RESOLUTION 16-711

A RESOLUTION OF THE BOARD OF COMMISSIONERS OF THE CITY OF GOODLETTSVILLE, TENNESSEE TO ADOPT THE STREET STANDARDS AND SPECIFICATIONS POLICY OF 2016.

WHEREAS, the Board of Commissioners desire to have a policy which would ensure the adequate design and construction of all streets, roadway and traffic controls; and

WHEREAS, the Board of Commissioners desires to adopt a street standards and specifications that will protect the long term sustainability of streets, roadway and traffic controls.

NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF COMMISSIONERS OF THE CITY OF GOODLETTSVILLE THAT THE STREET STANDARDS AND SPECIFICATIONS POLICY OF 2016 AND REFERENCED AS ATTACHMENT "A" IS HEREBY ADOPTED.

Adopted this 27th day of October, 2016.

John Coombs

Mayor

Allison Baker

City Recorder

APPROVED AS TO FORM AND LEGALITY

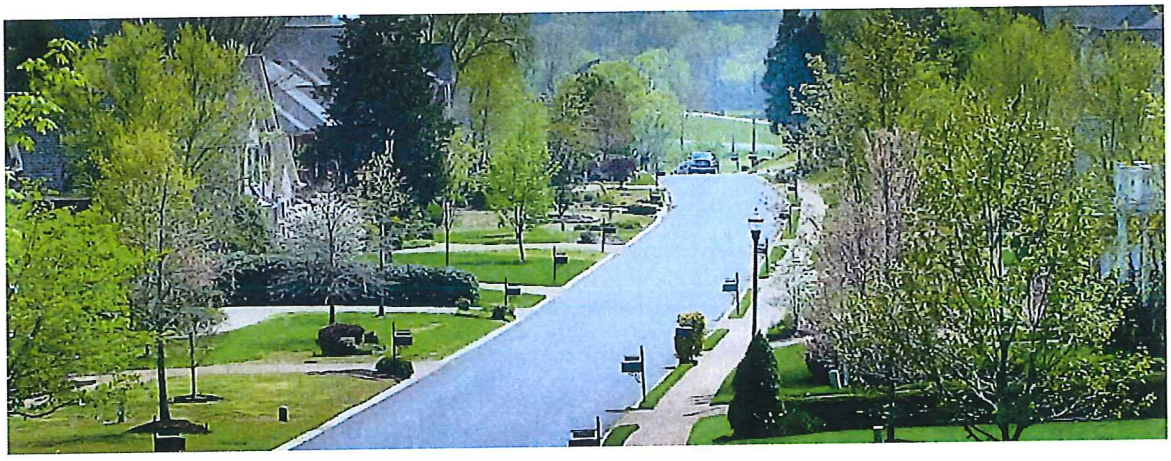
Joe M. Dwyer

City Attorney

16-711

Goodlettsville
Street Standards and Specifications

GOODLETTSVILLE
TENNESSEE



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City of Goodlettsville, TN
Street Specifications

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CHAPTER
I

GENERAL PROVISIONS AND REQUIREMENTS

1.1 Applicability

These specifications shall apply to any person, developer, firm, business, or entity interested in and desiring to construct additional streets, to extend existing streets, or to do any construction; such as curb cuts, that may affect the public and private streets within the City. These specifications are intended to apply only to new streets within new development areas and generally shall not apply to existing streets, unless remedial work such as widening or rehabilitation of the existing streets is required. Design of streets, structures and associated elements such as traffic signals, signing, and lighting shall be sensitive to the character of the surrounding area and the impacts on historic resources.

1.2 Jurisdiction / Regulations

Except as may otherwise be required by law, these rules and regulations govern the construction of streets and all associated improvements and appurtenances that shall be installed within the street system of the City of Goodlettsville, Davidson County and Sumner County, Tennessee, and shall apply to all areas within the jurisdiction of the City.

1.3 Glossary

AASHTO: American Association of State Highway and Transportation Officials.

APPROACH: The portion of an intersection leg which is used by traffic approaching the intersection.

ARMY CORPS OF ENGINEERS: Provides engineering services as a government agency as it relates to civil engineering projects.

ASTM: American Society for Testing and Materials.

AVERAGE DAILY TRAFFIC (ADT): The total bi-directional volume of traffic passing through a given point during a given time period (in whole days), divided by the number of days in that time period.

AWWA: American Water Works Association.

BOARD OF COMMISSIONERS: Appointed board of local citizens responsible for decision making related to growth and development within the City.

CAPACITY: The maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform segment of a lane or roadway during a given time period under prevailing traffic, roadway and control conditions.

CEMC: Cumberland Electric Membership Corporation.

CITY: The City of Goodlettsville, TN.

CITY MANAGER: City official appointed by the Board of Commissioners and responsible for overseeing all administrative tasks necessary for City operations.

CITY STANDARDS & SPECIFICATIONS: Those standards prescribed for the construction of streets, sidewalks, driveway access points, curb and gutter set out in the Subdivision Regulations.

CROSSWALK: (a) that part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway, and in the absence of a sidewalk on one side of the roadway, the part of a roadway included within the extension of the lateral lines of the sidewalk at right angles to the centerline; (b) any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other marking on the surface. (MUTCD)

CYCLE LENGTH: The time required for one complete sequence of signal indications. (MUTCD)

DETECTOR: A sensing device used for determining the presence or passage of vehicles or pedestrians. (MUTCD)

DEVELOPER: A site planner or subdivider.

DEVELOPMENT OR DEVELOPMENT PLAN: Any site plan or subdivision.

DIRECTOR OF PUBLIC WORKS: City official responsible for directing and overseeing construction, maintenance, traffic control and storm water implementation for improvements of City streets.

ENGINEER: A licensed professional engineer employed by the City or a duly authorized representative serving to direct and oversee engineering design, coordination and implementation of private and City capital improvements as well as public safety and welfare.

FHWA: Federal Highway Administration.

FLOW LINE: The transition point between the gutter and the face of the curb. For a valley curb it is the center of the pan. Where no curb exists, the flow line will be considered the edge of the traveled way.

IMSA: International Municipal Signal Association, Inc.

INTERSECTION: (a); the area embraced within the prolongation or connection of the lateral curb lines, or if none, the lateral boundary lines of the roadways of two highways that join one another at, or approximately at, right angles, or the area within which vehicles traveling on different highways that join at any other angle may come into conflict; (b) the junction of an alley or driveway with a roadway or highway shall not constitute and intersection. (MUTCD)

ITE: Institute of Traffic Engineers.

LAND DISTURBANCE PERMIT: Permit issued by the City of Goodlettsville Public Works Department that allows the contractor to begin grading work.

MAJOR STREET: The street normally carrying the higher volume of vehicular traffic. (MUTCD)

NFPA: National Fire Protection Agency.

NCHRP: National Cooperative Highway Research Program.

NES: Nashville Electric Service.

PAVEMENT MARKINGS: All lines, words or symbols, except signs officially placed within the roadway or parking area to regulate, warn or guide traffic.

PEAK-HOUR VOLUME: Hourly traffic volume used for roadway design and capacity analysis, usually occurring during one or more peak travel hours during a 24-hour period.

PEDESTRIAN: People who travel on foot or who use assistive devices, such as wheelchairs, for mobility.

PLANNING AND DEVELOPMENT SERVICES DIRECTOR: City official responsible for directing the enforcement and interpretations of the provisions of national and local building codes.

PRESCRIPTIVE EASEMENT: An easement claimed by the City upon an owner's real property by continuous, uninterrupted, open, visible, and exclusive use of the land for a period of twenty years or more with the true owner's knowledge and acquiescence.

RIGHT-OF-WAY, (ROW): An interest in land to the City which provides for the perpetual right and privilege of the City and its agents, franchise holders, successors, and assigns to construct, install, improve, repair, maintain, and use a public street, including related and customary uses of street rights-of-way such as sidewalk, bike path, landscaping, traffic control devices and signage, sanitary sewer, storm water drainage devices, water supply, cable television, electric power, gas, and telephone transmission and related purposes in, upon, over, below, and across the right-of-way. The City is authorized to remove, and keep removed from the rights-of-way all trees, vegetation, and other obstructions as is determined to be necessary by the City to maintain, repair, and protect facilities located in the right-of-way.

ROADWAY: See definition of street.

SIDEWALK: Any public or private pedestrian or bicycle walkway or path.

SIGNAL HEAD: An assembly of one or more signal faces together with the associated signal housings. (MUTCD)

SIGNAL INDICATION: The illumination of a signal lens or equivalent device. (MUTCD)

SIGNAL PHASING: The right-of-way, yellow change, and red clearance intervals in a cycle that are assigned to an independent traffic movement or combination of movements. (MUTCD)

SIGNAL TIMING: The amount of time allocated for the display of a signal indication. (MUTCD)

SIGNAL WARRANT: A threshold condition that, if found to be satisfied as part of an engineering study, shall result in analysis of other traffic conditions or factors to determine whether a traffic control signal or other improvement is justified. (MUTCD)

STATE ROUTE: An arterial highway designated and signed with a route number, which is primarily funded for construction and administered by TDOT. Improvements and maintenance of state routes is under the jurisdiction of TDOT.

STORMWATER PERMIT: If approaches to handling storm water are not standard or specified in the storm water ordinance, a storm water permit may need to be applied for by the contractor.

STREET: A public or private roadway, but is not considered a driveway access point.

SUBDIVISION REGULATIONS: Documents initiated by the City of Goodlettsville to establish guidelines for subdivision plans.

TIA: Traffic impact analysis.

TN DEPARTMENT OF ENVIRONMENT AND CONSERVATION (TDEC): A regulatory board that monitors pollution.

TRAFFIC CONTROL SIGNAL (TRAFFIC SIGNAL): Any highway traffic signal by which traffic is alternately directed to stop and permitted to proceed. (MUTCD)

TRAFFIC SIGN: A device mounted on a fixed or movable support conveying a message or symbol to regulate, warn or guide traffic.

VOLUME: The number of vehicles passing a given point during a specified period of time.

1.4 Standards, Specifications, and Resources

This document is the result of cooperation of many departments within the City. For a complete list of reference material, refer to the Appendix listings. The following publications will be referred to in these specifications.

- "ADA Standards for Accessible Design", latest edition; Department of Justice.
- "A Policy on Geometric Design of Highways and Streets", American Association of State Highway and Transportation Officials; AASHTO.
- "American Society for Testing and Materials Standards, D2321 & D2774", latest edition; ASTM
- "AWWA Standards", latest edition, American Water Works Association.
- "Bridge Standards Manual", American Association of State Highway and Transportation Officials; AASHTO.
- "Erosion and Sediment Control Handbook", latest edition, Tennessee Department of Environment and Conservation; TDEC.
- "Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT $\leq$ 400)" American Association of State Highway and Transportation Officials; AASHTO
- "Guidelines for Urban Major Street Design, a Recommended Practice", Institute of Transportation Engineers; ITE.
- "IMSA Wire and Cable Specifications Manual", latest edition, International Municipal Signal Association, Inc. (IMSA)
- "International Building Code", latest edition, International Code Council; ICC
- "Manual on Uniform Traffic Control Devices for Streets and Highways", (MUTCD), latest edition, U.S. Department of Transportation, Federal Highway Administration; FHWA.
- "Nashville Electric Service, Street Light Design Manual", latest edition; NES
- "National Electric Code", (NFPA 70), latest edition, National Fire Protection Association (NFPA)

- The Tennessee Department of Transportation; TDOT, "Standard Specifications for Road and Bridge Construction", latest edition, technical specifications only, shall apply and become a part of these specifications whenever these specifications do not adequately cover the work to be done. In the event of a conflict between these and TDOT specifications, Goodlettsville Public Works specifications shall govern, unless the construction is on a state route.

- "The Tennessee Department of Transportation; Survey Manual", issued by the Design Division; TDOT.
- "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (AASHTO-LTS)", American Association of State Highway and Transportation Officials; AASHTO.

In the event of a conflict between this document and the aforementioned referenced specifications, the specifications contained in this document shall govern.

1.5 Permits

Prior to beginning any construction, the Developer and/or Contractor, shall obtain all necessary permits as required by law. Such permits may include, but are not limited to, those required by State of Tennessee, Davidson County, Sumner County, and other City of Goodlettsville agencies.

The Developer shall obtain a "Land Disturbance Permit", "Stormwater Management Permit" and Landscape Plan Approval (when necessary) from the City prior to beginning any construction activities. The "Land Disturbance Permit" is issued by the Goodlettsville Public Works Department upon presentation of proof of required approvals of drawings and specifications and upon payment of required fees.

1.6 Notification of Construction

In addition to any other notices required by law (e.g., TN One Call, notices to non-participating utilities), before commencing any street construction operations, a ten (10) day notice must be given during regular business hours to the Public Works Department. This advance notice is required for all street construction projects to ensure proper inspection staff scheduling. Demolition permits, if required for the project, shall be obtained from the Planning and Development Services Office.

1.7 Utility Coordination

Locating and coordination for the relocation of existing utilities within the City's right-of-way is the responsibility of the contractor. Tennessee's One-Call and the City of Goodlettsville utility location service shall be utilized in addition to coordination with local utility owners. The contractor shall at all times protect existing utilities and will be responsible for costs due to damage caused to any utility lines.

1.8 Quality Control Testing

Construction materials, including aggregate base stone, asphalt, concrete, and roadway subgrades shall be fully tested in accordance with the designations and requirements within the referenced "TDOT Standard Specifications" sections. Unless otherwise noted within the "Standard Specifications" section, the type and number of tests called for by the referenced standards shall be performed.

Testing shall be done by an independent testing laboratory whose qualifications are approved by the City. Testing results will be submitted to and approved by the Director of Public Works. The City reserves the right to require industry standard certifications of testing and inspections by the testing laboratory, mills, shops, and factories. Such certifications required shall be submitted in duplicate.

The Developer shall provide the necessary labor and supervision required to support field testing by the independent testing firm and inspections by City officials at no cost to the City. Test reports of field testing if applicable shall be submitted directly to the Director of Public Works. Defects disclosed by tests shall be rectified at no cost to the City. The Developer is required to have the design tests shall be rectified at no cost to the City. The Developer is required to have the design engineer or a certified quality control inspector present during all phases of construction. A daily log of work performed should be kept by this individual and submitted to the City upon request.

1.9 Inspection

All projects shall be subject to inspection during and upon completion of construction by an authorized representative(s) of the City. Presence or absence of an inspector during construction does not relieve the Developer and/or Contractor from adherence to approved plans and material contained in these specifications or from liability. Materials and/or workmanship found not meeting requirements of approved plans and specifications shall be immediately brought into conformity with said plans and specifications.

An authorized representative of the City shall make a final inspection of the project after completion to determine acceptability of the work and for release of performance bonds if required. Before this final inspection can be made, the Engineer responsible for the project shall certify in writing to the Director of Public Works that the work has been completed in accordance with approved plans and specifications.

The cost for inspection during construction is covered by the "Land Disturbance Permit" fee. Additional inspection fees will be required only when an inspection requiring City approval fails and requires subsequent re-inspections. The Inspection Fee (current prices may be requested from the Public Works Department) shall be paid to the City before issuance of the "Land Disturbance Permit".

Drainage facilities including, but not limited to, culverts, detention basins and ditches, as well as the roadway sub-grade, base stone and binder & surface coarse shall be inspected, tested and given approval at each stage of installation prior to proceeding to the next stage of construction. Final construction inspection for approval and acceptance of streets and drainage systems will not be granted until all work has been completed in accordance with the approved plans.

1.10 Revision of Plans

Should, during construction, necessary changes be anticipated that would in the opinion of the City staff constitute significant revision of the plans already approved by the City, said plans shall be revised with said changes shown and resubmitted as required by the City, along with a letter stating why such changes are believed necessary. Changes deemed to be minor in nature by the Director of Public Services may be made during construction with the changes noted for inclusion in the "as-built" drawings to be submitted to the City prior to final acceptance.

The Director of Public Works shall have the right to re-review the entire set of Plans should a revision of the plans be required.

1.11 Acceptance of Facilities

After construction has been completed, a final inspection will take place by the City. A Certificate of Acceptance will be issued once all contractual agreements have been met and construction meets the extents considered satisfactory under these specifications and deemed as such by the City.

Acceptance of Facilities will only be issued after As-Built plans that adhere to requirements listed in Section 1.12 have been submitted and approved by the Director of Public Works.

No permit shall be issued by the Public Works Director or his designee to any person, firm, corporation, public or private utility, association, or others, for the privilege of excavating in, on, or across any street,

road, alley, sidewalk, or other public way with the jurisdiction of the City of Goodlettsville, until an excavation bond is posted. Such bonds shall meet the requirements of Goodlettsville Municipal Code, § 16-212.

1.12 Modifications

Occasions may arise where the minimum standards are either inappropriate or cannot be justified economically. Modifications from the standards in this manual will be considered by the Director of Public Works on a case-by-case basis using the following criteria:

1) Whether the modification requested complies with acceptable engineering standards;
2) Whether the modification requested does not present a danger to the general health, safety or welfare to the traveling public or pedestrians; and
3) Whether the modification is necessary and meets or exceeds the standard using acceptable alternative design or methods.

If the developer, contractor, or utility responsible to the City for public improvements desires to design and construct such improvements in modification to these standards, such modification(s) should be identified in a written attachment to the initial submittal of plans. A request for modification shall be denied if the following information is not provided:

1) Identification of the standard provision to be modified
2) Identification of the alternative design or construction standards proposed.
3) A thorough justification of the modification request including impact on short- and long-term capital and maintenance requirements and cost.
4) Request shall be prepared and sealed by a professional civil engineer licensed to practice in the State of Tennessee.

1.13 As-Built Plan Submittal

Final as-built plans should be submitted immediately following completion of construction activities. If the project is developed in phases, as-built plans for each phase shall be submitted once the work is complete in that phase. Acceptance of facilities will not be issued until satisfactory as-built plans have been approved by the Director of Public Works and the Engineer.

All aspects of the project that have been affected by construction should be verified and appear on the as-built plans. This would include, but is not limited to the following items:

- All property lines and easements
- Existing structures (include patio covers, decks, trellises, sheds, pools, fences, poles, etc.)
- Location of all "as-built" work with station and offsets.
- Height and location of all fences, walls, screens, trees, and hedges over 42" tall
- All commercial driveways, paved areas, and required parking spaces
- All concealed components with station and offsets (include known buried cables, utilities, drainage structures, etc.)
- Video documentation of storm drainage (if required)
- Stormwater BMP's (Detention / Retention ponds, Bioretention Areas, etc.)

Concealed components will require documented proof to be submitted with the as-built plans in the form of a certified construction log that has been generated by the design engineer or a certified quality control inspector.

As-built plans are required to be endorsed by a Tennessee registered professional engineer and/or a registered land surveyor.

1.14 Revisions to these Specifications

These specifications will be adopted by ordinance of the City Commission and shall be revised by ordinance; however, forms and administrative procedures or regulations to effectuate the intent of these specifications are subject to change as deemed necessary by the Director of Public Works with thirty (30) days' notice from posting on the City's website or advertising in a publication of general circulation within Davidson and Sumner County and placed on file at the City Hall for public inspection and written comment.

CHAPTER 2

EARTHWORK

2.1 – Overview

This Section includes all clearing and grubbing, stripping topsoil, excavation, embankment, trench excavation, backfilling and testing required for construction of city streets within the City. Earthwork embankments and excavations shall be constructed in close conformance with the lines, grades and typical cross sections shown on the approved plans. Demolition of structures and other obstructions and abandonment plans are contained in Section 2.5 of these specifications. For all earthwork operations, the developer/contractor will be required to provide testing from an independent geotechnical firm pre-approved by the City. See Chapter 1 for additional testing and inspection requirements.

2.2 – Reference Specifications

Unless modified by these specifications, all earthwork materials and construction requirements shall conform to the "Standard Specifications for Road and Bridge Construction" published by the Tennessee Department of Transportation (TDOT) (latest edition), hereafter referred to as the "Standard Specifications".

2.3 – Soil Erosion / Sediment Control

All projects requiring a land disturbance permit will require the development of a site-specific erosion prevention and sediment control plan. As a minimum, the plan shall provide for the temporary sediment control measures, designed to control runoff from a 2 year, 24-hour storm. All erosion prevention and sediment control measures shown on the approved plans shall be in place prior to receiving a final approved land disturbance permit, and must conform to the latest edition of the Tennessee Department of Environment and Conservation (TDEC) Erosion and Sediment Control Handbook.

2.4 – Clearing and Grubbing

Clearing the right-of-way of all vegetation and debris shall be limited to an area bounded by a line established five (5) feet beyond the actual line of construction unless otherwise directed by the designated Public Works representative. Complete removal of shrub and tree roots is required except for sound undisturbed stumps and roots that will be a minimum of 5 feet below proposed subgrade or slopes which may be allowed to remain.

2.4.1 – Tree Protection: Living trees with drip lines located beyond the construction lines are to remain undisturbed and protected by the contractor unless tree removal is part of an approved development plan. The Developer will be responsible for establishing the line of construction clearing in accordance with the above requirements.

2.4.2 – Burning Permit: Burning of cleared vegetation and perishable debris is not allowed unless approved by the City Fire Marshall's Office by issuance from the Fire Marshall of the required burn permit.

2.4.3 – Debris Removal: Unless otherwise approved, all debris (i.e. cleared trees, brush, fences, building materials, etc.) shall be removed from the right-of-way, out of view from the street, and shall not be buried or otherwise become part of the street subsurface. Removal of cleared materials from the developer's property shall be legally disposed of off-site and/or in a licensed landfill.

2.5 – Removal of Items

The following guidelines have been established for permit issuance and inspection of the demolition of transportation features and structures within the City. Work associated with demolition and abandonment will consist of the demolition, removal and satisfactory disposal of items that have been selected for demolition on approved construction plans. Demolition will not be approved until satisfactory arrangements have been made to maintain traffic. Demolition of all items, including those not detailed below, shall be coordinated with the City and/or the Director of Public Services.

2.5.1 – Removal of Drainage Structures: Where portions of existing drainage structures lie within the limits for a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure. Pipe designated to become the property of the City of Goodlettsville shall be carefully removed and every precaution taken to avoid breaking or damaging the pipe.

2.5.2 – Removal of Pavement, Sidewalks, Curbs, Etc.: All pavement, base course, sidewalks, curbs, gutters, driveways, etc. shall be removed and disposed of as follows: If the items are more than two feet below sub-grade elevation, they shall be broken into sizes not to exceed two feet in maximum dimension and remain in place, unless it interferes with succeeding items of construction. If the items are less than two feet below the sub-grade elevation, they shall be removed and disposed of.

2.5.3 – Right-of-Way Closure/Abandonment: Once right-of-way has been identified for closure, the City staff will make a recommendation to the City Commission. If approved by the City Commission, notification will be sent to adjacent property owners of the action as well as explaining the maintenance of the abandoned right-of-way will be the responsibility of adjacent property owners. A copy of the ordinance will be forwarded to the Davidson County or Sumner County Tax Assessors Office (whichever office is appropriate) for changing the property lines and the GIS map. Any plat recording of the changed boundaries will remain the responsibility of the respective property owners.

Failure of the plans to identify the existing of concrete pavement under asphaltic pavement shall not be construed to imply that concrete is not present. It is the contractor's responsibility to determine the presence of concrete pavement when it is not identified by the plans.

2.6 – Excavation

Excavation within the right-of-way includes stripping topsoil, grading of the street and required ditches, borrow material, channel excavation, rock excavation and undercutting. Excavation shall be performed in close conformance to the lines, grades, side slopes and typical cross sections of the approved construction plans.

2.6.1 – Property Protection: Excavation shall be performed in a safe and orderly manner with due consideration given to protection of adjoining property and trees outside the clear lines. Approved erosion control measures shall be installed and regularly maintained to insure protection of adjacent properties. Excavated material when required shall be stockpiled in such a manner as to not obstruct streets, driveways or sidewalks.

2.6.2 – Safety: All excavation shall comply with OSHA's "Construction Industry Standards" as well as all applicable Federal and state regulations. Protect open excavations and cut slopes with suitable means to protect workers, inspectors and other pedestrians able to access the site.

2.6.3 – Structure Excavation: Excavation for bridges and pipes shall be in accordance with the Standard Specifications. Excess rock excavation below foundation elevations shall be filled with leveling concrete. Excess rock excavation below the elevation of the bottom of the pipe bedding, cradle or encasement shall be filled with material of the same type and placed and compacted in the same manner as the bedding material.

2.6.4 – Channel Excavation: Excavation within swales, drainage ditches, channels, or waterways that carry concentrated flow, will require approved permits prior to commencing operations, and the equipment shall be kept out of the waterway to the greatest extent possible. An Aquatic Resource Alteration Permit (ARAP) may be required if excavation occurs within "Waters of the State". All excavation must conform to the latest edition of the Tennessee Department of Environment and Conservation (TDEC) Erosion and Sediment Control Handbook.

2.6.5 – Blasting: Rock excavation requiring blasting shall be performed only after obtaining blasting permits from the City of Goodlettsville Fire Marshal. Blasting operations shall be performed only by experienced, licensed blasting contractors. Blast areas shall be protected with mats or earth overburden to prevent flying debris. When blasting near public areas or motorists, blast zones are to be set up with proper signing and flagmen to secure the blast area prior to detonating explosives. The contractor shall be responsible for all damages and shall repair or replace any and all damages at no expense to the City. A pre-blast survey will be required by the Planning and Development Services Office. All blasting shall be conducted in accordance with TDOT Standard Specifications for Road and Bridge Construction, General Construction Requirements, § 203.04.

2.7 – Undercutting

When unsuitable material such as tree roots, trash, concrete and asphalt fragments or soft organic or plastic clays are encountered in the subgrade, the area shall be undercut and backfilled with select material.

2.7.1 – Limits of Undercutting: Areas and depths of undercutting required for existing streets will be determined by City officials during inspections of subgrade construction and for final acceptance of city streets. The extent of undercut areas shall be determined by proof-rolling the subgrade and marking the areas of distress with marking paint or other means. Undercutting required after curbs are installed shall be located no closer than 12 inches from the nearest concrete face.

2.7.2 – Proof Rolling: Vehicles for proof-rolling shall be tandem axle dump trucks fully loaded with a minimum material payload of 23 tons. Materials may be dry soil or rock loaded at the site or preferably loaded off-site at quarry with crushed stone and accompanied with a certified weight ticket.

2.7.3 – Backfill: Suitable material may consist of consistent soil from the site which matches the soil classification of the subgrade, or classified rock (surge rock) may be used. Backfill material should be placed in lifts not to exceed 12 to 24 inches and each lift shall be compacted with a dozer or other approved heavy equipment.

2.7.4 – Stabilization: Geotextile fabrics may also be used to strengthen backfill material in undercut areas provided the contractor can demonstrate their effectiveness on test repair areas at the same site or based on the recommendations of a pre-approved licensed geotechnical engineer.

2.8- Embankment

Embankment material shall consist of approved soil or rock obtained from on-site excavations or hauled from a borrow pit area, and shall be placed in fill embankments in reasonably close conformance with the lines, grades, side slopes and typical cross sections shown on the approved plans. All embankments shall be placed in accordance with Section 205, Embankments, of the Standard Specifications.

2.8.1 – Soil Materials: All borrow material used shall be of AASHTO M145 classification A-6 or better or of the same classification or better than the predominant soil comprising the roadway excavation. Borrow materials shall be free of organic material, and shall not be obtained from wetland areas.

2.8.2 – Rock Materials: Embankments comprised of shot rock shall be processed from an acceptable screening and or selection process that produces rock of the required gradation. Rock shall meet soundness requirements for degradable or non-degradable rock under a 60,000lb roller compactor as stated in the Standard Specifications.

2.8.3 – Soil Placement: Embankments comprised of predominantly soil or degradable rock shall be placed in horizontal layers not to exceed ten (10) inches in depth before compaction and each layer shall be compacted to a density not less than 95% of the maximum density determined by laboratory testing. The top six (6) inches of the subgrade, in both cut and fill sections, shall be compacted to 100% of maximum density. Maximum density and optimum moisture content shall be determined by an independent testing firm using the Modified Proctor testing procedure. In-place embankment material that pumps under the wheel loading of a fully loaded tandem axle dump truck during proof-roll testing shall be undercut and removed, regardless of density testing results. See Section 2.7 on Undercutting for additional information.

2.8.4 – Rock Placement: Embankments of predominantly non-degradable rock may be placed in three (3) feet thick lifts with no rock more than two (2) feet in thickness. Occasional rocks up to four (4) feet in thickness may be placed in the outer edges of the fill slope.

2.9 – Trench Excavation

Trenches cut within the limits of the subgrade shall be excavated to neat lines to minimize disturbance of the surrounding material. The contractor / developer is solely responsible for the stability of trench excavations and conformance with OSHA regulations.

All excavation for pipe and utility installation shall be performed in accordance with the Section 204, Structure Excavation Foundation Preparation and Backfill, of the Standard Specifications.

2.9.1 – Existing Street Cuts: Utility trenches cut into existing streets shall be performed in such a manner as to maintain the existing integrity and rideability of the street. Trench limits shall be saw-cut a minimum of 1-inch deep into the existing pavement. Excavation width shall be limited to the minimum width required to permit satisfactory jointing of the pipe and thorough backfilling.

2.9.2 – Backfill: Utility trenches excavated into existing streets shall be backfilled with granular stone and placed in layers not to exceed 6 inches. Each layer of backfill material should be placed with optimum moisture content and thoroughly compacted with mechanical tampers.

2.9.3 – Flowable Fill Backfill: For trench excavations subject to moderate and heavy truck traffic, the excavation shall be backfilled with flowable concrete fill. Pipe bedding shall be installed

and thoroughly compacted prior to placement of flowable fill material. Concrete for flowable fill shall meet the requirements of Chapter 4.

2.9.4 - Pavement Replacement: Base stone and asphalt paving shall be placed over trench backfill with thicknesses and gradations equal to the existing street pavement section. As a minimum, the asphalt pavement section shall consist of 8-inch base stone thickness, 3-inch asphalt binder coarse thickness and 1.5-inch thickness of asphalt surface course. Each course of base stone and asphalt shall be thorough compacted with mechanical tampers. Limits of pavement replacement shall be the same as those stipulated in **Section 2.7, Undercutting**.

2.10 – Underdrains

In addition to storm water drainage structures and appurtenances, subgrade underdrains are required under city streets adjacent to medians with irrigation systems. Underdrains shall consist of free draining crushed stone, 4-inch diameter perforated pipe and filter cloth. All underdrains shall be constructed in accordance with TDOT standard drawing RD-UD-3 for underdrains with pipe and filter cloth.

2.11 – Street Damages

Damage to existing streets and structures, utilities, trees, or private property shall be repaired and restored to its original condition by the Contractor in a timely manner, on a schedule to be determined by the City Manager, or their designee. A minimum $1,000.00 fine will be imposed for damage of existing streets due to hauling or otherwise moving equipment, spills of concrete, paint, oil or any other debris which damages the street or results in cleanup costs for the City. These fines are in addition to the bonding requirements set forth by Planning and Development Services Department.

2.12 – Dust Control

The contractor / developer shall sprinkle the street construction surfaces with water or apply a dust allaying material when such operations are necessary to prevent a dust nuisance or if directed by a representative of the Public Works Department.

2.13 – Final Dressing

Street side slopes and ditches shall be shaped within reasonably close conformity to the specified lines, grades and cross sections. Ditches shall be fine graded to eliminate areas of ponded water. All rock cuts shall be scaled of all loose fragments and left in a neat, safe and workmanlike manner as approved by the Director of Public Works, or their appointed representative.

2.14 – Seeding and Sodding

All slopes, ditches, and detention ponds shall be stabilized with seeded grass or preferably sod. Stabilizing of disturbed areas shall be accomplished when the section of residential development is 80 percent complete or when the construction of local streets is substantially complete. Stabilized areas shall be considered acceptable for final inspection when the seeded or sodded area has an 80 percent or better establishment of grass coverage.

CHAPTER 3

PAVEMENT DESIGN

3.1 – Overview

The Contractor (Developer) shall provide all plant, labor, material and equipment to furnish and construct the bituminous concrete pavements in reasonable close conformity with the lines, grades, thickness and typical cross sections shown on the standard drawings and specified herein, or as called for on the approved plans and specifications.

The specifications referenced for each material shall fully apply and no deviations from said specifications limits or quality will be permitted unless specifically stated otherwise in this Section. The failure of any component of a product to comply with the referenced specifications shall constitute failure of the whole product.

The Contractor (Developer) shall obtain approval of the subgrade and stone base from the Director of Public Works prior to commencing with the paving operations.

For all paving operations, the developer / contractor will be required to provide testing from an independent geotechnical firm pre-approved by the City. See **Section 1** for additional testing and inspection requirements.

3.2 – Requirements

3.2.1 – Design Standards: The design criteria and procedures presented follow the TDOT Standard Specifications for Road and Bridge Construction, Sections 307 (Bituminous Plant Mix Base (Hot Mix)), 407 (Bituminous Plant Mix Pavements (General)), 411 (Asphaltic Concrete Surface (Hot Mix)), & 907 (Concrete Reinforcement), dated January 1, 2015 and the American Association of State Highway and Transportation Officials (AASHTO) 1993 Guide for the Design of Pavement Structures.

1) ADT & Equivalent Daily Load Applications (EDLA): Loading values can be calculated using TDOT approved ADT numbers or Equivalent Daily Load Applications (EDLA) and Equivalent Single Axle Loads (ESAL) units if available. AASHTO's "A Policy on Geometric Design of Highways and Streets" and/or "Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)", whichever design method is appropriate, should be used if ADT, EDLA, or ESAL units are available.

2) Minimum Pavement Section: The standard drawings in the Appendix provide the default acceptable pavement sections for each street classification based on assumed subgrade support and traffic values. These pavement thicknesses may be used for preliminary planning purposes, cost estimates, or final pavement designs when approved by the Director of Public Works. All pavement thickness designs must be based on actual subgrade support test results (refer to the Earthwork Chapter) and traffic projections for the specific project. In specifying layer thickness, the designer shall consider how the pavement section will be physically constructed (e.g. Specify how to construct 2' of treated subgrade.)

3.2.2 – Pavement Type: Streets are to be constructed of asphaltic concrete pavement, base course material, or subbase material (where required), placed on compacted subgrade. Nonstandard design coefficients may be used, only if approved in advance by the Director of

Public Works. In addition, design values must be verified by pre-design mix test data and supported by daily construction tests.

3.2.3. – Treated Subgrade: The use of treated subgrade, treated base, and/or full depth asphalt pavement may be acceptable when designed and submitted by the designer, and approved by the Director of Public Works in accordance with these standards as well as the TDOT Standard Specifications for Road and Bridge Construction, Sections 302 (Subgrade Treatment), 304 (Soil-cement Base) & 306 (Portland Cement Concrete Base).

3.2.4 – Approval: A Pavement Design Report shall be submitted with final construction plans. The Pavement Design Report must include the pavement design calculations, methodology, typical sections selected, and basis for assumptions. The Director of Public Works shall review and approve the Pavement Design Report prior to construction.

3.3 – Rehabilitating / Repairing Existing Streets

On paved surfaces, within public right-of-ways, do not use or operate tractors, bulldozers, off-road trucks or other power-operated equipment, the treads or wheels of which are so shaped as to cut or otherwise damage such surfaces. Damaged roadways shall be repaired to the City's satisfaction by the Contractor (Developer). Placing of mats or using other methods of protection may be allowed subject to the approval of the Director of Public Works.

Any roadway surface damaged shall be promptly restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations. Suitable materials and methods shall be used for such restoration. All dirt and mud tracked on existing roadways shall be removed promptly.

Prior to overlaying existing asphalt, the Director of Public Works may require nondestructive testing to determine the amount of overlay necessary to bring the street to current standards. The method of nondestructive testing and the data obtained must be in a form compatible with the pavement management system for the Director of Public Works. All "pot-holes," utility trench settlement, cracking, and any similar imperfections shall be repaired to the Director of Public Works' satisfaction prior to overlaying. The following should serve as a guideline for the rehabilitation and repairing of existing asphalt streets in the City:

3.3.1 – General: The contractor is to provide the necessary labor materials and equipment to restore and maintain the various street and driveway surfaces of all types, pavement and driveway bases, curbs, curbs and gutters, and sidewalks disturbed, damaged, or demolished during the performance of the work.

3.3.2 – Permits: Before starting any work, secure the necessary permits to work within the City or State right-of-way and easements when surface materials will be disturbed or demolished. Separate street excavation permits for street cutting and road subsurface boring / jacking operations are issued at a cost of $100.00 each and expire after six months from the date of issue. A $10,000.00 bond is required for utility cuts or directional bores located within City ROW.

3.3.3 – Materials: The quality of materials used in the restoration of existing streets, parking areas and driveways shall produce a finish surface equal to or better than the condition before work began. Compacted crushed stone backfill shall be in conformance with the TDOT Standard Specifications for Road and Bridge Construction.

3.3.4 – Execution: Where trenches have been opened in any roadway or street that is a part of the State of Tennessee highway system, restore surfaces in accordance with the requirements of TDOT. All other restorations shall be done in accordance with the City Standards; these Specifications and the Standard Details.

Before trenching in paved areas the Contractor shall saw-cut the pavement in a straight line along the sides of the proposed trench to allow for pavement removal and trench excavation without damage to adjacent pavement. During construction, suitable precautions shall be taken to protect the pavement edges and surfaces and to minimize damage.

Upon completion of the utility installation, including backfill, fill the trench with crusher run and temporary pavement patch until such time that the permanent pavement patch will be constructed. The temporary patch shall be placed the same day or within 24 hours. The temporary pavement patch shall consist of at least twelve (12) inches of compacted stone base brought to within two (2) inches of the surface of the existing permanent pavement. A two (2) inch layer of cold mix asphaltic concrete shall then be applied to protect the base, prevent "pot holes" or "chuck holes", and provide a reasonably smooth pavement surface until the permanent patch is made. The temporary pavement patch shall be placed within twenty-four (24) hours of the completion of the utility installation. Permanent Hot Mix patching shall only be applied after the Cold Mix patch has been completely removed and adequate subbase is installed.

Concrete curbs, gutters and sidewalks shall be restored as required to match existing construction. Replace damaged sections with complete new sections or squares; patching of damaged sections will not be permitted.

When a manhole or valve box frame and cover, or other utility casting, requires adjustment to an elevation one inch or more above the existing pavement grade and is exposed to traffic before final paving is completed, a temporary ramp shall be constructed by feathering a cold mix for 360 degrees around the casting. A taper slope of not less than two feet per one inch shall be used. During the final paving operation, the temporary ramp shall be removed from around the casting to allow for the permanent paving installation.

3.4 – Pavement Structure Components:

3.4.1- Subbase: The layer(s) of specified or selected material of designed thickness placed on a subgrade to support a base course, surface course, or both.
A minimum of one boring shall be obtained for any roadway segment. A second boring shall be required in the trench of any installed utilities. The distance between borings shall not exceed 500 feet, two borings per locations where utility trenches exist (one boring in the trench and one in compacted subgrade). Multiple samples shall be taken alternately among lanes and shall be evenly spaced. The Director of Public Works may require more frequent testing to ensure that the subbase meets the adequacies presented in the design report.

3.4.2 – Base Course: The mineral aggregate base (stone base) shall be crushed stone as manufactured by local quarries in accordance with TDOT Standard Specifications.

The composite gradation of aggregate for the mineral aggregate base and for surface courses shall be Class A, Grading D, Pug Mill Mix, as specified in the TDOT Standard Specifications for Road and Bridge Construction (TDOT).

3.4.3 – Surface Course: One or more layers of a pavement structure designed to accommodate the traffic load; the top layer of which resists skidding, traffic abrasion and the disintegrating effects of climate. For asphalt pavement the top layer is sometimes called "Wearing Course." Asphalt thicknesses for surface courses are typically 1 ¼" to 1 ½" thick. For asphalt overlay projects, the total thickness of asphalt should be no more than 4".

3.5 – Asphaltic Concrete Pavement Design

3.5.1 – Material: The asphaltic concrete surface shall be a bituminous concrete consisting of crushed stone with fine aggregate, and stone screenings, or combination thereof, combined with asphaltic cement and sand resulting in a mixture of Grading D.

For City funded projects, use Grading E surface course mix for all streets with classification less than a Collector. Grading D surface course mix shall be used for all streets classified as a Collector or higher.

Aggregate for the plant mix surface course shall be sized, graded and combined in such proportions that the resulting composite blend meets the requirements of § 903.05, Aggregate for Mineral Aggregate Base and Surface Courses, of the Standard Specifications, together with the stipulations pertaining to the constituents of the blend hereinafter specified in the TDOT Standard Specifications for Road and Bridge Construction (TDOT).

When Grading E is used for surfacing of shoulders or other no traffic lane construction, the mineral aggregate may be composed entirely of limestone and manufactured sand, but in no case shall the mineral aggregate for this construction consist of less than 50 percent of limestone.

3.5.2 – Procedure: All pavement designs shall adhere to the specifications set forth in the TDOT Standard Specifications for Road and Bridge Construction (TDOT).

Pavement is required to be a 20-year design.

3.6 – Rigid Pavement Design

For concrete rigid pavement, **see Section 4, Concrete**, for concrete riding surfaces.

3.7 – Installation

The mineral aggregate base shall be constructed in one or more layers with the compacted thickness being that as shown on the approved plans or the construction standards. Prior to the spreading of any mineral aggregate, the subgrade shall be proof rolled with a fully loaded tandem dump truck (or other approved equipment). Any areas which pump will require undercutting, backfill and compaction to specified limits. Additional proof rolling shall be required for all repaired areas.

Hauling over material already placed will not be permitted until it has been spread, shaped and compacted to the required density.

If the required compacted depth of the mineral aggregate base course exceeds six (6) inches, the base shall be constructed in two or more layers of approximate equal thickness. For total base thickness of 8", lifts shall be placed and compacted in 4" thicknesses. For 10" base thickness, lifts shall not exceed 5".

Except where mechanical aggregate spreading equipment is used to place the mineral aggregate base material, final shaping of each layer prior to compaction shall be accomplished by motor grader. In the

event that mechanical spreading equipment fails to shape the base material properly, final shaping shall be done by motor grader or other approved means.

Immediately following spreading, the mineral aggregate base material shall be shaped to the required degree of uniformity and smoothness and compacted to the required density prior to any appreciable evaporation of surface moisture. Compaction of each layer shall be continuous until the minimum density requirement is achieved. Compacting equipment shall be smooth drum steel wheel vibratory rollers.

For density testing purposes, each completed layer is to be divided into lots of approximately 10,000 square yards. Five density tests are to be performed on each lot and the results averaged. Smaller lots may be considered when directed or approved by the Director of Public Works.

The average dry density of each lot shall be not less than 100 percent of theoretical density based upon 83 percent of a solid volume, unless otherwise specified. Further, no individual test shall be less than 97 percent of theoretical. The theoretical density of aggregates shall be based on bulk specific gravity AASHTO T-99. The theoretical density of all other aggregates shall be based on bulk specific gravity AASHTO T-85 AND T-99.

When mineral aggregate base is used to widen an existing pavement, to construct shoulders for resurfacing projects, base placed on bituminous asphalt mix, or base used for structure backfill, the average density of each lot shall be not less than 95 percent if maximum density determine in accordance with AASHTO T-99, Method D, unless otherwise specified. Further, no individual test shall be less than 92 percent of maximum density.

The thickness of the completed mineral aggregate base shall be in reasonably close conformity to the thickness shown on the approved plans or as called for by the construction standards. The thickness shall be measured at such frequency as established by the Director of Public Works by means of test holes, borings, or other approved methods.

The surface of the finished mineral aggregate base shall be in reasonably close conformity to the lines, grades and cross sections as shown on the approved plans or construction standards and shall have a satisfactorily smooth riding quality.

Upon completion of the mineral aggregate base, it shall be maintained, under traffic if required, smooth and uniform until covered by the following stage of construction.

The mineral aggregate base, prepared as outlined herein, shall be sprinkled lightly with water to settle any loose dust. The bituminous prime coat shall then be applied uniformly over the surface of the base by the use of an approved bituminous distributor. The prime coat shall be applied at the rate of three-tenths (0.3) gallon per square yard and shall be maintained at an application temperature between 60 and 140 degrees Fahrenheit (F). Any areas containing an excess or deficiency of priming material shall be corrected by the addition of blotter material or bituminous material, as directed by the Director of Public Works.

The Contractor shall protect all structures and concrete surfaces from the bituminous material during construction. If after the bituminous prime coat has been applied, it fails to penetrate before traffic has to be turned back to the road, or paving is interrupted overnight, a dry cover material shall be spread at a rate of ten (10) pounds per square yard to prevent damage to the primed surface. An excess of cover material shall be avoided. The cover material shall be applied with suitable spreading devices to prevent the tires of the trucks from running over the fresh bituminous prime coat.

The Contractor shall maintain the prime coat and the surface intact until it has been covered by the following stage of construction. No succeeding stage of construction shall be placed upon the prime coat until it has properly cured.

The asphaltic concrete base course or surface course; bituminous plant mix (Hot Mix); may be placed on properly constructed and accepted subgrade or previously applied layers provided the following conditions are met:

1. The subgrade or the surface upon which the hot mix is to be placed shall be free of excessive moisture.

2. The Hot Mix shall be placed in accordance with the temperature limitations specified on Table 407.09-1 of the Standard Specifications, and only when weather conditions otherwise permit the pavement to be properly placed, compacted and finished.

3. See § 407.09, Weather Limitations, of the Standard Specifications for additional seasonal weather requirements.

4. The Contractor may request a variance from the above required temperature and seasonal limitations to pave at lower temperatures if there is a benefit to the public. Submit such requests in writing at least one week before the anticipated need, and include a Paving and Compaction Plan for Cold Weather that meets the Department's Procedure. The plan shall identify what practices and precautions the contractor intends to use to ensure the mixture is placed and compacted to meet the specifications.

3.8 – Testing

All pavement installations and repairs will require the contractor to submit material testing certifications to the Director of Public Works. Materials should meet the requirements found in the TDOT Standard Specifications for Road and Bridge Construction. The following should be considered for the submittal:

1) Liquid Asphalt: Certification is needed to show specification compliance including the performance grade of the material.

2) Aggregate: A completed mix design along with aggregate stockpile results with percent passing each sieve.

3) Completed Mix: Complete mix gradation should be documented by tests using one of the following methods: Hot Bins, Vacuum Extraction or Burnout Oven Testing.

4) Compaction: Density results shall be compliant with the TDOT Standard Specification Section 40 and field verified. The percent voids in the total mix and the theoretical gravity of the mix should be documented as bare minimum.

The Director of Public Works reserves to right to request any additional tests deemed necessary for acceptance.

CHAPTER 4

CONCRETE

4.1 – Overview

This Section includes cast-in-place and pre-cast concrete, including reinforcement where required, concrete materials, mix design, placement procedures, and finishes. All concrete pavements, sidewalks, ramps, driveway aprons, curb and gutter sections, paved ditches, pipe and pipe end treatments, box culverts and bridges, drainage structures, foundation and wall panels and all other miscellaneous concrete elements indicated on the approved drawing shall be constructed in accordance with these specifications unless approved otherwise by the City. All concrete shall be ready mixed concrete and not field mixed unless otherwise approved.

The Contractor (Developer) shall provide all materials, labor, and equipment necessary for the completion of all concrete work in accordance with the lines, grades, thickness and typical cross sections shown on the construction standards specified herein, or as indicated on the approved plans.

4.2 – Reference Specifications

Unless modified by these specifications, all concrete materials and construction requirements shall conform to the "Standard Specifications for Road and Bridge Construction" published by the Tennessee Department of Transportations (TDOT) (latest edition), hereafter referred to as the "Standard Specifications".

Where project plans and specifications refer to particular items, materials, equipment and construction requirements, the appropriate section of the Standard Specifications shall apply. Standard Specification sections regarding compensation shall not apply unless directed by the Engineer. The absence of a description or specification for any item of work shall automatically refer to the appropriate section of the Standard Specifications.

TDOT Specification Section 604 shall apply for all structural concrete to be used in load carrying structures including box and slab culverts, foundations including drilled caissons, traffic signal and overhead sign foundations, retaining walls and girder bridge members. Section 604 also specifies the requirements of concrete used in structures as well as other miscellaneous or incidental items.

Miscellaneous concrete items such as sidewalks, curbing and gutters, rigid street pavement, medians, driveways, paved ditches and roadside sign foundations, shall meet the requirements of TDOT Specification Sections 700 through 703.

All precast concrete including precast drainage structures, headwalls, box culverts, pipe, temporary barriers, noise and retaining walls, and bridge members shall meet the requirements of TDOT's Standard Operating Procedure 5-3 regarding the "manufacture and Acceptance of Precast Concrete Drainage Structures, Noise wall panels, and Earth Retaining wall products". This document requires that all producers of precast concrete products be certified in accordance with national quality standards developed by the National Precast Concrete Association (NPCA), the American Concrete Pipe Association (ACPA) and/or the Prestressed Concrete Institute (PCI). Certified producers must submit a copy of their certifications and documentation that have successfully completed the annual inspections. The Engineer may waive the requirements of precast concrete producer certification on a case-by-case basis. This waiver must be supplied by the City in writing and retained by the Contractor.

4.3 – Submittals

Where required in the project plans, technical performance and/or quality certification of concrete materials proposed for the work shall be submitted to the Engineer for approval. Such submittals may include the following:

4.3.1 – Concrete Mix Designs: Concrete mix designs are required for load carrying structures such as bridges, box culverts, large junction boxes within the roadway and retaining walls. Mix designs shall be prepared and certified by approved materials testing company, or alternately, an existing TDOT approved design may be submitted provided the design is approved within the calendar year. Mix designs shall certify all admixtures and cement replacement such as fly ash proposed for the project concrete.

4.3.2 – Reinforcing Steel: Certifications for reinforcing steel used in load carrying structures shall be submitted to the Engineer. Letter of certification shall bear the signature of the supplier's representative and shall certify that the reinforcing meets the requirements of the Standard Specifications.

4.3.3 – Miscellaneous Items: Items included in concrete work such as handrails, anchors, joint materials, curing materials and other items may require submittals and/or representative samples at the discretion of the Engineer.

4.4 – Concrete Classification

Use of the following classes of concrete per the TDOT Standard Specifications:

Application	Class	Min. 28-day Strength
Sidewalks & Bikeways	A	3000 psi
Curb and Gutters, Drainage Structures	D	4000 psi
Bridge Substructures, Box Culverts, Retaining Walls	D	4000 psi
Light and Traffic Signal Pole Foundations	A	3000 psi
Bridge Deck Slabs	D or L	4000 psi
Underwater Foundations Seals	S	3000 psi
Leveling Concrete	A	3000 psi
Flowable Fill (backfill)	Excavatable EFF **	30 psi (140 psi @98 days)
Rigid Concrete Pavement	CP**	3000 psi

** See Section 204 (Structure Excavation Foundation Preparation, and Backfill), and Section 501 (Portland Cement Concrete Pavement) of the Standard Specifications.

4.5 – Curbing and Sidewalks

4.5.1 – Residential Sidewalks: All residential street sidewalks within the City shall be constructed within the street right-of-way and shall meet all current City zoning district requirements and Standard Drawing RP-4. The sidewalk forms and base material shall be inspected prior to concrete construction.

It is the contractor's responsibility to ensure safety and maintain access for pedestrians when sidewalks are under construction and to protect the in-place work from damage or vandalism.

Traffic control devices including cones, barrels and signs may be required on high volume streets to warn vehicular traffic in advance and adjacent to the area of construction.

1) All concrete sidewalks shall be a minimum uniform thickness of 4" using Class A Concrete, minimum 28-day compressive strength of 3000 psi. Sidewalks shall be constructed on 4

inches (minimum) of compacted, granular aggregate based stone (TDOT size #57, #67, or Class A, Grade D Base Stone). The base stone shall be mechanically compacted to a firm, even surface in reasonably close conformity with the grade and cross section required.

2) Subgrade soil which in the opinion of the Engineer is soft or subject to large volume changes, shall be excavated and replaced with suitable material. The depth of removal will be based on the quality and depth of the unsuitable soil, as field verified, or as determined by Geotechnical investigation, and is subject to approval by the Engineer.

3) Where driveway and alley approaches cross the sidewalk, the minimum concrete thickness of the approach slab shall be 6". See Standard Drawings for details. Granular base material for driveways shall be compacted base stone material conforming to Class A, Grading D of TDOT Section 303.02 (Aggregate). A 2.25" lowered curb height above the gutter line shall also be maintained at the front edge of the driveway approach.

4) Reinforcement of residential sidewalks is required and shall consist of fiber mesh.

5) Sidewalk cross slope shall be a maximum of 2% sloping toward the curb. Longitudinal sidewalk grades within the right-of-way shall not exceed the grade established for the adjacent roadway. Where pedestrian facilities are not contained within a right-of-way, the longitudinal grade shall not exceed five (5) percent.

6) A median strip of grassed or landscaped area at least two (2) feet wide shall separate all sidewalks from adjacent curbs. All sidewalks shall be a minimum of five (5) feet width. The difference in elevation between the top of sidewalk and the top of curb at any adjacent location shall not exceed the grade difference produced by a maximum 4:1 slope.

7) Sidewalk surface is to receive a light broom finish, to achieve a sandy texture with texture lines perpendicular to traffic. Exposed aggregate sidewalk finishes are not acceptable within the street right-of-way.

8) All exposed concrete edges shall be rounded to a 1/2" radius.

9) Final longitudinal surface variations shall not exceed ¼" under a 12 ft. straight edge and transverse variation shall not exceed 1/8" in 5 feet. Low spots which allow water to pond will not be acceptable.

10) Transverse control joints shall be spaced 5 feet maximum and shall be placed at right angles to traffic. Joints shall also be placed to intersect all inside or re-entrant corners. Joints shall be formed with a grooving trowel to a depth of 1 inch. The top edges of the grooves shall be rounded to 1/4" radius.

11) Longitudinal control joints are required for sidewalk widths greater than 6 feet and less than 10 feet. Two longitudinal joints are required for sidewalks greater than 10 feet. Longitudinal joints shall be centered in the width of the sidewalk. Joints shall be formed with a grooving trowel to a depth of 1 inch. The top edges of the grooves shall be rounded to 1/4" radius.

12) Expansion joints shall be constructed with 1/2"thick pre-molded rubberized expansion joint filler (manufactured by J.D. Russell Company, or equal). Bituminous fiberboard shall not be used. Expansion joint material shall extend the full width of the sidewalk and the depth shall extend to within 1 inch of the top surface. Space expansion joints at 30 feet maximum spacing and at each driveway and at any cold joint. Expansion joints are also required at the back edge of driveway approaches between the approach and the private drive and at each side interface with the sidewalk.

13) 1" thick pre-molded expansion joints are required when sidewalks are adjacent to curved sections of the street curb and when curb is placed adjacent to buildings and/or retaining walls. Use 1/2" isolation joints around other fixed objects like utility poles and hydrants. Use 1/2" expansion joints between the curb and sidewalks where constructed adjacent to each other.

14) Sidewalks and bikeways shall not be opened to pedestrian or bicycle traffic for at least 24 hours after placement. The contractor shall provide and maintain measures to restrict use during the curing period.

15) Concrete driveway aprons shall not be opened to vehicular traffic for at least 7 days after placement or until test cylinder breaks indicate an attained compressive strength of 2500 psi.

16) Backfill sidewalks flush with the surface of the walk and the surrounding ground line with soil. For detached sidewalks, backfill the area between the curb and the sidewalk on the straight line from the top of walk to the top of curb, but not to exceed a 4:1 slope.

4.5.2 – Commercial Sidewalks

All commercial street sidewalks within the City shall be constructed within the street right-of-way and shall meet all current City zoning district requirements and Standard Drawing, RP-4. The sidewalk forms and base material shall be inspected prior to concrete construction. In addition to, and including, the above requirements for residential street sidewalks, commercial sidewalks within the City shall be constructed to the following requirements:

1) Driveway and alley approaches crossing the commercial sidewalks shall be a minimum width of 14 feet and the minimum concrete thickness of the approach slab shall be 6 inches. See standard drawings for details. Granular base material for driveways shall be compacted base stone material conforming to Class A, Grading D of TDOT Section 303.02 (Aggregate). A 2.25 inch lowered curb height above the gutter line shall also be maintained at the front edge of the driveway approach.

2) Isolation joints are required around penetrations in the sidewalk such as fire hydrants, utility poles, manholes, and adjacent to any fixed structure such as a building or retaining wall. Use 1" thick joints against buildings and retaining walls and 1/2" thick pre-molded non- bituminous expansion joint material shall be used in all other locations.

3) All valve boxes, manhole covers and other castings in the sidewalk area shall be adjusted to the grade of the sidewalk.

4) Commercial sidewalk widths shall be specifically reserved for pedestrian travel. Furniture, planters, newspaper stands and other protruding obstacles shall be kept clear of a minimum required width of 4 feet, or as required by current City zoning district requirements. Obstacles in the pedestrian path shall be eliminated or a widened pathway around the obstacle will be required.

4.5.3- Bikeways

Where desired, concrete bike paths within the City shall be constructed using the same requirements of commercial sidewalks except that Control joints shall be saw cut 1" deep through the concrete slab in lieu of tooled joints to improve rideability. Expansion joint material shall be recessed 1/2" minimum below the riding surface.

4.5.4 – Handicapped Ramps

All sidewalks within the City shall include handicapped access ramps compliant with the latest edition of the ADA Standards for Accessible Design at all intersections, crosswalks and commercial driveways. Handicapped ramps shall be constructed in accordance with the TDOT Standard Drawings.

1) Concrete for ramps to be Class A and shall be finished by light broom finish texturing.

2) Install a 1/2" pre-molded, rubber expansion joint between the ramp section and the sidewalk and between the ramp section and the curb.

3) Truncated dome detectable warning areas shall be installed using yellow detectable warning panels or approved equivalent.

4) Minimum concrete thickness for a Handicapped Ramp shall be 8"

4.5.5 – Curb and Gutter Sections

All concrete curb and gutter sections shall be constructed in accordance with details shown in the Standard Drawings and the project plans. Curb openings will be located as shown on the approved plans and will be evaluated based on acceptable access control requirements by the City.

1) Class A Concrete shall be used for all curb and gutter sections and the concrete mix shall be air entrained.

2) Curb and gutter sections shall be constructed on the compacted stone aggregate base for residential and commercial streets.

3) Curb and gutter sections shall be reinforced with fiber filament mesh reinforcing.

4) Control joints for curb and gutter sections shall be spaced at a maximum of 10 feet. Joints shall be formed with a grooving trowel to a depth of 1 inch. The top edges of the grooves shall be rounded to 1/4" radius.

5) Expansion joints are required at all tangent points in curved sections, between curbs and sidewalks and between curbs and other rigid objects such as buildings, catch basins and driveway aprons, per §4.5.1.12 and 4.5.1.13.

6) Where curbs are attached to the sidewalk, expansion joint spacing shall match the spacing of expansion joints in the sidewalk.

7) Maximum expansion joint spacing for detached curbs shall be 100 feet.

8) Curbs and gutters shall be constructed to follow the geometry of the roadway unless noted otherwise on the plans. Curved sections of curb shall conform to the roadway curve geometry with smooth continuous curves with no chorded portions.

9) Flow lines of gutters shall be true to line and grade with no areas of ponding water. Final longitudinal surface variations shall not exceed ¼ inch under a 12 ft. straight edge.

10) Concrete finish for curb and gutter sections shall be a light broom finish with finish lines parallel to the flow of water.

11) Curb and gutter sections aprons shall not be opened to vehicular traffic for at least 7 days after placement or until test cylinder breaks indicate an attained compressive strength of 2500 psi.

4.6 – Stamped Concrete and Brick Pavers

4.6.1 – Stamped Concrete: For areas designated by the City, concrete finishing may incorporate imprinting or stamping and coloring of the exposed finish for improved aesthetics. Stamped concrete finishes are to be performed only by qualified contractors with a minimum of five years' experience in commercial concrete stamping finishes. For projects with proposed concrete stamping, the proposed pattern, finish and color shall be submitted with related product data to the Director of Public Works for approval. Prior to construction, a mock-up sample of a minimum 4 square feet size shall be constructed to demonstrate a typical finished product for review and approval by the City.

Concrete stamped areas may include color of the final surface by applying a colored antiquing release agent just after initial set of the concrete. Concrete may also contain a color additive provided the colorant additive is mixed at the batch plant and the color is completely dispersed in the concrete. After concrete curing, the colored concrete surface shall be sealed with a clear sealer containing at least 30% solids in a minimum of two coats. Alternate method of coloring the concrete surface may be submitted to the Director of Public Works for approval.

4.6.2 – Concrete Unit Pavers: While stamped concrete is the preferred method for aesthetic enhancement of concrete surfaces, concrete pavers may be used to create borders or bands within sidewalk areas. Pavers will not be allowed in areas subject to vehicular traffic unless otherwise approved by the Director of Public Works.

All paver units shall be concrete pavers installed over concrete mats with bituminous adhesives. Clay brick paver units shall not be used unless approved by the Director of Public Works.

4.7 – Rigid Concrete Pavement

For specific locations on city streets with large volumes of truck traffic and damage to asphalt pavement due to braking forces, rigid concrete pavement may be utilized. Typical locations for its use include intersection approaches, particularly at the bottom of steep grades. Thin concrete overlay with thickness of 4 inches or less, commonly referred to as "white topping" and are constructed over existing hot mix asphalt shall not be used on City streets.

Minimum design requirements for new concrete pavements include a fiber reinforced, 8-inch concrete pavement thickness on 10 inches of compacted mineral aggregate base stone. Use of Class CP (3000 psi strength) concrete is a minimum requirement with the additional requirement of High Early Strength cement for a reduced construction time. Concrete pavement construction shall be in accordance with Section 501, Portland Cement Concrete Pavement, of the TDOT Standard Specifications.

4.8 – Concrete Reinforcement

Where indicated on the approved drawings, concrete for load carrying structures such as box and slab culverts, bridges and retaining walls shall be reinforced with steel bar reinforcement, welded wire fabric

and pre-stressing strands. Sidewalks, curbs, combined curb and gutters and concrete pavement areas shall be reinforced with synthetic fiber reinforcement.

All steel reinforcing materials required for load carrying structures shall meet the requirements of the TDOT Standard Specifications unless noted. Sizes, spacing, gauges, locations and arrangements shall be as shown on the approved plans. Where project plans do not depict reinforcing placement plans or schedules, the contractor shall develop and submit reinforcing steel shop drawing to the Engineer for approval. All hooked bars shall conform to Concrete Reinforcing Steel Institute (CRSI) standard hook details.

In the case of bridge decks, top slabs of box and slab culverts used as riding surfaces, concrete barrier rails and bridge sidewalks, all reinforcing steel shall be epoxy coated per the Standard Specifications. In addition, the dowel bars projecting from the footing into the back face (backfill side) of the wall stem in retaining walls shall be epoxy coated.

4.8.1 Reinforcing Materials: Use the reinforcing materials below where indicated on the approved plans:

1) Steel Reinforcing shall be deformed steel bars conforming to ASTM A 615, Grade 60.

2) Steel reinforcement for bridge decks and top slab of box bridges when used as the riding surface shall be epoxy coated. All concrete bridge railing shall also require epoxy coated reinforcement.

3) Smooth steel dowel bars shall conform to ASTM A 615

4) Plain- Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

5) Prestressing steel shall be in accordance with ASTM A416

6) Synthetic Fibers (fiber reinforced concrete): Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

4.9 – Concrete Placement

All formwork shall be constructed in accordance with the Standard Specifications using pre-manufactured metal forms or dressed form lumber and plywood. Formwork shall be adequately braced, mortar tight and true to line and grade. Provisions shall be made during placement of concrete to minimize aggregate separation and ensure proper consolidation throughout the pour. To highlight a few key requirements of Standard Specifications in particular, the contractor shall ensure the following placement operations are observed:

1) Elapsed time from truck loading to delivery and placement shall be limited to 90 minutes when the air temperature is 90 degrees or less. When the air temperature exceeds 90 degrees, this time is reduced to 60 minutes.

2) Concrete that does not meet the specified limits regarding slump, air content, temperature, and delivery time shall not be used unless approved by the Engineer.

3) Concrete shall be compacted with suitable vibrators operating within the concrete unless otherwise directed by the Engineer.

4) Concrete may not be placed from a chute discharge height greater than five (5) feet.

5) No concrete other than foundation seals shall be placed underwater.

6) Do not add water to concrete during delivery, at project site, or during placement unless the concrete delivery ticket indicates that mix water was withheld at the plant. In such cases only the amount withheld per cubic yard may be added at the jobsite.

7) Concrete shall be placed in cold weather only when the air temperature is 40 degrees and rising.

8) Protect newly placed concrete from air temperatures below 40 degrees with insulation blankets to maintain the concrete temperature at not less than 45 degrees for a period of 120 hours after placement.

4.10 – Inspection and Laboratory Testing

It is the contractor's responsibility to ensure quality concrete meeting Section 604, Concrete Structures, of the TDOT Standard Specifications is delivered and placed on the project. All quality testing of the concrete shall be performed by an independent testing company pre-approved by the City in accordance with Section 1 of these specifications. All quality testing performed by the testing agency is subject to monitoring and review by the Engineer to ensure established procedures are followed. Reports of testing shall be certified and submitted to the City within ten days of actual testing to document the quality control before final acceptance of the project. The Contractor may pursue additional testing per § 604.15, Compressive Strength Tests of Concrete, of the TDOT Standard Specifications if concrete compression tests fail to meet the required strengths noted in Section 4.4 above. The contractor will be responsible for the costs associated with all testing and also re-testing due to failed acceptance tests.

Required tests for concrete construction to be performed by the testing agency include:

1) Slump
2) Yield
3) Entrained air content
4) Mix Temperature
5) Representatives test cylinders

4.10.1 – Testing Frequency

One composite sample (4 test cylinders) for each day's pour of each concrete mix exceeding 5 cu. yd. but less than 25 cu. Yd. plus one set for each additional 50 cu. yd. or fraction thereof.

Concrete placement operations shall be inspected by an on-site superintendent to ensure placement of the concrete meets requirements of the Standard Specifications. On-site inspection is required to be documented by the contractor and recorded in a field book subject to review by the Engineer.

CHAPTER 5

STRUCTURES

5.1 – Overview

This Section includes all fabricated, installed and erected structures and appurtenances related to street construction including pipes, culverts, headwalls, box culverts, box and slab bridges, and sign, signal and lighting supports.

5.2 – Reference Specifications

Unless modified by these specifications, all structure materials and construction requirements shall conform to the "Standard Specifications for Road and Bridge Construction" published by the Tennessee Department of Transportation (TDOT) (latest edition), hereinafter referred to as the "Standard Specifications".

5.3 – Pipe Culverts and Storm Sewers

Pipe used for cross drains under the street shall be rigid concrete pipe; side drains under driveways may be concrete or HDPE. Pipe manufactured from corrugated metal pipe (CMP) may only be used outside of the street right-of-way. CMP and plastic pipe may enter the back side of a street drainage structure provided it extends away from the street right-of-way or under a driveway and not under the street. All pipe culverts, side drains and storm sewers shall be furnished and installed in accordance with Section 204 (Structure Excavation Foundation Preparation, and Backfill) and Section 607 (Pipe Culverts and Storm Sewers) of Standard Specifications.

5.3.1 – Concrete Pipe: Concrete Pipe shall be reinforced Class III rigid pipe and shall be round, oval or flat based as shown on the approved plans. All precast concrete pipe shall be manufactured in accordance with the "TDOT Procedures for Manufacture and Acceptance of Precast Drainage Structures, Noise Wall Panels and Retaining Walls".

5.3.2 – Corrugated Metal Pipe: Corrugated metal pipe shall be zinc-coated galvanized iron or steel pipe conforming to ASTM M36.

5.3.3 – Plastic and Polyethylene Corrugated Pipe: This pipe shall be HDPE corrugated outside with smooth finish inside wall. This pipe may be used for site drainage, but shall only be used under driveways, not under streets. Plastic pipe may exit from the back side of a street drainage structure and extend off the City ROW.

5.3.4. – Pipe Bedding: Pipe bedding for concrete pipe shall be Class B, requiring a minimum of 6 inches of Class B granular stone below the pipe and shaped by a template to fit the lower part of the pipe exterior for at least 10 percent of its overall height. Pipe shall be properly backfilled in accordance with **Chapter 2,** § 2.9.2.

5.3.5 – Pipe Sizes: Normal pipe sizes readily available from suppliers may be used to satisfy drainage requirements. Minimum pipe size for drains and storm sewers shall be 15-inch diameter.

5.3.6 – Pipe Backfill: Pipe Backfill shall be Class B granular stone placed to the spring-line of the pipe in layers not to exceed 6". For pipe installed in solid rock cut, backfill shall be no less than 12" above the top of the pipe.

5.4 – Pipe Culvert, Endwalls, and Inlets

Pipe culvert endwall treatments may be precast or cast-in-place concrete and are required for all pipe locations within the street right-of-way.

1) Endwalls for pipe diameters greater than 24 inches shall be concrete construction in accordance with the appropriate safety endwall standard drawing (TDOT D-PE series), and shall be fitted with a steel bar safety grate.

2) Endwalls for pipe diameters 24 inches or smaller shall be concrete construction in accordance with the straight endwall details as shown in the standard drawings. Type U headwalls may be used for pipe diameters of 24 inches or less if approved by the Director of Public Works.

3) To improve the aesthetics of pipe headwalls, textured concrete finishes simulating stacked stone may be used. Additionally, veneers of stone or brick may be applied to exposed surfaces to enhance the appearance from the street.

5.5 Storm Drainage Structures

Storm drainage structures consist of junction boxes, drop inlets, catch basins and manholes which may be constructed as precast concrete sections. Cast-in-place concrete may be used with approval by the Director of Public Works.

Inlet and outlet pipes shall extend through the walls of structures a sufficient distance to make connections, but shall be cut flush with the inside surfaces of the box structure.

5.5.1 – Catch Basin Castings: Catch basin castings that are damaged during construction will be rejected. Castings shall be set true to line and grade. Standard catch basins shall meet the requirements of the Standard Drawings.

5.5.2 – Concrete Catch Basins: Standard catch basins are precast concrete or cast-in-place where directed by the Engineer. Catch basins shall meet the requirements of the Standard Drawings.

5.5.3 – Junction Boxes: Standard junction boxes for pipes where required may utilize single and double catch basin standard drawings by omitting the casting entrance in the top surface. Triple catch basins and specialty junction boxes may be used for unusual conditions. Details for these structures may be designed and detailed on the plans or may be referenced to the Standard Drawings. In either case, these special structures shall be submitted to the Director of Public Works for approval.

5.5.4 – Additional Pipe Openings: All boxes, existing or new installation, requiring additional pipe openings shall be neatly cored by means of mechanically sawing through wall of structure. Any damages caused to the structure may require replacement. This will be determined by an authorized representative of the City of Goodlettsville.

5.6 Concrete Box and Slab Culverts and Bridges

Box and slab culverts are required when design flows exceed the hydraulic capacity of dual pipe structures or when a clear waterway opening is required. All precast concrete structures must meet the requirements of § 604, Concrete Structures, and § 914, Non-metallic Pipe, of the Standard Specifications. All cast-in-place concrete structures must meet the requirements of § 604, Concrete Structures, and § 907, Concrete Reinforcement, of the Standard Specifications.

5.6.1 – Box Culverts: Typically span 18 feet or less over water with a single or double barrel box structure.

5.6.2 – Box Bridges: Box bridges are defined as a box culvert type structure with a single box or multiple boxes, but having a total horizontal distance measure parallel to the street centerline of 20 feet or more between inside faces of the outside walls.

5.6.3 – Slab Culverts and Slab Bridges: Slab culverts and bridges are differentiated the same as box culverts and box bridges, but are constructed without a bottom slab. Slab culverts and bridges are typically used when bedrock is within three feet or less from the streambed elevation.

5.6.4 – Bottom Slab Placement: Box culverts and bridges are supported on a bottom slab foundation and may be founded on the natural gravel or sand streambeds. The top surface of the bottom slab of box structures shall be located a minimum of 2 feet below the natural streambed to allow for future streambed degradation.

5.6.5 – Precast Bridge Units: Box and slab culverts and bridges may be precast or cast-in-place. Precast units speed construction times since only the foundations are required to formed and poured in place and the units are set quickly on the foundations. Where aesthetics is to be considered, precast modular arch type units such as "Con/span" are available and often provide greater clear spans than precast box type structures. Both precast box and arch units may be used in multiple span arrangements to convey larger flows.

5.6.6 – Riding Surface: Where practical, the top surface of the box culvert or bridge should be used as the riding surface of the street. The absence of fill material or asphalt placed on the top slab eliminates the detrimental effects of trapped moisture and extends the life of the concrete slab. Additional concrete thickness must be supplied to provide a clear concrete cover of 2 ½ inches over the top mat of reinforcing steel. When the top slab is used as the riding surface, the exterior curb portions of the standard box bridge designs should be omitted to allow surface water to rain off the slab. A bridge railing system of metal beam guardrail shall be thru-bolted to the top slab and extended off each end of the bridge. See TDOT standard drawings S-GRS-2, S-GRC-1, and S-GRC-2 for details of the guardrail attachment.

5.7 Sign and Signal Support Structures

Sign and signal support structures are to be designed, fabricated and erected in accordance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (AASHTO LTS, latest edition). The contractor shall provide design calculations and shop drawings sealed by a professional engineer licensed in the State of Tennessee for all sign and signal support structures. The standard foundations for lighting and luminaire supports found in the NES Street Light Design Manual may be used provided suitable soils (as determined by Engineer) are present or placed. All signal supports must be mast arms. No cable supported signalization will be allowed without direct consent from the Director of Public Works.

5.7.1 – Design Loadings: Basic wind speed for calculating wind pressure for all sign structures shall be 90 mph. Ice loading will be 3 psf applied to one face of each sign and all surfaces of the support members. Dead load of the structure, signal heads, signs and appurtenances shall be the actual calculated weights. Design of components shall be based on the maximum load combinations specified in the AASHTO standards. The design of cantilevered traffic signal support poles, mast arms and foundation anchor bolts shall be designed for Fatigue Category 1 as required in the AASHTO Standard Specifications and TDOT Standards, §604 (Concrete Structures), §730.10 (Foundations), and §730.11 (Anchor Bolts).

5.7.2 – Wind Area: To provide for future signs for overhead sign structures, the design wind area shall be calculated assuming a combined future sign width equal to the entire roadway width, not including shoulders. Sign wind height for design shall be based on the tallest sign initially installed unless larger signs are anticipated in the future. For all cantilevered sign structures, all design criteria required in the AASHTO specifications for Category 1 fatigue loading shall apply.

5.7.3 – Design Life: Overhead signs and signal support structures shall be designed based on a 50-year design life. Ground mounted roadside signs shall be designed for a minimum 10-year design life.

5.7.4 – Placement and Clearances: All sign posts, overhead sign structures and signal support structures shall be installed so as not to obstruct the motorist's view of the highway or other signs. In addition, posts shall not be installed in drainage ditches or in any way obstruct the flow of water runoff. Vertical and lateral clearances to sign edges shall be in accordance with the latest edition of the MUTCD. Wherever possible, large overhead signs should be installed outside the roadside clear zone. Where this clear zone placement is impractical, the support columns shall be protected by properly designed guardrail or concrete barriers. Poles and controller cabinets shall be located clear of traffic turning movements and to maximize horizontal clear zones. Pole and signal controller cabinet locations are to be coordinated with utilities to avoid conflicts and the final location shall be staked in the field and approved by the City Engineer before beginning installation. Traffic signal supports should be places as far away from the street as practical. Pedestrian signal poles shall be designed with breakaway bases due to their proximity to the street.

5.7.5 – Support Types: All ground mounted sign supports, overhead sign structures, and traffic signal supports shall be designed to meet the requirements of the design loading calculations in meet the requirements of §5.7.1 above, and shall conform to the requirements of the **National Electrical Code**; the **Standards of the American Society for Testing Materials (ASTM)**; the **American National Standards Institute (ANSI)**; the U.S. Department of Transportation, Federal Highway Administration **Manual on Uniform Traffic Control Devices (MUTCD)**; **Institute of Traffic Engineers; International Municipal Signal Association, Inc. (IMSA)**; and the **Nashville Electric Service (NES) Street Light Design Manual**. Wherever reference is made to the Standards mentioned above, the reference shall be construed to mean the code or standard that is in effect on the date of advertising the bids or authorization for force account.

5.7.6 – Foundations: Small sign posts shall be supported in the ground with telescoping anchors sleeves one size larger than the post and driven a minimum of three feet into undisturbed soil. The embedded sleeve shall not project more than 4 inches above the ground for a surrounding horizontal distance of 10 feet. Foundations for street signs larger than 9 square feet shall include a 12-inch diameter concrete foundation in accordance with TDOT standard drawings. Foundations for overhead sign structures and signal support foundations may be concrete drilled shafts or spread footings properly designed for local soil conditions including allowable bearing pressure and passive soil resistance in accordance with AASHTO LTS.

CHAPTER 6

STREET APPURTENANCES

6.1 – Signal Construction

Traffic signal installations/ modernizations shall be constructed in accordance with applicable sections of the TDOT Standard Specifications for Road and Bridge Construction, the TDOT Standard Specifications for Traffic Control Items, and the City requirements for Traffic Control Items. The specifications for traffic signal equipment had related appurtenances shall be approved by the Director of Public Services prior to the preconstruction meeting.

6.2 - Signal Design

The design of traffic signals is under the jurisdiction of the City and shall conform to the requirements and specifications outlined in this section. Traffic signal design on State highways in the City shall meet the requirements of the City as approved by TDOT. All traffic signal design shall conform to the requirements of the MUTCD, the TDOT "Traffic Design Manual", and the TDOT Standard Specifications for Road and Bridge Construction, Signal Specification (730N).

6.2.1 General Requirements:

1) **Signal Warrants:** For the installation of traffic signals to be considered, the location must satisfy the warrants outlined in the most recent edition of the MUTCD. In high growth areas where significant changes in traffic conditions are expected due to the development of the area, hourly volumes for 5 years after full build-out should be estimated and compared with the MUTCD signal warrants. The growth rate utilized to estimate the future traffic volumes is subject to the review and approval of the Engineer prior to its use. The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic signal. The Engineer shall make the final recommendation regarding the location of any new traffic signal. For state routes within the city, TDOT and City will review to make final decisions regarding signal warrants.

2) **Engineering Study:** An engineering study will be required for all proposed traffic signal installations. The engineering study shall include the estimation of future volumes and an analysis of the progression of traffic through the signal system, as defined by the Engineer. The evaluation shall include any planned future traffic signal installations. The analysis shall be submitted to the Engineer for review and shall include capacity analysis (using Synchro, HCM Cinema or other software as approved by the Engineer), as well as time-space diagrams of the signal system. The study periods shall be the AM, midday and PM peak hours, although other time periods may be required. Signal timing optimization for a corridor may be required depending on traffic impact analysis.

3) **Signal Spacing:** Signalized intersections shall be located to maintain progression of traffic along arterial streets. This normally entails relatively uniform spacing and sufficient distances between signals to allow vehicles to travel at reasonable speeds. Optimal spacing of traffic signals is always the desire of the City. The optimal spacing is a function of the cycle length and the progression speed of traffic along the major street, but a general guideline is that signals should be placed at least a quarter of a mile apart. New signal locations shall be subject to spacing requirements on a case by case basis as determined by the Engineer. Proposed signal locations not adhering to this spacing will be reviewed. The spacing requirements may be waived if the Engineer determines that the proposed traffic signal will not significantly hinder the progression of traffic along the major street. If the proposed location is rejected, the Engineer may require either the relocation of the proposed signal location, to better accommodate progression, or the evaluation of other alternatives, for management of the traffic generated by the side street / private access.

4) **Private Benefits Signals:** Private benefit signals provide signalized access to private streets or developments. These signals are generally required when the property owners

must improve access from their site onto the major street or facilitate movement between developments on opposite sides of the street.

i) Required Installations: If the Traffic Impact Study for a new development indicates that a traffic signal will be warranted within 10 years of full build-out, the Engineer may require the inclusion of a traffic signal as a part of the development plan. The financial responsibility for these signals shall be in accordance with the arrangements made during preparation of the development plan. The time frame for installation is dependent on the traffic projections and subject to the discretion of the Engineer. The site development plans will not be approved until provisions for the installation of the traffic signal or other alternative measures to enhance the safe movement of traffic through the intersection are included in the plans.

5) **Designer Pre-qualifications:** The design of the traffic signals shall be performed by the City or a qualified Engineer approved by the City. The design staff for any firm supplying traffic signal plans to the City must be familiar with the traffic signal design procedures used by the City. At the request of the City, the design engineer may be required to provide copies of their most recent traffic signal design and / or modification projects to the Engineer prior to their being assessed as qualified.

6) **Intersection Design Study (IDS):** An IDS must be prepared for any intersection that is proposed for the installation or modernization of traffic signals. Engineering work associated with the IDS will include topographical surveys, preparation of a base map, roadway geometric design, traffic signal layout and traffic signal phasing. The IDS shall include the traffic signal warrant study, detailed preliminary intersection and signalization design to meet present and future traffic needs, a list of needed rights-of-way, and a total project cost estimate suitable for budgeting purposes. An IDS that has been reviewed and approved by the Engineer is required prior to the submittal of traffic signal plans for review. If an IDS does not exist for the intersection, one shall be prepared as part of the project presentation stage of design (described in the following section). If an IDS exists and, at the discretion of the Engineer, the traffic conditions at the intersection have significantly changed since the preparation of the IDS, an update of the IDS may be required.

7) **Equipment:** All equipment provided must be approved by the City, and shall conform to the standards of the **National Electrical Manufacturers Association (NEMA – Standards Publication, Traffic Control Systems**, latest revision) or the **Radio Manufacturers Association**, whichever is applicable.

8) **Material and Work:** In addition to conforming to the Plans and Special Provisions, all material and work shall conform to the requirements of the **National Electrical Code**; the **Standards of the American Society for Testing Materials (ASTM)**; the **American National Standards Institute (ANSI)**; the U.S. Department of Transportation, Federal Highway Administration **Manual on Uniform Traffic Control Devices (MUTCD)**; **Institute of Traffic Engineers; International Municipal Sign Association, Inc. (IMSA)**; and the **Nashville Electric Service (NES) Street Light Design Manual**. Wherever reference is made to the Standards mentioned above, the reference shall be construed to mean the code or standard that is in effect on the date of advertising the bids or authorization for force account.

6.2.2 Design Requirements:

1) Proposed locations for traffic signal installations must be warranted under current conditions according to the Manual on Uniform Traffic Control Devices. For new development, traffic signals must be warranted upon a 5-10 year build-out. Installations that are not warranted by traffic conditions will not be considered.

2) The traffic signal controller and cabinet specified shall be complete with all incidental and auxiliary equipment necessary for installation and operation either as a remote location or as part of a system of intersections, as required and approved by the Engineer.

3) Fire preemption system complete with detectors, wiring, and card in the cabinet (3M system) is required, where approved by the Engineer. Emergency vehicle preemption is required along emergency response routes.

4) Pedestrian signals and pushbuttons shall be provided at the discretion of the Engineer. The international symbols for 'walk' and 'don't walk' shall be specified for all pedestrian signal indications.

5) Traffic detection to be performed by camera unless given prior approval by the Engineer and Director of Public Works. If loop detectors are approved, the following requirements must be met:

    1. Loop detectors complete with wiring and detector circuits for counting traffic shall be used on all approach lanes except for exclusive right turn lanes that will operate with recall phases.

    2. In addition to advance detector loops in the thru lanes of moderate and/or high speed approaches (35 mph or greater), system loops shall be installed in the opposite direction thru lanes at the same location (subject to lane restrictions) as the advance loops where feasible.

6) All Traffic Control Units (TCUs) to be pre-approved by the Engineer.

7) Combination mast arms and other equipment necessary to provide intersection lighting will be required for all new traffic signal installations and modernizations. Aluminum and painted mast arm/signal poles, luminaire arms, and extensions shall be used and shall be per City specifications.

8) Span wires are specifically excluded unless approved by the Engineer and the Director of Public Works.

9) Any street light luminaire extensions (aluminum and painted) shall be approved by the Engineer. A minimum 30-foot luminaire mounting height and a minimum 15-foot luminaire arm (aluminum and painted) shall be used to mount the streetlight fixture. The attachment height for mast arm to pole shall be per approved shop drawings.

10) All shop drawings for signals and poles are to be approved by the Engineer prior to installation.

11) The installation of a fiber optic interconnect is required between signalized intersections that are within ½ mile of one another or if analysis indicates that the signals would benefit from signal coordination. Communications interface must be installed as a part of the project if one does not exist already. All traffic signal systems will use IP based communications protocols and equipment shall have IP addressable ports.

12) Fiber optic interconnect shall include a copper tracer, pull string/jet line, marker tape and curb markers in all ITS conduit.

13) The traffic signal plan shall include a continuous grounding plan for the intersection.

14) Double handholes are required at all traffic signal cabinet locations.

15) Power disconnects shall be provided.

16) Service pedestals shall contain circuits and test switches for safety lighting and illuminated street name signs.

17) The **MUTCD** and **ADA Accessibility Guidelines for Buildings and Facilities** should be consulted regarding pedestrian signal timings, and the most stringent requirements should be applied.

18) Signal timing and detection should accommodate the needs of bicyclists. Special consideration of bicyclists' needs may be necessary at multi-lane crossings and at acute angle intersections, which take longer to cross. The clearance interval should take into consideration a bicyclists' speed of 6-8 MPH, and a perception/reaction/braking time of 1.0 second.

19) All Signal Phasing and Timing shall conform to the guidelines set forth in Part 4 of **The Federal Highway Administration, Manual on Uniform Traffic Control Devices (MUTCD)**.

6.3 - Street Lights

6.3.1 General: Street lights shall be designed and constructed in accordance with the applicable sections of the Nashville Electric Service (NES) Street Lighting Guidelines. The developer or property owner(s) is responsible for complying with the requirement to install street lighting and shall make all necessary arrangements with NES and/or Cumberland Electric Membership Corporation (CEMC) for the installation of streetlights and bear all costs relating to the purchase and placement of streetlights. Installation of street lighting materials shall be performed by a Tennessee licensed contractor also having any locally required business licenses prior to commencing any work.

6.3.2 Location: Locations of lighting fixtures in residential subdivisions to include:

1) Locate a fixture at each intersection

2) Locate a fixture in cul-de-sacs which are 200 ft. in length or greater.

3) Upon Approval from the City of Goodlettsville, locate a fixture at hazardous curves or those locations with a high accident rate.

Note: Light locations in Goodlettsville are approved during the permitting process. Developer is required to submit plans approved by the City to CEMC or NES Street Lighting Department, based on jurisdiction.

6.3.3 – Order: Underground electrical installation shall not begin until after curb and sidewalk is installed, unless other arrangements have been made with NES and/or CEMC. Curb returns shall not be installed on any street until after electrical installation, to facilitate the installation of underground vaults and other facilities.

6.3.4 – Coordination: The Developer is responsible for coordinating with NES and/or CEMC for all aspects of design and installation.

6.3.5 – Pull Boxes: Pull boxes should be located a minimum of 18" from the face of the curb to the center of pull box.

6.3.6 – Inspection: Inspection of installed light features will be completed by representatives from NES and the City Public Works Department, as required. Installations shall adhere to manufacturer's requirements as they relate to all aspects of the light feature, foundation and connections.

6.3.7 – Approval: Once the street lighting has been installed and operational, approval by the City will then be responsible for the energy costs thereafter. All maintenance is the responsibility of NES. All street lighting within each construction phase shall be complete and operational prior to acceptance of subdivision public improvements.

6.4 – Traffic Signs

6.4.1 – Installation and Maintenance: Because the City will maintain the permanent traffic control devices on public rights-of-way, all traffic control devices shall be fabricated and installed in accordance with this chapter, the latest revision of the MUTCD, and the applicable sections of the TDOT Standard Specifications.

6.4.2 – New Street Signing: Permanent signing, unless otherwise approved by the Engineer, shall be completely in place before any new street is opened to the public. Street signs shall display the City of Goodlettsville logo to match existing street signage in the City.

1) For Street Signs attached to overhead traffic signals signs should be 12-inch tall aluminum with 6" white reflective letters. Blue background to be 3M Electrocut Film Blue 1175C.

2) For ground mounted street signs the blue background is Orocal 651G-098 Gentian Blue with sizes as follows:
   a) 35 MPH or higher requires 9" blank with 5.75" white reflective letters
   b) Less than 35 MPH requires 6" blank with 3.75" white reflective letters

6.4.3 – Other Standards: These Standards are to be used in conjunction with other applicable City Regulations. The Engineer may allow the installation of decorative posts and sign frames. In these cases, the developer, homeowners' association, or other responsible entity shall be responsible for the maintenance of these special installations. Decorative traffic supports, whether city-provided or developer-provided should be black or dark green in color.

6.4.4 – Sign Posts, Supports, and Mountings: Sign posts and their foundations and sign mountings shall be constructed to hold signs in a proper and permanent position, to resist swaying in the wind or displacement by vandalism.

1) **Sign Post:** The post shall be constructed in two sections:
   a) **Anchor Post**: A 2.0 lb/ft or 3.0 lb/ft galvanized steel U-Post stub section with holes, is driven into the ground to minimum depth of 24 inches with 30 inches remaining above the final grade. The sign post system's material specification is Nucor RIB-BAK U-Channel (or approved equal), with 3/8" diameter mounting holes spaced 1 inch on centers for the length of the post.

   b) **Post Section:** A 2.0 lb/ft or 3.0 lb/ft galvanized steel U-Post stub section with holes, is mounted to the Anchor Post 12 inches above grade with an overlap of 18 inches. The sign post system's material specification is Nucor RIB-BAK U-Channel (or approved equal), with 3/8" diameter mounting holes spaced 1 inch on centers for the length of the post.
   c) **Post weight:** Use 2.00 lbs/ft or 2.50 lbs/ft posts for 24" x 24" signs. Use 3.00 lbs/ft posts for 30" x 30" signs.

2) **Other Sign Mounts:** Traffic signal and school flasher poles, when located appropriately, may be used to hold signs such as warning, parking, and speed limit signs. Signal poles should be checked for potential sign installation during the design process and shown on the sign plan

sheets. As regards utility and streetlight poles which are owned by owned utility companies; it is the City's policy to avoid using their facilities as sign supports.

3) **Breakaway Post System:** Posts must be of appropriate length to comply with MUTCD specifications for the location, must conform to **TDOT Specifications**, and must meet the standards as provided in NCHRP 350.

6.4.5 – Sign Reflectivity: All traffic control signs must be fabricated with reflective materials. All reflective materials must qualify as High Intensity Grade for all signs except those signs for schools, pedestrians and overhead street name blades. For these signs, Diamond Grade sheeting shall be used. All signs or traffic control devices must have a minimum 7-year materials warranty.

6.4.6 – Sign Blanks: Aluminum blanks of .080 gauges are standard, except for signs larger than 36 x 6 inches, which shall be .100 or .125-gauge aluminum.

6.5 – Pavement Marking and Striping

6.5.1 – Installation and Maintenance: The City maintains the permanent pavement striping and marking on public rights-of-way after completion of the warranty period. All such devices shall be specified and installed in accordance with these Standards; all designs shall be in accordance with these Standards, the latest revision of the MUTCD and the TDOT Standard Specification.

6.5.2 – New Street: Permanent striping and marking, unless otherwise approved by the Engineer, shall be completely in place before any new street is opened to the public. For streets opened to traffic prior to final surfacing and striping, temporary painted traffic markings shall be installed to permanent standards. New striping on new streets, overlays, and chip seals, etc. will require thermoplastic installations.

6.5.3 – Permanent Striping

1) Typical striping widths for lane lines are 4 inches, unless otherwise noted. Double yellow centerline must have a 4 inch minimum gap between stripes according to MUTCD.

2) Pavement. Epoxy paint shall be used for concrete pavement striping and thermoplastic shall be used for asphalt pavement striping.

3) Layout. All striping on sealcoats shall require a layout line. Prior to striping, tabs are required for sealcoats (prior to the sealcoat process). All other conditions require spot taping.

6.5.4 – Temporary Striping: All temporary striping shall conform to "Standard Specifications for Road and Bridge Construction," published by **TDOT,** the latest revision except as herein amended. When approved, temporary striping shall be required prior to the opening of a street for travel where pavement and/or permanent striping cannot be completed due to weather and/or time constraints.

1) **Specifications** – Temporary striping shall be the same color and width as for permanent striping. Temporary striping shall consist of temporary striping or thermoplastic (no pavement marking "tabs" or temporary tape is allowed), depending on the pavement surface, spaced at 25-foot intervals.

2) **Time Duration Limit** – Temporary striping is permitted on Collectors for no more than 30 days. Temporary striping is permitted on Arterials for not more than 15 days.

3) **Extensions** – Extensions must be requested in writing if weather does not allow installation of permanent striping.

6.5.5 – Specifications:

The following specifications shall be used for various types of striping and marking installations in the City.

1) Extruded Thermoplastic Striping and Markings

Thermoplastic pavement marking should be used on all public and private City street projects. Thermoplastic traffic striping and pavement markings shall conform to Section 716.0f "Thermoplastic Pavement Markings", of the Tennessee Department of Transportation Specifications (TDOT), and to these Specifications. Thermoplastic shall be Alkyd type for extrusion application, and shall produce an adherent reflectorized strip capable of resisting deformation by traffic. The thermoplastic material shall be one hundred percent (100%) solids. The binder shall consist of synthetic alkyd resins, and shall be homogeneously incorporated with all the necessary prime pigments, fillers, and glass beads to produce a coating that meets the TDOT specifications.

The thermoplastic material shall be applied in a single, uniform layer by extrusion methods. Stencils shall be used when applying thermoplastic material for pavement markings. Stencils may be new or used if in good condition. If stencils are bent or damaged they shall be replaced. The pavement surface to which thermoplastic material is applied shall be completely coated by the material and the voids of the pavement surface shall be filled. Unless otherwise specified in the Special Provisions, the thermoplastic material for traffic stripes shall be applied at a minimum thickness of .075 inch. Thermoplastic material for pavement markings shall be applied at a thickness of 0.125 inch. Glass beads shall be applied immediately to the surface of the molten thermoplastic material at rate of not less than eight (8) pounds per one hundred (100) square feet. The amount of glass beads applied shall be measured by stabbing the glass beads tank with a calibrated rod.

2) Painted Striping and Markings

Painted pavement markings may be used on all non- public projects and shall be replaced when visibly worn. Painted traffic stripes and pavement marking shall conform to Section 716.06, "Paint", of the TDOT Specifications, and to these Specifications. Self-sticking traffic marking tape, vinyl or otherwise, developed for such use shall be used for temporary striping as required, unless otherwise shown or specified in the Contract. The lengths of the gaps and individual stripes that form broken traffic stripes shall not deviate more than two inches (2") from the lengths required to produce a uniformly repeating, broken-stripe pattern.

3) Preformed Striping and Markings

Preformed traffic stripes and pavement markings shall be furnished and placed in accordance with TDOT Specifications – Section 716.05 and these Specifications and as directed by the Engineer. All pavement markings shall be in conformance with the latest edition of the Manual on Uniform Traffic Control Devices. The preformed stripes and pavement markings shall consist of white or yellow film with pigments blended to conform to standard highway marking colors. The pigments shall be thoroughly blended to produce long lasting colors resistant to the effects of weather exposure and to last through the expected life of the film. The preformed tapes shall consist of a pressure sensitive adhesive that is capable of adhering to clean and dry bituminous or Portland cement surfaces.

All surfaces shall be prepared and tape applied as indicated by the manufacturer's specifications. The Contractor shall post-inlay all traffic stripes and markings on new asphalt surfaces in accordance with the manufacturer's recommendations and these Specifications. The Contractor shall post-inlay within twenty-four (24) hours of the placement of an asphalt overlay. The Contractor shall provide manual or automatic application equipment as required. The application equipment shall be capable of simultaneously applying two (2) parallel four-inch (4") lines spaced three-inches (3") apart. The application equipment shall also be capable of applying unlined, pre-coated, pressure-sensitive, adhesive pavement marking tape. The manual unit shall have a manually actuated product feed advance system and a foot operated product cutting mechanism. The automatic unit shall have the capability of advancing, applying, and cutting the pavement marking tape at specific pre-programmed lengths, at speed up to six and one half miles per hour (6.5mph) when towed by an appropriate vehicle. Additional supplemental equipment for manual application of required primers, or for manual tamping of the applied marking shall also be provided. Prior to installation, the Contractor shall submit to the Engineer for approval the method the Contractor proposes to use to install traffic stripes and markings, including a list of equipment to be used in the installation. The completed traffic stripes and markings shall have clean, well-defined edges, without deformations, and be free of tears or other disfigurements. Improperly placed, defective, or disfigured traffic stripes and markings shall, at the Contractor's expense, be immediately removed from the pavement surface by methods approved by the Engineer. Completed traffic stripes shall be uniform, straight on tangent alignment, and on a true arc on curved alignment. On a tangent alignment, when a one-hundred-foot (100') string line is stretched taut and placed directly on the outer edge of the completed traffic stripe, the distance between the string and the edge of the traffic stripe shall not exceed three-quarters of an inch (3/4"), measured anywhere along any one hundred-foot (100') interval of the tangent alignment. On curved alignment, the outer edge of the traffic stripe shall not deviate more than three-quarters of an inch (3/4") from the true arc. The lengths of the gaps and individual stripes that form broken traffic stripes shall not deviate more than two inches (2") from the lengths required to produce a uniformly repeating, broken-stripe pattern.

Preformed striping material shall be durable retroreflective performed pavement tape (#5730) with glass beads as manufactured by the 3M Company or equivalent if approved in writing by the City. The preformed tape shall have the minimum reflective values measured in accordance with ASTM Designation: D 4061:

Twelve- inch (12") preformed traffic striping (white and yellow) and marking shall be furnished and placed in accordance with these Specifications and as directed by the Engineer. Preformed traffic stripes shall be installed on all newly resurfaced streets. Preformed striping material shall be durable retroreflective preformed pavement tape (#420) with glass beads as manufactured by the 3M Company or equivalent product as approved by the City Engineer. The preformed tape shall have the minimum reflective values as measured in accordance with ASTM Designation: D 4061.

4) High Reflective Preformed

Preformed striping material shall be durable retroreflective preformed patterned pavement tape (#380) with ceramic beads as manufactured by the 3M Company or equivalent if approved in writing by the Engineer. The preformed tape shall have the minimum retroreflective values measured in accordance with ASTM Designation: D 4061.

5) Placement

New traffic striping of the roadway centerline shall be installed on each segment of roadway construction on the same day that the final lift of asphalt concrete pavement is placed on that roadway segment. New traffic striping of lane lines, crosswalks, and stop bars (skip white and

solid white) shall be installed on each segment of roadway construction within one Calendar Day of the final lift of asphalt concrete pavement placed on that roadway segment. If application of lane line striping, crosswalks, and/or stop bars is not completed on the required day, the Contractor shall supply and install temporary pavement markings as detailed below:

Temporary pavement marking shall be flush mounted reflectorized tape squares, four inch by four inch (4" x 4") 3M "stamark" with backing liners, detour grade, #6350 yellow and #6351 white, or approved equivalent. Right turn barrier lines, edge lines, and shoulder lane lines shall not be delineated with temporary pavement markings. The Contractor shall remove the temporary pavement markings prior to the installation of new striping. All other required new striping (e.g. bicycle lane stripes, edge lines, pavement markings, etc., not listed above) shall be installed on each roadway segment within two (2) Working Days of the day the final lift of asphalt concrete pavement is placed on that roadway segment.

CHAPTER 7

DRAINAGE DESIGN

7.1 – Overview

As it relates to roadways, the objective of surface drainage is to remove storm water from the traveled roadway as rapidly as possible so that traffic may move safely and efficiently. This is accomplished through careful roadway engineering practices such as using proper cross slopes, longitudinal grades, and cross drainage structures. In the case of private development design, the planning and design of the overall drainage system should be done simultaneously with the road or street layout and gradient planning and design. Where positive lot drainage is proposed, coordination of the road or street grades and the finished lot elevations must be achieved.

7.2 – Requirements

All public and private roadways within the City shall be constructed at least one (1) foot above the 100-year base flood elevation established by FEMA.

7.2.1 – Analysis Method

Other analysis methods may be used as long as supporting calculations are included in the plan submittal.

The *Rational Method* is recommended for estimating the design storm runoff for *drainage areas less than 100 acres.* The Rational Method is the preferred method to be used when all of the required data is available. The Rational Method for computing peak storm runoff is expressed as:

$$Q = CiA$$

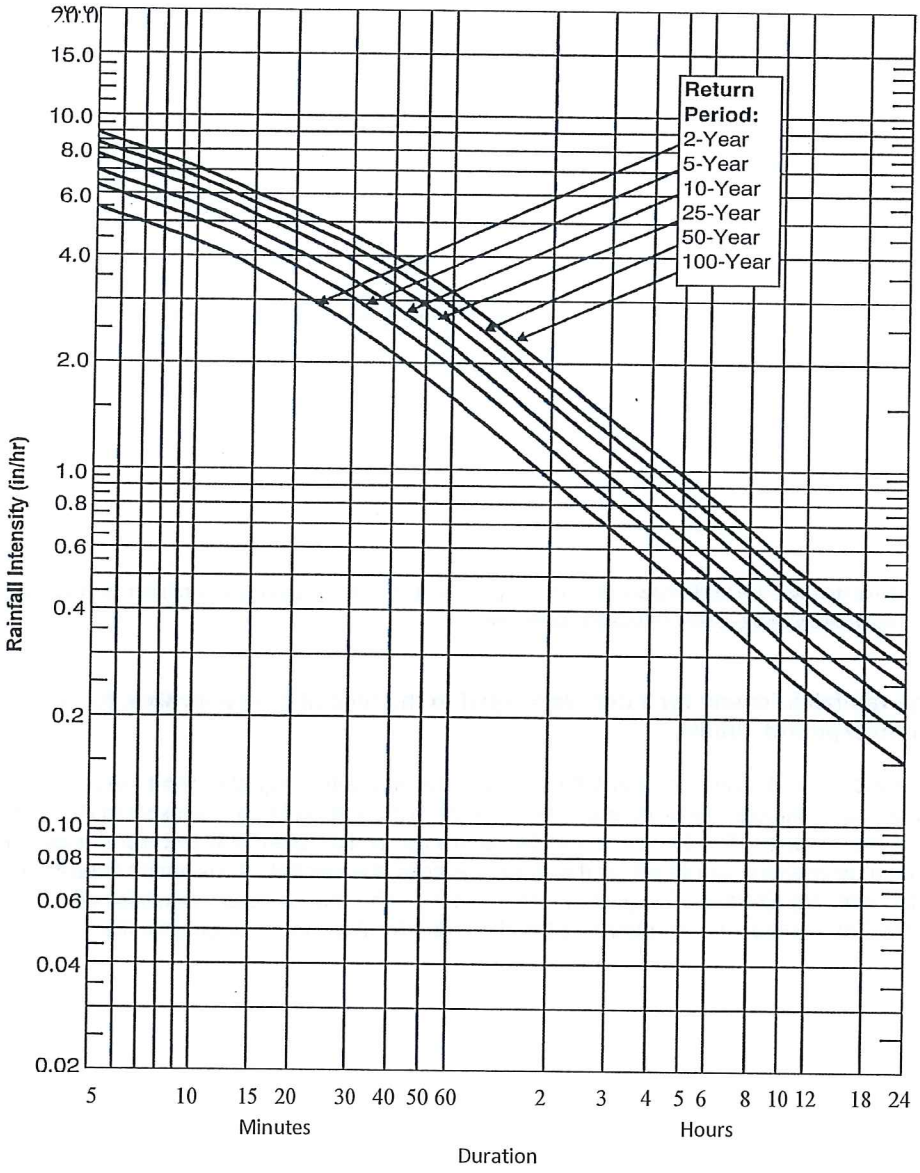
C = weighted runoff coefficient representing a ratio of runoff to rainfall, (unitless) see table below for values

Runoff Coefficients (C) for Use in the Rational Method	
Urban Areas	
Surface Type and Condition [1,2]	Runoff Coefficient (C)
Flat residential, with about 30 percent of area impervious	0.4
Flat residential, with about 60 percent of area impervious	0.55
Moderately steep residential, with about 50 percent of area impervious	0.65
Moderately steep developed area, with about 70 percent of area impervious	0.8
Flat commercial/industrial, with about 90 percent of area impervious	0.8
Rural Areas	
Surface Type and Condition [1,2]	Runoff Coefficient (C)
Concreate or sheet asphalt pavement	0.8-0.9
Asphalt macadam pavement	0.6-0.8
Gravel roadways or shoulders	0.4-0.6
Bare earth	0.2-0.9
Steep grassed areas (2H:1V)	0.5-0.7
Turf meadows	0.1-0.4
Forested areas	0.1-0.3
Cultivated fields	0.2-0.4

[1] For flat slopes and/or permeable soil, use the lower values. For steep slopes and or impermeable soil, use the higher values.
[2] For areas where there is a shallow bedrock surface use the higher values.

i = average rainfall intensity for a duration equal to the time of concentration, for a selected return period, (in/hr).

Rainfall intensity (I) is the average rainfall rate (in/hr) for a duration equal to the time of concentration for a selected return period. The NRCS TR55 method shall be used to determine the time of concentration, Tc. Once a particular return period has been selected for design, and the time of concentration calculated for the drainage area, the rainfall intensity can be determined from Rainfall Intensity Duration Frequency (IDF) Curves. The curves below represent the City of Lebanon, the Tennessee city representing the IDF zone for the City of Goodlettsville.



(Lebanon Gauge)
NOTE: Tc = 5 minutes is a minimum value to use in all cases
Reference: National Weather Service, NOAA Atlas 14, Volume 2 (2004)

A = drainage area tributary to the point under design, (acres)

The drainage area contributing to a point in question can be determined in the field or measured from a topographic map. Data needed to determine the required variables in the rational equation should be noted at the time of the field reconnaissance.

The *Regression Equation* method shall be used for drainage areas that exceed 100 acres.

Rural Regression Equations - The United States Geological Survey (USGS) developed regression equations for rural areas of Tennessee in 2003. The rural regression equation

development is described in Water-Resources Investigations Report 03-4176, "Flood-Frequency Prediction Methods for Unregulated Streams of Tennessee, 2000". The study was based on stream flow data gathered from 453 gauging stations located in rural and lightly developed areas of Tennessee and the adjacent states (except Arkansas). Of these, 297 gages were located in Tennessee. All of the gages had a minimum of 10 years of stream flow data. Stream gages where the historical discharge record had been significantly impacted by urbanization, dredging, or other man-made watershed changes were not included in the analysis.

A regional flood frequency analysis was developed with these gages. The USGS identified drainage area as the only consistently significant variable in predicting peak flow for the range of flood frequencies. The only variable in the equation is the contributing drainage area in square miles, represented by CDA. The resulting flow in cubic feet per second can be obtained by using these equations. The following equation is used for Hydrologic Area 3, which includes the City of Goodlettsville:

USGS Rural Regression Equation	
Recurrence Interval (years)	Hydrologic Area 3
2	$280(CDA)^{0.789}$
5	$452(CDA)^{0.769}$
10	$574(CDA)^{0.761}$
25	$733(CDA)^{0.753}$
50	$853(CDA)^{0.748}$
100	$972(CDA)^{0.745}$
500	$1250(CDA)^{0.739}$

- CDA is Contributing Drainage Area in square miles
- Results are in ft^3/s

Urban Regression Equations - The USGS developed regression equations for small urban streams of Tennessee in 1984. The process is described in Water-Resources Investigations Report 84-4182, "Synthesized Flood Frequency for Small Urban Streams in Tennessee". Twenty-two streams were studied statewide in urban areas with populations between 5,000 and 100,000. The drainage areas for these twenty-two sites ranged from 0.21 to 24.3 square miles. The impervious percentage in the watersheds for the study, ranged from 4.7 to 74.0 percent.

The stream flow record for the gages ranged from four to eight years. Due to the short record for the gages, rainfall-runoff models were calibrated for each of the watersheds. Flood magnitudes for selected recurrence intervals were then estimated for each of the watersheds using the calibrated models. These flood magnitudes were then used in a regional regression analysis to develop the regression equations. Three basin characteristics were determined to be significant in the regional regression analysis. These characteristics are drainage area, percent impervious, and the 2-year, 24-hour rainfall. The urban regression equations developed for Goodlettsville from this analysis are as follows:

USGS Urban Regression Equation
$Q_2 = 81.1(A/640)^{0.74} I_{IMP}^{0.48}$
$Q_5 = 138.8(A/640)^{0.75} I_{IMP}^{0.44}$
$Q_{10} = 175.2(A/640)^{0.75} I_{IMP}^{0.43}$
$Q_{25} = 242.7(A/640)^{0.75} I_{IMP}^{0.39}$
$Q_{50} = 273.5(A/640)^{0.75} I_{IMP}^{0.40}$
$Q_{100} = 312.2(A/640)^{0.75} I_{IMP}^{0.40}$

Q_r = estimated discharge for the recurrence interval indicated, (ft^3/s)
A = drainage area of the watershed, (acres)
I_{IMP} = percentage of impervious area in watershed, (%)
3.57 = $P_{2\text{-}24}$ = 2-year, 24-hour rainfall, (inches) for Goodlettsville

The USGS urban stream regression equations should be applied to all urban drainage areas greater than 100 acres. The impervious area for the watershed should be between 10 and 75 percent of the total watershed area. The stream flow should be unregulated. The peak flow magnitude should not be affected by in-channel storage or overbank detention storage.

7.2.2 – Minimum Standard Design Frequencies

Drainage structures for new construction shall be designed and built to pass the standard design frequencies in the table below.

Street Classification	Inlet Design Frequency	Storm Sewer Design Frequency	Culvert (Cross Drain) Design Frequency	Allowable Spread
Arterial	10-yr[1]	10-yr[1]	50-yr Check for 100-yr	1/2 traveled way plus gutter width
Collector	10-yr[1]	10-yr[1]	50-yr Check for 100-yr	1/2 traveled way plus gutter width
Local	10-yr	10-yr	10-yr Check for 25-yr	Traveled way plus gutter width

1. 50-yr for Roadway sag sections

7.2.3 – Drainage / Hydrology Calculations

Drainage/Hydrology Calculations are required as part of the Construction Plan submittal per the requirements set forth in Chapter 2 of these specifications. These calculations are *required to be endorsed by a TN registered professional engineer.*

The maximum allowable headwater to depth ratio shall be 1.5

Calculations should include the following as a minimum for submittal:

- Drainage area calculations include area in acres, runoff coefficients, a description of runoff calculation methods used, including rainfall intensity, and runoff (Q) used in calculations.
- Culvert cross sections clearly showing invert and outlet elevations, culvert lengths, roadway elevation and lengths.
- Energy Dissipation Design calculations (HY8 dissipator analysis reports will be accepted)
- Computer analysis report output. Preferred computer programs are as follows: HY8 (FHWA Culvert Analysis), Hydroflow Hydrographs, Hydroflow Storm Sewers, HEC-RAS for bridges and large culverts.
- Force effects (including earth pressure, dead load, and vehicular dynamic loading) on buried drainage structures *if requested by the Engineer.*
- Summary of high water elevations *if open channel flow is present*

7.2.4 – Drainage Structures

This section covers typical buried structures as they relate to drainage which is covered in the AASHTO Bridge Standards Manual.

1) ***General Guidelines***: The design life for buried drainage structures shall be a minimum of 100 years. Drainage structures shall be designed for force effects resulting from horizontal and vertical earth pressure, pavement load, live load and vehicular dynamic load. Where buried drainage structures with inverts below the water table are used, water buoyancy loads should be taken into consideration as well. References to tables in product design manuals or calculations showing that structures meet loading force requirements should be included in supporting calculations which are to be submitted with construction plans.

2) ***Curb and Grate Inlets***: Structures shall be designed to quickly drain the storm water from the roadway. The storm frequency and spread width shall be in accordance with Section 7.2.2. Spread shall not be allowed to overtop the curb. The maximum inlet spacing is generally 400. Inlets should be located at uphill corners of each street intersection to prevent sheet flow of storm water across the intersections. In addition, inlets shall be flush with curb and pavement surface.

3) ***Pipe Materials and Requirements***:

   All storm sewer drainage pipes located within the roadway right-of-way shall be reinforced concrete pipe (RCP). The minimum size diameter for storm sewers is 15 inches. The minimum slope shall be one-half percent (0.5%) or that necessary to create a full-flow velocity of two (2) feet per second "fps".

4) *Reinforced Concrete Pipe* – Buried reinforced concrete pipes shall be designed to resist structural failure due to flexure, thrust, shear, and radial tension. The dimensions of the pipe sections shall be determined with either the direct or indirect method as outlined in the AASHTO Bridge Standards Manual. For standard installations, the live load on the pipe shall be assumed to have a uniform vertical

distribution across the top of the pipe and the same distribution across the bottom of the pipe.

Reinforced Concrete Cast-in-Place and Precast Box Culverts – Installations of trenches or embankments due to the installation of this type of drainage structure shall adhere to **Chapter 5, Earthwork**, in these specifications. Distribution of wheel loads and concentrated loads for culverts with less than 2 feet of cover shall be as specified for slab-type superstructures.

High Density Polyethylene (HDPE) – Installations of HDPE pipe shall adhere to the latest American Water Works Association (AWWA) specification as well as the American Society for Testing and Materials Standards (ASTM) D2321 & D2774. Backfill material for HDPE must meet an 85% proctor density per manufacturer's requirements. The design requirements for HDPE pipe may be relaxed if used in temporary roadway settings or special conditions as approved by the Director of Public Works.

Corrugated Metal Pipes (CMP) – CMPs may be allowed as culverts during temporary construction or in the rare occurrence that one is needed to replace an existing CMP under a private driveway.

Polyvinyl Chloride Pipe (PVC) – (Contech A-2000 or approved equivalent) Installation of PVC pipe shall be in accordance with the American Society for Testing and Materials Standards (ASTM) D2321 and/or manufactures specifications. Backfill Material type and proctor density shall be in accordance with the manufactures specifications.

7.3 – Ditch Sections

Erosion Prevention and Sediment Control is a significant issue during and after construction. The City requires that the best management practices detailed in the Tennessee Department of Environment and Conservation (TDEC), Erosion and Sediment Control Handbook, Section 7 be followed. Adherence to these practices is required at all times during the construction of ditch sections to ensure that slopes and channels will continue to function adequately.

7.4 – Detention / Retention Basins

Detention basins are used to collect and hold stormwater runoff for a period of time to compensate for increases in stormwater runoff caused by reduced ground surface perviousness due to activities such as paving or building construction. Retention basins are similar to detention, but they retain a certain portion of the runoff in the basin. Both types of basins must adhere to the current edition of the TDEC Erosion and Sediment Control Handbook.

7.5 – Best Management Practices (BMPs)

The City of Goodlettsville adopts as its storm water design and BMP manual the following publications and policy (as such publications and policies may hereafter be amended and/or restated from time to time), which are incorporated by reference as is fully set out herein:

(1) TDEC Erosion and Sediment Control Manual

(2) TDEC Guide to the Selection & Design of Stormwater Best Management Practices (BMPs); A Guide for Phase II MS4 Communities for Protecting Post-construction Stormwater Quality and Managing Stormwater Flow

These manuals include policies for dry detention basin design and water quality buffer zones and a list of acceptable BMPs, including the specific design performance criteria and operation and maintenance

requirements for each storm water practice. The Storm Water Design and BMP Manuals may be updated and expanded from time to time, at the discretion of the City of Goodlettsville Board of Commissioners, upon the recommendation of the City staff based on improvements in engineering, science, monitoring, and local maintenance experience.

7.5.1 - General Performance Criteria

Refer to City of Goodlettsville Stormwater Management ordinance, Section 18-505.

7.5.2 - Minimum Control Requirements

Refer to City of Goodlettsville Stormwater Management ordinance, Section 18-507.

7.6 – Inspection and Laboratory Testing

It is the developer's responsibility to perform all materials testing required. The owner's engineer or his representative, familiar with assumptions inherent in the structure design, shall review the construction in sufficient detail to confirm that the construction is as specified. Inspection shall occur as frequently as necessary to assure that the construction conforms to the plans and specifications. Inspection shall be by qualified technical personnel experienced in the inspection of similar structures. Testing of materials shall conform to the requirements of TDOT Standard Specifications and applicable interims.

RD-1 TYPICAL STREET SECTIONS
RD-2 TYPICAL PAVEMENT THICKNESS
RD-3 UTILITY TRENCH REPAIR DETAIL
RD-4 STANDARD RESIDENTIAL DRIVEWAY CONNECTION WITHOUT CURB & GUTTER

RP-1 STANDARD 6" NON-MOUNTABLE CURBS & GUTTTERS
RP-2 4" MOUNTABLE CONCRETE CURB & GUTTER
RP-3 STANDARD CONCRETE DRIVEWAYS WITH GRASS STRIP
RP-4 TYPICAL 5' CONCRETE SIDEWALK
RP-5 PERPENDICULAR CURB RAMP DETAIL
RP-6 PARALLEL CURB RAMP DETAIL (ALTERATIONS ONLY)

DR-1 DRAINAGE STRUCTURES, MANDHOLES, GRATES, & ENDWALLS
DR-2 SINGLE INLET FOR 6-24 CURB & GUTTER
DR-3 DOUBLE INLET FOR 6-24 CURB & GUTTER
DR-4 SINGLE INLET FOR MOUNTABLE CURB & GUTTER
DR-5 DOUBLE INLET FOR MOUNTABLE CURB & GUTTER
DR-6 STANDARD DRIVEWAY CULVERT ENDWALL

SD-1 STANDARD CUL-DE-SAC
SD-2 TEMPORARY CUL-DE-SAC
SD-3 TYPICAL STREET SIGN

DATE: 10.27.16	INDEX OF DRAWINGS	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG.	

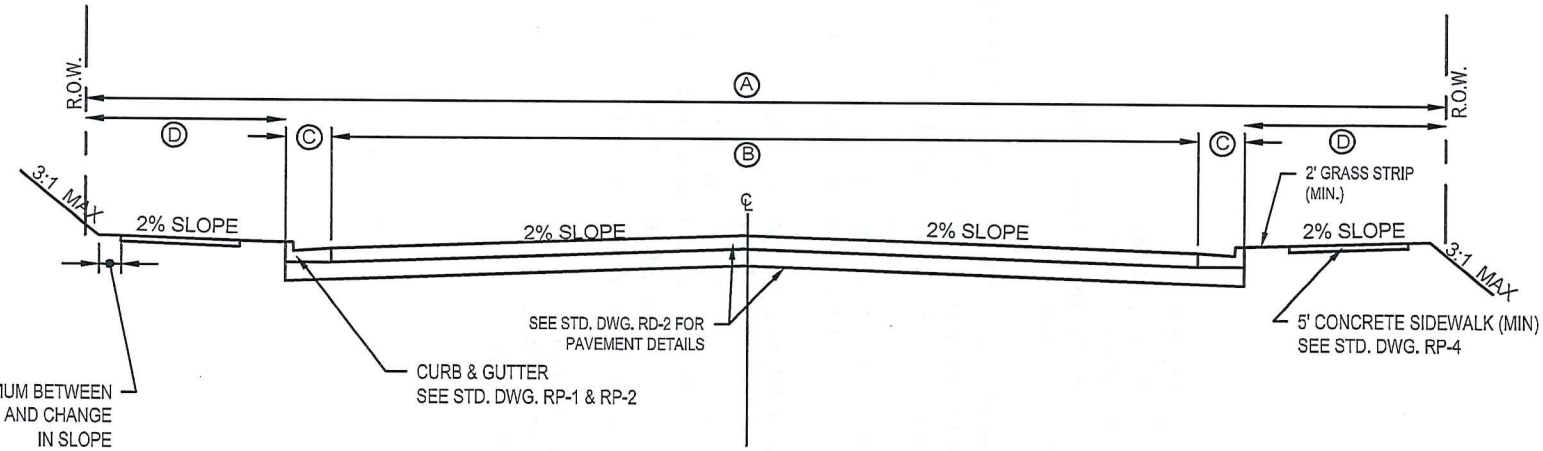
DATE: 10.27.16

REVISIONS

TYPICAL STREET SECTONS

STD. DWG. RD-1

N.T.S.



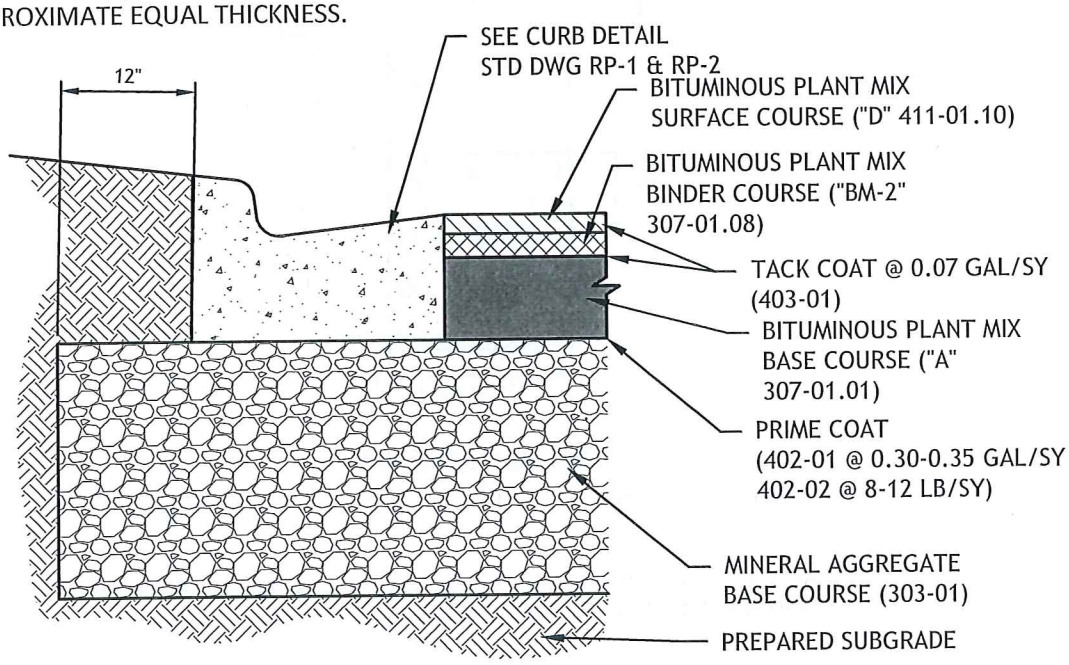
ROADWAY CLASSIFICATION	TOTAL RIGHT-OF-WAY Ⓐ	PAVEMENT Ⓑ	CURB & GUTTER Ⓒ	BACK OF CURB TO RIGHT-OF-WAY Ⓓ
MINOR RESIDENTIAL	50'	22'	2'	12'
RESIDENTIAL COLLECTOR	60'	36'	2'	10'
NON-RESIDENTIAL COLLECTOR	60'	36'	2.5'	9.5'
ARTERIAL	AS DETERMINED BY CITY ENGINEER			

GOODLETTSVILLE TENNESSEE

COMBINATION ASPHALT CONCRETE
AND AGGREGATE BASE
(MINIMUM REQUIRED THICKNESS)

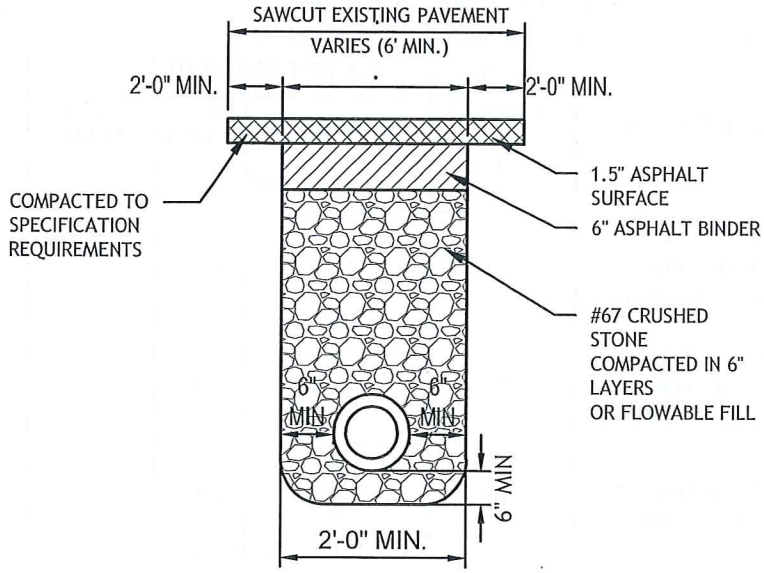
CLASSIFICATION	MINERAL AGGREGATE BASE COURSE	ASPHALT PAVEMENT			TOTAL THICKNESS
		BASE/BINDER		SURFACE COURSE	
		"A"	"B"-M2	"D"	
RESIDENTIAL COLLECTORS, & LOCAL STREETS	8"	-	3"	1.5"	12.5"
NON-RESIDENTIAL COLLECTORS & MINOR ARTERIALS	8"	3"	2.5"	1.5"	15"
MAJOR ARTERIALS & INDUSTRIAL	10"	4"	2.5"	1.5"	18"

1. THE CITY ENGINEER MAY REQUIRE PERFORMANCE GRADE ASPHALT BASED ON PROJECTED TRAFFIC LOADINGS. ADDITIONAL THICKNESS OR A DETAILED PAVEMENT DESIGN BASED ON A GEOTECHNICAL ANALYSIS MAY ALSO BE REQUIRED.
2. COMPACTED SUBGRADE SHALL BE INSPECTED AND ACCEPTED BY THE CITY PRIOR TO PLACEMENT OF ANY AGGREGATE OR PAVEMENT LAYERS.
3. IF THE REQUIRED COMPACTED DEPTH OF THE MINERAL AGGREGATE BASE COURSE EXCEEDS SIX (6) INCHES, THE BASE SHALL BE CONSTRUCTED IN TWO OR MORE LAYERS OF APPROXIMATE EQUAL THICKNESS.

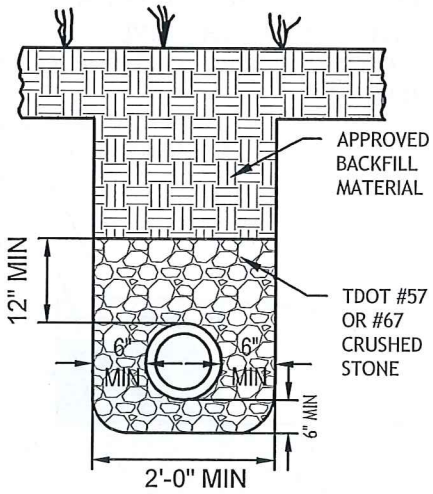


N.T.S.

DATE: 10.27.16	TYPICAL PAVEMENT THICKNESS	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. RD-2	



INSIDE ROADWAY



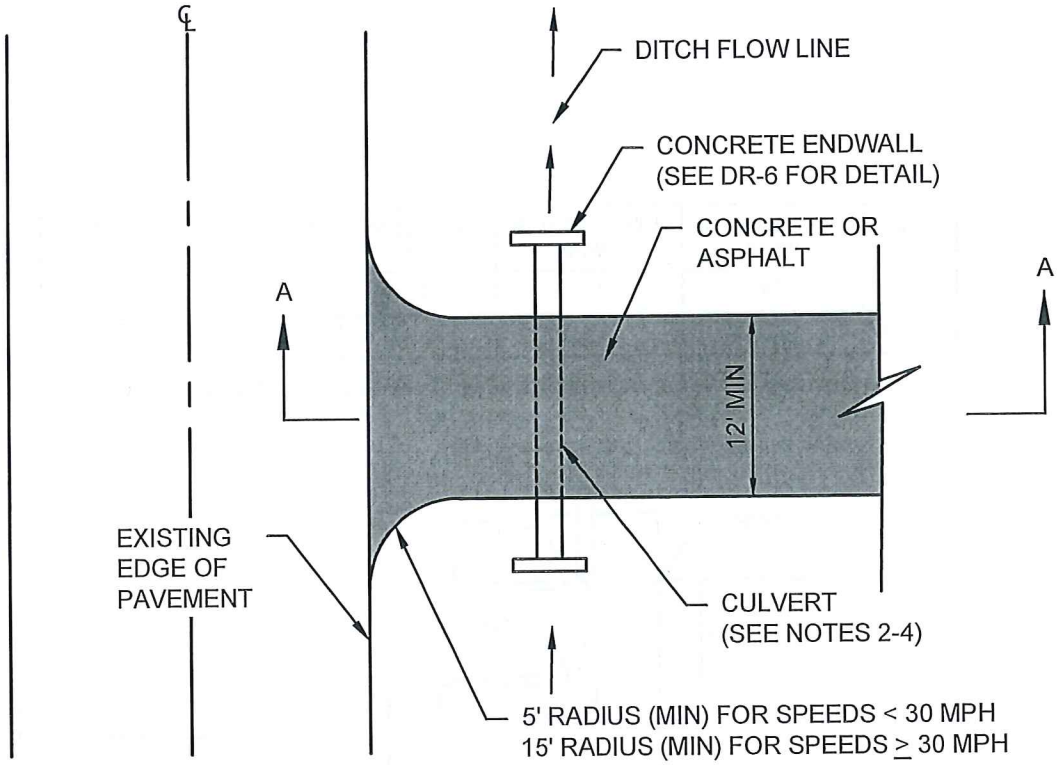
OUTSIDE ROADWAY

* EXACT DEPTH TO BE PER UTILITY SPECIFICATIONS

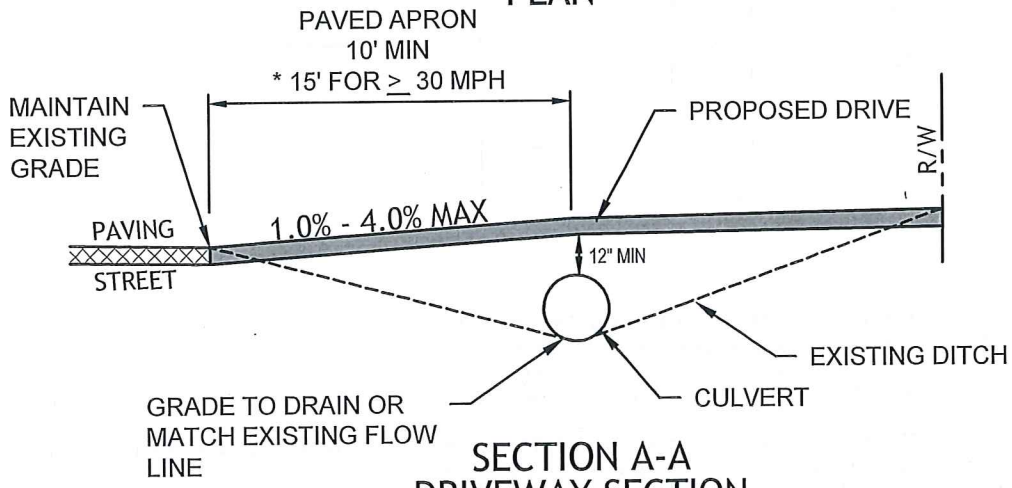
REFER TO CITY OF GOODLETSVILLE UTILITY CUT REPAIR GUIDELINES AND SPECIFIATIONS FOR REQUIREMENTS. (APPENDIX A)

N.T.S.

DATE: 10.27.16	UTILITY TRENCH REPAIR DETAIL	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. RD-3	



PLAN



SECTION A-A
DRIVEWAY SECTION

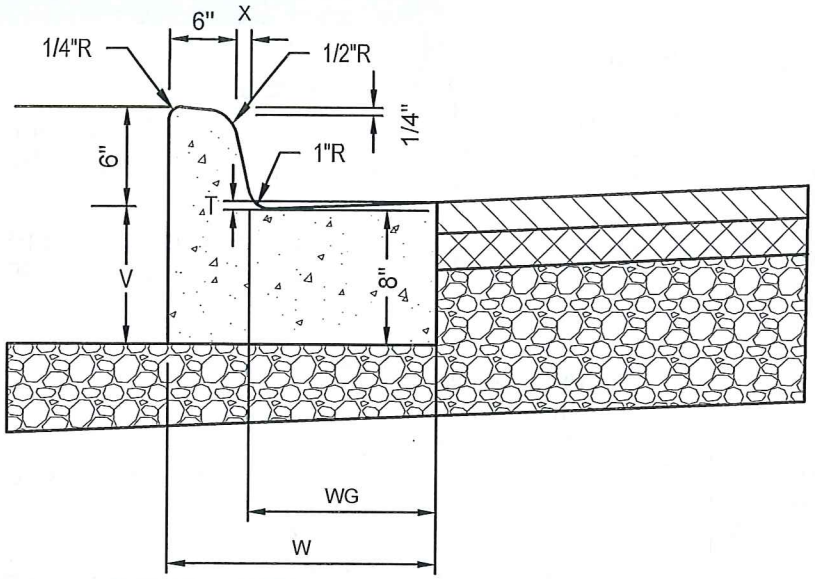
1. PAVED APRON SHALL BE SURFACED WITH HMA OR CONCRETE.
2. PIPE MUST BE RATED FOR H20 OR E80 LOADING CONDITIONS
3. MINIMUM CULVERT SIZE IS 15"; LARGER SIZE MAY BE REQUIRED BASED ON LOCAL DRAINAGE CONDITIONS. CITY ENGINEER TO APPROVE CULVERT MATERIAL, LENGTH, AND DIAMETER PRIOR TO INSTALLATION.
4. NEW DRIVEWAY APRONS CANNOT BE CONSTRUCTED OVER A CULVERT THAT IS LESS THAN 15" DIAMETER, IS IN POOR CONDITION, OR DOES NOT MEET CITY OF GOODLETTSVILLE STANDARDS.

N.T.S.

DATE: 10.27.16	STANDARD RESIDENTIAL DRIVEWAY CONNECTIONS WITHOUT CURB & GUTTER	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. RD-4	

TYPE	TOTAL WIDTH W (in)	WIDTH OF GUTTER WG (in)	CURB OFFSET X (in)	VERTICAL DROP T (in)	VERTICAL DEPTH V (in)
*6 - 24	24	18	1	1.5	8.5
6 - 30	30	23.5	0.5	2	6.47

* 6-24 CURB TO BE USED ON MINOR RESIDENTIAL STREETS ONLY



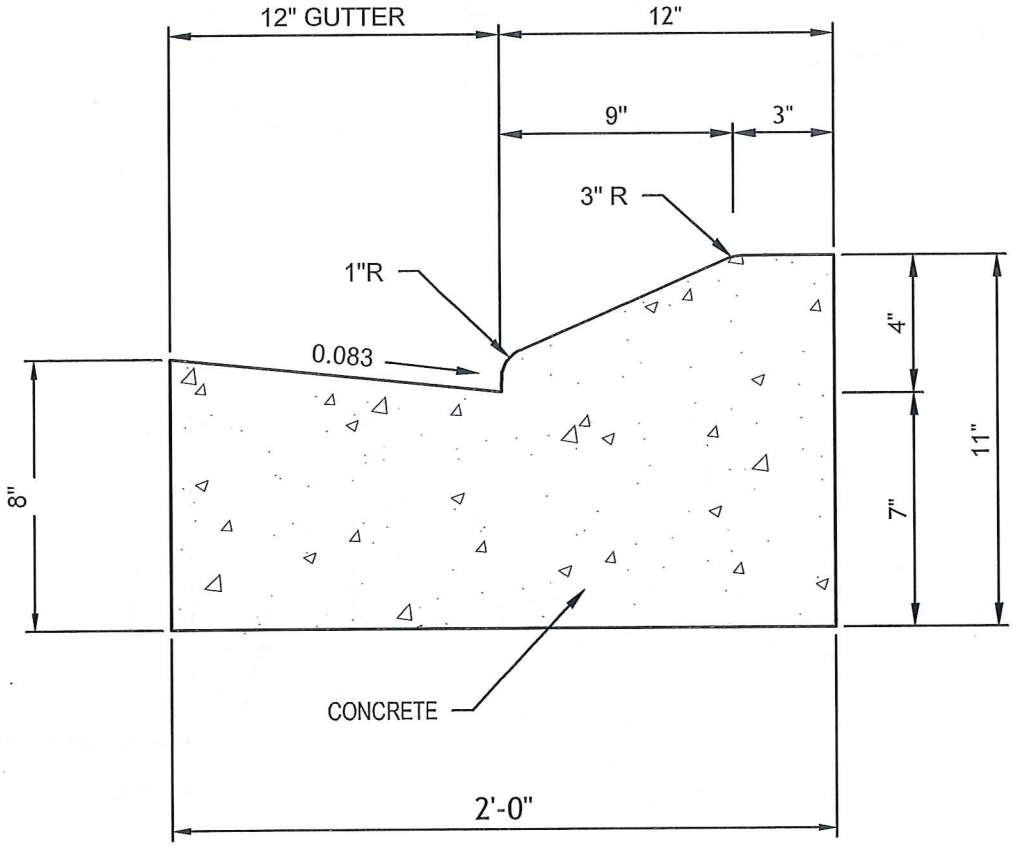
GENERAL NOTES

1. 6-24 CURB & GUTTER TO BE USED WITH JOHN BOUCHARD & SON 3080
2. 6-30 CURB & GUTTER TO BE USED WITH JOHN BOUCHARD & SON 3123
3. FOR SPECIFICATIONS SEE "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" OF THE TENNESSEE DEPARTMENT OF TRANSPORTATION, SECTION 702 - CEMENT CONCRETE CURB, GUTTER AND COMBINED CURB AND GUTTER.
4. CONCRETE EXPANSION JOINT MATERIAL IS TO BE 3/4" PREMOLDED FIBER IN ACCORDANCE WITH SECTION 905 - JOINT MATERIALS OF THE TDOT STANDARD SPECIFICATIONS.
5. CONTRACTION JOINTS ARE TO BE SPACED AT 10 FEET. THE SPACING OF 10 FEET MAY BE REDUCED FOR CLOSURES, BE NOT LESS THAN 6 FEET.
6. EXPANSION JOINTS ARE TO BE PLACED AS FOLLOWS: AT TANGENT JOINTS OF CIRCULAR CURBS, BETWEEN CURBS AND ABUTTING RIGID OBJECTS, AT OTHER PLACES WHERE STRESSES MAY DEVELOP, SO AS TO LINE UP WITH PAVEMENT JOINTS WHERE THE ADJACENT PAVEMENT IS CONCRETE. MAXIMUM SPACING IS TO BE 100 FEET.
7. CLASS "A" CONCRETE, MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI WITH SYNTHETIC MICROFIBER REINFORCEMENT.

N.T.S.

DATE: 10.27.16	STANDARD 6" NON MOUNTABLE CURBS & GUTTERS	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. RP-1	

ONLY TO BE USED WITH PRIOR APPROVAL BY CITY ENGINEER

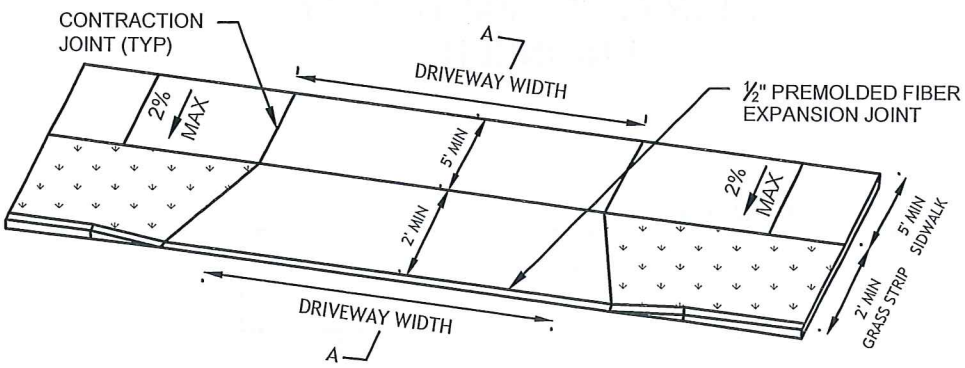


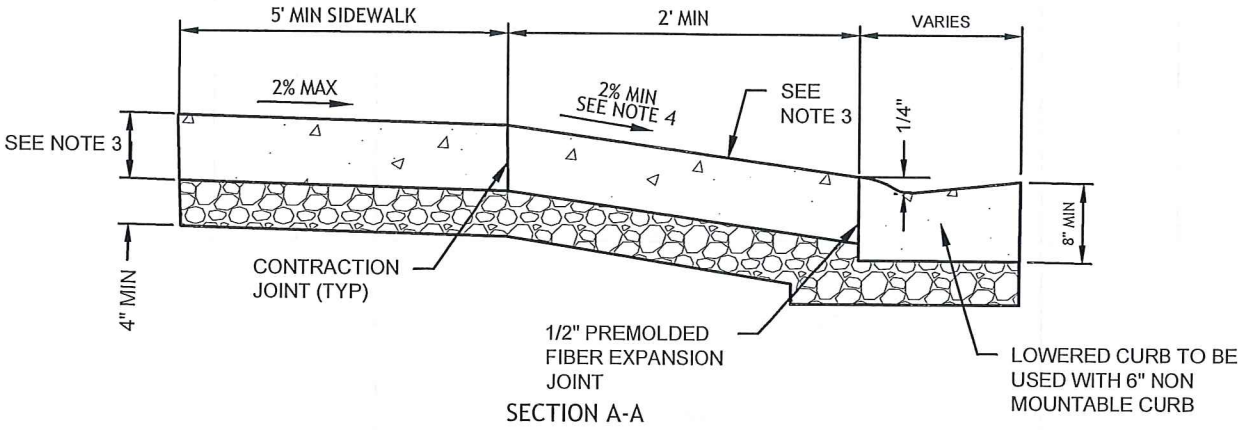
GENERAL NOTES

1. JOHN BOUCHARD & SON 3104.
2. FOR SPECIFICATIONS SEE "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION" OF THE TENNESSEE DEPARTMENT OF TRANSPORTATION, SECTION 702 - CEMENT CONCRETE CURB, GUTTER AND COMBINED CURB AND GUTTER.
3. CONCRETE EXPANSION JOINT MATERIAL IS TO BE ¾" PREMOLDED FIBER IN ACCORDANCE WITH SECTION 905 - JOINT MATERIALS OF THE STANDARD SPECIFICATIONS.
4. CONTRACTION JOINTS ARE TO BE SPACED AT 10 FEET. THE SPACING OF 10 FEET MAY BE REDUCED FOR CLOSURES, BE NOT LESS THAN 6 FEET.
5. EXPANSION JOINTS ARE TO BE PLACED AS FOLLOWS: AT TANGENT JOINTS OF CIRCULAR CURBS, BETWEEN CURBS AND ABUTTING RIGID OBJECTS, AT OTHER PLACES WHERE STRESSES MAY DEVELOP, SO AS TO LINE UP WITH PAVEMENT JOINTS WHERE THE ADJACENT PAVEMENT IS CONCRETE MAXIMUM SPACING IS TO BE 100 FEET.
6. CLASS "A" CONCRETE, MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI WITH SYNTHETIC MICROFIBER REINFORCEMENT.

N.T.S.

DATE: 10.27.16	4" MOUNTABLE CONCRETE CURB & GUTTER	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. RP-2	





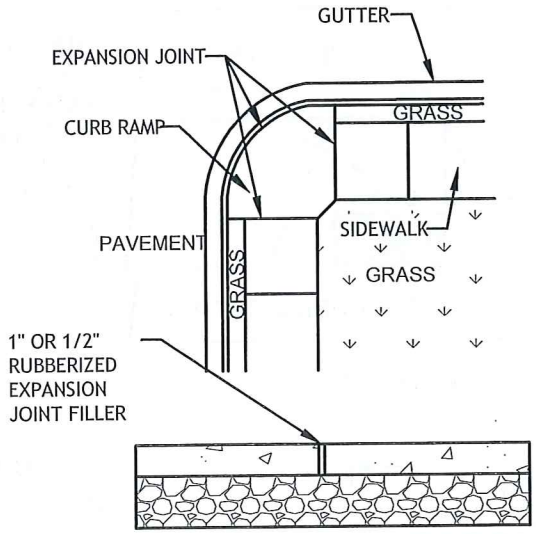
SECTION A-A

GENERAL NOTES

1. 5' MINIMUM SIDEWALK WITH A MAXIMUM CROSS SLOPE OF 2% THROUGH DRIVEWAYS
2. 4" MINIMUM BASE STONE REQUIRED UNDER ALL DRIVEWAYS.
3. RESIDENTIAL DRIVEWAYS SHALL BE A MINIMUM 6" OF CLASS "A" CONCRETE WITH SYNTHETIC FIBER REINFORCEMENT.
   COMMERCIAL DRIVEWAYS SHALL BE A MINIMUM 8" OF CLASS "A" CONCRETE WITH SYNTHETIC FIBER REINFORCEMENT.
4. DRIVEWAY RAMP GRADE VARIES, 8.33% MAXIMUM APRON GRADE FOR RESIDENTIAL DRIVEWAYS. 6.0% MAXIMUM APRON GRADE FOR COMMERCIAL DRIVEWAYS.
5. CLASS "A" CONCRETE, MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI WITH SYNTHETIC MICROFIBER REINFORCEMENT.

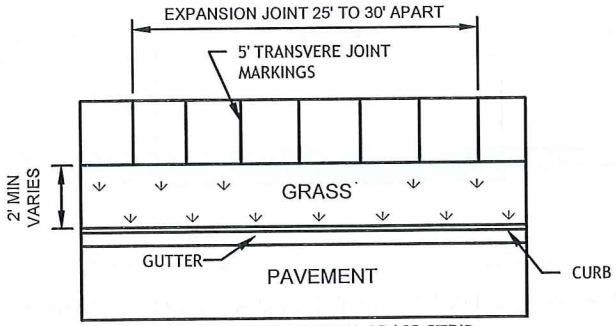
N.T.S.

DATE: 10.27.16	STANDARD CONCRETE DRIVEWAYS (WITH GRASS STRIP)	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. RP-3	

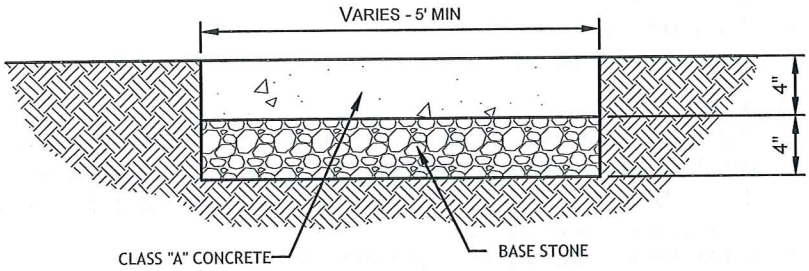


DETAIL OF EXPANSION JOINT

GENERAL NOTES
1. ONE-INCH JOINTS TO BE PLACED WHERE THE SIDEWALK IS IN CONTACT WITH CIRCULAR CURB, BUILDINGS AND RETAINING WALLS. HALF-INCH JOINTS TO BE USED IN OTHER LOCATIONS.
2. ONE LONGITUDINAL JOINT MARKING REQUIRED ON SIDEWALK GREATER THAN 5' IN WIDTH.



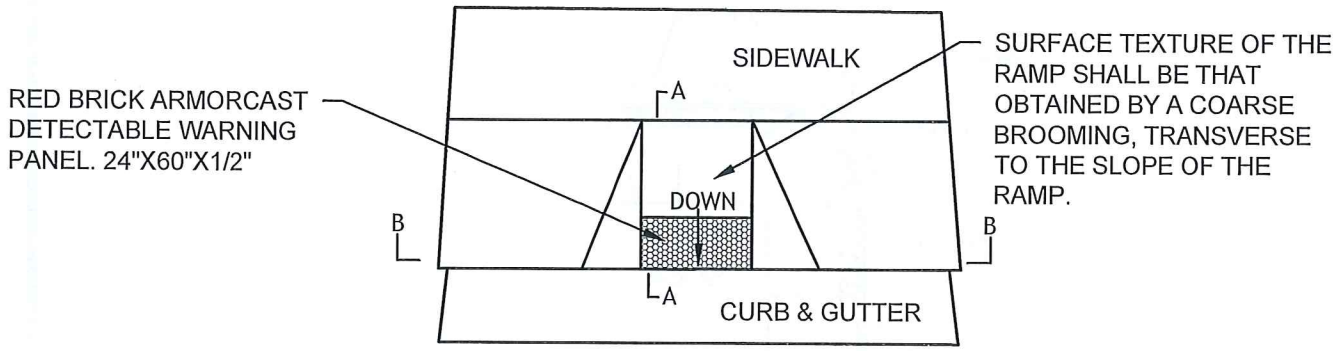
5' SIDEWALK WITH GRASS STRIP



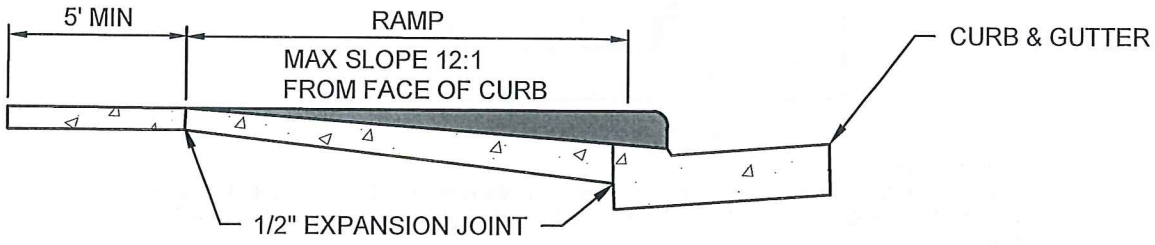
GENERAL NOTES
1.CLASS "A" CONCRETE, MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI WITH SYNTHETIC MICROFIBER REINFORCEMENT.
2. ROOT BARRIERS REQUIRED ON BOTH SIDES OF GRASS STRIP AROUND TREES.

N.T.S.

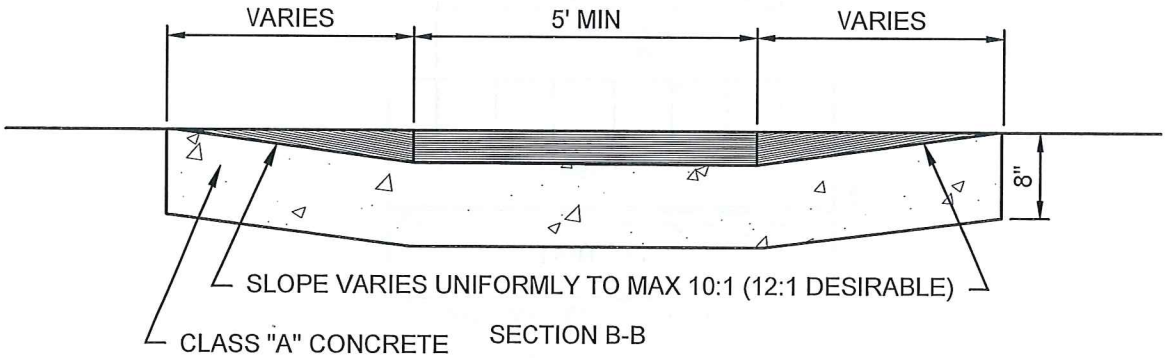
DATE: 10.27.16	TYPICAL 5' CONCRETE SIDEWALK	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. RP-4	



DETAIL "A"



SECTION A-A



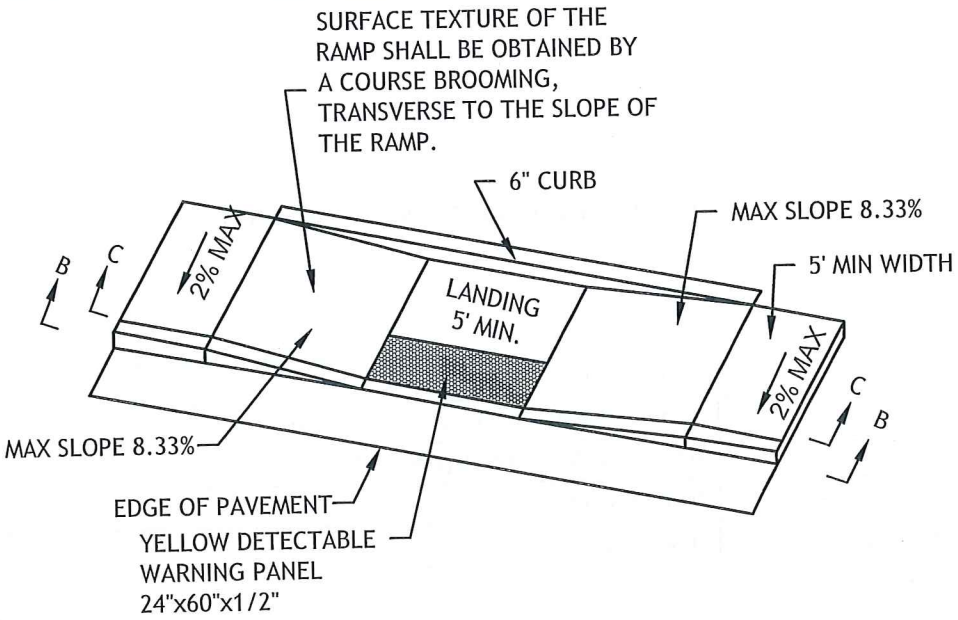
SECTION B-B

GENERAL NOTES

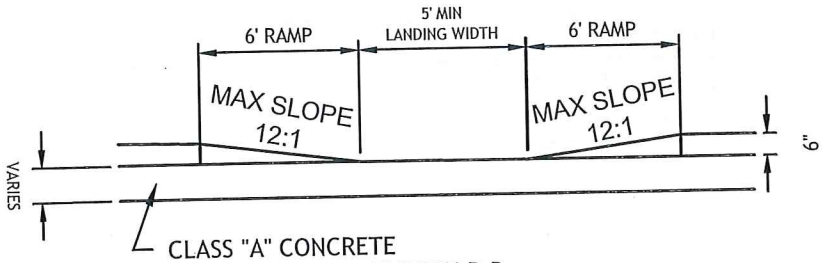
1. A VARIATION OF THE RAMP MAY BE USED IN CERTAIN CIRCUMSTANCES BUT MUST COMPLY WITH ACCESSIBILITY CODE REQUIREMENTS.
2. DESIREABLE SLOPE TO BE USED UNLESS OTHERWISE DIRECTED BY THE CITY OF GOODLETSVILLE.
3. MINIMUM LANDING AT TOP OF RAMP IS 5'
4. RAMPS SHALL BE PROVIDED AT ALL STREET INTERSECTIONS, WALK LOCATIONS AND MID-BLOCK LOCATIONS
5. RAMPS SHALL BE 8" CLASS "A" CONCRETE WITH SYNTHETIC MICROFIBER REINFORCEMENT.
6. 4" BASE STONE REQUIRED UNDER ALL RAMPS

N.T.S.

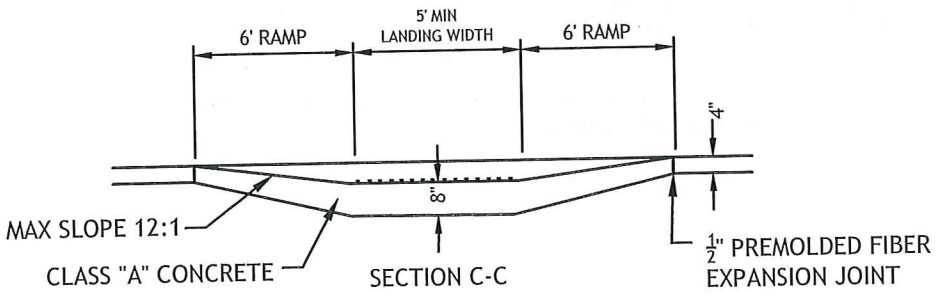
DATE: 10.27.16	PERPENDICULAR CURB RAMP DETAIL	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. RP-5	



PARALLEL CURB RAMP DETAIL



SECTION B-B



GENERAL NOTES

1. A VARIATION OF THE RAMP MAY BE USED IN CERTAIN CIRCUMSTANCES BUT MUST COMPLY WITH ACCESSIBILITY CODE REQUIREMENTS AND BE APPROVED BY THE CITY.
2. DESIREABLE SLOPE TO BE USED UNLESS OTHERWISE DIRECTED BY THE CITY OF GOODLETSVILLE.
3. MINIMUM LANDING AT TOP OF RAMP IS 5'
4. RAMPS SHALL BE PROVIDED AT ALL STREET INTERSECTIONS, WALK LOCATIONS AND MID-BLOCK LOCATIONS
5. RAMPS SHALL BE 8" CLASS "A" CONCRETE WITH SYNTHETIC MICROFIBER REINFORCEMENT.
6. 4" BASE STONE REQUIRED UNDER ALL RAMPS

N.T.S.

DATE: 10.27.16	PARALLEL CURB RAMP DETAIL (ALTERATIONS ONLY)	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. RP-6	

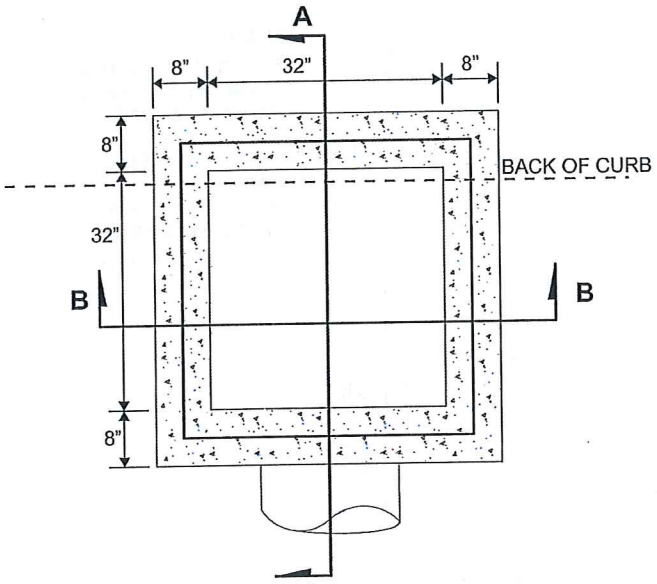
DRAINAGE STRUCTURES, MANHOLES, GRATES, PIPE CULVERTS AND ENDWALLS

TYPE	TDOT STANDARD DRAWINGS
CATCH BASINS*	TDOT CATCH BASINS 10, 12, 13, 14, 16 AND 17 TYPE
CATCH BASINS GRATES*	D-CBB-12A AND D-CBB-13 (SEE NOTE 1 AND 2 BELOW)
AREA DRAINS - 1 GRATE	D-CB-42 SERIES
AREA DRAINS - 2 GRATES	D-CB-43 SERIES
AREA DRAIN GRATES	D-CBB-42
JUNCTION BOX	D-JBS-1 THRU D-JBS-5
MANHOLES	D-JMH-2 THRU DRF-1
TRENCH DRAINS	D-TD-1
PROTECTED ENDWALLS	D-PE-1 THRU D-PE-9F
PIPE CULVERTS AND FLUMES	D-FLU-1, D-PB-1 THRU D-PB-3

NOTES
1. STANDARD 6" NON- MOUNTABLE CURB AND GUTTER SECTION SHALL BE USED WITH JOHN BOUCHARD & SONS NO. 3080 (OR APPROVED EQUAL).
2. 4" MOUNTABLE TYPE CURB & GUTTER SHALL BE USED WITH JOHN BOUCHARD & SONS NO. 3104 (OR APPROVED EQUAL).
3. INLETS, DRAINS, GRATES, MANHOLES AND ENDWALLS TO BE CONSTRUCTED IN ACCORDANCE WITH THE APPLICABLE TDOT STANDARD DRAWINGS.

N.T.S.

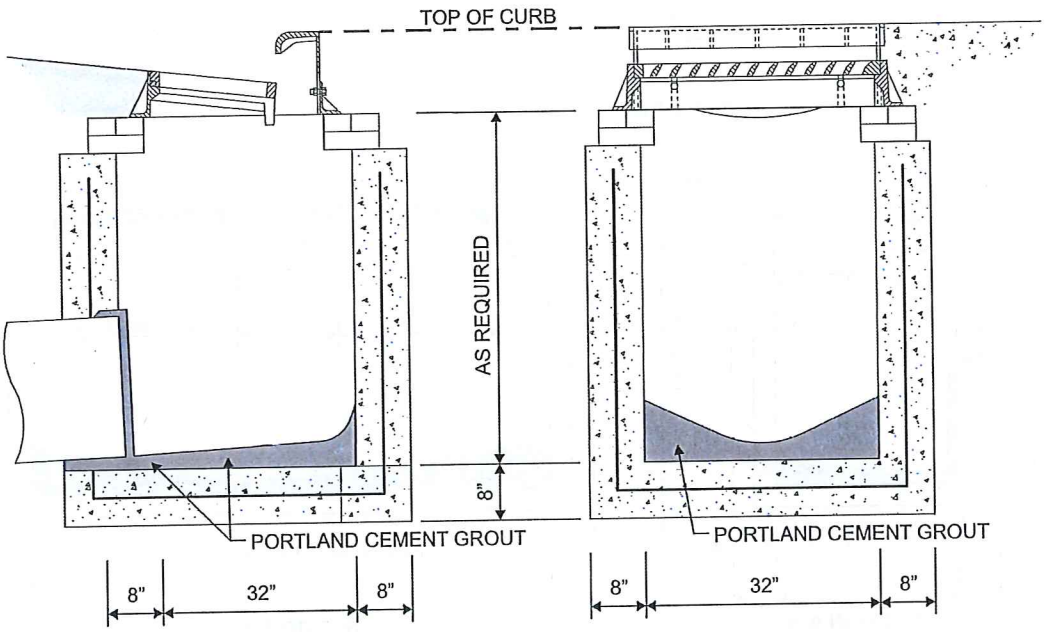
DATE: 10.27.16	DRAINAGE STRUCTURES, MANHOLES, GRATES AND ENDWALLS	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. DR-1	



TOP VIEW

NOTES:

1. GRATE AND CASTING TO BE JOHN BOUCHARD & SON NO. 3080 OR EQUAL
2. GRADE 60 STEEL
3. 4000 PSI @ 28-DAY REINFORCEMENT WITH #4 STEEL.

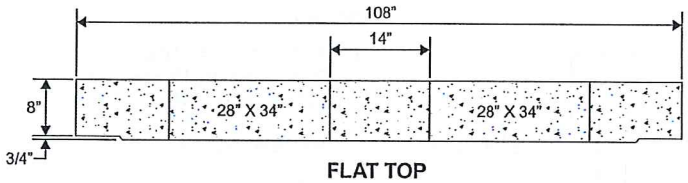


SECTION A-A

SECTION B-B

N.T.S.

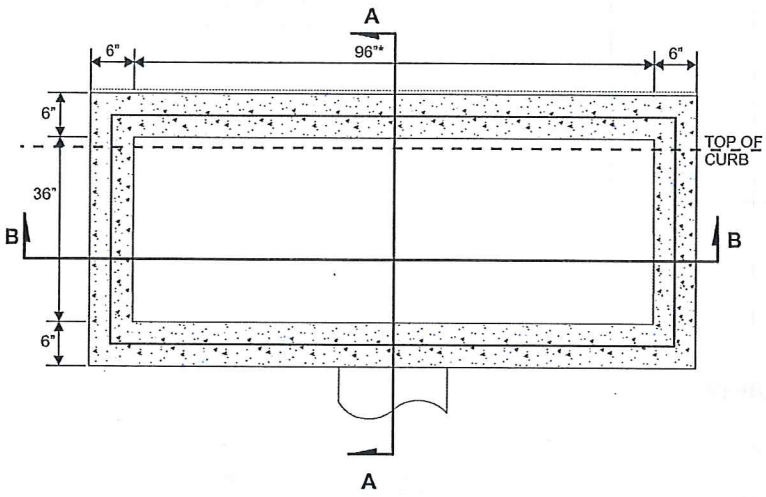
DATE: 10.27.16 REVISIONS	CONCRETE SINGLE INLET DETAIL FOR TYPE 6-24 CURB & GUTTER STD. DWG. DR-2	GOODLETTSVILLE TENNESSEE



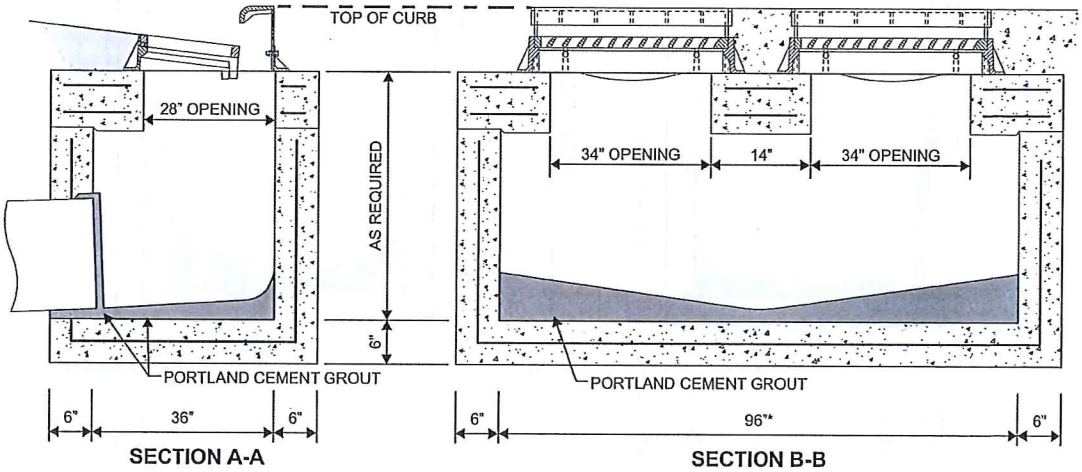
FLAT TOP

NOTES:

1. GRATE AND CASTING TO BE JOHN BOUCHARD & SON NO. 3080 OR EQUAL
2. GRADE 60 STEEL
3. 4000 PSI @ 28-DAY REINFORCEMENT WITH #4 STEEL.



TOP VIEW



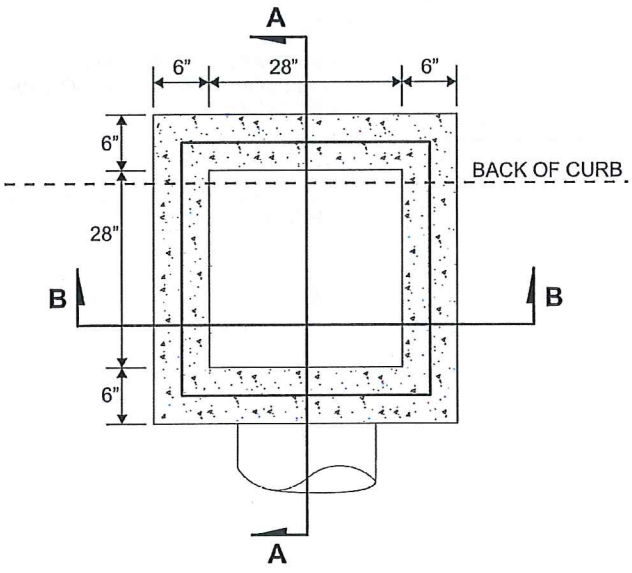
SECTION A-A

SECTION B-B

* 84" IF 1" X 14" LINTEL PLATE IS USED INSTEAD OF FLAT TOP

N.T.S.

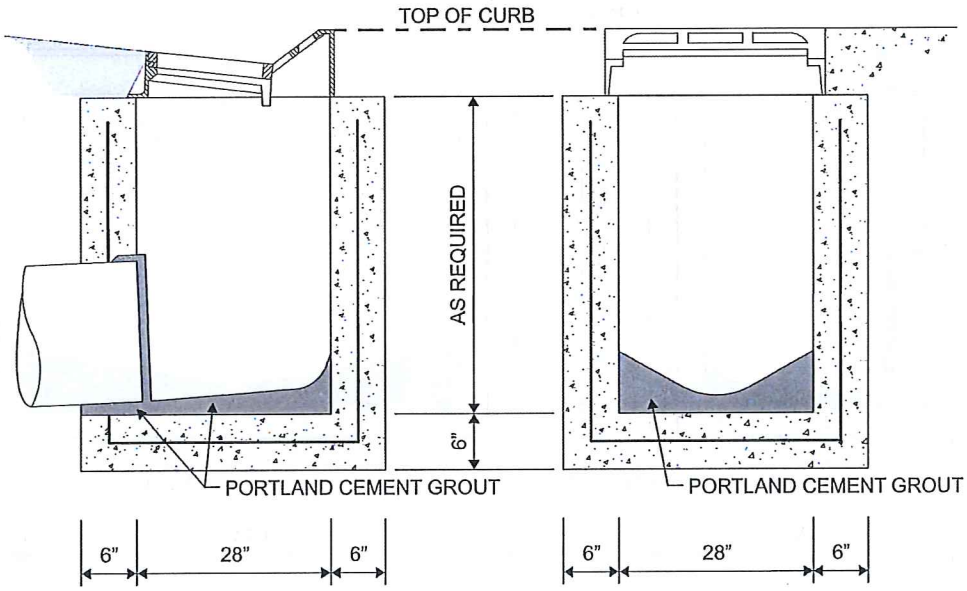
DATE: 10.27.16 REVISIONS	CONCRETE DOUBLE INLET DETAIL FOR TYPE 6-24 CURB & GUTTER	GOODLETTSVILLE TENNESSEE
	STD. DWG. DR-3	



TOP VIEW

NOTES:

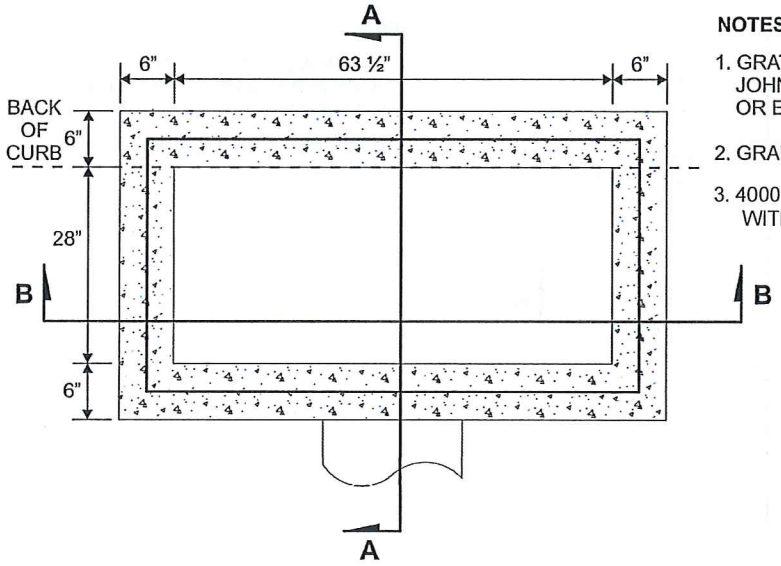
1. GRATE AND CASTING TO BE JOHN BOUCHARD & SON NO. 3104 OR EQUAL
2. 4000 PSI @ 28-DAY REINFORCEMENT WITH #4 STEEL.



SECTION A-A **SECTION B-B**

N.T.S.

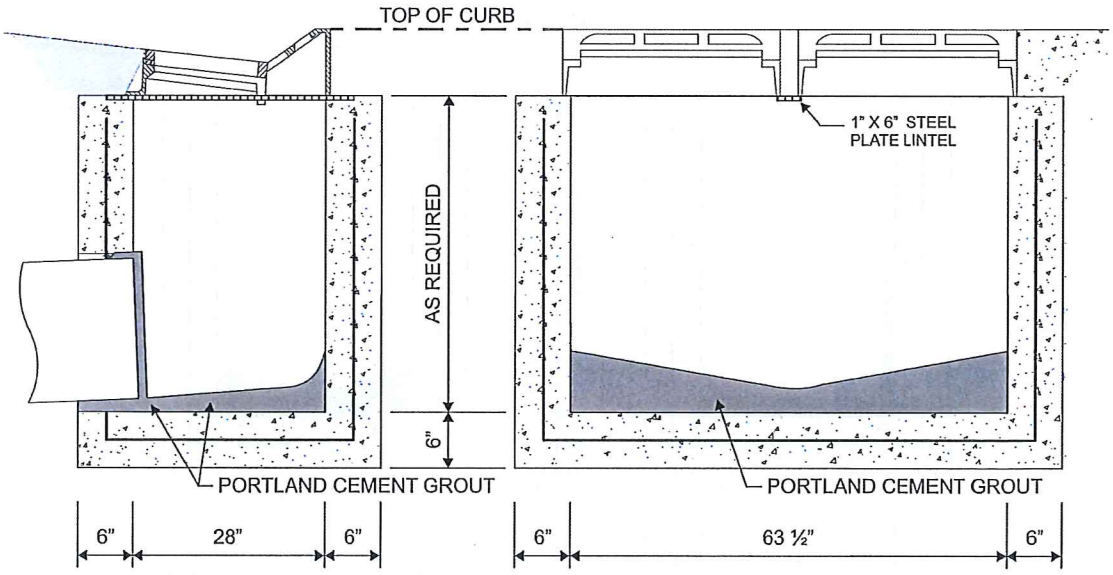
DATE: 10.27.16 REVISIONS	CONCRETE SINGLE INLET DETAIL FOR MOUNTABLE CURB & GUTTER STD. DWG. DR-4	GOODLETTSVILLE TENNESSEE



TOP VIEW

NOTES:

1. GRATE AND CASTING TO BE JOHN BOUCHARD & SON NO. 3104 OR EQUAL
2. GRADE 60 STEEL
3. 4000 PSI @ 28-DAY REINFORCEMENT WITH #4 STEEL.



SECTION A-A

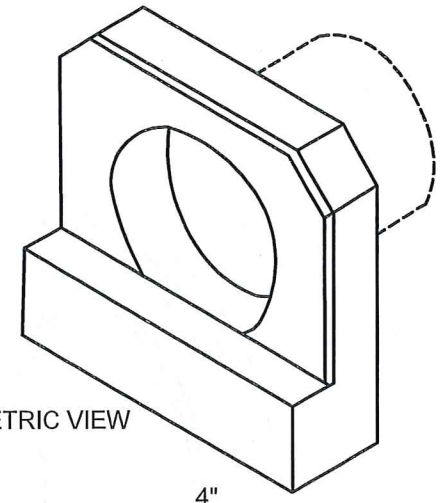
SECTION B-B

N.T.S.

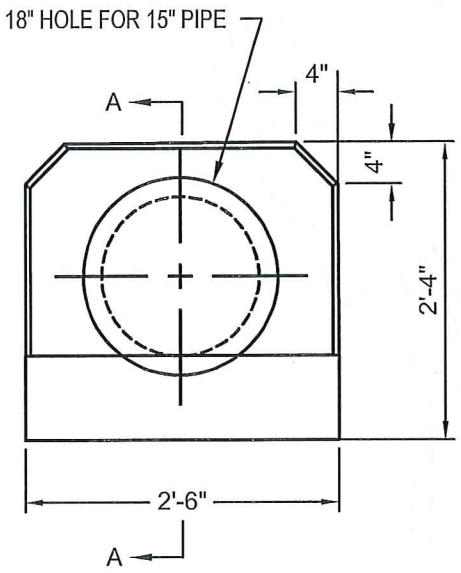
DATE: 10.27.16 REVISIONS	CONCRETE DOUBLE INLET DETAIL FOR MOUNTABLE CURB & GUTTER STD. DWG. DR-5	GOODLETTSVILLE TENNESSEE

WEIGHTS	
SECTION	WEIGHT
TOTAL	400LBS

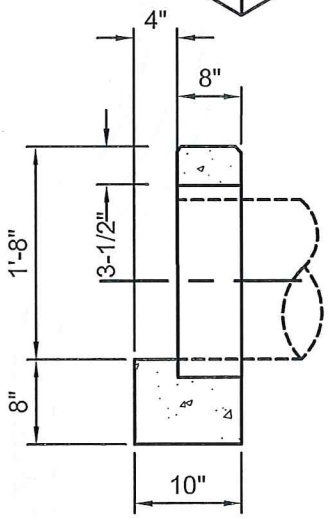
PLAN VIEW



ISOMETRIC VIEW



FRONT VIEW



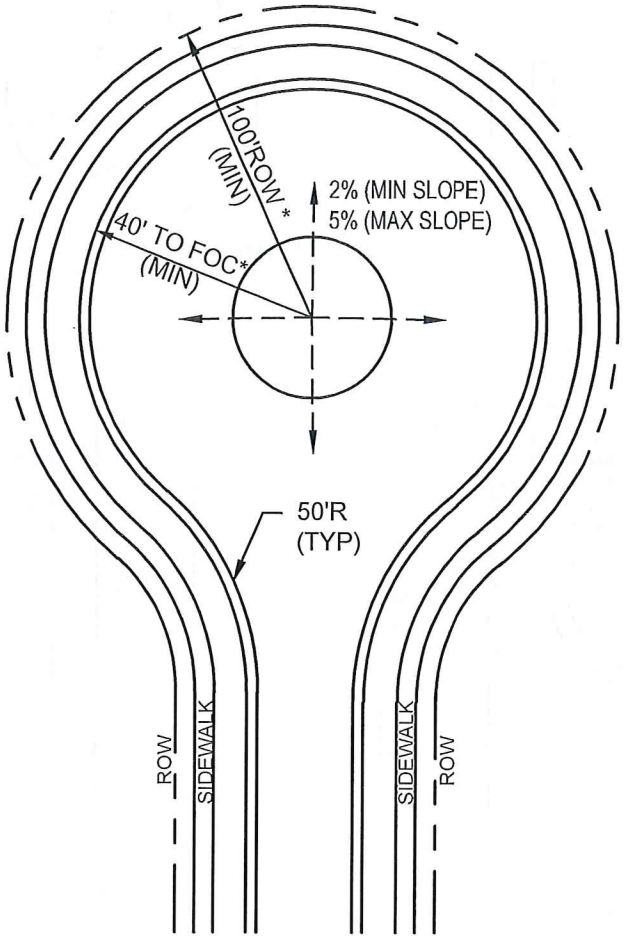
SIDE VIEW

GENERAL NOTES:

1. CONCRETE MINIMUM COMPRESSION STRENGTH: F'c=5,000 PSI @ 28 DAYS
2. REINFORCING STEEL: ASTM A615, Fy= 60,000 PSI
3. HEADWALL TO BE USED FOR 15" DRIVEWAY CULVERTS ONLY. FOR LARGER PIPES UP TO 24", USE STRAIGHT TYPE ENDWALLS PER TDOT STANDARD DRAWING D-PE-4. PIPES LARGER THAN 24" REQUIRE SAFETY TYPE ENDWALLS WITH GRATES, PER TDOT STANDARD DRAWING D-SEW-1A.

N.T.S.

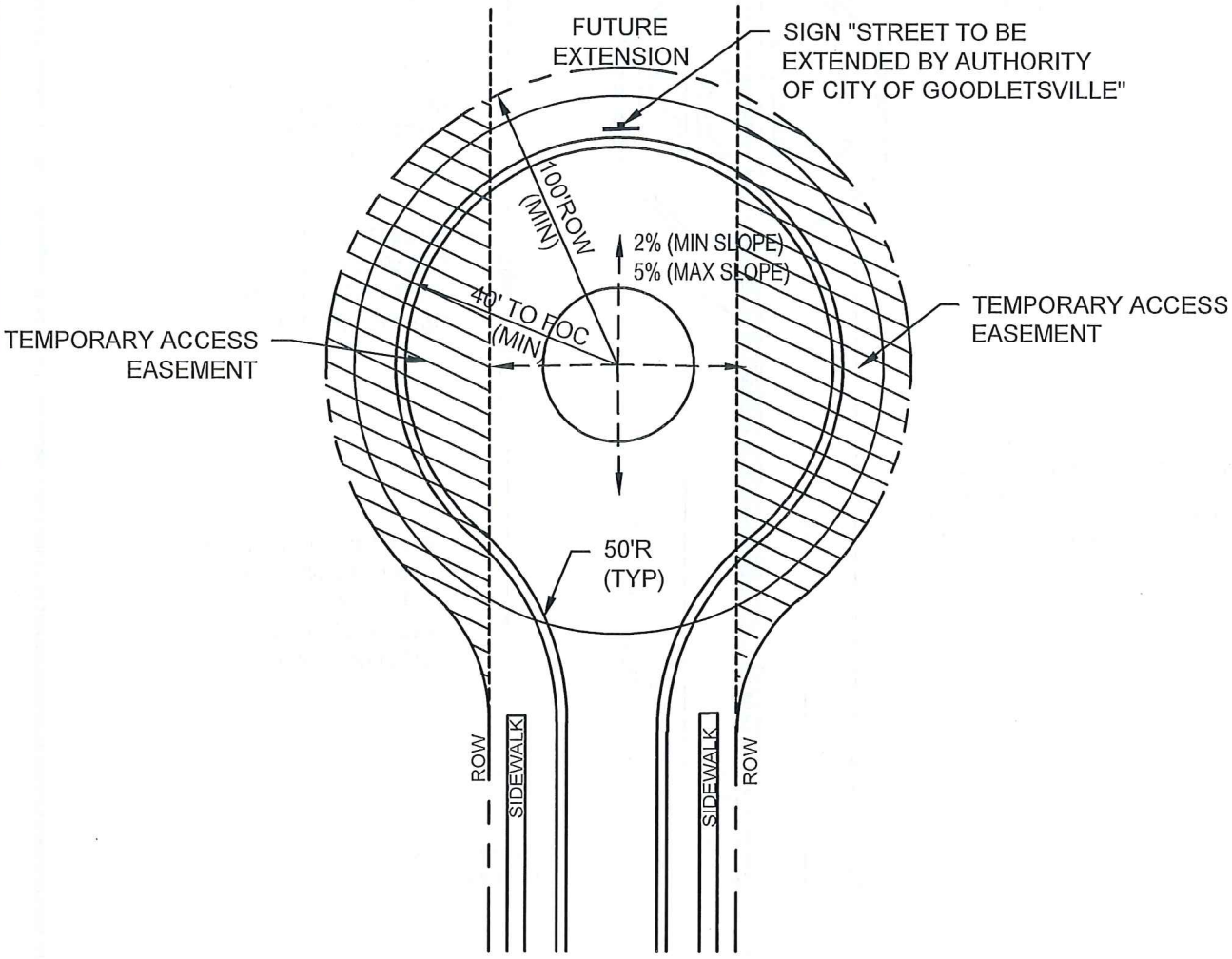
DATE: 10.27.16	STANDARD DRIVEWAY CULVERT ENDWALL	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. DR-6	



* FOR COMMERCIAL OR INDUSTRIAL APPLICATIONS. PAVEMENT RADIUS IS 140' WITH 160' R.O.W.

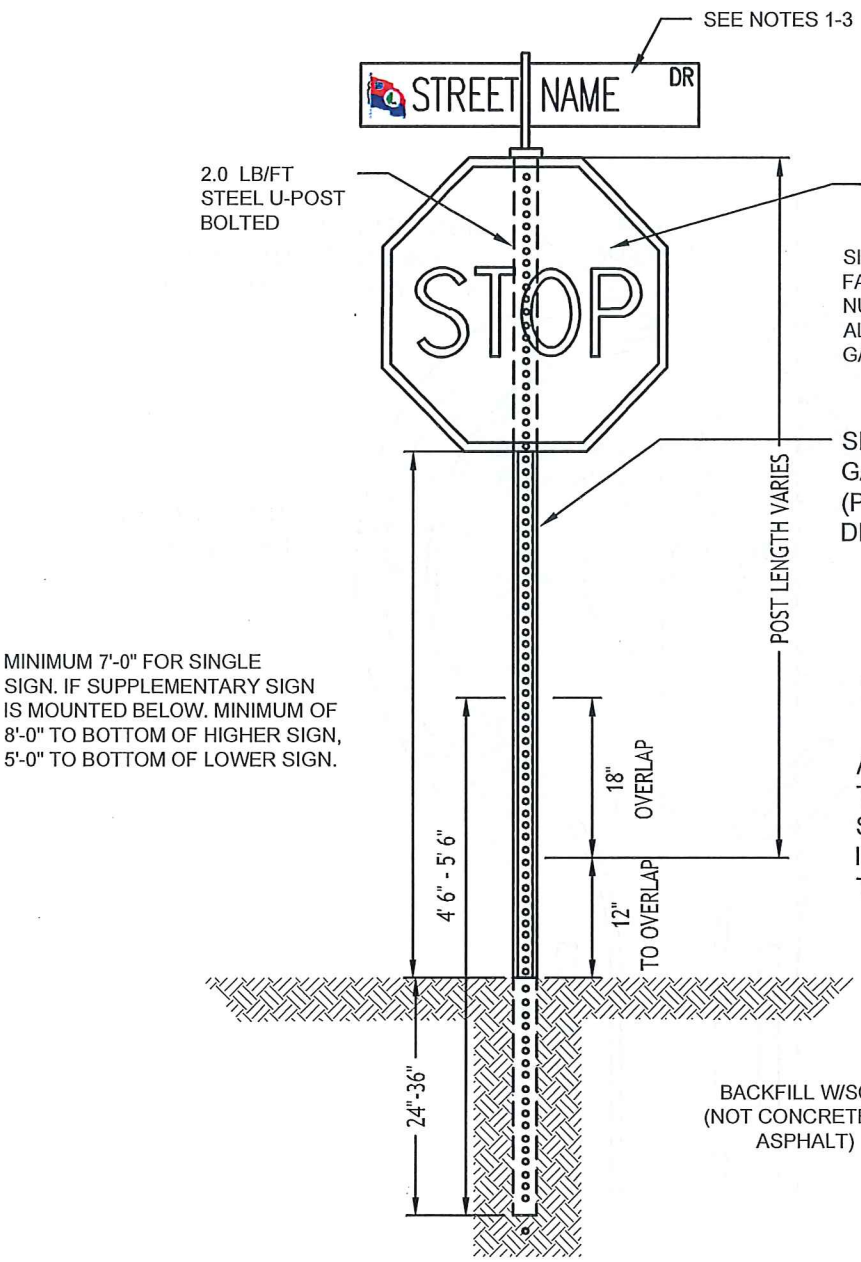
N.T.S.

DATE: 10.27.16	STANDARD CUL-DE-SAC	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. SD-1	



N.T.S.

DATE: 10.27.16	TEMPORARY CUL-DE-SAC	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. SD-2	



GENERAL NOTES

1. ALL PROPOSED SIGNAGE TO MATCH CURRENT CITY OF GOODLETTSVILLE VERSION OF STREET SIGNS

2. OVERHEAD TRAFFIC SIGNALS WITH ROAD NAME SIGNS :
   12 " TALL ALUMINUM WITH 6" WHITE REFLECTIVE LETTERS. THE BLUE BACKGROUND IS 3M ELECTROCUT FILM BLUE 1175C

3. ROAD NAME SIGNS: THE BLUE BACKGROUND IS OROCAL 651G-098 GENTIAN BLUE
   35 MPH OR HIGHER REQUIRES 9" BLANK WITH 5.75" WHITE REFLECTIVE LETTERS LESS THAN 35 MPH REQUIRES 6" BLANK WITH 3.75" WHITE REFLECTIVE LETTERS

N.T.S.

DATE: 10.27.16	TYPICAL STREET SIGN	GOODLETTSVILLE TENNESSEE
REVISIONS	STD. DWG. SD-3	