SECTION V. SUBDIVISION DESIGN STANDARDS

5.1 Streets

Level of Service. No development shall be approved if such development at full occupancy will result in or increase traffic on any intersecting street so that the intersecting street does not function at a level of service (LOS) of C or better. The applicant shall propose and construct on site and off site traffic mitigation measures to provide adequate roadway capacity for the proposed development. Level of service (LOS) calculations shall be made by the applicant utilizing current industry standards for methodology of analysis and statistics from the most recent edition of the *Highway Capacity Manual* of the Transportation Research Board.

Classification. All streets shall be classified as follows:

Arterial	A street which, in the opinion of the Board, is being used or will be used as a thorough-fare within the City of Haverhill, which will otherwise carry a heavy volume of through traffic, generally over one thousand (1000) vehicles per day. An arterial street is a high volume street which functions to convey traffic through the community and to major state and interstate highways.
Collector	A street which, in the opinion of the Board, is used or will be used to carry a substantial volume of traffic, generally over three hundred (300) and under one thousand (1000) vehicles per day. A collector street serves as a principle traffic artery within residential or commercial areas and conveys traffic between arterial streets, other collector streets and local access streets
Local access	A street which, in the opinion of the Board, is being used or will be used primarily to provide access to abutting lots and to other local access streets which will not be used for through traffic, and will generally carry less than three hundred (300) vehicles per day.

Several additional definitions pertinent to this section are as follows:

Sight distance(intersections)	All intersections shall have adequate sight distance (visibility) for automobiles. Each intersection shall provide a clear sight triangle the entire area of which shall be designed to provide the driver of a vehicle entering the intersection with an unobstructed view to all points 3.75 feet above the roadway along the centerline of the roadway for a distance of 500 feet when a proposed subdivision street intersects with an existing or proposed collector street or an existing or proposed arterial street; or 250 feet when the proposed subdivision street intersects with an existing or proposed local access street.
Street	(a) a public way; or (b) a way shown on a plan approved by the Planning Board under the Commonwealth's Subdivision Control Law.
Cul-de-sac	A local access street with only one vehicular ingress and egress that terminates in a vehicular turnaround having an appropriate terminal for the safe and convenient reversal of traffic.
Dead-end	A street or portion of a street with only one vehicular traffic ingress and egress that does not terminate in a vehicular turnaround. Dead end streets in excess of 200 feet shall not be permitted.
Way	Any point of access to a lot of record which does not classify as a street as specified in the definition of street. In general, a Way is a point of access established prior to the Subdivision Control Law.

Topography, Location, Alignment and Arrangement Standards-General. Streets shall be related appropriately to the topography and arranged so as to be properly integrated with the existing or proposed roadway system.

a. All streets in the subdivision shall be designed so that, in the opinion of the Board, they will provide safe vehicular access and travel. Due consideration shall also be given to the attractiveness of the street layout in order to obtain the maximum livability and amenity of the subdivision.

b. Streets shall be continuous and in alignment with existing streets, so far as practicable, and shall provide a convenient system with connections adequate to insure free circulation of vehicular travel.

c. If adjoining property is not subdivided, but is in the opinion of the Board, suitable for future development, provision shall be made for the proper projection of streets into such property by continuing appropriate streets with the subdivision to the exterior boundary thereof.

d. Temporary cul-de-sac streets, laid out to permit future projection, shall conform to the provisions of alignment, width, and grade that would be applicable to such streets, if extended.

e. Reserve strips prohibiting access to streets and adjoining property shall not be permitted except where, in the opinion of the Board, such strips shall be in the public interest.

f. Roadways shall be constructed for the full length of all streets in the subdivision, except in cases where provision has been made for the projection of streets to adjoining land. The centerline of such roadways shall coincide with the centerline of the exterior street lines unless a deviation has been authorized by the Board.

g. Streets shall be constructed and municipal services installed by the applicant.

Widening and Realignment of Existing Streets. When an applicant's development modifies, extends or continues an existing street or way which does not conform to the standards of these subdivision regulations, the applicant may be required by the board to widen and improve at the developers expense the existing streets or ways so impacted. These streets or ways shall be improved to the standards of these subdivision regulations in order to provide for streets of suitable location, width, and improvements to accommodate prospective traffic and afford satisfactory access to police, fire fighting, snow removal, sanitation and road maintenance equipment and to coordinate streets so as to compose a convenient system and avoid undue hardship to adjoining properties.

Design Standards. In order to provide for streets of suitable location width, and improvements to accommodate prospective traffic and afford satisfactory access to police, fire fighting, snow removal, sanitation and road maintenance equipment and to coordinate streets so as to compose a

convenient system and avoid undue hardship to adjoining properties, the following design standards for streets are hereby required.

General

Street jogs with centerline off-sets of less than one hundred and twenty-five (125) feet shall not be permitted.

The minimum centerline radii of curved streets shall be two hundred and seventy (270') feet.

Streets shall be laid out so as to intersect as nearly as possible at right angles. No streets shall intersect any other street at less than sixty (60) degrees.

The intersection of street lines and the transition to turnarounds shall be accomplished by means of a curve. The complete curve data shall be shown on the plans. The minimum travel radius on turnarounds shall be fifty (50) feet.

When the intersection of two streets varies more than ten (10) degrees from a right angle, the travel radius of the curve at the obtuse angle shall be thirty (30) feet.

Proposed new intersections along one side of an existing street shall wherever practicable coincide with any existing intersections on the opposite side of the street. Where streets intersect arterial or collector streets, their alignment shall be continuous. Intersections of collector streets shall be at least 800 feet apart and local access streets shall be at least 400 feet apart.

Intersections shall be designed with a flat grade wherever practical. In hilly or rolling areas at the approach to an intersection, a leveling area shall be provided having not greater that a 2% rate at a distance of 50 feet measured from the nearest intersecting pavement of the intersecting street.

Where any street intersection will involve earth banks or existing vegetation inside any corner lot that would create a traffic hazard by limiting visibility, the developer shall cut such ground and/or vegetation (including trees) in connection with the grading of the public right of way to the extent deemed necessary to provide an adequate intersection sight distance from the stop line or stop sign location.

The Board shall require that roadway and driveway intersections have adequate sight distance (visibility) for automobiles. Each intersection shall provide a clear sight triangle the entire area of which shall be designed to provide the driver of a vehicle entering the intersection with an unobstructed view to all points 3.75 feet above the roadway along the centerline of the roadway for a distance of 500 feet when a subdivision street intersects with an existing or proposed collector or arterial street or 250 feet when the subdivision street intersects with an existing or proposed local access street. If intersection sight distance is restricted, the Board shall require waivers be granted and that acceptable mitigation improvements be undertaken to improve and maximize the sites visibility.

Width

Right of Way

a. Residential Streets - In all residential zones the streets right-of-way width shall be fifty (50) feet.

b. Business and Industrial Zones - In all business and industrial zones, the street right-of-way shall be sixty (60) feet.

c. Cul-de-sac Turnarounds - The street right-of-way at turnarounds shall be a minimum of one hundred and twenty (120) feet in diameter.

e. Increase/Reduction of Width - The Board may increase or reduce the width of the travel way if deemed necessary to address: (1) both present possible future traffic demands; (2) the preservation of existing site features such as hillsides, wetlands, and the reduction of cutting and filling due to topography conditions found on the site; or (3) other reasons deemed necessary.

Pavement

The minimum width of pavement for roadways between curb lines shall be as follows:

Pavement Sections For Residential Zones:

Collector Streets: Thirty-two (32) feet and a gravel base of thirty-five (35) feet;

Local access Streets: Twenty-eight (28) feet and a gravel base of thirty-one (31) feet.

Pavement Sections for Business or Industrial Zones:

All Streets: Forty (40) feet and a gravel base of forty-three (43) feet.

Greater or lesser pavement width may be required by the Planning Board where deemed necessary for present and/or future vehicular travel.

Grade

a. Grades of streets shall not be less than one (1) percent nor more than seven (7) percent.

b. Where the grade of any street at the approach to an intersection exceeds four (4) percent, a leveling area shall be provided having not greater than two (2) percent grade for a distance of at least fifty (50) feet measured from the nearest exterior line of the intersecting street.

c. Adequate sight distance for a speed of thirty (30) miles per hour should be provided on all vertical or horizontal curves.

Cul-de-Sac Streets

a. Cul de Sac streets shall not be longer than eight hundred (800) feet. The length of a cul-de-sac street shall be measured from its intersection with the nearest through street along the road centerline for its entire length.

b. Cul de sac streets shall be provided at the closed end with a turnaround having an outside property line diameter of at least one hundred and twenty (120) feet.

c. Cul de sac streets may be longer than the required maximum length, if a greater length is necessitated by topography or other unique local considerations and if the Board makes a finding that all of the

conditions listed below are met by the subdivision plan:

1. The roadway may be extended into adjacent property in the future to allow the continuation of the roadway or to help facilitate a roadway connection;

2. No wetlands shall be impacted, except in cases where the property could not gain access for driveways over two hundred (200) feet in length;

3. Topography of the area is level and will not be impacted by a roadway which will necessitate extensive cut and fill of the existing topography; and

4. The roadway once constructed will not exceed grades of seven (7) percent.

Curbing

1. In all subdivisions, curbing shall be installed along both sides of the complete roadway and along the entire cul-de-sac, where applicable. Curbing shall be vertical granite curb (type VA-1) with 7 inch reveal or sloped granite curbing (type SA) with 6 inch reveal. No other type of curbing is permitted.

2. When proposed curbed intersections involve one or more existing streets having a grassed shoulder, the curbing shall be placed within 5' of the edge of the roadway, and the pavement on the street or streets with such shoulder shall be widened to the full width of the roadway (thus meeting the curb) within a distance of 50' of the intersection. tapering down to normal width within 75' thereof.

Sidewalks

Sidewalks shall be provided on each side of any roadway constructed under these regulations unless a waiver is granted by the board. Sidewalks shall be constructed to the following standards.

1. Sidewalks shall have a finished grade of two (2) percent maximum sloping toward the roadway. When unusual physical land characteristics of topographic conditions require, the Board may approve placement of a sidewalk at a greater distance from the roadway or at a higher or lower elevation in relation thereto, provided such variation is approved by the Board as a waiver and indicated on the Definite Plan. Sidewalks of not less than five (5) feet in width shall be constructed on both sides of the street to promote the public safety of pedestrians in the city. All sidewalks shall be constructed to conform with Americans with Disabilities Act (ADA) requirements.

2. In constructing all sidewalks, the material shall be removed for the full width of the sidewalk to a subgrade at least eight (8") inches below the approved finished grade, and also all soft spots and other undesirable material below such subgrade shall be replaced with a good binding material and rolled with a two-ton roller or equivalent. Unless the applicant elects to install cement concrete sidewalks (built according to specifications of the Massachusetts Department of Public Works), the excavated area shall be filled with at least six (6") of select gravel containing some binding material and compressed and rolled to a surface slope of two-percent. Sidewalks shall then be paved to a thickness to two (2") inches with bituminous concrete pavement, applied in two (2) one-inch courses. All pedestrian access ramps shall be cement concrete as specified in the paragraph immediately above.

3. Bikeways and footpaths may be part of the normal sidewalk provisions. They shall be designed with a minimum ten (10) foot right-of-way, six (6) to eight (8) feet in width, maximum gradient of five percent (5%), except for short segments and a minimum radius of twenty-five (25) feet.

4. Public bikeways or footpaths may be required by the Board to provide circulation or access to schools, recreational areas, shops, transportation or community facilities, or for other reasons deemed appropriate by the Board to promote safe access to important areas of the City or to heavily traveled locations.

Grass Strips/Planting Strips

Planting strips shall be provided on each side of the roadway, between the roadway and the sidewalk, in accordance with the following standards.

1. Planting strips shall be required on each side of the roadway, be of a 4-foot minimum width, and be between the roadway and the sidewalk.

2. The finished grade of such planting strips shall be two (2) percent sloping toward the roadway. Where unusual physical characteristics or topographic conditions exist, the Board may approve the construction of a planting strip at a slope greater than two (2) percent, provided the finished slope will not project above or below a plane sloped two horizontal to one vertical upward from the edge of the roadway or top of curb, if any.

3. No trees or other obstruction shall be placed or retained within the planting

strip so as to be closer than two feet (2') from the edge of the roadway. The developer shall install street trees with each planting strip of such species and variety in accordance with the requirements of the Highway Superintendent/ Tree Warden or his designee. In no case shall there be less than two trees per lot.

4. The top four (4) inches of planting strips shall consist to good quality loam, screened, raked, and rolled with a hand roller to grade. The loam shall be seeded with lawn grass seed applied in sufficient quantity to assure adequate coverage and rolled when the loam is moist or some other form of ground cover (plant material) specifically accepted by the Board may be used.

5. Existing trees standing within the exterior street lines which, because of their location, species, and condition are suitable for preservation, shall be shown on the subdivision plan and shall be preserved by the subdivider. The method used for their preservation shall be shown on the plan.

6. New trees shall be at least two and one-half (2.5) inches caliper (caliper at two (2') feet above the ball of the tree) and shall be planted at intervals of every fifty (50) linear feet of roadway subject to the location of driveways, street intersections, or other subdivision features.

7. The developer or builder shall plant at least two (2) trees on each lot between the front line of the house and the street layout lines, or preserve at least two (2) trees in the same area.

8. The species and variety of the trees to be planted shall be approved by the Highway Superintendent/Tree Warden or his designee

Side Slopes /Shoulders

The area in back of the sidewalk shall be formed, graded, and loamed in accordance with the following standards.

1. All areas between the exterior street lines and the curb lines of the roadways thereon which are not occupied by sidewalks shall be graded, and seeded with grass seed. The loam shall be graded so that the surface at the exterior street lines shall be eight (8) inches higher than at the curb line of the roadway.

   Eight (8) foot shoulders shall be provided with 2:1 side slopes (maximum).

2. Where a driveway occurs in the shoulder area, the driveway shall be laid out so that there is a straight grade from the exterior street line to the curb line of

the roadway.

3. The entire width between the exterior street lines shall be graded. Stabilized shoulders shall be constructed on each side of the roadway.

4. In no case shall side slopes outside of the exterior street lines be steeper than two (2) feet horizontal to one foot (1) vertical be constructed except in rock or definite ledge formation, where the maximum slope shall be one (1) foot horizontal to four (4) feet vertical. These maximum slopes shall apply from street lines to the finished grade of adjacent lots.

5. Where maintenance of required slopes is impractical, retaining walls may be constructed, with approval of the Board, of a type specified by the City Engineer and approved by the building inspector.

6. All slopes outside the exterior street lines shall be turfed with grass seed, except those in rock or ledge formations, as soon after roadway construction as practical, as determined by the Engineering Department.

Street Lights

Street lighting with underground wiring along all roadways and cul-de-sacs shall be required to be installed by the owner/developer for all subdivision projects, prior to the base coat paving of each roadway, in accordance with the City Engineering Dept., Massachusetts Electric Company and the Haverhill Wire Inspector requirements, and any Preliminary or Definitive Plans submitted to the Board shall note this requirement.

Street Signs.

1. Street signs and standards bearing the name of the street as indicated on the approved Definitive Plan and the intersecting street shall be erected at all intersections of streets in the subdivision.

2. At all points at which a private street within the subdivision intersects with an existing public way, there shall also be erected on the same standard and immediately above or below the street sign, a sign reading "Private Way".

3. Street signs and standards shall be of a design and material, and shall be installed in conformity with the specifications of the Division of Public Works.

Street Grading/Roadway Surfacing

All roadways shall be brought to a finished grade as shown on the profiles of the Definitive Plan with at least the top fourteen (14) inches consisting of eight (8) inches of good quality bank run gravel with no stones larger than six (6) inches and six (6) inches of processed gravel on top of this and shall be provided with a finished surface for their full width and length.

Roadways shall be constructed for the full length and width. The centerline of such roadways shall coincide with the centerline of the streets right-of-way, unless specifically approved by the Board.

Monuments

Monuments shall be installed at all street intersections, at all points of change in direction or curvature of right-of-way/lines and at other points as on the Definitive Plan and where in the opinion of the Board, permanent monuments are necessary.

1. Monuments shall be set on the exterior street lines at all angle points, at all points of change in direction of curvature, and at all street intersections.

2. Such monuments shall be set in bank gravel with their tops at the proposed finished surface grade, unless the City Engineering Department directs otherwise. Monuments shall be of granite, not less than three (3) foot -six (6) inches long, and not less than six (6) inches square, with the top surface hammer-dressed to a six (6) inch square area. They shall be accurately set on the street lines. A drill hole one-half (1/2) inch diameter by two (2) inches deep shall be placed in the center of the top of each monument.

3. Monuments will be in conformity with the specifications of the City Engineering Department.

4. Driveways shall not be placed at monument locations.

Table 1. Street Cross Sectional Design Standards for Subdivisions

CHARACTERISTIC	COLLECTOR STREETS	LOCAL ACCESS	INDUSTRIAL STREETS
Design Speed	30 mph	30 mph	30 mph
Minimum right-of-way width	50 ft.	50 ft.	60 ft.
Moving Lanes (No.)	2	2	2
Minimum width (each moving lane)	12 ft.	14 ft.	12 ft.
Parking Lanes (No.)	1	0	2
Minimum width (each parking lane)	8 ft.	0 ft.	10 ft.
Total minimum width of roadway	32 ft.	28 ft.	40 ft.
Planting strip minimum width (each)*	4 ft.	4 ft.	0 ft.
Sidewalk minimum width (each)*	4 ft.	4 ft.	0 ft.
Curbing required*	Yes	Yes	Yes

* Shall be on both sides of roadway

Table 2. Geometric Street Design Standards for Subdivisions

CHARACTERISTIC	INDUSTRIAL STREETS/ COLLECTOR STREETS	LOCAL ACCESS STREETS
Horizontal Alignment		
Minimum radius at centerline	500 ft.	270 ft.
Vertical Alignment		
Clear sight distance at 3.75 ft. above pavement	275 ft.	220 ft.
Grade		
a. Maximum	6%	7%
b. Minimum	1%	1%
Intersection of Streets		
a. Minimum intersection angle	60 deg.	60 deg.
b. Minimum centerline offset	125 ft.	125 ft.
c. Minimum radius at edge of roadway	30 ft.	25 ft.
d. Sight distance at intersection	500 ft.	250 ft.
Cul-de-sac Streets		
Maximum length without a turnaround	Not permitted	200 ft.
Maximum length with a turnaround required	Not permitted	800 ft.
Minimum turnaround radius to outside roadway (pavement) line	Not permitted	50 ft.
Minimum radius of turnaround at property line	Not permitted	60 ft.

Table 3. Roadway Construction Standards for Subdivisions

AREA	COLLECTOR	LOCAL ACCESS	INDUSTRIAL
PAVEMENT CLASS	**HEAVY**	**MEDIUM**	**HEAVY**
Asphalt Concrete Surface Course Sec. 460, Class I Bituminous Concrete Pavement Type I-1 (Top course Mix)	1 ½"	1 ½"	1 ½"
Asphalt Concrete Binder Course Sec. 460, Class I Bituminous Concrete Pavement Type I-2 (Binder Course Mix)	2 ½"	2"	2 ½"
Base A. Cohesive compacted to 95% AASHO T180-D to a depth of Sec. 170, Sub-grade **(note # 3)** B. Cohesionless compacted to 100% AASHO T180-D to a depth of Sec. 150, Embankment **(note # 3)**	15" 15"	15" 15"	15" 15"

5.2 Utilities

Water Facilities

1. Water Main Design

   a. Water mains shall be sized for existing and future conditions by a hydraulic analysis based on pressure requirements and domestic, irrigation and fire protection flows. The minimum size of water mains within residential subdivisions shall be eight (8) inches. The minimum size of water mains in all commercial/industrial parks shall be twelve (12) inches. Larger size water mains shall be provided if necessary to maintain minimum pressures specified herein. Smaller mains may be allowed only under special circumstances and must be justified by hydraulic analysis and future water use.

   b. The distribution system shall be designed to maintain a minimum pressure within the subdivision of 35 psi at the highest fixture elevation during Peak Hour Demand and a minimum of 20 psi at ground level under all flow conditions. Higher pressure may be required by the Water Division under special circumstances.

   c. Dead ends shall be minimized by looping of all mains whenever practical. Where dead end mains occur, they shall be provided with a fire hydrant or blow-off approved by the Water Division.

   d. Sufficient valves shall be provided so that inconvenience and sanitary hazards will be minimized during repairs. Valve spacing and location shall be approved by the Water Division. Consideration shall be given to number of services, location of hydrants, future connections, construction considerations, and pipeline control for operation and maintenance. As a minimum, valves shall be located in such number and locations so individual blocks may be isolated for maintenance purposes.

   e. Locations of fire hydrants shall be determined by the Water Division and the Fire Department. All city fire hydrants shall be located within street right-of-ways or approved easements. No service connections or water main connections are allowed on a fire hydrant branch.

   f. All bends, reducers, tees, plugs, caps, and fire hydrants shall be provided with concrete thrust blocks or suitably restrained joints. Thrust resulting from the closure of valves shall also be considered

and thrust restraint provided as necessary.

g. At high points in water mains where air can accumulate, provisions shall be made to remove air by means of a fire hydrant or air relief valve. Automatic air release valves shall not be used where the valve is subject to flooding.

2. Water Main Materials

a. Pipe, fittings, valves, fire hydrants, and all appurtenances shall be in accordance with the latest American Water Works Association (AWWA) Standards and requirements of the Water Division.

3. Water Main Installation

a. Pipe, fittings, valves and fire hydrants shall be installed in accordance with the latest version of AWWA C600 Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances and requirements of the Water Division.

b. All water mains shall be installed at a depth sufficient to provide a minimum of 5 feet of earth cover to protect against freezing. Maximum depth of cover shall be 7 feet.

c. Water mains shall be pressure and leakage tested in accordance with the latest version of AWWA C600 Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances, and requirements of the Water Division.

d. All new and repaired water mains shall be disinfected in accordance with the latest version of C651 AWWA Standard for Disinfecting Water Mains and requirements of the Water Division.

e. Water mains shall not be put in service until all testing, disinfecting, and flushing are completed successfully as approved by the Water Division. Written test results for leakage and chlorination shall be submitted to the Water Division. Pressure testing and chlorination shall be witnessed by a representative from the City.

f. During the installation of water mains the Developer or his agent shall make field tie measurements from permanent structures to locate valves, fittings, service connections, crossings of sewers and drains, and any other significant feature. Developer or his agent shall make field measurements along the pipe between bends, valves, fittings, service connections, crossings of sewers and drains, and any other significant feature. Clear and accurate field notes shall be kept and shall be available for inspection by the Water Division. Copies of field notes shall be provided to the Water Division.

g. Utility line markers shall be installed on all cross-country water mains. Markers shall be located at all bends and not less than 250 feet apart on straight runs. Utility markers shall be as specified by the Water Division.

4. Separation Of Water Mains And Sewers

a. Where a water main is parallel with a proposed or existing sewer(s), the water main shall be laid with at least 10 feet of horizontal clearance from the sewer(s). Where it is not practical to maintain 10 feet of horizontal clearance, the water main shall be laid in a separate trench or on an undisturbed shelf on the side of the sewer and at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

b. Water mains crossing existing or proposed sewers shall be laid above the sewer with at least 18 inches of vertical clearance between the water main and the sewer. At crossing, one full length of water pipe shall be located so both joints will be as far from the sewer as possible.

c. Water mains shall not pass through or come into contact with any part of a sewer manhole.

5. Pumping Stations

a. Booster pumping stations may be required in some areas to provide adequate pressure and volume. Booster pumping stations will be considered as a special feature and will be considered on an individual case basis. The Water Division will determine the areas where booster pumping is required and whether individual booster systems or a pumping station is required.

b. Pumping stations shall be designed and constructed in accordance with requirements of the Water Division.

6. Service Connections

a. Materials, manufacturers, models, sizes, and accessories for pipe, fittings, valves, and backflow devices for services shall be in accordance with all State and City codes, and requirements of the Water Division.

b. Installation of services for residential, commercial, industrial and fire protection shall be in accordance with requirements of the Water Division at the time the service is installed.

c. Water meter manufacturer, type, model, size, meter reading

equipment, and appurtenances shall be in accordance with requirements of the Water Division. Water meters shall be supplied by the Developer. Size of the meter will be determined by the Water Division at the time application is made for the service.

7. Public water system shall be protected against backflow. Cross connection installations must be approved and permitted in accordance with Massachusetts Drinking Water Regulations, 310 CMR 22.22; City Council Document #59 of March 1989; and requirements of the Water Division.

8. Private Water Supplies (private wells)

   a. Private water supplies (private wells) shall be designed and constructed in accordance with the Drinking Water Regulations of Massachusetts, and applicable City of Haverhill Board of Health regulations, and Title V of the State Environmental Code.

   b. Private water systems that are serviced by the municipal sewage system shall have a water meter for billing purposes. The water meter and appurtenances shall be in accordance with Water Division requirements.

9. As-built plans of the water system and services must be submitted to the Water Division before any water will be turned on.

Wastewater Facilities

1. Gravity sewers shall be designed according to WPCF Manual of Practice No. 9 (Design and Construction of Sanitary and Storm Sewers) and good professional engineering practices.

2.Gravity sewers shall be sized for existing and projected future flow conditions for the entire drainage basin area to be serviced. The Wastewater Division reserves the right to size sewers to provide service for projected future needs. Sewers shall be sized such that peak flow shall not exceed the following percentage of full capacity of the pipe:

Pipe Diameter (inches)	Percent of Full Flow Capacity

8 – 12	50
15	60
18	70
Over 18	75

The minimum size of sewers in residential subdivisions shall be eight (8) inches. The minimum size of sewers in all commercial/industrial parks shall be twelve (12) inches. Smaller size sewers may be allowed only under special circumstances and must be justified by hydraulic analysis and projected future needs.

3. The design flow velocity shall not be less than 2 feet/second and not greater than 10 feet/second at peak flow. The slope between manholes shall be uniform. Slopes of 1.0 percent or greater are preferred and in no case shall the slope be less than the following:

Pipe Diameter (inches)	Minimum Slope (ft/ft)
8	0.0040
10	0.0028
12	0.0022
15	0.0015
18	0.0012
21	0.0010

Supercritical velocities will not be allowed in sewers.

4. Manholes shall be installed at the end of each line, at all pipeline intersections, changes in grade, pipe size and alignment and at distances not greater than (300') three hundred feet. Manholes shall be located to allow access by maintenance vehicles. Manholes shall be located and constructed to prevent the entrance of surface water.

5. The inside diameter of manholes shall not be less than the following:

Pipe Diameter (inches)	Manhole Size (ft)
8 - 16	4.0
18 - 30	5.0
36 and larger	6.0

Manholes with inside drop shall have a minimum inside diameter of (5) five feet.

6. Drop manholes shall be internal drop type manholes and only used where approved by the Wastewater Division. Drop manholes shall be in accordance with Wastewater Division requirements.

7. The slope of the manhole invert channel shall not be less than the most restrictive slope of the pipe in or out of the manhole. Changes in direction shall not be greater than 90 degrees. Where sewer lines intersect or change directions within a manhole, invert channel shall be a smooth curve with a radius tangent to the adjoining pipelines.

8. Inverted siphons, stream crossings, railroad crossings and other structures for wastewater collection shall be considered on an individual case basis.

9. Materials for sewer pipe, manholes, services and all appurtenances shall be in accordance with Wastewater Division requirements.

10. Installation

    a. Sewer pipe, manholes, services and all appurtenances shall be installed in accordance with Wastewater Division requirements.
    b. All gravity sewers shall be installed at a depth sufficient to receive the contributed flows from the tributary area by gravity flow. The minimum depth of earth cover shall be (6) six feet for sewer lines under streets and (4) four feet for cross-country sewer lines.
    c. Sewer pipe, manholes and appurtenances shall be cleaned, tested and television inspected in accordance with Wastewater Division requirements. Submit copies of inspection videocassettes to Wastewater Division. All testing methods shall be as required by the Wastewater Division. Sewer lines and manholes shall not be put into service until all cleaning, testing and video inspection is completed successfully and approved by the Wastewater Division.
    d. During the installation of force mains the Developer or his agent shall make field tie measurements from permanent structures to locate valves, fittings, and any other significant feature. Clear and accurate field notes shall be kept and shall be available for inspection by the Wastewater Division. Copies of field notes shall be provided to the Wastewater Division.
    e. Utility line markers shall be installed on all cross-country force mains. Markers shall be located at all bends and not less than 250 feet apart on straight runs

11. Separation of water mains and sewers shall be as specified in Section 6.2.1 Paragraph 4.

12. Pumping Stations

    a. Sewer lift stations and individual sewer ejector systems may be permitted on a case-by-case basis as approved by the Wastewater Division. Sewer lift stations and force mains shall be designed, constructed and tested in accordance with requirements of the Wastewater Division.

13. Service connections shall be in accordance with Wastewater Division requirements.

14. As-built plans of the wastewater collection system and services must be submitted to the Wastewater Division before any system will be approved for service.

15. Private Individual Sewage systems

    a. Individual systems for the disposal of sanitary sewerage in areas where municipal sewerage systems are not accessible shall be designed and constructed in accordance with Title V of the State Environmental Code of the Commonwealth of Massachusetts and applicable City of Haverhill Board of Health regulations.

    b. Community-type systems shall be subject to the standards of the Massachusetts Department of Public Health and approved by the City Board of Health.

Drainage Facilities

Must meet current Stormwater Rules and Regulations for this entire section.

1. Adequate drainage of all lots and improvements to the subdivision will be provided for. In no case will the natural contour of the land be changed to direct drainage onto adjacent land. Drainage from adjacent land will be adequately accommodated. The drainage system from any subdivision will not create an adverse effect on any other person's land.

2. Drainage calculating shall be provided for the subdivision for the two (2), ten (10) and one hundred (100) year storm events using one of the following methods:

    SCS TR55
    SCS TR20

3. Storm drains, culverts, and related facilities shall be designed to permit the unimpeded flow of all natural water courses, to ensure adequate drainage at all low points in streets, to control erosion, and to intercept storm water run-off along streets at intervals reasonably related to the extent and grade of the area being drained. To the maximum extent feasible:

   a. Storm water shall be recharged rather than piped to surface waters; and

   b. Peak flow rates at the boundaries of the development shall be no higher following development than prior to development.

4. Catch basins shall be installed on both sides of the roadway at all low points in the road profile, at a distance no greater the three hundred (300) feet from the crest of summit curves and at each multiple of three hundred (300) feet thereafter, and prior to all corners of intersections, except where the grade declines to the intersection on both streets in which case the catch basins shall be located at the bisector of the curb. In the latter case, gutter profiles shall be submitted for approval to indicate the slope and location of the gutter grade. A catch basin to drain manhole configuration shall be used. A manhole shall be constructed at all angle points, grade changes of the pipe, and all points of entrance or exit to the drain system. Drain manholes shall be constructed at a minimum of three hundred (300') feet apart. Catch basins shall be placed three hundred (300') feet apart.

5. Headwalls shall be constructed at all inlets and outlets to the piped drainage system and shall be either:

   a. Formed and poured concrete with chamfer edges

   b. Stone and mortar

   c. Precast flared sections

   All headwalls shall be of good workmanship and finish. Construction details of any headwall to be used shall be submitted to the Planning Board for approval and become part of the subdivision plans. Headwalls shall conform to the following minimum specifications:

   Concrete Headwalls:

   a. Footings shall be of concrete to a depth of three (3) feet below grade and a width of two (2) feet;

b. Above grade, it should be one (1) foot thick and the width and length and taper (if required) would be determined by height of planned grade to be established; and the diameter of the pipe;

c. If the footage is poured prior to top, 3/4 inch grade 60 rods shall be inserted into footings to a depth of two (2) feet and protrude two (2) feet above;

d. Concrete to be of at least 4,000 psi. and all work to be of good quality workmanship and finish.

Stone Headwalls:

a. Footings shall be three (3) feet in depth and two and one-half (2.5) feet in width of concrete;

b. Stone laid in good quality cement mortar starting at one (1) foot below grade;

c. Width of wall shall be twenty (20) inches; height, length, and taper (if required) to be determined by height of planned grade to be established; and the diameter of the pipe;

d. Stone shall be one man size and all joints to be flush and solid; all work to be of good workmanship and finish.

6. Where an existing brook is to be used as an outlet, the drainage system shall be piped to the brook. Should this outlet extend beyond the subdivider's property an open ditch of a type and size approved by the Engineering Department may be used on the adjoining property, after acquisition of the necessary easement including a "Right to Outlet" the proposed size of pipe.

7. Any connection to the street drainage system by private lot or cellar drain shall be constructed in accordance with specifications of the Department of Engineering and shall require written approval of the Department of Engineering, including release of the City of maintenance responsibility. Any such connection shall also have the written approval of the Board of Health if such proposed drain was not shown on the subdivision plans.

8. Proper connection shall be made with any existing drains in adjacent streets or easements which prove adequate to accommodate the drainage flow from the subdivision. In the absence of such facilities or inadequacy of the same, it

5.3 Design Standard for the Flood Plain District

1. All subdivision proposals and other proposed new development shall be reviewed to determine whether such proposals will be reasonably safe from flooding. If any part of a subdivision proposal or other new development is located within the Flood Plain District as shown on the Federal Emergency Management Agency Flood Hazard Boundary Map, it shall be reviewed to assure that:

    a. The proposal is designed consistent with the need to minimize flood damage; and

    b. All public utilities and facilities, such as sewer, gas, electrical, and water systems shall be located and constructed to minimize or eliminate flood damage; and

    c. Adequate drainage systems shall be provided to reduce exposure to flood hazards; and

    d. Base flood elevation (the level of the 100 year flood) data shall be provided for that portion within the Flood Plain District; and

    e. The registered professional engineer shall certify the Definitive Plan has been prepared in compliance with (a) through (d) above.

5.4 Additional design standards

1. Utility systems, such as electricity, telephone, cable television, and gas shall be installed entirely underground, within the limits of the subdivision. Plans of electric, telephone, and gas systems shall be provided to the Engineering Department prior to installation.

2. Utility systems will be installed so that service may be extended to each lot shown on the plan, whether or not there is a building thereon, without need to penetrate the paved roadway surface at such future time as the service extension may be made.

Easements

1. Easements for utilities and storm drains across lots or centered on rear or side lot lines shall be provided where necessary and shall be a minimum of

twenty-five (25) feet wide.

2. Where a subdivision is traversed by a water course, drainage way, channel, or stream, the Board may require that there be provided a storm water or drainage easement of adequate width to conform substantially to the lines of such water courses, drainage way, channel, or stream, and to provide for construction or other necessary purposes.

3. Where side slopes outside of the exterior street lines, steeper than four feet (4') horizontal to one foot (1') vertical, are to be constructed, the City shall be granted and conveyed an easement for maintenance or these slopes.

4. All easements proved for utilities or for public or private improvements and any other easement that the Planning Board deems necessary shall be granted to the City of Haverhill. A copy of the written easement, along with a registered land surveyor's plan of the easement, shall be provided to the Planning Board for filing. Also, to any and all departments or Boards affected and recorded in the appropriate Registry of Deeds at the expense of the grantor.

I. Lots-layout, configuration and access

1. All lots shown on any plan shall comply with the area, frontage, and other requirements of the Zoning Bylaw of the City of Haverhill. All lots shall have adequate actual access to the building site and buildable portion of the lot directly from an approved street. Such actual access shall be provided from the required frontage to the building site. Actual access to lots shall be such that it provides for safe easy access for public safety vehicles including fire, police and ambulance units. Actual access shall not exceed 200 feet for purposes of this section without a waiver from the planning board.

2. Not more than one building designed for use or available for use for dwelling purposes shall be erected or placed or converted to use as the consent of the Board and such consent may be conditioned upon the providing of adequate ways furnishing access to each site for such building in the same manner as otherwise required for lots within a subdivision.

J. Protection of Natural Features

1. Due regard shall be shown for all natural features, such as large trees, stone walls, water courses, areas of archaeological interest, scenic points, historic

structures or landscapes, and similar community assets, which, if preserved, will add attractiveness, distinctiveness and value to the subdivision, or to the City.

2. The Planning Board may require such conditions as deemed necessary to protect such natural and man-made features of the landscape to insure its preservation during and after construction.

5.5. Design Standards for Open Space Cluster projects

Where the applicant proposes a project in compliance with the zoning ordinance section 255-88, the applicant may propose subdivision design standards which are suitable for waivers of conditions as discussed above. These waivers of conditions for roadways, drainage etc. must in the opinion of the board be warranted as a result of the substantial commitment of open space within the project and compliance with the zoning ordinance requirements for open space cluster projects.

[insert requirements and standards]

5.6. Public Safety Design Standards

The Planning Board shall consider in addition to all roadway access considerations for fire safety, the following criteria when approving a preliminary or definitive plan:

When fire safety response time to a proposed subdivision exceeds four(4) minutes from a manned fire station facility, then residential sprinklers shall be required to be installed in each unit; and /or

If response distance exceeds 1.5 miles for an engine company or 2.5 miles for a ladder company from a manned fire station facility, then residential sprinklers shall be installed in each unit.

When water volume for fire suppression is less than ISO requirements or less than 500 GPM for Two(2) hours at the proposed site, then residential sprinklers shall be installed in each unit.

In addition to the above all buildings shall be in compliance with the current updates of the following Building codes MGL 148 and CMR 527 and NFPA 101.