ORDINANCE 187
APPENDIX A: ENGINEERING DESIGN STANDARDS
TOWNSHIP OF BRUCE
MACOMB COUNTY, MICHIGAN

Adopted: February 9, 2011
Amendments adopted: February 24, 2011

SECTION

TOWNSHIP OF BRUCE
ENGINEERING DESIGN STANDARDS

SECTION 1.0 – PROJECT PROCESS OVERVIEW

These Engineering Design Standards are intended to provide a reasonable and proper basis for the design and construction of subdivision and other project site improvements, including sanitary sewer, water main, storm water management, paving, etc.

The Township of Bruce Standard Details and Specifications shall be considered a part of the Design Standards.

All improvements to vacant land, expansions and/or modifications to existing developed parcels, and improvements or extensions to water main systems, sanitary sewers, storm water management systems, mass grading, landscape walls, retaining walls and paving require the review and approval of detailed engineering design plans prior to the issuance of permits and start of construction.

This standard establishes the basic submittal, review and permit processing procedures in the Township.

1.1 SITE PLAN REVIEW

Please refer to the Township's Zoning Ordinance for Site Plan review process and the Land Division Ordinance for the Plat review process.

If the Developer receives approval from the Planning Commission and/or Township Board, the Developer shall then submit plans for review of Engineering/Construction Plans and Specifications under 2.2 of the Engineering Design Standards.

1.2 CONSTRUCTION/ENGINEERING PLAN REVIEW

1. Upon completion and approval of the Site plan, the Developer/Applicant shall make an application for a Plan Review on a form furnished by the Township. All applicable materials shall be submitted to the Township Planning and Zoning Department as part of this Application, the Developer shall submit the following to the Planning and Zoning Department:

a. Five (5) sets of signed and sealed Engineering Design Plans with applicable Township Standard Detail Sheets and project specific details. The plans covering all of the required Site Improvements for a specifically designated area of the Developer's land shall be submitted as one package before any plan review shall commence.

b. Five copies of the Sanitary Sewer Basis of Design (gravity or low pressure sewer).

c. The calculations for volume, outlet restrictor size, sediment loading, percolation rates, etc. for detention/ retention/infiltration storm water management systems.

d. Drainage district maps showing the various areas contributing to the points of inlet and total area drained (including off-site contributions).

e. Soil boring logs and geotechnical report.

f. Detailed storm sewer/open drain calculations.

g. All wetlands are to be delineated by a qualified wetland specialist. The Township will verify all of the wetland delineations. If there is a question or a discrepancy between the Township and the applicant on the status of a wetland, a determination will be required to be made by the Michigan Department of Natural Resources and Environment.

h. Delineation of floodplain boundaries unless determined unnecessary by Township and application for Flood Plan Development permit, if necessary.

i. A construction cost estimate shall be supplied in sufficient detail to enable the Township to review the construction estimate for all proposed work as outlined in the construction application permit.

j. A cash payment, computed according to the schedule indicated in the Utility Fees Schedule, to cover the cost of the Plan Review and Administrative Fee.

k. Application for tree removal and soil removal permits, if necessary.

l. Other information/calculations pertinent to the project and all information required under these Engineering Standards.

2. Upon engineering plan approval, the applicant is responsible for obtaining all necessary permits; please refer to the permits section of these Engineering Standards. Applicant is responsible to submit the changes

requested by any state or county agency back to the Township for approval.

3. In granting approval of the plans, it shall be understood that the approval of such plans be in effect for only one year and the approval may be renewed, subject to the amendment of such plans by the addition of current construction detail sheets, standards, and/or construction specifications as applicable. The engineering plan approval may be extended if the site plan has also been extended by the Planning Commission, upon request from the Developer with necessary application and fees.

4. Required easements shall be submitted and reviewed to the Planning and Zoning Department for review and approval by the Township's Engineer and Attorney.

5. Prior to the start of construction, the applicant shall submit the following to the Planning and Zoning Department:

   a. eight (8) sets of approved engineering plans.

   b. inspection fees based on percent of construction costs.

   c. required insurance for the underground contractor; please refer to insurance requirements in these standards.

   d. all necessary bonds; please refer to the bond requirements in these standards.

   e. required as-built/record drawing deposit.

   f. pays for Water and Sewer frontage fees, if applicable.

   g. sewer cleaning deposit, if applicable.

6. Upon receipt of all required items listed in paragraph 4 above, a pre-construction meeting shall be held. The required attendees shall be determined by the Township's Planning and Zoning Department and the Township Engineer.

7. The applicant may apply for building permits upon receiving all required permits, off-site easements, attending a pre-construction meeting, and receiving a Permit for Construction from the Planning and Zoning Department.

1.3 FINAL ACCEPTANCE

The following items shall be conditions of final project acceptance:

1. The applicant completed the site improvements as approved by the Township with required inspection.

2. The applicant submits as-builts/record drawings and final easements to the Planning and Zoning Department for review and approval review and approval by the Township Engineer. As-built/record drawing shall meet the requirements in these standards.

3. Upon approval of the as-builts/record drawings and easements, the Township Supervisor or his designated representative shall give the applicant approval to proceed.

4. The applicant shall submit Master Deed for review to the Planning and Zoning Department for Attorney, Planner and Engineering review, if applicable.

5. The applicant shall address any outstanding construction issues required by the Planning and Zoning Department and Building Department.

6. The applicant shall deposit acceptable Maintenance and Guarantee bonds; please refer to bonding requirements in these standards.

7. The applicant shall submit recorded easements documents to the Planning and Zoning Department.

8. Applicant applies for all necessary building permits from the Building Department.

9. All off-site areas disturbed during construction shall be restored to original condition.

10. Certificate of Occupancy by the Building Department.

SECTION 2.0 – PLAN REQUIREMENTS

2.1 SITE PLAN REVIEW REQUIREMENTS

1. For site plan review requirements, please refer to Article 3 of the Bruce Township Zoning Ordinance.

2. Complete improvement plans shall be submitted prior to review and approval of any portion thereof.

3. Plans submitted shall be on 24"x 36" white prints having blue or black lines and shall be neatly and accurately prepared. Good engineering judgment should be exercised in the design, layout and presentation of proposed improvements. Applicant shall also provide the Township with one CD of all of the site plan sheets in a pdf format.

4. Street names, lot or property lines, and property identification numbers shall be shown on all plans.

5. Depending on the scope of work, the following engineering related items are to be incorporated in the plans or submitted as applicable to the project:

   a. Preliminary calculations for volume, outlet restrictor size, sediment loading, percolation rates, etc. for detention/ retention/infiltration storm water management systems.

   b. Preliminary drainage district maps showing the various areas contributing to the points of inlet and total area drained (including off-site contributions).

   c. All existing utilities shall be shown on the plans.

   d. Other information/calculations pertinent to the project or requested by the Township.

6. The Township Engineer shall check the plans and related material for conformity to the standards set forth herein and to the overall utility plans of the Township after which he/she will return one (1) set with the appropriate comments to the applicant and retain one (1) set for records.

7. The applicant, after making any revisions recommended on the set returned to him/her, shall submit two (2) sets of revised plans and related material to the Planning Department for transmission to the Township Engineer for final review and/or approval.

8. The applicant shall provide the Township with one CD with the stamped approved engineering plan set in a pdf format.

2.2 CONSTRUCTION/ENGINEERING REVIEW REQUIREMENTS

GENERAL

This standard establishes the minimum requirements for engineering plans for submittal to the Township.

Prior to starting any design, the design engineer is encouraged to make use of maps and information available at the Township and County offices. It shall be the responsibility of the design engineer to verify utility locations provided by the Township, Macomb County or other agencies.

PLANS AND SPECIFICATIONS

The plans and specifications shall be prepared under the supervision of a Civil Engineer registered in the State of Michigan and the plans shall have imprinted thereon the seal of that engineer.

Plans shall consist of a title sheet, plan and profile, project specific notes and details, and standard detail sheets. Sheet size shall be 24" x 36", minimum scale of 1" = 50' horizontal and 1" = 5' vertical for plan and profile sheets (an overall development and/or utility layout plan may be at 1" = 100'). Details specific to the project shall be drawn at scale.

Engineering plans shall be in compliance with these Engineering Standards.

A copy of the site boundary survey with computed control lines indicated, or a copy of the computed plat, if applicable, shall be submitted with the engineering plans. Boundary surveys shall comply with Act 132 requirements.

1. TITLE SHEET

   A title sheet, or the first sheet of a set of plans, shall show the following:

   a. Project Title.

   b. Name, address and phone number of proprietor.

   c. Name, address and phone number of designing engineer.

   d. The seal and signature of engineer responsible for the project.

   e. Location map drawn to an appropriate graphic scale, generally not greater than 1" = 100' nor smaller than 1" = 2000', with North indicator, showing location of project area with respect to the surrounding area.

   f. Reference bench marks, established at intervals not greater than 1,200 feet and on NAVD88 Datum, convenient to the proposed construction. Each benchmark shall be noted with number, location,

description and established elevation. A minimum two bench marks shall be provided.

g. Name of the Township.

h. Legal description of the property.

i. Address of the property, if available

j. Legend.

k. Plan completion date.

l. Dates of submittals and revisions.

m. Sheet Index.

n. Quantity List of Public Improvements.

2. GENERAL ITEMS

a. All elevations shall be on NAVD88 datum.

b. As a minimum, plan sheets shall include:

i. North arrow.

ii. All easement

iii. Existing topography and proposed ground contours. Superimposed on a general plan of the site shall be contour lines of the project area, including the area at least one hundred (100) feet outside of the project area. Contour lines shall be shown at intervals as follows:

1. Where the general slope of the land is one (1) percent or less, the interval shall be one (1) foot.

2. Where the general slope of the land is more than one (1) percent, but less than five (5) percent, the interval shall be two (2) feet.

3. Where the general slope of the land is five (5) percent or greater, the interval shall be five (5) feet.

iii. Plans shall have all lettering a minimum height of eight-hundredths of an inch and be of such quality as to provide for clear and legible plans.

3. SOIL EROSION AND SEDIMENTATION CONTROL PLANS

Can be incorporated with Drainage Area plan sheet or other appropriate construction plan.

a. As a minimum, sheets shall include:

i. Location, types and details of perimeter and on-site sediment and erosion control methods.

ii. An erosion control and construction sequence schedule.

iii. Location and details of mud mats.

iv. Location, dimensions, surface material and thickness, method of containment, and restoration of construction staging and equipment and material storage areas.

v. Construction sediment basins (when indicated on the plans or required due to site conditions):

1. Location of basin.

2. Calculations for the size of the basin and amount of sediment loading.

3. Method and/or location of conveying site runoff to the basin and erosion control measures along drainage route.

4. Location, cross-section, and details of access route to basin for periodic dredging and maintenance.

5. Maintenance schedule for removing accumulated sediment. Note indicating method and location of disposal of sediment basin soils.

6. Location and detail of basin outlet filter.

7. Location and elevation of emergency spillway.

8. Location and detail of temporary security fencing.

9. Plan or description for the removal of the temporary basin and restoration of the affected area once permanent control devices and stabilization are in place.

b. The following Erosion Control Standard Notes" shall be placed on the soil erosion and sediment control plans:

i. All erosion and sedimentation control work shall conform to the current standards and specifications of the Macomb County Drain Commissioner and the Township of Bruce.

ii. Daily inspections shall be made by the Contractor for effectiveness of erosion and sedimentation control measures. Any necessary repairs shall be performed without delay.

iii. Erosion and any sedimentation from work on this site shall be contained within the work area and not allowed to collect on any off-site areas or in waterways. Waterways include both natural and man-made open ditches, streams, storm drains, lakes, ponds and wetlands.

iv. The Contractor shall apply temporary erosion and sedimentation control measures as directed on these plans and where otherwise required by the work. The Contractor shall remove temporary measures as soon as permanent stabilization of slopes, ditches, and other changes have been accomplished.

v. Soil erosion control practices will be established in early stages of construction by the Contractor. Sediment Control Practices will be applied as a perimeter defense against any transporting of dirt off the work area.

vi. The Contractor shall preserve off-site natural vegetation as much as possible.

vii. Protect all existing trees, including their branches and roots, from damage due to this work unless specifically identified for removal.

viii. Stabilization of all disturbed areas shall be established using the appropriate vegetation within 5 days of completion of final grading.

ix. The Contractor shall sweep the existing streets surrounding the project site as needed.

x. The Contractor shall be responsible for dust control and shall provide all equipment and material to keep dust in check at all times. The Contractor shall respond immediately to any and all complaints.

xi. The Contractor shall be responsible for obtaining the NPDES permit and ensuring compliance with all applicable permit regulations, including but not limited to, inspection, restoration and record keeping requirements. Reports from the Certified Storm Water Operator shall be made available to the Township.

4. GRADING PLANS

a. As a minimum, plan sheets shall include:

i. Centerline of street stationing with centerline or top-of-curb elevations at 50-foot intervals.

ii. Existing and proposed ground elevations shall be provided at all lot corners along the boundaries of the development and 50 foot intervals along all site boundary lines.

iii. Street names, street widths, subdivision names, lot numbers, and permanent parcel numbers for all unplatted parcels for the site and adjacent properties.

iv. Floodplain contour line, where applicable.

v. Wetland limits, where applicable and the name of the consultant that flagged the wetland limits.

vi. All proposed and existing storm drainage facilities, storm sewers, manholes, catch basins and inlets including rim and end section finish grades, and all existing and proposed utility structures (i.e., sanitary manholes, hydrants, etc.) with rim or finished grade elevations and invert elevations to one hundredths of a foot.

vii. Proposed top of curb or shoulder elevation opposite each front lot corner to hundredths of a foot.

viii. Finish grades are to be placed in rectangular boxes drawn to dimensions comparable to a typical house to be built in the development. A box shall be placed on each proposed lot according to the front yard setback. Indicate walkouts (w/o) on rectangle box.

ix. Proposed ground elevation at each lot corner (front and rear), and side lot elevations between houses to tenths of a foot.

x. Provide sidewalk elevations at all lot corners to one hundredths of a foot. The slope across walk shall be noted as 2%.

xi. Provide elevations for pavement, sidewalks, parking islands and other locations as required by the Township Engineer.

xii. When swales for lot drainage are called for on the plan, swale elevations at the high point adjacent to the house, the back of the house, and the front of the house shall be provided. General flow direction of swales shall be shown with arrows.

xiii. Drainage flow arrows shall be provided to indicate the direction of surface water drainage over the development.

xiv. In residential developments each grading plan sheet shall contain a note indicating the location of footing drain/sump pump discharge.

xv. Indicate rear yard catch basins where required. The proposed rim shall be shown to the nearest hundredths of a foot. Catch basins are required to be placed at a lot corner and the catch basin elevation shall be the only proposed elevation shown at that corner.

5. PAVING PLANS

a. The plan portion of the sheet shall include, at a minimum:

i. Street names, street and easement widths, subdivision names, lot numbers and frontage dimensions, for all unplatted parcels.

ii. Location of existing and proposed utilities crossing or within proposed right-of-way.

iii. Existing adjacent streets.

iv. Type of paving.

v. Radii of all curves.

vi. Construction notes.

vii. A tabulated list of quantities appearing on that sheet.

viii. Sidewalks and approaches.

ix. Proposed public street approaches with alignment and dimensions.

b. The profile portion of the sheet, when applicable, shall appear below the companion plan portion, generally projected vertically, and shall show at least the following:

i. Existing and proposed centerline.

ii. Proposed top of curb.

iii. Proposed storm sewer and or ditch.

iv. Existing storm sewer facilities.

v. Stationing were applicable.

c. Cross-sections shall be provided with the following information:

i. Paving type, thickness and specification.

ii. Base type, thickness and specification.

iii. Pavement width, crown and cross-slope.

iv. Curb section (where applicable).

v. Subgrade treatment.

6. PLAN AND PROFILE SHEETS (SANITARY, WATER MAIN & STORM)

a. Each plan and profile sheet shall include a tabulated list of quantities appearing on that sheet.

b. Structures shall be identified by numbers assigned consecutively and increasing in direction opposite to direction of flow in each sewer.

c. The plan portion of sheet shall include, at minimum:

i. All existing or planned surface or underground improvements in streets or easements in which sewer construction is proposed, and in adjacent areas if pertinent to design and construction.

ii. Street names, street and easement widths, subdivision names, lot numbers, lot dimensions, and parcel numbers and frontage dimensions for all unplatted parcels.

iii. Location, length, size, slope and direction of flow of each section of proposed sewer between manholes.

iv. Natural or man-made features such as drainage courses, county drains, lakes, wetlands and floodplains.

v. Locations of all manholes, air release valves, intermediate flushing connections, branch flushing connections, terminal flushing connections and other sewer appurtenances and special structure.

vi. Existing pipe inverts involved in the project.

vii. House leads, wye branches or tee inlets, to be constructed with the proposed sewer, with locations at easement and/or property lines.

viii. Limits of special backfill requirements.

ix. A note stating that the Contractor shall adjust existing manhole covers, as required.

d. The profile portion of sheet shall appear below companion plan portion, generally projected vertically, and shall show at least the following:

i. Size, length, slope, type and class of pipe, and bedding for each section of proposed sewer between structures.

ii. Limits of special backfill requirements.

iii. Profile, over centerline of proposed sewer, of existing and proposed finished ground and pavement surfaces.

iv. Location of existing and proposed utilities crossing the line of the sewer or otherwise affecting sewer construction, with a note of caution.

v. Location of all proposed structures, with structure number, invert elevation/direction of all connecting pipes, top of casting elevation, and structure type.

vi. Location of all house leads and wye branches to be constructed with the proposed sewer.

vii. Length of risers.

viii. Invert elevation at property line or easement line for house leads to be included with sewer construction.

ix. A note stating that the Contractor shall verify the location and elevation of existing utilities prior to construction.

6. STORM WATER MANAGEMENT BASINS AND PRETREATMENT SYSTEMS

a. Storm water management basins and/or pretreatment systems can be placed on the storm drainage plan and profile sheets or on a separate plan sheet.

b. Design calculations for detention/retention basin volumes required and provided, sediment loading calculations, basin outlet restriction, and a plan of the drainage area tributary to the basin shall accompany construction plans submitted for review.

c. For all open detention/retention basins, indicate the top-of-bank, high water and bottom of pond elevations, and side slopes. Provide location, elevation and details of basin outlet restriction and emergency overflow spillway or manhole for detention basins.

d. For enclosed detention basins, provide high water and bottom of system elevations, cross-section or profile of system; location, elevation and details of outlet restrictor, and method of providing for emergency overflows.

e. For infiltration (recharge) systems, provide soil boring logs and soils analysis, volume requirements, percolation rate, infiltration/exfiltration design calculations, cross-section or profile of system, and method for handling emergency overflows caused by rainfall in excess of the design storm event or failure of the infiltration/exfiltration medium. Soil boring for retention basins also to show ground water level, and soil types.

f. For open basin pretreatment systems, provide storage volume calculations, top of bank, high water and basin bottom elevations, side slopes, location of emergency overflow, details of outlet control, and maintenance schedule.

g. Cross-section of basin side slopes, top of bank/basin bottom elevations, inlet/outlet elevations, and water surface elevation/depth of storage.

7. DETAIL SHEETS

a. The Sanitary Sewer, Water Main, Soil Erosion, and Storm Sewer Standard Detail sheets as adopted by Bruce Township shall be considered as a part of these design standards and shall be included as part of the construction plans. A reproducible copy of these details may be obtained from the Township..

b. Detail sheets shall include complete details for all sewer appurtenances and structures to be included with the sewer construction.

c. Scales for special details shall be selected to clearly portray intended construction and component or equipment arrangement. Scales used shall be clearly identified.

SECTION 3.0 –STANDARD UTILITY LOCATIONS

The Schedule of "Standard Utility Locations" are as follows:

	Existing and new streets Location of utilities from centerline (1)				
Subject utility		60' ROW (28' pvmt with curbs) (2)	86' ROW (36' pvmt with curbs) (2)	86' ROW (44' pvmt with curbs) (2)	120' ROW (58' pvmt with curbs) (2)
Sanitary Sewer (3)		29 L	35 L	37 L	44 L
Storm Sewer		19 L	25 L	27 L	34 L
Gas		18 R	27 R	31 R	34 R
Hydrants		20 R	24 R	28 R	36 R
Water Main		22 R	22 R	26 R	42 R
Second Sanitary Sewer (3)		--	35 R	36 R	66 R
Second Water Main (or storm drain)		--	--	--	54 L
DE—MBT (underground)		--	--	--	52 R
DE—MBT (overhead)		31 R	44 R	44 R	61 L/R
Curb radius at intersections		20'	25'	25'	30'

Notes:

1) L means Left; R means Right. In some existing streets where one or more of the utilities have been installed in a location other than described above, the location

of remaining proposed utilities shall be determined by the Superintendent with the concurrence of the Road Commission when appropriate. Where, in the opinion of the Superintendent, these locations are not desirable or possible, suitable adjustments may be made.

2) This is not a categorically approved width of pavement, but only an allowance assumed for purposes of this schedule.
3) Sanitary sewers may be installed in twenty feet wide easements adjacent to street rights-of-way in lieu of these locations if approved by the Superintendent—in this event the storm sewer location for 60' R.O.W. (28' Pavement) may be moved to 19'L.
4) R.O.W. shall be right-of-way for all public streets and easements for all private streets.
5) The Water and Sewer Superintendent may allow variations from the above referenced table on a case-by-case basis, only if, it is not possible to construct utilities in said location.

SECTION 4.0 – WATER MAIN

4.0 GENERAL

This standard establishes the minimum requirements for the design of water main in the Township.

4.1 DESIGN CONSIDERATIONS

1. GENERAL

a. Water mains shall be looped whenever possible or at the discretion of the Water and Sewer Superintendent or his designated representative.

b. Water mains in new developments shall be installed from boundary to boundary in abutting roads and interior streets, and at other locations as may be deemed necessary by the Township for future extensions.

c. All water mains shall be installed with a minimum cover of 5-1/2 feet below finish grade. Whenever water mains must dip to pass under a sewer or other obstruction, the sections that are deeper, shall be kept to a minimum length by the use of vertical 11-1/4 degree bends properly anchored.

d. A 5-1/2 foot minimum horizontal clearance at all open drain crossings is required between the bottom of the drain and the top of the water main.

e. The minimum separation (barrel to barrel) of water main to sewers shall be ten (10) feet horizontal and eighteen (18) inches vertical.

f. Where water main is constructed in pavement areas or within a one-on-one influence of pavement, compaction of backfill to 95% maximum density is required and shall be tested by an independent laboratory.

g. Where the water main crosses another utility, provide Class II backfill material in twelve (12) inch compacted lifts to the top of the higher utility.

h. All water mains shall be designed for 150 p.s.i. minimum working pressure.

i. Concrete thrust blocks or other approved restraint systems shall be provided at all bends, tees, hydrant shoes, at plugs and caps and at any crosses where necessary to prevent lateral movement of the pipe. Thrust blocks shall bear against undisturbed earth and shall have sufficient bearing area to develop the full resultant axial thrust of the pipe at test pressure.

j. No house or hydrant leads shall be made to a transmission main 16" or larger without approval of the Water and Sewer Department.

k. All water main shall be shown on the plan view. All sewers and those water mains having a diameter of twelve (12) inches or greater shall be indicated in profiles. There shall be a separate profile view for each utility. However, it shall be the responsibility of the design engineer to ascertain that the depth of the storm sewer (or storm drain) does not interfere with the building service sewers crossing the storm sewer. Profiles shall indicate the size of pipe, class of pipe, slope of the utility, and control elevations of the utility. The existing and proposed grade lines shall be shown along the profile view of each utility.

l. In the profile view, all crossings of utilities must be shown. When a water main crosses a sewer, the top of pipe elevation of the water main shall be indicated. Minimum vertical clearance between utilities shall be 18 inches. Compacted sand backfill is required between utilities. Exceptions may be considered if there is no alternative at the discretion of the Water and Sewer Superintendent or designated representative.

m. The current Bruce Township Standard Details must be included with the plan set.

n. The plan shall indicate the proposed finished grade elevations of all hydrants, gate wells, stop boxes and/or other structures and, where a public main or hydrant is not located in a public street, shall show an easement for the mains and hydrants.

o. The type, capacities, location, and layout of a building service water supply pipe shall comply with all requirements of the Township, the Macomb County Health Department, and the State of Michigan.

p. The type of pipe and joints indicated on the plans shall be in accordance with the currently adopted Township Standards.

2. DESIGN FLOWS

The Design Engineer shall arrange a meeting with the Township Engineer Superintendent, and the Fire Chief to discuss specific fire protection needs.

a. Single Family Residential- Water mains shall have the ability to provide a fire demand of at least 1,200 gallons per minute at 20 p.s.i. residual for a period of 1 hour. Design calculations shall be furnished upon request to the Township.

b. Multiple Family and Institutional- Water mains shall have the ability to provide a fire demand of at least 2,000 gallons per minute at 20 p.s.i. residual for a period of 1 hour in multiple family, institutional, and school areas. Design calculations shall be furnished upon request to the Township.

c. Commercial & Industrial- Water mains shall have the ability to provide a fire demand of at least 3,000 gallons per minute at 20 p.s.i. residual for a period of 1 hour in commercial, industrial, office and shopping center developments. Design calculations shall be furnished upon request to the Township.

3. MINIMUM SIZE

a. Single Family Residential-Water mains within new single family residential developments shall be eight (8) inches in diameter minimum or larger as design dictates.

b. Major Roads- Water mains within major roads shall be minimum 12 inches in diameter. Larger mains will be required as indicated on the Township's Water main Master Plan.

c. Commercial & Industrial- Within commercial, office, industrial and multiple family residential developments, 12 inches in diameter water main is considered to be the minimum, except in a looped system of 1,500' or less where 8 inches in diameter mains may be permitted.

4. PIPE MATERIALS

a. The following are the required pipe materials for public water main in the Township. Any proposed pipe material alternatives shall be approved by the Water and Sewer Superintendent or his designated representative.

i. Private water services: material is subject to the approval of the Bruce Township Water and Sewer Department Superintendent or his designated representative.

ii. Public water main 8" – 12" shall be:

Ductile Iron, Class 54 with rubber gasket push on type joints; ANSI A21.51; AWWA C151

iii. Public water Main 12" & 16" shall be:

Ductile Iron, Class 54 with rubber gasket push on type joints; ANSI A21.51; AWWA C151 or

Prestressed Concrete lined cylinder pipe, AWWA 301 with rubber gasket and steel joint ring.

iv. Public water main 24" and larger shall be:

Ductile Iron, Class 54 with rubber gasket push on type joints; ANSI A21.51; AWWA C151 or

Prestressed Concrete embedded cylinder pipe, AWWA C301 with rubber gasket and steel joint ring.

v. Building Service Water Supply Pipe may be any of the following materials:

1. Service pipe 2" diameter and smaller:

a. On the supply side of a water meter: Copper type "K" pipe.

b. On a customer side of a water meter: Poly Vinyl Chloride (P.V.C.) pipe, rubber gasket push on type joints or copper type "K" pipes.

2. Service Pipe over 2" diameter: Ductile Iron Pipe with rubber gasket push on type joints (Note: Next size above 2" must be 4", no intermediate sizes are allowed)

5. VALVES AND GATE WELLS

a. General

i. When connecting to an existing water main, a tapping sleeve, gate valve and well will be required unless connection to the existing water main can be made without interrupting service. Only mechanical joint tapping sleeves shall be used.

ii. All valves 8" and greater shall be installed in a gate well.

b. Location

i. In single family residential areas, valves shall be arranged so that no single water main failure will require more than 1,000 feet of water main, not more than 26 homes and not more than two (2) hydrants to be out of service.

ii. In multiple housing, commercial and industrial areas, valves shall be so arranged that no single water main failure will require more than 800 feet of water main or more than one (1) hydrant to be out of service.

iii. Valves shall be so arranged that any section can be isolated by closing not more than four (4) valves.

iv. Valves shall generally be located at street intersections, and such that the gate well structure cover will clear sidewalks, five (5) feet from the intersecting street right-of-way line.

6. HYDRANTS

a. General

i. Spacing of hydrants around multiple family, institutional, commercial and industrial areas shall be considered as individual cases and the design engineer is encouraged to arrange a meeting with the Township Engineer, the Superintendent of the Water and

Sewer Department and the Fire Chief to review specific fire protection requirements. The Fire Chief shall have final approval for number and arrangement of hydrants.

ii. Hydrant valve shall face the road.

iii. Hydrant leads shall be six (6) inch diameter minimum with a maximum length of 35 feet. Hydrant leads longer than 35 feet must be eight (8) diameters and have an eight (8) inch gate valve and well installed at the tee.

iv. Hydrants shall be plumb and set to grade before final acceptance.

v. No service leads are allowed to extend from a 6" hydrant lead.

b. Location

i. In single family residential areas, hydrants shall be generally located ten (10) feet off the street right-of-way line, and spaced along the water main so that all dwelling units are within 300 feet of a hydrant.

ii. In multiple family, institutional, commercial, and industrial areas, hydrants shall be arranged so that all exterior parts of a building are within 250 feet of a hydrant.

iii. In single family residential areas, hydrants shall be located at the center of the lot or at lot lines.

iv. When near a street intersection, hydrants shall be located 15 feet from the intersecting street right-of way.

v. Hydrants shall be located at least 25 feet from any exterior wall of a masonry building and at least 50 feet from any exterior wall of frame or equivalent construction including brick and stone veneer.

vi. Hydrants located in parking areas shall be protected with a six (6) inches (minimum) concrete curb or standard guard posts.

vii. All dead end water mains shall end with a hydrant blow-off, gate valve and minimum ten (10) feet of stub and plug for future extensions. A temporary blow-off in lieu of a hydrant will be considered based on hydrant spacing and future extension of the water main.

viii. Hydrants shall be installed along the water main at least every five hundred (500) feet.

7. PRESSURE REDUCING VALVES

a. In systems where two or more pressure districts are to be interconnected, the plans shall include a pressure reducing valve near the point of connection to the higher pressure district to balance pressures across the new water system. The PRV shall conform to the Township's Standards for such facilities.

b. A line gate valve shall be installed both upstream and downstream of each pressure reducing valve to permit isolation of the pressure reducing valve for maintenance and repair. A bypass line that is equivalent in pipe size to the water main and an additional bypass gate valve and well shall be provided.

4.2 FINAL ACCEPTANCE

1. Water mains shall be flushed and cleaned, and followed by chlorination and bacteria testing. Water main sterilization shall be in accordance with all local, state and federal regulations.

2. For every water main project all water mains shall be tested at 150 p.s.i. for two consecutive hours. The leakage exfiltration or infiltration shall not exceed 100 gallons per inch of pipe diameter per mile per day.

3. A set of approved Record Drawings, an approved dedication of improvements, and a copy of any recorded easement that was required for construction, shall be submitted to the Township prior to final acceptance of the water main. Please refer to these sections for specific requirements.

SECTION 5.0- SANITARY SEWER

5.0 GENERAL

This standard establishes the minimum requirements for the design of sanitary sewer systems in the Township.

Sanitary sewers are also subject to the Township of Bruce Land Development and Utility Ordinance.

Prior to starting any sanitary sewer design, the design engineer is encouraged to make use of maps and information available at the Township offices. It shall be

the responsibility of the design engineer to verify utility locations provided by the Township.

5.1 DESIGN CONSIDERATIONS

1. GENERAL

a. No connection receiving storm water, surface water, or ground water shall be made to sanitary sewers.

b. Sanitary sewers shall be located so as to provide unrestricted access for maintenance and inspection purposes.

c. Sewer pipe and appurtenances shall conform to the current standards of the Township of Bruce and the Detroit Water and Sewage Department.

d. A grease interceptor will be required for all food service operations. No connections for domestic waste will be allowed to the interceptor.

e. The current Bruce Township Standard Details must be included with the plan set.

f. All Public sanitary sewers, gravity and pressure sewers shall be profiled.

g. In the profile view, all crossings of utilities must be shown. When a water main crosses a sewer, the bottom elevation of the water main and the top of pipe of the sewer shall be indicated. Minimum vertical clearance between utilities shall be 18 inches. Compacted sand backfill is required between utilities. Exceptions may be considered if there is no alternative at the discretion of the Water and Sewer Superintendent or designated representative.

h. A minimum horizontal separation of 10 feet shall be provided between the sanitary sewer and any water main or storm sewer.

i. For every gravity sewer project, there shall be indicated on the profile view (near the downstream end of the sewer) a manhole with a 12" deep manhole sump to be used for testing for infiltration. No gravity sewer section having an infiltration rate or an exfiltration rate of more than 250 gallons per inch of pipe diameter per mile of pipe per 24 hour period shall be approved for connection to the Township Sanitary Sewer System.

j. For gravity sewer projects, all sewers shall be tested according to the current edition of the "Recommended Standards for Wastewater Facilities," commonly known as the Ten States Standards.

k. For every pressure sewer projects, all force main or pressure sewers under 8" inside diameter shall be tested at 200 p.s.i. for two consecutive hours, pipe's 8" and larger shall be tested at 100 p.s.i. The leakage exfiltration or infiltration shall not exceed 100 gallons per inch of pipe diameter per mile per day.

l. Types of piping:

Any proposed pipe material alternatives shall be approved by the Water and Sewer Superintendent or his designated representative.

i. Public Sewer Pipe:

Gravity Sewer Pipe

1. 8" through 15" in diameter: Reinforced Concrete pipe in minimum lengths of five feet with Modified Groove Tongue and rubber gasket joints; Acrylonitrile-Budadiene-Styrene Composite Sewer Pipe (ABS Truss Pipe – ASTM Specification S2680) with chemical welded joints; Polyvinyl Chloride (PVC Truss Pipe – ASTM D2680) with chemical welded joints; Polyvinyl Chloride (PVC) Sewer Pipe (ASTM Specification D3034, SDR 35) with push-on rubber gasket joints; Concrete-lined Ductile Iron Pipe Class 50;

2. 16" though 22" in diameter: Reinforced Concrete pipe in minimum lengths of five feet with Modified Grooved Tongue and rubber gasket joints; Concrete-lined Ductile Iron Pipe Class 50;

3. 24" and larger in diameter: Reinforced Concrete pipe with Modified Grooved Tongue and rubber gasket joints or Concrete-lined Ductile Iron Pipe Class 50.

Pressure Sewer

1. High-density Polyethylene (HDPE) SDR 11 and Concrete-lined Ductile Iron Pipe Class 54 with rubber gasket push on type joints; or Polyvinyl Chloride (PVC) Pressure Pipe

ii. Building Service Sewers

1. Building Service Sewers 4" and 6": Poly Vinyl Chloride (PVC) (SDR 23.5 Sewer Pipe); Schedule 40 PVC; or ABS/PVC Truss Pipe.

2. Building Service Sewers 8" through 12": Reinforced Concrete Pipe, Acrylonitrile-Butadiene-Styrene Composite Sewer Pipe (ABS) Truss Pipe, or Polyvinyl Chloride (PVC) Truss Pipe.

3. Building Service Sewer Pipe Joints for the aforementioned pipe materials shall be premium type joints as required by the Standard Details and Specifications adopted by the Township Board.

4. A 6" diameter building service sewer (minimum capacity: 0.5 cubic feet per second) may be used for a building containing one to twelve capacity units or containing another use having equivalent capacity needs. An 8" or over diameter building service sewer (minimum capacity: 0.75 cubic feet per second) shall be furnished for any building containing from 13 to 100 capacity units or containing another use having equivalent capacity needs.

2. LOCATION OF GRAVITY, FORCE MAIN AND LOW PRESSURE SANITARY SEWERS

a. In Easements: All sanitary sewers shall be located within a minimum 20 foot wide easement, centered upon the sewer. Such easement shall be dedicated to the Township, with restrictions against use or occupation of easements, by the property owners and/or by other utilities, in any manner that would restrict sewer maintenance or repair operations.

A written description and drawing of the easement shall be prepared by the Design Engineer and be presented to the Township for review and approval by the Township Engineer and Attorney before recording.

i. Easements for possible extensions shall be provided to the property lines at locations designated by the Township.

ii. Sewers shall preferably be constructed outside of paved parking areas, streets, drives and rear-yard areas.

iii. Within unplatted projects, sewers shall be installed parallel to the property lines, or building lines, with clearance distances to accommodate the full width of the proposed easement or the distance necessary to accommodate a slope of one horizontal to one vertical from invert of sewer to ground surface, whichever is greater.

3. SEWER CAPACITY

a. Tributary Area

Sanitary sewers shall be designed to serve all natural tributary areas with due consideration given to topography, the Township Sanitary Sewer Master Plan, established zoning, and the adopted Township Master Land Use Plan. Sanitary sewers serving a tributary area beyond the project limits shall extend to the boundary of the project site to provide for future extension.

b. Population

For design purposes, population shall be based on a minimum of 2.59 persons per detached single-family home site. Population figures for all other dwelling units and buildings shall be based upon the current "Schedule of Unit Assignment Factors" as defined in the Land Division and Utility Ordinance and as accepted by the Water and Sewer Superintendent. The adopted unit factors shall be used to convert the different occupancy types to equivalent single-family units.

Submission for review shall include a tabulation of occupancy (usage) types and the conversion of these into terms of equivalent single-family units. The tributary area, in acres, may be used to calculate dwelling units based on density allowed in the Zoning Ordinance.

c. Sewage Quantities for Pipe Design

For service areas with design populations of 500 or less, sewer design capacity shall be based on a peak flow of 400 gallons per capita per day.

For service areas with design populations greater than 500 but less than 28,400, peak sewer design capacity per capita shall be based on the following formula:

$$Q = 100 \{ [18 + SQRT (P)] / [4+SQRT (P)] \}$$

Q = Design capacity in gallons per capita per day

P = Design population expressed in thousands

For service areas with design populations exceeding 28,400, peak sewer design capacity shall be 250 gallons per capita per day.

4. MINIMUM PIPE SIZE

Minimum pipe size for gravity sanitary sewers shall be eight (8) inches in diameter. Minimum pipe size for building sewer services shall be six (6) inches in diameter. However, a minimum of one six (6) inch building service sewer shall be provided for a building containing from one to twelve dwelling units (or equivalent); a minimum of one eight (8) inch building service sewer shall be provided for a building containing thirteen to one hundred dwelling units (or equivalent)

Minimum pipe size for low pressure sanitary sewers shall be 2 inches in diameter.

5. HYDRAULICS

a. Calculations

For gravity sanitary sewer, Manning's Formula, with n = 0.013, shall be used for hydraulic calculations.

For low pressure sanitary sewer, the Hazen-Williams formula with C = 120, shall be used for hydraulic calculations.

On force main trunk sewers, the Hazen-Williams formula with C = 120 shall be used for hydraulic calculations.

b. Minimum and Maximum Velocities

Minimum design velocity for gravity and low pressure sanitary sewers shall be two (2) feet per second, and maximum design velocity shall be twelve (12) feet per second, with pipe flowing full. The slope of the sewer between the last two manholes at the upper end of any gravity lateral shall be increased above the minimum permissible pipe slope, wherever possible, to obtain cleansing velocity.

c. Allowable Pipe Slopes For Gravity Sewers

PIPE DIAMETER (INCHES)	MINIMUM SLOPE (FEET PER 100 FEET)
8	0.40
10	0.28

12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.080
27	0.067
30	0.058
36	0.046

d. Allowances for Changes in Pipe Size in Gravity Sewers

Maximum flow velocity for pipe flowing full shall be maintained by matching the 0.80 of the diameter depth above invert for pipe size increases.

e. Allowances for Direction Change in Gravity Sewers

Provide a drop of 0.10 feet in the downstream sewer invert for a direction change of 30 degrees or greater to compensate for velocity head loss of the incoming flow.

6. BASIS OF DESIGN-LOW PRESSURE SANITARY SEWER

Areas of Use

Low pressure sanitary sewer systems consisting of individual grinder pump stations at each building site, connecting to a common pressurized sewer to convey domestic waste to an acceptable outlet will be considered for use in the Township.

The use of a low pressure sanitary sewer system in any development within the Township will require preliminary approval by the Township. A request for approval shall be submitted to the Township, together with a preliminary plan of the proposed development which delineates the extent of the proposed pressure sewer system, including future extension. The preliminary plan shall include existing ground contours at two feet intervals, proposed grades over the site, and the outlet for the pressure sewer system.

Upon securing the Township's preliminary approval for use of a low pressure sanitary sewer system and prior to commencing with final construction plans and specifications for the system, the project's Design Engineer shall submit for review and approval a basis of design for the

low pressure sewer system. The basis of design shall include as a minimum but not necessarily limited to the following:

Layout of development and pressure sewer system, including future extension, indicating:

1. Proposed grades over the site.
2. Sewer pipe sizes and lengths.
3. Sewer line numbering system for each branch of sewer by pipe size.
4. Elevation along centerline of sewer approximately 100 foot intervals and with maximum centerline of pipe denoted.
5. Elevation at each individual grinder pump station.
6. Location and elevation at connection of pressure sewer to source of outlet.

Tabular system analysis which is similar to and provides the system data as required "Low pressure Sewer System Pipe Schedule and Branch Analysis".

Submissions for review shall include a tabulation of occupancy (usage) types and the conversion of these into terms of equivalent single-family units. The tributary area, in acres, may be used to calculate dwelling units based on density allowed in the Zoning Ordinance. The adopted "Utility Fees Schedule" shall be used to convert the different occupancy types to equivalent single-family units.

7. DEPTH OF SEWERS

In general, gravity sanitary sewers shall have a minimum depth of nine (9) feet from top of curb (or centerline if uncurbed) to the top of the sewer. The sewer shall have sufficient depth to serve a standard depth basement by gravity.

Pressure sewers and/or force mains shall have a minimum depth of 5.5 feet to the top of pipe.

8. SPECIAL BACKFILL REQUIREMENTS

Granular material meeting the requirements for MDOT Granular Material, Class II, shall be required for full depth backfill of trenches, above a horizontal line one (1) foot above the pipe, under existing or planned road surfaces, pavements, curbs, driveways, parking areas and sidewalks, and where the trench edge is within three feet of the edge of existing or planned pavements. Backfill shall be compacted to a minimum of 90% maximum dry density from above the pipe to 18 inches below grade.

Compaction shall be 95% of maximum dry density for top 18 inches of trench. The Compaction results will be determined by a Modified Proctor Test, ASTM Designation D-1557. House lead trenches shall have compacted granular backfill within the entire street right-of-way where sidewalks are required. Compacted granular backfill shall be provided between all utility crossings.

9. HOUSE LEADS

a. Unless otherwise approved, construction of house leads from a gravity sanitary sewer to the easement and/or property line, for each fronting parcel in which the sewer is designed to serve, shall be included with the construction of the sanitary sewer.

b. Where construction of house leads to the property line is not required concurrently with gravity sanitary sewer construction, a wye branch with riser, and water-tight stopper or plug, shall be installed for every lot or building site which the sewer is designed to serve.

c. Minimum size for house leads shall be six (6) inches in diameter.

d. Minimum slope for house leads shall be 1/8 inches per foot (1.00%).

10. MANHOLES - GRAVITY SEWER

a. Location

Manholes shall be constructed at every change in sewer grade, alignment and pipe size, and at the end of each sewer line. Generally maximum distance between manholes shall be as follows:

Diameter of Sewer	Maximum Manhole Spacing
8" - 21"	350'
24" and larger	400'

b. Monitoring manholes are required for all non-residential connections to the sanitary sewer system.

c. Drop Connections

Internal drop connections are required at new manholes where the outlet pipe is 18 inches or more below the inlet pipe. Inverts shall be matched at the flow line whenever possible if 18 inches or less. All manholes with an internal drop connection shall be a minimum of 5' in diameter.

Generally, drop connections are discouraged and will be considered only if other alternatives are not acceptable.

11. AIR RELEASE VALVES (ARV), INTERMEDIATE FLUSHING CONNECTIONS (IFC), BRANCHED FLUSHING CONNECTIONS (BFC) AND TERMINAL FLUSHING CONNECTIONS (TFC)- LOW PRESSURE AND FORCEMAIN SEWER

    a. Air Release Valves shall be located at all high points in low pressure and force main sewers.

    b. Intermediate Flushing Connections in low pressure and force main sewers shall be located so as not to allow more than 600 feet between structures. Intermediate flushing connections may also be required at significant low points.

    c. Branched Flushing Connections shall be located at places where the low pressure sewer branches off.

    d. Terminal Flushing Connections shall be located at the ends of the low pressure and force main sewer systems.

12. STUBS

    Where future connections to a manhole are anticipated, stubs or blind drop connections, with watertight bulkheads, shall be provided. Stubs shall be 10 feet minimum in length.

13. GRINDER PUMPS

    Grinder pumps are prohibited within five feet of any permanent structure, including buildings, decks, sheds, etc. Grinder pumps shall be located in the side yard of new residential and new non-residential buildings, except for walk-out residential buildings. Grinder pumps for new residential and new non-residential properties shall have a maximum of one four foot extension.

5.2 FINAL ACCEPTANCE

1. A set of approved Record Drawings, an approved Bill of Sale, and a copy of any recorded easement that was required for construction, shall be submitted to the Township prior to final acceptance of the sanitary sewer.

SECTION 6.0 – STORM WATER MANAGEMENT

6.0 GENERAL

The management of increased storm water which results from the development of vacant land or expansions to existing facilities will be considered as a critical component of all development plans which are submitted to Bruce Township for approval. The intent of this standard is to provide guidelines for the sound management of increased storm water run-off and to provide sufficient flexibility for design professionals to develop innovative solutions that protect the resources of Bruce Township while meeting the objectives of water quality preservation and flood control.

The use of natural drainage features, shallow swales and landscape areas shall be incorporated into the drainage planning for a site whenever possible. The objective is to achieve a functional and aesthetically pleasing development that minimizes the use of extensive enclosed storm drains and large obtrusive storm water detention or retention basins while providing for the proper management of storm water runoff.

Development plans must present a unified design that, as a minimum, provides the following protections:

1. The design must show that the development will not cause any impact to downstream properties or upstream properties. Both the rate of storm discharge and the volume of storm water discharge must be considered.

2. The development plan shall be fitted to the topography and soil to create the least erosion potential and to effectively accommodate the increased runoff caused by changed soil and surface conditions during and after development.

3. The design must demonstrate the use of "Best Management Practices" for minimizing erosion and controlling sedimentation and other pollutants through all phases of construction.

4. The design must demonstrate that proposed buildings or other permanent structures on, and adjacent to, a proposed development are and will remain safe from flooding.

5. All sets of plans which include plans for storm sewers shall include the current Township Storm Sewer Detail Sheets which shall be considered an inseparable part of the plans when said plans are approved.

6. A Site Grading and Drainagewater Collection and Disposal Plan is required for all Developments. A rear yard (in the case of land

subdivisions) or a general site enclosed storm drainage system shall be designed for all land development projects. If there are any upstream watershed drainage areas which need to be drained through the site under design consideration, sufficient capacity shall be provided to take fully developed upstream drainage into the system.

6.1 SOIL EROSION AND SEDIMENTATION CONTROL

Under the Natural Resources & Environmental Protection Act (Act 451), Part 91, the developer/applicant shall submit an erosion control plan to the Macomb County Drain Commission - Soil Erosion Control Division. The Soil Erosion and Sedimentation Control Permit must be issued by the prior to any earth moving operations. The methods used for soil erosion control must be in accordance with the Macomb County Drain Commission erosion Control Manual.

An approved National Pollution Discharge Elimination System (NPDES) permit where applicable, will be required prior to the commencement of any earthmoving operations.

1. DESIGN CONSIDERATIONS

To provide effective erosion and sedimentation control, practical combinations of the following technical principles shall be applied to the erosion control aspects of the plan:

a. Please refer to the Permits section of these standards for necessary permits relating to storm water.

b. The applicant/permittee shall be responsible for maintaining temporary erosion control devices during all phases of construction.

c. The smallest practical area of land shall be exposed at one time during development.

d. When land is exposed during development, the exposure shall be kept to the shortest possible period of time.

e. Temporary vegetation and/or mulching shall be used to protect critical areas exposed during development.

f. Temporary sedimentation basins (debris basins or silt traps) shall be installed and maintained to remove sediment from runoff waters from land undergoing development.

i. Sediment basins for construction purposes shall be separated from permanent storm water detention or retention basins.

ii. Basins shall be designed in accordance with the Macomb County Public Works standards for sedimentation basin design.

iii. Construction runoff shall be directed to the basin in a controlled manner through mass grading techniques, diversion berms/swales, enclosed storm sewers or any combination thereof that would limit runoff velocities and provide for the least potential for erosion of the site.

g. Mud mats shall be installed at construction access points to provide a buffer area where vehicles can deposit mud and sediment prior to leaving the site, to control erosion from surface runoff and to help control dust.

h. Areas set aside on the site for equipment storage, laydown, fuel, lubricants, chemical compounds and material stockpiles shall be contained in such a manner as to prevent any leakage or spillage from contaminating the surrounding soils and groundwater, and from entering any storm water management system or existing surface waters.

i. Filters shall be provided at catch basins and culvert inlet points to prevent sedimentation of storm sewers for both new and existing systems.

j. Adequate dust control shall be maintained at all times. Surface streets adjacent to the site will be cleaned of any deposits on a daily basis.

k. The permanent vegetation and structures shall be installed as soon as practical in the development.

l. Whenever feasible, natural vegetation shall be retained and protected.

m. Riprap shall be required at all pipe entrances to detention or retention basins. The minimum width of the riprap shall be twice the outside diameter of the pipe. The riprap shall extend from the bottom of the basin to the top of the pipe. Two types of materials may be use:

i. fieldstone or broken concrete of a minimum of eight (8) inches;

ii. gabions installed per the manufacturer's specifications.

6.2 STORM WATER MANAGEMENT BASINS AND PRETREATMENT SYSTEMS

On-site storm water detention or retention is necessary for all developments in the Township (including private roads) whenever runoff is increased.

Generally speaking, detention basins temporarily store storm runoff for a period of time in which the runoff is released through a positive outlet, at a controlled rate. Retention basins do not have a positive outlet, so that the stored runoff will either percolate or evaporate.

Infiltration (recharge) systems that store and release run-off through permeable soils to the groundwater may be allowed under specific circumstances and with the review and approval of the Township.

In cases where the requirements for detention/retention basins have been waived, storm water pretreatment (in the form of permanent debris and sedimentation control systems) will be required.

1. DESIGN CONSIDERATIONS

a. Detention Basins

i. Detention basins may only be used when the design shows that there is an adequate outlet for the storm water, and where the increased volume of storm water will not damage downstream property owners. Construction drawings must include sufficient off-site information to demonstrate the existence of an adequate outlet. Downstream easements and maintenance agreements may be required.

ii. Water originating from off-site is not required to be detained in the detention basin. Storm water originating from off-site should be diverted around the detention basin whenever practical, and where the diversion will not increase the erosion of soils. Storm water originating from off-site may pass through the detention basin without storage.

iii. Discharge from the detention basin shall be at a controlled rate such that the entire capacity of the basin can be discharged in about forty-eight hours.

iv. The storage capacity (volume) of such detention basins shall be rated in acre feet and shall contain a capacity equivalent to a minimum of 0.2 feet of water over the area of the development that drains into the detention basin.

v. The maximum water level shall be controlled by gravity outlets. Pumping of storm water will only be considered if there are no other options at the discretion of the Water and Sewer Superintendent or his designated representative.

vi. Detention basin volumes shall not include volumes below the invert of outlet pipe(s). Provide storage for a 2-year, 24-hour event below the outlet pipe (must be a minimum of 2' of depth below the outlet pipe) per the Township's NPDES Permit.

vii. Detention basins shall be provided with an overflow spillway or manhole set at 6" above the high water levels capable of passing a 100-year frequency storm. The overflow spillway shall be located so not to cause potential damage to adjacent properties. All overflow spillways shall be protected from erosion by surfacing with concrete or rip-rap. The edges of the surface shall have headers of the same or similar materials to prevent undercutting by the storm water overflow.

viii. One foot of freeboard shall be provided above the high water elevation.

ix. Side slopes for detention basins shall not be steeper than one (1) vertical to five (5) horizontal.

x. Detention basins will not be permitted within a floodplain.

xi. Storm water detention in paved parking lots will be considered under the following conditions:

1. The area contributing to any detention area within a paved area shall not exceed eight thousand (8,000) square feet.

2. Storm water run-off on sites with tributary areas greater then eight thousand (8,000) square feet may be detained within paved areas provided the area contributing to any individual paved detention area, shall not exceed eight thousand (8,000) square feet and individual paved detention areas shall be separated by landscaped greenbelts a minimum of ten (10') feet in width broken only by a circulation drive.

3. Storm water detained in paved areas shall not exceed six (6) inches depth. A positive overflow to an acceptable outlet shall be provided to control the six (6) inches maximum depth for each detention area.

4. Restricted catch basin covers shall be used to provide storage in paved areas. Manhole covers with two (2) vent holes often meet discharge requirements. The covers are designed to let the allowable discharge of water into the storm system. Flow calculations shall be submitted for the restricted covers specified. The flow shall be calculated for the maximum storage head.

5. Show limits of detention on plans.

xiii. Underground Detention will be considered on a case-by-case basis with the following conditions:

1. Provisions must be made in the design for the collection and removal of sediment and debris accumulated in the system. All applicable health and safety requirements shall also be incorporated in the design of systems that require access by inspection or maintenance personnel.

2. Detailed shop drawings are required for underground detention systems, including pertinent engineering calculations and soils information.

xiv. Concrete rip-rap shall be provided at all pipe entrances to the basin. All pipes entering or leaving the basin shall have either a headwall or flared-end-section at the end of the pipe.

xv. An overflow system shall be provided. The overflow system shall consist of either a pipe having an invert at the design storage level elevation or a concrete spill-way with an invert 0.5 feet above the design storage elevation. The concrete spill-way shall extend from inside the bank slope to the outlet drain.

xvi. Detention in wetland areas will be considered with the following conditions:

1. If in a regulated wetland, an MDEQ permit is required.

2. A permanent pretreatment system for the removal of sediment is required prior to outletting to the wetland.

3. Calculations indicating what the water elevation will rise to during the design storm event will be required. The design must show that properties adjacent to the wetland area will not be negatively impacted by the increase in storm water runoff. Consideration must be given to future developments in the

immediate area that could also use the wetland for storm water management purposes.

b. Retention Basins

i. If a gravity outlet cannot be provided, then the storm water holding facility shall be designed as a retention basin with a storage capacity (volume) of such retention basin shall be rated in acre feet and shall contain a capacity equivalent to a minimum of 0.4 feet of water over the entire watershed area that drains into the retention basin.

ii. Off-site tributary areas: Retention basins must be sized for storm water that originates off-site and which cannot be bypassed around the proposed retention basin to a site where the storm water originally flowed to. In such cases, the retention basin must be sized using the following design parameters:

Tributary acres: On-site area plus the off-site area

iv. Retention basin volumes shall not include volumes below the existing groundwater table, permanent water elevation or invert of outlet pipe(s).

v. One foot of freeboard shall be provided above the high water elevation.

vi. Side slopes for retention basins shall not be steeper than one (1) vertical to five (5) horizontal.

vii. Retention basins will not be permitted within a floodplain.

viii. Retention of storm water in parking lots is strictly prohibited.

ix. The retention basin design shall demonstrate that the soils are capable of providing necessary infiltration. A soils report will be required to show that the underlying soils are well-drained (hydrologic groups A or B) and the ground water is suitable for percolation.

x. The entire retention basin area must be seeded or sodded and the turf shall be fully established before the Township will give final approval.

xi. Concrete rip-rap shall be provided at all pipe entrances to the basin. All pipe entering the basin shall have either a headwall or flared-end-section at the end of the pipe.

c. Infiltration (Recharge) Systems

i. An infiltration system will be considered if the design engineer can demonstrate that all of the following conditions exist:

1. An adequate positive outlet is not available or it is not possible to construct an off-site drainage system to convey basin discharge to the nearest outlet, and the installation of a retention basin is not feasible or practical.

2. The natural underlying soils are well-drained (hydrologic groups A or B) and the ground water is suitable for percolation.

3. The underlying soils and ground water table have the ability to move water away from the site for the area and volume being drained.

ii. Permanent pretreatment system upstream of inlet point to prevent any material from potentially clogging the infiltration medium (both surface and subsurface).

iii. An overflow for a 100 year storm must be provided.

iv. Infiltration system can be easily accessed for maintenance and replacement if necessary. The use of perforated storm pipe under pavements is discouraged.

v. There must be a method for determining a failure in the infiltration system. The system cannot be designed such that a failure in the infiltration system results in short circuit to the emergency overflow without on-site ponding.

vi. The following information shall be supplied and/or incorporated in the design of infiltration systems:

1. Soil boring logs/sieve analysis/geotechnical report indicating type and properties of both surface and subsurface soils, suitability of surface soils for infiltration, capability of subsurface soils to conduct seepage to the underlying groundwater table, and flow from the system under mounding conditions at the maximum infiltration rate. Conditions of <6 inches per day. percolation rate will not be allowed.

2. Computed percolation rate and infiltration/exfiltration calculations.

3. Drainage area map, including any off-site contributing areas and emergency overflow route in the event of system failure.

4. Construction methods to prevent compacting the surface soils which may reduce the infiltration capacity of the soils.

d. Permanent Pretreatment Systems

i. Permanent pretreatment systems when called for on the plans, shall be sized for a "first flush" depth of 0.5 inches of runoff from the entire drainage basin area of the project. Permanent systems are required when discharging to an existing lake, stream, waterway or wetland.

ii. Pretreatment can be in the form of open basins or engineered treatment systems.

1. Open basins shall be designed with minimum side slopes of one (1) vertical to five (5) horizontal, one (1) foot of freeboard above design storm water elevation, emergency

2. Overflow and outlet control devices.

3. Design calculations, plans and shop drawings for engineered treatment systems shall be certified by a Professional Engineer licensed in the State of Michigan.

4. Horizontal velocities through the system shall be minimized to prevent turbid flows and allow particles to settle in the pretreatment system.

iii. Permanent pretreatment facilities will not be allowed within a floodplain.

2. MAINTENANCE OF STORM WATER MANAGEMENT BASINS AND PRETREATMENT FACILITIES

a. Commercial, Industrial, Residential and Office Sites: The proprietor shall maintain the storm water management basins and permanent pretreatment facilities in proper working order at all times. All maintenance and inspections shall meet the Township's Long-Term

Operation and Maintenance Program and the Township's NPDES MS4 Permit.

6.3 GRADING AND SURFACE DRAINAGE

For all new building sites, subdivisions, site plans, private roads, and other development proposals within the Township, a grading plan shall be submitted for review and approval.

This standard establishes the minimum requirements for the design of grading and surface drainage in the Township.

1. DESIGN CONSIDERATIONS

   a. Site grading for all building sites shall be reviewed to determine that proposed and/or actual site grading is proper and that drainage from land lying upstream is not obstructed and that downstream properties will not be adversely affected by runoff from the property under design consideration. Before a Certificate of Occupancy for any building is issued, the Building Official shall approve the final site grading and drainage for each building, which shall be sealed and signed by a Professional Engineer or Land Surveyor, Registered in the State of Michigan. The Development may require that a survey, drawing, and certificate—done by a Professional Engineer or Land Surveyor, Registered in the State of Michigan—be furnished by the Developer indicating that the work has been done in conformity to the approved site grading and drainage plan. It shall be unlawful for any person to interfere with, modify, or obstruct the flow of drainagewater across any property in any manner different from the approved plan.

   b. The grading plan shall be designed to insure that if a failure occurs in any storm drainage system, storm waters will drain to an approved outlet in overland swales without flooding buildings or adjacent properties.

   c. Positive drainage of all yard areas is required for all residential developments. In special cases involving extreme vertical relief and wooded areas, isolated undrained potholes will be considered. These undrained areas must be provided with an easement for surface drainage and retention which will encompass the storm water storage level for two 100 year frequency storms plus one (1) foot of freeboard.

   d. Generally, residential lot drainage shall be split at the building; drainage from the front of the building shall drain to the road and drainage from the rear of the building shall drain to the rear lot line. Rear to front surface drainage shall be avoided and will only be

permitted under extreme topographic conditions. If rear to front drainage is permitted, only the drainage from the rear of the specific lot is allowed.

e. Side yard swales shall be a minimum of 0.5 feet below the building brick ledge grade of the building and located a minimum of ten (10) feet away from the building.

f. Rear to front lot drainage shall have protective drainage swales around the building. The high point of the swale shall generally be located a minimum distance of 15 feet off the rear of the building and generally one (1) foot (0.5 foot minimum) below the building brick ledge grade.

g. Rear-yards shall be drained with swales and shallow ditches unless topographic features prevent surface drainage.

h. Meet existing ground at the property boundaries. Construct an intercepting swale to prevent drainage onto adjacent property or lots.

i. All buildings having foundation drains shall direct the flow of drainagewater from such foundation drains into a storm sewer or storm drains by means of an underground enclosed conveyance pipe. No building permit for any building having a basement shall be issued unless the plans for such building indicate a building service sewer (drainagewater) with drainage to a storm sewer or storm drain. If a storm sewer is not available, the Township Engineer shall approve the discharge location of the outlet of the building service sewer (drainage water).

j. In residential development with poor draining soils or high groundwater table, an enclosed drainage system for footing drains/sump pumps discharge is required. (See Underdrain/Sump Pump Collection systems).

k. No rear yard drainage system shall be constructed until rear yard grading is completed and approved.

l. The fall of the land away from any building shall be a minimum of six (6) inches in the first twenty-five (25) feet. From this elevation the land shall slope to a drainagewater collection swale at a minimum slope of one foot in one hundred feet (one percent).

m. Drainage water run-off from building roofs shall be piped to a point five (5) feet away from the outside walls of any building.

n. Where required by the Township, a four inch diameter open joint drainage pipe shall be provided for drainage with said pipe trench being backfilled entirely with pea gravel up to within four inches of the grade line of the swale.

2. SLOPE REQUIREMENTS

a. Protective perimeter slope: A minimum slope of 5% is required for areas within 10 feet of building perimeter, except at doors, patios and porches.

b. Minimum ground slope for any portion of the site shall be two (2) %. A one (1) % minimum will be considered for occasional use.

c. Drainage swales along side and rear property lines, and the protective swale around buildings shall generally have a two (2) % slope. A one (1) % minimum will be considered for occasional use. Rear yard swales shorter than 300 feet may have a minimum slope of 0.8%. The maximum distance drainage water shall travel in a drainage swale without an intercepting yard catch basin shall be 350 feet. Not more than 100 feet of drainagewater travel shall be upstream of an angle point (deflection angle 45 degrees or greater) in the drainage swale. Planned final grade elevations shall be indicated on the plans at a maximum spacing of 50 feet.

d. Maximum ground slope for any graded portion of the site shall be 25% (one (1) vertical to four (4) horizontal). A maximum slope of 33% (one (1) vertical to three (3) horizontal) will be considered for occasional use and for side slopes of landscape berms.

3. PLOT PLAN REQUIREMENTS

a. Prior to issuance of a building permit the permit holder shall submit a plot plan drawing to the Building Department for review and approval. All grades shown on the plot plan shall be in accordance with the approved subdivision grading plans. All plot plans shall be in accordance with an accurate boundary line survey and include the following information:

i. Date of plan or revision, north arrow, drawing scale, property address, sidwell number, and legal description of property.

ii. Provide site benchmark on USGS datum.

iii. All existing and proposed water courses, swales and ditches.

iv. Elevations at each lot corner, along property lines, along top of curb, along top and bottom of retaining walls, high points, low points and grade change points. Provide proposed spot grades on an approximate 50-foot grid pattern throughout the site and to 100-feet onto adjacent sites. Proposed grade contours can be provided to supplement the spot grades. Proposed grades along property lines shall meet the approved master grading plan.

v. Finish grade and finish floor elevations for first floor, garage and basement. Provide 0.5 feet of fall within first 25 feet from building finish grade to side, front or rear yard high points. Provide finish grade elevations of adjacent houses. Please indicate if the adjacent lot is vacant.

vi. All overland drainage routes must be maintained. The lowest house grades are to be a minimum of one foot higher the highest overland flow route elevation.

vii. Location of all the new construction on the site and distances from lot lines.

viii. Ensure architectural plan elevations and footprint match plot plan.

ix. Slopes from building to side yard shall not exceed 1:3 slopes. Stability computations must be provided for any grade change over 2 feet that is steeper than one vertical or two horizontal, example: retaining wall.

x. Minimum land and swale slopes to be 1%.

xi. All proposed and existing utility structures, with as-built rim elevations and finish grade elevations for hydrants.

xii. Sidewalks and driveways (with elevations). Please indicate driveway slopes, they shall be less than 10%, preferred slopes for driveways are 2-8%. All sidewalks and driveways shall be ADA compliant. Driveway locations shall match the approved plans. Show 5-foot wide concrete sidewalk along right-of-way with proposed grading as appropriate for development.

xiii. All setback and easement locations.

xiv. Wetland boundaries, water surface and floodplain locations and elevations.

xv. Show and label all easements.

xvi. Provide sanitary sewer lead location shall be shown at the as-built location with invert elevation. Provide proposed grade of the sanitary lead.

xvii. Provide sump lead location. Sump leads shall have a minimum cover of 2 feet at the building and a minimum of 3 feet of cover in all other locations. The sump lead must connect above all trunk line pipes at structures.

b. Prior to backfill inspection as-built brick grade elevations and foundation locations tied to property lines must submitted for review and approval by the Building Official.

c. Prior to issuance of a Certificate of Occupancy a Final Grade Certificate must be submitted and approved by the Building Official indicating that all lot grading has been done and accomplished in accordance with the approved plot plan (within an allowable tolerance of plus or minus 0.25 feet. During periods of the year when weather conditions make site grading work unfeasible, a temporary Certificate of Occupancy may be issued at the discretion of the Building Official, subject to the furnishing of a satisfactory bond, letter of credit, or cash deposit guaranteeing the completion of the work when weather conditions permit.

6.4 STORM SEWERS AND OPEN DRAINS

The following details and specifications shall be required for developments utilizing storm sewers and/or open drains to convey runoff from the site. All such storm drainage systems must outlet to either a detention basin, retention basin, infiltration system, or pretreatment facility as outlined in Section 3.2 of this Standard prior to discharging to any natural or man-made water course, wetland, drain or other body of water.

In general, trunk storm sewers or any sewer that carries street drainagewater shall be located within a public street right-of-way. Such sewers shall not be located along rear lot line easements. Where public storm sewers are located outside of public streets, they shall be placed in a recorded public utility easement that provides for unlimited access to the storm sewer for repairs, connections, and maintenance. The minimum acceptable width of easements for storm sewers shall be 12 feet for sewers 12 inches through 48 inches in diameter; and 30 feet wide for sewers over 48 inches in diameter. The sewer shall be placed in the center of the above designated easement width.

This standard establishes the minimum requirements for the design of storm drainage systems in the Township.

1. DESIGN CONSIDERATIONS

a. Storm Sewer Capacity

i. Sufficient capacity shall be provided in the storm sewer system to allow existing runoff from upstream drainage to "pass through" the proposed storm sewer system.

ii. When a storm sewer is designed to provide capacity for upstream areas, the hydraulic gradient shall remain in the pipe. For storm sewer designed to take on-site drainage only, the hydraulic gradient must be no higher than one (1) foot below storm structure rim elevations. For storm sewers considered to be trunk sewers, the hydraulic gradient shall be maintained within the pipe.

iii. When the hydraulic gradient is above the top of the sewer pipe the design elevation of the hydraulic gradient shall be indicated on the profile at each manhole.

iv. If the heights of the hydraulic gradient exceed two (2) feet above the top of pipe, rubber joints shall be used.

b. Hydraulics and Hydrology

i. Storm drainage systems shall be designed for a minimum of a ten-year storm. To determine the storm water runoff, the rational method shall be used (Q=CIA)

where Q = peak rate of runoff in cubic feet per second
A = area in acres
C = runoff coefficient for drainage area
I = average rainfall intensity in inches per hour for a given time of concentration

ii. The formula for rainfall intensity (I) shall be determined by using the formula I = 175/(T+25), where T is the time of concentration in minutes. For residential areas, T shall usually be 20 minutes; for commercial and office areas, T shall be 15 minutes or less.

iii. Run-off coefficients shall be determined for each individual drainage area. Drainage area coefficient determination shall generally be based on the following:

SURFACE	C
Agricultural/Grass	0.15
Pavement/Buildings	0.90
Residential	0.35
Multiple Housing	0.55
Commercial	0.90
Industrial	0.90

The above run-off coefficients are minimum. Actual site design may require an increase in run-off coefficient. A weighted run-off coefficient can be used (provide calculations). Coefficients proposed for a project are subject to approval by the Township.

iv. An overland flood route for a 100 year storm frequency shall be provided and shown on the plans. A minimum freeboard of six inches shall be provided from any building's exterior finished grade (brick ledge) to the 100 year flood elevation.

v. In Manning's formula, n = 0.013 for reinforced concrete pipe and n=0.025 for corrugated metal pipe, if corrugated metal pipe is allowed, shall be used for hydraulic calculations.

vi. Minimum design velocity shall be 2.5 feet per second and maximum design velocity shall be 10 feet per second, with the pipe flowing full.

vii. Allowable minimum pipe slopes:

Pipe Diameter (in)	Minimum Slope (ft/100 ft)
12	0.32
15	0.24
18	0.18
21	0.14
24	0.12
27	0.10
30	0.09
36	0.07
42	0.06
48	0.05
54	0.04
60	0.04

viii. For changes in pipe size, the maximum flow velocity for full pipe flow shall be maintained by continuity of the 0.80 diameter depth above invert.

ix. For changes in direction, a drop of 0.10 feet in the downstream sewer invert shall be provided for direction changes of 30 degrees or greater to compensate for velocity head loss of the incoming flow.

x. All catch basin and inlet leads shall be laid on a minimum slope of 1%.

xi. Wherever differences in manhole pipe invert elevations exceed two (2) feet, a two (2) foot sump shall be provided to prevent channel erosion.

c. Sewer Pipe
Any proposed pipe material alternatives shall be approved by the Township Engineer.

i. Size and Material Requirements:

Public Sewers or Private Sewers that service one or more properties:

1. Pavement Underdrain Pipe shall be a minimum of 6" in diameter and shall be Galvanized Perforated Corrugated Metal Pipe or ABS Truss Pipe, PVC SDR 35, high-density polyethylene N12 sewer pipe.

2. Storm Sewer for surface water runoff:
   a. For Pipe within the right-of-way shall be a minimum of 12" in diameter and shall be Reinforced Concrete Pipe.

   b. For Pipe outside of the right-of-way shall be a minimum of 12" in diameter and shall be Reinforced Concrete Pipe.

   c. The minimum pipe size for storm sewers, catch basin leads and inlet leads shall be 12 inches in diameter.

3. Foundation drain service sewer (more than one building outlet) shall be a minimum of 8" in diameter and shall be ABS Truss Pipe, PVC Truss, Nonreinforced Concrete Pipe C14SM, Reinforced Concrete Pipe, or PVC pipe.

4. Rear yard underdrain system with no inlets shall be a minimum of 8" in diameter and shall be perforated plastic pipe (please see foundation drain service pipe paragraphs for material requirements).

5. An extension of the storm sewer system shall be provided to furnish an outlet for foundation drain service pipe for any buildings not otherwise serviced, such extensions shall have a minimum diameter of 8".

Building Service sewers for drainagewater:

1. Foundation drain service pipe (single building outlet) shall be a minimum of 3" in diameter and shall be Polyvinyl Chloride (PVC) schedule 40 pipe.

2. Foundation drain service pipe (more than one building outlet) shall be a minimum of 8" in diameter and shall be ABS Truss, PVC Truss, Nonreinforced Concrete C14XM, PVC Schedule 40, Reinforced Concrete Pipe or Polyvinyl Chloride (PVC) Sewer Pipe.

3. Underdrain pipe shall be a minimum of 6" in diameter and shall be Galvanized Perforated Corrugated Metal Pipe or High-Density Polyethylene N-12 with loose center joint.

4. Storm sewer for surface water runoff shall be a minimum of 12" in diameter and shall be Reinforced Concrete Pipe or Galvanized Corrugated Metal Pipe.

ii. Location

1. Storm sewer shall have a minimum of three (3) feet of cover from the top of the finish road or earth grade to the top of any storm sewer, unless an alternative is approved by the Township.

2. Storm sewers shall generally be located on the opposite sides of streets from water mains.

3. A minimum ten feet horizontal separation is required between storm sewer and water mains (barrel to barrel).

4. Special Backfill Requirements:

a. Granular material meeting the requirements for MDOT Granular Material, Class II, compacted to 95% maximum density, shall be required for full depth backfill of trenches under existing or proposed road surfaces, pavements, curbs, driveways, parking areas, and sidewalks, and where the storm sewer is within a one-on-one influence of the edge of existing or proposed pavements. Compaction testing shall be performed by an independent laboratory.

b. Storm sewer leads shall have compacted granular backfill within the entire street right-of-way where sidewalks are required. Compacted granular backfill shall be provided between all utility crossings.

d. Manholes

i. Location

1. Manholes shall be located at:

- Points where the sewer changes direction
- Points where the size of the sewer changes
- Points where the slope of the sewer changes
- The junction of sewer lines
- Street intersections or other points where catch basins or inlets are to be connected
- The end of the sewer line
- Per spacing below

2. Maximum distance between manholes shall be as follows:

Diameter of Sewer	Maximum Manhole Spacing
8" - 30"	350'
36" - 42"	400'
48" - 60"	500'
66" & larger	600'

Note: Height of elliptical and arch pipes shall be used as the criteria for manhole spacing

e. Catch Basins, Inlets and End-Sections

i. Size

1. Inlets and rear-yard catch basins up to four (4) feet deep from invert to top of casting may be (two) 2 feet in diameter.

2. Inlets and rear-yard catch basins more than four (4) feet deep from the inlet to top of casting and all other catch basins shall be four (4) feet in diameter.

3. Catch basin leads may tap directly into sewers 42 inches and larger, except that taps shall not be made into precast manholes tee pipe section.

ii. Location

1. Catch Basins shall be located at:

a. The radius return of street intersections. A maximum distance of 150 feet is allowed when drainage is required to go around a corner between a high point and a corner catch basin.

b. Maximum intervals of 500 feet along a continuous slope.

c. All low points in streets, swales and ditches, where applicable.

d. intermediate points along the street such that there is a maximum pavement drainage area per structure as follows:

i. Intercepting catch basins – 7,500 S.F./C.B.

ii. Low point catch basins – 10,000 S.F./C.B.

e. Standard rear yard basins shall be provided at all low points in the drainage swales, in easements. All catch basins shall be located within four (4) feet of lot corners. 12-foot side yard easements to the street shall be included at all rear yard basins. Provide intercepting yard type catch basins such that not more than 350 feet of swale drainage runs into any one catch basin other than a low point catch basin where 600 feet of drainage is allowed.

f. All catch basins and inlets located at low points in poor draining soils shall have a minimum of two ten (10)-foot runs of six (6) inches perforated pipe with pea gravel bedding and

backfill. Other trench collecting underdrains may be required, as required by the Township.

g. End-sections or headwalls shall be placed at all culverts and pipe inlets or outlets.

h. A prefabricated bar screen shall be used on all storm sewer openings 18 inches in diameter and larger. The bar screens shall be constructed according to an approved separate enlarged detail in the drawings and shall be designed to be sturdy, permanent easily maintained, non-clogging and shall have clear openings of no more than six (6) inches. Bar screens shall not be required on driveway culverts.

i. Manholes and catch basins may be combined and utilized as a stormwater inlet structure.

f. Underdrain/Sump Pump Systems

i. Where the proposed ground surface slope is less than 2% (two percent), supplementary drainage shall be provided by an underdrainage system.

ii. Locate the underdrain/sump pump systems in a six (6) foot drainage easement along the rear or side lot lines at three (3) feet from the property line. Where abutting off-site property, it shall be located six (6) feet from the property line in a twelve- foot easement.

iii. Trench for underdrain shall have adequate depth to provide gravity flow of sump pump and softener discharge lines to underdrain, and shall have a minimum depth of three (3) feet from the property line.

iv. Install two (2) foot diameter inlets at 400 foot maximum intervals along the underdrain and located three (3) feet from side lot lines.

v. Install a two (2) inch P.V.C. capped tee at each lot for the sump pump.

vi. Show the underdrain system with sump pump on the storm sewer plan, with a dimension to the nearest lot line for each sump pump tee.

vii. The sump pump collector system may be combined with the underdrain system, as noted above.

viii. Minimum pipe material shall be eight (8) inch PVC constructed with a minimum of 3.0 feet of cover and 0.50 percent slope.

ix. Eight (8) inch lines must not be used for the collection of surface runoff and therefore structures on these size lines must have solid covers.

g. Open Drain Requirements

i. Open drains shall have slope protection (rip-rap) at bends with radius of 500 feet or less and other points as designated by the Township.

ii. The drain bottom and slopes, to the hydraulic gradient line, shall be sodded. The remainder of the drain shall be seeded. The Township will not approve the work until all turf is established.

iii. Specific drain cross-section and velocity control measures will be approved by the Township on an individual basis.

iv. Where open drains are proposed for drainagewater disposal, the Manning's formula shall be used for determination of flow depth and capacity. However, if the Township and/or the Michigan Department of Natural Resources and Environment deems it advisable, the Developer's Engineer may be required to furnish computations and plans showing the backwater curve for the open drain under fifty-year fully-developed-upstream-watershed conditions.

v. Improved open drains may be permitted under special circumstances provided the Township has determined that the enclosure of such open drains would require a storm sewer 60 inches or larger in diameter. When open drains are used, the easement width shall be sufficient to accommodate a thirty feet wide maintenance plateau (with a maximum slope of ten percent) on each side of the channel.

vi. The side slopes of open drains shall have a maximum slope of one (1) foot vertical to four (4) feet horizontal, except that a low-flow channel may have side slopes of one (1) foot vertical to three (3) feet horizontal. Open drain side slopes shall have an established sod surfacing as soon as possible after construction. In any event, sufficient measures shall be taken to conform to the erosion and sedimentation control requirements of applicable state or local ordinances.

SECTION 7.0- PAVING

7.0 GENERAL

This standard establishes the minimum requirements for paving in the Township.

7.1 PARKING LOTS

The design of parking lots shall conform to the Bruce Township Zoning Ordinance and the following standards:

1. Parking lots shall be of the size and configuration as required by the Bruce Township Zoning Ordinance. Where the Bruce Township Zoning Ordinance requires off-street parking, the design of the parking area shall conform to these requirements and shall be reviewed and approved by the Township.

2. In parking areas the minimum grade allowed on any surface is 1% and the maximum grade allowed is 6.0%.

3. Approaches to any sites from roads under the jurisdiction of the Macomb County Road Commission (MCRC) or the Michigan Department of Transportation (MDOT) shall be designed according to their criteria. Approval and issuance of permits of these improvements by the above agencies must be obtained and furnished to the Township prior to Township approval of the paving. Passing lanes and acceleration/deceleration lanes are required by the Township on connections to all paved roads under MCRC or MDOT standards.

7.2 MATERIAL REQUIREMENTS

All paving material for off street parking, non-public streets, sidewalks and bike paths shall conform to the requirements of the Macomb County Road Commission and the M.D.O.T. Standards and Specifications, current edition.

1. Minimum parking lot pavement material shall be as follows:

   a. Concrete pavement: 6" non-reinforced concrete over 6" compacted subgrade. If subgrade cannot achieve compaction of 95% Modified Proctor, 6" of compacted MDOT 22A aggregate shall be placed as the base, below the concrete.

   b. Asphalt pavement: 4" MDOT 1100 mixture over 8" MDOT 21AA aggregate or 8" of MDOT 22A aggregate. Base material shall be placed over 6" of compacted subgrade to 95% Modified Proctor.

c. Cross-section may be amended for a. or b. above with a recommendation from a geotechnical engineer, licensed in the State of Michigan.

2. Private Streets and Commercial Areas shall have as a minimum the following pavement material:

a. Macomb County Road Commission Standards shall be required.

7.3 PUBLIC STREETS

1. All streets within public right-of-way shall be designed according to the criteria and specifications of the Macomb County Road Commission or MDOT.

7.4 PRIVATE ROADS

These specifications establish minimum standards for roads within the Township. All private roads shall meet the following standards. If the private road serves as a parcel split fronting a public road, the parcels and legal description of the common ingress/egress easement shall be provided along with the construction plans.

For the purposes of this section, a Private Road shall be considered to mean the vehicular ingress and egress for more than one residence or more that one commercial or industrial building; and where such roads are not to be under the jurisdiction and control of a public agency. All applicable foregoing requirements shall apply:

1. Plan Requirements

a. Elevations shall be provided at every 50' station on tangent, every 25' in a vertical curve (or as often as necessary), and at such intermediate points as may be necessary to define the profile. Elevations shall be provided at every 50' station for straight portions of the road.

b. Elevations at spring points of all intersection radii.

c. Profile of existing ground on center line of proposed road. Stationing shall be on center line of proposed road. Center line of proposed road shall be on center line of right-of-way or easement.

d. Proposed center line elevations of the road and ditches shall be shown on uncurbed roads. Proposed center line elevations of the road and top of curb elevations shall be shown on curbed roads.

e. Location of all existing and proposed manholes and catch basins within the project, and related adjacent areas.

f. Show distances and grade between high points and catch basins, or between catch basins.

g. Pavement with curbs shall give curb elevations on plans in lieu of center line elevations. Gutter grades shall also be shown in areas where curb height varies.

h. Corner and/or stopping sight distance in areas where sight distance may be restricted. Unless otherwise noted, AASHTO guides will be used.

2. Grade

a. Generally, a minimum grade shall be 0.5% for concrete pavements and a minimum grade of 1.0% for asphalt pavements and maximum grade shall be 6.0%, unless approved by the Township Engineer.

3. Intersection Radii

a. Minimum intersection radii shall be twenty-five (25) feet as measured from the back of curb. Thirty (30) feet or larger radii shall be used at intersection with main roads.

4. Vertical Curve

When the algebraic difference in grade exceeds 1.0% a vertical curve is necessary. The following information shall be shown for vertical curves:

a. Station and elevation at the Point of Intersection, Point of Curvature, and Point of Tangency.

b. Length of vertical curve.

c. Station and elevation of high point or low point of vertical curves.

d. Corrected or curve elevations at 25 foot intervals along the curve.

5. Length

a. Unless otherwise specifically permitted under other applicable Ordinances, the length of dead-end roads shall not exceed one mile and shall be provided with a suitable turnaround.

6. Turnarounds
   a. A cul-de-sac shall be required at the end of any dead-end private road and shall have a minimum easement radius of 60' and a minimum improved, paved, surface radius of 44'. When the proposed road will serve less than five dwelling units, alternate turnaround designs may be considered with the approval of the Township Engineer and the Township Fire Chief.

7. Right-of-Way and Drainage Easements

   a. Right-of-Way shall be 60' for low volume local roads, 86' for collector roads, and 120' or greater for primary or high volume roads. A permanent easement for ingress/egress and/or right-of-way dedication documents shall be reviewed, approved, and recorded prior to commencement of construction.

   b. Right-of-Way for cul-de-sacs shall be 60' radius from the center of the cul-de-sac.

   c. Additional right-of-way or easements shall be provided for road or drainage purposes when required by the Township Engineer or the Macomb County Road Commission. 20' wide permanent drainage easements will be required over all related properties within the development as well as beyond the boundary of the development to a county drain, river, or other suitable outlet.

8. Surfacing
   a. Unless otherwise approved, all roads shall be hard surfaced (paved with asphalt or concrete). No surfacing shall be placed until all utilities have been installed and properly backfilled.

   b. Crown of road shall be 2%. Roads with ditches shall have a crown with a minimum slope of 2% and a maximum slope of 3%.

   c. The minimum pavement width shall be 28' back to back of curb on local roads and 36' back to back of curb on collector roads. When a storm drainage outlet of sufficient depth is not available, uncurbed pavements with open ditches may be approved. In such cases, the minimum pavement width on local roads shall be 24' with a minimum of a 2' paved shoulder on each side; and on collector roads, 30' with a 4' paved shoulder and a 4' gravel shoulder on each side. All uncurbed pavements shall be marked with 4" wide pavement edge lines placed at each edge of the pavement to separate the pavement from the paved shoulder.

d. Materials Required for residential private roads:

   i. Asphalt Pavement: 8" MDOT 21AA aggregate base, compacted to 95% density Modified Proctor with 4" Bituminous Pavement, compacted to 95% density Modified Proctor. The 4" Bituminous Pavement shall consist of: 1-1.5" Course MDOT 1300T & 1-2.5" Course MDOT 1300L. Or 4.5" Bituminous Pavement shall consist of 1-2.5" Course MDOT 3C, & 1-2" Course MDOT 4C
   ii. Concrete Pavement: Existing subgrade compacted to 95% density Modified Proctor with 7" Portland Cement Concrete Pavement, minimum of 3,500 psi 28 day strength. If existing subgrade is unable to achieve required density, 6" MDOT 21AA aggregate will be required as the base, compacted to 95% density Modified Proctor.
   iii. An additional 2 inches of MDOT 21AA shall be compacted in place on clay or silt subgrades for the two above mentioned options.
   iv. The above material thicknesses are considered to be the minimum allowable. Other configurations will be considered providing that the total Structural Number is greater than or equal to the standard section (AASHTO S.N.) and with a recommendation by a geotechnical engineer, registered in the State of Michigan.

e. Materials Required for Commercial and/or Industrial Roads
   i. Asphalt Pavement: 8" MDOT 21AA aggregate base, compacted to 95% density Modified Proctor with 6" Bituminous Pavement, compacted to 95% density Modified Proctor. The 6" Bituminous Pavement shall consist of: 1-1.5" Course MDOT 1300T & 1-2" Courses MDOT 1100L & 1-2.5" Course MDOT 2C or 1-3" Course MDOT 2C, 1-1.5" Course MDOT 3C, & 1-1.5" Course MDOT 4C
   ii. Concrete Pavement: Existing subgrade compacted to 95% density Modified Proctor with 7" Portland Cement Concrete Pavement, minimum of 3,500 psi 28 day strength. If existing subgrade is unable to achieve required density, 6" MDOT 21AA aggregate will be required as the base, compacted to 95% density Modified Proctor.
   iii. An additional 2 inches of MDOT 21AA shall be compacted in place on clay or silt subgrades for the two above mentioned options.
   iv. The above material thicknesses are considered to be the minimum allowable. Other configurations will be considered providing that the total Structural Number is greater than or equal to the standard section (AASHTO S.N.) and with a

recommendation by a geotechnical engineer, registered in the State of Michigan.

9. Fill Material

   a. All fill material under and within 2 feet of edge of pavement, and under sidewalk or pathways shall be 2NS Sand or approved equal and shall be properly drained.

10. Signs

   a. All signs shall be erected in conformance with the current edition of the Michigan Manual of Uniform Traffic Control Devices.

   b. Street name signs shall be provided and placed as follows, in order of preference:

      i. Posts shall be 3 lb

      ii. Above the stop sign

      iii. Next to the stop sign

      iv. At the northwest corner of the intersection

      v. At the southeast corner of the intersection

11. Completion of Construction

   a. Final Inspection: When construction is completed the Macomb County Road Commission or the Township Engineer shall make a final inspection before issuing a letter stating that the streets and grading have been constructed in accordance with plans and specifications.

   b. Owner Certification: The owner shall certify in writing that all contractor fees, engineering fees and any other monetary claims against the development have been paid in full. Waivers of Lien from each contractor shall be provided before final approval by the Township.

7.5 SIDEWALKS, PATHWAYS, AND DRIVEWAYS

This standard establishes the minimum requirements for pathways, sidewalks and driveways repair in the Township. Please refer to the Township Pathway Ordinance, Zoning Ordinance and Master Plan for additional information.

1. Pathways

   a. Where pathways are proposed or required, they shall be indicated on the site plan. Proposed grades shall be indicated at the lot lines.

   b. The pathway shall be eight (8) feet wide and located one (1) foot inside the existing or proposed right-of-way line of public street.

   c. Pathway material shall be 4" MDOT 1100 mixture on 4" of MDOT 22A aggregate base. Where driveways cross the pathway, the pathway shall be 6" MDOT 1100 mixture on 4" of MDOT 22A aggregate base.

   d. The existing subgrade shall be compacted to 95% modified proctor and must have a soil sterilant applied prior to placing base material.

   e. All pathways shall be in compliance with current AASHTO geometric standards.

   f. ADA barrier free access ramps are required at all crossings. Pathways must comply with all ADA requirements, including detectable warnings.

2. Sidewalks

   a. Where sidewalks are proposed, they shall be indicated on the site plan. Proposed grades shall be indicated at the lot lines.

   b. The sidewalk shall be a minimum of five (5) feet wide and located one (1) foot inside the existing or proposed right-of-way line of public street.

   c. Sidewalks shall extend through all driveways without steps.

   d. Sidewalks shall be four (4) inches thick, except at driveways where they shall be six (6) inches thick on 4" of 2NS Sand base, compacted to 95% density Modified Proctor.

   e. ADA barrier free access ramps are required at all crossings. Sidewalks must comply with all ADA requirements.

f. Construction joints with a half inch premolded expansion filler shall be placed at maximum intervals of 50 feet. Contraction joints shall be placed at a maximum intervals of five feet, or equal to the width of the walk, whichever is greater.

g. Sidewalks shall be constructed using concrete shall have a 28 day compressive strength of at least 3,500 pounds per square inch.

h. Sidewalks shall be constructed along a planned longitudinal grade line. The maximum longitudinal slope shall be 5%. The transverse slope of the sidewalk shall be a maximum of 2% (1/4 of an inch per foot).

i. All sidewalks/pathways should be in compliance with current AASHTO geometric standards.

3. Driveway requirements are as follows:

a. Driveways shall be a minimum of 6 inches thick. However, where loads heavier than standard automobile loads are anticipated, the minimum thickness should be 7 inches.

b. Construction joints with a half inch premolded expansion filler shall be placed at maximum intervals of 50 feet.

c. Driveways shall be constructed using concrete and shall have a 28 day compressive strength of at least 3,500 pounds per square inch.

4. Sidewalk repair requirements

a. Sidewalk flags shall be replaced when one or more of the following conditions exist:

i. Stubber - A tripping hazard created when a vertical separation of one-half (1/2) inch or greater exists between two (2) flags.

ii. Crack - A tripping hazard created when a horizontal separation of one-half (1/2) inch or greater exists between two (2) flags.

iii. Drainage Problem - A flag that can collect water and freeze creating a slip-and-fall condition.

iv. Holes - A tripping hazard created by holes two (2) inches or greater in size in any direction or severe pitting over 25% or more of the flag.

v. Scaling - Deterioration of the sidewalk surface.

vi. Slope - A flag sloped three (3) inches or more creating a safety hazard.

vii. Reverse Pitch - A flag pitched toward a building. This flag may be required to be replaced.

viii. Thin Walk - Evidence of thin (substandard) concrete. The flag may be damaged when the adjacent flags are being repaired and may require replacement.

ix. See Sidewalk section for required materials.

7.6 FINAL ACCEPTANCE

1. All public road systems shall be subjected to a Final Inspection by the Macomb County Road Commission prior to acceptance of the system by the Township or issuance of a certificate of occupancy.

2. A set of approved record drawings, together with copies of all material certifications, density testing reports, concrete cylinder test reports and any recorded easement shall be submitted to the Township prior to final acceptance.

SECTION 8.0 PUMP STATION STANDARDS

8.0 GENERAL

Pump stations may be planned for sanitary sewer and storm sewer if there are no other alternatives. The location, sizing, details, and specifications of pump stations will require Township approval.

8.1 SANITARY SEWER PUMP STATIONS

i. Pump stations will only be allowed when gravity sewer is not an option at the discretion of the Township Engineer or his designated representative.

j. Pump stations will require an on-site generator.

k. Pump stations shall be designed to handle ultimate peak flow for the tributary area.

l. Shop drawings will be required for the pump station.

m. Pads for transformers and control panels shall be concrete, contact the Township for current standards and specifications.

n. The developer/applicant will be required to coordinate the electrical supply with DTE.

o. Control panel requirements: contact the Township for control panel standards and specifications.

p. Valve Vault Requirements

   i. Valve vault structures shall be concrete, contact the Township for current standards and specifications.

   ii. Piping through valve vaults shall have double in-line check valves.

   iii. Valves shall be approved by the Township Engineer.

q. Wetwell Requirements

   i. Wetwell structures shall be concrete, contact the Township for current standards and specifications for wetwells and pumps.

   ii. Pump stations will require one back-up pump.

   iii. Explosion-proof submersible pumps are required.

   iv. Pump stations shall be designed so that each pump will not run more than six (6) times in one hour at ultimate peak flow.

8.2 STORM SEWER PUMP STATIONS

a. Storm sewer pump stations are discouraged and will only be considered when gravity discharge is not available and with the approval of the Township Engineer.

b. Pump stations will require an on-site generator.

c. Shop drawings will be required for the pump station.

d. Pads for transformers and control panels shall be concrete, contact the Township for current standards and specifications.

e. The developer/applicant will be required to coordinate the electrical supply with DTE.

f. Control panel requirements: contact the Township for control panel standards and specifications.

g. Pump stations shall be designed to handle a 100 storm event for the tributary area.

h. Valve Vault Requirements

i. Valve vault structures shall be concrete, contact the Township for current standards and specifications.

ii. Piping through valve vaults shall have double in-line check valves.

iii. Valves shall be approved by the Township Engineer.

r. Wetwell Requirements

i. Wetwell structures shall be concrete, contact the Township for current standards and specifications for the wetwell and pumps.

ii. Pump stations will require one back-up pump.

iii. Explosion-proof submersible pumps are required.

iv. Pump stations shall be designed so that each pump will not run more than six (6) times in one hour at ultimate peak flow.

SECTION 9.0 LANDSCAPE WALLS AND RETAINING WALLS

9.0 GENERAL

Landscape and retaining walls shall be designed to ensure stability against overturning, sliding, excessive foundation pressure and water uplift. Landscape and retaining walls shall be designed for a safety factor of 1.5 against lateral sliding and overturning.

Landscape and retaining walls shall be designed in accordance with the current adopted issue of the Michigan Building Code.

9.1 DESIGN

1. Design details and computations (sealed by an Engineer, Registered in the State of Michigan) shall be submitted and approved for all walls not attached to a building which are greater than four (4) foot in height. Cost

of walls should be included in engineer's estimate submitted at the time of engineering review.

2. Any face of a retaining/landscape walls shall be a minimum of two feet from the nearest property line.

3. Easement from abutting parcels will be required for any retaining wall footing that encroaches on said parcel, or where it appears that "normal" (1 on 1 side slope) excavation to the bottom of the footing would require encroaching or if tie-backs encroach.

4. Typically, utilities shall not be proposed under a retaining/landscape wall. If it is unavoidable, then all proposed utilities shall be installed in a proper casing pipe.

5. Wall details shall be included in the overall plan set.

6. The design engineer shall execute and submit a certification form that the wall was installed per design, the certification shall be signed and sealed by an Engineer, Registered in the State of Michigan. Additionally, if the design engineer for the site did not complete the design of the retaining wall, then the retaining wall design engineer shall sign and seal the certification statement.

7. The following types of walls are acceptable in the Township:

   a. Concrete wall

   b. Pre-cast wall

   c. Block wall

   d. Wood wall

   e. Boulder wall (maximum height: 4 feet)

8. The following items shall be included in all retaining/landscape wall submittals for review:

   a. Plan view

      i. Clearly identify location of the structure in the plan view.

      ii. Indicate the top of wall and bottom of wall elevations, at a minimum interval of 25' along the wall.

iii. Provide finished grades adjacent to the structure at a maximum interval of 25'.

iv. Show location of protective guardrail and/or fencing. The necessity for guardrail and/or fencing will be reviewed on a case-by-case basis. Typically, a guard, fence, or guardrail is required on structures greater than 30" in height. The typical guard, fence or guardrail is 42" high with openings less than 4" in diameter.

v. The proposed drainage system shall be shown on the plans as well as its ultimate discharge point, i.e. storm structure, ditch, swale, etc.

b. Cross-section/profile view

i. Provide minimum and maximum heights of the wall.

ii. Identify the material type and all manufacturers' specifications.

iii. State the proposed structural dimensions, including wall thickness, and the depth and thickness of the footing.

iv. Geo-grid length shall be provided, dimensioned and labeled, as well as the embedment depth. Any changes in layout shall be shown on the plans.

v. Fence, guard, or guardrail post footings or connections to walls shall be detailed. Installation of the post or post footing shall be specified so as not to damage any geo-grid, if applicable.

vi. The location of utility crossings shall be noted. Additionally, the manner in which these crossings will be constructed so as not to diminish the integrity of the wall shall be noted.

c. Calculations

i. Design loads including vehicular impact and surcharge loadings where applicable. Loads due to attached structures (guards, fences, guardrails, etc.) shall be considered in the design wall.

ii. Note the grade of reinforcing steel, as well as the cover depth and the horizontal spacing.

iii. Provide the bearing pressures (noted or referenced) and the soil bearing capacities.

iv. Provide soil boring information and geotechnical analysis, if required.

SECTION 10.0 PERMITS

The Design Engineer shall forward plans to any public utility and any state or county agency whose facilities or rights-of-way may be affected by the proposed construction.

Permits-Jurisdiction-Notification

1. The proprietor shall obtain, or cause his contractor(s) to obtain all permits, post all required bonds, and pay all required fees for each and all permitting agencies departments having jurisdiction over the land and rights-of-way involved in the project. Proper notification shall be given to each governmental agency and utility company prior to beginning of construction. The Township of Bruce shall require a minimum of 2 business days of notice prior to commencement of any construction.
2. Upon approval of the plans and specifications by the Township, the Developer's Engineer will coordinate the securing of necessary approvals from other reviewing agencies. The Applicant shall furnish such plans and other documents as necessary to accomplish such approvals. However, after approval of plans by the Township, the Developer's Engineer shall obtain approval from all necessary agencies and/or utilities where the approval is not obtained by the Township. Also, the Developer's Engineer shall forward plans to any public utility and/or other agency whose facilities or rights-of-way may be affected by the proposed construction.
3. Applicant must submit copies of the documentation from other agencies (as applicable to the project) to the Township indicating that the plans have received their approval for work within, and/or modifications to, their facilities prior to a pre-construction meeting.
4. For projects where the water main will become part of the public system, the Township Engineer shall notify the applicant for additional copies of the plans, including current standard detail sheets, signed and sealed by a Michigan Registered Professional Engineer for processing and eventual issuance of a Michigan Department of Natural Resources and Environment construction permit for water main systems. No construction may commence on the public water system until this permit is issued.
5. For projects where the sanitary sewer will become part of the public system, the Township Engineer shall notify the applicant for additional copies of the plans, including current standard detail sheets and a completed Act 451 permit application, signed and sealed by a Michigan Registered Professional Engineer for processing and eventual issuance of a Michigan Department of Natural Resources and Environment

construction permit for sanitary sewer systems. No construction may commence on the public sanitary sewer system until this permit is issued.

6. All other permits and payment of associated fees required to perform the work shall be the responsibility of the applicant and/or his designee. No construction may commence until permits, as applicable to the project, are secured from the appropriate agencies. Such permits include, but are not limited to, the following:

   a. Road Commission for Macomb County permit for work within the county road right-of-way, including discharges from storm water management systems to county road drainage facilities, work within the right-of-way and approach permits.

   b. Utility permit from Macomb County Drain Commission

   c. Macomb County Drain Commissioner permit for storm water discharge and/or taps to county controlled drainage facilities.

   d. Macomb County Soil Erosion permit.

   e. N.P.D.E.S. permit for storm water discharge for areas disturbed greater than five (5) acres.

   f. Michigan Department of Natural Resources and Environment permit for all work and/or storm water discharges to a regulated wetland or floodplain.

   g. Michigan Department of Natural Resources and Environment permit for all public water main and sanitary sewers.

   h. Township Permit for Construction.

   i. When all approvals have been obtained and prior to starting construction, the applicant will be notified of the time and place for a pre-construction meeting.

SECTION 11.0 INSURANCE AND BONDING REQUIREMENTS

Financial Guarantee shall be provided in accordance with these Standards of the Township of Bruce.

1. Bonds

   a. Site improvement Bond: After site plan approval or tentative preliminary subdivision approval by the Township Planning Commission, but before the issuance of building permits for buildings

within the development, the Developer shall provide the Township with a guarantee for the satisfactory completion of the required site improvements for his development. Such guarantee shall be in the form of cash, certified check, or irrevocable bank letter of credit, whichever the Developer selects, or in the form of surety bond acceptable to the Township. The amount of the deposit shall be set by the Township. The Township shall release funds from this deposit as site improvements are completed and approved by the Township approximately in proportion to the amount of improvements satisfactorily completed.

b. A separate bond will be required for landscaping for 2 years for 50% of the cost of installation (including the plantings).

c. If required, Contractor shall furnish to the Township a performance bond and labor and material bond with sureties satisfactory to the Township in an amount equal to one hundred (100%) percent of the contract price for the construction of the project. Performance bonds and Labor and Material bonds shall be executed on AIA (American Institute of Architects) documents.

d. Permit bonds, as required by the Township, may be executed on documents other than AIA forms that are acceptable to the Supervisor.

e. An acceptable three year Maintenance Bond shall be furnished to the Township before any development is approved and accepted. The term of the bond shall begin on or after the date of acceptance of the work by the Township. The amount of the bond shall be equal to 33% of the construction cost for water main, sanitary sewer, storm sewer and private roads. The correction of any defects or deficiencies in the improvements covered under the construction permit.

2. Insurance

a. Contractors shall procure insurance and maintain it during the entire term of the contract with an insurance company with a current rating no less than A by A.M. Best Company and must be an admitted carrier. The Township and Township's Consulting Engineer shall be listed as named additional insured in language acceptable to the Township. Insurance coverage shall be as follows:

i. Commercial Liability Occurrence Form

Commercial Liability Occurrence Form	
Limits:	$1,000,000 each occurrence
	$1,000,000 general aggregate
	$1,000,000 personal & advertising injury

	$1,000,000 products/completed operations aggregate
	$500,000 fire damage to real property
	$5,000 medical payments

Coverage shall not exclude contractual liability, explosion, collapse, or underground hazards.

ii. Contractor shall procure Owners and Contractors Protective Liability.

Owners and Contractors Protective Liability Occurrence Form	
Limits:	$1,000,000 each occurrence
	$1,000,000 general aggregate

Township of Bruce shall be Additional Named Insured, also naming the Township Engineer.

iii. Commercial Automotive Liability

Commercial Automotive Liability	
Limits:	$1,000,000 combined single limit
	Michigan No Fault as specified by law

Commercial automobile liability coverage must include coverage for all autos, owned and non-owned, and hired.

iv. Workers compensation including Employers Liability Statutory

Employers Liability	
Limits:	$500,000 each accident
	$500,000 policy limit
	$500,000 each employee

v. If work involves exposure to a Federal Waterway, workers compensation coverage shall include coverage for Longshoreman's & Harbor Worker's Act and Maritime Liability.

Umbrella Liability	
Limits:	$2,000,000 each occurrence
	$2,000,000 general aggregate

Coverage should be umbrella form and not excess insurance. Maximum Self-Insured Retention Limit: $10,000.

vi. Pollution insurance may be required for some projects based on the type of work being performed and at the discretion of the Township Board or the Township Engineer.

Pollution Liability	
Occurrence or Claims Made Forms are acceptable	
Limits:	$2,000,000 each claim/occurrence
	$2,000,000 general aggregate/per project

Coverage shall include clean-up costs, on and off the site, and liability to third parties. Licensed and unlicensed insurers must maintain an A.M. Best rating of A.

vii. Builders Risk/Installation Material Coverage: Contractor shall maintain property insurance for one hundred (100) percent of the completed value of any structure or one hundred (100) percent of the materials being used in the installation. If the Township of Bruce maintains an interest in any building materials or installation materials, the Township shall be named as a Lenders Loss Payee.

viii. Certificates of Insurance: Contractor shall furnish to the Township certificates of insurance evidencing the above coverages. Each policy and certificate shall grant a thirty-day notice of intent to cancel or change any such insurance. The Cancellation Clause of the Certificate of Insurance shall strike the words "endeavor to," and "but failure to mail such notice shall impose no obligation or liability of any kind upon the company, its agents, or representatives."

Certificates of Insurance shall be furnished to the Township prior to commencement of any project, and the certificate shall verify that coverage is in effect until the Township approves and accepts the work performed by Contractor. If the project continues beyond the expiration date of Contractors Insurance, a renewal certificate must be provided, proving continuous coverage.

SECTION 12.0 PLANNING AND ZONING PERMIT FOR CONSTRUCTION

Upon securing of approvals and construction permits from all other appropriate agencies, the Developer shall make an Application for a Permit for Construction of site improvements on a form furnished by the Township. As part of this Application, the Developer shall submit the following:

1. Eight (8) sets of approved plans and specifications covering all construction proposed and approved for construction. The cover sheet of the set of plans shall contain the following statement signed by the Developer's Engineer:

   "I hereby certify that these are true copies of the plans approved by the Township on (Date) by (Developer's Engineer P.E. No.)"

2. A cash deposit, computed according to the deposit schedule indicated in the Utility Fees Schedule, from which the final cost of construction inspection, administrations and/or construction water usage will be deducted.

3. A deposit for easement review shall be required prior to the issuance of a Permit for Construction.

4. All required on-site and offsite easements shall be reviewed by the Township Engineer. Once they have been approved they shall be signed, recorded and submitted to the Township prior to the issuance of a Permit for Construction

5. All public improvements must be staked under the supervision of a Registered Engineer or Land Surveyor according to the latest approved plans. All plans used by the contractor for construction must be stamped "Approved For Construction" by the Township. Cut sheets must be prepared for all construction work by the engineer or surveyor responsible for the staking.

6. Prior to the start of construction, a pre-construction meeting shall be held. Attendees shall include the Developer's Representatives and the Township's Respresentatives. Other utility companies and reviewing agencies shall be invited to attend the pre-construction meeting.

7. Such other information and data as the Township deems reasonably necessary to enable the approval of the Construction Permit.

8. Upon approval of the Construction Permit by the Township, the Developer's Construction Contractor shall perform the construction under detail inspection.by the Township or their representative. Please see Inspection section for additional requirements.

9. If the improvements installed include sewers, the Developer shall make a cash deposit to the Township in the amount indicated in the Utility Fees Schedule, from which the final cost of such sewer cleaning will be deducted. To pay for the cleaning of any sanitary sewers or storm sewers covered under the Permit during the period of construction of the buildings in the Development served by said Public and Private Utilities, or for a period of three (3) years, whichever is the lesser period. Applicant further agrees that all such costs incurred during said appropriate period may be deducted from the Cash Deposit (made with this Application) until such period as expired (after which time the remaining money will be returned).

10. Prior to the issuance of a Construction Permit, the Applicant shall satisfy all of the conditions listed below:

    a. Payment to the Township for all costs of the inspection of the construction of Public Utilities and all other improvements covered under the Permit. Applicant will be responsible to supplement the

Inspection Deposit (made with this application) with sufficient payment if the final costs of inspection exceed the Inspection Deposit.

b. To give notice to the Township at least 2 business days prior to starting any construction.

SECTION 13.0 INSPECTION

1. All work covered under a Permit for Construction of Site Improvements shall be performed according to the approved plans and specifications and in accordance with the requirements of this Ordinance. By making an application for a Permit for Construction of Site Improvements, the Developer grants the Township the right to perform inspection of any work covered under the permit and the Developer shall correct, at his expense, any work which is discovered to be done in conflict with the approved plans and specifications or in conflict with the requirements of this Ordinance.

2. The Developer shall pay a fee to cover all costs of inspection of work covered under the Permit for Construction of Site Improvements. The basis of the fee to be paid the Township shall be according to the Utility Fees Schedule.

3. The fee for construction inspection as determined above shall be deducted from the amount of the construction deposit paid upon application for a Permit for Construction as set forth in the Utility Fees Schedule. If the fee so determined exceeds the amount of the deposit, the Developer shall make up such deficiency in deposit by paying forthwith, upon discovery, an additional deposit to cover the cost of inspection until the job is completed and approved. Upon completion and final approval of the work, any money left in the construction inspection deposit account will be returned to the Developer.

4. The Township reserves the right to inspect all work covered under the Permit for Construction of Site Improvements and intends to provide detailed inspection for all of the following:

   a. All of those types of construction where detailed inspection requirements are covered under the Township Sewer and Water Ordinance;

   b. All sanitary sewers (public or private) including connections thereto;

   c. All water supply pipe (public or private) including connections thereto;

d. All open and enclosed storm drains (public or private) including connections thereto, except in the case of those storm sewers considered private storm sewers in mobile home parks that do not receive drainagewater from premises other than the mobile home park site;

e. All site grading for any site;

f. All sidewalk and driveway construction installed outside of those rights-of-way that are dedicated to the County Road Commission; and

g. All street and/or parking lot pavement installed outside of those rights-of-way that are dedicated to the Macomb County Road Commission.

SECTION 14.0 EASEMENTS AND DEDICATION OF IMPROVEMENTS

1. An appropriate Dedication of Improvements for all parts of the improvements expected to the public sewer and/or public water main together with copies of recorded easements for public utilities as signed by all persons having an interest in the land. A title search statement indicating the names of all persons interest (certified by a recognized Title Insurance Company) shall accompany the copies of recorded easements. Dedication of Improvements shall be conveyed to the Township on forms approved by the Township.

2. Prior to final approval, the Developer shall furnish to the Township copies of acceptable recorded easements for all improvements as shown on the approved plans. A separate easement document is required even if the easements are shown in the Master Deed and/or Plat.

3. Easement requirements are as follows:

   a. A written description and drawing of the easement shall be prepared by the Design Engineer and be presented to the Township for examination before recording. Easement description shall be on forms approved by the Township.

   b. Easements for storm sewers and open ditches shall have a minimum width of twelve feet for sewers 12 inches to 48 inches in diameter and a minimum width of twenty feet for sewers greater than 48 inches in diameter, centered upon the sewer or ditch.

   c. Provide a minimum 12 feet wide easement for access for maintenance and/or inspection of storm water management facilities.

d. Provide a minimum 20 feet wide easement for access for maintenance and/or inspection of water mains and sanitary sewers. The easement shall extend 10 feet beyond all hydrants.

e. An easement shall be provided for the pretreatment system to allow access for maintenance and/or inspection.

f. When drainage is required to flow across an adjacent lot, a 12-foot wide storm water easement, centered on the drain, must be provided. This easement shall be dedicated to the Homeowners Association or Township with restriction against use or occupation of easements by the property owners and/or by other utilities in any manner that would restrict storm system maintenance or repair operations.

g. A written description and drawing of the easement shall be prepared by the Designing Engineer and be presented to the Township Engineer and Attorney for review and approval before recording.

h. Easements for possible extensions shall be provided to the property lines at locations designated by the Township Engineer.

i. The easement must be large enough to accommodate a slope of 1 horizontal to 1 vertical from the sewer invert to the edge of easement.

j. The horizontal alignment of sewers that are not proposed to generally follow street, drive, or parking area pavements, shall parallel property lines or building lines.

k. Temporary construction easements from adjacent property owners and/or permanent easements for off-site facilities shall be obtained by the applicant. Documents shall be in a form acceptable to the Township Attorney. Copies shall be submitted to the Township prior to construction plans being approved.

l. No permanent structure shall be placed within or over the permanent easement.

m. Easements for possible extensions shall be provided to the property lines at locations designated by the Township Engineer.

n. Water mains shall preferably be constructed outside of paved parking areas, streets, drives, and rear-yards.

SECTION 15.0 RECORD DRAWINGS

One full-scale mylar and four (4) blackline sets of all record drawings of sanitary sewer, storm sewer, water main, retention basin, paving and grading shall be provided to the Township, upon approval of the Record Drawings and to such County agencies as required prior to acceptance of the improvements by the Township. Two electronic copies shall be provided to the Township, upon approval of the record drawings.

15.00 GENERAL

This standard establishes the minimum requirements for record drawings in the Township.

Four (4) copies of record drawings of water main, sanitary sewer, storm sewer, detention and retention basins, drainage ditches and swales shall be submitted for review and approval prior to acceptance of the improvements by the Township.

15.10 PLAN REQUIREMENTS

Record drawing information shall be provided on the original approved construction drawings and shall contain, but not necessarily be limited to, the following items:

1. General Items

   a. All record drawings shall contain a statement by an engineer or land surveyor, registered in the State of Michigan certifying that the project improvements indicated on the record drawings conform to the latest approved construction drawings. The statement shall be signed, dated and sealed by the State registered engineer or land surveyor.

   b. All record drawing elevations shall be based on NAVD88 Datum. The record drawing coordinate system shall be the State Plane coordinate system as adopted by Macomb County.

   c. All record drawing information shall be clearly marked as such.

   d. Record drawing locations shall be shown on the plans to an accuracy of one (1) foot horizontal and 0.01 foot vertical.

   e. All location changes of 10 feet or more horizontally and .5 feet vertically shall be redrawn on the plan and the original location shall be crossed out (X-ed) on the plan.

   f. Upon final approval of the record drawings, the proprietor's engineer shall provide the Township with an electronic copy of the record drawing. This is required so that water mains, sanitary and storm sewer improvements can be added to the Township's G.I.S. database, and the costs incurred are at the proprietor's responsibility. The

electronic files shall conform to G.I.S./Shape file format or AutoCad (DWG) format.

2. Water mains

   a. Location of all water mains with respect to property line, back of curb or edge of pavement.

   b. Rim elevation of gate wells.

   c. Fire hydrant bury line/arrow elevations.

   d. Top of pipe elevation at gate wells.

   e. The distance between the hydrant and the center line of the water main.

   f. Accurately locate all utilities, both horizontally and vertically, (storm, sanitary, water main etc.) where the recommended separation horizontally or vertically is less than that required ten (10) feet horizontal and 18" vertical.

   g. The Liber and Page number for any easement obtained for water main as well as any existing easement involved in the project shall be noted.

   h. Northing and easting coordinates shall be shown on the record drawings for all hydrants and gate valves.

   i. Materials installed:

      i. Size, length, type, class, joint and manufacturer of pipe.

      ii. Size, brand and manufacturer of valves and hydrants.

      iii. A total record drawing quantity list, on the cover sheet.

3. Sanitary and Storm Sewer

   a. Location of all sewers with respect to property line, back of curb or edge of pavement.

   b. Rim elevation of all structures.

   c. Pipe invert elevations at all structures, end-sections or headwalls.

   d. Percent grade of all pipe runs.

e. Length of pipe from center to center of manholes, and length of stubs out of manholes.

f. Length and location (witnessed to three (3) points) of any casing pipe.

g. Materials installed:

   i. Size, type, class, joint and manufacturer of pipe.

   ii. For pressure sewers, a diagram of all appurtenances in each valve structure shall be drawn with flow arrow.

   iii. A total record drawing quantity list.

h. The Liber and Page number for each easement obtained for the construction of sewer as well as any existing easement involved in the project shall be noted.

i. Northing and easting coordinates shall be shown on the record drawings for all storm and sanitary manholes.

j. House lead locations:

   i. Information shall be obtained from inspection records and transferred to the plans.

   ii. Location of wye measured from downstream manhole.

   iii. Length of lead.

   iv. Length of any risers, if placed.

   v. Location of end of lead measured from downstream manhole.

4. Detention/Retention/Infiltration Basins

a. Width and length of top and bottom of basin.

b. Elevations at sufficient intervals to verify basin side slopes and capacity.

c. Centerline location, width and elevations, and material of basin overflow facility spillway or control structure.

d. Invert elevation of inlet and outlet pipes.

e. Basin outlet restriction size.

f. Calculations of the basin volume between the high water elevation and the invert of the outlet pipe for a detention basin, and the bottom of the basin for a retention basin (based on as-built elevations).

g. Freeboard elevation all around the basin.

5. Drainage Ditches and Swales

a. Location of centerline of all ditches and swales with respect to property lines, the bottom low and the side high elevations of these swales.

b. Elevations showing drainage patterns of paving and grades between impervious pavements and property lines, showing how they match adjacent abutting properties or phase.

SECTION 16.0 FINAL ACCEPTANCE

In addition to the record drawings, and prior to final approval, Dedications of Improvements and Permanent Easements for Water Mains, and Sanitary Sewers, storm, cross-access (including Exhibits A & B) must be provided, signed, and notarized by the proprietor, using Township Attorney's forms.

Upon completion of construction and prior to using any of the facilities covered under the construction permit, the Developer shall apply for a written final approval and acceptance of the Improvements. As part of this Application, the Developer shall submit the following:

1. To furnish sworn statements and waivers of lien upon completion of construction, indicating that all labor and materials have been paid in full.

2. To furnish the required number of sets of "as-builts" or "record drawings" drawings, mylars and digital record indicating as-built information as required by the Engineering Design Standards, or to provide fees and digital records as required to allow the Township's Consulting Engineer to produce the required as-built data.

3. To secure the written approval from the Township of all construction covered under this Permit before using any Public or Private Utilities covered under this Permit.

4. Building permits can be issued prior (at the discretion of the Building Official) to final acceptance if a monetary bond covering the cost of installing the remaining improvements is provided to the Township.

5. Certificates of Occupancy will not be issued for any residential or commercial developments until all project improvements have been accepted (per requirements).