STANDARDS OF DESIGN - STREETS AND ROADWAYS

Scope

These standards establish the minimum requirements for the design of streets and roadways in the City.

Plans and Specifications

1. The plans and specifications shall be prepared by a professional engineer registered in the State of Michigan.

2. Plans shall consist of a cover sheet showing a location map and site plan of the proposed project, plan and profile sheets covering all the proposed street and roadway construction, and a standard detail sheet. Plan sheet size shall be 24 x 36. Plan scale shall be either 1 inch = 40 feet or 1 inch = 20 feet horizontally and 1 inch = 5 feet vertically.

3. Plans shall be developed using AutoCad software; exceptions may be granted by the City

4. Elevations shall be based upon U.S.G.S. datum. Elevations based upon assumed datum will not be approved.

5. Plan profiles shall indicate existing and proposed ground levels, U.S.G.S. elevations, and stationing.

6. Ten (10) sets of plans and specifications shall be submitted by the Developer to the City for preliminary approval. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design. Modifications required to meet the municipal standards, if any, will be noted on two sets, with one such set returned to the Developer for final corrections within thirty (30) days of receipt.

7. Six (6) sets of final plans and specifications shall be submitted by the Developer to the City for approval. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design.

8. The Developer will be responsible for securing all State and local construction permits required for street and roadway construction.

9. One (1) set of reproducible “as-built” tracings, on mylar or polyester film, and one (1) disk in AutoCad format, shall be submitted to the City upon completion of the construction.

Standards of Design - Streets and Roadways

1. Subsurface Soil Conditions - The Developer shall provide sufficient soil borings and other information to accurately describe the prevailing soil conditions under proposed streets and roadways. The minimum soil boring depth shall be ten feet below the plan road grade, unless unstable soil conditions are encountered. If such conditions are found, the boring depth shall be extended until stable soil is encountered.

2. Curb and Gutter - All streets and roadways shall include concrete curb and gutter; bituminous curb will not be allowed. On local streets, the minimum street width shall be 31 feet back to back of curb. Concrete curb and gutter width on major streets shall conform to the "Uniform Criteria for Major Streets" as adopted by the Michigan Department of Transportation and the City's Master Plan. At all intersections, the minimum curb radius shall be 25 feet, unless otherwise approved. Concrete curb and gutter shall conform to MDOT F-4.

3. Sidewalk - Concrete sidewalks (where required) shall be four feet wide and shall be located one foot inside right-of-way line. At all intersections of sidewalks and curb and gutter, appropriate pedestrian ramps shall be constructed. Unless otherwise approved, the ramps shall be MDOT Type 1. The maximum allowable sidewalk grade shall be seven percent and the minimum allowable grade shall be 0.50 percent. Sidewalk shall have a cross slope of ¼ inch per foot away from the property line. Sidewalks shall project one inch above finished grade. In cut sections, the maximum sidewalk elevation shall be one foot above the street centerline elevation. In fill sections, the sidewalk elevation shall be no lower than 0.5 feet below the street centerline elevation. Sidewalks shall be 4 inches thick except across residential driveways, which shall be 6 inches thick, and across commercial driveways, which shall be 10 inches thick unless otherwise approved by the Engineer.

4. Grade, Horizontal and Vertical Alignment - The minimum vertical grade on any street or roadway shall be 0.50 feet per 100 feet and the maximum grade on any street or roadway shall be 5 feet per 100 feet of length. In general, the minimum length of a vertical curve shall be 100 feet, unless otherwise dictated by site topography. In general, all intersections of streets or roadways shall be made perpendicular to each other. However, intersections ranging from 75 degrees to 90 degrees from perpendicular may be approved. Additional information concerning street geometrics, right-of-way widths, block length requirements and other relevant requirements are available from the City.

5. Driveway Approaches - All driveway approaches between the curb and gutter and sidewalk shall be paved with either concrete or bituminous material. Bituminous pavement shall consist of minimum of 275 pounds per square yard (2-1/2 inches). Concrete driveway approaches for residential sections shall be 6 inches thick and 10 inches for commercial approaches. The maximum grade on driveway approaches shall be 10 percent. The width of the driveway curb cut shall conform to the standard detail.

6. Right-of-Way Width - The minimum width of street rights-of-way shall be sixty-six feet for local streets and eighty feet for arterial or section line streets.

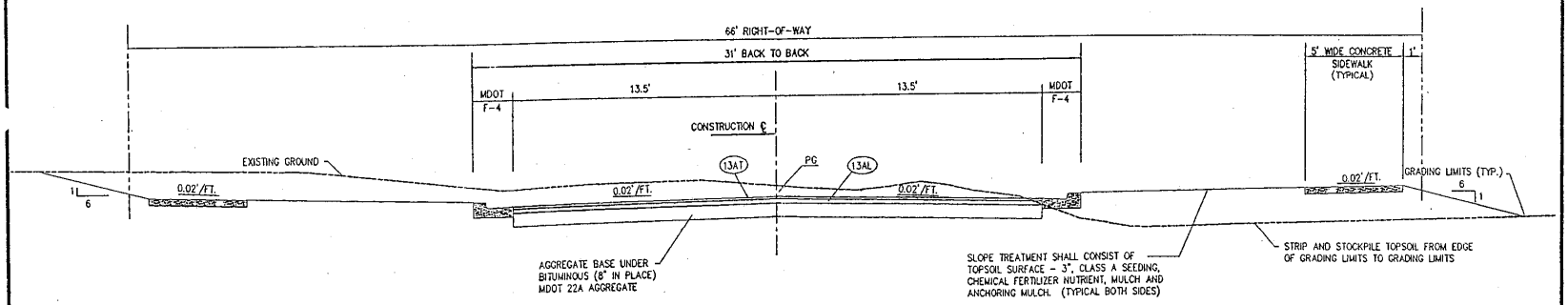
7. Utility Location Within Street Right-of-Way - The utilities listed below shall be constructed in the designated location within all street right-of-way as follows:

sanitary sewers	-	on the centerline of the street.
storm sewers	-	8 feet from the centerline of the right-of-way.
water main	-	23 feet from the centerline of the right-of-way.
6. gas main	-	in dedicated frontage easement.
other utilities	-	as approved by the City.

5. Street Surface Materials and Pavement Thickness - The following pavement designs are minimum requirements for local streets with restricted wheel loads. Pavement design for major streets shall reflect the increased traffic volume and higher axle loads and shall be subject to approval by the City. Minimum pavement sections for local and major streets are indicated on the following pages.

BITUMINOUS APPLICATION SCHEDULE

IDENT NO.	ITEM	RATE PER SYD	ASPHALT PENETRATION	REMARKS
13AT	BITUMINOUS MIXTURE – 13A	165 LBS	85–100	TOP LEVELING
13AL	BITUMINOUS MIXTURE – 13A	275 LBS	85–100	FOR INFORMATION ONLY
	BITUMINOUS BOND COAT	0–0.10 GAL		



FOR STREETS WITH MAJOR STREET DESIGNATION, THE PAVEMENT CROSS SECTION SHALL BE DETERMINED BY THE CITY ENGINEER.

MINIMUM SECTION – LOCAL STREET

NO SCALE

DURAND 11/98

STANDARDS OF DESIGN - SANITARY SEWERS

Scope

These standards establish the minimum requirements for the design of sanitary sewers in the City.

Plans and Specifications

1. The plans and specifications shall be prepared by a professional engineer registered in the State of Michigan.

2. Plans shall consist of a cover sheet showing a location map and site plan of the proposed project, plan and profile sheets covering all the proposed sanitary sewer construction, and a standard detail sheet. Plan sheet size shall be 24 x 36. Plan scale shall be either 1 inch = 40 feet or 1 inch = 20 feet horizontally and 1 inch = 5 feet vertically.

3. Plans shall be developed using AutoCad software; exceptions may be granted by the City

4. Elevations shall be based upon U.S.G.S. datum. Elevations based upon an assumed datum will not be approved.

5. Plan profiles shall indicate existing and proposed ground levels, U.S.G.S. elevations, and stationing.

6. Ten (10) sets of plans and specifications shall be submitted by the Developer to the City for preliminary approval. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design. Modifications required to meet the municipal standards, if any, will be noted on two sets, with one such set returned to the Developer for final corrections within thirty (30) days of receipt.

7. Six (6) sets of final plans and specifications shall be submitted by the Developer to the City for approval. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design and shall include a completed Act 98 Permit Application.

8. The City will secure the sanitary sewer construction permit from the MDEQ. The Developer will be responsible for securing all other permits required for the sanitary sewer construction.

9. One (1) set of reproducible “as-built” tracings, on mylar or polyester film and one (1) disk in AutoCad format shall be submitted to the City upon completion of the utility construction. The location of all tees, manholes and the intersection of the service lateral and the respective property line shall be witnessed from at least two permanent topographic features.

Standards of Design - Sanitary Sewers

1. Location - The location of the sanitary sewer within the street right-of-way shall be on the centerline of the street.

2. Minimum Grades and Velocities - Sanitary sewers shall be designed to maintain a minimum velocity of two feet per second; maximum velocity shall not exceed ten feet per second. Suggested minimum grades for various size sanitary sewers are listed below:

6" (lateral)	1.00%	15"	0.15%
8"	0.40%	18"	0.12%
10"	0.28%	24"	0.10%
12"	0.22%		

3. Minimum Diameter - The minimum diameter of collection sewers shall be eight (8) inches; the minimum diameter of the service lateral shall be six (6) inches for commercial and four (4) inches for residential. The City may require an increase in the size of certain sewers to accommodate future system requirements.

4. Manholes - Sanitary sewer manholes shall be constructed at all changes in grade, size and alignment of the sanitary sewer. The maximum run between manholes shall be 300 feet. Manholes shall be precast concrete with rubber "O" ring at joints; block or brick sanitary manholes will not be approved. Pipe openings shall be cast in the precast section or cored in the finished wall. Manhole pipe connections shall be furnished with an integrally cast seal system, "Kor-N-Seal" or equal. Sanitary manholes shall have integral concrete manhole bottom. A drop pipe shall be constructed for all sewers entering a manhole at a height of 24 inches or greater above the proposed manhole invert. The minimum inside diameter of a sanitary sewer manhole for sewers through 21 inches in diameter shall be 48 inches. For sanitary sewers 24 to 36 inches in diameter, the minimum inside diameter of the sanitary manholes shall be 60 inches. A minimum of three rows and a maximum of six rows of concrete adjusting bricks or rings shall be constructed on top of the precast cone section. The interior and exterior of the adjusting bricks or rings shall receive a ½ inch coat of plaster. Manholes shall be provided with approved manhole steps.

5. Sewer Mains - See section 02732, 1-6 for size and class. All sewer main extensions must be continued across the total frontage of the lot to be served, or across the total frontage of the lot facing one street in the case of a corner lot.

6. Service Laterals - Connection of the service laterals to the collection sewers shall be by means of a sewer pipe tee or wye. The service lateral shall be constructed to the property line of all lots and marked in accordance with the sanitary sewer standard of construction included herein. In addition, the Developer shall be required to furnish to the City a map indicating the precise location of all sanitary sewer laterals at the property line intersection. The location should be witnessed from two recoverable reference points. For service laterals of extended length, clean outs shall be

constructed at 50 foot intervals. A 6 inch cleanout shall also be installed at the property line. Where sanitary sewers are deeper than 12 feet, 6 inch diameter risers shall be constructed such that the service lateral is at least 10 feet below finished grade at the property line. All changes in direction, materials, or pipe size shall be completed with proper fittings.

7. Subsurface Soil Conditions - The Developer shall provide sufficient soil borings along the sanitary sewer route to accurately describe the prevailing soil conditions. The borings shall be constructed to a depth of five (5) feet below the proposed invert elevation of the sanitary sewer.

8. Manhole Casting - The standard manhole casting shall have a 24 inch clear opening. Refer to specification Section 02100 - Standard Casting, Valves and Hydrants for the municipality's standard manhole castings.

9. Lift Stations - Sewage lift stations shall be one of the following types:

    a. A wet pit-dry pit arrangement with centrifugal pumps; shall be either steel shell, reinforced concrete section, or reinforced fiberglass structures.

    b. Submersible pump lift station with concrete chamber and an exterior valve chamber.

    c. Self-priming pump with enclosure.

    The lift station should, to the extent possible, be of the same type and manufacturer as existing municipal lift stations. The pumping stations shall be equipped with duplex pumps. Conventional wet pit-dry pit stations shall be equipped with a ventilation fan, sump pump and fire extinguisher in addition to the pumps, compressors, valves, ejectors and other associated components. Pumping stations shall be equipped with a flowmeter on the discharge with a recording chart. Submersible pump lift stations shall be equipped with slide rails to facilitate the removal of the pumps for repair. Lift stations shall be equipped with high and low level alarms, including visual (red light) and autodialer systems. Lift station design shall conform to the guidelines contained in the Recommend Standards for Sewage Works, Great Lakes-Upper Mississippi River Board of State Sanitary Engineers (Ten-States Standards) unless otherwise noted or approved. Submersible pump lift stations shall be provided with intrinsically safe electrical control systems. The electrical system shall have provisions for accepting portable electrical generator service. Lift station design shall be subject to the approval of the City.

10. Inverted Siphons - Generally, the use of inverted siphons will not be approved unless specific conditions warrant their use.

11. Illegal Connections - The connection of footing drains, roof drains, sump pump discharge, or yard drains to the sanitary sewer is strictly prohibited.

12. Connection Elevations - Plans submitted for approval shall note the elevation of the sanitary sewer service lead at the building foundation line as well as the invert elevation of the service lead at the collection sewer. Minimum cover over the service lateral shall be four feet.

13. Trench Loading Design - All sanitary sewers shall be designed so as to resist all trench backfill and construction load or anticipated superimposed loadings utilizing a factor of safety of 2.0 of the pipe's resistance to failure.

STANDARDS OF DESIGN - STORM SEWERS

Scope

These standards establish the minimum requirements for the design of storm sewers in the City

Plans and Specifications

1. The plans and specifications shall be prepared by a professional engineer registered in the State of Michigan

2. Plans shall consist of a cover sheet showing a location map and a site plan of the proposed project, plan and profile sheets covering all the proposed storm sewer construction, and a standard detail sheet. Plan sheet size shall be 24 x 36. Plan scale shall be either 1 inch = 40 feet of 1 inch = 20 feet horizontally and 1 inch = 5 feet vertically.

3. Plans shall be developed using AutoCad software; exceptions may be granted by the City

4. Elevations shall be based upon U.S.G.S. datum. Elevations based upon an assumed datum will not be approved.

5. Plan profiles shall indicate existing and proposed ground levels, U.S.G.S. elevations, and stationing.

6. Ten (10) sets of plans and specifications shall be submitted by the Developer to the City for preliminary approval. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design. Modifications required to meet the municipal standards, if any, will be noted on two sets, with one such set returned to the Developer for final corrections within thirty (30) days of receipt.

7. Six (6) sets of final plans and specifications shall be submitted by the Developer to the City for approval. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design.

8. The Developer will be responsible for securing all State and local construction permits for storm sewer construction.

9. One (1) set of reproducible “as-built” tracings, on mylar or polyester film, and one (1) disk in AutoCad format, shall be submitted to the City upon completion of the utility construction. The location of all tees, manholes and catch basins, shall be witnessed from at least two permanent topographic features.

Standard of Design - Storm Sewers

1. Location - The location of the storm sewer shall be within the street right-of-way 8 feet from the centerline of the right-of-way.

2. Minimum and Maximum Velocity - All storm sewers shall be designed to provide a minimum velocity of three feet per second and a maximum velocity of ten feet per second when the pipe is flowing full.

3. Minimum Diameter - The minimum diameter for all storm sewer, including catch basin leads, shall be 12 inches. The City may require an increase in the size of certain sewers to accommodate future system requirements.

4. Manhole - Storm sewer manholes shall be constructed at all changes in grade, size, and alignment of the storm sewer, The maximum run between storm sewer manholes shall be 500 feet. Manholes shall be constructed with precast concrete structures. The minimum inside manhole diameter for storm sewers through 21 inches in diameter shall be 48 inches. For storm sewers from 24 to 36 inches in diameter, the minimum storm manhole diameter shall be 60 inches. For storm sewers 42 inches and larger, the "tee" manhole riser sections shall be used. Should a change in grade, size, or alignment of the pipe occur in a manhole where one or more of the sewers are 42 inches in diameter or lager, the manhole section shall have a minimum inside diameter of the largest pipe diameter plus two feet. Manholes shall be provided with approved manhole steps.

5. Storm Sewer Design - Storm sewers which discharge to a county drain shall meet the requirements of the Shiawassee County Drain Commissioner. Where applicable, the one hundred (100) year flood plain limits and flood plain elevations shall be noted on the plans.

6. Catch Basins - Storm sewer catch basins shall have a minimum inside diameter of 48 inches and shall provide a minimum sump depth of 24 inches below the lowest pipe invert elevation. Catch basins shall be constructed at all low points in the curb and gutter and shall be located so as to limit storm water travel in the gutter section to a maximum distance of 250 feet.

7. Standard Castings - Refer to specification Section 02100 - Standard Castings, Valves and Hydrants for the municipality's standard castings.

8. Trench Loading Design - All storm sewers shall be designed so as to resist all trench backfill and construction load or anticipated superimposed loading utilizing a factor of safety of 2.0 of the pipe's resistance to failure.

9. Storm Water Detention/Retention - The City may require the construction of storm water detention/retention facilities. If required, the facilities shall meet the requirements of the standards of the Shiawassee County Drain Commissioner.

STANDARDS OF DESIGN - WATER DISTRIBUTION SYSTEMS

Scope

These standards establish the minimum requirements for the design of water distribution systems in the City.

Plans and Specifications

1. The plans and specifications shall be prepared by a professional engineer registered in the State of Michigan.

2. Plans shall consist of a cover sheet showing a location map and site plan of the proposed project, plan and profile sheets covering all the proposed water main construction, and a standard detail sheet. Plan sheet size shall be 24 x 36. Plan scale shall be either 1 inch = 40 feet or 1 inch = 20 feet horizontally and 1 inch = 5 feet vertically.

3. Plans shall be developed using AutoCad software; exceptions may be granted by the City.

4. Elevations shall be based upon U.S.G.S. datum. Elevations based upon an assumed datum will not be approved.

5. Plan profiles shall indicate existing and proposed ground levels, U.S.G.S. elevations, and stationing.

6. Ten (10) sets of plans and specifications shall be submitted by the Developer to the City for preliminary approval. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design. Modifications required to meet the municipal standards, if any, will be noted on two sets, with one such set returned to the Developer for final corrections within thirty (30) days of receipt.

7. Six (6) sets of final plans/lead sheets shall be submitted by the Developer to the City for approval. Lead sheets must include measurements for all service leads, tee's, 90s, valves, etc. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design.

8. The City will secure the water main construction permit from the Michigan Department of Environmental Quality, Drinking Water and Radiological Protection Division. The Developer will be responsible for securing all other permits required for the water distribution system construction.

9. One (1) set of reproducible “as-built” tracings, on mylar or polyester film and one (1) disk in AutoCad format, shall be submitted to the City upon completion of the utility construction. The location of all valves and curb shutoffs shall be witnessed from at least two permanent topographic features.

Standards of Design - Water Distribution Systems

1. Location - The location of the water main within the street right-of-way shall be 23 feet from the centerline of the right-of-way. In no case shall a water main be constructed within ten feet (measured horizontally) from a sanitary sewer.

3. Minimum Diameter - The minimum size of water main shall be eight (8) inches in diameter. The City may require an increase in the size of certain water mains to accommodate future system requirements.

3. Valves - Valves shall be Resilient Wedge left to open, (Kennedy American Flow Valve Series 2500, Tyler, or EJIW). All valves and tees shall have restraint rings. AWWA approved valves shall be placed throughout the distribution system in accordance with the following regulations:

   a. On straight runs, valve shall be spaced at maximum intervals of 500 feet.

   b. At tees, three valves are required.

   c. At crosses, four valves are required.

   d. At the end of dead end mains, a valve and two (2) full lengths of water main shall be constructed to facilitate future connections.

   e. A valve shall be installed at the intersection of water mains and easement lines; the City intends to maintain water main within legal easements.

4. Valve Boxes and Manholes - Valve Boxes shall be Tyler 6860 Series three piece. Valves shall be provided with adjustable screw type valve boxes. In some cases, valve manholes may be required in State Highway rights-of-way, paved surfaces, berms, sidewalks, and any other location where re-excavation may be difficult. Refer to specification Section 02100 - Standard Casting, Valves and Hydrants.

5. Water Mains - See section 02665, 1-4 for size and class. Water mains shall be constructed of ductile iron with a minimum cover of 6 feet. In general, water mains shall be designed in a network with sufficient looping to eliminate “dead end” runs. All water main extensions must be continued across the total frontage of the lot to be served, or across the total frontage of the lot facing one street in the case of a corner lot.

6. Hydrants - Fire hydrants shall be East Jordan Model 5-BR (left to open) with two 2 ½" National Standard hose connections and one 4" National Standard pumper connection with breakable flange. All hydrants shall have restraint rings. The minimum size for fire hydrant leads shall be 5 inch diameter and the hydrant shall have connections and special construction as noted in specification Section 02100 - Standard Casting, Valves and Hydrants. Hydrants shall be spaced along the water main network such that all residential and commercial establishments are within 300 feet of a hydrant (measured along the street right-of-way). The hydrants shall have

plugged drains. The pumper connection shall face the street. Hydrants shall be constructed at all dead end mains. Hydrants shall be constructed from the main by use of a standard tee and gate valve; the use of Lucas tees will not be permitted. A concrete thrust block of sufficient area shall be constructed to resist the thrust.

7. Service Connections - Connection to the existing main shall be made with a double banded brass saddle and corporation stop, with a minimum diameter of three quarter (3/4) inch for residential and one (1) inch for commercial. Corporation Stops shall be Ford F600-3 flange/compression curb stop. (All service connections must have at least one compression fitting) Service lead shall be type K annealed seamless copper water tubing with flared type fittings. Service lead shall be constructed to within six inches of the property line and shall be terminated with a curb valve and adjustable curb box with stationary rod extension, The open end shall be capped and protected during backfill operations. The size of water service connection shall be approved by the City. Each service connection shall be provided with a minimum of 6 feet of cover. Refer to specification Section 02100 - Standard Casting, Valves and Hydrants for acceptable makes and model numbers.

8. Water Meters - Water meters, and remote readers, together with the necessary setting equipment, are to be furnished by the City upon payment of the necessary fee as established by the City. Effective December 1, 1998 Remote Readers shall be required in all new construction. The meter and appurtenances shall remain the property of the City and shall be maintained by the City in accordance with the City Water Ordinance.

9. Service Clamps - Shall be Ford FSI stainless, Mueller 500 1104 stainless, or Smith Blair Type 261 stainless. **All Repair Clamps are Double Band.**

10. Curb Boxes - Shall be Ford Minneapolis Base with Brushing Lid 27/32 Brass Pentagon Head Plug.

STANDARDS OF DESIGN - SITE GRADING

Scope

These standards establish the minimum requirements for the design of site grading.

Plans and Specifications

1. The plans and specifications shall be prepared by a professional engineer registered in the State of Michigan.

2. Plans shall consist of a cover sheet showing a location map and site plan of the proposed project, a plan sheet showing the street and lot drainage, and a standard detail sheet. Plan size shall be 24 x 36. Plan scale shall be either 1 inch = 40 feet or 1 inch = 20 feet horizontally and 1 inch = 5 feet vertically.

3. Plans shall be developed using AutoCad software; exceptions may be granted by the City.

4. Elevations shall be based upon U.S.G.S. datum. Elevations based upon an assumed datum will not be approved.

5. The site plan for street and lot layout shall indicate both existing and proposed contours at a two foot contour interval. Individual lot drainage patterns shall be indicated on the plan.

6. Ten (10) sets of plans and specifications shall be submitted by the Developer to the City for preliminary approval. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design. Modifications required to meet the municipal standards, if any, will be noted on two sets, with one such set returned to the Developer for final corrections within thirty (30) days of receipt.

7. Six (6) sets of final plans and specifications shall be submitted by the Developer to the City for approval. All plans and specifications submitted for approval shall be sealed by the registered engineer in charge of design.

Standards of Design - Grading

Site grading shall be designed to allow for drainage of storm water away from residential or commercial buildings. Grades shall be such as to minimize earth settlement problems, avoid concentrating run-off onto adjacent properties, prevent creation of water pockets or pools of standing water and to minimize erosion The grading design shall incorporate natural drainage courses where possible. In areas where natural drainage is not present, surface (ditches) or subsurface (storm sewers) drainage shall be provided for collection and disposal of storm run-off. It is the intent of these regulations that the grading design minimize the need for banks, retaining walls or terracing. Minimum grade away from structures shall be two percent. On slopes of 3.5 horizontal to 1 vertical or greater, Class A sodding with pegs must be provided to minimize erosion. The maximum allowable

slope shall be 4.0 horizontal to 1 vertical. Site grading shall conform to the applicable sections of the Soil Erosion and Sedimentation Control Act. Where mulch is required, a mulch adhesive shall be used.

Grading plans for parking lot and sidewalk construction shall conform to the requirements of the Americans with Disabilities Act and the Michigan Barrier Free codes.