



CITY of NOVI CITY COUNCIL

Agenda Item 7
November 24, 2014

SUBJECT: Consideration of Ordinance No. 14-124.19, Chapter 11 "Design and Construction Standards", Articles XI "Bicycle Paths", and Article XII "Pedestrian Safety Paths"; and Ordinance No. 14-45.30, Appendix C of the City of Novi Code of Ordinance, Article VI, "Design Standards", Section 4.05, "Pedestrian Safety Paths, Bicycle Paths and Public Walkways", in order to amend the existing design and construction standards to incorporate the Engineering Design Manual standards for off-road non-motorized facilities and to repeal conflicting Design and Construction Standards for Bicycle Paths, Pedestrian Safety Paths and public walkways. **FIRST READING**

SUBMITTING DEPARTMENT: Department of Public Services, Engineering Division ^{PS} ^{BTC}

CITY MANAGER APPROVAL: 

BACKGROUND INFORMATION:

The *City of Novi Non-Motorized Master Plan* was adopted by City Council in 2011 to promote a healthier and more walkable community. One of the many goals listed in the plan recommended revisions to the Design and Construction Standards (DCS, in Chapter 11 of the Code of Ordinances) to provide engineering standards and details for the concepts presented in the plan. Additionally, Section 4.05 of the Subdivision Ordinance, which also discusses pathways and sidewalks in subdivisions, has been reviewed and updated.

Based on feedback from Council members, staff has also revised the section requiring pathways in front of new single family homes on collector and arterial streets. We are proposing revised ordinance language as summarized below:

- Variance process would become administrative using criteria in Section 11-10
- If there is no existing sidewalk within 300 feet of the property on the same side of the street:
 - Builder will have the option to pay the current construction cost in lieu of construction (funds to be used for pathways elsewhere in the City).
 - Property owner may be required to grant an easement for the future sidewalk

The DCS have not been fully reviewed and updated since the late 1990s, so staff has spent a considerable amount of time reviewing and updating the sections related to off-road non-motorized facilities, which includes sidewalks, pathways, and regional trails. The revised designs standards are proposed to be incorporated into the Engineering Design Manual (EDM), which was established by the attached resolution by City Council in 2007. The EDM is adopted by reference in the ordinance and provides the City Engineer with the flexibility to make changes in the design standards as the civil construction industry

changes and new technologies appear. The EDM also allows the City Engineer to grant variances administratively rather than sending variance requests to City Council. This will increase the efficiency of site plan review and decrease the plan review time for difficult sites that for various reasons can't meet the standards.

Articles XI and XII of the DCS address bicycles paths and pedestrian safety paths. These articles have been reviewed and combined into a single section relating to all off-road non-motorized facilities to remove overlapping and conflicting requirements. Similarly, Section 4.05 of the Subdivision Ordinance was reviewed to remove and clarify any language conflicting with the DCS. The remaining ordinance section relates to when and where pathways are required. The repealed sections of the ordinance dealing with the design standards and details are incorporated into the EDM.

As with any administrative variance, the applicant can appeal the City Engineer's decision to City Council.

The proposed ordinance was reviewed and recommended to approval by the Ordinance Review Committee on November 10, 2014 (draft minutes, attached). The draft of the EDM is also included for reference.

RECOMMENDED ACTION: Consideration of Ordinance No. 14-124.19, Chapter 11 "Design and Construction Standards", Articles XI "Bicycle Paths", and Article XII "Pedestrian Safety Paths"; and Ordinance No. 14-45.30, Appendix C of the City of Novi Code of Ordinance, Article VI, "Design Standards", Section 4.05, "Pedestrian Safety Paths, Bicycle Paths and Public Walkways", in order to amend the existing design and construction standards to incorporate the Engineering Design Manual standards for off-road non-motorized facilities and to repeal conflicting Design and Construction Standards for Bicycle Paths, Pedestrian Safety Paths and public walkways. **FIRST READING**

	1	2	Y	N
Mayor Gatt				
Mayor Pro Tem Staudt				
Council Member Casey				
Council Member Markham				

	1	2	Y	N
Council Member Mutch				
Council Member Poupard				
Council Member Wrobel				



RESOLUTION OF AUTHORITY ENGINEERING DESIGN MANUAL

CITY COUNCIL

Mayor
David B. Landry

Mayor Pro Tem
Kim Capello

Bob Gatt

Terry K. Margolis

Andrew Mutch

Toni Nagy

Gene Paul

City Manager
Clay J. Pearson

City Clerk
Maryanne Cornelius

WHEREAS, the City of Novi's Code of Ordinances contains numerous technical details and specifications relating to construction; and,

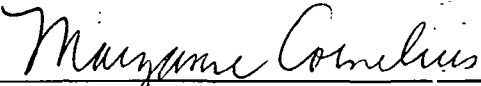
WHEREAS, standards in the construction industry change frequently as technologies, materials and equipment improve; and,

WHEREAS, the City and its development community would benefit from a streamlined, single document that contains construction details and specifications.

NOW, THEREFORE, BE IT RESOLVED that the Mayor and Council of the City of Novi authorize the City Engineer to prepare, maintain and approve the contents of an Engineering Design Manual for purposes of clearly conveying technical details and specifications related to construction within the City of Novi.

CERTIFICATION

I, Maryanne Cornelius, duly appointed Clerk of the City of Novi, do hereby certify that the foregoing is a true and complete copy of a resolution adopted by the City Council of the City of Novi at a regular meeting held this 24th day of September, 2007.



Maryanne Cornelius
City Clerk



DRAFT

ORDINANCE REVIEW COMMITTEE

November 10, 2014 | 5:00 p.m.

Mayor's Conference Room | Novi Civic Center | 45175 Ten Mile Road

Mayor Gatt called the meeting to order at 5:00 p.m.

ROLL CALL: Mayor Gatt, Council Member Mutch, Council Member Wrobel

ALSO PRESENT: Victor Cardenas, Assistant City Manager

Brian Coburn, Engineering Senior Manager

Jeff Muck, Parks, Recreation and Cultural Services Director

Thomas Schultz, City Attorney

APPROVAL OF AGENDA: Agenda was unanimously approved as presented.

AUDIENCE COMMENT: None

MATTERS FOR DISCUSSION:

1. Approval of minutes from August 11, 2014

ORCM 14-11-01 Moved by Mutch, seconded by Wrobel; CARRIED UNANIMOUSLY:

To approve the Ordinance Review Committee meeting minutes from August 11, 2014.

2. Launching of non-motorized watercraft at any shoreline not designated a swim or beach area.

Discussion was held regarding the issue of launching non-motorized watercraft such as kayaks or paddleboards. Access to any Novi park doesn't include launching watercraft. The same applied to Endwell as it has a no-parking sign that includes trailers. Any violation would need to be addressed by Public Safety.

3. Sidewalk construction requirements

A proposed ordinance amendment has language that will be added to clarify when an applicant would need to build sidewalks. If it is within 300 feet of another sidewalk or pathway, it would be necessary to build the sidewalk. If not, the ordinance would

November 10, 2014

require the granting of an easement and the applicant would submit an amount to the City for the sidewalk to be built at a later date. The subdivision ordinance also has pathway changes/updates that will allow non-motorized connections.

ORCM 14-11-02 Moved by Mutch, seconded by Wrobel; CARRIED UNANIMOUSLY:

To recommend to City Council the proposed ordinance amendment at Chapter 11, Design and Construction Standards, Article XI, Bicycle paths, and Article XII, Pedestrian Safety Paths, in order to amend the existing design and construction standards to incorporate the engineering design manual standards for off-road non-motorized facilities and to repeal conflicting design and constructions standards for bicycle paths and pedestrian safety paths.

4. Possible Ordinance Amendments regarding Medical Marijuana

Attorney Schultz noted dispensaries have become a real possibility and that allows for legal use. Examples from 5 different communities were included in the packet with the potential items for discussion being 1) where 2) licensing 3) operations requirements and 4) penalties. I-1 or I-2 are limited areas. A district could be created such as an overlay district or use as of right. The importance of local control was the most important issue. A suggestion was made to invite Senator Mike Kowall to inform the ORC as to the status of pending legislation. Additional uses with a separate set of standards seemed to fit. There was also some discussion of having final approval come from Administration. Council would hear any appeals. Under the subject of licensing, it would be necessary to have the person meet the minimum qualifications. Operating requirements such as potency or purity would be regulated in a State bill. Penalties would be a misdemeanor. Attorney Schultz will work with Community Development Director Boulard and Deputy Director McBeth on items discussed at Ordinance Review. Assistant City Manager Cardenas will contact Senator Kowall's office to determine his availability to speak with the Ordinance Review Committee.

The meeting was adjourned at 5:44 p.m.

Recorded by: Maryanne Cornelius

City Clerk

**MARKED-UP VERSION
OF ORDINANCE SECTIONS**

STATE OF MICHIGAN

COUNTY OF OAKLAND

CITY OF NOVI

ORDINANCE NO. _____

AN ORDINANCE TO AMEND THE CITY OF NOVI CODE OF ORDINANCES, AT CHAPTER 11, "DESIGN AND CONSTRUCTION STANDARDS," ARTICLE XI, "BICYCLE PATHS," AND ARTICLE XII, "PEDESTRIAN SAFETY PATHS," IN ORDER TO AMEND THE EXISTING DESIGN AND CONSTRUCTION STANDARDS TO INCORPORATE THE ENGINEERING DESIGN MANUAL STANDARDS FOR OFF-ROAD NON-MOTORIZED FACILITIES AND TO REPEAL CONFLICTING DESIGN AND CONSTRUCTION STANDARDS FOR BICYCLE PATHS AND PEDESTRIAN SAFETY PATHS.

THE CITY OF NOVI ORDAINS:

PART I. That Chapter 11, "Design and Construction Standards," Article XI, "Bicycle Paths," and Article XII, "Pedestrian Safety Paths," of the City of Novi Code of Ordinances is hereby amended to **delete** existing Articles XI and XII, creating new Article XI, "Off-Road Non-Motorized Facilities" which shall read as follows in its entirety:

ARTICLE XI. OFF-ROAD NON-MOTORIZED FACILITIES

~~Sec. 11-256. -- Scope.~~

~~(a) — This article establishes the minimum requirements for the design of bicycle paths within the city.~~

~~(b) — Bicycle paths shall be placed across the arterial and collector street system frontage for all projects in accordance with the "Master Plan for Bicycle and Pedestrian Safety Paths."~~

~~Sec. 11-257. -- Defined.~~

~~The words "bicycle path" for the purpose of this article shall include a permanent easement, when located outside of street rights-of-way for the construction, operation, maintenance, repair and/or replacement of the pathway, which will allow pedestrian and nonmotorized traffic access to adjacent properties.~~

~~Sec. 11-258. -- Design considerations.~~

~~(a) — Bicycle paths are to be constructed of portland cement concrete pavement.~~

~~(1) — Concrete pavement shall be four (4) inches thick air entrained concrete conforming to state department of transportation grade 35S on compacted subgrade. The concrete forms must be inspected by the city prior to pouring of concrete. Joints in concrete pathways shall be sawcut, no tooled joints will be allowed.~~

~~(2) — Preparation of base, mixing of materials, placing and finishing of concrete paving is to be done in accordance with the applicable standards as detailed in "Standard Specifications for Construction," latest edition, published by the state department of transportation.~~

~~(b) — Thickness of concrete bicycle paths shall be increased to six (6) inches at unpaved drive and road crossings.~~

~~(c) — Bicycle path widths shall be eight (8) feet, except at intersections with roadways or streets, where the pathway width will be reduced to six (6) feet.~~

~~(d) — Bicycle paths shall be located within one (1) foot of future rights-of-way lines, unless otherwise directed by the city engineer, for the enhancement of natural resources, or when the topography or existing landscaping warrants an alternate location. Additionally, bicycle paths should be located with an offset from the road surface of twelve (12) feet. Lesser distances may be allowed along curbed streets or in front of existing residences or when approaching intersections of streets to provide a safe alignment for crossing at the intersection. A pathway shall not be placed closer than five (5) feet from back of curb for a curbed roadway, or twelve (12) feet from edge of pavement of an uncurbed roadway; provided, however, that the city engineer may permit such placement if a vehicular guardrail is constructed between the roadway curb and the pathway.~~

~~(e) — Bicycle paths will generally follow the longitudinal slope of the existing ground, with adjustments in grade provided for intersecting drives and streets.~~

~~(f) — The maximum grade of a bicycle path shall be eight and three tenths (8.3) percent for one hundred (100) feet.~~

~~(g) — Bicycle paths will be sloped one-fourth inch per foot toward the road or street, unless existing surface drainage requires reversal of the pathway slope.~~

~~(h) — Minimum horizontal and vertical clearances shall be in accordance with Figure XI except that where bicycle paths are built or rebuilt in an area that contains trees greater than six (6) inches d.b.h., a separation of four (4) feet from said trees shall be provided wherever feasible. Where the path must be closer than four (4) feet to such a tree, a physical barrier or herbicide impregnated barrier cloth must be placed under the path to prevent the tree roots from heaving the path. The area requiring the barrier shall include any portion of the path following within the points as set forth in section 11-~~

~~50~~

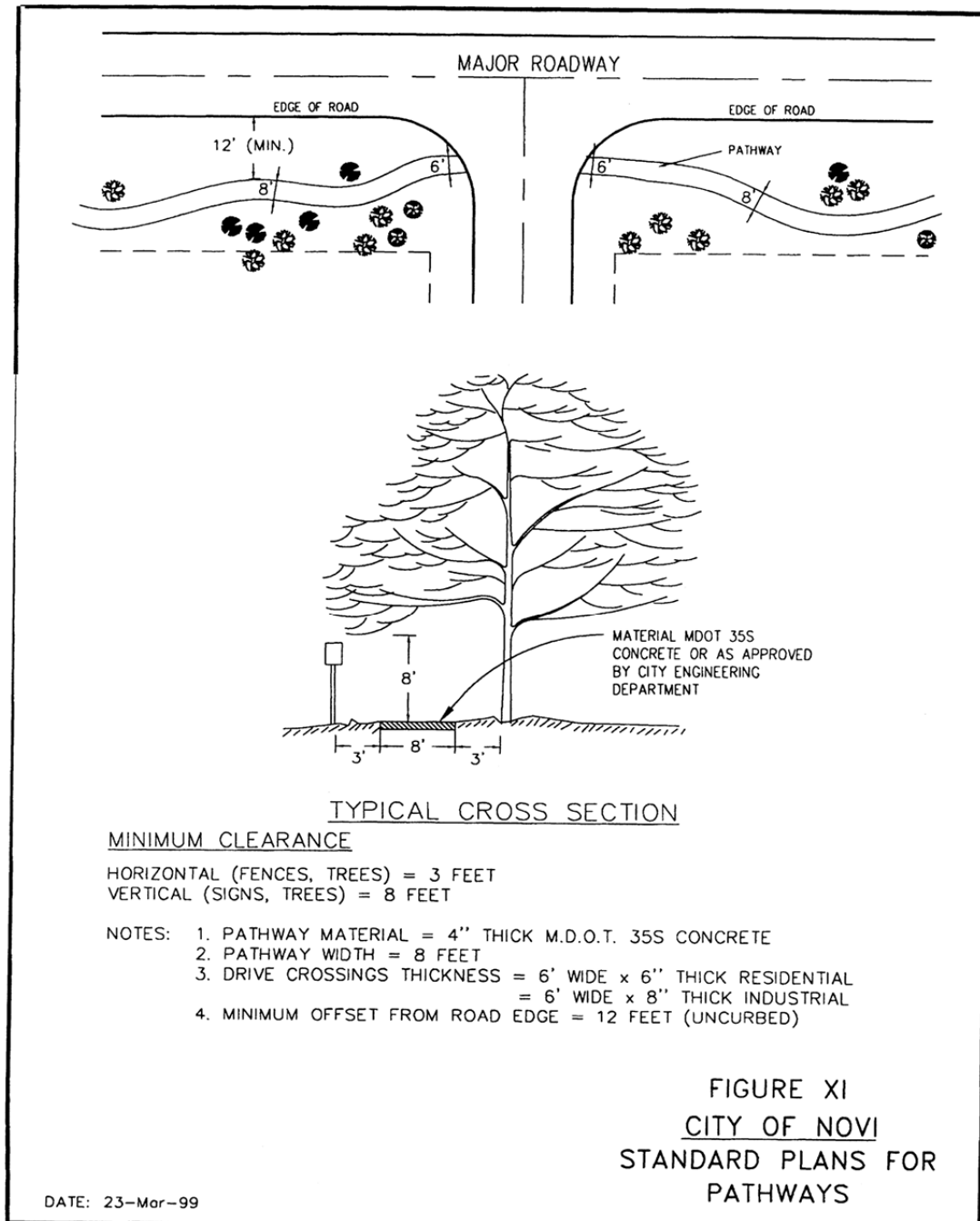


FIGURE XI

(i) At drive or street crossings (residential, commercial or otherwise), the bicycle path shall be sloped to meet the drive or street entrance grade. Detectable warning surfaces are required at all barrier free ramps and hazardous vehicular ways. Detectable warning surfaces must be manufactured of a material approved by the city

engineer. The barrier-free ramps shall comply with current MDOT specifications for ADA Sidewalk Ramps and the Americans with Disabilities Act.

~~(j) — Bicycle paths shall be designed and constructed to abut existing residential and commercial paved driveways without the removal of driveway pavement for crossing. Bicycle paths shall be constructed across gravel driveways or paved driveways determined to have an inferior cross-section when compared to the existing bicycle path.~~

~~———— **Sec. 11-259. — Plan and specifications.**~~

~~Plans and specifications for bicycle paths shall be prepared per requirements set forth in [section 11-277](#).~~

ARTICLE XII. — PEDESTRIAN SAFETY PATHS

~~**Sec. 11-276. — Scope. Sec. 11-256. Requirement.**~~

(a) This article establishes requirements for the design and construction of ~~pedestrian safety paths (sidewalks)~~ off-road non-motorized facilities within the street right-of-way of platted subdivisions, the arterial and collector street system, roads in unplatted residential areas and private roads in other unplatted areas within the city. Off-road non-motorized facilities include sidewalks, bicycle paths and regional trails.

(b) ~~Pedestrian safety paths~~ Non-motorized facilities shall be placed across the ~~arterial and collector street system~~ frontage of all streets and roadways (public or private) for all projects in accordance with the "~~Master Plan for Bicycle and Pedestrian Master Plan Safety Paths~~", as well as at those locations specified in the City of Novi Subdivision Ordinance (Appendix C) and the City of Novi Zoning Ordinance (Appendix A). If the project entails the construction of an individual single family residential structure, the property owner/builder may request an administrative variance from this requirement. An administrative variance request shall be reviewed using the standards in Section 11-10(b). If the subject property is located such that no other pathways exist within 300 feet on the same side of the street, the property owners/builder shall have the option to pay the City the current construction cost of the sidewalk, as approved by the City Engineer, to be used by the City for construction of pathway segments elsewhere in the City. The City Engineer may require the property owner to submit a pathway easement, in a location to be determined by the City Engineer, for future construction, operation and maintenance of a pathway across the property by the City.

(c) In the case of new streets and roadways to be constructed as part of the project, a sidewalk shall be provided on both sides of the proposed street or roadway. Sidewalks along streets identified by the master plan as arterials and collectors shall be six (6) feet or eight (8) feet wide as designated by the "Bicycle and Pedestrian Plan," whereas sidewalks along local streets and private roadways shall be five (5) feet wide.

(d) Non-motorized connections shall also be made between the development and the adjacent parcels and the overall city network of non-motorized facilities as directed by the City Engineer and as specified in the City of Novi Subdivision Ordinance (Appendix C) and the City of Novi Zoning Ordinance (Appendix A).

(e) A permanent easement for the non-motorized facility shall be provided when located outside of street rights-of-way for the construction, operation, maintenance, repair and/or replacement of the pathway and to allow pedestrian and non-motorized traffic access to the facility.

(f) Non-Motorized facilities shall be designed and constructed to meet the requirements of the Engineering Design Manual, unless otherwise approved by the City Engineer.

(g) Non-motorized facilities, as required above shall be constructed as part of the site improvements for the development as follows:

(1) For commercial and industrial developments, non-motorized facilities shall be constructed as part of the site improvements for the development prior to issuance of a temporary certificate of occupancy.

(2) For residential developments other than an individual single family home, non-motorized facilities along the frontage of the development and any common areas shall be constructed as part of the site improvements for the overall development prior to issuance of the first building permit, excluding model homes as defined in Chapter 26.5.

(3) For individual single family homes, the non-motorized facilities shall be constructed prior to the issuance of a temporary certificate of occupancy for that individual home.

(4) If seasonal weather conditions prohibit the completion of non-motorized facilities as required above, the developer may request an administrative variance from the City Engineer provided that the developer posts a financial guarantee in conformance with the requirements of Chapter 26.5 and completes said non-motorized facilities by July 1 of the following year.

Sec. 11-277. - Plans and specifications.

~~(a) The plans and specifications shall be sealed by a civil engineer registered in the state and shall have imprinted thereon the seal of that engineer.~~

~~(b) Plans shall consist of a cover sheet allowing a plan view of the complete job, split plan and profile sheets drawn to a scale of one (1) inch equals one hundred (100) feet horizontal and one (1) inch equals five (5) feet vertical, and standard detail sheets. Profiles of existing centerline of the roadway, street right of way line and parallel drainage facilities are to be provided. In addition, the proposed profile along the street right-of-way line shall be provided. The horizontal location of the centerline of each~~

driveway within the limits of construction shall also be delineated in the profile view. Sheet size shall be twenty-four (24) inches by thirty-six (36) inches.

(c) — The length of the frontage of each parcel of land abutting the proposed improvement shall be dimensioned on the plans. Each such parcel shall be identified by its subdivision name and lot number, or by its permanent parcel number, as established and assigned by the county equalization department, and street address number.

(d) — The direction of drainage from each parcel shall be indicated by drainage arrows.

(e) — For any straight run of a safety path, grades shall be given in percent, and the station and length of each vertical curve shall be shown, with grade elevations computed and stated for intervals not exceeding fifty (50) feet.

(f) — Elevations shall be on U.S.G.S. datum. Bench marks shall be shown at least every one thousand two hundred (1,200) feet. Street names and widths, subdivision names, legend, list of quantities, and other pertinent information shall be shown on the plans.

(g) — The plans shall contain a note requiring that all construction shall conform to the city's construction standards.

Sec. 11-278. — Design considerations.

(a) — *Materials.* Pedestrian safety paths shall be constructed in concrete. The materials shall meet the requirements specified in the sections of the state department of transportation's "Standard Specifications for Construction" designated as follows:

(1) — Portland Cement Concrete;

(2) — Granular Material Class II;

(3) — Premolded Joint Fillers;

(4) — Concrete Curing Materials.

(b) — *General.*

(1) — Pedestrian safety path grades shall be set to match the general profile on the traveled road, and elevations shall blend in with the general grading plan of the abutting property and shall not impede drainage to presently established storm structures, ditch drainage, or site drainage swales.

(2) — Pedestrian safety path construction shall include grading of the existing land parallel to the sidewalk. Drainage on the street side shall be provided by slope grading

to the existing ditch or to the back of curb. Typical cross sections shall detail the work in these areas.

(3) — At street intersections where open ditch drainage prevails, a 12-inch minimum size or larger sixteen-gauge corrugated metal culvert pipe shall be installed and backfilled with Granular Material Class II (MDOT specification) prior to the walk construction. The culvert pipe shall have sufficient length to provide a walk five (5) feet wide with a grass area two and one-half (2 ½) feet wide each side at top, and a maximum slope of one (1) foot vertical on three (3) feet horizontal to the ditch flow line. The entire area of the filled ditch section, from the ditch bottom to the edges of the new safety path, shall be protected with sod. The safety path shall terminate at the shoulder point, eight (8) feet from the edge of the traveled roadway, or at the back of curb.

(4) — At drive or street crossings (residential, commercial or otherwise), the pedestrian safety path shall be sloped to meet the drive or street entrance grade. Detectable warning surfaces are required at all barrier free ramps and hazardous vehicular ways. Detectable warning surfaces must be manufactured of a material approved by the city engineer. The barrier-free ramps shall comply with current MDOT specifications for ADA Sidewalk Ramps and the Americans with Disabilities Act.

(5) — Pedestrian safety paths shall be located within one (1) foot of future rights-of-way lines, unless otherwise directed by the city engineer, for the enhancement of natural resources, or when the topography, existing landscaping, or an existing residence warrants an alternate location. Pedestrian safety paths shall be located a minimum of five (5) feet from back of curb for a curbed roadway, or twelve (12) feet from edge of pavement of an uncurbed roadway. Pedestrian safety paths should be constructed no closer than three (3) feet from fences, trees or other permanent above-grade obstruction, except as otherwise approved by the city engineer.

(6) — Pedestrian walk cross-overs. Pedestrian walk cross-overs shall be provided at the intersections to public residential streets in accordance with Figure VIII-J, within article VIII of this chapter.

Sec. 11-279. - General construction.

(a) — Pedestrian safety paths shall be flush with abutting curbs and paved surfaces.

(b) — Pedestrian safety paths shall slope one-fourth (¼) inch per foot toward the drainage side.

(c) — All pedestrian safety paths shall be concrete and four (4) inches thick except residential driveway crossings which shall be six (6) inches thick, and industrial/commercial driveway crossings which shall be eight (8) inches thick. Safety paths shall be five (5) feet wide unless otherwise approved by the city.

~~(d) — The longitudinal gradient shall not exceed one (1) inch per foot (eight and three-tenths (8.3) percent).~~

~~(e) — The "General Construction Standards" of the city apply to all pedestrian safety path construction.~~

~~(f) — Along the frontage of lots in residential subdivisions and abutting cul-de-sacs, a physical barrier or herbicide impregnated barrier cloth shall be placed under the walk to prevent street tree roots from heaving the walk.~~

Sec. 11-280. — Materials.

The materials shall meet the requirements specified in the applicable section of the state department of transportation's (MDOT) *Standard Specification for Construction*.

~~(1) — Portland Cement Concrete;~~

~~(2) — Granular Materials Class II;~~

~~(3) — Premolded Joint Fillers;~~

~~(4) — Concrete Curing Materials.~~

~~The concrete mixture shall conform to the MDOT requirements listed for Grade of Concrete 35S.~~

Sec. 11-281. — Construction.

~~(a) — All unstable subgrade material shall be removed and replaced with Class II granular material per MDOT specification. Subgrade material other than such Class II may be used with prior approval of the engineer. Where safety paths are built or rebuilt in an area that contains trees greater than six (6) inches d.b.h., a separation of four (4) feet from said trees shall be provided wherever feasible. Where the path must be closer than four (4) feet to such a tree, a physical barrier or herbicide impregnated barrier cloth must be placed under the path to prevent the tree roots from heaving the path. The area requiring the barrier shall include any portion of the path following within the points as set forth in [section 11-50](#)~~

~~(b) — Forms shall be clean and straight, composed of wood or metal. The forms shall be staked to line and grade in a manner that will prevent deflection or settlement. Forms shall be oiled before placing concrete.~~

~~(c) — The base shall be thoroughly wetted and the concrete deposited thereon to the proper depth. Concrete shall be spaded along the forms, compressed and struck off flush with the top of the forms. The surface shall be floated with a steel float, edges and~~

joints properly tooled, and then finished with a wood float or brush, transverse to the centerline of the pedestrian safety path to provide a nonslip surface.

~~(d) — One half inch transverse expansion joint, the full depth of the pedestrian safety path, shall be placed at uniform intervals not exceeding fifty (50) feet, at driveways, and where the new walk abuts existing concrete structures. Contraction joints shall be formed every five (5) feet. All joints shall be constructed at right angles to the centerline of the safety path.~~

~~(e) — The concrete shall be cured with white membrane curing compound, wet burlap, or by other methods approved by the department of building and safety, as soon as surface moisture has disappeared. Concrete shall not be placed on frozen ground. When the temperature is below forty (40) degrees Fahrenheit, or when freezing temperatures within the next twenty four hour period are forecast, concrete shall not be placed unless protection against freezing of the concrete, as required by the traffic engineer, is provided.~~

Secs. 11-257 – 11-300. – Reserved.

PART II. That Chapter 11, “Design and Construction Standards,” Article XIII, “Record Drawings, Procedures and Requirements,” is hereby renumbered to Article XII.

PART III. Severability. Should any section, subdivision, clause, or phrase of this Ordinance be declared by the courts to be invalid, the validity of the Ordinance as a whole, or in part, shall not be affected other than the part invalidated.

PART IV. Savings Clause. The amendment of the Novi Code of Ordinances set forth in this Ordinance does not affect or impair any act done, offense committed, or right accruing, accrued, or acquired or liability, penalty, forfeiture or punishment, pending or incurred prior to the amendment of the Novi Code of Ordinances set forth in this Ordinance.

PART V. Repealer. All ordinances or parts of ordinances in conflict herewith are hereby repealed.

PART VI. Effective Date. The provisions of this Ordinance are ordered to take effect following publication in the manner prescribed by the Charter of the City of Novi.

PART VII. Adoption. This ordinance is hereby declared to have been adopted by the Novi City Council in a meeting thereof duly held and called on the ___ day of _____, 2014, in order to be given publication in the manner prescribed by the Charter of the City of Novi.

Moved by _____ and supported by _____.

Robert J. Gatt, Mayor

Maryanne Cornelius, City Clerk

Certificate of Adoption

I hereby certify that the foregoing is a true and complete copy of the ordinance adopted at the regular meeting of the Novi City Council held on the ____ day of _____, 2014.

Maryanne Cornelius, City Clerk

STATE OF MICHIGAN

COUNTY OF OAKLAND

CITY OF NOVI

ORDINANCE NO. _____

AN ORDINANCE TO AMEND APPENDIX C OF THE CITY OF NOVI CODE OF ORDINANCES, ARTICLE VI, "DESIGN STANDARDS," SECTION 4.05, "PEDESTRIAN SAFETY PATHS, BICYCLE PATHS AND PUBLIC WALKWAYS," IN ORDER TO AMEND THE EXISTING DESIGN AND CONSTRUCTION STANDARDS TO INCORPORATE THE ENGINEERING DESIGN MANUAL STANDARDS FOR OFF-ROAD NON-MOTORIZED FACILITIES AND TO REPEAL CONFLICTING DESIGN AND CONSTRUCTION STANDARDS FOR SAFETY PATHS, BICYCLE PATHS AND PUBLIC WALKWAYS.

THE CITY OF NOVI ORDAINS:

PART I. That Appendix C of the City of Novi Code of Ordinances, Article IV, "Design Standards," is hereby amended to read as follows:

Section 4.05 - Pedestrian Safety Paths, Bicycle Paths and Public Walkways.

A. A five-foot wide Pedestrian safety path (sidewalks) shall be constructed of concrete along both sides of all local streets shown on the plat. Provided, however, that pedestrian safety paths will not be required along industrial service streets, service drives, and will only be required along one side of marginal access streets. Pedestrian safety paths, where required, shall be five (5) feet wide and shall be placed one (1) foot off property lines. Sidewalks may be omitted on only one side if that side cannot be developed and there are no anticipated uses that would generate pedestrian trips on that side of the street as determined by the City Engineer.

B. Bicycle paths which conform to the City of Novi Design and Constructions Standards shall be constructed along all major arterials, arterials and minor arterials shown on or abutting the plat, as required by Section 11-256 of the Novi Code of Ordinances.

C. At the time of street construction and prior to issuance of the first building permit within the development excluding model homes as defined by Chapter 26.5, sidewalks Pedestrian safety paths (sidewalks) shall be required and constructed where necessary along the frontage of storm water basins, retention ponds, outlots, and open space areas to provide continuity with sidewalks installed within the development in and other adjoining developments.

D. The design and construction of ~~pedestrian safety paths~~ sidewalks and bicycle paths shall be in ~~conformity~~ accordance with Chapter 11 of the Novi Code of Ordinances (Design and Construction Standards, and the Engineering Design Manual unless otherwise approved by the City Engineer.

E. When a plat is adjacent to property owned by a school district, the plat shall include at least one ~~pedestrian safety path~~ eight (8) foot wide pathway to provide access to such adjacent property. In addition, such ~~pedestrian safety paths~~ pathways may be required where adjacent property is utilized or planned to be utilized for a church, park or other community facility, or within the plat where the length of a block exceeds one thousand (1,000) feet. Pathway connections within easements dedicated to the City shall also be provided to allow neighborhood connections with adjacent properties as required by the City Engineer. All pathway connections shall be constructed to meet with Chapter 11 of the Novi Code of Ordinances (Design and Construction Standards).

F. An permanent easement ~~at least twelve (12) feet wide~~ shall be maintained for a public walkway with a width as specified in the Engineering Design Manual.

G. ~~The surface of a public walkway shall be eight (8) feet wide and constructed to meet Chapter 11 of the Novi Code of Ordinances (Design and Construction Standards).~~ Pedestrian safety paths Sidewalks and bicycle paths, or portions thereof, otherwise required may be eliminated where the City Council determines upon Planning Commission recommendation that installation would have an adverse impact on a woodland area. In such instances, the City Council may require alternative methods of providing public walkways.

PART II. Severability. Should any section, subdivision, clause, or phrase of this Ordinance be declared by the courts to be invalid, the validity of the Ordinance as a whole, or in part, shall not be affected other than the part invalidated.

PART III. Savings Clause. The amendment of the Novi Code of Ordinances set forth in this Ordinance does not affect or impair any act done, offense committed, or right accruing, accrued, or acquired or liability, penalty, forfeiture or punishment, pending or incurred prior to the amendment of the Novi Code of Ordinances set forth in this Ordinance.

PART IV. Repealer. All ordinances or parts of ordinances in conflict herewith are hereby repealed.

PART V. Effective Date. The provisions of this Ordinance are ordered to take effect following publication in the manner prescribed by the Charter of the City of Novi.

PART VI. Adoption. This ordinance is hereby declared to have been adopted by the Novi City Council in a meeting thereof duly held and called on the ___ day of _____, 2014, in order to be given publication in the manner prescribed by the Charter of the City of Novi.

Moved by _____ and supported by _____.

Robert J. Gatt, Mayor

Maryanne Cornelius, City Clerk

Certificate of Adoption

I hereby certify that the foregoing is a true and complete copy of the ordinance adopted at the regular meeting of the Novi City Council held on the ____ day of _____, 2014.

Maryanne Cornelius, City Clerk

**CLEAN VERSION
OF ORDINANCE SECTIONS**

STATE OF MICHIGAN

COUNTY OF OAKLAND

CITY OF NOVI

ORDINANCE NO. 14-124-19

AN ORDINANCE TO AMEND THE CITY OF NOVI CODE OF ORDINANCES, AT CHAPTER 11, "DESIGN AND CONSTRUCTION STANDARDS," ARTICLE XI, "BICYCLE PATHS," AND ARTICLE XII, "PEDESTRIAN SAFETY PATHS," IN ORDER TO AMEND THE EXISTING DESIGN AND CONSTRUCTION STANDARDS TO INCORPORATE THE ENGINEERING DESIGN MANUAL STANDARDS FOR OFF-ROAD NON-MOTORIZED FACILITIES AND TO REPEAL CONFLICTING DESIGN AND CONSTRUCTION STANDARDS FOR BICYCLE PATHS AND PEDESTRIAN SAFETY PATHS.

THE CITY OF NOVI ORDAINS:

PART I. That Chapter 11, "Design and Construction Standards," Article XI, "Bicycle Paths," and Article XII, "Pedestrian Safety Paths," of the City of Novi Code of Ordinances is hereby amended to **delete** existing Articles XI and XII , creating new Article XI, "Off-Road Non-Motorized Facilities" which shall read as follows in its entirety:

ARTICLE XI. OFF-ROAD NON-MOTORIZED FACILITIES

Sec. 11-256. Requirement.

(a) This article establishes requirements for the design and construction of off-road non-motorized facilities within the street right-of-way of platted subdivisions, the arterial and collector street system, roads in unplatted residential areas and private roads in other unplatted areas within the city. Off-road non-motorized facilities include sidewalks, bicycle paths and regional trails.

(b) Non-motorized facilities shall be placed across the frontage of all streets and roadways (public or private) for all projects in accordance with the " Bicycle and Pedestrian Master Plan ", as well as at those locations specified in the City of Novi Subdivision Ordinance (Appendix C) and the City of Novi Zoning Ordinance (Appendix A). If the project entails the construction of an individual single family residential structure, the property owner/builder may request an administrative variance from this requirement. An administrative variance request shall be reviewed using the standards in Section 11-10(b). If the subject property is located such that no other pathways exist within 300 feet on the same side of the street, the property owners/builder shall have the option to pay the City the current construction cost of the sidewalk, as approved by the City Engineer, to be used by the City for construction of pathway segments elsewhere in the City. The City Engineer may require the property owner to submit a

pathway easement, in a location to be determined by the City Engineer, for future construction, operation and maintenance of a pathway across the property by the City.

(c) In the case of new streets and roadways to be constructed as part of the project, a sidewalk shall be provided on both sides of the proposed street or roadway. Sidewalks along streets identified by the master plan as arterials and collectors shall be six (6) feet or eight (8) feet wide as designated by the "Bicycle and Pedestrian Plan," , whereas sidewalks along local streets and private roadways shall be five (5) feet wide.

(d) Non-motorized connections shall also be made between the development and the adjacent parcels and the overall city network of non-motorized facilities as directed by the City Engineer and as specified in the City of Novi Subdivision Ordinance (Appendix C) and the City of Novi Zoning Ordinance (Appendix A).

(e) A permanent easement for the non-motorized facility shall be provided when located outside of street rights-of-way for the construction, operation, maintenance, repair and/or replacement of the pathway and to allow pedestrian and non-motorized traffic access to the facility.

(f) Non-Motorized facilities shall be designed and constructed to meet the requirements of the Engineering Design Manual, unless otherwise approved by the City Engineer.

(g) Non-motorized facilities, as required above shall be constructed as part of the site improvements for the development as follows:

(1) For commercial and industrial developments, non-motorized facilities shall be constructed as part of the site improvements for the development prior to issuance of a temporary certificate of occupancy.

(2) For residential developments other than an individual single family home, non-motorized facilities along the frontage of the development and any common areas shall be constructed as part of the site improvements for the overall development prior to issuance of the first building permit, excluding model homes as defined in Chapter 26.5.

(3) For individual single family homes, the non-motorized facilities shall be constructed prior to the issuance of a temporary certificate of occupancy for that individual home.

(4) If seasonal weather conditions prohibit the completion of non-motorized facilities as required above, the developer may request an administrative variance from the City Engineer provided that the developer posts a financial guarantee in conformance with the requirements of Chapter 26.5 and completes said non-motorized facilities by July 1 of the following year.

Secs. 11-257 – 11-300. – Reserved.

PART II. That Chapter 11, "Design and Construction Standards," Article XIII, "Record Drawings, Procedures and Requirements," is hereby renumbered to Article XII.

PART III. Severability. Should any section, subdivision, clause, or phrase of this Ordinance be declared by the courts to be invalid, the validity of the Ordinance as a whole, or in part, shall not be affected other than the part invalidated.

PART IV. Savings Clause. The amendment of the Novi Code of Ordinances set forth in this Ordinance does not affect or impair any act done, offense committed, or right accruing, accrued, or acquired or liability, penalty, forfeiture or punishment, pending or incurred prior to the amendment of the Novi Code of Ordinances set forth in this Ordinance.

PART V. Repealer. All ordinances or parts of ordinances in conflict herewith are hereby repealed.

PART VI. Effective Date. The provisions of this Ordinance are ordered to take effect following publication in the manner prescribed by the Charter of the City of Novi.

PART VII. Adoption. This ordinance is hereby declared to have been adopted by the Novi City Council in a meeting thereof duly held and called on the ___ day of _____, 2014, in order to be given publication in the manner prescribed by the Charter of the City of Novi.

Moved by _____ and supported by _____.

Robert J. Gatt, Mayor

Maryanne Cornelius, City Clerk

Certificate of Adoption

I hereby certify that the foregoing is a true and complete copy of the ordinance adopted at the regular meeting of the Novi City Council held on the ___ day of _____, 2014.

Maryanne Cornelius, City Clerk

STATE OF MICHIGAN

COUNTY OF OAKLAND

CITY OF NOVI

ORDINANCE NO. 14-45.30

AN ORDINANCE TO AMEND APPENDIX C OF THE CITY OF NOVI CODE OF ORDINANCES, ARTICLE VI, "DESIGN STANDARDS," SECTION 4.05, "PEDESTRIAN SAFETY PATHS, BICYCLE PATHS AND PUBLIC WALKWAYS," IN ORDER TO AMEND THE EXISTING DESIGN AND CONSTRUCTION STANDARDS TO INCORPORATE THE ENGINEERING DESIGN MANUAL STANDARDS FOR OFF-ROAD NON-MOTORIZED FACILITIES AND TO REPEAL CONFLICTING DESIGN AND CONSTRUCTION STANDARDS FOR SAFETY PATHS, BICYCLE PATHS AND PUBLIC WALKWAYS.

THE CITY OF NOVI ORDAINS:

PART I. That Appendix C of the City of Novi Code of Ordinances, Article IV, "Design Standards," is hereby amended to read as follows:

Section 4.05 - Pedestrian Safety Paths, Bicycle Paths and Public Walkways.

A. A five-foot wide sidewalk shall be constructed along both sides of all local streets shown on the plat. Sidewalks may be omitted on only one side if that side cannot be developed and there are no anticipated uses that would generate pedestrian trips on that side of the street as determined by the City Engineer.

B. Bicycle paths shall be constructed along all major arterials, arterials and minor arterials shown on or abutting the plat, as required by Section 11-256 of the Novi Code of Ordinances.

C. At the time of street construction and prior to issuance of the first building permit within the development excluding model homes as defined by Chapter 26.5, sidewalks shall be required and constructed along the frontage of storm water basins , outlots, and open space areas to provide continuity with sidewalks installed within the development and other adjoining developments.

D. The design and construction of sidewalks and bicycle paths shall be in accordance with Chapter 11 of the Novi Code of Ordinances (Design and Construction Standards, and the Engineering Design Manual unless otherwise approved by the City Engineer.

E. When a plat is adjacent to property owned by a school district, the plat shall include at least one eight (8) foot wide pathway to provide access to such adjacent

property. In addition, such pathways may be required where adjacent property is utilized or planned to be utilized for a church, park or other community facility, or within the plat where the length of a block exceeds one thousand (1,000) feet. Pathway connections within easements dedicated to the City shall also be provided to allow neighborhood connections with adjacent properties as required by the City Engineer. All pathway connections shall be constructed to meet with Chapter 11 of the Novi Code of Ordinances (Design and Construction Standards).

F. An permanent easement shall be maintained for a public walkway with a width as specified in the Engineering Design Manual.

G. Sidewalks and bicycle paths, or portions thereof, otherwise required may be eliminated where the City Council determines upon Planning Commission recommendation that installation would have an adverse impact on a woodland area. In such instances, the City Council may require alternative methods of providing public walkways.

PART II. Severability. Should any section, subdivision, clause, or phrase of this Ordinance be declared by the courts to be invalid, the validity of the Ordinance as a whole, or in part, shall not be affected other than the part invalidated.

PART III. Savings Clause. The amendment of the Novi Code of Ordinances set forth in this Ordinance does not affect or impair any act done, offense committed, or right accruing, accrued, or acquired or liability, penalty, forfeiture or punishment, pending or incurred prior to the amendment of the Novi Code of Ordinances set forth in this Ordinance.

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Moved by _____ and supported by _____.

Robert J. Gatt, Mayor

Maryanne Cornelius, City Clerk

Certificate of Adoption

I hereby certify that the foregoing is a true and complete copy of the ordinance adopted at the regular meeting of the Novi City Council held on the ____ day of _____, 2014.

Maryanne Cornelius, City Clerk

REVISED DRAFT
ENGINEERING DESIGN MANUAL



Engineering Design Manual for City of Novi Oakland County, Michigan

**CITY OF NOVI
ENGINEERING DESIGN MANUAL
UPDATED DECEMBER XX, 2014**

DRAFT



**Engineering Division
Department of Public Services**
Field Services Complex
26300 Lee BeGole Drive
Novi, MI 48375
t: 248.347.0454 or 248.735.5640
cityofnovi.org | InvestNovi.org

Reviewed and Approved:

Rob Hayes, P.E.
Director of Public Services/
City Engineer

Date: _____

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Cover Photos and Design by Phil Kerby

REVISIONS

September 2007

- Storm Water Standards added as Chapter 5 to first publication

XXXXX 2014

- Design standards for off-road non-motorized facilities were added as Section 7-4
- The sections in Chapter 5 were renumbered to be consistent with new Section 7-4
- All references within Chapter were updated to reflect the new section numbering
- The following sections of Chapter 5 were updated:
 - 5.2.1 *Allowable Discharge Rate* updated to address bankfull detention prior to discharge to an open channel
 - 5.5.1 *The Rational Method* updated to add runoff coefficients for pervious pavement and turf grass.
 - 5.6.4 *Basin Inlets and Outlets* –equation under (B)(1)(b) was updated and (C) was updated to allow a secondary stand pipe and to clarify elevations.
 - 5.6.5 *Additional Requirements* subsection H updated to better define that an easement is required, the width and cross-slope of the access.
 - 5.7 *Underground Detention* updated (H)(2) to clarify the number of soil borings required and updated (I) to allow the requirement for inspection ports.
 - 5.7.1 *Restricted Outlet* updated (F) to revise the minimum restrictor size.
 - 5.10 *Sediment Forebays* update the equation in F to correct a previous typo.
 - 5.14.1 *Easement Width* updated (D) to clarify the width and location of the access easement.

CHAPTER 5 STORMWATER MANAGEMENT

This document sets forth specific performance, design, construction and maintenance standards that will be used by the city in review of proposed stormwater management systems in accordance with the objectives of managing both the quantity and quality of stormwater runoff.

It is difficult or impossible to develop one (1) set of uniform standards that can accommodate all variables and unique site circumstances. In particular, it is recognized that these standards shall be difficult to realize on small sites. Waivers or variances from specific provisions of these standards shall be requested, and alternatives consistent with the overall intent of stormwater quantity and quality management shall be proposed, subject to the approval of the city in accordance with the procedure and standards in the City's Code of Ordinances.

PART ONE - PERFORMANCE CRITERIA FOR STORMWATER MANAGEMENT SYSTEMS

This Part One sets forth performance standards that the City has adopted to meet the objectives of managing the quantity and quality of stormwater runoff. Designers may select any combination of stormwater management elements which meet the performance standards provided the selections: (1) comply with the requirements identified in this document and the City's Code of Ordinances; (2) comply with other local, county, state or federal requirements; and (3) do not conflict with the existing local stormwater management and watershed plans.

The performance standards described in this Section pertain to permanent stormwater management systems.

SECTION 5.1 LOW-IMPACT DEVELOPMENT

There are several additional methods of controlling the quantity of and improving the quality of stormwater runoff from the site. The designer should consider incorporating low impact design principles into the site design as a method of improving the stormwater quality and reducing peak flows. The goal of low impact design is to more closely mimic the watershed's natural hydrologic functions and include:

- Prevent stormwater impacts rather than having to mitigate for them.
- Manage stormwater quantity and quality as close to the source as possible and minimize the use of large or regional collection and conveyance.
- Preserve natural areas, native vegetation and reduce the impact on the watershed hydrology.

- Use natural drainage pathways as a frame work for site design.
- Utilize simple, non-structural methods for stormwater management that are lower cost and lower maintenance than structural controls.
- Create a multifunctional landscape.

Low impact design practices and techniques for site design include the following:

- A. Preservation of Natural Features and Conservation Design
 1. Preservation of undisturbed areas
 2. Preservation of buffers
 3. Reduction of clearing and grading
 4. Locating sites in less sensitive areas
 5. Open space design
- B. Reduction of Impervious Cover
 1. Roadway reduction
 2. Sidewalk reduction
 3. Driveway reduction
 4. Cul-de-sac reduction
 5. Building footprint reduction
 6. Parking reduction
- C. Utilization of Natural Features and Source Control for Stormwater Management
 1. Vegetated buffer/filter strips
 2. Open vegetated channels
 3. Bioretention, rain gardens and bioswales
 4. Infiltration
 5. Rooftop runoff mitigation
 6. Stream daylighting for redevelopment projects
 7. Tree planting

Additionally, the following techniques can improve the stormwater management plan for a site:

- Disconnection of impervious surfaces.
- Reduced slopes and increased roughness of flow paths.
- Avoid channelizing of stormwater flow.

SECTION 5.2 STORMWATER QUANTITY CONTROL

The design of a stormwater management system must incorporate elements for protecting against the effects of flooding. To control flooding, the City has adopted the following minimum performance standards for controlling the volume of stormwater runoff from development projects:

- A. Stormwater quantity control facilities must accommodate the 100-year storm event and provide additional protection for the bankfull flood and first flush events. Acceptable methods for determining the volume of runoff from the 100-year storm and bankfull flood and are in Section 5.5.
- B. Stormwater management facilities shall, in every way feasible, conform to the natural drainage patterns within the site and the watershed in which it is located.
- C. Where a positive outlet (detention systems) is provided, the flow shall be restricted to provide protection for the 100-year storm event and bankfull flood as defined in Section 5.5.2 and Section 5.6 or Section 5.7.
- D. Stormwater management facilities shall not be constructed within the 100-year floodplain unless specifically approved by the Michigan Department of Environmental Quality, Oakland County and the City.
- E. The designer may consider the following stormwater management technologies for meeting these performance standards:
 - 1. Detention Basins
 - 2. Retention Basins
 - 3. Infiltration Trenches or Ponds
 - 4. Underground Detention Systems are typically discouraged unless the criteria outlined in Section 5.7 have been met.
 - 5. Use of Existing Wetlands for stormwater management is typically discouraged unless the criteria outlined in Section 5.2.5 have been met.

Additional design requirements for the above mentioned technologies are detailed in Part Two of this Chapter Five.

5.2.1 Allowable Discharge Rate

In no event shall the maximum design rate or volume of discharge exceed the maximum capacity of the downstream land, channel, pipe or watercourse to accommodate the flow and conform with all public and private rights. It is the applicant's obligation to meet this standard. Should a stormwater system, as built, fail to comply, it is the applicant's responsibility to design and construct, or to have constructed at his/her expense, any necessary additional and/or alternative stormwater management facilities. Such additional facilities shall be subject to the city's review and approval.

The stormwater discharge from the site shall be directed to a defined watercourse, channel or storm sewer. The stormwater discharge from the site shall not exceed **0.15 cfs per acre**, provided sufficient capacity exists within the downstream watercourse, channel or storm sewer. The applicant is required to identify the ultimate stormwater

outlet for the site (surface water body, established country drain, etc.) and provide documentation that sufficient conveyance capacity exists within the downstream watercourse between the site and the ultimate outlet for the discharge from the site.

If sufficient capacity does not exist within the downstream watercourse, channel or storm sewer to effectively handle a concentrated flow of water from the proposed development, allowable discharge rates shall be further reduced. If an open channel is used to convey storm water discharge to an off-site storm water basin for quantity control, bank full detention must be provided on the site prior to discharge into the open channel.

Discharge should outlet within the drainage basin where flows originate, and generally shall not be diverted to another basin.

5.2.2 Determination of Required Detention Storage Volume

Stormwater detention facilities must provide enough storage volume so as not to exceed the maximum allowable runoff rate for the site during a 100-year, 24-hour design storm event. Detention volume must be provided for all on-site and off-site acreage contributing to the detention basin. Alternatively, off-site drainage may be routed around the detention basin. The method for determining required detention volume is provided in Section 5.5.2. Additional requirements for detention facilities are identified in Section 5.6 or Section 5.7.

5.2.3 Determination of Required Retention Storage Volume

Retention of stormwater within a “no outlet” retention basin is discouraged and will only be considered when the designer can demonstrate that no possible stormwater outlet exists for the site. A retention basin is permissible only under specific site conditions that are outlined in Section 5.8.1.

Stormwater retention facilities must provide sufficient storage capacity for two consecutive 100-year storm events from the entire contributing tributary area including any off-site drainage. The method for determining required retention volume is provided in Section 5.5.3. Additional requirements for retention facilities are identified in Section 5.8.

5.2.4 Determination of Required Infiltration Storage Volume

Where infiltration facilities are installed to meet the performance standards for quantity control, the minimum design volume shall be calculated in a manner similar to the method used for determining required detention volume outlined above. The infiltration facility shall be sized to accommodate the runoff from a 100-year, 24-hour design storm. The “outlet” rate shall be determined based on the infiltration rate of the in-situ soils. Additional requirements for infiltration facilities are identified in Section 5.9.

5.2.5 Use of Existing Wetlands

The City discourages the use of existing wetlands for the purposes of providing stormwater quantity control. The City will only consider approval of use of an existing wetland for stormwater quantity control if all of the following requirements are satisfied:

- A. The wetland must already be highly altered by watershed development and meet certain benchmarks for isolation, high water level fluctuation, low wetland plant richness, dominance of invasive or aggressive plants and altered hydrology.
- B. It must be shown that the wetland site does not contain any unique wetland features.
- C. The wetland must be characterized as an emergent, submergent aquatic or open water wetland. In some cases, scrub-shrub or forested wetlands may be considered if it is clearly demonstrated that the additional storage would not jeopardize the health of the wetland community.
- D. An analysis of the pre-developed and post developed water balance for the wetland shows no negative impacts to the existing wetland or adjacent properties. The designer is required to provide the water balance documentation for review. The water balance shall include runoff from irrigation.
- E. A stormwater management easement shall be provided for the entire wetland. Where portions of the wetland are located on adjacent properties, the developer shall secure all of the required easements. See Section 5.14 of this chapter for additional easement requirements.
- F. Sufficient pretreatment of the stormwater is provided prior to its discharge to the wetland. Pretreatment shall be designed in accordance with the requirements of Section 5.2.
- G. A wetland enhancement plan shall be provided for all wetlands that are dominated by invasive species. The enhancement plan shall include some or all of the following: removal of all or some of the invasive species and restoration with native species as permitted by the City; planting of additional trees and shrubs; and creation of open water areas.
- H. For wetlands regulated by the Michigan Department of Environmental Quality, a permit from the MDEQ has been obtained all proposed stormwater discharges and use of the existing wetland for stormwater quantity control.
- I. For wetlands regulated by the City, a permit from the City has been obtained for all proposed stormwater discharges and use of the existing wetland for stormwater quantity control.

SECTION 5.3 STORMWATER QUALITY CONTROL

The design of a stormwater management system must incorporate elements for providing stormwater quality improvements. To protect water resources from stormwater pollutants, the City has adopted the following minimum performance standards for controlling the quality of stormwater runoff from development projects.

- A. Volume based stormwater quantity control facilities (sediment forebay, bioretention, etc.) must provide treatment for the first flush volume. The first flush volume is defined as the first ½ -inch of stormwater runoff and can be determined using the following relationship:

$$V_{ff} = 1815 \times \text{drainage area (acres)} \times \text{the relative imperviousness factor } C$$

- B. Flow based stormwater quality control facilities (manufactured treatment systems) must provide treatment for the peak flow associated with a 1-year storm event. The procedure for determining the peak flow rate associated with a 1-year storm event is provided in Section 5.5.1.
- C. The designer may consider the following stormwater management technologies for meeting these performance standards:
1. Sediment Forebays
 2. Bioretention/Rain Gardens
 3. Wet Detention Basins (as approved by the City for small sites)
 4. Manufactured Treatment Systems are typically discouraged unless the criteria outlined in Section 5.11 have been met.

Additional design requirements for the above mentioned technologies are detailed in Part Two of this Chapter Five.

SECTION 5.4 STORMWATER CONVEYANCE

The design of the site shall include sufficient provisions for stormwater conveyance. Stormwater management facilities may use open channels or closed conduits or both for means of conveying stormwater runoff provided. To ensure adequate stormwater conveyance, the City has adopted the following minimum performance standards.

- A. Stormwater conveyance facilities shall have capacity to convey stormwater runoff from the 10-year storm event. Increased capacity requirements may be required by other governing agencies. Acceptable methods for determining the runoff associated with a 10-year storm event are included in Section 5.5.1.

- B. Open channels are generally preferred to closed conduits as a method for stormwater conveyance. Specifically, natural water courses, vegetated swales and channels and bioswales are preferred.

Additional design requirements for stormwater conveyance technologies are detailed in Section 5.13.

PART TWO - DESIGN CRITERIA FOR STORMWATER MANAGEMENT SYSTEMS

This Part Two sets forth specific design and construction standards that will be used by the City in review of proposed stormwater management systems in accordance with the objectives of meeting the performance standards.

The standards and design criteria set forth herein are intended to guide designers to develop a stormwater management system that controls the quantity and quality of stormwater discharge from a site. The internal drainage for a site as well as the downstream conditions will be reviewed. Every site is part of an overall watershed and the system shall be designed with this in mind. The system shall conform to natural drainage patterns both on and off-site. These standards are the minimum requirements of the City and shall not be construed as all-inclusive. The design engineer shall consider many factors when planning the stormwater management system. In particular, Federal, State and Local standards may be stricter than these standards. In the case where conflicting standards arise, the more stringent requirements will govern. Exceptions will be considered when conformance with a local community master plan, stormwater management plan or watershed plan is required.

SECTION 5.5 DETERMINATION OF SURFACE RUNOFF

The Rational Method of calculating stormwater runoff is generally acceptable for calculating peak flow rates at any particular location within a stormwater management system for sites less than 150 acres in size. More precise methodologies for predicting runoff such as runoff hydrographs are widely available, and may be required by the City for sizing drainage systems on large sites and/or smaller sites that are deemed potentially problematic. Acceptable alternative methods will include:

- A. Corps of Engineers HEC-1
- B. Soil Conservation Service UD-21, TR-20 and TR-55
- C. U.S. EPA's SWMM
- D. Continuous simulation (e.g. HSPF)

Unless a contiguous simulation approach to drainage system hydrology is used, all design rainfall events will be based on the SCS Type II distribution.

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

5.5.1 The Rational Method

For all stormwater management systems that are designed using the Rational Method, the following formula must be used for calculating peak flow rate:

$$Q = c \times i \times A$$

Where: Q = peak runoff (cfs)
 C = composite runoff coefficient
 I = design rainfall intensity (inches/hour),
 A = drainage area in acres

A. Runoff Coefficient

A realistic runoff coefficient will be used based upon the imperviousness of the tributary area. The range of this coefficient shall vary from 0.15 for completely grassed areas to 0.95 for impervious areas and 1.0 for open water.

Certain calculations require use of a composite runoff coefficient value. The composite runoff coefficient is calculated as follows:

$$c = \frac{\sum_{i=1}^n c_i A_i}{\sum_{i=1}^n A_i}$$

Where: c = composite runoff coefficient
 c_i = runoff coefficient for each sub-area
 n = total number of sub-areas
 A_i = drainage area in acres for each sub-area

Minimum runoff coefficients for various surface types are provided in the table below:

<u>Type of Surface</u>	<u>Runoff Coefficient (c)</u>
Water surfaces	1.0
Roofs	0.95
Asphalt or concrete pavements	0.95
Gravel or brick	0.85
Pervious Pavement	0.55
Turf grass lawn (minimum)	0.35

Semi-pervious^{1,2}:

	Slope <4%	Slope 4-8%	Slope >4%
Hydrologic Soil Group A		0.15	0.20
Hydrologic Soil Group B		0.25	0.30
Hydrologic Soil Group C		0.30	0.35
Hydrologic Soil Group D		0.45	0.50

Notes:

1. Semi-pervious surfaces include meadow, forest, landscaped areas, etc.
2. Turf grass lawns shall have a minimum runoff coefficient of 0.35.

Soil compaction reduces soil volume and increases runoff rates and volumes. Construction activity causes significant compaction of soils. Grading for new sites shall include a final de-compaction tillage to reduce soil bulk density and improve infiltration. Alternatively, when de-compaction is not done, the Hydrologic Soil Group for post-construction conditions shall be increased by one letter. That is, what used to be Group A becomes Group B due to compaction. Group C becomes D.

The runoff coefficient calculation must be included with plan submittal.

B. Design Rainfall Intensity

Formulas for determining rainfall intensities for various storm events are as follows:

Design Storm	Intensity (in/hr)
1-year	$72/(t_c+25)$
10-year	$175/(t_c+25)$
100-year	$275/(t_c+25)$

Where: t_c = Time of Concentration (min)

C. Time of Concentration

An initial time of concentration of 20 minutes will be used on residential subdivisions. The time of concentration must be calculated for commercial and industrial subdivisions.

The design engineer may also use a calculated time of concentration if desired. The methodology and computations must be submitted for review. The time of concentration for unimproved, pre-development lands will be checked using the following formulas:

$$\text{Small tributary - } T_c (\text{min}) = \frac{L'}{2.1\sqrt{S_o} \times 60}$$

$$\text{Waterway} - T_c (\text{min}) = \frac{L'}{1.2\sqrt{S_o} \times 60}$$

$$\text{Sheet Flow} - T_c (\text{min}) = \frac{L'}{0.48\sqrt{S_o} \times 60}$$

Where: L' = flow length, in feet
 S_o = slope, in %

When more than one type of flow exists, the individual flows shall be summed up to find the total time of concentration.

D. Determination of Runoff from Green Roofs, Porous Pavers, Cisterns and other LID Techniques

The design of green roofs, porous pavers, cisterns and other LID techniques varies greatly from site to site. The City recognizes that these technologies will provide a reduction in the peak flow rate and volume of runoff. The design engineer should work with the City to identify how use of these technologies fit into the overall stormwater management plan for a site. In general, the following information should be considered when these LID techniques are proposed:

1. The storage capacity (volume) of the system.
 - a. For green roofs and porous pavers: a porous material is often provided for the base materials and the capacity within the void space should be identified.
 - b. For cisterns: the total volume of the vessel.
2. The anticipated time for complete drainage of the system.
 - a. For green roofs: a summary of how long it takes for the base material and underdrain system to drain following a rain event.
 - b. For porous pavements: if infiltration is the only mechanism for drainage from the base material, the time for complete drainage will be based on the infiltration rate of the in-situ soil. Sufficient documentation (similar to the requirements for infiltration facilities outlined in Section 2.5) shall be provided to support the assumed infiltration rate. If an underdrain is proposed, the time to drain will be a function of the base material and pipe capacity.
 - c. For cisterns: if water is to be used as grey water for a building or for irrigation purposes, an annual water balance calculation shall be provided.
3. An analysis of the overflow, including prediction of when overflow will occur (i.e. storm events larger than 1-year, etc.) and identification of where water will be directed.

5.5.2 Determination of Required Detention Storage Volume

The following equations can be used to determine the required storage volume for a 100-year, 24-hour storm event:

$$Q_o = \frac{Q_a}{A \times c}$$

Where: Q_o = allowable outflow per acre imperviousness (cfs/ac. imp.)
 Q_a = allowable outflow (cfs) as defined in Section 1.2.1
 A = Tributary area (ac)
 c = runoff coefficient

$$T = -25 + \sqrt{\frac{10312.5}{Q_o}}$$

Where: T = time of maximum storage (min)
 Q_o = allowable outflow per acre imperviousness (cfs/ac. imp.)

$$V_s = \frac{16500T}{T + 25} - 40Q_oT$$

Where: V_s = Storage volume per acre imperviousness (cf/ac. imp.)
 T = time of maximum storage (min)
 Q_o = allowable outflow per acre imperviousness (cfs/ac. imp.)

$$V_t = V_s \times A \times c$$

Where: V_t = required detention storage volume (cf)
 V_s = Storage volume per acre imperviousness (cf/ac. imp.)
 A = Tributary area (ac)
 c = runoff coefficient

5.5.3 Determination of Required Retention Storage Volume

Retention of stormwater within a "no outlet" retention basin is discouraged and will only be considered when the designer can demonstrate that no possible stormwater outlet exists for the site. A retention basin is permissible only under specific site conditions that are outlined in Section 5.8.1.

Stormwater retention facilities must provide sufficient storage capacity for two consecutive 100-year storm events from the entire contributing tributary area including any off-site drainage. The following formula can be used to determine the required retention volume.

$$V_r = 33,000 \times A \times c$$

Where: V_r = required retention storage volume (cf)
 A = Tributary area (ac)
 c = runoff coefficient

SECTION 5.6 DETENTION BASINS

Stormwater detention may be provided as part of a stormwater management system in order to satisfy the quantity control performance standards described in Section 5.2. Stormwater detention basins are generally acceptable for most sites. Detention ponds should be designed to be ecologically sustainable. Mosquito populations can proliferate in environments that are ecologically unbalanced. A detention pond environment rich with diverse vegetation, including wetland plantings and riparian buffer plantings supplemented with trees and shrubs in appropriate areas promotes a diverse wildlife population. Wildlife will include birds, butterflies, insects and various aquatic species. This combination creates a sustainable and ecologically balanced environment.

The following standards shall be adhered to when designing stormwater detention basins.

- A. Pretreatment shall be provided for the stormwater prior to discharge into the detention basin. Acceptable methods and performance standards for pretreatment of stormwater are outlined in Section 5.3.
- B. The volume of detention provided must be equal to or in excess of the volume of stormwater runoff generated from a 100-year storm event. The method for determining this volume is outlined in Section 5.5.2.
- C. Detention basins must have a positive method for draining. If a permanent pool is proposed, the basin must completely dewater to the elevation of the permanent pool. The outlet shall restrict the flow so that the flow does not exceed the maximum allowed outflow defined in Section 5.2.1.
- D. In general, wet ponds and stormwater 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.
- E. Shade plantings on the west and south sides of facilities are encouraged unless such plantings would not thrive or are not otherwise in the public interest.

- F. Public safety will be a paramount consideration in stormwater system and pond design. Providing safe detention is the applicant's responsibility. Pond designs will incorporate gradual side slopes, vegetative and barrier plantings, and safety shelves. Where further safety measures are required, the applicant is expected to include them within the proposed development plans.
- G. Subdivision stormwater holding facilities and pretreatment systems shall be located in parks or outlots and not on a subdivision lot. During the plat approval process, the council may, at their discretion, allow the use of a lot for holding facilities and pretreatment systems when the lot has been oversized for this use or when construction on the lot is prohibited until elimination of the holding facilities and pretreatment system. Holding facilities and pretreatment systems within proposed septic field areas will not be permitted.

5.6.1 Detention Basin Types

Detention basins may be designed in a number of ways. The following are examples of types of ponds:

A. Wet detention basins

A wet detention basin is small man-made surface water designed to treat stormwater runoff. Incoming stormwater runoff displaces "old water" out of the basin and is then stored until the next storm. By retaining the water for long periods of time, pollutants are effectively removed. The basin also deters re-suspension of deposited materials. Wetland vegetation shall be used around the banks to help removed dissolved contaminants and algae. In addition to the general requirements for all detention basins outlined in this Manual, wet detention basins shall meet the following requirements:

1. A minimum permanent pool depth of 3 feet shall be provided. Where a permanent pool is provided for meeting the quality performance standards, the volume of the permanent pool shall be equal to or greater than the first flush volume.
2. A safety shelf of fringe wetland (minimum 4-foot wide and 1-foot deep) should be provided along the perimeter of the pond to establish aquatic vegetation and for safety concerns. The total area of the shelf should be 25-50% of the water surface area.
3. Plant vegetation should be used to control erosion and enhance sediment entrapment.

4. Where feasible, a drain for completely dewatering the pond should be installed for maintenance purposes.

B. Constructed wetlands

Constructed wetlands are characterized as a man-made basin with over 50% of its surface area covered by wetland vegetation. Permanent wetland pool depths should vary between 0.5 and 3.0 feet depending on vegetation type. Wetlands should be constructed to mitigate stormwater quality and quantity impacts associated with development projects and should not serve to mitigate the loss of natural wetlands or encroach on natural delineated wetland areas. Wet ponds and constructed marsh/wetland systems are an effective BMP for controlling both stormwater quantity and quality. In addition to the general requirements for all detention basins outlined in this Manual, constructed wetlands should meet the following requirements:

1. Basins should be designed to maximize sheet flow across the wetland. In general, a rectangular configuration should be used with a length to width ratio of 3 to 1 placing the inlet and outlet pipes at the opposite ends. Baffles may be used to increase the flow path and maintain the topography.
2. A diversity of depth zones throughout the basin should be used to meet the unique growing requirements of divergent wetland plants.

C. Dry detention basins

Dry detention basins are designed so to drain completely following a storm event. Dry ponds are generally not preferred except where thermal impacts to the receiving waters are a concern.

5.6.2 Pond Geometry

- A. Ponds (basins) shall be designed as an integral part of the overall site plan and shall be considered a natural landscape feature having an irregular shape.
- B. The basin shape should be such that flow entering the basin is evenly distributed and no stagnant zones can develop. An irregularly shaped basin is best. The inlet and the outlet shall be at opposite ends with the maximum distance possible between them. For dry basins, use of swales or berms on the bottom of the basin to maximize travel distance during periods of low flow is encouraged.
- C. A minimum length to width ratio of 3 to 1 should be provided.

- D. When there is no permanent pool of water, the bottom of all detention basins shall be graded in such a manner as to provide positive flow to the outlet.
- E. Detention basin side slopes shall generally not be flatter than 1 foot vertical to 20 feet horizontal and shall not exceed 1 foot vertical to 4 feet horizontal.
- F. One foot of freeboard shall be provided above the 100-year storm storage elevation.
- G. An emergency (secondary) overflow shall be provided at an elevation 6-inches above the 100-year storm storage elevation. Standards for the emergency overflow are provided in Section 5.6.5.
- H. Anti-seep collars should be installed on any piping passing through the sides or bottom of the basin to prevent leakage through the embankment.

5.6.3 Determination of Storage Volume Provided

- A. Storage volume shall be considered to be the volume above the invert elevation of the outflow device. Any storage within storm sewer shall not be considered as storage volume.

5.6.4 Basin Inlets & Outlets

Velocity dissipation measures shall be incorporated into basin designs to minimize erosion at inlets and outlets, and to minimize the resuspension of pollutants.

- A. *Basin Inlets.* All inlets to the detention basin shall meet the following requirements:

1. The velocity of the storm water entering the storage facility should be a non-erosive velocity. This velocity is generally between 2.5 fps and 5 fps.
2. 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 detention system.
3. For all developments, regardless of size, a permanent four (4) foot deep sump is required to be constructed in the last stormwater structure that is readily accessible for maintenance prior to release off-site or into a sedimentation or stormwater holding facility.

- B. *Restricted Outlet.* All detention basin outlets shall meet the following requirements

1. The outlet for storm water detention facilities shall be designed to meet the following requirements:
 - a. The maximum outlet rate at the design high water level shall not exceed the maximum allowable outflow rate as defined in Section 5.2.1.
 - b. Unless otherwise treated by a bioretention facility or sediment forebay, the first flush volume shall be retained for a minimum of 24 hours. The first flush volume is generally considered to be the first ½ inch of runoff from the site and can be determined by the following equation:

$$V_{ff} = 1815 \times \text{acreage} \times \text{the relative imperviousness factor } C$$

- c. The bankfull flood volume shall be retained in the detention facility for a minimum of 24 hours and no more than 40 hours. The bankfull flood is generally defined as the total rain from a 1.5-year, 24-hour design storm, which can be determined by the following equation:

$$V_{bf} = 5160 \times \text{acreage} \times \text{the relative imperviousness factor } C$$

2. V-notch weirs, dual outlets, riser pipe or other designs shall be utilized to assure an appropriate detention time and maximum outlet rate for the 100-year flood and bankfull flood volumes as required above. Where orifice holes or restrictor pipes are provided to restrict the flow and the required size is less than 4-inches, maintenance provisions for preventing clogging of the restrictor hole should be provided.
3. The outlet will be well protected from clogging.
4. All outlets will be designed to be easily accessible for heavy equipment required for maintenance purposes.
5. Riser pipe designs shall meet the following requirements:
 - a. Flow restrictive devices shall be located inside a standpipe. One (1) inch holes, spaced a minimum of 4-inches apart shall be provided around the perimeter of the riser between the elevation of the permanent water and the 100-year storm event. The riser will not function to restrict flow but will prevent clogging of the internal restrictive device.
 - b. Hoods or trash racks shall be installed on the riser to prevent clogging.
 - c. The riser shall be placed near or within the embankment, to provide for ready maintenance access. Where the outlet structure is not located near enough to the bank to facilitate visual inspection of the structure, a stone bridge with a minimum top width of five (5) feet shall be provided.
 - d. The riser pipe shall be a minimum of three (3) feet in diameter and constructed of materials that will reduce future maintenance requirements.

- e. Where feasible, a drain for completely de-watering the pond shall be installed for maintenance purposes.
6. Backwater on the outlet structure from the downstream drainage system will be evaluated when designing the outlet.
7. Pumped outlets are not permitted absent a variance from City Council, which shall require demonstration that it is in the public interest and no feasible alternative exists. IF City Council grants a variance to allow a pumped outlet, the following documentation shall be standards shall apply:
 - a. The pump(s) shall be designed to meet the maximum discharge rate and time requirements for the 100-year and bankfull flood events. Minimum and maximum system head curves and pump curves shall be provided to verify the operating duty points of the pump(s).
 - b. Pumps shall be of appropriate construction for conveying storm water.
 - c. A redundant pump shall be provided.
 - d. A generator shall be provided for the pump station. A permanent on-site generator shall be provided or a generator receptacle in combination with a portable generator shall be provided.
 - e. A mechanism for determining failure of the pumps (alarm lights, water depth indicator, etc.) shall be provided. The mechanism shall be of a nature that ensures the ultimate property owner (filed with the Register of Deeds) will easily be able to identify a pump failure.
 - f. An operation and maintenance plan shall be provided and a maintenance agreement shall be in place with the ultimate property owner (filed with the Register of Deeds).

C. Overflow

1. An emergency spillway with a defined downstream drainage path or a secondary standpipe must be provided at an elevation 6-inches about the 100-year elevation to allow discharge from the basin when the flows exceed the capacity of the outlet structure. Provisions for preventing erosion of the spillway shall be provided. The emergency spillway or secondary stand pipe shall have sufficient capacity to convey the peak flow associated with a 100-year design storm. Methods for determining the 100-year storm peak flows are outlined in Section 5.5.1.

5.6.5 Additional Requirements

- A. Fencing around detention basins shall not be permitted to allow for steeper side slopes unless specifically approved by the City Engineer.

- B. A permanent buffer strip of natural vegetation with a minimum width of 25 feet shall be provided and maintained for the following and preferably around the entire perimeter of the basin. The buffer strip should be planted with native vegetation. Chemical lawn care applications and mowing are prohibited in the buffer. Buffers shall be provided as follows:
- a. In residential developments, buffers should be provided around the perimeter of the basin.
 - b. In commercial and industrial developments, buffers shall be provided in areas where impervious surface is directed to the basin via surface flow.
 - c. Where elevations allow, a buffer shall be provided at the outlets to the detention basin.
- C. All detention basins must be permanently stabilized to prevent erosion. Basins must be stabilized prior to directing stormwater flow to them.
- D. Construction of pretreatment systems is required prior to commencement of any construction activities on site except clearing and grubbing operations. Sump manhole construction must be completed as soon as is practicable during construction of the storm sewer system. Removal of collected sediment from the pretreatment systems is required at regular intervals during the construction process or at the direction of the City such that the basins are maintained in working order at all times.
- E. Landscaping shall be provided as required by the City's Landscape Design manual and as directed by the City's Landscape Architect.
- F. Detention basins constructed by building up on existing grade must have berms with a clay core keyed into native ground.
- G. Easement requirements for detention basins are outlined in Part Three of this Chapter Five.
- H. Adequate maintenance access from a public or private right-of-way to the basin shall be provided via an access easement granted to the City.. The access shall be a minimum of 15-feet wide, have a maximum running slope of 1-foot vertical to 5 feet horizontal, have a maximum cross-slope of three percent, and be stabilized to withstand the passage of heavy equipment. Additional maintenance requirements for detention basins are outlined in Part Three of this Chapter Five.

SECTION 5.7 UNDERGROUND DETENTION

Underground detention systems are the least preferred method of detention and may only be allowed for sites that meet at least one of the following criteria, as determined by City Engineer:

- The site is an existing developed site that is proposed to be redeveloped.
- The site has topographical constraints that would limit the effectiveness of a traditional basin.
- The site has size constraints (typically two acres or smaller).

The following will be required for underground detention facilities:

- A. Pretreatment shall be provided for the storm water prior to discharge into the underground detention facility. Acceptable methods and performance standards for pretreatment of storm water are outlined in Section 5.3.
- B. The volume of detention provided must be equal to or in excess of the volume of storm water runoff generated from a 100-year storm event. The method for determining this volume is outlined in Section 5.2.2.
- C. 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 detention system.
- D. For all developments, regardless of size, a permanent four (4) foot deep sump is required to be constructed in the last stormwater structure that is readily accessible for maintenance prior to release off-site or into a sedimentation or stormwater holding facility.
- E. Underground detention systems shall be designed, installed and maintained per the manufacturer's recommendations.
- F. Underground detention systems must have a positive method for draining. The outlet shall restrict the flow so that it does not exceed the maximum allowed outflow defined in Section 5.2.1.
- G. The bottom of the underground detention facility must be a minimum of three (3) feet above the groundwater elevation.
- H. Perforated pipe and open bottom systems shall be subject to the following requirements:
 1. Perforated or open bottom systems will 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.
 2. Soil borings must be obtained within the location of the proposed detention system and extend to a depth of 25 below the existing ground or 20 feet below the proposed underground detention facility bottom elevation, whichever is greater. Additional boring depth may be appropriate for large detention systems. A minimum of one soil boring shall be obtained for every 1,000 square feet of detention area, with a minimum of two borings for any detention system.

The soil borings shall be provided for review. The soil borings shall indicate the ground water elevation. The ground water elevation shall be at least 3 feet below the bottom of the storage volume.

3. If storage volume is intended to be provided in the stone material adjacent to the pipe, the designer should assume that a maximum of 85% of the available void space is available for storage volume for any given stone mix to account for potential clogging of void space. The designer shall submit documentation supporting the volume of voids available in the proposed stone mix. Additionally, appropriate measures shall be provided to prevent migration of sediment into the adjacent stone material.
 4. Sufficient design provisions shall be made to facilitate cleaning of the system without disruption to the surrounding stone.
 5. If storage volume is intended to be provided within the stone base below the pipe or chamber, a mechanism for continuous drainage of the base material shall be provided.
- I. Permanent inspection and maintenance practices shall be considered when designing an underground detention facility. The final design shall minimize the effort required for regular inspection and maintenance of the facility by the future property owner (filed with the Register of Deeds). The City Engineer may require inspection ports or manholes depending on the design and configuration of the system. The designer will need to provide documentation indicating the procedures and required frequency for inspection and maintenance of the facility. Ease of inspection and maintenance will be considered in review of the underground detention system. A maintenance plan must be provided and a maintenance agreement must be in place with the ultimate property owner (filed with the Register of Deeds). Additional requirements for maintenance are identified in Part Three of this Chapter Five.

5.7.1 Restricted Outlet

- A. The outlet for underground detention facilities shall be designed to meet the following requirements:
1. The maximum outlet rate at the design high water level shall not exceed the maximum allowable outflow rate as required in Section 5.2.1.
 2. The bankfull flood volume shall be retained in the facility for a minimum of 24 hours and no more than 40 hours. The bankfull flood is generally defined as the total rain from a 1.5-year storm, which can be determined by the following equation:

$$V_{bf} = 5160 \times \text{acreage} \times \text{the relative imperviousness factor } C$$

- B. V-notch weirs, orifice plates or other designs shall be utilized to assure an appropriate detention time for the 100-year flood and bankfull flood volumes as required above.
- C. The outlet will be well protected from clogging.
- D. All outlets will be designed to be easily accessible for heavy equipment required for maintenance purposes.
- E. The restricted outlet shall be located in a catch basin, manhole or other structure that will allow for regular inspection and maintenance.
- F. The standard orifice equation shall be used in determining the outflow from orifice holes used in the detention basin outlet. The minimum restrictor size is one square inch. If a one square inch restrictor permits discharge in excess of the allowable outflow then a different restricted outlet design may be required, such as a weir.
- G. Pumped outlets are not permitted for underground detention facilities.
- H. An emergency overflow with a defined drainage path shall be provided.

SECTION 5.8 RETENTION BASINS

5.8.1 Minimum Site Requirements

Stormwater retention may be approved on sites where the all of following can be documented. Soil borings must be obtained within the location of the proposed basin and extend to a depth of 25 below the existing ground or 20 feet below the proposed retention basin bottom elevation, whichever is greater. Additional boring depth may be appropriate for large basins. A minimum of one soil boring shall be obtained for every 50 square feet of basin area, with a minimum of two borings for any basin. The soil borings shall be provided for review.

- A. No stormwater outlet exists for the site.
- B. Soil types in the area of the proposed retention basin are hydrological soil group classifications of A or B.
- C. The permeability of the existing soils must be such that percolation of the retained stormwater is possible. Calculations performed by a professional geotechnical and/or hydrogeological engineer shall be submitted to support this. The calculations shall be based on the percolation rates for the soils encountered in the soil borings.

- D. The ground water elevation is a minimum of 3 feet below the bottom of the retention basin.

5.8.2 Additional Requirements

- A. Pretreatment shall be provided for the storm water prior to discharge into the detention basin. Acceptable methods and performance standards for pretreatment of storm water are outlined in Section 5.3.
- B. The retention basin shall have sufficient capacity to store the runoff from two consecutive 100-year storm events. The method for determining this volume is provided in Section 5.2.3. The City will consider approval of modified storage volumes based on the recommendation from a licensed hydrogeological engineer.
- C. Underground retention shall not be permitted.
- D. The side slopes of the proposed retention basin shall be no steeper than 1-foot vertical to 4-foot horizontal.
- E. One foot of freeboard shall be provided above the proposed high water level.
- F. A permanent buffer strip of natural vegetation with a minimum width of 25 feet shall be provided and maintained for the following and preferably around the entire perimeter of the basin. The buffer strip should be planted with native vegetation. Chemical lawn care applications and mowing are prohibited in the buffer.
 - 1. In residential developments, buffers should be provided around the perimeter of the basin.
 - 2. In commercial and industrial developments, buffers shall be provided in areas where impervious surface is directed to the basin via surface flow.
 - 3. Where elevations allow, a buffer shall be provided at the outlets to the detention basin.
- G. 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 basin.
- H. For all developments, regardless of size, a permanent four (4) foot deep sump is required to be constructed in the last stormwater structure that is readily accessible for maintenance prior to release off-site or into a sedimentation or stormwater holding facility.
- I. An overflow structure shall be provided and an overflow assessment shall be provided to the City for review. Elevations of the surrounding buildings, structures and other facilities that would be impacted by a basin overflow must be indicated.

If an overflow structure cannot be constructed, a defined overflow routed must be indicated. The overflow route shall not endanger and existing structures. Downstream drainage easements shall be required for the overflow route.

- J. Subdivision stormwater holding facilities and pretreatment systems shall be located in parks or outlots and not on a subdivision lot. During the plat approval process, the council may, at their discretion, allow the use of a lot for holding facilities and pretreatment systems when the lot has been oversized for this use or when construction on the lot is prohibited until elimination of the holding facilities and pretreatment system. Holding facilities and pretreatment systems within proposed septic field areas will not be permitted.
- K. All retention basins must be permanently stabilized to prevent erosion. Basins must be stabilized prior to directing stormwater flow to them.
- L. Landscaping shall be provided as required by the City's Landscape Design Manual and as directed by the City's Landscape Architect.
- M. Adequate maintenance access from a public or private right-of-way to the basin shall be reserved. The access shall have a maximum slope of 1-foot vertical to 5 feet horizontal and stabilized to withstand the passage of heavy equipment. Additional maintenance requirements for retention basins are provided in Part Three of this Chapter Five.

SECTION 5.9 INFILTRATION FACILITIES

Stormwater infiltration systems are generally described as natural or constructed depressions located in permeable soils that capture, store and infiltrate stormwater runoff with a certain period of time. Stormwater infiltration may be provided through the use of infiltration trenches, infiltration basins or other mechanisms. While infiltration practices may not be practical as a sole method for meeting the performance standard of this manual, they can be incorporated as one component of an overall stormwater management system.

5.9.1 Minimum Site Requirements

Stormwater infiltration may be approved on sites where the following can be documented. Soil borings must be obtained within the location of the proposed infiltration facility and extend to a depth of 20 feet below the proposed bottom elevation. Additional boring depth may be appropriate for large basins. A minimum of one soil boring shall be obtained for every 50 square feet of basin area, with a minimum of two borings for any basin. The soil borings shall be provided for review.

- A. Infiltration facilities will be permitted only on sites with undrained hydrologic soil group classifications of A or B. Where infiltration facilities are proposed, a sufficient number of soil borings will be provided in each location to evaluate the soil suitability.
- B. The infiltration rate of the existing soils must be such that percolation of the retained stormwater is possible within a reasonable time. Calculations performed by a professional geotechnical engineer shall be submitted to support this. The calculations shall be based on the percolation rates for the soils encountered in the soil borings. Pre and post construction percolation tests shall be performed to confirm the actual infiltration rate of the soil.
- C. The seasonal high ground water elevation or bedrock must be a minimum of 4 feet below the bottom of the infiltration facility.
- D. Infiltration facilities are not suitable for land uses or activities with potential for high sediment or pollutant loads.
- E. It is recommended that drainage areas for infiltration trenches not exceed 5 acres and drainage areas for infiltration basins be between 5 and 50 acres.
- F. Slopes in the tributary area shall not exceed 5% unless proper energy dissipation devices are installed.

5.9.2 Design Requirements

- A. Pretreatment shall be provided for the storm water prior to discharge into the infiltration facility. Acceptable methods and performance standards for pretreatment of storm water are outlined in Section 5.3. Special care shall be taken to ensure that coarse sediments and oil that would clog infiltration facilities are sufficiently removed from the storm water upstream of the infiltration facility.
 1. The use of pretreatment systems that provide some degree of storage is encouraged.
 2. For infiltration facilities designed to meet the water quality performance standard, a vegetated filter strip with a minimum width of 25 feet is required.
 3. For discharges from an enclosed storm sewer, an oil/grit separator or other pretreatment mechanism that will remove oil and grease in addition to coarse soils shall be provided in the structure upstream of the infiltration facility.
 4. For all developments, regardless of size, a permanent four (4) foot deep sump is required to be constructed in the last stormwater structure that is readily accessible for maintenance prior to release off-site or into a sedimentation or stormwater holding facility.

- B. Where infiltration facilities are installed to meet the performance standards for quantity control, the facility shall be sized to accommodate the runoff from a 100-year, 24-hour design storm event as outlined in Section 5.2.4 and pretreatment shall be provided to meet the stormwater quality performance standards. Sufficient documentation shall be provided to support the infiltration rate of the in-situ soils.
- C. Infiltration facilities shall be designed to hold water for a minimum of 6 hours and a maximum of 72 hours.
- D. It is recommended that flows entering the infiltration facility (and exiting the pretreatment facility) have non-erosive velocities (less than 3 fps) and are evenly distributed across then width of the infiltration facility
- E. The bottom of the infiltration facility should be generally flat in order to enable even distribution and infiltration of storm water. Additionally, the bottom of the facility will be placed two (2) feet below the frost line to ensure operation during the winter.
- F. Where an overflow pipe is provided, the pipe will be placed near the surface of the trench and outlet to an acceptable point of discharge.

5.9.3 Additional Requirements

- A. It is recommended that infiltration facilities not be hydraulically connected to structure foundations or pavement to avoid seepage and frost heave concerns. A minimum separation of 100 feet shall be provided between infiltration facilities and building foundations.
- B. Infiltration facilities shall not be located with 100 feet of a water supply well.
- C. Uniform, washed stone. 1.5 inches to 3 inches in diameter will be used within the facility.
- D. Filter fabric shall be used to line the sides of the trench and either filter fabric or six 6 inches of sand shall be used on the bottom of the infiltration facility. Filter fabric placed six (6) to twelve (12) inches below the surface of the infiltration facility can prevent the need for major rehabilitation.
- E. An observation well, consisting of a perforated vertical pipe within the trench will be installed in every infiltration facility to monitor performance.
- F. Trenches and underground components shall be readily accessible for maintenance purposes.

- G. Infiltration facilities should not be built down slope of new construction until the entire development area has been permanently stabilized.
- H. Great care shall be taken during construction to avoid compaction of the existing in-situ soils. The bottom of the infiltration facility shall be scarified or roto-tilled to a depth of 6 inches or more to reduce the possibility of initial soil compaction caused by excavation with heavy equipment. All methods for avoiding soil compaction shall be provided on the site plan.
- I. A legally enforceable and binding maintenance agreement will be provided. All systems will require annual inspection and maintenance.
- J. Subdivision stormwater holding facilities and pretreatment systems shall be located in parks or outlots and not on a subdivision lot. During the plat approval process, the council may, at their discretion, allow the use of a lot for holding facilities and pretreatment systems when the lot has been oversized for this use or when construction on the lot is prohibited until elimination of the holding facilities and pretreatment system. Holding facilities and pretreatment systems within proposed septic field areas will not be permitted.

SECTION 5.10 SEDIMENT FOREBAYS

A sediment forebay is generally very compatible with an above ground detention or retention basin. However, it could also be used in combination with an underground detention system or infiltration system. Sediment forebays shall meet the following requirements:

- A. The sediment forebay shall be sized to accommodate the first flush volume. The first flush volume is generally considered to be the first ½ inch of runoff from the site and can be determined by the following equation:

$$V_{ff} = 1815 \times \text{acreage} \times \text{the relative imperviousness factor } C$$

The volume of storage provided in the forebay shall not be included as a part of the total provided storage volume required for storm water quantity control, above any permanent pool of water.

- B. 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.
- C. For all developments, regardless of size, a permanent four (4) foot deep sump is required to be constructed in the last stormwater structure that is readily accessible

for maintenance prior to release off-site or into a sedimentation or stormwater holding facility.

- D. When used in combination with an above ground detention or retention basin, the sediment forebay shall be a separate cell, which can be formed by gabions or an earthen berm. For small sites, where the size of the forebay would not provide sufficient settling time, alternative methods of providing quality control should be considered.
- E. Forebay side slopes shall not exceed 1-foot vertical to 4 feet horizontal.
- F. The forebay should have a sump with a minimum of 2 feet deep 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. The sump should be located near the inlet(s) to the forebay.
- G. The outlet shall be designed to capture the first flush volume and dewater the basin after 24 hours or longer. An outlet structure with restricted discharge is recommended. Guidelines for designing restricted outlets are provided in Section 5.6.5.
- H. An outlet (overflow) spillway shall be constructed in a manner that allows water to exit the forebay at non-erosive velocities. Overflow from the sediment forebay shall be directed into the storm water quantity control facility.
- I. All forebays must be permanently stabilized to prevent erosion. Basins must be stabilized prior to directing stormwater flow to them.
- J. Direct maintenance access to the forebay for heavy equipment shall be provided.
- K. An adequate disposal area should be provided for accumulated sediment.
- L. The forebay should also 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 sediment should be removed when half of the sediment storage capacity has filled in. The marker shall be constructed of a material that will not rust.
- M. Subdivision stormwater holding facilities and pretreatment systems shall be located in parks or outlots and not on a subdivision lot. During the plat approval process, the council may, at their discretion, allow the use of a lot for holding facilities and pretreatment systems when the lot has been oversized for this use or when construction on the lot is prohibited until elimination of the holding facilities and

pretreatment system. Holding facilities and pretreatment systems within proposed septic field areas will not be permitted.

SECTION 5.11 MANUFACTURED TREATMENT SYSTEMS

Manufactured treatment systems include underground swirl concentrators, which are “treatment systems” used to remove sediment and other particulate matter from stormwater runoff. Manufactured treatment systems are the least preferred method for meeting the stormwater quality performance standard and will only be allowed for sites that meet at least one of the following criteria:

- The site is an existing developed site that is proposed to be redeveloped.
- The site has topographical constraints that would limit the effectiveness of a traditional sediment forebay or bioretention facility.
- The site has size constraints (typically two acres or smaller).

For sites where a forebay would be relatively small, a swirl concentrator device may an acceptable substitute because of the reduced effectiveness and inadequate detention time of small forebays.

5.11.1 General Performance and Design Specifications

- A. The system may be used to meet the storm water quality performance standards outlined in Section 5.3 as approved by the City Engineer. Only manufactured treatment systems approved by the City Engineer shall be used.
- B. Systems that have demonstrated 80% removal of the annual total suspended solids load based on third party independent testing are required.
- C. The system must treat 100% of the runoff from the 1-year, 24-hour storm event and remove a minimum of 80% of the Total Suspended Solids (TSS) load based on a 110-micron particle size. The peak runoff from a 1-year, 24-hour storm event can be calculated as provided in Section 5.5.1..
- D. Rain events larger than the 1-year, 24-hour event shall bypass the system without causing any re-suspension of trapped sediments and without causing re-entrainment of floatable contaminants.
- E. The system shall not create any backwater in the upstream pipe network during any dry weather conditions.
- F. The treatment system must prevent oil and floatable contaminants from entering downstream piping during routine maintenance and during rain events.

- G. Direct access must be provided to the sediment and floatable chambers to facilitate maintenance. There shall be no appurtenances or restrictions within these chambers.
- H. Systems that require confined space entry for inspections or maintenance are not approved for use as a treatment system.
- I. If the system is proposed in traffic areas, then it must be designed to handle H2O loadings.
- J. A maintenance plan must be provided and a maintenance agreement must be in place with the ultimate property owner (filed with the Register of Deeds). An inspection and maintenance manual must be provided for review specific to the model.
- K. All treatment systems shall be cleaned of accumulated sediment and other materials prior to inspection of the system by the City.
- L. Additional requirements for maintenance are identified in Part Three, of this Chapter Five.

SECTION 5.12 BIORETENTION/RAIN GARDENS

Bioretention basins (sometimes referred to as rain gardens) can generally be described as shallow, landscaped depressions that receive runoff and are designed to use soil and plant material to mimic the natural water cycle by storing, filtering and infiltrating stormwater into the ground. Bioretention areas may be used anywhere to meet the stormwater quality performance standards. Bioretention areas are the preferred method of meeting the stormwater quality performance standards of this Manual.

Some key components of bioretention facilities are defined below:

- *Pretreatment* – mechanism(s) for removing coarse sediments.
- *Ponding Area* – created by a “bowl-shaped” topography that allows for surface storage of runoff and promotes evaporation.
- *Plant Material* – takes up some of the nutrients and other pollutants from stormwater through natural processes. The use of native plant material is recommended for this component wherever possible.
- *Organic or Mulch Layer* – placed on top of the planting soil/filter media, this layer provides an environment for plant growth by maintaining moisture, providing micro-organisms, decomposing incoming organic matter and acts as a filter for finer particles.
- *Filter Media/Planting Soil* – is generally the thickest layer of the facility that provides the environment for water and nutrients to be made available to the vegetation.

The soil particles can absorb some additional pollutants through cation exchange and voids within the filter media/planting soil can store some of the first flush volume. A minimum infiltration rate (permeability) of 0.5 inches per hour is desired.

- *Sand Bed* – provided to keep finer particles from washing out through the underdrain system.
- *Gravel Underdrain System* – used to collect and distribute the treated runoff where in-situ soils do not allow for sufficient infiltration of the runoff.
- *Overflow System* – allows for bypass of larger storm flow volumes to the downstream stormwater quantity treatment system.

5.12.1 Site Suitability

Bioretention basins are generally suitable for all land uses, provided the tributary area is appropriate for the size of the facility. Common bioretention opportunities include landscaping islands, cul-de-sacs, parking lot setback areas, open spaces and streetscapes.

5.12.2 Design Guidelines

- A. The bioretention basin shall be sized to accommodate the first flush volume. The first flush volume is generally considered to be the first ½ inch of runoff from the site and can be determined by the following equation:

$$V_{ff} = 1815 \times \text{acreage} \times \text{the relative imperviousness factor } C$$

Storage provided within the bioretention facility (including above-grade ponding and storage within the subsurface porous medium) and/or calculated infiltration will count toward the detention/retention storage requirements.

- B. The surface area of the bioretention basin shall generally be sized based on the principle's of Darcy's Law, as follows:

$$A_f = \frac{V_{ff} d_f}{k(h_f + d_f)t_f}$$

Where: A_f = Surface area of facility (sf)
 d_f = Depth of filter media/planting soil (ft)
 k = Coefficient of permeability of filter media/planting soil¹ (ft/day)
 h_f = Average height of water above filter media/planting soil (ft)
 t_f = design filter media bed drain time (days)

Notes: ¹ Where an underdrain is *not* provided, the lesser or the k value for the in-situ soils and filter media/planting soil shall be used.

Additionally, the designer must demonstrate that the volume provided within the bioretention facility is equal to or greater than the first flush elevation. Where the designer intends to consider storage volume provided within the planting media and stone base, documentation needs to be provided to support the assumed void space. Further, the designer shall assume that 15% of the void space is unavailable for storage. This will account for accumulation of sediment within the medias. The City may require a field test for verification of the assumed void space.

- C. A separation distance of 3 feet shall be provided between the bottom of the bioretention facility and the ground water elevation.
- D. The tributary area to a bioretention facility should be smaller than 5 acres and preferably less than one acre. For larger sites, multiple bioretention areas can be used.
- E. The maximum recommended ponding depth is 6 inches. A maximum ponding depth of 3 to 4 inches is preferred for areas that receive high hydraulic loading or have soils with low infiltration rates. The ponding depth may exceed 6 inches in cases where sandy soils and underdrain systems are being used to increase infiltration.
- F. An overflow structure shall be provided. Generally, a catch basin with a raised rim installed in the bioretention facility is appropriate. The rim of the overflow structure shall be located to allow for the design ponding depth and prevent water from overflowing the bioretention facility. The overflow structure and storm sewer outlet pipe shall be sized to convey the 10-year storm event and shall convey water into the storm water quantity treatment facility.
- G. An emergency overflow spillway shall be provided a minimum of 6 inches above the rim elevation of the overflow structure. The spillway shall be constructed in a manner that allows water to exit the bioretention facility at non-erosive velocities. Overflow from the bioretention facility shall be directed into the storm water quantity control facility
- H. Bioretention areas should be designed as off-line treatment systems wherever possible. This is to prevent erosive flow of water within the facility.
- I. Adequate pretreatment shall be provided to capture and remove coarse sediment particles from storm water prior to entering the bioretention facility. Pretreatment may be accomplished with the following methods:
 - 1. Grass filter strip

2. Gravel diaphragm
 3. Mulch layer
 4. Forebay
- J. 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.
- K. For all developments, regardless of size, a permanent four (4) foot deep sump is required to be constructed in the last stormwater structure that is readily accessible for maintenance prior to release off-site or into a sedimentation or stormwater holding facility.
- L. Bioretention facilities must be permanently stabilized to prevent erosion. Facilities must be stabilized prior to directing stormwater flow to them.
- M. Bioretention areas shall not be hydraulically connected to structure foundations or pavement to avoid seepage and frost heave concerns. It is recommended that a minimum separation of 10 feet be provided between bioretention facilities and buildings or other structures.
- N. Sloped areas exceeding 20% shall not be used for bioretention. It is recommended that the slope of the surface of the bioretention facility not exceed 1% to promote even flow distribution.
- O. Bioretention facilities should be located away from traveled areas such as public pathways to avoid compaction.
- P. In parking lot applications, bumper blocks or gapped curbing should be used to prevent entry of vehicles into the bioretention area.
- Q. Underdrains should be installed for all facilities placed in residential areas and in areas where the slow infiltration rate of in-situ soils may cause excess surface ponding or other drainage problems. When in-situ soils are being used without an underdrain system, a soil investigation will be required to document the in-situ soil suitability. Additionally, a raised "underdrain" (located near the top of the stone subbase layer) is recommended for all systems to provide a mechanism for a subsurface "overflow".
1. Underdrains shall have a hydraulic capacity greater than the planting soil infiltration rate.
 2. The underdrain shall be perforated. The locations of the perforations (invert of pipe or elsewhere) depends on the design of the facility. Typically, the perforations are placed closest to the invert of the pipe to achieve maximum potential for draining the facility. The perforations can be placed near the top of the pipe if an anaerobic zone is intended. Water below the perforated portion

of the underdrain will have a tendency to accumulate during periods of saturation. Otherwise, water will have a tendency to infiltrate into the surrounding in-situ soils.

3. Underdrains shall connect to a storm sewer or watercourse to achieve positive flow.
 4. A gravel bed is recommended to protect underdrain pipes and reduce clogging. Placement of 6 inches of gravel bedding is recommended beneath the discharge points.
 5. A mechanism for cleaning the underdrain system shall be provided.
- R. Geotextile filter fabric shall be provided to separate the planting material from the underdrain/base material or in-situ soils.
- S. The planting soil should have sufficient depth to provide adequate moisture capacity and create space for root systems. Soil for bioretention facilities should have a sandy loam, loamy sand, or loam texture per USDA textural triangle. Maximum clay content is <5%; soil mixture shall be 50-60% sand; 20-30% leaf compost; and 20-30% topsoil. Leaf compost is essentially composed of aged leaf mulch and provides added organic matter to improve the health of the soil and ensure adequate soil structure. The soil must be a uniform mix, free of stones, stumps, roots, or other similar objects larger than two inches. No other materials or substances should be mixed or dumped within the bioretention that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations. The planting soil must be free of plant or seed material of non-native, invasive species, or noxious weeds.

5.12.3 Additional Requirements

- A. In residential properties, bioretention facilities provided to meet the stormwater management performance standards must be located within common areas and be protected from changes to grading and landscaping by the Master Deed or other appropriate document.
- B. Subdivision stormwater holding facilities and pretreatment systems shall be located in parks or outlots and not on a subdivision lot. During the plat approval process, the council may, at their discretion, allow the use of a lot for holding facilities and pretreatment systems when the lot has been oversized for this use or when construction on the lot is prohibited until elimination of the holding facilities and pretreatment system. Holding facilities and pretreatment systems within proposed septic field areas will not be permitted.
- C. Landscaping shall be provided as approved by the City's Landscape Architect. Plantings for bioretention facilities should be appropriate for the anticipated hydrologic and nutrient loading conditions. A list of suitable plantings for bioretention

facilities is provided in Appendix 5-A. The list is not inclusive of all appropriate plant materials and the designer may choose to propose alternate plant materials.

- D. Maintenance requirements for bioretention facilities are provided in Part Three, of this Chapter Five.

SECTION 5.13 STORMWATER CONVEYANCE

Stormwater management facilities may use open channels or closed conduits or both for means of conveying stormwater runoff provided. Sufficient stormwater conveyance of a 10-year storm event is required. Methods for determining the 10-year design flow for a tributary area is outlined in Section 5.1.1. Generally, open channels are preferred to closed conduits and naturally vegetated or grassed lined channels or swales are preferred.

All stormwater conveyance structures shall be constructed in accordance with governing specifications that may include Michigan Department of Transportation, Oakland County Road Commission and/or the City. In the event of no other governing specifications, the latest edition of the Michigan Department of Transportation Standards will be observed.

5.13.1 Storm Sewer

Detailed requirements for storm sewer are provided in Chapter 11 of the City's Ordinance.

5.13.2 Open Channels

Detailed requirements for storm sewer are provided in Chapter 11 of the City's Ordinance.

5.13.3 Vegetated Swales

- A. Vegetated swales shall follow natural, predevelopment drainage paths insofar as possible and be well vegetated, wide and shallow.
- B. Flow velocities within the swale shall neither be siltative nor erosive. In general, the minimum acceptable velocity should be two (2.0) feet per second and the maximum acceptable velocity will be six (6.0) feet per second.

- C. Swale slopes shall be appropriate for the swale cross section and capacity, existing soils and proposed vegetation. Wherever possible, the slope shall be greater than 1.5 percent. For slopes less than 1.5 percent, additional inspection will be necessary to ensure proper, positive drainage. In no case shall slopes be less than one (1.0) percent, unless other techniques such as infiltration are implemented. Maintenance for these devices must be detailed in the overall maintenance plan.
- D. Side slopes of swales shall be no steeper than 1-foot vertical to 3-foot horizontal. Soil conditions, vegetative cover and access for maintenance will be the governing factors in determining side slope requirements.
- E. The sides and bottom of swales shall be temporarily and permanently stabilized to prevent erosion.
- F. A minimum swale length of 200 feet is recommended to increase the contact time of stormwater.
- G. A series of check dams or drop structures across swales should be provided to enhance water quality and reduce velocities.
- H. Bioswales are encouraged to enhance water quality. Bioswales shall generally be designed in accordance with the above noted requirements for vegetated swales and as follows:
 - 1. The longitudinal slope of the bioswale shall be steep enough to prevent ponding and shallow enough to slow water velocity. Recommended slopes range between one percent (1%) and four percent (4%).
 - 2. Flow velocity should be sufficiently low to provide adequate residence time within the channel.
 - 3. Channel bottom width should be maximized. A wider channel allows for maximum filtering surface and slower water velocities within the channel.
 - 4. Flow depth should not be taller than the proposed vegetation. A maximum depth of four (4) inches is recommended.
 - 5. The channel length shall be long enough to provide approximately 10 minutes of residence time.
 - 6. Plantings for bioswales shall be appropriate for the anticipated hydrologic and nutrient loading conditions as approved by the City's Landscape Architect. A list of suitable plantings for bioretention facilities is provided in Appendix 5-A. The list is not inclusive of all appropriate plant materials and the designer may choose to propose alternate plant materials.

5.13.4 Natural Streams and Channels

- A. Natural stream are to be preserved. Modifications to existing natural streams, where unavoidable shall be designed and constructed according to governing regulations including, but not limited to, the Michigan Department of Environmental Quality, the U.S. Army Corps of Engineers and the Federal Emergency Response Agency.
- B. Natural swales and channels shall be preserved whenever possible.
- C. If channel modifications must occur, the physical characteristics of the modified channel will meet the existing channel in length, cross section, slope, sinuosity and carrying capacity. For unstable existing channels, a geomorphologic analysis should be completed to determine the most stable channel geometry and capacity.
- D. Streams and channels are expected to withstand all events up to the one-hundred year storm without increased erosion. Floodplains should be constructed where necessary. Armoring the banks with rip rap and other manufactured materials will only be accepted where erosion cannot be prevented in any other way.

PART 3 – EASEMENT AND MAINTENANCE REQUIREMENTS

SECTION 5.14 EASEMENTS FOR STORMWATER MANAGEMENT FACILITIES

Permanent easements shall be provided for all stormwater management facilities. If a facility is to be located within the right-of-way or any existing public utility easement, it shall be located such that it will not significantly increase the expense of maintaining the drainage facility. Easement requirements for legally established County Drains are detailed in the Oakland County Drain Commissioner's Standards. The following pertain to private storm water management facilities:

5.14.1 Easement Width

Minimum easements widths for facilities that are not part of a legally established County Drain are as follows:

- A. Open Drains and Watercourses – The minimum easement width shall be equal to the extreme width of the drain or watercourse plus fifteen (15) feet from the top of bank on both sides of the channel. Additional width may be required in some cases, including, but not limited to: water courses with floodplains delineated by FEMA, sandy soils, steep slopes and at access points from road crossings. Public easements shall be provided to the City for natural water courses that are not under the jurisdiction of the Oakland County Drain Commission, Michigan Department of Environmental Quality or other regulatory agency.

- B. Enclosed Drains – The easement width shall be equal to twice the depth of the sewer plus the size of the outside diameter of the pipe. Certain soil conditions may require larger easements. In no cases shall the easement width be smaller than twenty (20) feet. The easement shall be centered on the centerline of the pipe.
- C. Rear Yard Swales - The minimum easement width shall be twenty (20) feet centered on the centerline of the swale.
- D. Detention/Retention & Other Storm Water Management Facilities - Sufficient easement area to allow for operation and maintenance of the entire facility, including freeboard area, the banks and any berms at the top of the banks. Easements shall be 15-foot wide or greater and located to accommodate access and operation of equipment, spoils deposition and other activities identified in the maintenance plan. An access easement from the right-of-way shall be granted to the City as part of the maintenance agreement.

5.14.2 Additional Requirements

- A. Easement information shall be included on preliminary and final site plans.
- B. In cases where storm water is discharged to a drain or watercourse on adjoining private property, an improvement to the drain and agreement with the property owner (filed with the Register of Deeds) may be necessary. An off-site drainage easement will be required if:
 - 1. The watercourse is not depicted as a solid blue line on a USGS map.
 - 2. It is not indicated on the MIRIS map.
 - 3. The watercourse is not considered wetlands by the governing municipality.
- C. In cases where storm water is discharged to a wetland located on the development property, the developer may be required to obtain an easement from the adjacent property owners, approved by the City, and filed with the Register of Deeds. An off-site drainage easement will be required if all of the following conditions are met:
 - 1. The wetland extends onto adjacent properties
 - 2. The development would cause a change in the natural flow of storm water from the development by diverting (or concentrating) additional storm water flow from the property into wetlands, which extend onto the adjacent property.
 - 3. The development would cause the amount of water on the adjacent property to increase and/or changes the velocity of the water moving across the adjacent property

SECTION 5.15 MAINTENANCE REQUIREMENTS FOR STORM WATER MANAGEMENT FACILITIES

- A. All sites shall have a stormwater drainage facility maintenance easement agreement for the on-site storm water management facilities. Stormwater drainage facility maintenance easement agreement shall be submitted with all construction plans and included in the bylaws of all developments and site condominiums. Additional requirements for maintenance plans are provided in Section 5.15.1.
- B. The applicant may fulfill his or her obligation to ensure that a governmental entity will be responsible for drainage system maintenance by establishing a county drainage district, or other similar mechanism approved by the City to provide for the permanent maintenance of stormwater management facilities and necessary funding. If a county drain is not established, the applicant will submit evidence of a legally binding agreement with another governmental agency responsible for maintenance oversight.
- C. A legally binding private stormwater drainage facility maintenance easement 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.
- D. Stormwater management facilities shall be designed to minimize and facilitate maintenance, including, but not limited to:
 - 1. Riser pipes placed near or within pond embankments
 - 2. Easily accessible trash racks
 - 3. Alternative outflows for wet detention basins that can be used to completely drain the pool for sediment removal (pumping shall be considered if drainage by gravity is not feasible)
 - 4. Access for heavy equipment
 - 5. On-site area for spoil deposition, wherever possible

5.15.1 Maintenance Plan Requirements

The stormwater drainage facility maintenance easement agreement shall outline the tasks associated with maintenance of the storm water management facilities during the construction process and once the property owner (filed with the Register of Deeds) has assumed responsibility of the storm water management facilities. Where underground detention facilities, manufactured treatment systems and/or storm water pumps are proposed, the maintenance plan for the site shall be developed in accordance with the recommendations of the manufacturer.

The following information shall be included in the stormwater drainage facility maintenance easement agreement:

- A. A copy of the final approved drainage plan that delineates the facilities, easements, maintenance access and buffer areas.
- B. An estimated annual maintenance budget, itemized in detail by task and a description of the financing mechanism.
- C. A listing of appropriate maintenance tasks and a schedule for their implementation, including:
 - 1. Regular inspections
 - 2. Sediment/pollution removal
 - 3. Vegetation management
 - 4. Debris and litter control
 - 5. Embankment and outlet stabilization
- D. Identification of the party responsible for performing each of the inspection and maintenance described.
- E. Detailed descriptions of the procedure(s) for preventative and corrective maintenance activities. Preventative activities shall include:
 - 1. Periodic inspections, adjustments and replacements
 - 2. Record keeping of operations and expenditures
- F. Provisions for the routine and non-routine inspection(s) of all components within the system, including:
 - 1. Wet weather inspections of structural elements (including inspection for sediment accumulation in detention basins) should be conducted annually with as-built plans in hand. These inspections should be carried out by a professional engineer reporting to a responsible agency or owner.
 - 2. Housekeeping inspections, such as checking for trash removal, should be conducted at least annually.
 - 3. Emergency inspections on an as-needed basis, upon identification of severe problems, should be carried out by a professional engineer.
- G. A description of on-going landscape maintenance needs. The viability of plantings will be monitored by the applicant and for at least one (1) year after establishment and plantings will be replaced as needed. After one (1) year, the responsibility of monitoring and replacing plantings shall be the responsibility of the property owner. The City is not responsible for landscape maintenance.
- H. Provisions 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.

5.15.2 Maintenance Guidelines

Specific minimum guidelines for maintenance of various storm water management facilities are as follows:

A. Detention Basins

1. Check outlets regularly for clogging and clean when necessary, especially after large storm events. Replace stone around standpipe as needed.
2. Inspect entire system at least annually including inlet/outlet pipes, animal grates and filters.
3. Inspect for and remove floatables and debris at least annually.
4. Regularly check banks and bottom for erosion (at least annually) and correct as necessary.
5. Reseed banks near inlet/outlet and stabilize eroded banks as necessary.
6. Add additional plantings as necessary.
7. Remove dead vegetation (in early spring) that obstructs flow.
8. Inspect for sediment accumulation. Remove sediment when accumulation reaches six inches or resuspension is observed.

B. Underground Detention Systems

1. Maintenance of underground detention systems shall performed be in accordance with the manufacturer's recommendations.
2. Underground detention systems should be inspected regularly in accordance with the manufacturer's recommendations and site conditions. At a minimum, the system should be inspected every six months.
3. Check outlets regularly for clogging and clean when necessary, especially after large storm events.
4. Accumulated sediment should be removed from the underground detention system on a regular basis.

C. Retention Basins

1. Regularly check banks and bottom for erosion (at least annually) and correct as necessary.
2. Inspect for and remove floatables and debris at least annually.
3. Reseed banks near inlets and stabilize eroded banks as necessary.
4. Add additional plantings as necessary.
5. Remove dead vegetation (in early spring) that obstructs flow.
6. Inspect for sediment accumulation. Remove sediment when accumulation reaches six inches or resuspension is observed.

D. Infiltration Facilities, including Porous Pavement

1. Infiltration systems, including porous pavement must be aggressively maintained and protected from clogging by sediment, including maintenance of vegetative buffer strips.

2. In the event of clogging by accumulated sediments, partial or total reconstruction of the infiltration facility shall be required.
3. Porous pavement shall be vacuum swept and jet hosed at least four (4) times per year to remove any grit or sediment trapped in the pores of the open-graded asphalt. Evidence of a regular service contract for performing this activity will be required.

E. Sediment Forebays

1. Check outlets regularly for clogging and clean when necessary, especially after large storm events. Replace stone around standpipe as needed.
2. Inspect entire system at least annually including inlet/outlet pipes, animal grates and filters.
3. Inspect for and remove floatables and debris at least annually.
4. Regularly check banks and bottom for erosion (at least annually) and correct as necessary.
5. Reseed banks near inlet/outlet and stabilize eroded banks as necessary.
6. Add additional plantings as necessary.
7. Remove dead vegetation (in early spring) that obstructs flow.
8. Remove sediment when accumulation reaches six inches or resuspension is observed.

F. Manufactured Treatment Systems

1. Treatment systems shall be maintained according to the manufacturer's recommendations.
2. At a minimum, the system must be inspected and cleaned every 6 months, or more frequently if recommended by the manufacturer or directed in the reasonable exercise or discretion by the City Engineer.

G. Bioretention Facilities

1. Mulch should be re-applied uniformly with 2 to 3 inches of depth every six months. The mulch layer should be removed and replaced every two (2) years.
2. Soils should be tested regularly and replaced when soil fertility (ability to filter pollutants) is lost.
3. Regular weeding should be performed to remove unwanted and/or invasive plants.
4. Take appropriate actions to correct clogging that causes long-term pooling water. This shall include:
 - a. Clean the underdrain system.
 - b. Remove the mulch layer and rake the surface to eliminate surface blockages.
 - c. Use small lengths of reinforcing bar (e.g. 2-3 feet or #4 rebar) to puncture the filter fabric with holes to correct blocked filter fabric.
 - d. Punch holes in the soil to eliminate blockages within the soil layer.
5. Water plantings if wilted plants do not recover in the evening or if soils are dry at depths below 4 inches.

6. Replace dead or diseased plants.
7. Trash and debris should be removed from the bioretention facility regularly.

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APPENDIX 5-A
Short List of Suitable Plants for Bioretention Facilities

Bioretention Basin/Rain Garden Side Slopes	
Scientific Name	Common Name
<i>Trees and Shrubs</i>	
<i>Acer saccharinum</i>	silver maple
<i>Aronia melanocarpa</i>	black chokeberry
<i>Celtis occidentalis</i>	hackberry
<i>Cornus racemosa</i>	gray dogwood
<i>Cornus sericea</i>	red-osier dogwood
<i>Ilex verticillata</i>	winterberry
<i>Physocarpus opulifolius</i>	ninebark
<i>Quercus bicolor</i>	swamp white oak
<i>Salix nigra</i>	black willow
<i>Spiraea alba</i>	meadowsweet
<i>Viburnum lentago</i>	nannyberry
<i>Viburnum trilobum</i>	high bush cranberry
<i>Forbs and Ferns</i>	
<i>Anemone canadensis</i>	Canada anemone
<i>Asclepias tuberosa</i>	butterfly milkweed
<i>Aster laevis</i>	smooth aster
<i>Aster lanceoloatus</i>	panicle aster
<i>Aster macrophyllus</i>	big-leaved aster
<i>Aster novae-angliae</i>	New England aster
<i>Aster pilosus</i>	hairy aster
<i>Boltonia asteroides</i>	false aster
<i>Eryngium yuccifolium</i>	rattlesnake master
<i>Euthanmia graminifolia</i>	grass-leaved goldenrod
<i>Helianthus grosseserratus</i>	sawtooth sunflower
<i>Heuchera richardsonii</i>	prairie alumroot
<i>Matteuccia struthiopteris</i>	ostrich fern
<i>Monarda fistulosa</i>	wild bergamot
<i>Osmunda regalis</i>	royal fern
<i>Physosotegia virginianum</i>	mountain mint
<i>Smilacina racemosa</i>	false solomon's seal
<i>solidago flexicaulis</i>	broad-leaved goldenrod
<i>solidago riddellii</i>	Riddell's goldenrod
<i>solidago rigida</i>	stiff goldenrod
<i>tradescantia ohiensis</i>	common spiderwort
<i>Zizia aurea</i>	golden alexanders

<u>Grasses, Sedges and Rushes</u>	
<i>Andropogon gerardii</i>	big bluestem
<i>Bromus ciliatus</i>	fringed brome
<i>Panicum virgatum</i>	switchgrass
<i>schizachyrium scoparium</i>	little bluestem
<i>sorghastrum nutans</i>	indian grass

Bioretention Basin/Rain Garden Basin Bottom	
Scientific Name	Common Name
<u>Trees and Shrubs</u>	
<i>Aronia melanocarpa</i>	black chokeberry
<i>Cornus sericea</i>	red-osier dogwood
<i>Ilex verticillata</i>	winterberry
<i>Viburnum trilobum</i>	high bush cranberry
<u>Forbs and Ferns</u>	
<i>Anemone canadensis</i>	Canada anemone
<i>Asclepias incarnata</i>	swamp milkweed
<i>Aster novae-angliae</i>	New England aster
<i>Aster puniceus</i>	swamp aster
<i>Boltonia asteroides</i>	false aster
<i>Chelone glabra</i>	turtlehead
<i>Eupatorium maculatum</i>	joe-pye weed
<i>Eupatorium perfoliatum</i>	boneset
<i>Gentiana andrewsii</i>	bottle gentian
<i>Helenium autumnale</i>	sneezeweed
<i>Iris versicolor</i>	blue flag iris
<i>Lobelia cardinalis</i>	cardinal flower
<i>Lobelia siphilitica</i>	blue lobelia
<i>Lysimachia thysiflora</i>	tufted loosestrife
<i>Onoclea sensibilis</i>	sensitive fern
<i>Osmunda regalis</i>	royal fern
<i>Physosotegia virginianum</i>	mountain mint
<i>rudbeckia subtomentosa</i>	brown-eyed susan
<i>Silphium perfoliatum</i>	cup plant
<i>Solidago rigida</i>	stiff goldenrod
<i>Thalictrum dasycarpum</i>	purple meadow rue
<i>Verbena hastata</i>	blue vervain
<i>Vernonia fasciculata</i>	ironweed
<i>Veronicastrum virginicum</i>	Culver's root

<u>Grasses, Sedges and Rushes</u>	
<i>Bromus ciliatus</i>	fringed brome
<i>Carex comosa</i>	bottlebrush sedge
<i>Carex crinita</i>	caterpillar sedge
<i>Carex hystericina</i>	porcupine sedge
<i>Carex vulpinoidea</i>	fox sedge
<i>Glyceria striata</i>	fowl manna grass
<i>Juncus effusus</i>	soft rush
<i>Panicum virgatum</i>	switchgrass
<i>Scirpus cyperinus</i>	woolgrass
<i>Spartina pectinata</i>	prairie cord grass

Bioswale	
Scientific Name	Common Name
<u>Trees and Shrubs</u>	
<i>Acer saccharinum</i>	silver maple
<i>Aronia melanocarpa</i>	black chokeberry
<i>Celtis occidentalis</i>	hackberry
<i>Cornus racemosa</i>	gray dogwood
<i>Physocarpus opulifolius</i>	ninebark
<i>Quercus bicolor</i>	swamp white oak
<i>Salix nigra</i>	black willow
<i>Spiraea alba</i>	meadowsweet
<i>Viburnum lentago</i>	nannyberry
<i>Viburnum trilobum</i>	high bush cranberry
<u>Forbs and Ferns</u>	
<i>Anemone canadensis</i>	Canada anemone
<i>Asclepias tuberosa</i>	butterfly milkweed
<i>Aster laevis</i>	smooth aster
<i>Aster lanceolatus</i>	panicle aster
<i>Aster macrophyllus</i>	big-leaved aster
<i>Aster novae-angliae</i>	New England aster
<i>Aster pilosus</i>	hairy aster
<i>Boltonia asteroides</i>	false aster
<i>Eryngium yuccifolium</i>	rattlesnake master
<i>Euthamia graminifolia</i>	grass-leaved goldenrod
<i>Helianthus grosseserratus</i>	sawtooth sunflower
<i>Heuchera richardsonii</i>	prairie alumroot
<i>Matteuccia struthiopteris</i>	ostrich fern

<i>Monarda fistulosa</i>	wild bergamot
<i>Osmunda regalis</i>	royal fern
<i>Physosotegia virginianum</i>	mountain mint
<i>Smilacina racemosa</i>	false solomon's seal
<i>solidago flexicaulis</i>	broad-leaved goldenrod
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<i>solidago rigida</i>	stiff goldenrod
<i>tradescantia ohiensis</i>	common spiderwort
<i>Zizia aurea</i>	golden alexanders
<u>Grasses, Sedges and Rushes</u>	
<i>Andropogan gerardii</i>	big bluestem
<i>Bromus ciliatus</i>	fringed brome
<i>Carex vulpinoidea</i>	fox sedge
<i>Elymus canadensis</i>	Canada wild rye
<i>Panicum virgatum</i>	switchgrass
<i>schizachyrium scoparium</i>	little bluestem
<i>sorghastrum nutans</i>	indian grass
<i>Sporobolis heterolepis</i>	prairie dropseed

DRAFT

SECTION 7.4 OFF-ROAD NON-MOTORIZED FACILITIES (SIDEWALKS AND PATHWAYS)

The City of Novi adopted a comprehensive Non-Motorized Master Plan in 2011 as a tool for short-term and long-term planning for the improvement of Non-Motorized Facilities within the City of Novi. This section establishes the minimum requirements for the design of off-road non-motorized facilities within the city, which includes but is not limited to sidewalks, pathways and regional trails within the right-of-way or within public easements.

7.4.1 Requirement

Off-road Non-Motorized Facilities shall be placed in those locations specified in Section 11-256 of the Novi Code of Ordinances, the City of Novi Subdivision Ordinance (Appendix C), and the City of Novi Zoning Ordinance (Appendix A). Site plans should be designed to incorporate all users of the public and private streets including, pedestrians, bicyclists and motor vehicles.

7.4.2 Design Considerations

- A. Standards and Guidelines: All Non-Motorized Facilities shall be designed and constructed in accordance with the following standards and guidelines, in addition to other regulatory standards and the City of Novi Code of Ordinances:
1. *City of Novi Non-Motorized Master Plan*, Greenway Collaborative, 2011
 2. *Guide for the Planning, Design, and Operation of Pedestrian Facilities* AASHTO (latest edition)
 3. *Guide for the Development of Bicycle Facilities*, AASHTO (latest edition)
 4. *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-way*, United States Access Board (latest edition).
 5. *Guidance for Installation of Pedestrian Crosswalks on Michigan State Trunkline Highways*, Michigan Department of Transportation, 2014.
 6. *Best Design Practices for Walking and Bicycling in Michigan*, Michigan Department of Transportation.
 7. *Michigan Manual of Uniform Traffic Control Devices*.
- B. Width: Non-Motorized facility width shall be in accordance with the "Master Plan for Bicycle and Pedestrian Paths" and the following minimum widths.
1. Sidewalks shall be a minimum of five (5) feet wide along local streets.
 2. Sidewalks shall be a minimum of six (6) feet wide along collector and arterial streets.

3. Shared Use Pathways and Neighborhood Connectors shall be a minimum of eight (8) feet wide.
 4. Regional trails shall be a minimum of ten (10) feet wide.
- C. Location: Non-Motorized facility location shall be in accordance with the following requirements, unless otherwise approved by the City Engineer:
1. Sidewalks, pathways and trails shall generally be located such that the outside edge is located one (1) foot inside the future right-of-way line. In the case of private streets and roadways, the required sidewalks, pathways, and trails the outside edge should be located a minimum of 15 feet from the back of curb.
 2. Other dimensions for placement related to future right-of-way lines may be permitted by the City Engineer for the enhancement of natural resources, when the topography, existing landscaping, or an existing residence warrants an alternate location.
 3. Non-Motorized facilities shall not be placed closer than five (5) feet from back of curb for a curbed roadway, or twelve (12) feet from edge of pavement of an uncurbed roadway.
- D. Cross-Sections:
1. Sidewalks, Shared Use Pathways, and Neighborhood Connectors shall be constructed of Portland cement concrete. The cross-section shall conform to the minimum standard shown in Figure 7.4-1, unless otherwise approved by the City Engineer.

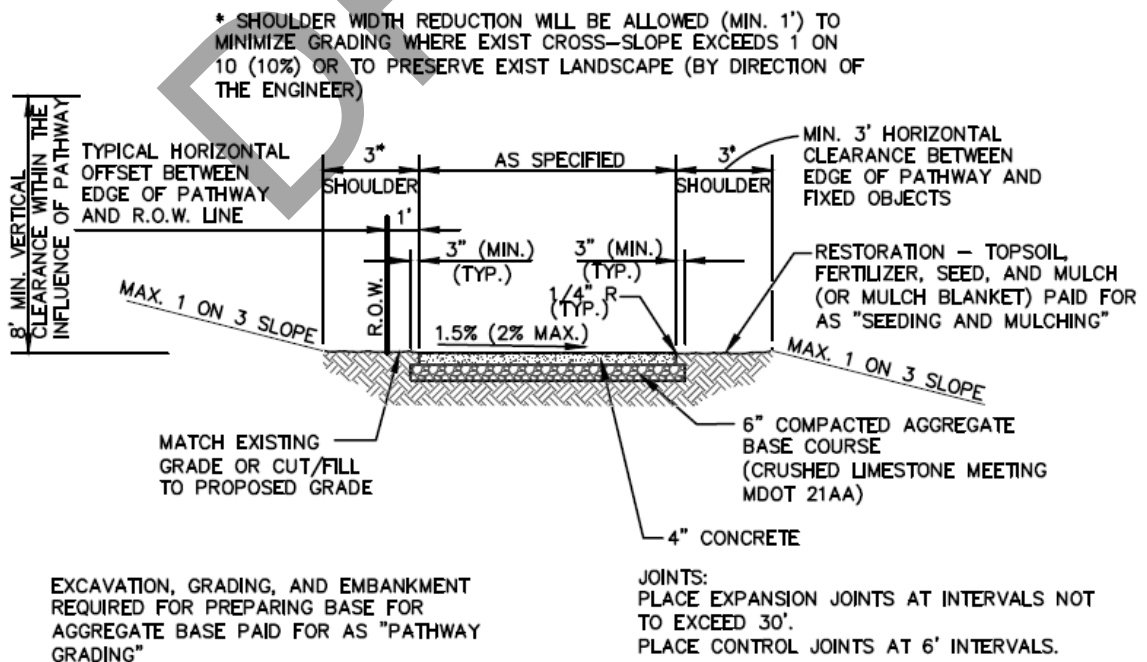


Figure 7.4-1. Standard Cross-Section for Concrete

2. Regional Trails shall be constructed of hot mix asphalt. The cross-section shall conform to the minimum standard shown in Figure 7-4.2, unless otherwise approved by the City Engineer.
3. The aggregate base course shall extend beyond the width of the pavement surface as indicated in Figure 7-4.1 and Figure 7-4.2.
4. The design engineer is responsible for the design of the cross-section based on the soil conditions found in the field.

* SHOULDER WIDTH REDUCTION WILL BE ALLOWED (MIN. 1') TO MINIMIZE GRADING WHERE EXIST CROSS-SLOPE EXCEEDS 1 ON 10 (10%) OR TO PRESERVE EXIST LANDSCAPE (BY DIRECTION OF THE ENGINEER)

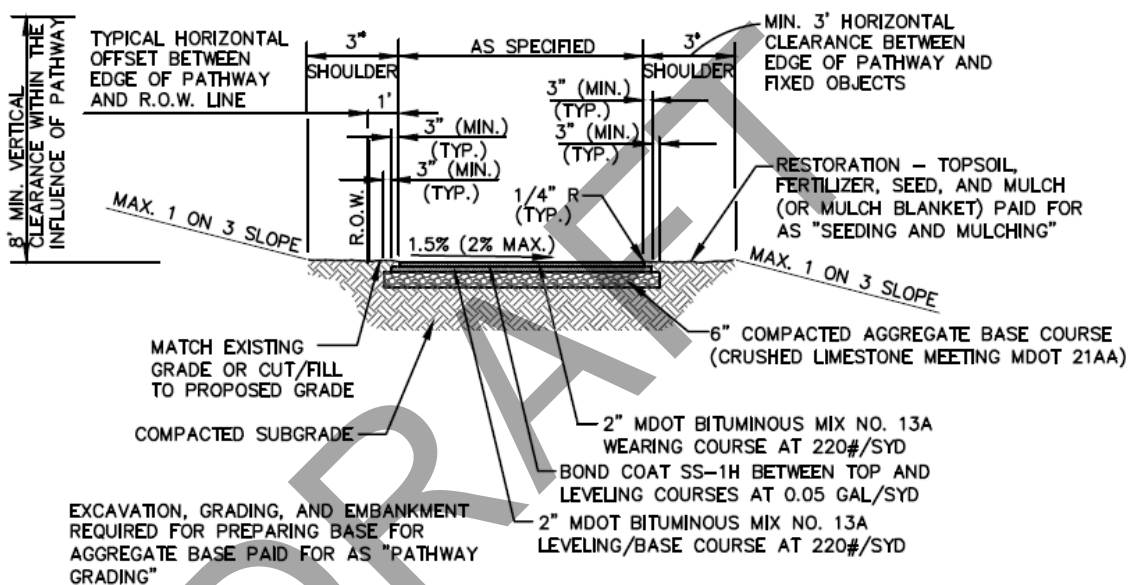


Figure 7.4-2. Standard Cross-Section for Asphalt

E. Slopes and Grade:

1. Non-Motorized facilities located in the right-of-way will generally follow the profile on the traveled road, and elevations shall blend in with the general grading plan of the abutting property and shall not impede drainage to presently established storm structures, ditch drainage, or site drainage swales.
2. Non-Motorized facilities located outside the roadway right-of-way will generally follow the longitudinal slope of the existing ground, with adjustments in grade provided for intersecting drives and streets or to accommodate drainage as appropriate.
3. To the extent possible, the maximum grade of a non-motorized facility shall be five (5.0) percent. Grades in excess of five (5.0) percent may be allowed in accordance with applicable ADA requirements as approved by the City Engineer.

4. Non-Motorized facilities will be sloped toward the road or street, unless existing surface drainage requires reversal of the pathway slope.
5. The maximum constructed cross slope is two (2.0) percent. The design cross-slope shall be 1.5 percent.

F. Clearances:

1. Non-Motorized facilities should be constructed no closer than three (3) feet from fences, trees or other permanent above grade obstructions.
2. The horizontal clearance from trees greater than six (6) inches diameter at breast height (d.b.h.) should be increased when possible to avoid the roots of the tree. As a general rule, the clearance from the tree shall be measured as follows:
 - i. Horizontal clearance shall be four (4) feet around trees less than or equal to eight (8) inches in diameter.
 - ii. Horizontal clearance shall be equal to the diameter of the tree in inches multiplied by one-half ($\frac{1}{2}$) foot per inch for all trees greater than eight (8) inches in diameter. For example, the excavation shall not approach closer than six (6) feet to a twelve-inch diameter tree.
3. Where the path must be closer than four (4) feet to such a tree, a physical barrier or herbicide impregnated barrier cloth must be placed under the path to prevent the tree roots from heaving the path. The area requiring the barrier shall include any portion of the path following within the points as set forth in section 11-50.
4. A minimum vertical clearance of eight (8) feet as measured from the final surface elevation along the entire length of the pathway shall be provided. The clearance shall be increased to 10 feet for shared use pathways and regional trails. Trees shall be professionally pruned to provide the necessary clearance.

G. Drainage and Grading: Construction of a Non-Motorized facility shall include grading of the existing land parallel to the path as shown in the standard cross-section in Section 7.4-2D such that all water drains away from the facility. Drainage on the street side shall be provided by slope grading to the existing ditch or to the back of curb. Typical cross sections shall provide sufficient detail of the work in these areas. Standing water is not allowed on a non-motorized facility. The path shall be designed to prevent the potential for any standing water.

H. Easements: Non-Motorized Facilities for use by the public that are constructed outside of the existing dedicated public right-of-way shall have an easement dedicated to the City and recorded with the County Register of Deeds. The easement shall be reviewed and approved by the City Engineer and the City Attorney prior to recording. The width of the

permanent easement shall be based on the width of the pathway as indicated below, or as directed by the City Engineer.

Table 7-4.1. Pathway Easement Width Requirements

Width of Non-Motorized Facility	Width of Permanent Easement
5 feet	9 feet
6 feet	10 feet
8 feet	12 feet
10 feet	14 feet

I. Pathways and Sidewalks at Intersections:

1. All street crossings shall meet the requirements of the Americans with Disabilities Act and the following requirements:
 - i. All sidewalk ramps shall be constructed of Portland cement concrete.
 - ii. Detectable warning surfaces are required at all barrier free ramps and hazardous vehicular ways and shall be a color that contrasts with the adjacent surface. Detectable warning surfaces must be manufactured of a material approved by the City Engineer and cast into the concrete.
 - iii. The barrier-free ramps and level landing shall comply with the current MDOT standard detail for ADA Sidewalk Ramps and the Americans with Disabilities Act.
2. Pedestrian crosswalks shall be provided at all intersections and sidewalk ramps meeting the requirements above shall be constructed on all corners of an intersection within and adjacent to the project.
3. At street intersections where open ditch drainage prevails, a 12-inch minimum size or larger sixteen-gauge corrugated metal culvert pipe shall be installed and backfilled with Granular Material Class II (MDOT specification) prior to the non-motorized facility construction. The culvert pipe shall have sufficient length to provide for the path width with a grass area two and one-half (2 ½) feet wide each side at top, and a maximum slope of one (1) foot vertical on three (3) feet horizontal to the ditch flow line. The entire area of the filled ditch section, from the ditch bottom to the edges of the new path, shall be protected with sod or other erosion control measures as approved by the City Engineer.

- J. Mid-Block Crossings: Mid-block crossings shall be required at one-half mile intervals along arterial and collector roads as shown in the Non-Motorized Master Plan, or as determined by the City Engineer to facilitate pedestrian movements to schools, parks and other public institutions. The mid-block crossing shall be designed and constructed in accordance with AASHTO

guideline for pedestrian facilities and *Guidance for Installation of Pedestrian Crosswalks on Michigan State Trunkline Highways*. Mid-block crossings shall be illuminated and shall have adequate signage in accordance with the Michigan Manual of Uniform Traffic Control Devices.

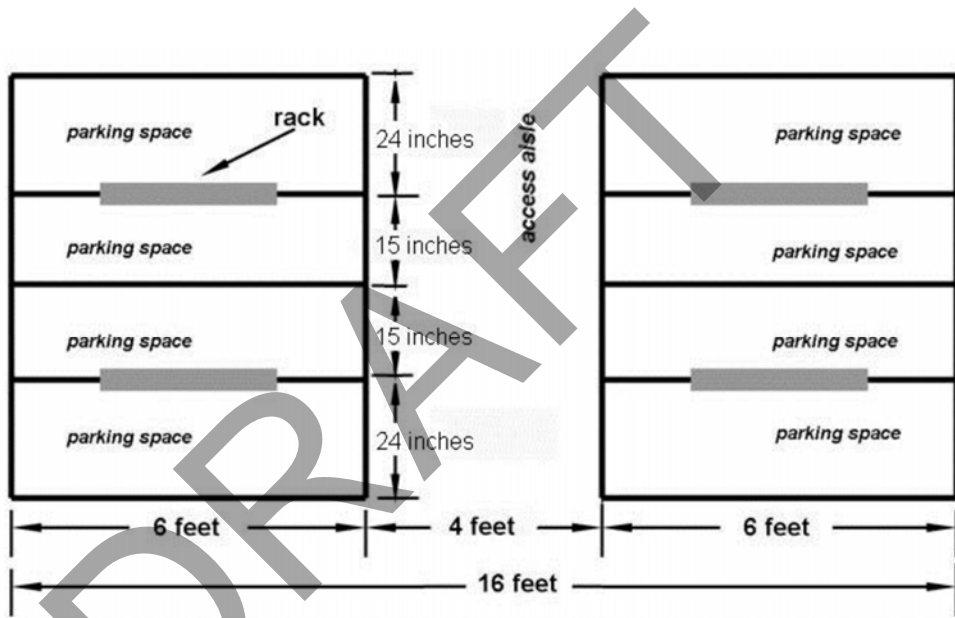
- K. Driveway Crossings: At drive crossings, non-motorized facilities shall have priority and shall be constructed across driveways. The pavement cross-section (thickness) of the non-motorized facility at drive crossings shall be increased to six (6) inches, except for commercial or industrial driveway crossings which shall have a depth of eight (8) inches.
- L. Boardwalks and Non-Motorized Bridges: A wetland or water course that is regulated by the City or the State may necessitate the construction of a boardwalk or bridge to complete a segment of a non-motorized facility. The width of the bridge or boardwalk shall be a minimum of two (2) feet wider than the width of the adjacent non-motorized facility. The design of a boardwalk shall meet the minimum requirements of the *City of Novi Pathway and Boardwalk Standard Details*. A non-motorized bridge shall be designed by a professional engineer having competence in the field of structural engineering. Bridges and boardwalks require a separate building permit from the City of Novi Community Development Department.
- M. Sidewalks on Private Property: Sidewalks on private property shall meet the general requirements for off-road non-motorized facilities. The developer/property owner is responsible for compliance with the applicable rules and regulations for private development under the Americans with Disability Act.
- N. Bicycle Parking: When bicycle parking is required by the Zoning Ordinance, plans for the layout of bicycle parking facilities shall be in accord with the following minimum requirements:
 - 1. All bicycle parking spaces shall be paved and adjacent to a bicycle rack of the inverted "U" design, that is solid, cannot be easily removed with common tools, provides at least two (2) contact points for a bicycle, is at least three (3) feet in height, and permits the locking of a bicycle through the frame and one (1) wheel with a standard U-Lock or cable in an upright position. The rack shall be securely anchored in concrete or asphalt. Alternative installations and designs may be considered by the City Engineer if the proposed rack design functions similar to the inverted "U" design.
 - 2. All bicycle parking facilities shall be accessible from adjacent street(s) and pathway(s) via a paved route that has a minimum width of six (6) feet.
 - 3. All bicycle parking facilities shall be separated from automobile parking spaces and access aisles by a raised curb, landscape area, sidewalk, or other method that complies with all city ordinances.

4. The layout of the bicycle parking facilities shall be as follows:

Table 7-4.2. Bicycle Parking Standards

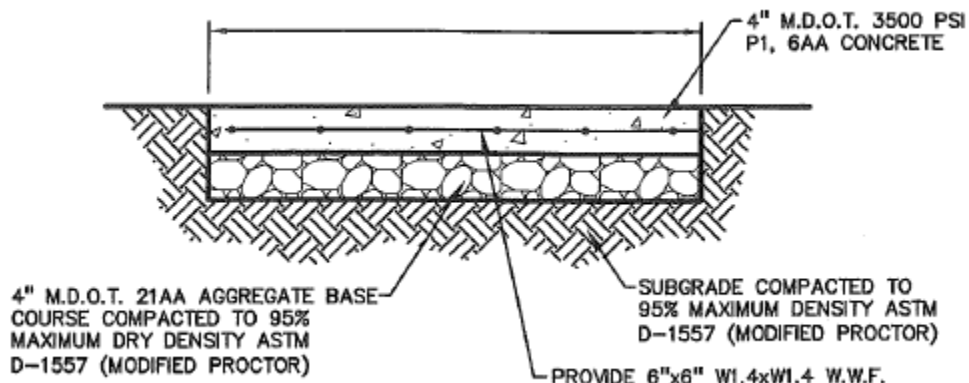
Bicycle Parking	Access Aisle Width	Parking Space Width	Parking Space Length	Total Width Of One Tier Of Spaces Plus Access Aisle	Total Width Of Two Tiers Of Spaces Plus Access Aisle
90°	Four (4) feet	Two (2) feet for single side parking, or two and one-half (2½) feet for double	Six (6) feet	Ten (10) feet	Sixteen (16) feet

Figure 7-4.3. Bicycle Parking Layout



5. The bicycle parking area shall be designed and constructed to meet the minimum cross-section shown in Figure 7.4-4.

Figure 7-4.4. Bicycle Parking Cross-Section



7.4.3 Plans and Specifications

- A. Seal: The plans and specifications shall be sealed by a civil engineer registered in the state of Michigan and shall have imprinted thereon the seal of that engineer in accordance with Public Act 299 of 1980, as amended, and Administrative Rules promulgated under the act.
- B. Plan Requirements: In addition to requirements elsewhere in this manual, plans shall consist of a cover sheet showing a plan view of the complete job, split plan and profile sheets drawn to a scale of one (1) inch equals one hundred (100) feet horizontal or better and one (1) inch equals five (5) feet vertical, and standard detail sheets. Profiles of existing centerline of the roadway, street right-of-way line and parallel drainage facilities are to be provided. The horizontal location of the centerline of each existing driveway within the limits of construction shall also be delineated in the profile view. Sheet size shall be twenty-four (24) inches by thirty-six (36) inches.
- C. Parcel Labels: The length of the frontage of each parcel of land abutting the proposed improvement shall be dimensioned on the plans. Each such parcel shall be identified by its subdivision name and lot number, or by its permanent parcel number, as established and assigned by the City Assessor. The plan shall also show the street address number, if applicable.
- D. Grading and Drainage:
 - 1. The plan shall include contours at one-foot intervals a minimum distance of 30 feet from the proposed pathway alignment, unless otherwise approved by the City Engineer. The direction of drainage from each parcel shall be indicated by drainage arrows. No drainage shall be directed toward the non-motorized facility.
 - 2. For any straight run of a non-motorized facility, grades shall be given in percent, with grade elevations provided for intervals not exceeding fifty (50) feet. For pathways with a width of 10-feet or greater, station and length of each vertical curve shall be shown.
 - 3. A minimum of six (6) spot elevations where the pathway crosses each driveway (one at each corner and two in the center of the driveway on each side of the pathway) shall be provided. Spot elevations shall also be provided to demonstrate a level landing adjacent to each side of the pathway crossing.
 - 4. Provide a minimum of four spot elevations at the intersection of the proposed pathway with any existing pathway to demonstrate that a turning space has been provided per Americans with Disabilities Act.
 - 5. No more than ¼" vertical obstacle shall be allowed at each transition between a pathway and any drive approach.
 - 6. A blow-up detailed grading plan shall be provided for all ramps and level landings when required.
- E. Cross-Section: A standard cross-section for each type of pavement and/or non-motorized facility shall be provided in the plan set. The cross-section

shall meet or exceed the standard cross-section provided in Section 7.4.2 of this manual.

F. Miscellaneous:

1. Elevations shall be on U.S.G.S. datum. City of Novi bench marks shall be shown at least every one thousand two hundred (1,200) feet along the alignment. Street names and right-of-way widths, subdivision names, legend, list of quantities, and other pertinent information shall be shown on the plans. All existing easements shall be shown on the plan.
2. The plans shall contain a note requiring that all construction shall conform to the city's construction standards.

7.4.4 Construction

A. Materials: The construction materials shall meet the requirements specified in the applicable section of the state department of transportation's (MDOT) Standard Specification for Construction. The specific materials shall be as indicated in the standard cross-section (Figure 7.4-1 and Figure 7.4-2) or as shown on the plan approved by the City.

1. Portland Cement Concrete; the concrete mixture shall conform to the MDOT requirements listed for Grade of Concrete 35S.
2. Hot Mix Asphalt; the hot mix asphalt concrete shall conform to the MDOT requirements listed for 36A. Other MDOT mixes including 13A and 5E1 will also be considered per the City Engineer.
3. Aggregates;
4. Premolded Joint Fillers;
5. Concrete Curing Materials.

B. Submittals: The developer shall provide the following submittals to the City or it's agent for review and approval prior to construction:

1. Shop Drawings
2. Material Certifications
3. Mix Designs
4. Substitutions
5. Manufacturer specifications

C. Field Quality Control: The engineer shall be responsible for quality control in the field and shall provide all testing results to the City Engineer, or his or her designee, to ensure quality control in the field.

D. Observation of Work: The developer/contractor shall make the work available for observation by City staff or agents. All non-motorized facilities to be dedicated to the public shall be observed on a full time

basis by the City or its agent. Defective work must be corrected prior to acceptance of the improvement.

E. Tree Protection

1. All trees to be saved should have protective fencing installed prior to construction. Fencing should be installed as far away from the tree trunk as possible and should be inspected prior to construction commencing.
2. Excavate as far away as possible (minimum of 8'), or as otherwise approved by the City.
3. Roots over 2" that are broken should be cut flush. This will help the tree recover from its injury.
4. Any areas adjacent to trees to be saved and where soil will be compacted by equipment should have 4 to 6 inches of woodchips placed in the area to help reduce compaction.
5. No herbicides should be used in the construction area.
6. No storage of materials, construction vehicles, and contractor traffic should take place under trees to be saved.
7. Tree branches shall be pruned for vehicle clearance.
8. Fertilizer applications before and after construction can enhance tree vigor. A slow-release organic form of nitrogen fertilizer is recommended. A soil-injection fertilizer may be recommended on sites with compacted soils.

F. Construction:

1. All work shall conform to the requirements specified in the applicable section of the state department of transportation's (MDOT) Standard Specification for Construction.
2. The General Construction Standards of the Design and Construction Standards applies to non-motorized facility construction.
3. Non-Motorized facilities shall be flush with abutting curbs and paved surfaces.
4. Concrete pavement shall meet the minimum design criteria in Figure 7-4.1 and Section 7.4.2(K). The concrete forms must be inspected by the city prior to pouring of concrete. Joints in concrete pathways shall be sawcut. No tooled joints will be allowed.
5. Preparation of base, mixing of materials, and placing and finishing of concrete paving is to be done in accordance with the applicable standards as detailed in "Standard Specifications for Construction," latest edition, published by the Michigan Department of Transportation.
6. Forms shall be clean and straight, composed of wood or metal. The height of the forms shall be the same height as the adjacent concrete section to be poured. The forms shall be staked to line

and grade in a manner that will prevent deflection or settlement. Forms shall be oiled before placing PCC.

7. All unstable subgrade material shall be removed and replaced with Class II granular material per Michigan Department of Transportation specification. Subgrade material other than such Class II may be used with prior approval of the engineer.
8. The base shall be thoroughly wetted and the concrete deposited thereon to the proper depth. Concrete shall be vibrated along the forms, compressed and struck-off flush with the top of the forms. The surface shall be floated with a steel float, edges properly tooled, and then finished with a wood float or brush, transverse to the centerline of the pedestrian safety path to provide a nonslip surface. Joints shall be sawcut at the appropriate time and at a spacing interval equal to the width of the pathway. Special care shall be taken when a sawcut joint is in conflict with a structure to ensure that the pattern is revised to avoid cracking.
9. A transverse expansion joint, one-half inch wide, shall be placed the full depth of the pedestrian safety path, at uniform intervals not exceeding fifty (50) feet, at driveways, and where the new walk abuts existing concrete structures. Contraction joints shall be formed every five (5) feet or (6) feet based on the respective pathway width. All joints shall be constructed at right angles to the centerline of the safety path.
10. The concrete shall be cured with white membrane curing compound, wet burlap, or by other methods approved by the City Engineer, as soon as surface moisture has disappeared. Concrete shall not be placed on frozen ground. When the temperature is below forty (40) degrees Fahrenheit, or when freezing temperatures within the next twenty-four-hour period are forecast, concrete shall not be placed unless protection against freezing of the concrete, as required by the City engineer, is provided.
11. Along the frontage of lots in residential subdivisions and abutting cul-de-sacs, a physical barrier or herbicide impregnated barrier cloth shall be placed under the non-motorized facility to prevent street tree roots from heaving the pavement.

END OF SECTION 7.4