FOR ALL MANHOLES 6'-0" OR LESS
IN DEPTH — PROVIDE RISER WITH FLAT
TOP IN LIEU OF ECCENTRIC CONE IN
ACCORDANCE WITH ASTM C-478
2. THE CROWN OF THE INFLUENT PIPE
SHALL BE AT OR ABOVE THE CROWN
OF THE OUTLET PIPE
3. DROP MANHOLES SHALL BE USED
WHENEVER THE DISTANCE FROM THE
INVERT OF THE INCOMING LINE AND
BOTTOM OF MANHOLE IS GREATER THAN
TWO FEET.

STANDARD SANITARY MANHOLE DETAIL

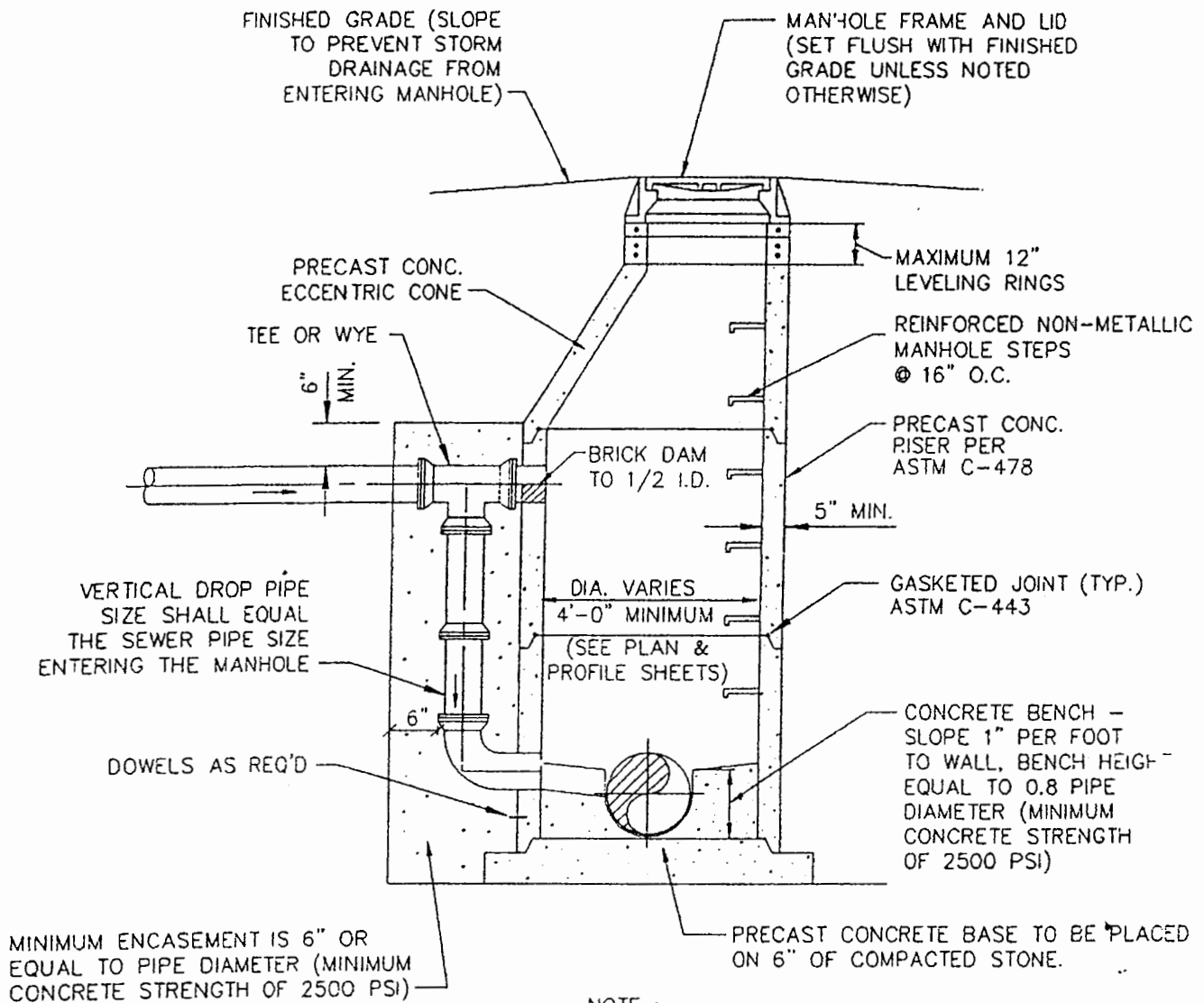
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-1



NOTE :

1. FOR ALL MANHOLES 6'-0" OR LESS IN DEPTH - PROVIDE RISER WITH FLAT TOP IN LIEU OF ECCENTRIC CONE IN ACCORDANCE WITH ASTM C-478
2. THE CROWN OF THE INFLUENT PIPE SHALL BE AT OR ABOVE THE CROWN OF THE OUTLET PIPE
3. DROP MANHOLES SHALL BE USED WHENEVER THE DISTANCE FROM THE INVERT OF THE INCOMING LINE AND BOTTOM OF MANHOLE IS GREATER THAN TWO FEET.

SANITARY DROP MANHOLE DETAIL

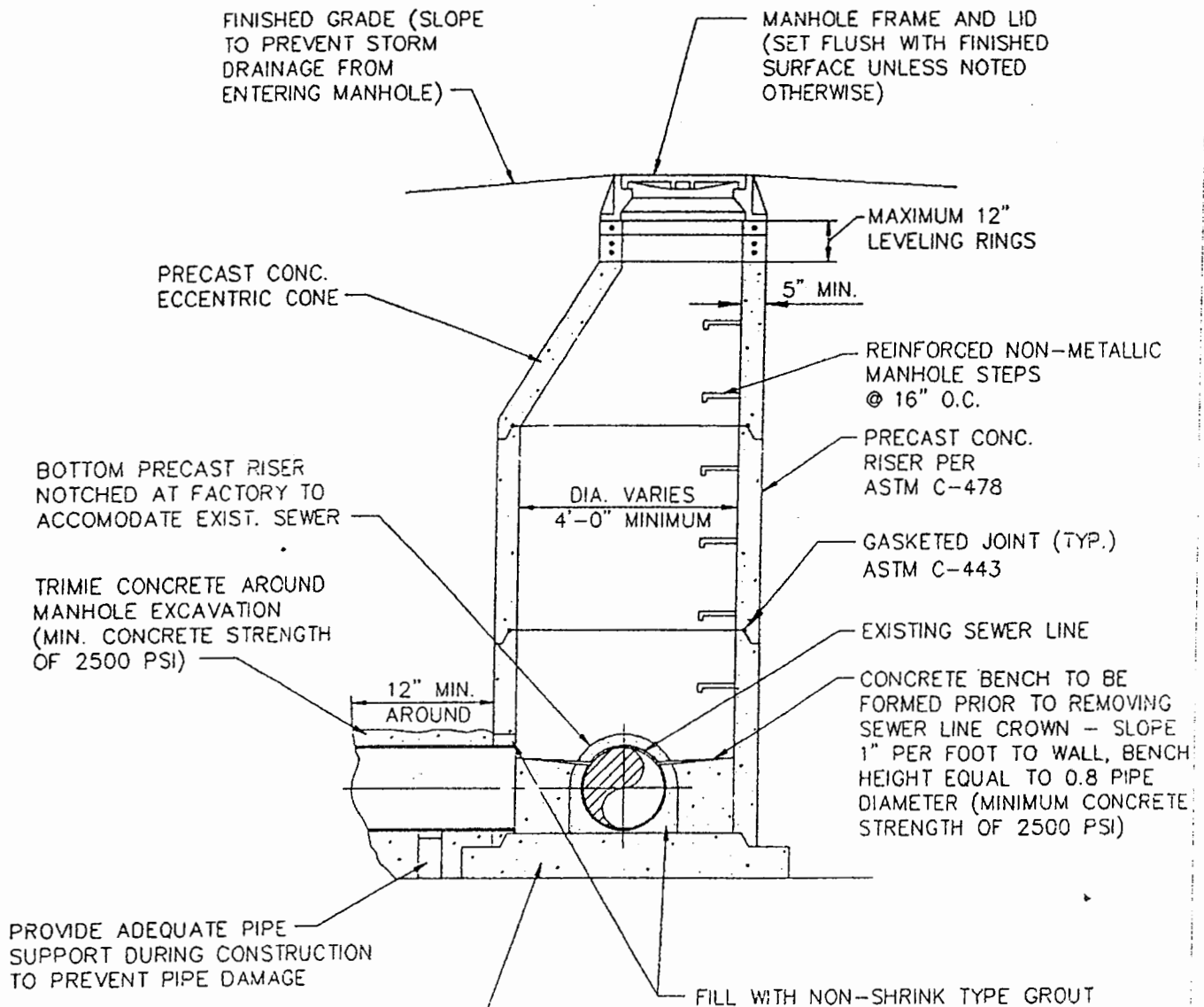
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-2



NOTE :

1. FOR ALL MANHOLES 6'-0" OR LESS IN DEPTH - PROVIDE RISER WITH FLAT TOP IN LIEU OF ECCENTRIC CONE IN ACCORDANCE WITH ASTM C-478
2. DROP MANHOLES SHALL BE USED WHENEVER THE DISTANCE FROM THE INFLUENT PIPE INVERT TO THE MANHOLE INVERT EXCEEDS 2'-0"

SANITARY MANHOLE INSTALLED OVER EXISTING SEWER

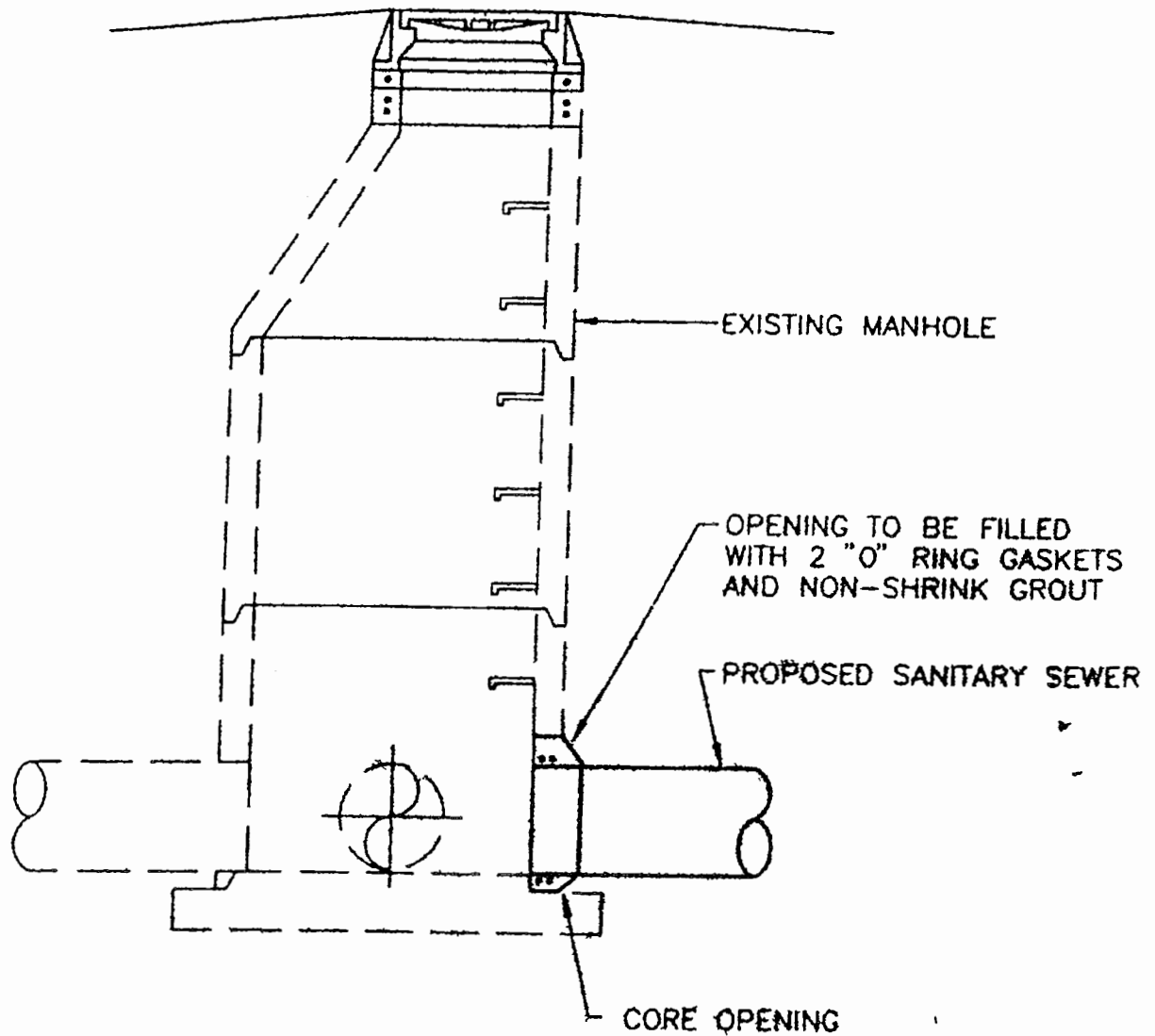
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-3



TYPICAL EXISTING MANHOLE ENTRY DETAIL

NO.	REVISION	DATE



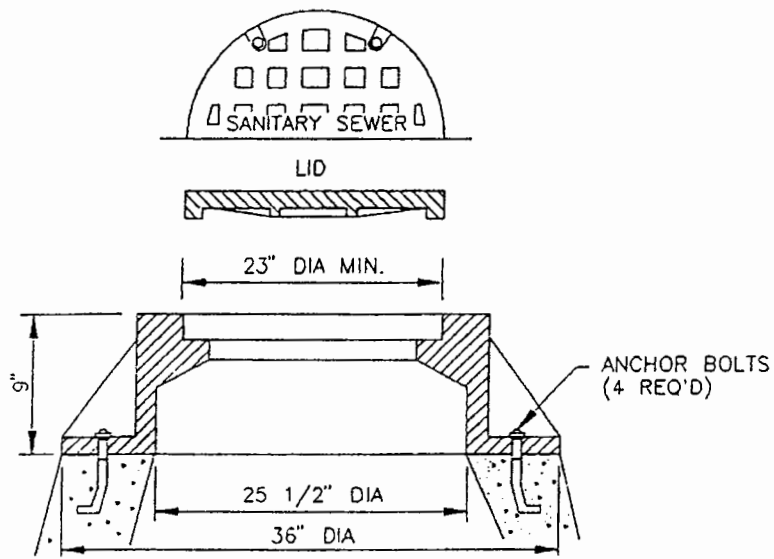
CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-4


5-5

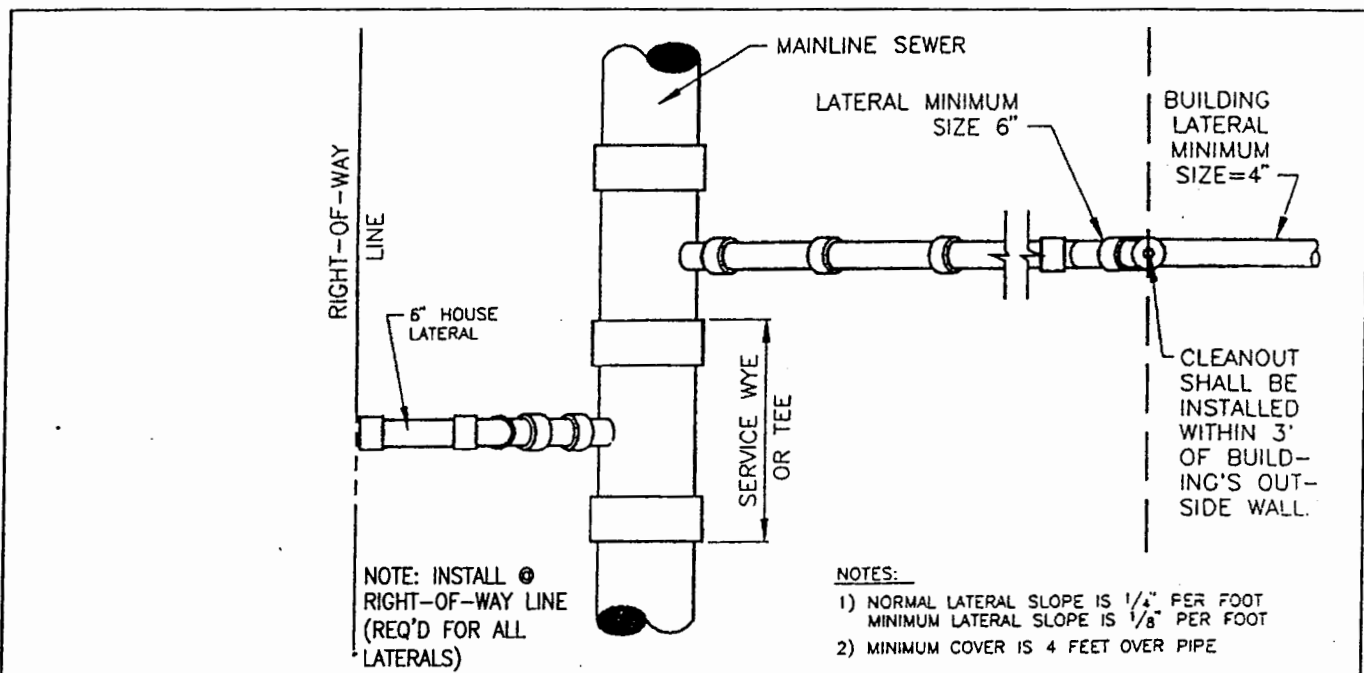




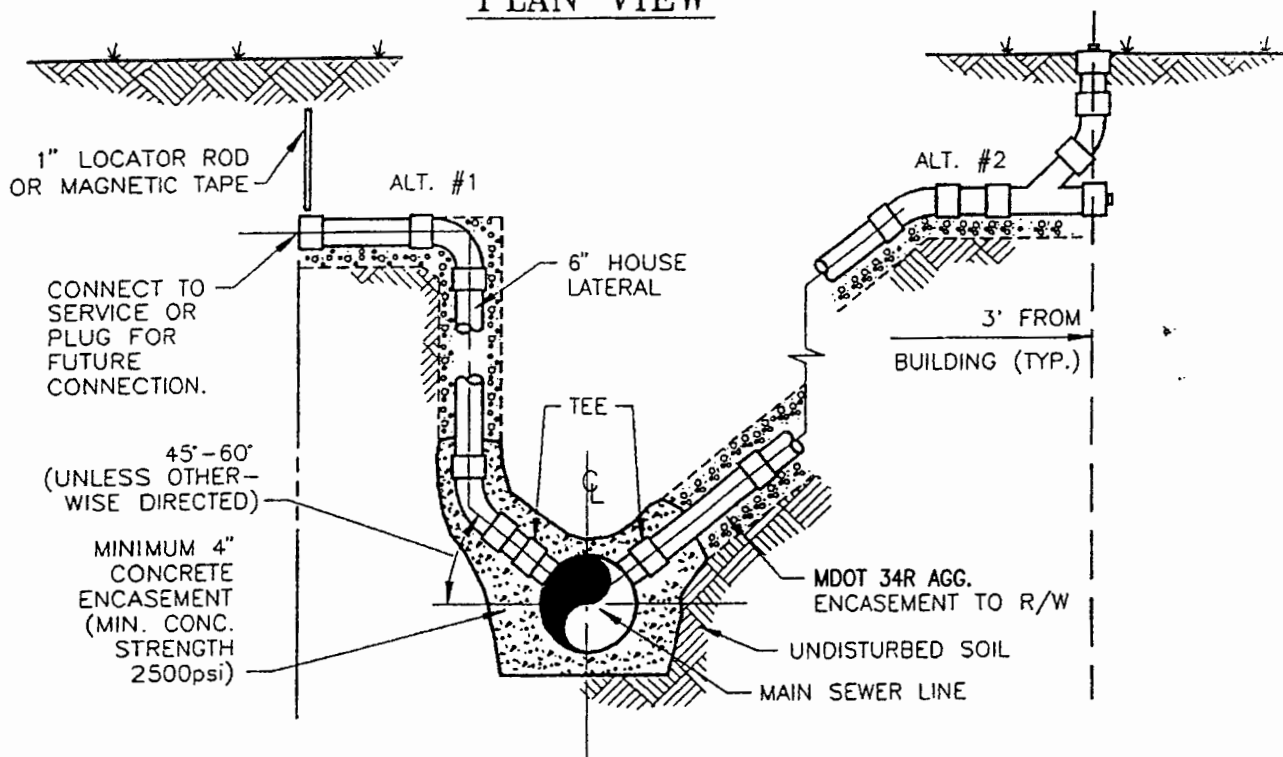
NEENAH FOUNDRY CO., R-1916-C w/GASKET SEAL AND BOLTED LID. CONCEALED PICKHOLES.
JOHN BOUCHARD & SONS COMPANY, NASHVILLE, TENNESSEE OR EQUAL. WEIGHT OF FRAME
AND COVER TO BE 300 LBS. (MINIMUM).

WATERPROOF SANITARY MANHOLE FRAME AND BOLTED LID

NO.	REVISION	DATE	 <div style="text-align: center;">CITY of NEW BUFFALO MICHIGAN</div>	FIGURE
				5-7



PLAN VIEW



ELEVATION

SERVICE CONNECTION FOR SHALLOW SEWERS (ALT.#1 & ALT.#2)

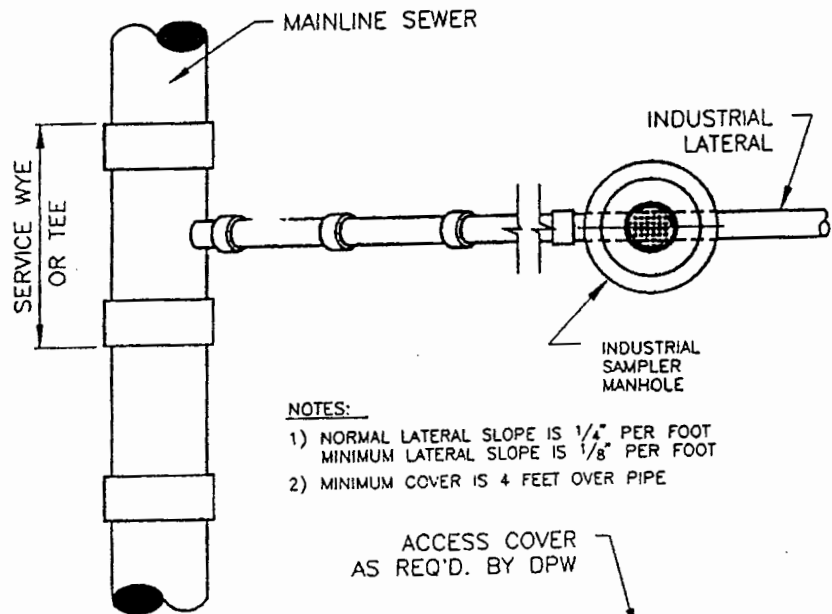
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-8

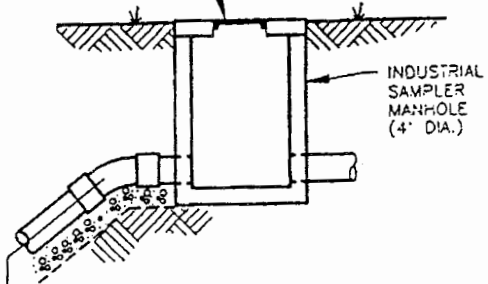


NOTES:

- 1) NORMAL LATERAL SLOPE IS $\frac{1}{4}$ " PER FOOT
MINIMUM LATERAL SLOPE IS $\frac{1}{8}$ " PER FOOT
- 2) MINIMUM COVER IS 4 FEET OVER PIPE

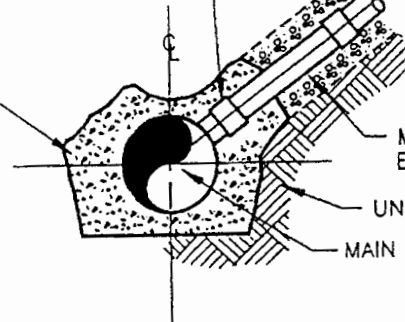
PLAN VIEW

ACCESS COVER
AS REQ'D. BY DPW



MIN. 4" CONC.
ENCASEMENT (MIN.
CONC. STRENGTH
2500 PSI)

WYE OR TEE



MDOT 34R AGGREGATE
ENCASEMENT TO R/W

UNDISTURBED SOIL

MAIN SEWER LINE

ELEVATION

INDUSTRIAL SEWER SERVICE CONNECTION

NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-9

EXISTING GRADE

4" COMPACTED TOPSOIL

TRENCH BACKFILL, COMPACTED EXCAVATED SOIL, UNLESS SOIL IS UNSUITABLE, SUCH AS PEAT, MARL, VEGETATION, ETC.

1.25 x O.D. + 12" *

*8" O.D. *8"

12" O.D. 12"

INITIAL BACKFILL MDOT 2G OR 34R COARSE AGGREGATE

BEDDING/HAUNCHING MDOT 2G OR 34R COARSE AGGREGATE

4" MIN.


SHEETED TRENCH UNSHEETED TRENCH

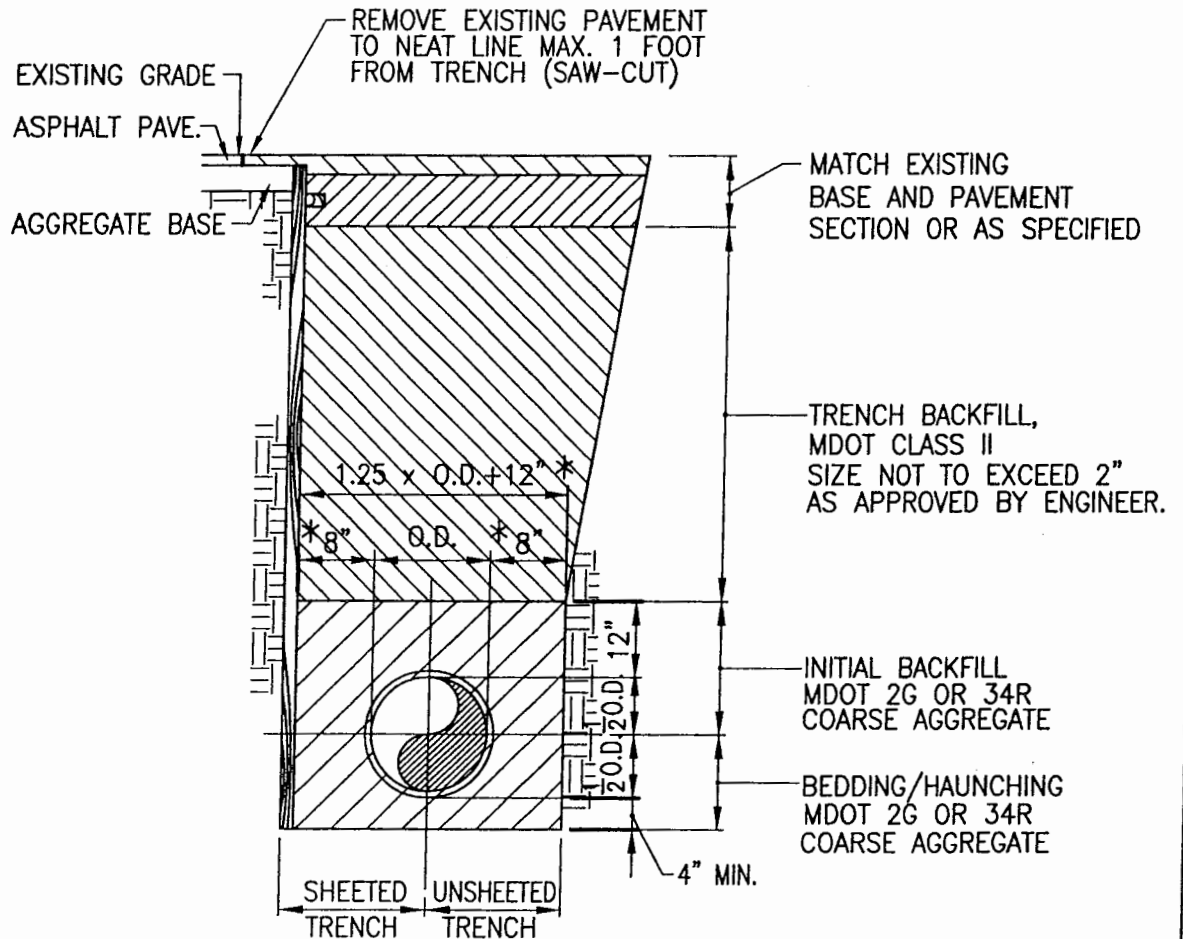
NOT TO SCALE

NOTES:

1. THE COST OF TRENCH SUPPORT SHALL BE INCLUDED IN THE COST OF THE PIPE.
2. OPEN-CUT TRENCHES SHALL BE SHEETED AND BRACED AS REQUIRED BY OSHA (29CFR 1926/1910), AND AS NECESSARY TO PROTECT LIFE, PROPERTY, AND THE WORK.
- * 3. WHICHEVER PROVIDES GREATER TRENCH WIDTH

FIRST CLASS PIPE LAYING METHOD FOR: CONDUITS IN GRASSED AREAS

NO.	REVISION	DATE		<p>CITY of NEW BUFFALO MICHIGAN</p>	FIGURE
					5-10




PIPE BEDDING DETAIL NOT TO SCALE

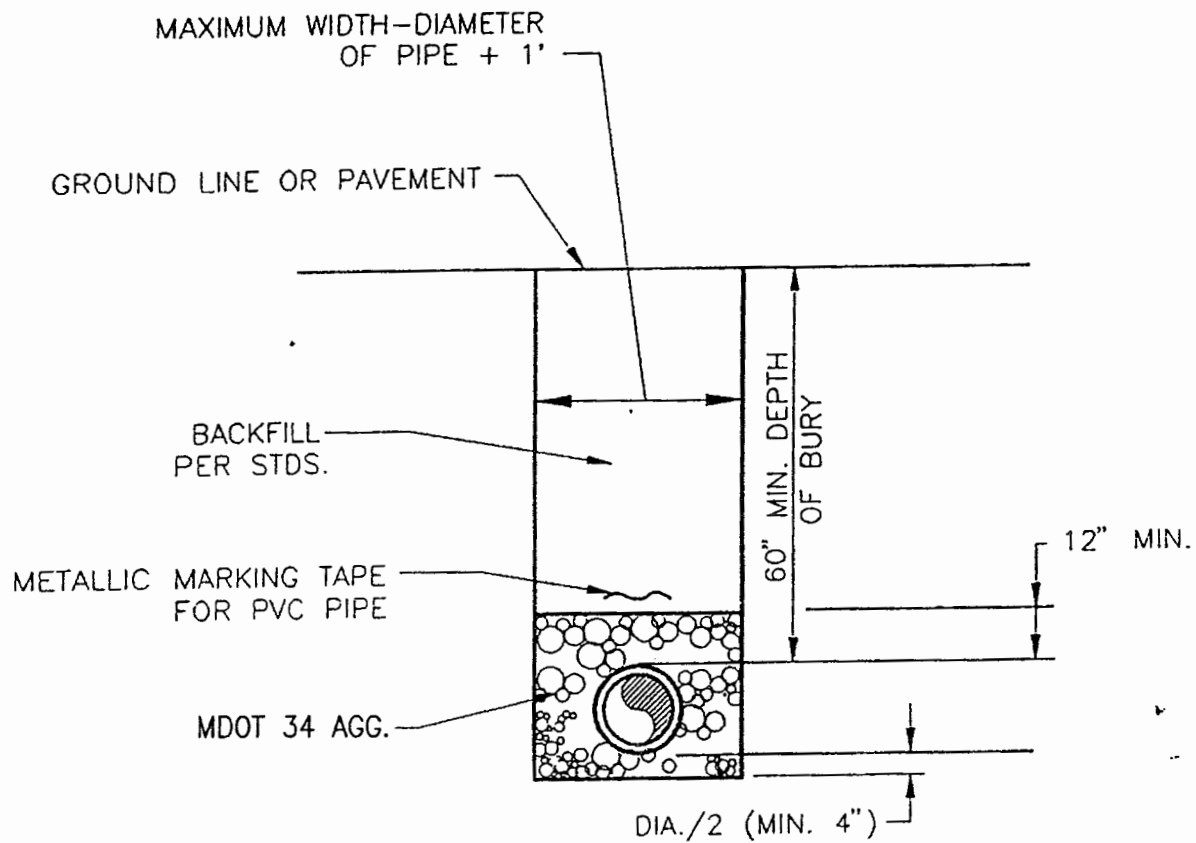
FOR TRENCH IN PAVED AREAS

NOTES:


1. THE COST OF TRENCH SUPPORT SHALL BE INCLUDED IN THE COST OF THE PIPE.
2. OPEN-CUT TRENCHES SHALL BE SHEETED AND BRACED AS REQUIRED BY OSHA (29CFR 1926/1910), AND AS NECESSARY TO PROTECT LIFE, PROPERTY, AND THE WORK.
- * 3. WHICHEVER PROVIDES GREATER TRENCH WIDTH

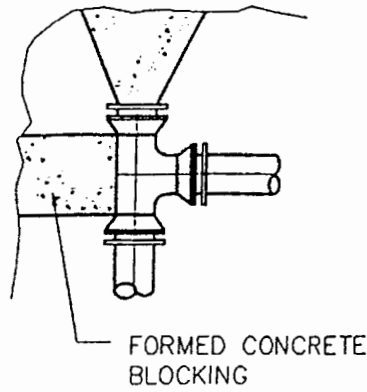
FIRST CLASS PIPE LAYING METHOD FOR CONDUITS IN PAVED AREAS

NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-11

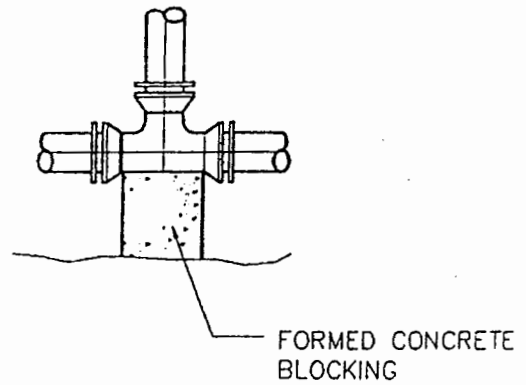


FORCE MAIN PIPE TRENCH DETAIL

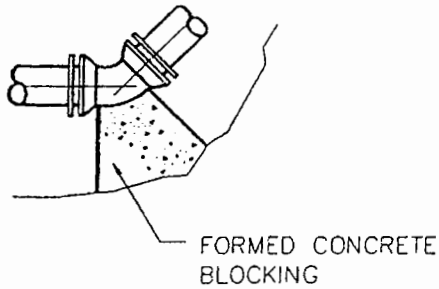
NO.	REVISION	DATE	 CITY of NEW BUFFALO MICHIGAN	FIGURE
				5-12



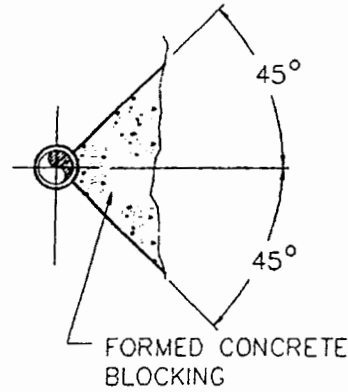
DETAIL A



DETAIL B



DETAIL C




DETAIL D

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

NOTES:

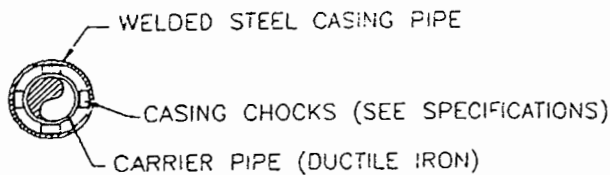
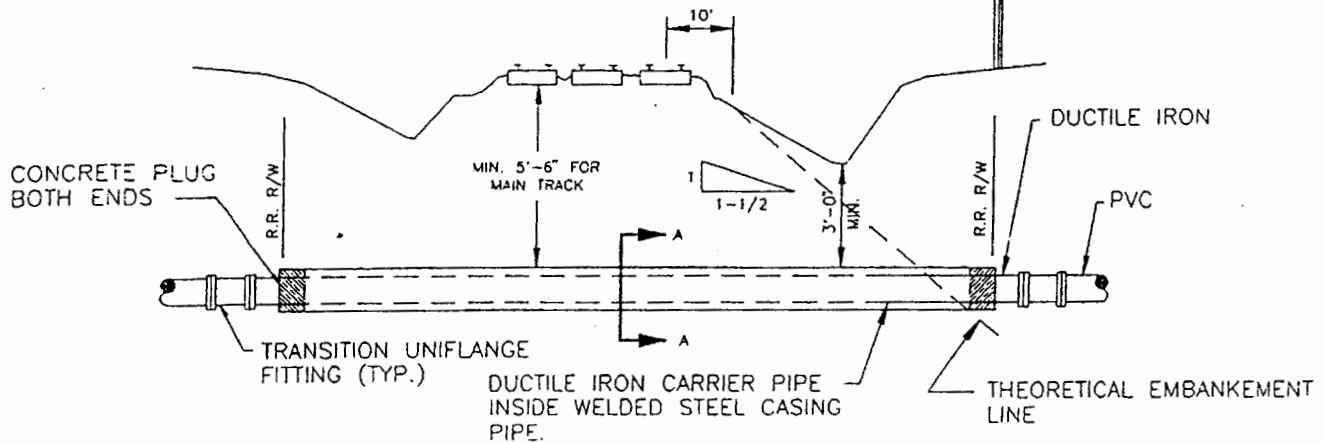
1. THRUST BLOCK AREAS ARE BASED ON A SOIL BEARING LOAD OF 2,000 lb./SQ. FT.
2. GREASE ALL PIPE SURFACES OR WRAP WITH POLYETHYLENE SHEETS PRIOR TO PLACEMENT OF CONCRETE

THRUST BLOCKING DETAILS FOR PRESSURE MAIN

NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-13

WARNING SIGN(S) TO BE A DURABLE, WATERPROOF SIGN LOCATED OVER CENTERLINE OF PIPE AND SHOWING THE FOLLOWING INFORMATION:

1. NAME AND ADDRESS OF TOWN
2. CONTENTS OF PIPE
3. PRESSURE IN PIPE
4. DEPTH BELOW GRADE AT POINT OF SIGN
5. EMERGENCY TELEPHONE NO. IN CASE OF PIPE RUPTURE.



SECTION "A-A"

CASING PIPE UNDER RAILWAY TRACKS SHALL EXTEND TO THE GREATER OF THE FOLLOWING DISTANCES.

1. 2 FEET BEYOND TOE OF SLOPE
2. 3 FEET BEYOND DITCH LINE
3. A MINIMUM OF 25 FEET EACH SIDE FROM CENTER LINE OF OUTSIDE TRACK
4. DISTANCE SHOWN ON PLANS
5. ACROSS THE ENTIRE WIDTH OF THE RIGHT-OF-WAY.
6. BEYOND THE THEORETICAL EMBANKMENT LINE.

RAILROAD PIPE CROSSING DETAIL

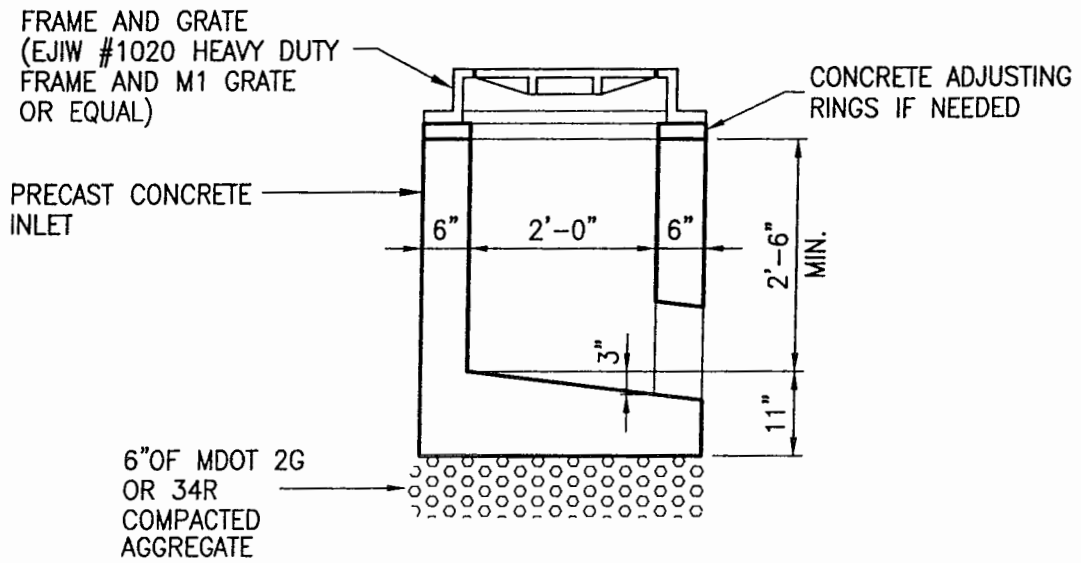
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-14




INLET DETAIL

NOT TO SCALE

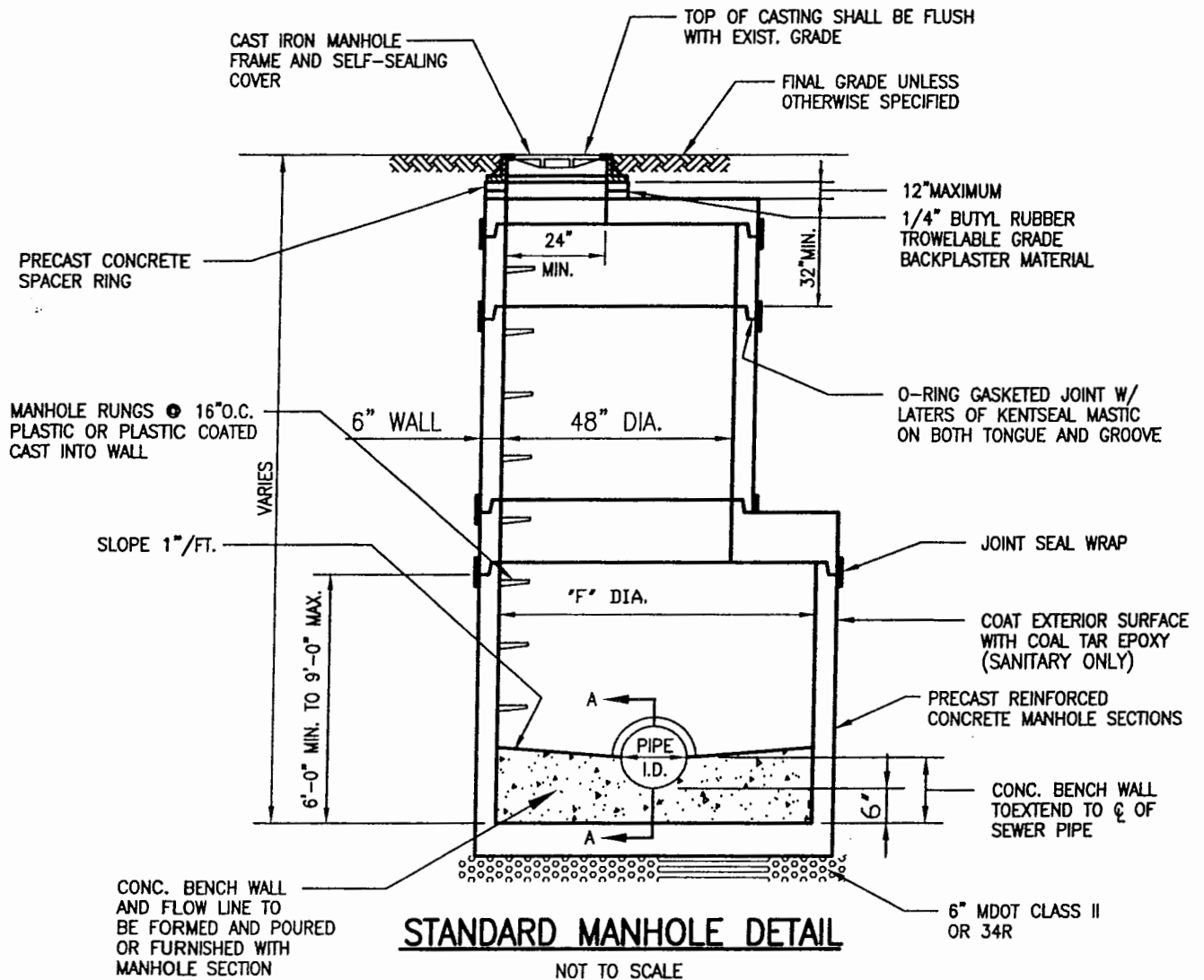
NOTES:

1. INLET AND APPURTENANCES SHALL MEET ASTM C-478 SPECIFICATIONS

STORM SEWER INLET AND CATCHBASIN DETAILS

NO.	REVISION	DATE	 CITY of NEW BUFFALO MICHIGAN	FIGURE
				5-21

5-22



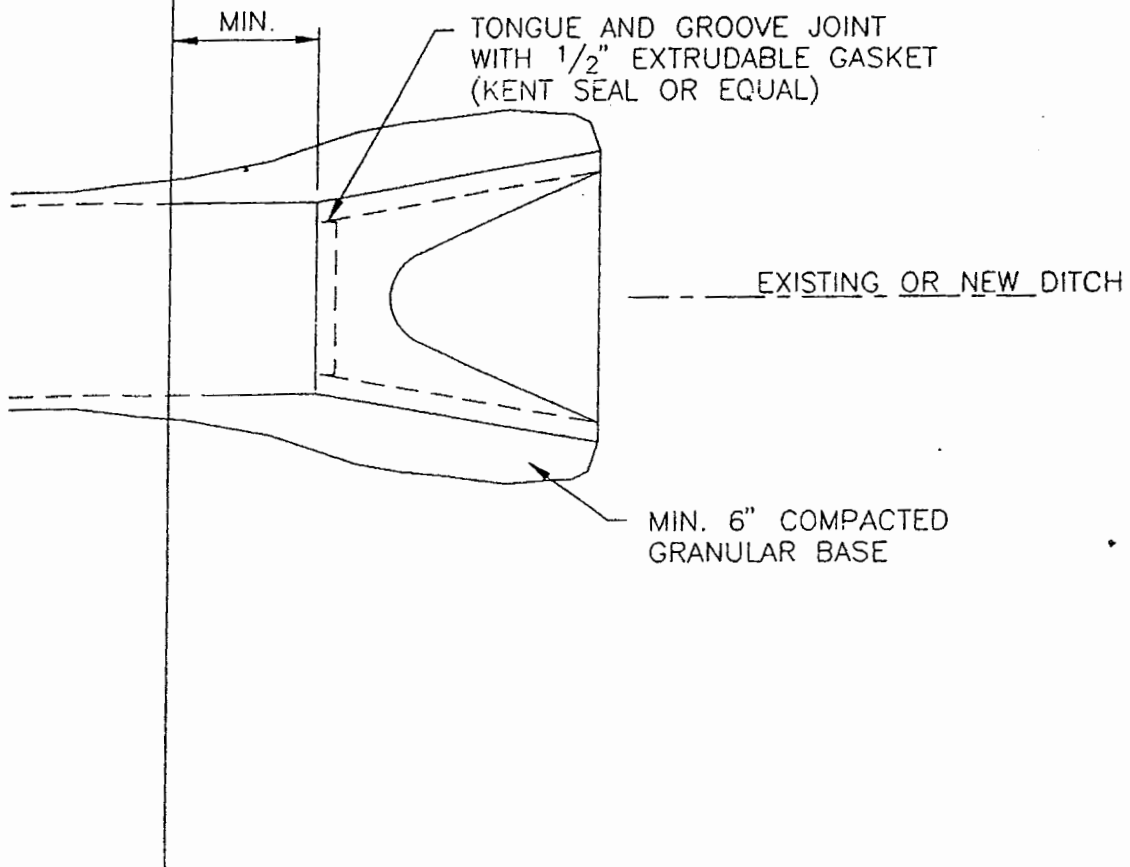
MANHOLE STRUCTURE DATA		
DIA. "F"	DIA. "G"	COMMENTS
108"	72"	PIPE TURNS GREATER THAN 45° UP TO 90°
102"	68" TO 72"	PIPE STRAIGHT THRU AND TURNS UP TO 45°
102"	54" TO 68"	PIPE TURNS GREATER THAN 45° UP TO 90°
96"	54"	PIPE STRAIGHT THRU AND TURNS UP TO 45°
96"	48"	PIPE TURNS GREATER THAN 45° UP TO 90°
84"	42"	PIPE TURNS GREATER THAN 45° UP TO 90°
72"	42" TO 48"	PIPE STRAIGHT THRU AND TURNS UP TO 45°
72"	36"	PIPE TURNS GREATER THAN 45° UP TO 90°

LARGE DIAMETER SEWER MANHOLE DETAIL

NO.	REVISION	DATE	FOR SEWERS 36" TO 72" DIA.	FIGURE
			CITY of NEW BUFFALO MICHIGAN	5-23



- NOTES: 1) MANUFACTURE OF END SECTION TO BE IN ACCORDANCE WITH APPLICABLE PORTIONS OF ASTM C76.
2) GRADE AREA TO COVER PIPE / END SECTION JOINT.



CULVERT PIPE CONCRETE END SECTION DETAIL

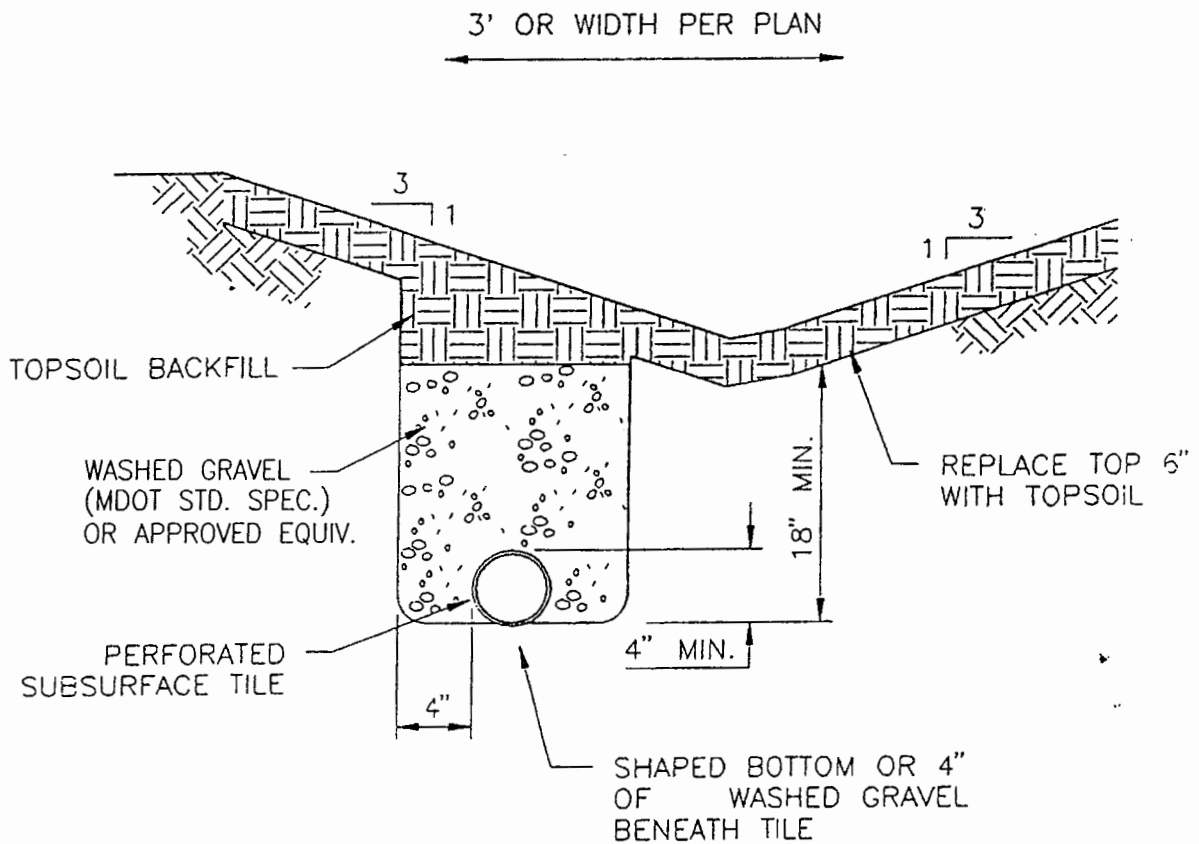
NO.	REVISION	DATE




CITY of NEW BUFFALO
MICHIGAN

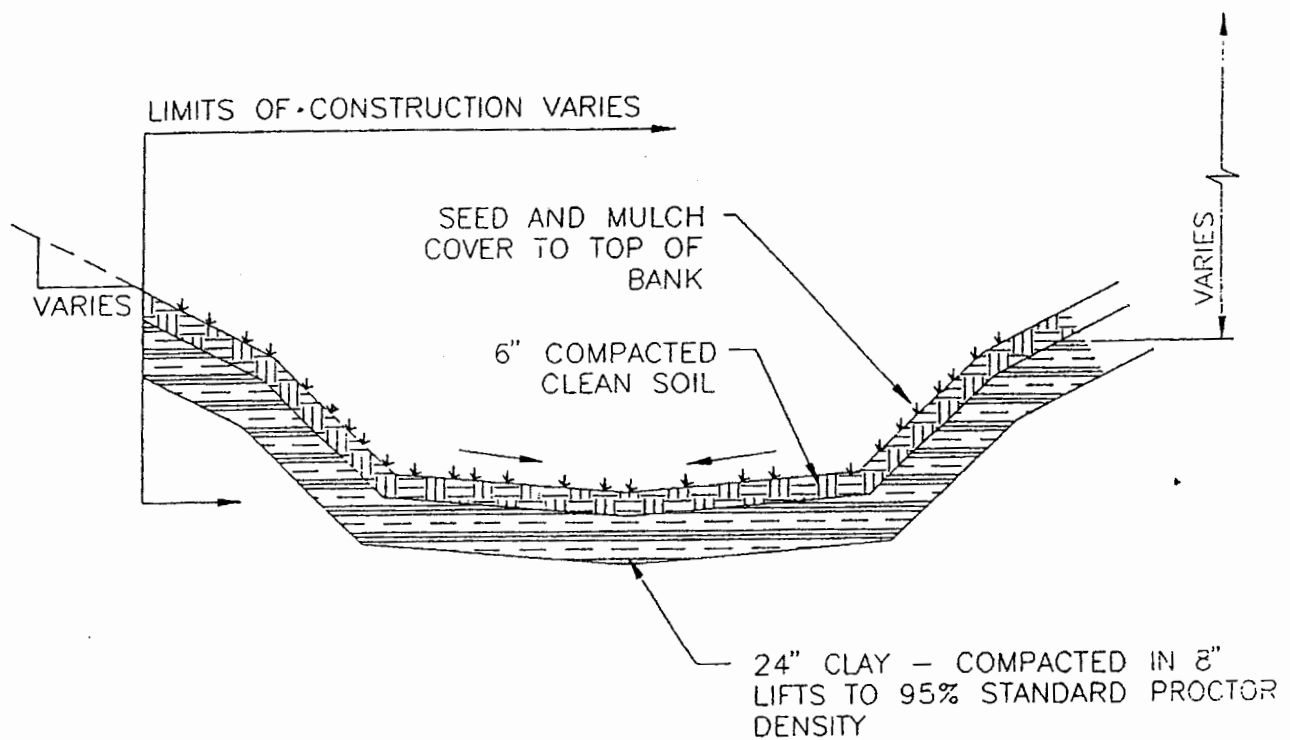
FIGURE

5-25



DITCH/SWALE UNDERDRAIN DETAIL

NO.	REVISION	DATE	 CITY of NEW BUFFALO MICHIGAN	FIGURE
				5-26



NOTE: ADDITIONAL SIDESLOPE STABILIZATION MEASURES NEEDED FOR SIDESLOPES STEEPER THAN 3:1

STREAM/DITCH RESTORATION

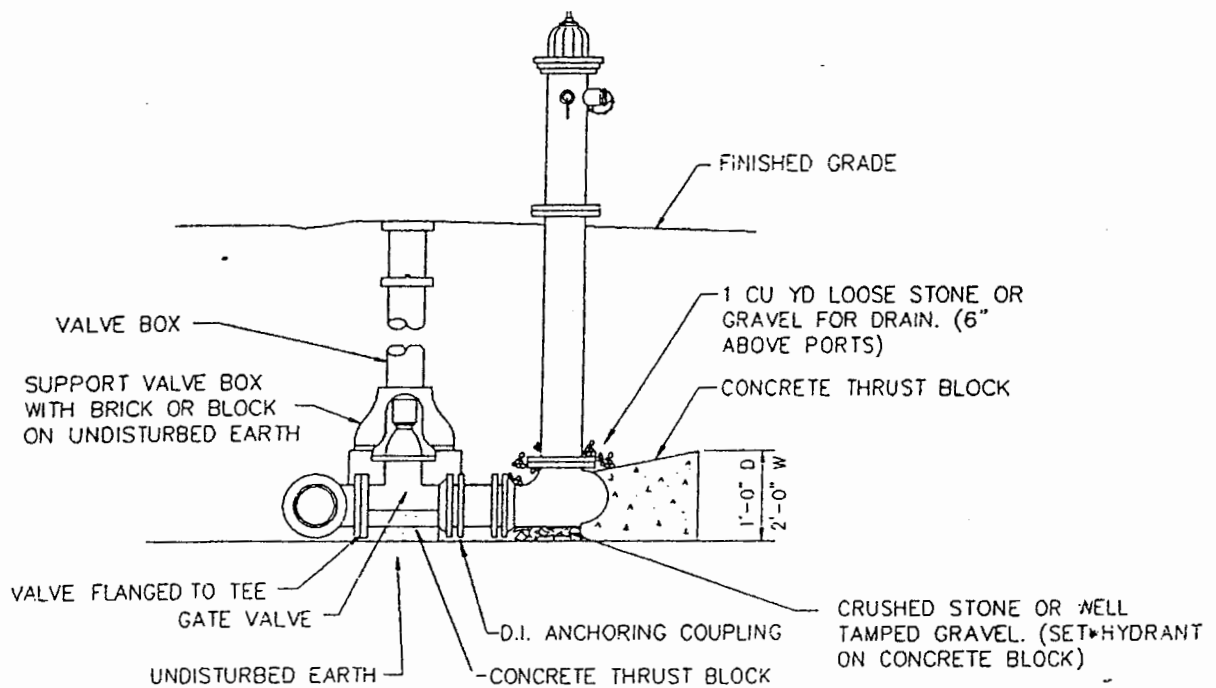
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-27



HYDRANT AND GATE VALVE DETAIL

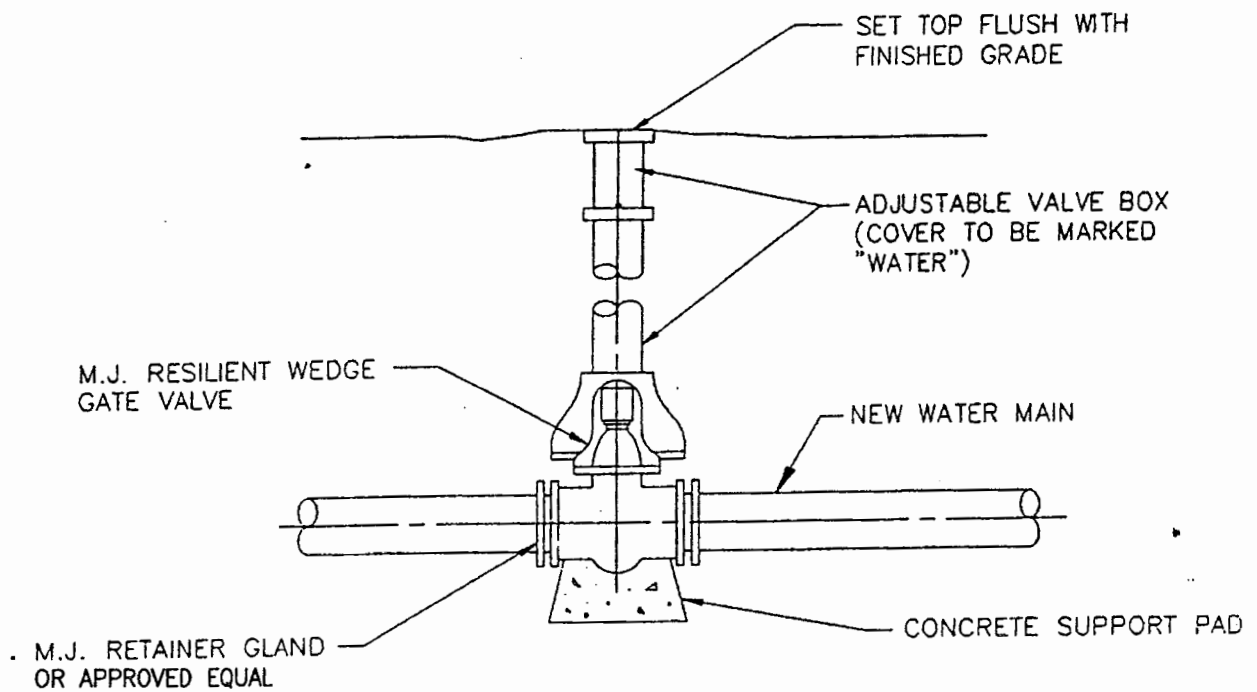
NO.	REVISION	DATE




CITY of NEW BUFFALO
MICHIGAN

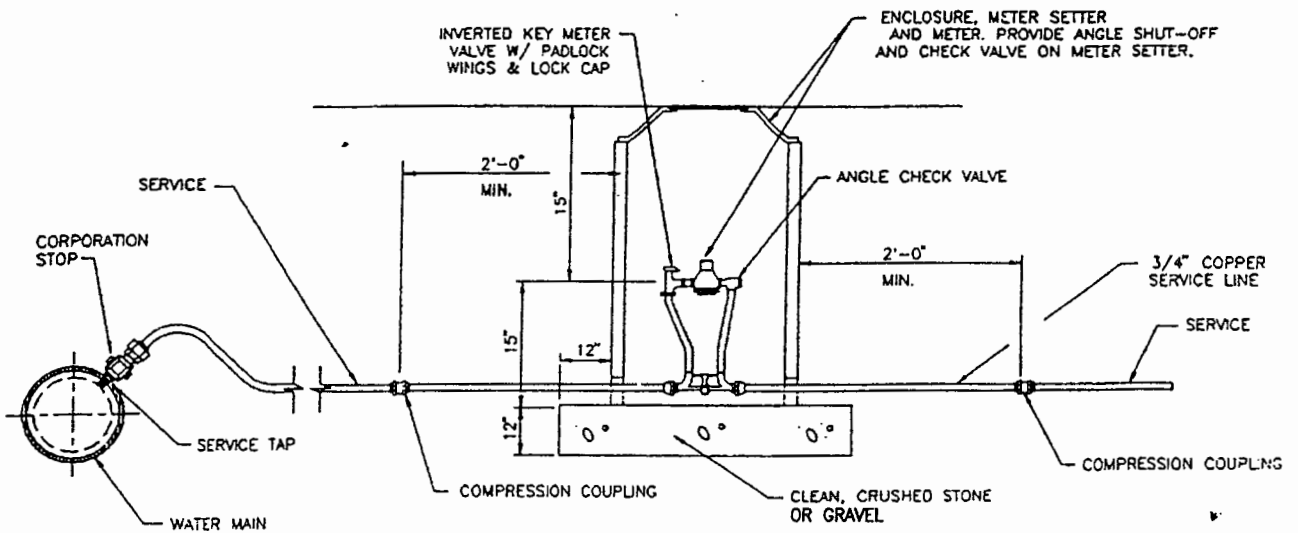
FIGURE

5-28



GATE VALVE AND BOX

NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-29



RESIDENTIAL METER/SERVICE INSTALLATION

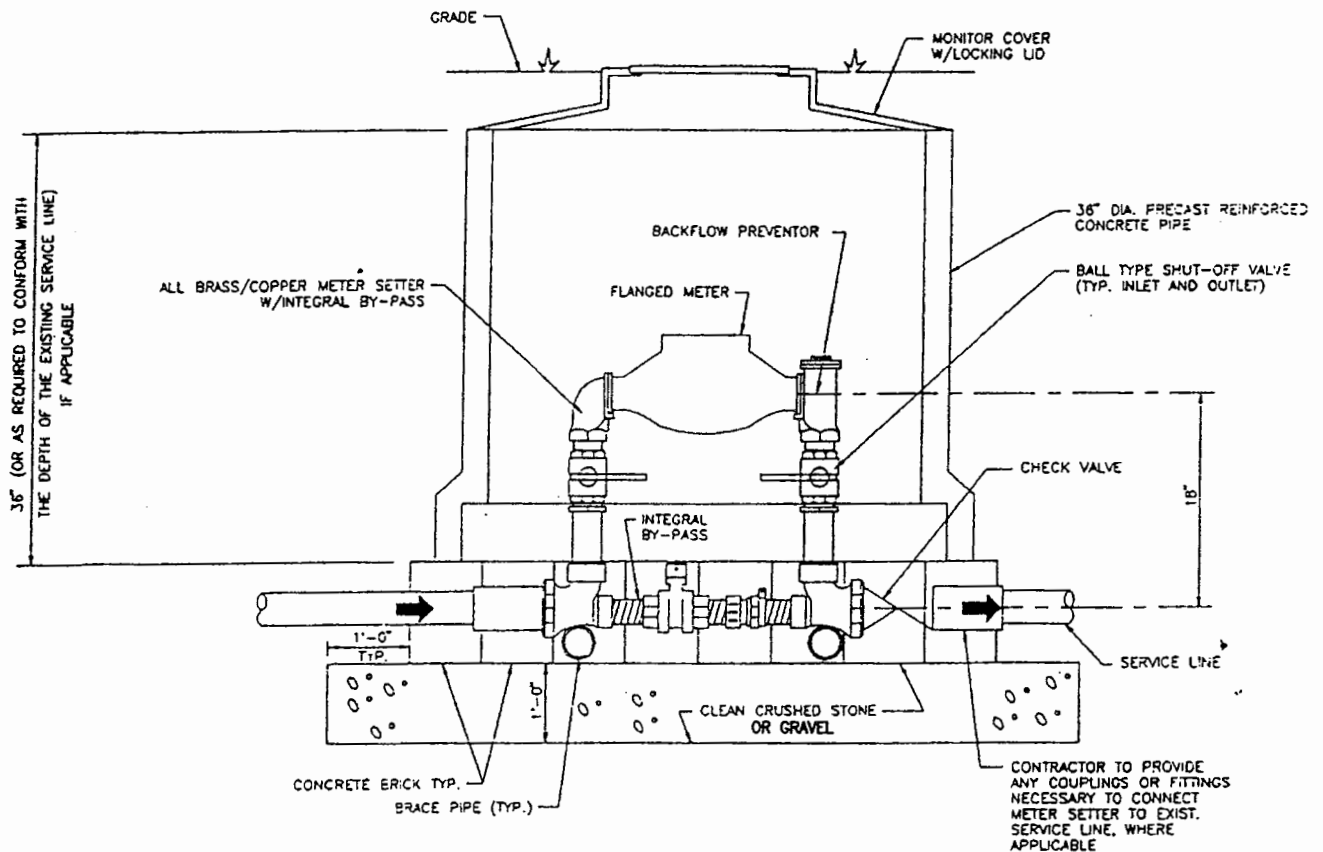
NO.	REVISION	DATE




CITY of NEW BUFFALO
MICHIGAN

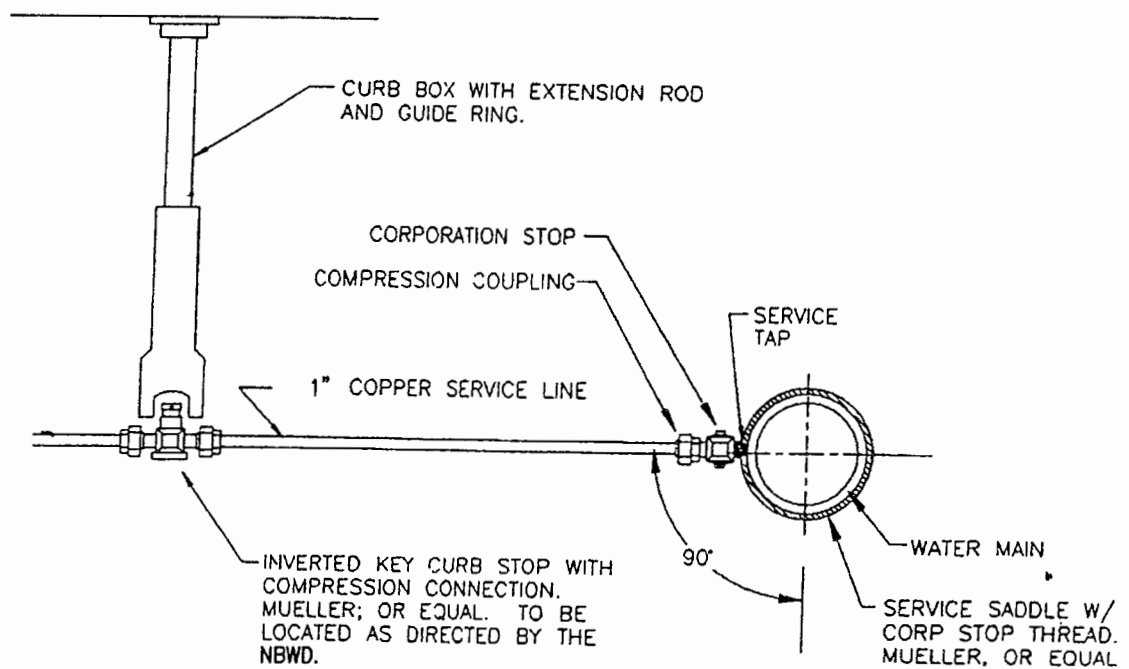
FIGURE

5-30




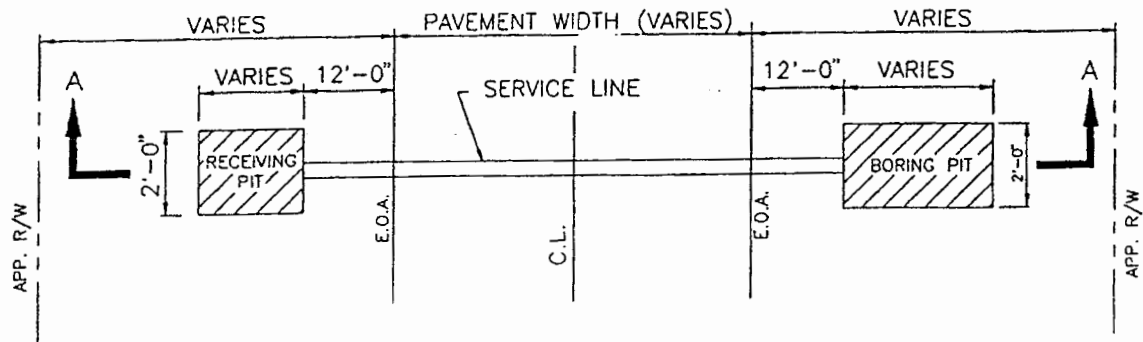
COMMERCIAL METER INSTALLATION 2" SIZE AND LARGER

NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-31

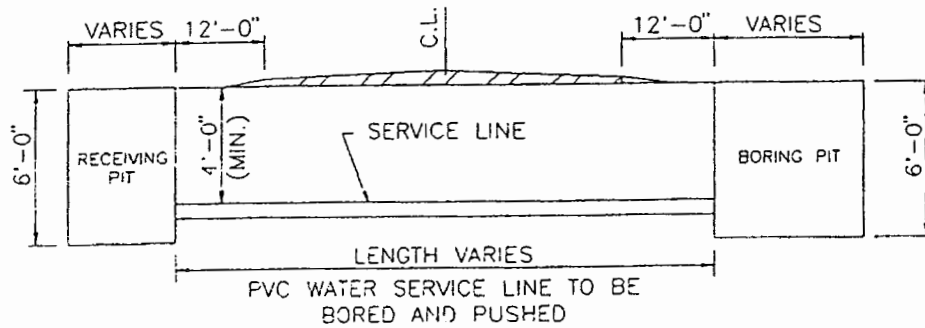


REMOTE-METERED SERVICE INSTALLATION DETAIL

NO.	REVISION	DATE	 CITY of NEW BUFFALO MICHIGAN	FIGURE
				5-32



PLAN



SECTION "A"

NOTE: FOR TOWN ROAD BORINGS, BORING & RECEIVING PITS TO BE SET BACK 5' FROM E.O.A.

CONSTRUCTION NOTE:

ANY DISTURBED AREAS WITHIN RIGHT-OF-WAY TO BE RESTORED TO SAME OR BETTER CONDITION AS PRIOR TO CONSTRUCTION.

WATER SERVICE LINE JACK AND BORE DETAIL

NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-33



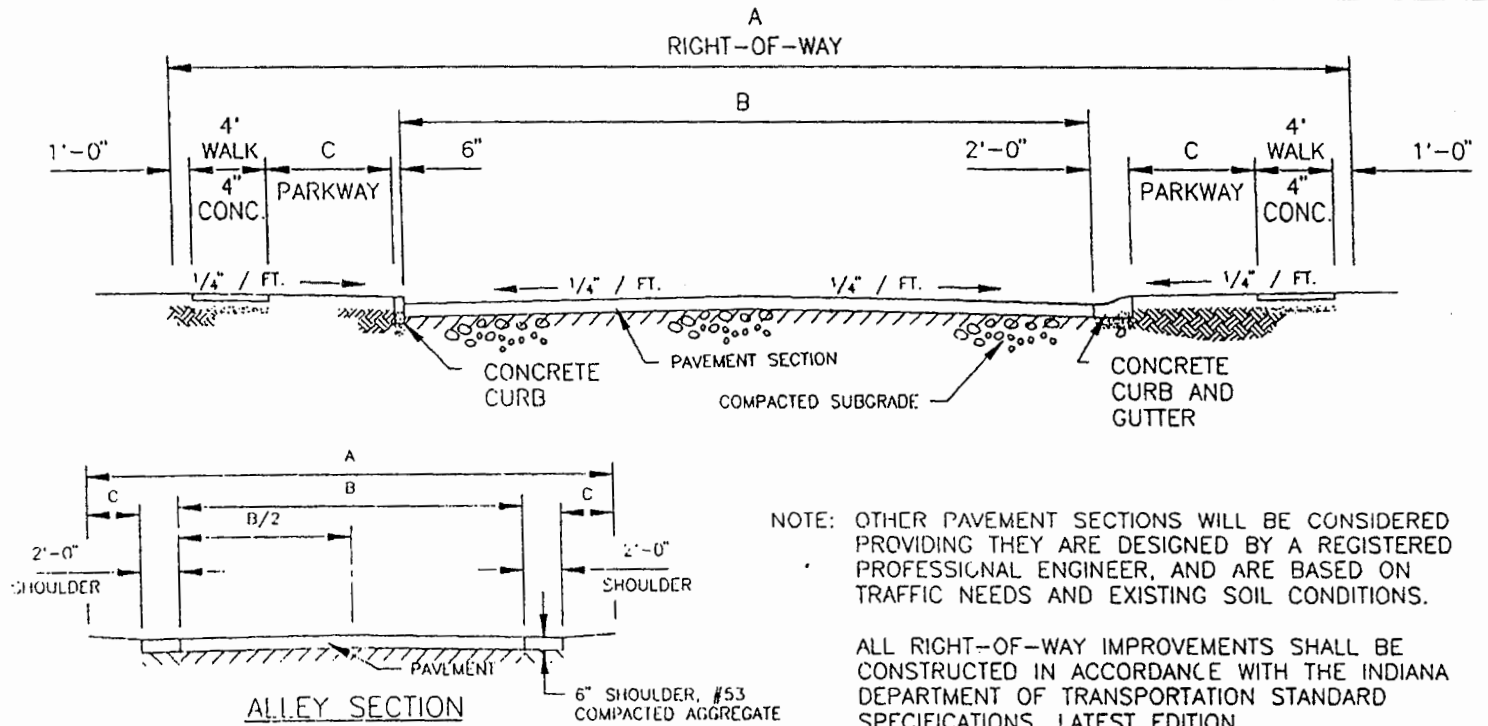
CITY of NEW BUFFALO
MICHIGAN

5-34

NO. REVISION DATE

FIGURE

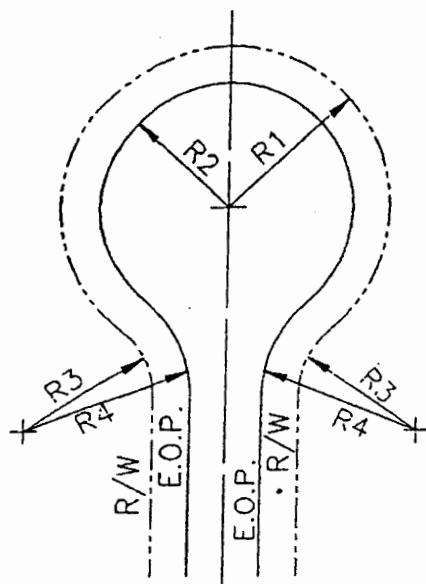
PAVEMENT DETAILS



MINIMUM PAVEMENT THICKNESS						
CLASSIFICATION	BITUMINOUS				CONCRETE	
	H.A.C. SURFACE #11 OR #12 (INCHES)	H.A.C. BINDER #9 OR #11 (INCHES)	H.A.C. BASE #5 (INCHES)	COMPACTED AGG. BASE (INCHES)	PCC (INCHES)	COMPACTED AGG. BASE (INCHES)
PRIMARY, ARTERIAL	1	2.5	6	8	8	6
SECONDARY, COLLECTOR	1	2.5	4	8	7	6
LOCAL, MINOR	1	3	N/A	10	6	6
SERVICE DRIVE	1	3	N/A	10	6	6
ALLEY	1	3	N/A	10	6	6

CLASSIFICATION	NO. OF LANES	A (FEET)	B (FEET)	C (FEET)	CURB TYPE	COMMENTS
PRIMARY, ARTERIAL	3	60	36	6.5	STRAIGHT	
SECONDARY, COLLECTOR	2	60	30	8	ROLL/STRAIGHT	
LOCAL, MINOR	2	50	24	6	ROLL/STRAIGHT	
SERVICE DRIVE	2	50	24	5	STRAIGHT	
ALLEY	1	30	18	4	N/A	

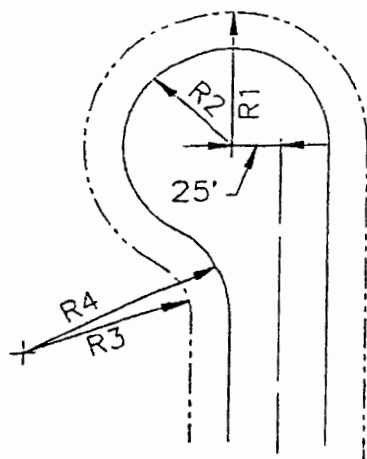
MIN. DIMENSIONS (IN FEET)




	R1	R2	R3	R4
RESIDENTIAL	50'	38'	48'	60'
COMMERICAL	60'	50'	88'	100'

NOTES:

1. PAVEMENT SECTIONS AND STREET WIDTHS (PAVEMENTS AND RIGHT OF WAY) SHALL BE IN ACCORDANCE W/ THE REQUIREMENTS OF TABLE 4-1.
2. MAX. CUL-DE-SAC STREET LENGTH ALLOWED IS 500 FT., DEFINED TO THE CENTER OF THE CUL-DE-SAC.
3. OFFSET TYPE CUL-DE-SAC ALLOWED, W/ SAME MIN. DIMENSIONS.
4. CUL-DE-SAC W/ MIN. DIMENSIONS WILL NOT BE ALLOWED TO CONTAIN ISLANDS, LANDSCAPED, CURBED OR OTHERWISE.
5. TRAFFIC CONTROL SIGNING, AS NECESSARY, WILL BE IN ACCORDANCE W/ THE MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
6. CUL-DE-SAC WILL NOT BE ALLOWED AT INTERSECTIONS (CIRCULAR TRAFFIC PATTERNS).
7. PAVEMENT MATERIALS (CONC. OR ASPH.) SHALL BE THE SAME AS THE REMAINDER OF THE STREET.



CUL-DE-SAC DETAIL

NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-35

PUBLIC STREET OR ROAD APPROACH DETAIL

NO. REVISION DATE



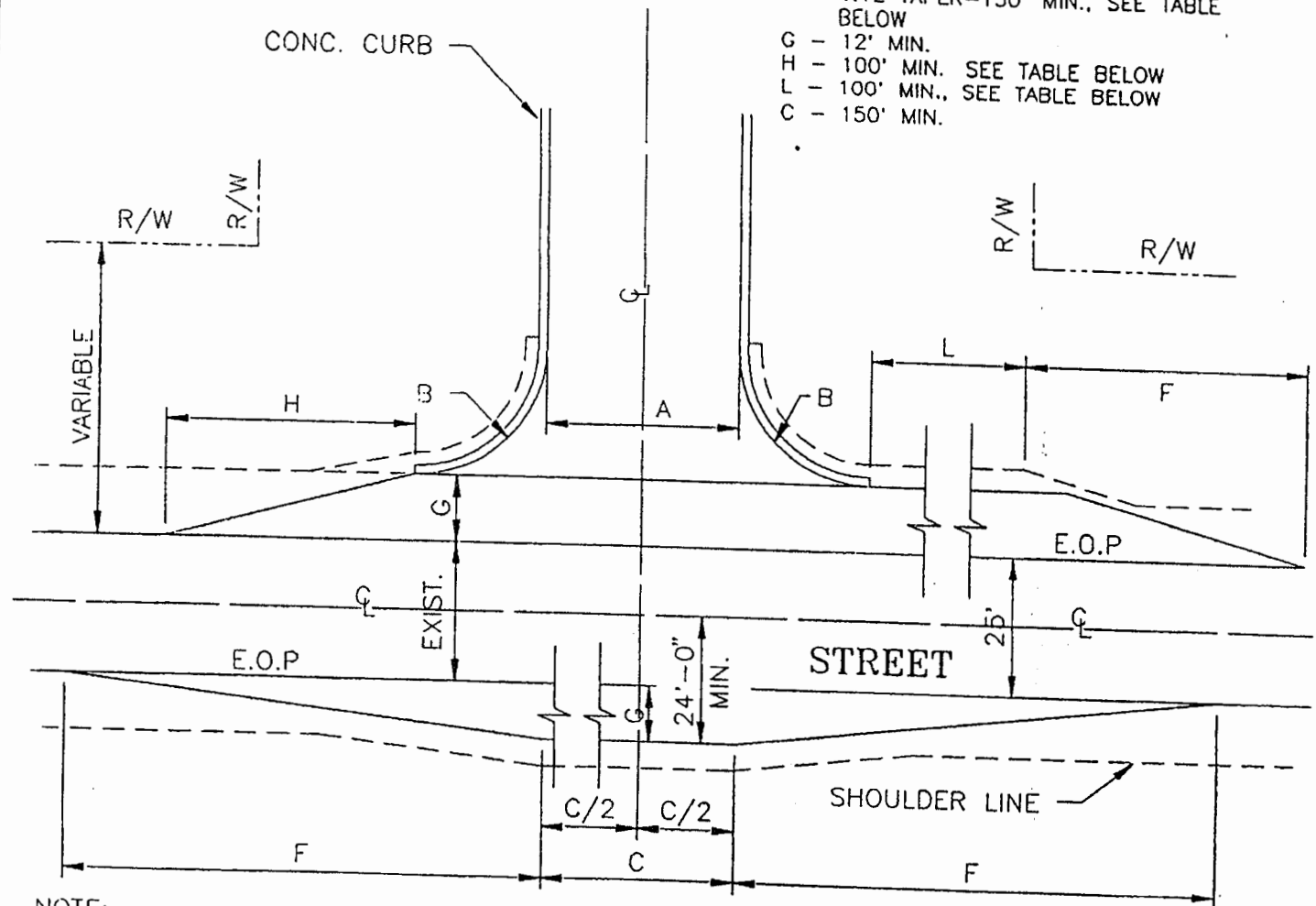
CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-36

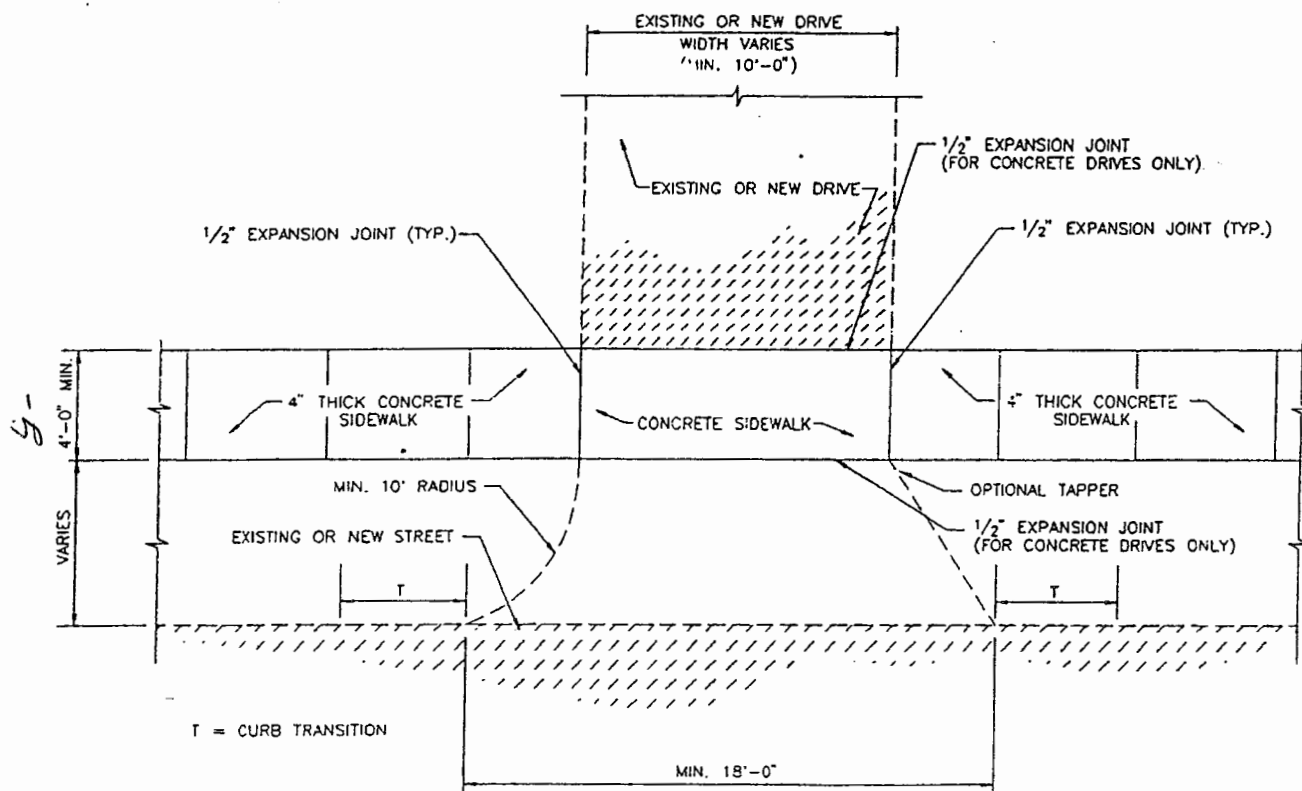
LEGEND

- A - TOWN PUBLIC WORKS STANDARDS, TABLE 4-1
- B - 25' STD., 10' MIN. RADIUS
- F - 1:12 TAPER-150' MIN., SEE TABLE BELOW
- G - 12' MIN.
- H - 100' MIN. SEE TABLE BELOW
- L - 100' MIN., SEE TABLE BELOW
- C - 150' MIN.



- NOTE:
1. PROVIDE LARGER RADIUS, "B", IF DESIGN VEHICLE REQUIRES IT.
 2. WHEN "I" IS OTHER THAN 90° "B" (EDGE RADI) IS TO BE BY APPROVAL OF CITY ENGINEER.


DESIGN SPEED	F + L
30	250 FEET
40	370 FEET
50	500 FEET



NOTES FOR SIDEWALK RAMP:

1. CURB CUT RAMPS ARE TO BE LOCATED AS SHOWN ON THE PLANS OR AS DIRECTED.
2. SURFACE TEXTURE OF THE RAMP SHALL BE NO LESS THAN A BROOM FINISH, BUT SHALL MEET AMERICAN DISABILITIES ACT REQUIREMENTS
3. CARE SHALL BE TAKEN TO ASSURE A UNIFORM GRADE ON ALL RAMPS WITH NO BREAKS IN GRADE.
4. THE NORMAL GUTTER LINE PROFILE SHALL BE MAINTAINED THROUGH THE AREA OF THE RAMP.
5. EXPANSION JOINT FOR THE RAMP SHALL BE A MAXIMUM 1/2" WIDE. THE TOP OF THE JOINT FILLER FOR ALL RAMP TYPES SHALL BE FLUSH WITH ADJACENT CONCRETE.

TYPICAL RESIDENTIAL DRIVE APPROACH DETAIL

NO.	REVISION	DATE	 CITY of NEW BUFFALO MICHIGAN	FIGURE
				5-37

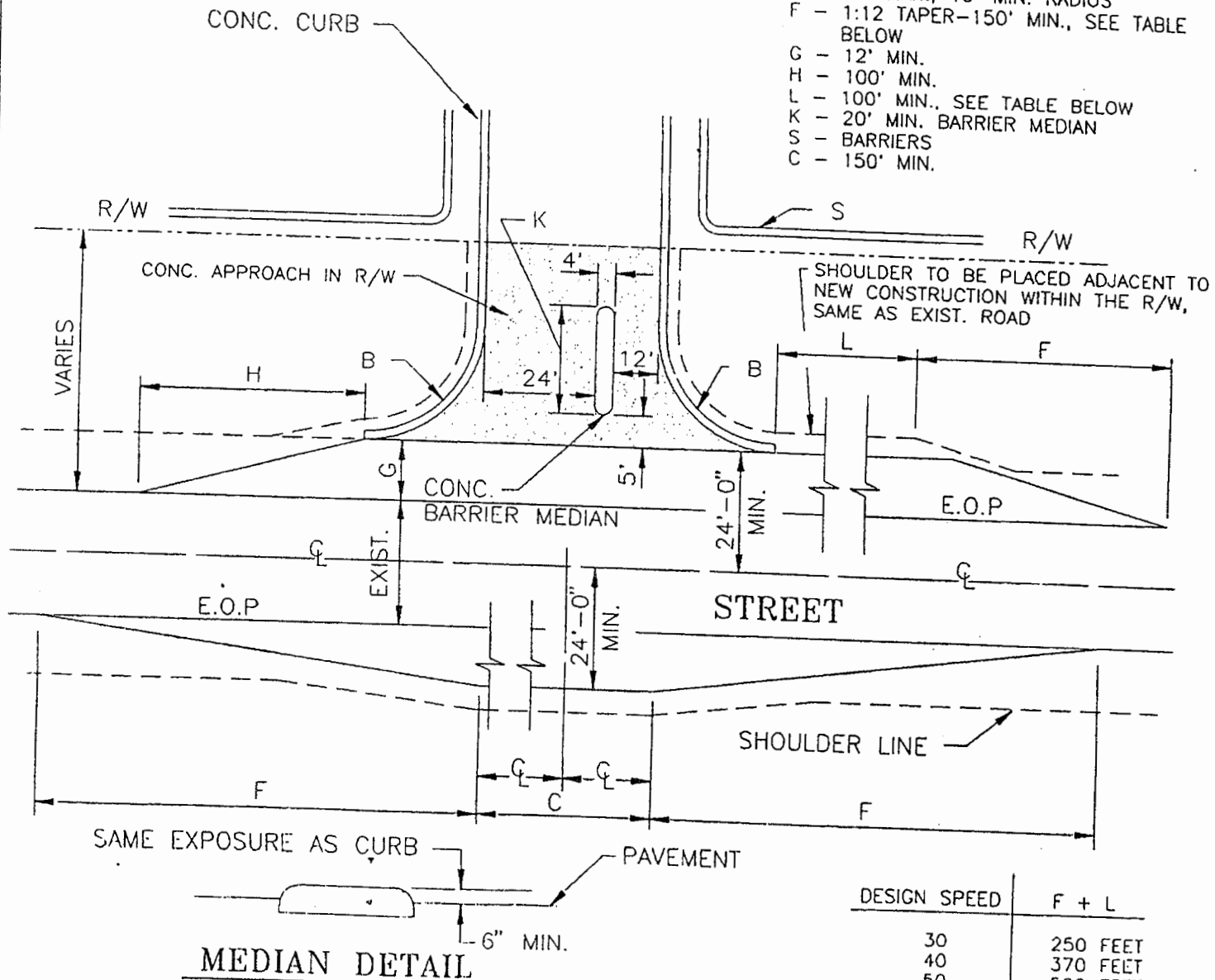
142



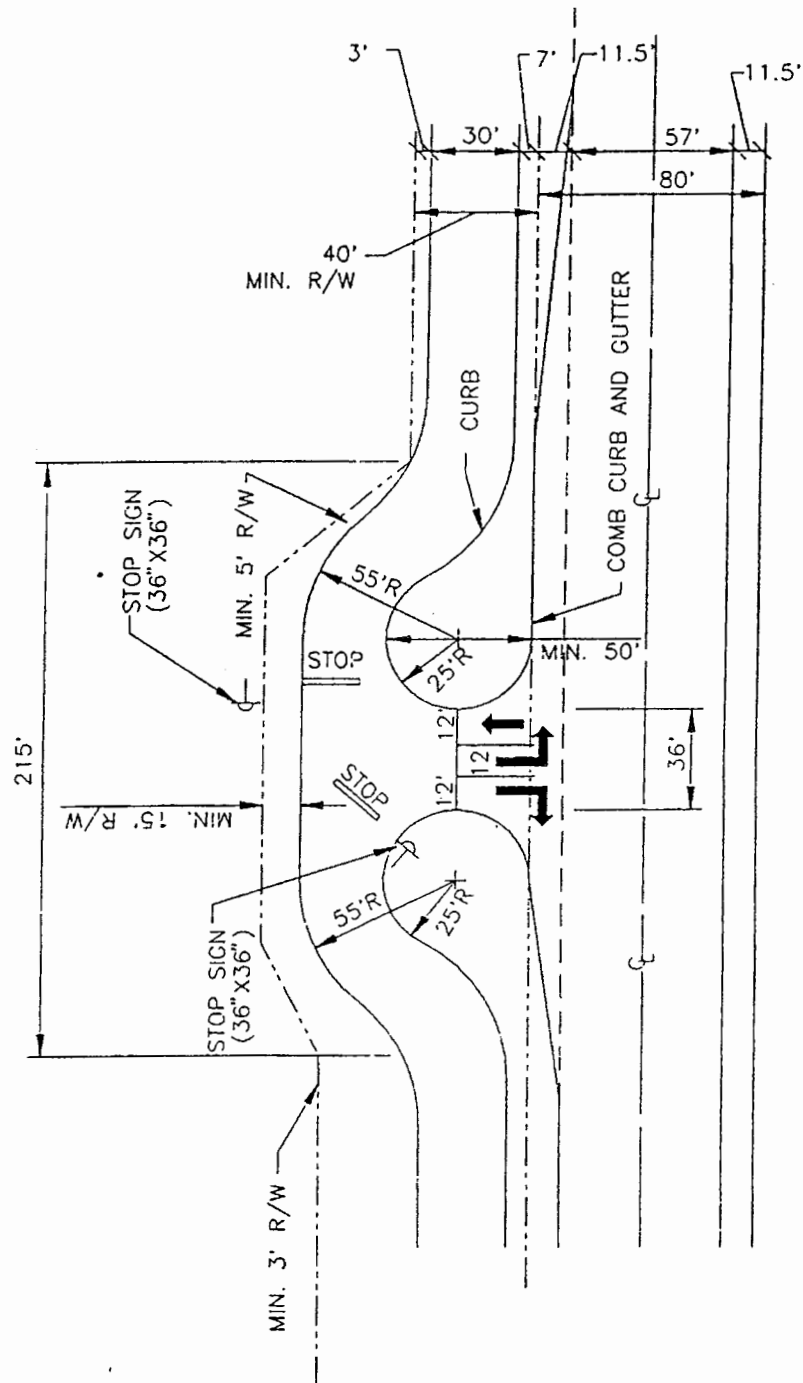
COMMERCIAL DRIVE APPROACH DETAIL – TYPE II

NOTE: PROVIDE LARGER RADIUS, "B" IF
DESIGN VEHICLE REQUIRES IT.

A - 40'
B - 25' MAX., 10' MIN. RADIUS
F - 1:12 TAPER-150' MIN., SEE TABLE
BELOW
G - 12' MIN.
H - 100' MIN.
L - 100' MIN., SEE TABLE BELOW
K - 20' MIN. BARRIER MEDIAN
S - BARRIERS
C - 150' MIN.



DESIGN SPEED	F + L
30	250 FEET
40	370 FEET
50	500 FEET



TYPICAL SERVICE ROAD ENTRANCE

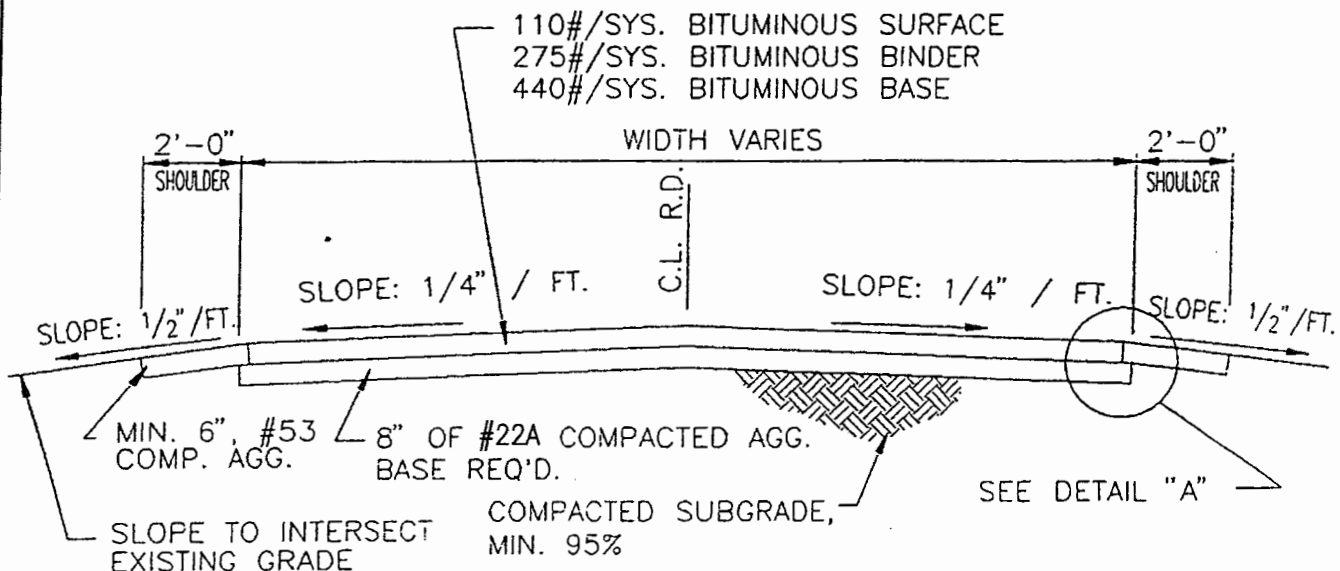
NO.	REVISION	DATE



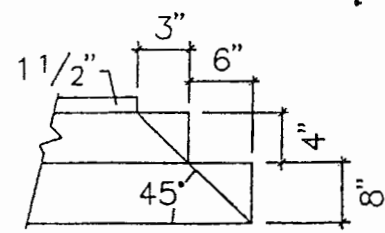
CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-40




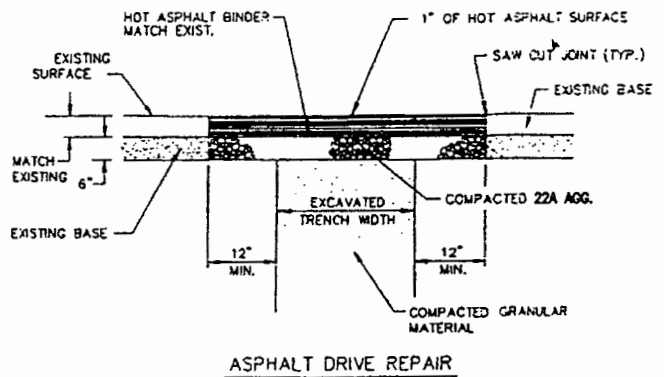
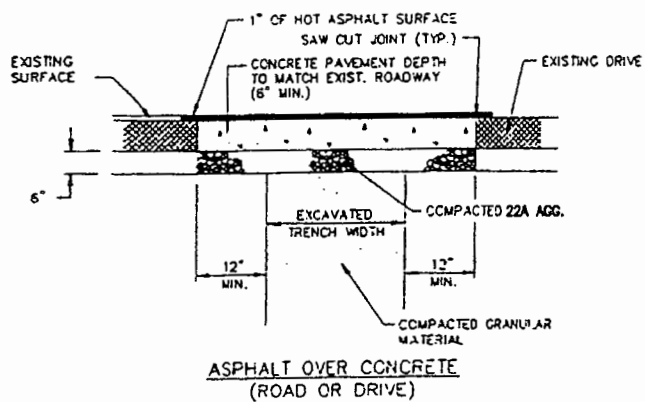
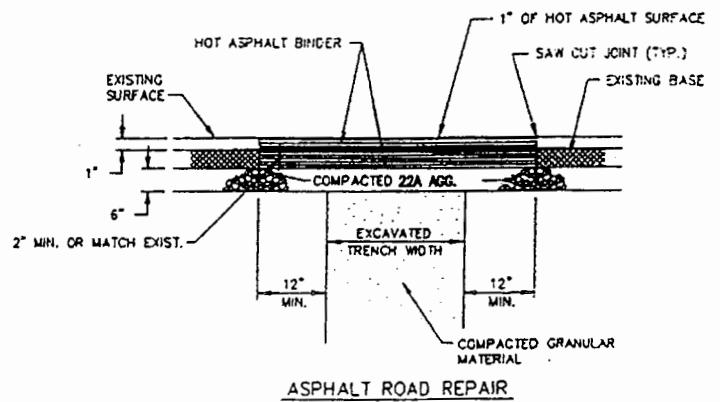
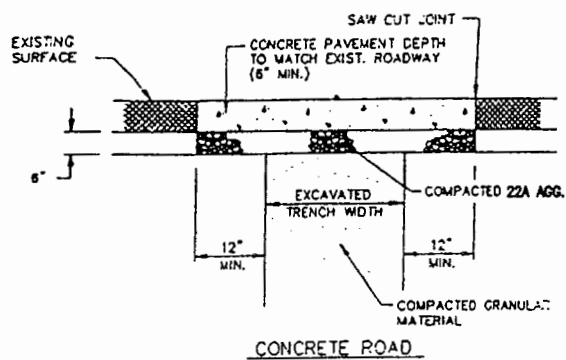
NOTE: ALL BITUMINOUS TO BE TYPE "LV" OR BETTER.




DETAIL "A"

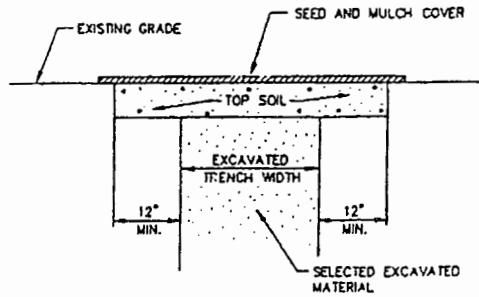
TYPICAL SECONDARY ROAD REPLACEMENT OPEN SECTION

NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-41

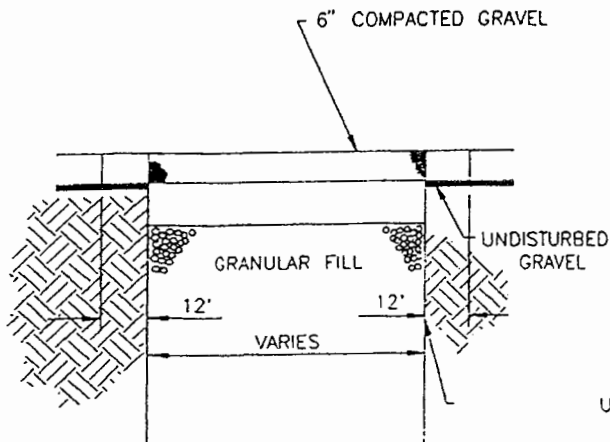


STREET AND DRIVE REPAIR DETAILS

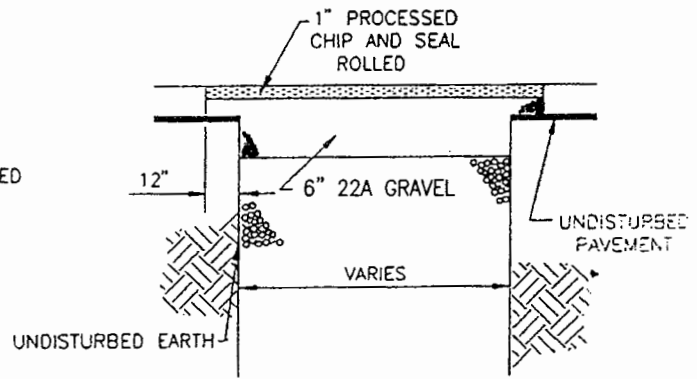
NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-42



GRASSED AREA



GRAVEL STREET REPAIR



CHIP & SEAL REPAIR

NOTE:

ALL STREETS ROADS & PAVED DRIVE CROSSINGS ARE TO BE BACKFILLED WITH GRANULAR MATERIAL & TOPPED WITH 10' OF 22A STONE OR APPROVED MATERIAL DURING CONSTRUCTION PRIOR TO FINAL PAVEMENT REPAIR

STREET AND DRIVE REPAIR DETAILS


NO.	REVISION	DATE

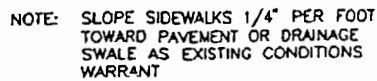


CITY of NEW BUFFALO
MICHIGAN

FIGURE


5-43

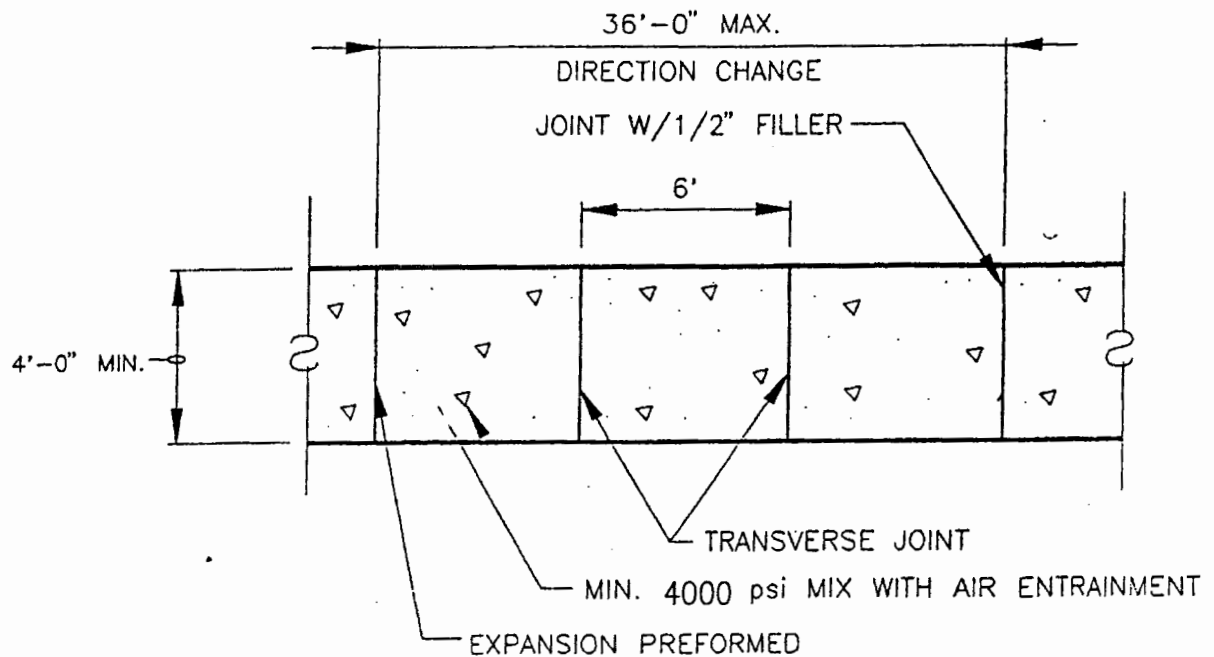
NO.	REVISION	DATE	 <div style="text-align: center;"> CITY of NEW BUFFALO MICHIGAN </div>	FIGURE
				5-44

[illegible]

This diagram illustrates a cross-section of a curb and gutter repair. Key components and dimensions include:

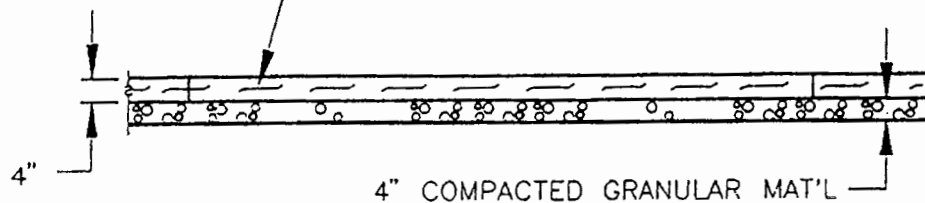
- PAVEMENT REPAIR:** Indicated by a hatched area on the left.
- PAVEMENT:** The existing road surface.
- GRANULAR BACKFILL:** Material used for the base and under the repair.
- 12 3/4" CURB REPLACEMENT:** The new curb section on the left.
- LONGITUDINAL DUMMY JOINT:** A joint in the concrete curb.
- SLOPE 1/4" 1 FT.:** The slope of the pavement surface.
- CONC. WALK:** Concrete walkway on the right.
- COMPACTED SUBBASE:** The base layer under the concrete walk.
- GRANULAR BACKFILL:** Material under the concrete walk.
- 11 1/2" R:** Radius of the curb corner.
- 8":** Width of the curb top.
- 4":** Width of the concrete walk.
- 6":** Width of the granular backfill under the curb.
- 10" MIN.:** Minimum width of the pavement repair.
- 12 3/4" R:** Radius of the curb corner.
- LIMITS OF EXIST. CURB:** Boundary of the existing curb.
- VARIABLE:** Indicated for the width of the granular backfill under the concrete walk.

NO.	REVISION	DATE	 <div style="text-align: center;"> CITY of NEW BUFFALO MICHIGAN </div>	FIGURE
				5-45

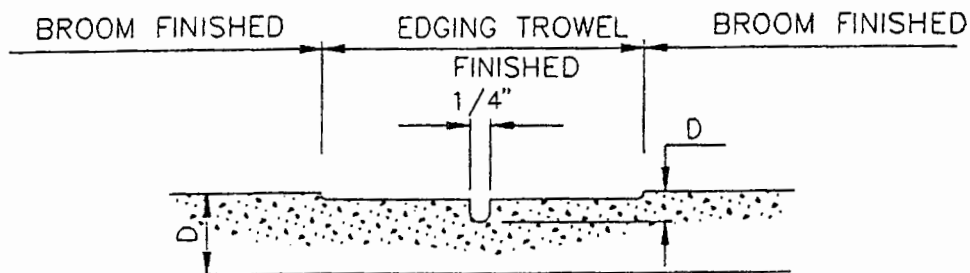


4 X 4-1.4 X 1.4 WWF
PLACED AT MID DEPTH

SIDEWALK PLAN



SIDEWALK SECTION



TRANSVERSE JOINT DETAIL

TYPICAL SIDEWALK DETAIL

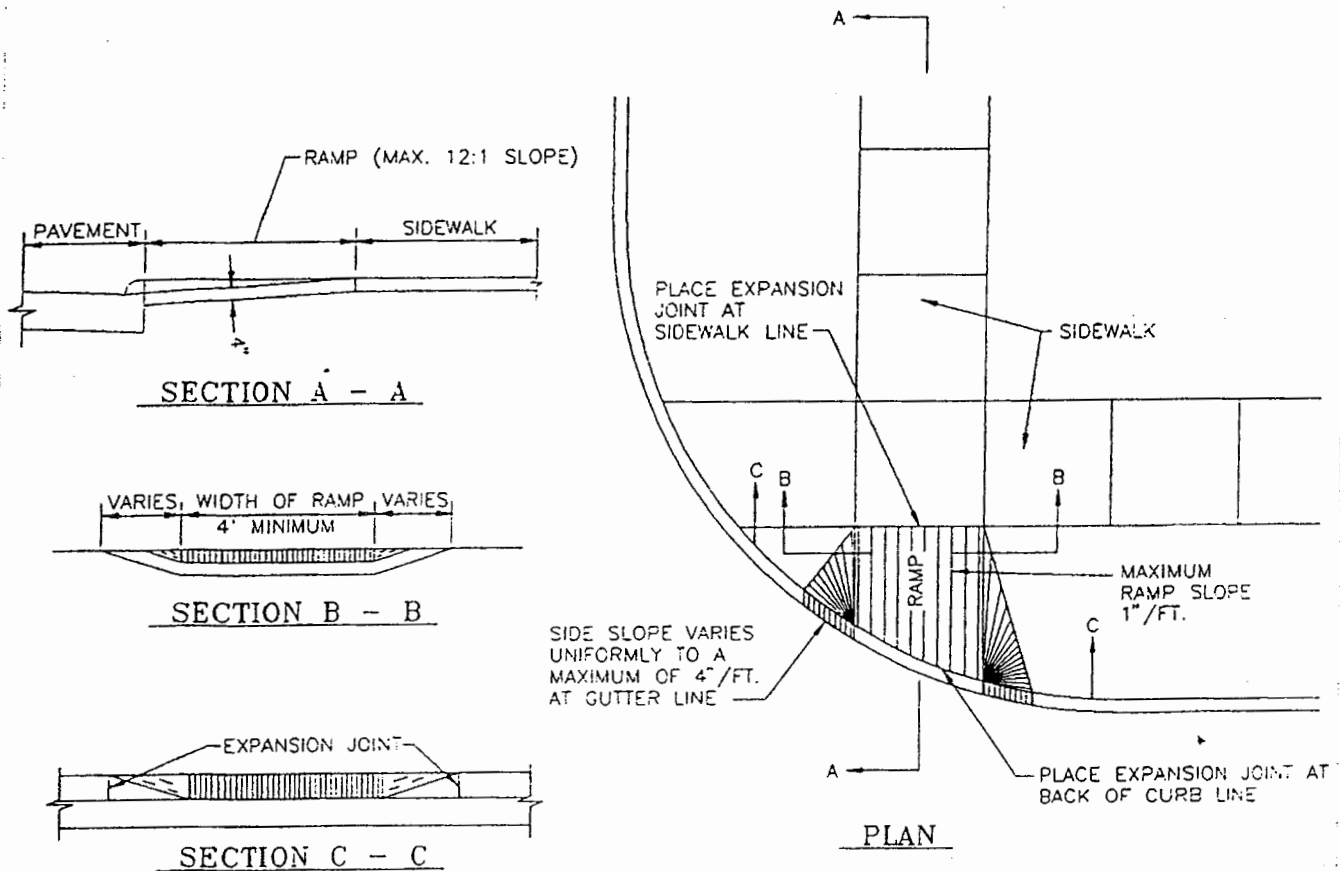
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-46



SIDEWALK RAMP DETAIL

NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-47

38

ROAD
CONSTRUCTION
NEXT 10 MILES

G20-1
60" X 36"

39

END
CONSTRUCTION

G20-2
60" X 24"

40

END
ROAD WORK

G20-2
60" X 24"

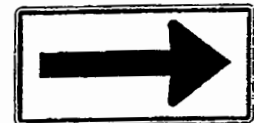
41 42

DETOUR
→

M4-9(R or L)
30" X 24"

M4-9-B(R or L)
60" X 48"

43 44



W1-6
48" X 24"

45

ROAD
CLOSED

R11-2
48" X 30"

46

ROAD CLOSED
10 MILES AHEAD
LOCAL TRAFFIC ONLY

R11-3
60" X 30"

47

ROAD CLOSED
TO
THRU TRAFFIC*

R11-4
60" X 30"

TRAFFIC CONTROL SIGN DETAILS

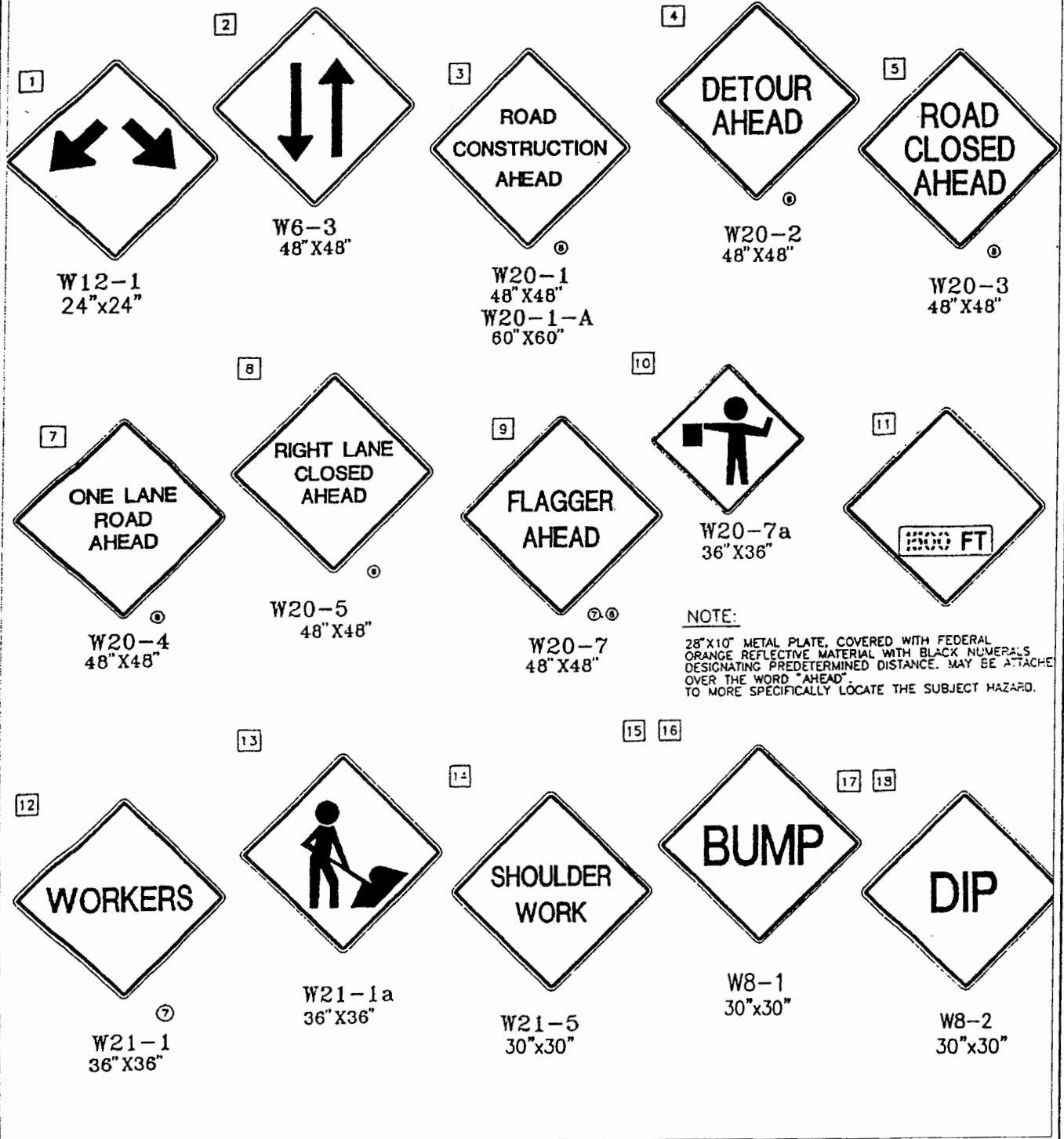
NO.	REVISION	DATE




CITY of NEW BUFFALO
MICHIGAN

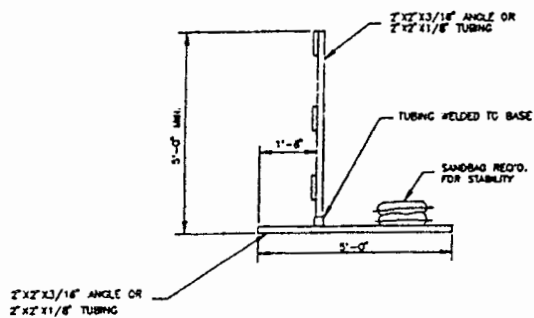
FIGURE

5-48

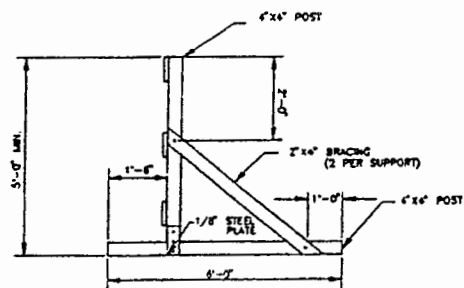


TRAFFIC CONTROL SIGN DETAILS

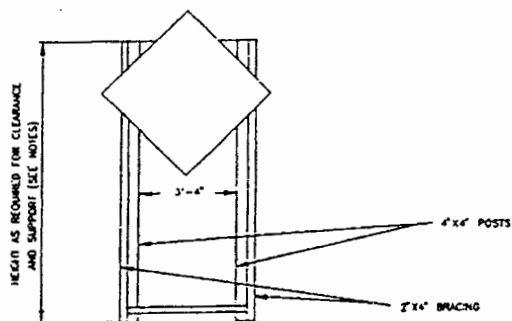
NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-49



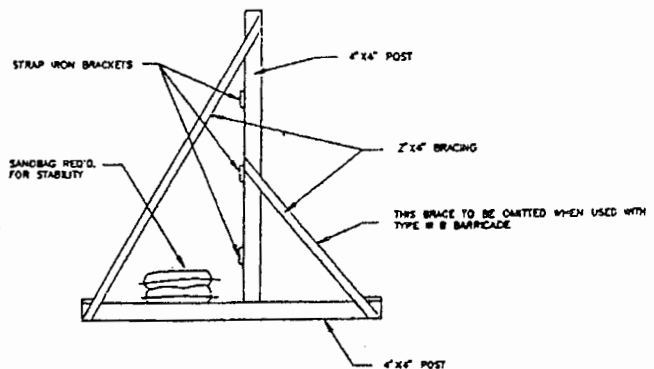
STEEL SUPPORTS



WOOD SUPPORTS



DETAIL OF TYPICAL SIGN STANDARD (T.S.S.)



TRAFFIC CONTROL SIGN STANDARD DETAILS

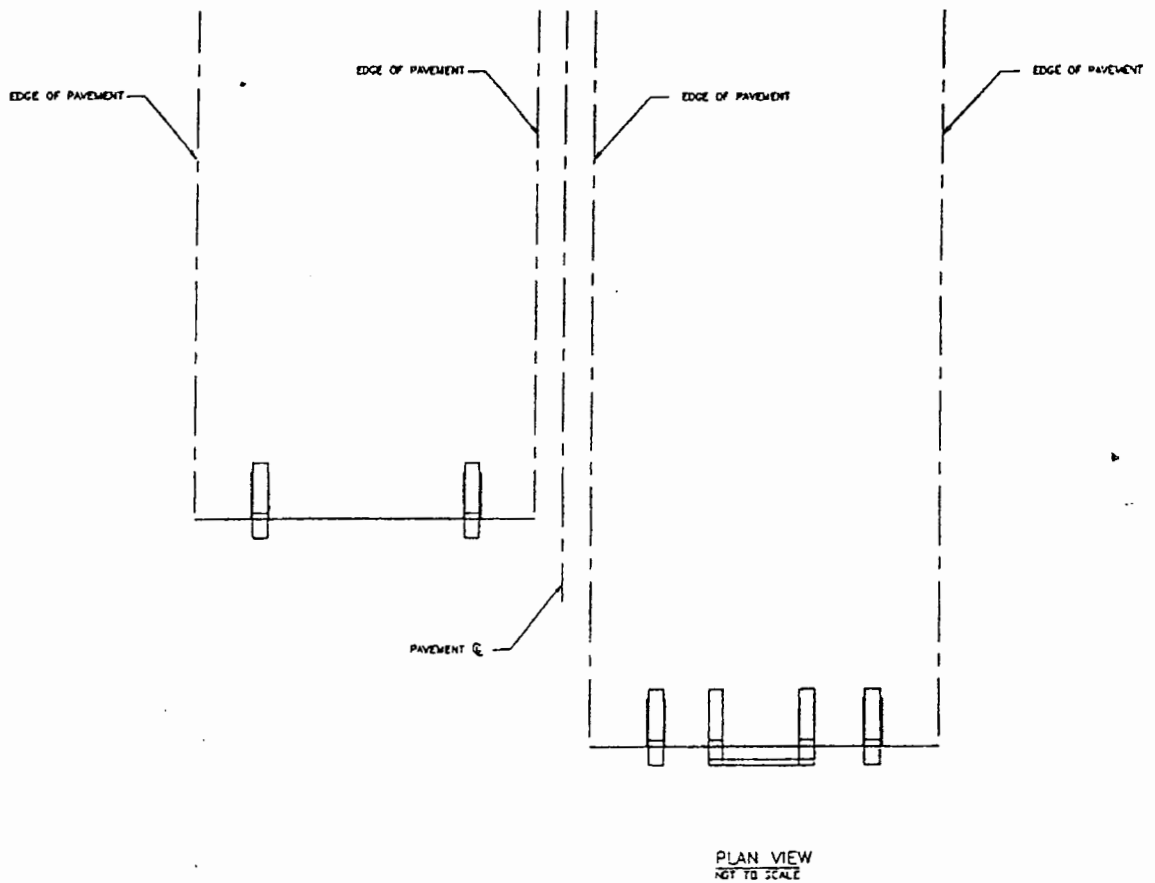
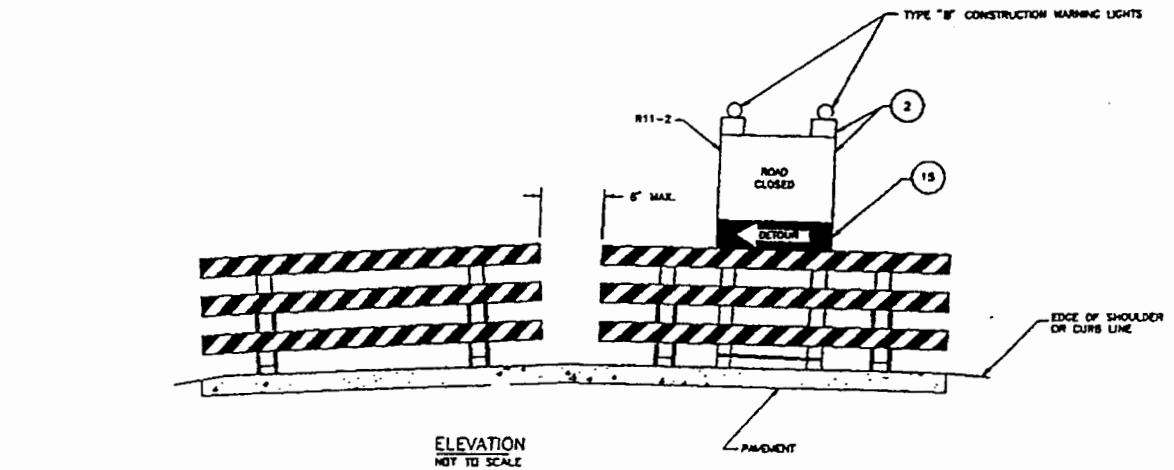
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-50



TRAFFIC CONTROL BARRICADE DETAILS

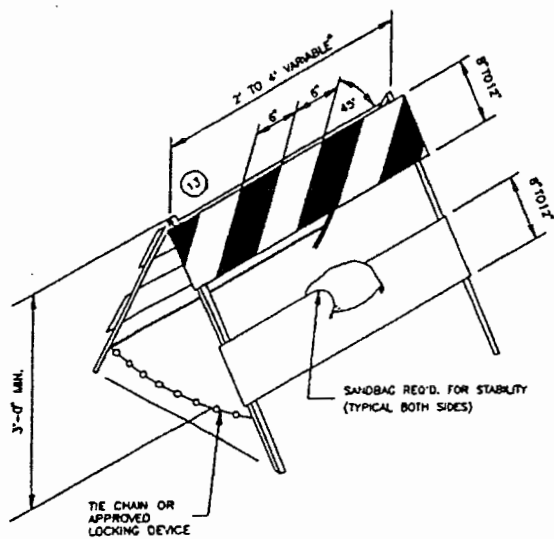
NO.	REVISION	DATE



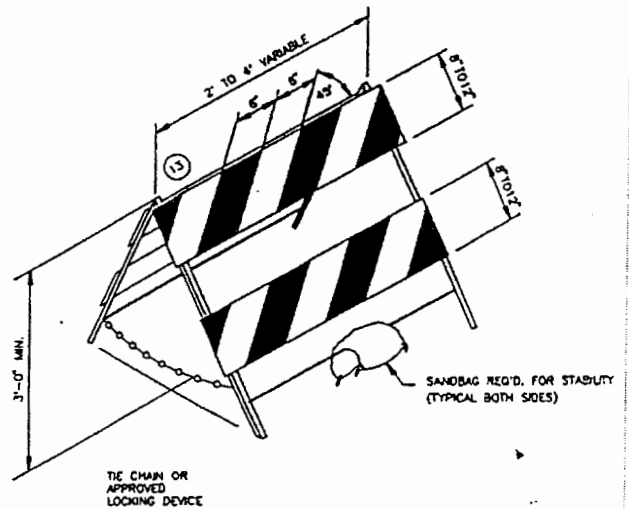
CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-51



BARRICADE TYPE I



BARRICADE TYPE II

TRAFFIC CONTROL BARRICADE TYPE I AND II DETAILS

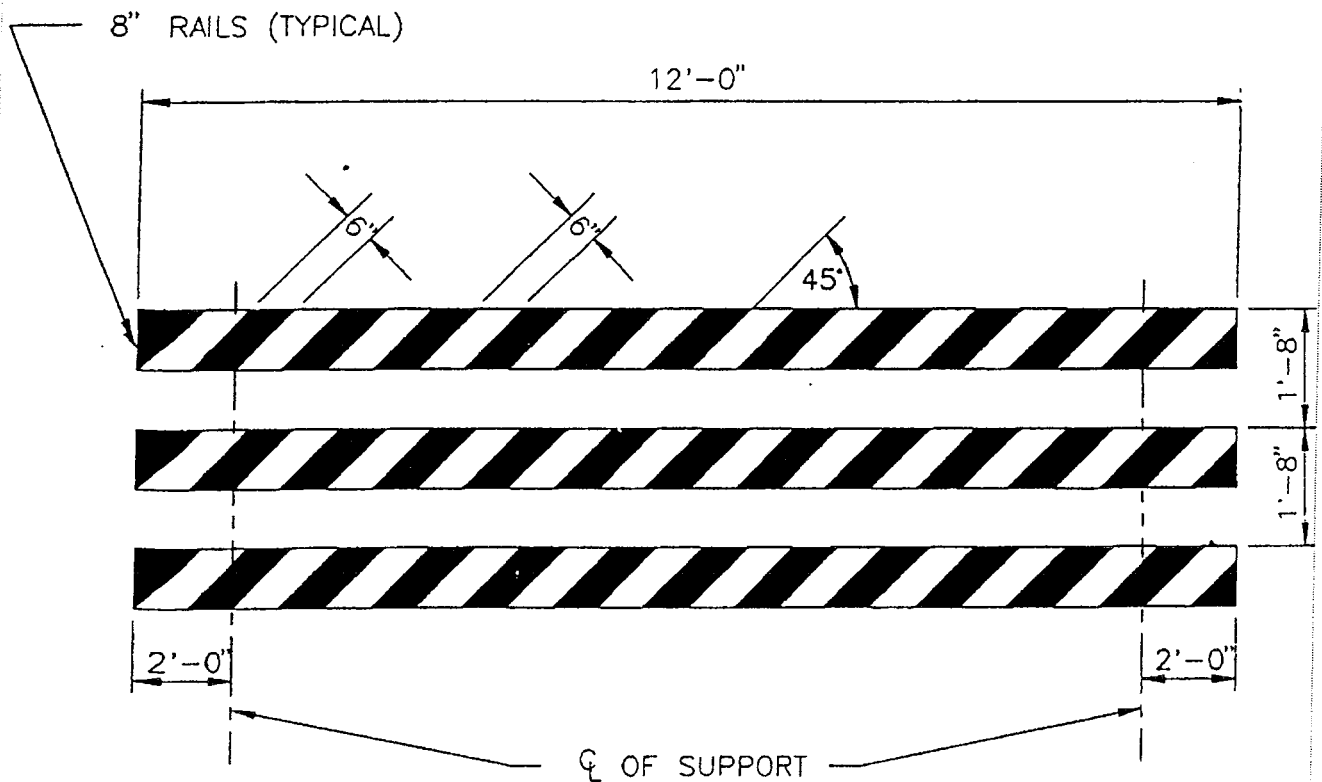
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN


FIGURE

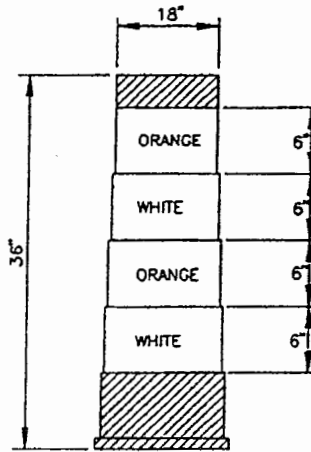
5-52



NOTE: RAILS SHALL BE REFLECTORIZED
ON BOTH SIDES

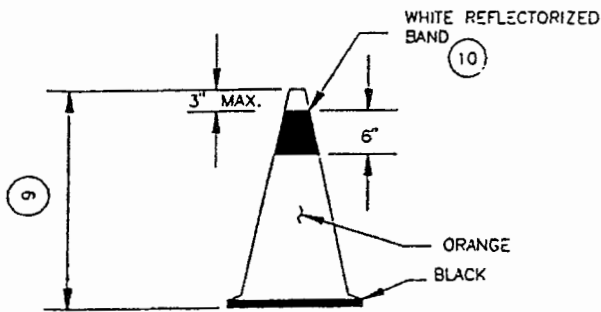
TRAFFIC CONTROL BARRICADE TYPE III - B DETAILS

NO.	REVISION	DATE	 <p>CITY of NEW BUFFALO MICHIGAN</p>	FIGURE
				5-53

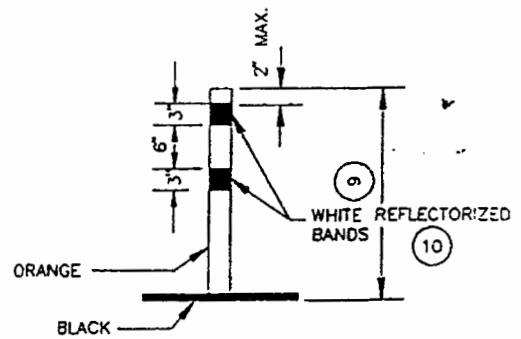


 BLACK OR OTHER APPROVED COLOR

STANDARD DRUM




STANDARD CONE



STANDARD TUBULAR MARKER

TRAFFIC CONTROL CONE/DRUM/TUBULAR MARKER DETAILS

NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-54

GENERAL NOTES

1. TEMPORARY CONCRETE BARRIER SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS, INDOT, LATEST EDITION.
2. TEMPORARY CONCRETE BARRIER SHALL BE DELINEATED AS SHOWN. TYPE "C" CONSTRUCTION WARNING LIGHTS SHALL BE ATTACHED AS SHOWN AND SHALL BE SPACED NUMERICALLY EQUAL TO THE 85 PERCENTILE SPEED WITH A MINIMUM SPACING OF 20' C-C. WIDE ANGLE REFLECTORS SHALL BE MOUNTED AS SHOWN AND SHALL BE REQUIRED ON BOTH SIDES OF THE BARRIER WHEN THE BARRIER IS USED TO SEPARATE OPPOSING TRAFFIC.
3. THE DIMENSION OF THE LIFTING SLOTS ARE SUBJECT TO ADJUSTMENT AS NECESSARY TO ACCOMMODATE HANDLING EQUIPMENT.
4. HEX NUT MAY BE TACK WELDED TO BOTTOM SPACER TO FACILITATE INSTALLATION AND REMOVAL. BOLTS SHALL BE TIGHTENED ONLY TO TIGHT CONDITION. CLEARANCE BETWEEN SPACER AND THE ENDS OF THE BARRIER SHOULD ALLOW ANGULAR DEFLECTION AT THE JOINTS TO PERMIT FLARE RATE OF 10:1.
5. WHEN ANCHORING AGAINST LATERAL MOVEMENT IS SPECIFIED FOR TEMPORARY CONCRETE BARRIER LOCATED ON CONCRETE OR BITUMINOUS PAVEMENT OR SHOULDER, THE METHOD OF ANCHORING SHALL BE AS SHOWN AND SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS, INDOT, LATEST EDITION.

1. TEMPORARY CONCRETE BARRIER SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS, INDOT, LATEST EDITION.
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3. THE DIMENSION OF THE LIFTING SLOTS ARE SUBJECT TO ADJUSTMENT AS NECESSARY TO ACCOMMODATE HANDLING EQUIPMENT.
4. HEX NUT MAY BE TACK WELDED TO BOTTOM SPACER TO FACILITATE INSTALLATION AND REMOVAL. BOLTS SHALL BE TORQUED ONLY TO TIGHT CONDITION. CLEARANCE BETWEEN SPACER S1 AND THE ENDS OF THE BARRIER SHOULD ALLOW ANGULAR DEFLECTION AT THE JOINTS TO PERMIT FLARE RATE OF 10:1.
5. WHEN ANCHORING AGAINST LATERAL MOVEMENT IS SPECIFIED FOR TEMPORARY CONCRETE BARRIER LOCATED ON CONCRETE OR BITUMINOUS PAVEMENT OR SHOULDER, THE METHOD OF ANCHORING SHALL BE AS SHOWN AND SHALL BE ACCORDANCE WITH THE STANDARD SPECIFICATIONS, INDOT, LATEST EDITION.

TRAFFIC CONTROL CONCRETE BARRIER GENERAL NOTES


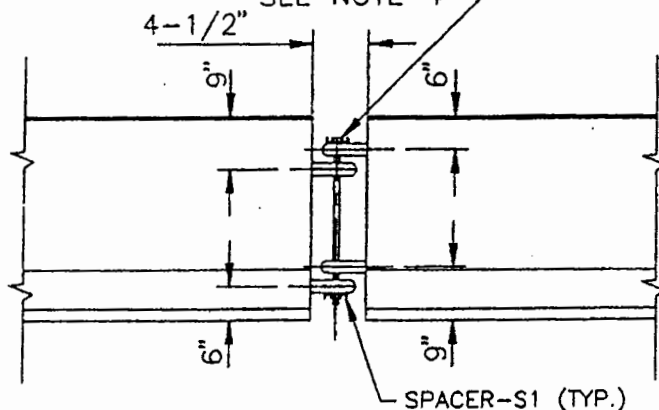
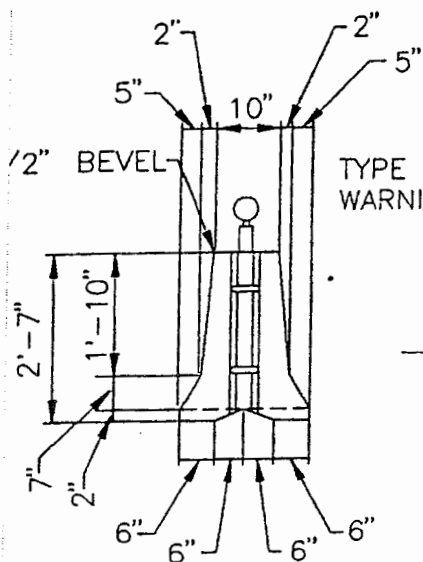
NO.	REVISION	DATE	 <div style="text-align: center;"> CITY of NEW BUFFALO MICHIGAN </div>	FIGURE
				5-55

TABLE NO. 1	
CONSTR. ZONE SPEED	TAPER FLARE RATE
20	10:1

1" DIA. BOLT X 1'-10 (4" MIN. THREAD, HEX HEAD AND HEX NUT)
SEE NOTE 4

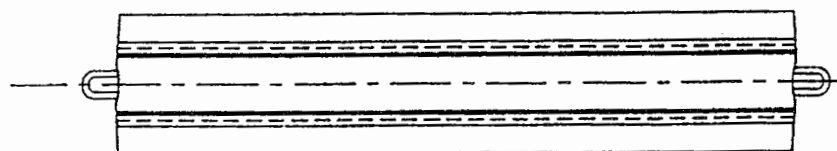


FRONT VIEW
NOT TO SCALE

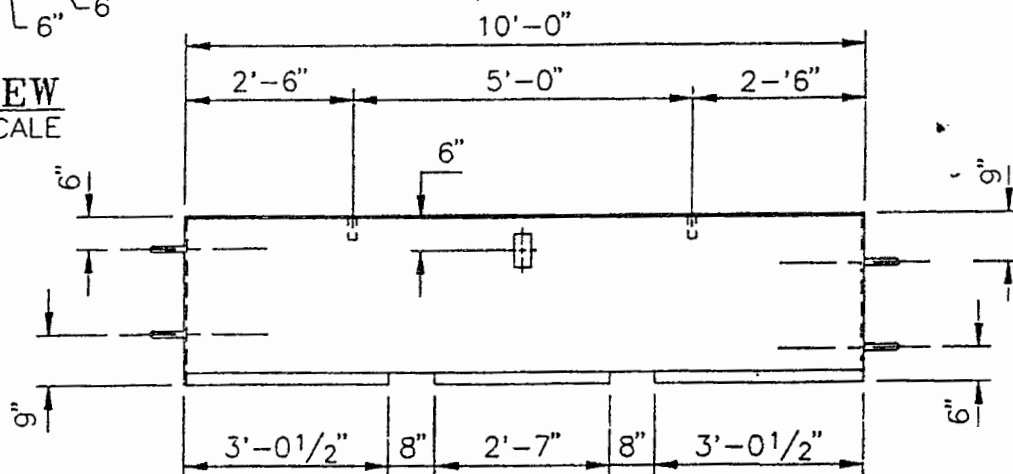


END VIEW
NOT TO SCALE

TYPE "C" CONSTRUCTION
WARNING LIGHT



TOP VIEW
NOT TO SCALE



FRONT VIEW
NOT TO SCALE

TRAFFIC CONTROL CONCRETE BARRIER DETAIL

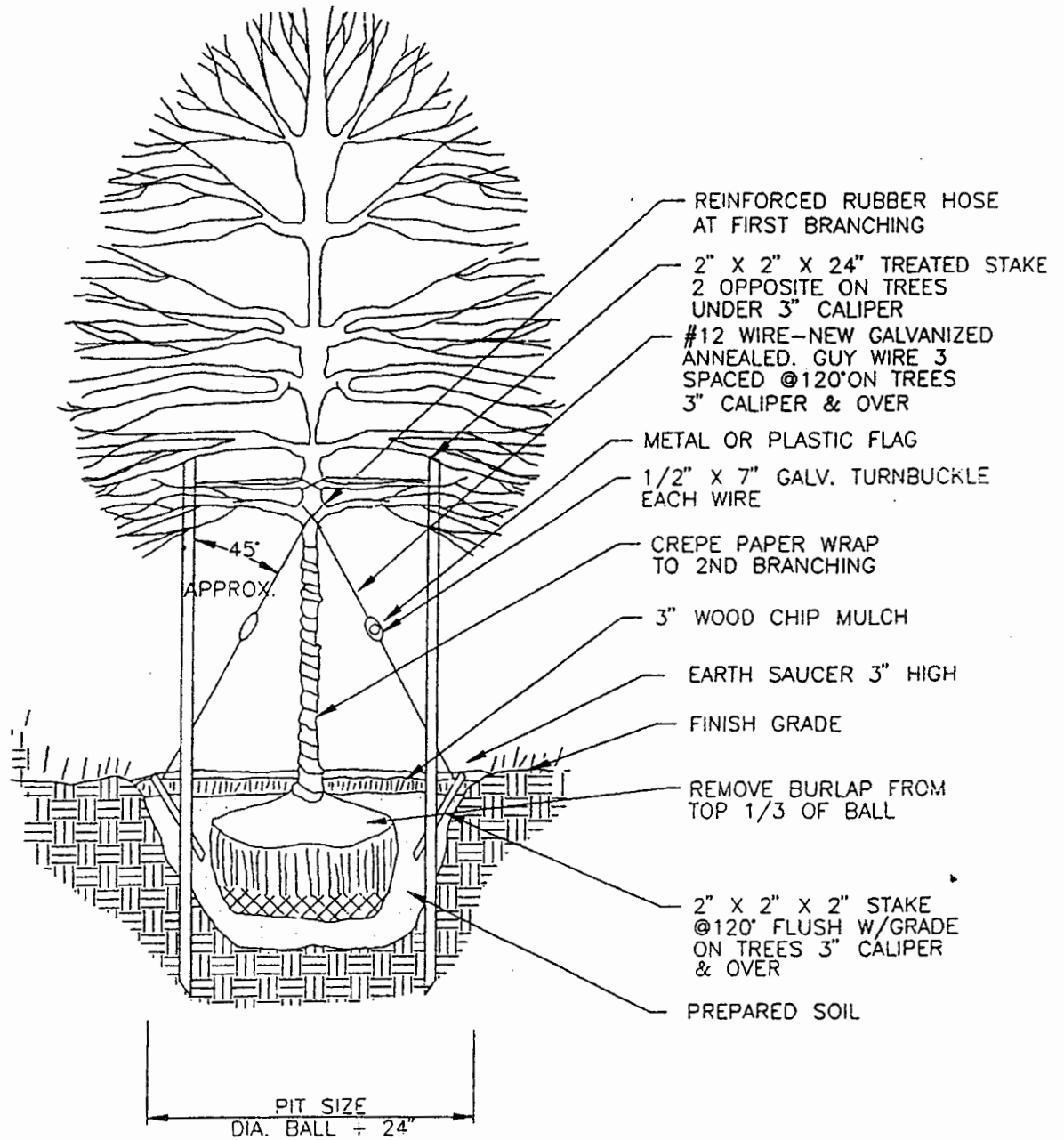
NO.	REVISION	DATE




CITY of NEW BUFFALO
MICHIGAN

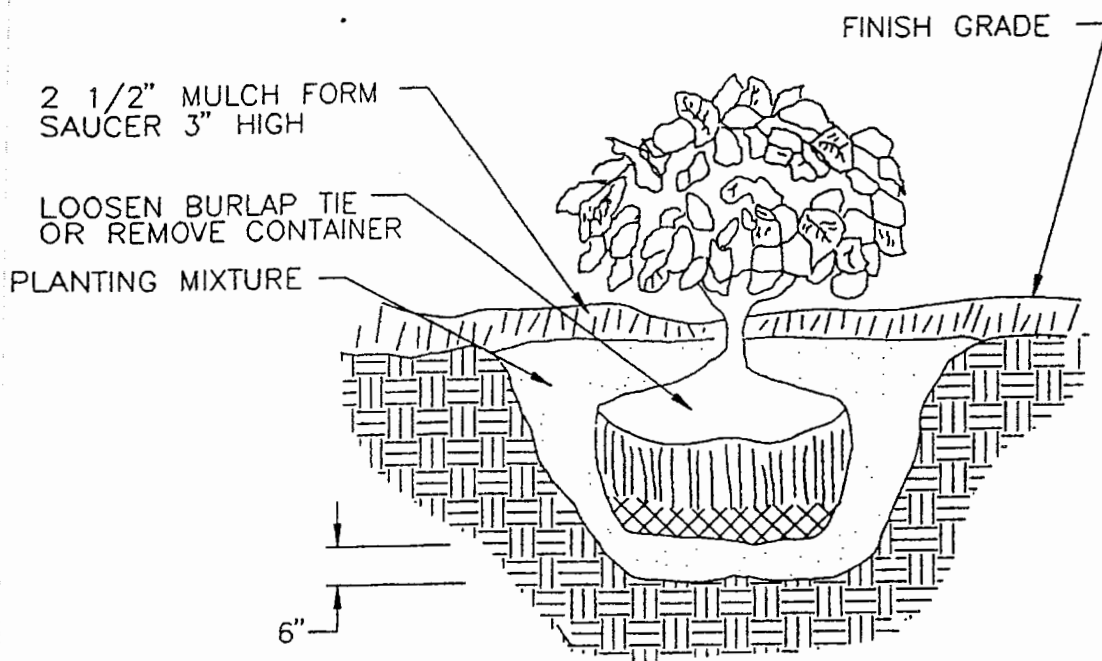
FIGURE

5-56



TREE PLANTING DETAIL

NO.	REVISION	DATE	 CITY of NEW BUFFALO MICHIGAN	FIGURE
				5-57

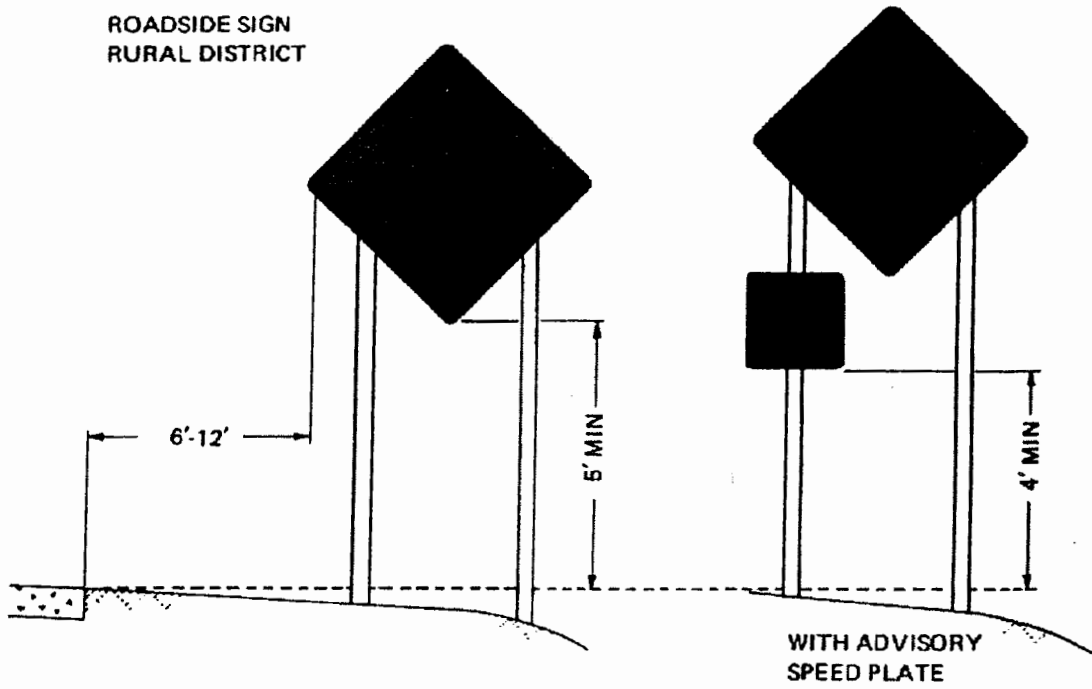


SHRUB PLANTING DETAIL

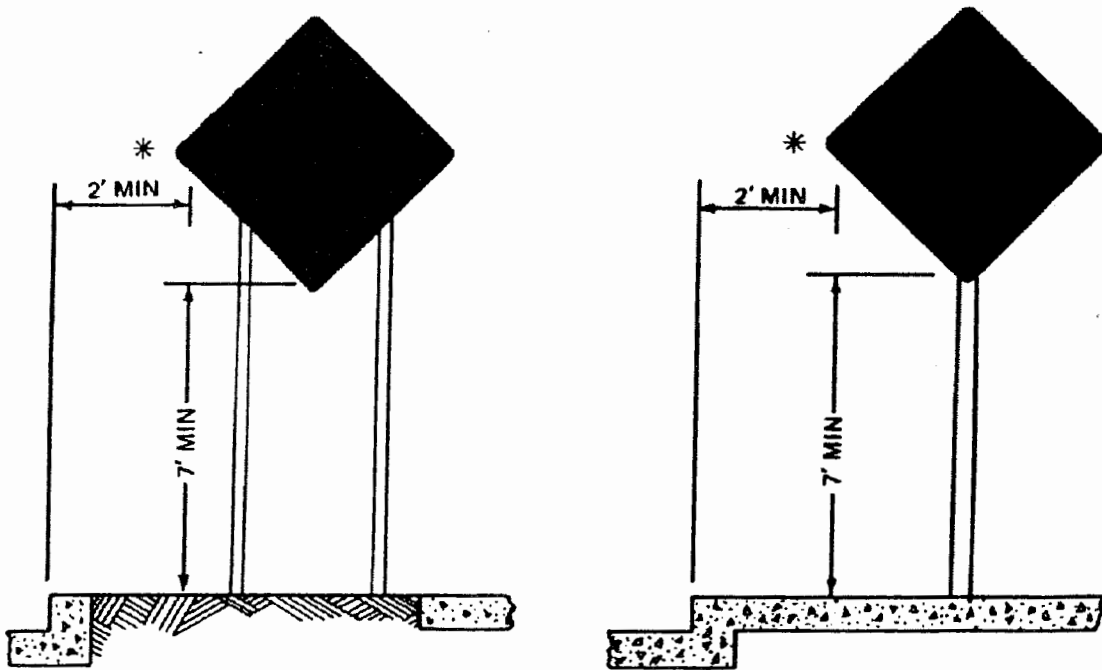
NO.	REVISION	DATE	CITY of NEW BUFFALO MICHIGAN	FIGURE
				5-58



ROADSIDE SIGN
RURAL DISTRICT



ROADSIDE SIGN
URBAN DISTRICT



ROADSIDE SIGNS

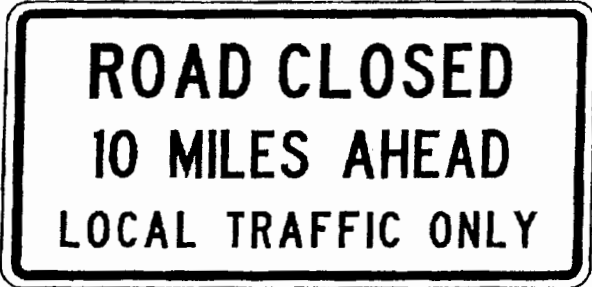
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

5-59



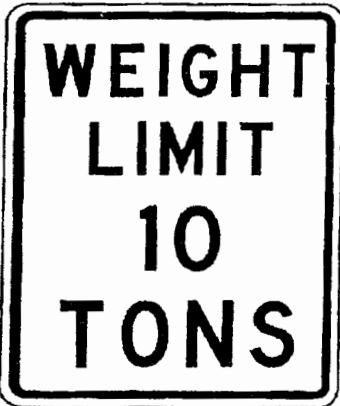
R11-3
60" x 30"



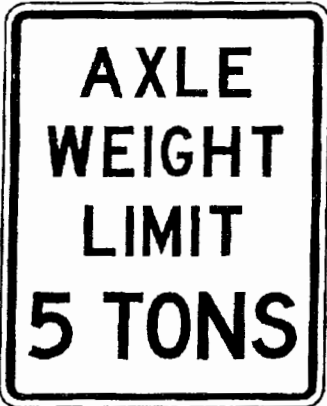
R11-4
60" x 30"



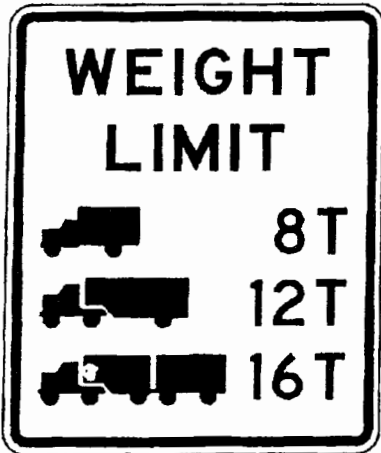
R11-2
48" x 30"



R12-1
24" x 30"



R12-2
24" x 30"



R2-5
30" x 36"

ROAD CLOSED AND
WEIGHT LIMIT SIGNS

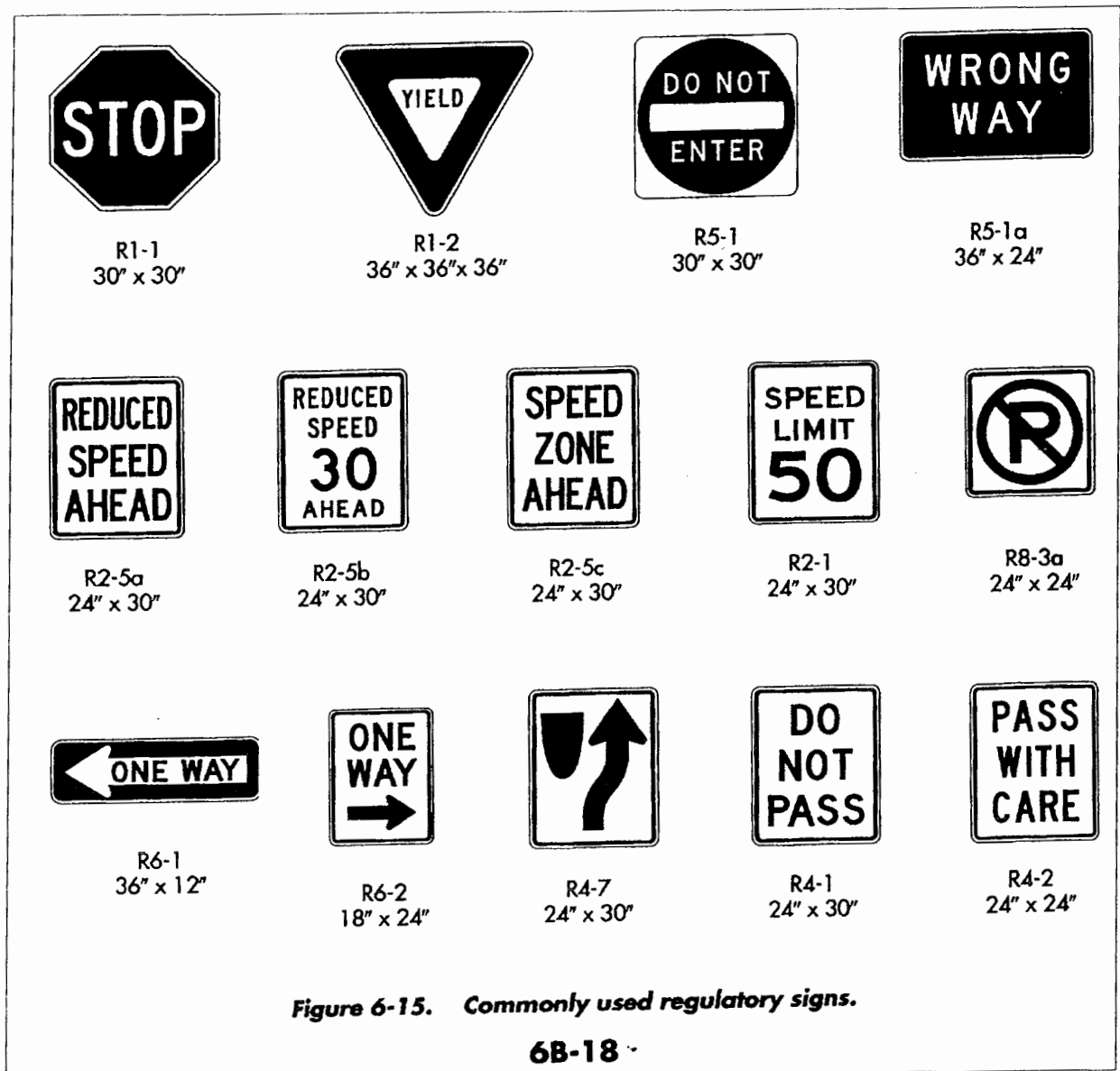
NO.	REVISION	DATE




CITY of NEW BUFFALO
MICHIGAN

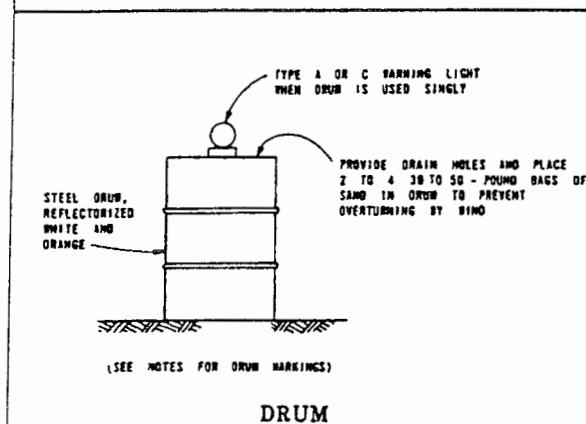
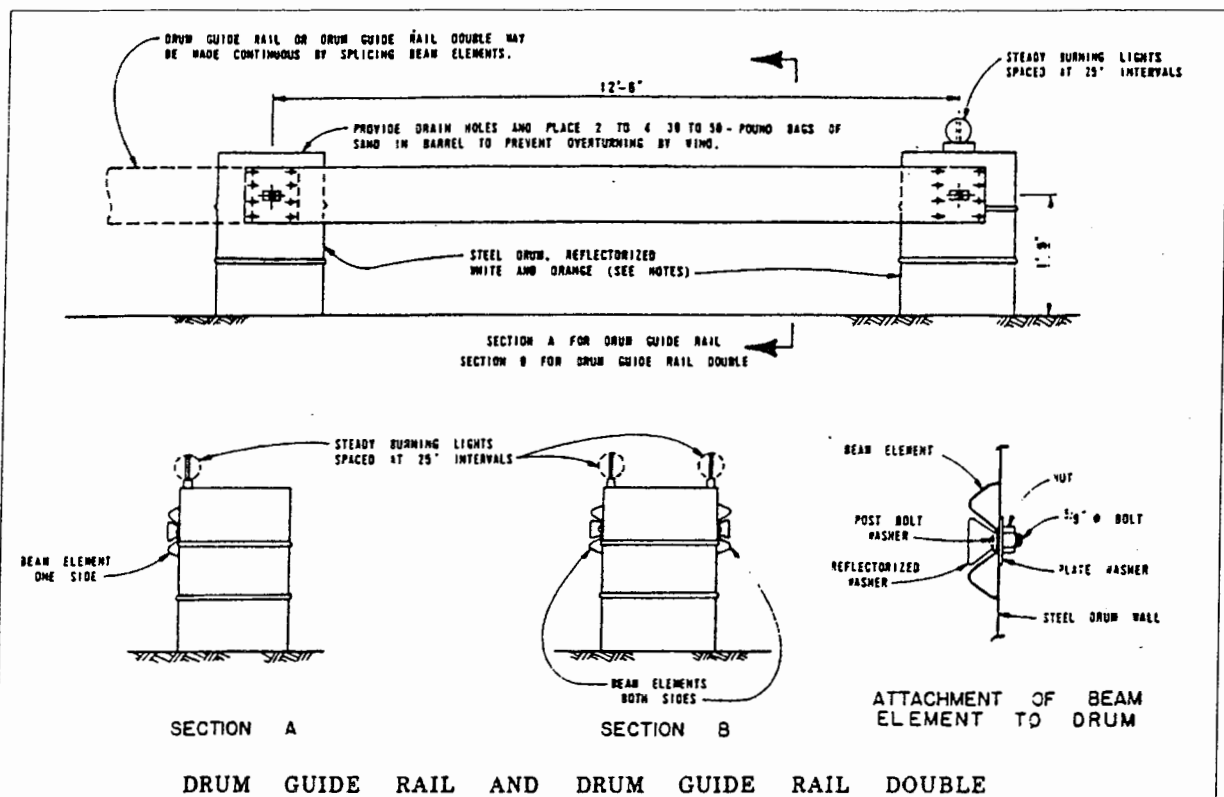
FIGURE

5-60



REGULATORY SIGNS

NO.	REVISION	DATE	 CITY of NEW BUFFALO MICHIGAN	FIGURE
				5-61



DRUM
SYMBOLS

DRUM GUIDE RAIL	-----	•••••
EXISTING DRUM GUIDE RAIL	-----	○••••
DRUM GUIDE RAIL DOUBLE	-----	••••••
EXISTING DRUM GUIDE RAIL DOUBLE	-----	○••••○
DRUM	-----	•
EXISTING DRUM	-----	○

NOTES:

DRUM GUIDE RAIL BEAM ELEMENTS AND SPLICES SHALL CONFORM TO CURRENT STANDARD SPECIFICATIONS AND CURRENT STANDARD PLAN 33-60 SERIES, EXCEPT BEAM ELEMENTS SHALL BE GALVANIZED.

DRUMS FOR "DRUM GUIDE RAIL" SHALL BE A NOMINAL 55 GALLON CAPACITY AND "DRUMS" SHALL BE 30 - 55 GALLON CAPACITY, WITH 18" MINIMUM DIAMETER AND 27" MINIMUM HEIGHT.

DRUMS SHALL BE MARKED WITH HORIZONTAL CIRCUMFERENTIAL ORANGE AND WHITE REFLECTORIZED STRIPES, 4" TO 8" WIDE, WHICH SHALL DISPLAY THE SAME APPROXIMATE SIZE, SHAPE, AND COLOR DAY AND NIGHT. THERE SHALL BE AT LEAST TWO ORANGE AND TWO WHITE STRIPES ON EACH DRUM. ANY NONREFLECTORIZED SPACES, BETWEEN THE HORIZONTAL ORANGE AND WHITE STRIPES, SHALL BE NO MORE THAN 2" WIDE.

REFLECTORIZATION OF DRUMS FOR "DRUM GUIDE RAIL" AND "DRUMS" SHALL CONSIST OF PRESSURE - SENSITIVE REFLECTORIZED SHEETING (TYPE 2).

REFLECTORIZED ORANGE AND WHITE SHEETING SHALL COVER AT LEAST SIXTY (60) PERCENT OF THE DRUM SURFACE.

DRUM GUIDE RAIL SHALL BE SO ALIGNED THAT THE BEAM RAIL ENDING IS NOT EXPOSED TO ONCOMING TRAFFIC.

DRUM GUIDE RAIL SHALL NOT BE USED FOR PHYSICAL REDIRECTION OR CHANNELIZATION OF TRAFFIC.

LOCATION AND SPACING OF DRUMS ARE SHOWN ON STANDARD PLANS V-113 AND V-114 SERIES.

DRUM GUIDE RAILS AND DRUMS

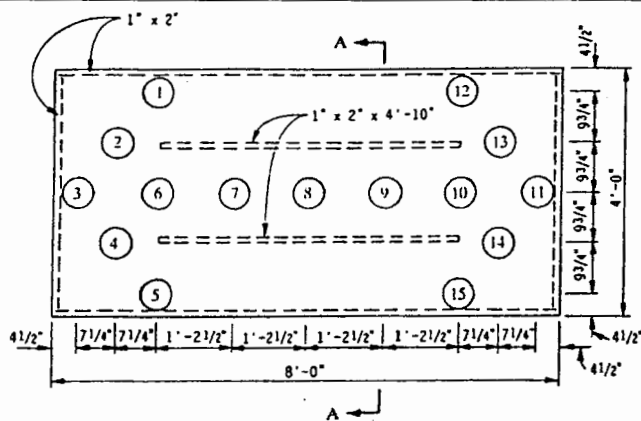
NO.	REVISION	DATE



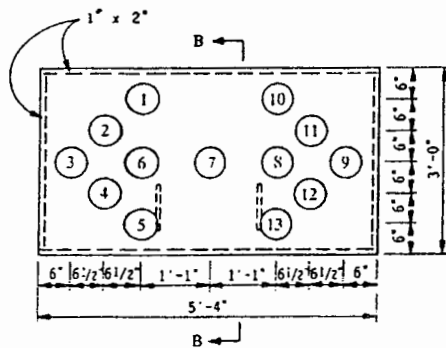
CITY of NEW BUFFALO
MICHIGAN

FIGURE

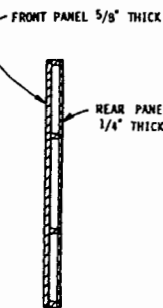
5-62



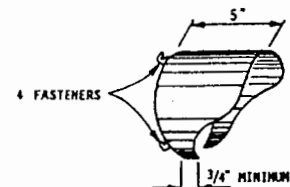
LIGHTED ARROW-TYPE A
(FRONT PANEL-PAINTED FLAT BLACK)



LIGHTED ARROW-TYPE B
(FRONT PANEL-PAINTED FLAT BLACK)



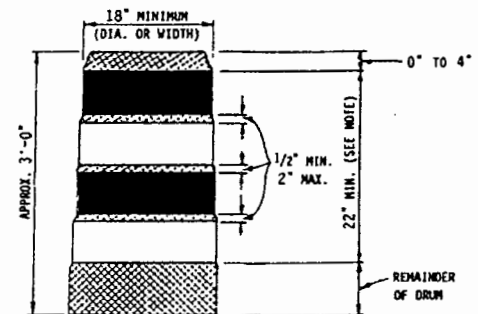
SECTION A-A



VISOR

NOTE:

A STANDARD 6" DIAMETER CUTAWAY VISOR SIMILAR TO THE ONE SHOWN SHALL BE MOUNTED OVER EACH LIGHT. THE ARC ENCLOSED BY THE VISOR SHALL BE A MINIMUM OF 290 DEGREES. THE VISOR SHALL BE OF SHEET CONSTRUCTION AND OF NON-FERROUS, CORROSION-RESISTANT MATERIAL WITH A MINIMUM THICKNESS OF 0.045". IT SHALL BE PAINTED FLAT BLACK INSIDE AND OUT. THE AXIS OF THE VISOR SHALL BE PERPENDICULAR TO THE PANEL.



NOTE: DRUMS SHALL HAVE AT LEAST 4 HORIZONTAL REFLECTORIZED STRIPES (2 ORANGE AND 2 WHITE) OF 4" TO 8" UNIFORM WIDTH, ALTERNATING IN COLOR WITH THE TOPMOST REFLECTORIZED STRIPE BEING ORANGE. NONREFLECTORIZED SPACES BETWEEN THE HORIZONTAL REFLECTORIZED ORANGE AND WHITE STRIPES SHALL BE ORANGE IN COLOR AND EQUAL IN WIDTH.

PLASTIC DRUM

OPERATION MODES USE LIGHTS AS FOLLOWS				
LIGHTED ARROW	LEFT ARROW	RIGHT ARROW	LEFT-RIGHT ARROW	BAR
TYPE A	1, 2, 3, 4, 5, 7, 8, 9, 10, & 11 (10 BULBS)	3, 6, 7, 8, 9, 11, 12, 13, 14, & 15 (10 BULBS)	ALL EXCEPT 6 & 10 (13 BULBS)	** 3, 7, 8, 9, & 11 (5 BULBS)
TYPE B	1, 2, 3, 4, 5, 6, 7, 8, & 9 (9 BULBS)	3, 6, 7, 8, 9, 10, 11, 12, & 13 (9 BULBS)	ALL (13 BULBS)	3, 6, 7, 8, & 9 (5 BULBS)

** BULBS 6 & 10 ARE OPTIONAL IN THE BAR MODE OF THE LIGHTED ARROW-TYPE A.

NOTES:

FOR WOODEN BARRICADES, NOMINAL LUMBER DIMENSIONS WILL BE ACCEPTED.

WARNING LIGHTS SHALL BE PLACED IN ACCORDANCE WITH THE CURRENT STANDARD SPECIFICATIONS WHEN THEY ARE USED ON TYPE I, II, AND III BARRICADES.

SEE STANDARD PLANS V-113, V-114, AND VI-126 SERIES FOR TYPICAL LOCATION AND SPACING OF TYPE II BARRICADES.

BARRICADES AND DRUMS SHALL BE FACED WITH PRESSURE-SENSITIVE REFLECTIVE SHEETING TYPE 2 IN ACCORDANCE WITH THE CURRENT STANDARD SPECIFICATIONS.

FIBERGLASS RAILS MAY BE USED ON TYPES I, II, AND III BARRICADES.

WHEN SUPPLEMENTAL WEIGHTS ARE REQUIRED TO ACHIEVE STABILITY, THE WEIGHTS SHALL BE SANDBAGS. THE SANDBAGS SHALL BE PLACED SO THEY WILL NOT COVER OR OBSTRUCT ANY REFLECTIVE PORTION OF THE TRAFFIC CONTROL DEVICE. ACCEPTABLE METHODS INCLUDE SUSPENSION OF THE SANDBAG OR DRAPING IT OVER A LOWER SUPPORT MEMBER ON TRAILING LEG OF BARRICADE. (SEE ILLUSTRATIONS)

PLASTIC DRUMS MAY BE USED AS TYPE I AND II BARRICADES.

SYMBOLS TO BE USED ON PLAN

PROPOSED TYPE I BARRICADE	■
PROPOSED TYPE II BARRICADE	●
PROPOSED TYPE III BARRICADE	▲
EXISTING TYPE III BARRICADE	▲

LIGHTED ARROWS AND BARRICADES

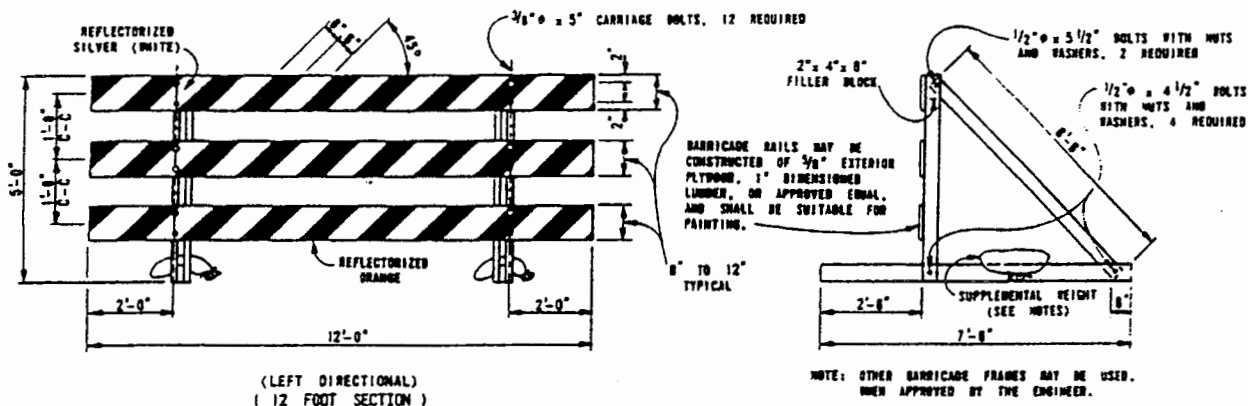
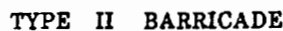
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE

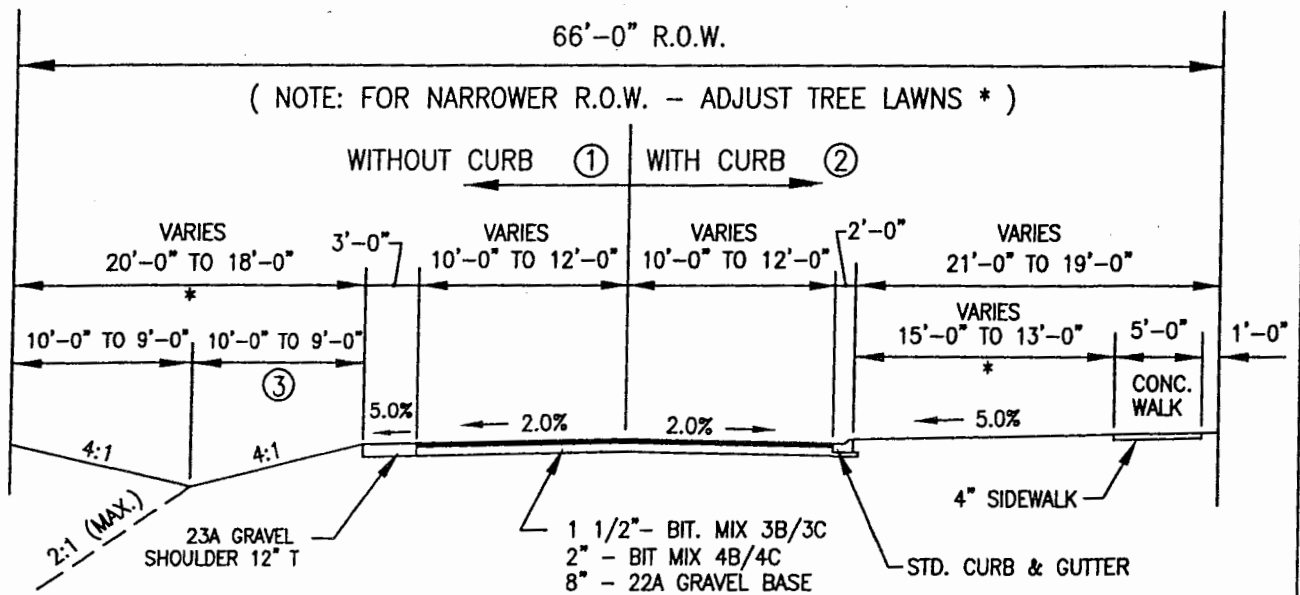
5-63



TYPE III BARRICADES

TYPES II AND III BARRICADES AND LIGHTED ARROWS


5-64

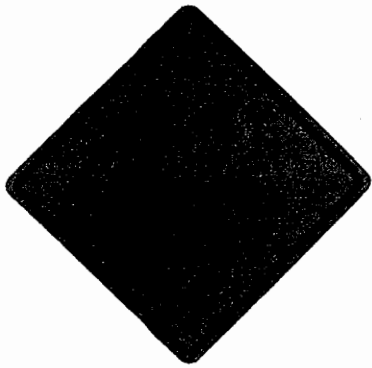


NOTES:

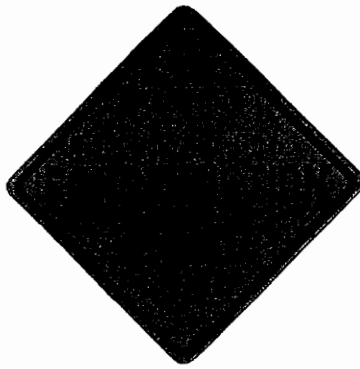
1. POSITIVE OUTLET FOR SIDE DITCH DRAINAGE REQUIRED.
2. IF CURBED, STORM DRAINAGE SYSTEM REQUIRED.
3. IF GRADE IS STEEPER THAN 4:1, GUARD RAIL MAY BE REQUIRED BY CITY ENGINEER.

LOCAL STREET SECTION - WITHOUT PARKING

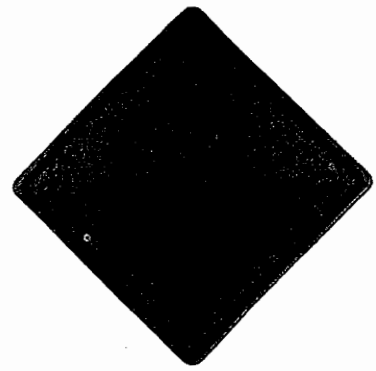
NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-66



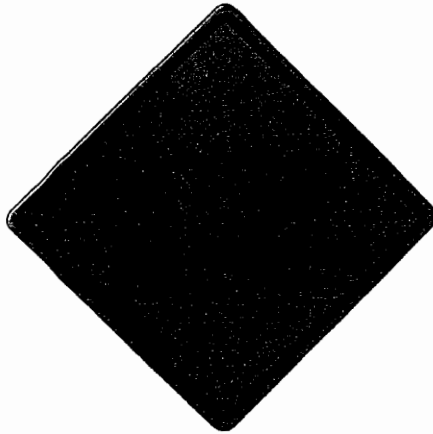
W21-4a
48" x 48"



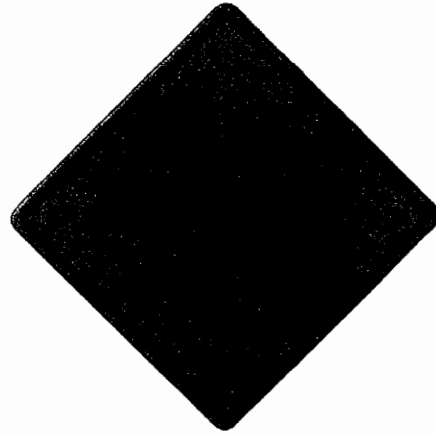
W20-1
48" x 48"



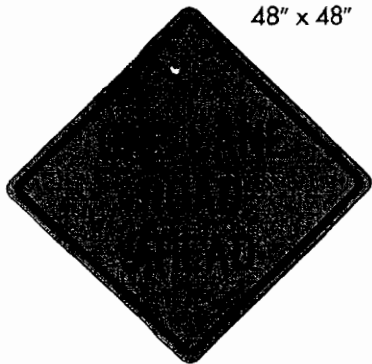
W21-4
48" x 48"



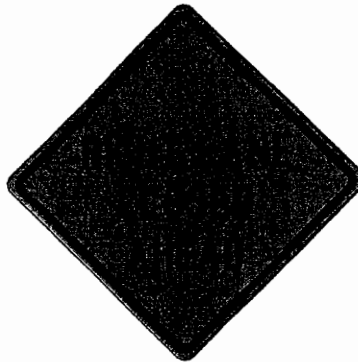
W20-2
48" x 48"



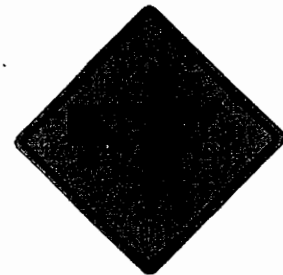
W20-3
48" x 48"



W20-4
48" x 48"



W20-5
48" x 48"



W20-7a
36" x 36"

ROAD CONSTRUCTION SIGNS

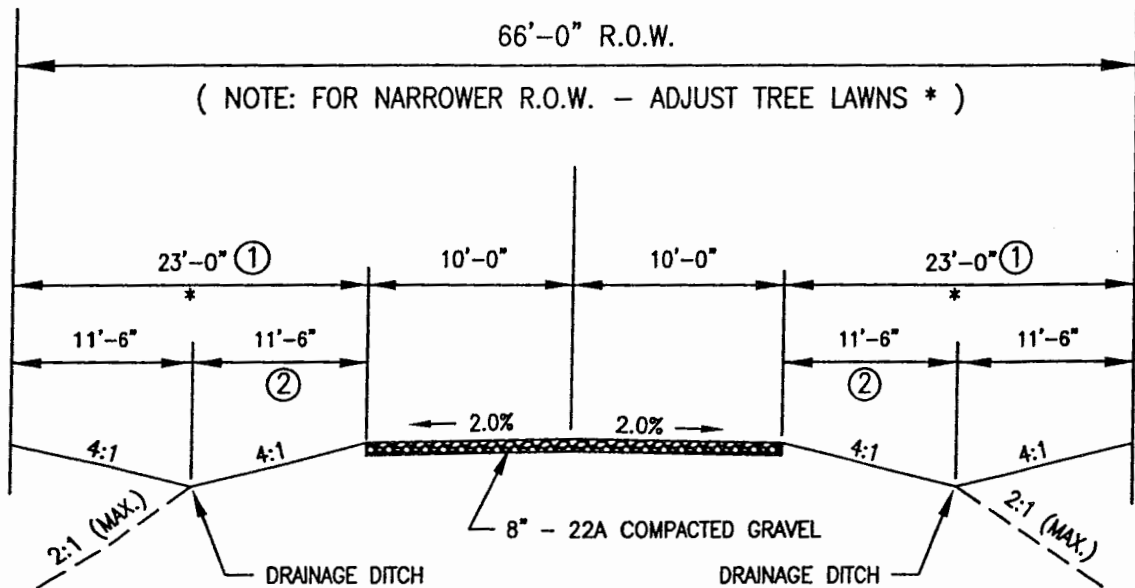
NO.	REVISION	DATE



CITY of NEW BUFFALO
MICHIGAN

FIGURE


5-65



NOTES:

1. POSITIVE OUTLET FOR SIDE DITCH DRAINAGE REQUIRED.
2. IF GRADE IS STEEPER THAN 4:1, GUARD RAIL MAY BE REQUIRED BY CITY ENGINEER.

LOCAL GRAVEL STREET SECTION - WITHOUT PARKING

NO.	REVISION	DATE		CITY of NEW BUFFALO MICHIGAN	FIGURE
					5-67