DESIGN CRITERIA FOR PUBLIC IMPROVEMENTS
2021

HIGHLAND CITY

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Ordinance No. O-2021-25

DESIGN CRITERIA FOR PUBLIC IMPROVEMENTS
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DIVISION 1 GENERAL REQUIREMENTS

Section 1.01 PURPOSE OF DOCUMENTS

The purpose of the Design Criteria is to govern any design and engineering performed regarding public improvements. Engineers and designers working on projects within Highland City should thoroughly read and understand these requirements before designing and creating construction plan sets for public improvements.

This division contains design criteria that are in addition to normal and acceptable engineering practices including APWA, AWWA, AASHTO, and ACSE standards and are to be used on designs in the City. The City Engineer shall have authority to modify the criteria as needed to meet changing or unusual needs or conditions.

Section 1.02 USES OF THESE CRITERIA

The criteria contained in this document are organized into divisions and sections covering specific areas of design. It will often be necessary to use a number of sections for the design of a single project. For instance, the design of a street may require the use of standards regarding streets, sidewalks, pressure pipe, sewer, and storm drain.

These standards are a guide for design, but not a substitute for good engineering. It is the obligation of the designer to use these standards responsibly and professionally to produce designs conforming with commonly accepted engineering practices and the Code of Professional Conduct. It will at times be desirable and/or necessary to vary from the standards in this document to produce a good product. When the need arises, please refer to the following section on modifications.

Section 1.03 MODIFICATIONS

If a person believes it is necessary or desirable to modify the technical requirements and standards presented in this document in connection with a particular improvement, a request for modification may be requested from the City Engineer. Such a request shall be made in writing and will include:

a) The standard to be modified.
b) The proposed modification.
c) Justification for the modification.

A written response will be given within a reasonable timeframe of the submittal of the request. A modification determination may be appealed to the appropriate land use authority. If a request seeks a modification of a land use regulation, the person shall follow the City's variance process.

Section 1.04 AMENDMENTS

Amendments to these standards may be requested by writing the City Engineer with details and justification for an amendment. The City Engineer along with the City Staff will meet periodically to discuss proposed amendments and make recommendations to the City Council. The City Council will entertain changes to the standards once a year at their discretion.

DIVISION 2 STREET DESIGN CRITERIA

Section 2.01 GENERAL

The following street design criteria shall apply to all street designs in the City. It will be necessary to refer to the current master transportation plan for correct street designation. Design shall comply with the current AASHTO guidelines on geometric design. Additional design criteria are specified in the Standard Drawings.

Section 2.02 STREET CLASSIFICATION

Streets will be classified according to their functional use as described below. Existing facilities may not fully comply.

Sub-Section A. Arterials:

The arterial streets provide continuous routes for the movement of large volumes of all types of through traffic across Highland and between Highland and outlying areas. Geometric design and traffic control should emphasize the safe movement of through traffic and minimize property access. Access to arterials shall be limited from local streets or individual driveways. Arterials will typically be multi-lane streets and shall have separate turning lanes at intersections. Arterials will connect to the Expressway system.

Sub-Section B. Collectors:

The collector streets provide continuous routes for the movement of large volumes of all types of through traffic across Highland and may also connect to outlying areas. Geometric design and traffic control should emphasize the safe movement of through traffic and minimize property access. Access to collectors shall be limited from local streets or individual driveways. Collectors will typically be two-lane streets with separate turning lanes at intersections and may be multi-lane streets if warranted by traffic volumes.

Sub-Section C. Local Streets:

The Local Streets serve as a means of access to abutting property. They are intended to serve low speeds, short trip routes, and a relatively uniform low traffic volume.

Sub-Section D. Design Vehicle for Classification Type:

All street classifications are designated to carry passenger vehicles and up to the following Design Vehicle Types:

1) Arterial Streets up to WB50.
2) Collector Streets up to WB40.
3) Local Streets up to SU30.

Section 2.03 TRAFFIC IMPACT STUDIES

A traffic impact study may be necessary to identify, review and make recommendations for mitigation of the potential impacts a development may have on the roadway system. Physical and operational characteristics of the roadway are typically identified. The development design engineer is expected to follow the Utah Department of Transportation document entitled “Traffic Impact Study Requirements” (current edition). Generally, a traffic study may be required for all developments expected to produce over 100 average daily trips (ADT). The City engineer will have the authority to dismiss this requirement if it can be illustrated that the traffic impact will be negligible on the roadway system. All developments expected to produce over 100 ADT must be discussed with the City Engineer to determine the necessity of this requirement.

Section 2.04 MINIMUM AND MAXIMUM GRADES

The minimum acceptable grade slope measured at the centerline of the street is one-half percent (0.5%). The flow line of curb returns, knuckles and cul-de-sacs' shall also be no less than one-half percent (0.5%). The maximum slope varies depending on road classification. The sub-sections below shall be used to determine maximum slope.

Sub-Section A. Arterials and Collectors:

Arterial and Collector streets shall be limited to a maximum grade of eight percent (8%). Sustained grades (600 feet or more) shall be limited to seven percent (7%).

Sub-Section B. Local Streets:

Local streets shall be limited to maximum grade of twelve percent (12%). Sustained grades (600 feet or more) shall be limited to eight percent (8%).

Sub-Section C. Cul-de-sacs:

Cul-de-sacs shall be limited to a maximum grade of six percent (6%). The cul-de-sac shall terminate at the bulb with a grade not to exceed three percent (3%) for the last one hundred feet (100') of traveled surface.

Sub-Section D. Vertical Alignment:

All changes in vertical alignment shall be made by vertical curves with minimum length of one hundred feet (100') for local streets and three hundred feet (300') for arterial and collector streets. Actual vertical curve length shall be a function of design speed.

Section 2.05 STREET DESIGN

The following street design criteria shall apply to all street designs in the City. Additional design criteria are specified in the Standard Drawings.

Sub-Section A. Design Speeds:

The design speed will be used to design and establish geometric features including sight distance, intersections, etc. to current AASHTO standards. The following minimum design criteria shall be met:

1) Local streets shall be designed to at least 30 mph.
2) Collector streets shall be designed to at least 40 mph.
3) Arterial streets shall be designed to at least 50 mph

Posted speed limits shall be 5 mph less than the listed design speeds.

Sub-Section B. Horizontal Curves:

Changes in horizontal alignment of over one degree shall be made using horizontal curves. In some cases horizontal alignment changes on local streets may be allowed without a horizontal curve if the resulting alignment functions as a two-legged intersection.

1) Local streets shall have a centerline radius of at least 150 feet.
2) Collector streets shall have a centerline radius of at least 370 feet.

Sub-Section C. Vertical Curves:

Streets shall be designed with vertical curves where grade changes greater than 1% occur. Vertical curves shall be designed using the appropriate design speed according to the latest AASHTO design guidelines. It is encouraged to include the "K" value in the profile illustrating the vertical curve.

Sub-Section D. Cul-de-sacs:

The cul-de-sac shall be limited to a maximum length of six hundred feet (600') as measured from the intersection centerline to the center of the cul-de-sac. Cul-de-sacs shall have a minimum radius of fifty feet (50'). Cul-de-sac returns shall have a twenty-four foot (24') radius at TBC. Downhill cul-de-sacs are strongly discouraged and may only be allowed if it can be demonstrated that surface drainage will be controlled in a manner acceptable by the City Engineer and approved by City Council.

Sub-Section E. Widening Asphalt along an Existing Road:

When a development project requires asphalt widening due to the placing of new curb and gutter along an existing road, the existing asphalt shall be cut a minimum of two feet (2') from the lip of gutter and twelve inches (12") from the existing edge of asphalt. The cross slope of the new asphalt must be between one percent (1%) and four percent (4%). The construction drawings must adequately show the cross slope and the asphalt "saw cut line" required to create the slope. Overlays shall be a minimum thickness of two inches (2").

Sub-Section F. Finished Width of Exterior Roads:

When roads are designed along the exterior of developed property, a minimum of ten (10) feet of unobstructed asphalt on the opposite side of the designed centerline must be constructed. Depending on the classification of the road, additional width may be requested by the City.

Sub-Section G. Lane Widths, Turning Lanes and Clear Zones:

1) The minimum traffic lane width will be 12 feet. Pavement widths are as defined in the Highland City Standard Drawings.
2) Turning lanes shall be incorporated on arterial and collector street designs. Length of separate turning lanes shall be designed using the currant addition of AASHTO and based on a capacity analysis. Width of separate turning lanes shall be 12-foot width for arterial streets and 12-foot width for collector streets.
3) A three (3) foot clear zone shall be required on all streets built with a curb and having a speed limit of 25 mph or less. Streets with speed limits greater than 25 mph will use the AASHTO Standard to determine clear zone limits. Modifications to clear zone requirements will be considered for overhead electrical facilities where compliance will significantly impact existing trees. In no case will a clear zone of less than eighteen (18) inches be allowed. A clear zone modification must be approved by the City Engineer.

Sub-Section H. Pavement Loading and Design:

Asphalt shall be PG 58-28 Performance Graded Asphalt Cement placed in maximum of four (4) inch lifts. Road base shall be compacted to ninety-five percent (95%) modified proctor.

1) Table 2.1 illustrates the minimum requirements to be used for the roadway structural sections.

TABLE 2.1

MINIMUM STREET CROSS SECTION			
	Asphalt	Road Base	Sub Base
Residential	3"	8"	*
Collector	4"	8"	*
Arterial	6"	8"	*

* The Northwest Area of Highland City or Dry Creek Bench Area, shall have an 18" minimum sub base with an underlying woven geotextile as per APWA Section 31 05 19 on all street cross sections.

Sub-Section I. Pavement Placement:

Asphalt shall be placed between April 1st and October 31st per current APWA Standard Specifications. No Asphalt construction will be accepted by the City outside of these dates.

On new roadways to be dedicated to the City the Developer shall either 1) provide a high density mineral bond seal coat over the hot mix asphalt at the end of the one year warranty period, or 2) make a cash payment for Highland City to do it. The amount of the cash payment shall be determined by the City Engineer. The high density mineral bond seal coat shall be placed per APWA Section 32 01 13.68.

Section 2.06 INTERSECTION DESIGN

The following intersection design criteria shall apply to all intersection designs in the City. Additional design criteria are specified in the Standard Drawings and the American Public Works Association (APWA) Manual of Standard Specifications.

Sub-Section A. Street Alignment and Offsets:

Angular street alignment at an intersection shall be as close to perpendicular as possible. In no case shall an intersecting street be more than 10° from perpendicular. Centerlines of opposing streets should match at the intersection whenever possible. Offsets of up to ten (10) feet may be allowed in a single intersection but separate intersections must have at least one hundred fifty (150) feet of separation.

Sub-Section B. Curb Returns:

Curb returns shall be designed such that there is a smooth transition from one leg of the intersection to another, using vertical curves where grade changes greater than 2% occur. The designer shall include enough information on the plans to demonstrate compliance. In some cases, this requires profiling the top back of curb through the curb returns. Elevations at the PC, PT, and appropriate sub-divided delta (central angle) locations will be required. Curb returns shall have a twenty-four foot (24') radius at TBC.

Sub-Section C. ADA Curb Ramp Design:

Curb ramps shall be designed in accordance with current ADA standards and guidelines, and shall meet the Accessibility Standards found in the Highland City Standard Specifications. The standard drawings also include specific dimensional information.

Sub-Section D. Stop Controlled Grades at Intersections:

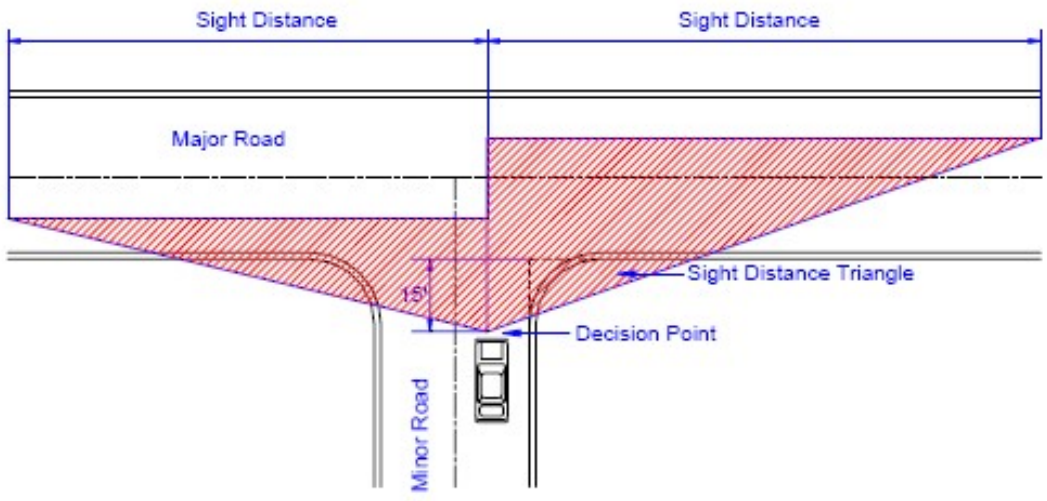
Streets that will have stop control at an intersection shall not have a grade slope of greater than three percent (3%) for a distance of fifty (50) feet from the intersecting streets right-of-way.

Sub-Section E. Roundabout Design:

Roundabouts shall be designed in accordance with the U.S. Department of Transportation publication FHWA-RD-00-067 (*Roundabouts: An Informational Guide*). Roundabouts in local streets shall also follow the criteria shown in the standard drawings. The engineer shall submit the circulatory design speeds with the design drawings.

Sub-Section F. Site Distance Triangle:

A clear line of sight must be provided at all intersections. The "Sight Distance Triangle" must be calculated using the stopping "Sight Distance" of the road being intersected. The stopping "Sight Distance" is 200 feet for a Local street, 300 feet for a Collector and 425 feet for an Arterial. The figure below illustrates the required "Sight Distance Triangle" based on the "Sight Distance". Compare to drawing.



Section 2.07 CITY UTILITY CONDUITS

Four (4) inch gray PVC utility conduits shall be placed in bundles of three (3) at each leg of intersections, at the bulb of cul-de-sacs and every three hundred (300) feet. A single conduit for lighting shall be placed for lighting if conduit bank is not near.

Section 2.08 STREET LIGHTING

Double head type street lights shall be placed at intersections and every three hundred (300) feet on all collector and arterial streets.

Single head type street lights shall be placed at intersections and every three hundred (300) feet and at the end of cul-de-sacs on all residential streets.

Section 2.09 ADDRESSING

The following addressing design criteria shall apply to all addressing of city streets and lots in the City. All addressing shall be reviewed and approved by the City Engineer.

Sub-Section A. Street Addressing:

Street addresses shall have a name and a number ending in zero digits. Only provide street names on the Plat without the street numbers. Provide both the street names and the numbers on the design drawings.

Sub-Section B. Lot Addressing:

Lot addresses shall end in non-zero digits. Corner lots require both addresses for optional siting. Use 6.6 feet per digit to determine lot address. Even numbers on North and East side, and odd numbers on South and West side of the street.

Section 2.10 PARKWAY LANDSCAPING

Landscape plans for parkways shall be stamped be a licensed landscape architect. The design shall include a sprinkler design, with approved materials, and with approved plantings as outlined in the City Ordinances and Development Codes.

DIVISION 3 SEWER DESIGN CRITERIA

Section 3.01 GENERAL

All sanitary sewer design shall comply with Utah Department of Environmental Quality, Division of Water Quality as Administrative Rules for Design Requirements for Wastewater Collection, Treatment and Disposal System, R317-3. The following sewer design criteria shall apply to all gravity sewer system designs in the City. Additional design criteria are specified in the Standard Drawings.

Section 3.02 SEWER PIPE DESIGN

Sub-Section A. Pipe Material:

Gravity sewer pipe and fittings shall be PVC material and conform to ASTM D3034, for diameters from four inch (4") to fifteen-inch (15") and ASTM F679 for eighteen-inch (18") to twenty-seven-inch (27"), with integral bell gasket joints. Rubber gaskets shall be factory installed and conform to ASTM F477. Pipe shall be made of PVC plastic having a cell classification of 12454A or 13364B (with minimum tensile modulus of 500,000 PSI) as defined in ASTM D1784 and shall have a SDR of 35 and minimum pipe stiffness of 46PSI according to ASTM test D2412.

Sub-Section B. Pipe Sizing and Slope:

A Residential Annual Average of 80 gpcd shall be used for sewer main sizing in residential areas which includes infiltration, inflow, and extraordinary flows. Non-residential areas include commercial, industrial, and institutional areas. Non-residential flows shall be determined from average indoor water use. Roughness Coefficient N = 0.013 shall be used for gravity sewer design and C = 120 for force mains.

The minimum sewer pipe shall be eight-inch (8”) diameter and shall be designed at a grade no flatter than that, which is specified in the table below. If the State guidelines require steeper grades than indicated below, the State guidelines shall apply. The engineer shall coordinate the pipe size with the City Engineer for future design capacities. Any connections to one of TSSD lines require prior approval from TSSD and any applicable fees will be paid for by developer.

8-inch sewer lines	0.0033 foot/foot
10-inch sewer lines	0.0025 foot/foot
12-inch sewer lines	0.0019 foot/foot
15-inch sewer lines	0.0014 foot/foot
18-inch sewer lines	0.0012 foot/foot
21-inch sewer lines	0.0010 foot/foot
24-inch sewer lines	0.0008 foot/foot
Larger than 24-inch	City Engineer’s Approval

Unless otherwise approved and/or required by the City Engineer, sewer lines eight (8) through fifteen (15) inches in diameter shall be designed to flow no more than half-full during peak flow. Sewer lines larger than fifteen (15) inches in diameter shall be designed to flow seven-tenths full.

No sewer main lines are to be laid at less than 0.50% unless approved by city. Maximum sewer main slope not to exceed 12% unless approved by city.

All sewers shall be designed and constructed to give mean velocities of not less than two (2) feet per second at peak design flow, based on Manning’s formula using an n value of .013. Absolute minimum slope allowed shall be those published by the Utah Department of Environmental Quality, Division of Water Quality as Administrative Rules for Design Requirements for Wastewater Collection, Treatment and Disposal System, R317-3, Table R317-3-2.3 (D)(4)

Top of pipe bury depths shall be between ten (10) and twelve (12) feet below finished grade.

Locator tape shall be installed twenty-four inches (24") above pipe.

Section 3.03 MANHOLE DESIGN

Sub-Section A. Manhole Sizing:

Minimum manhole interior diameter is five-foot (5'). The diameter of the manhole shall be determined by the intersection pipe sizes and the clearances required between the pipes for proper construction. Generally there should be a minimum of twelve inches (12") clear distance between any two connecting pipes.

All manholes and combination boxes shall feature steps made of copolymer polypropylene conforming to ASTM D-4101.

Pipe inverts through a manhole shall have a minimum two-tenths (0.20) fall from the inlet to the outlet when the pipes are greater than 100° apart in alignment. When the pipes are 90° to 100° apart in alignment, three-tenths (0.30) fall will be required. Pipe alignments under 90° will not be allowed and will require the construction of additional manholes.

Sub-Section B. Manhole Spacing and Locations:

Spacing between manholes shall be no more than four hundred (400) feet and placed at all changes of grade, pipe size, alignment, and at intersections unless special approval is granted by the City Engineer.

A manhole must be provided at the end of all piping sections in a development. The manhole must be located as close to the edge of the project as reasonably possible when future adjacent land development is possible. A pipe stub of equivalent pipe diameter shall be placed in the manhole for future connection. The stub shall have a plug installed at the end of the pipe. No service laterals will be allowed in the stub.

Section 3.04 LATERAL CONNECTIONS

Lateral connections directly into a manhole will not be allowed. Wherever possible, buildings shall be discharged to the Sewer Main Line with a gravity flow Sewer Lateral. Sewer Laterals shall conform to the requirements of the Utah County Department of Health Regulations and the Uniform Plumbing Code.

Each unit of separate ownership shall be required to have a separate sanitary Sewer Lateral, unless otherwise approved by the City Council.

Sewer Laterals shall have at least four (4) feet of cover, unless otherwise approved by the City Engineer.

All sewer laterals shall be located ten (10) feet from the lot center line on the downhill side and stamped with "S" on the curb at the lateral location.

Sub-Section A. Gravity Sewer Laterals:

The size of Sewer Laterals shall be determined on the basis of the total fixture units drained by such sewer, in accordance with the Uniform Plumbing Code. The minimum size for gravity Sewer Laterals shall be four (4) inches in diameter. Sewer Laterals shall be run at a uniform slope of not less than 2% grade. Where it is impractical to run the sewer at a 2% grade due to the depth of the Sewer Main Line, Sewer Laterals may be run at 1% grade if approved by the City Engineer. Cleanouts shall be installed at not more than 100-foot spacing. No more than two (2) bends in excess of 45 degrees will be installed without a cleanout.

Sub-Section B. Pressure Sewer Laterals:

Professional advice should be obtained prior to installing pumping equipment or pressure Sewer Laterals.

In locations where buildings cannot be discharged to the Sewer Main by a gravity flow Sewer Lateral, flows shall be discharged into a tightly covered and vented sump from which the flows shall be pumped, by automatic pumping equipment and discharged into a gravity flow Sewer Lateral, connecting at a cleanout, or the Sewer Main, connecting in a manhole, with an approved restrained coupling(s).

Unless otherwise approved by the City Engineer, pressure Sewer Laterals shall be constructed of HDPE.

The pump shall be designed to exceed the anticipated use requirements. The total maximum system head shall not exceed the pump manufacturer's recommended allowable head for the pump system being proposed.

Pressure Sewer Laterals shall be sized to provide a minimum velocity of 2.0 feet per second at the design pumping rate. Pressure Sewer Laterals shall be designed and constructed on a constant reverse grade.

Section 3.05 SEWER LIFT STATIONS

Sewer lift stations will only be allowed upon written approval by the City Engineer. At least two pumps are required. Each pump shall be designed to exceed the anticipated use requirements. The total maximum system head shall not exceed the pump manufacturer's recommended allowable head for the pump system being proposed.

DIVISION 4 PRESSURE PIPE DESIGN CRITERIA

Section 4.01 GENERAL

The following pressure pipe design criteria shall apply to all pressure pipe designs in the City. Design shall comply with the current applicable AWWA standards and Utah Division of Drinking Water Rules. Additional design criteria are specified in the Standard Drawings. Drinking water and pressure irrigation pipe mains shall be eight-inch (8”) diameter minimum.

Section 4.02 DRINKING WATER PIPE DESIGN

Sub-Section A. Pipe Material:

Ductile iron pipe shall conform to all requirements of ANSI/AWWA C151/A21.51, "American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined molds, for Water or Other Liquids." Minimum pressure Class will be 250 for pipes larger than 12-inch diameter. Pipes of 12-inch diameter and smaller shall be pressure Class 350. If thickness class pipe is used, pipes of diameters from 4 inches through 10 inches shall be minimum Class 51 and pipe from 12-inch diameter and larger shall be minimum Class 50. Ductile iron pipe shall be installed per the manufacturer’s recommendations or per AWWA Standard C600-10, “Installation of Ductile Iron Water Mains and Their Appurtenances”.

All main lines shall be in ductile iron. Transmission lines with no services on them may be installed in C900 with approval.

Polyvinyl Chloride (PVC) pipe for the transmission and distribution of water shall be manufactured in accordance with AWWA C900-07, "AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water:" PVC pipe fourteen inches (14”) and larger shall be manufactured in accordance with AWWA C905-10, "AWWA Standard for Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 48-inch." All PVC pipe four-inch (4”) and larger shall be dimension ratio (DR) 18 with a working pressure of 150 psi. The PVC pipe shall have a cast-iron-pipe-equivalent outside diameter. Pipe smaller than four inches (4”) shall be schedule 40 PVC. PVC pipe shall be installed per the manufacturer’s recommendations or per ASTM D2774, Recommended Practice for Underground Installation of Thermoplastic Pressure Piping and PVC Pipe and AWWA Manual of Practice M23, 2003.

All materials that may come in contact with drinking water, including pipes, gaskets, lubricants and O-Rings, shall be ANSI-certified as meeting the requirements of ANSI/NSF Standard 61, Drinking Water System Components - Health Effects. To permit field-verification of this certification, all components shall be appropriately stamped with the NSF logo. All pipe and fittings used in routine operation and maintenance shall be ANSI-certified as meeting NSF Standard 61 or Standard 14.

Pipe, joints, fittings, valves, and fire hydrants shall conform to ANSI/NSF Standard 61, and applicable sections of AWWA Standards C104-A21.4-08 through C550-05 and C900-07 through C950-07.

Only materials that have been used previously for conveying drinking water may be reused. Used materials shall meet the above standards, be thoroughly cleaned, and be restored to their original condition.

The use of asbestos cement pipe shall not be allowed.

Pipes and pipe fittings shall be “lead free” in accordance with Section 1417 of the Federal Safe Drinking Water Act. They shall be certified as meeting ANSI/NSF 372 or Annex G of ANSI/NSF 61.

Valves shall be located as a cluster in intersection.

Top of pipe bury depths shall be between forty-eight inches (48”) and sixty inches (60”) below finished grade. Any modifications due to conflicts must be approved by City Engineer.

Locator tape shall be installed twelve inches (12”) above pipe.

Where distribution systems are installed in areas of contamination:

a) pipe and joint materials which are not susceptible to contamination, such as permeation by organic compounds, shall be used; and,
b) non-permeable materials shall be used for all portions of the system including water mains, service connections, and hydrant leads.

Sub-Section B. Fire Hydrant Spacing:

Fire Hydrants shall be Waterous type and placed on the drinking water main side of the street. Fire Hydrants shall be placed in locations that allow for accessibility by the lay of a fire hose of no more than two hundred fifty (250) feet from the hydrant to the most remote point of any structure intended for occupancy and spaced no greater than five hundred (500) feet. Minimum fire hydrant spacing to structures shall be reduced to two hundred (200) feet in cul-de-sacs and dead ends.

Buildings that are to be equipped with sprinkled fire suppression are to have a hydrant within one hundred (100) feet of the “Fire Department Connection” (FDC). Other requirements shall be based on the “International Fire Code” or as specified by the Highland City Fire Marshall.

A concrete pad shall be poured around the hydrant barrel below traffic flange from curb to sidewalk and 18 inches to each side of hydrant with thickness equal to sidewalk.

Sub-Section C. Blow-off Locations:

If a fire hydrant is not located at the end of a cul-de-sac or temporary dead-end street, a blow-off hydrant shall be placed at those locations.

Sub-Section D. Isolation Valve Locations:

Valves shall be located at not more than 500' intervals in commercial districts and at not more than one block or 800' intervals in other districts. Where systems serve widely scattered customers and where future development is not expected, the valve spacing shall not exceed one mile.

Sub-Section E. Water Mains and Sources of Contamination.

Caution shall be exercised when locating water mains at or near certain sites such as sewage treatment plants or industrial complexes. Individual septic tanks shall be located and avoided. The Utah Division of Drinking Water shall be contacted to establish specific design requirements prior to locating water mains near a source of contamination.

Transmission lines shall conform to all applicable requirements in the Utah Division of Drinking Water rules. Transmission line design shall minimize unpressurized flows. An unpressurized transmission line shall not be installed less than 20 feet from a concentrated source of pollution (e.g., septic tanks and drain fields, garbage dumps, pit privies, sewer lines, feed lots, etc.). Furthermore, unpressurized transmission lines shall not be placed in boggy areas or areas subject to the ponding of water.

Sub-Section F. Chamber Drainage:

Chambers, pits, or manholes containing valves, blow-offs, meters, or other such appurtenances to a distribution system, shall not be connected directly to a storm drain or sanitary sewer.

Chambers shall be provided with a drain to daylight, if possible. Where this is not possible, underground gravel-filled absorption pits may be used if the site is not subject to flooding and conditions will assure adequate drainage. Sump pumps may also be considered if a drain to daylight or absorption pit is not feasible.

Sub-Section G. Control Valve Stations:

Pressure Reducing Valves (PRVs): Isolation Valves shall be installed on both sides of the pressure reducing valve. Where variable flow conditions will be encountered, consideration shall be given to providing parallel PRV lines to accommodate low and high flow conditions.

Backflow Devices: Installation of Backflow devices shall conform to the State-adopted plumbing code.

Meters: Installation shall conform to the State-adopted plumbing code and local jurisdictional standards

Sub-Section H. Cross Connections and Interconnections:

There shall be no physical cross connections between the distribution system and pipe, pumps, hydrants, or tanks that may be contaminated from any source, including pressurized irrigation.

Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the drinking water supply.

Sub-Section I. Installation:

Under no circumstances shall the pipe or accessories be dropped into the trench.

The open ends of all pipelines under construction shall be covered and effectively sealed at the end of the day's work

Special design and burial techniques shall be employed when water mains are in areas of geologic hazards. Consideration shall also be given to materials to be used when corrosive soils or groundwater will be encountered. The City Engineer shall approve all such installations and may require alternative materials or methods of construction.

Above Water Crossings: The pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.

Underwater Crossings:

a) A minimum cover of 2 feet or greater, as local conditions may dictate, shall be provided over the pipe.
b) When crossing water courses that are greater than 15 feet in width, the following shall be provided:
    i. Pipe with joints shall be of special construction, having restrained joints for joints within the surface water course and flexible restrained joints at both edges of the water course.
    ii. Isolation valves shall be provided on both sides of the water crossing at locations not subject to high ground water or flooding, so that the section can be isolated for testing or repair.
    iii. A means shall be provided, such as a sampling tap, not subject to flooding, to allow for representative water quality testing on the upstream and downstream sides of the crossing.
    iv. A means shall be provided to pressure test the underground water crossing pipe.

Section 4.03 PRESSURE IRRIGATION PIPE DESIGN

Sub-Section A. Pipe Material:

Polyvinyl Chloride (PVC) pipe for the transmission and distribution of water shall be manufactured in accordance with AWWA C900-07, "AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water:" PVC pipe fourteen inches (14”) and larger shall be manufactured in accordance with AWWA C905-10, "AWWA Standard for Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 48-inch." All PVC pipe four-inch (4”) and larger shall be dimension ratio (DR) 18 with a working pressure of 150 psi. The PVC pipe shall have a cast-iron-pipe-equivalent outside diameter. Pipe smaller than four inches (4”) shall be schedule 40 PVC. Pressure Irrigation pipe shall be purple in color for easy identification.

Valves shall be located in intersections at the extension of the property lines.

Top of pipe bury depths shall be between twenty-four inches (24") and thirty inches (30”) below finished grade. Any modifications due to conflicts must be approved by City Engineer.

Tracer wire and locator tape shall be installed on the pipe.

Sub-Section B. Blow-off Locations:

A blow-off shall be placed at the end of all cul-de-sacs and temporary dead-end streets unless an irrigation pipe drain is placed at those locations.

Sub-Section C. Pipe Drainage Facilities:

Pressure irrigation pipe drains must be designed at all low-lying locations that will collect water at the end of the irrigation season. Care should be taken in the design process to assure the fewest number of drains as possible. Highland City must approve the location of all drains. Details of acceptable pipe drains are included in the standard drawings.

Section 4.04 PIPE LOOPING

Circumstances that require a drinking water pipe to be placed under a sanitary sewer pipe require special construction. There must be 18" to 36" clear distance between the pipes. The drinking water pipe must be in a casing that extends ten (10) feet on each side of the crossing. This also must be approved by the State Division of Drinking Water.

Section 4.05 AIR VALVES

The engineer must give special consideration in the design of a pressure pipe system to include air valves of the appropriate type and location when necessary. Generally, special valves that may need to be designed into the system include vacuum relief valves, air and vacuum valves and combination air valves. Air valves are essential in the design of an expansive system in order to operate effectively. Without the proper application and placement of air valves, pipeline capacity may be reduced. Valves are especially necessary for pressure irrigation systems that are drained annually. In pressure irrigation systems, manual valves that provide air inlet and removal are generally acceptable. The design engineer should work closely with the City Engineer and Public Works Director to determine the most appropriate type of valve.

The following is a description of the application concerning the specified valves:

a) Vacuum Relief Valves shall be of the type that automatically admits large quantities of air to enter a system on negative pressure.
b) Air and Vacuum valves shall be of the type that automatically exhausts large quantities of air during the filling of a pipeline and to close water tight when the water enters the valve and allows air to re-enter during the draining or when a negative pressure occurs. The discharge orifice area shall be equal to or greater than the inlet of the valve.
c) Combination Air Valves shall be of the single housing style that combines the operating features of both an Air/Vacuum and Air Release Valve. The Air/Vacuum portion shall automatically exhaust large quantities of air during the filling of the pipeline and automatically allows air to re-enter the pipeline when the internal pressure of the pipeline approaches a negative value due to column separation, draining of the pipeline, power outage, pipeline break, etc. The Air Release portion shall automatically release small pockets of air from the pipeline while the pipeline is in operation and under pressure.
d) Air Inlet and Removal Valves using manual controls are used to flush air from the pressure irrigation system upon annual filling and emptying. Refer to the Standard Drawings for details.

Sub-Section A. Drinking Water Air Valves:

At high points in water mains where air can accumulate, provisions shall be made to remove air by means of hydrants or air relief valves.

The open end of the air relief vent pipe from automatic valves shall be provided with a #14 mesh, non-corrodible screen and a downward elbow, and where possible, be extended to at least one foot above grade. Alternatively, the open end of the pipe may be extended to as little as one foot above the top of the pipe if the valve's chamber is not subject to flooding, or if it meets the requirements of Chamber Drainage (Sub-Section F of Section 4.02).

Blow-offs or air relief valves shall not be connected directly to a sewer.

Adequate number of hydrants or blow-offs shall be provided to allow periodic flushing and cleaning of water lines.

The air relief valve shall be installed in a manner to prevent it from freezing. A shut-off valve shall be provided to permit servicing of an air relief valve.

Section 4.06 THRUST BLOCKING

All tees, bends, plugs, and hydrants shall be provided with thrust blocking, anchoring, tie rods, or restraint joints designed to prevent movement. Restraints shall be sized to withstand the forces experienced.

A Highland City inspector is required to inspect the areas dug out for thrust blocking. The inspector also will be present during installation of the thrust blocking and collect batch tickets at the time of installation.

Section 4.07 PRESSURE TESTING AND DISINFECTING DRINKING WATER MAINS

Ductile iron pipe shall be pressure tested at 200 psi. Pressure testing shall conform to AWWA C600-10 (Installation of Ductile Iron Mains and Their Appurtenances and disinfection shall conform to AWWA C651-05 (Disinfecting Water Main). A Highland City inspector shall be present for the filling of the pipe and will perform the chlorine test. The inspector shall be present for the flushing, pressure test, and will collect samples to ensure proper disinfection.

Section 4.08 LATERAL CONNECTIONS

Sub-Section A. Drinking Water Service Lateral:

Service taps shall not jeopardize the quality of the system's water.

Water services and plumbing shall conform to the State-adopted Plumbing Code.

Pipes and pipe fittings shall be “lead-free” in accordance with Section 1417 of the federal Safe Drinking Water Act. They shall be certified meeting the ANSI/NSF 372 or Annex G of ANSI/NSF 61.

The minimum residential drinking water service lateral pipe diameter shall be three-fourths of an inch (3/4”) for residential services (distances exceeding fifty (50) feet in length will require one (1) inch minimum.) The minimum commercial service lateral pipe diameter shall be one and a half inches (1.5”). Service laterals one inch (1”) or smaller shall be installed in Type K soft copper. Service lateral larger than one inch (1”) may be installed in blue poly pipe with a tracer wire. Water service meters shall be located in the park strips.

Service lines shall be capped until connected for service. The portion of the service line from the meter to the mainline is considered to be part of Highland City’s distribution system. Connections between the service meter and the home shall be in accordance with the State-adopted Plumbing Code.

All drinking water laterals shall be located at the lot centerline and stamped with “W” on the curb at the lateral location.

Sub-Section B. Pressure Irrigation Service Lateral:

Refer to the standard drawings for pressure irrigation service lateral pipe size diameter. The minimum service lateral shall be three-fourths of an inch (3/4”) and purple poly pipe material. One (1) double service shall be provided to every two (2) lots where possible.

All pressure irrigation laterals shall be located in the park-strip at lot lines and stamped with “I” on the curb at the lateral location.

DIVISION 5 STORM DRAINAGE CRITERIA

Section 5.01 GENERAL

The following storm drainage design criteria shall apply to all storm drainage designs in the City that will be maintained by the City of Highland. Additional design criteria are specified in the Standard Drawings and the Highland City Storm Drainage Master Plan. The minimum allowed pipe size for storm drain pipe mains (manhole to manhole) is fifteen-inch (15") diameter. The minimum for tributary piping (curb face inlet to manhole) is fifteen-inch (15") diameter. Storm Drainage should be designed to avoid conflicts with water lines that would require looping of water lines.

Section 5.02 INLET BOXES AND MANHOLES

Sub-Section A. Storm Water Inlets:

Curb face inlets (or an acceptable alternative) must be constructed at all low lying areas. Curb face inlet boxes will serve tributary piping and shall not be used as junction boxes or manholes. If multiple piping is required in a structure using a curb face inlet, a combination box shall be constructed which must include a manhole for access. No inlets shall be allowed at the bottom of an ADA ramp structure or in a designated pedestrian path.

Sub-Section B. Manholes:

Minimum manhole interior diameter is four-foot (4'). The diameter of the manhole shall be determined by the intersection pipe sizes and the clearances required between the pipes for proper construction. Generally there should be a minimum of twelve inches (12") clear distance between any two connecting pipes. Inside a rectangular type box, a minimum of 6 inches (6") clear distance between the pipe and a side wall is preferred.

Spacing between manholes shall be no more than four hundred (400) feet unless special approval is granted by the City Engineer.

All manholes and combination boxes shall feature steps made of copolymer polypropylene conforming to ASTM D-4101.

Sub-Section C. Pipe Material:

Storm drain pipe material shall be reinforced concrete pipe. All reinforced concrete pipe used for storm drain construction shall be of the rubber gasket type, bell and spigot joint design, conforming to the requirements of the latest revision of ASTM Designation C76 (minimum Class III.) Pipe class shall be as shown on the Improvement Drawings. The minimum joint length of all pipes provided shall be 7 1/2 feet.

Sub-Section D. Storm Water Treatment:

All new land development will require provisions for storm water treatment before the water is allowed to discharge into the existing City system, ponds, or sumps. A design that will separate oils and particulates from the discharged water will have to be approved by the City Engineer. The treatment facility must be easily accessible and maintainable without unreasonable effort.

Sub-Section E. Sumps:

Sump interior diameter shall be six-feet (6') with a nine-foot (9') minimum wall section. Pre-treatment shall be required for flows before discharge into sumps. Sumps shall be placed as required by storm drain calculations and where discharge into the existing city system is not available. Additional design criteria are specified in the Standard Drawings. A licensed geotechnical engineer will be required to establish a

percolation rate to verify sump design requirements. As noted in the Stormwater Master Plan the design infiltration rate is equal to the measured infiltration rate divided by four.

Section 5.03 MULTIPLE-LOT STORM DRAINAGE CALCULATIONS

The following information shall be included in the storm drainage calculations for multiple-lot development.

Sub-Section A. Hydrologic (Flow) Calculations:

1) A map showing drainage sub-basins and the piping system.
2) Cumulative peak flow calculations for each sub-basin (submit all input data, calculations and results).

Sub-Section B. Hydraulic (Inlet and Pipe) Calculations:

1) Capacity calculations for each segment of the pipe system.
2) Calculations demonstrating that flow rates in streets do not exceed maximums before being caught in storm drain inlets. “Section 5.07, Sub-Section C: Inlet Spacing” dictates the criteria required for allowable water spread.
3) Calculations demonstrating that inlets are sufficiently long to capture peak design flows.

Sub-Section C. Detention Calculations:

1) Detention volume requirement which includes an analysis that identifies the storm whose duration creates the greatest detention volume requirement, given storm duration and stage storage curve and outlet discharge curve.
2) Orifice calculations illustrating that the maximum release rate is not exceeded.

Section 5.04 COMMERCIAL SITE STORM DRAINAGE CALCULATIONS

The following information shall be included in the storm drainage calculations for commercial site property development.

Sub-Section A. Hydrologic (Flow) Calculations:

1) Peak flow calculations for the site (submit all input data, calculations and results).

Sub-Section B. Hydraulic (Inlet and Pipe) Calculations:

1) Capacity calculations for each segment of the pipe system.

Sub-Section C. Detention Calculations:

1) Detention volume requirement-an analysis that identifies the storm whose duration creates the greatest detention volume requirement, given storm duration and stage storage curve and outlet discharge curve.
2) Stage storage curve - generally required only on large detention basins.
3) Outlet discharge curve - generally required only on large detention basins.
4) Orifice calculations illustrating that the maximum release rate is not exceeded.

Section 5.05 LANDSCAPED STORM DETENTION BASIN REQUIREMENTS

Storm water must be detained such that the peak flow rate released from the site does not exceed 0.10 cubic feet per second per acre of development (cfs/acre). Detention basins must have vehicular access for maintenance and will not be allowed in the backyards of single family residences. The following limitations apply to detention basins:

a) The side slopes of the basin may not be steeper than 3:1 unless special circumstances warrant a change. Any change must be approved by the City Engineer. The bottom of the detention basin must slope toward the drain.
b) An oil water separator is required on the inlet to the pond.
c) Within 10 feet of the outlet, the slope of the basin bottom must not be flatter than 5% unless a concrete apron is constructed around the outlet.
d) Excluding areas within 10 feet of the outlet, the maximum allowable depth of water in the basin is 3 feet. An additional one (1) foot of freeboard must be constructed on all basins.
e) Storm drain pipes are to be continuous through detention areas to allow low flows to proceed through the storm drainage system without having to come to the surface. These flows must still pass through the outlet restriction that limits runoff rates.
f) Basins are to be designed such that water does not run into them after storm water reaches a maximum depth (unless a free flowing overflow is provided)—this can usually be controlled by the elevation of an inlet box in the street adjacent to the basin.
g) Basins are to be designed such that when runoff exceeds design values or when restrictions plug, excess storm water will be directed to the street system or bypass the restriction by entering the piped system via a free flowing overflow.
h) A basin may be designed for dual use, but uses other than the detention of storm water must be approved by the City Engineer.
i) In cases where the basin detains water from and is part of a project controlled by a "Home Owners Association" (HOA), the HOA will be responsible to maintain the operation, landscaping and irrigation sprinkling of the basin.

Section 5.06 HARD SURFACE STORM DETENTION STORAGE REQUIREMENTS

Storm water may be detained above ground on hard surface areas if the depth does not exceed a maximum of one-foot (1'). If property is not available for a landscaped detention basin or cannot meet the one-foot depth criteria, storm water shall be detained underground in an approved underground system. Storm water must be detained such that the peak flow rate released from the site does not exceed 0.10 cubic feet per second per acre of development (cfs/acre). Underground storage designs should be discussed with the City Engineer before submittal. The following limitations apply to underground detention storage:

a) Basins are to be designed such that when runoff exceeds design values or when restrictions plug, excess storm water will be directed to the street system or bypass the restriction by entering the piped system via a free flowing overflow.
b) The private property owner benefiting from the hard surface or underground detention storage will be responsible to maintain the operation of the system.

Section 5.07 STORM WATER QUANTITY CRITERIA AND DESIGN GUDELINES

The following storm drainage criteria and design guidelines apply to all storm drainage plans in Highland and shall be used in storm drainage calculations. The City Engineer has authority to modify the criteria and guidelines as needed to meet changing or unusual needs or conditions.

Sub-Section A. Design Storm:

Precipitation and Frequency Data can be found online at NOAA 14
(http://hdsc.nws.noaa.gov/hdsc/pfds/sa/ut_pfds.html)

i. Design piping system for a 10 year storm
ii. Design detention, retention, sumps, control point of discharge, open channels and flooding hazard for a 100 year storm

Sub-Section B. Runoff Coefficients:

Highland City requires the design engineer to calculate a composite runoff coefficient based on surface type and associated runoff coefficient, weighted by the area of each surface type.

Sub-Section C. Inlet Spacing:

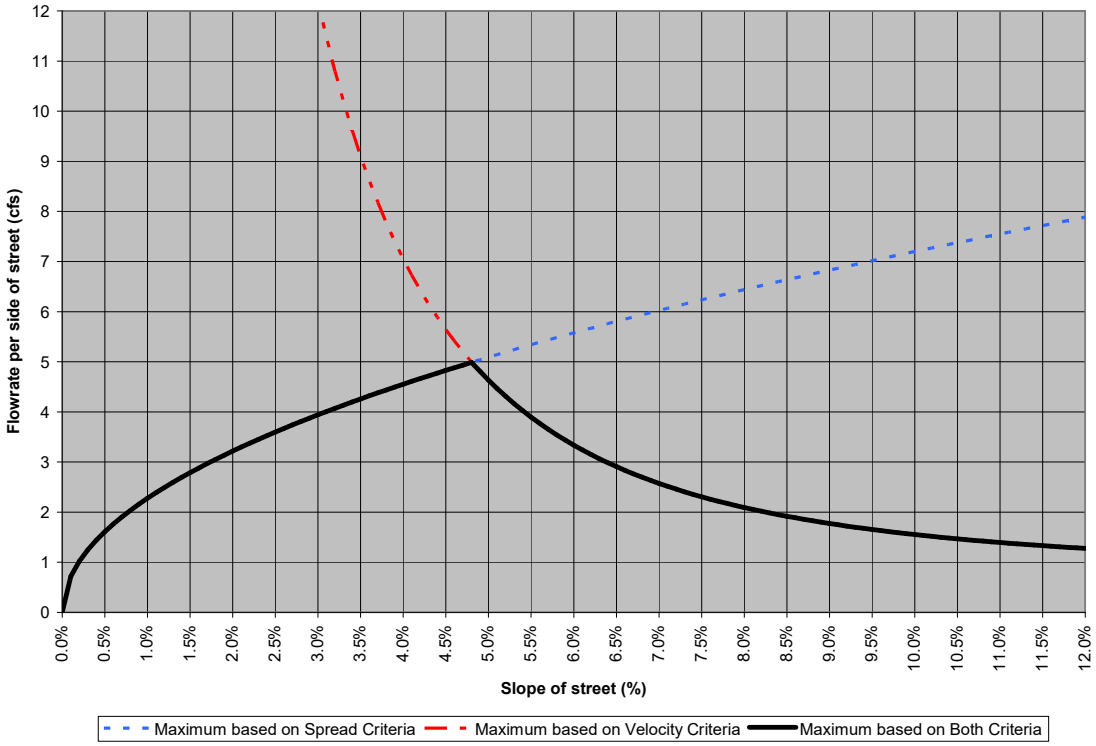
Determined by the Highland City Storm Water Design Criteria and at the direction or discretion of the City Engineer.

Two criteria must be met.

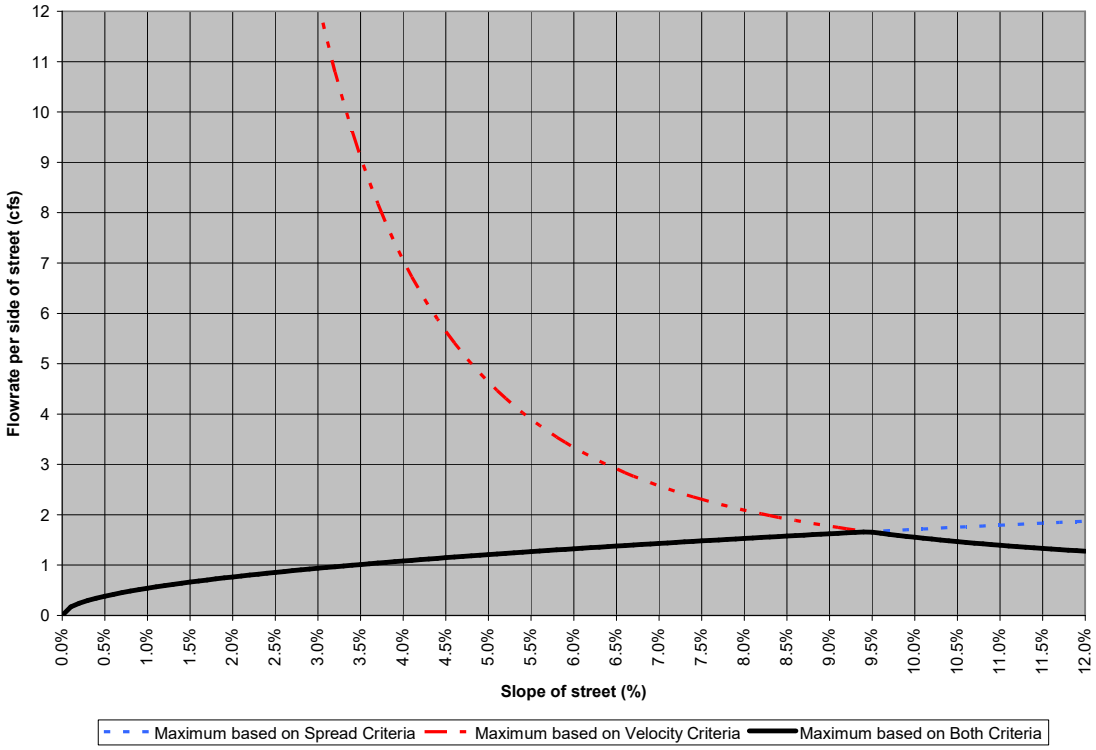
1) Spread of water in the street:
   Storm water must be delivered from the street into an underground piped system when the spread of water in the street covers the outside 7 feet of asphalt on a local street, the outside 2 feet on a Collector street and the outside 2 feet on an Arterial street. This will leave 12-feet of unsubmerged asphalt for local streets (that have 26 feet of asphalt), 10-feet in each direction of unsubmerged asphalt for Collector streets (that have 24 feet of asphalt) and 22-feet in each direction of unsubmerged asphalt for Arterial streets (that have 48 feet of asphalt).
2) Gutter velocity:
   Water must be delivered from the street into an underground piped system when the velocity of water in the deepest part of the gutter reaches 10 feet per second (as a safety consideration).

Both of these requirements are a function of street slope and storm water flow rate. Storm water must be delivered from the street to storm drains when flows reach amounts shown in the following graphs. This means that for a given longitudinal street slope, flows on the street surface must be delivered into the underground piped system when they reach the amount indicated on the graph by the solid line.

GRAPH FOR LOCAL SUBDIVISION STREETS



GRAPH FOR COLLECTOR AND ARTERIAL STREETS



Note: The spread of water in the street is calculated using the Manning equation in the form developed by Izzard, with a roughness coefficient of 0.013 and the standard street cross section. The velocity criteria is based on the velocity at the deepest part of the gutter with the Manning Equation, with a roughness coefficient of 0.013, and using a depth at a point six inches from the face of the curb as the hydraulic radius.

Sub-Section D. Inlet Capacity:

The designer is to assume 50% blockage of inlets when considering storm drain inlet capacity.

Sub-Section E. UPDES and Storm Water Pollution Prevention Plan:

All construction sites, which disturb an area of 1 acre or more, currently need a UPDES permit from the State of Utah. As a condition of the permit, a Stormwater Pollution Prevention Plan (SWPPP) must be developed and implemented as outlined at the Department of Environmental Quality website (http://www.waterquality.utah.gov/UPDES/stormwater.htm). The permit requires the responsible party to control and eliminate storm water pollution sources through the development and implementation of a Storm Water Pollution Prevention Plan. In the Plan, you identify possible sources of storm water pollutants then select Best Management Practices (BMPs) to reduce or eliminate their impacts. BMPs are the most important element of this Plan. The aim is to control storm water sediment and erosion to the maximum extent practicable. Controls can encompass a wide range of structural and non-structural options. The SWPPP shall address each of the following items:

1. construction environmental summary
2. clearing limits
3. construction access
4. storm water detention
5. sediment controls
6. soil stabilization
7. slope protection
8. drain inlet protection
9. storm water outlet protection
10. spill prevention and response
11. storm water treatment
12. BMP maintenance
13. project management

The *DWQ* finds the owner, developer, or project instigator and controller (the entity responsible for obtaining funding, procuring initial contracts or agreements, selecting [or assuming the position of] a general contractor, and that has control over site specifications) as the ultimate party responsible for pursuing permit procurement and compliance.

DIVISION 6 LAND DEVELOPMENT CRITERIA

Section 6.01 GENERAL

The following land development criteria shall apply to all designs for land development in Highland. It will be necessary to refer to the current general plan and zoning plan for correct land use designations. Design shall comply with the current Highland City Zoning Ordinance and the Highland City Subdivision Ordinance. Additional design criteria are specified in the Standard Drawings.

Section 6.02 PROJECT IMPACT ON ADJACENT PROPERTIES

The design of public improvement and utility projects shall evaluate the project impact to adjacent private and public property. The evaluation shall include mitigation measures for right of way acquisition, public utility easements, and construction easements. The design engineer shall give consideration to traffic and pedestrian safety, accessibility and storm water surface flows that may have an impact on all adjacent properties.

The design of the new development must not create a non-conforming use out of a neighboring parcel. For example, if a pre-existing lot designed to function as an interior lot will change to a corner lot because of the design of the new development, additional property may need to be deeded to that lot to insure it is in conformance to the current zoning ordinance for a corner lot.

Section 6.03 DESIGN CONSIDERATIONS TO PRESEVE NATURAL FEATURES AND MITIGATE HAZARDOUS CONDITIONS

Sub-Section A. Natural Features:

The design of public improvements shall preserve the natural features such as natural drainage, wetlands, existing native vegetation and wild life habitat where applicable. The Applicant(s) or his representative shall delineate the location of such natural feature when submitting concept plans or preliminary design drawings for all public improvement projects. The design engineer shall be responsible to incorporate all natural features identified by City Staff reviews and shall be required to notify and get approval from all state and federal agencies that control the natural features.

Sub-Section B. Hazardous Conditions:

Land subject to hazardous conditions such as wetlands, surface fault rupture, debris flow, rock fall, landslides, soil liquefaction, shallow water table, floods, and polluted or non-potable water supply shall be identified and shall not be developed until the hazards have been preserved or will be mitigated during development process and will appear on construction design plans. The approval of a subdivision plat or construction drawings does not terminate the responsibility of the design engineer in using standard duty of care in the investigation and design for the hazardous conditions associated with the project. The design engineer shall be required to notify and get approval from all state and federal agencies that control the preservation or mitigation processes.

Section 6.04 IDENTIFICATION OF EXISTING EASEMENTS AND RIGHTS OF WAY

The design engineer shall identify all easements and rights of way that exist on the subject property that is to be developed. Sufficient investigation and agreements must take place to illustrate to the City the status of all easements and rights of way on the property. These easements and rights of way must be illustrated on the appropriate drawings and in a clear manner.