



THE CITY OF MOUNT CLEMENS STORMWATER ENGINEERING AND CONSTRUCTION STANDARDS

Standards: The Stormwater Engineering and Construction Standards presented herein have been prepared for the City of Mount Clemens, Michigan. The Standards have been developed with the intent to set forth a reasonable, uniform and sound basis for engineering design, preparation of plans and specifications, and construction of site improvements for public and private developments in the City of Mount Clemens. The Standards may not include all conditions that may possibly exist and may consist of items that may be applicable only in the future. These guidelines should be used in combination with sound engineering judgment for design and construction activities. Innovative and alternate solutions may be permitted if approved by the City.

If any standard conflicts with Federal, State or City statute and/or ordinance, then the provisions of such statute and/or ordinance shall control. If any standard is judged illegal, invalid, or unenforceable, such illegality, invalidity or unenforceability shall not affect any other standards and/or guidelines contained herein.

1. Site Grading, Drainage Water Collection and Disposal Plan

- A. All sets of plans which include construction plans for storm sewers shall include the current City Standard Storm Sewer Detail Sheets, which shall be considered an inseparable part of the plans when said plans are approved.
- B. A Site Grading, Storm Water Drainage Collection and Disposal Plan is required for all developments; however, if the building site is located within a subdivision or other project for which a general site grading plan has been submitted and approved, no separate grading plan or permit will be required. 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 routed through the site, sufficient capacity shall be provided for fully developed upstream drainage into the system.
- 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. Before a Certificate of Occupancy for any building is issued, the Building Department Supervisor or municipal engineer shall approve the final site grading and drainage for each building. The Building Department may require that a survey, drawing, and certificate, done by a Registered Professional Engineer or Registered Land Surveyor, be furnished by the Developer indicating that the work has been done in complete conformance with the approved site grading and drainage plan. 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.

During periods of the year when weather conditions make site grading work unfeasible, a temporary Certificate of Occupancy may be issued, subject to the furnishing of a satisfactory bond, letter of credit, or cash deposit guaranteeing the completion of the work when weather conditions permit.

- D. Planned final grade elevations shall be indicated on the plans at a maximum



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spacing of 50 feet. The fall of the land away from any building shall be a minimum of six inches in the first 25 feet. From this elevation the land shall slope at a minimum slope of one percent and a maximum slope of seven percent.

- E. Residential lots shall be graded in accordance to a unit's brick ledge. A brick ledge is defined as the bottom of the first row of brick resting upon the unit's foundation wall. Finish grade elevation of the adjoining earth soil shall meet at the bottom of the brick ledge or shall be graded by the current amendment of the Building Code of the City of Mount Clemens. A residential lot shall be graded as follows:
1. A maximum difference of 0.5 feet shall be provided between adjacent units' brick ledges.
 2. Brick ledge grade elevations shall be a minimum of 1.5 feet and a maximum of 2.5 feet above the adjacent top of curb.
 3. A minimum two percent or 0.5 feet and a maximum seven percent or one foot fall shall be provided from the brick ledge to the adjacent side yard high point.
 4. For units with non-stepped brick ledges, the side yard high point shall be located approximately 50 feet from the right-of-way.
 5. For units with stepped brick ledges, front and rear side yard elevations shall be shown at approximately 25 and 70 feet, 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.
 6. Reasonable building envelopes or footprints shall be shown for each lot, ensuring that the side yard elevations correctly correspond to the front, center, or rear enveloped location as necessary.
- F. The maximum slope of the land for the site, except for transitional ramps between usable site areas, shall be seven (7) feet in one hundred feet (seven percent.) The sodden ramp slopes shall be a maximum of one foot vertically and three feet horizontally.
- G. Adequate soil erosion and sedimentation control measures shall be specified on the plans, and followed during construction, to conform to the requirements of Michigan Act 347, P.A. of 1972, entitled, "Soil Erosion and Sedimentation Control Act of 1972." Approval by the Macomb County Public Works Commissioner's Office of the Soil Erosion Plan is required prior to approval of the engineering plans.
- H. All buildings having foundation drains shall direct the flow of drainage water from such foundation drains into an enclosed storm drainage system structure. No building permit for any building having a basement shall be issued unless the plans for such building indicate a building service sewer (drainage water) directly connects to an enclosed storm sewer at a storm sewer structure.



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- I. For residential developments, drainage water from basement drains or sump pumps shall be directed by a sump drainage pipe with a minimum 3 inch diameter to a rear yard storm sewer structures. A minimum two foot diameter structure is required for the most upstream storm structure within a sewer, provided the structure only accepts sump drainage. Minimum three foot structures may be provided for all other structures that only accept sump discharge. Storm drainage shall be conveyed within a minimum 8 inch diameter sewer from the rear yard catch basins to a storm structure within the right-of-way.

Lot grading and storm sewer systems shall be designed such that each lot drains to a catch basin structure at a rear corner of the lot. Rear yard swales shall be designed to carry surface drainage from the opposite lot corner to the storm structure. Therefore, 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 lot lines.

Dry well storm structures, which outlet into the surrounding soils, may be allowed if the soils permit adequate infiltration. A geotechnical investigation must be performed and recommendations as to the construction of the drywell must be made by a certified soils engineer.

Storm sewers shall be designated as premium joint where designed along lot lines within the influence of adjacent units or when 15 inch or greater diameter sewer is indicated.

- J. Drainage water run-off from building roofs, whenever possible shall be directed five feet away from the outside walls of any building to a defined overland vegetated drainage course. Roof leads under the influence of pavement shall be a six inch SDR 23.5 pipe or an eight inch truss pipe and shall be clearly labeled as roof drains.
- K. Where required by the City, a four inch diameter open joint drainage pipe shall be provided for drainage with said pipe trench being backfilled entirely with pea gravel to within four inches of the grade line of swale.
- L. Storm water runoff drainage systems shall be designed for a 10 year storm by means of the Rational Method formula: $Q = CIA$; where Q is the peak rate of run-off in cubic feet per second, A is the area in acres, C is the coefficient 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 consulting engineer shall use judgment in arriving at proper imperviousness factors, but in general the following factors are acceptable minimums:



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1. Lawn areas - 0.1
2. Pavement and roof areas - 0.9
3. Overall area of single family residential - 0.35
4. Overall area of multiple family residential - 0.55
5. Overall area of commercial development - 0.90
6. Overall area for industrial development - 0.80

The developing 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, upstream and downstream inverts and hydraulic grades. The minimum acceptable size of storm sewer downstream of any storm water inlet structure is 12 inches in diameter.

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

In general, trunk storm sewers or any sewer that carries street drainage water shall be located within a public street right-of-way. Where public storm sewers are located outside of public streets, they shall be placed in a recorded public 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: 12 feet wide for sewers 21 inches and under in diameter; 20 feet for sewers 24 inches through 48 inches in diameter; and 30 feet wide for sewers over 48 inches in diameter.

Where possible, a minimum of three 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 sewer pipe; however, the design elevation of the hydraulic gradient profile shall be indicated on the sewer profile view and hydraulic gradients shall be a minimum of one foot below the surface at any location. However, hydraulic gradients shall be maintained within the pipe on any storm sewers considered to be trunk storm sewers.

- M. 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:



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

Storm sewer structures shall be designed with sufficient diameter based on the number, size and configuration of incoming and outgoing storm pipes. For sewers 42 inch diameter and greater, radius pipe may be used at changes in pipe direction. Catch basin leads may tap directly into sewers 42 inches and larger, except that taps shall not be made into a precast manhole tee pipe section.

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 storm water inlet structure. Additionally, no more than three upstream catch basins will be allowed to discharge into any catch basin. However, if a normal manhole location (outside of streets) coincides with a storm water inlet structure location and at least 75% of the upstream storm water inlet structures are catch basins (with sumps), the manhole may be used as a storm water inlet structure by placing a catch basin cover on the manhole. Catch basins shall be a minimum four feet diameter with a minimum two foot sump.

- N. In general, pavement type catch basins shall be located as follows:
1. At the radius return of street intersections such that drainage may travel a maximum allowable 150 feet distance around a corner without an intercepting catch basin
 2. At all low points in streets
 3. At intermediate points along the street such that there is a maximum pavement drainage area for each structure as follows:
 - a. Intercepting Catch Basins 7,500 S.F./C.B.
 - b. Low point Catch Basins 25,000 S.F./C.B.
- 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 600 feet of drainage is allowed.
- P. Generally, The City of Mount Clemens policy is to use open drains for drainage of storm water. However, multiple residential, institutional, commercial and industrial developments including parking lots and critical areas (as determined by the City) may require enclosed storm sewers and perhaps, retention/detention ponds. In cases where the enclosed storm sewer sizes become 60 inches or larger in diameter, the City may require improved open drains. When open drains outside the road right-of-way are used, the easement width shall be sufficient to



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accommodate a thirty 30 feet wide maintenance plateau (with a maximum slope of 10 percent) on each side of the channel.

- Q. The side slopes of open drains shall have a maximum slope of one foot vertical to four feet horizontal, except that a low flow channel may have side slopes of one foot vertical to three feet horizontal. Open drain side slopes shall have an established vegetated 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.
- R. 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 eight inches if not containing surface drainage.
- S. When, in the opinion of the City and/or the Macomb County Drain Commissioner, there is inadequate drainage water outlet capacity, the developer may be required to install retention/detention basins or reservoirs. Many design considerations need to be incorporated in the design of retention/detention basins. Section 2 provides detailed discussions and design standards for retention/detention ponds. It includes site drainage, storm water management facilities including various types of basins and other pertinent issues related to storm water retention.
- T. For lots developed where an engineering, grading and drainage plan has not been prepared and approved according to the above conditions, the following minimum requirements shall apply:
1. An eight-inch enclosed drainage line of materials subject to approval by the City shall be constructed along the side and rear property lines. A variance in the size and location of the eight-inch line shall be subject to issuance by the Utilities Director upon written application therefore.
 2. A two-foot catch basin or a special basin as approved by the Utilities Director shall be placed in approved locations at the intersections of the side and rear property lines.
 3. The drainage line shall be made available to adjacent property owners through extension of the line to abutting property lines. An easement permitting the receipt of drainage and the establishment of a connection shall be provided.
 4. Lots shall be graded to allow water to flow freely to the catch basin.
 5. As determined by the City, a swale may be required alongside lots.
 6. Sump pumps may not discharge to any road surface. Sump pumps may only be directed to a storm sewer or a location in a ditch or swale as approved in writing by the City.
 7. In the event three or more contiguous lots are being developed, the rear lot storm sewer line shall be constructed of materials as approved by the City.



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8. In the event a site drainage plan cannot meet the requirements of this section, a variance may be sought in writing from the City.

2. Design Standards for Storm Management Systems

The following stormwater management system improvements are required to address runoff from new development and redevelopment of projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into the drainage system.

A. Channel Protection Criteria

The maximum design rate or volume of discharge shall not exceed .20 cubic feet per second (cfs) per acre for a 10-year storm unless otherwise directed by the governing body that has jurisdiction over the storm sewer discharge outlet. The City of Mount Clemens may, at its 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 storm water 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 his/her expense, any necessary additional and/or alternative storm water management facilities to bring the system into compliance. Such additional facilities will be subject to The City of Mount Clemens's review and approval. Additional volume controls will be required in such cases as will acquisition of rights-of-way from downstream property owners receiving the storm water flow.

B. Determination of Surface Runoff

The rational method of calculating storm water runoff as described earlier is generally acceptable for sites less than 100 acres in size. For larger sites due caution should be exercised. Other methodologies such as runoff hydro-graphs may be required by The City of Mount Clemens for sizing the drainage systems on sites that are deemed potentially problematic. Acceptable alternative methods include;

- U.S. Army Corps of Engineers HEC-RAS
- Soil Conservation Service UD-21, TR-20 and TR-55
- U.S. Environmental Protection Agency's Storm Water Management Model ("SWMM")

All design rainfall events will be based on the Soil Conservation Service (SCS) Type II distribution.

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



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C. Retention and Detention Systems

All runoff generated by proposed impervious surfaces, unless otherwise permitted by The City of Mount Clemens, must be conveyed into a storm water storage facility for water quality treatment and retention/detention prior to being discharged from the site. The following criteria will apply to the design of all storm water retention and detention facilities.

1. In general, wet ponds and storm water marsh systems will be preferred to dry ponds. Dry ponds providing extended storage will be accepted when the development site's physical characteristics or other local circumstances make the use of a wet pond infeasible.
2. Public safety will be a paramount consideration in storm water system and pond design. Providing safe retention/detention is the property owner's responsibility. Pond designs will incorporate gradual side slopes, and vegetative and barrier plantings. Where further safety measures are required, the proprietor is expected to include them within the proposed development plans.
3. Storm water management systems incorporating pumps shall not be permitted in developments with multiple owners, such as subdivisions and site condominiums. Variances from this rule will be considered only as a measure of last resort, subsequent to demonstration 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.
4. For basins with pumped outlets, a silt trap and bar screen shall be installed on the inlet pipe to the pump station. The screen clean opening shall be a maximum of two inches.
5. Pumping stations for de-watering of the retention basins 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, and alternator for alternating the lead-lag pump, a high water alarm system with a light and a horn, and a safety all-pumps-off control. The control panel, pumps, and wet-well shall be installed inside of the fenced enclosure and the controls shall be installed in a suitable weatherproof and vandal-proof enclosure.
6. For drainage systems proposed to not be under the ownership of The City of Mount Clemens, detention and retention facilities, and associated buffer strips, shall be located on common-owned property (e.g. parks, etc.) and not on private lots or condominium units.
7. Underground storage must be treated for water quality improvements - before discharge to any watercourse, lake, or pond. Treatment may



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include storm water quality improvement devices, as approved by the City. Provisions for periodic testing of the water quality may be required by the City. The underground storage system must be a groundwater recharge or infiltration type system if the soil conditions are accommodating.

8. Sediment forebays (lower stage) or approved storm water quality improvement devices will be provided at the inlet of all storm water management facilities to provide energy dissipation and to trap and localize incoming sediments.
 - a. The forebay will be a separate basin, which can be formed by gabions or a compacted earthen berm.
 - b. The capacity of the forebay will be equivalent to the capacity of a 1.5 year storm.
 - c. Direct maintenance access to the forebay for heavy equipment will be provided.
 - d. Stormwater quality improvement devices must the following criteria:
 - 1) The system must demonstrate 80% removal of the total suspended solids load based on third party independent testing.
 - 2) The system must treat 100% of the runoff from the 1.5 year/24hour storm event.
 - 3) Rain events larger than the 1.5 year/24 hour rain event shall bypass the system without causing any re-suspension of trapped sediments and without causing re-entrainment of floatable contaminants.
 - 4) The system shall not create any backwater in the upstream pipe network during any dry weather conditions.
 - 5) The treatment system must prevent oil and floatable contaminants from entering downstream piping during routine maintenance and during rain events.
 - 6) Direct access must be provided to the sediment and floatable chambers to facilitate maintenance. There must be no appurtenances or restrictions within these chambers.
 - 7) If the system is proposed in traffic areas, then it must be designed to handle H₂O loading.
9. Vegetative Plantings Associated with Retention/Detention Facilities shall follow the following requirements:



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- a. Basins and marsh designs will be accompanied by a landscaping plan that gives preference to native plant species. Plantings shall be installed according to the current Macomb County Public Works Commissioner Procedures and Design Standards for Stormwater Management.
 - b. A permanent buffer strip of natural vegetation extending at least 25 feet in width beyond the freeboard is required around the perimeter of all storm water storage facilities.
10. For safety purposes and to minimize erosion, basin side slopes will generally not be flatter than one foot vertical to twenty feet horizontal, nor steeper than one foot vertical to four feet horizontal. For all developments other than residential, all basins having side slopes steeper than one foot vertical to six feet horizontal, will be permitted only with the installation of a six foot high chain link fence completely surrounding the detention facility and a minimum three foot flat shoulder between the top of the slope and the fence. Gates shall be provided that are twelve feet wide with a double opening.

Detention basins requiring fencing shall not be located within setback areas adjacent to public thoroughfares unless they are designed architecturally and aesthetically for the specific site. The location and concept of these basins shall be subject to approval by the Planning Department prior to the Engineering review.

Please note: other decorative fence types may be used if approved by the City Commission.

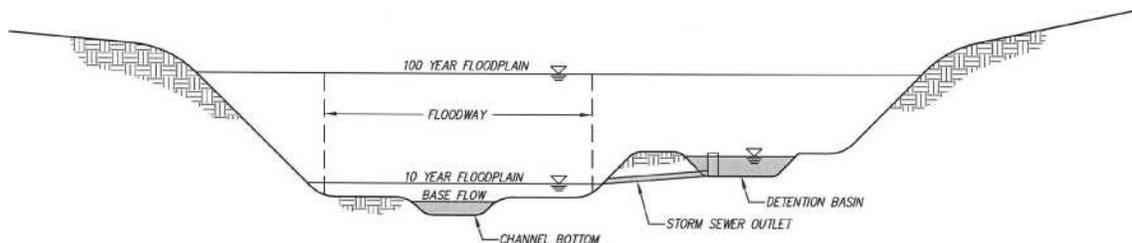
11. For all subdivisions and site condominiums, all basins shall be unfenced with side slopes no steeper than one foot vertical to six feet horizontal with a minimum three foot flat shoulder between the top of slope and property line.
12. Anti-seep collars should be installed on any piping passing through the sides or bottom of the basin to prevent leakage through the embankment.
13. All basins will have provisions for a defined emergency spillway, or overflow, routed such that it can be picked up by the main outflow channel or enclosed storm drain while not discharging directly over the outlet pipe. Where possible, an overflow structure shall be designed to outlet into an adequately sized storm drain. The emergency spillway must be designed to convey a minimum 10 year storm. There are two possible alternate methods:
 - a. Using an overflow pipe; the invert elevation of this pipe shall be above the maximum storage elevation of the basin.
 - b. A low point overflow; the low point of the basin shall be set at an elevation no lower than the maximum storage elevation of the



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basin.

14. Adequate maintenance access from public or private right-of-way to the basin will be reserved. The access will be on a slope of 5:1 or less, stabilized to withstand the passage of heavy equipment, and will provide direct access to both the forebay and the riser/outlet. Access easements will be required.
15. The placement of retention/detention basins within or below a 10 year floodplain of a flood risk zone is prohibited. For basins located within the 100-year floodplain the design engineer must evaluate the hydraulic grade line through the storm drainage system and provide written evidence that the stormwater will not result in a harmful interference to any proposed and existing structures or adjacent properties. Basins must not be located within a 100 year floodway.



16. The City will not accept subdivision and site condominium basins until vegetation is established in accordance with the City of Mount Clemens Standards and approved by the City Commission.

D. Detention Requirements

On-site 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.

1. A minimum of one foot of freeboard will be required for all detention basins.
2. At a minimum, the volume of storage provided for flood control will be equal to or in excess of that required by the method outlined in "A Simple Method of Detention Basin Design" developed by Glen Yrjanainen, P.E, and Alan W. Warren for a 10-year frequency storm.
3. The volume and storage provided for controlling the "bankfull" flood will be equal to or in excess of the total rain from a 1.5 year, 24-hour storm. This can be determined by:

$$5160 \times \text{acreage} \times \text{the relative imperviousness factor } C = \text{cubic feet}$$

The release rate from the "bankfull" storage volume will be such that this



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volume will be stored not less than 24 or more than 40 hours.

4. The "first flush" of runoff is defined as the first 0.5 inch of runoff over the entire site. The majority of this volume will be captured in the sediment forebay, with the residual volume detained for a minimum of 24 hours. The volume of the first flush which can be determined by:

$1815 \times \text{acreage} \times \text{the relative imperviousness factor } C = \text{cubic feet}$

5. Basin Inlet/Outlet Design

- a. Engineered velocity dissipation measures based on discharge flow rates and velocities will be incorporated into basin designs to minimize erosion at inlets and outlets, to minimize the re-suspension of pollutants, and to create sheet flow conditions where feasible.
- b. To the extent feasible, the distance between inlets and outlets will be maximized. The length and depth of the flow path across basins and marsh systems can be maximized by:
 - 1) Increasing the length to width ratio of the entire design.
 - 2) Increasing the dry weather flow path within the system to attain maximum sinuosity. If possible, inlets and outlets should be offset at opposite longitudinal ends of the basin.
- c. The outlet shall be protected from clogging.
 - 1) All outlets will be designed to be easily accessible for heavy equipment required for maintenance purposes.
 - 2) Discharging at the "crest" of slopes will not be permitted.
 - 3) Backwater on the outlet structure from the downstream drainage system shall be evaluated when designing the outlet.

6. Riser Design

- a. The use of a perforated standpipe-type riser structure to assure an appropriate detention time for all storm events is required.
- b. Orifices used to maintain a permanent pool level should withdraw water at least one foot below the surface of the water.
- c. Hoods or trash racks shall be installed on the riser to prevent clogging. Grate openings shall be a maximum of three inches.
- d. Orifice plates are discouraged. Where an orifice plate is to be used



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in the standpipe to control discharge, it will have a minimum diameter of 4 inches.

- e. The riser shall be placed near the pond embankment to provide for ready maintenance access.
- f. Barrels and risers will be constructed of materials that will reduce future maintenance requirements. The riser pipe shall be a minimum of 36" in diameter for riser pipes up to four feet in height. Riser pipes greater than four feet in height shall be 48" in diameter. Riser pipes will be constructed with concrete bottoms.
- g. Riser outlets must include a simple oil/water separator consisting of a "T" or elbow-shaped pipe.
- h. Where feasible, a drain for completely de-watering the pond should be installed for maintenance purposes.

E. Wet Detention Basins

1. Storage Volume Requirements will be as follows:

For a gravity outflow wet basin storage, volume is defined as "the volume of detention provided above the invert of the outflow device." Any volume provided below the invert of the outflow device will not be considered as detention.

At a minimum, the volume of the permanent pool should be at least:
 $2.5 \times 0.5 \text{ inch}^* \times \text{runoff coefficient} \times \text{site drainage area}$

*0.5 inch represents the mean storm event. This was determined by adding the total precipitation rainfall recorded at Detroit Metro Airport from 1977 to 1987 and dividing by the total number of storm events. Storms below 0.2 inch of precipitation, snowfall, and snowmelt were omitted.

2. Wet detention pond configuration will be as follows:
 - a. Surface area to volume ratio should be maximized.
 - b. In general, depths of the permanent pool should be varied and average between 3 and 6 feet.
 - c. A minimum length to width ratio of 3:1 should be used unless structural measures are used to extend the flow path.
 - d. Ponds should be wedge-shaped, narrower at the inlet and wider at the outlet.
 - e. Irregular shorelines are preferred.
3. Plantings within the detention pond shall be installed according to the



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current Macomb County Public Works Commissioner Procedures and Design Standards for Stormwater Management.

4. A shelf, a minimum of four feet wide at a depth of one foot, will surround the interior of the perimeter to provide suitable conditions for the establishment of aquatic vegetation and to reduce the potential safety hazard to the public.
5. In-line detention basins are strongly discouraged in all circumstances, and are prohibited on watercourses greater than two (2) square miles upstream. In-line basins are also prohibited if the waterway to be impounded traverses any area outside of the proposed development.

H. Stormwater Wetland Systems

Stormwater wetlands are defined as, constructed systems explicitly designed to mitigate the storm water quality and quantity impacts associated with development. They do so by temporarily storing storm water runoff in shallow pools that create growing conditions suitable for emergent and riparian wetland plants. The runoff storage, complex micro-topography, and emergent plants in the storm water wetland together, form an ideal system for the removal of urban pollutants. Because of their water quality benefits, the use of storm water wetlands is encouraged.

As a general rule, storm water wetlands should not be located within delineated natural wetland areas.

The design of an effective and diverse storm water wetland requires a sophisticated understanding of hydrology and wetland plant ecology. Therefore, a qualified professional with specific wetland expertise must oversee wetland design, construction, re-construction, or modification. A reference for the design of storm water wetlands is by Thomas R. Scheuler, "Design of Storm water Wetland Systems" (published by the Metropolitan Washington Council of Governments). Plantings shall be installed according to the current Macomb County Public Works Commissioner Procedures and Design Standards for Stormwater Management.

1. Stormwater wetland systems must be designed to perform in conformance with all standards for storage volume and discharge rate established in these rules.
2. For developments with stormwater wetland systems requiring maintenance, the developer shall provide for the monitoring of wetland plantings and replacement as needed for a two-year period after construction.

I. Natural Wetlands



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This section governs natural wetlands (as distinct from stormwater wetland systems that are constructed expressly for stormwater management purposes), incorporated in an overall stormwater management scheme.

1. Natural wetlands will be protected from damaging modification and adverse changes in runoff quality and quantity associated with land developments. Before approval of the final plat or construction plans, all necessary wetland permits from the Michigan Department of Environmental Quality (MDEQ) will be in place.
2. Per MDEQ regulations, direct discharge of untreated storm water to a natural wetland is prohibited. All runoff from the development will be pre-treated to remove sediment and other pollutants prior to discharge to a natural wetland. Such treatment facilities will be constructed and vegetation established before property grading begins.
3. Whenever possible, a permanent 25-foot buffer strip, preferably vegetated with native plant species, will be maintained or restored around the periphery of wetlands.
4. Wetlands will be protected during construction by appropriate soil erosion and sediment control measures (see the standard detail for City of Mount Clemens Soil Erosion and Sedimentation Control Design).

J. Floodplains

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.

K. Safety Considerations

1. Drainage system components, especially all ponds, will be designed to protect the safety of all persons coming in contact with the system. The following criteria will apply:
 - a. All wet detention basins will have a level safety ledge at least four feet in width and one foot below the invert of the outlet pipe water depth, and other design and landscaping features as needed to provide for protection of the public.
 - b. Animal guards shall be placed on all outlet pipes with a diameter greater than 12 inches.
 - c. Signs may be required to alert residents of basin-use limitations (i.e. Warning against swimming, ice skating, etc.). Warnings may also be required in the master deed.



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3. Stormwater Management System Maintenance Plans

- A. Property deed restrictions (or condominium master deed documents) will specify the timeframe for action to address needed maintenance of stormwater management facilities. Deed restrictions (or condominium documents) will also specify that, should the private entity fail to act within this timeframe, the responsible governmental entity may, but shall not be obligated to, perform the needed maintenance and assess the costs against the property owners within the development or condominium association by allowing such costs, together with a reasonable administrative fee be recovered (or collected prior to undertaking work), with the particular language and means to be approved by the City Attorney.
1. Routine maintenance of stormwater management facilities will be completed within 30 days of receipt of written notification that action is required, unless other acceptable arrangements are made with the supervising governmental entity.
 2. Emergency maintenance will be completed within 36 hours of written notification.
- B. A legally binding private maintenance agreement will be executed before final project approval is granted. The agreement shall be referenced on the property deed (or condominium master deed document) so that it is binding on all subsequent property owners.
- C. Maintenance plans will be submitted with all construction plans and included in the bylaws of all developments and site condominiums and will include the following information:
1. An estimated annual maintenance budget itemized in detail by task and description of a financing mechanism.
 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 will be covered:
 - a. Maintenance of facilities such as pipes, channels, outflow control structures and pumps.
 - b. Debris removal from catch basins, channels and dry and wet basins.
 - c. Dredging operations for both channels and basins to remove sediment accumulation.



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4. The party responsible for performing each of the various maintenance activities described which will be recorded with final approved plans.
 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. Record-keeping of operations and expenditures.
 6. Provision for the routine and non-routine inspection of all components within the system described:
 - a. Wet weather inspections of structural elements (including inspection for sediment accumulation in detention basins) shall be conducted annually, with as-built plans in hand. These shall be carried out by a professional engineer or certified stormwater operator reporting to the responsible agency or owner.
 - b. Housekeeping inspections, such as checking for trash removal, shall take place at least once, annually.
 - 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.
 7. A description of ongoing landscape maintenance needs. Landscaping shall consist of low maintenance and/or native plant species. The viability of plantings will be monitored by the applicant for at least two years after establishment and plantings will be replaced as needed. The City is not responsible for landscape maintenance.
 8. Provision for the maintenance of vegetative buffers by homeowner's associations, conservation groups or a public agency. Buffers will be inspected annually for evidence of erosion or concentrated flows through or around the buffer.
- D. The stormwater drainage system will be designed to minimize and facilitate maintenance.
1. Riser pipes placed near or within pond embankments.
 2. Easily accessible trash racks.
 3. Alternate outflows for wet detention basins that can be used to completely drain the pool for sediment removal (pumping may be considered if drainage by gravity is not feasible).



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4. Sediment forebays for localizing sediment deposition and removal.
 5. Access for heavy equipment.
 6. On-site area for spoil deposition, wherever possible.
- E. Infiltration system, including porous pavement, must be aggressively maintained and protected from clogging by sediment (including the maintenance of grass buffer strips). In the event of clogging by accumulated sediments, partial or total reconstruction of infiltration facilities may be required.

Porous pavement shall be vacuum swept and jet hosed at least four times per year to remove any grit or sediment trapped in the pores. Evidence of a regular service contract for performing this activity will be required.