

PUBLIC IMPROVEMENT SPECIFICATIONS

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SECTION ONE - INTRODUCTION

1.0 PURPOSE - The purpose of this Chapter is to give a general view of the working relationship between the developer and the local government concerning the specifications listed in this manual. This chapter also explains some of the terminology used throughout this manual and lists the references herein.

1.1 GENERAL - These specifications are established under the authority of the Henderson City-County Planning Commission for the use of all persons, firms, or corporations constructing improvements which are or may become public facilities under the jurisdiction of the City and County of Henderson. Whenever, in these specifications, the term developer is used, it shall refer to the person, firm or corporation installing the work, and includes contractors, subcontractors, agents, and any other person or entity installing or constructing public improvements.

Whenever, in these specifications, the term Engineer is used, it shall refer to Engineers employed by the City of Henderson, Henderson County, a Local Utility Engineer, or any other duly authorized representative having jurisdiction over the work to be performed, including inspectors employed by local government or a public utility.

The term HWU in these specifications refers to the Henderson Water Utility.

1.2 REFERENCES - Certain technical aspects concerning construction materials and methods of construction are based on the Kentucky Transportation Cabinet, Standard Specifications for Road and Bridge Construction, current edition, hereafter referred to as the KYTC Specifications. A copy of said specifications is available for reference in the office of the Henderson City Engineer.

Other standards or specifications referred to are those of the American Society of Testing Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), the American National Standards Institute (ANSI) and the American Waterworks Association (AWWA).

Standard drawings showing details of certain improvements which may be issued by the various Engineers shall be complementary to and a part of these specifications.

1.3 INTERPRETATION - The Engineer shall decide on all questions which may arise as to the interpretation of the specifications or plans relating to the work, and all questions as to the acceptable fulfillment of the work performed by the developer. The Engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the manner of performance of the work.

1.4 OBLIGATION OF THE DEVELOPER - The developer shall perform and complete the work to the satisfaction of the Engineer and in accordance with these specifications. The developer shall conduct his work so as to minimize interference with public and private business and traffic, and shall, at his own expense, whenever necessary or required, provide barricades, flagmen,

maintain lights, and take other precautions as may be necessary to protect life, property, adjacent buildings, and structures. The developer shall be liable for all damages and injuries received or sustained by any person, persons or property in consequence of any neglect or misconduct by him or his agents, subcontractors, employees, or workmen.

- 1.5 PLANS - For use during construction of improvements, two (2) complete sets of prints of all improvement plans shall be furnished to the office of the Engineer. These plans shall have received preliminary approval by the Henderson City-County Planning Commission, when appropriate. All plans for potable water lines, sanitary sewers, and storm sewers shall be certified by a Licensed Professional Engineer registered in the State of Kentucky. In addition, copies of all design calculations in connection with sanitary and storm drainage facilities shall be furnished to the Engineer and to the Planning Commission. The Engineer may at his discretion require submittal of suitable electronic copies of plans in a standard format (e.g., AutoCAD).

GPS coordinates in an appropriate datum specified by the City or County shall be collected and submitted to the Engineer for all utility improvements, including sanitary, water and stormwater, and other utilities when required. Coordination of this activity with local government and utility staff shall be the responsibility of the developer, and the developer may be required to uncover any facilities not so recorded. Utility connections (laterals and services) shall be included in this location information. One (1) copy of this information shall be furnished to the Engineer.

Plans shall be complete, and shall show all information necessary to allow construction of the improvements to the requirements of these specifications. Plans shall be drawn to a scale, and shall include all construction notes, topographic details, elevations, property lines, proposed improvements and other information as required by the Engineer.

- 1.6 COOPERATION - Cooperation with the Engineer concerning construction planning and procedures is required. Reasonable notice shall be given the Engineer or his representative prior to beginning any phase of construction, normally 24 hours prior to work activity. In emergencies notice may be given not less than 4 hours in advance of work. In instances where the developer fails to request inspections prior to or during performance of the work, the Engineer may require cores, samples, destructive testing or other measures to insure that work performed meets the requirements of these specifications, and all such additional tests or procedures and costs of removing, replacing or repairing items so tested shall be at the sole expense of the developer.
- 1.7 DEFECTIVE MATERIALS AND WORKMANSHIP - All improvements must conform to the adopted Public Improvement Specifications and be satisfactory to the Engineer. Materials not in accordance with the specifications or defective work may be rejected by the Engineer at any time before final approval and acceptance by the Engineer. Failure by the Engineer to reject defective work shall not be construed as acceptance of same. Defective work shall be removed and replaced at the developer's sole expense.

1.8 INSPECTION DURING CONSTRUCTION - All improvements must be inspected by the Engineer or his representative. The Developer may be required to uncover, test and/or remove work that was not inspected prior to backfill.

1.9 FINAL INSPECTION - In addition to normal inspection which may be conducted during construction of development improvements, a final inspection will be made by the Engineer or his representative, prior to acceptance of any part of the work for maintenance by the local government. As part of the final inspection, all sanitary and storm manholes shall be opened. All sanitary and storm drain facilities shall be cleaned of all dirt, mud, and other foreign matter. The developer shall provide personnel as required to aid in the final inspection.

CCTV inspection of Sanitary and Storm Sewers in the HWU service areas shall consist of televising 10% of the main pipelines and 25% of the sanitary laterals, and a fee is computed and assessed at the time of approval of the plans. Should CCTV inspection reveal the failure of any portion of the system to meet the requirements of the applicable Technical Standards, HWU reserves the right to televise any additional portions up to and including the entire system in which a failure was identified at the developer's expense.

1.10 EXISTING UTILITIES - Special precautions shall be taken by the Developer to avoid damage to existing overhead and underground utilities owned and operated by the City or by public or private utility companies.

Where existing utilities or appurtenant structures, whether underground or aboveground are encountered, they shall not be displaced or disturbed unless necessary, and in such cases shall be replaced in as good or better condition than found as quickly as possible.

The developer shall bear the entire responsibility for locating, avoiding or repairing damage to said existing utilities. No work shall be performed prior to contacting Kentucky 811 and existing underground utilities being located and marked. Developer is responsible for contacting utilities that do not subscribe to Kentucky 811.

In accordance with KRS 367.4901 through .4917, Developers are responsible for notification of utility companies prior to the commencement of work. All underground facilities installed after January 1, 2013, shall include a means to accurately identify and locate the underground facilities from the surface. This does not apply to the repair of existing facilities.

1.11 PERMITS, EASEMENTS AND RIGHTS-OF-WAY - Unless otherwise required by the agencies involved, the developer shall make application for, obtain and pay for all licenses, permits, easements, and rights-of-way. The developer shall be required to comply with all State and local ordinances, laws, and codes which may apply to the work.

1.12 SOIL AND/OR MATERIAL TESTING - Material and soil testing shall be performed by the Developer under the direction of the engineer or street inspector. When an independent laboratory test is requested by the Engineer or the developer, such testing shall be paid in full by the party requesting the additional testing.

- 1.13 EROSION AND WATER POLLUTION CONTROL – Developer shall control water pollution through use of best management practices that limit eroded sediment leaving the site, and shall coordinate these measures with the construction schedule to ensure effective and continuous erosion control throughout the construction and post construction periods.

Before any disturbance is made, perform an initial site inspection with the Engineer, record what areas are to be disturbed, submit an erosion and sediment control plan showing what BMPs will be used, design BMPs according to good engineering practices, and install the designated BMPs. Before opening or affecting any new areas, repeat this process and ensure all BMPs are installed before starting work.

For sites containing more than one (1) acre of disturbed area, a Notice of Intent (NOI) must be filed with the Kentucky Division of Water. The complete NOI submittal shall be copied to the Engineer, for local review and permitting, and this review and permitting is separate and apart from State approval of any plan.

1.13.1 DESIGN REQUIREMENTS - Grading, erosion control practices, sediment control practices, and waterway crossings shall meet the design criteria set forth in the most recent version of the applicable Technical Stormwater Manual, and shall be adequate to prevent transportation of sediment from the site. Design requirements include:

- a. Cut and fill slopes shall be no greater than 2:1, (horizontal: vertical), except as approved by the Engineer to meet other community or environmental objectives.
- b. Clearing and grading of natural resources, such as forests and wetlands, shall not be permitted, except when in compliance with State and Federal regulations. Clearing techniques shall retain natural vegetation and drainage patterns to the maximum extent practicable, as described in the Technical Stormwater Manual.
- c. Clearing, except that necessary to establish sediment control devices, shall not begin until all sediment control devices have been installed and stabilized.
- d. Phasing is encouraged on all sites, with the size of each phase to be established at plan review and as approved by the Engineer.
- e. Erosion control measures shall include the following:
 - (i.) Soil stabilization shall be initiated within fourteen (14) days of clearing or inactivity in construction.
 - (ii.) If seeding or another vegetative erosion control method is used, adequate temporary erosion control may be required until permanent cover is established.
 - (iii.) Special techniques that meet the design criteria outlined in the applicable Technical Stormwater Manual on steep slopes or in drainage ways shall be used to ensure stabilization.
 - (iv.) Soil stockpiles must be contained at the end of each workday, with adequate measures taken to control and treat runoff.
 - (v.) The entire site must be stabilized, using a heavy mulch layer or another method that does not require germination to control erosion, at the close of the construction season.
 - (vi.) Techniques shall be employed to prevent the blowing of dust or sediment from the site.
 - (vii.) Techniques that divert upland runoff past disturbed slopes shall be employed.

- f. Sediment control measures may be required to include, if applicable:
 - (i.) Settling basins, sediment traps, or tanks and perimeter controls.
 - (ii.) Settling basins that are designed in a manner that allows adaptation to provide long term storm water quantity and quality management, if required by the Engineer.
 - (iii.) Protection for adjacent properties by the use of a vegetated buffer strip in combination with perimeter controls.
- g. Waterway and watercourse protection requirements shall include:
 - (i.) A temporary stream crossing installed and approved by the Kentucky Division of Water if a wet watercourse will be crossed regularly during construction.
 - (ii.) Stabilization of the watercourse channel before, during, and after in-channel work.
 - (iii.) All on-site storm water conveyance channels designed according to the criteria outlined in the applicable Technical Stormwater Manual.
 - (iv.) Stabilization adequate to prevent erosion located at the outlets of all pipes and paved channels.
 - (v.) Vegetative buffer strips may be required along watercourses, in conformance with the applicable Flood Damage Prevention Ordinance.
- h. Construction site access requirements shall include:
 - (i.) Approved temporary access entrance(s) provided at all sites.
 - (ii.) Other measures necessary to ensure that sediment is not tracked onto public streets by construction vehicles or washed into storm drains.
- i. Other requirements include:
 - (i.) Trash control.
 - (ii.) Contained washout facility for concrete trucks.
- j. Stormwater Management Measures Post-Construction: Owners or operators of any new development or redevelopment project shall design, construct and perpetually maintain stormwater management facilities or measures that will treat, filter, infiltrate, screen, harvest or reuse stormwater runoff from all impervious areas to manage stormwater quality. Facilities constructed or measures used to meet this requirement shall capture or treat all such runoff up to and including that from an 80th percentile storm event. The 80th percentile storm intensity and technical details of treatment requirements in the applicable Technical Stormwater Manual.

SECTION TWO - MATERIALS

- 2.0 PURPOSE - The purpose of this chapter is to give the specifications for the materials utilized in the construction of public improvements.
- 2.1 PORTLAND CEMENT CONCRETE & FLOWABLE FILL - Materials, placement, finishing and testing shall conform to the KYTC Standard Specifications, current edition. Digable Flowable Fill shall obtain an average compressive strength of 50 to 100 psi in 28 days. Non-Digable Flowable Fill shall obtain a minimum compressive strength of 250 psi in 28 days.
- 2.2 ASPHALT - Shall conform to KYTC Standard Specifications current edition.
- 2.3 AGGREGATE MATERIALS - Shall conform to KYTC Standard Specifications, current edition.
- 2.4 REINFORCED CONCRETE PIPE – Circular reinforced concrete pipe shall conform to the requirements of AASHTO M-170, Classes I through V. Reinforced concrete elliptical pipe shall conform to the requirements of AASHTO M-207.
- 2.5 CORRUGATED METAL PIPE - Corrugated metal culvert pipe and pipe arches may be used for the construction of culverts. All corrugated metal pipe shall be fully bituminous coated. Pipe shall be fabricated in full compliance with the requirements of AASHTO M-36. Coupling bands shall not be less than 12 inches wide for metal pipe having diameters of 54 inches or less.
- 2.6 CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE) PIPE – Double wall HDPE pipe, with smooth flow interior, manufactured specifically for use as storm sewer pipe may be used for storm sewer construction. This pipe shall be sized based on a Manning Number of no less than 0.012, shall be designed to have a minimum of two foot cover, shall be backfilled in accordance with the manufacturer's recommendations, and shall meet ASTM standards for storm sewer construction. At the discretion of the Engineer, the developer shall submit manufacturer's information to prove that a specified HDPE storm sewer pipe meets these minimum requirements. Pipe fittings shall meet the same specifications as the pipe.
- 2.7 STEEL CASING PIPE - Steel casing pipe for highway or railroad crossings shall be bored or jacked in place, or where allowed may be laid in a properly excavated trench. All joints between lengths shall be solidly welded with a smooth non-obstructing joint inside. After the pipe has been installed in the casing pipe, inspected and tested, both ends of the casing pipe shall be sealed in a manner acceptable to the Engineer.
- 2.8 ALTERNATIVE PIPES - Any other pipes not covered above will be evaluated by the Engineer on an individual basis to provide adequate drainage and structural requirements.

- 2.9 SEED – Seed mixture for permanent seeding shall consist of the following:
- a. 30% Kentucky 31 Tall Fescue (*Festuca arundinacea*)
 - b. 20% Creeping Red Fescue (*Festuca rubra*)
 - c. 35% Hard Fescue (*Festuca longifolia*)
 - d. 10% Ryegrass, Perennial (*Lolium perenne*)
 - e. 5% White Dutch Clover (*Trifolium repens*)

SECTION THREE - STREETS

3.0 PURPOSE - The purpose of this chapter is to give the standards to which all streets should be designed and built.

3.1 STREET GEOMETRIES - All streets shall conform to the applicable geometric, cross-section, and intersection standards outlined in the Subdivision Regulations and standard drawings, including the design criteria for right of way width, design speed, pavement width, minimum and maximum grades, horizontal and vertical sight distance, cross slope and sidewalk width. Where design criteria are not specified in any locally adopted document, the design standards contained in the AASHTO "Green Book" (A Policy on the Geometric Design of Highways and Streets, 2011 version) shall apply. All newly constructed streets in or adjacent to areas of special flood hazard shall be constructed above the base flood elevation.

3.2 EARTHWORK - All embankments, excavation, grading, stripping, topsoiling, etc., shall be done in accordance with the following specifications.

3.2.1 GENERAL - Only materials acceptable to the Engineer shall be used in embankment formation. No frozen material, stumps, logs, roots or other perishable or organic materials shall be placed in any embankment. No stone or masonry fragment greater than 4 inches in any dimension shall be placed within 12 inches of the finished grade elevation.

All excavation, embankment construction, grading and topsoiling shall be accomplished at such places as are indicated on the plans and to the lines, grades and elevations shown on the plans, in the specifications or as directed by the Engineer.

3.2.2 EMBANKMENT CONSTRUCTION METHODS - Before embankment placement is begun, all vegetation and rubbish shall be removed from the area within the limits of the embankment. This material shall be disposed of in a method approved by the Engineer.

Embankments shall not be constructed upon frozen areas. All snow and ice shall be removed from the area to be covered prior to placement of embankment material.

Earth embankment shall be formed by distributing the material in successive uniform horizontal layers not exceeding 12 inches in thickness, loose depth, to the full width of the cross section. Each layer of the embankment shall be thoroughly compacted as hereinafter specified. The embankment shall be properly drained at all times.

- a. Clearing and Grubbing - The developer shall accomplish all clearing and grubbing within the limits designated on the plans or as directed by the Engineer, or as required for the construction of the work involved and shall satisfactorily dispose of all materials so removed.

The work under this paragraph shall consist of cutting and removing all trees, stumps, brush, logs, removal of fences, or other loose or projecting material within the designated areas. Unless otherwise specified, it shall also include the grubbing of

stumps, roots, and other natural obstructions which, in the opinion of the Engineer, must be removed to properly prosecute the construction work and properly operate the facility upon completion of construction. Disposal shall be by burning or other methods satisfactory to the Engineer. Trees which are designated to remain shall be properly protected.

- b. Excavation - This work shall consist of the removal and satisfactory disposal of all materials taken from between the original ground line and the excavation limits approved by the Engineer as shown on the final cross-sections.

All materials encountered, of whatever nature, within the limits designated shall be removed and disposed of as directed. During the process of excavation, the grade shall be maintained in such condition that it will be well drained at all times. When directed, temporary drains and/or drainage ditches shall be installed at the Developer's expense to intercept or divert surface water which may affect the prosecution or condition of the work. If at any time it is not possible to place excavated material in its final location in the permanent construction, it shall be stockpiled in approved areas for later use.

Where rock, shale, clay, hardpan or other unsatisfactory subgrade material is encountered, it shall be excavated to a depth of at least 12 inches, or to such greater depth as the Engineer may direct. The portion so excavated shall be refilled and compacted as set out herein or as specified by the Engineer.

- c. Embankment Compaction - Place the soil layers to a uniform density not less than 95 percent of maximum density as determined by the Method of ASTM D1557 Modified Proctor.

Should the subgrade lose its density for any reason, it shall be recompacted or replaced as directed by the Engineer. Any area in the subgrade which has yielding or unsuitable material shall be excavated and backfilled with approved material properly compacted as directed by the Engineer.

Breakage and undercutting, including slides in that portion of any material displaced or loosened beyond the limits of the finished work, shall be removed by the developer and disposed of as directed by the Engineer.

3.2.3 GRADING - Consists of the preparation, shaping, and compaction of that portion of the roadbed upon which aggregate or pavement, including shoulders is to be placed.

- a. Subgrade Preparation - Shape subgrade to the lines, grades and typical sections shown on the plans. Where the Engineer directs that areas of the subgrade are to be stabilized, the subgrade surface in such areas shall be left uniformly below grade to provide for the addition of stabilizer aggregate. Geotextile, filter fabric, or similar products may also be installed if shown on the plans or required by the Engineer.

Material excavated in preparing the subgrade shall be stored or stockpiled in such manner as to not interfere with proper drainage or any of the subsequent operations of placing base or pavement.

Compaction of subgrade shall be accomplished as set out in the section on "Embankments". The developer shall dry or add moisture to the subgrade to achieve a uniformly compacted and acceptable subgrade and to achieve the specified compaction at or near optimum moisture content as determined by ASTM D 1557 Modified Proctor.

A tolerance of plus or minus 3/4 inch from the established grade will be permitted in the graded, compacted subgrade. No base or pavement construction shall begin on subgrade which has not been inspected and approved by the Engineer.

- b. Subgrade Drainage – Perforated pipe underdrains shall be required when subgrade conditions warrant, at the discretion of the Engineer. Perforated pipe shall conform to the requirements of Section 704 of the KYTC Standard Specifications. Pipe bedding and backfill shall consist of No. 78, 8 or 9M Coarse aggregate. Perforated pipe shall be a minimum of four inches (4") diameter. Minimum trench width shall be eighteen inches (18"). Provide outlet headwalls or connections to drainage structures conforming to KYTC requirements. See Exhibit 3.2.

When backfilling, place geotextile fabric in the trench and shape to the sides and bottom of the trench without stretching the fabric. Ensure that the geotextile fabric does not pull down into the trench when placing the backfill material. Do not damage the geotextile fabric when placing the filter aggregate. Fold the fabric over the backfilled trench and secure it with steel pins at intervals of 5 feet to produce a double thickness of fabric over the top of the trench.

- c. Stabilized Shoulder – Where stabilized shoulder is required (rural-type typical sections without curb and gutter) it shall consist of crushed stone or dense graded aggregate courses equal in depth to the total depth of the adjacent pavement section. Design details shall be as specified by the Engineer, and shall consider traffic and zoning classification of the area.

3.3 BASE COURSE FOR ASPHALT AND CEMENT CONCRETE SURFACES - Base course shall be of Dense Graded Aggregate (DGA) as per the KYTC Standard Specifications, and shall be a minimum of six (6) inches thick after compaction for asphalt pavements. Additional DGA thickness may be required as shown on approved plans.

Number 610 crushed stone or crushed (recycled) concrete may be used in lieu of DGA where permitted by the Engineer. Crushed concrete used as base shall meet grading requirements set by the Engineer, and shall be reasonably free from metal and other deleterious material.

The DGA shall be placed on the prepared subgrade, shaped and compacted to the lines, grades and cross sections shown on the plans or approved by the engineer. It shall have no more than plus or minus 1/2 inch deviation from the typical section after compaction. The base material

shall be placed in a manner that produces uniform grades and cross sections satisfactory to the Engineer.

The DGA base shall be compacted to a density of not less than 90% of solid volume throughout the layer. The density determination will be based on the oven-dry bulk specific gravity, ASTM C-127 and the dry weight of the aggregate from the test hole. The in-place density will be determined by the Method of Test for Density of Soil in place by the Rubber-Balloon Method, ASTM D-2167.

- 3.4 ASPHALT BASE AND SURFACE COURSE - All asphalt shall be hot-mixed and hot-laid on a prepared subgrade, old surface or underlying course. The pavement on new construction of streets classified as Local Streets shall consist of not less than:

Three (3) inches of KYTC Class 2 Asphalt Base, 1.00D PG64-22; and
One and one half (1-1/2) inches of KYTC Class 2 Asphalt Surface, 0.38D PG64-22.

For streets in all other classifications (Collector, Minor Arterial, Principal Arterial), pavement type and thickness shall be designed by an Engineer licensed to practice in the Commonwealth of Kentucky, and shall be submitted to the Engineer for approval. The Engineer may require pavement design calculations for a Local Street when zoning, land use, traffic, soil type or other considerations warrant a special design. When existing pavement is widened, the Engineer may require matching existing materials and thicknesses of courses.

- 3.4.1 SPREADING AND FINISHING - All asphalt shall be laid using self-propelled pavers which are capable of spreading and screeding all courses to the indicated widths and depths, true to line, grade and cross section as shown on the plans or directed by the Engineer, with a smooth finish uniform in density and texture. The screed shall be preheated uniformly throughout its length. The paver shall be equipped with hopper and distributing screws of the reversing type that will place the material evenly in front of the screed. Mechanical or electronic devices shall be provided to confine the edge to true line and to adjust the gradeline so that minor changes in subgrade elevation will not be reflected in the finished surface.

A string line shall be used for the first lane of each layer of mixture placed to provide alignment control for the paver, except that a string line will not be required when the first layer is placed adjacent to a curb section.

Pavers shall be equipped with quick and efficient steering mechanism and shall operate at variable speeds consistent with proper placement of materials, but shall not exceed a speed of 50 feet per minute. When placing adjacent lanes of the same course, pavers shall be equipped with a joint matching device which will automatically provide control of the depth of the mixture being placed so that, when compacted, it will match the depth of the existing lane. All paving machines shall be kept in first class mechanical condition.

All asphalt shall be placed at a temperature of not less than 225 degrees F and not more than 300 degrees F. After screeding and before rolling, the surface of each course shall be

checked for irregularities and corrected as necessary. In areas where machine paving is impractical, hand spreading is allowed. The material shall be uniformly distributed, without segregation, to the depth necessary to provide the required compacted depth. Rakes may be used, but the final leveling and surface adjustment shall be done with mechanical or manually operated screeds or lutes.

Where new asphalt pavement abuts old, an edge key or other milling may be required by the Engineer to insure a smooth transition between surfaces.

- 3.4.2 COMPACTION - Roll each course as soon as the mixture has cooled sufficiently to bear the weight of the roller without undue displacement. Each paving operation shall have a minimum of the following rollers:

For initial or breakdown rolling on asphalt base course, one tandem steel-wheeled roller weighing not less than ten (10) tons and having a compressive capability at the rear wheels of at least 325 pounds per lineal inch of wheel width.

Provide intermediate rolling of at least 3 complete coverages with a tandem roller weighing at least ten (10) tons. Pneumatic tired rollers may be used when approved by the Engineer.

These rollers shall be in good condition, capable of reversing without backlash. The steel-wheel rollers shall be equipped with wetting devices to prevent the mixture from sticking to the roller wheels.

Perform final rolling of the uppermost layer or surface course with a tandem roller. Operate the roller, at all times, parallel to the centerline. Begin rolling at the sides and progress to the center on crowned surfaces. Begin rolling at the low side and progress to the high side on superelevated sections. Operate the rollers parallel to the centerline, and lap successive trips of each roller uniformly to the previous trip. End alternate trips of the rollers on transverse lines at least 3 feet apart. Regulate starting and stopping of the rollers to avoid distorting the surface.

In areas inaccessible to equipment, the mixture shall be thoroughly compacted by the use of hand tampers or hand operated mechanical tampers.

- 3.4.3 SURFACE TOLERANCE - Final surface shall show no deviation greater than 1/4 inch from a ten (10) foot straight edge placed parallel to the centerline of the street, nor more than 1/4 inch from the typical cross-section.
- 3.4.4 MINIMUM CONSTRUCTION LENGTH - Minimum construction length of street which will be approved to receive asphalt paving shall be 500 feet or the distance between street intersections unless otherwise approved by the Engineer.

Except for streets stubbed out to adjacent property, the subgrade shall be prepared to elevations as shown on the plans for a minimum of 25 feet beyond the end of the base aggregate.

The asphalt base shall be placed no closer than 10 feet from the end of an aggregate base and the asphalt surface no closer than 5 feet from the end of the asphalt base.

- 3.4.5 JOINTS - When the laying of the mixture is to be suspended long enough to permit the mixture to become cool, cut back a distance of one foot (1') or to full-depth asphalt, whichever is greater, to allow correct tie-in to the cold joint. Such joints shall be vertical and in a straight line perpendicular to the course.

At the end of the day construct a sloped wedge ahead of the end of the full depth pavement to provide for proper compaction and protection of the full depth pavement.

When multi-lane, multi-layer construction is required, the width of paving spreads shall be adjusted so as to provide for off-setting of longitudinal joints in the base and surface courses.

- 3.4.6 WEATHER AND SEASONAL LIMITATIONS - No asphalt shall be laid when the air temperature is below 40 degrees F, nor when the underlying course is wet, nor when other weather conditions are unsuitable.

No hot-mix asphalt shall be laid between December 1 and April 1, without prior written approval by the Engineer.

- 3.5 PORTLAND CEMENT CONCRETE PAVEMENT - Shall consist of a single course, having a minimum depth of at least six (6) inches for streets classified as Local Streets, and shall be constructed on a prepared base in close conformity with the lines, grades and cross-sections shown on the plans, in accordance with the specifications contained herein.

DGA base shall not be required under cement concrete pavement unless warranted by subgrade conditions as deemed necessary by the Engineer. Number 610 crushed stone or crushed (recycled) concrete may be used in lieu of DGA where permitted by the Engineer. Crushed concrete used as base shall meet grading requirements set by the Engineer.

The pavement shall include longitudinal and transverse joints as shown on the plans in accordance with the specifications contained herein. The concrete pavement shall be at least six inches (6") thick and shall consist of Type "P" 4000 psi, air entrained concrete in accordance with the KYTC Standard Specifications.

For streets in all other classifications (Collector, Minor Arterial, Principal Arterial), pavement type and thickness shall be designed by an Engineer licensed to practice in the Commonwealth of Kentucky, and shall be submitted to the Engineer for approval. The Engineer may require pavement design calculations for a Local Street when zoning, land use, traffic, soil type or other

considerations warrant a special design. When existing pavement is widened, the Engineer may require matching existing materials and thicknesses of courses.

Perforated pipe underdrains shall be installed parallel to the centerline of the street as shown on the plans in accordance with these specifications.

3.5.1 PREPARATION AND CONTROL OF CONCRETE MIXES - Shall be made in accordance with the following specifications and shall meet the approval of the Engineer.

- a. Batching may be performed at a batch plant, central mix plant, or in truck mixers as approved by the Engineer. All such plants or mixers shall have bins, weighing hoppers, and scales which meet the approval of the Engineer.
- b. Proportioning - The Engineer shall approve the proportions for the aggregates and water to obtain a satisfactory mix with the required cement content, and no subsequent changes will be permitted except as directed by the Engineer. The concrete mix shall be designed to a six (6) bag mix of cement for each cubic yard produced.

The quantity of fine aggregate shall not be less than 35% nor more than 38% of the total combined solid volumes of the fine and coarse aggregate in a saturated surface dry condition, used in the proportions per bag of cement. The aggregates shall be proportioned to use the maximum percentage of coarse aggregate and the minimum percentage of fine aggregate which will produce a plastic workable mix. When the aggregates are drier than a saturated-surface-dry condition, or when the aggregates contain free moisture, proper adjustments shall be made for aggregate batch weights to compensate for any such conditions.

The maximum free water content in the mix, including the surface moisture in the aggregates, shall not exceed 5.75 gallons per bag of cement.

- c. Consistency of Concrete - The mixture shall contain no more water than is necessary to produce a workable plastic concrete. The consistency of the concrete shall be continuously uniform and shall be measured in accordance with the "Slump Test" ASTM C-143.

The slump shall not be less than 1-1/2 inches nor more than 2 inches for concrete to be placed without vibration. The slump shall not be more than 1-1/2 inches when the concrete is to be vibrated during placement.

- d. Air Entrainment - Unless otherwise specified, the required air content of the concrete shall be 6, plus or minus 2, percent by volume. The entrainment of air shall be accomplished by approved methods.
- e. Strength of Concrete - The minimum strength of concrete pavements at 28 days shall be 4,000 pounds per square inch compressive strength and 500 pounds per

square inch modulus of rupture when tested in accordance with methods ASTM C-39 and ASTM C-78, respectively. The Engineer may direct the removal and replacement of sections of the pavement from which the concrete specimens consistently test at low strength. Obtain sample of fresh concrete in accordance with ASTM C-172. Test cylinders for all classes of concrete shall be taken in sets of two, six inch diameter by twelve inch height (6" x 12") cylinders from a composite sample of concrete placed. Cylinders are tested and the average is treated as a single test. Developer shall pay the costs of all applicable testing.

f. Hauling Equipment - The concrete shall be transported in truck mixers approved by the Engineer.

g. Weather Limitations – Conform to limitations on maximum and minimum mixture and ambient temperatures as per the KYTC Standard Specifications.

3.5.2 SUBGRADE AND BASE PREPARATION - Subgrade for Portland cement concrete pavement shall be constructed in accordance with the requirements of Section 3.2.3 (a) using an approved machine to produce final subgrade and base surfaces meeting the lines, grades and cross-sections required by the plans.

The surface of the base shall be damp at the time the concrete is placed. The developer shall satisfactorily correct all soft areas in the subgrade or base prior to placing concrete.

Proper protection measures should be taken to prevent disturbance to the subgrade due to hauling over subgrade.

Subgrade underdrains conforming to the requirements of Section 3.2.3 above may be required as directed by the Engineer.

3.5.3 FORMING - Forms shall be of such section and design that they will adequately support the concrete and the construction equipment.

All forms shall be inspected and approved by the Engineer or his authorized representative, prior to placement of concrete. Forms shall be straight, free from warp, smooth faced, and of sufficient strength to support the concrete during construction.

The top face of the form shall not vary from a true plane more than 1/8 inch in ten feet. All forms shall be thoroughly oiled before any concrete is placed. Forms shall be set a sufficient distance in advance of the point where the concrete is being placed to provide for a continuous operation in placing the concrete and for proper inspection of line and grade.

Forms shall not be removed from freshly placed concrete until it has hardened sufficiently to resist spalling, cracking or any other damage, but in no case until at least 12 hours after the concrete has been placed. Any honey-combed areas along the sides or edges of the

slab shall be repaired by filling with mortar immediately after the forms have been removed. The mortar shall consist of one part cement and two parts fine aggregate.

- 3.5.4 CONCRETE PLACEMENT - Concrete shall be handled in such a manner as to prevent segregation and kept free from mud, soil or any other foreign matter.

Paving operations shall not be undertaken or shall be discontinued when any of the following conditions exist:

- a. When a descending air temperature in the shade and away from artificial heat reaches 40 degrees F.
- b. When the subgrade or base course is frozen.
- c. When aggregates to be used in the mix contain frozen particles.

The mixer and hauling equipment shall not be operated on any new pavement until at least 10 curing days have elapsed. When the mixer is operated on new pavement, the developer shall utilize wood matting or other approved material which will prevent the marking of the pavement and will distribute the load uniformly over the area.

- 3.5.5 SPECIAL DESIGN - Special designs may be required by the Engineer if subsoil condition is not adequate for heavily traveled and industrial roads.

- 3.5.6 SPREADING AND VIBRATING CONCRETE - The concrete shall be spread over the entire area between the forms without segregation. Spreading shall be done with appropriate spreading equipment. After the concrete has been placed, it shall be uniformly vibrated. This vibrating shall be accomplished by approved methods.

- 3.5.7 CONCRETE FINISHING - Finish concrete with approved equipment. Hand finishing will be permitted when the use of mechanical finishing equipment is impractical. The concrete shall be screeded and float finished to the required cross-section and then shall be checked by the use of hand-held, 10 foot straightedges for longitudinal surface uniformity. The final finishing of the pavement shall be accomplished by burlap dragging, brooming or other acceptable methods which produce a similar surface texture. Finish the outside edges and edges of expansion joints with an edging tool having a radius of 1/8 inch.

- 3.5.8 JOINTS - Shall be constructed according to the plans. Joint details shall follow the requirements of the KYTC Standard Specifications and Standard Drawings, with the exception that deformed tie bars shall be required only on transverse joints on collector and arterial streets.

- a. Transverse Contraction Joints - Shall be formed by an approved joint tool or by sawing with an approved concrete saw.

Where transverse contraction joints are to be sawed, approved joint filler shall be placed at intervals to control random cracking. Sawing shall be done as soon as the

concrete has hardened sufficiently to be sawed without spalling and raveling, usually 6 to 24 hours after placing and before shrinkage cracking occurs.

Transverse contraction joints shall be constructed at 20 foot intervals unless otherwise shown on the plans. Where the pavement is constructed adjacent to an existing concrete pavement, joints shall be placed to match the existing joints.

- b. Longitudinal Contraction Joints - Shall be constructed in all pavements wider than 20 feet in accordance with the details and dimensions shown on the plans, and shall be formed by an approved joint insert or by an approved concrete saw.

When a joint insert is used, the alignment of the finished joint shall be parallel with the center line of the pavement and shall be free from local irregularities in alignment.

Where longitudinal contraction joints are sawed, sawing shall be done as soon as the concrete has hardened sufficiently to be sawed without spalling and raveling, but not more than two (2) days after the concrete is placed.

- c. Transverse Construction Joints - Shall be constructed at the end of each day's operation (planned joint) or whenever the placing of concrete is suspended for more than 30 minutes (emergency joint). The joints shall be formed by placing an approved header shaped to fit the pavement typical section which forms a vertical face on the end of the pavement, and perpendicular to the pavement section.

Reinforcing steel tie bars shall be required at transverse construction joints on collector streets and arterials, and shall be epoxy coated. The header shall be designed to permit the placement of tie or dowel bars, where required, and shall hold such bars in their correct locations, in accordance with the joint detail drawings contained in the approved plans.

Planned transverse construction joints shall be located at the same spacing required for transverse contraction joints.

The spacing of contraction joints shall not be changed due to emergency construction joints and the emergency construction joint shall not be located within three (3) feet of a contraction joint.

- d. Longitudinal Construction Joints - Where necessary, shall be constructed in accordance with the joint detail drawings contained in the approved plans.
- e. Transverse Expansion Joints - Shall be constructed in accordance with the joint detail drawings contained in the approved plans.
- f. Sealing of Joints - The concrete shall be at least three (3) days old before the joint is sealed. Joints shall be sealed as soon after this three day period as possible, and

before any traffic is allowed on the pavement. The joint shall be thoroughly cleaned and dry before sealing.

When the joints have dried, they shall be filled to within approximately 1/8 inch of the surface of the pavement with joint sealer. Care shall be taken in handling the nozzle of the application equipment so that the joint will be filled from the bottom up. Any sealer spilled on the surface of the concrete shall be removed immediately.

A pre-molded insert may be used to seal joints where shown on the plans.

- 3.5.9 CURING CONCRETE - Immediately after finishing operations have been completed and surface water has disappeared, all exposed surfaces of the pavement shall be cured by one of the following methods.

The total curing period shall be a minimum of three (3) days for all methods.

- a. Liquid Membrane Curing Compounds - The minimum rate of application shall be one (1) gallon per 200 square feet when the application equipment is mechanically operated or one (1) gallon per 150 square feet when the application equipment is hand operated.
- b. Polyethylene Film - The sections of the film shall be spread in such a manner which will prevent damage to the finished pavement surface. Lap joints of the sections will be at least 12 inches wide and suitable precaution shall be taken to prevent the circulation of air beneath the film.
- c. Burlap - The sections of the burlap shall be spread in such a manner which will prevent damage to the finished pavement surface. Lap joints will be at least 6 inches wide.

The burlap shall be thoroughly saturated prior to placing on the concrete and shall be kept thoroughly wet throughout the curing period.

- 3.5.10 PROTECTION FROM COLD WEATHER AND RAIN - Concrete less than 72 hours old, which may be subject to damage by freezing, shall be adequately protected by insulation or heating until the concrete reaches an age of 72 hours. Concrete damaged as a result of freezing shall be removed and replaced at the expense of the developer.

Protective coverings which will protect the surface of freshly placed pavement from rain shall be readily available at the site of the work. An adequate quantity of other materials shall be stored at the paving train. Concrete damaged as a result of failure on the part of the developer to adequately protect the concrete from rain shall be repaired or removed and replaced at the expense of the developer.

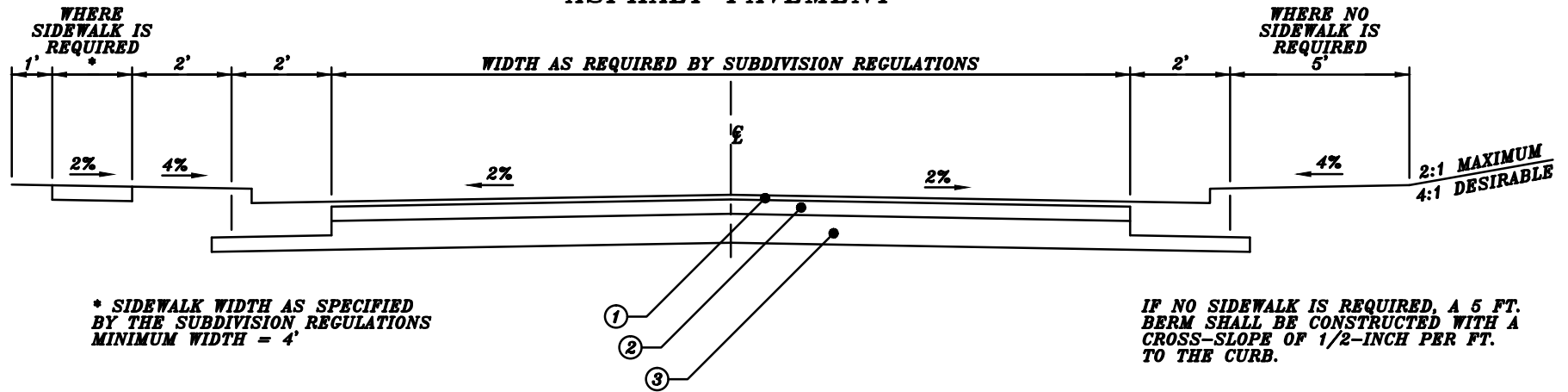
- 3.5.11 FINAL SURFACE TESTING - As soon as the concrete has set sufficiently to permit walking on it without marring the surface, it shall be tested by the contractor in the presence of the

Engineer along the center point and the quarter points of the pavement with a rolling straightedge furnished by the contractor.

The rolling straightedge (profilograph) shall be 10 feet in length between the centers of the wheels. It shall be so designed, constructed and adjusted so that it will adequately indicate and mark all pavement areas which deviate from a plan surface by more than 1/4 inch in 10 feet. The rolling straightedge shall be of a design approved by the engineer.

All deviations more than 1/4 inch in 10 feet marked by the straightedge shall be corrected to within this tolerance by being rubbed or ground down and refinished, or shall be replaced if directed by the Engineer.

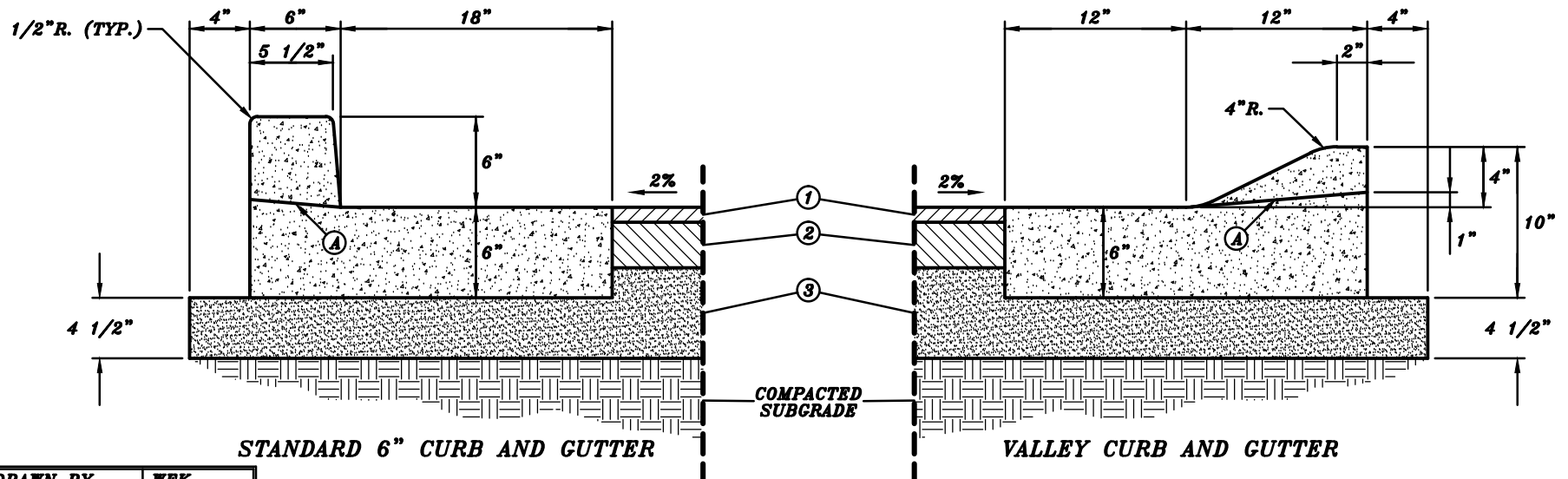
ASPHALT PAVEMENT



TYPICAL SECTION

- ① 1 1/2" COMPACTED DEPTH KYTC CLASS 2 ASPHALT SURFACE, 0.38D PG 64-22
- ② 3" COMPACTED DEPTH KYTC CLASS 2 ASPHALT BASE, 1.00D PG 64-22
- ③ 6" COMPACTED DEPTH DENSE GRADED AGGREGATE BASE

Ⓐ LINE FOR CURB AT DRIVEWAY



DRAWN BY	WFK
APPROVED BY	TDW
ORIGINATION	11/14/13
REVISION	05/05/15

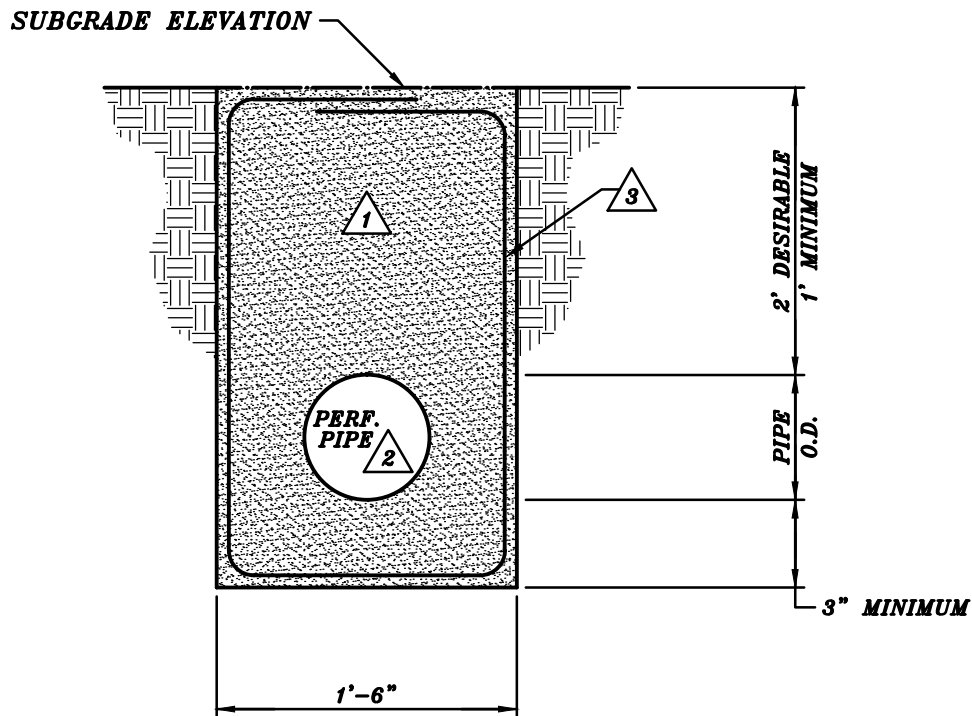
SUBGRADE DRAINAGE

PERFORATED PIPE UNDERDRAINS

NOTES

SUBGRADE DRAINAGE SHALL BE REQUIRED WITH PORTLAND CEMENT CONCRETE AND BITUMINOUS CONCRETE PAVEMENT WHEN:

- A. SUBGRADE CONDITIONS WARRANT.
- B. DIRECTED BY ENGINEER.



- 1 PIPE BEDDING AND BACKFILL SHALL CONSIST OF NO. 78, 8 OR 9M COARSE AGGREGATE. WHEN AN UNDERDRAIN IS PLACED WITHIN THE LIMITS OF STREET CONSTRUCTION, BACKFILL MATERIAL SHALL BE PLACED AND COMPACTED IN LAYERS NOT TO EXCEED SIX (6) INCHES.
- 2 PERFORATED PIPE SHALL HAVE A MINIMUM INSIDE DIAMETER OF FOUR (4) INCHES. MATERIALS AND CONSTRUCTION REQUIREMENTS SHALL MEET THE REQUIREMENTS OF SECTION 704 OF THE KTC STANDARD SPECIFICATIONS, UNLESS OTHERWISE DIRECTED BY THE ENGINEER. WHEN AN UNDERDRAIN IS PLACED WITHIN THE LIMITS OF STREET CONSTRUCTION, THE PIPE MUST BE PROTECTED FROM EXCESSIVE LOADS BY ENCASEMENT OR OTHER MEANS APPROVED BY THE ENGINEER.
- 3 WRAP ENTIRE TRENCH IN GEOTEXTILE FABRIC MEETING THE REQUIREMENTS OF SECTION 843 OF THE KTC STANDARD SPECIFICATIONS FOR MATERIALS.

DRAWN BY	WFK
APPROVED BY	TDW
ORIGINATION	11/14/13
REVISION	-

SECTION FOUR: SIDEWALKS, CURB AND GUTTER

- 4.0 PURPOSE - The purpose of this chapter is to outline requirements for proper design, construction, and inspection of concrete sidewalks, curb and gutter.
- 4.1 SIDEWALKS, CURB AND GUTTER - Shall be in accordance with the following specifications and subject to approval by the Engineer.
- 4.2 CONCRETE SIDEWALKS - Shall be constructed of Portland Cement Concrete in accordance with the requirements shown on the plans and the provisions of this specification.
- 4.2.1 Material - Concrete shall have a minimum 28 day compressive strength of 3500 psi. Air-entraining admixture shall be used. No reinforcing steel or wire mesh shall be installed in sidewalks, curbs, or curb and gutter unless directed by the Engineer.

Expansion joint material shall conform to the requirements of KYTC Standard Specifications current edition.

- 4.2.2 Construction Methods - Sidewalk shall be constructed on a prepared, compacted smooth subgrade of uniform density formed by trenching or filling, to the required elevation. Large boulders and ledge rock found in the subgrade shall be removed to a minimum depth of 6 inches below the finished subgrade elevation and the space shall be backfilled with suitable material which shall then be thoroughly compacted.

The forms shall be of either metal or wood and shall be straight, free from warp, smooth-faced, of sufficient strength to support the work during construction, and of a height equal to the depth to the sidewalk or sidewalk apron to be constructed. Wood forms shall have a minimum nominal thickness of 1-1/2 inches. Metal forms shall be of adequate type and shall have a flat top surface. The forms shall be cleaned, well oiled, securely staked, braced, and held to the required line and grade before any concrete is deposited. Sidewalk shall slope 1/4 inch per foot toward the roadway, unless conditions warrant otherwise.

The concrete shall be deposited between the forms on moistened subgrade, shall be struck off to a minimum 4 inch thickness, and shall be worked sufficiently to bring the mortar to the surface. At driveway crossings, sidewalk thickness shall be increased to either nine inches (9") of concrete, or six inches (6") of concrete on six inches (6") of compacted DGA. The surface shall then be made smooth and even by proper means and given a broom finish. All edges shall be rounded with an edging tool to 1/4 inch radius. The surface shall be divided into rectangular panels by means of a jointer having a radius of 1/4 inch and forming a groove not less than 1 inch in depth for the full width of the walk. The length of the panels formed shall not exceed the width of the sidewalk being constructed, unless otherwise specified by the Engineer.

Joints may be sawed at the discretion of the Engineer. Ensure that sawed joints are of uniform width throughout. Use sawing equipment to cut the joint in strict conformity with

the required alignment and depth. Do not saw the joints until the concrete has hardened to the extent that tearing and raveling will not occur, but as soon as necessary to preclude random cracking.

When the sidewalk is constructed integral with the curb, ensure that the width and spacing of the joints conform to that in the curb. Round the edges of the sidewalk at all expansion joints with an approved edging tool to a 1/4 inch radius. Install 1/2-inch premolded expansion joint material to the full depth of the sidewalk where the sidewalk abuts any rigid structure or fixture, such as curbs, columns, castings, buildings, and light standards.

When sidewalks cross a driveway, delineate the extent of the sidewalk by jointing as directed by the Engineer.

The developer shall install 1/2 inch premolded full-depth expansion material at intervals not to exceed 40 feet, and where the sidewalk abuts any rigid structure or fixtures such as curbs, columns, castings, buildings, light standards, existing sidewalks or pavements, etc.

Flexible, non-extruding, expansion-contraction joint filler material approved by the Engineer shall be used on all expansion joints. If any type of closed-cell material is used, an elastomeric sealing compound shall be applied to the top surface to seal the joint. Sealing compounds shall be applied in accordance with manufacturer's recommendations, and shall be approved by the Engineer. Zip-strips or other preformed expansion joint materials may only be used with approval of the Engineer.

Sidewalk and aprons shall be cured in the same manner as specified for concrete pavement.

After the concrete has set sufficiently, the developer shall remove the forms and shall backfill the space on each side of the walk. The earth shall be compacted and graded in a satisfactory manner.

- 4.3 CURB AND GUTTER - All curb and gutter shall be Portland cement concrete. Concrete shall have a minimum 28 day compressive strength of 4,000 psi. Air-entraining admixture shall be used.

- 4.3.1 Subgrade - Subgrade for curb and gutter shall be at least four inches (4") of compacted DGA.

When curb and gutter is constructed prior to establishment of the street subgrade, the curb and gutter subgrade may be compacted by approved methods. The width of the subgrade shall be not less than the width of the curb and gutter plus six (6) inches on each side. No curb and gutter concrete shall be placed until the subgrade has been inspected.

- 4.3.2 Construction - All curbs shall be placed by a continuous pouring (extruding) curb machine with an approved mold and jointed on ten foot (10') centers. Joints shall meet the requirements of Section 4.2.2 above, and may be sawed at the discretion of the Engineer.

Where radii, tie-ins or other conditions make extruded curb impractical, curbs may be constructed using forms and methods approved by the Engineer, and shall be finished in a manner that matches adjacent extruded curb.

When indicated on the plans or directed by the Engineer, entrance and drainage openings of the required dimensions shall be formed through the curbing at the designated location. The back of curb and gutter may be depressed as approved by the Engineer to provide vehicle entrance and exit to private property.

Forms shall be removed in not less than 6 hours nor more than 24 hours after the concrete has been placed.

- 4.3.3 Concrete Placement - Moisten prepared subgrade before the concrete is placed. Immediately after placement by machine, the concrete shall be floated to a smooth and consistent surface and lightly broomed.

Reinforcing steel is not normally allowed, but when required by the Engineer, it shall be placed in accordance with the details shown on the plans.

Expansion joints shall not be used except at catch basins or inlets, or as deemed necessary by the Engineer.

- 4.3.4 Concrete Finishing - The top surfaces of the curbs and gutters shall be given a uniform float finish and the edges shall be rounded with an edging tool having a radius of 1/4 inch. All honeycombed areas shall be corrected by filling with mortar, composed of 1/2 mixture by volume of cement and sand. Plastering will not be permitted. The top and face of all curbing shall be finished while the concrete is still green by wetting and rubbing. The face of header curbs shall be finished to the ground line. The concrete shall be finished to a smooth surface, presenting a uniform texture and color and be given a final broom finish. Concrete surfaces within the right of way shall not be stained, stamped or receive other than a broom finish.

- 4.3.5 Protection and Curing - Concrete shall be cured for a period of not less than 7 days after pouring. The method used to provide curing shall be approved by the Engineer. Membrane curing, plastic sheet curing, and wetted burlap curing will be considered satisfactory.

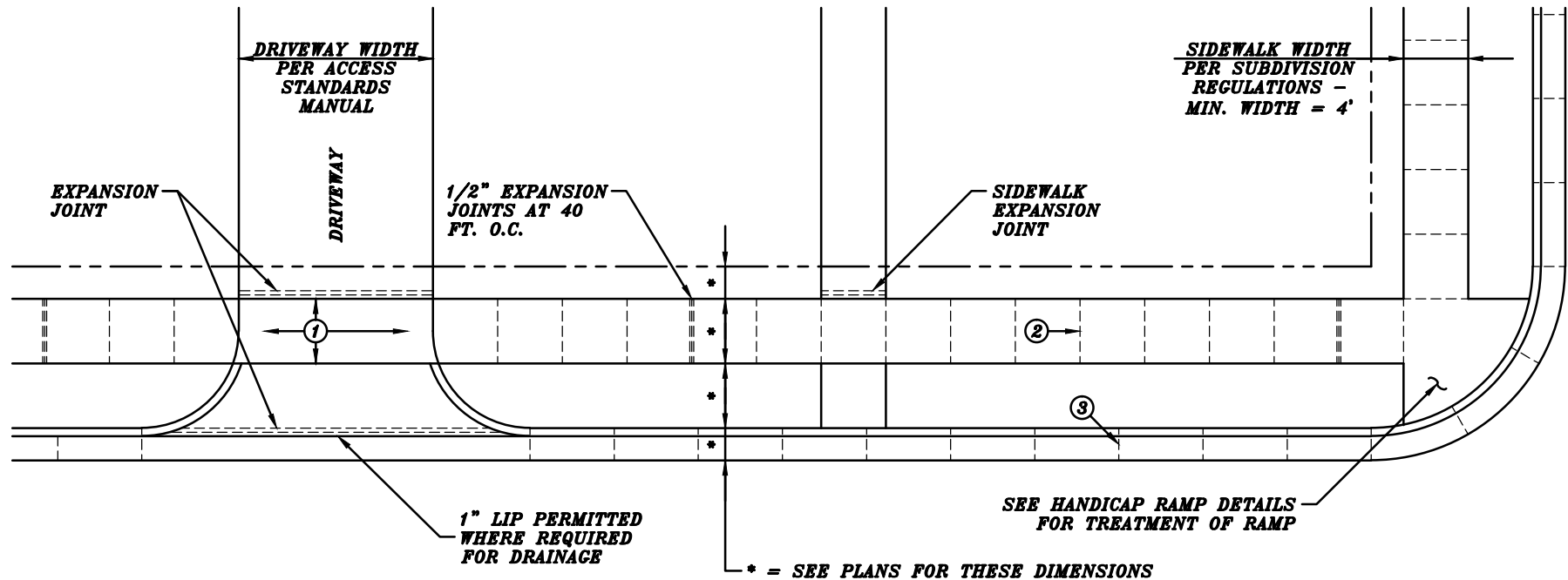
If at any time during the seven (7) day curing period, the air temperature is 40 degrees F. or less, concrete shall be insulated and/or heated as directed by the Engineer to aid curing and to prevent freezing. Protective covering which will protect the surface of freshly placed concrete from rain shall be readily available at the site of the work. Concrete damaged as a result of failure on the part of the developer to adequately protect the concrete from rain or freezing shall be removed and replaced at the expense of the developer.

- 4.4 RAMPS FOR THE HANDICAPPED - Ramps for handicapped shall be included in curb and gutter and sidewalk construction as provided by KRS 66.660. All new curbs and all existing curbs which are a part of any reconstruction, within any block which is contiguous to any highway and in which fifty per cent (50%) of the territory is devoted to or zoned for business, commercial, or industrial use, shall be so constructed to enable persons using wheelchairs to travel freely and without assistance. At each cross-walk a ramp with nonslip surface shall be built into the curb so that the sidewalk and street blend to a common level. Such a ramp shall not be less than 48 inches wide. In all ramps there shall be a gradual rounding at the bottom of the slope.

Maximum ramp slope in new construction shall be 1:12, except that in areas where ramps are retrofitted into existing sidewalks, grades of 1:8 for no more than two feet or 1:10 for no more than five feet are permissible. Ramps should provide a minimum four foot square landing area (no more than five percent grade or cross slope) at street level and at other locations as required by ADA Standards. Provide truncated domes or other devices or surface finishes in accordance with ADA Standards.

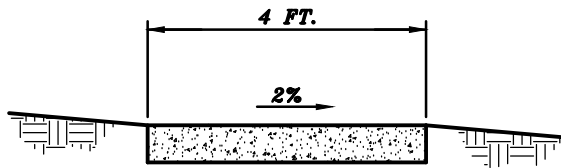
See Exhibits 4.2 and 4.3 for construction guidelines and details.

TYPICAL CONSTRUCTION LAYOUT OF CURB, GUTTER, SIDEWALK AND DRIVEWAY



NOTE: EXPANSION JOINTS SHALL INCLUDE 1/2 INCH PRE-MOLDED EXPANSION JOINT MATERIAL.

- ① SIDEWALK THICKNESS INCREASED AT DRIVEWAYS. SEE PUBLIC IMPROVEMENT SPECIFICATIONS
- ② SAWED OR TOOLED JOINT • SPACING NOT TO EXCEED SIDEWALK WIDTH.
- ③ SAWED OR TOOLED JOINTS • MAXIMUM SPACING OF 10 FEET.



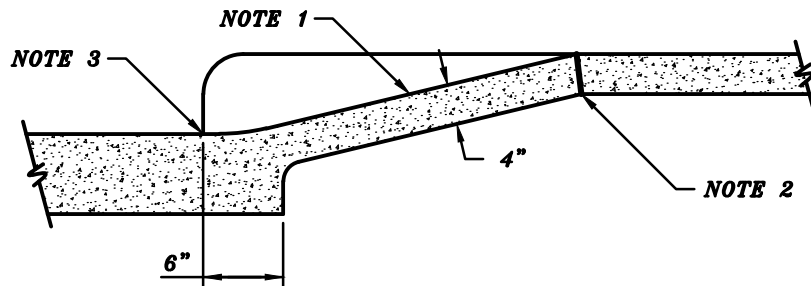
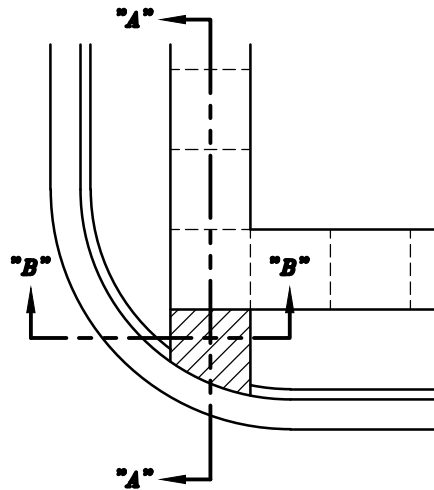
MINIMUM SIDEWALK WIDTH = 4 FT. - SEE SUBDIVISION REGULATIONS FOR WIDTH REQUIRED

SIDEWALK THICKNESS = 4 IN. EXCEPT AT DRIVEWAY

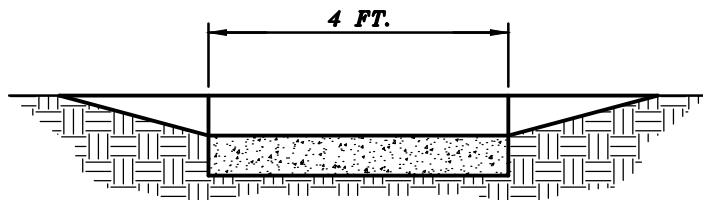
DRAWN BY	WFK
APPROVED BY	TDW
ORIGINATION	11/14/13
REVISION	05/05/15

EXHIBIT 4-1

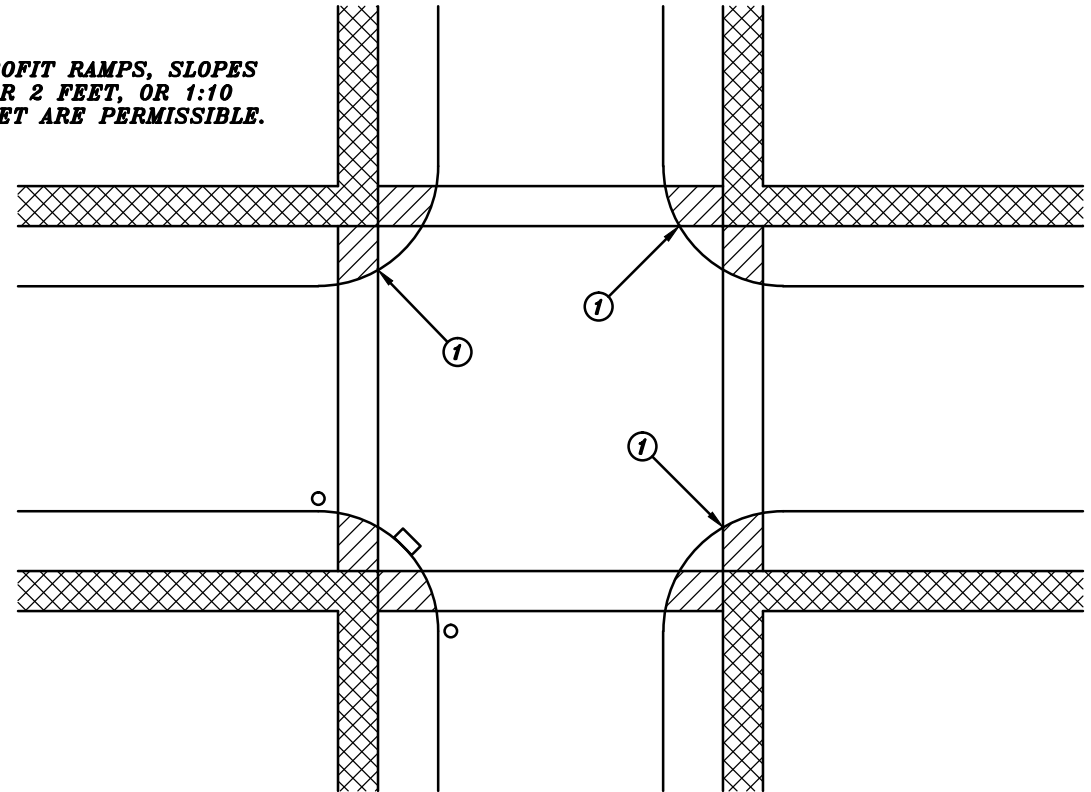
NOTE:
FOR RETROFIT RAMPS, SLOPES
OF 1:8 FOR 2 FEET, OR 1:10
FOR 5 FEET ARE PERMISSIBLE.




SECTION "A-A"



SECTION "B-B"



① **RAMP TYPE 1**

 **SIDEWALK**

 **SIDEWALK RAMPS**

○ **PREFERRED LOCATION
OF DRAINAGE INLET**

□ **ALTERNATE LOCATION
OF DRAINAGE INLET**

— **CROSSWALK MARKINGS**

NOTES:

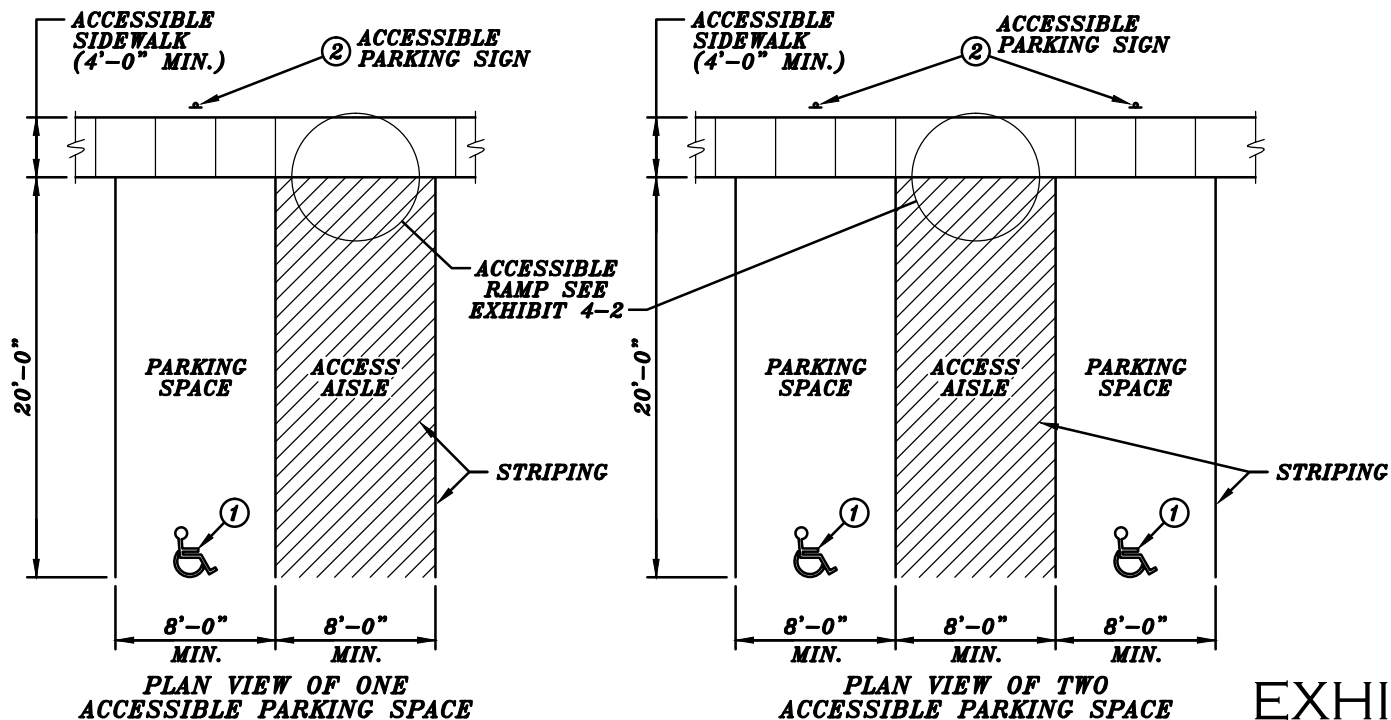
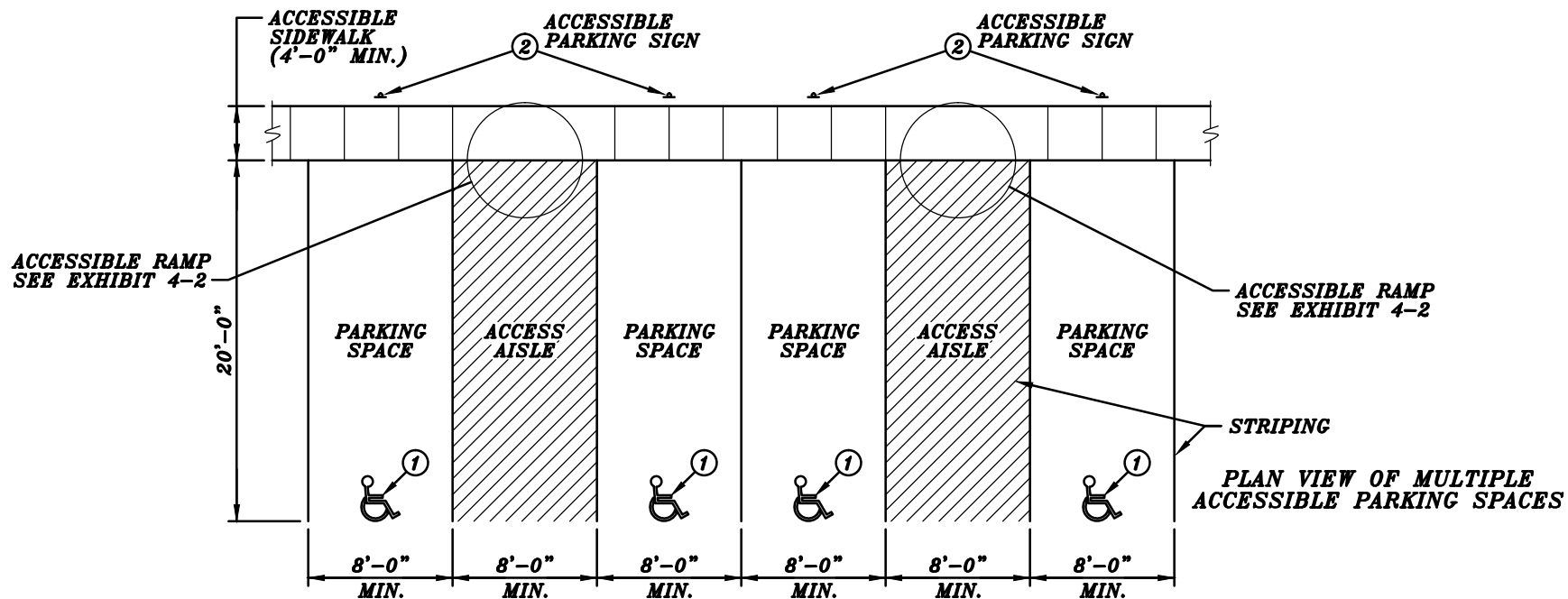
1. MAXIMUM RAMP SLOPE SHALL BE CONSTRUCTED TO ADA STANDARDS.
2. 1/2" EXPANSION JOINT AT BACK OF CURB LINE AND AT SIDEWALK.
3. NO BUMP PERMITTED.
4. THE RAMP SHALL BE CONSTRUCTED OF CLASS "A" CONCRETE. A BROOM FINISH OR EQUAL NON-SKID FINISH IS REQUIRED.
5. THE NORMAL GUTTER LINE SHALL BE MAINTAINED THROUGH THE AREA OF THE RAMP.
6. PROVIDE ADA COMPLIANT DOMES WHERE REQUIRED.

DRAWN BY	WFK
APPROVED BY	TDW
ORIGINATION	11/14/13
REVISION	-

HANDICAP SIDEWALK RAMPS DETAIL

EXHIBIT 4-2

ACCESSIBLE PARKING SPACE DETAILS



NOTES:

- ① INTERNATIONAL SYMBOL OF ACCESSIBILITY
- ② INTERNATIONAL SYMBOL OF ACCESSIBILITY WITH "VAN-ACCESSIBLE" SIGN MOUNTED BELOW

DRAWN BY	WFK
APPROVED BY	TDW
ORIGINATION	11/14/13
REVISION	-

EXHIBIT 4-3

SECTION FIVE: STORM SEWERS

- 5.0 PURPOSE - The purpose of this chapter is to outline the requirements for proper storm sewer pipe sizing, construction and inspection.
- 5.1 DESIGN REQUIREMENTS - Storm water facilities shall be designed in accordance with the procedure of the Henderson Water Utility Technical Stormwater Manual. A complete set of design calculations for the storm drainage facilities shall be provided. As per the Stormwater Manual, depths of flow and velocity for various design flows for the storm sewers, culverts and constructed channels proposed shall be provided in tabular form. Plans shall show the location of all streams, swales and springs within the limits of or adjacent to the proposed work.
- 5.2 PIPE AND JOINTS - Pipe for storm sewers shall be circular reinforced concrete pipe, ductile iron pipe, solid wall PVC pipe, or HDPE corrugated pipe (smooth interior wall), as per the requirements of the applicable Technical Stormwater Manual. Joints and pipe bedding shall conform to manufacturer's recommendations. Where a storm sewer crosses or lies within an arterial roadway, or where there is less than twelve inches (12") cover over the pipe (as measured from the top of the pipe to subgrade elevation of the pavement), reinforced concrete pipe shall be required.
- 5.3 TRENCH EXCAVATION - Unless specifically directed otherwise by the Engineer, not more than 100 feet of trench shall be opened ahead of the pipe laying work of any one crew, and not more than 100 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavation and other obstructions, shall be provided by and at the expense of the developer.

When so required or when directed by the Engineer, only one-half of street and road crossings shall be excavated before placing temporary bridges over the side excavated, for the convenience of the traveling public. All backfilled ditches shall be maintained in such a manner that they will offer no hazard to the passage of traffic. Excavated materials shall be disposed of so as to cause the least disruption to pedestrian and vehicular traffic, and in every case the disposition of materials shall be satisfactory to the Engineer.

Trenches in which pipes are to be laid shall be excavated to the depths shown on the approved plans or as specified by the Engineer. The minimum allowable trench width shall not be less than the outside diameter of the pipe plus eight (8) inches. Where rock is encountered it shall be removed to a minimum depth of four (4) inches below the pipe bells.

Unless specifically authorized by the Engineer, trenches shall in no case be excavated or permitted to become wider than 2 feet 6 inches plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench becomes wider than 2 feet 6 inches at the level of or below the top of the pipe, special precautions may be necessary, such as providing compacted granular fill up to the top of the pipe or providing pipe with additional crushing strength as determined by the Engineer after taking into account the actual trench loads that

may result and the strength of the pipe being used. The developer shall bear the cost of such special precautions as necessary.

Where conditions exist that may be conducive to slides or cave-ins, proper and adequate sheeting, shoring and bracing shall be installed to provide safe working conditions and to prevent damage to work. Adequate and proper shoring of all excavations, and design and fabrication of all sheeting and shoring systems shall be the entire responsibility of the Developer.

Trenches shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled. Suitable dewatering equipment shall be provided, and water generated by dewatering shall be contained and treated as required.

- 5.4 PIPE BEDDING – All storm sewer pipes shall be laid using bedding of No. 9 crushed stone placed to a minimum depth of four inches (4”) below the bottom of the pipe barrel. Unstable soil shall be stabilized by over-excavating and placing a layer of No. 3 crushed stone below the 4 inches of No. 9 bedding.
- 5.5 LAYING OF PIPE - The laying of sewer pipe in finished trenches shall be commenced at the lowest point so that the spigot or tongue ends point in the direction of flow. No pipe shall be laid resting on solid rock, blocking, or other unyielding objects or materials.

Contractors may use a laser instrument to set the grades on sewer lines in lieu of using a grade string and batter boards set from grade stakes. In using such an instrument, the developer shall be responsible for maintaining grades and elevations as called for on the drawing profiles, and any variances found shall be corrected by the developer at his expense.

All pipe lengths shall be properly joined and true to line and grade. Supporting of pipe shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipe on blocks be permitted.

Fittings for storm sewers shall be provided and laid as and where directed by the Engineer or shown on the plans.

Before each joint of pipe is lowered into the trench, it shall be thoroughly inspected to insure it is clean. Jointing before placement in the trench and subsequent lowering of more than one section will not be allowed. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting is discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe and repair type coupling used as a splicing device.

When pipe installation is stopped for any reason, the exposed end of such pipe shall be closed with a plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench.

When located near water lines, the horizontal separation between water lines and storm sewers shall be at least 10 feet measured from the outside edges of the two pipes. Should conditions prevent this horizontal separation, deviation may be allowed at the discretion of the Engineer, provided the storm sewer is laid in a separate trench, or if in the same trench, with the water line located on a bench of undisturbed earth. In any case, the elevation of the top crown of the storm sewer shall be at least 18 inches below the bottom of the water line.

When storm sewers cross water lines, maintain 18 inches of separation between the pipes, measured from the edges of the two pipes. Storm sewers crossing water lines shall be constructed of reinforced concrete pipe or cement coated ductile iron pipe for a distance of 10 feet either side of the water main. At all crossings, one full stick of the water main pipe shall be located so that both joints are as far from the storm sewer pipe as possible. Special structural support for the water main and storm sewer may be required at the direction of the Engineer.

- 5.6 BACKFILLING PIPELINE TRENCHES – All backfilling shall be accomplished in accordance with Section 6.7 for Backfilling in Open Terrain (Method A), Backfilling under Sidewalks and Unpaved Driveways (Method B), or Backfilling under Streets and Paved Driveways (Method C).

When directed by the Engineer, the developer shall add water or dry out the material when needed to attain a condition near optimum moisture content for a maximum density of the material when it is compacted. The developer shall obtain a compaction of the backfill of at least 95 percent of standard (ASTM D698) Proctor density where mechanical compaction of backfill is required.

Before final acceptance, the developer will be required to level off all trenches or to bring the trench up to the level of the surrounding terrain. The developer shall also remove from roadways, rights-of-way, and/or private property all excess earth or other materials resulting from construction.

When pavement is not placed immediately following trench backfilling in streets and highways, the developer shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

In all cases walking or working on the completed pipelines except as necessary in compacting and backfilling, will not be permitted until the trench has been backfilled to a point one foot above the top of the pipe. The filling of the trench and the compaction of backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be disturbed and injurious side pressures do not occur.

Flowable fill shall be allowed as an alternate method for backfilling of utility cuts and trenches, with approval of the Engineer.

- 5.7 REMOVAL AND REPLACEMENT OF EXISTING FACILITIES – Shall be accomplished in accordance with the approved plans and specifications, and as directed by the Engineer.

- 5.8 CONCRETE CRADLE, ANCHORS, OR ENCASEMENT – Concrete cradle, anchors, or encasement for sewer lines shall be placed where shown on the plans, required by the specifications, or as directed by the Engineer. Concrete shall be Class “B” and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed. In compacting concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints.
- 5.9 MANHOLES – Manholes of the form and dimensions shown on the plans shall be built as directed. They shall be constructed on 3000 psi concrete foundations with adequate structural and geometrical capacities, and in conformance with ASTM C-478.
- 5.9.1 Precast Concrete Rings – Precast concrete rings for manholes shall conform to ASTM C-478.
- 5.9.2 Precast Concrete Cones – Precast concrete cones shall be of the size and shape shown on the plans and shall conform to ASTM C-478.
- 5.9.3 Manhole Inverts – Manhole inverts shall be formed from 3,000 psi concrete as shown on the plans. Inverts for a “straight-through” manhole may be formed by laying the pipe straight through the manhole, pouring the concrete invert, and then cutting out the top half of the pipe. Curved invert shall be constructed of concrete, as shown, and shall form a smooth, even half-pipe section. The inverts shall be constructed when the manhole is being built using prefabricated forms. Precast inverts will be allowed if approved by the Engineer.
- The excavation shall be kept free of water while the manhole is being constructed and the manhole shall not be backfilled until inspected by the Engineer.
- 5.10.4 Manhole Frames and Covers – Manhole castings shall consist of cast iron frames and covers, weighing not less than 300 pounds per frame and cover, dimensioned as shown in the standard drawings. Manhole covers must sit neatly in the rings, with contact edges machined for even bearing and tops flush with ring edge. They shall have sufficient corrugations to prevent slipperiness. The lids shall have two pick holes about 1-1/4 inches wide and 1/2 inch deep with 3/8 inch undercut all around.
- 5.11 CURB INLETS, GRATE INLETS, AND HEADWALLS - Shall be constructed to forms and dimensions shown on Standard Drawings, or as shown on plans approved by the Engineer. Headwalls may be required at the discretion of the Engineer on all storm drains which terminate in an existing or proposed open ditch or waterway. All concrete for inlets and headwalls shall have a minimum 28 day compressive strength of 3500 psi. Reinforcing steel shall be ASTM A-615, Grade 40 and the size and layout approved by the Engineer.
- 5.12 CLEAN UP – Upon completion of the installation of the storm sewers and appurtenances, the developer shall remove all debris and surplus construction materials resulting from the work. The developer shall grade the ground along each side of the pipe trench in a uniform and neat manner.

SECTION SIX: SANITARY SEWERS

6.0 DESIGN REQUIREMENTS - At the request of the Engineer a complete set of computations, in a tabular form, indicating depths and velocities at minimum, average and maximum daily waste flows for the different sizes of sewers proposed. Size, type, class, thickness and pressure rating of sewers shall be as shown on the approved plans.

6.0.1 Depth - In general, sewers shall be sufficiently deep so as to receive sewage from the first floor of all places served by the sewers and to prevent freezing. Minimum cover of sanitary sewers shall be 42 inches, unless approved otherwise.

6.0.2 Slope - All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second. The following are the minimum slopes which should be provided; however, slopes greater than these are desirable.

<u>Sewer Size</u>	<u>Minimum Slope in Ft. per 100 Ft.</u>
8 inch	0.40
10 inch	0.28
12 inch	0.22
14 inch	0.17
15 inch	0.15
16 inch	0.14
18 inch	0.12
21 inch	0.10
24 inch	0.08
27 inch	0.067
30 inch	0.058
36 inch	0.046

Sewers should be laid with uniform slope between manholes. Sewers on 20 per cent slope or greater shall be anchored securely with concrete anchors spaced no more than 36 feet center to center.

6.0.3 Sizing - New sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than 100 gallons per day. Generally, the main, trunk and outfall sewers shall be designed to carry, when running full, not less than 250 gallons daily per capita contributions of sewage, exclusive of sewage or other waste flow from industrial plants. The Engineer may modify these minimum flow conditions as required by system performance or modeling of future flows in the system.

No sewer shall be less than 8 inches in diameter. Sewer taps and laterals shall not be less than 6 inches in diameter. Cleanouts shall be a minimum of 6 inches in diameter.

6.1 PIPE AND FITTINGS - Sanitary sewers shall be constructed of the following pipe unless otherwise approved by the Engineer. At cover depths less than 10 feet, any of these pipe types may be used. At cover depths greater than 10 feet, SDR 35 PVC pipe shall not be used. At cover depths greater than 15 feet, no PVC pipe may be used.

6.1.1 Reinforced Concrete Pipe - Reinforced Concrete sewer pipe and fittings for sewers shall be minimum Class III. Interior shall be lined with Permite PCS-9043 Type II or approved equal.

6.1.2 PVC Pipe (Gravity) - Polyvinyl chloride plastic pipe and fittings for gravity sanitary sewers shall be Type PSM SDR-35 or SDR-26 in accordance with ASTM D-3034 and F-679.

Pipes and fittings shall have integral molded bells for bell and spigot type joints with elastomeric ring gaskets providing a water tight seal. Gaskets shall be certified by the manufacturer to be chemically immune to normal sewage and sewer gas and the gasket design arrangement on the bell shall be approved by the Engineer.

All pipe fittings shall be molded or otherwise made as one piece integral units.

Adapters as furnished by the pipe manufacturer shall be used to connect PVC pipe to all other type of pipes or fittings.

PVC pipe shall not be used in any system which may receive industrial waste or materials with temperatures greater than 140 degrees F.

6.1.3 Ductile Iron Pipe - Ductile iron pipe for gravity sewers and sewage force mains shall be pressure class 150-350, and shall conform to AWWA/ANSI C150/A21.5. Interior shall be lined with Protecto 401, TNEMEC Series 431 Perma-Shield PL, or approved equal. Pipe fittings shall be mechanical joint Class 250 conforming to ANSI Specification A1.10 (AWWA C-110) for short body cast iron fittings.

6.1.4 High Density Polyethylene Pipe (HDPE) - HDPE pipe for sewage force mains shall be 160 psi working pressure, DR11 (DR9 for 4" diameter and smaller), and shall conform to ASTM D-1248 and ASTM D-3350. Fittings shall be molded or fabricated with ends to match system piping.

6.2 TRENCH EXCAVATION - Unless specifically directed otherwise by the Engineer, not more than 100 feet of trench shall be opened ahead of the pipe laying work of any one crew, and not more than 100 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavation and other obstructions, shall be provided by and at the expense of the contractor. Conformance to all state highway requirements shall be the responsibility of the contractor when encroachment on highway right-of-way is necessary.

When directed by the Engineer, only one half of street crossings and road crossings shall be excavated before placing temporary bridges over the side excavated for the convenience of the

traveling public. All backfilled ditches shall be maintained in such a manner that they will offer no hazard to the passage of traffic. The convenience of the traveling public and property owners abutting shall be taken into consideration. All public or private drives shall be taken into consideration and shall be promptly backfilled or bridged at the direction of the Engineer. Excavated materials shall be disposed of so as to cause the least interference, and in every case the disposition of materials shall be satisfactory to the Engineer. Trenches in which pipes are to be laid shall be excavated in open cut to the depths shown on the approved plans, cut sheets or as specified by the Engineer. Where rock is encountered, it shall be removed to a minimum depth of four (4) inches below the pipe bells.

Unless specifically authorized by the Engineer, trenches shall be in no case excavated or permitted to become wider than 2 feet 6 inches plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench does become wider than 2 feet 6 inches at the level of or below the top of the pipe, special precautions may be necessary, such as providing compacted granular fill up to the top of the pipe or providing pipe with additional crushing strength as determined by the Engineer after taking into account the actual trench loads that may result and the strength of the pipe being used. The contractor shall bear the cost of such special precautions as necessary.

Trenches shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled. Removal of water shall be at the contractor's expense.

- 6.3 PIPE BEDDING - All sanitary sewer pipes shall be laid using bedding of #9 crushed stone placed to a minimum depth of four inches (4") below the bottom of the pipe barrel. Unstable soil shall be stabilized by over-excavating to allow a layer of #3 crushed stone below the four inches (4") of #9 bedding.

6.4 LAYING PIPE

The laying of the sewer pipe in finished trenches shall be commenced at the lowest point so that the spigot or tongue ends point in the direction of flow. Jointing of pipes shall follow the manufacturer's recommended procedures.

Contractors may use a laser instrument to set the grades on sewer lines in lieu of using a grade string and batter boards set from grade stakes. In using such an instrument, the contractor shall be responsible for maintaining grades and elevations as called for on the drawing profiles, and any variances found shall be corrected by the Contractor at his expense.

All pipe lengths shall be laid with ends properly jointed and true to line and grade as approved by the Engineer. They shall be joined to form a sewer with a smooth and uniform invert. Supporting of pipe shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipe on blocks be permitted.

Branches, fittings and specials for sewer lines shall be provided and laid as and where directed by the Engineer or shown on the plans.

Before each piece of pipe is lowered into the trench, it shall be thoroughly inspected to insure it is clean. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Engineer. No piece of pipe or fittings which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, they shall be removed and replaced with a satisfactory pipe or fitting. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe and a repair type coupling used as a splicing device.

When installation is stopped for any reason, the exposed ends of pipes shall be closed with a plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench.

6.5 OBSTRUCTIONS

In cases where storm sewers, gas lines, water lines, telephone lines, and other utilities, or other underground structures are encountered, they shall not be displaced unless necessary, in which case they shall be replaced in as good condition as found as quickly as possible. Any lines or underground structures damaged in the construction shall be replaced at the contractor's expense, unless in the opinion of the Engineer, such damage was caused through no fault of the contractor.

The contractor shall notify the utility companies prior to excavation adjacent to their facilities.

The contractor's attention is further directed to Section 1.4 for additional requirements.

6.6 SHORING, SHEETING AND BRACING OF EXCAVATIONS

Where unstable material is encountered or where the depth of excavation in earth exceeds six feet, the sides of the trench or excavation shall be supported by substantial sheeting, bracing or shoring in accordance with applicable regulations. Adequate and proper shoring of all excavations, and design and fabrication of all sheeting and shoring systems shall be the entire responsibility of the Developer.

Care shall be taken to avoid excessive backfill loads on the completed pipelines and the requirements that the width of the ditch at the level of the crown of the pipe be not more than two feet six inches plus the nominal diameter of the pipe shall, as set out in Section 6.2, be strictly observed.

6.7 BACKFILLING PIPELINE TRENCHES - All backfilling shall be accomplished in accordance with the details shown on Standard Drawings.

When directed by the Engineer, the contractor shall add water to the backfill material or dry out the material when needed to attain a condition near optimum moisture content for a maximum density of the material when it is compacted. The contractor shall obtain a compaction of the backfill of at least 95 per cent of standard (ASTM D 698) Procter density.

Where required by the Engineer, impervious check dams shall be installed in pipeline trenches to prevent migration of groundwater along the pipe. At a minimum, these check dams shall be installed at any crossing of a creek or stream, and at one thousand foot (1000') intervals along any run of pipe.

Before final acceptance, the contractor will be required to level off all trenches or to bring up the level of the surrounding terrain. The contractor shall also remove from roadways, rights-of-way, and/or private property all excess earth or other materials resulting from construction.

In the event that pavement is not placed immediately following trench backfilling in streets and highways, the contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

In all cases walking or working on the completed pipelines, except as may be necessary in compacting or backfilling, will not be permitted until the trench has been backfilled to a point one foot above the top of the pipe. The filling of the trench and the compaction of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be distributed and injurious side pressures do not occur.

Flowable fill shall be allowed as an alternate method for backfilling of utility cuts and trenches, with approval of the Engineer.

6.7.1 Method "A" Backfilling in Open Terrain - Backfilling of pipeline trenches in open terrain shall be accomplished in the following manner:

The lower portion of the trench, from the pipe bedding to a point 6 inches above the top outside surface of the pipe shall be backfilled with No. 9 crushed stone. This material shall be placed in 6" layers along each side of the pipe taking care to keep the level of fill on each side of the pipe equal. Compaction shall be accomplished by hand-tamping or by approved mechanical methods. Upon approval of the Engineer, crushed stone, fine gravel, or sand may be used as backfill in lieu of compacted earth.

The upper portion of the trench above the compacted portion shall be backfilled with material which is free from large rock. Incorporation of rock having a volume exceeding eight (8) cubic inches is prohibited. Backfilling this portion of the trench may be accomplished by any means approved by the Engineer. The trench backfill shall be heaped over or leveled as directed by the Engineer.

6.7.2 Method "B" - Backfilling Under Sidewalks, and Unpaved Driveways - The entire trench shall be backfilled with No. 9M crushed stone.

6.7.3 Method "C" - Backfilling Under Streets and Paved Driveways - The lower portion of the trench, from the pipe bedding to a point six inches (6") below the bottom of the pavement or concrete sub-slab shall be backfilled with No. 9 crushed stone or fine gravel.

The upper portion of the trench, from a point 6 inches below the base of the pavement or concrete, shall be backfilled with a base course of dense graded aggregate. At such time that pavement placement is accomplished, the excess base course shall be removed as required.

6.8 TESTING OF LINES

The testing of sewage force mains and gravity sewers shall be accomplished by the contractor in accordance with the procedures listed hereinafter.

6.8.1 Sewage Force Mains - On all projects involving the installation of sewage force mains, the finished work shall comply with the provisions listed below, or similar requirements which will insure equal or better results:

- a. Leakage in pipelines, when tested under pressure of 50 psi in excess of normal operating pressures, shall not exceed 50 gallons per 24 hours per inch of diameter per mile of pipe.
- b. Where practicable, pipelines shall be tested between line valves or plugs in lengths of not more than 1500 feet.
- c. Pipelines shall be tested before backfilling at joints except where otherwise required by necessity, local ordinance or public convenience.
- d. Duration of test shall be not less than two hours where joints are exposed and not less than 24 hours where joints are covered.
- e. Where leaks are visible at exposed joints and/or evident on the surface where joints are covered, the joints shall be retightened or relayed, and leakage minimized, regardless of total leakage as shown on test.
- f. All pipe, fittings and other materials found to be defective under test shall be removed and replaced at the contractor's expense.
- g. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with.
- h. Where nonmetallic joint compounds are used pipelines should be held under normal operating pressure for at least three (3) days before testing.

6.8.2 Gravity Sanitary Sewer Lines - On all projects involving installation of sanitary sewer lines, the finished work shall comply with the provisions listed below or similar requirements which will insure equal or better results:

- a. After collecting and/or outfall lines or system have been brought to completion, and prior to final inspection, the contractor will be required to clean all dirt, debris and trash from lines and manholes.
- b. All lines or sections of lines that are found to be laid improperly with respect to line or grade, that are found to contain broken or leaking sections of pipe, or are obstructed in such a manner that they cannot be satisfactorily corrected otherwise, shall be removed and replaced at the contractor's expense.
- c. The contractor shall lay sewer lines, including house connections so that the ground water filtration shall not average more than 200 gallons per inch of pipe diameter per 24 hours per mile of sewer.

The length of the main sewers shall be used in making the foregoing computation even though the house connections (from the main sewer to the property line) should be in place and included as a part of the system when infiltration is measured. This requirement may be applied to a portion of the contract work, such as the sewers in a separate drainage area or to a single section of the line between two manholes.

- d. Prior to acceptance, all sewers shall be tested for leakage. Leakage shall conform to ASTM C-828, as follows:
 - i. Contractor shall flush and clean the line prior to testing to wet the pipe surface and clean out debris. Contractor shall plug all outlets.
 - ii. Calculate the test time for the section in accordance with the Technical Manual.
 - iii. Plug and brace the plugs in all openings in test section.
 - iv. Add air until the internal pressure is raised to approximately 4 psi gage. Allow the pressure to stabilize, and start the test. Record the drop in pressure for the test time. If the pressure drops more than 1.0 psi gage during the test time, the line has failed the test. Report test results to the Engineer.
- e. In order to test for infiltration, the Engineer may also require exfiltration tests on each section of pipe between manholes after it has been laid out but prior to backfilling of joints. Exfiltration tests shall be conducted by plugging the lower end of the section of sewer to be tested and filling the sewer with water to a point approximately five feet above the invert at the lower end and at least one foot above the pipe at the upper end, observing for leakage at all joints and measuring the amount of leakage for a given interval of time. Exfiltration shall not exceed 110 per cent times the infiltration limits set out hereinbefore. All observed leaks shall be corrected even though exfiltration is within the allowable limits. Exfiltration tests will normally be required for flat sections of sewer that are expected to be below the wet season, ground water table.

- f. To test for infiltration, the Engineer may also require that the contractor plug the open ends of all lines at the manhole so that measurements may be made at each section of the sewer line. This infiltration test will not be made until the sewer line is completed, and the contractor will be required to correct all conditions that are conducive to excessive infiltration and may be required to relay such sections of the line that may not be corrected otherwise. All observed leaks shall be corrected even though infiltration is within allowable limits.

6.9 MANHOLES

Manholes shall be installed at the end of each line, at all changes in grade, size or alignment, at all intersections, and at distances not greater than 400 feet (500 feet for 18-inch or larger sewers).

Drop pipes shall be provided for any sewer entering a manhole at an elevation 24 inches or more above the manhole invert. Drop manholes shall be constructed with an outside drop connection, where practical. The entire outside drop connection shall be encased in concrete.

Manholes shall be constructed to the form and dimensions shown on the approved plans. Manholes shall be constructed as per the Standard Drawings. They shall be constructed on 3500 psi concrete foundations. Minimum manhole diameter shall be 48 inches.

All connections to manholes or other structures shall be made using a chemical resistant rubber compression diaphragm, precast into the manhole. Diaphragms shall meet the requirements of ASTM C-923.

- 6.9.1 Standard Manholes - The standard manhole shall be six feet or more in depth, measured from the base of the cover frame to the top of the concrete footing and shall be of cone type, top construction as shown on the Standard Drawings.
- 6.9.2 Shallow Manholes - The shallow manholes shall be less than six feet in depth, measured from the base of the cover frame to the invert of the effluent pipe and shall be of flat top construction as shown on the Standard Drawings. Manholes shallower than four (4) feet from the bench to the top of the frame and lid shall replace the flat concrete top with East Jordan catalog No. V-7048, or Neenah Foundry catalog No. R-1740-F with access lid in the center of the casting.
- 6.9.3 Plastic Adjusting Rings - Plastic adjusting rings shall be round, injection molded high density polyethylene (HDPE) adjustment rings as manufactured by LADTECH, Inc. or approved equal, and shall be traffic rated AASHTO HS-20. Adjustment rings shall be molded from 100% recycled material..
- 6.9.4 Precast Concrete Cones - Precast concrete cones shall be concentric, of the size and shape shown on the plans, and shall conform to the ASTM C 478.

- 6.9.5 Manhole Inverts - Manhole inverts shall be formed from 3500 psi concrete as shown on Exhibit. Curved invert shall be constructed of concrete, as shown, and shall form a smooth, even half-pipe section as shown. The inverts shall be constructed when the manhole is being built using prefabricated forms.

The excavation shall be kept free of water while the manhole is being constructed and the manhole shall not be backfilled until inspected by the Engineer.

- 6.9.6 Manhole Frames and Covers - Unless otherwise approved manhole castings shall consist of cast iron frames and 22 - 3/4 inch diameter covers, weighing not less than 300 pounds per frame and cover, dimensioned as shown on the plans. Manhole covers must sit neatly in the rings, with contact edges machined for even bearing and tops flush with ring edge. They shall have sufficient corrugations to prevent slipperiness. The lids shall have two pick holes about 1 - 1/4 inches wide and 1/2 inch deep with 3/8 inch undercut all around. Lids on sanitary sewer manholes must not be perforated.
- 6.9.7 Drops into Standard Manholes - Drops into standard manholes shall be built as per the Standard Drawings. Internal drops are permissible as shown on the Standard Drawings.
- 6.9.8 Manhole Testing - All manholes shall be subjected to a vacuum test in accordance with ASTM C1244, except as specified otherwise herein. Manholes shall be tested after installation with all connections in place, and shall include testing of the seal between the frame and the concrete cone, slab or grade rings. A vacuum of at least ten inches of mercury (10" Hg) shall be drawn on the manhole. The manhole shall be considered to pass the test if the vacuum reading does not drop more than one inch Hg (from 10" to 9" Hg) during the minimum test time. Minimum test time is based on manhole diameter and manhole depth, as specified in the applicable Technical Manual.

6.10 SERVICE LATERALS

Approved taps shall be installed on the public sewer for all house or building connections at locations established by the developer's engineer. At least one connection shall be provided for each platted lot. The contractor shall lay the service laterals from this point to the property line, or easement line. The developer shall place a cap on the end of the service lateral and use a metallic marker with PVC pipe and cap around it for protection. This marker should be even with the ground. The developer is not required to install the tee and cleanout, unless so directed by the Engineer during plan review.

Sanitary sewer tap clean-outs and service connections shall be installed in accordance with the plans and details by a qualified plumber. Clean-outs shall be 6-inch minimum in diameter and have cast iron covers installed according to the standard drawings.

Each separate dwelling structure, commercial building or industrial building shall be provided with a separate service lateral. All connections which service single family dwellings shall be not less than 6 inch in diameter pipe. All connections which service multi-family dwellings, or commercial and industrial buildings shall be sized based on occupancy or use. Trenching, pipe

installation and backfilling shall conform to the requirements set out herein. All open ends of service laterals shall be sealed with a standard PVC plug or cap, with compression joints compatible with the pipe.

Service laterals shall be PVC (polyvinyl-chloride) sewer pipe, ASTM D-3034, latest revision, or ductile iron pipe, AWWA specification C-151 cement lined, and shall meet requirements of the state plumbing code. Any part of a service lateral that is located within five (5) feet of a water service pipe shall be constructed with ductile iron pipe, unless the service lateral is at least one (1) foot deeper in the ground than the water service line. Ductile iron pipe may be required where the service lateral is exposed to damage or stoppage by tree roots. Ductile iron pipe shall be used in filled or unstable ground, in areas where the cover over the service lateral is less than three (3) feet, or in areas where the sewer is subject to vehicular or other external loads.

Under normal conditions service laterals shall be laid on a slope of not less than two percent (approximately 1/4 inch per foot). A minimum grade of one percent may be used with the approval of the Engineer.

The tapping of service laterals into manholes on the newly constructed sewers will not be permitted, except as permitted by the Engineer. Where it is necessary to do so, the invert of the service lateral shall not be higher than a point three inches below the top of the bench in the manhole and suitable trough shall be provided in the bench to prevent the accumulation of solids on the bench. If necessary, a standard drop connection shall be provided for a house service that is tapped into a manhole.

The installation of service laterals shall follow immediately or be concurrent with the construction of the main sewer.

6.11 CONNECTIONS TO EXISTING LINES - Connection to existing gravity sewer lines shall be made where indicated on the plans. All connections to existing sewers shall be performed by HWU personnel, with costs to be borne by the developer in accordance with utility standard operating procedures.

6.12 REMOVAL AND REPLACEMENT OF EXISTING FACILITIES

6.12.1 Concrete Sidewalks, Curbs and Gutters - Where concrete sidewalks, curbs or gutters are cut or disturbed during the construction work, they shall be removed to limits as directed by the Engineer, and shall be replaced in fully as good or better condition than that which existed prior to the contractor's operation.

When replacing concrete sidewalks, existing sidewalk shall be removed to the edge of the next panel. The developer shall install 1/2 inch premolded full-depth expansion material at the exposed edges of existing concrete, and at intervals not to exceed 40 feet.

Sidewalk shall be formed, poured and cured in conformance with Section 4.2 of these specifications. Curbs and Gutters shall be formed, poured and cured in conformance with Section 4.3 of these specifications.

6.12.2 Concrete Pavement - Where Portland Cement concrete streets, alleys and driveways are removed, they shall be reconstructed to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than existed prior to the operation.

The existing concrete paving shall be sawed or cut to straight edges 12 inches outside the edges of the trench or removed to an existing joint as directed by the Engineer.

Concrete pavement shall be formed, poured and cured in conformance with Section 3.5 of these specifications.

6.12.3 Asphalt Highway, Street and Driveway Replacement - The contractor shall replace those sections of existing alleys, streets and driveways which have been removed during construction. He shall reconstruct same to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to his operation.

Prior to trenching, the pavement shall be scored or cut to straight edges at least 12 inches outside each edge of proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be recut and trimmed to square, straight edges after the pipeline has been installed and prior to placing the new base and pavement.

Backfilling the trench shall be in accordance with the previous section on backfilling trenches. Base course for the paving shall be Dense Graded Aggregate and shall be placed in accordance with section 3.4 to a depth equal to the existing base course, but not less than 6 inches in streets and alleys, and 4 inches in driveways.

Pavement shall be replaced in conformance with Section 3.4 of these specifications.

6.13 CONCRETE CRADLE, ANCHORS, OR ENCASEMENT

Concrete cradle, anchors or encasement of sewer lines and/or fittings are discouraged and shall only be placed where shown on the plans, required by the specifications, or as directed by the Engineer. Concrete shall be Class "B" and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed. In consolidating concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints. See standard drawing.

6.14 LOCATING NEAR WATER MAINS

6.14.1 Horizontal Separation - Sewers should be laid at least 10 feet, horizontally, from an existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to the water main if:

- a. It is laid in a separate trench.
- b. It is laid in the same trench with water mains located on one side on a bench of undisturbed earth.
- c. In either case, the elevation of the top of the sewer is at least 18 inches below the bottom of the water main.

6.15.2 Vertical Separation - Whenever sewers must cross under water mains, the sewers shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirements, the sewer line shall be reconstructed with ductile iron pipe for a distance of 10 feet on each side of the water line. One full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible.

6.15 REPLACEMENT OF EXISTING MAIL BOXES, CULVERTS, CLOTHES LINE POSTS, FENCES AND OTHER SUCH FACILITIES - Existing mail boxes, drainage culverts, clothes line posts, fences, and the like shall not be disturbed unless necessary, in which case, they shall be replaced in as good condition as found as quickly as possible. Existing materials shall be reused in replacing such facilities when materials have not been damaged by the contractor's operations. Existing facilities damaged by the contractor's operations shall be replaced with new materials of the same type at the contractor's expense.

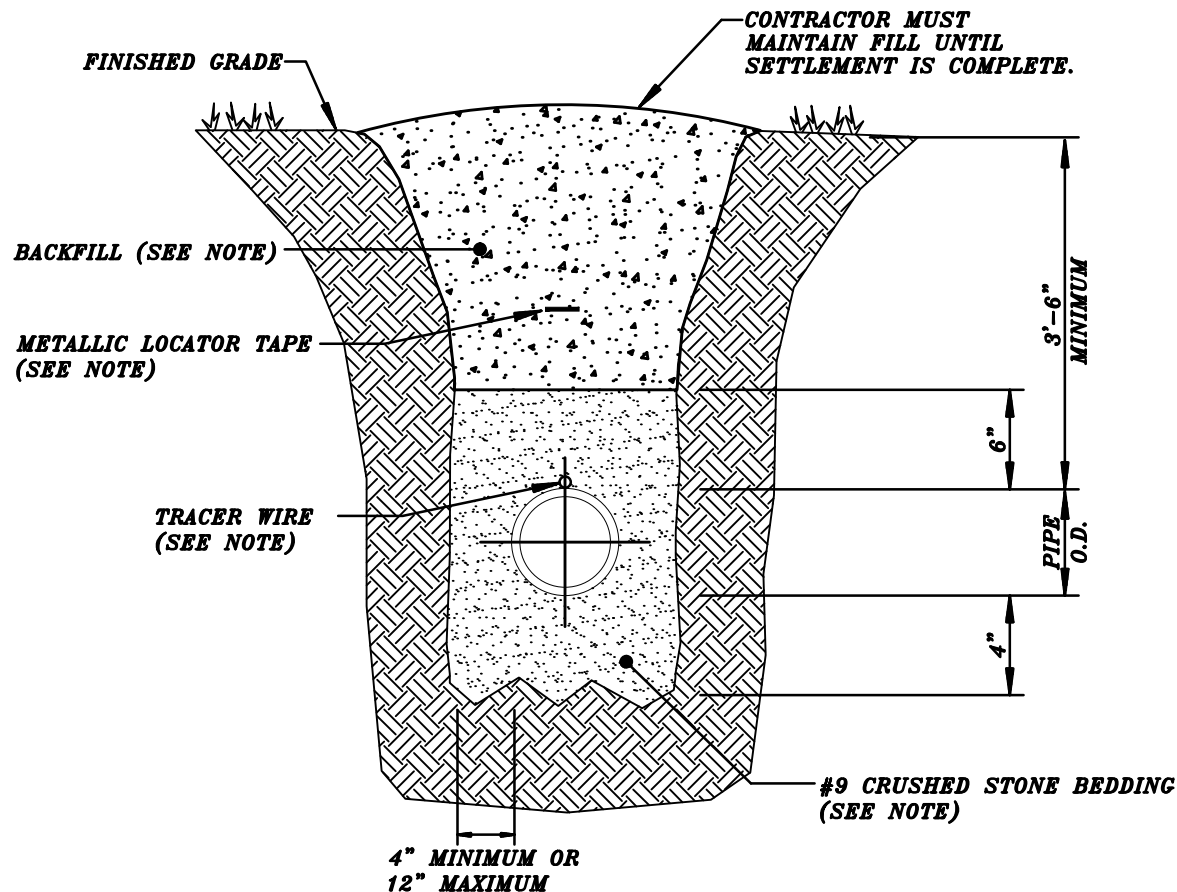
6.16 STEEL, PLAIN END CASING PIPE - Casing pipe shall be steel, plan end, coal tar enameled, mill coated inside and out. The steel pipe shall have welded joints and be at least 18 foot lengths. The wall thickness of the pipe shall be at least 1/4 inch.

6.17 CLEAN-UP - Upon completion of the installation of the sewer pipes and appurtenances, the contractor shall remove all debris and surplus construction materials resulting from the work. The contractor shall grade the ground along each side of the pipe trench in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line.

6.18 SEEDING AND SODDING - Unless otherwise specified by the Engineer, all graded areas shall be left smooth and sown with a mixture of grasses at a rate of not less than 100 pounds per acre. Seed mixture shall be as specified in Section 2.9. When final grading has been completed, the area to be seeded shall be fertilized with number 12-12-12 fertilizer at a rate of 1000 lbs. per acre. Agricultural limestone shall be added at a rate of 3 tons per acre. After the fertilizer and agricultural limestone have been distributed, the contractor shall disc or harrow the ground to thoroughly work the fertilizer into the soil. The seed shall then be broadcast either by hand or by approved sowing equipment. After the seed has been distributed, the contractor shall then lightly cover the seed by use of a drag or other approved device. All seed shall be certified. The seeded area shall then be mulched with clean, weed-free straw to a depth of approximately 2

inches. Any necessary reseeding or repairing shall be performed by the contractor prior to final acceptance.

When sodding is required, it shall be so laid that no voids occur between strips. Weed roots shall be removed as the sod is laid, and the finished surface shall be true to grade even and equally firm at all points. Well screened topsoil shall be lightly sprinkled over the sodded areas and shall be raked to insure sealing the sod joints. The sodded areas shall be thoroughly watered.



TRENCH SECTION METHOD "A" OPEN TERRAIN DUCTILE & PVC GRAVITY SEWER MAIN & HDPE FORCE MAIN: OPEN CUT INSTALLATION

NOTE:

HAND PLACE AND COMPACT BACKFILL MATERIAL TO 6" ABOVE TOP OF PIPE SO AS NOT TO DISTURB OR DAMAGE PIPE.

UPPER PORTION OF TRENCH USE EXCAVATED MATERIAL FREE FROM OBJECTS HAVING A VOLUME EXCEEDING EIGHT CUBIC INCHES.

PLACE BURIED METALLIC LOCATOR TAPE 18"-24" ABOVE TOP OF PIPE AS SHOWN. TAPE MUST CONTINUOUSLY READ: "CAUTION: BURIED SEWER LINE BELOW".

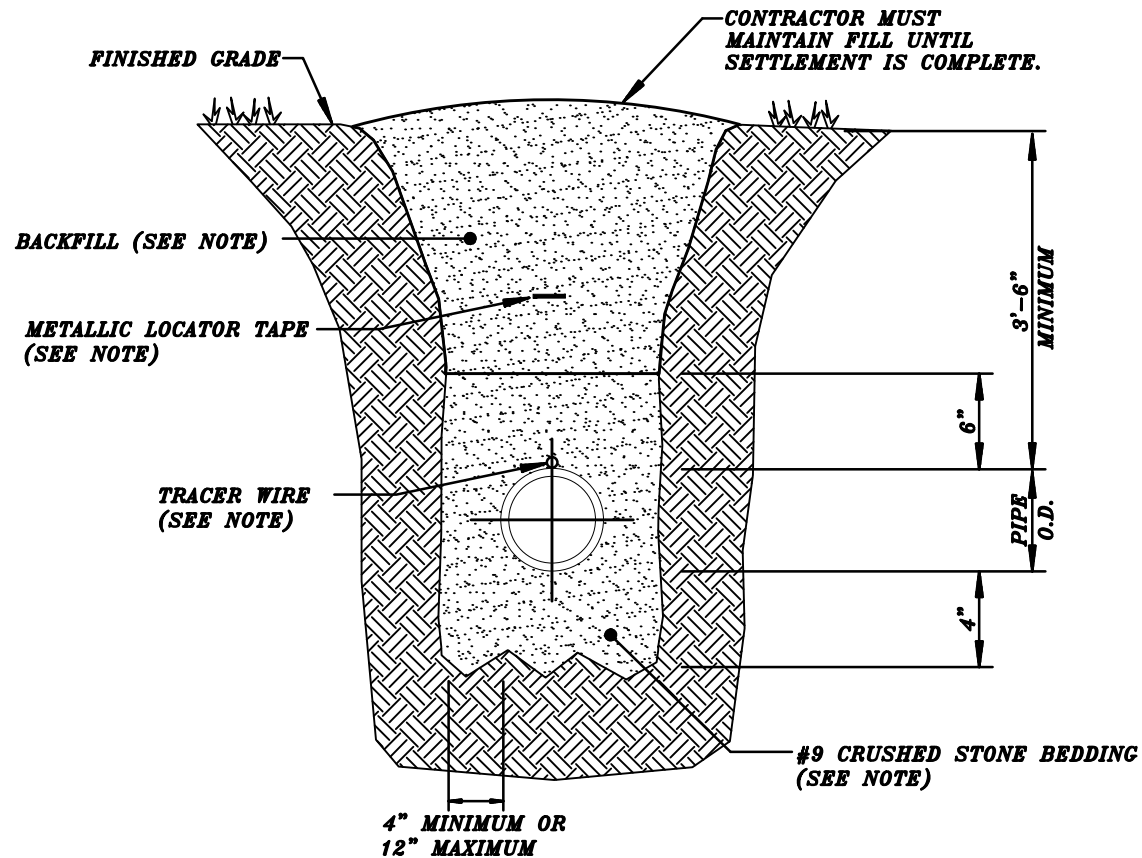
USE TRACER WIRE FOR FORCE MAIN INSTALLATION ONLY.

FORCE MAIN DEPTH 3'-6" MIN. TO 5'-0" MAX.

HOLES IN BEDDING FOR PIPE BELLS MUST BE PROVIDED AT EACH JOINT.

DRAWN BY	WFK
APPROVED BY	TDW
ORIGINATION	11/14/13
REVISION	-

EXHIBIT 6-1



TRENCH SECTION METHOD "B" SIDEWALKS & UNPAVED DRIVEWAYS DUCTILE & PVC GRAVITY SEWER MAIN & HDPE FORCE MAIN: OPEN CUT INSTALLATION

NOTE:

BACKFILL TRENCH FROM BEDDING TO FINISH GRADE WITH #9 CRUSHED STONE. HAND PLACE AND COMPACT BEDDING TO FINISHED GRADE SO AS NOT TO DISTURB OR DAMAGE PIPE.

PLACE BURIED METALLIC LOCATOR TAPE 18"-24" ABOVE TOP OF PIPE AS SHOWN. TAPE MUST CONTINUOUSLY READ: "CAUTION: BURIED SEWER LINE BELOW".

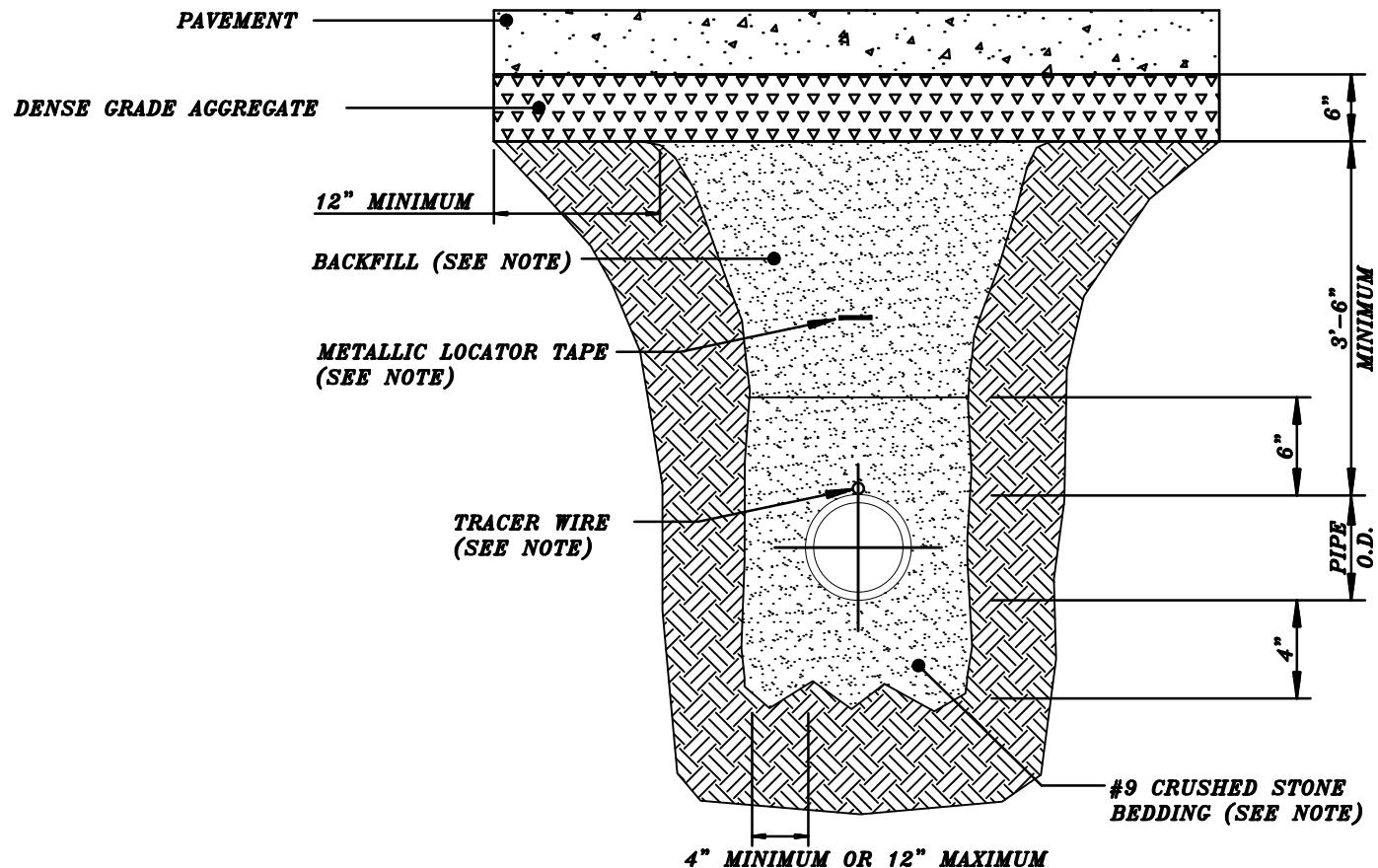
USE TRACER WIRE FOR FORCE MAIN INSTALLATION ONLY.

FORCE MAIN DEPTH 3'-6" MIN. TO 5'-0" MAX.

HOLES IN BEDDING FOR PIPE BELLS MUST BE PROVIDED AT EACH JOINT.

DRAWN BY	WFK
APPROVED BY	TDW
ORIGINATION	11/14/13
REVISION	-

EXHIBIT 6-2



TRENCH SECTION METHOD "C" STREETS, ROADS, & PAVED DRIVEWAYS DUCTILE & PVC GRAVITY SEWER MAIN & HDPE FORCE MAIN: OPEN CUT INSTALLATION

NOTE:

HAND PLACE AND COMPACT BEDDING MATERIAL TO 6" ABOVE THE TOP OF PIPE SO AS NOT TO DISTURB OR DAMAGE PIPE.

LOWER PORTION OF TRENCH FROM BEDDING TO SIX INCHES BELOW BASE OF PAVEMENT USE #9 CRUSHED STONE.

UPPER PORTION OF TRENCH FROM #9 STONE TO BASE OF PAVEMENT USE A BASE COURSE OF DENSE GRADED AGGREGATE.

PLACE BURIED METALLIC LOCATOR TAPE 18"-24" ABOVE TOP OF PIPE AS SHOWN. TAPE MUST CONTINUOUSLY READ: "CAUTION: BURIED SEWER LINE BELOW".

USE TRACER WIRE FOR FORCE MAIN INSTALLATION ONLY.

FORCE MAIN DEPTH 3'-6" MIN. TO 5'-0" MAX.

HOLES IN BEDDING FOR PIPE BELLS MUST BE PROVIDED AT EACH JOINT.

DRAWN BY	WFK
APPROVED BY	TDW
ORIGINATION	11/14/13
REVISION	-

EXHIBIT 6-3

SECTION SEVEN: WATER MAINS IN HWU SERVICE AREA

- 7.0 DESIGN REQUIREMENTS – Portions of the water system are constructed by the appropriate utility, and portions are constructed by private developers. To responsibly regulate the potable water infrastructure, a consistent quality of construction is necessary. Design and construction of potable water infrastructure shall follow the Technical Manual for Potable Water Facilities as published by HWU. Size, type, class, wall thickness and pressure rating of water mains shall be as shown on the approved plans.
- 7.0.1 Depth - In general, water mains shall be sufficiently deep so as to prevent freezing. Minimum cover shall be 42 inches, unless approved otherwise.
- 7.0.2 Sizing – New water mains shall not be less than eight inches (8”) in diameter, unless approved by the Engineer. Any pipe larger than eight inches (8”) shall be ductile iron. Where a main dead ends at a cul-de-sac, and the water main is not likely to be extended in the future, a two inch (2”) HDPE pipe may be laid around the head of the cul-de-sac.
- 7.1 PIPE, FITTINGS AND VALVES – Potable water mains and service lines shall be constructed of the following pipe unless otherwise approved by the Engineer.
- 7.1.1 Polyvinyl Chloride (PVC) Pipe - Polyvinyl chloride pipe and fittings for water mains shall be C-900 or C-905. Pipe 4” to 12” diameter: 150 psi pressure class, DR18. Pipe larger than 12”: 165 psi pressure class, DR 25.
- 7.1.2 Ductile Iron Pipe – Ductile iron pipe and fittings for water mains shall be pressure class 350 and shall conform to AWWA/ANSI C150/A21.5. Poly-wrap is required for all ductile iron pipe installations. Interior lining shall be cement mortar. Fittings shall be Class 350, mechanical joint, AWWA/ANSI C153/A21.53. Ductile iron pipe with special pipe jointing materials resistant to permeation of petroleum products shall be used within 200 feet of any oil or gasoline pipeline, underground storage tank, or any soil contaminated with petroleum products.
- 7.1.3 High Density Polyethylene Pipe (HDPE) – HDPE pipe for water mains shall be 160 psi working pressure, DR11 (DR9 for 4” diameter and smaller), and shall conform to ASTM D-1248 and ASTM D-3350. Fittings shall be molded or fabricated with ends to match system piping.
- 7.1.4 Service Pipes & Meter Installations: All service pipe shall be type K soft copper. Meter setter kits, meter boxes, meter box lids, corporation stops and service saddles shall all meet the standards and specific manufacturer’s models and part numbers as detailed in the HWU Technical Manual for Potable Water Facilities. Service saddles are required for PVC mains. All soft copper connections shall be flare type connections.

7.1.5 Fittings – Fittings for all water mains shall be ductile iron, AWWA/ANSI C153/A21.53. Fittings shall have mechanical joints meeting the requirements of AWWA/ANSI C111/A21.11. Fitting shall have interior cement mortar lining as specified for DI pipe.

7.1.6 Valves – Gate valves shall conform to AWWA C-509, and shall be resilient seat, ductile iron body, non-rising stem, fully bronze mounted, and suitable for working pressures of 150 psi. All gate valves shall be furnished with mechanical joint end connections, unless otherwise shown on the Drawings. Each gate valve installed in the ground shall be installed in a vertical position with a valve box. Gate valves set with valve boxes shall be provided with a 2-inch square operating nut and shall be opened by turning to the left (counterclockwise).

Butterfly valves shall be of the tight closing, rubber seat type, which are recess mounted and securely fastened to the valve body or to the valve disc. Valves shall be rated for 150 psi pressure. Valve discs shall rotate 90 degrees from the full open position to the tight shut position. Valves shall meet the full structural requirements of the application classes of AWWA C504, latest revision. Valve bodies shall be constructed of ductile iron and shall have integrally cast mechanical joint ends. Two (2) trunnions for shaft bearings shall be integral with each valve body. Valves shafts shall be constructed of stainless steel or of other approved construction. Operators shall be the traveling nut type, AWWA C504, Class 150B. Operators shall be fully gasketed and grease packed and designed to withstand submersion in water to 10 psi. The number of turns to move from fully open to fully closed shall closely resemble conventional distribution valve practice.

7.1.7 Hydrants – Fire hydrants shall be installed as directed, and not more than 600 feet apart. Fire hydrant barrels shall have a safety breakage feature above the ground line. All hydrants shall have 6-inch mechanical joint shoe connection; two 2-1/2-inch hose discharge nozzles and one 4-1/2-inch pumper nozzle. The nozzle connection threads shall be National Standard Threads (N.S.T.). The main valve shall have 5-1/4-inch full opening and be of the compression type, opening against water pressure so that the main valve remains closed should the barrel be broken off. Each nozzle is to be protected by nozzle caps. The caps shall be furnished with a 1-1/2-inch pentagonal opening nut, gaskets and attachment chains.

Flush hydrants shall be installed at locations as specified, and at the end of all dead-end lines. Flush hydrant outlets shall be a minimum of 2-1/2 inches, with minimum 3 inch barrels.

7.1.8 Air Release Valves – Air release valves and boxes shall be installed at the high points in the lines as shown on the Drawings. Air valve stems shall be connected to the main by a corporation stop. Valves shall be suitable for average working water pressure of 300 psi, have a 2-inch large orifice and a 3/32-inch small orifice. Valves shall be equipped with cast iron body and cover, stainless steel float, Buna-N seat and bronze linkage. Air valve boxes shall be a straight section of 36" RCP with standard manhole frame and lid, and shall be set on a crushed stone or gravel base.

7.1.9 Valve Boxes – Valve boxes shall be of 5-1/4 inch, standard cast iron, two or three piece, screw-type valve box with drop cover marked “WATER”.

7.1.10 Casing Pipe – Casing pipe for water lines installed by road boring or in ditch crossings shall be steel, plain end, uncoated and unwrapped, have a minimum yield point strength of 35,000psi and conform to ASTM A252 Grade 2 or ASTM A139 Grade B without hydrostatic tests. The steel pipe shall have welded joints and be in at least 18-foot lengths. Pipe shall be straight along the centerline axis within 1/50 of the outside diameter. Pipe shall also be free from dents or humps due to damage or variations in wall thickness. For highway and ditch crossings, the minimum wall thickness of the casing pipe shall be 0.250 inches for 16 inch and smaller casings; 0.312 inches for 18 inch, 20 inch, and 22 inch casings, 0.344 for 24 inch and larger casings. For railroad crossings casings shall have a minimum wall thickness of 0.344 inches. Field lock gaskets shall be installed at all carrier pipe joints within all encasement pipe and within one pipe length outside the casing on both ends.

7.2 TRENCH EXCAVATION - Unless specifically directed otherwise by the Engineer, not more than 100 feet of trench shall be opened ahead of the pipe laying work of any one crew, and not more than 100 feet of open ditch shall be left behind the pipe laying work of any one crew. Watchmen or barricades, lanterns and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavation and other obstructions, shall be provided by and at the expense of the contractor. Conformance to all state highway requirements shall be the responsibility of the contractor when encroachment on highway right-of-way is necessary.

Water line trenches shall be excavated to the depths shown on the plans or as directed by the Engineer. If depths are not shown on the plans, all water lines shall have 3'-6" to 4'-0" cover unless otherwise approved by the Engineer.

Unless specifically authorized by the Engineer, in no case shall trenches be excavated or permitted to become wider than 2 feet 6 inches plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench does become wider than 2 feet 6 inches at the level of or below the top of the pipe, special precautions may be necessary, such as providing compacted granular fill up to the top of the pipe or providing pipe with additional crushing strength as determined by the Engineer after taking into account the actual trench loads that may result and the strength of the pipe being used. The contractor shall bear the cost of such special precautions as necessary.

All excavated materials shall be placed a minimum of 2 feet back from the edge of the trench.

Prior to excavating the trench, Contractor shall pothole far enough ahead to reveal obstructions that may necessitate changing the line or grade of the pipeline, in order to avoid delays or the addition of avoidable fittings.

When directed by the Engineer, only one half of street crossings and road crossings shall be excavated before placing temporary bridges over the side excavated for the convenience of the traveling public. All backfilled ditches shall be maintained in such a manner that they will offer

no hazard to the passage of traffic. The convenience of the traveling public and property owners abutting shall be taken into consideration. All public or private drives shall be taken into consideration and shall be promptly backfilled or bridged at the direction of the Engineer. Excavated materials shall be disposed of so as to cause the least interference, and in every case the disposition of materials shall be satisfactory to the Engineer. Trenches in which pipes are to be laid shall be excavated in open cut to the depths shown on the approved plans, cut sheets or as specified by the Engineer. Where rock is encountered, it shall be removed to a minimum depth of four (4) inches below the pipe bells.

Where conditions exist that may be conducive to slides or cave-ins, proper and adequate sheeting, shoring and bracing shall be installed (See Section 7.6) to provide safe working conditions and to prevent damage to work. Trenches shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled. Removal of water shall be at the contractor's expense.

- 7.3 PIPE BEDDING - All water main pipe shall be bedded with select material. Where suitable soil conditions are encountered, the trench bottom may be shaped to cradle the bottom 60 degrees of the pipe. All water main pipe shall be supported on a level trench bottom. Holes in the trench bottom or bedding for pipe bells must be provided at each joint and should be no larger than necessary for proper joint assembly and assurance that pipe barrel will lie flat on trench bottom. The trench must supply true and even support for pipe. In no case shall the pipe be supported directly on solid rock. When rock is encountered in the trench bottom, bedding shall consist of fine gravel or size #9 crushed stone only.

7.4 INSTALLING PIPE, FITTINGS AND HYDRANTS

Pressure pipe shall be installed in accordance with AWWA C600, latest revision, and laid to lines, cover or grades shown on the drawings. Water lines installed on a slope greater than 20 degrees shall be approved on a case by case basis by the Engineer.

Jointing of pipes shall follow the manufacturer's recommended procedures. The pipeline shall be installed on a level bottom with holes for the bells cut at each joint and bedded with select material. Mechanical restraint retainer glands shall be used on all fittings.

Gate valves for lines smaller than 16" or butterfly valves for lines 16" and larger shall be spaced at a maximum of 500 feet, or at each fire hydrant tee. Gate or butterfly valves shall also be provided at all branch lines and at the tie-in to the existing line. At line tee connections, 3 valves shall be installed. A valve shall be installed at the end of every line followed by a full section of pipe and end cap unless otherwise approved in writing by HWU. Hydrant valves shall be installed with a 6" tee installation and no other taps or services. The hydrant valve shall isolate the hydrant only. All valves shall be located outside roadways unless approved by the Engineer.

The points insisted upon in the laying of pipe will be: Proper alignment, evenness of width and depth of joints, perfection in jointing, and care of the pipe in handling. Joint deflections shall not exceed one-half of the manufacturer's recommended maximum allowable. Supporting of

pipe shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipe on blocks be permitted.

Before each piece of pipe is lowered into the trench, it shall be thoroughly inspected to insure it is clean. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Engineer. No piece of pipe or fittings which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, they shall be removed and replaced with a satisfactory pipe or fitting. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe and a repair type coupling used as a splicing device.

When installation is stopped for any reason, the exposed ends of pipes shall be closed with a plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench.

When locating near sewer lines, the horizontal separation between water and sewer lines should be at least 10 feet measured to the pipe wall exterior. Should location conditions prevent a horizontal separation of 10 feet, HWU may allow a deviation on a case by case basis, if supported by data from the engineer. Such deviation may be allowed if the sewer is laid in a separate trench or if it is laid in the same trench with the water main located at one side on a bench of undisturbed earth. In either case, the elevation of the crown of the sewer is at least 18 inches below the invert of the water main.

Water mains crossing above sewer lines shall be waterworks grade ductile iron pipe. The crossing shall be at the midpoint of the section of sewer pipe. The ductile iron water pipe shall be laid with a 20-foot section of pipe centered at the sewer line to insure that joints are as far as possible from the crossing.

Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. Should location conditions prevent the water main from being buried to meet the above requirements and maintain minimum cover, HWU may allow a deviation on a case by case basis, if supported by data from the engineer. Such deviation may be allowed if the sanitary sewer line is constructed with ductile iron pipe with protective internal coating of "Protecto-401" or equivalent epoxy coating (RCP or cement lined DIP for storm sewer) for a distance of 10 feet on each side of the water line and one full length of water main is centered over the sewer so that both joints will be as far from the sewer as possible. As an alternative for existing sewers, the sewer line may be encased.

Concrete anchors and thrust blocking of water mains and fittings shall be placed where shown on the Drawings, required by the Specifications, or as directed by the Engineer. Concrete shall be 2,500 psi and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed.

Hydrants shall be located as shown on the plans or as directed by the Engineer. The location shall provide complete accessibility and minimize the possibility of damage from vehicles or

injury to pedestrians. When placed behind the curb or sidewalk, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 4'-0" from the gutter face of the curb, the edge of sidewalk, or a driveway. All hydrants shall stand plumb with the pumper nozzle facing the curb. Hydrants shall be set to the established grade, with nozzles at 18 inches above finished grade as shown on the drawings or as directed by the Engineer. Unless otherwise shown, each hydrant on the drawings shall be connected to the main with a 6-inch branch connection controlled by an independent 6-inch gate valve. Fine graded river gravel to be placed 6" from surface to 6" below water line in a 2'-0" radius around hydrant barrel, for dissipation of weep-hole drainage. No drainage sump shall be connected to a sanitary sewer. No hydrant shall be set over any other utility.

All hydrants shall be provided with a concrete thrust block, minimum of 2'-4" x 6" x 16" poured concrete, set against undisturbed earth. The thrust block shall be placed between undisturbed ground and the fitting to be anchored. The thrust block shall be so placed that the pipe and fitting joints will be accessible for repair. If shown on the drawings or directed by the Engineer any movement shall be prevented by attaching suitable metal rods, clamps, or restrained fittings.

M.J. Fittings shall be installed with a restraining gland or other mechanical restraining system approved in writing by the Engineer and torqued at the specified foot-pounds of the manufacturer. Additionally, joining restraint is required along the length of pipe indicated on the drawings for the various type and size of fitting.

Mechanical joints shall be made in accordance with the recommendations of the manufacturer. Joint bolts shall be drawn up equally around the entire periphery maintaining equal spacing from the gland to the face of the flange at all points around the joint. All bolts shall be tightened to within the following torque range. Bolts may be snugged with an air wrench.

Tracer wire and locator tape shall be furnished and installed with all water mains. The tracer wire shall be taped or suitably held over the top center of the pipe and shall be #12 single strand copper wire with THW insulation or approved equal. All splices shall be made with the aid of DBR Direct Bury Splice Connectors as manufactured by 3M Electrical Products Division to insure continuity and insulation of the copper wire from the soil. Tracer wire shall be securely connected at flange bolts to all valves, fittings and hydrants to provide a suitable electrical connection. The electrical continuity of tracer wire between valves and fire hydrants shall be verified and defects found shall be corrected prior to acceptance by the Engineer. A metallic locator tape shall be buried in the trench a minimum of 12" over the top of the pipe and a minimum of 12" below the finished grade. The words "Caution Water Line Below" shall be repetitively printed along the length of the tape.

For residential lots a double meter box and hanger setting, placed on the property line between the two lots, shall be installed where possible. One-inch soft copper service line shall be installed for double meter settings and ¾" soft copper service line shall be installed for single meter settings.

7.5 OBSTRUCTIONS

In cases where storm sewers, gas lines, sewer lines, telephone lines, and other utilities, or other underground structures are encountered, they shall not be displaced unless necessary, in which case they shall be replaced in as good condition as found as quickly as possible. Any lines or underground structures damaged in the construction shall be replaced at the contractor's expense, unless in the opinion of the Engineer, such damage was caused through no fault of the contractor.

The contractor shall notify the utility companies prior to excavation adjacent to their facilities.

The contractor's attention is further directed to Section 1.10 for additional requirements.

7.6 SHORING, SHEETING AND BRACING OF EXCAVATIONS

Where unstable material is encountered or where the depth of excavation in earth exceeds six feet, the sides of the trench or excavation shall be supported by substantial sheeting, bracing or shoring in accordance with applicable regulations. Adequate and proper shoring of all excavations, and design and fabrication of all sheeting and shoring systems shall be the entire responsibility of the Developer.

Care shall be taken to avoid excessive backfill loads on the completed pipelines and the requirements that the width of the ditch at the level of the crown of the pipe be not more than two feet six inches plus the nominal diameter of the pipe shall, as set out in Section 7.2 hereinbefore, be strictly observed.

7.7 BACKFILLING PIPELINE TRENCHES - All backfilling shall be accomplished in accordance with the details shown on Standard Drawings.

When directed by the Engineer, the contractor shall add water to the backfill material or dry out the material when needed to attain a condition near optimum moisture content for a maximum density of the material when it is compacted. The contractor shall obtain a compaction of the backfill of at least 95 per cent of standard (ASTM D 698) Procter density where mechanical compaction of backfill is required.

Before final acceptance, the contractor will be required to level off all trenches or to bring up the level of the surrounding terrain. The contractor shall also remove from roadways, rights-of-way, and/or private property all excess earth or other materials resulting from construction.

In the event that pavement is not placed immediately following trench backfilling in streets and highways, the contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

In all cases walking or working on the completed pipelines, except as may be necessary in compaction or backfilling, will not be permitted until the trench has been backfilled to a point

one foot above the top of the pipe. The filling of the trench and the compacting of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be distributed and injurious side pressures do not occur.

Flowable fill shall be allowed as an alternate method for backfilling of utility cuts and trenches, with approval of the Engineer.

7.7.1 Method "A" Backfilling in Open Terrain - Backfilling of pipeline trenches in open terrain shall be accomplished in the following manner:

The lower portion of the trench, from the pipe bedding to a point 6 inches above the top outside surface of the pipe shall be backfilled with No. 9 crushed stone. This material shall be placed in 6" layers along each side of the pipe taking care to keep the level of fill on each side of the pipe equal. Compaction shall be accomplished by hand-tamping or by approved mechanical methods. Upon approval of the Engineer, crushed stone, fine gravel, or sand may be used as backfill in lieu of compacted earth.

The upper portion of the trench above the compacted portion shall be backfilled with material which is free from large rock. Incorporation of rock having a volume exceeding eight (8) cubic inches is prohibited. Backfilling this portion of the trench may be accomplished by any means approved by the Engineer. The trench backfill shall be heaped over or leveled as directed by the Engineer.

7.7.2 Method "B" - Backfilling under Sidewalks, and Unpaved Driveways - The entire trench shall be backfilled with No. 9 crushed stone.

7.7.3 Method "C" - Backfilling Under Streets and Paved Driveways - The lower portion of the trench, from the pipe bedding to a point six inches (6") below the bottom of the pavement or concrete sub-slab shall be backfilled with No. 9 crushed stone or fine gravel.

The upper portion of the trench, from a point 6 inches below the base of the pavement or concrete, shall be backfilled with a base course of dense graded aggregate. At such time that pavement placement is accomplished, the excess base course shall be removed as required.

7.8 TESTING OF LINES: The testing of water mains shall be accomplished by the developer in accordance with the procedures listed hereinafter. All testing shall be witnessed by the Engineer. Tests not witnessed by the Engineer shall be repeated at the developer's expense.

7.8.1 The developer will be required to test all pipelines and appurtenances with water. The maximum test pressure, measured at the lowest elevation of the pipeline being tested, shall be the pressure class of the pipe unless a specific test pressure is shown on the Drawings. The minimum test pressure shall be 1.5 times the design static pressure or 150 psi, whichever is greater.

7.8.2 When the line or section being tested is pumped up to the required pressure, it shall be valved off from the pump and a pressure gauge placed in the line. The pressure drop in

the line, if any, shall be noted. If no pressure drop is noted in 4 hours, the HWU, at its discretion, may accept the line or section as being tested, or HWU may require the test run the full 24 hours

- 7.8.3 At the end of the 24-hour test period, the pressure shall be recorded. If there is a drop in pressure, the developer shall be required to find and repair any leaks, and retest until there is no pressure drop over the test period.
 - 7.8.4 Regardless of the testing, all leaks that are evident, in the opinion of the engineer, due to water at the surface of the ground, or by listening, the leak can be heard underground with the geophone, or any other means of determining a leak, the developer shall be required to repair those leaks.
 - 7.8.5 The developer shall furnish the meter or suction tank, pipe test plugs, and bypass piping, and make all connections for conducting the above tests. The pumping equipment used shall be centrifugal pump, or other pumping equipment, which will not place shock pressures on the pipeline. Power plunger or positive displacement pumps will not be permitted for use on closed pipe system for any purpose.
 - 7.8.6 Inspection of pipe laying procedures shall in no way relieve the developer of the responsibility for passing tests or correcting poor workmanship.
 - 7.8.7 All testing will be observed by the Engineer.
 - 7.8.8 Test sections of water main shall not exceed 2500 feet in length. Inline valves are to be suitably located along the water main to accommodate this requirement.
- 7.9 **DISINFECTION:** Before any new section is put into service and prior to final acceptance, the developer shall disinfect all constructed water lines carrying treated water in accordance with AWWA C651, latest revision, and local and state regulations. All disinfection shall be witnessed by the Engineer. Tests not witnessed by the Engineer shall be repeated at the developer's expense.
- 7.9.1 Prior to starting disinfection, all water mains must be thoroughly flushed to remove debris. Disinfection will then be accomplished by the adding of the chlorine solution while filling the main to obtain the initial 50 ppm of chlorine. The developer shall supply all equipment, labor, etc. necessary for flushing and disinfecting the mains. The developer shall submit, in writing, to the Engineer, the method he proposes to use for adding the chlorine.
 - 7.9.2 Disinfection shall be accomplished by filling the new and/or repaired portions of the system with water having a chlorine content of at least 50 parts per million and at the end of a 24 hour contact time a residual of at least 25 parts per million shall remain. At the end of the 24-hour contact period, all the sterilized surfaces and areas shall be thoroughly flushed from the water system.
 - 7.9.3 For tie-ins to an existing system such as the use of tapping valves where keeping the main out of service would restrict service to existing customers, disinfection shall, at the ENGINEER'S discretion, consist of thoroughly cleaning the new part with a solution containing not less than 200 mg/l (ppm) chlorine.
 - 7.9.4 After initial disinfection and flushing, the developer will use a certified lab to collect water samples for bacteriological testing. A core zone, which includes up to the first ½ mile, shall be established. Two samples shall be taken from the core zone. Additionally, 1 sample taken from each mile of new distribution main shall be submitted to HWU. A new or routine replacement main shall not be placed in service until negative laboratory results

are obtained on the bacteriological analyses. Sample bottles shall be clearly identified as "special" construction tests. If any of the samples are found to be positive or contain confluent growth, the developer shall repeat the disinfection procedure until the required numbers of negative samples are obtained.

7.9.5 Certified results shall be presented to Engineer in writing before the new section is put in service. Engineer will then place the new section in service if usage connections are made and the section is ready for use. Under no circumstances are valves to be operated by anyone other than authorized utility personnel.

7.9.6 De-Chlorination: Chlorinated water shall be disposed of in accordance with 401 KAR 5:031 and 8:020 which state that the allowable in stream concentration of chlorine is 10 ug/l, which is equal to 0.01 mg/l. The developer shall submit, in writing to the Engineer, the method he proposes for dechlorinating. Recommended chemicals, as given in AWWA C651-86, are sulfur dioxide, sodium bisulfate, sodium sulfite, and sodium thiosulfate.

7.10 SERVICE CONNECTIONS: All new service lines, corporation stops and meter kits necessary for service up to and including the meter box shall be installed before water main is tested or put in service.

7.10.1 All new corporation stops are to be installed in the horizontal 3 o'clock or 9 o'clock positions in accordance with the standard drawing.

7.10.2 All taps on the water main shall be made with an AWWA approved tapping machine (no manual taps will be allowed). Saddles are not required for taps of 1" or smaller on ductile iron pipe. All other taps require the use of a service saddle. Saddles are required on all PVC pipe.

7.10.3 A standard setter kit shall be installed at locations as shown on the construction drawings and as per standard drawings.

7.10.4 Location of dual meter kit assembly shall be centered on property line.

7.11 REMOVAL AND REPLACEMENT OF EXISTING FACILITIES

7.11.1 Concrete Sidewalks, Curbs and Gutters - Where concrete sidewalks, curbs or gutters are cut or disturbed during the construction work, they shall be replaced in fully as good or better condition than that which existed prior to the contractor's operation.

When replacing concrete sidewalks, the existing concrete edges shall be trimmed straight 6 inches back of the trench sides or to the nearest joint as directed by the Engineer. The existing edges shall be cleaned and kept moist during pouring to insure a good bond with new concrete.

Sidewalk shall be formed, poured and cured in conformance with Section 4.2 of these specifications. Curbs and Gutters shall be formed, poured and cured in conformance with Section 4.3 of these specifications.

7.11.2 Concrete Pavement - Where Portland Cement concrete streets and driveways are removed, they shall be reconstructed to the original lines and grades and in such

manner as to leave all such surfaces in fully as good or better condition than existed prior to the operation.

The existing concreted paving shall be sawed or cut to straight edges 12 inches outside the edges of the trench or broken out to an existing joint.

Concrete pavement shall be formed, poured and cured in conformance with Section 3.5 of these specifications.

7.11.3 Asphalt Highway, Street and Driveway Replacement - The contractor shall replace those sections of existing alleys, streets and driveways which have been removed during construction. He shall reconstruct same to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to his operation.

Prior to trenching, the pavement shall be scored or cut to straight edges at least 12 inches outside each edge of proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be re-cut and trimmed to square, straight edges after the pipeline has been installed and prior to placing the new base and pavement.

Backfilling the trench shall be in accordance with the previous section on backfilling trenches. Base course for the paving shall be Dense Graded Aggregate and shall be placed in accordance with section 3.4 to a depth equal to the existing base course, but not less than 6 inches in streets and alleys, and 4 inches in driveways.

Pavement shall be replaced in conformance with Section 3.4 of these specifications.

7.12 LOCATING NEAR SEWER MAINS

7.12.1 Horizontal Separation – Water mains should be laid at least 10 feet, horizontally, from an existing or proposed sewer main. Should local conditions prevent a lateral separation of 10 feet, a water main may be laid closer than 10 feet to the sewer if:

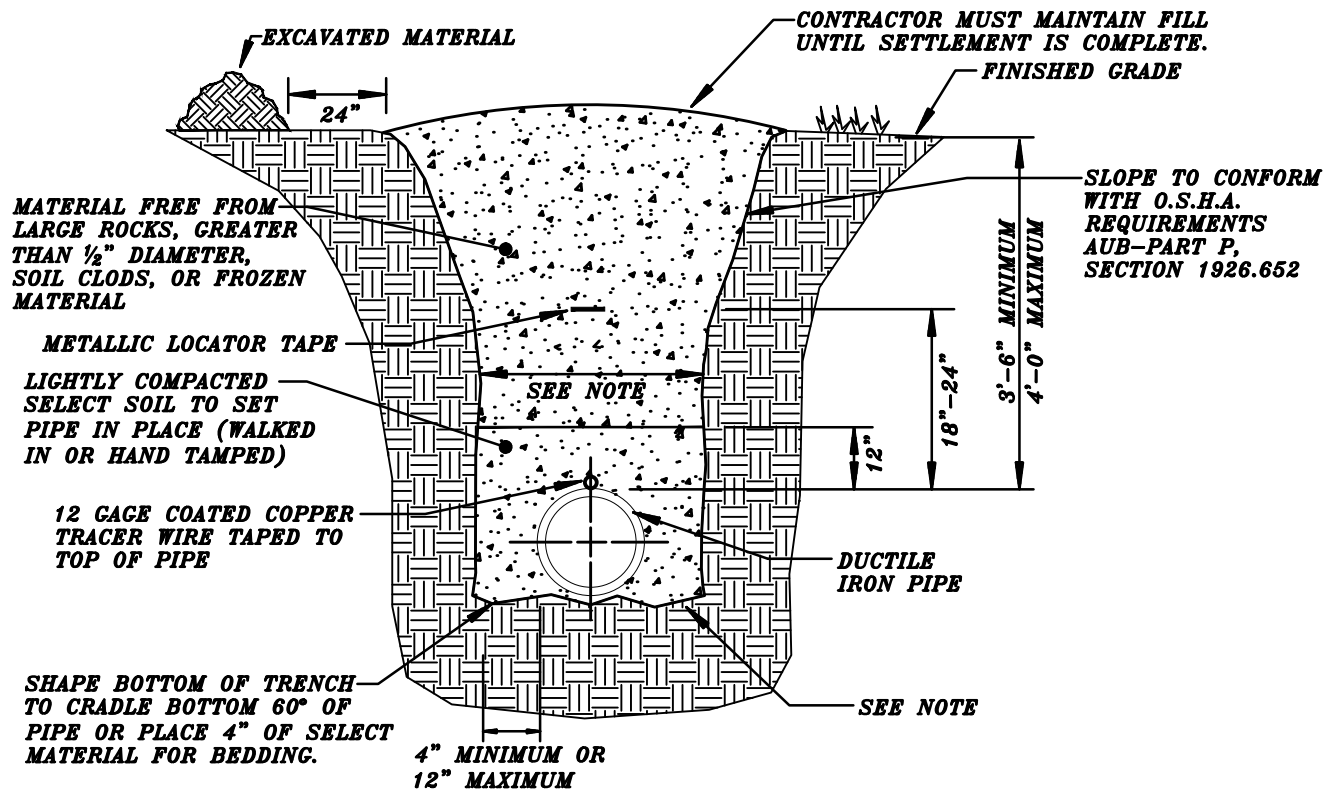
- a. It is laid in a separate trench.
- b. It is laid in the same trench with the sewer but is located on one side on a bench of undisturbed earth.
- c. In either case, the elevation of the top of the sewer is at least 18 inches below the bottom of the water main.

7.12.2 Vertical Separation - Whenever sewers must cross under water mains, the sewers shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirements, the sewer line shall be reconstructed with ductile iron pipe for a distance of 10 feet on each side of the water line. One full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible.

7.13 REPLACEMENT OF EXISTING MAIL BOXES, CLOTHES LINE POSTS, FENCES AND OTHER FACILITIES

- Existing mail boxes, clothes line posts, fences, etc., shall not be disturbed unless necessary, and if disturbed, shall be replaced in like or better condition as quickly as possible. When materials have not been damaged by the contractor's operations, they may be reused in replacing such facilities. Damaged materials shall be replaced with new materials of the same type at the contractor's expense.

7.14 CLEAN-UP - Upon completion of the installation of the water mains and appurtenances, the contractor shall remove all debris and surplus construction materials resulting from the work. The contractor shall grade the ground along each side of the pipe trench in a uniform and neat manner. Seeding and sodding, if required, shall meet the requirements of Section 6.18.



METHOD A

WATER MAIN: OPEN CUT INSTALLATION

NOTE:

TYPE A: BACKFILLING IN OPEN TERRAIN.

TYPE B: BACKFILLING UNDER SIDEWALKS AND UNPAVED DRIVEWAYS.

TYPE C: WHEN UNDER STREETS, ROADS, OR PAVED DRIVEWAYS, THE PIPE MUST BE PLACED ON TOP OF 6" OF #9 CRUSHED STONE. THE TRENCH MUST BE FILLED TO WITHIN 6" OF BASE OF ASPHALT WITH GRANULAR MATERIAL MEETING ROAD CUT PERMIT REQUIREMENTS. TAKE CARE NOT TO DAMAGE SOFT COPPER SERVICE LINES. THE TRENCH MUST BE FILLED TO GRADE WITH DENSE GRADE AGGREGATE.

PLACE BURIED METALLIC LOCATOR TAPE 18"-24" ABOVE TOP OF PIPE AS SHOWN. TAPE MUST CONTINUOUSLY READ: "CAUTION: BURIED WATER LINE BELOW". HOLES IN TRENCH BOTTOM FOR PIPE BELLS MUST BE PROVIDED AT EACH JOINT.

RAKE BOTTOM OF TRENCH WITH TEETH OF BUCKET TO A DEPTH OF 2"-4" TO LOOSEN SOIL.

BACKFILL TO SPRINGLINE WITH LIGHTLY COMPACTED BACKFILL MATERIAL.

MAINTAIN CONTINUITY OF TRACER WIRE AT ALL TIMES.

MAXIMUM WIDTH OF TRENCH TO BE 2'-0" + PIPE DIAMETER.

DRAWN BY	WFK
APPROVED BY	TDW
ORIGINATION	11/14/13
REVISION	-

EXHIBIT 7-1