

CITY OF LEAGUE CITY

Department of Public Works, Engineering, and Traffic & Transportation Design Guidelines

GENERAL PROVISIONS

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ITEM 101 GENERAL INFORMATION

101.1 Purpose.

It is the intent of these General Design and Construction Standards (“Standards”) of the City of League City, Texas, to state the requirements for sub-dividers, developers, engineers, surveyors, realtors, and other persons interested and involved in the development of land. Where adopted, the applicable City master plan shall be adhered to. Further, it is the intent, purpose, and scope of these Standards to promote and protect the health, safety, and general welfare of the public.

Presented herewith are the general requirements of the Engineering Department for designing public storm sewers, drainage facilities, water lines, paving, and sanitary sewers within the City of League City and its extraterritorial jurisdiction (“ETJ”). These requirements are the general guideline to inform the design engineers and contractors performing work in League City of the Department’s policies and procedures. In no way does the following information provide all answers to design and construction questions or situations; however, it does provide a means to initiate the design and construction of facilities in the manner utilized by the Utilities and Street Departments.

The design of any public utility or paving must be approved by the Engineering Department prior to any issuance of a permit for its construction. ~~The construction of all public utilities and street paving shall be approved by the Department of Public Works and City Council before final acceptance and maintenance.~~

Upon approval of construction by all appropriate City Inspectors, the City Engineer will issue a Final Acceptance Letter for the Development. All warranties, except warranties for streets, shall start at the time of final City acceptance. Street warranties shall start upon ninety (90) percent completion of build-out.

No final acceptance shall be granted until the following documents have been submitted and approved by the City Engineer:

- a. A formal Acceptance Request Letter by the Developer or his designee.
- b. An Engineer’s Certificate of Completion. This certificate should include, at a minimum, the name of the development, the owner of the development, the contractors, engineering company, and a statement certifying that the EOR provided inspection during construction. The certificate should be signed by the EOR.
- c. A Summary of Public Infrastructure Cost. This summary should provide construction and engineering costs for all public infrastructure installed within the development.
- d. A complete set of reproducible copies of As-Builts accompanied by a letter from the EOR certifying that the work required by the subject contract has been

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[completed in general conformance with the approved plans and technical specifications.](#)

101.2 Authority.

In pursuance of the authority granted to cities and counties under the Constitution and Laws of the State of Texas, including the provisions of Section 4 of the Municipal Annexation Act, as heretofore or hereafter amended, the City Council of League City has adopted the following rules and regulations governing the engineering design and construction of public works within the city limits and extraterritorial jurisdiction of League City, Texas.

ITEM 102 DEFINITIONS OF TERMS AND ABBREVIATIONS.

AASHTO – American Association of State Highways and Transportation Officials.

ACI – American Concrete Institute

ADMINISTRATIVE OFFICIAL – Any employee or advisory, elected, or appointed body, which is authorized to administer any provisions of this ordinance.

AI – The Asphalt Institute

ANSI – American National Standards Institute

API - American Petroleum Institute

ASTM - American Society for Testing Materials

AWWA - American Water Works Association

BASE FLOOD - The flood having a one-percent chance of being equaled or exceeded in any given year.

CITY - The City of League City, Texas

CITY COUNCIL- The City Council of the City of League ~~City, being the elected legislative body, has final jurisdiction in the approval of matters pertaining to plats of subdivisions, the establishment of standards of design, and the acceptance of lands and improvements that may be proposed for subdivision improvements~~City's.

CITY ENGINEER – [A licensed professional engineer designated to represent the City of League City.](#)

CITY INSPECTOR - The authorized representative of the ~~Public Works~~[Engineering](#) Department, assigned to inspect any and all parts of the work and the materials to be used therein.

CITY LIMITS - City boundary as fixed by Mayor and City Council and defined in City Ordinance.

CITY STAFF - Personnel working for the City.

PLANNING & ZONING COMMISSION - A commission that acts as an advisory agency to the City Council.

CONTRACT - The agreement between the developer and the contractor covering the furnishing of materials and performance of the work. The directions, provisions, and requirements contained herein or in special specifications,

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supplemented by such special provisions as may be issued or made pertaining to the method and manner of performing the work, or to quantities and quality of materials.

CONTRACTOR - The individual, firm, or corporation or any combination thereof, with which the contract is made by a developer or the City. The work shall include the furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to the duties and obligations imposed by the contract.

CRSI - Concrete Reinforcing Steel Institute.

DEDICATORIAL - An acknowledgement by the owner and lien holders of property being subdivided under applicable City codes and ordinances and appearing on the plat dedicating said property.

DEVELOPMENT - The construction of a facility that is built, installed, or established to serve a particular purpose.

DEVELOPER - Any individual, firm, co-partnership, corporation, or any other legal entity commencing proceedings under this Ordinance.

EASEMENT - A right granted for the limited purpose of use over, across, or under private land.

EASEMENT, AERIAL - An easement for the exclusive use of constructing and maintaining above ground utilities within its confines.

EASEMENT, DRAINAGE - An easement for the exclusive use of constructing and maintaining drainage facilities within its confines.

EASEMENT, MAINTENANCE - A perpetual 4-foot wall-maintenance easement shall be provided on the lot adjacent to the ~~zero-lot~~zero-lot line/property line, which, with the exception of walls and/or fences, shall be kept clear of structures. This easement shall be noted on the plat and title to the property.

EASEMENT, STORM SEWER - An easement for the exclusive use of constructing and maintaining storm sewer lines and appurtenances within its confines.

EASEMENT, UTILITY - An easement granted for the purpose of placing and maintaining utilities within its confines.

EASEMENT, WASTEWATER - An easement for the exclusive use of constructing and maintaining wastewater lines and appurtenances within its confines.

EASEMENT, WATER - An easement for the exclusive use of constructing and maintaining water lines and appurtenances within its confines.

ENCROACHMENT - An intrusion into or onto a public right-of-way or easement with a ~~privately-owned~~privately-owned structure or amenity

ENGINEER - An individual duly authorize under the provisions of the Texas Engineering Practice Act. Article 3271a, Vernon's Texas Civil Statutes, as amended to practice the profession thereof.

ENGINEER OF RECORD ("EOR") - The Engineer-of-Record shall be a professional engineer licensed in the State of Texas retained by the developer. The EOR shall be of unquestionable professional integrity, because he is

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expected to act as a representative of the City of League City, as well as the developer, in enforcing the specifications and construction standards.

ENGINEERING DEPARTMENT – Designated representatives within the City of League City Engineering Department that are empowered to make decisions concerning items within this specification book.

EXTRATERRITORIAL JURISDICTION - The area defined by the City Attorney and the Public Works Department and the Texas Municipal Annexation Act, Article 970a, Vernon's Texas Civil Statutes, as amended.

FLOOD PLAIN - A land area which is flood prone as defined by the Federal Emergency Management Agency (**FEMA**), pursuant to enforcement of the latest National Flood Insurance Study.

FLOODWAY - As defined by **FEMA** on the most recent flood boundary and floodway maps floodway maps.

GCHD - Galveston County Health Department

HCFD - Harris County Flood Control District

NLA - National Lime Association

NSF - National Sanitation Foundation

PLAT - The map on which the developer presents his plan for a subdivision for approval.

- a. **PRELIMINARY PLAT** - An initial plan or map illustrating the proposed subdivision or development of land which will be submitted for approval before preparation of the final plat.
- b. **FINAL PLAT** - A finished plan or map illustrating the proposed subdivision or development of land having been certified to by a Registered Public Surveyor and submitted for approval by the Planning Commission and the City Council. A copy shall be recorded in Galveston County Clerk's office or Harris County Clerk's office, as appropriate.
- c. **REPLAT** - A map on which an existing subdivision or portion thereof is being officially changed. A copy of such plat shall be recorded in the Galveston County Clerk's office or the Harris County Clerk's office, as appropriate.
- d. **VACATION of SUBDIVISION PLAT INSTRUMENT** - An instrument declaring that a plat and its dedications be vacated or cancelled and that the land be converted to acreage. A copy shall be recorded in the Galveston County Clerk's office or the Harris County Clerk's office, as appropriate.

PROPERTY - The land (whether leasehold or in fee simple) and the building, all improvements and structures thereon, and all easements, rights, and appurtenance belonging thereto.

PUBLIC WORKS DEPT. – Designated representatives within the City of League City Public Works Department that are empowered to make decisions concerning items within this specification book.

RIGHT-OF-WAY - A tract of land dedicated or deeded in fee simple to the perpetual use of the public or other specified entity.

TxDOT – The Texas Department of Transportation

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SPECIFICATIONS - The directions, provisions, and requirements contained herein or as may be issued or made pertaining to the methods and manner of performing the work or quantities and qualities of materials to be furnished. Where reference is made to specifications of ASTM, AASHTO, AWWA, ANSI, or bulletins and manuals, it shall be construed to mean the latest standard or tentative standard in effect.

STREET - A permanently reserved thoroughfare which affords principal means of access to abutting property.

- a. **MAJOR ARTERIAL STREET** - A highway which permits rapid and relative unimpeded traffic movement throughout the city.
- b. **MINOR ARTERIAL STREET** - A thoroughfare having function similar to major arterials, with the exception those minors can be oriented into residential areas.
- c. **COLLECTOR STREET** - A Street designed to serve the local needs of the neighborhood and to provide direct access to an arterial street.
- d. **LOCAL or RESIDENTIAL STREET** - A Street designed to serve the local needs of the neighborhood and to provide access from abutting residential properties to other streets.
- e. **CUL-de-SAC** - A Street which is part of the local street system and closed on one end in a circular or other approved pattern meeting minimum radius requirement.
- f. **ALLEY** - A narrow public or private right-of-way which provides a secondary means of vehicular access to abutting property and not intended for general travel.
- g. **STUB STREET** - Streets which terminate at the boundary of a subdivision for future access to adjoining unplatted property.
- h. **PRIVATE STREET** - A Street within a gated or private subdivision conforming to the City's current Private Streets Ordinance.

SUBDIVISION - By means of a plat, the division of a tract or parcel of land, for the purpose of transfer of ownership or building development, expressly excluding development for agricultural purposes.

SURVEYOR - An individual duly authorized in Texas under the current Land Surveying Practices Act of 1979, as amended, Article 5282c, Vernon's Texas Civil Statutes, as amended, to practice the profession thereof. A surveyor shall be responsible for all descriptions and plats to be recorded in official records.

SURVEY - A boundary or topographic map

TMUTCD - Texas Manual on Uniform Traffic Control Devices for Streets and Highways.

TxDOT - The Texas Department of Transportation

UL - Underwriters Laboratories, Inc.

UNI-B - UNI-BELL PVC Pipe Association

UTILITIES - Facilities for public use, i.e., water, wastewater, and drainage, gas, telephone lines, electricity, cable television, etc.

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ITEM 103 SCOPE OF WORK

103.1 Intent of Plans and Specifications.

It is the intent of plans and specifications submitted to the City for review to describe a complete work to be performed.

103.2 Changes and Alterations.

All changes and alterations in the plans and specifications must be prepared by the EOR and approved by the [Public Works Engineering](#) Department.

ITEM 104 CONTROL OF WORK

Many new street, drainage and utility construction projects within League City are performed by commercial and residential property developers. These constructed roadway, drainage and utility networks are conveyed to the City at the time of acceptance and turned over to the City for operation and maintenance. However, such projects must not be viewed as a “gift”. These facilities frequently represent significant additions to League City’s maintenance and operational responsibilities. The establishment of adequate quality control procedures for these types of projects is extremely important because the City is not able to exercise day-to-day control of the work.

Development projects shall be controlled with a binding contract between the Developer and the Contractor. Specifications establishing contractual requirements shall be prepared and administered by the Developer’s EOR.

104.1 Authority and Duties of Engineer-of-Record.

The EOR shall provide for inspection, sampling and testing necessary for day-to-day job control. The EOR or his representative shall inspect all work performed and all materials furnished to the project and bring any deficiencies in work or materials to the attention of both the Contractor and the City.

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He shall see that all sampling and testing required by specifications or job site conditions, are performed by an independent Material Testing Laboratory. He shall also issue a certificate, at the completion of the work, acknowledging that the project was constructed in accordance with City approved plans, specifications, and special provisions.

104.2 Authority of ~~Public Works~~Engineering Department

The ~~Public Works~~Engineering Department's representative will decide all questions which may arise as to the quality or acceptability of materials furnished and work performed, the manner of performance, the interpretation of the City's construction requirements, and the acceptable fulfillment of the Developer/Contractor's obligations.

104.3 Authority and Duties of City Inspector

City inspectors will be authorized to inspect the work done and all materials furnished. A City Inspector will be assigned to the work by the ~~Public Works~~Engineering Department and will report to the ~~Public Works~~Engineering Department as to the progress of the work and the manner in which it is being performed, also to report whenever it appears that the material furnished and the work performed by the Developer/Contractor fail to fulfill the requirements of the specifications and to call attention of the Contractor to any such failure or other infringement. Such inspection will not relieve the Developer/Contractor from any obligations to perform the work in accordance with the requirements of the specifications. In case of any dispute arising between the Developer/Contractor and the Inspector as to materials furnished or the manner of performing the work, the Inspector will have the authority to reject materials or suspend work until the question at issue can be referred to and decided by the ~~Public Works~~Engineering Department. The Inspector will not be authorized to approve or accept any portion of work. He will in no case act as foreman or perform other duties for the Developer/Contractor. The place, frequency and thoroughness of inspection will vary depending of the construction activity and the quality of work exhibited by the construction organization. The presence of a City Inspector does not relieve the EOR of his inspection responsibilities.

104.4 Cooperation of Contractor

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The Contractor shall give the work his constant attention to facilitate the progress thereof and shall cooperate with the City and the EOR in every way possible. He shall have at all times a satisfactory and competent English-speaking Superintendent on the work site.

104.5 OMITTED

104.6 Bond or Cash Deposit for Unsatisfactory Repairs or Damages

~~If required, it#~~ will be the responsibility of the Contractor to put up a bond or cash deposit in the amount affixed by the ~~Director of Public Works~~[City Engineer](#) to cover any damages incurred to City Facilities or authorized franchise utilities during construction.

ITEM 105 CONTROL OF MATERIALS

105.1 Quality of Materials

All Materials shall be new and of a quality conforming to the requirements of these specifications. Whenever the quality or kind of materials or articles is not particularly specified, the materials or articles shall be of the best grade in quality and workmanship obtainable in the market from firms of established good reputation.

105.2 Samples and Test

All properly installed materials, before being incorporated in the work, shall be inspected, tested, and approved. Subject to the approval of the ~~Public Works~~[Engineering](#) Department, pre-tested sampling and testing will be provided at the developer's expense, by a materials-testing firm approved by the ~~Public Works~~[Engineering](#) Department. All tests of materials shall be made in accordance with these specifications and recognized practices.

105.3 Storage of Materials

Materials shall be stored and protected in accordance with manufactures recommendations to insure the preservation of their quality and fitness for the work.

105.4 Defective Materials

All materials which do not conform to the requirements of these specifications shall be considered as defective, and all such materials, whether in place or not, shall be rejected and immediately be removed from the site of work, unless otherwise permitted by the Public Works Department. Rejected materials, the defects of which have been subsequently

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corrected, shall have the status of new materials, as approved by the [Public WorksEngineering](#) Department.

105.5 Hauling of Materials

Any vehicle, truck, truck-tractor, trailer or semi-trailer or combination of such vehicles, when used to deliver materials to a project shall comply with the State and City laws concerning gross weight and load limits. Special haul routes for construction traffic will be designated by the Public Works Department within the City limits. The Developer/Contractor is responsible for the protection of all existing roads and small structures traveled by his material haulers.

Any damage by the use of construction equipment shall be restored to its original condition or replaced at the Contractors/Developers sole expense. (See ITEM 104.6)

ITEM 106

LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC

106.1 Laws to be Observed.

The Developer/Contractor shall make himself familiar with and at all times shall observe and comply with all Federal, State, and Local laws, ordinances, and regulations which in any manner affect the conduct of the work and shall indemnify and save harmless the City and its representatives against any claim arising from the violation of any such law, ordinance, or regulations, whether by himself or by his employees.

106.2 Permits, Licenses, and Taxes

The Developer/Contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work.

106.3 Sanitary Provisions

The Developer/Contractor shall, at his entire expense, provide and maintain in neat, sanitary conditions such accommodations for the use of his employees as be necessary to comply with the requirements and regulations of the State Department of Health or of other authorities having jurisdiction.

106.4 Public Safety and Convenience

The safety of the public and the convenience of traffic shall be regarded as of prime importance. Unless approval has been given by the [Public WorksEngineering](#) Department, all portions of a roadway shall be kept open to traffic. It shall be the entire responsibility

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of the Developer/Contractor to provide for traffic along and across a roadway as well as ingress and egress to private property. The Contractor shall plan and execute his operations in a manner that will cause the minimum interference with traffic. The Contractor shall secure the ~~Public Works~~Engineering Department's approval of his proposed plan of operation, sequence of work, and methods of providing for the safe passage of traffic before it is placed into operation. If at any time during construction, the approved plan does not accomplish the intended purpose due to weather or other conditions affecting the safe handling of traffic, the Contractor shall immediately make necessary changes therein to correct the unsatisfactory conditions. All equipment and materials shall be stored in such a manner and at such locations so as not to interfere with the safe passage of traffic. If in the opinion of the ~~Public Works~~Engineering Department the above requirements are not complied with, the ~~Public Works~~Engineering ~~Director~~Department may direct such work as he may consider necessary, however, this shall not change the legal responsibilities. The expense for such work performed by the City will be borne by the Developer/Contractor.

106.5 Barricades and Danger, Warning, Detour Signs, and Traffic Handling

The Contractor shall have the sole responsibility for providing, installing, moving, replacing, maintaining, cleaning, and removing upon completion of the work all barricades, warning signs, barriers, cones, lights, signals, and other such type devices, and the handling of traffic. All barricades, warning signs, barriers, cones, lights, signals, and other such type devices shall conform to the Texas Manual of Uniform Traffic Control Devices for Streets and Highways, as amended.

106.6 Protection of Property.

The Developer/Contractor shall take proper measures to protect private and public property which might be injured or damaged by any process of construction; and in case of any injury or damage resulting from any act or omission on the part of or on behalf of the Developer/Contractor, he shall restore, at his own expense, the damaged property to a condition equal to or better to that existing before such injury or damage was done, or he shall make good such injury or damage in an acceptable manner.

106.7 Responsibility for Damage Claims

The Developer/Contractor agrees to indemnify and be responsible for all damages or injury to property of any character occurring during the prosecution of the work resulting from any act, omission, neglect, or misconduct on his or his agents part in the manner or method of executing the work; or from failure to properly execute the work; or from defective work or materials. The Developer/Contractor's attention is directed to the fact that the location of pipelines and other underground installations are not always exact. The Developer/Contractor shall save and hold harmless the City from any and all claims resulting from these responsibilities.

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GENERAL DESIGN PROCEDURES

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ITEM 201 PRELIMINARY RESEARCH REQUIREMENTS

Step one in the Preliminary Research Process is to contact all applicable City offices and discuss concepts outlining what is to be proposed and its usage. Depending on the location and size of development, the initial contact may be handled by phone or a meeting at the city offices. The Developer/Engineer should verify that no restriction are existing that will deny the approval of the concept and research all existing utilities and right-of-way and easement information with the City, State, County and other authorities whose approval will be necessary for the proper use of the development. The Developer/Engineer shall research all laws, ordinances, rules and regulations that may pertain to the development. [The development standards should also meet all requirements of the City's most current Comprehensive Plan and its related Master Plans, City zoning requirements, Development Agreements, and the standards outlined in this manual.](#)

ITEM 202 PRELIMINARY DESIGN REQUIREMENTS

The Developer/Engineer shall provide the Engineer Department(s) with all maps, plans, and calculations to support the proposed design. These exhibits will not be considered unless they have been prepared under the direction of a Texas Licensed Professional Engineer. Final plans showing the seal of the Engineer responsible placed on each sheet is required. All developments shall follow proper filing procedures through the City and comply with the current Ordinances.

A preliminary report proposing processes, methods or procedures not covered by these specifications or a request for an exception to any portion of the regulations, shall be submitted during preliminary design. Concurrence, at this point, between the Developer/Engineer and the Department regarding the essential design data is desired to eliminate delay or inconvenience and to avoid the likelihood of having to re-do the detailed final plans.

ITEM 203 FINAL DESIGN REQUIREMENTS

Final design requirements involve the review of detailed construction drawings to ensure that all proposed facilities are designed in accordance with League City Standards and Criteria. All plans and specifications submitted for final review must be sealed and dated by a Texas Licensed Professional Engineer.

Developer/Engineer shall submit adequate, complete prints of plans for feasibility, preliminary and final review to the City's Engineering/Planning Development Review Committee. Planning material submitted shall in all instances be in such detail as to permit a comprehensive review.

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ITEM 204 PLAN SUBMITAL REQUIREMENTS

This ITEM is for the intent of supplying the submitting Engineer/Developer with a guideline of what is required as a set of plans; For review, the Engineer/Developer shall submit two (2) full sets of the proposed construction plans along with a digital copy on a CD. The plans shall be submitted in 24"x36" media and will consist of but not be limited to:

1. Cover sheet should include the following information:
 - a. ~~with~~ proposed subdivision name and location
 - b. the name and address of the owner(s)
 - c. the name and seal of the EOR
 - d. a vicinity map drawn at a minimum scale of one (1) inch to five hundred (500) feet.
 - e. ~~sheet~~ index
 - f. ~~City~~ signature block
 - ~~g. and City~~ preconstruction note if infrastructure is to be public.
2. Construction and or general notes.
3. Overall site plan layout sheet.
4. Topographic survey sheet(s). For developments sized fifty (50) acres or less, contours will need to be shown at a minimum of one (1) foot intervals and indicating the direction of surface water. For developments sized greater than fifty (50) acres, contours will need to be shown at a minimum of two (2) foot intervals and indicating the direction of surface water.
5. Paving and grading sheet(s).
6. Utility sheet(s) (water, sanitary, storm)
7. Plan and Profile sheets if necessary.
8. Photometric survey- (for business plans)
9. Detail sheets-
10. Storm water pollution prevention plan sheet.
11. Provide State Plain Coordinates (x, y and flowlines) NAD 83 for water valves, sanitary sewer manholes, storm manholes, storm outfalls, and, storm inlets.

Accompanying documents:

- a. EOR's Construction Cost Estimate
- ~~a.b.~~ Flood Impact Assessment document for business (CoLC ftp site: ftp.leaguecity.com).
- ~~b.c.~~ TxDOT approvals for driveway and drainage into their jurisdiction (if applicable).
- ~~c.d.~~ Pipeline company approvals on pipeline letterhead (if applicable).
- ~~d.e.~~ Storm Water Quality Management Plan and Permit (for business plans: CoLC ftp site: ftp.leaguecity.com)
- ~~e.f.~~ Traffic Impact Assessment (if applicable).

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ITEM 205 FINAL PLAN APPROVAL

Approval from all governmental agencies, all utility companies, and applicable City Commissions and Departments and Zoning must be obtained prior to final plan approval.

All developments shall conform to the City of League City's current ordinances.

All easements and rights-of-way required for the construction of a proposed project must be accepted, approved, and filed for record with Galveston County or Harris County, as appropriate, prior to City acceptance.

Inside the City limits, easements and rights-of-way shall be either a part of the dedication on the plat or dedicated to League City by separate instruments. It shall be required and the duty of the person seeking to dedicate such easement and/or right-of-way to furnish the ~~Public Works~~[Engineering](#) Department with a reproducible map showing the easement and/or right-of-way location and a copy of the recorded instrument along with a letter from the District Board or property owner stating the intent to obtain or dedicate the necessary easements or rights-of-way.

ITEM 206 "AS BUILT" REQUIREMENTS

When the work provided for in the approved plans and specifications has been satisfactorily completed, "As Built" plans ([Record Drawings](#)) will be required to replace the approved plans that are on file at the ~~Public Works~~[Engineering](#) Department's office. These plans shall be labeled "As Built" and certified and dated by the EOR.

A reproducible Mylar film print of the final as-built plans will be required, as well as, a CD (electronic set) and shall remain on file at the ~~Public Works~~[Engineering](#) Department's office for the use of any person who may be interested in same.

"As Built" drawings shall contain information within tolerances pertinent to the intended function of the design.

Waterlines and appurtenances shall be field located with a horizontal and vertical location within a tolerance of 1.0', more or less.

Gravity wastewater lines and manholes shall be field located with a vertical location within a tolerance of 0.05', more or less, and a horizontal location within a tolerance of 1.0', more or less.

Pressure wastewater lines and appurtenances shall be field located with a horizontal and vertical location within a tolerance of 1.0', more or less.

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Drainage facilities shall be field located with a vertical location within a tolerance of 0.05', more or less, and a horizontal location within a tolerance of 1.0' more or less.

Roadway paving shall be field located with a vertical location within a tolerance of 0.05', more or less, and horizontal location within a tolerance of 1.0', more or less.

All public facilities shall be shown to be located within public rights-of-ways or appropriate easement.

The EOR shall also submit a ~~erified~~certified list of permanent control monuments used for the construction of the development – inclusive of location and USGS elevations.

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GENERAL DESIGN AND PLAN REQUIREMENTS

ITEM 301 SURVEY REQUIREMENTS

The following guidelines are suggested for use by Engineers in the development of plans. The intention of these requirements is to provide all the evidence available for the proper location of improvements within functional and legal boundaries. All survey activity shall be performed under the direction of a qualified professional.

301.1 Field Work Required for Plans

Field Work Required for Plans. The transit or base line must be monumented at its beginning, end, and at all angle points with markers of a permanent nature. Monuments shall be set on long lines at intervals not to exceed 1000 feet.

The existing right-of-way monuments or property corners that are found must be plainly shown on the plans and located by station and distance, “Right” or “Left” from the transit line or construction center line. Those monuments that were used to determine the construction center line, must be identified as “control points”, and their relationship to the construction center line and to proposed or existing right-of-way lines must also be shown.

NGS datum must be used for elevations, and the complete numerical designation of the monuments must be identified on the plans, as well as the year of the datum of the monuments must also be identified on the plans.

Plans must show centerline angles of intersections of side streets with the main roadway and the centerline station on the main roadway. Where bearings are used, care should be taken so that bearings are shown on both base line and constructions center line. The source of the bearings shall be clearly stated.

All topographic features within the right-of-way must be shown. The topography on intersecting streets shall be shown twenty feet beyond the intersection of the right-of-way lines.

Where plans identify proposed utility lines, the location of manholes, service connections, angel points, valves, fire hydrants, bends, etc. must be identified by station and distance from transit or base-line with relationship to the right-of-way lines.

All existing pipelines, utilities, and other features that may conflict with design shall be field verified for actual location.

All cross sections taken will be made at intervals not to exceed 50 feet. Elevation shots shall be taken on the centerline of all driveways at approximately the existing or proposed right-of-way line.

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301.2 Right-of-Way Maps

All maps shall be sealed, dated and signed by a Texas Registered Public Surveyor.

ITEM 302 GRAPHIC REQUIREMENTS

All plans shall be prepared using ink on Mylar. Plans shall be standard sheet size 24" X 36" over all dimensions.

The seal, date, and original signature of a Texas Licensed Professional Engineer are required on each sheet.

A cover sheet shall be required for all projects involving three or more sheets. All plan sheet numbers should be included on the cover sheet or area key map. A signature block shall be placed on the cover. A vicinity map should always be included to show the project location. Service area shall be delineated on the cover sheet or area map. For Public projects, add the note "A PRE-CONSTRUCTION MEETING WITH CITY OF LEAGUE CITY ENGINEERING DEPARTMENT IS REQUIRED AT LEAST 10 WORKING DAYS PRIOR TO ON SITE CONSTRUCTION ACTIVITIES. CALL (281) 554-~~1440~~ 1445 FOR A MEETING DATE AND TIME. A PRE-CONSTRUCTION MEETING FOR THIS PROJECT MAY NOT BE SCHEDULED AND CONSTRUCTION OF THE PROJECT MAY NOT COMMENCE PRIOR TO APPROVAL OF THESE PLANS BY THE PUBLIC WORKS ENGINEERING DEPARTMENT AS EVIDENCED BY THESE SIGNATURES".

A copy of the final plat should be included with the final plans when the design drawings are submitted for final approval.

Key overall layouts may be drawn at a scale of 1" = 100' or 1" = 200'. Major thoroughfares or special intersections/situations plan and profile should be drawn at a scale of 1" = 2' ~~vertical; 1" = 20' vertical;~~ 1" = 20' horizontal and plan. Minor streets and easements plan and profile should be drawn at a scale of 1" = 5' vertical; 1" = 50' horizontal and plan, or 1" = 4' vertical; 1" = 40' horizontal and plan.

Details of special structures and standard details, such as stream and gully crossings, special manholes, etc., should be drawn with the vertical and horizontal scales equal to each other.

Temporary benchmarks and NGS datum shall be described on each sheet.

Label each plan sheet as to street widths, right-of-way widths, pavement width and thickness, type of roadway materials, curbs, intersection radii, curve data, stationing, existing utilities type, location, etc.

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Stationing must run from left to right, except for short streets or lines originating from a major intersection where the full length can be shown on one single plan and profile sheet.

A north arrow is required on all sheets and should be oriented either upward or to the right. It is the intent of this requirement that all stationing should start from cardinal points of the compass and proceed in the direction of construction.

Show all lot lines, property lines, right-of-way lines, and easement lines.

If a roadway exists where plans are being proposed to improve or construct new pavement or to construct a utility, this roadway should be labeled as to its existing width, type of surface, and base thickness.

All utility lines four inches in diameter or larger within the right-of-way or construction area should be shown in the profile view. All utility lines, regardless of size, should be shown in the plan view.

Show flow line elevations and direction of flow of all existing ditches.

Show natural ground profiles at each right-of-way or easement lines. Centerline profiles will be satisfactory for right-of-way or easements, except where there is a difference of 0.50' or more from one right-of-way or easement line to the other.

Resolve all construction conflicts of proposed utilities and facilities with existing or future utilities or facilities.

All street and/or road alignments shall be shown on plans. Plans shall be drawn to accurate scale, showing proposed pavement typical cross section and details, lines and grades, and all existing topography within the street right-of-way; and at intersections, the cross street shall be shown at sufficient distance in each direction along the cross street for designing adequate street crossings.

Grades should be labeled for the top of the curb except at railroad crossings. Centerline grades are acceptable only for paving without curbs and gutters. Curb return elevation for turnouts shall show in the profile. Gutter elevations are required for vertical curves where a railroad track is being crossed.

The surface elevation at the property line of all existing driveways should be shown in the profile.

The design of both roadways is required on all pavement sections with an esplanade. Station all esplanade noses, both existing and proposed.

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Station all P.C.'s, P.T.'s, radius returns, and grade change P.I.'s in the profile with their respective elevations.

ITEM 303 GENERAL UTILITY LOCATIONS

Water mains, sanitary sewer lines, and storm sewer lines shall be located within a public right-of-way or within an abutting dedicated easement specified for the exclusive use of the particular utility. These municipal utilities shall not be located in combination easements without the specific approval of the [Public Works Engineering](#) Department.

All other utilities; electric, gas, communications, and cable TV should be located in perimeter lot easements and back-to-back lot easements wherever possible. These utilities shall not be located in a public right-of-way or a specified easement, prohibiting its use, without the approval of the [Public Works Engineering](#) Department. The locations of these utilities within general utility easements shall be in accordance with the "Standard Details." The location of these utilities within a public right-of-way or specified easement shall be considered for approval, on an individual basis, by the [Public Works Engineering](#) Department. It is expected that all utilities will be placed underground unless specifically approved otherwise.

ITEM 304 EASEMENT REQUIREMENTS

For Municipal Utilities a minimum of ten feet (10') is required for front and side utility easements. A minimum of fourteen feet (14') is required for multiple-use easements located along back lot lines. A minimum of seven feet (7') may be accepted along back lot lines in certain circumstances as deemed appropriate by the [Public Works Engineering](#) Department.

Utility easements shall be located adjacent to and contiguous with public or semi-public street right-of-way wherever possible and be dedicated for the purpose of constructing, reconstructing, and maintaining the specified utility or general utilities. Utility easements may be fenced by the builder, developer, or subsequent property owner. The City or utility company shall have the right to remove said fence for the purpose of entry into the easement, and shall not bear the responsibility for replacement of landscaping features, irrigation systems, buildings, fences, nor for the care and preservation of same.

Drainage easements shall be dedicated for the purpose of constructing, reconstructing, and maintaining open ditch or channel facilities. Drainage easements shall be maintained unobstructed of all improvements, except as approved by the [Public Works Engineering](#) Department. Landscaping of these easements may be permitted by the [Public Works Engineering](#) Department if a responsible developer agrees to properly maintain the drainage facility.

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304.1 Water System Easements.

Dedicated waterline easements shall be restricted to water-mains only. Location of easements shall be determined on a case by case need. The minimum easement width for waterlines shall be ten feet (10').

Fire hydrants located outside of public rights-of-way, waterline or utility easements shall be encompassed by a ~~ten-foot~~ten-foot (10') easement. Fire hydrants shall not be located in water meter easements.

Water meter easements shall be provided in accordance with ITEM 406, "Location of Water Meter Service."

304.2 Sanitary Sewer Easements.

Dedicated sanitary sewer easements shall be restricted to sanitary sewer lines only. Location of easements shall be determined on a case by case need. The total width of the easement shall be at least twice the sewer diameter plus the depth of the proposed sewer, but not less than ten feet (10').

304.3 Storm Sewer Easements.

Dedicated storm sewer easements shall be restricted to storm sewer lines and appurtenances only. Storm sewer easements may be located along side lots for outfall pipes and structures only. The basic minimum width shall be fifteen feet (15') with storm sewers centered in the easement. For storm sewers greater than forty-two inches (42") in diameter, the minimum width of easement shall be twice the diameter plus ten feet (10').

304.4 Drainage Easements.

Channels

One of the most important considerations in the design of flood control and drainage facilities is the right-of-way or easement necessary for long-term operation and maintenance. The easement width shall be determined by the width necessary for the channel combined with the adjacent berm areas required for channel maintenance. Minimum widths required for earthen channels and concrete-lined channels are presented in the Master Drainage Plan. All major drainage channels shall be dedicated as right-of-way in fee simple. This will avoid disputes with the property owners on fencing of the right-of-way, which inhibits efficient maintenance. Dedication in fee simple essentially removes the potential for this problem.

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Generally, right-of-way or easement dedication requirements are in accordance with the ultimate drainage requirements for the area as defined by the Master Drainage Plan for a watershed developed by the City of League City.

Commercial and Residential Detention

~~All commercial and residential detention/retention facilities shall be considered private and maintained by the property owner, the Home Owners Association or their designate. The City shall retain drainage and access rights through privately owned residential detention/retention facilities for the purpose of controlling storm water from right-of-way, public lands and facilities, designed per City of League City master drainage plan. All detention facilities shall at a minimum have a floatables collection device installed at the outfall structure. The privately owned residential detention/retention facilities shall be maintained by the Home Owners Association or their designate.~~

Storm Water Pollution Prevention Plan

All construction sites shall conform to TCEQ's Storm Water Pollution Prevention Plan during pre and post construction.

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SPECIFICATIONS FOR WATER PROJECTS

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ITEM 401 GENERAL

This section covers the design and construction of potable water distribution facilities including water mains, flushing valves, and service connections. In addition to these standards, all public drinking water systems will be provided in accordance with the current guidelines promulgated by The Texas Department of Water Resources and Texas Commission on Environmental Quality.

All potable water distribution systems, including pump stations, mains, ground and elevated storage, shall be designed, installed and constructed in accordance with current AWWA Standards, with reference to materials used and construction procedures to be followed.

All water distribution systems shall be designed and constructed so as to provide at all times a minimum residual pressure of 20 psi under any and all conditions of demands that can be placed on the system. Under normal operation conditions, minimum pressures should be not less than 35 psi.

The system shall be provided with sufficient valves and fire hydrants so that necessary repairs can be made without undue interruption of service over any considerable area and for the purpose of flushing the system.

The system shall be designed so as to afford effective circulation of water, where dead ends are necessary as a stage in growth of the system; they shall be located and arranged with a view to connecting them ultimately so as to provide circulation. Approved dead-end mains shall be provided with a blue ~~dead-end~~~~dead-end~~ fire hydrant.

ITEM 402 WATER MAIN SIZING

Waterline sizing of mains shall be six-inches and greater in diameter. Listed below is a minimum recommendation and should be exceeded when the design engineer deems it necessary. The use of 4" water line shall be addressed on case-by-case bases.

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Six-inch lines may be a maximum of one-thousand feet in length when supported at both ends by larger lines. Six-inch lines shall support no more than one fire hydrant.

Eight-inch lines are used for normal distribution and lengths over one-thousand feet. Eight-inch lines must be circulated and must provide at least two sources of supply from different supply lines where possible. Eight-inch lines may support more than one intermediate fire hydrant. Temporary dead-end eight-inch lines, when necessary as extension of subdivision sections occur, shall be no more than five hundred feet in length with a temporary fire hydrant at the end per detail “End of Line Fire Hydrant and Valve for Future Line Extension”.

Twelve-inch and larger lines shall be used where the Design Engineer or the [Public Works Engineering](#) Department determine it necessary or for future extension.

ITEM 403 LOCATION OF WATER MAINS

All water mains shall be located within a public right-of-way, dedicated waterline or utility easement. Water mains within State Right-of-Ways shall only be used for crossing.

Water mains should not be installed closer than nine feet, horizontally, to any wastewater facility. See section 503.1, Separation Distance and City ~~Of~~ League City detail “Sanitary Sewer Installation Crossing or Parallel ~~To~~ Water Line” for further information. In cases where the ~~nine-foot~~nine-foot separation cannot be met; the water-main location shall comply with TCEQ requirements.

403.1 Easements.

Water mains within easements shall be centered in dedicated waterline easements or as shown on the COLC Easement Detail.

403.2 Rights-of-Way.

Within a ~~one hundred foot~~one-hundred-foot right-of-way: Eight-inch and smaller mains shall be installed a maximum of eight feet from a right-of-way line, twelve-inch and larger mains shall be installed a maximum of seven feet from the right-of-way line.

Within an eighty-foot right-of-way: Eight-inch and smaller mains shall be installed a maximum of seven feet from the right-of-way line, twelve-inch and larger mains shall be installed a maximum of six feet from the right-of-way line.

Within a seventy-foot or ~~sixty-foot~~sixty-foot right-of-way: All mains shall be installed a maximum of five feet from the right-of-way line.

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When necessary, water mains may be located within the esplanade section of boulevard type streets. Mains should be located as near the centerline as possible to avoid conflict with future pavement widening.

Along rights-of-way with open ditch drainage, all twelve-inch and smaller water-mains may be located five feet from the right-of-way line, and sixteen-inch and larger mains shall be located subject to the [Public Works Engineering](#) Department's approval. When directed by the Public Works Department or city engineering staff, all joints under pressure where cover is minimal shall have a restraining device as described in the City's details.

403.3 Depth-of-Cover.

Twelve-inch and smaller mains, normally, shall have a standard depth of four foot of cover over the top of pipe. In an open ditch section, mains shall have a depth of five foot of cover over the top of pipe. A variance of this depth of cover may be granted by the Public Works Department in special cases. Sixteen-inch and larger mains shall have a minimum depth of five feet of cover over top of pipe.

Changes in grade to clear obstructions or underground features which result in a less than standard depth of cover over the top of pipe, a restrained joint section with a 4" thick by 2' wide protective slab over the pipe will be used with the standard depth of cover maintained at each connection. This practice may be used until the top of the pipe is two feet below the sub-grade in roadway sections. When directed by the City, all joints under pressure where cover is minimal shall have a restraining device as described in the City's details.

403.4 Alignment.

When a water-main is placed parallel to another utility line other than wastewater and at near the same grade, it shall have a minimum of seven feet horizontal separation. When the other utility is a wastewater facility, nine feet of wall to wall horizontal separation must be provided. When a water main crosses another utility, a minimum of six-inch clearance must be obtained.

ITEM 404 LOCATION OF VALVES

The water system shall be provided with sufficient block (gate) valves so that necessary repairs can be made without undue interruption of service over any considerable area. Valve box caps shall be painted blue and a "V" saw cut made on the adjacent curb.

404.1 Spacing.

Six-inch through twelve-inch mains, valves shall be installed along the line with a maximum spacing of fifteen hundred feet.

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Sixteen-inch through ~~twenty-four inch~~twenty-four-inch mains, valves shall be installed along the line with a maximum spacing of twenty-two hundred feet.

Thirty-inch and larger mains, valves shall be installed with a spacing determined by the Public Works Department.

At the intersection of all mains, a tee shall require two valves and a cross three valves.

404.2 Location.

All lateral lines of less than thirty-inches shall be valved within the street right-of-way or easement. Valve locations are normally along the street right-of-way line as projected across the main. Intermediate valves not located on the projection of the right-of-way line may be located on lot lines or five feet from fire hydrants. Tees shall have two valves and crosses shall have three valves unless approved otherwise.

All fire hydrants shall have an isolation valve as shown per City of League City Details.

ITEM 405 LOCATION OF FIRE HYDRANTS

All fire hydrant locations must be approved by the League City Fire Marshal's office. All dead-end mains, where approved, shall terminate with a blue ~~dead-end~~dead-end fire hydrant. Bends and offsets are not permitted in fire hydrant leads.

All fire hydrants shall have a 4"x4" 2 way blue reflective street marker placed per the following locations: on un-striped roadways, blue markers shall be set in the center of the roadway; on undivided striped roadways, blue markers shall be set 6" to the hydrant side of the center stripe; on divided roadways, the blue marker shall be set 6" to the side of the lane striping which is closest to the hydrant; in locations where hydrants are situated on corners, blue markers shall be installed on both approaches which front the hydrant.

For fire hydrant material requirements see ITEM 407.9.

For the setting of fire hydrants see ITEM 409.5.

405.1 Spacing.

Residential or low risk areas; fire hydrants shall be installed within a maximum five hundred street feet of each other.

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Higher risk developments (Mercantile Districts); fire hydrants shall be installed within a maximum three hundred feet of each other.

Fire hydrants should be located at street intersections where possible.

405.2 Location.

Fire hydrants should be located a minimum of three feet behind the back of curb or proposed future curb and set at the point of curve of the intersection curb radius.

On all state highways and open ditch roadways, fire hydrants shall be installed within three feet of the right-of-way line.

Fire hydrants located between right-of-way intersections shall be set on the lot lines as extended to the pavement; however, this location may be adjusted five feet to avoid driveways or other obstructions, in which case the fire hydrant shall be no closer than three feet from a curbed driveway or five feet from a non-curbed driveway.

Fire hydrants may be located in the esplanade section of City streets if it is not feasible to locate them back of curb; in such case it is preferable to locate the fire hydrant seven feet behind the esplanade back of curb to provide access for parkway mowers; but no instance shall they be closer than three feet.

Fire hydrants shall not be installed within nine feet vertically or horizontally of any wastewater line regardless of construction.

Adjustments in the location of fire hydrants after acceptance of the distribution system shall be provided in accordance with current city policy. Plans shall be submitted to [Public WorksEngineering](#) Department for approval.

405.3 Depth of Bury.

The depth of bury for all hydrants shall be per the City details. If at any time the finish grade is lowered or raised, it shall be the responsibility of the individual who caused the grade to be adjusted to adjust the hydrant.

ITEM 406

LOCATION OF WATER METER SERVICES

Meters may be located in water-main easements or at the right-of-way line provided the location is such that the accessibility and protection of the meter is as specified above. Service meters within private property that are 2" and smaller should be set in a separate easement with minimum dimensions of 5'x5' and shall be located in easily accessible areas, but protected from traffic behind curbed sections.

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Service meters within private property that are 3" and larger shall be set in a separate easement with minimum dimension of 10'x20' and shall be located in easily accessible areas, but protected from traffic behind curbed sections.

The location of the service lines shall be designated on the construction plans for informational purposes only in the appropriate location to serve the future meters.

All apartments or town-homes proposed in a private street development shall install meters as directed and in compliance with League City Standard Detail Drawings or as approved by the [Public Works Engineering](#) Department.

ITEM 407 MATERIALS

Materials shall be stored, handled and used as described under ITEM 105, "Control of Materials." All pipe installed within dedicated public rights-of-way or easements shall be PVC water pipe AWWA C 900 (DR 18) for sizes 6" through 12" or C-905 (DR 18) PVC for sizes 14" through 24"; ductile iron pipe Class 52 for sizes 6" thru 36"; All service connections 3/4" thru 2" shall be polyethylene tubing in conformance with material specifications set out herein. HDPE will be considered on a case-by-case bases.

The use of manufactures names and catalog numbers as may be used to describe various products is not intended to be proprietary, but merely to indicate clearly the respective type of material that can be accepted. Submittals for product acceptance must be directed to the [Public Works Engineering](#) Department by the Engineer representing the Developer. Contractor submittals will not be accepted.

The City of League City reserves the right to engage, at any time during the progress of the work, a Material Testing Laboratory to test and inspect all pipe and accessories.

407.1 Iron Pipe and Fittings.

All pipe, fittings and accessories shall be shipped, stored, handled and installed in accordance with the manufacturer's recommendations and as specified herein.

Iron pipe shall be bell and spigot jointed where possible. Other jointing may be necessary for special applications when approved by the Public Works Department. All fittings shall be mechanical joint with "Mega-Lug" type restraints as per League City details.

All pipe and fittings shall be wrapped with 8-~~mil~~^{mil} (min) polyethylene film meeting ANSI 21.5 (AWWA C105) with all edges and laps taped securely (with product approved tape) to provide a continuous and watertight wrap.

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407.1.1 Ductile Iron Pipe.

Ductile iron pipe shall have 60,000 psi tensile strength, 42,000 psi yield strength, 10% minimum elongation and meet the requirements of the latest revision of ANSI A 21.51 (AWWA C151). Pipe shall be thickness Class 52. Pipe shall be cement mortar lined and seal coated with an asphaltic material inside and outside in accordance with ANSI A21.4 (AWWA 104) the exterior of the pipe shall have a bituminous coating approximately one mil minimum thickness.

407.1.2 Ductile Iron Fittings.

All fittings shall be mechanical joint; flange joints may be necessary for special applications when approved by the Public Works Department. All fittings shall be cement lined and seal coated with an asphaltic material inside and outside in accordance with ANSI A21.4 (AWWA C 104).

Pipe joints shall be in accordance with ANSI A21.11 (AWWA C 111-80) with bell sockets designed to receive pressure pipe O.D.'s. As specified in ANSI A21.6(AWWA C 106) ANSI A21.51(AWWA C 151) and AWWA C 900. Rubber rings shall be furnished in accordance with ITEM 407.1.4, "Joints."

Ductile iron mechanical joint fittings shall be cast in accordance with ANSI A21.53(AWWA C 153) the working pressure rating shall be 350 psi. and shall follow all applicable ANSI and AWWA requirements. All mechanical joint fittings to use "Mega-Lug" type restraints as per League City details.

407.1.3 Tapping Sleeves.

Full -body Mechanical joint cast iron tapping sleeves shall be used for three-inch and larger connections to an existing water-main. Tapping sleeve shall be suitable for use at hydrostatic working pressures of 200 psi. Outlet flange shall conform to class 125 ANSI B 16.1. Minimum lengths of tapping sleeves are recommended by the Unit-Bell PVC Pipe Association. Assembly and installation shall be in accordance to manufactures recommendation.

407.1.4 Joints.

All gaskets shall be of natural or synthetic rubber conforming to ANSI A 21-11 (AWWA C 111-current). Gaskets shall be provided by the manufacturer of that particular pipe being used. A joint lubricant shall be used, and applicable recommendations of the manufacturer shall be followed.

Bolts for flanges or mechanical joints shall be corrosion-resistant, low alloy, high strength steel bolts equal to "cor-ten." In sizes for which "cor-ten" bolts may be used coated as follows:

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Bolts and nuts shall be immersed in Koppers super tank solution or approved equal, inserted and tightened in the joint while still wet, and all exposed parts touched up with a brush coat immediately after tightening. After an interval of at least one hour, the entire joint shall be coated with Bitumastic #50, as specified under protective coatings.

407.2 HDPE

Polyethylene pipe shall be made from HDPE material having a material designation code of PE4710 or higher. The material shall meet the requirements of ASTM D 3350 and shall have a minimum cell classification of PE445474C. In addition, the material shall be listed as meeting NSF-61.

The pipe and fittings shall meet the requirements of AWWA C906.

The HDPE pipe shall be rated for use at a pressure class of 200 psi. The outside diameter of the pipe shall be based upon ductile iron pipe size sizing system.

The pipe shall be marked in accordance with the standards to which it is manufactured. Color identification by the use of stripes on the pipe to identify pipe service shall be required and colored blue for potable water.

407.2.1 Fittings

Butt Fusion fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification of PE445474C. Butt Fusion fittings shall meet the requirements of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe. All fittings shall meet the requirements of AWWA C906. Markings for molded fittings shall comply with the requirements of ASTM D 3261. Fabricated fittings shall be marked in accordance with ASTM F 2206.

Electrofusion fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification of PE445474C. Electrofusion fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe. All electrofusion fittings shall be suitable for use as pressure conduits, and have nominal burst values of four times the Working Pressure Rating of the fitting. Markings shall be according to ASTM F 1055.

Flange and Mechanical Joint Adapters shall have a material designation code of PE4710 or higher and a minimum Cell Classification of PE445474C. Flange and Mechanical Joint Adapters can be made to ASTM D 3261 or if machined, must meet the requirements of ASTM F 2206. Flange and Mechanical Joint Adapters shall have a pressure rating equal to the pipe. Marking for molded or machined flange adapters or MJ Adapters shall be per ASTM D 3261. Fabricated flange adapters shall be per ASTM F 2206. Bolts and nuts shall be SAE Type 316 stainless steel. Van-Stone style, ductile iron, convoluted or flat-plate, backup rings and bolt

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materials shall follow the guidelines of Plastic Pipe Institute Technical Note # 38, and shall have the bolt holes and bolt circles conforming to one of these standards: ASME B-16.5 Class 150, ASME B-16.47 Series A Class 150, ASME B-16.1 Class 125, or AWWA C207 Class 150 Series B, D, or E. The backup ring shall provide a ~~long-term~~long-term pressure rating equal to or greater than the pressure class of the pipe with which the flange adapter assembly will be used, and such pressure rating shall be marked on the backup ring. Backup rings, bolts, and nuts shall be SAE Type 316 stainless steel. An internal ~~stainless-steel~~stainless-steel stiffener sleeve that is expanded hydraulically to create an interference fit with the pipe must also be used.

407.2.2 Joining Methods

Butt Fusion: The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per PPI TN-42.

Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of ~~electrofusionelectrofusion~~ joining information are ASTM F 1290 and PPI TN 34. The process of ~~electrofusionelectrofusion~~ requires an electric source, a transformer, commonly called an ~~electrofusionelectrofusion~~ box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of ~~electrofusionelectrofusion~~ box used. The electrofusion box must be capable of reading and storing the ~~inputinput~~ parameters and the fusion results for later download to a record file. Qualification of the fusion technician shall be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized.

Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, and ductile iron fittings shall use flange or mechanical joint adapters and other devices in conformance with AWWA Manual of Practice M55, Chapter 6.

The critical parameters of each fusion joint, as required by the manufacturer shall be recorded either manually or by an electronic data logging device. All fusion joint data shall be included in the Fusion Technician's joint report.

407.3 Polyvinyl Chloride (PVC) Pipe.

All polyvinyl chloride (PVC) pipe shall be of the rigid (un-plasticized) type pressure rated at 150 or 200 psi, conforming to AWWA C 900 or C 905 (DR18), and must bear the National Sanitation Foundation seal of approval for potable water pipe and shall be blue in color. Each joint of pipe shall consist of a single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe laying lengths shall be twenty (20) feet normally. Pipe shall have push-on, rubber gasket joints of the bell and spigot type with thickened integral bells, or of the double spigot type with thickened coupling sleeves with rubber gasket joints.

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The wall thickness of each pipe bell and joint coupling must be greater than the standard pipe barrel thickness. Clearance must be provided in every gasket joint for both lateral pipe deflection and for linear expansion and contraction. Rubber gaskets shall be of such a cross section that compression of the gasket within the pipe joint and water pressure within the pipe will cause a reaction by the gasket which tends to seal the joint. Gaskets shall conform to retaining grooves in the bell or coupling, shaped to position the gasket and aid in sealing the joint.

407.3.1 Applicable Specifications.

Except as modified or supplemented herein, PVC pipe shall meet all applicable current requirements of the following standards:

Product Standard PS 22 "Polyvinyl Chloride Plastic Pipe" (SDR)

- ASTM Specification D 2241
- AWWA Specification C 900
- ASTM Specification D 1784
- ASTM Specification D 1598
- ASTM Specification D 1599
- ASTM Specification D 2152
- ASTM Specification D 2412
- ASTM Specification D 2444
- ASTM Specification D 1869

407.4 Polyethylene Tubing.

All polyethylene (PE) plastic tubing shall be high density, high molecular weight plastic tubing pressure rated at 200 psi working pressure, and must bear the NSF seal of approval for potable water service. PE tubing shall be standard copper tube size outside diameter, with standard dimension ratio (SDR) of nine (9). The PE tubing shall be homogenous throughout and free of cracks, holes, foreign inclusions or other injurious defects.

407.4.1 Applicable Specifications.

All polyethylene plastic tubing shall conform to all applicable requirements in the latest revision of the following standards unless otherwise specified herein:

- ASTM Specification D 2737
- ASTM Specification D 1599
- ASTM Specification D 1598
- AWWA Specification C 901

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407.5 Copper Service Tubing.

Copper tubing is no longer being used as a City Service connection material.

407.6 Service Connecting Fitting.

All fittings used in a Customer Service connections (tap saddles, tapping sleeves, meters, meter connections, etc.); shall be provided and shown in the details of submitted plans, see COLC Engineering web site for approved details, any details altered shall be approved by the City of League City ~~Public Works Department~~[Engineering Department](#).

407.6.1 Corporation Stops.

Corporation stops shall be new and made of brass conforming to ITEM. 407.7, inlet ends shall be standard corporation stop thread as per Table 1. AWWA C 800, iron pipe thread, or locking insert type. Valve body shall be taper plug type "O" ring seat ball type, or rubber seat ball type. Outlet end shall be compression type fitting.

407.6.2 Curb Stops.

Curb stops shall be new and conform to ITEM 407.7 inlet end shall be compression type fitting. Valve body shall be straight through or angled meter stop design equipped with padlock wings and shall be of either of the "O" ring seal straight plug type or rubber seat ball type.

Outlet shall be female iron pipe thread or swivel nut meter spud thread on 3/4" and 1" stops and two-hole flange on 1-1/2" and 2" sizes.

407.6.3 Service Saddles.

Service saddles for two-inch and smaller services shall be single strap stainless steel epoxy coated.

407.7 Brass Goods.

All brass stops, couplings, bends, connections, nipples, and miscellaneous brass pipe fittings and accessories used in meter connections, copper service lines, air release piping assemblies and wherever needed in the water distribution system, shall conform to the standards set within AWWA C 800-current, and ASTM B 62, except as herein modified or supplemented.

Unless otherwise noted, the goods described herein shall be fabricated of standard red brass (waterworks brass: 85-5-5-5) exposed threads shall be covered with plastic caps or sheathing to protect the threads.

407.7.1 Functional Requirements.

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Corporation stop thread (where used) shall conform to Table 1, Figure 1, AWWA C 800 (corporation stops with iron pipe threads are also permitted). Iron pipe threads shall conform to ANSI B2.1 - 1960 and Table 9, Figure 9, of AWWA C 800.

Cooper fittings threads shall conform to Table 2 and 3, Figure 2 and 3 of AWWA C 800 and ANSI B1.1960 with tolerance of Class 2 flanges shall conform to ANSI 6.1 Class 125 (or Class 250 where noted), as dimensions, drillings, etc.

All fittings shall be suitable for use at hydrostatic working pressures up to 150 psi.

407.8 Valves.

Unless otherwise approved, all valves six inches (6") and larger shall be resilient seated gate valves, manufactured to meet or exceed the requirements of AWWA C 509-current. All valves shall be wrapped with 8-mil Polyethylene film with all edges and laps securely taped to provide continuous wrap. Operator shall be equipped with hand-wheel or ~~two-inch~~two-inch square nut operating counterclockwise to open valve. Where not otherwise noted, all valves shall be mechanical joint with gasket and mega-lug type restraint to match the pipe material. Unless otherwise noted, all valve stems shall be ~~adjusted~~adjusted, or extensions provided to situate the operating nut no more than sixty inches (60") below the proposed grade of finished project.

407.8.1 Resilient Seat Gate Valves.

Gate valves shall be resilient seat, manufactured to meet or exceed the requirements of AWWA C 509-current. Valves shall have an unobstructed waterway equal to or greater than the full normal diameter of the valve.

The valves are to be non-rising stem with the stem made of cast, forged or rolled bronze shown in AWWA C 509. Two stem seals shall be provided and shall be of the "O" ring Type, one above and one below the thrust collar. The upper "O" ring must be protected from contact with ground water by an external stem seal. The stem nut, also made of bronze, must be independent of the gate to protect against stem binding.

The sealing mechanism shall consist of a cast iron gate, having a vulcanized synthetic rubber coating. The resilient-sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.

Seating mechanism shall have no metal to metal stops. Valve gate shall have no metal seams or edges on the water way when in the fully closed position. Further, it shall be designed that no sliding or rubber on the seating surfaces is required to compress the rubber. It shall also be designed such that compression-set of the rubber shall not affect the ability of the valve to

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seal when pressure is applied to either side of the gate. The valve shall be further designed that no metal fasteners or screws other than the stem and stem nut are exposed to water.

The valve body, bonnet and bonnet cover shall be cast iron ASTM A 126, Class B. All ferrous surfaces inside and outside shall have a fusion-bonded epoxy coating not less than 8 mils in thickness for a holiday free surface. All parts to be epoxy coated must be shot blasted just prior to application of epoxy. All bonnet bolts shall be stainless steel.

A hand-wheel or wrench nut shall be provided for operating the valve. The shut-off torque must not vary when the valve is installed and the line flows in either direction.

407.8.2 **Butterfly Valves.**

Where approved by the ~~Public Works Department~~ Engineering Department, butterfly valves shall conform to current AWWA Standards for rubber-seated butterfly valves, AWWA C 504 Class 150B for buried service.

Valves shall have flange connections on both ends unless otherwise called for. Valves shall have vertical operating stems underground operator and end covers shall be permanently sealed against ground water infiltration. Operator shall be properly adjusted to assure 100% seal.

Valve seating shall be a true bubble tight sealing desired in a resilient seated valve. A ~~360 degree~~ 360-degree offset continuous seating surface shall be provided by a disc edge of synthetic rubber. The mating surface in the valve body, to this resilient seat, is a ~~304 stainless~~ 304-stainless steel body ring.

The disc shall be ductile iron with thru shaft connections, stainless steel drive.

The rubber seat shall be so mounted that it can be replaced and/or adjusted without disassembling the valve or removing the valve from the pipeline. Valve body material shall be ASTM A126 Grade B cast iron.

407.9 **Fire Hydrants.**

Fire hydrants shall conform to requirements and tests of AWWA Standard for dry barrel fire hydrants C 502-80, or latest revision thereof, pertaining to the design, component materials, construction and manufacture except as modified or supplemented hereinafter.

The operating nut shall be non-rising, pentagonal shape measuring 1-1/2" from point of opposite flat. Pentagon shall have a depth of at least 1-1/4."

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A weather cap shall be affixed which conceals the hold down nut and on which is embossed an arrow indicating the opening direction. The direction of opening shall be counterclockwise.

A lubrication reservoir shall be provided, sealed top and bottom by "O" rings and filled with a viscous, non-toxic lubricant. The design shall be such that the bearing surfaces and threaded parts are automatically lubricated when the hydrant is operated. There shall be not less than two "O" rings separating the waterway from the oil reservoir and that portion of the stem making this seal shall be sleeved with bronze. An anti-friction washer shall be in place above the thrust collar to minimize operation torque.

The bonnet shall be attached to the upper barrel by not less than eight bolts utilizing a cloth impregnated rubber gasket as a pressure seal.

Hydrants shall be three-way, having two 2-1/2" hose nozzles being right hand National Standard Thread and one integral 5" Storz quick connection pumper nozzle installed at the time of final walk-through. Nozzles shall thread counter-clockwise into barrel with "O" ring pressure seals. Storz connection shall have matching cap with cable tether. All Storz shall be free of louvers.

Hydrants shall be traffic model having upper and lower barrels joined approximately 2" above the final grade line by a separate and breakable swivel flange providing ~~360-degree~~ 360-degree rotation of the upper barrel. This flange shall include a minimum of eight bolts. The pressure seal between the barrels shall be cloth impregnated rubber gasket, an "O" ring is not acceptable. The ground line shall not be less than eighteen inches below the centerline of the lowest nozzle and shall be clearly embossed on the lower barrel. A breakable stem coupling shall join the two-piece stem adjacent to the ground-line flange and shall be of similar metal. Screws, pins, fasteners or bolts used in the coupling shall be stainless steel. The weakened portion of the stem coupling shall be below the coupling pins.

Upper and lower barrels shall be fabricated of cast iron so as to minimize the possibility of shoe damage upon traffic impact.

Main valves shall be compression type, closing with the pressure, and shall be not less than 5 1/4" in diameter. Composition of the main valve shall be rubber or neoprene having a durometer hardness of 90 + 5 and shall be not less than 1" thick.

Hydrant shall be equipped with drain valves which drain the barrel when the hydrant is ~~closed~~ closed, and seal shut when the hydrant is in the open position. ~~These drain~~ These drain valves shall be an integral part of the upper valve plate and shall operate without employing springs, tubes, levers, toggles or ~~other intricate~~ other intricate mechanism. A gravel bed around the weep holes is required; see COLC "Fire Hydrant and Valve Detail" for additional information.

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The upper valve plate, seat ring and drain ring (shoe bushing) must be bronze and work in conjunction to form an all-bronze drain-way. Drain holes drilled in the shoe must be bronze lined.

Two drain openings are required; the bronze seat ring must thread into a bronze drain ring or shoe bushing providing a bronze to bronze connection. Seat ring seals shall be "O" ring type. Zinc content of bronze parts shall not exceed 16%.

The 6" shoe connection shall be an approved mechanically restrained joint and have ample blocking pads for sturdy setting and concrete blocking. A minimum of six bolts is required to fasten the shoe to the lower barrel.

The interior of the shoe, including the lower valve plate and cap nut shall have a protective epoxy coating of a least 4 mils. If cap nut is utilized, it must be locked in place with a ~~stainless steel~~stainless-steel lock washer or similar non-corrosive device.

Fire hydrant shall be those types and models meeting the above criteria and installation shall be in accordance with manufacturer's recommendation and as shown in the "Standard Details."

All above ground parts of the fire hydrant shall be field coated after installation with an approved rust inhibiting paint. The body parts, bonnet, and caps shall be Carmine Red in color. Dead end flushing hydrants shall be blue in color.

For location of fire hydrants see ITEM 405.

For the setting of fire hydrants see ITEM 409.5.

407.10 Air-Vacuum Release Valves.

Unless otherwise designated, all air-vacuum release valves shall be automatic combination air-vacuum release valves, and shall be those types and models specified on the design plans or approved by the City of League City ~~Public Works Department~~Engineering Department.

407.11 Meter Boxes and Vaults.

Unless otherwise designated all ~~meter~~meter, boxes and vaults shall be those types and models listed and shown on the "Standard Details."

407.12 Valve Boxes

Valve boxes shall be adjustable thread type cast iron and shall be those types and models approved by the City of League City Public Works Department and shown in the "Standard Details." Valve box lids shall be labeled as water.

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407.13 Steel Pipe and Fittings.

Steel carrier pipe and fittings shall be used for special installations only. Steel casing pipe shall be used for all waterlines bored and jacked. Metal liner plate shall be used for all tunneling.

407.13.1 Steel Carrier Pipe.

All steel pipe intended for use as carrier pipe in the distribution system sizes 6" through 24" shall conform to AWWA Standard C 200. Pipe shall be supplied in double random lengths unless otherwise specified. The ends of pipe shall be beveled for field butt welding.

Pipe shall be new and manufactured in compliance with UL current specifications for "Steel Pipelines For Underground Water Service" and shall be acceptable, without penalty, to the "Texas Fire Insurance Commission" for use in water works distribution systems.

Minimum wall thickness shall be in accordance with the following:

Nom. Pipe Size	Wall Thickness
6"	0.280"
8"	0.322"
10"	0.365"
12"	0.375"
16"	0.375"
20"	0.375"
24"	0.375"

407.13.2 Steel Casing Pipe.

All pipe intended for use as casing pipe shall be manufactured in accordance with the specifications for steel carrier pipe except that the wall thickness may be reduced, the Kraft paper wrap is not required, and the compliance with UL and TFIC is not required. The casing shall be solid welded with a min. wall thickness of 0.219 inches for casing pipe 8 inches through 18 inches and a min. wall thickness of 0.250 inches for casing pipe 20 inches through 36 inches, any casing larger than 36 inches shall be specified by the designing engineer.

Spacers and End Seals shall be "Advance Products and Systems, INC." or approved equal; see City of League City "Pipe Casing Detail" for other info.

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407.13.3 Metal Liner Plate.

The plates shall be fabricated from steel sheets conforming to ASTM A-569. The plates shall be new and unused prior to fabrication. All plates shall be punched for bolting on both longitudinal and circumferential seams or joints and shall be so fabricated as to permit complete erection from inside tunnel.

One-half of the total number of plates shall be equipped with 2" diameter grout holes to facilitate grouting above and around the tunnel liner conduit. All grout holes shall be equipped with screw type galvanized plugs.

Galvanized steel liner plates shall be given a bituminous coating prior to installation. Tunnel liner plates may be the two-flange or four-flange type, 16" or 18" in width.

The minimum thickness gauge, joint strength and wall buckling strength shall meet or exceed the values calculated by the design methods of the AASHTO Design specifications for tunnel liner plates.

407.13.4 Steel Pipe Fittings.

All steel pipe fittings 6" through 24" shall be factory forged fittings. All bends shall be long radius fittings unless otherwise specified. Ends shall be beveled for field butt welding. Wall thickness shall be equal to or greater than the pipe to which fitting is to be welded. Field welding of steel water pipe shall be provided in accordance with AWWA C 206.

407.13.5 Steel Pipe Flanges.

Steel pipe flanges shall conform to AWWA Standard C 207 for Class D flanges (same diameter and drilling as Class 125 cast iron flanges ASA B 16.1). All flanged joints made up between steel and ~~cast iron~~cast-iron flanges shall maintain an electrically isolated joint by means of the use of epoxy coated bolts, nuts and washers and an insulating type gaskets unless otherwise stipulated.

407.13.6 Corrosion Protection.

When required or specified, underground installations of carrier pipe shall provide for a coal-tar enamel lining, coating, and wrapping in conformance with AWWA C-203. Underground installations of casing pipe shall provide for a coal-tar enamel exterior coating in conformance with AWWA C-203. Interior lining and Kraft paper wrapping may be omitted for casing pipe.

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Above-ground installations of all steel pipe and fittings (not stainless) shall be in conformance with AWWA C-218 Coating System No. 2 or better and shall be suited for the environment intended.

407.14 Pipe Bedding Material.

Where not otherwise specified or noted, all pipe bedding material shall conform to one of the classifications described below.

407.14.1 Sand.

Sand for use as pipe bedding shall be clean, granular material composed mainly of mineral matter free of mud, silt, clay lumps, clods, vegetation or debris. The material removed by decantation (Tex 406A) plus the weight of any clay lumps, shall not exceed 4.5% by weight.

407.14.2 Cement-Stabilized Sand.

Sand shall be unwashed sand free of all foreign matter and meeting the following graduation requirements:

Sieve Size	% Retained
1-1/4"	0-10
1/2"	10-20
3/8"	15-30
No. 4	30-65
No. 40	50-75

Do not use material passing the No. 40 sieve with a plasticity index greater than 10 or a liquid limit greater than 35.

The cement shall be standard Type I Portland cement conforming to ASTM C 150.

Water used in the mix shall be clean, clear, and free from oils, acids, alkali, or vegetable matter. Water of doubtful quality shall be tested by briquette test to determine if it is equal to water of known satisfactory quality.

Unless otherwise specified, use no less than 1.5 sacks of cement per ton of mixture. Use amount of water necessary to obtain optimum moisture content for mechanical tamping. Mix cement, sand and water in a mill type mixer.

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Cement-stabilized sand shall not be used after it loses its moisture content or it has obtained an initial set. Material not in place within 4 hours shall be rejected.

407.14.3 Washed Rock.

The material shall consist of washed ¾"-1" durable particles of crushed limestone rock together with approved binding material, and when properly slaked and tested by laboratory methods, it shall meet the following requirements:

Retained on 2-1/2" Sieve	0 to 5%
Retained on 1" Sieve	10 to 35%
Retained on 1/4" Sieve	50 to 75%
Retained on No.200 Sieve	92 to 100%

407.15 Concrete.

Concrete shall be composed of cement, fine and coarse aggregates, mineral filler if necessary, and water, proportioned and mixed as provided in these specifications or as required by the EOR.

407.15.1 Cement.

All cement shall be standard white or gray Portland cement conforming to ASTM C 150, all cement shall be Type I.

407.15.2 Water.

Water for use in concrete or for curing shall be potable water from municipal supplies approved by the State.

407.15.3 Mineral Filler.

Used as concrete aggregate shall consist of stone dust, clean crushed sand, or other approved inert material.

407.15.4 Fine Aggregate.

Fine aggregate shall consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without mineral filler conforming to ASTM C 33.

407.15.5 Coarse Aggregate.

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Coarse aggregate shall consist of durable particles of gravel, crushed stone conforming to ASTM C 33. When tested by ASTM C 131 procedures coarse aggregate shall have a percentage of wear of not more than forty.

407.15.6 Proportions and Mixing.

Concrete shall be mixed in quantities required for immediate use. Re-tempering of concrete will not be allowed. Continuously agitated concrete shall be placed within one hour of initial mixing; non-agitated concrete must be placed within twenty minutes of initial mixing. It shall be the responsibility of the Contractor to determine the batch quantity of each ingredient to produce a concrete mix conforming to the following requirements:

Cement (Sacks/cy)	28-Day Min Comp Strength	Max Water Cement Ratio (gallon/sac)
4.5	2,500 psi	7.0 Thrust Blocking
5.0	3,000 psi	7.0 Normal
6.0	4,000 psi	6.25 Structural

407.15.7 Reinforcing Steel.

Where required, steel reinforcing shall conform to TxDOT current "Standard Specifications" for reinforcing steel.

407.15.8 Consistency.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. The concrete shall be workable, cohesive, possess satisfactory finishing qualities and be of the stiffest consistency that can be placed and vibrated into a homogenous mass.

407.15.9 Quality Control.

If the strength required or consistency requirement cannot be maintained, the contractor may use an approved water reducing or retarding agent, or additional cement or aggregates, which will produce the required results.

407.15.10 Weather Conditions.

The contractor is responsible for the protection of concrete placed under any and ~~all weather~~ conditions. In threatening weather, which may result in conditions that will adversely affect quality of the concrete to be placed, the contractor shall postpone the work.

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Where work has been started and changes in weather conditions require protective measures, the contractor shall furnish adequate shelter to protect the concrete against damage from rainfall or from freezing temperatures. No concrete may be placed unless the atmosphere temperature is at least 40 degrees F and rising; concreting shall be discontinued if the temperature drops to 45 degrees F and is falling. Concrete shall be ~~protected~~protected, and its surface temperature maintained at 40 degrees F or above for at least seventy-two hours after placement.

407.15.11 Placing Concrete.

The contractor shall give the ~~Public Works~~Engineering Department's office sufficient advance notice before placing concrete to permit the inspection of forms, reinforcing steel and other preparations. Concrete shall not be placed prior to the approval of preparation.

Concrete mixing, placing and finishing shall be done in daylight hours. The placing shall be regulated so the pressures caused by the plastic concrete shall not exceed the loads used in the form design. The method of handling, placing and consolidation of concrete shall minimize segregation and displacement of the reinforcement, and produce a uniformly dense and compact mass. Concrete shall not have free-fall of more than four feet. The method and equipment used to transport concrete to the forms shall be capable of maintaining the rate required for a continuous placement. Concrete shall be placed with a termite, closed bottom-dump bucket, or other approved method.

Each part of the forms shall be filled by depositing concrete as near its final position as possible. The coarse aggregate shall be worked back from the face and the concrete forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point and running or working it along the forms will not be allowed. Concrete shall be deposited in layers of suitable depth but not more than 36" in thickness.

The sequence of successive layers or adjacent portions of concrete shall be such that they can be vibrated into a homogeneous mass with the previously placed concrete without a cold joint. Unauthorized construction joints shall be avoided by placing all concrete between the authorized joints in one continuous operation.

All concrete shall be well consolidated by mechanical means and the mortar flushed to the form surfaces by continuous working with immersion type vibrators. The vibration shall continue until thorough consolidation and complete embedment of reinforcement and fixtures is produced but not long enough to cause segregation.

Footings, forms, trenches, etc., shall be free of standing or flowing water before any concrete is placed therein. Any necessary pumping or bailing during concreting operations shall be done from a suitable sump located outside the forms or excavations receiving concrete.

407.15.12 Curing Concrete.

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Concrete shall be allowed to cure at 40 degrees or above for at least seventy-two hours after placement before any backfill, load, or strain is placed on the concrete or any projecting reinforcing. While curing, the concrete shall be protected from drying by leaving the forms in place, or by covering with damp mats, blankets, or by complete coverage of the moist concrete with a sealing "membrane" curing compound.

The contractor shall inform the City of League City ~~Public Works~~[Engineering](#) Department fully of the methods and procedures proposed for curing, and shall provide the proper equipment and material in adequate amounts, and shall have the proposed method, equipment and materials approved by the City of League City ~~Public Works~~[Engineering](#) Department prior to the placing concrete.

ITEM 408 EXCAVATION

All excavation and backfilling shall be accomplished in accordance with all current standards and recommendations of the State Health Division of Occupational Safety. Wherever existing utility branch connections, sewers, drains, conduits, ducts, pipes, or structures present obstructions to the excavation, they shall be permanently supported, removed, relocated or reconstructed by the contractor through cooperation with the owner of the utility, structure, or obstruction involved.

Adequate temporary support, protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the contractor.

Adequate provisions shall be made for the flow of sewers, drains, and water courses encountered during construction, and all the structures which may have been disturbed shall be satisfactorily restored as soon as possible.

When rainfall or runoff is occurring or is forecast, the contractor shall not perform or attempt any excavation or other earth moving work within the immediate flood plain of any stream or water course, or on slopes subject to erosion or runoff. Adjacent property shall be protected from rainfall runoff resulting from earth moving operations within the work. Gutter and drainage channels shall be kept clear, or other means of securing proper drainage shall be provided by the contractor.

All excavated material shall be piled in such a manner that it will not endanger the work in progress and will not block sidewalks, driveways or obstruct traffic. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, until such time as the backfill has been completed and then shall be removed from the site. All surplus material shall be removed from the rights-of-way or easements and

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properly disposed of by the contractor. The excavation shall be finished flush with surrounding natural ground.

Work performed on Railroad right-of-way is subject to the concurrence of the Railroad Company. Work performed on State Highway right-of-way is subject to the concurrence of the Texas Highway Department. Work performed within waterways, such as rivers, creeks, bayous, and drainage ditches, is subject to the concurrence of the appropriate governmental agency.

408.1 Trench Excavation.

Prior to commencing any trench excavation, the contractor shall provide ample labor, equipment, shoring materials, and such other safety equipment as required ~~to insure that~~ ensure that the work will be carried out without interruption or damage to existing installations. The contractor shall abide by all applicable federal, state or local laws governing excavation work.

408.1.1 Lines and Grade.

Trench excavation shall be to the line and grade shown on the approved plans or called for in these specifications. The contractor shall provide adequate vertical and horizontal control for accurate work.

408.1.2 Trench Width.

The trench width at the pipe zone (six-inches below and twelve-inches above the outer projections of the pipe or accessories) should be kept to a minimum. The minimum permissible clearance between the outside body of the pipe and the trench wall at the pipe zone will be such that the bedding material can be consolidated on all sides of the pipe. The minimum clearance will be 12" on each side. Excavation along curves shall be so oriented that the trench and pipe are centered on the centerline of the curve, or where necessary to conform to the recommendations, horizontal bend fittings shall be utilized.

Where bracing or sheathing and bracing, are used, the trench width shall be increased accordingly. After the pipe has been laid and the trench backfilled 12" above the top of the pipe, the bracing shall be removed, but with special care that the pipe is undisturbed. As each brace is removed, the space left by its removal must be thoroughly filled and compacted.

Pipe laid in trench exceeding the specified width, the entire width between the undisturbed walls of the excavation must be backfilled and compacted as pipe trench in accordance with ITEM 409.2, "Pipe Bedding."

408.1.3 Trench Depth and Depth of Cover.

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Trenches shall be excavated to a depth which provides proper clearance beneath all parts of the pipe and fittings for placement of the bedding, cradle, jacket, ~~etc.~~, called for in these specifications. Before placing any bedding, any part of the trench which may be excavated to deep shall be filled to the proper trench bottom sub-grade with cement stabilized sand and thoroughly tamped over the full width of the excavation. All pipe and in-line appurtenances shall be laid to the depths called for in the plans or these specifications.

408.1.4 Foundation Mat for Unsuitable Soils.

No pipe or bedding shall be placed where the trench bottom is found to be a soft material, fill, or otherwise unstable material not suitable as a foundation. In case of unsuitable ~~material~~, the entire trench width shall be excavated twenty-four inches below the ordinary trench sub-grade depth and refilled to the normal sub-grade with gravel tamped solidly into the trench bottom. The specified bedding material shall then be placed over the supporting mat, and the pipe laid in the usual manner. In severe cases of unstable trench bottom, a concrete seal slab shall be placed prior to pipe bedding. See bedding and backfill details.

408.2 Jacking, Boring, And Tunneling.

Roadway crossings under existing pavement shall be placed by jacking and boring, unless special permission is granted by the City of League City Public Works Department. The installation of lines under private driveways in rights-of-way shall be placed by jacking or boring unless special permission is granted by the property owner. All lines placed by jacking or boring shall consist of smooth-wall pipe with welded joints and seams, and shall be continuous. Casing shall extend from crown line to crown line or five feet behind curb on each side thereof. See Item 407.13.2 for Steel Casing specifications. Service connections may omit casing if service material is continuous, without joints, and is a smooth wall pipe or tubing. Bore hole or tunnel shall not exceed the diameter of the casing by more than one inch. Over cutting or excavation will be remedied by filling the annular space between the outside of the pipe and the tunnel face with concrete grout.

Suitable pits, shaft or trenches shall be excavated and, if necessary, shall be properly ~~shored~~ stored on all sides in a safe manner. Shoring shall be material of ample strength to safely withstand all structural loadings of whatever nature due to site or soft conditions. Preparations shall be kept dry during all operations. Pumping and bailing operations shall be performed as necessary. In the event the excavations bottom is not stable, the bottom shall be excavated to such additional depth as required and place gravel, shell, or concrete seal slab for a working mat.

Construction shall be made in such a manner that it will not interfere with the operations of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure.

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408.2.1 Jacking.

Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. A suitable jacking head, usually of timber and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides, properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into space thus provided.

When jacking of pipe commences, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment. Any pipe damaged in jacking operations shall be removed and replaced. The pits, shafts or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

408.2.2 Boring.

The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method an approximate 2-inch pilot hole shall be bored the entire length of the crossing and shall be checked for proper line and grade at each end. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cutting; jetting will not be permitted.

In unconsolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least 10% of high grade carefully processed bentonites may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the pipe immediately thereafter. When the cutting operation begins, the operation shall be carried on without interruption, insofar as practicable, until the casing is in place.

408.2.3 Tunneling.

The tunnel excavation shall be performed by methods consistent with good practice and with due regard for the safety of personnel, protection of property and progress of the work. The methods of excavating in tunnels, whether by hand digging, mechanical means, or use of hydraulic or compressed air tools, shall be accomplished by procedures which are acceptable to the City of League City Public Works Department.

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The City of League City Engineering and Public Works Departments will not attempt to dictate specific working methods, but it shall be the contractor's responsibility to ascertain beforehand that the methods which he desires to use will be acceptable to the City of League City Public Works Department, taking into account the actual job conditions expected. The tunnel shall be permanently lined with galvanized steel deformed plates as describes under ITEM 407.13.3 "Metal Liner Plate." As tunneling proceeds, and following as closely behind erection of the liner plate as working space will permit, the annular space between the outside of the steel liner plates and the tunnel wall shall be filled with grout in such a manner and by such methods as to completely fill the space and leave it free of voids.

Grout for voids shall consist of ~~one part~~one-part standard Portland cement and four parts of fine clean sand mixed with potable water to produce a homogeneous, workable mix. Suitable equipment for the expeditious placement of the grout shall be furnished.

Pipe shall be handled and placed in tunnels by the use of proper cradle bedding, skids, wedges, guide rails or other approved means. The contractor's methods for setting pipe and making joints must be approved by the City of League City Public Works Department prior to their use.

Every reasonable and proper precaution shall be taken by the contractor to insure the safety of the public, the work and personnel, and all adjacent property.

ITEM 409 PIPE LAYING

All pipe shall be laid and maintained in the required lines and grades; with fittings, valves, and hydrants at the required locations; and with joints centered and spigots home; and with all valve and hydrant stems plumb.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times, and stored in a manner that will protect them from damage.

During handling and placement, materials shall be carefully observed and inspected, and any damaged, defective; or unsound materials shall be rejected and removed from the job site. Damaged coating or lining shall be inspected by manufacturer and repaired in a manner satisfactory to the manufacturer's requirements.

409.1 Trench Condition.

Before pipe installation, all water, slush, debris, etc., encountered in the trench must be removed and the trench must be kept clean and dry while the pipe is laid and backfilled.

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Where ground water is encountered, the water table shall be lowered so that all necessary work may be carried on in a dry condition.

All open ends, outlets or other openings in the pipe shall be protected from damage and properly plugged and blocked watertight, to prevent the entrance of trench water, dirt, etc. The interior of the pipeline shall at all times be kept clean, dry, and unobstructed.

409.2 Pipe Bedding and Embedment.

Except where otherwise approved by the City of League City Public Works Department, all pipe and appurtenances shall be installed in a continuous envelope of specified bedding material. Specified bedding material for waterlines and appurtenances shall be sand (see ITEM 407.14, "Materials") extending from minimum 6" below to minimum 12" above the outer part of the pipe, fittings, and accessories extending for the full width between the undisturbed trench walls. The bedding material required beneath the pipe shall be placed, graded and tamped to the pipe sub-grade profile over the entire width between undisturbed trench walls and cut-outs made for the projects of the pipe bells, couplings, etc.

The pipe shall be placed and adjusted to proper grade on this prepared bedding, then jointed, braced and blocked as required. After pipe is graded into place, bedding material shall be placed simultaneously on both sides of the pipe and worked carefully into place without disturbing the pipe alignment, to an elevation of minimum 12" over the pipe. Minimum clearances between lines that cross each other shall be determined by the amount of bedding and backfill required as shown on the details in the given set of plans.

409.2.1 Wet Sand Construction

This ITEM shall include the following:

- A. If deemed necessary, timber sheeting and floorboards
- B. Washed crushed rock bedding (ASTM D2321 Class 1B bedding) or equal with filter fabric wrap.

All ITEMS (A&B) must be approved by the EOR, City of League City ~~Public Works Department~~Engineering Department and the Owner and constructed per the City of League City Details.

The use of wet sand construction shall be strictly controlled by the EOR and shall be performed only when authorized in writing by the EOR. Payment will be based on the measured linear footage at the unit price bid.

If wet sand is found in the field use wet sand bedding per League City Details.

409.3 Assembling Pipe.

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Assembly shall meet the manufacturer's recommendations for the pipe and accessories being used. Side outlets shall be rotated so that operating stems and valves will be vertical when valves are installed. Unless otherwise directed, pipe shall be laid with bell ends facing the direction of laying lines of an appreciable slope, the bell shall face up-grade.

Before joining any pipe, any foreign matter shall be removed from the ends of each pipe, the pipe shall be wiped clean and dry, and primed in accordance with manufactures recommendations.

409.4 Setting Valves, Drains, and Air Releases.

Unless otherwise directed, mainline valves, drain valves and piping, air and vacuum release assemblies and other miscellaneous accessories shall be set and jointed in the manner described for assembling pipe.

Valves shall be installed and the stems adjusted so that the tops of operating stems will be at the proper depth required. Valve boxes and valve stem casings shall be firmly supported and maintained centered and plumb over the operating stem, with the bury line of the box flush with the finished ground. Valve boxes shall have a minimum 8" adjustment available above the final setting.

409.5 Setting Fire Hydrants.

All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb or future curb. They shall be installed with the hydrant bury mark approximately 6" above level with the finish grade. The contoured shoe of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete thrust blocking (taking care not to obstruct the hydrant drain holes) and each hydrant cradled with a minimum of 6" of concrete placed under the shoe. A drainage pit 2 feet in diameter and 2 feet in depth, located about the drain ring housing, shall be filled with coarse gravel.

For spacing, location, and depth of bury for fire hydrants see ITEM 405.

For fire hydrant material requirements see ITEM 407.9.

409.6 Pipe Anchorage, Support and Protection.

On all pipelines 6" in diameter or larger, all tees, plugs, caps and bends exceeding 11 1/4 degree and other bends as directed, shall be securely anchored by mechanical joint restraints and suitable concrete thrust blocking.

Unless otherwise provided, concrete for use as reaction or thrust blocking shall be as specified under "Concrete," concrete blocking shall be placed between solid ground and the fitting to be anchored; the area of bearing on pipe and on ground in each instance shall be that stipulated

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by sound engineering practices. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair.

A poly wrapped material shall be used to avoid bonding of the concrete to the pipe or fitting.

ITEM 410 BACKFILL AND SETTLEMENT

The backfill and settling of trenches and excavation shall include whatever methods and procedures may be necessary to restore the entire work area to a safe geologically stable condition satisfactory to the Department of Public Works and generally equal or superior to the conditions prior to construction. Special backfill conditions will be required within existing and proposed paved surfaces and special rights-of-way.

410.1 Cement-Stabilized Backfill.

Excavation within the paving sub-grade zone (area under pavement to 3' outside pavement each way thereof) of proposed or existing pavement shall be a backfill with cement-stabilized material. Material shall be as specified under ITEM 407.14.2, "Cement-Stabilized Sand."

Cement-Stabilized backfill shall be placed at optimum moisture content in layers not to exceed 12" measured loose. Compact with mechanical hand tamps to at least 95% Standard Proctor Density as determined by ASTM D 698. Mechanical tamps shall be rammer-type capable of 50 ft. lbs./blow or approved equal.

Cement-Stabilized Sand shall not be used after it loses its moisture content or it has obtained an initial set. Material not in place within 4 hours shall be rejected.

410.2 Backfill, Compaction, and Density.

Compaction of all backfill material shall be performed in a manner that will not crack, crush, and/or cause the installed pipe to be moved from the established grade and alignment.

In existing or proposed City street rights-of-way and easements and outside of the paving sub-grade zone, the backfill above the pipe zone may ordinarily include the select excavated soil material. All material above the pipe zone shall be compacted to obtain a minimum of 95% of Max Density as determined by ASTM D 698. Where sidewalks, driveways, and/or pavement have been cut; backfill material shall be in accordance with ITEM 410.1, "Cement Stabilized Backfill." Backfill within Railroad right-of-way boundaries must satisfy the specifications and conditions in the railroad permit, issued for work. Backfill within the State Highway right-of-way must satisfy the specifications and conditions in the State Highway Permit issued for work.

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410.2.1 Tamping.

Backfill Material shall be near optimum workability and moisture content when tamped, with no discernible free water, ponding or drainage. The backfill shall be placed in uniform layers of not more than 8" loose measurement, extending completely across the excavation between the undisturbed trench walls, and tamped evenly and uniformly to the proper density by hand tamping or by mechanical tampers. Extreme care must be exercised to prevent movement or injury of the pipe while tamping; the pipe position, grade or alignment shall not be disturbed. Flooding or water jetting will not be allowed in soils whose plasticity index (PI) is greater than 15.

ITEM 411 HYDROSTATIC TESTING

After the pipe has been installed, backfilled, and all service connections (if required), fire hydrants and other appurtenances installed, connected and adjusted; and all surface pavement, lot grading and other related construction activities are complete within the area of line to be accepted; a pressure and leakage test will be conducted by the contractor and monitored by the city inspector. The contractor shall furnish the pump, meter and gauges for the tests. The specified test pressures will be based on the elevation of the lowest point on the line under test. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all dead ends and high points, the contractor shall install corporation cocks at such points. Location of test pump may require additional corporation cocks. At the conclusion of the pressure test, the corporation cocks shall be properly plugged and secured to prevent leakage.

All valve connections between a system that is presently ~~serviced~~serviced, and an unaccepted system shall be operated only by League City personnel. Pressurization and flush of the line will be coordinated by the City, with ample notification. Charges for water usage will be consistent with current City policy.

The leakage test will be conducted on the entire project, or each valve section, concurrently with the pressure test. The leakage test shall be at 150 psi for four (4) hours or 125 psi for eight (8) hours. Leakage shall be defined as the quantity of water that must be supplied into any test section of pipe, to maintain the specified leakage test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. All potable water provided for water test shall be through a City provided contractors meter assembly and backflow preventer; no direct connection will be allowed for filling of lines.

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No pipe installation will be considered acceptable if the leakage is greater than that determined by the current AWWA Standards "Allowable Leakage"; for applicable pipe material. All visible leaks are to be repaired regardless of the amount of leakage.

ITEM 412 SANITARY PRECAUTIONS AND DISINFECTION

Sanitary precautions, flushing, and disinfections procedures and bacteriological sampling, as prescribed in AWWA Standard C 601 for disinfecting water-mains, shall be followed in laying waterlines.

Pipe shall not be laid in water or placed where it can be flooded with water or sewage during storage or installation. The effectiveness of disinfections depends in large measure on maintaining clean pipes and avoiding major contamination during construction.

All newly installed mains shall be disinfected in accordance with ANSI/AWWA C 601 and flushed and sampled before being placed in service. After satisfactory completion of the hydrostatic testing, League City personnel will flush and collect samples for bacteriological analysis to check the efficiency of the disinfections procedure, which shall be repeated if contamination persists. A minimum of one sample for each 1,000 feet of completed main will be required. Charges for water usage will be consistent with current City policy.

Following the chlorination period, all treated water flushed from the lines shall be disposed of by discharging to the nearest sanitary sewer or other approved means. No discharge to any storm sewer or natural water course will be allowed.

ITEM 413 CONNECTIONS TO EXISTING SYSTEM

Connections to an existing system shall be accomplished without interrupting normal service, where ever possible.

In-line installations and extensions that require the operation of valves within the serviced system shall be scheduled in advance and must be approved by the Public Work Department. City personnel will make all shut-outs on existing mains. The contractor shall be responsible for the advance notification to individuals affected by the interruption of service. Notifications must be written and include the date, time and the proposed duration of interrupted service.

Unless otherwise approved, connections to an existing system shall be pressure tapped. A pressure tap shall consist of connecting new piping to the existing water system by drilling into the existing pipe while it is carrying water under normal pressure, without taking the existing piping out of service. The contractor shall perform all excavation, furnish and install tapping sleeve, valves and accessories in conformance with these specifications and provide

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the tapping machine and drill the tap and shall block, cradle and backfill the piping, valve and all accessories.

All service connections shall be constructed in accordance with "Standards Details," and all service connections shall be inspected prior to any cover up by a representative from the City's Line Repair Department.

ITEM 414 CLEAN-UP AND RESTORATION

It shall be the contractor's responsibility to keep the construction site neat, clean and orderly at all times. Clean-up shall be vigorous and continuous to minimize traffic hazards or obstructions along streets and to driveways.

Materials at the site shall be stored in a neat and orderly manner so as not to obstruct pedestrian or vehicular traffic. All damaged or surplus material shall be removed from the construction site immediately and disposed of in a proper manner.

Immediately following the pipe laying work as it progresses, the contractor shall backfill, grade and settle all excavations as provided elsewhere and shall immediately clean up and remove all unused spoil, waste and debris, and restore all surfaces and improvements to a condition equal or superior to that before construction began and to an appearance which complements the surroundings. The contractor shall grade and dress the top 6" of earth surfaces with material similar to the surroundings, fill and smooth any tracks or ruts, replace and re-establish all damaged or disturbed turf or other vegetation, and otherwise make every effort to encourage return of the entire surface and all improvements to a pleasant appearance and useful condition.

ITEM 415 APPROVAL AND ACCEPTANCE

When all of the work provided for in the plans and specifications has been satisfactorily completed and all clean-up work has been performed, as provided elsewhere in these specifications; the inspector assigned to the work will notify the ~~Public Works~~Engineering Department to make the "Final Inspection." Such inspection will be scheduled within 10 days after such notification. "Final Inspection" by League City representatives shall be concurrent with the final inspection by representatives of the Developer, engineer, contractor, and other authorities whose approval is necessary for the proper use of the facilities. All deficiencies that are noted shall be corrected to the approval of all the authorities involved.

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~~Formal acceptance of public infrastructure will follow the process noted in Item 101.1 of this manual. When formal City Council acceptance is required, the Developer shall submit to the Public Works Department the following ITEMS in pdf format: The Developer's Request for Acceptance of the work, Engineer's Certificate of Completion, Summary of Infrastructure Cost, "As Built Drawings", and a letter requesting the action by the City Council.~~

~~Neither formal acceptance by City Council nor any~~No action by a representative of the City shall relieve the Developer/Contractor of the obligation for fulfillment of the warranty of the work.

ITEM 416 WARRANTY OF WORK

The Developer, the contractor and/or his surety will be required by the City to repair, replace restore and/or make to comply strictly in all things with these specifications and the plans and any and all work and/or materials, which within a period of one year from and after the date of the passing approval and/or acceptance of any such work or material, are found to be defective or to fail in any way to comply with these specifications. Effective date for beginning ~~one-year~~one-year guarantee shall be the date of the City Council acceptance or the permit of occupancy for the facility. Should the Developer/Contractor fail to remedy the defects as outlined herein within a reasonable length of time, the City may have such work done and charge the cost to the Developer/Contractor or the surety company.

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SPECIFICATIONS FOR WASTEWATER PROJECTS

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ITEM 501 GENERAL

These standards for wastewater collection systems have been adopted to establish a criteria compatible with existing State statutes pertaining to effluent quality, and to provide facilities which will be designed in accordance with good public health and water quality engineering practices. In addition to these standards, all wastewater systems will be provided in accordance with current guidelines promulgated by The Texas Department of Water Resources of the Texas Commission on Environmental Quality.

It will be the responsibility of the EOR to show capacity calculations. Wastewater facilities will be designed considering the estimated contributing population to be served in the future. The peak flow of domestic sewage, peak flow of waste from industrial plants, peak flow for institutional and commercial flows shall be considered in determining capacities. Strict attention shall be given to minimizing infiltration/inflow into the system.

The use of pressure sewers may be considered when justified by unusual terrain, low population density, or other circumstances where a pressure system would offer an advantage. A pressure system will not be considered a substitute for a conventional gravity system.

Onsite Sanitary Sewer Facilities (OSSF) installation and approvals shall be in accordance with Galveston County Health Department and other regulatory authorities.

ITEM 502 SANITARY SEWER LINE SIZING

All sewer lines installed shall be at a size to conform to designs permitting an orderly expansion of the City's wastewater system. The design shall avoid a duplication of lines in the future.

No sewers other than individual service connections and force mains shall be less than eight (8) inches in diameter.

Six (6) inch service connections shall not serve more than two single family lots or more than six (6) dwelling units.

All four (4) inch sewers shall be confined within the limits of the property they serve. No four (4) inch sewers shall be installed in any right-of-way or easement. Four (4) inch sewers will be considered the property of the individual served and will not be maintained by the City.

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ITEM 503 LOCATION OF SANITARY SEWER LINES

All public sewers shall be located in public rights-of-way or sanitary sewer easements. Non-sanitary sewer easements or fee strips, such as pipelines, power utility easements, drainage easements, railroad, etc., are in and of themselves insufficient and not acceptable to permit the installation of sanitary sewers or force mains. Sanitary sewer lines installed in sanitary sewer easements shall be centered in the easement.

Sewers should be installed in straight alignment with uniform grade between manholes.

503.1 Separation Distance.

When sanitary sewers are installed parallel with existing or proposed water lines and ~~there~~their appurtenances, they shall be installed no closer than nine (9) feet horizontally, pipe wall to pipe wall, and must be installed in separate trenches. All sewer and water line crossings shall comply with the TCEQ Chapter 290, Subchapter D, Rule 290.44 (e) (B), Public Drinking Water, New Waterline Installation-Crossing Lines, paragraphs (i) through (vi) and all sub paragraphs therein.

Sanitary sewer lines shall not be installed within nine (9) feet horizontally of a fire hydrant, regardless of construction.

When a sanitary sewer is placed parallel to another utility other than water, it shall have a minimum of seven (7) feet horizontal separation.

Minimum clearances between lines that cross each other shall be determined by the amount of bedding and backfill required as shown on the details in the given set of plans.

503.2 Depth-of-Cover.

The sanitary sewer should be laid with the top of the pipe a minimum of three and one-half (3 1/2) feet below the surface of the ground. Where this minimum cover is not possible, the sewer may be constructed of special material, if approved by the Public Works Department.

503.3 Slopes and Velocities.

All sewers shall be designed and installed with hydraulic slopes sufficient to give a velocity when flowing full of not less than 2.0 feet per second. The design and installed grades shall be based on Manning's Formula and an "n" factor of 0.009 – 0.011 and shall be the minimum acceptable slopes.

When velocities greater than 10 feet per second are attained, special provisions shall be

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made to protect against displacement by erosion and shock. Service connections shall be installed with a minimum slope of 0.70% and a maximum slope of 4.00%.

ITEM 504 LOCATION OF MANHOLES

Manholes shall be placed at points of changes in alignment, grade or size of sewer, and at the intersection of sewers and the end of all sewer lines. Clean-outs with plugs may not be installed in lieu of manholes at the end of sewer lines unless approved by the Public Works Department.

The maximum manhole spacing for sewers with straight alignment and uniform grades shall be four hundred and fifty (450) feet.

Manholes shall be installed where a sewer main crosses a street.

Manholes used as cleanouts at the end of service lines shall be considered as an extension to the system and will require plan and profile engineered drawing. Any service lead past said manhole will be considered private. See ITEM 505.

ITEM 505 LOCATION OF SERVICE LEADS

Sewer service leads shall be installed integrally with the construction of the sewer main whenever possible. Service leads not exceeding one hundred (100) feet in length may extend off the sewer main without the use of manholes. Service leads exceeding one hundred (100) feet in length shall have manholes at both ends. Manholes constructed on city mains for the purpose of providing private service shall be built to COLC standards and inspected by ~~Public Works Department~~Engineering Department. A 24 ~~hr.~~ notification is required before construction and/or inspection.

Service leads shall be installed as nearly perpendicular as possible to the sewer main and the lot line. Sewers constructed close to or parallel to the right-of-way or easement shall not be considered as a service lead.

Service leads shall be kept as free from bends as conditions will permit.

Stacks shall be installed for service leads on all sewer mains having a depth of eight (8) feet or greater.

Single service leads shall have a clean-out and plug adjacent to a lot line or double service at each second lot line of both lots. Clean-out and plug will be located at the right-of-way line or easement line. An "X" saw cut shall be made on the adjacent curb where clean-outs are located.

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Service leads from developments with more than 17,500 gal/day discharge shall discharge directly into a proposed or existing manhole.

ITEM 506 GREASE, MUD, AND LINT INTERCEPTORS

Establishments classified as serving food individually, in bulk, or carry out and served in boxes or on plates and ~~washeterias~~washeterias shall have a Park Equipment Grease Interceptor Series GT (DWG NO. GT-1 or 2) or approved equal, installed. Size of interceptor shall be determined by the developers' engineer and shown on plans. If requested, engineer shall supply all calculations and paper work on interceptor sizing.

Car washing establishments shall have a Park Equipment Sand /Oil Interceptor (DWG NO. SOCMP-1) or approved equal, installed. Developers' engineer shall determine that the size is adequate for proposed car wash and shall present any calculations and paper work stating so.

Establishments that require an interceptor or separator shall have a Park ~~Equipment~~Sample Equipment Sample Well Basin (DWG NO. SWB 15) or approved equal, installed.

ITEM 507 MATERIALS

Materials shall be stored, handled and used as described under ITEM 105, "Control of Materials." All pipes for gravity sanitary sewer lines installed within dedicated public rights-of-way or easements shall be in accordance to the material specifications set out herein.

The use of manufacturers' names and catalog numbers, as may be used to describe various products, is not intended to be proprietary, but merely to indicate clearly the respective type of materials that can be accepted. The use of other materials and products will require an approval from the Public Works Department prior to installation. Submittals for product acceptance must be directed to the ~~Public Works Department~~Engineering Department by the EOR representing the Developer. Contractor submittals will not be accepted.

The City of League City reserves the right to engage, at any time during the progress of the work, a Materials Testing Laboratory to test and inspect all pipe or accessories.

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507.1 Iron Pipe and Fittings.

All pipe, fittings and accessories shall be shipped, stored, handled and installed in accordance with manufacturer's recommendations and as specified herein.

Iron pipe shall be bell and spigot joints where possible. Other jointing may be necessary for special applications when approved by the Public Works Department.

All pipe and fittings shall be wrapped with 8 mil (min) polyethylene film meeting ANSI/AWWA C 105 with all edges and laps taped securely to provide a continuous and water-tight wrap.

507.1.1 Ductile Iron Pipe.

Ductile iron pipe for pressure and gravity sewer applications shall be provided in accordance with ITEM 407.1.1, "Ductile Iron Pipe" with the following exception:

Ductile iron sewer pipe shall be thickness class 50.

507.1.2 Ductile Iron Fittings.

All fittings shall be provided in accordance with ITEM 407.1.2, "Ductile Iron Fittings."

507.1.3 Joints.

All joints shall be provided in accordance with ITEM 407.1.4, "Joints."

507.2 Polyvinyl Chloride (PVC) Gravity Pipe and Fittings

PVC pipe shall meet the requirements of ASTM D 3034 (SDR 26) for sizes 6" through 15", and ASTM F 679 (wall thickness T-1) for sizes 18" through 27". The pipe shall be made of PVC plastic having a cell classification of 12454-B, 12454-C or 13364-B, as defined in ASTM D 1784 and shall be green in color. Each joint shall consist of a single continuous extrusion with push-on, rubber gasket joints of the integral bell and spigot type. Elastomeric Gaskets shall comply in all respects with the physical requirements specified in ASTM F 477.

PVC fittings shall meet the requirements of ASTM D 3034 (SDR 26) for sizes 6" through 15" and ASTM F 679 (wall thickness T-1) for sizes 18" through 27". Fittings shall be made of PVC plastic having a cell classification of 12454-B, 12454-C or 13343-C as defined in ASTM D 1784. Fittings shall be suitable for use with PVC gravity sewer pipe and shall not deflect more than the pipe when loaded similar. Elastomeric gaskets shall comply in all respects with the physical requirements specified in ASTM F 477. All PVC fitting shall

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be solid molded (no glue and heat fabrication) for sizes up to 15", for sizes over 15" product specifications shall be submitted for approval.

PVC gravity pipe and fittings shall be installed in accordance with UNI-B-5-86 and as specified herein.

507.3 Polyvinyl Chloride (PVC) Pressure Pipe.

PVC pressure pipe shall meet the requirements of ASTM D 2241 (SDR 26) for sizes 4" through 36". The pipe shall be made of PVC plastic having a cell classification of 12454 B as defined in ASTM D 1784. Pipe and fittings shall be accordance with 407.1.2 and shall ~~be green~~be green in color.

Each joint shall consist of a single continuous extrusion with push-on rubber gasket joints of the integral bell and spigot type with a recommended hydrostatic design stress for PVC 1120. Elastomeric seals shall comply with ASTM D 3139. Rubber gaskets shall comply in all respects with the physical requirements specified in ASTM F 477.

507.4 Triple Wall and Dual Wall Polypropylene Gravity Pipe and Fittings

Polypropylene Dual and Triple Wall Pipe for use in gravity flow sanitary sewer shall be in strict accordance with the requirements and test methods of ASTM F2736 – "Standard Specification for (6 inch to 30 inch) Polypropylene Corrugated Single Wall pipe and Double Wall Pipe" and ASTM F2764 – "Standard Specification for (30 inch to 60 inch) Polypropylene Triple Wall pipe and Fittings for Non-Pressure Sanitary Sewer Applications". Pipe shall have a green stripe impregnated within the pipe.

Triple Wall Pipe shall consist of a smooth inner wall and outer wall separated by annular corrugations manufactured in accordance with ASTM F2764.

Dual Wall Pipe shall consist of a smooth inner wall and outer wall annular corrugations manufactured in accordance with ASTM F2736.

Joints shall be watertight according to the requirements of ASTM D3212. Spigot shall have two gaskets meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable protective wrap to ensure the gaskets are free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. ~~12-inch to 60-inch~~ diameters shall have a reinforced bell with a polymer composite band installed by the manufacturer.

Pipe shall have a minimum stiffness of 46 psi when tested in accordance with ASTM D2412 "Test Method for External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading".

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507.5 Fiberglass Reinforced Plastic Pipe.

Where the application of fiberglass reinforced plastic pipe is approved by the Public Works Department, pipe shall be equal to that manufactured by HOBAS Pipes with a minimum stiffness class 72. Pipe shall be green or have a green stripe or placement of sanitary marker tape above the pipe.

Applications of fiberglass reinforced plastic pipe will only be considered for gravity sewers sizes 18" and larger. Smaller pipe sizes shall not be accepted.

507.6 High-Density Polyethylene Pipe.

Polyethylene pipe shall be made from HDPE material having a material designation code of PE4710 or higher. The material shall meet the requirements of ASTM D 3350 and shall have a minimum cell classification of PE445474C. In addition, the material shall be listed as meeting NSF-61.

The pipe and fittings shall meet the requirements of AWWA C906.

The HDPE pipe shall be rated for use at a pressure class of 200 psi. The outside diameter of the pipe shall be based upon ductile iron pipe size sizing system.

The pipe shall be marked in accordance with the standards to which it is manufactured. Color identification by the use of stripes on the pipe to identify pipe service shall be required and colored blue for potable water.

507.6.1 Fittings

Butt Fusion fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification of PE445474C. Butt Fusion fittings shall meet the requirements of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe. All fittings shall meet the requirements of AWWA C906. Markings for molded fittings shall comply with the requirements of ASTM D 3261. Fabricated fittings shall be marked in accordance with ASTM F 2206.

Electrofusion fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification of PE445474C. Electrofusion fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe. All electrofusion fittings shall be suitable for use as pressure conduits, and have nominal burst values of four times the Working Pressure Rating of the fitting. Markings shall be according to ASTM F 1055.

Flange and Mechanical Joint Adapters shall have a material designation code of PE4710 or higher and a minimum Cell Classification of PE445474C. Flange and Mechanical Joint

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Adapters can be made to ASTM D 3261 or if machined, must meet the requirements of ASTM F 2206. Flange and Mechanical Joint Adapters shall have a pressure rating equal to the pipe. Marking for molded or machined flange adapters or MJ Adapters shall be per ASTM D 3261. Fabricated flange adapters shall be per ASTM F 2206. Bolts and nuts shall be SAE Type 316 stainless steel. Van-Stone style, ductile iron, convoluted or flat-plate, backup rings and bolt materials shall follow the guidelines of Plastic Pipe Institute Technical Note # 38, and shall have the bolt holes and bolt circles conforming to one of these standards: ASME B-16.5 Class 150, ASME B-16.47 Series A Class 150, ASME B-16.1 Class 125, or AWWA C207 Class 150 Series B, D, or E. The backup ring shall provide a ~~long-term~~long-term pressure rating equal to or greater than the pressure class of the pipe with which the flange adapter assembly will be used, and such pressure rating shall be marked on the backup ring. Backup rings, bolts, and nuts shall be SAE Type 316 stainless steel. An internal ~~stainless-steel~~stainless-steel stiffener sleeve that is expanded hydraulically to create an interference fit with the pipe must also be used.

507.6.2 Joining Methods

Butt Fusion: The pipe shall be joined by the but fusion procedure outlined in ASTM F 2620. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per PPI TN-42.

Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of ~~electrofustionelectrofusion~~ joining information are ASTM F 1290 and PPI TN 34. The process of ~~electrofustionelectrofusion~~ requires an electric source, a transformer, commonly called an ~~electrofustionelectrofusion~~ box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of ~~electrofustionelectrofusion~~ box used. The electrofusion box must be capable of reading and storing the ~~imputinput~~ parameters and the fusion results for later download to a record file. Qualification of the fusion technician shall be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized.

Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, and ductile iron fittings shall use flange or mechanical joint adapters and other devices in conformance with AWWA Manual of Practice M55, Chapter 6.

The critical parameters of each fusion joint, as required by the manufacturer shall be recorded either manually or by an electronic data logging device. All fusion joint data shall be included in the Fusion Technician's joint report.

507.7 Manholes.

Manholes shall be constructed of pre-cast concrete sections or when and where approved concrete cast-in-place. Detailed drawings of various types and sizes of manholes are

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included in the "Standard Details" and each manhole shall be constructed in strict accordance with these drawings. Manholes shall be installed vertical and symmetrically above sewer main.

Manholes shall have inverts in them in which flow channels to the spring line of the pipes are constructed, inverts equal in depth to one-half the diameter of the pipes connected to that manhole. Where sewer lines enter the manhole higher than 6 inches but less than 24 inches above the manhole invert, the invert shall be filled and formed to prevent solids deposition. A drop pipe shall be provided in accordance to the "Standard Details" for a sewer main entering a manhole more than 24 inches above the manhole invert.

The top of a manhole shall be adjusted by the installation of pre-cast concrete rings. The maximum adjustment of the confined man-way shall be 18 inches.

Access steps shall not be installed in manholes.

All concrete manholes shall have either an antimicrobial additive added into the concrete mix design per manufactures specifications or a 25 mil bitumastic coating applied per manufacture recommendations. The liquid antibacterial additive shall be an EPA registered material. The amount used shall be as recommended by the manufacture and included in the total water content of the concrete mix design. The additive shall be added into the concrete mix water to ensure even distribution of the additive throughout the concrete mixture. Acceptance shall be a letter of certification from the precaster or concrete provider stating that the correct amount and correct mixing procedures were followed.

~~All interior concrete above the manhole invert shall be coated complete with Bitumastic, per manufactures recommendation, a minimum thickness of 25 mil.~~

Application shall be certified by coating manufacturer.

Manhole rings, covers, and inflow protection devices shall be furnished and installed with all manholes in accordance with ITEM 507.7.4, "Rings, Covers, and Inflow Protection Devices."

507.7.1 Pre-Cast Concrete Manholes and Bases.

Pre-cast reinforced concrete manholes and bases shall be manufactured in accordance with ASTM C 478 and shall be equal to Hansen Manholes. Steel reinforcement shall be in accordance with ASTM C 478 latest revision. Design loads shall be for H-20 live load and 16 kips wheel load. The section joint shall be a confined "O" ring rubber gasket, conforming with ASTM C 443. Manholes shall be furnished with formed holes for all planned connections with compression seals of pre-molded polyurethane pipe adapters.

Installation shall be in accordance with manufacturer's recommendation and as shown in

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the "Standard Details."

507.7.2 **Fiberglass Manholes**

Fiberglass manholes are to be used in special situations only and must be approved by the office of the Public Works Department.

507.7.3 ~~Deleted~~—Cast-in-Place Monolithic Concrete Manholes

Cast-in-Place Manholes shall be constructed in accordance with the details on monolithic poured professionally engineered sealed design plans.

The minimum wall thickness shall be 6 inches. Maximum wall thickness shall be determined by the design engineer as dictated design by supporting design load and geotechnical reports. Concrete shall be placed complete in one casting. No joints will be allowed. Concrete shall be handled as described under concrete ITEM 407.15, "Concrete." Engineer of record shall supply engineered detail drawings for cast-in-place manholes.

507.7.4 **Rings, Covers, and Inflow Protection Devices**

Ferrous castings shall be of uniform quality, free from blow holes, shrinkage, distortions, and other strength defects. They shall be smooth and cleaned by shot blasting. Gray Iron used in the manufacture of castings shall conform to ASTM A 48 Class 35B; Ductile Iron casting shall conform to ASTM A 536.

All castings shall be manufactured true to pattern, component parts shall fit together in a satisfactory manner. Round frames and covers shall have machine bearing surfaces to prevent rocking and rattling. Frame and cover castings must meet the proof-load testing requirement of AASHTO M 306. Castings shall be customized for the City of League City and shall be manufactured and installed in accordance with the City of League City "Standard Details."

The mill test reports or manufacturer's certification to the EOR for each lot or shipment of steel and iron materials shall be provided to the office of the ~~Public Works Department~~Engineering Department. For castings, also furnish a manufacturer's certification stating that the casting meets the proof-load testing requirements of AASHTO M 306.

Inflow Disks shall be installed in ditch locations or as directed by ~~Public Works Department~~Engineering Department. Inflow protection devices and its associated valve body and components shall be manufactured from Stainless Steel suitable for atmospheres containing hydrogen sulphide and dilute sulfuric acid as well as other gasses associated with wastewater collection systems. The thickness shall not be less than 3/32" nor greater than 3/16. The gasket shall be made of closed cell neoprene and shall form a long lasting seal. The gas relief valve shall be designed at a pressure of one (1) pound. The valve shall

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be positioned so that it is protected and will not be broken by any movement of the cover. The inflow protection insert shall be manufactured to fit the manhole frame rim upon which the manhole cover rests.

507.8 Service Leads

All service leads shall be constructed per the City Detail. Sewer service leads shall be installed integrally with the construction of the sewer main, where possible, using "All Bell" gasket fittings. The minimum service connection shall be six (6) inches in diameter.

Direct taps on an existing PVC sewer main shall be made with a gasket PVC Saddle with stainless steel clamps, all bell Wye or Tee. Saddles shall be installed in accordance with manufacturer's recommendation. Holes for saddle connections shall be made by a mechanical hole cutter to conform to the fitting.

Risers or vertical stacks shall be required for service leads to sewer mains eight (8) feet and deeper. Connection fittings and pipe material shall be same as specified above.

Service taps into existing manholes shall be a minimum of 6-inches in diameter and be made by means of core cutting into the manhole with approved equipment. (Chipping into manhole will not be allowed.) The core cut shall be of sufficient size as to allow for 6-inch service line and approved gasket type (Link-Seal) sealing material. Upon passing inspection the core cut shall be grouted over with Quikrete or approved equal ~~non~~ shrink-non-shrink grout inside and out per ASTM C1107. On inside of manhole, all exposed cured grout and any concrete exposed from tap shall be coated with Bitumastic feathered out onto manhole wall a minimum of 6 inches from edge of core cut.

Service leads and all fittings shall be installed in strict conformance with the "Standard Details."

507.9 Lift Stations.

Design and construction of lift stations, pumps, and motor control units shall be in accordance with current TCEQ Criteria and City Policy. Application and materials shall be approved by the ~~Public Works Department~~ Engineering Department.

507.10 Steel Pipe and Fittings.

Steel carrier pipe and fittings shall be used for special installations only when approved by the Public Works Department.

Steel Casing shall be used for gravity and pressure sewer lines bored or jacked. Sewer service connections may omit casing when pipe material used is continuous, smooth wall,

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and without joints for the entire length of bore or jack. Metal liner plate shall be used for all tunneling.

507.10.1 Steel Carrier Pipe.

Pipe shall be provided in accordance with ITEM 407.13.1, "Steel Carrier Pipe."

507.10.2 Steel Casing Pipe.

Casing Pipe shall be provided in accordance with ITEM 407.13.2, "Steel Casing Pipe."

507.10.3 Metal Liner Plate.

Liner plate shall be provided in accordance with ITEM 407.13.3, "Metal Liner Plate."

507.10.4 Steel Pipe Fittings.

Fittings shall be provided in accordance with ITEM 407.13.4, "Steel Pipe Fittings."

507.10.5 Steel Pipe Flanges.

Flanges shall be provided in accordance with ITEM 407.13.5, "Steel Flanges."

507.10.6 Corrosion Protection.

Corrosion protection shall be provided in accordance with ITEM 407.13.6, "Corrosion Protection."

507.11 Pipe Bedding Material.

Where not otherwise specified or noted, all pipe bedding material shall be provided in accordance with ITEM 407.14.2 "Cement-Stabilized Sand."

507.12 Concrete.

Concrete shall be provided in accordance with ITEM 407.15, "Concrete."

ITEM 508 EXCAVATION

Excavation shall be provided in accordance with ITEM 408, "Excavation."

ITEM 509 PIPE LAYING

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All pipe shall be laid and maintained in the required lines and grades; with all appurtenances at the required locations.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. The interior of all pipe and accessories shall be kept free from dirt and foreign matter at all times, and stored in a manner that will protect them from damage.

During handling and placement, materials shall be carefully observed and inspected, and any damaged, defective, or unsound materials shall be rejected and removed from the job site. Damaged coating or lining shall be repaired in a manner satisfactory to manufacturer's requirements.

509.1 Trench Condition.

Trench condition shall be provided in accordance with ITEM 409.1, "Trench Condition."

509.2 Pipe Bedding and Embedment.

Except where otherwise approved by the Public Works Department, all pipe and appurtenances shall be installed in a continuous envelope of specified bedding material. Specified bedding material for sanitary sewer lines and appurtenances shall be cement stabilized sand (see ITEM 407.14.2, "Materials") per League City Detail. The bedding material required beneath the pipe shall be placed, graded and tamped to the pipe sub-grade profile over the entire width between undisturbed trench walls and cut-outs made for the projection of the pipe bells.

The pipe shall be placed and adjusted to proper grade on this prepared bedding, then jointed, braced and blocked, as required. After pipe is graded into place, bedding material shall be placed simultaneously on both sides of the pipe and worked carefully into place without disturbing the pipe alignment, to an elevation per League City Detail.

509.2.1 Wet Sand Construction

This ITEM shall include the following:

- A. If deemed necessary, timber sheeting and floorboards
- B. Washed crushed rock bedding (ASTM D2321 Class 1B bedding) or equal with filter fabric wrap.

All ITEMs (A&B) must be approved by the EOR and the Owner and constructed per the City of League City Details.

The use of wet sand construction shall be strictly controlled by the EOR and shall be performed only when authorized in writing by the EOR. Payment will be based on the measured linear footage at the unit price bid.

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If wet sand is found in the field use wet sand bedding per League City Details. Wet Sand Manholes shall have support as per League City Details.

509.3 Assembling Pipe.

Assembling pipe shall be provided in accordance to ITEM 409.3, "Assembling Pipe."

ITEM 510 BACKFILL AND SETTLEMENT

Backfill and settlement shall be provided in accordance with ITEM 410, "Backfill and Settlement."

ITEM 511 LOW PRESSURE AIR TEST

After the gravity sanitary sewer line has been installed, backfilled, and all service connections (if required) and other appurtenances installed, connected and adjusted, and all surface pavement, lot grading and other related construction activities are complete within the areas of line to be accepted, a ~~low-pressure~~low-pressure air test will be conducted by the contractor and monitored by the City. The ~~low-pressure~~low-pressure air test shall be provided in accordance with UNI-B-6-85. Included in these standards are requirements for equipment accuracy, safety precautions, line preparations, test method, and minimum holding times.

The specified minimum time required for a 1.0 psi pressure drop will be in accordance to UNI-B-6-85 (Table I).

All manholes must pass a leakage test. All manholes must be tested (after assembly and backfilling) for leakage, separate and independent of the collection system pipes, by vacuum testing, or other method approved by the Public Works Department.

Vacuum testing of manholes shall be provided in accordance with TCEQ Rule 217.58.

ITEM 512 VISUAL TEST

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All sanitary sewer lines shall be inspected visually to verify accuracy of alignment and freedom from debris and obstruction.

The total footage of lines 36 inches and smaller diameter shall be inspected with television equipment. All lines shall be cleaned and low-pressure air tested before any camera work begins.

Any pipe settlement which causes excess ponding of water in pipeline, any miss-aligned joints, or other defects; shall be cause for rejection.

The developer is responsible for the TV inspection of newly constructed sanitary sewer lines. The TV inspection shall take place after the ~~low-pressure~~low-pressure testing has been completed, but before the final walk-through inspection is performed

Personnel from the City's Line Repair Department or the City's Engineering Department shall witness the TV inspection, which shall be performed during the City's normal working hours.

The method for the inspection shall include:

1. Cleaning the lines, (if not already cleaned);
2. Removing downstream plugs, if any;
3. Introduction of several hundred gallons of clean water into the extreme upstream manhole(s) of the system;
4. Allowing adequate time for the water to flow completely through the system; and
5. Videotaping the system.

The developer shall provide the City with one copy of the TV videotape and one copy of the TV inspection report. For each segment the video tape and corresponding written report shall clearly identify.

1. Each line segment being inspected;
2. The size and type of pipe being inspected;
3. Accurate footage of the line segment inspected;
4. Deficiencies in materials, alignment, pipe shape, grade, or any other apparent deficiencies; and
5. Locations of all service connections.

Deflection testing of the gravity sewer line shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5.0%. The deflection test shall be conducted using a rigid mandrel having an outside diameter equal to 95% of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices.

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HYDROSTATIC TESTING

All pressure sanitary sewer lines shall be tested in accordance with ITEM 411, "Hydrostatic Testing," with the following exceptions:

The leakage test shall be at a pressure of 1.5 times greater than the maximum head pressure of the pumps operating the system, but in no instance less than 50 psi.

The contractor will be responsible for filling and flushing the line by a means approved by the Public Works Department.

ITEM 514

MAIN CONNECTIONS TO THE EXISTING SYSTEM

Unless otherwise approved by the Public Works Department, all connections of a sewer main made to existing sewer mains shall be made at manholes, either existing or constructed by developers, with the crown of the inlet pipe being installed at the same elevation as the crown of the existing pipe. Extreme care shall be exercised to prevent material from depositing in the existing pipe as the taps are being made.

When connections to existing mains are made, a temporary plug, that is a type approved by the Public Works Department, must be installed in the manhole to prevent water and debris from the construction activity from entering the existing system before final acceptance. These plugs shall not be removed prior to final acceptance. After final acceptance of the work, the contractor shall remove these plugs immediately.

When required by Public Works Department all multiple taps and tie-ins to an existing sewer system shall be tested in accordance with the League City Specifications.

ITEM 515

CLEAN UP AND RESTORATION

Clean up and restoration shall be provided in accordance with ITEM 414, "Clean Up and Restoration."

ITEM 516

APPROVAL AND ACCEPTANCE

Approval and acceptance shall be provided in accordance with ITEM 415, "Approval and Acceptance."

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ITEM 517 WARRANTY OF WORK

Warranty of work shall be provided in accordance with ITEM 416, "Warranty of Work."

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SPECIFICATION FOR STREET PROJECTS

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ITEM 601 GENERAL

Standards established by the City of League City for the design and construction of its streets shall provide for pavements with long service life and low maintenance. Excess maintenance of inadequate pavements is an unnecessary drain on tax dollars. An investment in adequately designed and constructed streets needing little maintenance over a long service life frees more dollars for capital improvements necessary to serve the community.

Pavements are designed for both economy and long service. The EOR shall take into consideration the street classification and traffic which will include the axle weights and volumes, thickness design, surface material quality, base material quality, sub-grade material quality, geometric design, and jointing.

Standards of this publication shall be considered minimum for any specific location and the EOR should base his design upon the actual conditions which exist within the development under consideration for design.

Provisions must be made for the un-interrupted extension of main thoroughfares as shown on the major street plan for the City. Streets must provide for free circulation within developments and interconnectivity to adjacent developments.

ITEM 602 GEOMETRIC DESIGN

A street is a public way for purposes of vehicular travel including public transit and refers to and includes the entire area within the right-of-way. The street also serves pedestrian and bicycle traffic and usually accommodates public utility facilities within the right-of-way. The improvement or development of streets shall be based on the street classification that is part of a comprehensive community development plan for League City. The design values shall be those for the ultimate planned development.

All streets shall be designed with a thorough understanding of the capabilities of the vehicle-driver system and a sound knowledge of traffic engineering principles.

For balance in street design, all geometric elements shall, as far as economically feasible, be determined to provide safe, continuous operation at a speed likely under the general conditions for that streets classification.

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602.1 Residential Street. (SEE STREET AND ROAD MATRIX)

Residential streets primarily are land service streets in residential subdivisions. Traffic generally consists of vehicles serving the homes plus an occasional heavy truck. Traffic volumes range from less than 200 to 700 vehicles per day with 1% to 2% heavy commercial traffic. Trucks using these streets have a maximum tandem-axle load of 36 kips and 20 kips maximum single axle load.

602.1.1 Pavement Type.

Urban residential streets shall be provided with a standard curb, gutter and storm sewer design. These streets shall consist of a pavement composed of Portland Cement concrete constructed on a prepared sub-grade. The concrete pavement shall have a minimum thickness of six inches (6") and constructed in accordance with ITEM 606 "Concrete Pavement". The prepared sub-grade shall have a minimum thickness of six inches (6") and constructed in accordance with ITEM 604, Sub-grade, Sub-base and Base courses".

602.1.2 Pavement Width.

On residential streets in areas where the primary function is to provide land service and foster a safe and pleasant environment, at least one unobstructed moving lane must be ensured even where parking occurs on both sides. The level of user inconvenience occasioned by the lack of two moving lanes is remarkably low in areas where single-family units prevail. Residential streets shall have a minimum pavement width of twenty-eight feet (28'). This back-of-curb to back-of-curb width provides for 8 feet parking lanes. Opposing conflicting traffic will yield until there is sufficient width to pass.

602.1.3 Right-of-Way Width.

The Right-of-way width shall be sufficient to accommodate the ultimate planned roadway including median (if used), sidewalks, utility strips in the border areas, and necessary drainage facilities. The minimum right-of-way width for residential streets shall be sixty feet (60'). Additional easements adjacent to the right-of-way may be required for multiple utility installations.

602.1.4 Cul-de-Sacs and Turnarounds.

A residential street that is designed to leave one end permanently closed shall not exceed 880 feet in length and shall be provided at the closed end with a turnaround. Length shall be measured from the centerline of the adjoining street to the center of the cul-de-sac bulb. The surface portion of the turnaround shall have a minimum diameter of eighty feet (80'). The minimum right-of-way shall exceed the turnaround diameter by twenty feet (20') to provide at least a ten-foot (10') border area adjacent to the street.

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602.1.5 Design Speed.

Design speed is not a major factor for residential streets. For consistency in design elements, a design speed of 25 MPH shall be used.

602.1.6 Sight Distance.

Minimum stopping distance should be 155 feet. Passing sight distance is not applicable. Corner intersection sight distance should comply with ITEM 805 – Intersection Sight Distance of this manual.

602.1.7 Intersection Design.

Intersections, including median openings, shall be designed with adequate corner sight distance, and the intersection area shall be kept free of obstacles. Any landscaping in the sight distance triangle shall be low-growing, and shall not be higher than three feet (3') above the level of the intersecting street pavements.

The intersecting streets should meet at approximately a ~~90-degree~~90-degree angle, but in no case less than a ~~75-degree~~75-degree angle. The maximum lengths between intersections shall be 1200 feet, except cul-de-sac street shall be 880 feet. At street intersections, the minimum radius of curb returns shall be twenty-five feet (25').

602.1.8 Horizontal Alignment.

There is an advantage in residential areas in purposely arranging the alignment to discourage through traffic. The alignment design shall be such that the safety of the facility is not reduced. Street curves should be designed with as large a radius curve as feasible; the minimum center line radius on simple or compound curves being 160 feet, the minimum centerline radius on reverse curves being 300 feet with a minimum tangent length of 100 feet. Streets designed with less than the minimum curve radius shall include a bubble type intersection with a minimum surface radius of forty feet (40').

602.1.9 Grades.

Grades for residential streets should be as flat as is consistent with the surrounding terrain. The gradient should be less than 15 percent. Where grades of 4 percent or steeper are necessary, the drainage and erosion control designs shall become critical. Vertical curves shall be installed when algebraic differences in grade exceeds 1 percent.

To provide for proper drainage, the minimum grade that shall be used for streets with outer curbs is 0.25 percent, with a minimum 1 percent fall around curb return radius at intersections with a ~~twenty-five foot~~twenty-five-foot (25') radius. Grades for larger radius shall be determined on an individual basis. The minimum grade for a cul-de-sac street with

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a ~~forty foot~~forty-foot (40') curb radius shall be 0.60 percent along the gutter. A minimum gradient of 0.40 percent around the longest radius is required on an L-type street intersection. Drainage across street intersections by means of "valley" Gutters shall be prohibited.

602.1.10 Pavement Crown.

Pavement cross slope shall provide proper drainage. The amount of cross slope over the pavement section shall be a minimum of one-half inch (1/2") per foot from the curb line to quarter point, and three-eighth inch (3/8") from quarter point to centerline.

602.1.11 Drainage.

Surface sheet flows are usually intercepted by the street section of curb and gutter and conveyed to appropriate outlets, for urban streets, the flow is transferred at frequent intervals from the street cross section by curb-opening inlets to basins and from there by storm sewer conduit to major outfalls. To avoid undesirable flow line conditions, the minimum gutter grade shall be as specified in ITEM 602.1.8 "Grades."

Inlets shall be located in such a manner that storm water is not carried more than 300 feet along the curb line from the high point of a gutter to an inlet opening. Inlets should be placed away from collector streets or arterial streets and on the side streets at street intersections. An attempt should be made to place the proposed inlets away from the esplanade openings and out of major intersections. No inlets or grates shall be placed within residential driveways. Storm sewers and inlets shall be provided in accordance to ITEM 703.1.11 "Closed Conduit Systems".

602.1.12 Border Area.

The border between the roadway and the right-of-way line shall be wide enough to serve several purposes; including provisions of a buffer space between pedestrians and vehicular traffic, sidewalk space, and an area for placement of utilities. The roadway shall be centered within the designated right-of-way and the border area sloped from the property line to the top of the curb at a minimum grade of three-eighth's inch (3/8") per foot.

602.1.13 Sidewalks.

In residential areas, sidewalks shall be constructed on both sides of the street. The sidewalks shall be located as far as practical from the traffic lanes and usually close to the right-of-way lines. Clear sidewalk width shall be four-foot (4') minimum. Curb-cut ramps shall be provided at cross walks to accommodate physically handicapped persons. Sidewalks and curb-cut ramps shall be provided in accordance with ITEM 806 – Pedestrian Facilities (Sidewalks and Wheel Chair Ramps).

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602.1.14 Driveways.

A driveway is an access constructed within the public way, connecting the public roadway with adjacent property and intended to be used in such a way that access into the adjacent property will be complete and will not cause the blocking of any sidewalk border area or street roadway. Driveways shall be constructed in accordance with ITEM 801 – Access Management Standards and League City "Standard Details".

602.1.15 Street and Roadway Lighting.

Good visibility under day or night conditions is one of the fundamental requirements enabling motorists to move on roadways in a safe and coordinated manner. Properly designed street lighting shall produce comfortable and accurate visibility at night, which will facilitate and encourage both vehicular and pedestrian traffic. Street lights shall be provided at a maximum spacing of five-hundred feet along residential streets. Street lights shall be located at street intersections. Installation shall be per AASHTO's "Roadway Lighting Design Guidelines" (latest edition).

602.1.16 Traffic Control Devices.

Consistent and uniform application of traffic control devices is important. Details of the standard devices and warrants for many conditions are found in the Texas Manual on Uniform Traffic Control Devices. Geometric design of streets shall include full consideration of the types of traffic control to be used. Multi-way stops will require a multi-way stop warrant study. Design per AASHTO's ~~"Guidelines"~~ "Guidelines" for Geometric Design of Very Low Volume Local Roads".

602.2 Local Streets. (SEE STREET AND ROAD MATRIX)

Local streets primarily serve as access to farms, residences or other abutting property not planned as urban style development. Because of the relatively low traffic volumes, design standards are of a comparatively low order as a matter of practicality. However, to provide the requisite traffic mobility and safety, together with the essential economy in construction, maintenance, and operation, they must be planned, located and designed to be suitable for predictable traffic operations and must be consistent with the development abutting the right-of-way.

602.2.1 Pavement Type.

Local streets shall be provided with a curb, gutter and storm sewer design, or an open drainage ditch design with appropriate right-of-way dedication. These streets shall consist of a pavement composed of Portland cement concrete constructed on a prepared sub-grade, or a hot mix asphaltic concrete constructed on a prepared sub-base and sub-grade.

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The concrete pavement shall have a minimum thickness of six-inches (6") and constructed in accordance with ITEM 605 "Concrete Pavement".

The hot mix asphaltic concrete pavement shall have a minimum thickness of two-inches (2") and constructed in accordance with ITEM 606 "Hot Mix Asphaltic Concrete Pavement". The prepared sub-base shall have a minimum thickness of eight-inches (8") and constructed in accordance with ITEM 604 "Sub-grade, Sub-base and Base Courses". The prepared sub-grade shall have a minimum thickness of six-inches (6") and constructed in accordance with ITEM 604 "Sub-grade, Sub-base and Base courses".

602.2.2 Pavement Width.

Two travel lanes usually can accommodate the normal traffic volumes on local roads. Streets that are planned with a curb, gutter and storm sewer design shall be provided in accordance with ITEM 602.1 "Residential Streets". Streets that are planned with an open ditch design shall be provided with a minimum pavement width of twenty-four feet (24'). ~~Two-foot~~Two-foot (2') roadway shoulders shall be constructed adjacent to all pavement edges that are not curbed.

602.2.3 Right-of-Way Width.

The right-of-way width shall be sufficient to accommodate the ultimate planned roadway including median (if used), sidewalks (if required), utility strips in the border areas, roadway shoulders, necessary drainage facilities and outer slopes.

The minimum right-of-way width for rural local streets with a curb, gutter and storm sewer design shall be sixty feet (60'). The minimum right-of-way width for streets with an open ditch drainage design shall be determined by the open ditch drainage requirement, but in no case, less than seventy feet (70'). Additional easements adjacent to the right-of-way may be required for multiple utility installations.

602.2.4 Cul-de-Sacs and Turnarounds.

Cul-de-sacs and turnarounds for rural local streets shall be provided in accordance with ITEM 602.1.4 "Cul-de-sacs and Turnarounds".

602.2.5 Design Speed.

Geometric design features should be consistent with a design speed selected as appropriate for environmental and terrain conditions. A design speed of 25 mph is generally applicable to roads in level terrain and where expected traffic volumes warrant rural local road classification.

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602.2.6 Sight Distance.

Sight distance for rural local roads shall be provided in accordance with ITEM 805 – Intersection Sight Distance of this manual.

602.2.7 Intersection Design.

Intersection design for rural local roads shall be provided in accordance with ITEM 602.1.7 "Intersection Design".

602.2.8 Horizontal Alignment.

Horizontal alignment shall be provided in accordance with ITEM 602.1.8 "Horizontal Alignment".

602.2.9 Roadside Shoulders.

A shoulder is the portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use and for lateral support of sub-base and surface pavement. Roadway shoulders shall be constructed adjacent to all pavement edges that are not curbed.

Shoulders shall be surfaced to provide a better all-weather load support than that afforded by the native soil. Materials used to surface shoulders include gravel, shell, crushed rock, mineral or chemical additives, bituminous surface treatments, and various forms of asphaltic or concrete pavements.

Shoulders are important links in the lateral drainage systems. Shoulders shall be flush with the roadway surface and abut the edge of the travel lane. Shoulders shall provide an adequate cross slope for drainage of the roadway.

602.2.10 Pavement Crown.

Surface cross slope must be provided to ensure drainage. Roads of this type shall be out slope graded toward the curb or open ditch. The amount of cross slope shall be one-half inch (1/2") per foot from edge of pavement to centerline. The cross slope on roadside shoulders shall be three-quarter inch (3/4") per foot.

602.2.11 Roadside Slopes.

Back-slopes, fore-slopes and roadside ditches shall have gentle well-rounded transition. Roadside ditches shall provide for a fore-slope of 3:1 or flatter. Flat Fore-slopes increase safety by providing maneuvering area in emergencies, are more stable than steep slopes, aid

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in establishment of plant growth, and simplify maintenance work. Back-slopes of roadside ditches shall be 3:1 or flatter to make it easier for motorized equipment to be used in maintenance.

602.2.12 Grades.

Grades for rural local roads should be as flat as is consistent with the surrounding terrain. The maximum gradient for roadways without curbs shall be less than 7 percent. Where grades of 4 percent or steeper are necessary, the drainage and erosion control design shall become critical. Vertical curves shall be installed when algebraic differences in grade exceeds 1 percent. Grades for curb, gutter, and storm sewer designs shall be provided in accordance with ITEM 602.1.9 "Grades".

602.2.13 Drainage.

Roadside drainage channels perform the vital function of collecting and conveying surface sheet flows from the roadway and adjacent property. Roadside drainage channels, therefore, shall have capacity for the design run-off, shall provide for unusual storm water without saturation of the pavement subgrade, and shall be located and shaped to avoid hazard to traffic. The channel grade does not have to follow that of the road bed. The minimum grade shall be 0.10 percent.

Drainage for roadways with outer curbs shall be provided in accordance with ITEM 602.1.11 "Drainage".

602.2.14 Border Area.

The border between the roadway and the right-of-way line shall be wide enough to serve several purposes; including drainage maintenance and an area for placement of underground utilities and possible overhead utilities.

The roadway shall be centered within the designated right-of-way and the border area constructed in a stable and easily maintained state.

602.2.15 Driveways.

Driveways shall be provided in accordance with ITEM 602.1.14 "Driveways".

602.2.16 Traffic Control Devices.

Traffic control devices shall be provided in accordance with ITEM 602.1.16 "Traffic Control Devices".

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602.3 Collector Streets. (SEE STREET AND ROAD MATRIX)

The collector street is intended to serve the collection function for a group of access roads and ideally not the immediate access needs of individual residences. However, the collector street does serve the access function for higher density residential development and for some neighborhood facilities.

602.3.1 Pavement Type.

Collector streets shall be provided with a standard curb, gutter and storm sewer design. These streets shall consist of a pavement composed of portland cement concrete constructed on a prepared sub-grade. The concrete pavement shall have a minimum thickness of seven - inches (7") and constructed in accordance with ITEM 605 "Concrete Pavements". The prepared sub-grade shall have a minimum thickness of six-inches (6") and constructed in accordance with ITEM 604 "Sub-grades, Sub-based, and Base courses".

602.3.2 Pavement Width.

Two moving traffic lanes plus additional width for parking are sufficient for most collector streets. Collector streets may be designed with two divided one-way roadways or a single two-way roadway. A median separating the two opposing traffic lanes is a highly desirable element in planned ~~high-density~~ high-density areas.

Divided one-way roadways design shall provide for two ~~25-foot~~ 25-foot width roadways. This back-of-curb to back-of-curb width shall provide for two ~~12-foot~~ 12-foot width traffic lanes and two 12 foot parking lanes, allowing parking on the outer two lanes until development necessitates use of all four lanes for moving traffic. Collector streets with two divided one-way roadway designs may be constructed in stages with development when approved by the Public Works Department.

A single two-way roadway shall include two ~~12-foot~~ 12-foot width traffic lanes. Parallel parking lanes from 9 to ~~10-foot~~ 10-foot width shall be provided on both sides of traffic lanes. This back-of-curb to back-of-curb width will vary from 42 to 44 feet as the conditions and intensity of development may require.

602.3.3 Median.

A median is defined as the portion of a divided street separating the traveled way for traffic in opposing directions. The median width is expressed as the dimension between the through-lane edges. For maximum efficiency, a median should be highly visible both night and day and in definite contrast to the through-traffic lanes. Medians should be as wide as feasible but of a dimension in balance with other components of the cross section. Medians

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with grass shall be of raised curb and gutter design while turning lane medians shall be flush with the pavement surface.

For collector streets median treatment shall comply with ITEM 807 – Median Design of this manual. A continuous left-turn lane, flush with the adjoining traffic lanes and painted, may be an acceptable approach, with approval from the Public Works Department.

On collector streets with raised median, openings shall be designed in accordance with ITEM 807 of this manual. Median openings shall be designed to include left turn lanes as needed and designed per ITEM 801 of this manual.

Openings must have adequate sight distance and the design shall comply with ITEM 807 of this manual.

602.3.4 Right-of-Way Width.

The right-of-way width shall be sufficient to accommodate the ultimate planned roadway, including median (if used) sidewalks, utility strips in the border areas, and necessary drainage facilities. The minimum right-of-way width for collector streets with two divided one-way roadway designs shall be ninety feet (90'). The minimum right-of-way width for collector streets with one single two-way roadway designs shall be eighty feet (80'). Any collector street designed with open ditches shall require an additional ten feet (10') of right-of-way dedication. Additional easements adjacent to the right-of-way may be required for multiple utility installations.

602.3.5 Cul-de-Sacs and Turnarounds.

A collector street shall terminate at a residential street and/or a minor/major arterial.

602.3.6 Design Speed.

Design speed is a factor in the design of collector streets. For consistency in design elements a minimum design speed of 35 MPH shall be used for collector streets. In the typical street grid, the closely spaced intersections usually limit vehicular speeds and thus make the effect of design speed of lesser significance. The longer sight distance and curve radius commensurate with design speeds higher than the value indicated result in safer streets and shall be used.

602.3.7 Sight Distance.

Stopping sight distance for collector streets shall be 250 feet. Design for passing sight distance seldom is applicable on collector streets. Intersection corner sight distance shall comply with ITEM 805 of this manual.

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602.3.8 Intersection Design.

Intersections, including median opening, shall be designed with proper corner sight distance, and the intersection area shall be kept free of obstacles. Where predicted turning volumes may be significant, speed-change lanes and channelization shall be incorporated into the intersection design. The intersection streets should meet at approximately a ~~90 degree~~90-degree angle, but in no case less than a ~~75-degree~~75-degree angle. The maximum lengths between street intersections shall be 1200 feet with a minimum spacing of 300 feet. Intersections should be designed with a corner radius for pavement adequate for larger vehicles anticipated; a minimum radius of curb returns shall be thirty feet (30').

602.3.9 Horizontal Alignment.

The designer shall strive for as high a standard as practical for collector alignments. Horizontal and vertical alignments must complement each other and be considered in combination. Caution that the safety of the facility is not reduced should be taken in the design. Street curves should be designed with as large a radius curve as feasible; the minimum centerline radius being 500 feet and a minimum tangent length in reverse curves of 100 feet.

602.3.10 Grades.

Grades for collector streets should be as level as consistent with the surrounding terrain. A 0.30 percent grade is acceptable to facilitate drainage, however, it is recommended to use 0.50 percent grade or more, when possible, for drainage purposes. Street grades are depressed below the surrounding terrain to accommodate adjacent property sheet drainage to the curb area and accumulation in the storm drainage system. Vertical curves shall be installed when algebraic differences in grades exceed 1 percent. Vertical curves shall meet the sight distance criteria for the design speed.

602.3.11 Pavement Crown.

Pavement cross slope shall provide proper drainage. Each pavement of a divided street shall be sloped to drain to the outer curb. Normally, parabolic sections are used for single two-way streets, and plane sections are used for divided streets. The amount of cross slope over a single two-way street shall be three percent (3%) from the curb line to quarter point, and two percent (2%) from quarter point to center line. Pavements on divided collectors shall have a normal cross slope of two percent (2%). On an auxiliary lane, normally the cross slope should not exceed 2 percent on outer lanes and 1 percent on inner left turn lanes.

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602.3.12 Drainage.

Drainage for collector streets shall be provided in accordance with ITEM 602.1.11 "Drainage" with the following exception: The gutter grade shall be as specified in ITEM 602.3.10 "Grades".

602.3.13 Border Area.

The border areas between the roadway and the right-of-way line shall be wide enough to serve several purposes including provisions of a buffer space between pedestrians and vehicular traffic, sidewalk space, and an area for both underground and above ground utilities, such as traffic signals and fire hydrants. The roadway shall be centered within the designated right-of-way and the border areas sloped from the property line to the top of the curb at a minimum grade of three-eighths inch (3/8") per foot. Traffic signals, utility poles, fire hydrants, and other utilities shall be placed as far back of the curb as practical for safety reasons. Breakaway features should be built into structures when feasible and as an aid for safety considerations.

602.3.14 Sidewalks.

On Collector Streets, sidewalks ~~may be~~ constructed on both sides of the street. The sidewalks shall be located as far as practical from the traffic lanes and usually close to the right-of-way lines. Clear sidewalk width shall be ~~five feet~~ five-foot (5') minimum. ~~In case of, sidewalk constructed on one side of street only, width shall be a minimum of eight feet (8').~~ Curb-cut ramps shall be provided at cross walks to accommodate physically handicapped persons. Sidewalks and curb-cut ramps shall be provided in accordance with ITEM 806 – Pedestrian Facilities (Sidewalks and Wheel Chair Ramps).

602.3.15 Driveways.

Driveways for collector streets shall be ~~limited to commercial property as~~ provided in accordance with ITEM 602.1.14, "Driveways".

602.3.16 Street and Roadway Lighting.

Street lights shall be provided at all intersections with other roadways and at appropriate spaced intervals as determined by the Public Works Department. Design shall be per AASHTO's "Roadway Lighting Design Guide" (latest edition).

602.3.17 Traffic Control Devices.

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Traffic control devices shall be applied consistently and uniformly. Details of the standard devices and warrants for many conditions are found in the TMUTCD. Geometric design of streets shall include full consideration of the types of traffic control to be used, especially at intersections where multiple phases of actuated traffic signals are likely to be needed. Traffic signals are a major element in the design of major collector street intersections. Successful operations of a collector street depend largely on proper pavement markings. Pavement markings shall be provided in accordance to the TMUTCD.

602.4 Omitted

602.5 Minor Arterial Streets. (SEE STREET AND ROAD MATRIX)

The design of minor arterials covers from two-lane to multi-lane roads. Minor arterial streets bring traffic to and from major arterial streets and expressways, and serve major movements of traffic within and through and urban area. Traffic volumes vary from 3000 to 7000 vehicles per day with 5% to 7% heavy commercial traffic. Trucks using these streets have a maximum tandem axle load of 46 kips and a ~~35-dip~~35-dip maximum single-axle load. The principle characteristic of the arterial should be mobility with limited or restricted service to local development.

602.5.1 Pavement Type.

Urban arterial streets shall be provided with a standard curb, gutter and storm sewer design. These streets shall consist of a pavement composed of Portland Cement concrete constructed on a prepared sub-grade. The concrete pavement shall have a minimum thickness of eight-inches (8") and constructed in accordance with ITEM 605, "Concrete Pavements". The prepared sub-grade shall have a minimum thickness of six-inches (6") and constructed in accordance with ITEM 604, "Sub-grades".

602.5.2 Pavement Width.

A minimum of four moving traffic lanes ~~are~~is required to handle the capacity of urban minor arterials. Pavements shall be widened through intersections by the addition of one or two lanes to accommodate turning vehicles. Parking on an arterial street should only be considered when provision is required because of existing conditions. Medians shall be provided for all minor arterial streets. The divided one-way roadways design shall provide for two twenty-five feet (25') width roadways. This back-of-curb to back-of-curb width shall provide for two twelve-foot (12') travel lanes in each direction.

602.5.3 Medians.

Medians for urban minor arterial streets shall be provided in accordance with ITEM 602.3.3 "Medians".

602.5.4 Right-of-Way Width.

The width of right-of-way for the complete development of an arterial street is influenced by traffic requirements, intersection design, and extent of ultimate expansion. The required width of right-of-way is the summation of the various cross-sectional elements - through pavements, median, auxiliary lanes, and borders. Every opportunity shall be taken to provide the required width along all of the facility. The minimum right-of-way width for minor arterials shall be one-hundred feet (100'). Additional easements adjacent to the right-of-way shall be required for utility installations.

602.5.5 Design Speed.

A design speed for minor urban arterial streets generally range from 40 to 50 mph. The lower (40 mph and below) speeds apply in built-up areas or under particularly restricted conditions in suburban areas. A high speed (50 mph or above) is appropriate in outlying sections approaching rural conditions.

602.5.6 Sight Distance.

The provision of adequate sight distance is important in urban minor arterial design. Stopping sight distance shall be in the range from 305 to 425 feet. Stopping sight distance is based upon posted speed and AASHTO guidelines. Design for passing sight distance seldom is applicable on urban minor arterials with two divided one-way roadways. Intersection corner sight distance shall comply with ITEM 805 of this manual.

602.5.7 Intersection Design.

Each individual intersection shall be carefully evaluated by a traffic engineer to determine the best design to handle the expected traffic volumes and adjacent developments. Intersections shall be designed with a minimum edge corner radius of 50 feet. Where expected turning volumes are significant, speed change lanes and channelization shall be considered. Turn lane design shall comply with ITEM 801 of this manual. Intersection legs that will operate under stop sign or signal control shall be at right angles. Where necessary, cut slopes should be flattened, and horizontal or vertical curves shall be lengthened to provide additional sight distance.

602.5.8 Horizontal Alignment.

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Alignment of the minor arterial is ideally developed strictly with the design speed selected. It is desirable to use the highest alignment design possible with a minimum centerline radius being 800 feet and a minimum tangent length in reverse curves of 100 feet.

602.5.9 Grades.

Grades for minor arterial streets shall be provided in accordance with ITEM 602.3.10, "Grades".

602.5.10 Pavement Crown.

Each pavement of a divided arterial shall be sloped to drain to the outer edge. Pavement should have a normal cross slope of 2 percent. On auxiliary lanes, the cross slope should not exceed 2 percent on outer lanes and 1 percent on inner left turn lanes.

602.5.11 Drainage.

A drainage system to accommodate design run-off shall be included in the design of every arterial street. Street flows from adjacent property that is intercepted by the street section of curb and gutter shall be limited to a property depth of 150' along and adjacent to the right-of-way. For urban streets, the flow is transferred at frequent intervals from the street cross section by curb-opening inlets to basins and from there by storm sewer conduit to major outfalls. To avoid undesirable flow-line conditions, the minimum gutter grade shall be 0.30 percent, it is recommended to use 0.50 percent grade or more, when possible, for better drainage purposes. Inlets shall be located in such a manner that storm water is not carried more than 300 feet along the curb line from the high point of a gutter to an inlet opening. Inlets should be placed away from arterial streets, on side streets, at intersections. Storm sewers and inlets shall be provided in accordance with ITEM 703, "Closed Conduit System".

602.5.12 Border Area.

Border areas for minor arterials shall be provided in accordance with ITEM 602.3.13, "Border Area".

602.5.13 Sidewalks.

Sidewalks for urban minor arterials shall be provided in accordance with ITEM 602.3.14, "Sidewalks".

602.5.14 Access Control.

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Control of access is highly desirable on an arterial facility. This provision will not only enhance its initial service capability but will also preserve the original level of service. While service may be required to abutting property, it shall be carefully regulated to limit the number of points and their locations. Access control is especially needed in areas approaching intersections where auxiliary and storage lanes may be required. Access to arterial streets shall be permitted only where minimum spacing standards are met. The spacing standards are the minimum distance between access points on the same side of the road. To ensure a safe balance between access and traffic mobility, these standards vary depending on the nature of the access point. Residential driveways shall not be designed for access to arterial streets. Commercial driveways shall be allowed access to arterial and shall comply with ITEM 801 of this manual.

602.5.15 Lighting.

Lighting is very important to safe operation of an urban arterial. The higher volumes and speeds require the driver to make correct decisions with adequate time to make the proper maneuvers without creating undue conflict in the traffic lanes. A safely designed lighting system is more important to optimum operation of an urban arterial than any other city street. The lighting shall be continuous and an energy-saving type. Design shall be per AASHTO's "Roadway Lighting Design Guide".

602.5.16 Traffic Control Devices.

Traffic control devices such as signs, markings, signals, and islands are placed on or adjacent to a street to regulate, warn, or guide traffic. Each device is designed to fulfill a specific need with regard to traffic operation, control, or safety. The need for traffic control devices shall be determined by an engineering study made in conjunction with the geometric design of the street. The TMUTCD shall be used to ensure standard design and uniform application of the various traffic control devices.

Traffic signal design shall comply with ITEM 803 of this manual.

Successful operation of an arterial street depends largely on proper pavement marking. Recent development in products for pavement markings shows considerable promise in providing adequate long-life marking. Pavement markings shall be provided in accordance to the TMUTCD and the "Standard Details".

602.6 Omitted.

602.7 Major Arterials.

The major arterial system serves the major centers of activity, the highest traffic volume corridors, and longest trip desires and carries a high proportion of the total city area travel on a minimum of mileage. The system should be integrated both internally and between

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major rural connections. The major arterial system carries most of the trips entering and leaving the city, as well as most of the through movements by passing the central city. In addition, significant intra-area travels, such as between central business districts and outlying residential areas, between major inner-city communities and between major suburban centers, is served by this class of facility.

The design of major arterials covers a broad range of roadways, from four-lane to six-lane, and is the most difficult class of roadway design because of the need to provide a high standard of operation. The designer must be thoroughly familiar with the standards established by the American Association of State Highway and Transportation Officials in order to skillfully blend the various geometric aspects into a functional network. All major arterials shall be provided in accordance with the requirements of the Texas State Department of Highways and Public Transportation.

602.7.1 Pavement Type.

Urban arterial streets shall be provided with a standard curb, gutter and storm sewer design. These streets shall consist of a pavement composed of Portland Cement concrete constructed on a prepared sub-grade. The concrete pavement shall have a minimum thickness of eight-inches (8") and constructed in accordance with ITEM 605, "Concrete Pavements". The prepared sub-grade shall have a minimum thickness of six-inches (6") and constructed in accordance with ITEM 604, "Sub-grades".

602.7.2 Pavement Width.

A minimum of four moving traffic lanes ~~are~~^{is} required to handle the capacity of urban major arterials. Pavements shall be widened through intersections by the addition of one or two lanes to accommodate turning vehicles. Medians shall be provided for all major arterial streets. The divided one-way roadways design shall provide for two ~~twenty-five foot~~^{twenty-five-foot} (25') width roadways. This back-of-curb to back-of-curb width shall provide for two twelve-foot (12') travel lanes in each direction.

602.7.3 Medians.

Medians for major arterial streets shall be provided in accordance with ITEM 602.3.3 "Medians".

602.7.4 Right-of-Way Width.

The width of right-of-way for the complete development of an arterial street is influenced by traffic requirements, intersection design, and extent of ultimate expansion. The required width of right-of-way is the summation of the various cross-sectional elements - through pavements, median, auxiliary lanes, and borders. Every opportunity shall be taken to provide the required width along all of the facility. The minimum right-of-way width for

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major arterials shall be one-hundred feet and twenty (120'). Additional easements adjacent to the right-of-way shall be required for utility installations.

602.7.5 Design Speed.

A design speed for major arterial streets generally range from 40 to 50 mph. The lower (40 mph and below) speeds apply in built-up areas or under particularly restricted conditions in suburban areas. A high speed (50 mph or above) is appropriate in outlying sections approaching rural conditions.

602.7.6 Sight Distance.

The provision of adequate sight distance is important in urban minor arterial design. Stopping sight distance shall be in the range from 305 to 425 feet. Stopping sight distance is based upon posted speed and AASHTO guidelines. Design for passing sight distance seldom is applicable on urban minor arterials with two divided one-way roadways. Intersection corner sight distance shall comply with ITEM 805 of this manual.

602.7.7 Intersection Design.

Each individual intersection shall be carefully evaluated by a traffic engineer to determine the best design to handle the expected traffic volumes and adjacent developments. Intersections shall be designed with a minimum edge corner radius of 50 feet. Where expected turning volumes are significant, speed change lanes and channelization shall be considered. Turn lane design shall comply with ITEM 801 of this manual. Intersection legs that will operate under stop sign or signal control shall be at right angles. Where necessary, cut slopes should be flattened, and horizontal or vertical curves shall be lengthened to provide additional sight distance.

602.7.8 Horizontal Alignment.

Alignment of the major arterial is ideally developed strictly with the design speed selected. It is desirable to use the highest alignment design possible with a minimum centerline radius being 800 feet and a minimum tangent length in reverse curves of 100 feet.

602.7.9 Grades.

Grades for minor arterial streets shall be provided in accordance with ITEM 602.3.10, "Grades".

602.7.10 Pavement Crown.

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Each pavement of a divided arterial shall be sloped to drain to the outer edge. Pavement should have a normal cross slope of 2 percent. On auxiliary lanes, the cross slope should not exceed 2 percent on outer lanes and 1 percent on inner left turn lanes.

602.7.11 Drainage.

A drainage system to accommodate design run-off shall be included in the design of every arterial street. Street flows from adjacent property that is intercepted by the street section of curb and gutter shall be limited to a property depth of 150' along and adjacent to the right-of-way. For urban streets, the flow is transferred at frequent intervals from the street cross section by curb-opening inlets to basins and from there by storm sewer conduit to major outfalls. To avoid undesirable flow-line conditions, the minimum gutter grade shall be 0.30 percent, it is recommended to use 0.50 percent grade or more, when possible, for better drainage purposes. Inlets shall be located in such a manner that storm water is not carried more than 300 feet along the curb line from the high point of a gutter to an inlet opening. Inlets should be placed away from arterial streets, on side streets, at intersections. Storm sewers and inlets shall be provided in accordance to ITEM 703, "Closed Conduit System".

602.7.12 Border Area.

Border areas for minor arterials shall be provided in accordance with ITEM 602.3.13, "Border Area".

602.7.13 Sidewalks.

Sidewalks for urban minor arterials shall be provided in accordance with ITEM 602.3.14, "Sidewalks".

602.7.14 Access Control.

Control of access is highly desirable on an arterial facility. This provision will not only enhance its initial service capability but will also preserve the original level of service. While service may be required to abutting property, it shall be carefully regulated to limit the number of points and their locations. Access control is especially needed in areas approaching intersections where auxiliary and storage lanes may be required. Access to arterial streets shall be permitted only where minimum spacing standards are met. The spacing standards are the minimum distance between access points on the same side of the road. To ensure a safe balance between access and traffic mobility, these standards vary depending on the nature of the access point. Residential driveways shall not be designed for access to arterial streets. Commercial driveways shall be allowed access to arterial and shall comply with ITEM 801 of this manual.

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602.7.15 Lighting.

Lighting is very important to safe operation of an urban arterial. The higher volumes and speeds require the driver to make correct decisions with adequate time to make the proper maneuvers without creating undue conflict in the traffic lanes. A safely designed lighting system is more important to optimum operation of an urban arterial than any other city street. The lighting shall be continuous and an energy-saving type. Design shall be per AASHTO's "Roadway Lighting Design Guide".

602.7.16 Traffic Control Devices.

Traffic control devices such as signs, markings, signals, and islands are placed on or adjacent to a street to regulate, warn, or guide traffic. Each device is designed to fulfill a specific need with regard to traffic operation, control, or safety. The need for traffic control devices shall be determined by an engineering study made in conjunction with the geometric design of the street. The TMUTCD shall be used to ensure standard design and uniform application of the various traffic control devices.

Traffic signal design shall comply with ITEM 803 of this manual.

Successful operation of an arterial street depends largely on proper pavement marking. Recent development in products for pavement markings shows considerable promise in providing adequate long-life marking. Pavement markings shall be provided in accordance to the TMUTCD and the "Standard Details".

ITEM 603 PREPARATION OF RIGHT-OF-WAY

This ITEM shall consist of preparing the right-of-way for construction operations by the removal and disposal of all obstructions from the right-of-way and from designated easements, except such trees, shrubs and structures and certain areas designated by the Public Works Department for preservation.

603.1 Clearing and Grubbing.

The right-of-way shall be cleared of stumps, brush, logs, rubbish, trees and shrubs, and all obstructions and objectionable materials whether above or below ground except live utility facilities or other facilities designated for preservation by the Public Works Department or EOR.

Areas required for embankment construction; for roadway, channel and structural excavation; and for borrow sites and material sources shall be cleared and grubbed. On

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areas required for roadway, channel, or structural excavation, all stumps, roots, etc., shall be removed to a depth of at least two (2) feet below the lower elevation of the excavation.

Holes remaining after removal of all obstructions, objectionable material, trees, stumps, etc., shall be backfilled with suitable material and tamped as directed by the Public Works Department or EOR. The operation of preparing the right-of-way shall be completed by balding, bull dozing, or by other approved methods, so that the prepared right-of-way shall be free of holes, ditches and other abrupt changes in elevations and irregularities of contour to prevent pounding of water and to provide proper drainage. All cleared and grubbed material shall be disposed of in a proper manner.

603.2 Roadway Excavation.

Substances encountered within the limits of the roadway shall be excavated to the lines, grades and typical cross sections and in accordance with specifications and as indicated in the plans. All excavation shall be accomplished in such a manner as to allow proper drainage. All suitable material removed from the excavation should be used for embankments and other such purposes as directed by the Public Works Department or EOR. If material encountered within the limits of the work is considered unsuitable, it shall be excavated and replaced with suitable material.

All utility trenches and structure excavation shall be backfilled in accordance with ITEM 410, "Backfill and Settlement".

603.3 Embankment.

Embankments shall be constructed by placing and compacting materials of acceptable quality following the lines, grades, and cross sections as indicated on the approved construction plans. Before any embankment is placed, all clearing and grubbing operations shall have been completed. Each layer of embankment material shall not exceed six inches (6") in compacted depth. It shall be disked sufficiently to break down oversize clods and thoroughly mixed so that a uniform material is secured. Each layer shall be uniformly compacted to at least 95% maximum density at optimum moisture by roller or vibratory equipment suitable for the type of material encountered. Testing for density will be in accordance with ASTM D2922 and ASTM D698.

ITEM 604 SUBGRADE, SUBBASE AND BASE COURSES

All sub-grade, sub-base and base course construction shall provide for a stabilized material with uniform support and with no abrupt changes in degree of support. Stabilization, as applied to roadway construction, can be defined as a means of permanently consolidating soils and base materials by markedly increasing their strength and bearing capacity and decreasing their water sensitivity and volume change during wet/dry cycles. Soils with a

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PI (plasticity index) value greater than ten (10) shall be stabilized with hydrated lime, Portland cement, or lime-fly ash as long as the material has been found chemically reactive with stated material. Soils with a PI (plasticity index) value less than ten (10) or soils that are not suitable for chemically treating with lime shall be stabilized with Portland Cement or fly ash or lime-fly ash. A geo-technical investigation shall be performed on all projects to assist in the design phases in determining the type and amount of additive that will be required to produce the optimum results. Sub-grade, sub-base and base courses shall be constructed with a width of two feet (2'), on each side thereof, greater than the width of the subsequent course. All sub-grade, sub-base and base courses shall be constructed as herein specified and in conformity with the typical cross sections of the approved plans.

604.1 Stabilization. (Lime, Lime-Fly Ash, Portland Cement)

This ITEM shall consist of treating the sub-grade, sub-base or base course by pulverizing, addition of stabilization material, mixing and compacting the mixed material to the required density. This ITEM applies to natural ground, borrow fill, existing pavement structure or base material and shall be constructed as specified herein and in conformity with the typical sections, lines and grades as shown on the plans or as established by the Public Works Department.

604.1.1 Lime.

Only sub-grade, sub-base, or base material, in-place or borrow, that has been found to be effectively treated with lime, containing no weeds, roots, or other vegetation; pulverized so 100% passes ~~two-inch~~two-inch (2") sieve shall be considered acceptable material. Hydrated lime shall be Type "B", commercial lime slurry in conformance with TxDOT, ITEM 264. The amount of lime required shall be determined by a qualified materials testing laboratory to be the optimum content of the soil in no case less than 5% by weight.

604.1.2 Construction Method.

It is the primary requirement of this specification to secure a complete course of stabilized treated material containing a uniform mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses.

604.1.2.a Scarification and Pulverization.

After the soil has been shaped to conform to the typical sections, lines and grades as shown on the plans and all soft areas (revealed by proof rolling) have been removed and corrected, the material should be scarified to the specified depth and width of stabilization and then partially pulverized. All delirious materials like roots, turf, etc., and aggregates larger than three inches (3") shall be removed.

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604.1.2.b Application.

Hydrated lime shall be uniformly spread by successive passes over a measured section of roadway until the proper moisture and lime content has been secured. Provisions shall be made for agitation in the distributor truck to prevent settling of lime solids.

604.1.2.c Preliminary Mixing.

The material and lime shall be thoroughly mixed by approved rotary speed road mixers and the mixing continued until a homogeneous, friable mixture of material and lime is obtained, free from clods or lumps. Materials containing plastic clays or other material which will not readily mix with lime shall be mixed as thoroughly as possible at the time of lime application. During this step, water should be added to raise the moisture of the soil-lime mixture to at least 5% above optimum moisture content. After the initial mixing, the lime-treated layer shall be shaped to the approximate section and compacted lightly with a pneumatic roller prior to curing in order to minimize evaporation loss, lime carbonation, and to prevent excessive wetting from possible heavy rains.

604.1.2.d Preliminary Curing.

The lime material mixture shall cure a minimum of 48 hours to permit the lime and water to break down (or mellow) the soil material. Duration of this curing period should be based on engineering judgment; for extremely heavy clays, the curing period may be extended to 7 days or more, if necessary.

604.1.2.e Final Mixing.

After the required curing time, the lime material mixture shall be uniformly mixed. Mixing and pulverization shall continue until all clods are broken down and a homogeneous friable mixture of material and lime is obtained, such that when all non-slaking aggregates retained on the no.4 sieve are removed, the remainder of the material shall meet the following requirements when tested from the roadway in the roadway conditions by laboratory sieves:

Minimum Passing	1-inch sieve	100%
Minimum Passing	No.4 Sieve	60%

Additional water may be required after final mixing to raise the mixture to optimum moisture content prior to compaction. Rotary mixing is mandatory for this operation.

604.1.2.f Compaction.

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Compaction of the mixture shall begin immediately after final mixing. The lime material mixture shall be compacted to at least 95% of the maximum density within 3% of optimum moisture as determined by ASTM D 698 (Standard Proctor Density). The density value shall be based on a representative field sample of the lime material mixture.

604.1.2.g Finishing, Curing and Preparation for Surfacing.

After the final layer of lime-soil material has been compacted, it shall be shaped to the required lines and grades in accordance with typical sections. The completed section shall then be finished by rolling with a pneumatic tire roller sufficiently light to prevent hair cracking. The completed section shall be moist-cured, which consists of maintaining the surface in a moist condition by light sprinkling and rolling, as necessary, moist rolling. Curing shall continue until covering with a subsequent course. Such course shall be applied within 14 days after final mixing is completed.

604.1.3 Quality Control.

The design and construction of all lime stabilized sub-grade and sub-bases shall be monitored and tested in accordance to specified ASTM and TxDOT Standards by a recognized Independent Testing Laboratory, experienced and well qualified for providing geo-technical engineering and material testing / inspection services within the local area. All specified field tests shall be performed in the presence of a city inspector at locations and frequencies determined by city inspector. The laboratory shall furnish reports to the Public Works Department, the Developer and the Contractor on all of its design determinations, all of its services and all of its quality control testing.

604.1.3.a Design.

A representative sample of the raw-soil or soil / aggregate for use in sub-grade, sub-base or base course shall be obtained to determine the optimum lime content of the material. A minimum of four (4) Atterberg limits (ASTM D 4318) will be required; starting with 5% lime and increasing lime content. A PI-Value vs. lime curve will show the percentage of hydrated lime required to produce optimum results the lime content required shall not be less than 5% of the dry weight of lime material mixture.

604.1.3.b Sieve Analysis.

Field tests at a frequency of one test for every 2000 ~~square yards-yd's~~ with a minimum of one test for each street, shall be required during the final mixing. The material shall be properly cured, uniformly mixed and pulverized to meet the specifications.

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604.1.3.c Plasticity Indexes of Lime Material Mixture.

A representative field sample of the final mixed lime-material shall be obtained to determine the Atterberg limits (ASTM D 4318). The PI value of the lime soil material shall conform to the previous lime determination and in all cases less than 20. If the lime material mixture is not uniform in composition, additional samples will be required.

604.1.3.d Standard Proctor.

A representative field sample of the final mixed lime material mixture shall be obtained to prepare the moisture / density relationship (ASTM D 698). If the lime material mixture is not uniform in composition, additional samples will be required.

604.1.3.e Lime Material Depth Check.

Representative areas of the lime material mixture, at a frequency of one test for every 2000 sq. yds., a minimum of one test for each street, shall be checked after final grade has been achieved to determine if the specified depth of sub-grade or sub-base material has been obtained.

604.1.3.f Compaction Tests.

Representative areas of the lime material mixture, at a frequency of one test for every 500 sq. yds., a minimum of one test for each street, shall be tested at each ~~six-inch~~six-inch (6") layer of required lime material mixture depth. Compaction tests (ASTM D 2922) shall be performed on areas that will receive subsequent courses within five (5) days or if lime material mixture loses stability due to drying, wetting or construction damage; retests will be required. The lime material mixture shall be compacted to at least 95% maximum density within 3% of optimum moisture as determined by ASTM D 698 (Standard Proctor Density).

604.1.4 Lime-Fly Ash.

Only sub-grade, sub-base, or base material, in-place or borrow, that has been found to be effectively treated with lime-fly ash, containing no weeds, roots, or other vegetation; pulverized so 100% passes ~~two-inch~~two-inch (2") sieve shall be considered acceptable material. Hydrated lime shall be Type "B", commercial lime slurry in conformance with TxDOT, ITEM 264. Fly ash shall be residue or ash remaining after burning finely pulverized coal at high temperatures conforming to requirements of ASTM C 618, Type C" or "F" with a minimum CaO content of 20 %, loss on ignition not to exceed 3% and contain no lignite ash. The amounts of lime-fly ash required shall be determined by a qualified materials testing laboratory to be the optimum lime content of the soil in no case less than 5% by weight.

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604.1.5 Construction Method.

It is the primary requirement of this specification to secure a complete course of stabilized treated material containing a uniform mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses.

604.1.5.a Scarification and Pulverization.

After the soil has been shaped to conform to the typical sections, lines and grades as shown on the plans and all soft areas (revealed by proof rolling) have been removed and corrected, the material should be scarified to the specified depth and width of stabilization and then partially pulverized. All delirious materials like roots, turf, etc., and aggregates larger than three inches (3") shall be removed.

604.1.5.b Application.

Hydrated lime-fly ash shall be uniformly spread as a single mix, single pass over a measured section of roadway. Provisions shall be made for agitation in the distributor truck to prevent settling of lime-fly ash solids. Include fly ash in percentage amounts in lime or lime slurry as established from geotechnical evaluation for application, mixing, and compaction.

604.1.5.c Preliminary Mixing.

The material and lime-fly ash shall be thoroughly mixed by approved rotary speed road mixers and the mixing continued until a homogeneous, friable mixture of material and lime-fly ash is obtained, free from clods or lumps. Materials containing plastic clays or other material which will not readily mix with lime-fly ash shall be mixed as thoroughly as possible at the time of application. During this step, water should be added to raise the moisture of the soil-lime mixture to at least 5% above optimum moisture content. After the initial mixing, the lime-fly ash treated layer shall be shaped to the approximate section and compacted lightly with a pneumatic roller prior to curing in order to minimize evaporation loss, lime carbonation, and to prevent excessive wetting from possible heavy rains. Operations shall be conducted to minimize elapsed time between mixing and compacting lime-fly ash subgrade in order to take advantage of rapid initial set characteristics. Complete compaction within 2 hours of commencing compaction and not more than 6 hours after adding and mixing last stabilizing agent.

604.1.5.d Preliminary Curing.

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The lime-fly ash material mixture shall cure a minimum of 48 hours to permit the lime and water to break down (or mellow) the soil material. Duration of this curing period should be based on engineering judgment; for extremely heavy clays, the curing period may be extended to 7 days or more, if necessary.

604.1.5.e Final Mixing.

After the required curing time, the lime-fly ash material mixture shall be uniformly mixed. Mixing and pulverization shall continue until all clods are broken down and a homogeneous friable mixture of material and lime-fly ash is obtained, such that when all non-slaking aggregates retained on the no.4 sieve are removed, the remainder of the material shall meet the following requirements when tested from the roadway in the roadway conditions by laboratory sieves:

Minimum Passing	1-inch sieve	100%
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Minimum Passing	No.4 Sieve	60%
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Additional water may be required after final mixing to raise the mixture to optimum moisture content prior to compaction. Rotary mixing is mandatory for this operation.

604.1.5.f Compaction.

Compaction of the mixture shall begin immediately after final mixing. The lime-fly ash material mixture shall be compacted to at least 95% of the maximum density within 3% of optimum moisture as determined by ASTM D 698 (Standard Proctor Density). The density value shall be based on a representative field sample of the lime material mixture.

604.1.5.g Finishing, Curing and Preparation for Surfacing.

After the final layer of lime-fly ash-soil material has been compacted, it shall be shaped to the required lines and grades in accordance with typical sections. The completed section shall then be finished by rolling with a pneumatic tire roller sufficiently light to prevent hair cracking. The completed section shall be moist-cured, which consists of maintaining the surface in a moist condition by light sprinkling and rolling, as necessary, moist rolling. Curing shall continue until covering with a subsequent course. Such course shall be applied within 14 days after final mixing is completed.

604.1.6 Quality Control.

The design and construction of all lime-fly ash stabilized sub-grade and sub-bases shall be monitored and tested in accordance to specified ASTM and TxDOT Standards by a recognized Independent Testing Laboratory, experienced and well qualified for providing geo-technical engineering and material testing / inspection services within the local area.

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All specified field tests shall be performed in the presence of a city inspector at locations and frequencies determined by city inspector. The laboratory shall furnish reports to the Public Works Department, the Developer and the Contractor on all of its design determinations, all of its services and all of its quality control testing.

604.1.6.a Design.

A representative sample of the raw-soil or soil / aggregate for use in sub-grade, sub-base or base course shall be obtained to determine the optimum lime-fly ash content of the material. A minimum of four (4) Atterberg limits (ASTM D 4318) will be required; starting with 5% lime-fly ash and increasing lime-fly ash content. A PI-Value vs. lime-fly ash curve will show the percentage of hydrated lime-fly ash required to produce optimum results the lime content required shall not be less than 5% of the dry weight of lime-fly ash material mixture.

604.1.6.b Sieve Analysis.

Field tests at a frequency of one test for every 2000 ~~sq.-yd~~^{square yards} -with a minimum of one test for each street, shall be required during the final mixing. The material shall be properly cured, uniformly mixed and pulverized to meet the specifications.

604.1.6.c Plasticity Indexes of Lime-Fly Ash Material Mixture.

A representative field sample of the final mixed lime-fly ash material shall be obtained to determine the Atterberg limits (ASTM D 4318). The PI value of the lime-fly ash soil material shall conform to the previous lime determination and in all cases less than 20. If the lime-fly ash material mixture is not uniform in composition, additional samples will be required.

604.1.6.d Standard Proctor.

A representative field sample of the final mixed lime-fly ash material mixture shall be obtained to prepare the moisture / density relationship (ASTM D 698). If the lime-fly ash material mixture is not uniform in composition, additional samples will be required.

604.1.6.e Lime Material Depth Check.

Representative areas of the lime-fly ash material mixture, at a frequency of one test for every 2000 sq. yds., a minimum of one test for each street, shall be checked after final grade has been achieved to determine if the specified depth of sub-grade or sub-base material has been obtained.

604.1.6.f Compaction Tests.

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Representative areas of the lime-fly ash material mixture, at a frequency of one test for every 500 sq. yds., a minimum of one test for each street, shall be tested at each ~~six-inch~~six-inch (6") layer of required lime material mixture depth. Compaction tests (ASTM D 2922) shall be performed on areas that will receive subsequent courses within five (5) days or if lime-fly ash material mixture loses stability due to drying, wetting or construction damage; retests will be required. The lime-fly ash material mixture shall be compacted to at least 95% maximum density within 3% of optimum moisture as determined by ASTM D 698 (Standard Proctor Density).

604.1.7 Portland Cement.

This ITEM shall consist of treating the sub-grade, sub-base or base by pulverizing, addition of Portland cement, mixing, wetting and compacting the mixed material to the required density. This ITEM applies to natural ground, embankment, existing pavement structure, or flexible base material, and shall be constructed as specified herein and in conformity with the typical sections, lines and grades as shown on the plans or established by the Engineer. Only sub-grade soil, sub-base or base material (TxDOT ITEM 275 or 276), that has been found to be effectively treated with Portland Cement; containing no weeds, roots or other vegetation; pulverized so that 100% passes ~~two-inch~~two-inch (2") sieve, 20% maximum passes No. 200 sieve; and PI value maximum of 10 shall be considered acceptable.

Portland cement shall conform to ASTM C150 Type I. The amount of Portland cement required for treatment of sub-grade shall produce a cement-soil material with a minimum 200 PSI compressive strength at seven (7) days (TEX-120-E). The amount of Portland cement required for treatment of sub-base or base courses shall produce a cement-soil aggregate material with a minimum 650 PSI compressive strength at 7 days (TEX-120-E). Portland cement treatment of material in place shall be constructed in accordance with TxDOT ITEM 275.

Portland cement treatment of base material shall be constructed in accordance with TxDOT ITEM 276.

604.1.8 Construction Method.

It is the primary requirement of this specification to secure a complete course of stabilized treated material containing a uniform mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses.

604.1.8.a Scarification and Pulverization.

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After the soil has been shaped to conform to the typical sections, lines and grades as shown on the plans and all soft areas (revealed by proof rolling) have been removed and corrected, the material should be scarified to the specified depth and width of stabilization and then partially pulverized. All delirious materials like roots, turf, etc., and aggregates larger than two inches (2") shall be removed.

604.1.8.b Application.

Portland cement shall be uniformly spread by successive passes over a measured section of roadway until the proper moisture and Portland cement content has been secured. Provisions shall be made for agitation in the distributor truck to prevent settling of ~~solids~~solids.

604.1.8.c Mixing.

Do not place and mix cement when temperature is below 40 degrees F and falling. Place base when temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Spread cement uniformly on soil at rate specified by laboratory. When bulk cement spreader is used, position it by string lines or other approved method to ensure uniform distribution of cement. Apply cement only to area where operations can be continuous and completed in daylight, within one hour of application. Amount of moisture in soil at time of cement placement shall not exceed quantity that will permit uniform mixture of soil and cement during dry mixing operations. Do not exceed specified optimum moisture content for solid cement mixture. Do not allow equipment other than that used in spreading and mixing to pass over freshly spread cement until it is mixed with soil. Dry mix cement with soil after cement application. Continue mixing until cement has been sufficiently blended with soil to prevent formation of cement balls when water is applied. Mixture of soil and cement that has not been compacted and finished shall not remain undisturbed for more than 30 minutes. Immediately after dry mixing is complete, uniformly apply water as necessary and incorporate it into mixture. Pressurized equipment must provide adequate supply to ensure continuous application of required amount of water to sections being processed within 3 hours of cement application. Ensure proper moisture distribution at all times. After last increment of water has been added, continue mixing until thorough and uniform mix has been obtained. Ensure percentage of moisture in mixture, based on dry weights, is within 2 percentage points of specified optimum moisture content prior to compaction. When uncompacted soil cement mixture is wetted by rain indicating that average moisture content exceeds tolerance given at time of final

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compaction, reconstruct entire section in accordance with this Section at no additional cost to City.

604.1.8.d Compaction

Prior to beginning compaction, ensure mixture is in loose condition for its full depth. Uniformly compact the loose mixture to specified density, lines and grades. After soil and cement mixture is compacted, apply water uniformly as needed and mix thoroughly. Then reshape surface to required lines, grades, and cross section and lightly scarify to loosen imprints left by compacting or shaping equipment. Roll resulting surface with pneumatic-tire roller and “skin” surface with power grader. Thoroughly compact mixture with pneumatic roller, adding small increments of moisture, as needed. When aggregate larger than No. 4 sieve is present in mixture, make one complete coverage of section with flat-wheel roller immediately after skinning operation. When approved by Public Works Department, surface finishing methods may be varied from this procedure, provided dense uniform surface, free of surface compaction planes is produced. Maintain moisture content of surface material at its specified optimum during finishing operations. Compact and finish surface within period not to exceed 2 hours to produce smooth, closely knit surface, free of cracks, ridges or loose material, conforming to crown, grade, and line shown on Drawing within period not to exceed 2 hours.

604.1.8.e Construction Joints

At the end of each day’s construction, form straight transverse construction joint by cutting back into total width of completed work to form true 2-inch depth vertical face free of loose and shattered material. Construct cement treatment for large wide areas in series of parallel lanes of convenient length and width approved in advance by the Public Works Department.

604.1.8.f Finishing, Curing and Preparation for Surfacing.

Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. When open, restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together. Place base and surface within 14 days after final mixing and compaction, unless prior approval is obtained from the Public Works Department.

604.1.9 Quality Control.

The design and construction of all Portland Cement stabilized sub-grade, sub-bases and base courses shall be monitored and tested in accordance with specified ASTM and THD standards by a recognized independent testing laboratory, experienced and well qualified for providing geo-technical engineering and material testing / inspection services within the local area. All specified field tests shall be performed in the presence of a City Inspector

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at locations and frequencies determined by the City Inspector. The laboratory shall furnish reports to the Public Works Department, the Developer and the Contractor on all of its design determinations, all of its services and all of its quality control testing.

604.1.9.a Design.

The mix will be designed with the intention of producing a minimum average compressive strength as specified. Cement stabilized material specimens shall be prepared, cured and tested as outlined in test method TEX-120-E. The cement content shall not be less than 4.5% of the dry weight of the cement material mixture.

The base material, when tested in accordance to test method TEX-110-E, shall meet the requirements of TxDOT ITEM 275.4. The soil binder material, when tested in accordance to test method TEX-106-E, shall meet the requirements of TxDOT ITEM 275.4.

604.1.9.b Sieve Analysis.

Field test at a frequency of one test for every 2000 sq. yds., with a minimum of one test for each street shall be required during mixing and pulverization of Portland Cement treatment for material in place. The material shall be so pulverized that, at the completion of moist-mixing, when all non-slaking aggregate retained on the No.4 sieve are removed, the remaining material shall meet the following requirements when tested from the roadway in the roadway condition by laboratory sieves:

Minimum Passing 1-inch Sieve 100%

Minimum Passing No. 4 Sieve 60%

604.1.9.c Standard Proctor.

A representative field sample of the mixed cement material mixture shall be obtained to prepare the moisture / density relationship (ASTM 698).

604.1.9.d Compaction Tests.

Representative areas of the cement material mixture, at a frequency of one test for every 500 sq. yds., a minimum of one test for each street, shall be tested at each ~~six-inch~~six-inch (6") layer of required cement material mixture depth. Compaction tests (ASTM 2922) shall be performed within 4 hours after Portland cement is added to the sub-grade, sub-base or base course material. If the cement material mixture ~~loses~~loses stability due to drying, wetting or construction damage; additional cement shall be added and retests will be required, the cement material mixture shall be compacted to at least 95% maximum density within 3% of optimum moisture as determined by ASTM 698 (Standard Proctor Density).

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ITEM 605 CONCRETE PAVEMENT

This ITEM shall consist of a pavement composed on Portland Cement concrete, with reinforcement, with or without curbs, constructed as herein specified on a prepared stabilized sub-grade in conformity with thickness, lines and grades, and typical cross sections as indicated in the specifications and plans.

605.1 Materials.

The source of supply of each material shall be approved by the Public Works Department or EOR, before being incorporated in the work, and shall be sampled and tested for determining compliance, before and during the course of the work. Only materials conforming to these specifications and approved by the Public Works Department or EOR shall be used in the work.

605.1.1 Portland Cement.

Portland cement shall conform to ASTM C-150, Type I or Type IA. The cement shall conform to applicable ASTM specifications for weight variations and length of storage. Cement which has become caked or lumped shall not be used.

605.1.1.a Mineral Filler for Portland Cement.

Type “F” fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, store and inspect in accordance with ASTM C 618. Do not use fly ash in amounts to exceed 25 percent by weight of ~~ementitious~~cementitious material in mix design. Cement content may be reduced when strength requirements can be met. Note: When fly ash is used, term “cement” is defined as cement plus fly ash.

605.1.2 Coarse Aggregate.

Coarse aggregate shall consist of durable particles of gravel, crushed gravel, or crushed stone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter or objectionable material and shall conform to ASTM C-33. Grading of Course Aggregate for roadway paving shall conform to the requirements prescribed in ASTM C-33 for size Number 467. Grading of course aggregate for curb installation shall conform to the requirements prescribed in ASTM C-33 for size Number 7.

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605.1.3 Fine Aggregates.

Fine aggregates shall consist of sand or a combination of sand, and shall be composed of clean, hard, durable, uncoated grains and shall conform to ASTM C-33.

605.1.4 Water.

Water used in mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter, or other substance injurious to the finished product. Water shall be tested in accordance with AASHTO T26. Water known to be potable may be used without test.

605.1.5 Admixtures.

Admixtures shall have proven compatibility with all local concrete materials, including cement and other proposed admixtures, and shall ~~be capable of providing~~ can provide the concrete with the desired properties without subsequent loss of strength or durability. Admixtures shall not be used to replace cement. Admixtures shall comply with all the requirements of TxDOT ITEM 437. When using admixtures in concrete, the compatibility of intermixing admixtures and the amounts required to produce the desired result shall be assured by the admixture manufacturer. The water contained in admixtures shall be considered part of the mixing water.

605.1.6 Reinforcing Steel.

All bar reinforcement for concrete streets shall be deformed, conforming to ASTM A615, Grade 40, open hearth, basic oxygen, or electric furnace new billet steel, minimum bar size No. 4. Steel for reinforcement may be shop or field bent or cut. All bending and cutting shall be performed in accordance with TxDOT ITEM 440.3.

All steel for reinforcement shall be secured in place by use of approved metal or plastic supports and spacers and ties. Supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation. All splices in reinforcement shall have a minimum lap of 30 bar diameters. Lapped ends of bars shall be placed in contact and securely wired. All tie-wire shall be 16 gauge or heavier, black annealed wire.

605.1.7 Load Transmission Device for Expansion Joints.

Expansion joints shall be of the dowel type, load transmission device consisting of smooth, steel dowel bars of size and type indicated in the standard details, secured in position by a transverse joint filler board. Steel dowel bars shall be open-hearth, basic oxygen, or electric-furnace steel conforming to the properties specified for grade 60 in ASTM A 615. One end of dowel bar shall be encased in an approved cap having an inside diameter of

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1/16 inch greater than the diameter of the dowel bar. The cap shall be such strength, durability and design as to provide free movement of the dowel bar. Dowel bars shall be installed through approved fittings at ~~22-inch~~22-inch centers.

Joint filler materials shall be timber boards, ~~rebonded~~rebounded neoprene filler, or rebonded recycled tire rubber. In all cases the joint filler material shall be 3/4 inch and furnished in a single piece for the full depth and width required for the joint unless otherwise authorized by the Public Works Department or EOR.

Joint filler timber boards shall be obtained from Redwood or Cypress. They shall be sound heartwood and shall be free from sapwood, knots, clustered bird's eye, checks and splits.

Rebounded neoprene filler consists of ground closed-cell neoprene particles, rebonded and molded into sheets of the required dimensions. These sheets must meet the requirements of ASTM D 1752, Type I.

Rebonded recycled tire rubber consists of granular particles of rubber, made by grinding automobile and truck tires, securely bound together by a synthetic resin or plastic binder. The filler must be molded into sheets of the required dimensions and which meet the testing requirements of both ASTM D 1751 and ASTM D 1752, except that the requirements for asphalt content and expansion are waived. The density of the material must be at least 30 lb./ft.

605.1.8 Joint Sealing Material.

Poured sealer for joints shall conform to the requirements of ASTM D 1190, alternatively, low-modules Silicone Rubber Highway Joint Sealant conforming to TxDOT ITEM 433.2 (f) may be used.

605.1.9 Curing Material.

Membrane curing compounds for concrete shall be the white pigmented type conforming to the requirements of ASTM C-309.

605.2 Equipment.

All equipment necessary for the proper handling, mixing, hauling, placing, finishing and curing of the concrete shall be maintained in good working condition, throughout the construction of the project, to assure the proper prosecution of the work.

605.2.1 Aggregate Weighing Equipment.

Aggregate bins and scales shall conform to ASTM C 94.

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605.2.2 Cement Weighing Equipment.

Where bulk cement is used, it shall be batched by weight and the scales shall conform to the requirements ASTM C94.

605.2.3 Mixers.

Mixers shall be of an approved stationary or truck-type capable of combining the ingredients into a thoroughly mixed and uniform mass and shall conform to the requirements of ASTM C-94.

605.2.4 Hauling Equipment.

Hauling equipment shall be provided in accordance with ASTM C-94.

605.2.5 Forms.

Forms shall be of such cross section and strength and so secured as to resist the pressure of the concrete when placed and the impact and vibration of any equipment they support, without springing or settlement. the method of connection between sections shall be such that the joints shall not move in any direction. The maximum deviation of the top surface shall not exceed 1/8 inch in 10 feet or the inside face not more than 1/4 inch in 10 feet from a straight line.

605.2.6 Mechanical Vibratory Equipment.

All concrete placed for pavement shall be consolidated by approved mechanical vibrators. A vibratory form-type paving screed shall be so designed and operated as to strike off, consolidate, and finish the pavement to the required cross section. Paving screeds shall be maintained in a tight and good operating condition, accurately adjusted to the required crown or profile, and free from deflection, wobble, or vibration tending to affect the precision of finish.

605.2.7 Joint Sealing Equipment.

Sealing equipment shall be capable of installing the sealant in joints in accordance with manufacture's recommendation.

605.2.8 Membrane Sprayer.

A pressure sprayer capable of applying a continuous uniform film will be required.

605.2.9 Other Equipment.

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The contractor shall also furnish all other equipment, small tools, and supplies which are necessary to the proper prosecuting of the work.

605.3 Proportioning and Design of Concrete.

Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, water, and admixtures. The actual proportions of materials to be used for various mixes shall be determined by an approved independent testing laboratory in accordance with ACI Standard 211 so as to produce a quality concrete that will meet or exceed the requirements as herein specified.

605.3.1 Concrete Strength.

The concrete mix will be designed to produce a minimum flexural strength of 550 PSI at the age of 7 days and a minimum compressive strength of 3500 PSI at the age of 28 days. Unless otherwise specified, the concrete shall contain not less than 5.5 sacks of Portland cement per cubic yard of concrete. The water-cement ratio (net gallons of water per sack of cement) shall not exceed 6.25 gallons/sack. Concrete specimens shall be prepared, cured and tested in accordance with ASTM C-39 and ASTM C-239.

605.3.2 Workability of Concrete.

Concrete shall be uniformly plastic, cohesive and workable. Workable concrete is defined as concrete which can be placed without honeycomb and without voids in the surface of the pavement after the specified finishing operation has been completed. Workability shall be obtained without producing a condition such that free water appears on the surface of the slab when being finished.

The mix will be designed to produce concrete which will have a slump of 4(+/-1) inches when tested in accordance with ASTM C-143. The maximum allowed slump for field placement shall be 5 inches (5").

605.3.3 Entrained Air.

Entrained air shall be used in all concrete. Air entrainment shall be provided with air-entrained Portland Cement or by adding an air-entraining agent. The amount of admixture shall be adjusted to meet variations in concrete ingredients and job conditions to provide a total air content (percent by volume) of 5 (+/- 1) inches when tested in accordance with ASTM C-173.

605.3.4 Water Reducing Retarding Admixtures.

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A water reducing retarding admixture shall be used in the concrete batch when the air temperature is expected to exceed 78 degrees during the concrete placement.

605.3.5 Mix Design.

It shall be the responsibility of the Contractor to furnish the mix design. The mix shall be designed to conform with the requirements contained herein and in accordance with ACI 214. An Independent Material Testing Laboratory employed by the Developer shall perform the work required to substantiate the design. Complete concrete design data shall be submitted to the Public Works Department for approval.

605.4 Subgrade and Forms.

The sub-grade for pavement sections shall be properly constructed in accordance to ITEM 604 "Sub-grade, Sub-base and Base Courses" before forms, steel or concrete can be placed. All forms shall be accurately set to the required grade and alignment and, during the entire operation of placing, compacting and finishing of the concrete, shall not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. The forms shall not be removed for at least 12 hours after the completion of finishing operations. They shall be carefully removed in such a manner that no damage will be done to the edge of the pavement. Any damage resulting from this operation shall be immediately repaired by saw cut and full-depth replacement. Adjacent slabs may be used instead of forms provided that the concrete is well protected from possible damage by finishing or placing equipment.

605.5 Reinforcing Steel Placing.

All reinforcing steel, including tie bars, dowel bars, and load transmission devices used in accordance with plan provisions shall be accurately placed and secured in position in accordance with details shown on the "Standard Details". The reinforcement shall be accurately located in the forms, and firmly held in place, before and during concrete placement, by means of bar supports, adequate in strength and number to prevent displacement, to keep the steel at the proper distance from the forms and to carry the reinforcing bars they support. Bars shall be supported by standard galvanized bar supports, bar supports with plastic tips, stainless steel bar supports, or approved plastic bar supports. Reinforcing bars shall be securely wired together at alternate intersections, following a pattern approved by the Engineer, and at all splices, and shall be securely wired to each dowel intersection. Before any concrete is placed, all mortar, mud, dirt, etc., shall be cleaned from the reinforcement. No concrete shall be deposited until the Engineer has inspected the placement of the reinforcing steel and given permission to proceed.

605.6 Joint Assemblies.

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All transverse and longitudinal joints when required in the pavement shall be of the type or alternate type shown on the approved plans and shall be constructed at the required location, on required alignment, in required relationship to tie bars and joint assemblies. Such stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position. Careful workmanship shall be exercised in the construction of all joints ~~to insure that~~ to ensure that the concrete sections are separated by an open joint or by the joint materials and ~~to insure that~~ to ensure that the joints will be true to the outline indicated.

605.6.1 Construction Joints.

Intentional stoppage of the placing of concrete shall be at either an expansion joint or at a weakened plane joint. When the placing of concrete is stopped at an expansion joint, the complete load transmission device shall be installed and rigidly secured in required position and cross section. When placing of concrete is stopped at a weakened plane joint, the complete joint assembly, including 24" tie bars, shall be installed and rigidly supported in required position. Weakened plane joints shall be either keyed, tongue and grooved, or butt-type with tie bars to hold adjacent slabs in vertical alignment. Construction joints shall be tooled to a sufficient width and depth in order to receive joint sealant material.

605.6.2 Expansion Joints.

Traverse expansion joints shall be formed perpendicular to the centerline and surface of the pavement and shall be constructed at radius points of curb returns for cross street intersections and at regular intervals, a maximum spacing of 80 feet. Expansion joints shall be of the dowel type, load transmission in accordance with ITEM 605.1.7 "Load Transmission Devices for Expansion Joints". On completion of curing of the pavement, the joint seal space form shall be removed and the joint seal space above the joint filler board shall be thoroughly cleaned to remove all projecting concrete, laitance, dirt or foreign matter. The concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint. The faces of the joint seal space shall be clean and surface dry at the time joint sealing filler is placed.

605.6.3 ~~Weakend Plane Joints.~~Weakened-Plane-Joint

Weakened plane joints shall consist of longitudinal joints and block-out-type construction joints and shall be formed or sawed. When the joints are sawed, the saw shall be power driven, shall be manufactured especially for the purpose of sawing concrete, and shall be capable of performing the work. Longitudinal joints shall be constructed accurately to required lines, shall be perpendicular to the pavement surface at the joint, and the pavement surface over and adjacent to the joint shall be finished as specified. If the deformed metal strip is used, it shall be secured in position with metal stakes, adequate to prevent any lateral movement while the concrete is being place. Longitudinal joint spacing shall not exceed 15 feet.

605.7 Mixing and Delivery of Concrete.

The Concrete shall be mixed and delivered to the work site in accordance with ASTM C-94.

605.8 Placing Concrete.

The method of concrete placement shall avoid segregation of the aggregate or displacement of the reinforcing steel and joint assemblies. Concrete shall be deposited on a moist grade as near as possible in its final position in the forms. Workers will not be permitted to walk in concrete with any earth or foreign material on their boots or shoes. The placing of concrete shall be rapid and continuous between planned transverse joints. Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and width of the slab by an approved mechanical vibratory unit. Concrete shall be distributed to such a depth that when consolidated and finished, the slab thickness required will be obtained at all points and the surface shall not at any point, be below the established grade. Special care shall be exercised in placing and spading concrete against forms and at all joints to prevent the forming of honey combs and voids. The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When conditions are such that additional moisture is needed for finish, the water shall be applied to the surface by fog spray only, and shall be held to a minimum amount.

The maximum time interval between the addition of cement to the batch, and placing of concrete in the forms shall not exceed 60 minutes for agitated concrete and 15 minutes for non-agitated concrete. The use of an approved water reducer retarding agent will permit the extension of time maximum by 30 minutes. The use of a water reducer retarding agent will be required when the air temperature is expected to exceed 78 degrees during the concrete placement.

605.8.1 Placing Concrete in Hot Weather.

When concrete is to be placed during hot weather, air temperatures above 78 degrees F, it shall be placed without the addition of more water to the concrete than required by the design - slump and consistency. Control of the initial set of the concrete and lengthening the time for finishing operations, under adverse wind, humidity and hot weather conditions shall be accomplished with the use of an approved water reducer retarding agent. Because of the detrimental effects of high concrete temperatures, operations in hot weather shall be directed towards keeping the concrete as cool as is practicable and protecting the surface of the concrete from rapid evaporation of moisture. Slab sections with numerous plastic shrinkage cracks shall be considered unacceptable and shall be removed and replaced.

605.8.2 Placing Concrete in Cold Weather.

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Concrete shall not be placed when the air temperature is 40 degrees F. and falling, but may be placed when the air temperature is above 40 degrees F. and rising. When concrete is placed in cold weather conditions, the contractor shall have available a sufficient supply of approved covering material to maintain the temperature of the air surrounding the concrete at not less than 50 degrees F. for not less than 5 days.

605.8.3 Placing Concrete in Inclement Weather.

Concrete placement will not be permitted when impending weather conditions will impair the quality of the finish work. If rainfall should occur after placing operations are started, the contractor shall provide ample covering to protect the work. Areas of the pavement surface where the texture has been damaged by the protective cover shall be textured and cured unless the concrete has hardened. Areas that have suffered surface erosion and have coarse aggregate exposed shall be considered unacceptable and shall be removed and replaced.

605.9 Finishing Concrete.

All concrete pavements shall be struck off and consolidated with an approved vibrating screed, except as herein provided. Hand-finishing will be permitted on that portion of pavement outside the normal pavement width or configuration. As soon as the concrete has been spread between the forms, the approved vibrating screens shall be operated to consolidate the concrete and remove all voids. Hand-manipulated vibrators shall be used for areas not covered by the mechanical vibratory unit. The vibrating screed shall first be operated to compact and finish the pavement to the required section and grade, without surface voids.

After the pavement has been struck off and consolidated, it shall be scraped with a metal straightedge 10 ft. long equipped with a handle to permit operation from the edge of the pavement. Any excess water and laitance shall be removed from the surface of the pavement. The straightedge shall be operated parallel to the centerline of the pavement and shall be moved forward one-half its length after each pass. Irregularities shall be corrected by adding or removing concrete. A burlap drag or canvas-rubber belt shall be used for final finish texture. Burlap ~~bragbag~~ or belt shall be long enough to cover the entire pavement width. They shall be kept clean and saturated while in use. The burlap drag shall be laid on the pavement surface and dragged in the direction which the pavement is being placed. The canvas-rubber belt shall be laid on the pavement surface and moved forward with a combined transverse and longitudinal motion in the direction which the pavement is being placed. These textures shall provide a gritty, skid resistant surface.

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After completion of texturing, and before the concrete has taken its initial set, the edges of the slab, and expansion joints shall be tooled. A stiff bristled broom shall be drawn along these edges.

605.10 Curbs.

Curbs shall be installed along the edges of all streets where shown in the plans and shall be constructed to the cross section in accordance with the approved plans. Curbs, and curbs and gutters may be constructed using forms or Slip form or extrusion equipment. The edge of each gutter of the curb and gutter section built first may be used as a slab form in lieu of setting forms. The curb, or curb and gutter, shall be given a textured finish to match the pavement.

605.11 Curing.

All concrete pavement shall be cured by protecting it against loss of moisture for a period of not less than 3 days from the beginning of curing operations. Unless otherwise specified on the plans, white liquid membrane curing shall be used for concrete pavement and curbs. The membrane method of curing shall be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the required rate of 150 sq. ft. per gallon shall be required. The compound shall be kept agitated to prevent the pigment from settling, and it shall be applied to the pavement edges immediately after the forms have been removed. Should the film of compound be damaged from any cause before the expiration or 3 days after original application, the damaged portions shall be repaired immediately with additional compound.

605.12 Opening Pavement to Traffic.

The pavement shall be closed to all traffic, including vehicles of the Contractor, until the concrete is at least 3 days old. At the end of the 3-day period, if so desired by the Contractor, the pavement may be opened for use by light vehicles of the Contractor. The pavement shall remain closed to all other traffic, including public access, construction equipment and heavy trucks until the concrete has reached a minimum compressive strength of 3000 psi. Sections of pavement not required to be open for public traffic should remain barricaded and closed to public traffic until the approval of the City.

605.13 Sealing Joints.

Joints to be sealed shall be filled with joint-sealing material before the pavement is opened to traffic and as soon after completion of the curing period as is feasible. Just before sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound, and joint faces shall be clean and surface-dry when seal is applied. The sealing material shall be applied to each joint opening in accordance with the approved

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plans. The joint filling shall be done without spilling material on the exposed surfaces of the concrete.

605.14 Laboratory Services.

The design and construction of all concrete pavement shall be monitored and tested in accordance to specified ASTM, ACI and/or TxDOT Standards by a recognized independent testing laboratory, experienced and well qualified for providing concrete engineering and material testing / inspection services within the local area. The testing laboratory shall be responsible for the prompt notification to the Public Works Department or EOR and the Contractor of any observed irregularities of deficiencies of work or materials.

605.14.1 Mix Design Verification.

A representative sample of the proposed materials shall be obtained from the supplier's plant to determine if the materials and the design are within the specifications: Analysis of Strength Data - ACI 214, Standard Specification for Concrete Aggregates - ASTM C33, Concrete Admixtures - THD 437. Mix design verifications will be required for pavement projects over 2000 ~~sq. yd's.~~
square yards.

605.14.2 Batch Plant Inspections.

Laboratory technicians shall inspect batch plant prior to each placement to verify compliance with mix design, weights, procedures, and handling.

605.14.3 Monitor Placement.

Laboratory technicians shall monitor field placement of concrete to verify compliance with mix design, slump range, time and temperature control, procedures and handling. Continuous monitoring will be required for the placement of all roadway pavement and curb and gutter pavement. Continuous monitoring will not be required for curb installation. No roadway pavement may be placed without the presents of the laboratory technician.

605.14.4 Strength.

Strength tests as well as slump, air content, and temperature tests shall be made with a frequency of not less than one set of samples for each 150 cubic yards of concrete. Each test shall be made from a separate batch on each day concrete is placed, at least one set of samples shall be made for each class of concrete and at least one set of samples shall be made for each street. A set of samples shall include ~~4 cylinder~~ 4-cylinder specimens 2 at 7-day and 2 at 28-day strengths. Cylinder specimens shall be tested in accordance with

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ASTM C39. Slump tests shall be made in accordance with ASTM C143, Air content test shall be made in accordance with ASTM C 173, and temperature tests shall be made in accordance with ASTM C 1064. Strength tests shall be required for all concrete placements.

605.14.5 Core Samples.

The testing laboratory shall core drill the pavement to determine pavement thickness. Length of drilled cores shall be determined in accordance with ASTM C174. Core samples shall be required for all roadway pavements prior to approval at a frequency of not less than one test for each 1000 sq. yds. with a minimum of one core for each street.

605.15 Deficient Pavement Thickness.

The thickness of the pavement will be determined in accordance with ITEM 605.14.5 Core samples. Locations of core tests may be selected by the engineer. When the measurement of the initial core from any unit is not deficient more than 0.20 inches from the plan thickness, the pavement thickness will be considered satisfactory. When the measurement of the initial core from any unit is deficient more than 0.20 inches but not less than 0.25 inches from the plan thickness one additional core will be taken from the unit and the average of the two cores will be determined. If the average measurement of these two cores is not deficient more than 0.25 inches from the plan thickness, the pavement thickness will be considered satisfactory. If the average measurement of these two cores is deficient more than 0.25 from plan thickness, the pavement thickness will be considered unsatisfactory. This pavement unit with unsatisfactory thickness may be isolated by existing control joints and additional core samples shall be required in the pavement units along the width and length in each direction from the identified unit of deficient thickness. These pavement units shall be tested in the same method as described above. All pavement units of unsatisfactory thickness will be considered unacceptable by the city and shall be removed and replaced with pavement of required thickness.

ITEM 606 HOT MIX ASPHALTIC CONCRETE PAVEMENT

This ITEM shall consist of a base course, a leveling up course, a surface course or any combination of these courses as shown on the plans. Each to be composed of a compacted mixture of mineral aggregate and asphaltic material. The pavement shall be constructed on the previously completed and approved sub-grade, and base course. Materials and construction requirements for asphaltic, concrete, pavement shall be provided in accordance with TxDOT 340, Type "D".

ITEM 607 TRAFFIC SIGNS

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All traffic signs shall conform to the requirements of "Part II-Signs" of the TMUTCD. All blank signs shall be Reflectorized sheet aluminum, in accordance with TxDOT 636, mounted on 2" galvanized steel posts with vandal-proof bolt-thru brackets. Street name signs shall be 6" extruded aluminum blades with a green reflective background and white reflective letters mounted on 2" galvanized steel posts with approved caps and vandal-proof fasteners. Roadside traffic sign supports for collector streets and arterial streets shall be provided in accordance with TxDOT ITEM 646.

ITEM 608 PAVEMENT AND CURB MARKINGS (Reflectorized Paint)

Reflectorized paint markings shall be provided for all rural streets. Reflectorized paint markings may be used on urban streets for special applications when approved by the Public Works Department. Pavement and curb markings shall conform to the requirements of "Part III-Markings" of the TMUTCD and League City standards unless on a TxDOT facility where TxDOT standards shall apply. All materials used for Reflectorized paint shall conform to the requirements of the State Department of Highways and Public Transportation, Material and Test division. The contractor shall obtain a certification from the paint manufacturer attesting that the paint provided conforms to the state requirement.

Construction method for Reflectorized pavement marking shall be provided in accordance with TxDOT ITEM 666.

ITEM 609 TRAFFIC BUTTONS

Traffic buttons shall be provided for all Urban Collector Streets and Urban Arterial Streets and shall conform to the requirements of "Part III-Markings" of the TMUTCD.

All materials and construction methods shall be provided in accordance with TxDOT ITEM 672.

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Design Guidelines

DESIGN FEATURE	MAJOR ARTERIAL	MINOR ARTERIAL	COLLECTOR	RESIDENTIAL	RURAL / LOCAL
Number of Lanes	4 to 6	2 to 4	2	2	2
Right-of-Way (min)	120'	100'	80' (90' if ditch) 90' (100' if ditch)	60'	60'
Lane Width a) Divided one-way: lane b) Single two-way c) Shoulders	TX DOT	a) 2 - 25' roadways, 12' lanes b) N/A c) N/A	a) 2-25' roadways, 2-12' traffic & 2-12' parking lanes b) 12' lanes-10' parking lanes c) N/A	a) N/A b) 24' travel path c) 4' for ditch drainage	a) N/A b) 24' travel path c) 4' for ditch drainage
Median Width	TX DOT	14' to 40'	14' to 40'	N/A	N/A
Design Speed (mph)	50 mph	50 mph	Min 35 mph	25 mph	30 mph
Sight Distance a) Stopping sight dist. b) Passing sight dist. c) Intersection corner sight dist.	TX DOT	a) 475' to 550' b) 1,800' to 1,950' c) N/A	a) 275' to 325' b) 1,300' c) N/A	a) 120' to 200' b) N/A c) 210' to 310'	a) 120' to 200' b) N/A c) 210' to 310'
Intersection Design a) Length between intersections b) Intersecting street angle c) Radius of curb return	Traffic engineer to determine the best design to handle the expected traffic volumes.		a) 300' min. 1200' max. b) no less than 75' c) 30'	a) 1200' max. b) no less than 75' c) 25'	a) 1200' max. b) no less than 75' c) 25'
Horizontal Curve a) centerline radius b) centerline radius reverse curve c) tangent length reverse curve	a) 2,000 b) c)	a) 800' b) N/A c) 100'	a) 500' b) N/A c) 100'	a) 160' b) 300' c) 100'	a) 160' b) 300' c) 100'
Grades a) Slope b) Vertical curves	TX DOT	a) 0.5% or more b) diff. in grades exceed 1%	a) 0.5% or more b) diff. in grades exceed 1%	a) less than 15% b) diff. in grades exceed 1%	a) less than 7% b) diff. in grades exceed 1%
Pavement Crown a) Driving lanes b) Left turn lanes c) Shoulders	TX DOT	a) 2% b) 1% c) N/A	a) 2% b) 1% c) N/A	a) 2% b) 1% c) N/A	a) 2% b) 1% c) 4%
Pavement Type	TX DOT	8" thick concrete Curb and gutter or open ditch	7" thick concrete Curb and gutter or open ditch	6" thick concrete or 2" thick hot mix asphalt; curb and gutter or open ditch	6" thick concrete or 2" thick hot mix asphalt; curb and gutter or open ditch
Storm Inlets Spacing	TX DOT	300' max.	300' max.	300' max.	300' max.
Driveway Access a) Residential b) Commercial	TX DOT	a) No Access b) 500' - 1,000' desirable	a) See standard details b) See standard details	a) See standard details b) See standard details	a) See standard details b) See standard details
Street Lighting	Continuous and energy saving type	Continuous and energy saving type	Continuous and energy saving type	Continuous and energy saving type	
Traffic Control Devices	MUTCD shall be used	MUTCD shall be used	MUTCD shall be used	MUTCD shall be used	MUTCD shall be used
Sidewalks	2 - 4' sidewalks or 1 - 8' sidewalk	2 - 4' sidewalks or 1 - 8' sidewalk	2 - 4' sidewalks or 1 - 8' sidewalk	2 - 4' sidewalks or 1 - 8' sidewalk	2 - 4' sidewalks or 1 - 8' sidewalk
Cul-de-Sacs & Turnarounds a) Length (max.) b) Diameter (min.) c) Right of way width	N/A	N/A	a) 880' b) 100' c) exceed diameter by 20'	a) 880' b) 80' c) exceed diameter by 20'	a) 880' b) 80' c) exceed diameter by 20'

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SPECIFICATION FOR DRAINAGE PROJECTS

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ITEM 701 GENERAL

The intent of this section is to present minimum standards for storm water quality and the design and construction of hydraulic structures for the secondary system of storm sewers and roadside ditches. Hydraulic structures for these secondary systems should convey storm water safely, control erosion, be cost effective, require minimal maintenance, and add safety and esthetics to the drainage system.

Specific design criteria; including the appropriate rainfall frequency and discharge methodology selected for use in the area, as well as specific hydrologic and hydraulic criteria used for the planning ~~of storm of storm~~ sewers, channel improvements and detention facilities, is defined in The Master Drainage Plan. Structural designs for primary channels, lateral outfall channels and detention facilities, as well as drop structured, culverts, bridges, storm sewer outfalls, and detention reservoir control structures; the City has as of Resolution No. 2011-07 adopted The Harris County Flood Control Districts (HCFCD) Criteria Manual for the design of flood control and drainage facilities, except where superseded by The Master Drainage Plan. Storm water management for construction activities shall follow the “Storm Water Management Handbook for Construction Activities”. ~~Also~~Also, as of Resolution No. 2011-07 the City has adopted the Master Drainage Plan prepared by Dannenbaum Engineering.

ITEM 702 CULVERTS

Culverts allow for roadway, railroad, driveway and other utility crossings of open ditches. Materials used for culvert construction shall include pre-cast reinforced concrete pipe, monolithic reinforced concrete boxes and pre-cast reinforced concrete boxes.

The size and flow line of a culvert will depend on the hydraulic requirements, with the minimum pipe diameter of 18 inches and the minimum box size of 24 inches x 24 inches.

All culverts for public roadway crossings of drainage channels with a depth greater than 4 ~~feet~~feet shall include headwalls to protect the embankment from erosion. Protective traffic rated guardrails shall also be included along culvert headwalls for the protection of the general public.

ITEM 703 CLOSED CONDUIT SYSTEMS

Closed conduit systems for storm sewers shall be constructed of HDPE, reinforced concrete pipe, monolithic reinforced concrete boxes or pre-cast reinforced concrete box structures.

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The size and flow-line of a pipe or box structure will depend on the hydraulic requirements. Inlet leads servicing curb opening inlets shall have a minimum pipe diameter of 24 inches.

703.1 Alignment.

All closed conduit systems shall be typically designed in a straight line with inlet lead perpendicular to the storm sewer system.

Storm sewers shall be located in public street ~~right-of-way~~ right-of-way's or in a storm sewer easement adjoining and parallel to a street right-of-way. If reinforced concrete pipe is to be used for the storm sewer, the location of the storm sewer may be installed in the roadway with a five-foot (5') offset from the centerline of the roadway. -The location of a storm sewer shall not be within side lot easements that prohibit future maintenance access, unless approved by the Public Works Department. Closed conduit systems may be installed within adequately sized drainage easements or drainage fee strips.

703.2 Manholes.

A manhole is used for access to closed conduit systems for maintenance and inspection. Manholes shall be placed at changes in conduit size, material, grade, alignment, junction of two or more conduits, and at intervals no greater than 600 feet on continuous runs.

703.3 Inlets.

Inlets to closed conduit drainage systems shall be designed to convey the design storm discharge. Inlets shall be designed so debris will not reduce the entry capacity below the design storm discharge.

Curb inlets for roadways shall be spaced so that the maximum travel distance of water in the gutter will not exceed 300 feet. Inlets should be placed away from collector streets or arterial streets and on the side streets at street intersections. An attempt should be made to place inlets away from esplanade openings and out of major intersections. Inlets should be located along the street at the extension of a lot line in order to avoid conflicts with future or existing driveways. Curb inlets should be located at the point of curve of the intersection curb radius along urban residential streets. Curb inlets should be located out from under the pavement surface. Curb inlets shall have a minimum capacity of 5 c.f.s.

Grate top inlets will not be permitted in unlined open ditch areas.

703.4 Storm Sewer Outfalls.

All storm sewer outfall pipe sewers for unlined channels shall be constructed of RCP or HDPE ~~or polymer-coated CMP~~. In accordance with the ITEMS in this manual and shall include a timber bent structure, regardless of pipe size. A standard manhole must be placed just outside of the ultimate channel right-of-way or drainage easement. The grade of the pipe

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shall be that required to produce a three feet per second velocity when flowing full. Erosion protection will be required for all storm sewer outfalls.

ITEM 704 MATERIALS

Materials shall be stored, handled and used as described under ITEM 105 "Control of Materials".

The use of manufactures names and catalog numbers as may be used to describe various products is not intended to be proprietary, but merely to indicate clearly the respective type of material that can be accepted. Submittals for product acceptance, other than those named, must be directed to the Public Works Department by the EOR representing the developer. Contractor submittals will not be accepted.

The City of League City reserves the right to engage, at any time during the progress of the work, a material testing laboratory to test and inspect all pipe, boxes, or accessory structures.

704.1 Reinforced Concrete Pipe.

Unless specifically called for, Reinforced Concrete Pipe (RCP) shall include both Fiber Reinforced Concrete Pipe (FRCP) meeting ASTM C-1450 and Steel Reinforced Concrete Pipe (SRCP) meeting ASTM C-76, both types having a bell and spigot ends. The spigot end shall have a groove made into it to accept the manufactures rubber gasket. RCP& FRCP shall be installed in accordance to ASTM C1479.

704.1.1 Joints.

Joint material shall be tubular rubber gasket conforming to ASTM C 443 manufactured from extruded closed cellular rubber, the base polymer being a blend of nitrile and vinyl meeting the physical requirements of ASTM D 1056, Class 2 CL and meeting the chemical resistance requirements of AASHTO M 198. Joint lubricants shall consist of flax soap or equal, mineral lubricants are not permitted. Install per pipe manufacturers recommendations or as specified by the notes on plans or as directed by COLC.

Special care shall be taken in joining the bell and spigot ends as not to cause damage to the gasket. Damaged gaskets shall be cause for rejection of acceptance to the City's system.

704.2 Precast Reinforced Concrete Boxes.

Pre-cast reinforced concrete box sections for storm sewers or culverts shall conform to the requirements of ASTM C-850 for H20 loading.

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704.2.1 Joints.

Joint material shall be rubber gasket meeting the requirements of ASTM C1677. Filter fabric to be used at all joints per City of League City Box Culvert Bedding and Backfill Details.

704.3 Monolithic Reinforced Concrete Boxes.

Monolithic reinforced concrete boxes for storm sewers and culverts shall be provided in accordance with The Standard Structural Designs of The Texas State Department of Highways and Public Transportation and in accordance with TxDOT ITEM 462.

704.4 High Density Polyethylene (HDPE).

HDPE pipe to meet AASHTO M 294 and shall be installed in accordance to ASTM D 2321.

704.4.1 Joints.

Coupling devices shall provide a positive union of adjacent pipe sections while effectively preventing displacement of the pipe along its axis and lateral displacement at the joint and shall provide leak resistant connections. Couplings shall be provided and supplied by the same manufacturer of the pipe.

704.5 Manholes.

Manholes shall be constructed of pre-cast concrete sections or concrete cast-in-place. Detailed drawings of various types and sizes of manholes are included in the engineered plans and each manhole shall be constructed in strict accordance with these drawings. Manholes shall be installed vertical and symmetrically above storm sewer main.

Manholes shall have inverts in them in which flow channels to the spring line of the pipes are constructed, inverts equal in depth to one-half the diameter of the pipes connected to the manholes.

Inlet and outlet pipes shall extend through the walls of the manhole for a sufficient distance beyond the outside surface to allow for connections but shall be cut off flush with the wall on the inside surface. Non-shrink grout shall be placed around these pipes so as to form a tight, neat and smooth connection.

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Manhole bases shall be cast or installed on a firm 6 inch minimum of cement stabilized sand. Backfilling of manholes shall be provided in accordance with ITEM 410 "Backfill and Settlement" and Manhole Backfill Detail.

704.5.1 Precast Concrete Manholes.

Pre-cast concrete manholes shall be provided in accordance with TxDOT ITEM 465, (excluding ITEM 465.2 C, D and E), Park Equipment Storm Manhole Detail PCMHST-1 or approved equal.

704.5.2 Cast-in-Place Monolithic Concrete Manholes.

Cast-in-Place Manholes shall be constructed in accordance with the details on monolithic poured professionally engineered sealed design plans.

The minimum wall thickness shall be 6 inches. Maximum wall thickness shall be determined by the design engineer as dictated design by supporting design load and geotechnical reports. Concrete shall be placed complete in one casting. No joints will be allowed. Concrete shall be handled as described under concrete ITEM 407.15, "Concrete." Engineer of record shall supply engineered detail drawings for cast-in-place manholes.

704.5.3 Rings and Covers.

Ferrous castings shall be of uniform quality, free from blow holes, shrinkage, distortions, and other strength defects. They shall be smooth and cleaned by shot blasting. Gray Iron used in the manufacture of castings shall conform to ASTM A 48 Class 35B; Ductile Iron casting shall conform to ASTM A 536.

All castings shall be manufactured true to pattern, component parts shall fit together in a satisfactory manner. Round frames and covers shall have machine bearing surfaces to prevent rocking and rattling. Frame and cover castings must meet all the requirements of AASHTO

M 306. Castings shall be customized for the City of League City and shall be manufactured and installed in accordance with the City of League City "Standard Details."

The mill test reports or manufacturer's certification to the Engineer for each lot or shipment of steel and iron materials shall be provided to the office of the ~~Public Works Department~~ Engineering Department. For castings, also furnish a manufacturer's certification stating that the casting meets the proof-load testing requirements of AASHTO M 306.

704.6 Inlets.

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Inlet structures for open ditch interceptor structures shall be constructed of pre-cast concrete or cast-in-place concrete. Curb inlets for roadways shall be constructed of pre-cast concrete sections. Detail drawings of various types and sizes of inlets shall be included in the approved plans.

Inlet and outlet pipes shall extend through the walls of the structure for a sufficient distance beyond the outside surface to allow for connections but shall be cut off flush with the wall on the inside surface. Mortar shall be placed around these pipes so as to form a tight, neat, smooth connection.

Inlet inverts shall be constructed and shaped accurately with concrete so as to be smooth, uniform and cause minimum resistance to flowing water. The inlet bottom shall be sufficiently sloped downward toward the outlet to prevent pounding.

Inlet bases shall be cast or installed on a firm bedding of 6 inches of cement stabilized sand. Backfill around curb inlets shall be cement stabilized sand.

704.6.1 Precast Concrete Inlets.

Pre-cast inlets shall be provided in accordance with TxDOT ITEM 465, (excluding ITEM 465.2 C, D and E), Park Equipment Storm Inlet Details or approved equal.

704.6.2 Cast-in-Place Concrete Inlets.

Cast-in-Place Inlets shall be constructed in accordance with the details on monolithic poured professionally engineered sealed design plans.

The minimum wall thickness shall be 6 inches. Maximum wall thickness shall be determined by the design engineer as dictated by supporting design loads and geotechnical reports. Concrete shall be placed complete in one casting. No joints will be allowed. Concrete shall be handled as described under concrete ITEM 407.15, "Concrete." Engineer of record shall supply engineered detail drawings for cast-in-place inlets.

704.6.3 Frame, Grates, Rings and Covers.

Ferrous castings shall be of uniform quality, free from blow holes, shrinkage, distortions, and other strength defects. They shall be smooth and cleaned by shot blasting. Gray Iron used in the manufacture of castings shall conform to ASTM A 48 Class 35B; Ductile Iron casting shall conform to ASTM A 536.

All castings shall be manufactured true to pattern, component parts shall fit together in a satisfactory manner. Round frames and covers shall have machine bearing surfaces to prevent rocking and rattling. Frame and cover castings must meet the proof-load testing

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requirement of AASHTO M 306. Castings shall be customized for the City of League City and shall be manufactured and installed in accordance with the City of League City "Standard Details."

The mill test reports or manufacturer's certification to the Engineer for each lot or shipment of steel and iron materials shall be provided to the office of the ~~Public Works Department~~Engineering Department. For castings, also furnish a manufacturer's certification stating that the casting meets the proof-load testing requirements of AASHTO M 306.

704.7 Headwalls and Wingwalls.

Headwalls and wing-walls shall be provided in accordance with the standard structural designs of the Texas State Department of Highways and Public Transportation and in accordance with TxDOT ITEM 466. Concrete shall be provided in accordance with ITEM 407.15 "Concrete".

704.8 Pipe Bedding Material.

Where not otherwise specified or noted, all bedding material shall be provided in accordance with ITEM 407.14.2 "Cement-Stabilized Sand".

704.9 Concrete.

Concrete shall be provided in accordance with ITEM 407.15 "Concrete".

ITEM 705 EXCAVATION

Excavation shall be provided in accordance with ITEM 408 "Excavation".

ITEM 706 CONDUIT LAYING

All conduits shall be laid and maintained in the required lines and grades; with all appurtenances at the required locations.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. During handling and placement, materials shall be carefully observed and inspected, and any damage, defective, or unsound materials shall be rejected and removed from the job site.

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706.1 Trench Condition.

Trench condition shall be provided in accordance with ITEM 409.1 "Trench Condition".

706.2 Conduit Bedding and Embedment.

Except where otherwise approved by the ~~Public Works Department~~Engineering Department, all pipe, boxes and appurtenances shall be installed in a continuous envelope of specified bedding material. Specified bedding material for drainage structures shall be cement stabilized sand (see ITEM 407.14., "Materials"), extending from 6" below to 6" above the outer part of the conduit, extending for the full width between the undisturbed trench walls. The bedding material required beneath the conduit shall be placed, graded and tamped to the conduit sub-grade profile over the entire width between undisturbed trench walls and cut-outs made for the projection of the pipe bells.

The conduit shall be placed and adjusted to proper grade on this prepared bedding, then jointed, braced and blocked, as required. After conduit is graded into place, bedding material shall be placed simultaneously on both sides of the conduit and worked carefully into place without disturbing the conduit alignment, to an elevation of 6" over the conduit.

706.3 Assembling Conduit.

Assembly shall meet the manufactures recommendations for conduit and accessories being used. Unless otherwise directed, conduits shall be laid with bell ends facing up-grade.

All connections shall be watertight and made so that a smooth uniform flow-line will be obtained throughout the drainage system.

ITEM 707 BACKFILL AND SETTLEMENT

Backfill and settlement shall be provided in accordance with ITEM 410 "Backfill and Settlement".

ITEM 708 VISUAL TEST

All drainage facilities shall be inspected visually to verify accuracy of alignment and freedom from debris and obstruction. Storm Sewers 48 inches and smaller will be inspected with television equipment.

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The developer is responsible for the TV inspection of newly constructed storm sewer lines. The TV inspection shall take place before the final walk-through inspection is performed.

Personnel from the City's Storm Water Department or the City's Engineering Department shall witness the TV inspection, which shall be performed during the City's normal working hours.

The method for the inspection shall include:

1. Cleaning the lines, (if not already cleaned);
2. Removing downstream plugs, if any;
3. Videotaping the system.

The developer shall provide the City with one copy of the TV videotape and one copy of the TV inspection report. For each segment the video tape and corresponding written report shall clearly identify.

1. Each line segment being inspected;
2. The size and type of pipe being inspected;
3. Accurate footage of the line segment inspected;
4. Deficiencies in materials, alignment, pipe shape, grade, or any other apparent deficiencies; and

Any drainage structure which causes excess pounding of water, any miss aligned joints, settled conduits or other defects; shall be cause for rejection.

Any system designed as a submerged system shall be inspected in the dry, prior to flooding. All other drainage systems shall be dry and clean prior to visual test.

ITEM 709

STORM SEWER CONNECTIONS TO THE EXISTING SYSTEM

Unless otherwise approved by the ~~Public Works Department~~ Engineering Department, all connections of a storm sewer system to existing storm sewer systems shall be made at manholes with the crown of the inlet pipe installed at the same elevation as the crown of the existing pipe as the taps are being made.

ITEM 710

CLEAN UP AND RESTORATION

Clean up and restoration shall be provided in accordance with ITEM 414 "Clean-up and Restoration".

ITEM 711

APPROVAL AND ACCEPTANCE

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Approval and acceptance shall be provided in accordance with ITEM 415 "Approval and Acceptance".

ITEM 712 WARRANTY OF WORK

Warranty of work shall be provided in accordance with ITEM 416, "Warranty of Work".

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TRAFFIC AND TRANSPORTATION STANDARDS AND GUIDELINES

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B. DEFINITIONS

1. **AADT** is the total volume of traffic passing a point or segment of a highway facility in both directions for one year divided by the number of days in the year.
2. **Access Connection** is any facility for entry and/or exit such as a driveway, street, road, or highway.
3. **Access Management** is the systemic control of the location, spacing, design and operation of driveways, median openings, interchanges and street connections to a roadway.
4. **ADT** is the average daily traffic volume. It represents the total two-way traffic on a roadway for some period less than a year, divided by the total number of days it represents, and includes both weekday and weekend traffic. Usually, ADT is adjusted for day of the week, seasonal variations, and/or vehicle classifications.
5. **All-Way Stop Controlled** is an intersection with stop signs at all approaches.
6. **Analysis Engineer (TIA)** an individual, group, firm, or corporation having demonstrated professional emphasis and experience in traffic engineering, the preparation of similar analyses, and a Texas Licensed Professional Engineer specializing in the branch of civil engineering.
7. **Anticipated Opening Year** means the opening year of each phase of a development.

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8. **Applicant** shall mean the owner of property or the owner's authorized agent who applies for a subdivision plat, development plat, general plan or street dedication plat pursuant to Chapter 102 of the League City Code of Ordinances.
9. **Auxiliary Lane** is a lane striped for use as an acceleration lane, deceleration lane, right-turn lane, or left-turn lane, but not for through traffic use.
10. **Background Traffic Conditions** are the operating characteristics of transportation infrastructure within the corresponding TIA category analysis areas prior to the opening of a proposed development. Establishing project traffic conditions shall be accomplished by growing existing traffic volumes and adding any approved or identified future development traffic volumes.
11. **Building** means the principal structure or structures erected or to be erected upon the land described in a declaration which determines the use to be made of the improved land, whether or not such improvement is composed of one or more separate buildings, containing one or more floors or stories.
12. **Building Permit** shall mean a certificate issued by the building official authorizing performance of a specified activity under the Construction Code.
13. **Bus** is a design vehicle class that includes intercity (motor coaches), city transit, school and articulated buses.
14. **Capacity** is the number of vehicles that can traverse a point or section of a lane or roadway during a set time period under prevailing roadway, traffic and control conditions.
15. **City** means the City of League City.
16. **City Limits** means the city boundary as fixed by the mayor and council and defined in the League City Code of Ordinances.
17. **Collector Streets** means a street designed to provide both local access and traffic circulation within residential neighborhoods, commercial and industrial areas. They differ from arterial systems in that collector streets may penetrate identifiable neighborhoods. Collector streets distribute traffic between the arterial and local street system.
18. **Connection Spacing** is the distance between connections, which is measured along the edge of the traveled way from the closest edge of pavement of the first access connection to the closest edge of pavement of the second access connection.
19. **Context Sensitive Solutions** is a collaborative, interdisciplinary process that involves all stakeholders to design a transportation facility that fits its applicable setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility. CSS respect design objectives for safety, efficiency, capacity and maintenance, while integrating

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community objectives and values relating to compatibility, livability, sense of place, urban design, cost and environmental impacts.

20. **Corner Clearance** is the distance along the edge of the traveled way from the closest edge of pavement of the intersecting public or private street to the closest edge of pavement of the nearest driveway.
21. **Corner Lot** is a lot located at the intersection of two streets that has frontage on each street.
22. **Delay** means control delay as outlined in the Highway Capacity Manual or as simulated in approved analysis software.
23. **Design Exception** shall mean any City Traffic Engineer approved variation from the requirements of section 1.03 of this chapter.
24. **Design Manual** shall mean the League City General Design & Construction Standards (2010) for wastewater collection systems, water lines, storm drainage, and street paving, as it may be amended from time to time.
25. **Design Speed** is a selected speed used to determine the various geometric design features of the roadway.
26. **Design Vehicle** is a chosen vehicle, with representative weight, dimensions, and operating characteristics used to establish design controls for accommodating vehicles of designated classes. There are four general classes of design vehicles: passenger cars, buses, trucks, and recreational vehicles.
27. **Develop/Development** means any site where construction, demolition, site clearing, grubbing, grading and any other activity which may disturb the surface of land (streets, drives, parking lots, sidewalks, etc.) and all other proposed improvements.
28. **Divided Street** is a street with a median designed to separate traffic moving in opposite directions.
29. **Driveway** is an access connection constructed within the public right-of-way, used to connect a public or private street with adjacent property.
30. **Driveway, Commercial** shall be any driveway that provides access to offices, retail buildings, institutional buildings (schools), gas stations, industrial facilities needing a driveway that operates with little or no heavy vehicle traffic, or multi-family buildings. Commercial driveways serve passenger cars and a small number of trucks usually for deliveries.
31. **Driveway, Industrial** shall be any driveway that provides access for heavy vehicles into loading areas (docks) for industrial facilities, warehouses, and truck terminals. Developments may have designated driveways designed and marked as industrial driveways to provide access for heavy vehicles.

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32. **Driveway, Multi-Family** shall be any driveway that provides access to multi-family buildings. Multi-Family driveways serve passenger cars and a small number of trucks usually for deliveries.
33. **Driveway, One-way** shall be any driveway with operation limiting vehicles to either enter or exit but not both.
34. **Driveway, Residential** shall be any driveway that provides access to single-family residences. Residential driveways typically serve passenger cars.
35. **Driveway, Two-way** shall be any driveway that allows vehicles to both enter and exit simultaneously.
36. **Engineering Study** represents supporting documentation or evidence based on state of the practice transportation engineering methods relevant to the situation under review.
37. **Existing Traffic Conditions** are the current operating characteristics of transportation infrastructure within corresponding TIA category analysis areas. Existing traffic conditions shall be acquired through traffic counts.
38. **Extraterritorial Jurisdiction** is the unincorporated territory extending beyond the corporate boundaries of the city established pursuant to Chapter 42 of the Texas Local Government Code, as may be amended from time to time.
39. **Final Plat** shall have the meaning ascribed to it in Chapter 102 of the League City Code of Ordinances: A map or drawing of a proposed subdivision prepared in a manner suitable for recording in the appropriate county map, plat or real property records and prepared in conformity with the requirements of Section 102-4 of Chapter 102 of the League City Code of Ordinances.
40. **Five Year Capital Improvement Plan (CIP)** is street improvement projects included in a Capital Improvement Plan by the City of League City, Galveston County, TxDOT, or other organizations for construction.
41. **Frontage Road** is a local street or road along an arterial highway allowing control of access and service to adjacent areas and property. May also be referred to as a service road.
42. **Full Build-Out Year** means the year when all phases of a development are expected to be completed.
43. **Functional Area (Intersection)** is the area of an intersection necessary to provide all required storage lengths for separate turn lanes and for through traffic plus any maneuvering distance for separate turn lanes. The functional boundary of an intersection includes more than just the physical area of the intersection.
44. **Functional Classification** group streets and highway according to the character of service they are intended to provide.

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- 45. **Internal Capture** means the application of a percent reduction in generated trips (driveway trips) and is typically applicable to projects such as shopping centers with out-lots.
- 46. **Intersection** means the area embraced within the prolongation or connection of the lateral curb lines, or if none, then the lateral boundary line of the roadways of two streets which join one another at, or approximately at, right angles, or in the area within vehicles traveling upon different highways joining at any other angle may come in conflict. Where a street included two roadways, 30 feet or more apart, then every crossing of each roadway of such divided street by an intersecting street shall be regarded as a separate intersection. In the event such intersecting street also includes two roadways 30 feet or more apart, then every crossing of two roadways of such street shall be regarded as a separate intersection. The junction of an alley with a street or highway shall not constitute an intersection.
- 47. **Joint Access** See "Shared Access"
- 48. **Level of Service (LOS)** represents the measure of traffic flow and congestion. As defined in the Highway Capacity Manual, it is a qualitative measure describing operational conditions within a traffic stream, generally described in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.
- 49. **Local Streets** means a street designated to serve the local needs of the neighborhood and to provide access from abutting residential properties to other streets.
- 50. **Major Arterial** means a continuous street system serving moderate to long trip lengths that distributes traffic from the freeway/expressway system to and from the metropolitan area. The focus of major arterials is to provide mobility rather than land access. Major arterials should not penetrate identifiable neighborhoods.
- 51. **Major Intersection** is any intersection carrying significant traffic volume or one that is controlled by a traffic signal or stop sign.
- 52. **Measure of Effectiveness (MOE)** are performance measures that quantify traffic operations objectives. Some examples of a MOE are travel time, speed, delay, queue length, stops, density, and travel time variance.
- 53. **Median** is the portion of a divided street separating opposing traffic flows. A median may be traversable or nontraversable.
- 54. **Median Opening Spacing** is the allowable spacing between openings in a nontraversable median to allow for crossing the opposing traffic in order to access property or for crossing the median to travel in the opposite direction (U-turn). The distance is measured from centerline to centerline of the openings along the traveled way.

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- 55. **Median, Directional Opening** is an opening in a nontraversable median that accommodates specific movements, such as U-turn movements and/or left-turn movements from the highway, and physically restricts other movements.
- 56. **Median, Full Opening** is an opening in a nontraversable median that allows all turning movements from the street and the adjacent connection, as well as crossing movements.
- 57. **Median, Nontraversable** is a physical barrier in a street or driveway that separates vehicular traffic traveling in opposite directions. Nontraversable medians include physical barriers (Such as a concrete barrier, a raised concrete curb and/or island, and a grass or a swale median) that prohibit movement of traffic across the median.
- 58. **Median, Traversable** is a median that, by its design, does not physically discourage vehicles from entering or crossing over it. This may include painted medians.
- 59. **Minor Arterials** accommodate moderate trip lengths at a somewhat lower level of mobility. Minor arterials provide a lower level of mobility and distribute traffic to smaller geographic areas than major arterials. Minor arterials should not penetrate identifiable neighborhoods, but can provide direct access to abutting property.
- 60. **Mitigation Measure** means a transportation improvement that will reduce or eliminate adverse traffic impact on the area street system, as typically identified in findings associated with a traffic impact analysis of a proposed development.
- 61. **Multi-Family Residential** shall mean the use of property with one or more buildings on a parcel designed for and containing an aggregate of three or more dwelling units. Multi-family residential includes apartments, condominiums, boarding houses, triplexes and quadriplexes.
- 62. **Off-Street Parking** is vehicular parking that is provided in a location other than the public right-of-way.
- 63. **Operating Speed** is the speed at which drivers are observed operating their vehicles during free-flow conditions. The 85th percentile of the distribution of observed speeds is the most frequently used measure of the operating speed associated with a particular location or geometric feature.
- 64. **Pass-By Trips** means the application of a percent reduction in background traffic conditions due to the expectations of overlapping travel patterns between some existing and generated trips. This rate does not affect the proposed project's driveway volumes but rather reassigns existing trip to movements entering and exiting the proposed development.
- 65. **Passenger Vehicle** is a design vehicle class that includes passenger cars of all sizes, sport/utility vehicles, minivans, vans, and pick-up trucks.

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- 66. **Peak Hour** means the peak one hour of traffic volume which occurs during the AM (6:00 – 9:00) and PM (4:00 – 7:00) period. In some cases, however, there may be need for additional hours, for example, Friday night, and Sunday morning.
- 67. **Private Drive** is a privately owned way used for vehicular travel that is not a street or private street and provides an unobstructed connection between one or more streets or private streets or to any portion of a parking lot, shopping center, institution, commercial area or industrial development. A private drive may provide for access by the general public, but the owner of the private drive shall maintain the right to restrict public access to the private drive.
- 68. **Private Street** means a non-dedicated street on private property. Private streets must conform to Section 102-5 of Chapter 102 of the League City Code of Ordinances.
- 69. **Project Traffic Conditions** are the future operating characteristics of transportation infrastructure within corresponding TIA category analysis areas. Establishing project traffic conditions is accomplished by adding the trips generated by the proposed development to background traffic conditions.
- 70. **Proposal of Scope** is a document prepared by the analysis engineer that is submitted to the City to ensure that the submittal of the TIA will allow the City to evaluate the overall impact of the development on an adjacent transportation infrastructure.
- 71. **Public Street** is a public right-of-way however designated, dedicated or acquired, that provides access to adjacent property.
- 72. **Recreational Vehicle** is a design vehicle class that includes motor homes, cars with camper trailers, cars with boat trailers, motor homes with boat trailers, and motor homes pulling cars.
- 73. **Reserve Tract** means a parcel of land that is not a lot, but is created within a subdivision plat for other than single-family residential use and is established to accommodate some purpose for which a division into lots is not suitable or appropriate.
- 74. **Right-of-Way** means real property interest in a parcel or strip of land that is conveyed or dedicated to the public or other specified entity for purposes of right of passage across said parcel or strip and/or for the right to install, maintain, and operate public or private infrastructure and appurtenances, including but not limited to, street paving, sidewalks and trails, drainage facilities, water and waste water facilities, and other public utilities (electric power, phone, gas, and cable television).
- 75. **Shared Access** is a single connection serving two or more adjoining lots or parcels.

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- 76. **Sight Distance** is the distance visible to the driver of a passenger vehicle measured along the normal travel path of a roadway from a designated location and to a specified height above the roadway when the view is unobstructed by traffic.
- 77. **Signal** is a traffic control signal.
- 78. **Signalized Intersection** is an intersection under the operational control of a traffic control signal and meets the design requirements for public or private streets as specified in this set of guidelines.
- 79. **Single Family Residential** means the use of a lot with one building designed for and containing not more than two separate units with facilities for living, sleeping, cooking and eating therein.
- 80. **Site Access Connection** See "Driveway"
- 81. **Site Access Private Street** See "Street"
- 82. **Site Plan** is a drawing that shows the existing and proposed conditions of a development as specified by Chapter 102 of the League City Code of Ordinances.
- 83. **Speed Change Lane** is an auxiliary lane, including tapered areas, primarily for the acceleration or deceleration of vehicles entering or exiting the through-traffic lanes.
- 84. **Stopping Sight Distance (SSD)** is the distance required by a driver of a vehicle, traveling at a given speed, to bring the vehicle to a stop after an object on the roadway becomes visible. It includes the distance traveled during driver perception-reaction time and the vehicle braking distance.
- 85. **Storage Lane Length** is the portion of an auxiliary lane required to store the number of vehicles expected to accumulate in the lane during an average peak period.
- 86. **Subdivision Plat** shall mean a map or plan prepared and approved pursuant to the applicable provisions of Chapter 102 of the League City Code of Ordinances, Section 102-4 showing the proposed subdivision of land of an instrument recorded in the map, plat or real property records of the appropriate county showing the previous subdivision of property. A subdivision plat includes a replat, an amending plat, and a vacating plat. For the purposes of this document a subdivision plat also represents the term manufactured home subdivision as defined in Chapter 102 of the League City Code of Ordinances.
- 87. **Suburban Area** is an area of the city or its extraterritorial jurisdiction that is not an Urban Area.
- 88. **Traffic Impact Category** is a division that is based on findings of an initial trip generation estimate of peak hour trips and specifies analysis horizons and limits.

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89. **TIA Guidelines** are the rules and regulations for a traffic impact analysis promulgated pursuant to League City Code of Ordinances, and contained in this manual.
90. **Traffic** means pedestrians, ridden or herded animals, vehicles, and other conveyances, either singly or together, while using any street or highway for purposes of travel.
91. **Traffic Impact Analysis (TIA)** is a study that analyzes the traffic impact of a development and determines measures necessary to mitigate any identified potential adverse traffic impacts with aim to maintain satisfactory/quality area street system traffic operations based on the qualitative measure Level of Service.
92. **Transportation Facility** is any facility which is intended for the movement of goods or persons and includes, but is not limited to, roadways, pedestrian walkways, bicycle lanes, and area transit.
93. **Trip Assignment** is the application of distribution factors to the estimated number of trips generated by the proposed development and other nearby approved projects and assigned to the existing traffic on the street network within the analysis area.
94. **Trip Distribution** is the directional distribution of the generated trips entering and exiting the proposed development via all access points. These distributions must be justified by the relative locations of other traffic generators (e.g., employment centers, transportation terminals, etc.).
95. **Trip Generation** is the application of average trip generation rates or regression equations for the peak hour of the adjacent street obtained from the current edition of the Institute of Transportation Engineer's *Trip Generation Handbook* or other local data provided it was collected using recommended methodology and can be properly documented.
96. **Trip Generation Estimate** is an estimated number of new peak hour trips generated by a proposed development.
97. **Truck** is a design vehicle class that includes single-unit trucks, truck tractor-semitrailer combinations, and truck tractors with semitrailers in combination with full trailers.
98. **Unsignalized Intersection** is an intersection that is not signalized and meets the design requirements for public or private streets as specified in the City of League City Design Guidelines.
99. **Urban Area** is characterized by higher population density and vast human features in comparison to areas surrounding it.
100. **Variance** is a commission-approved deviation from the requirements of League City Design Standards.

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ITEM 801 ACCESS MANAGEMENT STANDARDS

A. APPLICABILITY

1. The access management standards contained in this section are applicable to each development, all or a portion, which is located within the defined corporate city limits of the City of League City, Texas.
2. The requirements contained within this document are design standards and will serve as a reference for development plat approvals and building permits. These standards should be used in conjunction with the League City Code of Ordinances and other requirements set forth in this manual as currently amended.

B. GENERAL

1. Purpose and Intent of Access Management Standards
 - a. The overall purpose of implementing the City of League City Access Management Standards is to enhance the value of City streets. This enhancement will be accomplished through preservation and improvement of operational efficiency and safety. Improving efficiency delays the need for more costly street improvements, while improving safety creates more favorable driving conditions which in turn promote economic activity involving adjoining properties. All access management standards and specific implementation measures have been identified and developed for supporting the goal of enhancing the value of City streets. This goal should be the purpose for all application and implementation of these standards and requirements. The intent of all criteria and requirements of the access management standards is to preserve and improve street efficiency, street safety, and opportunities for economic activity.
 - b. Each specific application and implementation of these standards and requirements must be consistent with such intent. Furthermore, it is not the intent of the Access Management Standards to affect the diminution in value of private properties by either creating an unintended limitation on use of private property or by the complete prevention of reasonable access to the property (land locking). It is also not the intent of the Access Management Standards to revoke or unreasonably restrict access existing prior to the implementation date of the Standards where no intervening change in land use has occurred. Any application or implementation of the Standards, which would have the aforementioned impacts, must be carefully considered and altered to avoid or mitigate such adverse impacts to property values.

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- c. The intent of the criteria and requirements of the Access Management Standards should not be construed to eliminate the need for specific engineering study and analysis for each instance where they are to be applied and implemented.
- 2. Document Limitations
 - a. While this document contains standards applicable to site development within the City, the City does not intend this document to be a “catch all” device. This document does not adequately address location specific characteristics that vary from normal traffic operations including areas with relatively high pedestrian and bicyclist volumes.

C. BACKGROUND

- 1. Before detailing the specific technical aspects of access management, it is important to gain a clear understanding of what are access management standards, how they are implemented, and how implementing standards may affect potential stakeholders.
- 2. What are Access Management ~~Standards~~Standards?
 - a. "Access management is the systematic control of the location, spacing, design, and operation of driveways, medians, auxiliary lanes, and intersections in order to improve the balance between access and mobility while preserving street efficiency and safety. Access management can have significant positive impacts on the community by improving street safety and operation, potentially delaying costly street improvements by efficiently removing slower, turning vehicles from the street. In addition, access management can have a positive impact on local businesses by creating more favorable driving conditions through increased capacity and circulation, thus exposing more motorists to those businesses."
 - b. Access management standards will control the location, spacing, design, and operation of access. Application of Access Management Standards should be consistent and firm, but with enough flexibility to consider limitations under special circumstances.
- 3. Implementing Access Management Standards
 - a. Traditionally, agencies exercise access management techniques using a street classification system. This classification system defines streets by level of mobility, and with access characteristics. For example, the Texas Department of Transportation (TxDOT) defines four functional classifications in their Access Management Manual; freeways, arterials, collectors, and local streets. The City of League City Master Mobility Plan designates four functional street classifications; major arterial, minor arterial, collector, and local. One can see in **Figure 801.01** an inverse

relationship between mobility and access as well as an orderly relationship between mobility, access, and functional class.

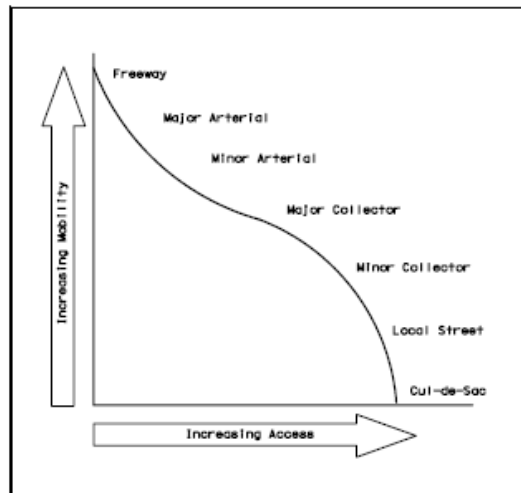


Figure 801.01 Mobility, Access, and Functional Class Relationships (TxDOT)¹

- b. For the purposes of this manual the City of League City Master Mobility Plan functional classifications and Average Annual Daily Traffic (AADT) should be utilized.

4. Benefits of Access Management

- a. Available research suggests that the implementation of access management techniques will improve safety, travel speed, and street capacity without negatively influencing local businesses. Implementing access management techniques, in many cases, has improved business, and motorist/customer opinion of driving conditions within studied corridors.

D. APPLICATION OF ACCESS MANAGEMENT CRITERIA

- 1. The access management standards in the following sections are intended for application to city streets (within the corporate city limits) where the city has permitting authority (see **Figure 801.02**). Access management standards contained within this document have been assembled utilizing local, state, and national guidance.

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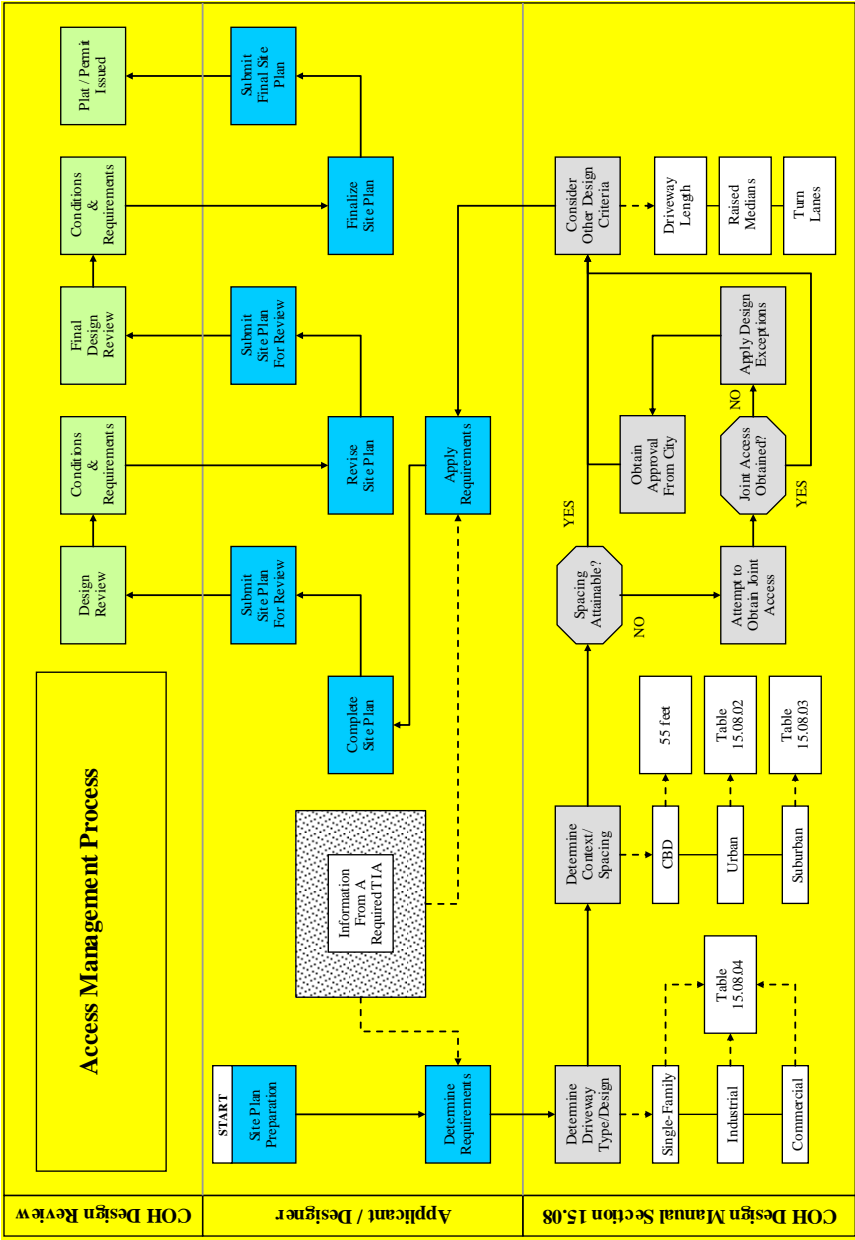


Figure 801.02 Access Management Overview

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2. Access Management Connection Spacing
 - a. The section titled Access Management Connection Spacing is intended for passenger cars on level grade. These distances may be increased for downgrades, truck traffic, or where otherwise indicated for the specific circumstances of the site and roadway. Design exceptions (shorter distances) may be appropriate to provide reasonable access, and such decisions should be based on safety and operational factors supported by engineering study.
 - b. Design exceptions may also be appropriate where topography or other existing conditions make it inappropriate or not feasible to conform to the connection spacing intervals. The location of reasonable access will be determined with consideration given to the topography, established property ownerships, unique physical limitations, and/or physical design constraints. The selected location should serve as many properties and interests as possible to reduce the need for additional direct access to City streets. In selecting locations for full movement intersections, preference will be given to public roadways that are in the City's Master Mobility Plan.
3. Access Management Design
 - a. The section titled Access Management Design is intended to provide standards that allow for the quick and efficient movement of vehicles from the City street system. Design exceptions may be appropriate to accommodate all system users, and such decisions should be based on safety and operational factors supported by engineering study.
 - b. Design exceptions may also be appropriate where existing conditions make it inappropriate or not feasible to conform to the design standards. Acceptable design element exceptions will be determined with consideration given to unique physical limitations, physical design constraints, system user characteristics, safety, and operations.
4. Reserved Future Programs
 - a. Access management techniques may be tailored to particular future planning concepts. Decision to vary from these standards should be based on safety and operational factors supported by engineering study
 - Urban Corridor Planning
 - Pedestrian Oriented Development Districts
5. Existing Access and Exemptions
 - a. Existing access shall be maintained unless the existing land use is being changed. Any site modifications that drastically change building orientation and/or location will trigger an evaluation of existing access. An increase in

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trips that is greater than 100 trips per hour will also trigger an evaluation of existing access. See Item 802 for TIA details and requirements.

- b. As of the effective date of this section all previously permitted access will be considered acceptable to the City of League City based on the above amendment. However, property owners must coordinate with the City prior to making any property modifications that will result in changes to the traffic patterns associated with the access. This paragraph will not operate to convey property rights or eliminate the need to purchase access in location where the City controls the access.

E. DESIGN EXCEPTION PROCESS (The City of League City as Permitting Authority)³

1. Access Management Connection Spacing

- a. An approved spacing that is shorter than the minimum allowable, as set forth in this document, is considered a design exception from the standards, and requires a design exception request. Design exception requests shall be submitted to the Traffic and Transportation Department and must be approved by the City Traffic Engineer.
- b. It should be noted that a design exception (smaller connection spacing than set forth in this document) must be allowed in the following situations:
 - To prevent land-locking a property where such land-locking is solely the result of action by the City (for example, design and construction modifications which physically prevent a driveway installation due to grade changes, retaining walls, or barrier installations) where the City does not control the access; or
 - Replacement or re-establishment of reasonable access to the City street system under street reconstruction/rehabilitation projects.
- c. The above references to land-locking do not apply to circumstances where an existing larger tract of land is subsequently (after the effective date of this section) further subdivided (and the subdivided lots sold to separate owners) and the original tract of land either already has an existing permitted access connection point, or would qualify for such an access connection point based upon the spacing requirements of this section. Potential land-locking caused by subdivision and resale is the result of such subdivision process and will not alone justify design exceptions in the spacing requirements contained in this section (801). Therefore, as part of the subdividing process, the party proposing the subdivision should provide some type of internal access easements to the existing access connection points (or to such access connection point locations that qualify for the future permits based on the section's spacing requirements).

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- d. When a design exception request is approved for an access connection spacing that is less than the given connection spacing criteria, the permit may include conditions such as, driveway type (if applicable) or other conditions with respect to granting the exception. Violation of the conditions under which the exception was granted may require reevaluation of the access permit, particularly if safety or crash records indicate deteriorated traffic safety on the abutting City street.

2. Access Management Design

- a. City approved design criteria that does not adhere to the standards set forth in this section (801) is considered an exception from the standards and requires a design exception request. Design exception requests shall be submitted to the Traffic and Transportation Department and must be approved by the City Traffic Engineer.
- b. It should be noted that variance from design criteria set forth in this document may be allowed without a design exception in the following future planning concepts:
 - Urban Corridors as determined by City Planner
 - Pedestrian Oriented Development Districts as determined by the City
- c. When a design exception is approved, the approval may include conditions such as driveway type and design vehicle, or other conditions with respect to granting the exception. Violation of the conditions under which the exception was granted may require reevaluation of access design, particularly if safety or crash records indicate deteriorated traffic safety on the abutting City street.

F. ACCESS MANAGEMENT CONNECTION SPACING

1. Connection spacing requirements are broken into five categories; signalized intersection, un-signalized intersection, frontage roads, driveway spacing and corner clearance, and median opening spacing.
2. Signalized Street Spacing
 - a. Signalized intersection spacing is a minimum of 1320 feet.
3. Un-signalized Street Spacing
 - a. Un-signalized intersection spacing criteria can be found in ITEM 602 – Section 602.1.7 – Intersection Design.
4. Frontage Roads
 - a. **Table 801.01** provides the minimum intersection and driveway spacing criteria for frontage roads. Additionally, for areas with conventional diamond ramp patterns the most critical areas for operations are between the exit ramp and the arterial street and between the arterial street and the

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entrance ramp. In X-ramp configurations, the most critical areas are between the exit ramp and the subsequent entrance ramp. Although **Table 801.01** gives minimum spacing criteria, these aforementioned critical areas may need greater spacing requirements for operational, safety, and weaving efficiencies.

- b. The distance between access connections shall be measured along the edge of traveled way from the closest edge of pavement of the first access connection to the closest edge of pavement of the second access connection. Additionally, the access connection spacing in the proximity of frontage road U-turn lanes will be measured from the inside edge of the U-turn lane to the closest edge of the first access connection (see **Figure 801.03**).

Table ~~801.01~~ Frontage Road Connection Spacing Criteria

Posted Speed (mph)	Minimum Spacing (ft)	
	Suburban	Urban
30	175	150
35	225	200
40	305	250
45	360	360
>50	425	425

Other notes regarding frontage road spacing requirements:

- (1) Distances are for passenger cars on level grade.
- (2) Distances are for both one-way and two-way frontage roads
- (3) These distances may be adjusted for downgrades and locations with heavy truck traffic.
- (4) Where present or projected traffic operations indicate specific needs, consideration may be given to intersection sight distance and operational gap acceptance measurement adjustments.

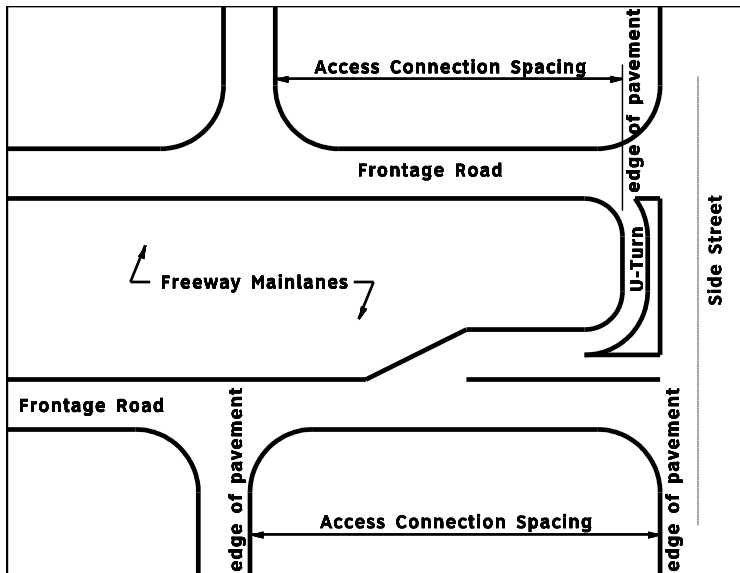


Figure 801.03 Frontage Road Spacing

5. Driveway and Corner Clearance Spacing (City and State Facilities)
 - a. The distance between connections (driveway-driveway and driveway-street) is measured along the edge of traveled way from the closest edge of pavement of the first connection to the closest edge of pavement of the second connection (see **Figure 801.04**). Access connection spacing for Urban and Suburban Areas can be found in **Tables 801.02 to 801.03**.

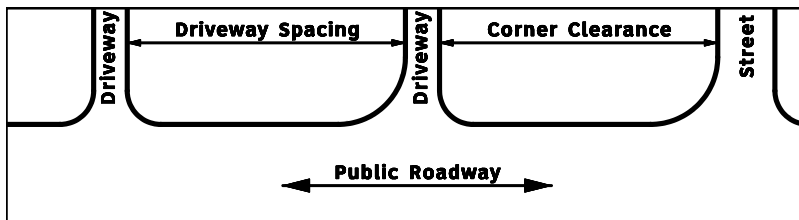


Figure 801.04 Driveway Spacing

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Table 801.02 Urban Access Spacing Criteria

	Functional Classification			
	Major Arterial	Minor Arterial	Collector	Local**
Speed* (mph)	Access Spacing (ft)			
30 or Less	150	125	100	50
35	200	175	150	50
40	250	225	200	50
45	350	325	300	50

*Greater of design speed, posted speed, or operating speed.

**Existing Standard

Table ~~801.03 Suburban~~ 801.03 Suburban Access Spacing Criteria

	Functional Classification			
	Major Arterial	Minor Arterial	Collector	Local**
Speed* (mph)	Access Spacing (ft)			
30 or Less	200	175	150	50
35	250	225	200	50
40	305	305	250	50
45	360	360	360	50
50 or Greater	425	425	425	50

*Greater of design speed, posted speed, or operating speed.

**Existing Standard

b. Notes regarding connection spacing:

- Spacing criteria is for passenger cars on level grades. Distances may need to be increased for driveways carrying a high volume of heavy vehicle traffic.
- Spacing criteria is applicable only for multi-family residential, commercial, and industrial driveways.
- Properties may have multiple frontages and criteria should be applied to each frontage individually.

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- Where present or projected traffic operations indicate specific needs, consideration may be given to sight distance and operational gap acceptance measurement adjustments.
 - A pair of one-way driveways (entry and exit) should be considered as a two-way driveway for spacing purposes.
 - Spacing between one-way driveways may be at any distance so long as the entry precedes the exit in the direction off the adjacent travel lane and the one-way pair meets spacing requirements from adjacent driveways or streets.
 - For the special situation of multiple entry driveways placed on one street and exit driveways placed on a different street, two same street driveways should be considered as a one-way pair.
 - Driveways on a street without a median should align with driveways on the opposite side of the street.
 - Non-residential developments are allowed multiple driveways as long as spacing requirements are met.
 - Driveways shall not be placed in the functional area of any intersection of streets.
 - Special consideration shall be given to loading docks and service driveways for an optimum balance between traffic operation and specific needs of the development.
- c. Design Exception Guidance
- The spacing of access should be managed in a way that would still provide right of entry to the property, in the manner that is the least detrimental to the integrity of traffic operations and ~~cost efficient~~cost-efficient design. If the above spacing criteria cannot be met for the placement of a single driveway on a single frontage the following should be used to support a request for a design exception to be approved by the City Traffic Engineer.
 - ⇒ Provide evidence of an attempt to meet spacing criteria in the above tables.
 - ⇒ The City recommends that joint access be obtained if possible. It is recommended that if joint access is not possible, a letter of non-agreement or supporting documentation be provided to the City.
 - ⇒ Suggested minimum spacing if property is not on the corner of intersecting streets; place driveway equal distance from adjacent driveways no less than 55 feet apart.

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⇒ Suggested minimum spacing if property is on the corner of two intersecting streets; place driveway a distance no closer than the driveway radius from the property line farthest from the intersection of streets.

6. Median Opening Spacing

- a. Guidance for Median Opening Spacing also known as Minimum Median Lengths can be found in **Section 807** of this manual.

G. ACCESS MANAGEMENT – DESIGN

1. An important underlying aspect of managing access is managing the design of access related treatments such as driveways, medians, auxiliary lanes, and intersections. This process not only includes the actual design of a treatment, but in some cases when and where public agencies should implement a treatment.
2. Driveways
 - a. Driveways should be located and designed to minimize impacts on traffic while providing safe access to a development. The proper location and design of a driveway must take into account characteristics of the street, the development, and potential users. Therefore, driveway design is based on three different classifications; residential, multi-family/commercial and industrial. One-way driveways must intersect city streets between 45 and 90 degrees. Two-way driveways must intersect city streets at approximately 90 degrees. Driveway Width is measured at the beginning of the driveway radii tangents within the driveway (see **Figure 801.05**). Driveway Radius is the rounded edge of a driveway that permits easier entry and exit by turning vehicles. Design standards for minimum driveway width and radius can be found in **Table 801.04**.

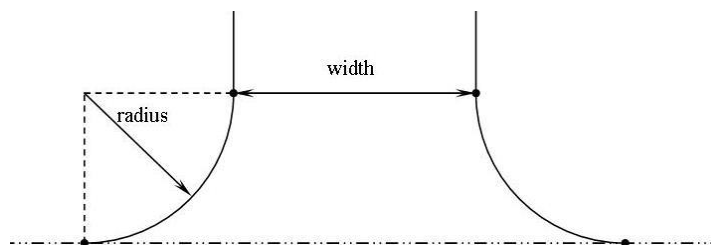


Figure 801.05 Driveway Radius and Width

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Table 801.04 Driveway Design Criteria

	Single Family Residential				Multi-Family and Commercial				Industrial			
	Radius (ft)		Width (ft)		Radius (ft)		Width (ft)		Radius (ft)		Width (ft)	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Two-Way	10	4	24	12	30	15	35	24	35	25	CBC*	
Joint-Access	10	4	24	12	30	15	35	24	35	25	CBC*	
	Entr y	Exit	Max	Min	Entr y	Exit	Max	Min	Entr y	Exit	Max	Min
One-Way	10	4	20	12	25	15	20	15	35	20	20	15

*CBC – Case-by-Case

b. Notes on Driveway Design Criteria

- Where situations permit AASHTO Green Book Design Vehicles may be used to justify driveway radii (see **Table 801.05**).

Table 801.05 AASHTO Design Vehicle Radius Needs

Design Vehicle	Code	Minimum Design Turning Radius (ft)
Passenger Car	P	24.0
Single Unit Truck	SU	42.0
Intercity Bus	BUS-40	45.0
Intercity Bus	BUS-45	45.0
City Transit Bus	CITY BUS	42.0
Conventional School Bus	S-BUS36	38.9
Large School Bus	S-BUS40	39.4
Articulated Bus	A-BUS	39.8
Intermediate Semi-Trailer	WB-40	40.0
Intermediate Semi-Trailer	WB-50	45.0
Interstate Semi-Trailer	WB-62	45.0
	WB-65 OR WB-	
Interstate Semi-Trailer	67	45.0
Double Bottom Comb	WB-67D	45.0
Triple Semi-Trailer	WB-100T	45.0
Turnpike Double	WB-109D	60.0

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Motor Home	MH	40.0
Car and Camper Trailer	P/T	33.0
Car and Boat Trailer	P/B	24.0
Motor Home and Boat	MH/B	50.0
Farm Tractor with 1 Wagon	TR/W	18.0

- A driveway at a signalized intersection must match the width and geometrics of the terminating street it is in alignment with.
 - Where present or projected traffic operations indicate specific needs, consideration may be given to pedestrians, heavy vehicles, and development characteristics; or as approved by the City.
 - For one-way driveways, the entry driveway shall precede exit driveways (in direction of adjacent travel lane).
 - Where off-street "back-in" type truck loading docks/wells are constructed on local streets, the width of the driveway opening may be increased to a maximum of 50 ft.
 - Entry and exit criteria refer to the entry and exit radii. Opposite radii on one-way driveways must be a minimum of 4 feet.
 - In no case shall the driveway radius encroach on abutting property or street corner radius.
 - Driveway must remain tangential for a minimum of 20 feet past the property line.
- c. Driveway Length helps guide entering vehicles without disturbing traffic within the development or on the abutting street. A minimum of 20 feet must be provided between the property line and the first parking stall.
- d. Driveway Grade is the slope a vehicle must traverse to enter a driveway. City design standards provides guidance on driveway grade.
3. Medians
- a. Median design involves mainly median type, opening, and length. Installing medians provide the potential for safer street operation, increased capacity, and improved aesthetics. Medians come in all shapes and sizes but in general there are two categories that can describe most medians; non-traversable and traversable. Both median types are highly successful in improving safety and reducing congestion if implemented under proper conditions. However, with the aim of this document to improve mobility and safety through the use of access management techniques the city recommends that raised medians be implemented when feasible. Literature suggests that non-traversable medians be implemented when traffic

volumes are anticipated to reach 20,000 vehicles per day and/or when the demand for mid-block left turns is high.

4. Median Openings

- Median openings allow vehicles to cross opposing traffic lanes at designated locations. In general, median openings should be considered at all access points to accommodate all turning paths. In addition, median openings may be provided between intersections at mid-block locations. Requirements for median openings can be found in **Section 807** of this manual.

5. Treatments for Turning Movements

- a. Turn lanes provide a refuge area for left and right turning vehicles. Turn lanes may be placed at intersection approaches, driveway approaches, and median openings to remove turning vehicles from the through lanes, thus reducing congestion and improving traffic operations, capacity, and safety.
- b. Dedicated Left-Turn Lanes
 - Left-turn lanes shall be considered in the following situations:
 - ⇒ All signalized intersection approaches along planned or existing roadways having a classification of collector or higher;
 - ⇒ All un-signalized intersections and driveways along divided roadways having a classification of collector or higher;
 - ⇒ All un-signalized intersections and driveways along undivided roadways having a classification of thoroughfare or higher;
 - ⇒ All development with an overall footprint in excess of five acres located within 500 feet of the intersection of two or more thoroughfare facilities;
 - ⇒ New public or private school construction;
 - ⇒ Shopping centers and other traffic generators with a lease space in excess of one hundred thousand square feet;
 - ⇒ Places of worship.
 - Dual left-turns at signalized intersection should be considered when turning volume exceeds 300 veh/hr.
 - The use of dedicated left-turn lanes should also always be guided by a traffic study. When considering the above situations left-turn lanes shall be considered required until proven unnecessary by using the following warranting criteria shown in the **Figures 801.06 to 801.09**. **Table 801.06** may also be used if appropriate. As it is the responsibility of the

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City to implement transportation infrastructure that is within the best interest of the motoring public, the decision to implement a left-turn lane, ultimately, remains with the City of League City.

- For streets with non-traversable medians, median openings should conform to design criteria found in **Section 807** of this manual.
- To use these figures, peak hour traffic volumes, including directional splits, will be required. In addition, the ITE Trip Generation Handbook may be used as a source to estimate peak hour traffic volumes. For design year analyses, appropriate growth rates are required.

- Traffic Volumes - Two-Lane Streets⁴

⇒ The following data are required:

1. Opposing Volume (veh/h), V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Advancing Volume (veh/h), V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Left-Turn Volume (veh/h), V_L - The number of left-turns captured in V_A .
4. Speed (mph), S - The greater of design or posted speed.

⇒ AASHTO guidance (**Table 801.06**); or

⇒ **Figures 801.05 through 801.08** and speed, the appropriate trend line can be identified by the percentage of left-turns in the advancing volume (rounded up to the nearest percentage trend line). If the coordinate of the advancing (x-axis) and opposing volume (y-axis) lies to the right of this trend line, a left-turn lane is warranted. Left-turn lanes are not warranted for left-turn volumes less than 10 veh/h.

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Table 801.06 AASHTO Guide for Left-Turn Lanes on Two-Lane Highways

Opposing Volume (veh/hr)	Advancing Volume (veh/hr)			
	5% Left Turns	10% Left Turns	20% Left Turns	30% Left Turns
40 mph Operating Speed				
800	330	240	180	160
600	410	305	225	200
400	510	380	275	245
200	640	470	350	305
100	720	515	390	340
50 mph Operating Speed				
800	280	210	165	135
600	350	260	195	170
400	430	320	240	210
200	550	400	300	270
100	615	445	335	295
60 mph Operating Speed				
800	230	170	125	115
600	290	210	160	140
400	365	270	200	175
200	450	330	250	215
100	505	370	275	240

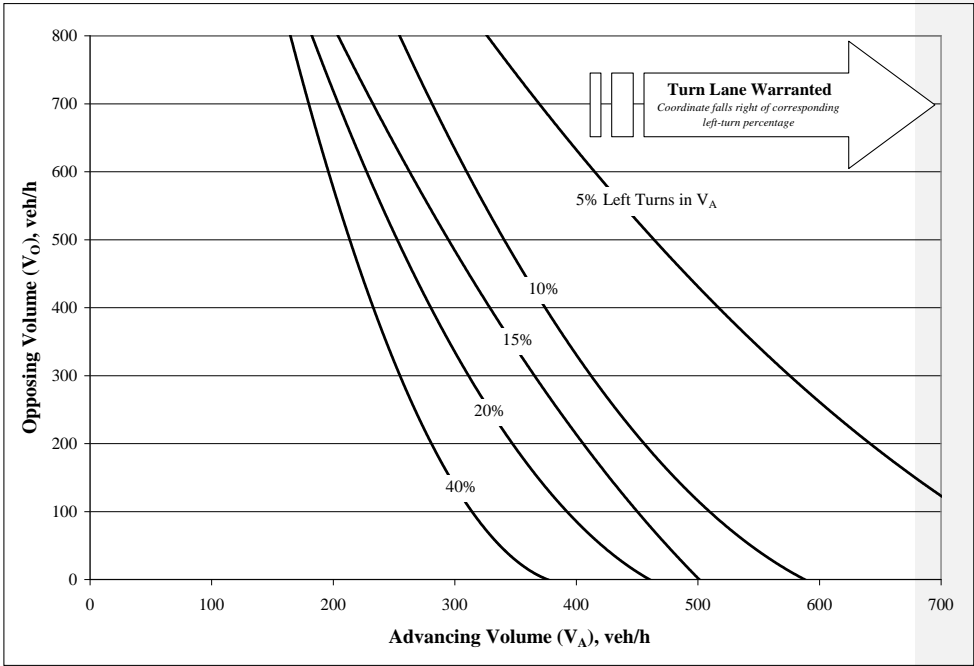


Figure 801.06 Left-Turn Lane Warrant for Two-Lane Street 40 mph

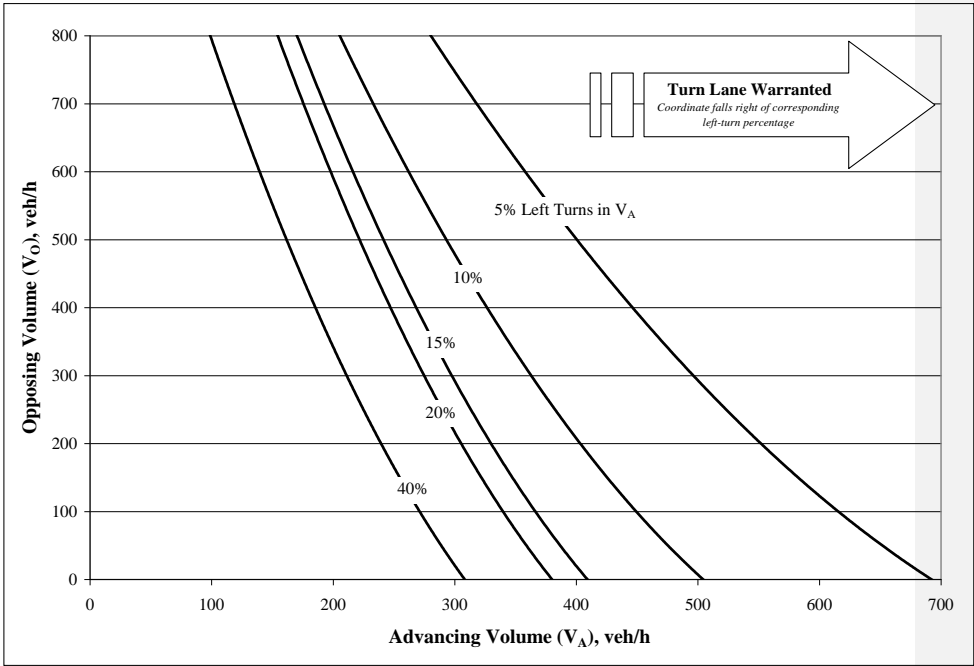


Figure 801.07 Left-Turn Lane Warrant for Two-Lane Street 50 mph

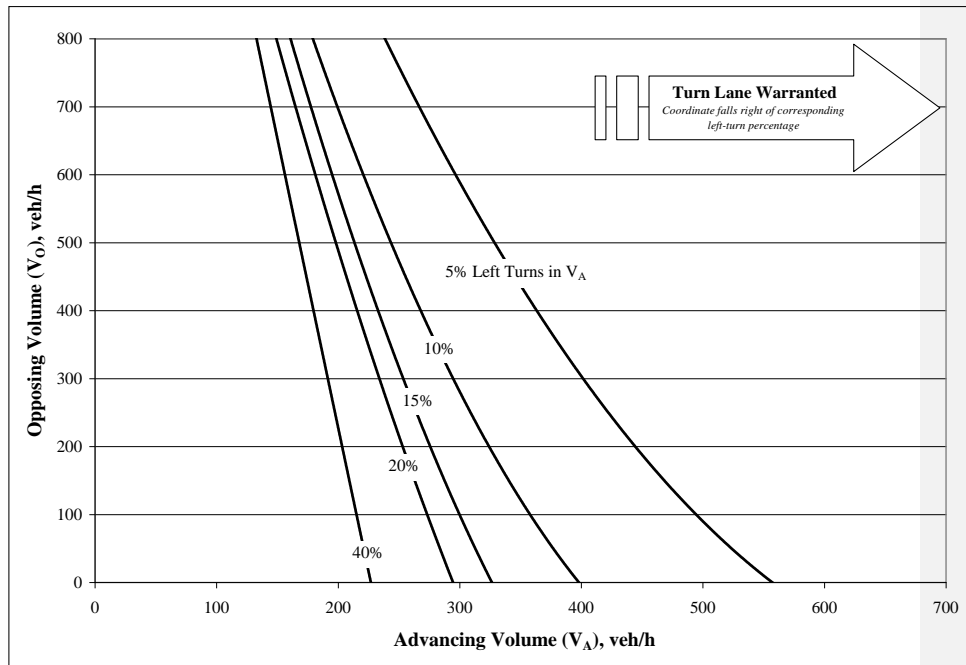


Figure 801.08 Left-Turn Lane Warrant for Two-Lane Street ≥ 60 mph

- Traffic Volume - Four-Lane Undivided Streets⁴

⇒ The following data are required:

1. Opposing Volume (veh/h), V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Left-Turn Volume (veh/h), V_L - The number of left-turns.

⇒ If the coordinate of left-turn volume (x-axis) and opposing volumes (y-axis) lies to the right of the trend line, a left-turn lane is warranted.

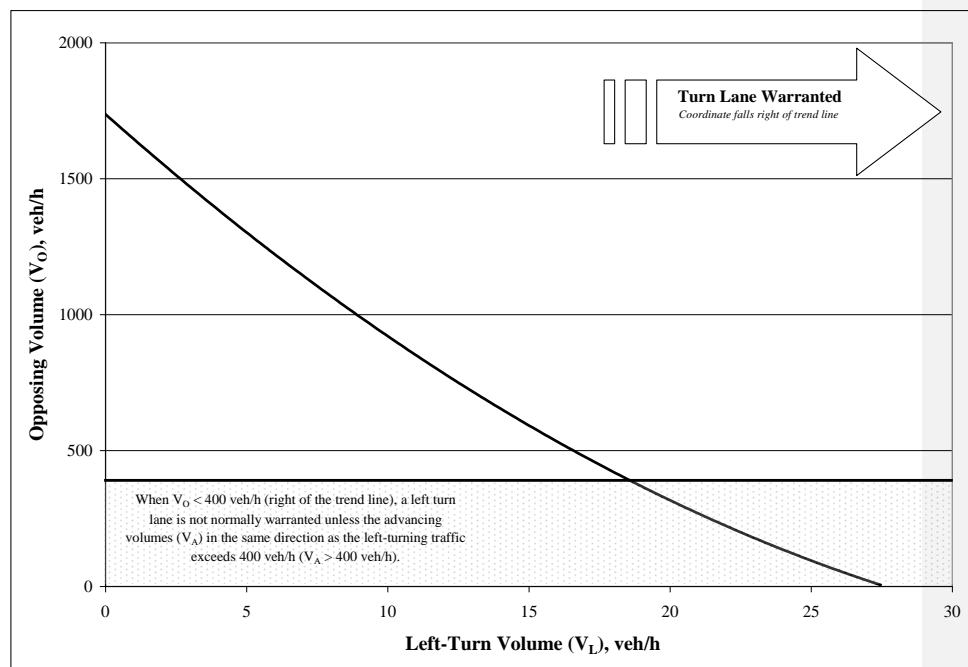


Figure 801.09 Left-Turn Lane Warrant for Four-Lane Undivided Street

6. Dedicated Right-Turn Lanes

a. Suburban Area

- Right-Turn Lanes are required if they meet the following conditions:
 - ⇒ The use of dedicated right-turn lanes should always be guided by a traffic study. In general, dedicated right-turn lanes should be provided in both rural and urban areas on two lane routes as shown in the figures below. Right-turn lane warrants are shown in the **Figures 801.10 and 801.11**. To use these figures, peak hour traffic counts, including directional splits, will be required. In addition, the ITE Trip Generation Manual may be used as an estimate for peak hour traffic counts. For design year analyses, appropriate growth rates will be required.
 - ⇒ Two-Lane Roadways⁴
- The following data are required

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1. Major Street Volume (veh/hr) - The major street volume should include the right-turn, left-turn and through movements in the same direction as the right turning vehicle.
2. Right Turning Volume (veh/hr) - The right turning volume is the number of advancing vehicles turning right.
3. Speed (mph) - The greater of design or posted speed.
4. If the combination of major-road approach volume and right-turn volume intersects above or to the right of the speed trend line corresponding the major road operating speed, then a right-turn lane is warranted. Right turn lanes are not warranted for right turn volume less than 10 veh/hr.

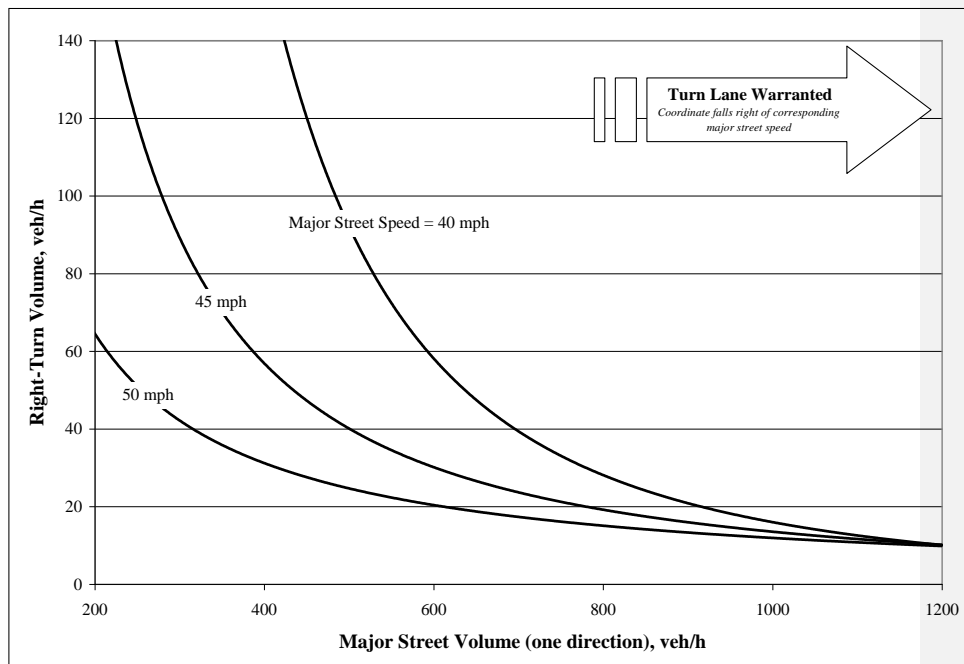


Figure 801.10 Right-Turn Lane Warrant for Two-Lane Roadways

⇒ Four-Lane Roadways⁹

The following data are required

1. Major Street Volume (veh/hr) - The major street volume should include the right-turn, left-turn and through movements in the same direction as the right turning vehicle.

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2. Right Turning Volume (veh/hr) - The right turning volume is the number of advancing vehicles turning right.
3. Speed (mph) - The greater of design or posted speed.
4. If the combination of major-road approach volume and right-turn volume intersects above or to the right of the speed trend line corresponding the speed of the major roadway, then a right-turn lane is warranted. Right turn lane not warranted for right turn volume less than 10 veh/hr.

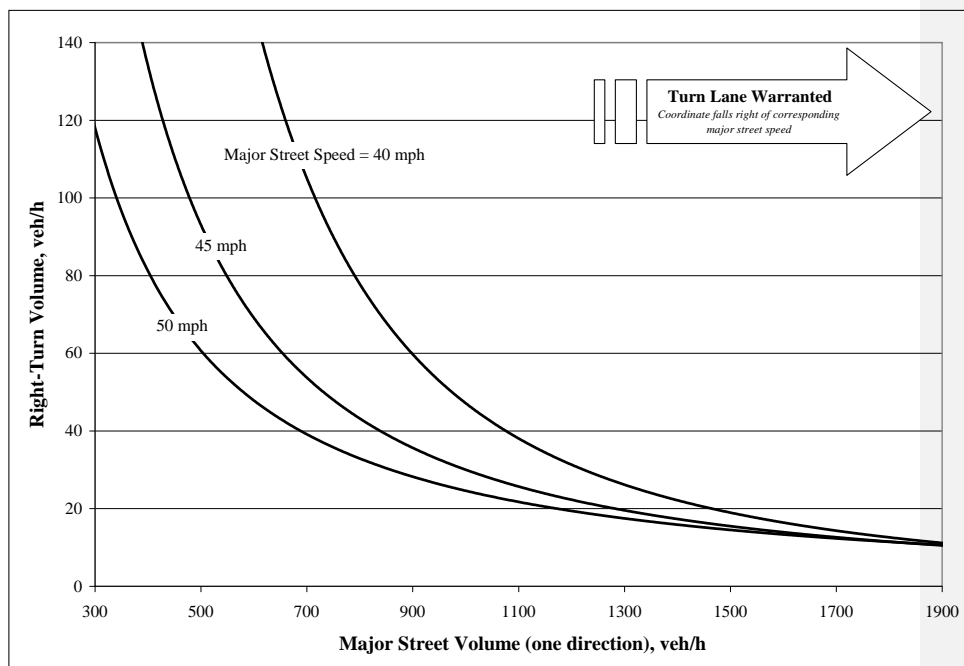


Figure 801.11 Right-Turn Lane Warrant for Four-Lane Roadways

- b. For Urban areas right-turn lane installation is recommended based on the above criteria (**Figures 801.10 – 801.11**)
7. Minimum Turning Treatment Storage Length
 - a. Storage length, as shown in **Figure 801.12**, is an important design element that ensures the provision of sufficient turn lane storage capacity to reduce instances of spillback. Left- and right-turn lane storage lengths must not be less than the minimum requirements outlined in Section 1.07 of this manual.

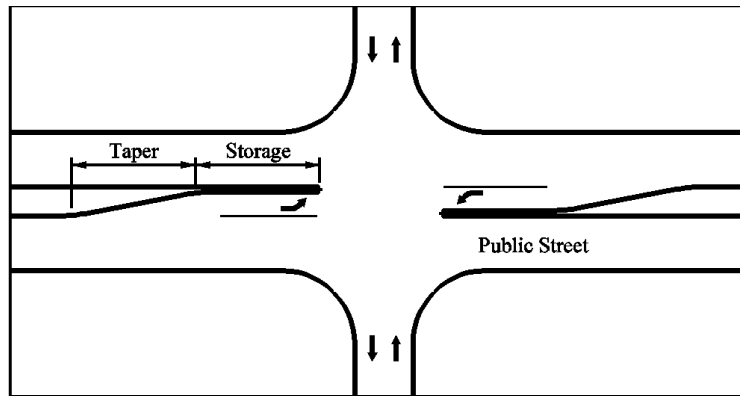


Figure 801.12 Turn Lane Details

b. Calculating Required Storage Length (Single Lane)

- The required storage length for both left- and right-turn lanes can be obtained using traffic modeling software such as the latest version of the HCM Software (HCS), Synchro/SimTraffic, or VISSIM. The 95th percentile queue length is a widely accepted value for storage length. If a model is not utilized the following equations may be used.

Signalized Storage Length

$$L = \left(\frac{V}{N} \right) (2)(S) \quad (\text{Equation 1})$$

Where:

L = storage length in feet

V = turning volume per hour

N = number of cycles

2 = a factor that provides for storage of all left-turning vehicles on most cycles

S = queue storage length, in feet per vehicle

Un-signalized Storage Length

$$L = \left(\frac{V}{30} \right) (2)(S) \quad (\text{Equation 2})$$

Where:

L = storage length in feet

$V/30$ = turning volume in a two-minute interval

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2 = a factor that provides for storage of all left-turning vehicles on most cycles
S = queue storage length, in feet per vehicle

ITEM 802 TRAFFIC IMPACT ANALYSIS GUIDELINES (TIA)

A. APPLICABILITY

Prior to each occurrence of the submission of a development, development plat application or building permit application (see **Figure 802.01**) for new development or redevelopment within the defined corporate city limits of League City, Texas, the applicant is required to submit pertinent project information from the city's traffic impact determination website (<http://www.leaguecity.com/index.aspx?nid=1685>) and submit to DRC. It is the intention of the traffic impact determination web application to provide feedback regarding traffic impact category and whether or not a TIA is required.

- a. All potential development/redevelopment prior to the time of application for reserve subdivision platting or development permitting, expected to generate one-hundred or more new peak hour trips (traffic impact Categories II, III, and IV) is required to complete and submit a TIA according to the guidelines found in the remainder of this section (802).
- b. All proposed development or redevelopment platted as an unrestricted reserve is exempt from the submission of a TIA as the ability to predict the expected number of new trips intermittently places this development into traffic impact Category I. However, applicants should understand that prior to the time of development platting or application for building permit (for all or part of an unrestricted reserve property) a TIA may be required if the proposed development is expected to generate one-hundred or more new peak hour trips (traffic impact Categories II, III, and IV).

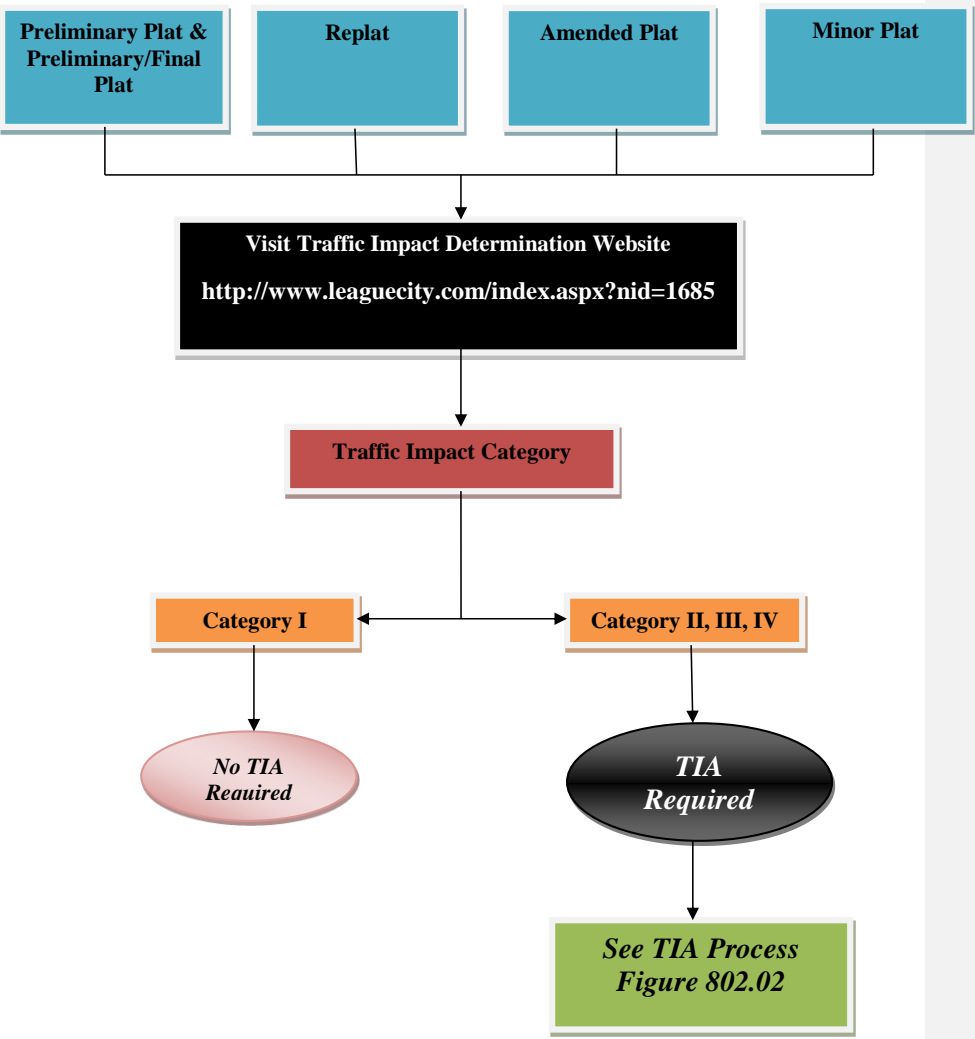


Figure 802.01 Traffic Impact Analysis Triggering Requirements

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2. The remainder of this section (802) contains guidelines and requirements for conducting a required TIA for new development or redevelopment within the defined corporate city limits of League City, Texas. The City of League City intends for the user to follow these guidelines in conjunction with this manual and the League City Code. If the City's traffic impact determination website has found the development impact to be within the trip generation criteria of Category I, no further traffic study is required.

B. GENERAL

1. Who Should Perform a Traffic Impact Analysis?
 - a. —Traffic Impact Analyses shall be prepared by an individual, group, firm, or corporation having demonstrated professional emphasis and experience in traffic engineering, and the preparation of similar analysis, hereinafter referred to as the "Analysis Engineer". The TIA document shall bear the seal and signature of a Texas Licensed Professional Engineer specializing in the branch of civil engineering. The individual, group, firm, or corporation seeking approval of a proposed development/redevelopment, hereinafter known as the "Applicant," is required to submit a completed TIA to the City of League City Traffic and Transportation Department, hereinafter referred to as the "City." The responsibility for assessing the traffic impacts associated with a proposed development/redevelopment, hereinafter referred to as the "Development," rests with the Applicant and the Analysis Engineer, while the City shall serve in a review/approval capacity.
2. Purpose and Intent of Traffic Impact Analysis Guidelines
 - a. —The overall purpose of requiring the submission of a traffic impact analysis is to establish a public/private partnership to coordinate land use and mitigate adverse impact by implementing transportation improvements. Both the City and Applicant share in the responsibility to consider all solutions to identify current and future transportation problems. Implementing the TIA guidelines found in this section (802) aim to assure that an Analysis Engineer will apply consistent and proper traffic planning and engineering practices when an Applicant considers land use actions.
 - b. Goals of a TIA Completed within the City of League City
 - —To identify any and all potential adverse traffic impacts to the existing area street system, the surrounding community and to additional proposed developments.

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- ~~_____~~ To identify transportation improvements with an aim to mitigate identified adverse traffic impacts and, when appropriate and reasonable, meet public concerns through the use of context sensitive solutions.
- ~~_____~~ To assist public and private sector entities in identifying and resolving issues related to the location of driveways, median openings, turn lanes, traffic signals, and other transportation facilities.
- c. ~~_____~~ The intention of TIA guidelines is to provide information necessary for an understanding of the development process, technical expectations, and required deliverables of a TIA submitted to the City.

3. Document Limitations

- a. ~~_____~~ While this section (802) contains guidelines and requirements necessary to complete a TIA for the City, the City does not intend this section (802) to be a sole reference for the preparation of a TIA. For more specific information regarding the various aspects of TIA preparation, the City suggests that the reader obtain and refer to the Institute of Transportation Engineer's (ITE) current edition of *Transportation Impact Analyses for Site Development*.

C. THE TRAFFIC IMPACT ANALYSIS PROCESS

1. Public agencies, and the City, have historically utilized a TIA as a tool to evaluate future interactions between existing transportation infrastructure and proposed land development/redevelopment projects. In general, a TIA determines traffic impacts of a development/redevelopment on the surrounding street system. The City will use this information to assist in establishing immediate transportation infrastructure needs and potential transportation improvements.
 - a. It is a goal of the City that these guidelines will allow for the maximization of efficiency and safety associated with area development/redevelopment. The City emphasizes that the TIA process should begin when the Applicant initiates development planning (i.e. prior to plat preparation).
 - b. The Applicant shall submit a completed TIA prior to or in conjunction with the preliminary reserve subdivision plat application and must obtain a Certificate of Approval from the City Traffic Engineer prior to submitting the final plat for approval (see **Figure 802.02**).
- ~~_____~~ Prior to submitting an application for development platting or a building permit the Applicant may be required

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to submit a revised TIA and obtain approval by the City (see **Figure 802.02**) if any changes have been made to the development (site plan) or original TIA assumptions related to:

- Land-use (revisions required only for an increase in trips),
 - Increase in the trip generation variable(s) (revisions required only for an increase in trips),
 - Intersection and roadway design, and
 - Access connections placement and design assumptions.
- c. ~~For~~ For properties platted as unrestricted reserve, the Applicant shall submit a completed TIA prior to or in conjunction with the application for development platting or a building permit if found to be within the trip generation criteria of traffic impact Categories II, III, and IV (to be determined by city's web application).

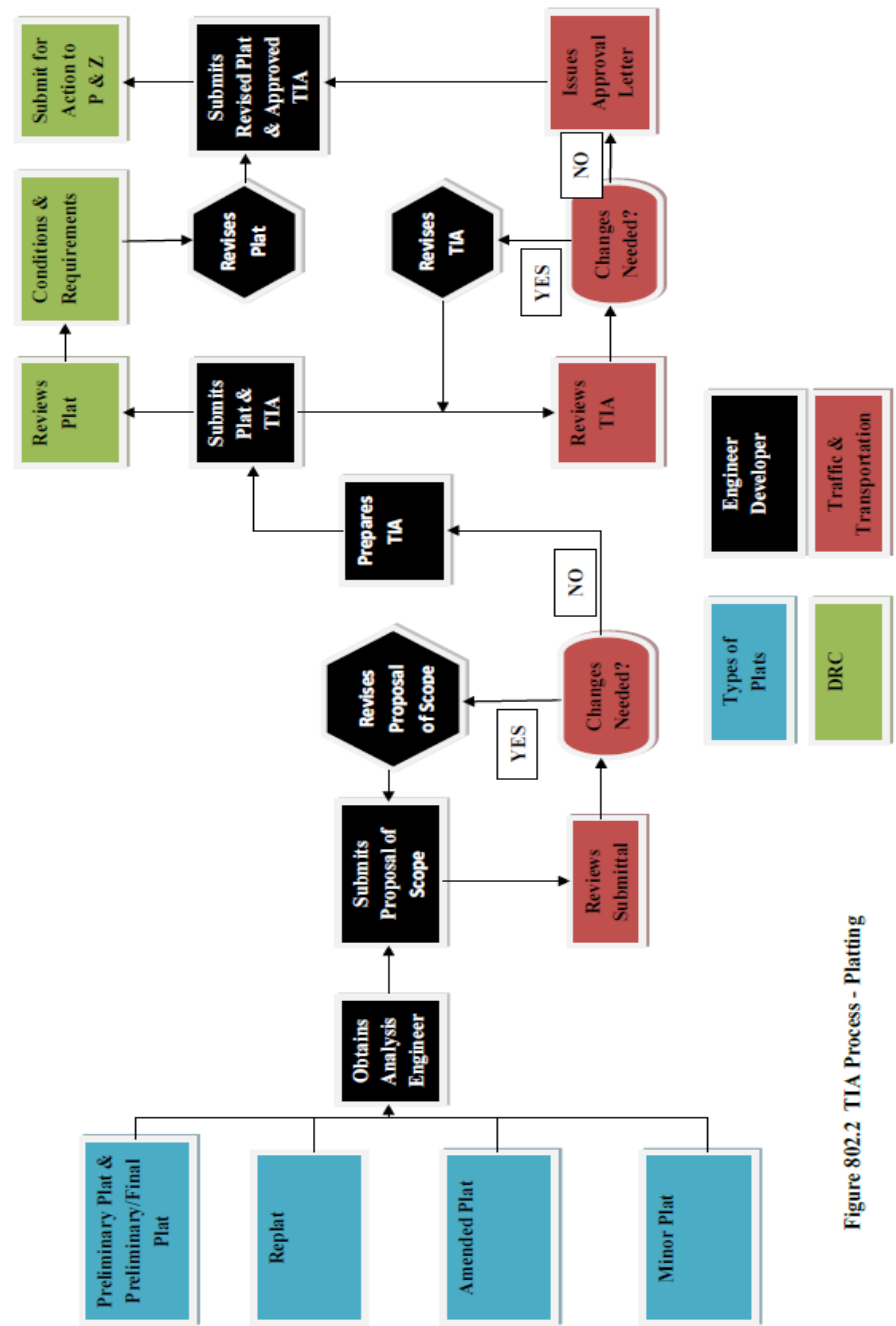


Figure 802.2 TIA Process - Platting

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2. The Proposal of Scope and Initial Trip Generation Estimate

The city's web application (<http://www.leaguecity.com/index.aspx?nid=1685>), using proposed development attributes (type, size, etc.), determines a corresponding traffic impact category for the Development by calculating the highest number of estimated new peak hour trips generated for an adjacent street (See **Table 802.01**). Using the resulting traffic impact category and the Boundaries and Horizons Guidelines in **Table 802.02**, the Analysis Engineer shall prepare and submit to the Traffic and Transportation Department a proposal of scope for the TIA.

- a. It is also a goal of the proposal of scope to minimize deliverables. In situations where initial trip generation estimates place the development in traffic impact Category IV, the Analysis Engineer shall be required to schedule a preliminary scoping meeting with the City Traffic Engineer. The City also encourages that, regardless of traffic impact category, the Analysis Engineer seek a preliminary scoping meeting with the City Traffic Engineer.
- b. An approved proposal of scope ensures that the submittal of a TIA will allow the City to evaluate the overall impact of the development on area transportation infrastructure.


Table 802.01 Traffic Impact Categories

Traffic Impact Category	Site Traffic Thresholds
	New Peak Hour Trips (PHT) on Adjacent Street
Category I	PHT < 100
Category II	100 to 499
Category III	500 to 999
Category IV	PHT ≥ 1000

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Design Guidelines



CITY OF LEAGUE CITY
TRAFFIC IMPACT ANALYSIS/ACCESS MANAGEMENT
DATA SUMMARY
FORM A

Check for whom all responses/questions should be directed (one or both):

☐ Property Owner ☐ Agent/Owner Representative

Submittal/Approvals

A scalable site plan layout with driveway locations indicating the extent of the access which the private property has or (is planned) to public streets must be submitted with the Form A. On-site traffic related features (loading docks, emergency lanes, driveway entrance/exits should be depicted on site plan. Types and locations of improvements should be placed as well.

Forms may be submitted at any time prior to or during Preliminary Plat and Final Site Plan submittal to the Development Review Committee.

Results of review/analysis will result in "Interpose no objection to Permitting" or "Requires submittal and approval of additional information prior to Permitting".

PROPERTY OWNER INFORMATION

Name: _____

Address: _____

City/State/Zip: _____

Telephone: _____

Email Address: _____

AGENT/OWNER'S REPRESENTATIVE INFORMATION

Name: _____

Firm Name: _____

Address: _____

City/State/Zip: _____


Telephone: _____

Email Address: _____

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CITY OF LEAGUE CITY
TRAFFIC IMPACT ANALYSIS/ACCESS MANAGEMENT
DATA SUMMARY
FORM A (CONTINUED)

SITE INFORMATION

Street Address (Primary Access): _____

Zip Code: _____

Legal Description (if no street address): _____

Tract Size (Sq. Ft. or Acres): _____

Current Land Use (include # of units, square footage of improvements, etc.) _____

CURRENT TRIP GENERATION RATES
(Based on ITE Trip Generation Handbook or City of League City approved local rate)

ITE Land Use Classification: _____ AM Trip Rate: _____ PM Trip Rate: _____
(Code & Description)

AM Peak Hour Trips: _____ PM Peak Hour Trips: _____ Average Daily Traffic: _____
(Provide Trip Generation supporting documentation as applicable).

Proposed use to be made of the private property: (include proposed # of units, square footage of improvements, etc.) _____

PROPOSED TRIP GENERATION RATES
(Based on ITE Trip Generation Handbook or City of League City approved local rate)


ITE Land Use Classification: _____ AM Trip Rate: _____ PM Trip Rate: _____
(Code & Description)

AM Peak Hour Trips: _____ PM Peak Hour Trips: _____ Average Daily Traffic: _____
(Provide Trip Generation supporting documentation as applicable)

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		CITY OF LEAGUE CITY TRAFFIC IMPACT ANALYSIS/ACCESS MANAGEMENT DATA SUMMARY FORM B	
Dimensions and type of construction of the street and the nature and volumes of traffic on the street on which the private property abuts:			
<u>PRIMARY ADJACENT STREET</u>			
Name: _____			
Right of Way Width: _____ No. of Lanes: _____ Speed Limit: _____			
Street Type/Material: _____ Pavement Width: _____			
<u>Weekday Traffic Count</u>			
AM Peak Hour: _____ PM Peak Hour: _____ Average Daily Traffic: _____			
<u>SECONDARY ADJACENT STREET</u>			
Name: _____			
Right of Way Width: _____ No. of Lanes: _____ Speed Limit: _____			
Street Type/Material: _____ Pavement Width: _____			
<u>Weekday Traffic Count</u>			
AM Peak Hour: _____ PM Peak Hour: _____ Average Daily Traffic: _____			
<u>OTHER ADJACENT STREET(S)</u>			
Name: _____			
Right of Way Width: _____ No. of Lanes: _____ Speed Limit: _____			
Street Type Material: _____ Pavement Width: _____			
<u>Weekday Traffic Count</u>			
AM Peak Hour: _____ PM Peak Hour: _____ Average Daily Traffic: _____			
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<small>October 2011 (B-1)</small>			

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Table 802.02 ~~Boundaries~~802.02 Boundaries and Horizon Guidelines

Requirements		Category I	Category II	Category III	Category IV
General	Traffic Impact Determination Web Form	X	X	X	X
	Meeting with the City		Recommended	Recommended	X
	Proposal of Scope		X	X	X
Horizon	Opening Year		X	X	X
	Full Build-Out Year			X	X
Limits	Analysis Area (From boundaries of development)		¼ Mile or Critical Intersections	½ Mile or Critical Intersections	1 Mile or Critical Intersections
	All Site Access Driveways		X	X	X
	All Site Access Private Street Intersections		X	X	X
	All Adjacent Signalized Intersections		X	X	X
	All Adjacent Major Un-signalizedSignalized Intersections		X	X	X
	All Analysis Area Signalized Intersections			X	X
	All Analysis Area Major Un-signalizedSignalized Intersections			X	X

3. Preparing the TIA

- a. The TIA shall be prepared according to the requirements detailed in the sections titled TIA Submission Requirements and Technical Notes (see **Figure 802.03**).

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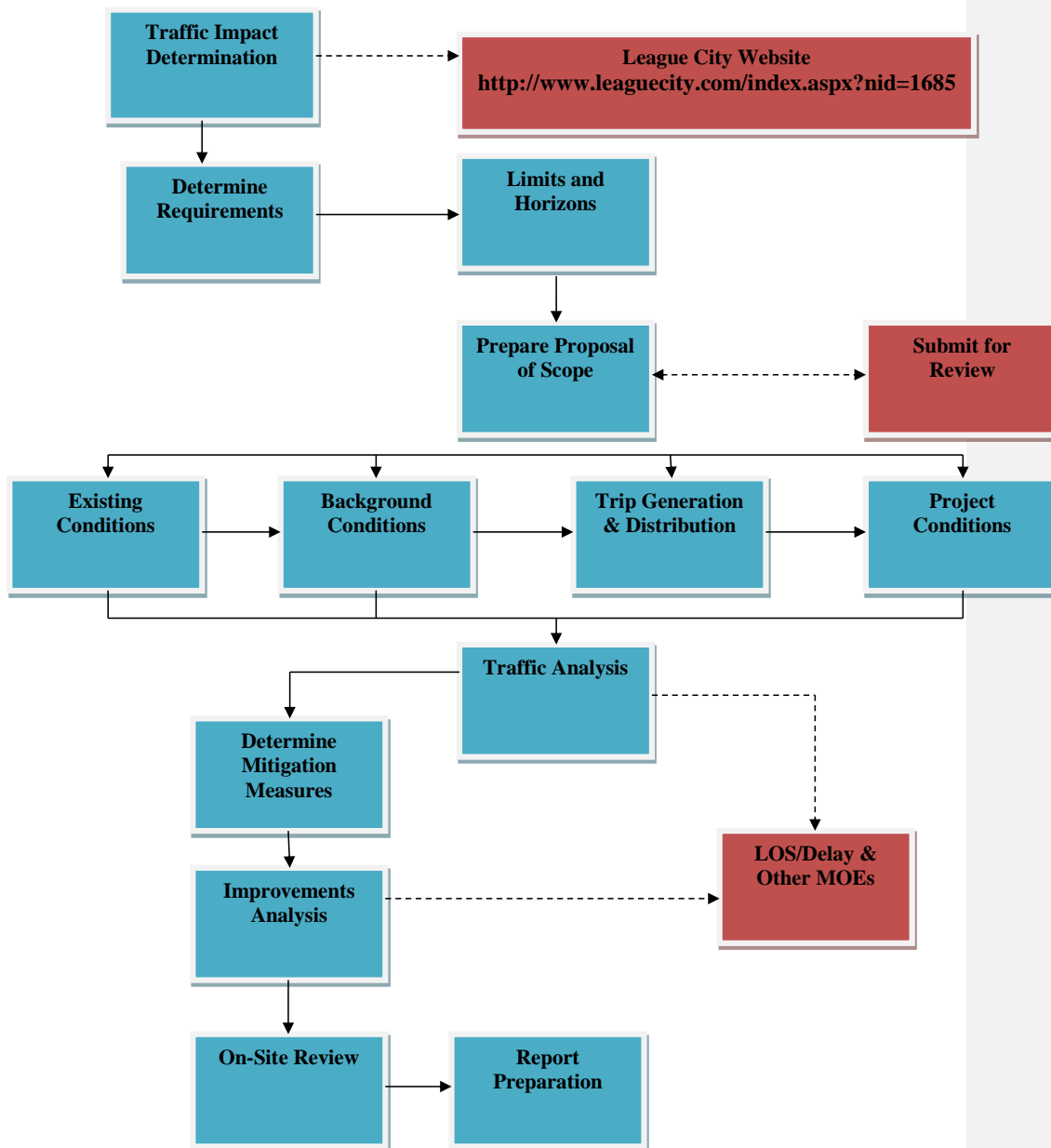


Figure 802.03 TIA Preparation Overview**4. TIA Submission and Review**

- a. Upon completion of the TIA, the Applicant shall submit to the City three (3) copies. The City will make an initial review of the TIA to determine if the Analysis Engineer completed the TIA in accordance with the technical requirements and within the submission requirements of the study as outlined in this manual or as established at the preliminary scoping meeting or proposal of scope. If the City finds deviations from the technical requirements and/or the submission requirements of the study, the City will terminate the initial review until the Analysis Engineer has addressed said deficiencies. At such a time when the City identifies deficiencies, the City will develop a notice of deficiencies and submit the notice to the Analysis Engineer and Applicant.
- b. Upon the Applicant submitting a TIA that meets the technical and submission requirements established in this document or at the preliminary scoping meeting or proposal of scope, the City will conduct a final review of the TIA. If during the course of the final review the City needs additional information, the City will provide the Analysis Engineer and Applicant a written request for addendum. TIA review time estimates can be found in **Table 802.03**

Table 802.03 Traffic Impact Analysis Estimated Review Time

Traffic Impact Analysis Category	Estimated Review Time
Category I	Not Applicable
Category II	3 weeks
Category III	4 weeks
Category IV	6 weeks

5. TIA Certificate of Approval and Mitigation Measures Requirements

- a. –Following the City’s completion of the final review, the City will provide to the Analysis Engineer and Applicant written recommendations regarding any requested variances, observations, objections to and/or concurrence with the findings of the study. In addition, the City will present the Analysis Engineer and Applicant

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with a Certificate of Approval and details of required mitigation measures.

b. Determining Mitigation Measures

- — The TIA shall have identified significant adverse traffic impacts. The need for mitigation is determined by using the qualitative measure Level-of-Service (LOS). The threshold of significance for transportation facilities on the area street system is LOS D. **Figure 802.04** provides a visual decision tree regarding mitigation and LOS thresholds.
- — Threshold of significance occurs when an adverse traffic impact exceeds a certain standard. The level of service (LOS) standards for City street facilities are based upon measures of effectiveness (MOEs). These MOEs describe the measures best suited for analyzing capacity of City street facilities.
- — Type of Street Facility and Measure of Effectiveness (MOE)
 - Basic Freeway Segments - Density (passenger car per mile per lane)
 - Ramps - Density (passenger car per mile per lane)
 - Ramp Terminals - Delay (seconds per vehicle)
 - Multi-Lane Highways - Density (passenger car per mile per lane)
 - Two-Lane Highways - Percent Time Spent Following and Average Travel Speed (miles per hour)
 - Signalized Intersections - Control Delay per Vehicle (seconds per vehicles)
 - Un-signalized Intersections - Average Control Delay per Vehicle (seconds per vehicle)
 - Urban Streets - Average Travel Speed (miles per hour)
 - Left Turn Lanes - Queue Storage (feet)
 - Right Turn Lanes - Queue Storage (feet)
 - Streets - Average Daily Traffic Volume (vehicles per day)
- — Methodology for determining each measure of effectiveness and corresponding LOS can be found in the Highway Capacity Manual.

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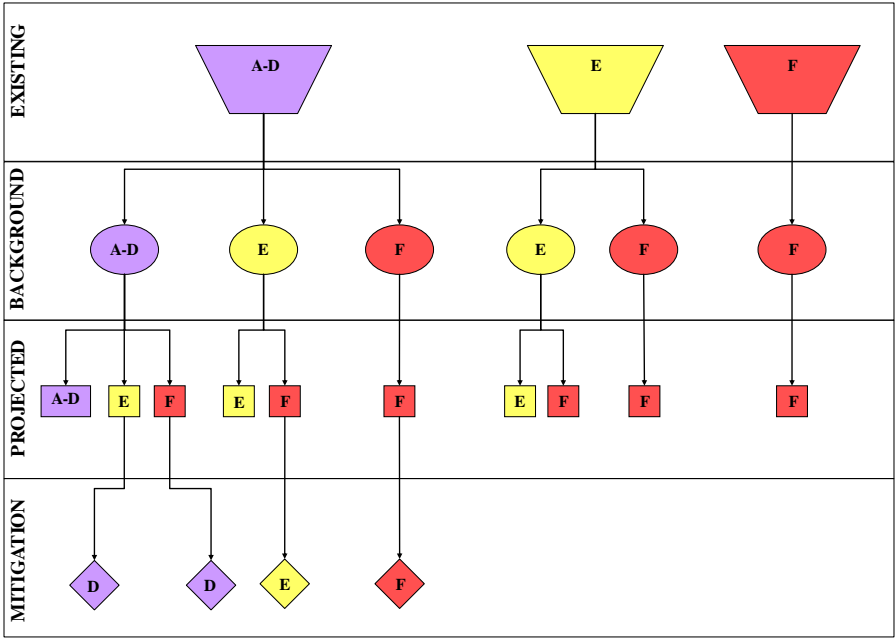


Figure 802.04 Mitigation Decision Tree

- c. Mitigation Measures Feasibility
- Mitigation strategies can be found in **Tables 802.04 through 802.06.**

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Table 802.04 Congestion Mitigation Strategies - Demand Management

Demand Management					
<i>Travel Alternatives</i>	<i>Land Use</i>	<i>Pricing</i>	<i>HOV</i>	<i>Transit</i>	<i>Freight</i>
Alternative Hours of Travel	Smart Growth Policies	High Occupancy Toll Lanes	Rideshare Matching	Subsidized Fares	Truck Only Toll Lanes
Alternative Work Schedules	Pedestrian/Bicycle Connections	Time-of-Day Pricing	Vanpools	Transit Oriented Design	Lane Restrictions
Telecommuting	Transit Stop/Station Design	Activity Center Pricing	Priority Parking for HOV	Enhanced Transit Stops/Stations	Delivery Restrictions
Pedestrian/Bicycle Facilities	Transit Oriented Design	Parking Pricing	Parking Cashout	Trip Itinerary Planning	
Alternative Fare Strategies	Parking Strategies		Instant Ridesharing	Transit Security Systems	
Public Education Campaign on Driving					

Table 802.05 Congestion Mitigation Strategies - Additional Capacity

Additional Capacity		
<i>Highway</i>	<i>Transit</i>	<i>Freight</i>
New Freeway/Arterials	New Rail Lines	Truck Only Lanes
Widen Freeways/Arterials	New Bus Routes	Rail Improvements
Street Connectivity	New Busways/BRT	
New Toll Roads/Toll Lanes	Additional Service on Existing Lines/Routes	
Grade Separations	Neighborhood Activity Center Circulation Routes	
HOV/Managed Lanes	Park/Ride Lots	
Multimodal Corridors		

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Table 802.06 Congestion Mitigation Strategies - Operational Improvements

Operational Improvements			
<i>Arterial</i>	<i>Freeway</i>	<i>Transit</i>	<i>Freight</i>
Road Weather Information Systems	Transportation Management Center Operations	Vehicle Tracking	Vehicle Tracking
Geometric Improvements	Incident Management	Advanced Scheduling/Run Cutting	Real-Time Freight Information
Intersection Improvements	Event Management	Signal Priority for Buses	Roadside Electronic Screening/Clearance Programs
One-Way Streets	Ramp Metering	Bus Ramp Bypass	
Access Management	Lane Controls	Real-Time Transit Information	
Advanced Signal Systems	Managed Lanes	Express Bus Service	
Signal Retiming/Optimization	Real-Time Traveler Information	Demand Responsive Bus Service	
Changeable Lane Assignments	Electronic Toll Collection	Fare Strategies	
HOV Ramp Bypass	Work Zone Management		
Incident Management	Road Weather Information Systems		
Event Management	Variable Speed Limits		
Real Time Traveler Information	Ramp Closures		
Parking Restrictions	Bottleneck Removal		

D. TRAFFIC IMPACT ANALYSIS SUBMISSION REQUIREMENTS

Analysis Engineer shall meet the following requirements for all TIA reports submitted to the City.

1. General

- a. -The Analysis Engineer must identify all of the required data and information in the appropriate sections of the report.

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- b. Text contained in the document shall be comprehensive and complete.
 - c. The report shall be typed and bound.
 - d. The report shall contain a table of contents, lists of figures and list of tables.
- 2. Executive Summary
 - a. Site Location & Analysis Area
 - b. Development Description
 - c. Principal Findings
 - d. Recommendations
- 3. Introduction
 - a. A statement about the purpose and objectives of the study.
 - b. A description of the existing and expected land use and intensity.
 - If residential, number and type of dwelling units.
 - If commercial or industrial, square footage and type.
 - If redevelopment, what is the expected trip generation differential
 - c. -A vicinity map identifying major and site access intersections and other approved projects near the Development.
 - d. A site plan for the Development.
 - e. A description of Development phasing and estimate year each phase will begin and end.
- 4. Area Conditions
 - a. A description of the analysis area.
 - b. A description of existing and future land uses within the analysis area. The description should include current land use, densities and occupancy, anticipated development, undeveloped properties, and current master plans.
 - If residential, number and type of dwelling units.
 - If commercial or industrial, square footage and type.
 - c. -A combination of narratives, tables and figures detailing area ~~street system~~street system characteristics within the analysis area including:

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- ~~Planned street improvements in the area (City of~~
League City ~~5-year~~~~5-year~~ Capital Improvement Plan)
- ~~Additional streets that may be impacted~~
- ~~Functional Classifications~~
- ~~Posted Speed Limits~~
- ~~Distance, and alignments from existing streets, driveways, and/or median openings to development access (needed to assess Access Management Requirements)~~
- ~~Traffic Control Devices (traffic signals and Stop signs)~~
- ~~Signal Locations and Timings (offsets need to be shown if in coordination)~~
- ~~Intersection layout, lane usage, and street configuration~~
- ~~Right-of-Way widths~~
- ~~Lane widths~~
- ~~Current traffic volumes within the past 1 year to have been captured on a typical Tuesday, Wednesday, or Thursday for all streets in the analysis. Depending on the type of development, it may also be necessary to capture volumes on a typical weekend.~~
 - ~~24-hour counts at major and site access intersections according to the methods described in section 15.05 of this chapter.~~
 - ~~Turning movement counts (Peak Hours).~~
- Pedestrians and Bikes (If Applicable)
 - ~~Facilities~~
 - ~~Volumes~~
- Transit Service (If Applicable)
 - ~~Major Transit Stops~~
 - ~~Ridership~~
 - ~~Routes and Service Intervals~~
- Public Concerns/Transportation Management (If Applicable)

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- — Transportation Infrastructure Vision (CSS)
- — Trade-Offs

d. Required Table(s)

- — ~~Twenty Four hour~~ ~~Twenty-Four-hour~~ approach volumes at major and site access intersections.
- — Peak Hour approach volumes at major and site access intersections

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e. Required Figure(s)

- — Major and site access intersection lane configuration diagrams with existing ~~Twenty Four hour~~ ~~Twenty-Four-hour~~ approach volumes. Preferably overlaid onto aerial photography.
- — Major and site access intersection lane configuration diagrams with existing AM and PM peak hour turning movement volumes. Preferably overlaid onto aerial photography.
- — The Analysis Engineer may also use photographs to document existing conditions.

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5. Project Traffic

- a. Sufficient details of calculations so that all calculations can be verified.
- b. Site generated traffic volumes (24-hour and peak periods) by corresponding development phase or year.

- — Trip Generation - List of trip generation rates and/or sources of rates used for the study.
- — Trip Distribution and Assignment - The gravity model or other acceptable trip distribution model used to estimate trip distribution. The Analysis Engineer can complete this task either manually or with applicable computer models.

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- — Background traffic volumes (24-hour and peak periods) by corresponding development phase or year.

- — Volumes should account for all approved developments in the analysis area as well as area growth beyond the analysis area. Contact the City for information about surrounding developments.

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- d.c. Pass-by and diverted traffic volume reduction rates, if applicable.
- e.d. Pedestrian, bicycle and transit reduction rates, and supporting evidence, if applicable.
- f.e. Internal capture reduction rates, if applicable.
- g.f. Total project traffic volumes (24-hour and peak periods) by corresponding development phase or year. Future traffic as may be required for a Development with multiple phases should also be included.

h.g. Required Table(s)

- ~~Pass-by trip, internal capture, pedestrian, bicycles, and transit reduction rates used, if applicable.~~
- ~~Twenty-Four-hour~~ Twenty-Four-hour approach volumes for background, pass-by, site generated, and total project traffic conditions at major and site access intersections and any additional transportation facilities specified by the City.
- ~~Peak Hour~~ approach volumes for background, pass-by, site generated, and total project traffic conditions at major and site access intersections and any additional transportation facilities specified by the City.

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i.h. Required Figure(s)

- ~~Twenty-Four-hour, and peak hour~~ approach volumes for background, pass-by, site generated, and total project traffic conditions overlaid onto major and site access intersections lane configuration diagrams. Preferably overlaid onto aerial photography.
- ~~Peak hour~~ turning movement volumes for background, pass-by, site generated, and total project traffic conditions overlaid onto major and site access intersections lane configuration diagrams. Preferably overlaid onto aerial photography.
- ~~Distribution and assignment rates for pass-by and site generated traffic volumes overlaid onto major and site access intersections lane configuration diagrams. Preferably overlaid onto aerial photography.~~

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6. Traffic Analysis

- a. Existing Traffic Conditions LOS and Delay of major and site access intersections and measures of effectiveness (MOE) for any

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additional transportation facilities necessary or specified by the City within the analysis area.

- Analysis must utilize existing traffic volumes.
- Analysis may be prepared manually or by using various software programs such as Highway Capacity Software, Synchro or as approved by the City.
- Analysis must utilize the capacity analysis methodology found in the current edition of the Highway Capacity Manual, or control delay calculations from Synchro or other software as approved by the City, and/or delay calculations from micro-simulation of the complete street network (no individual intersections) to determine LOS.
- Determination of necessary or specified MOEs should be completed using state-of-the-practice engineering methods.

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- b. Background Traffic Conditions LOS and Delay of major and site access intersections and measures of effectiveness (MOE) for any additional transportation facilities necessary or specified by the City within the analysis area.

- Analysis must utilize existing traffic volumes.
- Analysis may be prepared manually or by using various software programs such as Highway Capacity Software, Synchro or as approved by the City.
- Analysis must utilize the capacity analysis methodology found in the current edition of the Highway Capacity Manual, or control delay calculations from Synchro or other software as approved by the City, and/or delay calculations from micro-simulation of the complete street network (no individual intersections) to determine LOS.
- Determination of necessary or specified MOEs should be completed using state-of-the-practice engineering methods.

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- c. Project Traffic Conditions LOS and Delay of major and site access intersections and MOEs for any additional transportation facilities necessary or specified by the City within the analysis area.

- Analysis must utilize total project traffic volumes which include site generated traffic and the background traffic

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to complete analyses for the required study limits and horizons as they correspond to the predetermined TIA category.

- Analysis may be prepared manually or by using various software programs such as Highway Capacity Software, Synchro or as approved by the City.
- Analysis must utilize the capacity analysis methodology found in the current edition of the Highway Capacity Manual, or control delay calculations from Synchro or other software as approved by the City, and/or delay calculations from micro-simulation of the complete street network (no individual intersections) to determine LOS.
- Determination of necessary or specified MOEs should be completed using state-of-the-practice engineering methods.
- In addition to LOS and Delay, the Analysis Engineer should identify critical movements regarding capacity and potential locations of queue spillback.
- The Analysis Engineer should perform a signal warrant analysis for un-signalized intersections (engineering judgment) using the signal warrant guidance found in the Traffic Signal Installation Policy and Procedures prescribed by the City. Additionally, as part of the improvements analysis the Analysis Engineer should analyze any un-signalized intersections warranting a signal as a signalized intersection and discuss within the TIA report.

d. Additional Information (If Applicable)

- Site circulation and off-site parking requirements.
- Potential impact to nearby neighborhoods and neighborhood parking.
- Evaluation of potential need for traffic calming including bulb out, chicanes, roundabouts, or those elements that may be considered.
- If appropriate and reasonable, the evaluation of a potential need for application of context sensitive design methodologies to address public concern or area vision.
- Others (If Applicable)
 - Safety
 - Traffic control needs

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- Transit
- Pedestrian and bicycle access
- Delivery and service vehicles
- Transportation demand management.



e. Table(s)

- ~~Existing~~ Existing Traffic Conditions LOS and Delay for ~~each~~ each major and site access intersection and MOEs for any additional transportation facilities specified by the City.
 - Include critical movements and queue spillback
- ~~Background~~ Background Traffic Conditions LOS and Delay for each major and site access intersection and MOEs for any additional transportation facilities specified by the City.
 - Include critical movements and queue spillback
- ~~Project~~ Project Traffic Conditions LOS and Delay with Development generated traffic for each major and site access intersection and MOEs for any additional transportation facilities specified by the City.
 - Include critical movements and queue spillback

7. Transportation Improvements Analysis (Mitigation Measures)

- a. A description and justification of needed transportation improvements to accommodate background traffic conditions
- ~~LOS and Delay~~ LOS and Delay evaluation and comparison including review of critical movements and queue spillback
 - ~~MOE comparison~~ MOE comparison for any additional transportation facilities specified by the City
 - ~~If applicable, effectiveness of meeting community vision and public concerns with respect to the application of context sensitive solutions/design.~~
- b. A description and justification of additional transportation improvements to accommodate project traffic conditions

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- ~~LOS~~ and Delay evaluation and comparison including review of critical movements and queue spillback
 - ~~MOE~~ comparison for any additional transportation facilities specified by the City
 - ~~If applicable, effectiveness of meeting community vision and public concerns with respect to the application of context sensitive solutions/design.~~
 - c. A description and justification of alternative transportation improvements or mitigation measures
 - ~~LOS~~ and Delay evaluation and comparison including review of critical movements and queue spillback
 - ~~MOE~~ comparison for any additional transportation facilities specified by the City
 - ~~If applicable, effectiveness of meeting community vision and public concerns with respect to the application of context sensitive solutions/design.~~
 - d. The current status of transportation improvements already funded, programmed, or planned
 - e. Table(s)
 - e.
 - ~~LOS~~ and Delay comparisons for improvements
 - Include critical movements and queue spillback
 - ~~MOE~~ comparisons for any additional transportation facilities improvements
 - f. Figure(s)
 - ~~Concept~~ schematics of improvements including corresponding LOS and Delay values.
8. Site Improvement Analysis
- a. A description of site circulation and recommendations for improvement.
 - b. A description of on-site parking and recommendations for improvement.
 - ~~Include shared parking, if applicable~~

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- c. —A description of expected delivery and service vehicle operation and facility use and recommendations for improvement.
 - d. A description of expected site passenger loading characteristics and recommendations for improvement.
 - e. A description of adherence to related access management concepts as can be found in the City's set of Access Management Standards including driveway design, access spacing, and turning movement treatments.
9. Conclusions and Recommendations
- a. Traffic Impacts
 - b. Adjacent transportation improvements for each horizon year addressing, at a minimum, the following
 - —Traffic Control Device(s) (modification or installation)
 - —Additional Capacity (left, right, or through lanes)
 - —Need for acceleration or deceleration lanes
 - —Critical Movements
 - —Length of storage bays
 - —Implementation schedule
 - c. ~~Off site~~Offsite transportation improvements
 - —Modification to existing traffic control device(s)
 - —Additional traffic control device(s)
 - —Additional capacity at major intersections
 - —Additional street capacity
 - —Other
 - d. Site transportation improvements
 - —Access Management
 - —Site Circulation and Parking
 - e. Appendices may be included as an attached CD having individual electronic file folders for each appendix and appropriately titled Adobe PDF files.
 - —Basic Trip Generation Worksheet
 - —Capacity Analysis Worksheets or Modeling Software Output
 - —Traffic Volumes (24-hour and peak hour turning movement counts)

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Design Guidelines

➤ To be provided electronically or in a designated form by the City

➤ ~~To be provided electronically or in a designated form by the City~~

➤ ~~Selected Photographs~~

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E. TECHNICAL NOTES

1. Background Trip Determination

a. Background or non-site traffic forecasts are necessary to determine the impact of the development in horizon years such as the projected year of opening, year of full build-out and five years after full build-out. Background traffic consists of all trips that do not begin or end in the analysis area and all attraction and production trips from existing development within the analysis area. Trips generated from existing development within the analysis area are important as the proposed development may influence existing traffic patterns and potentially generate new trips for existing developments. Background traffic volumes should also include trips generated from other proposed developments within the analysis area. The Analysis Engineer should check with the City to ensure that all approved developments have been included in background traffic determination.

b. Methodologies for Background Traffic Determination

• ~~There are three basic methodologies used to determine background traffic volumes: build-up, area transportation planning, and trending. Each of these methodologies have strengths and weaknesses. Some methods may be more appropriate depending on the category of the Development. The Analysis Engineer may use any of the three aforementioned methods to determine background traffic volumes. The City anticipates that the majority of background traffic calculations will be completed using trending methods. For this reason, the City provides the following information on trending.~~

➤ ~~Trending or the use of growth rates is a common method used to generate background traffic. This method is particularly useful for smaller developments and studies having shorter horizon periods (5 to 10 years). City of League City traffic volumes have typically grown between one and two percent per year. Although these growth rates are typical for the~~

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whole of the City, there are some areas that may have higher and lower rates of growth. The Analysis Engineer may find higher growth rates in outlying areas of the City having lower development density, and lower growth rates in older more mature areas of the City that have little or no year-to-year changes in traffic. In general, the City of League City experiences a growth rate of one percent for all trending analyses. It is a requirement and the responsibility of the Analysis Engineer to apply appropriate growth rates as they correspond to different areas of the city. The Analysis Engineer should provide and justify an expected area growth rate in the proposal of scope for approval by the City.

c. Finalizing Background Traffic Volumes

- — Regardless of the methodology used, the Analysis Engineer preparing the TIA shall review background traffic volumes to ensure their practicality. It is a requirement, and the responsibility of the Analysis Engineer, to justify any adjustments to traffic volumes in the TIA report.

2. Site Trip Generation

- a. -The City requires that the Analysis Engineer generate site traffic using the methodologies found in the current edition of the ITE publication, *Trip Generation Handbook*. This publication suggests using rates from local studies as a preferred method for generating site traffic. If the Analysis Engineer utilizes local studies to determine appropriate rates, it is a requirement and the responsibility of the Analysis Engineer to reference these studies in the TIA report. In addition, the Analysis Engineer must make available copies of the referenced studies if requested by the City. If local rates are not available, the Analysis Engineer shall use equations and rates from the current edition of *Trip Generation*. The Analysis Engineer can find additional guidance on the subject of trip generation and traffic impact analysis in the ITE publication, *Transportation Impact Analyses for Site Development*.
- b. Pass-by Trips

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- ———Pass-by trips are those trips generated by the proposed development as they exist in the previously determined background traffic. These trips will occur along the adjacent street system regardless of completion of the proposed development. An illustration of the concept of a pass-by trip would start with a commuter who, prior to the completion of the proposed development, routinely traveled the adjacent corridor to and from work. After the completion of the development, this same commuter now frequents the new development on the same trip to and from work. The commuter literally passed by the development prior to completion and is included in calculated background traffic volumes.
- ———This added pass-by trip will have little impact on through movement traffic operations or be part of a potential change in travel demand requiring adjacent transportation infrastructure improvements. However, the City recognizes that pass-by trips can affect left- and right-turning movement frequency and may require installation of turn lanes or lengthening of turn lane storage bays. Typically, the Analysis Engineer can subtract these trips from those generated by the development, since they already exist as a part of the background traffic. However, the Analysis Engineer should be careful to account for any turning movement redistribution in the background traffic. The Analysis Engineer should redistribute pass-by trips from the through movement to the appropriate left- or right- turning movement for analysis purposes. The City requires that the Analysis Engineer use the methodology from the latest edition of the ITE publication *Trip Generation Handbook* to determine the appropriate number of pass-by trips. The Analysis Engineer should provide and justify an expected reduction rate for pass-by trips in the proposal of scope for approval by the City.
- ———Development access points should still carry pass-by trips and the Analysis Engineer should consider those trips in calculating the total number of trips generated by the proposed development and for necessary adjacent street improvements due to these trips. The City also recommends that the Analysis Engineer account for pass-by trips in the trip assignment step to ensure appropriate left and right turning movement volumes as these added turning vehicles may require the need for the

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installation of new or additional storage at existing left- and right-turn lanes.

c. Internal Capture

- —Internal capture is the application of a percent reduction in generated trips (driveway trips) and is typically applicable to projects such as shopping centers with out-lots.

d. Generating Trips for Redevelopment

- —For proposed redevelopment, the City allows the Analysis Engineer to subtract trips generated by the existing development from those the new development will generate. The City allows this because the existing Development's generated trips are already, ideally, included in background traffic volumes.
- —If an Applicant proposes changes to only a portion of an existing development, the City allows the Analysis Engineer to subtract any trips associated with that portion of the existing development from the trip that the proposed redevelopment will generate.

3. Site Trip Distribution and Assignment

- a. —Once the Analysis Engineer has finalized the number of trips a development will generate, he/she shall distribute and assign them through the proposed access connections to adjacent public and private streets. Site traffic distribution and assignment are very subjective tasks and requires the Analysis Engineer to exercise engineering judgment and to call on past experiences in transportation planning.

b. Trip Distribution

- —Trip distribution efforts, in general, take into consideration the Development as a whole. An example of this would be the determination of a percentage of generated trips accessing one particular portion of the proposed development (23% enter from the west). Determining how generated traffic will access the proposed development can vary greatly and depends on several factors:
 - Type of development
 - Size of the development

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- Where the development will draw or attract traffic from
- Competing developments in the area
- Surrounding land uses
- Condition and capacity of the surrounding street system

- ~~_____~~ The City recommends the Analysis Engineer refer to, or utilize similar studies on developments in the immediate vicinity, previously determined trip distribution models, planning software, or other recognized and substantiated methods to distribute traffic.
- ~~_____~~ It is a requirement and the responsibility of the Analysis Engineer to document the methodologies or references utilized in completing the task of trip distribution in the TIA report.- The Analysis Engineer will also be responsible to provide copies of referenced studies or models if requested by the City.

c. Trip Assignment

- ~~_____~~ Assigning trips determines the amount of traffic on routes within the street network and analysis area. Developments will usually have multiple access points potentially leading to multiple streets. The Analysis Engineer should assign trips after considering several area and street network characteristics such as logical routings, left-turn movements at un-signalized intersections and access points, available capacity and existing travel times. The Analysis Engineer should consider traffic conditions for each horizon year and adjust trip assignments accordingly. The Analysis Engineer may also find it necessary to prepare different sets of trip assignments for site generated trips. This may especially be useful if there are a significant number of pass-by trips. It is a requirement and the responsibility of the Analysis Engineer to detail and explain assumptions in the narrative portion of the TIA report.

4. Traffic Analysis

- a. Capacity analyses shall be performed on the transportation facilities within the determined analysis area. The Analysis Engineer shall use the methodology of the Highway Capacity Manual to complete any capacity analysis. The analyses may be

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prepared manually or by using various available software programs such as HCS, Synchro, or as approved by the City. In addition to capacity analyses, the Analysis Engineer should consider other factors including safety, circulation, traffic control needs, transit, neighborhood impacts, pedestrian and bicycle access, delivery and service vehicles and transportation demand management.

- b. For each analysis horizon, the Analysis Engineer shall utilize the total project traffic volume which includes site generated traffic and the background traffic. Background traffic shall include traffic from other proposed developments within the analysis area and horizon. The Analysis Engineer shall also complete capacity analyses for existing and background conditions in order to provide LOS comparisons.

~~b.~~

- c. The analysis and site plan of the Development are an iterative process necessary for each horizon year. The purpose is to show the relationship between the site, its circulation, and plan along with the existing area street system. Accomplishing this allows the Analysis Engineer to better determine deficiencies and develop alternatives for consideration. The Analysis Engineer should define and identify impacts, deficiencies, and need for improvement. The analysis of existing conditions is essential in order to determine pre-development deficiencies and need for improvements.
- d. The Analysis Engineer shall tabulate and report LOS and Delay for the transportation facilities within the determined analysis area. The Analysis Engineer should tabulate overall intersection LOS and delay for each approach and individual movements. The City recognizes that left turning movements and in many cases, the approach LOS may be less than desirable at stop-controlled facilities. Intersection capacity analysis shall include analysis of queue spillbacks and capacity of left and right turn lanes. The LOS for turning movements at all access points (driveways and turning lanes) at the project site shall also be analyzed.
- e. If the Applicant is proposing a traffic signal at an intersection or access point, the Analysis Engineer shall use the warranting process prescribed by the City's Signal Engineering Section Design Guidelines.
- f. All capacity analysis worksheets or computer print outs for the existing conditions and horizon years shall be included in the TIA report as an appendix.

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5. Site Access and Off-Site Improvements

- a. The Analysis Engineer should identify needs and deficiencies using the previously prepared analyses. In ~~addition~~addition, the Analysis Engineer should develop alternatives to address these needs and should address both on- and off-site improvements, if applicable.
- b. Mitigation measures can include, but are not limited to, median openings, turn lanes, traffic calming and traffic signals. The Analysis Engineer shall analyze proposed mitigation measures for capacity and other factors. The Analysis Engineer shall base capacity improvements on the LOS.
- c. Assessing the Need for Mitigation - Level of Service Thresholds
- d. Previously Proposed Transportation Improvements
 - ~~————~~The Analysis Engineer can factor proposed network improvements into the analysis and can use them as mitigation measures. For example, if the Applicant schedules a Development to open in three years, and the City has a capital project that will widen the street before that time, the Analysis Engineer can consider the proposed capital improvement in the analysis.
- e. Phased Developments
 - ~~————~~Phased Developments often present a challenge for the Applicant. In many cases, Phase I of the development is well defined while additional phases are vague and may change with market conditions.
 - ~~————~~It is acceptable to the City for an Applicant to submit a TIA for all phases of the Development including proposed improvements at the start of a project. However, if future phases of the Development change, generating more traffic than what the Applicant had previously submitted to the City, it will be necessary for an Analysis Engineer to update the existing TIA or prepare a new one. If the Applicant only submits to the City the first phase of the Development, the Applicant should be aware that conditions may change potentially requiring additional on- and off-site improvements. If a Development is to be completed in phases, the TIA can also propose phasing of mitigation. However, the Analysis Engineer must analyze

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any mitigation measures proposed for the appropriate horizon year.

- f. ~~–~~Application of context sensitive solutions to address public concern and vision may be done so only if arterial and intersection LOS expectations for mitigation are maintained. However, the city does recommend, where appropriate and reasonable, that the principles of CSS be utilized to improve mobility for all users.

6. On-Site Planning

- a. ~~–~~An integral component of any TIA should include basic site planning. This includes the identification of access points, internal circulation, service and delivery access points and service bays including the use of turning templates as appropriate, and the identification of optimal building locations.
- b. Access points operate as intersections and the City treats them as such. They should have an appropriate number of lanes, adequate storage, pedestrian facilities and appropriate signing and pavement markings. Adequate storage for a larger Development's access points is often a concern, and if not designed properly, will operate inefficiently creating the potential for traffic to back up onto the street system. Joint access between adjoining properties is desirable; particularly where street frontages are short or internal volumes will be low. Driveways should be located near the property line if possible or the Applicant should make cross access agreements with adjoining property owners.
- c. On-site circulation and street design should be consistent with off-site streets. The area street system has shaped driver behavior and expectations; violating these expectations provides potential for safety problems.
- d. This should extend to the use of Texas Manual on Uniform Traffic Control Devices (TxMUTCD) approved signs and pavement markings as well. Site access points shall conform to City of League City Access Management Standards and the Applicant and the Analysis Engineer should consider the following principles:
 - ~~————~~Locating proposed traffic signals to provide for progression along the intersecting street.
 - ~~————~~Providing access points to intercept traffic ~~tr~~aveling to the site and shall be limited in number.
 - ~~————~~Providing adequate capacity/storage at access points to ensure that traffic from the site does not spill back onto adjacent streets.

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- ~~————~~Intersecting two-way driveways with streets as close to perpendicular as possible.
 - ~~————~~Providing adequate capacity/storage at internal intersections to ensure that traffic from the site does not spill back onto adjacent streets.
 - ~~————~~Providing adequate sight distance and appropriate safety measures at all access points and internal intersections.
- e. ~~—~~The Analysis Engineer should base storage lengths at access points on the City of League City Design Manual and Access Management Standards. For smaller developments, the Analysis Engineer should design parking and access points to allow vehicles to align themselves perpendicularly to the adjacent street system. For larger developments, the Analysis Engineer should provide adequate storage to ensure that exiting traffic does not hinder internal circulation.

F. TRAFFIC IMPACT REPORT FORMAT

The following is an outline of an appropriate TIA report as it corresponds to the above submission requirements.

1. Executive Summary
 - a. Site Location & Analysis area
 - b. Development Description
 - c. Principal Findings
 - d. Recommendations
2. Table of Contents
3. List of Figures and Tables
4. Introduction
 - a. Purpose & Study Objective
 - b. Off-site Development
 - c. Description of Proposed Development
 - Land Use and Intensity
 - Location
 - Site Plan
 - Phasing & Timing of Development
5. Area Conditions

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- a. Analysis Area
 - b. Analysis Area Land Use
 - Existing Land Uses
 - Anticipated Future Growth
 - c. Site Accessibility
 - Area Street System
 - Traffic Volumes & Conditions
 - Transit Service
 - Existing Transportation Demand Management Programs
6. Project Traffic
 - a. Site Traffic
 - Pass-By/Internal Circulation
 - Pedestrian, Bicycle, Transit and CSS Considerations
 - b. Background/Through Traffic
 - c. Total Traffic
7. Traffic Analysis
 - a. Site Access
 - b. Capacity & Level of Service
 - c. Traffic Safety
 - d. Traffic Signal Warrant Analysis
 - e. Site Circulation & Parking
8. Transportation Improvement Analysis
 - a. Transportation Improvements to Accommodate Background Traffic
 - b. Additional Transportation Improvements to Accommodate Total Project Traffic
 - c. Alternative Transportation Improvements
 - d. Status of Transportation Improvements Already Funded, Programmed, or Planned
9. Site Improvement Analysis
 - a. Site Circulation

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- b. Site Parking
 - c. Delivery and Service Vehicles
 - d. Passenger Loading
 - e. Access Management
10. Conclusions & Recommendations
- a. Adverse Traffic Impacts
 - b. Transportation Improvements or Mitigation Measures (Background)
 - c. Transportation Improvements or Mitigation Measures (Total Project)
 - d. Site Improvements (Circulation and Parking) and Access Management
11. Appendix
- a. Basic Trip Generation Worksheet
 - b. Capacity Analysis Worksheets
 - c. Traffic Volumes
 - d. Pictures

ITEM 803

Traffic Signal System Design Guidelines

All traffic signal systems shall be designed in accordance with the Texas Manual on Uniform Traffic Control Devices and acceptable engineering practices to ensure a safe and efficient operation.

All traffic signal systems shall be designed to meet the latest and/or state-of-the-art operational and functional features for traffic signal system required by League City.

All traffic signal systems shall be designed in accordance with League City's latest specifications and standard drawings.

The basic set of signal system construction drawings shall include, but is not limited to the following categories:

1. Title Sheet
2. Existing Conditions Sheet
3. Proposed Signal Layout Sheet

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4. General Details
5. Signal Elevation Sheet
6. Signal Interconnect Sheet (when applicable)
7. Standard Detail Sheets

Unless otherwise specified, all drawings are to be 11" x 17" in size.

Typical project milestone design reviews are for 50%, 75% and 100% of the signal system design. The following is a list of review requirements that should be included at each milestone stage. The red-lined drawings and a written response of review comments from the latest review should always be included with the next submittal. League City reserves the right to alter the list in a manner that will best benefit the project.

The in-progress (50%) Design stage review shall consist of a field meeting at the project site(s) with the consultant and the City's Traffic Engineer. The review requirements are a working drawing showing, as a minimum, the following:

1. Right-of-way
2. Base line/Center line
3. All above ground and underground utilities. Underground utilities shall be located as accurately as possible, including profile and depth of cover information.
4. Existing roadway geometric layout
5. If making geometric improvements, show proposed geometric improvements and signal design based on those improvements
6. Existing sidewalks and/or driveways
7. Proposed wheelchair ramps, pads, and sidewalks, if required
8. Proposed crosswalks, if required
9. Proposed service outlet location
10. Proposed controller location
11. Proposed signal pole locations
12. Proposed pedestrian signal pole locations, if required
13. Proposed loop placement/detection zone
14. Proposed pull box locations
15. Proposed signal head locations
16. All proposed overhead signing
17. Proposed advance warning signs and flashers, if required
18. Proposed conduit, including bore locations
19. Proposed stop line locations

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20. For projects with road widening, construction phasing for traffic control should be included for a discussion in the field meeting
21. Any construction easements or right-of-entry that may be needed
22. Will need to provide documentation to City of posted speed and 85th percentile speed, if known
23. For signal interconnect, prepare pole attachment drawings in accordance with pole owner's requirements
24. At this stage, Texas New Mexico should be contacted to request a Service Outlet and Data Statement for each intersection

For the 75% Design stage review, it shall consist of two (2) full sets of construction drawings, one (1) set of construction drawings without League City Standard Sheets, and (2) sets of bid sheets including detailed bid ITEMS with quantities, and the respective specification designations. Approximately ten (10) additional sets of construction drawings without League City Standard Sheets shall be required to submit for utility coordination. The construction drawings shall consist of, but are not limited to, the following:

TRAFFIC SIGNAL INSTALLATION

1. Title Sheet (Harris County Standard Cover Sheet)
 - Project title including road names
 - Funding for construction
 - Names and titles for Mayor, each City Council Member, City Manager, Public Works Director
 - Site map with North arrow
 - Index of drawings (complete)
 - Name and seal of engineer
 - Signature block for League City Permit Division
2. Existing condition sheet
 - Make sure title block is filled in, sheet is numbered
 - Utility notes and Utility company signature block
 - Legend: The legend should be in compliance with the League City design criteria
 - Existing signing
 - Existing pavement markings

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- Existing geometrics
- Existing utility locations
- Any existing signal equipment
- Name and seal of engineer
- North arrow
- Scale

3. Proposed Signal Layout sheet

- Legend: The legend should be in compliance with the League City design criteria
- Special notes
- Right-of-way
- Roadway geometrics
- Utilities
- Electrical schedule (complete)
- Pole and controller locations (complete)
- Centerline or baseline description
- Controller description
- Construction signage
- Advance signal signing and/or flashers, if required
- Loop placement (call out distance from stop bar)
- Poles (signal and pedestrian signal w/station & offset)
- Signal head locations
- Luminaires
- Conduit runs and bores
- Pull boxes
- Meter pole
- Controller
- Stop bars
- Crosswalks, if required
- Wheelchair ramps, if required
- Call out of all conduit and wire runs
- North arrow
- Scale
- Complete title block
- Sheet numbers

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- Any reference to a different sheet should have sheet numbers filled in
- Show any easements or right-of-way that may be needed
- Name and seal of engineer

4. Proposed Traffic Signal Elevation

- Special Notes
- All sheet numbers referenced in special notes filled in
- Elevation views for all approaches
- All required details
- Show all conduits in foundations and call out what conduit runs to
- Fill in the title block
- Sheet numbered
- Name and seal of engineer

5. Signal Interconnect Sheet

- 1" = 100' scale unless otherwise specified
- Prefer aerial interconnect, if possible
- Show all poles, to be attached, conduits, pull boxes, utilities, roadway features, driveways, cross streets and etc.
- Special notes
- All required details and elevation details
- Fill in title block
- Sheet numbers
- Name and seal of engineer

6. League City Standard Traffic Details

- Fill in title block
- Add any revisions necessary
- Number each sheet

7. Bid ITEMS

- A complete list of bid ITEMS, quantities, specification listings, etc.

TRAFFIC SIGNAL INSTALLATION WITH ROAD WORK

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1. Title Sheet

- As noted for traffic signal installation project

2. Plan and Profile Sheets

- Single bank only
- Storm sewer size, alignment and profile grade, including horizontal and vertical ties
- Utility lines indicating size, horizontal and vertical alignments and description. Any utility conflicts should be notified
- Utility company signature block
- Plan and profile of proposed and existing roadside ditches and outfalls
- Proposed pavement alignment and profile
- Location of pavement widening areas

3. Traffic Control Plan, should include the following sheets: Phasing overview, advance signing sheet (optional), detour sheet (if needed), individual traffic control sheets, League City Traffic Control Standards (if needed)

A. Phasing Overview

- Should show each phase of construction for project limits
- Step description for each step in each phase
- A typical cross section for each phase
- Detour or temporary pavement should be shown constructed as a phase
- Fill in title block
- Sheet number
- Drawn not to scale
- See attachment for example
- North Arrow
- Engineer's name and seal

B. Advance Signing Sheet

- This is an optional sheet used to show all advance construction signing for the project. This includes all side sheet signing and

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supersedes the need for showing advance signing on each individual traffic control sheet

- Show Advance signing for major street and side streets
- Call out distance for placement of signs (as per TMUTCD)
- Show sign legend (all sign numbers must be called out)
- Show all necessary construction notes
- Show existing posted speed
- See attachment for example
- North Arrow
- Fill in the title block
- Sheet numbered
- Engineer's name and seal

C. Individual Traffic Control Sheet

- One construction phase per sheet
- 1" = 100' scale unless otherwise specified
- North arrow
- Steps to be done in individual phase should be shown on a separate sheet if room is not available on that individual phase sheet
- Show center line or base line
- Show storm sewers to be constructed
- Show cross section and cross section cut
- Show all striping (in cross section as well)
- ~~Ten-foot~~Ten-foot minimum travel lanes to be maintained at all times when possible
- Proposed and existing roadway should be distinguishable
- Show detour pavement (distinguishable from proposed and existing pavement)
- All construction signing and channeling devices
- Maintain existing left-turn lanes at intersections
- Filled in title block
- Sheet numbered
- All notes referencing standards should have sheet numbers filled in
- See Harris County Traffic Control Guidelines for specific details required for traffic control drawings
- Engineer's name and seal

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D. Detour Sheet

If detour sheet is required due to road closures, the following should be included on the detour drawing:

- Should show a map of area
- Trailblazer signs
- North arrow
- Does not have to be to scale
- All required signing, barricades and warning lights as per TMUTCD
- Fill in title block
- Sheet numbered
- Engineer's name and seal

E. League City Traffic Control Standards

These standards should be inserted with the Traffic Signal Standards

- Fill in title block
- Number each sheet
- Add any revisions, if necessary

4. Existing Condition Sheet

- As noted for traffic signal installation

5. Proposed Condition Sheet

- As noted for traffic signal installation

6. General Details & Notes

- As noted for traffic signal installation

7. Proposed Traffic Signal Elevation

- As noted for traffic signal installation

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8. Permanent signing and striping sheet

- All proposed striping
- All proposed signing
- Fill in title block
- Number sheet
- Make sure all referenced sheets have sheet numbers filled out in referenced note
- Engineer's name and seal

9. League City Traffic Signal Standards

- As noted for traffic signal installation project

10. Bid ITEMS

- As noted in traffic signal installation project

For the 100% Design Stage Review, it shall consist of three (3) full sets of construction drawings, three (3) sets of complete project manual, three (3) copies of the final construction cost estimates. The project manual and construction drawings shall as a minimum; include the following:

1. Completed title sheet
2. Completed estimate and quantity sheets
3. Completed existing condition sheets
4. Completed proposed condition sheets
5. Completed General Details & Notes
6. Completed elevation sheets
7. Completed plan and profile sheets when applicable
8. Completed traffic control drawings when applicable
9. Completed street name sign detail sheets
10. All required League City standard detail sheets

The project manual and final construction cost estimate shall as a minimum, include the following:

1. Cover sheet: Signed and sealed
2. Bid ITEMS
3. Special specifications
4. Utility locations

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5. Traffic specifications
6. See attachment for requirements
7. Complete project construction cost estimate
8. All sheets should be signed and sealed
9. All League City 75% review comments should be addressed on the plans and in writing. The written response should be submitted with the plans
10. Submit redline comments from 75% review
11. All easements (State, etc.) should be obtained by this point
12. The Texas New Mexico Service Outlet and Data Statement should be included in the project manual

Upon approval of the 100% submittal by League City, ~~mylar~~Mylar copies of the drawings are to be furnished by the consultant complete with all required agency and utility signatures.

See League City Traffic Signal Standards for League City facility and when traffic signal design is on a TxDOT facility, TxDOT Standards will be used.

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ITEM 804 Traffic Control Guidelines

The City of League City Engineering Department (City) has developed “Traffic control Guidelines” for use by Engineers in designing a Traffic Control Plan (TCP) for all construction activities within the City right-of-way. As part of the “Traffic Control Guidelines”, a set of guideline drawings will be provided to the Engineer for their use in designing a “Traffic Control Plan” for each project that the City undertakes. The Engineer who is to use these guideline drawings shall familiarize himself with them, their proper usage and what is expected in the Traffic Control Plan.

Construction Sequencing and Traffic Control Plan shall be in accordance with general traffic engineering principles and practices governing traffic control during construction as prescribed by the guidelines of the “Texas Manual on Uniform Traffic Control Devices” (Texas MUTCD), and City requirements.

Upon completion of the detailed Traffic Control Plan described herein, technical specifications and a detailed TCP cost estimate shall be completed. Quantities and cost estimates for each traffic control bid shall be provided by the Engineer and approved by the City.

CONSTRUCTION SEQUENCING

Construction Sequencing is a critical part of the Traffic Control Plan. The conceptual sequencing of any project will be addressed in the preliminary engineering report. To accomplish this, information must be obtained that delineates the existing topographic

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features, potential conflicts such as underground utilities and access to adjacent properties. This information combined with the proposed design elements of the project may then be prioritized to establish a construction sequencing plan.

The construction of the project should be scheduled or sequenced **to minimize the down time for the contractor and to maximize the utilization of space for the travelways travel ways**. This Sequencing is accomplished by partitioning the project into construction phases. The construction phases may be further fractionated into steps. The description of the phase and step components of a construction sequencing plan is as follows:

A “**phase**” is a major portion of the construction, scheduled in a logical progression toward project completion. For example, a typical construction phasing sequence might include the following: Phase I, construct temporary widening to the east of the existing pavement and transfer traffic to it. Phase II, construct the west half of the proposed roadway. Phase III, relocate traffic to new pavement and construct the east half of the proposed roadway.

A “**step**” is a minor portion of the construction, subordinate to a particular phase. For example, Phase II, Step I – Construct west roadway with driveway leave-outs for local access: Phase II- Step II complete driveway leave-outs using high early strength concrete.

A sample phasing overview drawing (TCP-2) is provided in the TCP Guideline Drawings.

The construction sequencing should be developed to confine the construction activities to a single lane at a time, whenever possible. Disruption of more than one lane of traffic, especially in the same direction, should be avoided. If, for any reason, construction has to take place in more than one lane at a time, consideration should be given to scheduling the work during periods of low traffic volumes, such as during weekends or ~~off-peak~~off-peak nighttime hours. Detouring traffic (routing the traffic off the normal existing travel surface) if utilized as part of the TCP, must be investigated, documented and approved by the City’s Traffic Engineer.

The drawings of the construction sequence should have a *plan view* of the project. The plan view should clearly distinguish areas of construction with areas of traffic for each phase. This may be accomplished by some form of shading, hatching or coloring. The work zone is to be distinguished from the actual construction limits (i.e. actual paving being constructed). Likewise, when phasing consists of multiple steps, the different steps should be clearly defined by contrasting patterns or coloring.

In conjunction with plan view sequencing of the project, *typical sections* should be developed at representative locations along the project. These sections should show: the existing and proposed construction elements, traffic lanes, work zone, construction pavement markings, barriers and buffer zones, anticipated drop-off’s and/or key elevational differences in the construction of the project. The typical sections should be drawn to an appropriate scale and be clearly dimensioned and annotated. These sections

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should be included with the plan view construction sequencing in the preliminary engineering report for approval by the City's Traffic Engineer.

In developing the representative sections, ***a minimum travel lane width of ten (10) feet*** shall be maintained. If space is not available within the existing facility, temporary widening of the pavement section may be necessary to provide a minimum ten (10) foot travel lane. The sections should coincide with the plan view in terms of clearly defining areas of traffic, the work zone and the construction limits by matching the shading or hatching of the plan view.

The Engineer shall ***meet*** with the City's Traffic Engineer during the following three (3) stages of the design process, as a minimum:

1. Prior to submittal of the preliminary engineering report to determine the critical objectives of the plan: whether sequencing can be accomplished with minimal lane closings, what level-of-service is adequate, etc.
2. Upon completion of preliminary engineering report and prior to start of detailed design, the Construction Sequencing Plan comments should be discussed and refined prior to proceeding with detailed design of the Traffic Control Plan.
3. Upon completion of a detailed Traffic Control Plan to review the drawings, specifications and quantity estimates for completeness.

TRAFFIC CONTROL PLAN – GENERAL REQUIREMENTS

Once the Construction Sequencing is established and approved by the City, the Traffic Control Plan (TCP) can be designed. The primary purpose of the TCP is to ***protect the traveling public and provide a safe area for construction***. The TCP should follow expeditious steps toward completion of the project within the federal, state and City standards and guidelines. To accomplish this, TCP drawings should provide sufficient details, complete with all necessary placement of barricades, signing, pavement markings, delineation, detours, temporary traffic signals and their adjustments and any other devices necessary to safely control traffic through the construction zones.

Wherever possible, the Traffic Control Plan should utilize the current phase placement of control devices to implement the next phase. By proper coordination of the construction sequencing, the traffic control plans can be simplified by utilizing portions of the current arrangement and devices already in place, for the next phase.

The Traffic Control Plan should contain the following four (4) basic elements:

1. Project approach signing
2. Phasing overview
3. Detailed plans for each phase of construction (including steps if any).
4. Necessary TCP details (this includes all applicable City TCP Details).

1. Project approach signing

The project approach signing drawings may be completed in linear fashion (stick drawing) or to an appropriate scale and will indicate the overall project limits and all necessary approach signing to be set up prior to the beginning of construction. All signing will be properly annotated and dimensioned. Engineering notes, which apply to the overall Traffic Control Plan, may also be placed on this sheet.

2. Phasing overview

The phasing overview drawing, depending upon the complexity of the TCP, is intended to convey the overall phasing of the project on a single drawing. If the project is complex and/or the phasing cannot be shown clearly on a single drawing, multiple drawings (one (1) phase per drawing) should be utilized. This drawing should also contain a brief description, on a step by step basis, as to the construction activities anticipated, and in what order, for the shown phase and where typical sections are cut. If sufficient space is available, typical sections may be included on this drawing for completeness.

3. Detailed plans for each phase of construction (including steps if any)

Following each phasing overview drawing is the set of detailed traffic control plans needed for each phase. The detailed plan has itself a set of requirements indicating completeness, which must be met by the Engineer.

- Travel lane widths shall not be less than 10 feet
- The TCP's should be designed to maintain the existing posted speed during the construction. If speed reductions are necessary, every attempt should be made to limit the reduction to no greater than 10 mph below the existing posted speed. If reductions beyond this are unavoidable, these speed reductions should be done in incremental steps with the City Engineering Department approval.
- The TCP's must emphasize maintaining the existing number of travel lanes during implementation, except for construction phase changes and then only during prescribed hours of low traffic as determined from a current traffic analysis.

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- TCP's should be prepared at a scale not smaller than 1" = 50' for full size drawings (24" x 36") or 1" = 100' for half size (11" x 17") drawings.
- Typical cross sections showing the existing and proposed construction complete with traffic lanes, construction pavement markings, delineators, barriers, buffer zones by barrels or CTB's, pavement drop-offs and construction details as applicable, shall be shown for all representative situations adjacent to their location in the plan view. The typical sections should be drawn to an appropriate scale and be clearly dimensioned and annotated.
- All construction signing shall be represented pictorially and designated with the appropriate identification numbers as shown in the Texas MUTCD.
- All other traffic control devices shall be shown pictorially and properly labeled on both the plan and cross section views.
- TCP's shall be complete, noting all barricades, signing, pavement markings, delineation, detours, etc., necessary to control traffic during the construction process.

4. Necessary TCP details (this includes all City of League City Barricade & Construction details).

Following the detail TCP drawings, sufficient details at an appropriate scale should be provided for the implementation of these plans for unique situations. These details may consist of but not be limited to: specific traffic handling at major intersections, traffic signal movements, handling of public and private driveways, special utility construction, detour layouts and pavement sections, etc. Inclusion of the City's barricades and construction devices as appropriate.

Speed limits on Construction Projects:

The Engineer should determine and recommend a construction zone design speed for the project. **Advisory** speed signs (orange and black) are mainly suggested for use on projects with spot or short speed reduction needs and projects where the advisory speed is no more than 10 mph below the posted speed or the observed 85th percentile speed. Speed limits for the entire length of a longer project where the advisory speed is more than 10 mph below the posted speed limit or the observed 85th percentile speed can be established

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below the posted speed utilizing **regulatory** (black and white) speed zone signs. The recommended speed should be **reasonable and safe** for the traveling public under the conditions found. Any such recommendation should be documented in the traffic engineering study and approved by the City's Traffic Engineer.

Advisory Speed Plate:

If the construction zone design speed is lower than the existing posted speed, the maximum recommended speed through the construction area may be indicated by orange and black **advisory speed limit plate** (for use with orange construction and maintenance signs, as per the T.M.U.T.C.D.). Please note that advisory speeds are "recommended" speeds for the benefit and assistance of the vehicle operator, not mandated and enforced by law.

Regulatory Speed Zones:

Reduction of the existing posted regulatory speed limit (or alteration of the prima facie speed limits) using black and white **regulatory** signs, must be made based on a comprehensive engineering or traffic investigation, and authorized by the City Council of the City of League City. If it is found to be necessary to alter the existing speed limit, and it has been studied and authorized, the new speed limit is **enforceable**. All existing regulatory speed limit signs must then be covered or removed and replaced with the temporary construction zone regulatory speed signs.

APPLICATIONS OF GUIDELINE DRAWINGS

A set of guideline drawings has been prepared to assist the Engineer in designing a Traffic Control Plan for a given project. The guideline drawings represent an arrangement of traffic control devices for a given situation. These guideline drawings show a deployment of a number of devices that represent a minimum requirement. Therefore, if in the judgment of the Engineer, additional signing is needed for a particular situation, it is advisable to add whatever is in the best interest of the safety of the public and the project.

In general, these guideline drawings should be used as a template or an example of how, where and how many devices to deploy in any particular situation.

After review of the typical construction and maintenance projects undertaken by League City, a set of guideline drawings have been developed (see **Table 804.01**) to address the typically encountered construction activities. These activities are broad enough to cover several kinds of construction operations. Therefore, in order to apply any one of the guideline drawings, ***the Engineer must have defined his particular construction operations in terms of the ITEMS of construction, space requirements and time of completion.*** These considerations apply to whether the entire project is being considered or only one construction phase at a time.

The guideline drawings show deployment of traffic control devices in a schematically straight section of roadway. This deployment does not show actual dimensions for device spacing. They do show, however, “X”s and dimensioning arrows for the places where dimension are to be calculated by the Engineer. The required distances are dependent on ***work zone speed*** within the construction area and are determined from **Table 804.02**, taken from MUTCD. ***The Engineer must show, as a minimum, all the devices shown on the guideline drawing, placed at actual location on the TCP drawings, with exact distances, and also taking into account the proposed roadway alignment.***

USE OF GUIDELINE DRAWINGS

The guideline drawings are meant to be schematic. The key information they contain is the type and location of the traffic control devices required for a given situation. Traffic control devices are standardized by the Texas Department of Transportation, in the Texas MUTCD. The guideline drawings present the selection of the appropriate devices for each particular condition. These ***guideline drawings depict minimum requirements*** for a particular condition and should be modified for actual conditions.

A key point in selecting the appropriate guideline drawings for preparing of the Traffic Control Plan is to choose only the drawings that apply to the project. The selection is based upon the development of the construction sequencing with each phase and step clearly defined. Selection of the guideline drawings may be accomplished to the extent that the description of the activity fits the general description of work in the guideline drawing selection tables (see **Tables 804.03 & 804.04**).

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Once the applicable guideline drawings are selected, the next step is to apply them to the project. To do this, engineer must survey the construction area to determine the posted speed limit or determine safe construction zone speed limit. Refer to the section “Traffic Control Plan – General Requirements”, ITEM 3 for proper selection of the construction zone speed.

With the speed selected, the distances of placement of the various devices can be obtained from the Speed/Distance Table (see **Table 804.02**). On the actual TCP drawing for each phase of the project, the Engineer must superimpose all the devices from the guideline drawing, at the required distances taken from the **Table 804.02**. These distances can be modified if necessary by project space constrictions, such as when a sign placement occurs at a driveway or intersection. In the case when the distance available between intersections is not sufficient to allow proper advanced warning, a lower construction zone speed, which is *safe and reasonable*, may be considered in order to obtain a comprehensive sign spacing. In cases of obstructions, the distance can be changed to clear the obstruction with the understanding that distances shown on **Table 804.02** are minimum requirements.

In summary, to use the guideline set of traffic control drawings, the Engineer should complete the following drawing selection process steps:

1. Develop a comprehensive construction sequence plan for the project and obtain City of League City Engineering Department approval.
2. Create a phasing overview drawing showing each phase of construction and steps of the major construction activities (Ref: Phasing Overview Dwg. TCP-2)
3. Create the project approach sign layout drawing for the current construction project (Ref: Project Approach Signing TCP-1).
4. Locate in **Table 804.04 (City- Traffic Control Operations)** under the “Construction Operations” column, the construction operation that best describes the project. Locate, in **Table 804.04**, under the “Construction Area Required” column, the lane closure conditions required by the project’s construction operation.

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5. With the information developed on the steps above, find the applicable guideline drawings. This is done by referring to **Table 804.05 (League City Traffic Control Guideline Drawing Chart)** and looking at the operation area required, i.e.: one lane closure, in relation to the roadway section, i.e.: 4 lane road, to find the applicable guideline drawings. The list of guideline drawings can be found in **Table 804.01 (League City Traffic Control Guideline Drawing List)**.
6. Conduct appropriate traffic study and determine the construction zone speed, preferably the existing posted speed, and calculate the appropriate device spacing. This step is accomplished by following the directions in **Tables 804.02 and 804.03 (Speed/Device Spacing)**.
7. If the appropriate work zone design speed is determined to be 15 mph less than the posted speed limit, it may be necessary to temporarily change the posted speed limit and/or post additional signs to inform the public that traffic fines may be doubled in the work zone. Any changes to the posted speed limit must be approved by the City's Engineering Department and League City's City Council.
8. Complete the TCP drawings and necessary details.
9. Prepare the required specifications and cost estimate.

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**TABLE 804.01
LEAGUE CITY TRAFFIC CONTROL
GUIDELINE DRAWING LIST**

<u>DWG NO.</u>	<u>DESCRIPTION</u>
TCP- 1	PROJECT APPROACH SIGNING
TCP- 2	PHASING OVERVIEW
TCP- 3	ONE LANE CLOSURE -3 & 4 LANE ROAD
TCP- 4	ONE LANE CLOSURE -4 & 5 LANE ROAD
TCP- 5	ONE LANE CLOSURE – 6 LANE ROAD
TCP- 6	TWO LANE CLOSURE – 4 LANE ROAD
TCP- 7	TWO LANE CLOSURE – 5 & 6 LANE ROAD
TCP- 8	TWO LANE CLOSURE – 6 LANE BLVD.
TCP- 9	SHOULDER WORK
TCP- 10	MEDIAN WORK
TCP- 11	INSIDE LANE CLOSURE- 4 LANE ROAD
TCP- 12	INSIDE LANE CLOSURE – 6 LANE ROAD
TCP- 13	BOULEVARD CLOSURES
TCP- 14	DETOURS- 1 AND 2 LANE
TCP- 15	TASK FORCE OPERATIONS
TCP- 16	1 LANE CLOSURE- FLAGGING OPERATION
TCP- 17	FLAGGING/MOVING OPERATION
TCP- 18	INTERSECTION SEQUENCING

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TCP-19
FACILITIES

CONSTRUCTION CROSSING EXISTING

TABLE 804.02
TYPICAL TRANSITION LENGTHS AND
SUGGESTED MAXIMUM SPACING OF DEVICES

Minimum Desirable Taper Lengths **						
Suggested Maximum Spacing of Device						
Posted Speed *	Formula	10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent
30	$L = \frac{WS}{60}$	150'	165'	180'	30'	60' – 75'
35	$L = \frac{WS}{60}$	205'	225'	245'	35'	70' – 90'
40	$L = \frac{WS}{60}$	265'	295'	320'	40'	80' – 100'
45	$L = WS$	450'	495'	540'	45'	90' – 110'
50	$L = WS$	500'	550'	600'	50'	100' – 125'
55	$L = WS$	550'	605'	660'	55'	110' – 140'
60	$L = WS$	600'	660'	720'	60'	120' – 150'
65	$L = WS$	650'	715'	780'	65'	130' – 175'

*85th Percentile Speed may be used on roads where traffic speeds normally exceed the posted speed limit.

**Taper lengths have been rounded off.

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L= Length of Taper (FT.)

W= Width of Offset (FT.)

S= Posted Speed (MPH)

TABLE 804.03
CONSTRUCTION WARNING
SIGN SPACING

Posted Speed or 85% Speed (MPH)	X Min. Distance (FT.)
30 or less	120
35	160
40	240
45	320
50	400
55	500
65	750

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TABLE 804.04

LEAGUE CITY – TRAFFIC CONTROL OPERATIONS					
CONSTRUCTION OPERATIONS	CONSTRUCTION AREA REQUIRED				
GENERAL DESCRIPTION	LANE CLOSURE				
	ONE	TWO	THREE	NONE	ALL
# 1 Bridge Construction	STD-OP	STD-OP	STD-OP	N/A	DETOUR
# 2 Bridge Repair	STD-OP	STD-OP	STD-OP	N/A	DETOUR
# 3 Bridge Replacement	STD-OP	STD-OP	STD-OP	N/A	N/A
# 4 Bridge Widening	STD-OP	STD-OP	STD-OP	N/A	DETOUR
# 5 Culvert Installation	STD-OP	STD-OP	N/A	N/A	DETOUR
# 6 Culvert Replacement	STD-OP	N/A	N/A	N/A	N/A
# 7 Ditch Maintenance	STD-OP	N/A	N/A	MISC-OP	N/A
# 8 Driveways Work	STD-OP	N/A	N/A	MISC-OP	N/A
# 9 Elect. Power Work	STD-OP	N/A	N/A	MISC-OP	N/A
# 10 Gas Lines Work	STD-OP	N/A	N/A	MISC-OP	N/A
# 11 Guard Rail Installation	STD-OP	N/A	N/A	N/A	N/A
# 12 Guard Rail Repair	STD-OP	N/A	N/A	N/A	N/A
# 13 Landscaping Inside	STD-OP	STD-OP	N/A	N/A	N/A
# 14 Landscaping Outside	STD-OP	N/A	N/A	MISC-OP	N/A
# 15 Lighting Installation	STD-OP	N/A	N/A	MISC-OP	N/A
# 16 Lighting Repair	STD-OP	N/A	N/A	MISC-OP	N/A
# 17 Loop Detectors	STD-OP	STD-OP	N/A	N/A	N/A

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# 18 Pavement Replacement	STD-OP	STD-OP	STD-OP	N/A	DETOUR
# 19 Road Repair	STD-OP	N/A	N/A	N/A	DETOUR
# 20 Road Resurfacing	MISC-OP	N/A	N/A	N/A	N/A
# 21 Road Striping	MISC-OP	N/A	N/A	N/A	DETOUR
# 22 Road Widening	STD-OP	N/A	N/A	N/A	N/A
# 23 R.O.W. Mowing	MISC-OP	N/A	N/A	MISC-OP	N/A
# 24 Sanitary Sewers Work	STD-OP	STD-OP	N/A	MISC-OP	DETOUR
# 25 Shoulder Construction	STD-OP	N/A	N/A	MISC-OP	N/A
# 26 Signs: Install/Repair	STD-OP	N/A	N/A	MISC-OP	N/A
# 27 Storm Drainage Work	STD-OP	STD-OP	N/A	MISC-OP	DETOUR
# 28 Street Repair	STD-OP	N/A	N/A	N/A	DETOUR
# 29 Street Resurfacing	MISC-OP	N/A	N/A	N/A	N/A
# 30 Street Striping	MISC-OP	N/A	N/A	N/A	DETOUR
# 31 Street Widening	STD-OP	N/A	N/A	N/A	N/A
# 32 Telephone Work	STD-OP	N/A	N/A		N/A
# 33 Traffic Signals	STD-OP	N/A	N/A		N/A
# 34 Water Lines Work	STD-OP	STD-OP	N/A		DETOUR

TABLE 804.05

LEAGUE CITY TRAFFIC CONTROL GUIDELINE DRAWING CHART							
GENERAL DESCRIPTION	ROADWAY SECTION						
STANDARD OPERATIONS	2 LANE RD.	3 LANE RD.	4 LANE RD.	5 LANE RD.	6 LANE RD.	4 LANE RD. W/MEDIAN	6 LANE RD. W/MEDIAN
ONE LANE CLOSURE	TCP-16 TCP-14	TCP-3	TCP-3	TCP-4	TCP-5	TCP-4	TCP-5
TWO LANE CLOSURE	TCP-14	N/A	TCP-6	TCP-7	TCP-7	TCP-13	TCP-8
THREE LANE CLOSURE	N/A	N/A	N/A	N/A	N/A	N/A	TCP-13 TCP-14
INSIDE LANE CLOSURE	N/A	N/A	TCP-11	N/A	TCP-12	TCP-11	TCP-12
TWO INSIDE LANE CLOSURE	N/A	N/A	N/A	N/A	TCP-11 TCP-12	N/A	TCP-10 TCP-11

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NON STANDARD STANDARD OPERATIONS							
NEW CONSTRUCTION- CROSSING EXISTING FACILITIES	TCP-19	TCP-19	TCP-19	TCP-19	TCP-19	TCP-19	TCP-19
INTERSECTIONS	TCP-18	TCP-18	TCP-18	TCP-18	TCP-18	TCP-18	TCP-18
BOULEVARD CLOSURES	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 804.05 Continued

LEAGUE CITY TRAFFIC CONTROL GUIDELINE DRAWING CHART							
GENERAL DESCRIPTION	ROADWAY SECTION						
STANDARD OPERATIONS	2 LANE RD.	3 LANE RD.	4 LANE RD.	5 LANE RD.	6 LANE RD.	4 LANE RD. W/MEDIAN	6 LANE RD. W/MEDIAN
MISCELLANEOUS OPERATIONS							
OVERLAY OPERATIONS (MOVING OPERATIONS)	TCP-15	TCP-15	TCP-15	TCP-15	TCP-15	TCP-15	TCP-15
FLAGGING OPERATIONS	TCP-17	TCP-17	TCP-17	TCP-17	TCP-17	TCP-17	TCP-17

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(POTHOLE PATCHING)							
MAINTENANCE WORK (GENERAL)	TCP-9	TCP-9	TCP-9	TCP-9	TCP-9	TCP-9	TCP-9
UTILITY OPERATIONS (GENERAL)	TCP-9	TCP-9	TCP-9	TCP-9	TCP-9	TCP-9	TCP-9
MOWING OPERATIONS (BY SECTOR)	TCP-17	TCP-17	TCP-17	TCP-17	TCP-17	TCP-17	TCP-17
CONSTRUCTION OF DRIVEWAYS (LOCALIZED)	TCP-9	TCP-9	TCP-9	TCP-9	TCP-9	TCP-9	TCP-9

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ITEM 805

Intersection Sight Distance

- A. Dedicated right-of-way or easements are required to meet the intersection sight distance triangle requirements.
- B. Design basis.
 - 1. Design Vehicle – Passenger Car
 - 2. Design Standard – AASHTO “A Policy on Geometric Design of Highway and Streets”
 - 3. Lane Widths – ~~12-foot-wide~~ 12-foot-wide travel lanes (typ. but can be 11-foot or 10-foot)
 - 4. Level Road Surfaces
 - 5. Driver’s Eye – ~~25-foot~~ 25-foot distance from curb line of the main roadway
 - 6. Sight Distance – Is measured to the center of the outside lane on the main roadway approaching from the left and to the center of the inside lane of traffic on the main roadway approaching from the right.
- C. Design procedures:

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1. Determine design speed of the main roadway. Design speeds for new roads should be based upon the proposed roadway classification.
2. For the appropriate design speed, determine the minimum sight distance from **Table 8.05.01**.

TABLE 8.05.01 – Required Intersection Sight Distance

Design Speed (mph)	Sight Distance (feet)*
30	200
35	250
40	305
45	360
50	425
55	495

* Based upon AASHTO intersection sight distance criteria

3. Develop a scaled drawing depicting the sight triangle base on the design criteria. Refer to **Intersection Sight Distance** sample drawing.

ITEM 806

Pedestrian Facilities (Sidewalks and Wheel Chair Ramps)

- A. Accessibility ramps shall be constructed at all intersections.
- B. Ramps, approaches, and sidewalks shall comply with ADA and TAS requirements.
- C. Approved sidewalk/ramp details are shown in **Pedestrian Facilities Sheets 1 to 4**. Use of these details are specific to certain field conditions such as ramp direction, driveway crossings, crosswalk locations and the location of the sidewalk with respect to the curb.
- D. Where use of standard sidewalk/ramp details is not possible due to field conditions, engineer shall submit proposed design drawings to the City for approval. Design drawings shall include site field survey conditions.
- E. Accessibility ramps should cross street at 90 degrees to centerline of street ~~when ever~~ whenever possible.

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- F. All ramps constructed on an intersection corner should be interconnected for pedestrian access continuity.
- G. Mid-block crosswalks are not permitted without the approval of the City. The specific conditions which warrant a mid-block crosswalk must be provided to support the request for a design variance.
- H. Sidewalks at intersections are to be provided with unobstructed areas as shown in **Pedestrian Facilities Intersection Geometry Curb Radius and Corner Cutback** and are to be free of obstructions and surface encroachments such as sign posts, power poles, and down guy wires within that area.
- I. Concrete sidewalk in esplanades:
 - ~~6-inch-thick~~6-inch-thick reinforced concrete sidewalk shall be constructed in esplanades when curbs are 10 feet face to face of curb or less in width with a minimum length of 6 feet measured from the face of curb of the esplanade nose.
 - Reinforced concrete sidewalk in esplanades shall be colored black for ~~concrete roadways~~concrete roadways.
 - Reinforced concrete sidewalk in esplanades shall be uncolored for asphaltic concrete roadways.

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ITEM 807 Median Design

Minimum Median Width:

- (1) For local streets, refer to **Divided Street Typical Cross Section**.
- (2) For street classifications depicted on the Master Mobility Plan, refer to **Divided Street Typical Cross Section**.

Minimum Median Length:

- (1) Median lengths are based on functional street classification of the main roadway and intersecting street.
- (2) Refer to **Median Design – Median Length and Opening** for minimum median length requirements.
- (3) Median Geometry – Refer to **Median Design – Median Nose and Left Turn Bay**.
- (4) Street Taper Geometry – Refer to **Median Design – Roadway Tapers for Median Designs** (~~Local~~**Local** Streets) for subdivision street taper geometrics.

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