



ENGINEERING DESIGN AND CONSTRUCTION STANDARDS

Standards: For engineering design, for preparation of engineering plans and specifications, and for construction of site improvements.

Section I. General Plan Submission Requirements

- A. Plans shall be submitted on 24" x 36" white prints having black lines and electronically in a format acceptable to the Township. Plans shall be neatly and accurately prepared. Judgment should be exercised in the design, layout, and presentation of proposed improvements.
- B. Engineering plans shall have a maximum scale of one (1) inch equals fifty (50) feet in plan view. The profile view shall have a maximum scale of one (1) inch equals fifty (50) feet horizontal and one (1) inch equals five (5) feet vertical.
- C. Any land development project requiring more than one plan sheet must be submitted with a "General Plan" having a maximum scale of one (1) inch = 100 feet showing the overall project layout (including building locations) and the existing and proposed location of all features as follows:
 1. Existing and proposed street names and right-of-way widths;
 2. Lot, unit or property identification numbers, dimensions and tract acreage;
 3. Location of all existing and proposed structures or buildings;
 4. Location and elevations of existing and proposed ditches, culverts, natural waterways, ponds, detention basins, and County Drains;
 5. All existing and proposed public and private utilities within the influence of the site;
 6. All existing and proposed public and private easements within the influence of the site;
 7. Existing and proposed 100-year floodplain and floodway limits and elevations; and
 8. Existing areas considered to be "wetlands" as defined by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) and any proposed wetland mitigation areas.
- D. The cover sheet shall include the following:
 1. A signed Engineer's Certification.
 2. A location sketch identifying the site and the nearest main crossroads;
 3. A north arrow;

4. The legal property description of all parcels involved in the proposed project or improvements;
 5. Macomb Township Standard Notes;
 6. A minimum of two benchmarks based on the North American Vertical Datum of 1988 (NAVD 88);
 7. A listing of all units/lots within the influence of the existing and proposed floodplain; and
 8. A listing of all units/lots affected by clay cutoff walls.
- E. All proposed public utilities shall be located at least three (3) feet away from parcel or unit/lot boundary lines and within the middle third of a dedicated utility easement unless located directly adjacent to public right-of-way. A minimum of ten (10) feet horizontal separation (in accordance with 10 States Standards) shall be provided between adjacent water main, sanitary sewer, and storm sewer.
- F. Superimposed on the general plan or on a separate topographic survey sheet of the site shall be existing contour lines for the project area, including the area at least 100 feet beyond the property limits and limits of construction. Contour lines shall be shown at intervals as follows:
1. Where the general slope of the land is one percent (1%) or less, the interval shall be one (1) foot;
 2. Where the general slope of land is more than one percent (1%) but less than five percent (5%), the interval shall be two (2) feet;
 3. Where the general slope of land is five percent (5%) or greater, the interval shall be five (5) feet.
- G. Any underground or overhead utilities shall be located on or along the public or private road right-of-way according to the schedule on the following page:

SCHEDULE OF STANDARD UTILITY LOCATIONS

Existing and New Streets Location of Utilities from Centerline⁽¹⁾

SUBJECT UTILITY	60' ROW (24' Pavement without curbs)	60' ROW (28' Pavement with curbs)	70' ROW (36' Pavement with curbs)	86' ROW (Ultimate) (36' Pavement with curbs)	120' ROW (Ultimate) (64' Pavement)
Water Main	23'R	23'R	28'R	28'R	43'R
Hydrants	21'R	21'R	26'R	26'R	41'R
Sanitary Sewer	36'L	36'L	41'L	49'L	50'L
Storm Sewer	22'L	22'L	26'L	27'L	40'L
Gas	16'R	18'R	22'R	22'R	35'R
Electric, Phone, Cable, Internet (Overhead)	--	--	--	--	48'R
Electric, Phone, Cable, Internet (Underground)	34'R	34'R	39'R	47'R	48'L/R

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 Township Engineer with the concurrence of the Macomb County Department of Roads (MCDR) when appropriate. Where, in the opinion of the Township Engineer, these locations are not desirable or possible, suitable adjustments may be made.

The Township Engineer may make adjustments to these utility locations as existing conditions dictate. All utility locations within the public right-of-way are subject to the review and approval of the Macomb County Department of Roads (MCDR) and the Michigan Department of Transportation (MDOT).

- H. All sewers and water mains shall be indicated in profile. There shall be a separate profile view for each utility. 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. It shall be the responsibility of the design engineer to ascertain that the depth of the utilities does not interfere with any building service sewers or other utilities by maintaining a minimum eighteen (18) inch clearance at all crossings. The profile shall show and label all existing and proposed crossing utilities with the crossing clearance.

- I. Elevations shall be based on the North American Vertical Datum of 1988 (NAVD 88). Township benchmarks shall be used where available.
- J. Finish grade elevations and diameter planned for each utility structure shall be indicated on both the plan view and the profile view.
- K. 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.
- L. Plans shall have all lettering a minimum height of one-tenth (0.1) of an inch.
- M. All plans submitted shall bear the seal of the Professional Engineer licensed in the State of Michigan responsible for the design.
- N. The plans covering all 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. If the site is planned to be phased as indicated on the Approved Site Plan, Site Condominium Subdivision Plan or Tentative Preliminary Plat, the engineering plan must show all phases within the development. Each phase may be submitted for engineering plan review separately. Each phase must include all site improvements necessary for the full function of said phase, including those located within future phases.

Section II. Site Grading

- A. Adequate soil erosion and sedimentation control measures shall be specified on the plans and followed during construction to conform to the requirements and be approved by the Macomb County Office of Public Works (MCOPW) prior to approval of the engineering plans.
- B. A grading plan is required for all development sites. The grading plan shall show existing grading contour lines, including 100 feet beyond each property line as well as grades for all proposed improvements meeting the requirements outlined in this section.
- C. 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. It shall be unlawful for any person to interfere with, modify, or obstruct the flow of drainage water across any property in any manner different from the approved plan.
- D. 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 at a minimum slope of one percent (1%).
- E. The maximum slope of the land for the site, except for transitional ramps between usable site areas, shall be seven percent (7%). The sodded ramp slopes shall be a maximum of one (1) foot vertically and four (4) feet horizontally.
- F. Except for residential developments, the longitudinal slope of any drainage swale shall be a minimum of one-half percent (0.5%) and a maximum of seven percent (7%). 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 drainage water travel shall be upstream of an angle point (deflection angle forty-five (45) degrees or greater) in the drainage swale. Planned final grade elevations shall be indicated on the plans at a maximum spacing of fifty (50) feet.
- G. Unless otherwise approved by the Township Engineer, residential building sites shall be graded as follows:
 - 1. A maximum difference of one-half (0.5) of a foot shall be provided between adjacent building brick ledge elevations;

2. Building brick ledge elevations shall be a minimum of one and a half (1.5) feet and a maximum of two and a half (2.5) feet above the adjacent top of curb;
3. A minimum two percent (2%) or one half (0.5) of a foot and a maximum seven percent (7%) or one (1) foot of fall, whichever is higher, shall be provided from the building's brick ledge to the adjacent side yard high point;
4. Rear yard drainage swales shall have a minimum seven-tenths percent (0.7%) or one-half (0.5) foot drop (whichever is greater) slope and a maximum five percent (5%) slope;
5. Side yard drainage swales shall have a minimum one percent (1%) slope. Side yard drainage swales shall have a maximum seven percent (7%) slope, except where a walk-out basement is proposed;
6. For residential buildings with non-stepped brick ledges, the side yard high point shall be located approximately fifty (50) feet from the right-of-way;
7. For residential buildings with stepped brick ledges, front and rear side yard elevations shall be shown at approximately twenty-five (25) feet and seventy (70), respectively, from the right-of-way. The brick ledges shall be stepped from front to back with the side yard high point provided at the front side yard elevation;
8. Unless the natural fall of the land being developed will not allow, unit/lot grading and storm sewer systems shall be designed such that each unit/lot drains to a catch basin structure at a rear corner of the unit/lot. Rear yard swales shall be designed to carry surface drainage from the opposite unit/lot corner to the storm structure. Therefore, units/lots shall be designed with alternating high points and low points with catch basins at rear corners ensuring that swales shall not convey water across unit/lot lines;
9. Reasonable building envelopes or footprints shall be shown for each unit/lot, ensuring that the side yard elevations correctly correspond to the front, center, or rear enveloped location as necessary;
10. Driveway slopes shall not exceed a maximum of seven percent (7%) slope from garage finished floor to sidewalk grade.

Section III. Storm Drainage Collection and Conveyance

The requirements outlined below shall govern all storm drainage facilities and conveyance. For facilities under Macomb County Office of Public Works (MCOPW) and Macomb County Department of Roads (MCDR) jurisdiction, where the MCOPW and MCDR guidelines conflict with Macomb Township guidelines, the more stringent of the requirements shall be met.

- A. All sets of plans which include plans for storm sewers shall include the current Township Storm Sewer Standard Details Sheet(s) which shall be considered an inseparable part of the plans when said plans are approved.
- B. A Storm Drainage Collection and Conveyance Plan is required for all development sites. An adequately sized enclosed storm drainage system shall be provided for all land development projects. If there are any upstream watershed drainage areas which, in the opinion of the Township Engineer, need to be routed through the development site, sufficient depth and capacity shall be provided in the on-site storm drainage system for the fully developed upstream drainage area(s). In this case, the enclosed storm drainage system shall be extended across the public road frontage and/or through the development site with a stub(s) provided for future connection by the upstream properties. A storm sewer manhole shall be provided ten (10) feet from the end of a storm sewer stub, unless otherwise determined by the Township Engineer. The location of the stub(s) is subject to approval by the Township Engineer.
- C. In areas immediately adjacent to open water courses, detention basins, and/or wetlands, the Township Engineer may allow for stormwater runoff to flow over the ground surface (sheet drain/flow) from the development into said water course, detention basin, and/or wetland.
- D. No building permit for any building having a basement shall be issued unless the plans for such a building indicate building service sewer (drainage water) directly connects to an enclosed storm sewer at a storm sewer structure. For residential developments, drainage water from basement drains or sump pumps shall be directed by a sump drainage pipe with a minimum three (3) inch diameter to a rear yard storm sewer structure.
- E. Where possible, drainage water run-off from building roofs shall be directed five (5) feet away from the outside walls of any building to a defined overland drainage course. Generally, roof drainage shall not be directed over impervious surfaces, including sidewalks. Unless an adjacent unpaved overland drainage course is available, drainage

from building roofs within industrial and commercial sites shall directly connect to an enclosed storm sewer system at a storm drainage structure.

- F. Stormwater runoff drainage systems shall be designed for a ten (10) year storm by means of the Rational Method formula: $Q=CIA$; where Q is the peak rate of runoff in cubic feet per second (cfs), A is the area in acres, C is the co-efficient of runoff for the drainage area, and I is the average rainfall intensity in inches per hour for a certain time of concentration. The rainfall intensity shall be determined by the formula $I=175/(25+T)$; where T is the time of concentration equal to the time required for a drop of water to run from the most remote point of the watershed to the point for which runoff is being estimated. The design engineer shall use judgement in arriving at proper imperviousness factors, but in general the following factors are acceptable minimums:
1. Lawn areas—0.1
 2. Pavement and roof areas—0.9
 3. Overall area of single-family residential developments—0.35
 4. Overall area of multiple-family residential developments—0.55
 5. Overall area of commercial developments—0.90
 6. Overall area for industrial developments—0.90

The design engineer shall submit a map outlining the various watershed drainage areas, including off site upstream areas which drain to each inlet point used for design. The map shall be accompanied by storm sewer design computations showing the calculated flow and flow capacity of each pipe run and upstream and downstream inverts and hydraulic grades. The minimum acceptable size of storm sewer downstream of any stormwater inlet structure is twelve (12) inches in diameter. However, for residential lots, units, or parcels that are not part of a platted subdivision or site condominium or are part of a development constructed prior to the effective date of the Land Development Ordinance, the minimum acceptable size of storm sewer may be reduced to eight (8) inches in diameter.

For the design of storm sewers, the Manning's formula shall be used for pipe sizing with a "N" factor of 0.013 for reinforced concrete pipe. Storm sewers shall be designed to provide a minimum velocity when flowing full of two and a half (2.5) feet per second (fps) and a maximum velocity of ten (10) feet per second (fps).

- G. The rational method of calculating stormwater runoff as described previously is generally acceptable for sites less than 100 acres in size. For larger sites, due caution should be exercised. Other methodologies such as runoff hydrographs may be required by Macomb

Township for sizing the drainage systems on sites that are deemed potentially problematic. Acceptable alternative methods include:

- U.S. Army Corps of Engineers HEC-HMS;
- Soil Conservation Service UD-21, TR-20 and TR-55;
- U.S. Environmental Protection Agency’s Storm Water Management Model (“SWMM”).

Alternative methods may be selected for appropriate site conditions. The Township Engineer retains the authority to approve or deny proposed alternative calculation methods at their discretion.

All design rainfall events will be based on the Natural Resource Conservation Service (NRCS) MSE3 rainfall distribution and the most current version of NOAA Atlas for rainfall intensity.

Computations of runoff hydrographs that do not rely on a continuous accounting of antecedent moisture conditions will assume a conservative wet antecedent moisture condition.

- H. In general, trunk storm sewers or any sewer that carries public street drainage water shall be located within a public street right-of-way. Where storm sewers are located outside of public streets and also carry stormwater runoff from more than one parcel, the storm sewers shall be placed in a recorded utility easement that provides for access to the storm sewer for repairs, connections, and maintenance. The minimum acceptable width of easements for storm sewers shall be:

<u>Diameter of Sewer</u>	<u>Minimum Easement Width</u>
21” or less	12’
24” to 48”	20’
Over 48”	30’

Additional easement width shall be provided as required by the equation below, and/or if in the Township Engineer’s opinion, the depth of the sewer requires wider excavation for construction and maintenance:

$$\text{Easement Width} = \text{Pipe Diameter} + 2 \times \text{Depth to Pipe Bottom} + 2 \text{ feet.}$$

- I. Where possible, a minimum of three (3) feet of cover shall be provided from the finished road or earth grade to the top of any storm sewer. In some cases, it will be acceptable to

allow the hydraulic gradient to be above the top of the storm sewer pipe; in this case, the design elevation of the hydraulic gradient profile shall be indicated on the storm sewer profile view and hydraulic gradients shall be a minimum of one (1) foot below the surface at any locations. However, hydraulic gradients shall be maintained within the pipe on any storm sewers considered to be trunk or public storm sewers.

- J. Access manholes shall be provided along the storm sewer at every change of pipe size, change of grade, or change of direction. However, the maximum spacing for storm sewer manholes shall be as follows:

<u>Diameter of Sewer</u>	<u>Absolute Maximum Manhole</u>
12" to 30"	350'
36" to 42"	400'
48" to 60"	500'
66" & larger	600'

- K. Storm sewer structures shall be designed with sufficient diameter based on the number, size and configuration of incoming and outgoing storm pipes. For sewers forty-two (42) inches diameter and greater, radius pipe may be used at changes in pipe direction provided a manhole is installed on the straight pipe section immediately downstream. Catch basin leads may tap directly into sewers forty-two (42) inches and larger, except that taps shall not be made into a precast manhole tee pipe section.
- L. Catch basins shall not be constructed over a main sewer line to replace manholes in street sewers or trunk sewers outside of streets. Moreover, a manhole normally shall not be used as a stormwater inlet structure. However, if a normal manhole location (outside of streets) coincides with a stormwater inlet structure location and at least seventy-five percent (75%) of the upstream stormwater inlet structures are catch basins (with sumps), the manhole may be used as a stormwater inlet structure by placing a catch basin cover on the manhole.
- M. Not more than three (3) upstream catch basins will be allowed to discharge into any catch basin. Where additional catch basins are required, a manhole with a two (2) foot sump and catch basin cover shall be provided.
- N. In general, pavement type catch basins shall be located as follows:
 1. At the radius return of street or drive lane intersections such that drainage may travel a maximum allowable 150 feet maximum distance around a corner without an intercepting catch basin.

2. At all low points in streets or parking areas such that there is a maximum pavement drainage area for each structure as follows:
 - i. Low point catch basin (streets) 10,000 SF/CB
 - ii. Low point catch basin (parking areas) 25,000 SF/CB

 3. At intermediate points along the street or parking areas such that there is a maximum pavement drainage area per structure as follows:
 - i. Intercepting catch basins (streets) 7,500 SF/CB
 - ii. Intercepting catch basins (parking areas) 25,000 SF/CB
- O. Yard type catch basins shall be provided at all low points in drainage swales. Intercepting yard type catch basins shall be provided such that a maximum of 350 feet of swale drainage runs into any one catch basin, other than a low point catch basin where 700 feet (350 feet in each direction) of drainage is allowed.
- P. For residential lots, units, or parcels that are not part of a platted subdivision or site condominium or are part of a development constructed prior to the effective date of the Land Development Ordinance, the minimum acceptable size of storm structures may be reduced to two (2) feet in diameter.
- Q. Where an enclosed storm system is being constructed adjacent to floodplain areas, all low point catch basins shall maintain a rim elevation above the 100-year floodplain elevation as identified by the Federal Emergency Management Agency (FEMA) and the Floodplain Insurance Study (FIS). The rims shall be placed at an elevation of at least two-tenths (0.2) of a foot above the floodplain elevation unless otherwise approved by the Township Engineer.
- R. Unless otherwise specified by the governing agency (i.e. Macomb County Department of Roads (MCDR), Macomb County Office of Public Works (MCOPW), etc.), a prefabricated bar screen shall be installed on the end of all storm sewers eighteen (18) inches in diameter and larger which outlet into an open drain or detention basin. Openings of the bar screen shall be no more than six (6) inches on center.
- S. In areas where surface water runoff is not directed into a nearby enclosed storm drainage system, an extension of the storm sewer system shall be provided to furnish an outlet for foundation drain service pipes for any buildings not otherwise serviced. This extension

shall have a minimum diameter of eight (8) inches with minimum two (2) foot diameter storm structures with manhole covers.

- T. Where required by the Township Engineer, a six (6) inch diameter perforated underdrain with geotextile wrap shall be provided for drainage with said pipe trench being backfilled entirely with pea gravel up to within four (4) inches of the grade line of swale.

- U. Improved open drains may be permitted under special circumstances provided the Township Engineer has determined that the enclosure of such open drains would require a storm sewer sixty (60) inches, or larger, in diameter. When open drains are used, the easement width shall be sufficient to accommodate a thirty (30) foot wide maintenance plateau (with a maximum slope of ten percent (10%)) on each side of the channel.

- V. Where open drains are proposed for drainage water disposal, the Manning's formula shall be used for determination of flow depth and capacity. All open drains under the jurisdiction of MCOPW or MCDR shall be designed to their standards. The design engineer shall provide calculations and plans showing the flow and capacity of the drain under a 100-year storm event over the upstream watershed for any open drain that conveys flow for the 100-year floodplain as designated on the Flood Insurance Rate Map (FIRM). Otherwise, all open drains shall be designed under a ten (10) year storm event.

- W. 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 vegetation surfacing as soon as possible after construction. Native plantings, as listed in the Macomb County Office of Public Works (MCOPW) Procedures and Design Standards Manual for Stormwater Management, shall be utilized where possible. In any event, sufficient measures shall be taken to conform to the soil erosion and sedimentation control requirements of the Macomb County Office of Public Works (MCOPW).

- X. Stormwater detention is required, except when determined by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Macomb County Office of Public Works (MCOPW), Macomb County Department of Roads (MCDR), Michigan Department of Transportation (MDOT) and/or the Township Engineer that the subject site is:
 - 1. Within an existing development that has established drainage facilities with adequate capacity for the subject site;
 - 2. The site is less than 1 acre; and/or

3. The site outlets to a facility under the jurisdiction of the Macomb County Office of Public Works (MCOPW), the Macomb County Department of Roads (MCDR), and/or the Michigan Department of Transportation (MDOT) and the governing agency does not require detention.

Several design considerations need to be incorporated into the design of the detention basin(s) in regard to site drainage, stormwater management facilities, and pertinent concepts related to stormwater quality. These items are as follows:

1. Discharge Rate Criteria:

Unless otherwise approved by the Township Engineer, Macomb County Office of Public Works (MCOPW), Michigan Department of Environment, Great Lakes, and Energy (EGLE), Macomb County Department of Roads (MCDR) and/or Michigan Department of Transportation (MDOT), the maximum design rate or volume of discharge shall not exceed two tenths (0.20) cubic feet per second (cfs) per acre. The Township Engineer may, at their discretion, determine that a lower rate is appropriate, when the required discharge rate exceeds drain capacity.

The volume and manner of water discharged due to development of the site shall not create adverse impacts to downstream property owners and watercourses.

It is the property owner's obligation to meet this standard. Should a stormwater system, as built, fail to comply with the design rate of discharge, it is the property owner's responsibility to design and construct, or to have constructed at their expense, any necessary additional and/or alternative stormwater management facilities to bring the system into compliance. Such additional facilities will be subject to Macomb Township's review and approval.

2. Detention Systems:

- i. The following criteria will apply to the design of all stormwater detention facilities:

1. Public safety will be a paramount consideration in stormwater management systems. Providing safe detention is the property owner's responsibility. Where further safety measures are required, the proprietor is expected to include them within the proposed development plans.

2. On-site management of storm drainage will be designed for control of flooding, control of downstream erosion, and improving water quality. Submission of flow calculations, cross-sections, and other pertinent data will be required.
3. At a minimum, the volume of storage provided for flood control will be equal to two-tenths (0.2) of a foot of water over the site.
4. A minimum of one (1) foot of freeboard (the difference between the maximum storage elevation and the low point in the watershed of the detention system) will be required for all detention systems.
5. The bottom of the detention facility must be a minimum of three (3) feet above the groundwater elevation.
6. The maximum design high water elevation for storage in detention systems shall be at least 3 feet below the low point of the watershed area. Alternatively, the hydraulic gradient line (HGL) of the storm sewer shall be one (1) foot or greater below the ground surface elevation above the pipe where the starting elevation for the HGL computation shall be the greater of:
 - a. The 2/3 depth elevation of the design detention system volume, or
 - b. The highest eight tenths (0.8) diameter point elevation of the basin inlet pipe(s).

In any event the lowest catch basin surface elevation shall be greater than the design water surface elevation of the detention system. The HGL shall be plotted on the storm sewer system profiles.

7. Backwater effects on the detention system from the downstream drainage system shall be considered.
8. If a proposed detention system is located within the 100-year floodplain, the detention system shall be sized such that the detention volume is stored above the floodplain elevation. The

Township Engineer may waive this requirement if compensating floodplain storage is provided within the detention system.

It is the responsibility of the Developer to demonstrate that any activity proposed within a 100-year floodplain will not diminish flood storage capacity. In certain instances, an analysis to determine the 100-year floodplain may be required. Where available, the community flood insurance study shall be used. Compensatory storage will be required for all lost floodplain storage.

ii. Open Detention Systems

1. Wet detention basins are required with a minimum permanent water depth of three (3) feet. Volume provided below the invert of the outflow pipe is considered as a permanent pool of water and is not included as storage volume. Dry detention basins will only be allowed at the Township Engineer's discretion when the development site's physical characteristics or other local circumstances make the use of a wet detention basin infeasible. If a dry detention basin is allowed, the bottom of the basin shall have a minimum slope of one percent (1%) to a swale line. The slope of the swale line to the outlet shall be a minimum of a half percent (0.5%).
2. Soil borings must be obtained within the location of the proposed detention system and extend to a minimum depth of five (5) feet below the proposed detention facility bottom elevation. Additional boring depth may be appropriate for large detention systems. A minimum of one soil boring shall be obtained for every 10,000 square feet of detention or forebay area, with a minimum of two borings for any detention or forebay system. The soil borings shall be provided for review. The soil borings shall indicate the ground water elevation.
3. For safety purposes and to minimize erosion, detention basin side slopes shall be a minimum of one (1) foot vertical to twenty (20) feet horizontal (1:20) and a maximum of one (1) foot vertical to four (4) feet horizontal (1:4).

4. For all residential developments, detention basins shall be unfenced with side slopes no steeper than one (1) foot vertical to six (6) feet horizontal (1:6). At the Township Engineer's discretion, detention basins side slopes may be reduced to one (1) foot vertical to four (4) feet horizontal (1:4) when the development site's physical characteristics or other local circumstances make a shallower sloped detention basin otherwise infeasible.
5. All detention basins having side slopes steeper than one (1) foot vertical to six (6) feet horizontal (1:6) will be permitted only with the installation of a six (6) foot high fence completely surrounding the detention basin including the required maintenance area. The fence shall be a commercial-grade decorative aluminum (simulated wrought iron) type and shall be powder coated with an earthen tone color (black, brown, beige, or green). All aluminum extrusions for posts, pickets, and rails shall have an alloy and temper designation of 35,000-psi strength aluminum alloy 6005-T5 or better. For fences in areas of low public visibility, the Developer may request approval of a commercial grade, vinyl coated chain link fence from the Planning Commission. A minimum sixteen (16') foot wide matching double opening gate shall be provided where the paved access drive enters the detention basin facility. Detention basin fencing shall not be located within setbacks, clear vision areas adjacent to public roadways or private drives, or any utility easements.
6. A minimum ten (10) foot wide maintenance area shall be provided around the entire perimeter of the detention basin between the top of bank of the basin and the property line, easement line, and/or fence line. This maintenance area will be considered part of the detention basin facility and shall be located completely within the property or easement area designated for the detention basin. The maintenance area shall have a grass surface (except for the access drive) with a cross slope no greater than seven percent (7%) and be clear of landscaping, fencing and other materials that may hinder maintenance of the detention basin.

Where a detention basin lies adjacent to a paved area where clear access is available on a non-residential development (i.e. no parking spaces, dumpster enclosures, loading/unloading zones, etc.), the ten (10) foot wide maintenance area can be eliminated at the discretion of the Township Engineer.

7. A minimum sixteen (16) foot wide paved access drive shall be provided to the detention basin to facilitate maintenance. This access drive shall extend onsite as necessary to provide direct access to the detention basin facilities such as the outlet control structure or other stormwater management devices. An adequate maintenance vehicle turnaround shall also be provided for access drives longer than 150 feet. The turnaround and/or access drive radii shall accommodate a vehicle with a minimum fifty-two (52) foot turning radius.
8. Concrete rip-rap shall be provided at all pipe entrances to the detention basin. All pipes entering or leaving the detention basin shall have either a headwall or a flared end section with concrete end header at the end of the pipe.
9. All detention basins shall have provisions for a defined emergency overflow, routed such that the stormwater can be conveyed to the main outflow channel or enclosed storm drain. Where possible, an overflow structure shall be designed to outlet into an adequately sized enclosed storm sewer. The overflow shall be designed to accommodate a one hundred (100) year storm event over the detention basin's contributory watershed. The following methods may be utilized:
 - a. Using an overflow pipe: the invert elevation of the pipe shall be set at the maximum storage elevation of the detention basin.
 - b. Using a concrete overflow structure having a steel top grate with three (3) inch by three (3) inch openings or built-in concrete weir wall: the elevation of the overflow shall be set at the maximum storage elevation of the detention basin.

- c. Using an overflow spillway:
 - i. The invert of the spillway shall be set at an elevation no lower than the maximum storage elevation of the detention basin;
 - ii. The spillway shall be constructed with concrete within the detention basin maintenance area. Once outside of the maintenance areas, the spillway may be constructed with concrete, heavy rip-rap over geotextile fabric, or reinforced earth designed to prevent erosion.

10. To the extent feasible, the distance between inlets and outlets shall be maximized. The length and depth of the flow path across the detention basin shall be maximized by increasing the length to width ratio of the entire design.

11. The outlet shall be well-protected from clogging.

12. Outlet Control:

- a. Orifice size shall meet the requirements of the agency governing the stormwater outlet (i.e. Macomb County Office of Public Works (MCOPW), Macomb County Department of Roads (MCDR), and/or Michigan Department of Transportation (MDOT)). However, where those agencies do not have jurisdiction, the orifice shall be sized for a discharge rate as outlined in Section III.X. of these standards or have a diameter no smaller than four (4) inches, whichever is greater. Discharge from the detention basin shall be at a controlled rate such that the basin is emptied within forty-eight (48) hours.
- b. The outlet control structure shall be placed near the detention basin embankment to provide for ready maintenance access.

- c. Outlet control can be provided using the following methods:
 - i. Using a restrictor pipe:
 - 1. It is preferred that the outlet control restrictor pipe is placed between two structures upstream of the overflow facility.
 - 2. When the physical characteristics or other circumstances make the use of a restrictor pipe between two structures infeasible, at the Township Engineer's discretion, a restrictor pipe may be grouted in place inside the outlet pipe.
 - ii. Using a weir wall:
 - 1. An opening for outlet control may be installed through a weir wall within the overflow structure.
 - iii. Other types of outlet control may be considered at the Township Engineer's discretion.

13. A shelf, at a minimum of four (4) feet wide at a depth of one (1) foot below the permanent water surface, shall surround the interior of the perimeter of the detention basin to provide suitable conditions for the establishment of aquatic vegetation and to reduce the potential safety hazard to the public.

14. As-Built Drawings Confirming Detention Volume and Geotechnical Inspection:

Upon construction of the detention basin but prior to restoration of the basin, the design engineer shall submit as-built drawings of the basin showing the as-built contour elevation lines and rim elevations of all structures within the basin to confirm the required storage volume of the basin. Additionally, a geotechnical engineer shall inspect the basin and provide written confirmation that the basin side slopes are stable as constructed. No basin restoration

shall take place until the Township Engineer has accepted the above information and authorized the restoration.

15. Restoration:

The entire detention basin area shall be vegetated with sod or seed with mulch blankets.

iii. Parking Lot Surface Detention

Parking lot surface detention shall only be considered at the Township Engineer's discretion for development sites that are less than five (5) acres in size when the physical characteristics or other local circumstances make the use of an open detention basin infeasible.

In addition to the general requirements listed for open detention basins, the following criteria must be met:

1. The storage elevation shall not exceed a depth of seven-tenths (0.7) feet in parking spaces and a depth of one (1) foot in all other areas of the parking lot.
2. The storage elevation must be six (6) inches or more below the finish floor of the building(s) on the site.
3. An overflow system is required in general conformance with the overflow requirements listed in this section for open detention systems.
4. Outlet control is required in general conformance with the requirements listed in this section for open detention systems. If the outlet control structure is located outside a paved area, a minimum sixteen (16) foot wide access drive shall be provided in general conformance with the access drive requirements listed in this section for open detention systems to access these structures.

iv. Underground Detention Systems

Underground detention systems are the least preferred method of detention. Use of underground detention will be at the discretion of the Township Engineer and shall only be considered for commercial or industrial uses when the physical characteristics or other local

circumstances make the use of an open detention basin infeasible. Underground detention will not be considered for single-family residential platted subdivisions, residential site condominiums, or multi-family condominiums.

1. Underground Detention in Storm Sewer Pipes:

- a. If underground detention is allowed, oversizing the storm sewer pipes throughout the site to account for the stormwater storage volume is preferred. The general requirements for detention systems listed in this section shall be met.
- b. An overflow system is required in general conformance with the overflow requirements listed in this section for open detention systems.
- c. Outlet control is required in general conformance with the requirements listed in this section for open detention systems. If the outlet control structure is located outside a paved area, a minimum sixteen (16) foot wide access drive shall be provided in general conformance with the access drive requirements listed in this section for open detention systems to access these structures.

2. Underground Storage Detention Facilities:

If oversizing the storm sewer pipes throughout the site is not feasible, an underground storage detention facility may be considered meeting the general requirements for detention systems listed in this section as well as the following additional criteria:

- a. Underground storage detention facilities shall not be constructed of corrugated metal pipe (CMP).
- b. Pretreatment shall be provided for stormwater prior to discharge into the underground storage detention facility.
 - i. Acceptable methods and performance standards for pretreatment of stormwater are:
 1. Sediment forebays;
 2. Manufactured treatment systems.

These facilities shall comply with the requirements listed later in this section.

- ii. The pretreatment facility shall be located so as to provide maintenance accessibility. If the pretreatment facility is located outside a paved area, a minimum sixteen (16) foot wide access drive shall be provided in general conformance with the access drive requirements listed in this section for open detention systems to access this facility.
- c. Underground storage detention facilities shall be designed, installed and maintained per the manufacturer's recommendations.
- d. Perforated pipe and open bottom systems shall be subject to the following requirements:
 - i. Perforated or open bottom systems shall be permitted if a suitable outlet is provided for the total storage volume. Any potential infiltration will not be considered to reduce the required storage volume.
 - ii. The void space in stone material adjacent to the underground detention system shall not be considered in the detention storage volume.
 - iii. Sufficient design provisions shall be made to facilitate cleaning of the system without disruption to the surrounding stone.
- e. An overflow system is required in general conformance with the overflow requirements listed in this section for open detention systems.
- f. Outlet control is required in general conformance with the requirements listed in this section for open detention systems. If the outlet control structure is located outside a

paved area, a minimum sixteen (16) foot wide access drive shall be provided to access these structures in general conformance with the access drive requirements listed in this section for open detention systems.

- g. Permanent inspection and maintenance practices shall be considered when designing an underground storage detention facility. The final design shall minimize the effort required for regular inspection and maintenance of the facility by the property owner. Inspection manholes for the underground storage detention facility are required, at a minimum at both ends of each chamber segment. Ease of inspection and maintenance will be considered in review of the underground storage detention facility.

v. Stormwater Pump Stations

1. As a general rule, stormwater management systems incorporating pumps shall be avoided. Exceptions to this rule will be considered only as a measure of last resort. The design engineer must demonstrate that no alternative system designs are technically feasible. Special requirements, such as the establishment of an operations/maintenance/replacement escrow account by the Developer, may be imposed to help defray special assessments that would be levied upon future property owners for maintenance of the system.
2. Pumping stations for de-watering of stormwater management systems shall include duplicate pumps with each pump capable of handling the design flow. The controls shall include a lead-pump start and stop, a lag-pump start and stop, an alternator for alternating the lead-lag pump, a high-water alarm system with a light, horn, telemetry, and a safety all-pumps-off control. The pump controls shall be installed in a suitable weatherproof and vandal-proof enclosure. The size, make, and type of pumps and controls shall be subject to approval by the Township Engineer. The pumps shall be connected to the outlet through a separate valve and/or junction chamber. Discharge from pump stations

shall be made to an enclosed storm sewer outlet to reduce the erosion effects of pump discharge.

3. For detention basins with pumped outlets, the inlet pipe from the detention basin shall be submerged below the permanent water surface to prevent debris from entering the pumping station.
4. A minimum sixteen (16) foot wide access drive shall be provided to access the pump station and all appurtenances (i.e. structures, controls, etc.) in general conformance with the access drive requirements listed in this section for open detention systems.

vi. Stormwater Best Management Practices (BMPs)

Unless otherwise permitted by the Township Engineer, the Macomb County Office of Public Works (MCOPW), Michigan Department of Environment, Great Lakes, and Energy (EGLE), Macomb County Department of Roads (MCDR) and/or Michigan Department of Transportation (MDOT), any runoff generated from a proposed development must be conveyed into a stormwater Best Management Practices (BMP) structure for water quality treatment prior to being discharged from the site. Stormwater BMPs shall be capable of reducing the Total Suspended Solids (TSS) to achieve a maximum discharge of eighty (80) milligrams per liter (mg/L) TSS or less.

1. Stormwater Quality Control

- a. Stormwater quality control devices shall be provided for all development sites to provide energy dissipation and to trap and localize incoming sediments. All stormwater management devices shall achieve a maximum discharge of eighty (80) milligrams per liter (mg/L) Total Suspended Solids (TSS) or less.
- b. The following stormwater management technologies shall be considered:
 - i. Wet detention basins;
 - ii. Sediment forebays;
 - iii. Manufactured treatment systems.

2. Sediment Forebays

- a. Forebays shall be a separate basin, which can be formed by a compacted earthen berm. Forebay side slopes shall be in conformance with slope requirements for open detention basins.
- b. The capacity of the forebay shall be equivalent to the capacity of a one and a half (1.5) year storm.
- c. The sediment forebay shall be sized at fifteen percent (15%) of a one (1) inch rainfall, and can be determined by the following equation:

$$V_f = 0.15 \times (3630 \times \text{precipitation volume of 1 inch} \times \text{runoff coefficient for 10-year event} \times \text{area})$$

- d. The volume of storage provided in the forebay may be included as a part of the total provided detention storage volume required, above any permanent pool of water.
- e. If a proposed forebay is located within the 100-year floodplain, the forebay shall be sized such that the storage volume is stored above the floodplain elevation. The Township Engineer may waive this requirement if compensating floodplain storage is provided within the detention system.

It is the responsibility of the Developer to demonstrate that any activity proposed within a 100-year floodplain will not diminish flood storage capacity. In certain instances, an analysis to determine the 100-year floodplain may be required. Where available, the community flood insurance study shall be used. Compensatory storage will be required for all lost floodplain storage.

- f. For safety purposes and to minimize erosion, sediment forebay side slopes shall be a minimum of one (1) foot vertical to twenty (20) feet horizontal (1:20) and a

maximum of one (1) foot vertical to four (4) feet horizontal (1:4).

- g. For all residential developments, sediment forebays shall be unfenced with side slopes no steeper than one (1) foot vertical to six (6) feet horizontal (1:6). At the Township Engineer's discretion, sediment forebay side slopes may be reduced to one (1) foot vertical to four (4) feet horizontal (1:4) when the development site's physical characteristics or other local circumstances make a shallower sloped sediment forebay otherwise infeasible.

- h. All sediment forebays having side slopes steeper than one (1) foot vertical to six (6) feet horizontal (1:6) will be permitted only with the installation of a six (6) foot high fence completely surrounding the sediment forebay including the required maintenance area. The fence shall be a commercial-grade decorative aluminum (simulated wrought iron) type and shall be powder coated with an earthen tone color (black, brown, beige, or green). All aluminum extrusions for posts, pickets and rails shall have an alloy and temper designation of 35,000-psi strength aluminum alloy 6005-T5 or better. For fences in areas of low public visibility, the Developer may request approval of a commercial grade, vinyl coated chain link fence from the Planning Commission. A minimum sixteen (16) foot wide matching double opening gate shall be provided where the paved access drive enters the sediment forebay facility. Sediment forebay fencing shall not be located within setbacks, clear vision areas adjacent to public roadways or private drives, or any utility easements.

- i. A minimum ten (10) foot wide maintenance area shall be provided around the entire perimeter of the forebay in conformance with the requirements for open detention basins.

- j. A minimum sixteen (16) foot wide paved access drive shall be provided to the forebay in conformance with the requirements for open detention basins.
- k. Oil and gas separators, designed to separate pollutants from stormwater within an enclosed storm drainage system, shall be provided at the last structure prior to discharge to the forebay.
- l. The forebay shall have a minimum three (3) foot deep sump to capture sediment and prevent resuspension of sediment. The bottom of the basin should slope toward the sump area to capture the sediment. The surface area of the sump should be approximately 1/3 of the total bottom area of the sediment forebay.
- m. The outlet shall be designed to capture the first flush volume and dewater the basin after twenty-four (24) hours or longer. An outlet structure with restricted discharge is required.
- n. An overflow spillway shall be constructed between the forebay and the detention basin to allow water to exit the forebay at non-erosive velocities. The overflow spillway shall be in conformance with the spillway requirements for open detention basins.
- o. All forebays shall be restored in conformance with the requirements for open detention basins.
- p. The forebay shall have a fixed vertical sediment depth marker to measure the amount of sediment that has accumulated. The depth marker shall have a marking showing the depth where sediment removal is required. The marker shall be constructed of a material that will not rust.

3. Manufactured Treatment Systems

- a. Manufactured treatment systems shall only be considered for residential developments at the discretion of the Township Engineer.
- b. Manufactured treatment systems shall provide treatment for the peak flow associated with a one (1) year storm event.
- c. Manufactured treatment systems shall not be located within the 100-year floodplain.
- d. A minimum sixteen (16) foot wide paved access drive shall be provided to the manufactured treatment system in conformance with the requirements for open detention basins.
- e. The manufactured treatment system shall have a means of overflow.
- f. Manufactured treatment system performance shall be verified by independent third-party testing.

3. Operations & Maintenance Plan Requirements:

- i. The provisions of these requirements shall apply to the entirety of the facilities noted such as: detention basin, sedimentation basin and other pollution control devices, flow control devices, pump stations, force mains and all appurtenances, bypass and overflow devices, fences, access driveways, and any other appropriate item necessary for the operation and maintenance of the facility, as intended.
- ii. Maintenance plans shall be established for all stormwater detention facilities and referenced in the Declaration of Covenants and Restrictions, Master Deed, and/or Operation and Maintenance Agreement with the Township for the development. This maintenance plan shall include the following information:
 - 1. An estimated annual maintenance budget itemized in detail by task. The financing mechanism shall also be described.

2. A copy of the final approved drainage plan for the development that delineates the facilities and all easements, maintenance access, and buffer areas.
3. A listing of appropriate tasks defined for each component of the system described, and a schedule for their implementation. The following areas shall be covered:
 - a. Maintenance of facilities such as pipes, detention basins, BMPs, channels, outflow control structures, pumps, etc.;
 - b. Debris removal from catch basins, channels, pumps and detention basins;
 - c. Dredging operations for both channels and detention basins to remove sediment accumulation.
4. The party responsible for performing each of the various maintenance activities described.
5. A detailed description of the procedure for both preventative and corrective maintenance activities. The preventative maintenance component will include:
 - a. Periodic inspections, adjustments and replacements;
 - b. Recordkeeping of operations and expenditures.
6. Provision for the routine and non-routine inspection of all components within the system described:
 - a. Inspections of structural elements, (including inspection for sediment accumulation in detention basins) shall be conducted at least annually, with as-built plans in hand. These shall be carried out by a professional engineer or certified stormwater operator reporting to the party responsible for the maintenance of the stormwater facility. Records of inspections shall be maintained by the owner and made available to the Township upon request.

- b. Housekeeping inspections, such as checking for trash removal, shall take place at least quarterly.
- c. Emergency inspections on an as-needed basis, upon identification of severe problems, shall be carried out by a professional engineer or certified stormwater operator.

Section IV. Street and Parking Lot Paving

- A. All sets of plans which include plans for street and/or parking lot paving shall include the current Macomb Township Paving Standard Details Sheet(s), which shall be considered an inseparable part of the plans when said plans are approved.

- B. Paving for all private or public streets shall be designed and constructed in accordance with the currently adopted specifications of MCDR. All sets of plans which include paving of streets shall include the current MCDR Paving Standard Detail Sheet(s).

- C. Paving for all streets and parking lots, including those privately owned and maintained, shall conform to the specifications of MCDR or the following specifications whichever is the more demanding requirement:
 - 1. Pavement cross sections and widths shall be in accordance with the Macomb Township Paving Standard Details Sheet(s).

 - 2. The subbase shall be adequately designed for sufficient thickness (minimum of six (6) inches) and type to be compatible with expected loading and sub-soil conditions.

 - 3. The allowable parking lot pavement grades shall be as follows:
 - i. Parking lot gutter slope: minimum one-half percent (0.5%) and maximum seven percent (7%);

 - ii. Parking lot pavement cross-slope: minimum one percent (1%) and maximum seven percent (7%), except for accessible routes which shall have a maximum slope of two percent (2%).

 - 4. Intersections shall be designed to allow for a minimum of one percent (1%) drop in elevation around the curb return.

 - 5. The minimum site distance for all roads shall be 200 feet for local streets and 300 feet for collector streets.

 - 6. Centerline curve data (radius, deflection angle, and total arc length) for all street pavement curves shall be indicated on the plans.

 - 7. The top of curb or the gutter grade elevations every fifty (50) feet shall be indicated on the profile view of each street.

8. When street centerlines have a deflection of more than ten (10) degrees, but less than seventy-five (75) degrees, the centerline shall have a curve with a minimum radius of 150 feet for local streets and 300 feet for collector streets. Between reverse curves, there shall be a tangent section of fifty (50) feet for local streets and 200 feet for collector streets. For streets with deflections of seventy-five (75) degrees or greater, the curvature requirements shall be determined by the Macomb County Department of Roads (MCDR) and/or the Township Engineer.
 9. Underdrains shall be provided along the entire length of public and private roads and at low point catch basins in parking lots as shown on the current Macomb Township Paving Standard Details Sheet(s).
- D. A detail shall be provided for all intersections, “eyebrows,” and cul-de-sacs. The detail shall show jointing and detailed pavement surface grades, including gutters and tops of curbs. The minimum scale of the detail shall be one (1) inch equals thirty (30) feet.
- E. The following criteria shall be maintained in the design of all street and parking lot intersections:
1. Streets and parking lot drive lanes shall intersect at ninety (90) degrees or closely thereto and in no case at less than eighty (80) degrees.
 2. Minimum clear sight distance at all intersections shall permit vehicles to be visible to the driver of another vehicle when each is 125 feet from the center of the intersection.
 3. No more than two streets or drive lanes shall cross at any one intersection.
- F. All street pavement in residential areas shall have four (4) inch mountable curbs, except for in Macomb Town Center where six (6) inch concrete straight curbs are required. Where the street pavement is a boulevard section, island curbs shall be standard six (6) inch straight curbs. A six (6) inch concrete straight curb shall be placed around the perimeter of paved parking areas (including entrance drives).
- G. Special backfill (MDOT Class II) shall be provided for all utilities installed under the influence of pavement.

- H. Standard “Road Ends” treatments per the current edition of the Michigan Manual on Uniform Traffic Control Devices (Figure 4-13 of the Macomb County Subdivision Development Procedures, Standards and Specifications) shall be provided.
- I. Temporary T-turnarounds per Figure 2-2 of the Macomb County Subdivision Development Procedures, Standards and Specifications, and the Macomb Township Paving Standard Details Sheet(s) shall be provided where required and comply with all Macomb Township Fire Department requirements.
- J. Where the Township Zoning Ordinance requires off-street parking, the design of the parking area shall conform to the following requirements:
 - 1. All parking lot layouts shall be designed to meet the requirements of the Township Engineer and shall receive their written approval. Drive lanes shall be twenty-four (24) feet wide for two-way traffic and twenty (20) feet wide for one-way traffic. Commercial approaches shall be thirty (30) feet wide at the road right-of-way (ROW) line.
 - 2. Parking bays shall have a standard width of sixty-four (64) feet. However, a car overhang of two (2) feet will be assumed and the width between the face of curbs may be reduced to sixty (60) feet. Moreover, on the curb side of a multiple bay parking area, the two (2) foot overhang may be assumed for the purposes of reducing the pavement width of the outside bay to sixty-two (62) feet. Where the parking area is adjacent to the project boundary line (except along road frontage), the back of curb shall be located at least four (4) feet from such boundary line. Along road frontage the curb shall be located at least fifteen (15) feet from the boundary line. Parking space overhang will not be allowed within the setback.
 - 3. When the parking area is to serve three (3) or more automobiles, the individual car spaces shall be marked by painted-on yellow or white stripes a minimum of three (3) inches wide. The stripe shall extend from the front of the parking stall space to a distance of twenty (20) feet (if curbs are proposed and space for vehicle overhang is available, the stripes shall extend eighteen (18) feet from face of the curb). The distance center to center of stripes, as measured perpendicular to the stripes shall be a minimum of ten (10) feet.
 - 4. When sidewalks are provided adjacent to the parking area curbs where car overhangs occur, such walks shall be a minimum width of seven (7) feet as measured from the face of the curb.

Section V. Water Supply and Distribution System

- A. All sets of plans which include plans for water mains shall include the current Macomb Township Water Main Standard Details Sheet(s) which shall be considered an inseparable part of the plans when said plans are approved. All water mains shall be sized in accordance with the current Township Water Main System Master Plan.
- B. All plans including water main shall provide a list of proposed water main pipe and structure quantities, a Basis of Design completed in accordance with Michigan Department of Environment, Great Lakes, and Energy (EGLE) requirements for Water Supply Systems including current and future populations and average and peak flows, and a service district map with pipe diameters and materials labeled.
- C. In general, water mains shall be located within a public street right-of-way. Where public water mains are located outside of public right-of-way, they shall be placed a minimum of three (3) feet off of an adjacent property line and in a recorded utility easement that provides for unlimited access to the water main for repairs, connections, and maintenance. The minimum acceptable width of easements for public water main shall be twelve (12) feet wide. The water main shall be located within the middle third of the above designated easement width.
- D. All water mains shall be shown in a plan and profile view and design in accordance with the current edition of the Recommended Standards for Water Works (10 States Standards) and the State permitting agency.
- E. The plans shall indicate the proposed finished grade elevations of all hydrants, valve wells, and/or other structures.
- F. The type capacities, location, and layout of a building service water supply pipe shall comply with all requirements of the Township Engineer and the Department of Public Works. A building service water supply pipe shall be shown on the plans for each building in the project. For single family residential developments, the building service water supply pipe for each lot or unit shall be extended by the Developer. Each service pipe shall be terminated with a curb stop and box located ten (10) feet outside of the road right-of-way and four (4) feet from the lot or unit line. A minimum of four (4) feet of separation between building service water supply pipes is required at the connection to the public water main. For multi-family developments, building service water supply pipes may be allowed to serve more than one unit at the discretion of the Township Engineer and the

Department of Public Works. A wood post or marker shall be provided to mark the end of all service water supply pipes.

- G. Fire suppression and domestic lines shall be separate services. Fire suppression lines shall be shown with a gate, valve and well at the connection to the public water main. The gate, valve and well shall be located within a utility easement. The size of the fire suppression line is subject to approval by the Township Fire Department.
- H. No bends shall be proposed for water mains with a deflection angle greater than forty-five (45) degrees.
- I. Where possible, the water main shall be located within greenbelt areas.
- J. The type of pipe and joints indicated on the plans shall be in accordance with the currently adopted Township Water Main Standard Detail Sheet(s).
- K. Water main stubs for circulation shall be provided along all stub streets and shall extend to the property line. A gate valve and hydrant shall be provided ten (10) feet from the end of all water main stubs, unless otherwise determined by the Township Engineer. The location of the stub(s) is subject to approval by the Township Engineer.
- L. Water main shall be extended around the circumference of all cul-de-sacs such that all lots and units will be served. Water service bores shall not be longer than twenty-eight (28) feet in length. Water main around cul-de-sacs shall be located a minimum of five (5) feet from the back of curb.
- M. All water main shall be installed with a minimum cover of five (5) feet below finished grade. Where water main must dip to pass under a storm sewer or sanitary sewer, the minimum acceptable clearance shall be eighteen (18) inches. At all open drain/river crossings, a five (5) foot minimum clearance between bottom of drain and top of water main shall be provided or a clearance as determined by the Macomb County Office of Public Works (MCOPW) and/or the Michigan Department of Environment, Great Lakes, and Energy (EGLE). Pipe sections deeper than normal shall be minimized by the use of vertical bends (the maximum deflection allowed is twenty-two and a half (22.5) degrees) properly anchored with restrained joints through the bend and two pipe lengths beyond the last bend.

- N. Water main other than hydrant leads shall be eight (8) inches minimum in diameter. All single hydrant leads longer than 100 feet shall be eight (8) inches minimum diameter and shall be valved as a dead-end main. Water main serving more than one industrial condominium unit, subdivision lot, or parcel shall be a minimum of twelve (12) inches in diameter.
- O. A minimum of two (2) water main system connections shall be provided for residential developments with more than thirty (30) dwelling units.
- P. All valves, except hydrant valves, shall be installed in a standard valve well. Valves shall be located in the system such that not more than four (4) valves need to be turned off to isolate any individual section of water main. Moreover, sufficient valves shall be placed such that not more than 30 dwelling units or service establishments shall be serviced within such section of water main that can be isolated. Where possible, valves shall be located five (5) feet from intersecting street right-of-way lines and outside of pavement with a maximum spacing of 800 feet. For single family residential developments, valves shall be located at lot/unit property lines.
- Q. Hydrants shall be installed along the water main with a minimum spacing of 500 feet within residential areas and a minimum of 300 feet elsewhere. Hydrants shall be installed at the ends of all dead-end water mains. The spacing and locations of all hydrants and valves are subject to review and approval by the Township Fire Department. Hydrants shall be a minimum of five (5) feet from driveways and intersections, fifty (50) feet from buildings, and within 100 feet of the fire department connection (FDC) for a building. For single family residential developments, hydrants shall be located at lot/unit property lines.
- R. A minimum ten (10) feet horizontal separation (in accordance with 10 States Standards) shall be provided between adjacent utilities. A minimum eighteen (18) inches vertical clearance shall be maintained at all storm sewer and sanitary sewer crossings.

Section VI. Wastewater Collection and Disposal System

- A. All sets of plans which include plans for sanitary sewers shall include the current Macomb Township Sanitary Sewer Standard Details Sheet(s) which shall be considered an inseparable part of the plans when said plans are approved. All sanitary sewers shall be sized in accordance with the current Township Sanitary Trunk Sewer System Master Plan.
- B. All plans including sanitary sewers shall provide a list of proposed sewer pipe and structure quantities, a Basis of Design completed in accordance with Michigan Department of Environment, Great Lakes, and Energy (EGLE) requirements for Wastewater System Construction, and a service district map delineating the initial and ultimate service areas of the proposed sanitary sewers as well as pipe diameters and materials.
- C. All sanitary sewers shall be designed to have sufficient depth and capacity to provide adequate service for all upstream areas within its district as delineated on the Township Sanitary Trunk Sewer System Master Plan.
- D. Where sanitary sewer is required to serve upstream areas, sanitary sewer shall be provided across public road frontage and/or through the development site to the property line for future connection. A sanitary sewer manhole shall be provided ten (10) feet from the end of a sanitary sewer stub, unless otherwise determined by the Township Engineer. The location of the stub(s) is subject to approval by the Township Engineer.
- E. All sanitary sewers shall be shown in a plan and profile view and design in accordance with the current edition of the Recommended Standards for Wastewater Facilities (10 States Standards) and the State permitting agency.
- F. For every sanitary sewer project, there shall be indicated on the profile view (near the downstream end of the sewer) a manhole with a twelve (12) inch deep manhole sump to be used for testing for infiltration. No sanitary sewer section having an infiltration rate, or an exfiltration rate, of more than 100 gallons per inch of pipe diameter per mile of pipe per twenty-four (24) hour period shall be approved for connection to the Township Sanitary Sewer System. A temporary bulkhead shall also be provided at the connection to the existing sewer until testing is completed.
- G. The minimum allowable size for public sanitary sewers shall be ten (10) inches in diameter. For all areas, except those zoned industrial, the building service sewer (wastewater) shall be a minimum of six (6) inches diameter. However, a minimum of eight

(8) inch building service sewer shall be provided for a residential building containing more than six (6) dwelling units. For areas zoned industrial, a minimum eight (8) inch building service sewer with an inspection manhole shall be provided. Cleanouts shall be provided at a maximum spacing of 100 feet along the building service sewer (wastewater).

H. The following table of acceptable slopes for sanitary sewers shall be used to provide a minimum of two (2) feet per second (fps) and a maximum ten (10) feet per second (fps) velocity:

<u>Sewer Size</u>	<u>Minimum Slope</u>	<u>Maximum Slope</u>
6"	1.00%	
8"	0.40%	
10"	0.28%	4.0%
12"	0.22%	3.0%
15"	0.15%	2.0%
18"	0.12%	1.5%
21"	0.10%	1.3%
24"	0.08%	1.2%

I. A building service sewer shall be indicated on the plans for each building in the project. Where sanitary sewers are planned along roadways, the building service sewers shall be extended by the Developer for each parcel, lot, or unit to a terminus that is located twelve (12) feet outside of the road right-of-way; such building service sewers shall be extended across the road right-of-way prior to paving. Unless otherwise approved by the Township Engineer, building service sewers shall be located in the middle of the parcel, lot, or unit. A minimum of four (4) feet of separation between building service sewers is required at the connection to the public sanitary sewer. The design engineer shall provide an elevation schedule on the plans that indicates the proposed clearance for all storm sewer and water main crossings.

- J. Manholes shall be provided along all sanitary sewers (eight (8) inches and larger) at:
1. Points of horizontal deflection;
 2. Points where the size of sewer is changed;
 3. Points where the slope of the sewer is changed;
 4. At junctions with other sewer lines;
 5. At the upstream terminus of a sewer run;

6. Along the sanitary sewer at other locations such that the maximum spacing between manholes shall not exceed the following:
 - i. For ten (10) inch through twenty-one (21) inch diameter 350 feet
 - ii. For twenty-four (24) inch and larger diameter 400 feet;
 7. Manholes shall be located at property lines so as to avoid conflicts with driveways.
- K. Manholes shall be a minimum four (4) feet in diameter and appropriately sized to accommodate inlet and outlet pipes, pipe orientation, drop assemblies, or other section features.
- L. At manholes where the size of sewer changes, the inlet and outlet sewer shall match eight-tenths (0.8) diameter elevation points. At horizontal deflections in the sanitary sewer greater than forty-five (45) degrees, a minimum of one-tenth (0.10) feet additional adjustment in grade elevation shall be provided to allow for loss of head. However, additional elevation adjustments may be made when conditions allow, provided that when the invert of any inlet sewer is more than eighteen (18) inches above the outlet sewer, an interior drop assembly within a minimum five (5) foot diameter manhole shall be provided.
- M. In general, sanitary sewers shall be located within or along the frontage of a public street right-of-way. Sanitary sewers shall not be located within rear or side parcel/unit/lot line easements, except in extremely unusual circumstances as determined by the Township Engineer. Where public sanitary sewers are located outside of public streets, they shall be placed in a recorded Easement for Municipal Utilities that provides for unlimited access to the sanitary sewer for repairs, connections, and maintenance. The minimum acceptable width of easements for public sanitary sewers shall be twenty (20) feet wide; however, a twelve (12) foot wide easement may be provided if adjacent and parallel to a public street. The sanitary sewer shall be located within the middle third of the above designated easement width.
- N. Sanitary sewers shall be designed to have a minimum depth from finish grade elevation to top of sewer of eight and one-half (8.5) feet at local control points or nine (9) feet at locations where the sewer grade is parallel to the road grade. The sewer shall be designed deep enough to serve a standard depth basement for the type of building for which the land is zoned.

- O. A minimum ten (10) feet horizontal separation (in accordance with 10 States Standards) shall be provided between adjacent utilities. A minimum eighteen (18) inches vertical clearance shall be maintained at all storm sewer and water main crossings.
- P. Each terminus of a building service sewer shall be plugged with an infiltration-proof plug having a solvent weld (glued) cap at the end of the pipe. A wood post or marker shall be provided to mark the end of all building service sewers.
- Q. The type of pipe and joints for sanitary sewers shall be in accordance with the currently adopted Macomb Township Sanitary Sewer Standard Details Sheet(s).
- R. Location and details of external grease interceptors shall be provided.

Section VII. Other Site Improvements and Borrow Pits

A. Sidewalks and Pathways

All sidewalks and pathways shall be constructed per Section 16-25: Sidewalks and pathways of the Macomb Township Code of Ordinances and as follows:

1. Five (5) foot wide concrete sidewalks shall be provided along all public rights-of-way, except along major roads as defined in Macomb Township's Master Thoroughfare Plan. An eight (8) foot wide concrete pathway shall be provided along a major road frontage for the full length of the subject parcel. Sidewalks and pathways shall be located one foot inside the right-of-way and designed in accordance with Section 16-25 of the Township Code and the Macomb Township Standard Paving Details Sheet(s). The location of all ramps and curb drops shall be shown in plan view.
2. Ramps designed in accordance with the current American Disabilities Act (ADA) standards are required at all intersections with public roads, parking lot drive lanes, and any other changes in sidewalk grade. Ramps shall be construction with concrete and shown on the engineering plans. Detectable warning plates in accordance with the Macomb Township Standard Paving Details Sheet(s) are required.
3. A minimum ten (10) foot buffer shall be provided between the sidewalk/pathway and the top of bank for any drain crossing or detention basin. In areas where a ten (10) foot buffer cannot be provided, the Township Engineer may approve a minimum four (4) foot high commercial-grade decorative aluminum (simulated wrought iron) type as a barrier between the drain crossing or detention basin and the adjacent sidewalk/pathway. The fence shall be powder coated with an earthen tone color (black, brown, beige, or green). All aluminum extrusions for posts, pickets and rails shall have an alloy and temper designation of 35,000-psi strength aluminum alloy 6005-T5 or better.

B. Other Public Utilities

Unless otherwise approved by the Township Engineer, the installation of public utilities other than Township sanitary sewers, water mains, or storm sewers shall not be started until the finished grade has been established. The utility company's contractor shall be required to restore the ground to the finished grade. The drainage water swales shall be restored to a workable condition at least as good as existed prior to construction. Furthermore, all land and/or other physical features affected by the construction of the

public utility shall be restored to a condition at least as good as that existing at the time construction began.

C. Borrow Pits

1. Borrow pits may be allowed within a development, provided the procedure and regulations cited below are complied with.

- i. No borrow pits may be dug within fifty (50) feet of a building for which a building permit has already been issued.
- ii. As part of the development's engineering plan submittal, the design engineer shall indicate the proposed elevations, depths, widths, lengths, slopes, and locations of any borrow pits proposed for the development. The only acceptable locations for borrow pits are as follows:
 1. In single family residential developments: within the rear thirty (30) feet of any unit/lot, but not within five (5) feet of any underground utilities.
 2. In developments other than single family residential: a minimum of five (5) feet from any proposed building, pavement (including streets, parking lots, and sidewalks), and underground utilities.
- iii. Borrow pit side-slopes shall not be steeper than seventy-one (71) degrees from the horizontal plane (i.e. not steeper than 1:3 slope). The Developer and his Contractor are responsible for complying with all OSHA requirements.
- iv. Borrow pits may not be excavated deeper than eight (8) feet below original undisturbed ground elevation.
- v. Borrow pits shall be backfilled with clean fill (i.e. free from any debris, building materials, trees, or other organic material, etc.) as soon as possible after excavation.
- vi. When a borrow pit that is more than five (5) feet deep is left open for more than ten (10) days, the Developer shall install a five (5) foot high fence completely around the borrow pit and maintain such fence until the borrow pit is filled.

- vii. No building permit shall be issued for any building within the development until the following requirements are fulfilled:
1. All borrow pits within the development are filled to within two (2) feet of original grade.
 2. The Developer has furnished a certification from their Engineer indicating:
 - a. Actual elevations, depths, widths, slopes, and lengths as excavated; and
 - b. All borrow pits in the development are backfilled to within two (2) feet of original grade.
 3. When the requirements listed above have been fulfilled, building permits may be issued for buildings on sites not affected by a borrow pit. However, on those sites affected by a borrow pit, a building permit will not be issued until the Township Engineer has been furnished representative compaction tests for said building sites, indicating that the complete borrow pit has been backfilled in layers (no greater than twelve (12) inches deep) of earth fill compacted to a density that is at least eighty percent (80%) as dense as the maximum obtainable density for such backfill material. The soil borings and compaction tests shall be performed under the direction of the Township Engineer. A site will be considered "affected by a borrow pit" if a borrow pit existed on the residential lot or unit or if a borrow pit is constructed within thirty (30) feet of a building on a non-residential site.

Section VIII. Construction and Construction Inspections

- A. 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 these standards. 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 their expense, any work which is discovered to be done in conflict with the approved plans and specifications or in conflict with the requirements of these standards.

- B. The Developer shall pay a fee to cover all costs of construction inspection of work covered under the Permit for Construction of Site Improvements. The basis of the fee to be paid to the Township shall in accordance with the Land Development Ordinance.

- C. 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:
 - 1. All types of construction where detailed inspection requirements are covered in the Township Sewer and Water Ordinances;

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

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

 - 4. All open and enclosed storm drains (public or private) including connections thereto, except those under the jurisdiction of the Macomb County Department of Roads (MCDR), Macomb County Office of Public Works (MCOPW) or the Michigan Department of Environment, Great Lakes, and Energy (EGLE);

 - 5. Stormwater management facilities associated with the development such as detention basins, sedimentation forebays, water quality devices, etc.;

 - 6. All site grading for any site;

 - 7. All driveway, sidewalk, or pathway construction installed with the development;

 - 8. All street and/or parking lot pavement installed outside of those rights-of-way that are dedicated to the Macomb County Department of Roads (MCDR) or the Michigan Department of Transportation (MDOT);

9. All borrow pit excavation and backfilling.

D. The Township reserves the right to require the developer to provide third party inspections of existing soil conditions and materials being placed at the project site.