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LEEDS
Standard Specifications
for
Design
And
Construction

Ordinance Number 05-04

Adopted JULY 27, 2005

This document identifies Standard Specifications for Design and Construction within the Town of Leeds

SECTION 3

SECTION 3

DESIGN STANDARDS

3.1 INTRODUCTION. This section defines design requirements for public improvements. It is not the intent of these standards to restrict professional judgement, but rather to serve as a guide and to establish consistency in design.

These standards are the minimum required and should be considered as such. It is recommended that the Engineer in charge review each project on its own merit and impose a higher professional standard as necessary for each project.

3.2 STREET DESIGN. All streets shall be designed to conform to the standards and technical design requirements contained within this sub-section. AASHTO, a policy on geometric design of highways and streets, shall be used as a supplement to these guidelines. In cases of conflict, a determination shall be made by the City Engineer, which determinations shall be final. These requirements may apply as required by sub-ordinance.

These requirements may apply as required by the subdivision ordinance.

3.2.1 STREET CROSS-SECTION STANDARDS. Requirements for the street cross-section configurations are shown in Table 3.1. These requirements are based on traffic capacity, design speed, projected traffic, system continuity and overall safety.

All new developments shall use street cross-sections with fifty feet (50) or more of right-of-way. Access to multi-family or commercial developments, shall use street cross-sections with sixty (60) feet or more of right-of-way.

Alternate road cross-sections incorporating the use of a planting strip may be permitted, if applicable safety and traffic standards are met and approved by the City Engineer.

3.2.2 ROADWAY NETWORK DESIGN. New roadway networks shall be designed in accordance with the general planning concepts, guidelines, and objectives provided within this sub-section.

- The "Quality of Life" for residential occupants shall be a primary concern when designing a residential roadway network.

- An emphasis on proper street hierarchy should be adhered to, namely, local streets should access residential collectors; residential collectors should access major collectors; major collectors should access minor arterials; etc.

- An emphasis on access management should provide control of the location, design, and operation of all driveways, median openings, and street connections to a roadway.

- Roadways should be designed in a curve a linear method in order to reduce, or eliminate, long straight stretches of residential roadways which encourage speeding and cut through traffic.

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- Substantial increases in average daily traffic, due to development of adjacent property on established streets not originally designed to accommodate such increases should be avoided.

- Drainage methods should concentrate on meeting the drainage needs while not impeding the movement of traffic (see drainage guidelines).

- Roads should be designed to lie within existing topographic features without causing unnecessary cuts and fills.

- A reduction in the use of cul-de-sacs should be emphasized in order to provide greater traffic circulation and less volume on collector roads. Circulation is of the up most importance, long blocks and excessive dead end streets should be avoided.

- Stopping sight distance should be considered at all intersections and curves to ensure the safety of the public, in accordance with AASHTO standards.

- Pedestrians and bicycle traffic should be considered in the planning and design of all developed streets.

Table 3.1
Street Cross-section Configurations

				Standard Section			Optional Section			
	Maximum ADT or [D.U.'s]	Traffic Index	Maximum Grade (%)	Right of Way (feet)	Pave-ment Width [1] (feet)	Sidewalk Width (feet)	Right of way (feet)	Pavement Width [1] (feet)	Planter Width (feet)	Sidewalk Width (feet)
Residential Local	<500 (2 to 50)	5	15	50	32	4	50	29	4	4
Residential Standard	510 to 1,250 (51 to 125)	5	15	50	35	4	53 [7]	32	4	4
Residential Collector	1,260 to 2,000 (126 to 200)	5.5	15	60	42	5	60	39	4	4
Major Collector [5]	2,010 to 6,000 (201 to 600)	6	12	66	49	6 [3]	70	46	4	5 [3]
Minor Arterial [5]	6,000 to 20,000	7	10	90	67	6 [3]	90	65	5	6 [3]
Arterial Major [5]	>20,000	8	8	>100	as req.	6 (min)	>100	as req'd.	6 (min)	6
Commercial Local	NA	10	8	60 [6]	43 [6]	6	66	42	4	5
Industrial Local	NA	10	6	66 [6]	48 [6]	6	68	45	4	5

1. Pavement width measured from lip of curb to lip of curb.
2. A four-foot wide or wider planter strip shall be placed between the back of curb and front of sidewalk within right-of-way widths shown.
3. A planter strip may be required between back of sidewalk and any wall, fence, hedge, etc. This area can be private or public. If public, additional right-of-way will be required. Alternate sections with meandering sidewalks may be proposed.
4. Not used.
5. Configuration of major collector and higher classifications may be adjusted with proper justification and approval of City Engineer. May require widening at intersections for turning movements. Where on street parking is allowed, additional width and other considerations may be required.
6. The minimum right-of-way and pavement width is shown. Each may be increased when required by a traffic impact study.
7. If approved by the City, a 50' wide right-of-way may be used with the three feet of sidewalk being placed in an appropriate easement.

NOTE: When approved by the City Engineer, approved modified curb (standard RU30) may be used on the Residential Local and Residential Standard streets using the Optional Section as follows:

1 - 100 ADT (2-10 lots) use Residential Local Optional Section
101-500 ADT (11-50 lots) use Residential Standard Optional Section.

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3.2.3 **IMPROVEMENT REQUIREMENTS.** All improvements including, but not limited to the following, shall be constructed in accordance with the standard specifications and drawings unless otherwise approved.

3.2.3.1 **Curb, Gutter and Sidewalk.** Required curb, gutter and sidewalk shall be constructed.

3.2.3.2 **Driveways.** Driveways shall be constructed in approved locations.

3.2.3.3 **Pavement.** All streets, public or private, shall be surfaced to grade, with asphalt concrete pavement, to the required minimum width and thickness in accordance with these specifications.

3.2.3.4 **Street lighting.** Street lighting shall be provided on all streets. The construction on public streets shall be in accordance with the standard drawings and these specifications. Standard Public street lights may be installed on private streets upon agreement with the City and the local power agency when applicable.

3.2.3.5 **Cross Gutters.** No cross gutters shall be allowed across major collector or major and minor arterial streets. On commercial and industrial streets, cross gutters are generally not allowed and require approval by the City Engineer for their use. The City Engineer may prohibit construction of cross gutters on any street deemed necessary.

3.2.3.6 **Handicap Ramps.** When new construction occurs handicap ramps shall be constructed at all street intersections, unless otherwise approved, in accordance with the standard drawings. In addition, when a project occurs where existing improvements are in place, handicap ramps shall be upgraded to meet current standards.

3.2.3.7 **Roadway Medians.** Medians on public roadways shall be approved by the City Engineer. Design and construction shall be in accordance with applicable standards.

3.2.3.8 **Minimum Access.** Proposed developments shall have only the required number of accesses to adequately address the needs of the development and only at approved locations. Too many access points or access on major routes hinder the safety and efficient travel of vehicles using these routes. In addition, too few accesses can stifle circulation and unnecessarily concentrate traffic at selected locations.

3.2.3.9 **Drainage.** Adequate drainage facilities shall be installed to properly conduct runoff from the roadway. Sub-drains and surface

drainage facilities shall be designed in accordance with the approved drainage study. Cross gutters shall be used sparingly to maintain the public's driving comfort and in accordance with these specifications.

3.2.3.10 Traffic Control Devices. Appropriate traffic control devices and street signs, as required by the City Engineer, shall be installed in accordance with the MUTCD.

3.2.3.11 Pavement Marking. Appropriate pavement markings, as required by the City shall be installed in accordance with the MUTCD.

3.2.3.12 Street Trees and Landscaping. Street trees and landscaping shall be required in accordance with current St. George City Street and Landscaping Ordinance (Shade Tree Ordinance #7-1-1994).

3.2.3.13 Other Improvements. The above-required improvements are not all inclusive. Other improvements needed to complete the development in accordance with current engineering and planning standard practice may be required by the City Engineer.

3.2.4 TECHNICAL DESIGN REQUIREMENTS. The following requirements apply to streets.

3.2.4.1 Street Grades

A. All street grades shall have a maximum grade as shown in Table 3.1

B. A request to increase the maximum street grades shown in Table 3.1 may be considered upon submittal of a request and information justifying such a request to the City Engineer. Request for approval must be based upon and in accordance with the latest edition of AASHTO's "A Policy on Geometric Design of Highways and Streets" guidelines. Any approvals for increased grades must be consistent with access requirements of fire apparatus as defined by the Fire Department. The City Engineer's decision will be final. Cost of construction will not be justification for approval.

3.2.4.2 Intersections

A. Wherever possible, all street intersections should intersect at ninety degree angles.

B. In the event an acute angle intersection is proposed, the City

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Engineer may require mitigation by realigning to achieve a ninety degree intersection. If no other reasonable option for realignment exists, a skew may be allowed up to a maximum of 15° from 90°. Other design approaches to mitigate the skewed angle may be required by the City Engineer.

C. Proper combination of horizontal and vertical alignment should be obtained by engineering study and consideration of the general guidelines listed in AASHTO (Section Titled: Combination of Horizontal and Vertical Alignment, 1990 edition).

D. Intersections should not be located on the interior of, or near, sharp curves. Intersections should be located a sufficient distance from all curves to provide proper sight distance for vehicles on the intersecting road or driveway and on the through road.

E. New intersections with more than four "legs" are generally not permitted. For arterial access, only four-leg intersections, "T" intersections and modern roundabouts are permitted. When designing local road networks, "T" and "L" intersections are desired. The "L" intersection (knuckle) will only be permitted when the street length, in either direction from the angle point, is three hundred-fifty feet (350'), or less. Four-leg intersections on local road networks are generally discouraged. Where determined that a four-leg intersection is necessary, approval from the City Engineer shall be obtained prior to final design of the local road network. Exceptions to these requirements may be granted by the City Engineer on a case by case basis. The developer's engineer must provide acceptable compelling Traffic Engineering analysis justification before deviations will be granted.

F. When designing local road networks, block lengths without an intervening connector street shall not exceed eight hundred feet (800') in length unless previous approval has been obtained from the City Engineer. Cul-de-sacs are not considered an intervening connecting street.

G. New access locations created by development shall be unified whenever possible to create the fewest number of access points onto arterials or major collectors. Cross use agreements shall be required where necessary.

H. Access to corner lots should be from the lesser-classified road at the greatest distance possible from the intersection, and should not

be less than the distances shown below. This distance is measured from the PC of the corner curve. A 25' radius is considered the minimum where the existing radius is less than 25'.

Table 3.2

ACCESS DISTANCE FROM CORNER (in feet)		
Facility Type	**Upstream**	**Downstream**
Residential Access	50**	50**
Local Residential	50**	50**
Residential Standard	50**	50**
Residential Collector	100	75
Major Collector	175	150
Minor Arterial *	200	185
Major Arterial *	250	230

* All access points shall be approved by the City Engineer. Distances shown may be increased as required by the City Engineer on a case-by-case basis. Exceptions can only be approved by the City Engineer upon submittal of proper traffic justification.

** Distance shown is preferred. See Section 3.2.4.2.K below or Section 7 of the St. George Zoning Ordinance for variations.

I. The intersection of two local roads should be designed to operate with minimal traffic control devices. For example, do not design an intersection to operate with a four-way stop or signal control.

J. Direct access will not be allowed for parking, loading or driveway areas that require backing maneuvers onto major collector or higher order streets. This requirement shall apply to commercial and industrial use regardless of the order or classification of street.

K. Residential and commercial developments are generally required to provide at least two improved accesses to the development depending upon the forecasted traffic volumes. Adjacent developments may be required to combine or share driveway access to public roadways. The access shall be of proper widths to accommodate the calculated traffic volumes and expected vehicle types when the area is fully developed and shall be in accordance

with Section 7 of the Zoning Ordinance. Projected traffic volumes shall be calculated using the criteria outlined within the Traffic Impact Study requirements of these specifications.

L. Covered driveways will not be allowed unless approved by the City Engineer.

3.2.4.3 Intersection Spacing

A. Street intersections shall be spaced far enough apart so that the existing and projected traffic stopped to make left turns at one intersection does not interfere with traffic movements at the adjacent intersection and to not hinder the capacity or safety of the roadway. When a street intersects a low volume residential street, the minimum distance is 150 feet. When a street intersects a minor or major collector street, the minimum distance is 250 feet. Minimum distance measurements are centerline-to-centerline. The minimum spacing requirement on arterials shall be as determined by the City Engineer. Locations shall be based upon a number of items such as projected volumes, turning and stacking distances, intersection spacing, traffic progression, etc. Generally the minimum distance will be 650 feet for arterials and 1/4 mile for major arterials. The City Engineer shall review and give final approval to any intersection requests on arterials.

3.2.4.4 Maximum Design Volume

A. The maximum design volume shown on Table 3.1 shall be used unless otherwise approved by the City Engineer. A request to increase these volumes may be submitted for consideration to the City Engineer. This request shall include all necessary and required information including support and justification from the Traffic Impact Study.

Conditions which must be considered when reviewing a request for an increase in maximum design volume include hillsides, safety, parking, traffic studies, access requirements, etc.

3.2.4.5 Cul-de-Sac Streets

A. Such streets shall not exceed six hundred (600') feet in length as measured from center of cross street to center of cul-de-sac. The turn-around pavement radius shall not be less than forty-two and one-half feet (42 ½') (50 feet at property line). Commercial pavement radii shall be no less than forty-seven and one-half feet (47½ ') (55 feet at property line). No road shall be ended without a properly designed cul-de-sac turnaround unless otherwise approved by the City

Engineer. Major collectors and higher order roads shall not be permanently dead-ended.

3.2.4.6 Sidewalks

A. Sidewalk shall be required in all residential and commercial developments. See Table 3.1.

B. For developments which are within hillside areas, see the City of St. George Hillside Ordinance.

C. Sidewalks in areas of high pedestrian traffic may require greater width as delineated by the City Engineer.

3.2.4.7 Curb and Gutter

A. All public or private streets shall use curb and gutter of the type shown in standard drawings unless otherwise approved by the City Engineer. In large subdivisions, in rural or agricultural settings, the curb and gutter may be eliminated (although the use of the rural curb is recommended) unless required for drainage or street continuity. When eliminated, roadside drainage and shoulder shall be as shown in standard drawings.

3.2.4.8 Planter Strips

A. Planter strip areas in road right-of-way must be landscaped with at least fifty percent (50%), by area, of live vegetation.

B. Xeriscape landscaping must be approved by City's Representative.

C. Planter strips shall not be filled with concrete or other hard surfaces.

D. Special drainage requirements may be imposed by City's Representative to protect pavement and curb and gutter from damage due to irrigation of planter strips.

3.2.4.9 Design Speed

A. The design of geometric features such as horizontal and vertical alignment will depend on the design speed selected for each street. The design speed is primarily determined by the street function and classification, and is the maximum speed for safe and comfortable operation of a vehicle. The use of design speeds other than those listed below must be approved by the City Engineer who may decide that the speed provided in this sub-section be changed to that

which is reasonable and prudent under the conditions and having due regard to the actual and potential hazards.

DESIGN SPEED

Classification	Design
Residential Access	25
Local Residential	25
Local Standard	25
Residential Collector	30
Major Collector	35-40
Minor Arterial	40-45
Major Arterial Varies *	(45 min.)
Commercial Local	30
Industrial Local	35

- Variance of design speeds on residential collectors or higher order roads may be granted by the City Engineer to no greater (or less) than five MPH increments when conditions warrant. Variances will not be granted for short segments of roads, but for entire contiguous stretches so that consistency and driver expectancy are maintained.

3.2.4.10 Clear Sight Distance at Intersections

A. At intersections, adequate, clear sight distance should be provided to permit drivers entering the higher order street from a driveway or STOP-controlled intersection to see approaching traffic from a long enough distance to allow them to decide when to safely enter the higher order street and complete their turning maneuvers in advance of approaching traffic. Clear sight distance, for both left and right turning vehicles, should be in accordance with AASHTO guidelines and generally as follows:

Through Street Design Speed	Sight* Distance
25	290
30	375
35	465
40	575
45	710
50	840
55	980

* Sight distances should be adjusted with cross road grades

3.2.4.11 Vertical Alignment

A. Vertical curves shall be provided in all changes in grade where

the algebraic difference is greater than one (1).

B. Longitudinal street grades shall not be less than one-half (1/2%) unless adequate alternative street drainage is provided, nor more than fifteen percent (15%), unless specifically approved by the City Engineer.

C. Vertical curve stopping sight distance design shall utilize criteria recommended by the latest edition of AASHTO. K-values shall be noted on all design drawings.

D. Minimum cross slope from street crown shall be two percent (2%) and the maximum four percent (4%) unless otherwise approved by the City Engineer.

E. Vertical alignment with the intersection is also of special nature, and design alternatives may be required. As a guideline, the approach area where vehicles stop while waiting to enter an intersection should not exceed five percent (5%) from the gutter line of the street being intersected for a distance of fifty (50) feet, though a range of fifty (50) to one hundred (100) feet is more desirable. This applies to all intersections, except those where both intersecting streets are minor or major collectors. In this situation, the landing area for a residential and major collector which is controlled by a STOP or YIELD sign should be designed for a grade of three percent (3%) for a distance of one hundred feet. Any other major intersection streets shall be approved by the City Engineer.

3.2.4.12 Safe Stopping Sight Distance

A. The minimum sight distance (length of roadway visible to the driver) to be provided for through traffic traveling at, or near, the design speed to stop before reaching a object in its path shall comply with the requirements set forth below (AASHTO guidelines):

Design Speed	Required Distance
25	150
30	200
35	250
40	325
45	400
50	475
55	550

3.2.4.13 Horizontal Curves

A. The recommended minimum centerline radius for horizontal curves are outlined below.

Design Speed	Curve Radius in Feet
25 MPH	185*
30 MPH	310
35 MPH	419
40 MPH	628
45 MPH	730
50 MPH	926

* For residential streets use 150.

3.2.4.14 Superelevation

A. Generally, Superelevation shall not be used on urban roads with design speeds less than thirty five miles per hour unless otherwise approved by the City Engineer.

B. Maximum Superelevation for urban roads shall be 4 percent (4%) unless otherwise approved by the City Engineer.

C. The use of Superelevation shall require prior approval from the City Engineer.

3.2.4.15 Deceleration Lanes

A. Deceleration lanes may be required on streets in conjunction with driveways and/or intersections adjacent to a proposed development. They are specifically required when all of the following factors are determined to apply:

B. 5,000 vehicles per day are using or are projected to use, the street;

C. The 85th percentile traffic speed on the street is thirty-five miles per hour or greater; or forty miles per hour for a two lane (one lane each direction) roadway; and

D. Fifty vehicles or more making right turns into the driveway or street during a one-hour peak period.

The lane lengths for a deceleration lane shall be determined on a case-by-case basis and must receive prior approval of the City Engineer. In addition to the above guidelines, deceleration lanes may

be required in connection with the results of a Traffic Impact Study or by the City Engineer.

3.2.4.16 Driveway Profiles

The slope of a driveway can dramatically influence its operation. Usage by large vehicles can have a tremendous effect on operations if slopes are severe. The profile, or grade, of a driveway should be designed to provide a comfortable and safe transition for those using the facility, and to accommodate the storm water drainage system of the roadway.

Required treatments of driveway grades are shown below. In commercial use, while eight percent (8%) should be the maximum allowable initial grade, maximum grades of three percent (3%) are preferable for high-volume driveways and six percent (6%) for low-volume driveways.

For driveways that require steeper grades an engineered design is recommended.

Driveway Type and Adjacent Street Classification	Maximum Grade
Low Volume Driveway** on Local Street*	15%
Low Volume Driveway** on Collector Street	10%
Low Volume Drive** on Arterial Street	5%
High Volume Driveway*** on Any Street	5%
* For single family residential homes these values apply to only the initial 10 ft. of the driveway beyond the sidewalk or right-of-way, whichever applies. ** Low Volume Driveway - defined as a driveway with less than 100 vehicles in the peak hour in the peak direction. *** High Volume Driveway - defined as a driveway with more than 100 vehicles in the peak hour in the peak direction.	
The above requirements apply only to driveways that adjoin public streets and are recommended for those adjoining private streets.	
For grade changes greater than 12%, a vertical curve of at least 10 ft. should be used to connect the tangents.	

3.2.4.17 Alignment and Continuity - Off-Site

A. Normally, off-site pavement construction requires asphalt concrete paving to the right-of-way centerline and in some cases beyond. When asphalt pavement is existing, the developer's engineer shall submit to the City Engineer sufficient information prepared by the Engineer to indicate vertical and horizontal alignments are

maintained and adequate drainage is provided for. The developer may be required to replace all, or any portion of existing roadway, in a manner that two-way traffic can be maintained without the use of potentially hazardous alignment transitions (vertical or horizontal) and in a manner to ensure that adequate drainage is provided for. As a minimum, there shall be twenty five feet of paving to accommodate through traffic. Required parking and shoulders are not included in the 25 feet.

When off-site pavement construction consists of improvement to the right-of-way centerline (approximately), leading and trailing transition tapers shall be placed at each end of the improvements. Horizontal transition tapers shall be designed and constructed based upon the roadway speed and in accordance with the taper requirements in the MUTCD and applicable AASHTO guidelines unless otherwise approved by the City Engineer.

B. When paving for partial street construction, the edges of the pavement are to be protected by placing a minimum two feet of aggregate base material beyond the edge of pavement matching the pavement grade.

C. Wherever partial street construction is required, grades shall be set for the future curb line and approved by the City's Representative. The future grades shall be compatible with the curb and centerline grades for the partial street construction. It may be necessary to design the roadway for a minimum of two hundred (200) feet to as much as one thousand (1000) feet beyond the development to ensure a future match.

D. Where a street abruptly ends or transitions, proper signage according to the MUTCD shall be required. Safe transitions into existing elevations shall be required where new roads transition into existing surfaces, i.e. gravel or natural surface.

3.2.5 PAVEMENT STRUCTURAL DESIGN

The structural details shown on the standard drawings are minimum requirements. The actual structural section for each roadway shall be designed by accepted Engineering design methods for flexible pavement (i.e. AASHTO, **UDOT** or CALTRANS). Required subgrade soil properties shall be obtained from an on-site geotechnical investigation. Required traffic information for design shall be approved by the City Engineer.

The geotechnical investigation shall be conducted by the Geotechnical Engineer. The investigation shall include a thorough exploration and sampling program of the subgrade to determine the nature and engineering properties of the on-site soils within the roadway construction area. For new construction and reconstruction projects, the minimum sampling and testing requirements are as follows.

- Excavate test holes to a minimum depth of five feet below subgrade. There shall be three test holes for the first one thousand (1000) feet and one for every eight hundred (800) feet thereafter, or as soil type varies.

- Calculate "R" values using AASHTO T 190-93 or ASTM D2844-69 (1975) using exudation pressure of 300 PSI (2070 Kpa) corrected to 2.50 inches (63.50 mm) specimen. Calculate "CBR" values using AASHTO T 193-93 three point using T 180 (Method D) for mold compaction with exceptions as listed in 5.1.1 through 5.1.3 of Test Method T193-93.

  Minimum Testing Frequency for "R" or "CBR" values shall be as follows:
  Two tests with at least one test per significant soil type for roadway lengths of one foot to one thousand feet.

  Three tests with at least one test per significant soil type for roadway lengths of one thousand feet to five thousand feet.

  Four tests with at least one test per significant soil type for roadway lengths of five thousand feet to sixteen thousand feet.

  Two tests per five thousand feet of roadway with at least one per significant soil type for any roadway over sixteen thousand feet.

- Conduct sieve analysis using either AASHTO T27-91 or ASTM C136-95. Conduct a sand equivalent test to determine the presence or absence of plastic fine material using either AASHTO T176-86(1993) 4.3.2 alternate method No. 2, pre-wet 4.3.3 mechanical shaker or ASTM D2419-91 9.4.2 Procedure B, 11.6.1 mechanical shaker. Either method shall use distilled or demineralized water for the working solution.

  One test for each stratum of each test hole.

- Calculate density in place using the drive-cylinder method ASTM D2937-83 or nuclear method ASTM D2922-93.

  Two tests per test hole.

- Calculate resistivity and pH using test methods AASHTO T-288-91 and AASHTO T-289-91.

  One test for each corrugated metal pipe culvert location.

- Test for soluble salts using St. George Standard Test Method S2297-96 at one-third of the number of test hole locations.

- Expansion index of soils shall be determined using the ASTM D4829-88 test method. This test shall be conducted whenever potentially expansive soils are encountered in a test hole.

  The above schedule represents minimum sampling and testing requirements. The Registered Professional Engineer responsible for directing and controlling the geotechnical investigation shall analyze each project to determine actual sample locations, frequency and testing program beyond the minimums given above.

  The above testing and design requirements may be waived by the City's Representative providing a prior development has already performed the above testing, design and construction on the first half of the roadway in the same location. In this case the new development shall match the existing roadway section.

3.2.6 CURB SIDE MAIL BOXES. All roadside mail boxes should be installed in accordance with applicable postal standards in the following locations:. In areas where the sidewalk is next to the curb, install boxes behind the sidewalk so as to not encroach into the sidewalk; in areas where a planter strip is provided, mail boxes may be installed within the strip, provided no part extends into the sidewalk or beyond the back of the curb; in rural areas where no barrier curb is installed, a minimum clear zone of ten feet from the traveled way should be provided.

3.2.7 SIGNS AND PAVEMENT MARKINGS. All street name and traffic control signs and pavement markings required on the street system within a

development or as a result of the development, shall be installed at the developer's expense in accordance with the standard drawings and MUTCD standards. A signing plan should be submitted with the engineering drawings, however, additional signing and traffic control may be added to the project as determined by the City's Representative.

3.2.8 UNDERGROUND WATER. When underground water in or adjacent to the site is encountered by geotechnical investigation or during the construction work, the City's Representative and the Project Engineer shall be notified immediately. The Project Engineer shall cause the necessary studies to be made and the required mitigation work to be installed. Do not ignore the situation!

3.3 OFF-SITE IMPROVEMENT SOIL STUDY GUIDELINES. The construction of off-site improvements is subject to the recommendations of a soils investigation report. This information shall be submitted at the same time off-site improvement plans are submitted to the City Engineer. The findings contained in the soils report shall be used as the basis for the design and construction of the off-site improvements unless otherwise directed by the City's Representative.

The soils investigation shall be conducted by the Geotechnical. The report shall be sufficiently comprehensive to determine the location and nature of all soils within the off-site construction area.

3.4 DRAINAGE AND FLOOD CONTROL DESIGN. This sub-section sets forth the criteria for engineering design of drainage and flood control systems.

3.4.1 GENERAL REQUIREMENTS. All development in the City that requires a grading permit or exceeds one acre in area, and all commercial development, shall submit a Drainage Control Plan and Report.

Design of drainage systems associated with development cannot cause increases in the flood peak discharges downstream from the development for 10-year and 100-year flood events.

All drainage plans shall conform to the requirements of the General Drainage Manual and be approved by the City Engineer or his designee.

Drainage and flood control plans shall be designed to conform to the City Flood Control Master Plan.

Drainage facilities shall be designed using currently accepted civil engineering standards of practice, applicable safety standards, and City or other approved design specifications.

In general, each development should handle its storm water runoff in such a manner that no increase in the 10 or 100-year peak storm runoff above the pre-development and/or natural state will occur on downstream properties.

In general, development changes the characteristic (quantity) of drainage from sheet flow to point discharge flow. While the amount of water may be controlled, the effects of all point discharges must be handled to insure no detrimental effects downstream of development.

Drainage facilities should be analysed, designed, and constructed to protect the development from the 100-year peak storm runoff. Most drainage collection system capacities for new development will be sized for the 10-year flood event, but no significant damage or risk of personal injury may occur from the 100-year flood. Major hydraulic structures (including bridges, large culverts, and open channels) will be designed for the 100-year flood.

For analysis purposes of the drainage system of a drainage basin area, all of the drainage basin upstream of the proposed development should be analysed for the conditions of new and/or planned development in conformance with the City's current Land Use Master Plan. Effects on downstream property owners and downstream flood control system shall be considered in the design and any negative impacts mitigated or design changes presented to mitigate problems to

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the satisfaction of the City Engineer or his designee. This may include acquisition of easements or agreements and/or construction or modification of existing improvements where needed both within the development and/or downstream.

All storm drainage and flood control systems shall be separate and independent from the sanitary sewer system.

New development should not cause a natural drainage channel to be filled in, obstructed, or diverted. When modifications to a natural drainage channel is proposed within the development, such changes will be addressed in the Drainage Control Plan and Report and shown on the improvement plans, and must be approved by the City Engineer prior to proceeding. In the event that modifications to natural drainage channels are approved, necessary easements and rights-of-way for structures and improvements shall be provided to the City.

The point at where the natural drainage channel enters and leaves the property will not be changed without approval of the City Engineer.

Improvements designed to protect a development shall be considered permanent and shall be designed and constructed accordingly. Such improvements shall be easily maintained by the maintaining agency.

New development shall provide the necessary means to insure drainage within the property being developed makes use of existing facilities and/or natural washes and shall be required to construct master planned improvements.

Streets are a significant and important component in urban drainage and shall be made use of in storm runoff within reasonable limits. The primary purpose of streets is for traffic. Reasonable limits for the use of streets for runoff shall be set by the City Engineer.

When drainage encroachments beyond that allowed for in the streets or point discharges are exceeded, an independent storm water system shall be designed and constructed by new development.

3.4.2 DESIGN CRITERIA - STREETS. Streets are a significant and important component in urban drainage and may be made use of in storm runoff within reasonable limits. The primary purpose of streets is for traffic. Reasonable limits for the use of streets for runoff shall be set by the City Engineer. Design criteria for gutter capacity and associated lane encroachment will depend on the roadway type as shown in Table 3.3. Street designs must include surface drainage relief points (inlets). This is especially important for flat gradient areas, local sumps or depressions and cul-de-sacs. For pedestrian safety, street flows must be limited such that the product of the depth (ft.) and velocity (ft./sec.) does

not exceed six (6) for the 10 year flow and eight (8) for the 100-year flow. Curb overtopping is not permitted in the 10 year event. When street encroachment limits are met, an underground storm sewer system shall be required. Where this underground conveyance is required to limit street flows, it will be designed for the 10-year design storm or greater.

Table 3.3

Street and Gutter Capacity for the *10-year* Event	
Street Classification	Maximum encroachment
Local (residential)	No curb overtopping.* Flow may spread to crown of street.
Minor collector (residential); Commercial	No curb overtopping.* Flow spread must leave one lane free of water.
Major Collector	No curb overtopping. * Flow must leave at least two lanes of travel free. (One lane in each direction)
Arterial	No Curb overtopping.* All travel lanes to remain open.
Major Arterial	No Curb overtopping.* No encroachment is allowed on any traffic lane.

* Where no curb exists, encroachment shall not extend over property lines.

Streets must also provide for routing of the 100-year design storm to adequate downstream conveyance facilities. The 100-year flood flows in streets should be contained within street right-of-way and adjacent drainage easements.

3.4.3 DESIGN CRITERIA - STORM DRAINS. Storm drain design conveyance capacity will be sized for a minimum of the ten year, three hour flood. The one hundred year, three hour design flood will be used for evaluation and prevention of significant damage to street overflow. Inlets must have sufficient capacity to prevent local ponding during the ten year event, with fifty percent (50%) blockage of inlets by debris. Analysis of combined street and storm drain capacity for the one hundred year flood must determine maximum ponding depths and water levels and show that these depths are non-damaging. In instances where sufficient combined capacity does not exist the storm drain size may have to be increased beyond that of the 10 year design.

In areas where underground water is anticipated to be added to the drainage system, the pipe size should be increased accordingly. In general, ground water will not be allowed to flow in streets and gutters and in other overland flow situations.

Design considerations will be given for differences in interception capacity of inlets on a gradient as compared to interception capacity of inlets in sag locations. Inlet spacing and locations will be for continuous grade or sag situations as appropriate. Inlets will be spaced so as to keep the street encroachment of flood waters to the minimum. Sag points may be required to have additional inlets spaced to control the maximum level of ponding.

All storm drains will be designed by application of the Mannings equation. Minimum design velocity shall be two ft./sec. flowing one-half full. The mannings "n" value shall represent that value that will be seen during the useful life of pipe which may differ from that of a new pipe. The hydraulic grade line will be shown for all pipe systems. The minimum storm drain diameter shall be 12" for smooth wall (insides) and 15" otherwise.

Storm drains shall not be designed for surcharged (pressure) pipe conditions unless otherwise approved by the City Engineer. When storm drains are designed for full pipe flow, or surcharged pipe conditions, the designer shall establish the hydraulic grade line considering head losses caused by flow resistance in the pipe, and changes of momentum and interferences at junctions, bends and structures. The water surface elevation profile and hydraulic grade line will be shown for the ten year and the one-hundred year design flood as required in the Drainage Control Plan and Report.

3.4.4 DESIGN CRITERIA - CULVERTS. In general, culverts are used to carry runoff from an open channel or ditch under a roadway to a receiving open channel or ditch. The minimum culvert diameter shall be 24". All culvert crossings under a roadway shall be designed to handle the 100 year storm (see bridges). All culvert crossings under arterial roads shall not have any road overtopping. Any other road overtopping shall be limited by the velocity/depth product and as detailed in Section 3.4.2.

A culvert entrance blockage factor of up to fifty percent (50%) shall be used for small diameter culverts and culverts placed in drainages with upstream debris as determined by the city. The one hundred year design storm water backwater surface upstream will be determined using an approved method (generally a HEC-2 or HEC-RAS) unless otherwise not required by the city. The back water must be shown to be non-damaging and be approved by the affected property owner. Potential paths of embankment overtopping flows will be determined and redirected, if necessary, so that no significant flood damage occurs. Entrance and exit structures must be installed to minimize erosion and maintenance. The minimum culvert slope shall be one percent (1%) unless otherwise approved.

3.4.5 DESIGN CRITERIA - BRIDGES. Bridges consist of major structures

carrying major washes or drainages. The roadway facility handled can be any classification of roadway. Low water crossings are generally not permitted Bridges can consist of free span structures, box culvert, multiple box culverts, multiple precast bridges and others.

Free-span bridges must pass the one hundred year event with a minimum of two feet of freeboard. No significant increases are allowed in upstream water levels. An approved method (generally a HEC-2 or HEC-RAS) of potential upstream water surface may be required by the City. Local and regional scour analysis are required on the structure, upstream and downstream and embankments. All potential scour will be mitigated. Appropriate references for this are Stream Stability at Highway Structures, Hydraulic Engineering Circular No. 20, Federal Highway Administration and computer programs such as USCOE HEC-6 or FHWA FESWMS.

For structures crossing FEMA designated flood plains and drainages, other requirements will be used, consult the City Engineering Dept.

3.4.6 DESIGN CRITERIA - CHANNELS

3.4.6.1. OPEN CHANNELS. Generally, there are two types of channels, they are man made and natural. Natural channels can be further subdivided into several sub-categories such as un-encroached, encroached, partially encroached, bank lined and others. The one-hundred year recurrence flood will be used for design for all channels unless otherwise approved by the city. All open channels must be designed as permanent in nature and have a minimum freeboard of one (1) foot. They must be designed as generally low maintenance facilities and must have adequate access for the entire length.

3.4.6.2. MAN-MADE CHANNELS. Man-made channel side slopes will generally be limited to a maximum slope of 2H:1V. Flatter slopes are generally recommended for maintenance and safety reasons. Safety is a primary concern. A channel should be designed such that a person falling into it could climb out within a reasonable length. A channel that is shallow in depth or in remote areas, or in areas of restricted right of way may, upon approval, have a steeper slope. Maximum velocities will depend on the type of material used for the channel lining. Supercritical velocities are not permitted for any material used. Drop structures and other energy dissipating design may be required to limit velocities to control erosion and head cutting.

Maximum velocities for grass lined channels depend on the type(s) of grass mixtures. The designers should consult appropriate design

literature for details. It is assumed that grass lined channels will be mowed at least annually. The minimum bottom width of a grass lined channel will be 6 feet unless otherwise approved by the maintenance agency. The minimum bottom width of all man-made channels shall be designed to facilitate access and maintenance.

3.4.6.3 NATURAL CHANNEL. The use and preservation of natural drainage ways shall be encouraged. Natural channels for drainage conveyance can reduce long term maintenance costs, can reduce initial costs associated with drainage, and can enhance passive recreation, and open space uses. When natural channels are incorporated into the drainage control plan, consideration shall be given to the impact of increased flows due to improvements to upstream drainage basins and areas, adequate access for maintenance and debris removal, long term degradation and erosion potential, and the need for additional set-backs for structures.

3.4.7 DESIGN CRITERIA - STORAGE FACILITIES. Generally, there are two types of storage: retention and detention. Retention ponds which are normally intended for infiltration of stored water may require extensive subsoil and groundwater studies as well as extensive maintenance requirements and safety concerns and are generally not allowed.

Detention facilities (basins) are used to temporarily store runoff and reduce the peak discharge by allowing flow to be discharged at a controlled rate. The controlled discharge rate is based on either limited down stream capacity, as in regional basins, or on a limit on the increase in flows over pre-development conditions, as in local facilities, and in some instances both.

Regional detention facilities are those identified by the City and will be identified in the Master Storm Drain Study and other regional studies. Generally, these facilities control flow on major washes or drainage basins, are of major proportion, and are built as part of major development or mitigation plans.

Local detention facilities are usually designed by and financed by developers or local property owners desiring to improve their property. These facilities are intended to allow development of property by protecting a site from existing flooding and/or to protect downstream property from increased runoff caused by development. In small facilities, detention storage volume may be provided in small landscaped or turfed basins, parking lots, underground vaults, excess open space, or a suitable combination. In larger facilities, dual functions may be served. These larger facilities are required

to reduce existing flooding to allow a development and/or control increased runoff caused by the development itself. These larger facilities may store significant flood volumes and may handle both off-site and on-site flows.

3.4.7.1 Design criteria - Detention facilities will generally be used to prevent local increases in the ten year, seventy two hour and the one-hundred year, seventy-two hour peak flows, or the one-hundred year three hour storm, whichever case requires the largest volume. Post-development discharges must not exceed pre-development discharges. If downstream facilities lack adequate capacity to handle the flow, other release rates must be used.

Standard engineering practice shall be used in determining the volume of the required facilities. A minimum of one (1) foot of freeboard is required above the maximum water surface elevation. Emergency spillways or overflows will be incorporated into all designs. Structures and facilities shall be designed so as not to be damaged in case of emergency overflow. Detention basins must empty within 24 hours. The maximum depth of a basin should be 3 feet unless otherwise approved. Below grade basins are preferred. Partially wet basins may be allowed for recreational or aesthetic purposes, but storage below permanent spillways or low-level outlets cannot be included in control calculations. Ground water should not be introduced into detention basins without approval of the City. Multi-use (e.g. recreation) should be considered for all detention basins.

Energy dissipation and erosion protection is required at all outlet structures where storm drainage is released into a natural or erodible channel, unless otherwise approved by the City. All basins are required to function properly under debris and sedimentation conditions. Adequate access must be provided to allow for cleaning and maintenance. All basins shall be designed as permanent facilities unless otherwise approved in writing by the City.

3.4.8 FLOODPLAINS. Flood plains are generally classified as FEMA (FEMA stands for Federal Emergency Management Agency) and non-FEMA. Any work in and around FEMA designated and mapped Flood plains should refer to the local ordinance governing their use. All work in the FEMA floodplain requires an appropriate permit.

3.4.8.1 FLOOD PLAINS (NON-FEMA)
In general, all building floor levels should be constructed two feet above the 100 year flood level. Encroachments into the 100 year floodplain for natural water courses will not be permitted unless

otherwise permitted by the City. All natural drainages, washes, and waterways that convey a developed 100-year flow of greater than 150 cfs will be left open unless otherwise approved. Developments located adjacent to or in Flood plains may be required to stabilize the continual degradation and erosion of the channel by installing grade control structures and/or by other effective means. Any alteration of the floodplain is not permitted unless the proposed use can be shown to have no significant negative influence on the flood conveyance, the floodplain, or the alteration itself.

In the layout and design of new developments, adequate access to Flood plains and erosion protection shall be provided. It is preferred that streets be positioned between Flood plains and structures. Where not possible or feasible, additional structural setbacks will be required.

Hydrologic, hydraulic, erosion, and geomorphologic studies will be required of developments adjacent to Flood plains.

3.4.9 EROSION CONTROL. Necessary measures shall be taken to prevent erosion due to drainage at all points in new developments. During grading and construction, the developer shall control all potential storm runoff so that eroded soil and debris cannot enter any downstream water course or adjoining property. All drainage that leaves a new development shall be adequately addressed to mitigate all erosion on adjacent properties. Erosion mitigation shall be permanent unless otherwise approved. A comprehensive reference on erosion control is Sedimentation Engineering by the ASCE.

3.4.10 IRRIGATION DITCHES. In general, irrigation ditches shall not be used as outfall points for drainage systems, unless such use is shown to be without unreasonable hazard substantiated by adequate hydraulic engineering analysis.

3.4.10.1 USE OF DITCHES - The irrigation ditches running through the area are laid out on very flat slopes and with limited carrying capacity. It is obvious, based on experience and hydraulic calculations, that irrigation ditches cannot, as a general rule, be used as an outfall point for storm drainage because of physical limitations. Exceptions to the rule are when the capacity of the irrigation ditch is adequate to carry the normal ditch flow plus the maximum storm runoff with adequate freeboard to obviate creating a hazard to those below and around the ditch. Ditches are almost always totally inadequate for use as drainage ways.

Irrigation ditches are sometimes abandoned in areas after the agricultural land is no longer farmed. Provisions must be made for ditch perpetuation prior to its being chosen and used as an outfall for drainage. Use of irrigation ditches for collection and transportation of storm runoff shall be made only when in accordance with the basin master plan.

3.4.10.2 Irrigation Company Approval. Any use of, alteration of, or relocation of structures on any irrigation ditch (or canal) shall have the written approval of the irrigation company who shall take the responsibility thereof.

3.5 SANITARY SEWER DESIGN. This sub-section sets forth the criteria for engineering design of wastewater collection systems. All wastewater lines shall be designed to be located in roadways or other vehicle travel ways unless approved by the Wastewater Division Manager.

Minor additions, renovations and repairs to an existing sewer or plumbing system shall be permitted in the same manner and arrangement as in the existing system, provided that such repairs or replacements are not hazardous and are approved by inspection.

All sewer main lines installed in public or private streets shall be inspected in accordance with these Standard Specifications for Design and Construction. These lines are public lines unless otherwise approved by the City Representative.

3.5.1 DESIGN FLOWS. All sanitary sewers and appurtenances shall be designed to carry the design flows from all contiguous areas which may, within a reasonable period in the future, be tributary thereto. Trunk lines shall be designed in accordance with the system master plan.

Sanitary sewers shall be designed to carry the peak discharge as specified below; also, all sewers shall be designed to transport suspended material so as to preclude the deposition of any solids in the sewer line.

New sewer systems shall be designed on the basis of an average daily per capita flow of not less than one hundred gallons per day. Other flow rates, based on accepted engineering practice, may be submitted to City's Engineer for review and/or approval. Sanitary sewer systems shall be designed to prohibit infiltration and exfiltration. To provide for peak loads, sanitary sewers shall be designed to carry not less than the flow shown in Table 3.4 when running 2/3 full.

TABLE 3.4
SANITARY SEWER DESIGN FLOWS

Laterals and sub mains galls/capita/day	400
Mains, trunks and outfalls gallons/capita/day	250

All sewers shall be designed and constructed with hydraulic slopes sufficient to give mean velocities (when flowing one half full) of not less than two feet per second, based on Manning's formula. As a minimum, Manning's "n" value shall be in accordance with pipe manufacturer's recommendation. An "n" value which

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Will yield higher friction losses shall be used where disturbing influences are known or anticipated, such as disruption of flow by tributary inflows, varied pipe materials, etc. The minimum slopes to be provided shall be as shown in Table 3.5, unless approved otherwise by the Wastewater Division Manager.

TABLE 3.5
SANITARY SEWER MINIMUM SLOPES

SEWER SIZE (Inches)	MINIMUM SLOPE (ft/100 feet)
4	2.00
6	0.80
8	0.50
10	0.40
12	0.35
15	0.30
18	0.25
21	0.20
24	0.15

Under special conditions, when justifiable reasons are given, slopes slightly less than those required for the two feet per second velocity when flowing one half full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for the design average flows, and where computations of the depth of flow in such pipes at minimum, average and peak rates of flow are submitted showing the basis of design. The Design Engineer must furnish computations for velocities and depth of flow for grades in excess of ten percent (10%) and for extremely low flow situations.

Hydraulic jumps shall be avoided whenever possible. Where velocities greater than fifteen feet per second are attained, special provision shall be made to protect against displacement by erosion and shock.

All Fernco repairs shall be encased in concrete and inspected. Repairs made on 8" or larger diameter pipes will be mandrel tested. Repairs made using solid couplers will be visually inspected before the repaired area is backfilled.

3.5.2 MINIMUM SIZE AND DEPTH. No public sanitary sewer shall be less than eight inches in diameter except as otherwise permitted in this sub-section. Minimum size of house connections shall be four inches in diameter. Minimum size of commercial connections shall be four inches in diameter. Lateral size and slope shall be based on the number of fixture units. Up to ninety (90) fixture

units shall be allowed per four inch lateral line. Each lateral connected to the public main shall serve only one residence, structure, or building. No connection of any sewer lateral to buildings or structures will be allowed until all downstream sewer lines have been tested and passed and all associated manholes have been raised and collared at asphalt grade.

In general, sanitary sewers shall be designed to a minimum depth of nine feet to the pipe invert in order to facilitate basements. Depth of pipe shall be measured from top of back of curb at low side of property to be served, in order to permit sewer laterals from basements to be connected. Exceptions may be granted in subdivisions or areas in which houses without basements are to be constructed. In such case a note to that effect shall be made on the plat map and on all plans presented for approval. In no case shall sanitary sewers be designed for a depth of cover less than thirty six inches over the top of the sewer pipe. All sewers shall be designed to prevent damage from super-imposed loads as well as trench loading conditions. When more shallow depths are unavoidable, consideration for approval may be given upon submittal of proper engineering design criteria to the City Engineer.

3.5.3 ALIGNMENT. All sanitary sewer mains shall be designed for uniform slope and alignment between manholes and shall be laid a distance of at least ten feet (horizontally) from any existing or proposed water main. In the event that a sewer main cannot be laid at least ten feet from an existing or proposed water main, then the City's Representative may authorize the implementation of the provisions of the appropriate section of the State of Utah Public Drinking Water Regulations.

All sewer laterals shall intersect the sewer main on the top third of the sewer main pipe as shown in the standard drawings.

3.5.4 SERVICE CONNECTIONS. Service connections to any public sanitary sewer shall be made only to a wye installed at the time of the sewer main installation or by a machine tap and approved saddle compatible with the main line sewer material in accordance with the standard drawings. They shall be a minimum of ten (10) feet, measured horizontally, from any culinary water line or tapping. All connections and service lines must be water tight. All sewer clean-outs shall be made with a standard wye fittings. New subdivisions shall install a sewer lateral from the main sewer to each proposed lot. The lateral shall be located fifteen feet from the low lot line, unless otherwise approved, and shall extend into the property a minimum of five to a maximum of ten feet from the front property line. Clean outs are required at 100-foot maximum spacing on straight runs and for each change in direction where the total aggregate change exceeds 135°.

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Service connections shall not be made to any sewer outfall line with a diameter greater than fifteen (15) inches or into a manhole unless otherwise approved by the City's Representative.

All sewer laterals connected to public sewer mains shall conform to Table 3.6. Laterals shall not be connected into main line stub ends extending from manholes.

All restaurants, food service establishments and other buildings that use high amounts of grease or oil shall install grease traps approved by the City's Representative and shall comply with City "pretreatment" standards.

Multiple connections to a lateral are not permitted.

Under no circumstances shall swimming pool drains, roof drains, foundation drains, storm drains or sub-drains be connected to the sanitary sewer system.

TABLE 3.6
SANITARY SEWER LATERALS

TYPE OF UNIT OR RESIDENCE	MINIMUM SEWER LATERAL SIZE (Diameter)	MINIMUM SLOPE
Single Family Residences	4 inches	2%
Townhomes (each unit)	4 inches	2%
Mobile Homes	4 inches	
Multi-family Condominiums	4 inches	1%
Commercial establishments	4 inches (see note below)	1%
Mobile Homes	4 inches (see note below)	22%
Apartments	4 inches (see note below)	

NOTE: Lateral size and slope shall be based on the number of fixture units. Up to ninety (90) fixture units shall be allowed per four-inch lateral pipe.

3.5.5 MANHOLES. Manholes shall be installed at all changes in grade, direction, pipe size or at all intersections; and at distances no greater than four hundred feet apart. All manholes shall be accessible to maintenance vehicles, and all sewer easements shall provide at least twelve feet of unobstructed width.

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Drop manholes shall be provided for a sewer line entering a manhole at an elevation of eighteen inches, or more, above the manhole invert.

Floor troughs shall be furnished for all sewers entering manholes, and shall be at least as deep as the full diameter of the sewer main in the manhole. Lines entering a manhole above the main trough but less than eighteen inches above the invert shall be provided with a slide inside the manhole to prevent sewage from getting into the manhole shelf and to minimize splashing of sewage.

A sewer main or service eight inches or larger connecting to an existing sewer main shall require a manhole at the point of connection. Where the junction consists of the same size sewers, a 0.2 foot drop shall be provided between the branch and main sewer. When a smaller sewer main joins a larger sewer main in a manhole, the top of pipe elevations shall match.

All manholes shall have eccentric manhole cones conforming to the detailed dimensions, construction details and materials as shown in the standard drawings.

Sewer manholes for all sewer mains of less than twelve (12) inches in diameter shall be a minimum four feet inside diameter. For sewers mains twelve inches in diameter or larger or over twelve (12) feet in depth, the manholes shall be not less than five feet in inside diameter. When the sum of all pipe sizes connecting to the manhole totals 24 inches or greater, the manhole diameter shall be five feet or greater.

When a sewer line is installed in a development or in a phase of a development, the line may be extended up to three feet beyond the last manhole on the line. The open end of the extension (the "stub") shall be the bell end of the pipe and must be sealed with a water-tight plug to allow for future extension. The stub shall be grouted and sealed around the pipe as it exits the manhole, to promote a water-tight fit.

Manhole sections shall be installed no less than 14 days after date of manufacture. Each manhole section shall be clearly marked on the inside with the name of the manufacturer and the date it was manufactured.

All new manhole lids and replacement lids on existing manholes shall have the City of St. George emblem.

3.5.6 UTILITY CLEARANCES. The following clearances must be maintained between sewer lines and other utilities unless otherwise approved by the City Representative:

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A. Utility clearances specified in applicable laws and codes shall be adhered to.

B. Sewer mains should be placed lower than other utilities.

C. Water distribution and sewage collection lines shall be laid in separate trenches, with at least ten (10) feet of separation measured horizontally.

D. Where the water line is less than eighteen (18) inches over the sewer line, where the water line is under the sewer line, and where the horizontal separation cannot be maintained because of physical obstructions, the water line shall be protected by construction of the sewer line with 1) ductile iron pipe; 2) water supply quality materials and joints; or 3) encasement with a minimum of two (2) inches of concrete. Each of these provisions shall extend ten feet on each side of the crossing. These provisions shall also be extended for other than ninety degree crossings to the point at which the ten (10) foot separation between the water and sewer lines is achieved.

E. Wastewater laterals and mains crossing under power, storm drain telephone, traffic signal conduit and/or street lighting conduit shall have at least one (1) foot separation, measured vertically. The clearance for gas lines shall be five (5) feet horizontally. If the required vertical clearance cannot be met, as determined by City Representative, a cushion of sand and cement slurry may be used to separate the utilities. Where use of sand and cement slurry are not practical, the Engineer may propose alternate methods.

F. The following clearances must be maintained between waterlines and other utilities

- Water to phone lines/cable TV - five (5) feet
- Gas to water or wastewater - five (5) feet
- Water to power - ten (10) feet
- Water to irrigation - five (5) feet
- Water to wastewater - ten (10) feet horizontal and eighteen (18) inches vertical.
- Gas to power - ten (10 feet.

3.5.7 SUSPENDED CROSSINGS. When suspended crossings are required, adequate support shall be provided for all joints in the pipe utilized for the crossings. The supports shall be designed to prevent frost heave, overturning and settlement. Precautions against freezing, such as insulation and increased

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slope, shall be provided. Expansion jointing shall be provided between above ground and below ground sewers. For suspended crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the one hundred year flood plain. When possible, the crossing supports shall be designed to allow for future adjustment in grade.

3.5.8 **PRESSURE (FORCE) MAINS.** The following defines design criteria and standards for pressure mains.

A. **Velocity:** A velocity of no less than three (3) feet per second shall be achieved at design flow. Calculation of pressure main velocity, design pressure, and hydraulic losses shall be submitted to the City's Representative for approval.

B. **Air Relief Valves:** Where required, an automatic air relief valve specifically designed for raw sewage application(s) shall be placed in the force main to prevent air locking.

C. **Slope:** To limit accumulations of gases, no segment of a force main shall have a zero slope. Wherever possible, low points which are subject to solids accumulation shall be avoided.

D. **Termination:** Pressure mains shall enter the gravity sewer system at a manhole. If necessary, provisions shall be made to direct or baffle sewage as it enters the manhole.

E. **Design Pressure:** The pressure main and fittings, including reaction blocking, shall be designed to withstand normal pressure, pressure surges (water hammer), and total (active and passive) earth loads.

F. **Suspended Crossings:** Pressure mains used for suspended crossings shall meet applicable requirements of SECTION 3.5.7.

G. **Hydraulic Losses:** Friction losses through pressure mains shall be based on the Hazen-Williams formula. For the Hazen-Williams formula, "C" = 100 shall be used for unlined iron or steel and "C" = 120 for all other materials. Turbulent losses at fittings, bends and valves shall be determined in a similar manner. The design data shall be submitted to City's Representative for review and prior approval.

H. **Thrust Blocks:** Thrust blocks and other restraints shall be included as necessary to secure the pressure main from movement.

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I. **Identification Ribbon:** A pipe locator ribbon shall be placed no less than eighteen (18) inches above the top of pipe, centered along the entire length of the pressure main. The ribbon shall be green in color and shall have the clearly printed legend, "Buried Sewer Line Below", printed continuously along its length with minimum one inch letters. The ribbon shall be not less than two (2) inches wide. For nonmetallic pressure mains, the locator ribbon shall have a metallic component, such as plastic-coated aluminum.

J. **Connection Into Existing Systems:** When connecting any sewer main or sub-main into an existing sewer system a plug shall be installed at the time the sewer is cut into, both on the downstream and upstream ends of the new line. The plug shall be a Cherne Gripper Mechanical Plug, or approved equal. The plugs shall not be removed until the new sewer system is approved and accepted by the City's Representative.

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3.6 **CULINARY WATER DESIGN**. All culinary water mains and appurtenances within the City of St. George shall be designed to provide for adequate future service for all contiguous areas which may, within a twenty year period in the future, be tributary thereto. Water trunk lines shall be designed in accordance with the system master plan.

3.6.1 **DESIGN FLOW PRESSURE**. Water mains shall be designed to provide a minimum residual pressure of twenty (20) psi under maximum day demand conditions including designed fire flow (as called out in SECTION 3.6.7 of these Standards). A minimum of forty (40) psi residual pressure must be maintained under normal peak hour conditions without fire flow.

3.6.2 **FLOW DESIGN CRITERIA.** Flow design criteria shall conform to the requirements outlined in the current edition of the State of Utah Rules for Public Drinking Water Systems, Section R309-1-5 "Quantity Requirements" and R309-112 "Distribution System". In any case where these specifications require a higher design standard than is contained in the referenced Rules, the higher design standard shall take precedence.

Peak instantaneous flow for outdoor use shall be assumed as follows:

Indoor Peak Instantaneous Flow multiplied by two.

Peak instantaneous fire flows shall be added to peak instantaneous domestic flows for distribution system design flow total.

Commercial or industrial areas may require special investigation to determine fire flow requirements. Existing and future static pressure and flow information used in the design must be approved by the Water Department.

3.6.3 **MINIMUM SIZE AND DEPTH**. The minimum depth of cover (to the top of the pipe) for water mains shall be three feet below the final grade of the street with a maximum of 10 feet unless otherwise approved by the Water Department. Where final grades have not been established, mains shall be installed to a depth great enough to ensure a minimum of three feet and a maximum of ten feet of cover below future grade. The water mains shall be sized to deliver the peak instantaneous flow rate as previously outlined. The fire flow requirements and pressures shall be as previously outlined. The size of the pipe shall also be based on a five (5) foot per second (fps) velocity maximum at peak instantaneous flows. However, the minimum water main size to be installed shall be eight inches in diameter unless otherwise approved by the Water Department.

Departures from the minimum requirements will be considered only in

special circumstances. Water mains in cul-de-sacs, internal streets within subdivisions, and other areas where water mains will not be extended in the future, may be six inches in diameter if that size water main meets the development's water demand requirements. Any departure from minimum requirements identified above shall be justified by a network hydraulic analysis.

A fire hydrant shall not be connected to a main which does not have sufficient fire flow capacity. as required by International Fire Code requirements. Appendix B and C.

In locations where the City has determined line size for the future based on a Masterplan Study, the master-planned line size will be installed.

3.6.4 VALVES AND HYDRANTS. The water system shall be looped and valves shall generally be spaced such that a break in any one length of main will put no more than six hundred feet of main, nor more than two fire hydrants, out of service (whichever is less) while maintaining adequate minimum service in the remainder of the water system during repairs, except for major transmission lines, where longer spacing may be allowed. All distribution mains connecting to larger transmission mains shall be valved at the connection. All fire hydrant runs shall also be valved at the distribution main.

Valves shall generally be located at street intersection.

3.6.5 PRESSURE REDUCING VALVES. Pressure reducing valves shall be installed on main lines where designated by the City Water Department. The standard design for these pressure reducing valves and vaults shall be provided by the City Water Department.

3.6.5.1 SECONDARY PRESSURE REDUCING VALVES. The Water Department requires that in high-water-pressure zones (greater than 80 psi), secondary pressure reducing devices be installed by the building owner on all water connections to buildings. The locations of the high-water-pressure zones within the City can be located and identified upon request from the Water Department.

3.6.6 FIRE HYDRANT SPACING AND LOCATION. Generally, fire hydrants shall be spaced and located as follows:

3.6.6.1 At each intersection, generally on the same sides of the street.

3.6.6.2 In residential areas, fire hydrant spacing shall be no greater

than five hundred feet and no house shall be more than two hundred fifty feet from a hydrant measured along a street access to the property being served.

B and C

3.6.6.3 In multiple family areas, PUD zones, P.D. zones, industrial, business or commercial areas, fire hydrant spacing shall require special investigation to determine the hydrant spacing per Appendix ~~111-B~~ of the International ~~Uniform~~ Fire Code (IFC). (Generally, spacing shall be no greater than three hundred fifty (350) feet and all commercial buildings shall be within one hundred seventy five (175) feet of a hydrant.)

3.6.6.4 Generally, hydrants shall be located in line with extensions of the property line when located mid-block.

3.6.6.5 Hydrants shall be placed no more than five (5) feet from the back of the sidewalk. Where sidewalk is not adjacent to the curb and a four (4) foot wide or wider planter area exists, the hydrant may be placed in the planter no closer than two feet from the back of the curb. Provide a five (5) foot elliptical radius of clearance to adjacent obstacles with the lowest water outlet not less than eighteen (18) inches nor more than thirty (30) inches from the final ground elevation (see standard drawings). The "break-away" flange at bottom of hydrant shall be installed so that it is at, or within six (6) inches above, final ground elevation.

3.6.6.6 All fire hydrants shall be owned, tested, and maintained, by the Water ~~Department~~ Company Supplying Water to that Location and shall be installed on dedicated easements or public rights-of-way.

3.6.6.7 A fire hydrant shall be placed in the end of all cul-de-sacs or on dead end lines.

Fire hydrants shall not be located:

A. within five feet of a driveway, power pole, light standard, or any obstruction

B. or, within three (3) feet of any block wall or fence when measured to the rear of the hydrant.

3.6.7 FIRE FLOW REQUIREMENTS. Under maximum day demand conditions, fire flow shall be at least seven hundred fifty (750) gallons per minute at any one hydrant with a total fire flow of at least one thousand

C. No obstruction, fence, or landscaping ~~other than~~ may be placed ~~within 3 feet~~ within 6 feet on either side of any fire hydrant. The front of the hydrant must remain unobstructed to the street or driveway it faces, and clearly visible from

five hundred (1,500) gpm at any combination of two hydrants in the area, and/or must meet the requirements of the Federal Insurance Service Office. The total system design shall be such that fire flows and normal peak instantaneous flow demand (as called out within this sub-section) can be met while still maintaining a minimum pressure of twenty (20) psi at all points in the distribution system.

A maximum water velocity of ten (10) feet per second shall be utilized when designing for fire flows and/or other emergency conditions.

High density residential, commercial or industrial areas shall require special investigation to determine fire flow requirements and hydrant spacing per the ~~Uniform~~ International Fire Code (UFC). Appendix ~~B~~ B and C

Existing and future static pressure and flow information used in the design shall be approved by the Water Department.

3.6.8 MISCELLANEOUS WATER SYSTEM DESIGN CRITERIA.

3.6.8.1 All public water mains shall be installed in a public rights-of-way, dedicated roadway, or designated drainage way, with adequate access for maintenance vehicles. Pipelines will not be installed on back lot or side lot lines due to potential flood and other damage.

3.6.8.2 Dead-end mains shall be avoided wherever possible and if installed, shall not exceed six hundred feet in length from a looped water line. Hydrants shall be located at the end of dead-end mains and cul-de-sac mains for flushing purposes as well as for fire protection. Blow-off valves rather than fire hydrants are not desirable except where warranted by special circumstances as determined by the Water Department. Blow-off valves shall be installed per the standard drawings.

3.6.8.3 Each building or lot shall be served by a separate line and meter except in PUD's as approved by the Water Department. In some situations a common tap and service line from the main to a manifold with two meter setters and boxes may be installed to serve two adjacent properties. All lots shall have a minimum of three quarter (3/4) inch service line from the main to the meter box. Multiple housing of two units, or more, shall have a minimum of one (1) inch service. When there are more than two multiple housing units the service line shall be sized accordingly.

3.6.8.4 All service line taps shall be machine tapped at the time of the water main installation. Service lines shall be installed prior to testing and acceptance of the water main.

3.6.8.5 Water mains shall be laid at least ten (10) feet horizontally from any existing or proposed wastewater main. The distance shall be measured edge to edge. If necessary, and where approved by the City's Representative, SECTION 12.2.1 of the State of Utah Public Drinking Water Regulations can be implemented.

3.6.8.6 When a water main crosses over a wastewater main, the water main shall be laid at such an elevation that the bottom of the water main is at least eighteen (18) inches above the top of the wastewater main. When the water main cannot be as high as eighteen (18) inches above the wastewater main, the wastewater main shall be constructed of material with pressure conduit standards for a distance of ten feet on either side of the crossing.

3.6.8.7 All tees, bends, plugs and hydrants shall be provided with reaction blocking, tie rods, and/or joints designed to prevent movement, i.e. " mega lug" or approved equal. Wood blocking of future main extensions is not acceptable. When thrust restraints cannot be used, concrete thrust blocks shall be formed and poured in place and must bear against undisturbed soil, per the thrust block details in the standard drawings. Installation of concrete thrust blocks shall receive prior approval of Water Department.

3.6.8.8 Air release vacuum assemblies and blow-off valves shall be provided on all mains twelve inches in diameter and larger, where required, to prevent damage due to air accumulations.

3.6.8.9 All water lines shall require a fourteen gauge insulated THWN wire be installed with the line for locating purposes. The wire shall be installed and extended up at each valve and hydrant.

3.6.8.10 Sufficient valves shall be provided on water mains to minimize inconvenience and sanitary hazards during repairs. Valves shall be generally located as follows:

A. At intervals to isolate no more than two (2) fire hydrants at any time.

B. At minimum intervals of five hundred (500) feet in commercially zoned areas.

C. In residential areas to isolate a maximum of thirty services (approximately six hundred (600) feet).

D. A maximum of five valves will be required to isolate any location.

E. Valves shall not be located in street gutters, valley gutters, or in driveways.

F. A valve is required at the end of all temporarily dead-ended

mains. The valve location is to be a minimum of ten (10) feet upstream of the cap or blow off assembly.

G. Valved outlet(s) for future service laterals six (6) inches in diameter and larger may be installed when approved by the Water Department. (Valved outlet installation approval does not constitute a water commitment.)

H. A shut off valve immediately adjacent to the water main shall be provided for all service laterals greater than two (2) inches in diameter and for all fire hydrant laterals.

I. The Water Department may require additional valves as deemed necessary.

3.6.9 NETWORK HYDRAULIC ANALYSIS.

3.6.9.1 WHEN REQUIRED. The Water Department may require that a network hydraulic analysis be conducted by the Engineer if:

- the project is a major subdivision with an internally looped system
- the project is located in the higher elevations of a low static pressure zone
- a high fire flow demand is required (greater than1500 gallons per minute)
- there will be extensive irrigation
- the new water plans will complete a loop on the current system, or
- as otherwise required by the Water Department.

3.6.9.2 DESIGN. The consulting engineer should request the source hydraulic grade line (HGL) from the water department prior to the initial design where a network hydraulic analysis is required. The following information shall be submitted at the time of such a request:

- location, type of development, and the acreage or number of units with the development, and
- anticipated fire flow requirements, and
- the location where the proposed water distribution system is planned to tie into the existing system.

3.6.9.3 SUBMITTAL FOR REVIEW AND APPROVAL. The network hydraulic analysis shall be submitted with the project design for review. For larger projects, such as a major subdivision, obtaining network hydraulic analysis approval prior to submitting the water plan is preferred. The Water Department shall, upon request, make a determination as to which submittal method must be followed.

The network hydraulic analysis submittal shall include two copies of the following items:

- the data input sheets, as well as the analysis results
- information about the development (i.e., type, number of acres, number of units, fire flow requirements, etc.)
- data sheet(s) outlining all assumptions (i.e, method used to assign demands to corresponding nodes and source HGL's used)
- map identifying pipe and node numbers and their locations
- fire hydrant locations
- the name and version of software used for the analysis
- elevations of junction nodes
- staging or phasing of development, and
- appropriate off-site demands.

3.6.9.4 MISCELLANEOUS. The roughness factors to be used in the analysis should be as follows:

- C equal to 100 for all unlined cast iron pipe
- C equal to 120 for existing pipe twelve inches, or less, in diameter
- C equal to 130 for existing pipe (150 for PVC) fourteen inches, or greater, in diameter
- C equal to 130 for new pipe (150 for PVC) regardless of diameter

For any other sizes or materials not covered by the above, the consulting engineer shall contact the Water Department for guidance.

When identifying the fire flow available in a network hydraulic analysis, use the hydrant located at the development's weakest point (highest point in the development and/or last hydrant on dead-end main). Also, verify the hydrant is located at a junction node.

The elevations used in the network hydraulic analysis should preferably be based on a project grading plan or the anticipated final elevation. If the final grading plan deviates significantly from the elevations used in the analysis, a revised analysis will be required.

A chart to be used as a guide to determine water consumption for various types of developments shall be obtained from the Water Department.

3.7 SECONDARY WATER OR WASTEWATER REUSE IRRIGATION SYSTEM. All secondary water irrigations systems shall be designed and constructed in accordance with the requirements outlined for culinary water systems in SECTIONS 3 and 4 of these specifications. However, all valve box covers shall bear the legend "Irrigation" in order to clearly differentiate between culinary and secondary systems. The pipe material shall be colored purple, or a discrete color different from the culinary water main. There shall be no cross connections between secondary and culinary water systems.

All wastewater reuse irrigation systems shall be designed and constructed in accordance with the requirements outlined for culinary water systems in SECTIONS 3 and 4 of these specifications. However, all requirements for the treating and reuse of wastewater outlined in the latest applicable Utah Division of Water Quality Standards for Utilization and Isolation of Domestic Wastewater Treatment Works Effluent shall be followed. These requirements include, but are not limited to, a reuse project plan, allowed uses, required treatment processes and water quality limits.

3.8 OTHER UTILITIES SYSTEMS DESIGN. All other utility systems shall meet the following:

3.8.1 RESPONSIBILITY. Other necessary utility installations (Gas, Electricity, Phone, T.V.) will be coordinated and installed by the developer.

3.8.2 STREET LIGHTS. All developments shall include street light and necessary appurtenance in accordance with the local power company's specifications.

3.8.3 BURIAL OF LINES. All utility lines in subdivisions, planned unit developments, and other developments shall be underground. Lines shall be buried at a minimum depth of forty-two (42) inches for primary power. Power lines shall not be buried in any water or sewer trench.

3.8.4 LAYOUT. Utility lines shall be located within designated utility easements and in accordance with the requirements of the Joint Utilities Committee (JUC).

3.8.5 FRONT LOT LINE SYSTEMS. Where utilities are located in front lot lines, other utility system construction shall not begin until the completion of water, sewer, curb and gutter, and must be complete before installation of street asphalt.

3.8.6 QUALITY CONTROL. All utility trench construction shall conform to the design and testing requirements set forth in Section 4.4 (Pipeline Construction) of these standards.

3.9 **TRAFFIC STANDARDS.** This sub-section sets forth the criteria for access control and Traffic Impact Studies.

3.9.1 ACCESS CONTROL. The general access control requirements for "major" and "minor" arterials and "major" collectors are provided below. All access points on these facilities shall be subject to approval by the City Engineer or his designated representative. Where deemed necessary, stricter requirements may be evoked.

3.9.1.1. GENERAL REQUIREMENTS. Direct access to a residential lot(s) shall not be allowed unless otherwise approved by the City Engineer. If allowed, additional requirements and restrictions may be imposed such as increased setbacks, circular drives, etc.

A. Driveway access shall not be allowed within one hundred fifty feet of the nearest right-of-way line of an intersecting street for major collectors and one hundred eight-five (185) feet for minor arterials (see section 3.2.4).
B. Unless otherwise approved by City Engineer, access shall be limited to one driveway for each tract of property separately owned. Properties contiguous to each other and owned by, or previously owned by, the same party are considered to be one tract.
C. Driveways giving direct access may be denied if alternate access is available.
D. When necessary for the safe and efficient movement of traffic, access points may be required to be designed for right turns in and out only and will include appropriate deceleration and turning lanes.
E. When approved, or directed by the City Engineer, a driveway access design may be a "street type intersection" with curb returns.

3.9.2 TRAFFIC IMPACT STUDIES. A Traffic Impact Study, (TIS) is a specialized study of the impacts that a certain type and size of development will have on the surrounding transportation system. It is specifically concerned with the generation, distribution, and assignment of traffic to and from the "new development". The term "new development" also includes properties that are being redeveloped.

A TIS shall be required for all new developments or additions to existing developments which generate 100 or more trips during the morning or afternoon peak hours or which will have a significant impact on the City's transportation system as determined by the City Engineer. Traffic Impact Studies are divided into three categories. The scale of development will determine which category of study will be required. Each category differs by specific analysis requirements for the study and the study's level of detail. Below is a description of each category.

CATEGORY I -- Developments which generate 100 or more new peak hour trips, but less than 500 trips during the morning or afternoon peak hours. Peak hour trips will be determined by ITE's Trip Generation Manual.

In addition to the above threshold requirements, a Category I TIS may also be required by the City Engineer for any specific traffic problems or concerns such as:

- proposed or existing offset intersections;
- situation with a high number of traffic accidents;
- driveway conflicts with adjacent developments;
- nearby intersections that have reached their capacity;
- proposed property rezones when there is a significant potential increase in traffic volumes;
- when the original TIS is more than two years old, or where the proposed traffic volumes in the original TIS increase by more than twenty percent (20%).

For a Category I TIS, the study horizon shall be limited to the opening year of the full build-out of the development.

The minimum study area shall include site access drives, affected signalized intersections and major unsignalized street intersections.

CATEGORY II -- Developments which generate from five hundred to one thousand new peak hour trips during the morning or afternoon peak hours.

The study horizon shall be for the year of completion for each phase of the development, the year of its completion and five years after the development's completion.

The minimum study area shall include the site access drives and all signalized intersections and major unsignalized street intersections within one-half mile of the development.

CATEGORY III -- Developments which generate above one thousand new peak hour trips during the morning or afternoon peak hours.

The study horizon shall be for the year of completion for each phase of the development, the year of its completion, five years after the development's completion, and ten years after the development's completion.

The minimum study area shall include the site access drives and all signalized intersections and major unsignalized street intersections within one-half mile of the development.

The City Engineer, or his designated representative, shall make the final

decision of requiring a TIS and determining whether the study falls within Category I, II, or III.

The TIS shall be conducted and prepared by the Traffic Engineer. The subject Engineer shall have special training and experience in traffic engineering and be a member of the Institute of Transportation Engineers (ITE).

Generally, the data necessary for such a study will require a description of the study area, the scope of development, turning movement traffic counts, accident analyses, roadway geometry, traffic control devices, and trips generated by the new development. The roadways and intersections within the study area shall be analyzed with and without the proposed development to identify and projected impacts with regard to level of service and safety.

Where the highway will operate a Level of Service 'C' or better without the development, the traffic impact of the development on the roadways, and intersections within the study area shall be mitigated to Level of Service 'C'. Mitigation to Level of Service 'D' may be acceptable with the concurrence of the City. A list of mitigation improvements will be provided in the study to achieve this Level of Service.

The guidelines and specific requirements for the preparation of a TIS are found in the "City of St. George Traffic Impact Study Guidelines". All studies prepared for submittal to the City shall follow these guidelines unless otherwise approved.

3.10 SURVEY MONUMENTATION STANDARDS. This sub-section sets forth the general standards for survey monuments.

3.10.1 GENERAL REQUIREMENTS. Only a Land Surveyor, registered in the State of Utah, shall be authorized to determine or establish the exact location for a survey monument. Only such registered Land Surveyor shall be authorized to perpetuate and reference existing Class I and II survey monuments located within the limits of public or private streets.

3.10.2 MONUMENTS. Class I or II monuments shall be set in accordance with the recorded maps so that the survey, or any part thereof, may be readily retraced. Such monuments shall be set at :

A. All angle points in survey boundary (Class II).

B. All angle points of tangency and points of curvature on and along survey boundary (Class II).

C. All street centerline intersections Class I).

D. At a P.I. outside of right-of-way (Class II).
If the P.I. falls outside the limits of pavement then P.C.'s and P.T.'s shall be monumented with Class I.

If the P.I. falls inside the pavement area then a Class I monument is required and no monumentation required for P.C.'s and P.T.'s.

E. All intersections of street centerlines at survey boundary (Class II).

F. Six hundred foot intervals, unless otherwise approved. If line of sight is not obtainable within a six hundred foot interval, then monuments will be required to be closer together unless otherwise approved by the City Surveyor.

All the above established points which fall within the limits of public or private rights-of-way shall be referenced with four permanently established reference points within a radius of twenty (20) feet to one hundred (100) feet all of which shall be outside the pavement area. The angle from tie to tie shall be as near ninety degrees as possible, radiating from the established intersection points. A copy of the survey notes documenting the setting of the reference ties shall be kept by the responsible surveyor and a copy shall be delivered to the office of the City Surveyor and of the County Surveyor's depository.

When a section corner, quarter corner or sixteenth corner falls within a fully improved roadway and must be set, or reset, the responsible surveyor shall contact the County and City Surveyor for directions and/or requirements.

All monuments shall have brass marker or aluminum cap in accordance with the standard drawings. The surveyor's registration or license number shall be stamped on the cap.

Monuments must be set prior to the final acceptance of the improvements.

Where hard rock or other physical obstructions are encountered, monument length sufficient to resist removal may vary within reasonable limits.

All monuments shall be set in such a manner that the accuracy of their relative positions is not less than second-order Class II, in accordance with the specifications established by the U.S. Federal Geodetic Control Committee. When monuments are being reset, the initial order used in the setting shall be used, but in no event shall it be less than second-order Class II.

3.10.3 TYPES OF MONUMENTS. Class I and II monuments shall be installed in accordance with City requirements.