

ORDINANCE NO. 2023-18

AN ORDINANCE OF THE CITY OF IOWA COLONY, TEXAS, FOR THE PURPOSE OF AMENDING THE IOWA COLONY ENGINEERING DESIGN CRITERIA MANUAL; REPLACING EARLIER VERSIONS OF THE DESIGN CRITERIA MANUAL, WITH EXCEPTIONS; REQUIRING COMPLIANCE; PROVIDING FOR DENIAL OR REVOCATION OF APPROVAL AND PERMITS DUE TO NONCOMPLIANCE; PROVIDING FOR OTHER REGULATIONS AND REQUIREMENTS; PROVIDING THAT A VIOLATION IS A MISDEMEANOR PUNISHABLE BY A FINE OF UP TO \$500 PER DAY; PROVIDING FOR OTHER PENALTIES AND REMEDIES; REPEALING PRIOR ORDINANCES ADOPTING OR AMENDING PRIOR DESIGN CRITERIA MANUALS, WITH EXCEPTIONS; AND PROVIDING FOR NONWAIVER BY NONENFORCEMENT, NONWAIVER OF IMMUNITY, NONLIABILITY OF THE CITY, A SEVERANCE CLAUSE, AND AN EFFECTIVE DATE

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF IOWA COLONY, TEXAS:

1. Adoption of Engineering Design Criteria Manual

That the attached City of Iowa Colony Engineering Design Criteria Manual (the "Engineering Design Criteria Manual" or "Design Criteria Manual") is hereby adopted and ordained, and the regulations and provisions therein stated are hereby established. Any reference in any other ordinance, policy, or other source to an engineering design criteria manual or design criteria manual of the City of Iowa Colony shall refer to the attached City of Iowa Colony Engineering Design Criteria Manual, as amended from time to time. Any reference herein to "this Ordinance" or similar terms shall also include the Engineering Design Criteria Manual hereby adopted, and that manual is a part of this ordinance.

2. Compliance Required

That any construction, planned construction, or plans for which a permit or approval from the City of Iowa Colony is required must be done in compliance with the Design Criteria Manual, according to its terms.

3. Denial or Revocation of Permits for Approval

That the failure of any plans, construction, or planned construction to comply with Design Criteria Manual shall be grounds for the City to deny or revoke any approval or permit from the City concerning such plans, construction, or planned construction.

4. Other Requirements

a. That the attached Engineering Design Criteria Manual replaces all prior Engineering Design Criteria Manuals of the City; provided, however, that to the extent of any vested rights under a prior version of the Design Criteria Manual, that prior version shall remain in effect.

b. That otherwise, the attached Engineering Design Criteria Manual is cumulative of all requirements from any other source and shall not authorize noncompliance with any other regulation or requirement from any source.

c. That in the event of any conflict in terms, the stricter requirement shall govern and control.

5. Offenses, Penalties, and Remedies

a. That any person who participates in any violation of any provision of this Ordinance shall be deemed guilty of a misdemeanor and, upon conviction, shall be fined in an amount not to exceed \$500.00. Each day or portion of a day a violation continues, occurs, or recurs shall constitute a separate offense.

b. That the City shall have the right to enforce this ordinance by injunction and by other actions in a civil court and/or by any and all remedies from any and all sources.

c. That all rights and remedies of the City provided in this ordinance shall be cumulative of all other rights and remedies provided herein, by other ordinances, or by any source.

d. That the exercise of any right or remedy by the City shall not be construed as an election of remedies and shall not impair any other right or remedy of the City. The City may exercise any right or remedy herein either alone or together with any other right or remedy under this ordinance, any other ordinance, or any applicable law. Without limiting the generality of the foregoing, pursuing or receiving any civil remedy for any violation of this ordinance shall not preclude the pursuit or receipt of any criminal penalty for any violation hereof.

6. Nonwaiver by Nonenforcement

That the failure or omission of the City, upon one or more occasions, to enforce any right, obligation, or remedy under this Ordinance or any other law concerning the subject matter hereof shall never be construed as a waiver of the City's right to strictly enforce such right, obligation, or remedy, and the City may resume such strict enforcement without advance notice.

7. **Nonwaiver of Immunity**

That nothing in this Ordinance shall ever be construed as a full or partial waiver of governmental immunity, official immunity, or any other immunity of the City or its officers, employees, agents, or representatives.

8. **Nonliability of City**

That neither the City, nor its officers, employees, agents, or representatives shall be liable to any person, other than the City, for any act, omission, or condition in any way concerning this ordinance or the subject matter hereof.

9. **Repeal**

That this ordinance repeals all prior ordinances adopting or amending any prior versions of the Design Criteria Manual, except that such prior ordinances shall remain in effect only as to prosecution and other enforcement concerning violations accruing while those ordinances were in effect.

10. **Severance Clause**

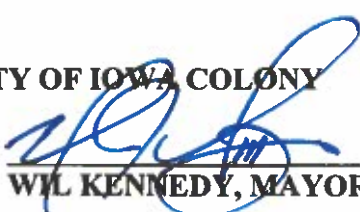
That if any part of this ordinance, of whatever size, is ever declared invalid or unenforceable for any reason, the remainder of this ordinance shall remain in full force and effect.

11. **Effective Date**

That this ordinance shall be effective immediately upon its passage and approval.

PASSED AND APPROVED ON JULY 17, 2023.

CITY OF IOWA COLONY

By: 

WIL KENNEDY, MAYOR

ATTEST:


KAYLEN ROSSER, CITY SECRETARY





ENGINEERING DESIGN CRITERIA MANUAL

Originally adopted as on July 20, 2009

Amended:

November 15, 2010

August 17, 2017

September 17, 2018

June 10, 2019

November 18, 2019

December 19, 2019

May 18, 2020

July 20, 2020

Adopted by the Iowa Colony City Council

Approved: DATE

Ordinance No. 2023-XX

Prepared by:

ADICO
CONSULTING ENGINEERS

**CITY OF IOWA COLONY
ENGINEERING DESIGN CRITERIA MANUAL**

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CHAPTER 1

GENERAL REQUIREMENTS

CHAPTER 1 – GENERAL REQUIREMENTS

1.1 GENERAL

- 1.1.1 This Manual describes the general requirements for the preparation of construction plans and the supporting documents required for submittal and approval by the City of Iowa Colony. Specific design requirements, in addition to these standards, may be required by the City of Iowa Colony.
- 1.1.2 Construction plans for public or private improvements within Iowa Colony city limits shall be approved by the City of Iowa Colony and applicable Drainage District. Construction plans for public or private improvements within the City of Iowa Colony extraterritorial jurisdiction (ETJ) shall be reviewed and approved by the City of Iowa Colony, Brazoria County Engineering Department, respective Municipal Utility Districts, and applicable Drainage District.
- 1.1.3 All projects that are required to conform to these Standards shall also comply with all applicable City of Iowa Colony ordinances.
- 1.1.4 All construction plans and supporting documentation shall conform to the requirements of these Standards and regulations of all Federal, State, County, and any other entities having jurisdiction.

1.2 PRELIMINARY RESEARCH

- 1.2.1 Personnel from the City will be available for preliminary meetings to discuss a proposed project with the project engineer and/or developer, if requested. This preliminary meeting between the City and the engineer/developer should be scheduled with the City Secretary before submittal of any documents for review.
- 1.2.2 Research of all existing utility and right-of-way information with City, County, State, and other public and private utility agencies shall be completed and documented prior to submittal of any plans to the City.

1.3 FEES

- 1.3.1 All plan review, plat review, and permit fees shall be paid to the City before beginning construction on a project. Please refer to the City's Official Fee Schedule.

1.4 DESIGN REVIEW REQUIREMENTS FOR PUBLIC OR PRIVATE IMPROVEMENTS

- 1.4.1 Submit one (1) copy of construction plans, one (1) digital copy (pdf) and supporting documentation to the City for review. Plans will be circulated to the appropriate departments for their review. Comments will be issued to the applicant in a timely manner.

- 1.4.2 Based on the trip estimates for the proposed development, a Traffic Impact Analysis may be required to determine any necessary traffic mitigation measures.
- 1.4.3 A Final Drainage plan must be approved and signed by the appropriate Drainage District prior to submitting to City of Iowa Colony for final plan approval.
- 1.4.4 After all comments have been adequately addressed, submit letter addressing the comments, including noting any revision to the plans and one copy of the revised construction plans and pdf to the City for final approval.
- 1.4.5 After final approval has been granted, submit original mylar sheets to the City for approval signatures, along with electronic files as per Section 2.2.4.
- 1.4.6 Submit two (2) copy and one (1) digital file (PDF) of the approved construction plans to the permit office at the time permitting for Engineering file and inspection.
- 1.4.7 All separate or special easements that may be required for construction shall be recorded with the plat prior to final approval. If platting is not required as part of the project, then record all easements prior to final approval.

1.5 CONSTRUCTION AND ACCEPTANCE REQUIREMENTS FOR PUBLIC INFRASTRUCTURE PROJECTS

- 1.5.1 Refer to the City of Iowa Colony's Construction, Inspection, Approval and Acceptance Procedures for Public Infrastructure.

1.6 APPROVALS AND VARIANCES

- 1.6.1 Approvals required in these Standards are the responsibility of the Owner. Failure to obtain appropriate approvals may be grounds for suspension of construction until appropriate approvals are granted. Items that do not conform to these Standards shall be submitted for a variance request.
- 1.6.2 Variances, as required by these Standards, shall be requested by the Owner prior to, or at the time of, submittal of review plans for the project. In order to be valid, all variance items must be granted by the City Administrator upon written recommendation by the City Engineer.
- 1.6.3 Construction work related to any variance item should not begin until the City has granted approval. Design engineer shall submit a Design Criteria Modification form for variance requests. Any work that proceeds without approval will be subject to removal and replacement, at no cost to the City, in accordance with these Standards.



CHAPTER 2

GRAPHIC REQUIREMENTS

CHAPTER 2 – GRAPHIC REQUIREMENTS

2.1 REQUIRED PLAN SHEETS

- 2.1.1 Cover Sheet
- 2.1.2 Plat (latest version of the plat shall be included in the drawings)
- 2.1.3 Construction Notes and Legend
- 2.1.4 Overall Layouts for Proposed Improvements (Water and Sewer, Drainage, Paving, etc.)
- 2.1.5 Drainage Area Map and Calculations
- 2.1.6 Lot Grading Plan
- 2.1.7 Plan and Profiles
- 2.1.8 Storm Water Pollution Prevention Plan
- 2.1.9 Specific Construction Details
- 2.1.10 Standard City of Iowa Colony Construction details

2.2 DRAWING REQUIREMENTS

- 2.2.1 Provide a cover sheet for all projects involving three or more drawings (including detail sheets). Plan sheet numbers and names shall be shown on the cover sheet. Include a vicinity map to identify project location within the City. Provide the City of Iowa Colony signature block for the City Engineer and Mayor with a note stating that approval is valid for 1 year only from date of signatures. Provide a signature block for the City Engineer on all internal sheets. Signature blocks is provided in Appendix “B”.
- 2.2.2 Drawings shall be prepared on nominal 24 inch x 36 inch overall drawings.
- 2.2.3 Show service area on cover sheet or area map.
- 2.2.4 After final approval has been granted, submit drawings with mylars on India ink or produced by on mylars. The engineer shall also submit, at this time, electronic AutoCAD (.dwg) and digital file in (PDF) file(s) of all construction plan sheets on digital versatile disk (DVD).

- 2.2.5 Details of special structures (not covered by approved standard drawings, such as stream or gully crossings, special manholes, or junction boxes, etc.) shall be drawn with vertical and horizontal scales equal to each other.
- 2.2.6 Each set of construction drawings shall contain overall paving and utility layout drawings indexing specific plan and profile sheets. Show all lot lines, property lines, rights-of-way lines and easement lines. Standard City drawings, where applicable, shall be included. All sheets shall have standard title blocks.
- 2.2.7 Draw overall layouts to a scale of 1 inch = 50 feet, 60 feet, 100 feet, or 200 feet.
- 2.2.8 Plan stationing must run from left to right, except for short streets or lines originating from a major intersection, where the full length can be shown on one sheet.
- 2.2.9 A north arrow is required on all sheets and should be oriented either toward the top or to the right.
- 2.2.10 Standard scales permitted for plans and profiles of paving and utility construction drawings are as follows:
- A. Major thoroughfares, streets with esplanades over 400 feet in length, or special intersections/situations:
 - a. 1 inch = 10 feet horizontal, 1 inch = 1 foot vertical
 - b. 1 inch = 20 feet horizontal, 1 inch = 2 feet vertical
 - B. Minor or residential single family streets:
 - a. 1 inch = 20 feet horizontal, 1 inch = 2 feet vertical
 - b. 1 inch = 40 feet horizontal, 1 inch = 4 feet vertical
 - c. 1 inch = 50 feet horizontal, 1 inch = 5 feet vertical
- 2.2.11 Each sheet of the plans shall have a benchmark elevation and description, along with applicable flood plain information. Include Base Flood Elevation, FIRM panel number and flood zone designation. All files shall be designed to State Plane Coordinate System – South Central 4204, NAD 83.
- 2.2.12 The seal, date, and original signature of the Licensed Professional Engineer responsible for the drawings shall be required on each sheet developed by the engineer. The engineer may use a stamped or embossed imprint for his seal; however, the embossed imprint must be shaded such that it will reproduce on prints.
- 2.2.13 If a roadway exists where drawings are being prepared to improve or construct new pavement or a utility, label the existing roadway width, surface type, and thickness, if available without destruction of pavement. Pavement thickness can be ascertained by coring. The resultant void shall be grout-filled.

- 2.2.14 Show all streets and/or roadway alignments on all drawings.
- 2.2.15 Develop drawings to accurate scale showing proposed pavement, typical cross-sections, details, lines and grade, all existing topography within street right-of-way, and any easement adjacent to the right of way. At intersections, the cross-street details shall be shown at sufficient distance (20 feet minimum distance outside the primary roadway right-of-way) in each direction along the cross-street.
- 2.2.16 Match lines shall not be placed at cross-street intersection for roadway alignment.
- 2.2.17 Natural ground profiles shall be shown as follows:
- A. For privately-funded projects, centerline profiles are satisfactory except where a difference of 0.50 feet or more exists from one right-of-way or easement line to the other, in which case, dual profiles are required.
 - B. For the City of Iowa Colony projects, provide natural ground profiles for each right-of-way line. Easement profiles shall also conform to this requirement.
- 2.2.18 Identify all lot lines, property lines, easements, right-of-way, and drainage outfalls.
- 2.2.19 Label each plan sheet as to street/easement widths, pavement widths, pavement thickness where applicable, type of roadway materials, curbs, intersection radii, curve data, stationing, existing utilities (type and location), and any other pertinent feature affecting design.
- 2.2.20 Show all utility lines four inches or larger within the rights-of-way or construction easement in profile view. Show all utility lines, regardless of size, in the plan view, including fiber optic cables.
- 2.2.21 Graphically, show flowline elevations and direction of flow for all existing ditches.
- 2.2.22 Label proposed top of curb grades except at railroad crossings. Centerline grades are acceptable only for paving without curbs and gutters.
- 2.2.23 Curb return elevations for turnouts shall be shown in profiles.
- 2.2.24 The surface elevation at the property line of all existing driveways shall be shown in profile.
- 2.2.25 Station all esplanade noses or the centerline of all esplanade openings with esplanade width shown - both existing and proposed.
- 2.2.26 The design of both roadways is required on all paving sections with an esplanade.
- 2.2.27 Station all point of curvatures (PC) and point of tangency (PT), radius returns, and grade change point of intersection (PI) in plan view. Station all radius returns and grade change PIs in profile with their respective elevations.

- 2.2.28 Standard City Details shall be included, when applicable.
- 2.2.29 All property ownership and easement recordation information shall be shown on the plans.
- 2.2.30 Provide stormwater pollution prevention plan, including details on all public and private projects.

2.3 EASEMENTS

- 2.3.1 All easements and recording information, existing and proposed, shall be shown on the construction plans.
- 2.3.2 Storm sewer, sanitary sewer, and water line easements shall be dedicated for the specific intended use. Easements for a specific facility shall be exclusive and shall not overlap other easements, except to cross the easements.
- 2.3.3 Dry Utility Easements shall be sixteen-feet (16').

2.4 UTILITY LOCATIONS

- 2.4.1 All utilities shall be underground with the exception of electric primary lines. The electric primary lines, defined as feeders or three phase lines, should be located around the subdivision perimeter whenever possible.
- 2.4.2 Water Line Location
 - A. All water lines shall be located within a public right-of-way or within dedicated water line easements. The location of water lines within a public street right-of-way is described in Section 3.3.3.
 - B. Water lines shall not be located in combination easements.
- 2.4.3 Sanitary Sewer Location
 - A. Sanitary sewers of twelve inches (12") or larger in diameter are usually located within a public right-of-way or an easement adjoining the right-of-way. Sanitary sewers may be located in exclusive or combination easements provided the easement widths comply with Section 2.3.
 - B. Sanitary sewers shall not be located in side lot easements.
 - C. Sanitary sewers should be located within the right-of-way between the property line

and the back of curb on the opposite side of the right-of-way from the water main.

2.4.4 Storm Sewers

- A. Storm sewers shall be located in the public street right-of-way in accordance with Section 5.3.6.E.c.
- B. All storm sewer lines shall be located within public rights-of-way or approved easements. Placement of a storm sewer in side lot and back lot easements is discouraged.

2.5 PRIVATE FACILITY LOCATIONS

- 2.5.1 Installation of private facilities, including utilities, in public road rights-of-way and their adjoining easements shall be approved by the City of Iowa Colony.
- 2.5.2 Private facilities shall not conflict with other facilities in the right-of-way and shall not be located in exclusive easements as required in these Standards. All structures within the public right-of-way require approval from the City Engineer and shall be located so as to not interfere with existing or proposed public facilities.
- 2.5.3 All facilities in the right-of-way shall be located at least two feet (2') behind the curb and all underground facilities in the right-of-way shall be located at least two and one-half feet (2.5') below the top of curb on a public street.
- 2.5.4 Private facilities shall be constructed in accordance with construction plans approved by the City Engineer.
- 2.5.5 Landscaping within the public right-of-way or adjoining easements shall not affect public utilities or traffic visibility.

2.6 CROSSINGS

2.6.1 Highway Crossings - All State and County Roads

- A. State Highway crossings shall be constructed in conformance with the requirements of the Texas Department of Transportation.
- B. A water main shall be encased in a steel pipe casing extending at least five feet (5') from outside edge of each service road or outside edge of pavement, across the right-of-way to a similar location on the other side of the highway. For highway or roadway crossing with open ditches, the casings shall extend from right-of-way to right-of-way.

- C. County road crossing shall be constructed in accordance with Brazoria County requirements.
- D. Where additional right-of-way has been acquired or will be required for future widening, the casing, where required, should be carried to within ten feet (10') of each future right-of-way line.

2.6.2 Street Crossings

- A. All water main and sprinkler line crossings under major thoroughfare boulevards shall be encased. For all water mains, steel casing shall be used. For fire sprinkler lines, SDR 26 PVC or welded steel pipe shall be used.
- B. Conduits and sewers that do not carry liquid under pressure may be bored and jacked or microtunneled into place without an encasement pipe.
- C. Crossings under existing concrete streets shall be constructed by boring and jacking or microtunneling. PVC pipe shall be jacked into place using equipment designed for that purpose. Water may be used to facilitate the boring and jacking operations. Jetting the pipe main into the place will not be allowed. When conditions exist that warrant open cut across an existing street, specific approval by the City Engineer is required.
- D. All street crossings shall be constructed in accordance with construction plans approved by the City. All street crossings shall be inspected by the City. All street crossings shall meet the requirements of these Standards.

2.6.3 Railroad and Pipeline Crossings

- A. For railroad crossings, the carrier pipe shall be encased in steel pipe casing extending from right-of-way to right-of-way.
- B. All construction within the railroad or pipeline right-of-way shall conform to minimum requirements set out in the agreement with the owner of the right-of-way.

2.6.4 Ditch and Stream Crossings

- A. Aerial crossings attached to the vehicular bridge structure are preferred by the City.
- B. Where existing or proposed bridges have sufficient space and structural capacity for installing water mains or conduits (twelve inches (12") or smaller) under the bridge, but above the top of the bent cap elevation, such installation will be permitted upon

specific approval of the construction plans. In all cases, the water main or conduit shall be above the bottom chord of the bridge and eighteen inches (18") above the 100-year water surface elevation. All conduits attached to a bridge shall be constructed using steel pipe and shall extend a minimum of ten feet (10') beyond the bridge bent or to the right-of-way line, whichever is greater. All conduit attached to a bridge shall be maintained by the owner of the conduit or will be subject to removal.

- C. Separate, free-standing crossings across drainage ways are discouraged.
- D. All stream or ditch crossings shall be constructed of steel pipe from right-of-way to right-of-way.

2.7 TRENCH SAFETY

- 2.7.1 Trench safety is required for all excavations greater than five feet (5') in depth, and shall conform to all applicable OSHA regulations.

2.8 BENCH MARKS

- 2.8.1 A permanent benchmark shall be set in each subdivision section or at a spacing of one mile, whichever is greater. The benchmark shall have an elevation based on the North American Vertical Datum of 1988 (NAVD 88), current adjustment.
- 2.8.2 The benchmark elevation and location shall be certified by a registered public surveyor as a Texas Society of Professional Surveyors (TSPS) Standard and Specifications for Category 8, TSPS Third Order Vertical Control Survey.
- 2.8.3 Accuracy of elevations for benchmarks shall be Texas Society of Professional Surveyors Category 8, Third Order.
- 2.8.4 All benchmark locations shall be provided with ties to existing monuments including coordinates based on the North American Datum of 1983 (NAD 83), Texas State Plane Coordinate System, South Central Zone.
- 2.8.5 Benchmarks shall be constructed of a brass disc set in concrete. The concrete footing for the bench mark shall be eight inches (8") in diameter and three feet (3') deep. Concrete shall be reinforced with two number four (2-#4) bars.
- 2.8.6 The construction plans shall clearly identify the location of the benchmark and shall include a complete description, coordinates and elevation, with adjustment date, of the benchmark.

2.9 RESIDENTIAL LOTS AND IMPROVEMENTS

- 2.9.1 All residential lots shall drain to a public right-of-way directly adjoining the lot. Drainage from a residential lot to a public right-of-way at the rear or side of a lot may be permitted provided the drainage system has been properly designed to accept the flow. Drainage from a residential lot to an adjoining greenbelt or golf course shall require a public easement for drainage purposes to be maintained by the homeowner's association or appropriate entity. Drainage to a private easement shall be noted on the recorded subdivision plat. Drainage to a drainage district easement shall be approved by applicable Drainage District.
- 2.9.2 A lot grading plan showing proposed minimum slab elevations shall be included in the construction plans. If slab elevations do not change, a notice of minimum elevation will suffice.

2.11 FLOOD PLAIN MANAGEMENT

- 2.10.1 The City Engineer is the acting flood plain manager for the City of Iowa Colony. All flood plain development within city limits or the ETJ shall be reviewed and approved by the City Engineer.
- 2.10.2 Amendments to the published flood insurance rate maps, map revisions and all requests for changes to the base flood elevation within Iowa Colony city limits or its ETJ shall be submitted to the City Engineer for review.
- 2.10.3 All data submitted shall be prepared under the supervision of a registered professional engineer and/or a registered public surveyor and shall comply with all requirements of the Federal Emergency Management Agency National Flood Insurance Program Regulations.



CHAPTER 3

WATER SYSTEM DESIGN CRITERIA

CHAPTER 3 – WATER SYSTEM DESIGN

3.1 WATER SYSTEM DESIGN GENERAL

- 3.1.1 Criteria for the design of water service and water distribution lines are herein established. All water lines constructed within the City of Iowa Colony or its Extraterritorial Jurisdiction (ETJ) shall follow these criteria.
- 3.1.2 Design, construction and sizing of all water mains and appurtenances shall meet or exceed the requirements of the Texas Commission of Environmental Quality (TCEQ) as per 30 TAC Chapter 290 and the Texas Board of Insurance (TBI).
- 3.1.3 The public water system shall not extend beyond the individual water meter. All water line construction in public rights-of-way up to and including construction to the water meter shall conform to these standards.
- 3.1.4 Design and construction shall conform to the City of Iowa Colony standard details and specifications.
- 3.1.5 For developments with multiple phases, consultant shall provide an overall general plan of the proposed water distribution system prior to approval of the first phase of development.

3.2 DEFINITIONS

- 3.2.1 Water line – Closed conduit designed to distribute potable water to various locations for human consumption, and to provide fire protection. Line size and fire protection accessory locations are dependent on distance from primary source and quantity of demand.

3.3 DESIGN REQUIREMENTS

- 3.3.1 Easements: The following minimum easements are required when facilities are not located within public street rights-of-way:
 - A. Fire hydrants located outside of public rights-of-way or water line easements shall be encompassed by a ten-foot by ten-foot (10'x10'), exclusive, easement. Fire hydrants shall not be located within any other type of easements.
 - B. Water meter easements shall be exclusive and should be located adjoining a public right-of-way or water line easement.
 - C. Two-inch (2") and smaller meters serving non-residential and multi-family developments shall be located inside rights-of-way, water line easements, or in a

minimum 5-foot by 5-foot (5'x5') exclusive water meter easement.

- D. Three-inch (3") and larger meters shall be set in a minimum of ten-foot by twenty-foot (10'x20') exclusive, water meter easements.
- E. Water lines may be located in easements not adjacent to public street rights-of-way. These water lines shall be centered in a fifteen foot (15') wide exclusive easement restricted to water only.
- F. For new construction, any water line, except at a fire hydrant, located less than five feet (5') from the right-of-way line and within the right-of-way shall have a water line easement adjoining the right-of-way. Water line easements adjoining a right-of-way shall have a minimum width of five feet (10').
- G. Water lines should be located at the center of a ten-foot (10') water line easement, provided the easement adjoins the public right-of-way.

3.3.2 Water Lines:

- A. Locate water lines within street rights-of-way, public utility easements, or dedicated water line easements:
 - a. No less than a 4-inch water line is allowed.
 - b. A dead end 4-inch line may supply a maximum of 10 lots, shall not exceed 400 feet in length, and shall terminate with a blow off or loop back. Fire hydrants are not allowed on a 4-inch line.
 - c. Six-inch interconnected/looped mains shall be a maximum of 800 feet long, and shall be supported on both ends by an 8-inch main or larger. Dead end 6-inch lines shall not be more than six hundred feet (600') in length and shall terminate with a blow-off valve. Only one fire hydrant or flushing valve is allowed on any length of 6-inch diameter line.
 - d. Except when 4-inch and 6-inch diameter lines are permitted under the above criteria, all water lines shall have a minimum diameter of 8-inches.
 - e. Ten inch diameter water line is not permitted.
 - f. Pipe with a minimum 12-inch diameter should be used for lines greater than 2000 feet in length as determined by the Professional Engineer of Record and the City of Iowa Colony.
 - g. Dead-end lines:

- (1) Dead-end lines should be avoided whenever possible, and may only be considered when a looped or interconnected water main system is not nearby.
- (2) The design of all water distribution systems should include the opportunity for future looping or interconnect of any approved or proposed dead-end line. Waterline line shall be extended to the boundary of the development along public right-of-way as required for future connection.
- (3) Dead-end lines within public right-of-way:
 - (a) On permanent dead-end lines not serving residential cul-de-sacs, the line shall be 8 inches in diameter and shall not exceed more than 700 feet in length from the closest interconnection main line and shall terminate with a fire hydrant, flushing valve or blow-off valve.
 - (b) In temporary dead-end situations or if the possibility for future extension of the water line exists, do not reduce pipe sizes successively. Carry 8-inch diameter pipe to the last appurtenance or the plug. Place the last service as near as possible to the end and install a standard blow off valve and box at the end of the 8-inch diameter line. The maximum length of such a line shall be 700 feet.
 - (c) In unavoidable permanent dead-end situations, reduce the sizes of pipe successively. Carry a 6-inch pipe to the last fire hydrant, then use 4-inch pipe to the end of the line (400' maximum). Install a 2-inch blow-off valve at the end of the 4-inch diameter line.
- (4) Water lines located in a public easement on private property in multi-family residential applications with 1 or more fire hydrants or flushing valves shall be 8-inch diameter with an interconnection to at least 2 supply sources when possible.
 - (a) Appropriately sized domestic service shall be taken from the 8-inch lines.
 - (b) If requested, the design engineer shall submit water/hydraulic modeling data to the City Engineer demonstrating that adequate water pressures can be maintained given projected water demand in non-single family residential applications.

- (c) The design engineer shall submit water/hydraulic-modeling data to the City Engineer demonstrating that fire flow capacity is available for the non-single family residential applications.
- h. Side lot water line placement is discouraged. Where side lot water line placement is unavoidable, install water line in continuous steel casing pipe, centered in a 20-foot wide dedicated water line easement. Extend the casing uninterrupted from right-of-way to right-of-way. No horizontal or vertical deflections are allowed. Construct encased water line of ductile iron or restrained joint bell and spigot pipe to prevent lateral movement. Provide and install casing spacers and end seals. This item shall only apply to publicly maintained lines.
- B. Layout and size of all water lines shall be consistent with the overall layout and phasing plan of the City's water system. The overall water system shall be designed to maintain adequate operating pressure throughout the system.
- C. Chlorination: All newly installed water lines shall have to pass bacteriological testing before being accepted for maintenance by the City of Iowa Colony. All costs associated with the testing shall be the responsibility of the owner.
- D. Pressure Testing: All newly installed water lines shall be flushed and pressure tested before being accepted for maintenance by the City of Iowa Colony. All costs associated with the testing shall be the responsibility of the owner.

3.3.3 Location

- A. Locate water lines within street rights-of-way.
- B. Boulevard streets: Water lines shall not be located within the esplanade.
- C. Locations within an easement: Locate water lines in the center of exclusive dedicated water line easements.
- D. When a water line is placed parallel to any other proposed or existing utility line, other than a sanitary sewer, the water line shall have a minimum of 4 feet horizontal clearance from the outside wall of the existing utility to the outside wall of the proposed water line.
- E. A minimum distance of 4 feet shall be maintained from the right-of-way or easement line to the outside edge of the water line.

3.3.4 Depth of Cover (See Table 3.1)

- A. Provide the minimum depths of cover shown in Table 3.1 from the top of finished grade behind the curb for curb-and-gutter streets, or from the lowest elevation of the nearby ditch bottom for roadside ditch street sections, whichever is applicable.
- B. Whenever possible, changes in grade or alignment to clear utilities or underground features should be accomplished by deflecting pipe joints. The maximum designed deflection shall be ½ of the manufacturer's allowable deflection. The use of regular bends for any change of grade shall not be allowed.
- C. If a depth greater than 8 feet or less than 4 feet to the top of the pipe is proposed, use restrained joint pipe, ductile iron, or other comparable high hoop strength material pipe, and continue for all areas where the depth of cover exceeds 8 feet or is less than 4 feet.
 - a. All transitions from ductile iron pipe to other water line material shall be constructed using electrically isolated flange joints.
 - b. Ductile iron or other comparable high hoop strength material pipe shall be pressure class 350.

Table 3.1 DEPTH OF COVER FOR WATER LINES		
SIZE OF LINE	DEPTH OF COVER*	
	TOP-OF-CURB	OPEN-DITCH
8-INCH & SMALLER	4 FEET	4 FEET below ultimate flow line
12-INCH & LARGER	5 FEET	5 FEET below ultimate flow line

*When crossing easements whose owning or governing agency has stricter depth of cover criteria than that shown in Table 3.1, the more stringent of the two shall apply.

3.3.5 Appurtenances

- A. Do not place appurtenances in pavement when the appurtenance would be covered in whole or in part by pavement. Gate valves may be placed in sidewalks provided that the top of the valve box is flush with the finished elevation with 24" x 24" blockout.
- B. All water system valves shall conform with AWWA standards and shall include:
 - a. Cast iron valve boxes are required on all valves less than or equal to 16 inches. Valve vaults are required on all valves 20 inches and larger.
 - b. All valves shall be sized to equal the size of the water main on which it is located.
 - c. All valves shall have 24" X 24" concentric collar per detail.

C. Valves

- a. Spacing – set at maximum distances along the water line as follows:
 - (1) 8" & Smaller – 1000 feet.
 - (2) 12" & Larger – 2000 feet.
 - (3) The total number of valves at any water line intersection shall equal the total number of lines leading out from the intersection point minus one.
 - (4) Refer to standard specifications for tapping sleeve & valve.
- b. Location
 - (1) Valves must be located at street intersections along the street right-of-way lines projected across the water line where possible. Tapping sleeve and valves are excluded from this requirement.
 - (2) Isolate fire hydrants and flushing valves from the service main with a valve located in the fire hydrant or flushing valve lead. This valve should not be located in the slope or flow line of roadside ditches.
 - (3) Intermediate valves, not located on the projection of the right-of-way line, shall be located on lot lines or 5 feet from fire hydrants, but shall not be set in a driveway.
 - (4) Locate valves a minimum of 10 feet horizontally away (either direction) from any sanitary sewer crossing.
 - (5) Valves located near reducers shall be located on the smaller diameter pipe.
 - (6) All water mains shall be valved within the street right-of-way or dedicated water line easement. Valves shall not be placed under or within 2 feet of ultimate pavement, when it is known that the street will be widened in the future.
 - (7) Valves shall be placed at the end of all water mains that are to be extended in the future and the main shall be extended a minimum of two pipe joint past the valve.
- c. Valve Type

- (1) 16" & smaller – Gate Valve
- (2) 20" & larger – Butterfly Valve

D. Fire Hydrants

a. Spacing

- (1) Single family residential development – 500 foot maximum spacing.
- (2) All other development – 300 foot spacing.

b. Location in or along street right-of-way

- (1) Locate fire hydrants primarily at or near street intersections.
- (2) Locate fire hydrants at the end of a curb radius of a street intersection, 3 feet behind back of curb or projected future curb in a curb & gutter road construction.
- (3) On streets with roadside ditches, set the fire hydrants within 5 feet of rights-of-way lines. Fire hydrant lead valves should not be located in the slopes or flow lines of ditches.
- (4) Set fire hydrants not located at intersections or block corners at mid-lot or on lot lines, as extended to pavement, when located between right-of-way intersections. These locations may be adjusted 5 feet either way to avoid driveways or obstructions. In either case, do not locate fire hydrants closer than 5 feet from driveways.
- (5) Fire hydrants are not allowed in esplanades of streets.
- (6) On all Texas Department Transportation (TXDOT) rights-of-way, the fire hydrant and flushing valve set-backs from the edge of right-of-way shall adhere to TXDOT criteria.

c. Location of fire hydrants or flushing valves outside street rights-of-way and in public easements:

- (1) City review and approval is required for all submitted locations of fire hydrants and flushing valves in all developments within the City of Iowa Colony and its ETJ.
- (2) Locate fire hydrant and flushing valves in protected, easily accessible areas behind curb lines.

- (3) For fire hydrants or flushing valves that are located adjacent to water lines constructed in 10 foot wide water line easements, the fire hydrant or flushing valve shall be centered in a minimum 10 foot by 10 foot separate easement.
 - (4) For non-residential developments in the City of Iowa Colony, provide isolation valves at each end of fire loops requiring on-site fire hydrants.
- d. Fire hydrant leads shall be designed to have a minimum 4 foot bury where possible. Bends may be used on the fire hydrant branch to maintain a 4 foot bury or a 3 foot back of curb set-back.
 - e. Do not install fire hydrants within 10 feet vertically or horizontally of sanitary sewers and force mains.

E. Fittings

- a. Fittings shall be Ductile Iron.
- b. Use plugs with retention clamps and carrying the designation "plug and clamp." Thrust blocking is required for dead-end lines that are plugged.
- c. Concrete thrust blocking shall be required on all bends, tees, plugs, and combinations thereof.
- d. All fittings and fire hydrants to be tied together with $\frac{3}{4}$ inch stainless steel all threads and I-bolts or with restrained joint fittings.
- e. All water main joints shall be push on joints. Mechanical joints may be used for above ground water line installations.
- f. All fittings are to be double wrapped in 6 mil plastic.

F. Ductile Iron Pipe

- a. Ductile iron pipe shall be provided with polyethylene encasement. Provide minimum 2 wraps of 8-mil polyethylene, or
- b. Polyethylene tube encasement shall conform with the minimum requirements of "Polyethylene Encasement for Gray and Ductile Cast Iron Piping for Water and other Liquids," ANSI/AWWA C-105, current revision. Soils within the project shall be tested to adequately determine the requirements of the encasement. Appendix A of ANSI/AWWA C-105 shall be consulted where

questions regarding soil conditions and encasement arise.

3.3.6 Water Meter Service

- A. All water meters shall be installed by and inspected by the City of Iowa Colony
- B. A water meter permit must be obtained from the City of Iowa Colony prior to installation.
- C. Stub outs for future water service are not allowed except where part of a preapproved master plan, site plan development plan or tract development plan.
- D. In new residential developments, water service lines shall be provided for all lots on the opposite side of the street. Services shall normally be at lot lines with a ¾ inch minimum size to serve a single lot and 1 inch minimum for two lots. Lines shall be SDR-9 polyethylene. The City of Iowa Colony Building Inspector should be consulted to ensure the properly sized meter is selected for any proposed service.
- E. Water service leads from the water main to the water meter shall be placed at a minimum 4 foot below final paving elevations.
- F. Water Meter Service for Lines in or Along Rights-Of-Way
 - a. Meters 2 inches and smaller: Locate inside rights-of-way, water line easements, or in a minimum 5-foot by 5-foot exclusive water meter easement. Provide concrete meter boxes for meters located in sidewalks. Meters shall be located in areas with easy access and protection from traffic.
 - b. Meters 3 inches and larger: Locate in minimum 10'x20' separate water meter easement:
 - (1) Meters shall be located in areas with easy access and protection from traffic, and adjacent to rights-of-way whenever possible.
 - (2) Meters shall not be located in areas enclosed by fences.
 - c. Separate taps and service leads shall be designed for each meter. Meter, line size, and appurtenances shall conform to the latest edition of the Uniform Plumbing Code.
 - d. Water meters shall be Hydrus Ultrasonic Water Meter by Diehl Metering.
- G. Meter boxes shall be located just within the public right-of-way if possible. Location of meters in the ditch of open ditch streets shall be avoided. Meter boxes shall be installed no more than 2 inches above grade.

- H. For proposed multi-family developments, provide one master meter sized for the entire development. An above-ground, reduced pressure, zone-type backflow preventer shall be installed on the water line downstream from the meter.
- I. For commercial developments with private on-site water mains for fire protection (i.e. not in a dedicated water line easement), provide fire service meters adjacent to the public right-of-way. If a dual (fire and domestic) feed is desired, both feeds shall be metered. An above-ground, reduced pressure, zone-type backflow preventer shall be installed on the water lines downstream from the meters.

3.3.7 Water Line Crossings within the City of Iowa Colony

- A. Public and private utility crossings other than sanitary sewer: Where a water line crosses another utility other than a sanitary sewer, a minimum of 12 inches of clearance must be maintained between the outside wall of the water line and the outside wall of the utility.
- B. Stream or ditch crossings
 - a. Elevated crossings
 - (1) Water lines shall be steel, ductile iron pipe, or other comparable high hoop strength material and shall extend a minimum of 15 feet beyond the last bend or to the right of way line, whichever is greater.
 - (2) Elevated crossings are preferred to underground crossings.
 - (3) Crossings attached to vehicular bridges are preferred to separate elevated water line structures.
 - (4) For new vehicular bridge construction, include provisions for attaching a water line.
 - (a) Adequate structural capacity shall have been calculated and provided for, including considerations for pipe deflection and all applicable loading.
 - (b) Clearance for maintenance purposes above bent cap elevation shall be provided where elevated water lines are to be run under bridges.
 - (5) For new water line crossings near existing vehicular bridges, a separate elevated water line structure shall be constructed.
 - (6) Design all elevated crossings with the elevation of the bottom of the

water line 2 feet above the 100-year water surface elevation in the channel.

- (7) Create a high point in the elevated stream or ditch crossing and provide an air release valve at that highest point of the water line.
- (8) Provide sufficient span length to accommodate the cross section of future widening of the stream or ditch to ultimate cross section.
- (9) Base the columns' support designs on soil capacity, spacing, loading, and all pertinent structural requirements.
- (10) Spacing of supports shall consider effect of support on channel hydraulics and be subject to city approval.
- (11) Provide pedestrian pipe guards on elevated crossings.

b. Underground Crossings

- (1) Provide a minimum 5 foot clearance from the top of the pipeline to the ultimate flow line of the ditch.
- (2) Provide sufficient length to exceed the ultimate future development of the stream or ditch.
- (3) Water lines shall be Class 150, C-900 or ductile iron pipe and shall extend a minimum of 40 feet beyond the last bend or to the right of way line, whichever is greater.
- (4) Restrained Joints shall be used.
- (5) Locate valves on each side of the crossing.
- (6) Where other agencies have review authority or jurisdiction and have different underground crossing requirements, the more stringent of the two shall apply.

C. State Highway and County Road Crossings

- a. Extend steel carrier pipe from 5' on each side beyond the edge of pavement.
- b. The approval of the design by the appropriate governmental agency shall be demonstrated to the City of Iowa Colony before plans will be approved.

- c. Where additional right-of-way has been acquired for future widening, the casing shall extend to the future right-of-way line.

D. Railroad Crossings

- a. For main line and spur line railroad crossings, the water line shall meet the requirements of the governing agency and such requirements shall be followed from 5 feet beyond each right-of-way line and across the right-of-way itself. Any deviation must be approved by the railroad companies.
- b. Where there is no railroad but a railroad owned easement or right-of-way, as a minimum, extend a steel casing from right-of-way to right-of-way line.
- c. The approval of the design concept by the railroad involved must be obtained and demonstrated to the City of Iowa Colony before plans will be approved.

E. Additional Requirements

- a. Use isolated flange joints for transitions between two dissimilar metallic pipes. Isolate water lines from casing with spacers and supports.
- b. The carrier pipeline shall extend a minimum of 1-foot beyond the end of the casing to allow flanged joints to be constructed if necessary.

F. Oil and Gas Pipeline Crossings

Use PVC pipe when crossing a non-service transmission pipeline regardless of depth. All non-service transmission pipeline crossings must have the approval of the company whose lines are being crossed. Maintain a minimum 2 foot vertical separation between the pipeline and the water line.

G. Fire flow Water line Loops within Non-Residential Developments

For non-residential developments inside the City of Iowa Colony requesting on-site water mains, comply with the following requirements to allow maintenance and future repair operations if the City of Iowa Colony will be the entity maintaining the water main:

- a. Avoid laying any new water lines under proposed or existing pavement, but where unavoidable, provide minimum 10 foot expansion joints (free joints) in the easement over the water line.
- b. Fire flow water line loops within non-residential developments that are to be maintained by the City of Iowa Colony shall be placed in a 20-foot wide water line easement that shall be dedicated to the City.

- c. There shall be no structures or equipment pads constructed over a publicly maintained water line.

3.3.8 Auger Construction: Use the following general criteria for establishing auger, bore and jack, or microtunneling sections when site conditions require their use. Identify the sections on the construction drawings.

- A. Improved streets – Use auger or microtunneling construction to cross a street regardless of surface. Auger or microtunneling length shall be computed as roadway width at the proposed bore location plus a minimum of 10 feet to either side of roadway.
- B. Driveways – Use auger or microtunneling construction to cross improved driveways. Bore and jack, auger or microtunneling length shall be a minimum of the driveway's width.

3.3.9 Circulation and Flushing for Water Quality: The layout of the water distribution system shall provide for maximum circulation of water.

- A. Provide a source of fresh water at each end or at multiple points of a subdivision or development. Provide ways to create circulation and place valves and fire hydrants to allow simple flushing of lines.
- B. Where stubs are provided for future extensions, isolate the stubs with a valve and no service connections will be allowed beyond the valve before the line is extended. Place two full joint of pipe between the valve and the plug.

3.3.10 New Water Lines Constructed Near Sanitary Sewers, Force Mains and Manholes

- A. New Water Lines Parallel to Sanitary Sewer and Force Mains: Locate water lines a minimum of 10 feet horizontally, outside wall to outside wall, when parallel to sanitary sewers and force mains. Use the following procedure when site conditions prohibit achieving 10 feet of separation:
 - a. When a new water line is to parallel an existing sanitary sewer force main or gravity sewer and the 10 foot minimum separation cannot be achieved, the existing sanitary sewer shall be replaced with lined ductile iron pipe, SDR-26 with pressure gaskets, or PVC C-900 150 psi pipe or better and equipped with pressure type joints.
 - b. The water lines and sanitary sewer shall be separated by a minimum vertical distance of 2 feet and at least 4 feet horizontally (per 30 TAC 290.44)

measured between the nearest outside walls of the pipes, where the water line shall always be located above the sewer.

B. New Water Lines Crossing New and Existing Sanitary Sewers and Force Mains

- a. No protection is required if the sanitary sewer is 10 feet below the water line.
- b. Use the protective requirements given in Table 3.2 and 3.3 for sanitary sewer crossings not 10 feet below the water line.

C. Sanitary Sewer Manholes: Provide a minimum 10 foot horizontal clearance from outside wall of existing or proposed manholes, make manholes and connecting sewers watertight and test for leakage. If a 10 foot clearance cannot be obtained, the water line may be located closer to the manhole when prior approval has been obtained from the City Engineer by using one of the procedures below; however, in no case shall the clearance be less than 4 feet.

- a. The City of Iowa Colony may require the water line to be encased when site conditions dictate or when the water line is within 5 feet of a manhole. The carrier pipe shall be a minimum of 1 joint of 150 psi pressure class pipe at least 20 feet long and two nominal sizes larger than the water conveyance pipe.
- b. The water line may be augured, bore & jacked, or microtunneled past the manhole with at least one 20 foot section of 150 psi pressure pipe installed centered about the existing sanitary manhole with pressure grouting of the annular space using a bentonite/clay mixture or other commercial grouts.

Table 3.2 WATER LINE – SANITARY SEWER CROSSINGS

PRIMARY CONDITION	PROPOSED WATER EXISTING SANITARY				PROPOSED WATER PROPOSED SANITARY OR EXISTING WATER PROPOSED SANITARY			
SECONDARY CONDITIONS	WATER OVER SANITARY		WATER UNDER SANITARY		WATER OVER SANITARY		WATER UNDER SANITARY	
IF THE CLEARANCE IS	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'
*Protection Requirement	1	2	3	4a or 4b	5	6a	3	6b & 6c

***PROTECTION REQUIREMENTS FOR SANITARY SEWER CROSSINGS (All clearances shall be measured
from outside wall to outside wall)**

1. One 20-foot joint of C-900 or C-905 PVC, 150 psi centered over sanitary sewer; 12-inch minimum clearance.
2. If no evidence of sanitary sewer leakage, center one joint of water line over sanitary sewer; 24-inch minimum clearance. If the sewer line is leaking, the sewer line shall be replaced with 150 psi lined ductile iron pipe or other approved pressure pipe with appropriate adapters on all portions of the sanitary sewer within 10 feet of the water line.
3. Not allowed.
4.
 - a. Auger, bore & jack or microtunnel 10 feet minimum each side of sanitary sewer. Place one 20-foot joint of C-900 or C905, 150 psi, centered under sanitary sewer. Fill bore hole with bentonite/clay mixture or grout; 2 foot minimum clearance. OR
 - b. Replace the existing sanitary sewer with 150 psi lined ductile iron pipe, C-900 or other approved pressure pipe with appropriate adapters on all portions of the sanitary sewer within 10 feet of the water line.
5. Minimum 20 foot joint of sanitary sewer, 150 psi lined ductile iron pipe, C-900 or other approved pressure pipe centered at the water line, 6 inch minimum clearance. Also center an 20 foot joint of water line over the sanitary sewer line. The sanitary sewer line shall be embedded in cement stabilized sand for one pipe segment plus 1 foot beyond each joint.
6.
 - a. Center a minimum 20 foot joint of sanitary sewer, 150 psi, lined ductile iron pipe, C-900 or other approved pressure pipe on water line.
 - b. Use cement stabilized sand backfill for all portions of the sewer within 10 feet of the water line, as measured perpendicularly from any point on the water pipe to the wastewater pipe (minimum 2.5 sacks cement per cubic yard of sand). The cement-stabilized sand bedding shall start at a point 6 inches below the bottom of the sanitary sewer to 6 inches above the top of the sanitary sewer and one quarter of the pipe diameter on either side of the sewer.
 - c. Center a minimum 20 foot joint of water line on the sanitary sewer line.

Table 3.3 PROTECTION REQUIREMENTS AT WATER LINE – FORCE MAIN CROSSINGS

PRIMARY CONDITION	PROPOSED WATER EXISTING FORCE MAIN				PROPOSED WATER PROPOSED FORCE MAIN OR EXISTING WATER PROPOSED FORCE MAIN			
SECONDARY CONDITIONS	WATER OVER FORCE MAIN		WATER UNDER FORCE MAIN		WATER OVER FORCE MAIN		WATER UNDER FORCE MAIN	
IF THE CLEARANCE IS	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'
*Protection Requirement	1	2	3	4a or 4b	5	6a	3	6a & 6b

***PROTECTION REQUIREMENTS FOR FORCE MAIN CROSSINGS (All clearances shall be measured from outside wall to outside wall)**

1. Construct water line with a 20-foot ductile iron section with all related appurtenances centered above the force main; 6-inch minimum clearance.
2. Construct water line with one 20 foot joint of C-900 or C-905 150 psi PVC centered above the force main.
3. Not allowed.
4.
 - a. Auger, bore & jack or microtunnel 10 feet minimum each side of force main. Place one 20-foot joint of C-900 or C905, 150 psi, centered under sanitary sewer. Fill bore hole with bentonite/clay mixture or grout; 2 foot minimum clearance. OR
 - b. Replace the existing force main with 150 psi lined ductile iron pipe with appropriate adapters on all portions of the force main within 10 feet of the water line.
5. Center a minimum 20 foot joint of force main, 150 psi lined ductile iron pipe under water line and use cement-stabilized sand backfill for all portions of the sanitary sewer force main with 10 feet of the water line as measured perpendicularly from any point on the water pipe to the sanitary sewer force main pipe (minimum 2.5 sacks cement per cubic yard of sand). The cement-stabilized sand bedding shall be from a point 6 inches below the bottom of the sanitary sewer force main to 6 inches above the top of the sanitary sewer force main and one quarter of the pipe diameter of the sanitary sewer force main on either side of the sanitary sewer force main.
6. Minimum 20 foot of sanitary sewer force main, 150 psi lined ductile iron pipe centered at the water line.

3.4 QUALITY ASSURANCE

- 3.4.1 Prepare calculations and drawings prepared under the supervision of a Texas Professional Engineer trained and licensed under the disciplines required by the nature of the drawings. The final design drawings, must be sealed, signed and dated by the Professional Engineer responsible for development of the drawings.
- 3.4.2 For Elevated Stream and Ditch Crossings: Prepare design calculations for support columns and column spacing.

3.5 RECLAIMED WATER

- 3.5.1 Reclaimed water facilities shall meet or exceed the requirements of the TCEQ, as per 30 TAC Chapter 321, Subchapter P.



CHAPTER 4

SANITARY SEWER DESIGN CRITERIA

CHAPTER 4 – SANITARY SEWER DESIGN

4.1 SANITARY SEWER DESIGN GENERAL

- 4.1.1 Criteria for the design of sanitary sewer service and collection lines are herein established. All sanitary sewer lines constructed within the City of Iowa Colony or its Extraterritorial Jurisdiction (ETJ) shall follow these criteria and be in agreement with the City of Iowa Colony Comprehensive Plan.
- 4.1.2 Design, construction and sizing of all sanitary sewer systems shall meet or exceed the requirements of the Texas Commission of Environmental Quality (TCEQ) as per 30 TAC Chapter 217.
- 4.1.3 The “City of Iowa Colony” for the purposes of these criteria shall consist of all land within the city limits, and land located within the City’s ETJ.
- 4.1.4 Design and construction shall conform to the City of Iowa Colony construction details and construction specifications.
- 4.1.5 This chapter addresses the design of the sanitary sewer systems to be located within the public right-of-way or a dedicated public easement. Sanitary sewers located on private property that are not in a dedicated public easement shall not be considered part of the publicly maintained sanitary sewer system.
- 4.1.6 The approving authority for the City of Iowa Colony with respect to the sanitary sewer system design criteria shall be the City Engineer.
- 4.1.7 For developments with multiple phases, consultant shall provide an overall general plan of the proposed wastewater collection system, including location of proposed lift station prior to approval of the first phase of development.
- 4.1.8 Wastewater collection system shall be designed to minimize the need for lift stations.

4.2 DEFINITIONS

- 4.2.1 Public Sanitary Sewer - Sewers that are maintained by the City of Iowa Colony and located in dedicated public easements or street rights-of-way, including pre-existing sanitary sewer lines that are serving the public at the time of the adoption of these regulations, and new public sanitary sewers that are installed in accordance with these standards.
- 4.2.2 Private Sewer – Sewers that are constructed and maintained by a private entity. Private sewers shall be located on private property. Private sewers are subject to the design and construction requirements of the Plumbing Code.

- 4.2.3 Sanitary Sewer Main – A sewer which receives the flow from one or more lateral sewers.
- 4.2.4 Lateral Sewer – A sewer running laterally down a street, alley or easement which receives flow from abutting property.
- 4.2.5 Service Lead – A sewer which branches off of a public sewer and extends to the limits of the public right-of-way. It shall be construed as having reference to a public sewer branching off from a main or lateral sewer to serve one or more houses, single family lots, or other types of small land tracts situated in the same block, but not directly adjacent to the main or lateral sewer. A service lead shall never exceed 100 feet in perpendicular length from the intersecting sewer main or lateral. If the sewer is designed to serve more than two houses, or the equivalent of two single family residences along a street, a lateral sewer as defined above shall be constructed.
- 4.2.6 Stack - A riser pipe constructed on main or lateral sewers which are deeper than 6 feet to facilitate construction of service leads or service connections.
- 4.2.7 Force Main - A pressure-rated conduit (i.e. ductile iron pipe, pressure-rated PVC, etc.) which conveys wastewater from a pump station to a discharge point.

4.3 DESIGN REQUIREMENTS

4.3.1 Easements: Sanitary Sewer Easements – the following minimum easements are required when facilities are not located within public street rights-of-way:

- A. The width of all exclusive sanitary sewer easements shall be equal to the depth of the sewer from finished grade plus two (2) pipe diameters, rounded up to the nearest multiple of 5-feet. Sewer shall be located in the center of the easement. The minimum width of a sanitary easement shall be twenty (20') when not adjacent to public street rights-of-way.
- B. Exclusive sanitary sewer easement adjoining a public right-of-way shall be a minimum of ten feet (10').
- C. Exclusive easements for force mains of all sizes shall have a minimum width easement of fifteen feet (15') for a single force main where the force main is not located adjacent to a public right-of-way. Where the force main is located in an easement adjacent to public rights-of-way, the force main may be located at the center of a ten-foot (10') easement. Where the force main is located less than five feet (5') from the right-of-way line within the public right-of-way, the minimum easement width shall be ten feet (10') adjacent to the right-of-way.
- D. Combined storm and sanitary sewer easements shall have minimum widths as required in Section 2.3.6 for storm sewer easements. Additionally, the sanitary sewer main, trunk or force main shall be located such that the centerline of the pipe shall be

located in at least half the width of the easement, as defined in Section 2.3.5.C, but not less than seven and one-half feet (7.5'), from the edge of the easement.

- E. For combined storm and sanitary sewer easements located adjacent to public rights-of-way where the sanitary sewer is located along the outside of the easement, the centerline of the sanitary sewer pipe shall be located in at least half the width of the easement defined in Section 2.3.5.C, but not less than seven and one-half feet (7.5') from the outside edge of the easement.
- F. Where sanitary sewers or force mains are installed in easements separated from public rights-of-way by other private or utility company easements, the sanitary sewer easement should be extended along or across the private utility company easement to provide access for maintenance of the sewer or force main.

4.3.2 Drawings to be Furnished

- A. Before any sanitary sewer main or lateral sewer is constructed and before the City will approve any proposed sanitary sewer for construction, plan-and-profile sheets of the proposed sanitary sewer shall be prepared and submitted to the City for approval.
- B. These drawings shall become the property of the City of Iowa Colony.
- C. Drawings shall include at a minimum layout sheets with contours, plan-and-profile sheets, and details sheets for special items.
- D. The construction drawings shall show at a minimum the exact location of the proposed sanitary sewer in the right-of-way, alley, or public easement with respect to the edge of the particular right-of-way, survey base line, any nearby utilities, 100-year floodplain elevation within the project area, major landscaping, and other structures (above ground and below ground) within the construction site.

4.3.3 Sanitary Sewer Mains and Lateral Sewers

- A. Sanitary sewers shall be identified by number, letter, or other identification as shown on the sanitary sewer layout sheet and manholes shall be identified by letter or number.
- B. Sanitary sewers must be shown in both plan and profile views.
- C. The profile shall show other underground and surface utilities and facilities, both in parallel and at crossings; the size, grade, and type of pipe of the proposed line, the elevations of the proposed line to the hundredths of a foot at manholes, changes of grade and clean outs where allowed; and the proposed finished grade over the sewer

with elevations. Where proposed fill or cut is contemplated, the proposed new natural ground line should be shown as a separate line from the pre-existing natural ground line. Type of pipe, bedding and backfill shall comply with City of Iowa Colony standard specifications and standard details, or if not available, shall comply with the City of Houston standard specifications and standard details.

- D. The construction drawings shall show the existing natural ground line at either the right-of-way or edge of easement when the proposed sanitary sewer is to be placed:
 - a. Between the existing pavement and the right-of-way line.
 - b. Between existing pavement and an existing or proposed easement.
- E. When a sanitary sewer is located under existing pavement, then the finished elevations of the pavement shall be shown on the construction drawings.

4.3.4 Plan and Profile Required for Sewer Mains

- A. Sanitary sewer overall layout sheets for single family residential subdivisions should use a standard engineering scale large enough to show the entire project on preferably one, but no more than two, standard 24"x36" sheets. In all cases, the following information must be shown on the layout.
 - a. All easements containing or buffering sanitary sewers, including corresponding recording information, if recorded by separate instrument.
 - b. Sanitary sewer sizes are shown at points of size change and between all manholes.
 - c. All manhole locations.
 - d. The sanitary sewer alignment shall accurately reflect in the plan and profile sheets the location of the sanitary sewer as shown on the detailed plan view. Alignment shall be stationed with 100-ft. stations.
 - e. Service leads that cross street pavement or serve adjacent property are to be shown on the overall layout.
 - f. The number, size, and layout of the lots depicted on both the overall sanitary sewer layout sheet and the individual plan-and-profile sheets shall match the number and size of the lots depicted on the final plat after recordation.

- g. The direction of flow for existing and proposed sanitary sewers shall be shown on the overall sanitary sewer layout sheet.
 - h. The location of the proposed sanitary sewer within either the public right-of-way or a dedicated public easement.
 - i. The overall sanitary sewer layout sheet shall show the area, in acres or in number of lots plus any acreage outside the project area, which the proposed sewer is designed to serve. Include a vicinity map which references the project or lots to nearby major thoroughfares.
- B. Commercial sanitary sewer layouts shall follow the same overall layout sheet format.
- C. Horizontal and vertical scales for the detailed plan-and-profile views shall be confined to standard engineering scales.
- D. The plan view shall show, at a minimum, all of the following information for the project area:
 - a. Topographical features.
 - b. Stationing for the proposed sewers.
 - c. All existing utilities including gas, power, telephone, fiber optic, cable etc.
 - d. Any significant landscaping or other structures which might impact construction or construction-related activities.
 - e. The width and type of existing and/or proposed easements.
 - f. Proposed service leads.
 - g. The limits of any proposed bore and jack, microtunnel, or auger operations.
 - h. Locations where pressure pipe is to be installed for water line crossings.
 - i. The proposed sanitary sewer with pipe diameter, length, material type, and grade clearly labeled.
- E. The profile view shall show, at a minimum, all of the following information for the project area:
 - a. Underground and surface utilities/facilities which are either parallel to the proposed sanitary sewer or cross the proposed sanitary sewer within the construction site.

- b. The proposed sanitary sewer's diameter, grade, length, and material type for each section between manholes. This shall be labeled on every applicable page and identified as "proposed."
 - c. The flowline elevation and centerline station for every sanitary sewer at every manhole.
 - d. The top of rim elevation of affected existing and proposed manholes.
 - e. The flowline elevation and centerline station at each sheet break.
 - f. The type of pipe bedding and backfill shall comply with City of Iowa Colony standard specifications and standard details where applicable.
 - g. The finished grade for proposed and existing pavement. Where cut and fill are proposed, the proposed new natural ground line should be shown as a separate line from the existing natural ground line.
 - h. The existing natural ground line at the centerline of the sanitary sewer when a sewer is to be placed between the edge of pavement and the public right-of-way. In the cases where roadside ditches exist, the centerline elevations of the roadside ditch shall be shown.
 - i. The existing ground line at the centerline of the proposed sanitary sewer where a sanitary sewer is to be placed within an existing easement. Show any proposed cut and fill as described above.
 - j. The limits of any proposed bore and jack, microtunnel, or auger operations.
 - k. Locations and limits of where pressure pipe is to be installed for water line crossings.
 - l. The location of special backfill and any proposed stacks shall be identified by stations indicated on the design plans.
 - m. Avoid vertical breaks in profiles. Use alternate scale for all profile sheets if all of proposed sanitary sewer cannot be shown on any one profile section for the station run indicated in plan view for that sheet.
- F. All construction drawings for new sanitary sewers shall show the proposed location, by stations and offsets, of all service leads, and service connection risers.

4.3.5 Service Lead Construction for Residential and Commercial Developments

- A. Space the location of service leads so as to limit the number of service lead taps to the lateral sewer or sewer main. Service leads should be spaced at every other property line between two adjoining residential lots unless there is an odd number of lots. The City reserves the right to direct the engineer to relocate any proposed service lead upon reviewing any submitted plans. A single 6-inch service lead located at the property line between two adjoining residential lots would serve two single-family residences with a wye placed at the end of the service lead. The wyes shall be located at the private property line.
 - a. Near side double sewer service leads shall not exceed 5 feet in length, shall terminate at the property line, and shall be located within the public right-of-way or public easement.
 - b. In cases where the sanitary trunk main is further than 5 feet from edge of the right-of-way, a single 6-inch service shall be run from the sewer main to the edge of the right-of-way whereupon a wye shall be placed as described above. This shall apply to residential sanitary service leads and not to commercial service taps.
- B. Any far side service lead of more than 150 feet perpendicular to the street right-of-way shall be treated as a lateral sewer.
- C. Service leads for single-family developments should connect to the manhole whenever practical. Commercial or industrial service leads expected to discharge more than 5000 gallons-per-day shall discharge directly into a proposed or existing sanitary sewer manhole. Where the flowline of the service lead is 30 inches or greater above the flow line of the manhole, provide a standard drop manhole.
 - a. Service leads shall be provided to serve each lot or parcel within a proposed residential, commercial or industrial development. The detail for a typical near-side and far-side service leads shall be included with the construction drawings.
 - b. Service leads shall be a minimum of 6 inches in diameter where two or more lots or parcels are served. If the perpendicular length of a service lead exceeds 100 feet, it shall be considered a lateral sewer, the minimum diameter shall be 8 inches, it shall end in a manhole, and a manhole shall be utilized for connection to the public sewer.
 - c. In such cases where a service lead is proposed to run diagonally across the street, prior approval from the City Engineer must be obtained.
 - d. Service leads with a diameter of 6 inches shall utilize full body fittings be they extruded or factory-fabricated for connection to a proposed public sewer

or an approved saddle-type connector for connection to an existing public sewer.

- e. PVC saddle-type connectors with gasket and stainless steel straps shall be installed with the stub oriented 45 degrees from the springline. Tees may be oriented the in the same manner.
- f. The service lead shall be placed so as to minimize the use of bends as site conditions permit.
- g. For existing residential lots (which are not served in accordance with these guidelines) that need a service lead, if the distance to the nearest existing sanitary sewer is less than 60 feet, the service lead shall be a 6 inch service tap if only one lot or parcel is to be served. Commercial and industrial lots and parcels shall have a minimum 6 inch service tap under the same conditions.
- h. The location where the service lead or wye meets the property line shall be shown on the plans and as-builts, and marked in the field as shown on the standard details. There shall be a riser placed where the service lead meets the property line so that the service lead stub-out can be recovered at the time that the connection to the service lead is made.
- i. All service leads shall be installed at the time of the construction of the sanitary sewer in new residential subdivisions.

4.3.6 General Requirements

- A. A licensed plumber shall be responsible for connecting private residential sanitary sewer service to the public sanitary sewer system, to wyes and/or tees or to lateral sewers as indicated on the plans. Said licensed plumber shall be responsible for a properly installed and watertight private residential service connection.
- B. Commercial service connections to the public sanitary sewer shall be made at manholes.
- C. Materials and construction shall conform to the City of Iowa Colony Standard Specifications and Standard Details where applicable.
- D. All constructed sanitary sewer lines shall be air tested for leaks and a mandrel pulled for structural defects. All sanitary sewer testing shall comply with or exceed the procedures and qualifications listed in Texas Administrative Code, Chapter 217.57. Manhole testing shall comply with or exceed the procedures and qualifications listed in Texas Administrative Code, Chapter 217.58.

- E. All public sanitary sewers and service leads shall have bedding and backfill that shall comply with or exceed City of Iowa Colony Standard Specifications and Details. Those sanitary sewers that are bore and jacked, microtunneled, augured, or encased in a steel pipe may require special bedding and backfill.
- F. Backfill shall be in accordance with Standard Details.
- G. Public sanitary sewers and force mains shall be located in either the public right-of-way or public easements. Side lot and back lot easements are not allowed. The location of the sanitary sewer within a dedicated public easement shall be along the centerline of the proposed public easement or as close to the centerline as can be designed. In those instances where the public easement is adjacent to the public right-of-way, the lateral location of the sanitary sewer shall be at the discretion of the Design Engineer with City approval.
- H. The drawings of the sanitary sewer shall show the location of any existing pipe or duct that might interfere with the construction of the sanitary sewer and call to the attention of the City any known obstacles that might be encountered in constructing the sanitary sewer in any location under consideration. The Professional Engineer of Record shall determine the existence of pipes, ducts, obstacles and other utilities (i.e. gas, telephone, electric, fiber optic, cable, etc.) from a visual survey on the ground plus research of the public records and private records when available.
- I. Sanitary sewers within the City of Iowa Colony's jurisdiction shall be designed and installed at such a size and depth as to allow for orderly expansion of the system, so as to avoid duplication in the future.
- J. Sanitary sewers shall be separated from water lines by a minimum of 9 feet of horizontal clearance. See Chapter 3 Water System Design for water and sanitary sewer crossing design criteria.
- K. Sanitary sewers shall be separated from storm sewer lines by a minimum of 4 feet of horizontal clearance and the storm sewer line shall be above the sanitary line where possible.
- L. For sanitary sewers crossing utilities other than water or storm sewer (i.e. gas, telephone, electric, fiber optic, cable, etc.) a minimum of 12 inches of horizontal clearance shall be maintained as measured from outside wall to outside wall.

4.3.7 Line Size

- A. The minimum pipe diameter for a public sanitary sewer main or lateral sewer other than a service lead shall be 8 inches.

- B. Service leads 6 inches in diameter shall not serve more than the equivalent of 2 single family lots or other equivalent types of small land tracts. Four inch service leads are not allowed.
- C. Service leads for single family residential lots shall have a recommended grade of 0.70% and a minimum grade of 0.50% for a 6 inch line.
- D. For commercial service leads such as street bores, the required size of the line shall be established from the plumbing drawings. Commercial, industrial, and office areas shall be designed for an average daily flow that can be anticipated from the contributing service area.
- E. Commercial sewer service leads shall be 6 inch pipe or larger. A single 6 inch commercial service connection shall not serve more than one commercial lot or parcel. Four inch service leads for commercial developments are not allowed.
- F. Sewer mains and lateral sewers shall meet at a manhole. Sewer mains and lateral sewers shall end in a manhole.
- G. The City Engineer shall have final review and approval authority as to the size and depths required for sanitary sewer mains and lateral sewers.

4.3.8 Line Depth

- A. The sanitary sewer should be laid with the top of the pipe a minimum of 4 feet below the surface of the natural ground or finished grade.
- B. Sanitary sewers laid in street rights-of-way with a curb and gutter section shall have a minimum cover of 4 feet from the top of the pipe to the flowline elevation of the gutter in the street at all locations. The Professional Engineer of Record shall account for any anticipated future sanitary sewer extension whereas the future sanitary sewer extension shall have a minimum 4 feet of cover from the top of the pipe to the flowline of the gutter of the street. The Professional Engineer of Record shall adjust the depth of the proposed pipe accordingly. The City of Iowa Colony reserves the right to require greater depth where the need is perceived by the City.
- C. Sanitary sewers laid in street rights-of-way with crowned roads and roadside ditches shall have a minimum depth of 5 feet from the crown of the road to the top of the pipe and an absolute minimum cover of 4 feet below the flowline of a roadside ditch when non-rigid pipes of low hoop strength are used. The City of Iowa Colony shall have final determination on any deviation from these criteria.
- D. Where the cover over the pipe is less than 4 feet, the sanitary sewer shall be laid with

Class 150 pressure pipe, steel pipe or ductile iron pipe. Class 150 pressure pipe must be backfill with cement stabilized sand in accordance with the Standard Details. Ductile iron pipe may be used but shall be lined with either a polyethylene or polyurethane coating with manufacturer recommendation and applied by the pipe manufacturer. The minimum liner thickness shall be 40 mil. Other rigid pipe or pressure pipe will be considered for approval on a case-by-case basis.

- E. Maximum depth for 8-12 inch diameter collection lines shall be 20 feet from average ground surface to sanitary sewer invert. Depths greater than 20 feet shall require the use of Class 150 pressure pipe with backfill in accordance with the Standard Details. Ductile iron pipe may be used but shall be lined with either a polyethylene or polyurethane coating with manufacturer recommendation and applied by the pipe manufacturer. The minimum liner thickness shall be 40 mil.

4.3.9 Line Grades

- A. The following table lists the minimum grade for 6-inch to 27-inch diameter public sanitary sewers. The recommended velocity for a sanitary sewer flowing full shall be 2.3 feet per second (fps). The minimum velocity for a sanitary sewer flowing full shall be 2.0 feet per second (fps). The maximum recommended grade shall be calculated by the Professional Engineer of Record for a maximum velocity of 4.5 fps based on a Manning equation for full flow with the Manning's "n" equal to 0.013.

PIPE SIZE (I.D., In.)	MINIMUM GRADE (PERCENT)
6	0.70
8	0.44
10	0.33
12	0.26
15	0.19
18	0.15
21	0.13
24	0.11
27	0.087

- B. For sewers larger than 27 inches in diameter, the Professional Engineer of Record shall determine the appropriate grade utilizing Manning's Formula, using a minimum full pipe velocity of 2.fps.

4.3.10 Gravity sanitary sewers shall be laid in straight alignment with uniform grade between manholes. Non-uniform grade change without the use of manholes at the grade change is not allowed.

4.3.11 Manholes

- A. Type: Manholes shall be precast concrete manholes in accordance with the standard

detail. All sanitary sewer manholes shall be Corrosion Resistant Manholes per city detail. It shall be the responsibility of the Professional Engineer of Record to ensure that the precast manholes conform to the latest ASTM requirements. Manhole covers shall have the City of Iowa Colony logo on them. All manholes shall be installed with stainless steel manhole inserts with 1/8 inch vents, strap handles and bolts .

B. Location: Manholes shall be placed at changes in alignment, changes in grade, changes in size of sanitary sewers, at the intersection of sanitary sewers, junction points, and either at street, alley, or easement intersections.

a. The maximum distance between manholes shall be determined from the following table for 8 inch to 48 inch pipe diameters. Spacing for manholes on sewer mains with diameters larger than 48 inches shall be recommended on an individual basis by the Professional Engineer of Record subject to City of Iowa Colony approval.

PIPE DIAMETER IN INCHES	MANHOLE MAXIMUM SPACING IN FEET
8-15	400
18-48	800
>48	Per PE of Record, subject to City of Iowa Colony Approval

b. Place manholes at the dead-end of sewer mains and lateral sewers.

c. Manhole covers shall be cast iron, traffic bearing type ring and cover.

d. Manholes shall not be located within handicap ramps and sidewalks if possible. Provide 5' X 5' blackout if necessary.

e. Criteria for Manhole Junctions

(1) Connections between public sanitary sewers and the manhole shall adhere to the following criteria.

(a) The elevation of the crown of the discharging sanitary sewer shall match the elevation of the crown of the receiving sanitary sewer for both equal and unequal pipe diameters.

(b) Drop manholes are allowed. A drop connection or drop manhole is required when the difference in elevation between the effluent flowline and the influent flowline is greater than 30 inches.

C. Manholes should be located as to minimize or eliminate the inflow of stormwater into the sanitary sewer. The top of manhole rim shall be set a minimum of 3 inches above the surrounding finished grade when the manhole is not in a paved roadway. Sealed manholes

are required on all newly constructed manholes within the 100-year flood plain. Under no circumstances shall the elevation of the top of rim of a sanitary sewer manhole be below the 100-year base flood elevation for the area in which it is built.

4.3.12 Manholes shall be constructed in accordance with the Standard Details where applicable. All manholes shall include rubber seals precast into the manhole for pipe inserts (no cement or grout). Precast manholes shall incorporate a boot-type connector for sanitary sewer diameters up to 24 inches. For sanitary sewer diameters greater than 24 inches, utilize either the boot-type connector (if available) or an integral gasket.

4.3.13 Steps in manholes are not allowed.

4.3.14 All manhole adjustments shall be made with precast concrete rings when an additional precast vertical section is too large. No brick manholes are allowed.

4.3.15 All manholes shall be tested by the construction contractor and results provided to the City of Iowa Colony before being accepted by the city for maintenance. The City of Iowa Colony reserves the right to require retesting of manholes if there is reason to question the results. All manhole testing shall comply with or exceed the procedures and qualifications listed in Texas Administrative Code, Chapter 217.58.

4.3.16 Lift Stations

- A. Lift station design and construction drawings as well as design requirements and pertinent data shall be sealed by a Professional Engineer registered in the State of Texas and submitted with the construction drawings for review by the City. Lift stations shall comply with Texas Administrative Code, Chapter 217.59-217.63.
- B. Lift Stations should be considered only when a gravity system cannot be achieved from both an engineering and an economic standpoint. Lift stations should only be considered with prior approval from the City of Iowa Colony or where the lift station is designed to be temporary in nature.
- C. Operation and maintenance should be considered in the design of the lift station and the location of the lift station.
- D. Wet Wells
 - a. Provide adequate clearance between pumps so as to easily facilitate retrieval of a pump (refer to manufacturer's recommendations). A minimum of 2 feet of clearance shall be provided between pumps and walls.
 - b. Wet well working volume shall be sized to allow for the following minimum pump cycle times:

Pump Horsepower (largest pump)	Minimum Cycle Time (minutes)
Less than 50	6
50-100	10
Over 100	15

- c. Tie reinforcing steel in lift station base to walls to provide watertight wet well (includes caisson construction).
- d. The below grade wet well and valve vaults are subject to buoyant forces. Include buoyancy calculations to ensure that the structure weight (include walls and slab only) will be sufficient to offset these forces.

E. Lift Station Site

- a. Site shall have a minimum size of 60 feet by 60 feet.
- b. Site access shall be provided by a minimum 20-foot wide public right-of-way or permanent access easement.
- c. Provide a 20-foot wide concrete vehicular access road to the site. Drive shall terminate adjacent to the station with a parking space such that a truck mounted hoist can remove pumps. Lift Station located within or adjacent to a residential subdivision shall be required to have a concrete driveway.
- d. Wet well or dry well structures shall be a minimum of 20 feet from outside walls of structure to site boundary fencing.
- e. Indicate method of drainage of site on site plan. Internal drainage, sheet flow, and valley gutter driveways are acceptable. Drain to street or storm sewer, never onto adjacent private property.

F. Site Security

- a. Lift station shall be enclosed in a building or fenced in such a way to deter unauthorized operation, vandalism, or terrorism.
- b. Fence shall be constructed of masonry, with steel gate and posts set in concrete. Fence shall be at minimum 8 feet high.
- c. Fence shall be located completely inside the site boundary.

G. The design of the lift station, including all electrical and mechanical equipment, must

be designed to withstand and operate during a 100-year flood event. The lift station's control panel shall be located a minimum of 2 feet above the nearest base flood elevation. The top of concrete of the lift station's wet well shall be a minimum of 2 feet above the nearest base flood elevation.

- H. Pumps shall be sized to operate at optimum efficiency. Minimum acceptable efficiency at the operating point shall be 60%. Include pump and system head curves and pump information summary chart on plans.
- I. A peak factor of 4 shall be used for Lift Station design.
- J. Low water level shall be at least 6 inches above impeller, higher if required by manufacturer. Complete immersion of submersible pump motor at low water level is preferred.
- K. Vent pipe shall be 8 inches minimum diameter, made of stainless steel and shall be equipped with odor control system.
- L. Nuts, bolts, chains, and all other metal components within wet well shall be stainless steel, not carbon steel.
- M. Dual stainless steel guide rails (or other pump removal method that avoids entering wet well) are required for submersible pumps.
- N. Bedding for PVC force main is bank sand, a minimum of 6 inches on all sides of pipe.
- O. PVC force mains shall be Pressure Class 150 or DIP bedded in bank sand and polyethylene wrapped.
- P. The velocity in the force main and riser pipes shall be less than 8 fps and greater than 2 fps.
- Q. Backfill structural excavations (wet well, etc.) with cement stabilized sand.
- R. Lift station site plans shall be submitted in scales of 1 inch = 5 feet or 1 inch = 10 feet.
- S. Provide a protective coating to interior walls of wet well. The City Engineer shall approve coating or additive used.
- T. Lift station shall be equipped with a telephone dialer and a red alarm light, approved by City. A transducer system shall be installed and shall be connected to telemetry system to monitor the status of the lift station. Floats will be utilized as back up to the transducer.

- U. Power supply to lift station shall be 3 phase and 480 volts where possible.
- V. A system of transducer with floats as backup shall be provided to control pumps.
- W. A tee, plug valve, and blind flange assembly are required on the force main on the downstream side of the discharge valves and header. This is required so truck-mounted pumps can bypass the lift station pumps and piping while emergency repair or maintenance work is being done.
- X. Lift station must be equipped with automatic transfer switch properly sized to connect to an on-site generator.
- Y. All lift station shall be required to have on-Site Generators. Generators must be sized to operate the lift station at its firm pumping capacity or at the average daily flow, if the peak flow can be stored in the collection system.
- Z. All sanitary sewer lift stations and WWTP design shall include provision for SCADA control system. Specifications shall be based on City of Houston criteria.
- AA. Provide O&M Manual as part of the approval/acceptance of infrastructure.

4.3.18 Design Analysis

- A. Calculations of design flows for the overall development or project shall be approved by the City of Iowa Colony.

4.4 QUALITY ASSURANCE

- 4.4.1 Prepare calculations and construction drawings under the supervision of a Professional Engineer trained and licensed under the disciplines required by the drawing. The final construction drawings must be sealed, signed, and dated by the Professional Engineer responsible for the development of the drawings. If more than one Professional Engineer was responsible for the development of the design/construction drawings, then the appropriate Professional Engineer should seal the drawings he is responsible for.
- 4.4.2 Post Construction TV Inspection of Sanitary Sewer System -
 - A. Contractor shall provide post construction CCTV surveys and assessments conducted after, and only after, all major construction has been completed and the line segment or manhole has passed all required post construction testing. Any line segment or manhole that has been televised or assessed prior to the full completion or testing of any newly constructed or rehabilitated sewer appurtenance will be rejected.

4.5 UNSEWERED BUILDING SITES AND SEPTIC TANKS

- 4.5.1 It is the responsibility of the land owner to contact the City to determine if a site has sanitary sewer service available.
- 4.5.2 If a lot or parcel is within 500 feet of an existing sanitary sewer then the site shall tie-on to the existing sanitary sewer. The owner/developer must pay for all materials, installation, and testing before the city will accept the sewer for maintenance.
- 4.5.3 Building sites proposing On-Site Sewage Facilities (OSSF) (i.e. septic tanks) shall obtain approval and applicable permits from the Brazoria County Department of Environmental Health. A copy of the permit shall be provided to the City of Iowa Colony prior to OSSF installation.



CHAPTER 5

STORM WATER DRAINAGE DESIGN CRITERIA

CHAPTER 5 – STORM WATER DRAINAGE DESIGN

5.1 STORM WATER DRAINAGE DESIGN GENERAL

- 5.1.1 The following sections include criteria for the design of storm water drainage improvements for the City of Iowa Colony and its Extraterritorial Jurisdiction (ETJ). These Storm Water Drainage Design Requirements are based on the Brazoria County Drainage Criteria Manual, dated May 2022, which is incorporated herein by reference. Refer to the Drainage Criteria Manual for complete methodologies, descriptions, tables and charts.
- 5.1.2 Drainage approval by the City of Iowa Colony is required for all development within city limits and within its extraterritorial jurisdiction. All drainage facilities proposed within these limits are to adhere to these criteria.
- 5.1.3 Development within the City of Iowa Colony or its extraterritorial jurisdiction will also require the approval of the applicable Drainage District. Brazoria County Drainage District No. 5 is the Drainage District responsible for the majority of drainage district oversight within Iowa Colony. Brazoria Drainage District No. 4 is responsible for certain northwest portions of the City. Although the City of Iowa Colony is not actually located within the boundary of Brazoria County Conservation and Reclamation District No. 3, a portion of the outfall drainage from the City enters C&R No. 3 channels and, therefore, their criteria and standards are to be considered where applicable.
- 5.1.4 All outfall pipes, ditches, and structures that enter Drainage District Channels or Facilities shall be designed according to requirements of the applicable Drainage District. If there is a discrepancy in the drainage criteria requirements between the City and applicable Drainage District, the City Engineer shall determine which criteria to apply.
- 5.1.5 Development and drainage shall comply with all applicable City of Iowa Colony Ordinances, including, but not limited to, the Floodplain Ordinance (No. 2006-10) and the Culvert Ordinance (No. 2002-9), as amended.
- 5.1.6 The goal for these criteria is to provide protection in a 100-year storm event. This is accomplished with the application of various drainage enhancements such as storm sewers, roadside ditches, open channels, detention, and overland (sheet) runoff. The combined system is intended to prevent structural flooding from extreme events up to a 100-year storm. In order to protect existing properties, water levels, due to runoff, shall not be increased upstream or downstream of a development due to the improvement.
 - A. Street Drainage: Street ponding of short duration in significant storms is anticipated and designed to contribute to the overall drainage capability of the system. Storm sewers and roadside ditch conduits are designed as a balance of capacity and economics. These conduits are designed to convey less intense, more frequent 5 year storms with the intent of allowing for traffic movement during these events. When rainfall events exceed the

capacity of storm sewer system, the additional runoff is intended to be stored or conveyed overland in a manner that reduces the threat of flooding to structures.

- B. **Flood Control:** The City of Iowa Colony is a participant in the National Flood Insurance Program. The intent of the flood insurance program is to make insurance available at low cost by providing for measures that reduce the likelihood of structural flooding.
- C. **Relationship to the Permitting Process:** Approval of storm drainage is a part of the review process for platting and permitting of the new development. All plans for plats and proposed new construction shall include drainage improvements in the plans submitted to the City Engineer.

5.2 DEFINITIONS

- 5.2.1 **Conduit:** Any open or closed device for conveying flowing water.
- 5.2.2 **C&R No. 3:** Brazoria County Conservation & Reclamation District No. 3
- 5.2.3 **Drainage Area Map:** Area map of watershed which is subdivided to show each area served by each subsystem.
- 5.2.4 **DD No. 4:** Brazoria Drainage District No. 4.
- 5.2.5 **DD No. 5:** Brazoria County Drainage District No. 5.
- 5.2.6 **FEMA:** Federal Emergency Management Agency.
- 5.2.7 **Hydraulic Grade Line:** A line representing the pressure head available at any given point within the drainage system.
- 5.2.8 **In-Fill Development:** Development of open tracts of land in areas where the storm drainage infrastructure is already in place and takes advantage of the existing infrastructure as a drainage outlet.
- 5.2.9 **Public Storm Sewers:** Defined as sewers and appurtenances that provide drainage for a public right-of-way, or more than one private tract, and are located in public right-of-way or easement and officially accepted by the City for maintenance. Private storm sewer connections public storm sewers shall occur at a manhole or at the back of an inlet, as approved by the City. All private storm sewers shall be constructed in conformance with these standards.
- 5.2.10 **Rational Formula:** A method for calculating the peak runoff for a storm drainsystem.
- 5.2.11 **Redevelopment:** A change in land use that alters the impervious cover from one type of development of either the same type or another type, and takes advantage of the existing infrastructure in place as drainage outlet.

- 5.2.12 **Sheet Flow:** Overland storm runoff that is not conveyed in a defined conduit, and is typically in excess of the capacity of the conduit.

5.3 DESIGN REQUIREMENTS

- 5.3.1 **Storm Sewer Easements** – the following minimum easements are required when facilities are not located within public street rights-of-way:
- A. When not adjacent to public street rights-of-way, the minimum width shall be twenty feet (20') with the storm sewer centered in an exclusive easement.
 - B. For storm sewers greater than eight feet (8') and less than or equal to twelve feet (12') in diameter or width, the minimum width of an exclusive easement shall be twenty-five feet (25').
 - C. For storm sewer greater than twelve feet (12') in diameter or width, the minimum width of an exclusive easement shall be determined by the City Engineer.
 - D. For storm sewers whose depth to flow line is greater than fifteen feet (15'), add five feet (5') to the minimum easement widths specified in Sections 2.3.6.A and 2.3.6.B.
 - E. For all easements specified in Section 2.3.6, a minimum distance of five feet (5') must be maintained from the easement line to the outside edge of the storm sewer.
 - F. Where approvals are granted for a special use or combination easement located along side lot or back lot, the minimum width shall be twenty-five feet (25'). The easement width shall meet or exceed all other easement requirements.
 - G. For specifically approved storm sewers located in an exclusive easement adjacent to public rights-of-way, the minimum easement width shall be ten feet (10'). The easement width shall meet or exceed all other easement requirements.
- 5.3.2 All projects shall be tied to National Geodetic Survey (NGS) Datum Adjustment which matches the Federal Emergency Management Agency (FEMA) rate maps or the most current NGVD which matches the FEMA rate maps. At least two references to bench marks relating to the FEMA rate maps must be identified. Equations may be used to translate other datum adjustments to the required adjustment.
- 5.3.3 Plan sets will include a drainage area map which shall contain all storm sewer drainage calculations.
- 5.3.4 All drainage systems for curb and gutter pavements shall be underground closed conduits; individual residential lot drainage is exempt. Drainage systems for pavements without curb and

gutter shall be roadside open-ditch sections.

5.3.5 Plan sets shall include the 5 year Hydraulic Grade Line for storm sewers and roadside ditches on the plan and profile sheets.

5.3.6 The quantity of storm water runoff (peak discharge) shall be determined for each inlet, pipe, roadside ditch, channel, bridge, culvert, outfall, or other designated design point by using the following criteria:

A. Determination of Runoff:

Design storm Events - All drainage improvements shall be designed for the following storm frequencies:

Roadside Ditches	5 years
Storm Sewers	5 years
Open Drainage Channels serving less than 100 acres	25 years
Secondary Arterials	25 years
Bridges	100-years
Creeks/Channels	100-years
Detention Facilities	100-years

B. Intensity-Duration Curves: Table 2-1 of the Brazoria County Drainage Criteria Manual provides intensity-duration values to be used for storm sewer and roadside ditch design in the City of Iowa Colony. These intensities are derived from the formula:

$$I = \frac{b}{(d+t_c)^e}$$

Values are as listed below:

<i>Intensity-Duration-Frequency Coefficients</i>			
Return Period	e	b	d
2-yr.	0.754	57.44	11.511
5-yr.	0.712	58.019	9.236
10-yr.	0.676	57.515	7.777
25-yr.	0.618	52.78	5.022
50-yr.	0.574	49.157	3.081
100-yr.	0.533	46.316	1.555
500-yr.	0.474	47.179	0.322

C. The Rational Method shall be used for determining the peak flow rate in the sizing of all local drainage improvements with drainage areas less than 50 acres.

D. Coefficients for the Rational Method:

a. Run-Off Coefficient: The following values for the run-off coefficient “C” in the Rational Method formula will vary based on the land use. Land use types and “C” values which are to be used in Iowa Colony are as follows:

<u>Land Use Type</u>	<u>Run-Off Coefficient</u>
Raw Undeveloped Acres	0.20
Improved Undeveloped Acres (i.e. mowed filled, regraded, etc.)	0.30
Park Land	0.20
Residential:	
Single Family Lots greater than 0.75 acre	0.35
Single Family Lots 0.25 acre to 0.75 acre	0.45
Single Family Lots less than 0.25 acre	0.55
Townhomes/Patio Homes	0.65
Commercial	0.80
Multifamily	0.80
Industrial	
50% impervious	0.65
75% impervious	0.75
95% impervious	0.85
Pond (detention and amenity)	1.00

b. Determination of Time Concentration: Time of concentration shall be calculated based upon an analysis of the actual travel time from the most remote point in the drainage area. The travel path should be clearly denoted and a sketch included in the design calculations.

E. Design Frequency:

a. Design Frequency:

(1) Newly Developed Areas: The design storm event for sizing storm sewers in newly developing areas will be a 5-year rainfall. Detention shall be provided and in accordance with Section 5.3.6 J. Calculations shall show that water surface elevations are not increased upstream or downstream of the tract.

- (2) **Redevelopment or In-Fill Development:** The existing storm drain will be evaluated using a 5 year storm, assuming no development takes place. The storm drain will then be evaluated with the development in place.
 - (a) If the proposed redevelopment has a lower or equal impervious cover, no modifications to the existing storm drain are required.
 - (b) If the impervious cover is increased, detention shall be provided in accordance with Section 5.3.6 J.
- (2) **Private Drainage Systems:** Storm sewers for private drainage systems shall conform to the requirements of public drainage systems.

b. Velocity Considerations:

- (1) All storm drains shall be designed by the application of the Continuity Equation and Manning's Equation.
- (2) Design velocities shall be a minimum of 2 feet per second (fps) with the pipe flowing full.
- (3) Maximum velocities should not exceed 7 feet per second.
- (4) **Minimum Storm Sewer Pipe Slopes:**

<u>Pipe Diameter</u>	<u>% Slope</u>
24	0.07
30	0.05
36	0.04
42	0.032
48	0.027
54	0.023
60	0.020

For pipe sizes not listed above, the minimum slope should be determined utilizing a design velocity of 2 fps.

c. Pipe Sizes and Placement:

- (1) Use the storm sewer and inlet leads with at least 24 inch inside diameter or equivalent cross-section. Box culverts shall be at least 2'x2'. Closed conduits, circular, elliptical, or box, shall be selected based on hydraulic principals and economy of size and shape.

- (2) Larger pipes upstream should not flow into smaller pipes downstream unless the upstream system is intended for use in detention.
- (3) Match crowns of pipe at any size change.
- (4) Locate public storm sewers in public street rights-of-way or in dedicated drainage easements. Side and back lot easements are discouraged. If unavoidable, the easement shall be at least 20 feet wide with the storm sewer centered in the easement.
- (5) Follow the alignment of the right-of-way or easement when designing cast-in-place concrete storm sewer easements.
- (6) A straight line shall be used for inlet leads and storm sewers.
- (7) Center storm sewer in side-lot storm sewer easements.
- (8) Provide 5 feet minimum from edge of pipe to edge of easement.

d. Starting Water Surface and Hydraulic Gradient:

- (1) The hydraulic gradient shall be calculated assuming the top of the outfall pipe as the starting water surface.
- (2) At drops in pipe invert, should the upstream pipe be higher than the hydraulic grade line, then the hydraulic grade line shall be recalculated assuming the starting water surface to be at the top of pipe at that point.
- (3) For the design storm, the hydraulic gradient shall at all times be below the gutter line for all newly developed areas.

e. Manhole Locations:

- (1) Use manholes for precast conduits at the following locations:
 - (a) Size or cross-section changes.
 - (b) Inlet and conduit intersections.
 - (c) Changes in pipe grade.
 - (d) A maximum spacing of 500 feet measured along the conduit run.
 - (e) Manholes shall be placed so as not to be located in driveways.

f. Inlets:

- (1) Locate inlets at all low points in gutters.
- (2) Valley gutters across intersections are not permitted.
- (3) Inlet spacing is generally a function of gutter slope. For minimum gutter slopes, the maximum spacing of inlets shall result from a gutter run of 500 feet from high point in pavement or the adjacent inlet on a continuously graded street section, with a maximum of 1000 feet of pavement draining towards any one inlet location.

- (4) Use only Standard Inlets:

<u>Inlet</u>	<u>General Application</u>	<u>Capacity</u>
Type A	Parking Lots/Small Areas	2.5 cfs
Type B-B	Residential	5.0 cfs
Type C	Streets	5.0 cfs
Type C-1	Commercial	10.0 cfs
Type D	Parking Lots	2.0 cfs
Type E	Roadside Ditches	20.0 cfs

- (5) Beehive grate inlets or other specialty inlets are not allowed.
- (6) Do not use grate top inlets in an unlined roadside ditch.
- (7) Place inlets at the end of the proposed pavement, if drainage will enter or leave pavement.
- (8) Do not locate inlets adjacent to esplanade openings.
- (9) Place inlets on side streets intersecting major streets, unless special conditions warrant otherwise.

F. Consideration of Overland Flow:

- a. **Design Frequency:** The design frequency for consideration of overland sheet flow will consider extreme storm events which exceed the capacity of the underground storm sewer system resulting in ponding and overland sheet flow through the development to the primary outlet.
- b. **Relationship of Structure to Street:** All structures will be at least 24 inches higher than the highest level of ponding anticipated resulting from the 100-year event analysis.

c. Calculation of Flow:

- (1) Streets will be designed so that consecutive high points in the street will provide for a gravity flow of drainage to the ultimate outlet.
- (2) The maximum depth of ponding will be 12 inches above the curb gutter, or 6 inches above the centerline of roads without curb, during the 100-year storm event.
- (3) Sheet flow between lots can be provided only through a dedicated drainage easement.
- (4) A map shall be provided to delineate extreme event flow direction through a proposed development and how this flow is discharged to the primary drainage outlet.

In areas where ponding occurs and no sheet flow path exists, then calculations showing that run-off from the 100-year event can be conveyed through inlets to the storm system and/or detention pond must be provided.

- d. Overland flow shall enter the drainage facilities (channels or detention pond) through a storm sewer sized to convey the 100-year event. Calculations shall be submitted for sizing the storm sewer and determining that adequate inlet capacity exists.

G. Design of Open Channels:

a. Design Frequency:

- (1) Open channels shall be designed according to the Brazoria County Drainage Criteria Manual, or the applicable Drainage District, whichever is more stringent.
- (2) Design standards for channel construction should follow the requirements specified in the corresponding Criteria Manual.

b. Determination of Water Surface Elevation:

- (1) Water surface elevations shall be calculated using Manning's Equation and the Continuity Equation.
- (2) For the design storm event, the water surface should be calculated to remain within banks and below freeboard.

c. Design of Culvert Crossings for Open Channels:

- (1) Head losses in culverts shall conform to TxDOT Design Division Hydraulics Manual, Chapter 7 - Culverts.
- (2) Culverts shall be Class III RCP conforming to ASTM C-76 or smooth interior dual wall corrugated polyethylene pipe conforming to AASHTO M294.

d. Channels shall be seeded or sodded and a permanent stand of grass obtained prior to project acceptance.

H. Design of Roadside Ditches:

a. Design Frequency:

- (1) Roadside ditch design is permissible only for single family residential lots having widths larger than, or equal to, 120 feet.
- (2) Design capacity for a roadside ditch shall be to 0.5 feet below the edge of pavement or the natural ground at the right-of-way line, whichever is lower.
- (3) The design must include an extreme event analysis to indicate that structures will not be flooded.

b. Velocity Considerations:

- (1) A grass lined or unimproved roadside ditch shall have side slopes no steeper than 3:1.
- (2) Minimum grades for roadside ditches shall be 0.1 foot per 100 feet.
- (3) Calculation of velocity will use a Manning's roughness coefficient of 0.040 for earthen sections and 0.025 for ditches with paved inverts.
- (4) Use erosion control methods acceptable to the City when design velocities are expected to be greater than 4 feet per second.

c. Culverts:

- (1) Culverts will be placed at all driveway and roadway crossings, and other locations where appropriate. Permanent low water crossings are not permitted.
- (2) Culverts will be designed assuming outlet control.

- (3) Roadside culverts are to be sized based on drainage area. Calculations are to be provided for each block based on drainage design criteria presented in this manual.
- (4) Cross open channels with roadside culverts no smaller than 18 inches in diameter. The size of culvert used shall not create a head loss of more than 0.20 feet greater than the normal water surface profile without the culvert.
- (5) Flow from roadside ditches must be conveyed to the drainage channel through a roadside ditch interceptor structure and pipe.
- (6) Culvert installation shall adhere to City of Iowa Colony Ordinance 2002-9 and as amended

d. Depth and Size Limitations:

- (1) All roadside ditches shall be fully contained in the right-of-way or a recorded drainage easement.
- (2) The maximum depth in residential areas shall not exceed 3 feet from the edge of pavement.
- (3) Ditches in adjoining and parallel easements shall have the top of bank not less than 2 feet from the outside easement line.
- (4) Roadside ditch bottoms should be at least 2 feet wide.
- (5) Roadside ditch side slopes shall not exceed 3:1.

I. Design of Outfalls

- a. Outfall design shall conform to the applicable Drainage District's Design Criteria Manual.
- b. Outfalls shall be placed one foot above the receiving waterway.
- c. Wet detention ponds may be connected by a submerged pipe. Storm sewers discharging into wet detention ponds may be submerged from the last manhole to the outfall.
- d. Outfalls must have a means to control erosion and washouts (i.e. concrete paving, interlocking blocks). Rip-rap is not acceptable.

J. Storm Water Detention:

a. Application of Detention:

- (1) As a normal consideration, storm water detention is required. The use of on-site detention is required in order to mitigate potential damage to existing structures unless participation in regional detention facilities is available that will provide equivalent protection to downstream property owners.
- (2) Design calculations for sizing the detention basin and related structures must be performed by the applicable method described in the following sections.
- (3) All calculations shall be sealed, signed, and dated by a registered professional engineer.
- (4) A parking lot may be used as part of the detention system, provided that the maximum depth of water over the inlet does not exceed nine inches (9") and the maximum depth in the parking stall does not exceed six inches (6").
- (5) All detention basins shall be maintained by the property owners except regional detention facilities that are owned and operated by the City of Iowa Colony, C&R District No. 3, DD No. 4, or DD No. 5.

b. Calculation of Detention Volume:

- (1) For developments with drainage areas of more than 100 acres, a detailed hydrologic analysis utilizing the HEC-HMS and HEC-RAS Flood Hydrograph method will be required following the procedure outlined the Brazoria County Drainage Criteria Manual, or applicable drainage district if more stringent.
- (2) For developments with drainage areas 50 acres or less, the acre-feet of flood control storage, S, to be provided by the facility for the 100-year storm event is:

$$S = I^{\frac{1}{4}} \times A$$

Where I = the average percent imperviousness of the area draining into the facility ($\div 100$), and A = the drainage area of the facility in acres.

- (3) Detention storage shall not be less than 0.75 acre-ft/acre of the parent tract.
- (4) Detention shall not be required for single-family lot improvements with increase in impervious area of less 1,000 SF.

c. Calculation of Outlet Size:

- (1) The minimum outflow pipe for a detention facility is 24 inches. When further flow restriction is necessary, a restriction should be placed at the entrance to the outfall pipe. Locate the restrictor to facilitate inspection and debris removal. Calculate the allowable outflow orifice size using the following equation:

$$Q = CA\sqrt{2gH}$$

Where:

Q = allowable discharge in cubic feet per second

C = coefficient of discharge

- 0.8 for short segments of pipe

- 0.6 for openings in plates or standpipes

A = maximum allowable area of orifice in square feet

g = acceleration due to gravity (32.2 feet/second²)

H = head difference between entrance and exit in feet when orifice is fully submerged, or the difference between the water surface elevation at the entrance and the centroid of the orifice in feet when orifice is partially submerged.

Determine H by establishing a maximum ponding level in the detention facility during the 100-year storm and assuming a tailwater at the top of the downstream end of the outlet pipe, or at a depth in the outlet channel associated with the maximum release flow rate, whichever is higher. In addition to a pipe outlet, the detention basin shall provide an extreme event emergency overflow spillway that will protect structures from flooding should the detention basin be overtopped.

- (2) Corrugated Metal Pipe (CMP) is not allowed for outfall structures.

d. Detention Pond Structural Requirements:

- (1) Side slopes shall not exceed a slope of 4 feet horizontally to one 1 vertically (4:1).
- (2) Dry detention ponds exceeding 60 feet in any direction shall have concrete pilot channels to aid drainage. Unlined detention pond bottom shall have a minimum slope of 1%.
- (3) Concrete pilot channels shall have a minimum width of 6 feet and a minimum thickness of 4 inches with #3 rebar spaced at 12 inches or #4 rebar spaced at 24 inches on center each way. The concrete channels shall be constructed of 5 sack cement concrete with a minimum compressive strength of 3000 psi at 28 days. Provide a 1 inch minimum

depression per every 1 foot of transverse slope with redwood headers spaced every 40 feet.

- (4) Appropriate covering (grass, slope paving, etc.) shall be established on side slopes and pond bottom to prevent erosion during periods of maximum water velocity.
- (5) A concrete or articulated block spillway, set at the maximum ponding elevation, shall be provided near the detention pond outfall structure, starting at the detention pond top of bank and extending to the toe of slope of the receiving channel.

e. Ownership and Access:

(1) Private Facilities:

- (a) Detention facilities which rely on gravity to discharge storm water are preferred by the City.
- (b) Responsibility for maintenance of the detention facility must be indicated on the plat and construction plans.
- (c) All private properties being served shall have drainage access to the pond.
- (d) A recorded maintenance agreement with a specific responsible party shall be provided when multiple tracts are being served.
- (e) The maintenance berms shall be at least 20 feet wide surrounding the top of bank of the detention area.

(2) Public Facilities:

- (a) Facilities may be accepted for maintenance by the City but only in cases where public drainage is being provided.
- (b) The City will require a maintenance work area 30 feet wide surrounding the top of bank of the detention area. Public rights-of-way or permanent access easements may be included as a portion of this 30 feet width.
- (c) A dedication of the maintenance easement or reserve must be provided by plat.
- (d) Proper dedication of public access to the detention pond must be shown on the plat or by separate instrument. This includes permanent access easements with overlapping public utility easements.

f. Pumped Detention

Pumped detention systems will not be maintained by the City of Iowa Colony under any circumstances and will be considered for approval only under the following conditions:

- (1) A gravity system is not feasible from an engineering standpoint.
- (2) The percentage of pumped volume must not exceed 50% of the total volume of the basin, the remaining volume must be able to drain from the basin by gravity.
- (3) The total time to empty the pumped volume may not exceed 72 hours after the gravity portion has vacated.
- (4) At least two pumps are provided, each of which is sized to pump the design flow rate; if a three-pump system is used, any two of the three pumps must be capable of pumping the design flow rate.
- (5) The selected design outflow rate must not aggravate downstream flooding. Example: A pump station designed to discharge at the existing 100-year flow rate each time the system comes on-line could aggravate flooding for more frequent storm events.
- (6) Fencing of the control panel is provided to prevent unauthorized operation and vandalism.
- (7) An on-site emergency generator capable of operating the pump station for the amount of time required to vacate the pumped volume must be provided.
- (8) A recorded maintenance agreement with a specific responsible party shall be provided to ensure that the system will be operated and maintained on a continuous basis.
- (9) Detention volume for pump detention shall be minimum 1.0 acre-ft/acre.

If a pumped system is proposed, it is strongly recommended that preliminary conceptual design be submitted to the City Engineer and applicable Drainage District for review before any detailed engineering is performed.

5.4 SUBMITTALS

- 5.4.1 All preliminary drainage plan submittals shall comply with and fully follow the procedures outlined in the City of Iowa Colony's Subdivision Ordinance.

5.4.2 Preliminary Submittals: Submit for review and comment:

- A. Lot and street layout.
- B. The approximate drainage areas for each system.
- C. The proposed drainage system.
- D. The proposed pipe diameters.
- E. Proposed detention areas with approximate volumes and depths.
- F. Any proposed drainage easements.
- G. Floodplain boundary, if applicable.
- H. Floodway boundary, if applicable.
- I. Base Flood Elevation.

5.4.3 Final Design: Submit the following for approval:

- A. Copies of any documents which show approval of exceptions to the City design criteria.
- B. Design calculations for storm line sizes and grades and for detention facilities.
- C. Design calculations for the hydraulic grade line of each line or ditch, and for detention facilities. Calculations shall show that the water surface elevations will not be increased upstream or downstream of the property on a 5 year and 100-year event.
- D. Contour map of the project and drainage area map for the project and the upstream.
- E. Plan and profile sheets showing storm water design.
- F. Projects located within a flood plain boundary or within a flood plain management area shall:
 - a. Show the flood plain boundary or flood plain area, as appropriate, on the drainage area map.
 - b. Show the floodway boundary, if applicable.

5.4.4 Additional Submittals: Submit the following for approval:

- A. Previous review prints.

- B. Revised drawings.
- C. Storm water detention maintenance agreement letters.
- D. Pipeline company agreements.
- E. Any and all applicable permits and agreements.

5.5 QUALITY ASSURANCE

- 5.5.1 Prepare calculations and construction drawings under the supervision of a Professional Engineer trained and licensed under the disciplines required by the drawings being prepared. The final construction drawings and all design calculations must be sealed, signed, and dated by the Professional Engineer responsible for the development of the drawings. Drawings shall contain the following statement "Based on these plans and calculations and minimum building elevations prepared under my direction, no structure will be subject to flooding in the 100-year storm and the upstream and downstream water surface elevations will not be increased."
- 5.5.2 A geotechnical report shall be performed by, or under the supervision of, a currently registered Professional Engineer in the State of Texas, pertaining to the Drainage Design requirements contained within this section. All reports and documents shall be sealed, dated, and signed by the Engineer responsible for the preparation thereof.



CHAPTER 6

PAVING DESIGN CRITERIA

CHAPTER 6 – PAVING DESIGN

6.1 PAVING DESIGN GENERAL

- 6.1.1 Criteria for the geometric design guidelines for streets, street paving requirements, and standard paving notes for drawing call-outs are herein established.

6.2 DEFINITIONS

- 6.2.1 AASHTO - American Association of State Highway and Transportation Officials.
- 6.2.2 ACI - American Concrete Institute.
- 6.2.3 ASTM - American Society for Testing Materials.
- 6.2.4 Curb Sections: Full width concrete pavement with doweled-on 6 inch high vertical curbs or 4"x12" curbs. Curb and gutter sections require inlets and underground storm sewers.
- 6.2.5 Geotechnical Engineer: An engineer certified by the American Association for Laboratory Accreditation (AALA).
- 6.2.6 HMAC: Hot Mix Asphaltic Concrete.
- 6.2.7 Roadway Ditch Sections: Ditch sections adjacent to either full width reinforced concrete pavement or asphaltic pavement. Roadside ditch sections do not require underground storm sewers; however, the ditch sections must be designed to accommodate a 5-year storm runoff.
- 6.2.8 TxMUTCD - Texas Manual on Uniform Traffic Control Devices.

6.3 DESIGN REQUIREMENTS

- 6.3.1 The following design requirements are applicable to all pavement within right-of-way limits within the City of Iowa Colony and its ETJ:
 - A. All paving and construction plans shall be approved by the City of Iowa Colony for all streets.
 - B. Street design should conform to all applicable planning tools, such as the Texas Manual on Uniform Traffic Control Devices, major thoroughfare plans, and master plans. Other considerations for design should include street function, street capacity, service levels, traffic safety, pedestrian safety, and utility locations. These additional considerations may affect the minimum requirements set forth herein. Refer to the City Thoroughfare Plan.
 - C. Design shall conform to the City of Iowa Colony's Construction Details where applicable, or if not available, the standards of the City of Houston.

D. Minimum Right-of-Way Width, Paving Section, and Maximum Design Speed Requirements for:

- a. **Marginal Access Streets:** Minimum 50 feet right-of-way, 2 lanes undivided without median. Maximum design speed 30 MPH.
- b. **Local:** Minimum 60 feet right-of-way, 2 lanes undivided without median. . Maximum design speed 30 MPH
- c. **Minor Collector Streets:** Minimum 80 feet right-of-way, 4 lanes undivided without median. Maximum design speed 30 MPH
- d. **Major Collector Streets:** Minimum 80 feet right-of-way, 4 lanes divided with raised median, minimum 12 feet wide, Maximum design speed 35MPH.
- e. **Minor Arterial:** Minimum 120 feet right-of-way, 4 lanes divided with raised median, minimum 32 feet wide, Maximum design speed 45MPH.
- f. **Major Arterial Streets:** Minimum 120 feet right-of-way, 4 to 6 lanes divided with raised median, minimum 32 feet wide, Maximum design speed 45 MPH.
- g. **Super Arterial:** As required by TxDOT

E. Minimum Width Requirements and Paving:

- a. **Curb and Gutter sections for low-density residential developments:** 28 feet back-to-back of curb (B/B).
- b. **Pavement for open ditch sections for low density residential developments:** 26 feet edge-to-edge of pavement, with a 6-foot shoulder on either side of the pavement:
 - (1) **Reinforced Concrete:** A thickened edge is required for this type of pavement. The thickened edge should be 8 inches decreasing to 6 inches at a point 4 feet from the edge of the pavement. Use only when approved by the City in large lot residential developments.
 - (2) **Asphalt:** 2 inch thick HMAC with 8 inch thick crushed limestone or crushed concrete base. Use only when approved by the City in large lot residential developments.
- c. **Curb and gutter sections of medium density residential, industrial, and commercial development secondary and collector streets:** 38 feet B/B of curb minimum.

- d. Pavement of major arterials and thoroughfares: Two divided traffic lanes, each way, of 25 feet B/B four (4) lane divided roadways or 34 feet B/B of curb for six (6) lane divided roadways.

F. Minimum Thickness and Reinforcement Requirements for Concrete Pavements: The following requirements are the minimum allowable. Pavement thickness and reinforcement shall be designed by the Professional Engineer responsible for the project based on a current soils analysis and recommendations by a qualified geotechnical engineer. All concrete shall have a minimum compression strength of 4,000psi. The design requirements in special cases may dictate a greater strength. Pavement design based on soils analysis, use, loading, and life span may require greater thickness and more reinforcement than the following minimums:

- a. For pavement widths less than or equal to 28 feet B/B of curb (for marginal and local streets):

- (1) Minimum concrete slab thickness shall be 6 inches with $F_c = 4,000$ psi and reinforcement shall be Grade 60, $f_y = 60,000$ psi, #4 deformed reinforcing bars spaced at 18 inches center-to-center both ways and minimum lap lengths of 18 inches.
- (2) Expansion joints shall be placed at the end of each curb return and at a maximum spacing of 40 feet 6 inches. Expansion joints shall include a $\frac{3}{4}$ inch redwood header, $\frac{3}{4}$ smooth dowel bar (18 inches length) and a 26 gauge hard plastic tube. The expansion joint shall include a standard steel wingplate.
- (3) Minimum stabilized subgrade thickness shall be 8 inches.

- b. For pavement widths greater than 28 feet B/B and for minor and major collectors

- (1) Minimum concrete slab thickness shall be 7 inches with $f_c = 4,000$ psi and reinforcement shall be Grade 60, $f_y = 60,000$ psi, #4 deformed reinforcing bars spaced at 18 inches center-to-center both ways and minimum lap lengths of 18 inches.
- (2) Expansion joints shall be placed at the end of each curb return and at a maximum spacing of 40 feet 6 inches. Expansion joints shall include a $\frac{3}{4}$ inch redwood header, $\frac{3}{4}$ smooth dowel bar (18 inches length) and a 26 gauge hard plastic tube. The expansion joint shall include a standard steel wingplate.
- (3) Minimum stabilized subgrade thickness shall be 8 inches.

- c. For pavement minor and major and arterials:

- (1) Minimum concrete slab thickness shall be 8 inches with $f_c = 4,500$ psi and reinforcement shall be Grade 60, $f_y = 60,000$ psi, #5 deformed

reinforcing bars spaced at 16 inches center-to-center both ways and minimum lap lengths of 18 inches.

- (2) Expansion joints shall be placed at the end of each curb return and at a maximum spacing of 40 feet 6 inches. Expansion joints shall include a $\frac{3}{4}$ inch redwood header, $\frac{3}{4}$ smooth dowel bar (18 inches length) and a 26 gauge hard plastic tube. The expansion joint shall include a standard steel wing plate.
- (3) Minimum stabilized subgrade thickness shall be 12 inches.

G. Subgrade Treatment: The Geotechnical Engineer shall base depth of subgrade stabilization on structural number (SN) in conjunction with pavement thickness design. Following is a general guidance for subgrade treatment:

- a. For subgrade soil conditions with a plasticity index (PI) of 10 or more, the subgrade shall be stabilized with lime and compacted to 95% standard proctor density. Subgrade shall be stabilized with the recommended percent of lime (6% min.) by weight as determined by the Geotechnical Engineer.
- b. For subgrade soil conditions containing a clean sand with no clay content, the subgrade shall be stabilized with cement.
- c. For subgrade soil conditions containing silt, the subgrade shall be stabilized with lime-fly ash.

H. Requirements for Intersections, Turnouts, Transitions, and Thoroughfares:

- a. At a "T" intersection with a street that has not been improved to its ultimate width, concrete pavement should be stopped either at the right-of-way line or at the end of the curb return, whichever would require less concrete removal at a future date.
- b. For roadway turnouts placed at an existing street intersection, the turnout should be designed to fit the ultimate pavement width of the intersecting cross-street and then transitioned to the existing roadway.
- c. The usual transition length for meeting an open ditch street is 50 feet for street widths less than or equal to 28 feet B/B; 75 feet for up to 38 feet B/B width, and 100 feet for 41 feet B/B width.
 - (1) Streets other than concrete shall have transitions of a minimum thickness of 8 inches of lime stabilized subgrade, 6 inches of hot-mix asphaltic concrete base, or approved equal, with 2 inches of hot-mix asphaltic surfacing.
 - (2) Concrete streets shall have transitions of a minimum thickness of 6 inches of stabilized subgrade and 6 inches of concrete pavement.
- d. When paving only one roadway of a proposed two roadway thoroughfare

(boulevard section) all left turn lanes and esplanade crossovers shall be paved to the centerline of the street right-of-way.

I. Requirements for Roadway Pavement with Open Ditch Sections (large lot residential subdivisions only):

- a. Minimum grade on ditches shall be 0.20 percent.
- b. Ditch capacity shall be designed to accommodate a 5-year storm runoff event.
- c. Maximum side slopes of ditches shall be 3 feet horizontally to 1 foot vertically (3:1). Sides may be sloped to 4:1 or 5:1 for easier maintenance by property owner.
- d. Culverts for roadside ditches only shall be designed to carry ditch discharge but not less than 18 inches diameter. Culverts shall be Class III RCP conforming to ASTM C-76 or smooth interior dual wall corrugated polyethylene pipe conforming to AASHTO M294.
- e. The minimum paving radius for cul-de-sac shall be 40 feet in a 50-foot radius right of way if the cul-de-sac is located on the interior of a residential subdivision, and is 600 feet or less in length. If the cul-de-sac opens onto a thoroughfare or exceeds 600 feet in length, the minimum pavement radius shall be 45 feet in a 50-foot radius right of way.

J. Requirements for Roadway Pavement with Curb and Gutter Sections:

- a. Minimum gutter gradient shall be 0.30 percent.
- b. Maximum cut from finished grade at property line to top of curb shall be 1.75 feet. The desired slope for driveways is 2% to 8%.
- c. Minimum grade shall be 0.70 percent fall around intersection turnout for a maximum radius of 25 feet. Grades for larger radius shall be determined on an individual basis.
- d. Vertical curves shall be installed when algebraic differences in grades exceed 1 percent. Elevations shall be shown at 10 foot intervals through vertical curves. Maintain a minimum of 0.02 feet elevation change at 10 foot intervals by altering the calculated elevations.
- e. When a curb and gutter intersects a drainage ditch, the grade of gutter shall be above the designed water surface of the ditch.
- f. The maximum travel distance of water in the street gutter to a curb inlet shall be 300 feet on a major thoroughfare and in commercial areas. The maximum travel distance of water in the street gutter to a curb inlet in a single-family residential area shall be 500 feet.
- g. All new residential and local streets poured with a curb and gutter shall have a

minimum of a 4 inch rollover, lay down curb. All new collector and thoroughfare streets shall have the standard 6 inch stand up curb. A standard 6 inch curb shall be used adjacent to all storm sewer inlets; 4 inch rollover curbs shall be transitioned to a 6 inch curb near the inlet.

- h. Major thoroughfares shall be super-elevated in accordance with AASHTO whenever the centerline radius of lanes or right-of-way is less than 2,000 feet.
- i. The amount of cross-slope over the pavement section shall be 2% sloping away from the crown of road or centerline.
- j. A minimum gradient of 0.70 percent around the longest radius is required on an L-Type street intersection or cul-de-sac.
- k. Fill lines shall be shown on the drawings. If this type of fill is required and the pavement is adjacent to a nonparticipating property owner, fill easements shall be obtained from the property owner and recorded. A copy of the easements shall accompany the final drawings. Construction of this nature will require back-slope drainage design to prevent trapping storm runoff.
- l. Grades should be labeled for all tops of curb. Centerline grades are acceptable for open-ditch sections only.
- m. The minimum paving radius for cul-de-sac shall be 40 feet in a 50-foot radius right of way if the cul-de-sac is located on the interior of a residential subdivision, and is 600 feet or less in length. Islands within cul-de-sacs are allowed provided that the minimum fire apparatus turning radius requirements are met. If the cul-de-sac opens onto a thoroughfare or exceeds 600 feet in length, the minimum pavement radius shall be 45 feet in a 50-foot radius right of way.

K. Requirements for Curbs and Sidewalks:

- a. Standard height of a curb is 4 inches and 12 inches wide for curbs located along residential streets. Curb height for streets other than residential shall be 6 inches. The curb height for all esplanades shall be 6 inches.
- b. Sidewalk wheelchair ramps shall be required at all intersections and driveways. The design and installation of ramps shall comply with Texas Accessibility Standards Architectural Barriers requirements.
- c. All sidewalks are to be a minimum 5 feet in width and are to be constructed in accordance with the City of Iowa Colony standard details.
- d. Sidewalks are required along all curb and gutter streets. The developer, prior to the City's final one-year acceptance of the public infrastructure, must install sidewalks along right of way and reserves.
- e. The location of all proposed and existing sidewalks shall be shown on the construction drawings.

L. Requirements for Driveways

- a. Driveways shall be asphalt or reinforced concrete, and shall be installed from the existing pavement to the right-of-way line (property line), minimum.
This applies to all types of new construction. It does not apply to property being actively used for agricultural purposes and designated with the agricultural-use exemption.
- b. Refer to Iowa Colony Standard Construction Details (Paving) for various driveway configurations.

M. Requirements for Miscellaneous Items:

- a. The type and amount of subgrade treatment shall be shown on the drawings.
- b. Paving headers shall be placed at the end of all concrete pavements.
- c. All concrete to be removed shall be removed either to an existing joint or to a sawed joint.
- d. Sight distance requirements based on the design speed of the roadway shall be used for determining lengths of crest vertical curves for all pavements except boulevard sections, which shall be designed for 45 mph.
- e. Standard Type III City barricades shall be placed at the end of all dead-end streets not terminating in a cul-de-sac.
- f. A letter of agreement from the affected pipeline company approving the construction plan crossing is required when paving is placed or construction work occurs over a transmission pipeline.
- g. When meeting existing concrete pavement, horizontal dowels shall be used if no exposed reinforcing steel for interconnection with new pavement exists. Horizontal dowels shall be Grade 60, #6 rebars, 24 inches long, drilled and embedded 12 inches into the center of the existing slab and epoxied. Dowels shall be 18 inches center-to-center, unless otherwise specified.
- h. When concrete is removed for interconnections, the pavement shall be saw cut and existing concrete removed to expose a minimum of 15 inches of reinforcing steel. If no reinforcing steel exists, use horizontal dowels as previously described.
- i. Dead-end streets or ends of concrete slabs designed to be extended in the future shall have paving headers and 15 inches of reinforcing steel exposed beyond the pavement, coated with asphalt and wrapped with burlap or paving headers and dowel type expansion joint for future pavement tie.
- j. Pavement extensions shall connect to the existing pavement with a pavement undercut and a minimum steel overlap of 18 inches.

- k. Concrete pavement thickness design is required for all pavement within industrial areas and on major thoroughfares. Concrete pavement thickness design shall be based on AASHTO design procedures for rigid pavements.
- l. Adjust manhole frames and covers within the limits of the pavement to meet the proposed final top of slab.
- m. Adjust manhole frames and covers outside the limits of the pavement to conform to the final grading plan.
- n. No more than one shrinkage crack shall be allowed in each forty foot header section. A shrinkage crack is defined as extending less than one half depth of the concrete (i.e. 3" or less on 6" thick concrete) appearing within one year of the final concrete placement. If two or more shrinkage cracks appear in one header section, the entire section shall be removed and replaced at contractor's expense.
- o. If shrinkage cracks are less than one-half the full depth of the concrete, then a recommendation letter and data sheets are required from the testing laboratory as to the type of sealant which will be used to seal the shrinkage cracks. This recommendation shall be approved by the City Engineer before application of sealant. Cracks shall be sealed at contractor's expense.
- p. Core samples for the sections will be taken no sooner than the 28 day break of the original concrete pour sample.
- q. All signage posts shall be galvanized black powder coated.

6.4 QUALITY ASSURANCE

- 6.4.1 All construction drawings and specifications shall be prepared by or under the supervision of a currently Registered Professional Engineer of the State of Texas, and all documents shall be sealed, dated, and signed by the engineer responsible for the preparation.
- 6.4.2 A geotechnical report shall be performed by or under the supervision of a currently Registered Professional Engineer of the State of Texas disciplined in the science of soils analysis. All reports and documents shall be sealed, dated, and signed by the engineer responsible for the preparation.
- 6.4.3 All pavement design shall be supported by calculations to establish the required thickness and reinforcement.
- 6.4.4 The current soils report shall be the basis for design considering the use, loading, and life span of the proposed pavement.



CHAPTER 7

STREET LIGHTING

CHAPTER 7 – STREET LIGHTING

7.1 GENERAL

- A. A street light is defined as any man-made light installed for the purpose of vehicular traffic illumination purposes on a pole with a minimum fixture height of thirty (30) feet above natural ground located within public or private street right-of-way. This chapter includes the installation and design requirements for street lighting within the city limit and the extra-territorial jurisdiction of the City of Iowa Colony within:
 - 1. All public roadway rights-of-way, except those directly controlled by the Texas Department of Transportation, and
 - 2. All private roadways within single family residential subdivisions where private roadways are provided for primary lot access, the private roadways are designed to public street standards, and there is a homeowner's association (HOA) established that can and will maintain and provide operation funding for the provided streetlights.
- B. The City of Iowa Colony City Engineer shall approve street lighting plans for all street light improvements within the City of Iowa Colony city limit and the extra-territorial jurisdiction of the City of Iowa Colony.
- C. Construction plans for private improvements within public rights-of-way and public easements that connect to or affect the public infrastructure shall be approved by the City of Iowa Colony City Engineer subject to the requirements of this manual and are subject to review and approval using the process defined in this manual. Private streets designed and built to public street standards with the same general geometric cross-section as a public street shall be required to have street lighting in conformance with this manual.
- D. The purpose of this chapter is to provide motor vehicle drivers and pedestrians with quick, accurate, and comfortable vision at night, taking into consideration the need to provide lighting in an economically feasible manner that is consistent, safe, and compatible with surrounding land use. The purpose of this chapter is to also help property owners and developers understand the standard street lighting process as well as the fixture options available.
- E. Street lighting is a vital part of any community and when properly designed, street lighting can reduce automobile collisions, deter crime, and foster a sense of safety. Properly designed street lighting can all add aesthetic appeal, as well as contribute to the overall structural design of any community.
- F. The City of Iowa Colony has standardized its street light fixtures in an effort to continue to provide exceptional service to its citizens and property owners. CenterPoint Energy is the company that provides, maintains, and operates street light fixtures within Iowa Colony. Fixtures have been selected from those currently available from CenterPoint Energy from various manufactures to ensure a

standardized community image. Using CenterPoint approved fixtures will ensure continued compatibility with the existing electrical system. Using CenterPoint approved fixtures also provides faster repair time, lower operational and installation costs, while maintaining a high level of street lighting standards.

- G. The City of Iowa Colony supports initiatives that reduce light pollution and ecosystem disturbance while maintaining the public's sense of safety and security within our community. To that end, the location and spacing criteria included herein shall be the maximum allowable lighting unless otherwise approved by the City Engineer.
- H. As new technology, after thorough testing, becomes available and as the lighting industry changes, the City of Iowa Colony will update this chapter to provide its citizens and property owners with the most reliable, cost effective, functional, and long-lasting lighting products.

7.2 BUG RATING

- A. For years, IESNA (illumination Engineering Society of North America) used the "cutoff" classification system (full cutoff, semi cutoff, and non-cutoff) to rate the amount of light emitted from a luminaire in unwanted directions. However, in 2005, IESNA began its efforts to replace the cutoff classification, ultimately resulting in the new **BUG (Backlight, Uplight, and Glare)** rating methodology. This represents a comprehensive system that limits lamp lumens to values appropriate for the lighting zone. The BUG rating system is based on the criteria outlined below:
- B. **Backlight** creates light trespass onto adjacent sites, the **B** rating takes into account the amount of light in the secondary solid angle zones of low, medium, high, and very high (BL, BM, BH, BVH), which are in the direction of the luminaire **OPPOSITE** from the area intended to be lighted.
- C. **Uplight** causes artificial sky glow. The **U** rating takes into account the amount of light into the upper hemisphere with greater concern for the lower uplight angles. Lower uplight (zone UL) causes the most sky glow and negatively affects professional and academic astronomy. Upper uplight (UH) is mostly energy waste.
- D. **Glare** can be annoying or visually disabling. The **G** rating takes into account the amount of frontlight in the high and very high (FH and FVH) zones.
- E. The fixture rating for the emitted lighting zone is determined by the highest classification in each of the zones (BUG) and is assigned a number from 0-5. The lower number, i.e. U0, the better the luminaire performs in this criteria.
- F. The LED fixtures used in the City of Iowa Colony should qualify as dark sky friendly based on the BUG rating determined by the IESNA. This is particularly important for the "U"- Uplight rating. For more information regarding BUG ratings, please visit the IESNA website at www.ies.org.

7.3 TYPICAL LIGHTING ARRANGEMENTS

A. Ambient Light Level (See also Unified Development Code, Section 3.4.1.3)

Zoning/Use

Recommended Uses or Areas

ALL-0

Wilderness areas, parks and preserves, and undeveloped rural areas and with greater than one (1) acre lots/tracts of residential and/or agricultural development.

No Ambient Lighting – Areas where the natural environment will be seriously and adversely affected by lighting. Impacts include disturbing the biological cycles of flora and fauna and/or detracting from human enjoyment and appreciation of the natural environment. Human activity is subordinate in importance to nature. The vision of human residents and users is adapted to the darkness, and they expect to see little or no lighting. When not needed, lighting should be extinguished.

ALL-1

Rural and low density residential areas with less than one (1) acre but greater than six-thousand, three-hundred (6,300) square feet lots of residential development.

Low Ambient Lighting – Areas where lighting might adversely affect flora and fauna or disturb the character of the area. The vision of human residents and users is adapted to low light levels. Lighting may be used for safety and convenience but it is not necessarily uniform or continuous. After midnight, most lighting should be extinguished or reduced as activity levels decline.

ALL-2

Light commercial business and high density or mixed-use residential areas with lots less than six-thousand, three-hundred (6,300) square feet lots of residential development.

Moderate Ambient Lighting - Areas of human activity where the vision of human residents and users is adapted to moderate light levels. Lighting may be typically used for safety and convenience but it is not necessarily uniform or continuous. After midnight, lighting may be extinguished or reduced as activity levels decline.

7.4 DESIGN REQUIREMENTS

- A. Street lighting plans shall be included with the design drawings for all residential land development projects on separate sheets but as a part of the street construction package submitted for review and approval by the City of Iowa Colony City Engineer. Commercial land development projects that include the construction of public or private roadways shall include a street light plan for the roadway. Developments required to construct adjacent perimeter streets shall include street lighting plans with that construction review and approval. A City of Iowa Colony approval block shall be provided on both the cover sheet and on the street lighting layout sheet for signatures by the City of Iowa Colony.

- B. Street lighting plans shall conform to the technical requirements of this chapter and any approved variances to the technical requirements.
- C. Drawings shall be prepared on nominal 24" x 36" drawing sheets, as appropriate.
- D. The firm/agency and original signature of the design professional responsible for the street light plan are required on each sheet.
- E. Final design drawings shall be permanent ink on mylar, or produced by CADD on mylar for City funded projects. Final design drawings shall be reproducible blacklines for privately funded projects. Do not use adhesive-backed material on final drawings. Stick-ons may be allowed with approval of the City Engineer for minor correction during the final review process.
- F. Details of special structures (i.e. street light bases) shall be drawn with vertical and horizontal scales equal to each other.
- G. All street lights shall be installed with LED luminaries.
- H. All plats shall include a commitment for the installation of street lights in accordance with the terms of this chapter. This commitment shall include a separate letter identifying the number and wattage/lumens of lights to be installed as required by this chapter. A separate street light installation plan shall be approved by the City Engineer prior to the acceptance of the project into the one-year maintenance period and/or prior to the permitting of private developments. A copy of the approved street light plan shall be included in the project closeout documents.
- I. All street light plans must include approval by Centerpoint with an original approval signature provided on each sheet.

7.5 RESPONSIBILITY FOR INSTALLATION AND MAINTENANCE IN EXISTING DEVELOPMENTS

- A. Existing developments are those developments where formal application for City approval, usually in the form of submittal of a set of construction plans, has been made as of the date of final adoption of this Chapter, or those developments that are already in existence at the time of adoption of this Chapter regardless of whether City approval was given, to the extent such development is already in place or to the extent application for City approval has already been made.
- B. In no case shall the standards in this Chapter be interpreted to mean that existing street lights already installed or proposed in existing developments be removed, relocated, or otherwise changed unless the current street light layout of an existing development is to be substantially altered from the condition in place due to public safety endangerment at the time of the adoption of this policy. In such instances, the new layout will conform to the technical standards set forth in this policy.

- C. In existing residential and commercial developments where street lights are installed or proposed to be installed throughout the development, or a section thereof, by the developer or homeowners association (HOA) of the development or section, CenterPoint Energy, as funded by the developer or HOA, shall maintain and ensure the proper illumination in accordance with this policy of the street lighting, including paying of the installation and the monthly utility cost therefore, as required by CenterPoint. It shall not be the responsibility of the City to maintain or pay the monthly utility cost for street lights.
- D. In existing residential and commercial developments or sections thereof, where street lights have not been installed nor are proposed to be installed by the developer or HOA, the City may, at their option and if funding is available and authorized by City Council, opt to provide for the installation and maintenance of street lighting by CenterPoint Energy.
- E. Notwithstanding anything to the contrary herein regarding existing developments, along existing major arterials or a portion thereof, where street lights have not been installed nor are proposed to be installed, the City may, at their option, provide for the installation and maintenance of street lights by CenterPoint Energy, including proper illumination, when the average daily traffic count, stage of development, street design, existing illumination levels and budgeted funds allow for the same, as determined by the City.
- F. In those cases where arterial or collector street intersections will be improved with traffic signalization, as indicated on the adopted City of Iowa Colony Major Thoroughfare Plan, street light design should incorporate the future traffic signalization criteria.

7.6 RESPONSIBILITY FOR INSTALLATION AND MAINTENANCE IN NEW DEVELOPMENTS

- A. New developments are those developments where formal application for City approval or conditional approval, usually in the form of submission of a preliminary plat (or where a preliminary plat is not required, a final plat) or a site plan, has not been made as of the date of adoption of this chapter. The developer shall include a street light layout plan, conforming to the provisions of this policy, with the construction plans submitted for approval by the City.
- B. In all new residential and commercial developments, CenterPoint Energy, as funded by the developer shall be responsible for the installation and maintenance, including the proper illumination, of street lights along all streets or portions of streets prior to the end of the one (1) year maintenance period of the streets. Utility charges for the operation and maintenance of same will be the responsibility of the developer or the HOA, and shall be paid directly to the electrical service provider. The developer or the HOA and CenterPoint Energy will maintain a contract for maintenance of the street lights.
- C. Notwithstanding anything to the contrary herein regarding new developments, the

developer of property adjacent to any arterial or collector, existing or proposed, designated on the City of Iowa Colony Major Thoroughfare Plan, or of property within which a portion of any arterial or collector, existing or proposed, designated on the City of Iowa Colony Major Thoroughfare Plan, is situated or proposed, shall be responsible for the installation and maintenance, including ensuring the property illumination, of street lights along the indicated roadway for the length of the designated thoroughfare along which the development is situated. When a developer develops only on one side of a designated thoroughfare, he is required to install and maintain only those street lights required for the developer side of the designated thoroughfare. The responsibility to install and maintain street lights as set forth herein by the developer continues with a direct contract with CenterPoint Energy. The monthly utility charge for the street lights is the responsibility of the developer or HOA, and is paid directly to the retail electric provider.

7.7 ORNAMENTAL LIGHTS

Ornamental lights are defined as any street or pedestrian path light that is mounted on a pole or mounted within a bollard with the fixture height being less than thirty (30) feet above the ground located within public or private street right-of-way or a public access easement and is not the single source of lighting for vehicle traffic safety. Ornamental lights are required to be installed by adjacent new development for pedestrian pathways that are indicated on any adopted City of Iowa Colony Master Pedestrian Pathway Plan. Ornamental lights are not required at any other location and may be allowed when following the regulations herein.

- A. New development is required to include ornamental lights along pedestrian pathways adjacent to or within developments as indicated on any adopted City of Iowa Colony Pedestrian Pathway Plan. The pole/bollard and fixture are subject to the approval of the City Engineer who will provide allowable pole/bollard and fixture specifications and manufacturers to ensure uniformity within the regulatory area of the City of Iowa Colony subject to detail specifications related to Ambient Lighting Level areas indicated below.
- B. Developers, homeowner and property owner associations may desire to install non-required ornamental lights and shall be considered ornamental lighting and may be permitted only upon prior application and approval by the City Engineer. In no event shall the installed ornamental light layout and design fall below the standards set forth in this Chapter, nor exceed the standards set by the IESNA as indicated in their Figure 22-10 – Recommended Average Maintained Illuminance Level for Pedestrian Ways in Lux. Even if the proposed ornamental light design is in addition to the required street light design, consideration for a cost adjustment or cost sharing by the City will not be entertained and the cost for such desired ornamental lights shall be paid by the developer, HOA or POA, under contract directly with the service provider, in perpetuity.
- C. Lighting for structures or buildings that is attached or designed within is not considered ornamental lighting as defined in this Chapter.
- D. The City standard for ornamental lights within or adjacent to new development is as

follows:

1. Ambient Light Level area “0” – Ornamental lighting is not allowed, except as required for pedestrian pathways indicated on an adopted City of Iowa Colony Master Pedestrian Pathway Plan.
 2. Ambient Light Level area “1” - Ornamental lighting is not allowed, except as required for pedestrian pathways indicated on an adopted City of Iowa Colony Master Pedestrian Pathway Plan or along major or minor arterials with non-required pedestrian pathways at least six (6) feet in width.
 3. Ambient Light Level area “2” – Ornamental lighting is allowed in all ALL 2 areas subject to the technical requirements herein.
- E. The installation, operation, and maintenance of ornamental lighting within public or private street rights-of-way or public access easements shall not be the responsibility of the City of Iowa Colony. The City may agree to accept responsibility under the following conditions:
1. A variance request to install ornamental lighting not required by this Chapter has been approved by the City Engineer.
 2. A street lighting plan that shows the lighting provided by the ornamental lights meets exceeds the coverage and lumens to the requirements of this Chapter for public lighting.
 3. An agreement is executed between the City and a perpetual entity acceptable to the City (i.e. a homeowners association), in which the perpetual entity agrees to cover the installation cost of all ornamental lighting and the monthly maintenance cost for all ornamental lights as approved by the City.

7.8 TECHNICAL REQUIREMENTS

7.8.1 Street Light Location/Spacing

- A. Ambient Lighting Level 0 –Street lights shall not be required except as follows:
1. Local Streets – Street lights shall not be required.
 2. Collector Streets – Street lights shall only be required at all street intersections along collector streets. Only one (1) street light is required at each intersection.
 3. Minor Arterials – Street lights shall only be required at all street intersections along minor arterial streets. Two (2) street lights - one (1) on each opposing diagonal corner for “X” intersections and one (1) street light on “T” intersections.
 4. Major Arterials – Street lights shall be only be required at all street intersections and at all median openings along major arterials. Two (2) street lights – one on each opposing diagonal corner for “X” intersections and at median openings with streets on both sides of the median opening and one (1) street light on “T” intersections and at median openings with only a street only on one (1) side of the median opening.

B. Ambient Lighting Level 1 – Street lights shall be required as follows:

1. Local Streets – Street lights shall be required at all street intersections, 90 degree turns, and at the end of cul-de-sacs or dead ends. Only one (1) street light shall be required in each of these conditions.
2. Collector Streets – Street lights shall be required at all street intersections along collector streets. Only one (1) street light is required at each intersection.
3. Minor Arterials - Street lights shall only be required at all street intersections along minor arterial streets. Two (2) street lights - one (1) on each opposing diagonal corner for “X” intersections and one (1) street light on “T” intersections.
4. Major Arterials - Street lights shall be only be required at all street intersections and at all median openings along major arterials. Two (2) street lights – one on each opposing diagonal corner for “X” intersections and at median openings with streets on both sides of the median opening and one (1) street light on “T” intersections and at median openings with only a street only on one (1) side of the median opening. In no case shall there be more than twelve-hundred (1,200) feet between street lights.

C. Ambient Lighting Level 2 – Street lights shall be required as follows:

1. Local Streets – Street lights shall be required at all street intersections, 90 degree turns, and at the end of cul-de-sacs or dead ends. Only one (1) street light shall be required in each of these conditions.
2. Collector Streets – Street lights shall be required at all street intersections along collector streets. Only one (1) street light is required at each intersection.
3. Minor Arterials - Street lights shall be required at all street intersections along minor arterial streets. Two (2) street lights - one (1) on each opposing diagonal corner for “X” intersections and one (1) street light on “T” intersections. In no case shall there be more than twelve-hundred (1,200) feet between street lights.
4. Major Arterials - Street lights shall be required at all street intersections and at all median openings along major arterials. Two (2) street lights – one on each opposing diagonal corner for “X” intersections and at median openings with streets on both sides of the median opening and one (1) street light on “T” intersections and at median openings with only a street only on one (1) side of the median opening. In no case shall there be more than twelve-hundred (1,200) feet between street lights.

D. Bridge Crossings – Street lights shall be required as follows unless lighting internal to the bridge structure sufficiently provides traffic safety lighting as determined by the City Engineer. Drainage structure opening sizes of twenty-four (24) inches or less shall not require lighting:

1. Ambient Lighting Level 0 – All street types shall not require a street light at bridge/culvert drainage crossings. Approved TxDOT reflective markings shall be required on bridges in these locations.

2. Ambient Lighting Level 1 – A street light shall not be required at a bridge/culvert drainage crossing except for a major arterial which will require one (1) street light or equal bridge lighting located within one-hundred (100) feet of one end of the bridge.
 3. Ambient Lighting Level 2 – A street light is required for all street types except local for a street light to be placed within one-hundred (100) feet of each end of a bridge/culvert drainage crossing.
- E. Notwithstanding any provision herein to the contrary, street lights at intersections on major and minor arterials will be located so as to illuminate the major arterial and not turned to illuminate the other public street.
- E. Pedestrian/bike path lighting shall be designed to conform with Figure 22-10, IESNA, Recommended Average Maintained Illuminance Level for Pedestrian Ways in Lux and be spaced to provide the recommended minimum illumination. The City may require a specific ornamental fixture or pole for those locations adjacent to a designated pedestrian pathway indicated on an approved City of Iowa Colony Master Pedestrian Plan but will not require a specific fixture of pole for those ornamental lighting locations other than a designated pedestrian pathway indicated on a Master Pedestrian Plan:
- Light uniformity ratio should be an average range between 4 to 6. In no case should lighting levels or uniformity ratios exceed recommended values per IESNA RP-33, RP-20.
- G. Light Trespass – Light levels at the property line should not exceed 0.1 foot-candle adjacent to business properties and 0.5 foot-candle at residential property lines.

7.8.2 Street Light Lumen Size/Manufacturer

The lumen size of street lights required to be installed will be in accordance (as provided by CNP as Approved LED Street Lights) with the following, subject to modification by the City Engineer should a specified light luminaire no longer be available or low-performing:

- A. Ambient Lighting Level 0 – All cul-de-sac end and dead-end street lights shall be 45W – 4,800 LED luminaire (Cree XSP) and all street intersection street lights shall be 95W – 7,900 lumen LED luminaire (EOI SL3c, grey), as CNP Approved LED Street Lights or equal. The “U”, uplight, rating shall be “U0” (zero) to be dark sky compliant per IESNA TM-15.
- B. Ambient Lighting Level 1 – All residential street lights shall be 95W – 7,900 lumen LED luminaire (EOI SL3c, grey), as CNP Approved LED Street Lights or equal. All commercial or non-residential street lights shall be 115 W – 10,850 lumen LED luminaire (Phillips RoadFocus, grey) as CNP Approved LED Street Lights or equal. The “U”, uplight, rating shall be “U0” (zero) to be dark sky compliant per IESNA TM-15.
- C. Ambient Lighting Level 2 – All street lights shall be 115 W – 10,850 lumen LED

luminaire (Phillips RoadFocus, grey) as CNP Approved LED Street Lights or equal. The “U”, uplight, rating shall be “U0” (zero) to be dark sky compliant per IESNA TM-15.

- D. In all Ambient Lighting Level areas, the maximum Color Corrected Temperature of the fixture shall not exceed 4200K to reduce “blue light” saturation levels.

7.8.3 Street Light Poles

The City of Iowa Colony desires a consistent, blended visual look for street light poles of either standard wooden poles or standard grey steel poles in the following locations.

- A. Wooden poles, with grey metal hangars for the luminaire, shall be used at all locations within Ambient Lighting Level 0 areas except along designated major and minor arterials which shall have grey steel poles (CenterPoint approved).
- B. Grey steel poles shall be used in all residential developments in Ambient Lighting Levels 1 and 2.
- C. In Ambient Lighting Levels 1 and 2, in commercial/industrial developments, grey steel poles are preferred. Where wood poles and overhead wires are already prevalent, wood poles will be used for street lights, using metal hangars for the luminaire.

7.9 SPECIAL CONDITIONS

From time to time, special conditions may exist that render it necessary to alter the lumen size, spacing requirement, or other technical standards to adequately meet the objectives of this policy. Such special conditions shall include, but not necessarily be limited to, the following:

- A. In new construction of developments and arterials, the developer may be required to install lights in excess of the standards set forth in this Chapter to lessen traffic and safety hazards existing because of certain site conditions which prevent the technical standards from providing sufficient lighting for traffic safety, as determined by the City Engineer. These conditions include, but are not limited to, pavement type, number of interchanges, street design, ratio of night to day accidents, and other relevant matters.
- B. Wherever the City may deem it necessary or desirable, the City may elect to be responsible for the installation and maintenance of street lighting in excess of policy standards to lessen traffic safety hazards or otherwise alter existing conditions.



CHAPTER 10

CONSTRUCTION, INSPECTION, APPROVAL AND ACCEPTANCE PROCEDURES FOR PUBLIC INFRASTRUCTURE

Prepared by Ron Cox Consulting

CHAPTER 10 – CONSTRUCTION, INSPECTION, APPROVAL AND ACCEPTANCE FOR PUBLIC INFRASTRUCTURE

Introduction

The City of Iowa Colony is experiencing considerable development throughout its jurisdiction. This includes development both inside the City Limits and within the City's Extraterritorial Jurisdiction (ETJ). It is, therefore, important for the City Council to approve a policy that sets out the procedures for the inspection, approval and acceptance of public infrastructure within its jurisdiction. These policies and procedures apply to construction in both subdivisions and commercial sites where it is anticipated that connections to the public infrastructure will be made, and where the infrastructure will be conveyed, either upon completion or in the future, to the City of Iowa Colony for operation and maintenance.

These procedures are designed so the developers and contractors will know both the procedures to be followed and the costs for the required reviews and inspections in advance.

It is important that all publicly accepted, operated and maintained infrastructure constructed within its city limits and ETJ be compliant with the City's standards and requirements. It is anticipated that even if the City does not accept the infrastructure for immediate operation and maintenance, it may eventually. As such, developers and contractors should refer to the City's Zoning and Subdivision Ordinances, as well as the City's Design Criteria Manual for specific guidance on allowable uses, platting and approval procedures and construction standards.

These procedures are designed to set out the process for approvals by the City of Iowa Colony during the construction phase of the development within the City of Iowa Colony and its ETJ.

Note: For all projects within the ETJ, the developer should also contact the Brazoria County Engineering Offices for instructions on their review procedures.

Permits and Inspection fees

The City currently utilizes a Consulting Engineer to provide infrastructure inspection services. The City expects the development to bear the costs of the services. The

contractor is expected to apply for the appropriate permits and pay the required fees in advance of the project start. Fees shall be set from time to time by the City Council and are designed to include the cost of inspections. The City may amend its fee schedule at any time to ensure the costs for the service are being covered, and may pass increased costs along to the responsible party at any time.

Pre-construction Phase

Prior to construction and prior to the issuance of a permit from the City, a preconstruction conference will be held with City staff and the City's Consulting Engineer. It is expected that prior to the preconstruction conference the following will be provided to the City in advance for review by the staff and the Consulting Engineer:

- **Plans.** Plans, specifications and other documents relating to the proposed development are to be provided.
- **Contract.** The contract between the developer and the contractor is to be provided.

Attendees at the preconstruction meeting should include the City's staff, the City's Consulting Engineer, a developer representative, a representative of the developer's engineering firm, a contractor's representative, and other people as may be identified by the City prior to the meeting. Attendance by all designated attendees is mandatory.

The project will be fully discussed at the meeting including but not limited to the developer's timetable, the points at which the City should be contacted for inspections of the infrastructure, the method of scheduling inspections, and the name, address, and contact information of all relevant participants in the construction process.

Construction Phase

It is expected the City's Consulting Engineer will make periodic reviews of the construction sites. The contractor responsible for construction should follow the procedures established by the City of Iowa Colony (Request form attached). The City's Consulting Engineer will review results of all testing data as required by the City's Design Criteria Manual.

Construction inspections will include but not be limited to the following.

- **Streets and sidewalks.** Inspections should be expected for sub-grade and base materials work, rebar placement, and concrete pours.
- **Drainage facilities.** The City's Consulting Engineer will inspect all storm water inlets, storm water drains, culverts, open ditches and detention facilities. Within their respective jurisdictions, representatives of Brazoria Drainage District 4 and 5 will also inspect and approve all drainage facilities associated with the development. The contractor should schedule inspections for DD 4 or 5 directly with that office.

- **Water and Sewer Utilities.** Inspections should be expected of all water and sewer lines (both grade and pressure testing), lift stations, water and wastewater plants, manholes, fire hydrants, valve locations and taps.
- **Other.** Depending on the type development, there may be landscaping, street lighting, façade type, and other inspections required. The contractor should be aware of all City requirements and call inspectors as appropriate.

Acceptance of Infrastructure for One-Year Maintenance Period

The City's Consulting Engineer will make a walk-through inspection upon completion of the project prior to making a recommendation for acceptance. The contractor is expected to have fully completed all construction prior to the walk-through inspection. During the walk-through inspection a punch list will be created. The contractor will be expected to complete/correct all the items on the punch list prior to presentation of the project to the City Council for acceptance.

Prior to acceptance for the one year maintenance period by the City Council the following must be on file with the City of Iowa Colony.

- **Proof of Drainage District Approval.** Documentation must be on file with the City that the appropriate Drainage District has approved the drainage improvements for the development.
- **Maintenance Bond (for Subdivision infrastructure only).** Documentation of the receipt of a properly completed Maintenance Bond (See the Subdivision ordinance for Maintenance Bond requirements for projects within the City Limits. For those in the ETJ, the County requirements shall be met and the City shall receive a copy of the Maintenance Bond).
- **Punch List.** Proof that all items listed on the punch list have been completed to the satisfaction of the City's Consulting Engineer.
- **Certification from the Engineer of Record.**
- Construction material testing lab report and Certification from the Geotechnical Engineer of Record.
- **As Built Drawings and Plans.** The contractor shall provide a true and correct paper and electronic copy in the format prescribed by the City of Iowa Colony Design Criteria Manual, Section 2.2.4, of the project as-built for filing and recording by the City. Construction documents shall be provided by both PDF and cadd (.dwg).
- Provide all required test reports for the infrastructure.
- Provide digital files of the post construction TV assessment of gravity sewers.
- **Engineer's Letter of Recommendation.** A letter of recommendation from the City's Consulting Engineer is required. This letter will document the project has been constructed in accordance with the plans and specifications originally reviewed, inspections during the construction process, and the Maintenance Bond and as-built drawings are properly executed and on file. The letter will be to recommend acceptance of the infrastructure for the one-year maintenance period to the City Council.
- Provide GIS shapefiles for water, sanitary sewer, storm sewer, drainage facilities and

- street as determined by City Engineer.
- **Electronic files of all of the above shall be required.** No building permits will be issued for the development until the City Council has accepted the project for the one year maintenance period.

Final Acceptance of Infrastructure

Prior to final acceptance of the infrastructure, and prior to the end of the one year maintenance period, a final inspection shall be scheduled and conducted by the City's Consulting Engineer. The responsible party for the development is required to contact the City and schedule the inspection. This inspection should be no sooner than eleven months after the beginning of the maintenance period. This inspection will be designed to inspect the infrastructure for failures or other deficiencies that may have occurred during the maintenance period. A punch list will be created if needed as a result of the inspection. The developer and/or contractor are expected to complete/correct all the items on the punch list prior to City Council consideration.

- A letter of recommendation from the City's Consulting Engineer to the City Council will again be required. This letter will document the project has completed its final inspection after the one year maintenance period, confirm the project is in compliance with the plans and specifications, the as-built drawings are properly executed and on file. The letter will be to recommend final acceptance of the infrastructure by the City Council and the release of the Maintenance Bond.

Conclusion

It is the purpose of these procedures to provide predictable criteria for the City, developers and contractors alike to follow. These procedures may be amended from time to time. All developers/contractors are urged to seek the most up to date copy of these procedures prior to beginning the planning process for developments that will have publicly operated and/or maintained infrastructure.

APPENDIX A

STANDARD CONSTRUCTION DETAILS

10 ALL FIVE MODERATE EFFORTS TO GET ALL FITTING
CUTS INTO BAGS.



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ADDRESS: ADDRESS : ORIGIN: ORIGIN: ADDRESS : ADDRESS : ADDRESS : ADDRESS :

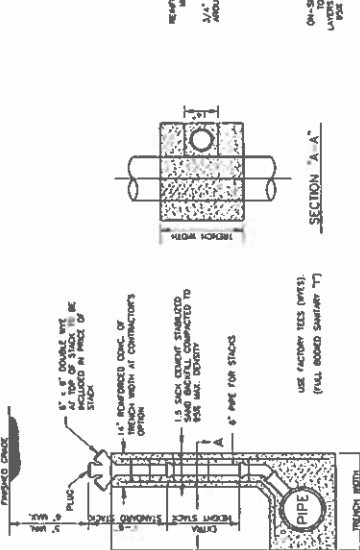
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NO.	REVISIONS	DATE	NAME
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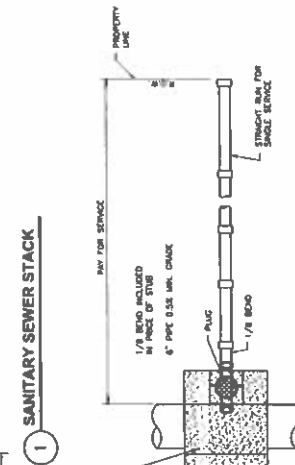
CITY OF IOWA COLONY, TEXAS
STANDARD DETAILS

SANITARY SEWER DETAILS
SHEET 1

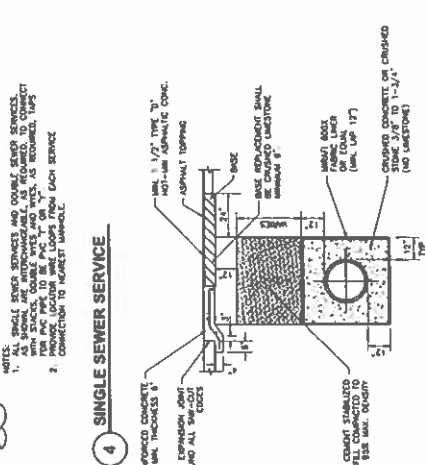
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APPROVED BY:		DATE:	
SANITARY SEWER DETAILS - 1			
COC STANDARD			



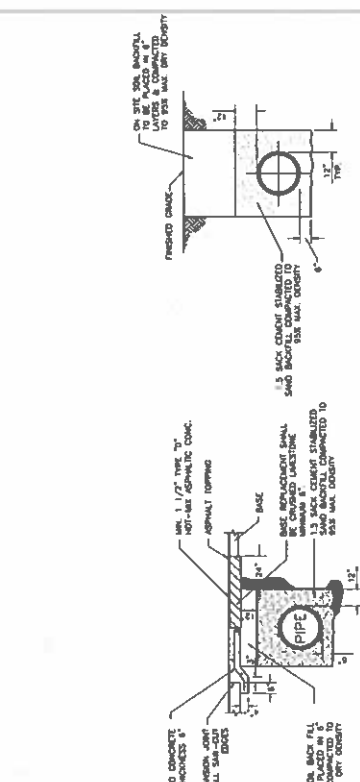
USE FACTORY TELS (WVZ\$)-



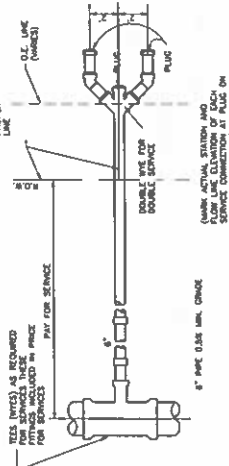
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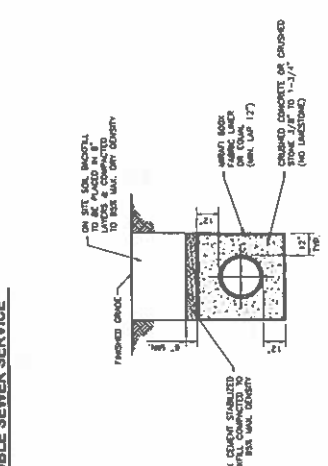
BEDDING AND BACKFILL FOR



RENCH SECTION IN PAVED AREA



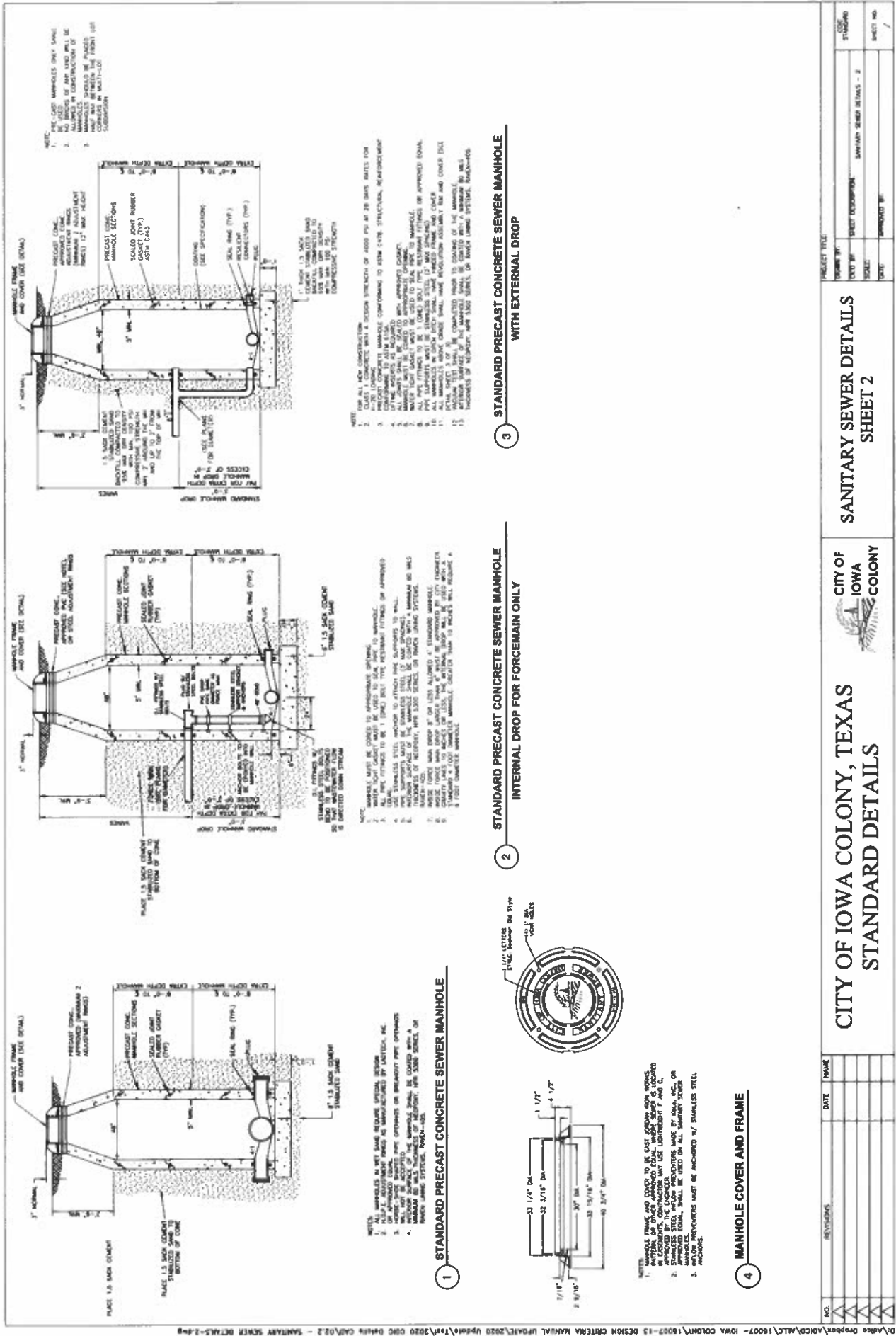
DAVID L. REWED, SERVICE



BEDDING AND BACKEN! FOR WET SAND

5216

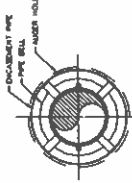
- ALL SENSITIVE SERVER TAPES SHOULD BE PLACED IN LINE WITH PROPERTY CARRIER OR PLACED HALF WAY BETWEEN THE FRONT AND REAR OF PC OF CLUB RETURN IN JAW, OR AT PC OF CLUB RETURN IN JAW, OR SUBDIVISIONS.
- NECESSITY FOR USE OF THIS SECTION TO BE DETERMINED BY THE ENGINEER AS CONSTRUCTION PROGRESSSES AND MAY BE ACCORDED BY THE SUBMITTER. OTHER THAN THE ABOVE, THE CONDITIONS TO BE MET SHALL BE INSTALLED AND THE TAPES KEPT DRY DURING CONSTRUCTION UNTIL BACKFILL IS COMPLETELY PLACED AND ENOUGH TIME AS APPROVED BY ENGINEER HAS ELAPSED.



SANITARY SEWER DETAILS
SHEET 3



TYPE	CHARGE	EXCISE IN THE 1ST QUARTER	EXCISE IN THE 2ND QUARTER	EXCISE IN THE 3RD QUARTER	EXCISE IN THE 4TH QUARTER	EXCISE IN THE 5TH QUARTER	EXCISE IN THE 6TH QUARTER	EXCISE IN THE 7TH QUARTER	EXCISE IN THE 8TH QUARTER	EXCISE IN THE 9TH QUARTER	EXCISE IN THE 10TH QUARTER	EXCISE IN THE 11TH QUARTER	EXCISE IN THE 12TH QUARTER	EXCISE IN THE 13TH QUARTER	EXCISE IN THE 14TH QUARTER	EXCISE IN THE 15TH QUARTER	EXCISE IN THE 16TH QUARTER	EXCISE IN THE 17TH QUARTER	EXCISE IN THE 18TH QUARTER	EXCISE IN THE 19TH QUARTER	EXCISE IN THE 20TH QUARTER	EXCISE IN THE 21ST QUARTER	EXCISE IN THE 22ND QUARTER	EXCISE IN THE 23RD QUARTER	EXCISE IN THE 24TH QUARTER	EXCISE IN THE 25TH QUARTER	EXCISE IN THE 26TH QUARTER	EXCISE IN THE 27TH QUARTER	EXCISE IN THE 28TH QUARTER	EXCISE IN THE 29TH QUARTER	EXCISE IN THE 30TH QUARTER	EXCISE IN THE 31ST QUARTER	EXCISE IN THE 32ND QUARTER	EXCISE IN THE 33RD QUARTER	EXCISE IN THE 34TH QUARTER	EXCISE IN THE 35TH QUARTER	EXCISE IN THE 36TH QUARTER	EXCISE IN THE 37TH QUARTER	EXCISE IN THE 38TH QUARTER	EXCISE IN THE 39TH QUARTER	EXCISE IN THE 40TH QUARTER	EXCISE IN THE 41ST QUARTER	EXCISE IN THE 42ND QUARTER	EXCISE IN THE 43RD QUARTER	EXCISE IN THE 44TH QUARTER	EXCISE IN THE 45TH QUARTER	EXCISE IN THE 46TH QUARTER	EXCISE IN THE 47TH QUARTER	EXCISE IN THE 48TH QUARTER	EXCISE IN THE 49TH QUARTER	EXCISE IN THE 50TH QUARTER	EXCISE IN THE 51ST QUARTER	EXCISE IN THE 52ND QUARTER	EXCISE IN THE 53RD QUARTER	EXCISE IN THE 54TH QUARTER	EXCISE IN THE 55TH QUARTER	EXCISE IN THE 56TH QUARTER	EXCISE IN THE 57TH QUARTER	EXCISE IN THE 58TH QUARTER	EXCISE IN THE 59TH QUARTER	EXCISE IN THE 60TH QUARTER	EXCISE IN THE 61ST QUARTER	EXCISE IN THE 62ND QUARTER	EXCISE IN THE 63RD QUARTER	EXCISE IN THE 64TH QUARTER	EXCISE IN THE 65TH QUARTER	EXCISE IN THE 66TH QUARTER	EXCISE IN THE 67TH QUARTER	EXCISE IN THE 68TH QUARTER	EXCISE IN THE 69TH QUARTER	EXCISE IN THE 70TH QUARTER	EXCISE IN THE 71ST QUARTER	EXCISE IN THE 72ND QUARTER	EXCISE IN THE 73RD QUARTER	EXCISE IN THE 74TH QUARTER	EXCISE IN THE 75TH QUARTER	EXCISE IN THE 76TH QUARTER	EXCISE IN THE 77TH QUARTER	EXCISE IN THE 78TH QUARTER	EXCISE IN THE 79TH QUARTER	EXCISE IN THE 80TH QUARTER	EXCISE IN THE 81ST QUARTER	EXCISE IN THE 82ND QUARTER	EXCISE IN THE 83RD QUARTER	EXCISE IN THE 84TH QUARTER	EXCISE IN THE 85TH QUARTER	EXCISE IN THE 86TH QUARTER	EXCISE IN THE 87TH QUARTER	EXCISE IN THE 88TH QUARTER	EXCISE IN THE 89TH QUARTER	EXCISE IN THE 90TH QUARTER	EXCISE IN THE 91ST QUARTER	EXCISE IN THE 92ND QUARTER	EXCISE IN THE 93RD QUARTER	EXCISE IN THE 94TH QUARTER	EXCISE IN THE 95TH QUARTER	EXCISE IN THE 96TH QUARTER	EXCISE IN THE 97TH QUARTER	EXCISE IN THE 98TH QUARTER	EXCISE IN THE 99TH QUARTER	EXCISE IN THE 100TH QUARTER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100		



CROSS SECTION

NOTES:

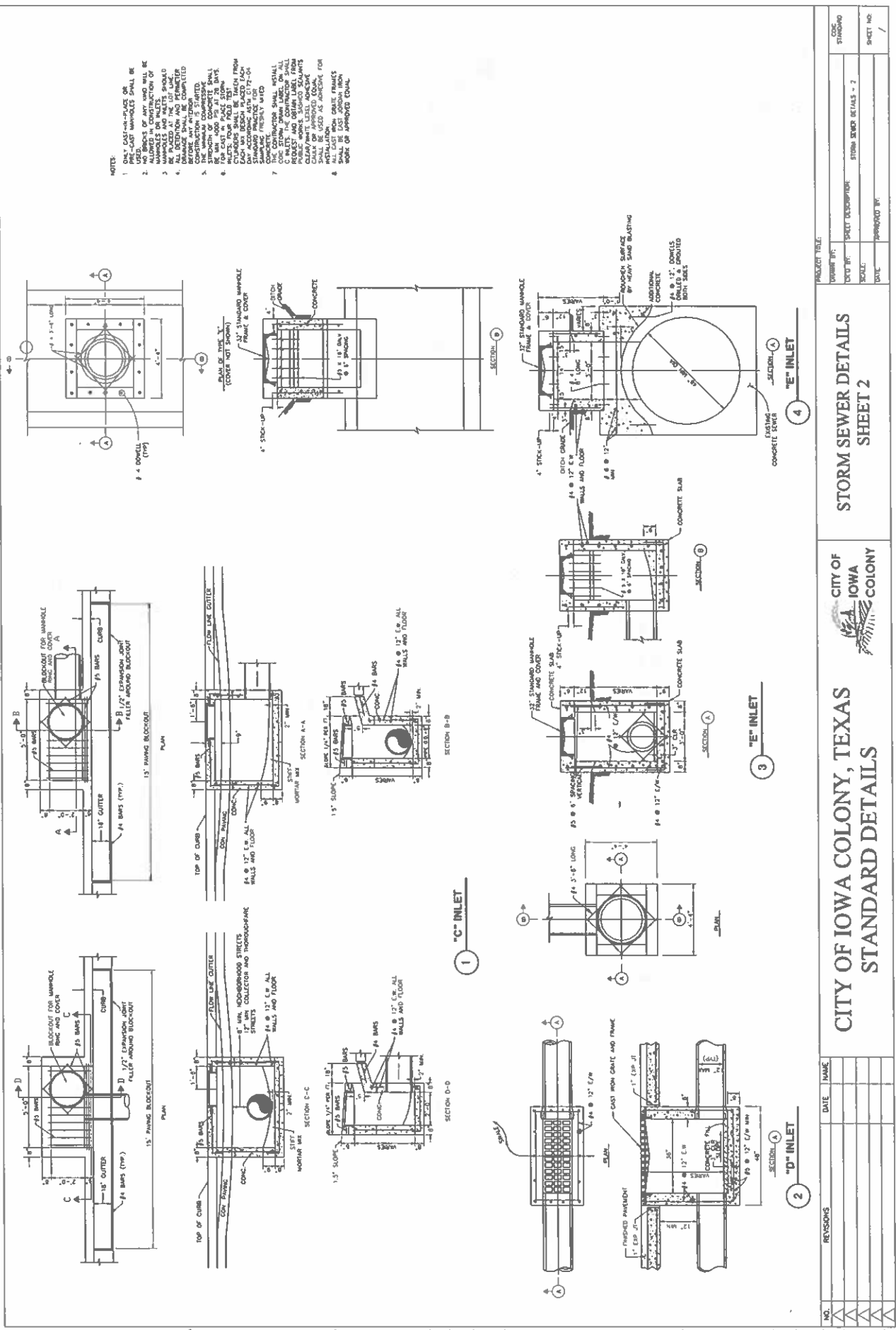
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STEEL PIPE CASING

www:

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TRENCH WIDTH TABLE		
NOMINAL PIPE SIZE (INCHES)	TRENCH WIDTH (INCHES)	DEPTH (INCHES)
18	30	24
24	36	30
30	42	36
36	48	42
42	54	48
48	60	54
54	66	60
60	72	66
66	78	72
72	84	78
78	90	84
84	96	90
90	102	96
96	108	102
102	114	108
108	120	114
114	126	120
120	132	126
126	138	132
132	144	138
138	150	144
144	156	150
150	162	156
156	168	162
162	174	168
168	180	174
174	186	180
180	192	186
186	198	192
192	204	198
198	210	204
204	216	210
210	222	216
216	228	222
222	234	228
228	240	234
234	246	240
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300	312	306
306	318	312
312	324	318
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408	420	414
414	426	420
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426	438	432
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444	456	450
450	462	456
456	468	462
462	474	468
468	480	474
474	486	480
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486	498	492
492	504	498
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552	564	558
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684	696	690
690	702	696
696	708	702
702	714	708
708	720	714
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720	732	726
726	738	732
732	744	738
738	750	744
744	756	750
750	762	756
756	768	762
762	774	768
768	780	774
774	786	780
780	792	786
786	798	792
792	804	798
798	810	804
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864	876	870
870	882	876
876	888	882
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1164	1176	1170
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1938	1950	1944
1944	1956	1950
1950	1962	1956
1956	1968	1962
1962	1974	1968
1968	1980	1974
1974	1986	1980
1980	1992	1986
1986	1998	1992
1992	2004	1998
1998	2010	2004
2004	2016	2010
2010	2022	2016
2016	2028	2022
2022	2034	2028
2028	2040	2034
2034	2046	2040
2040	2052	2046
2046	2058	2052
2052	2064	2058
2058	2070	2064
2064	2076	2070
2070	2082	2076
2076	2088	2082
2082	2094	2088
2088	2100	2094
2094	2106	2100
2100	2112	2106
2106	2118	2112
2112	2124	2118
2118	2130	2124
2124	2136	2130
2130	2142	2136
2136	2148	2142
2142	2154	2148
2148	2160	2154
2154	2166	2160
2160	2172	2166
2166	2178	2172
2172	2184	2178
2178	2190	2184
2184	2196	2190
2190	2202	2196
2196	2208	2202
2202	2214	2208
2208	2220	2214
2214	2226	2220
2220	2232	2226
2226	2238	2232
2232	2244	2238
2238	2250	2244
2244	2256	2250
2250	2262	2256
2256	2268	2262
2262	2274	2268
2268	2280	2274
2274	2286	2280
2280	2292	2286
2286	2298	2292
2292	2304	2298
2298	2310	2304
2304	2316	2310
2310	2322	2316
2316	2328	2322
2322	2334	2328
2328	2340	2334
2334	2346	2340
2340	2352	2346
2346	2358	2352
2352	2364	2358
2358	2370	2364
2364	2376	2370
2370	2382	2376
2376	2388	2382
2382	2394	2388
2388	2400	2394
2394	2406	2400
2400	2412	2406
2406	2418	2412
2412	2424	2418
2418	2430	2424
2424	2436	2430
2430	2442	2436
2436	2448	2442
2442	2454	2448
2448	2460	2454
2454	2466	2460
2460	2472	2466
2466	2478	2472
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2484	2496	2490
2490	2502	2496
2496	2508	2502
2502	2514	

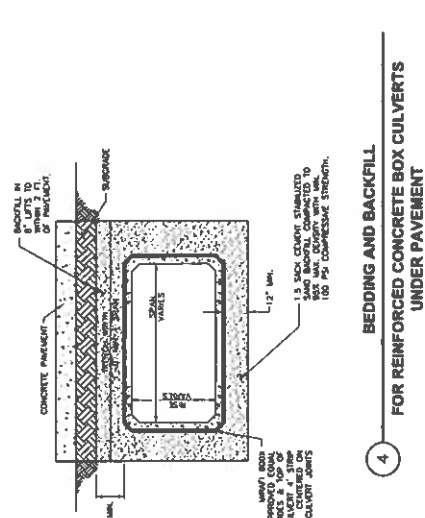
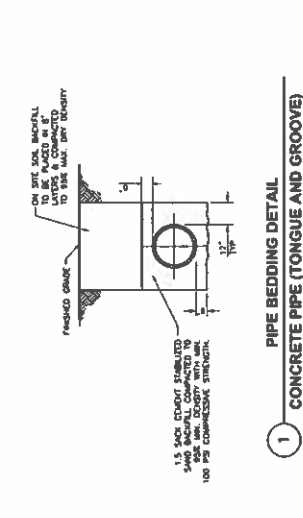


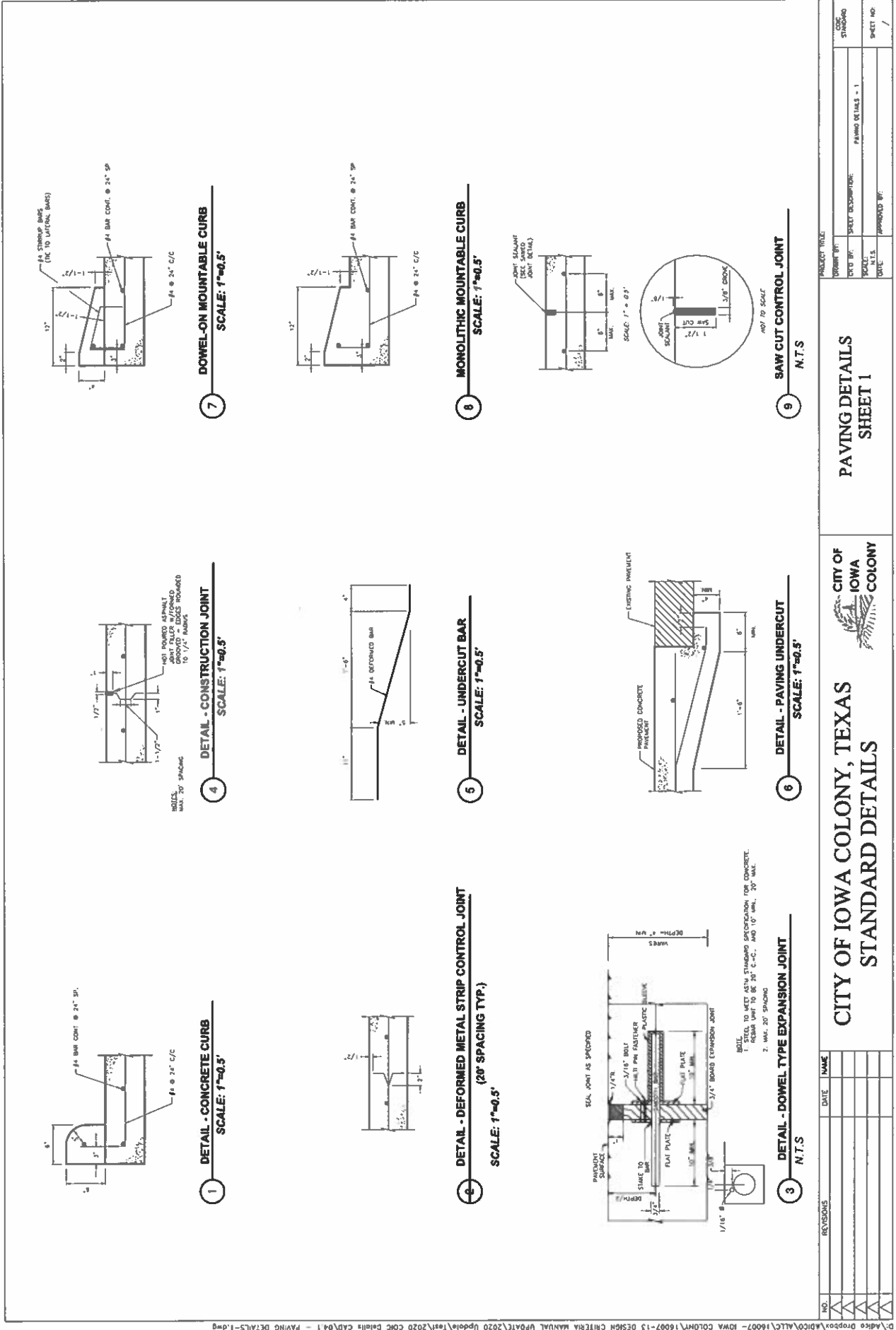
- NOTES:
1. ONLY CAST-IN-PLACE OR PRECAST MANHOLES SHALL BE USED.
 2. NO BRICKS OF ANY KIND SHALL BE USED IN THE CONSTRUCTION OF MANHOLES OR INLETS.
 3. MANHOLES SHALL BE CONSTRUCTED OF CONCRETE OR CAST-IN-PLACE CONCRETE.
 4. ALL INLETS AND MANHOLES SHALL BE PLACED AT THE LOT CORNER OR AT THE INTERSECTION OF ALL INTERSECTING ALLEYS.
 5. THE MANHOLE COVER SHALL BE PLACED AT THE INTERSECTION OF ALL INTERSECTING ALLEYS.
 6. THE MANHOLE COVER SHALL BE PLACED AT THE INTERSECTION OF ALL INTERSECTING ALLEYS.
 7. THE MANHOLE COVER SHALL BE PLACED AT THE INTERSECTION OF ALL INTERSECTING ALLEYS.
 8. THE MANHOLE COVER SHALL BE PLACED AT THE INTERSECTION OF ALL INTERSECTING ALLEYS.

NO.	REVISIONS	DATE	NAME

CITY OF IOWA COLONY, TEXAS	STORM SEWER DETAILS
STANDARD DETAILS	SHEET 2

PROJECT FILE:	PROJECT NO.	DATE

[illegible]

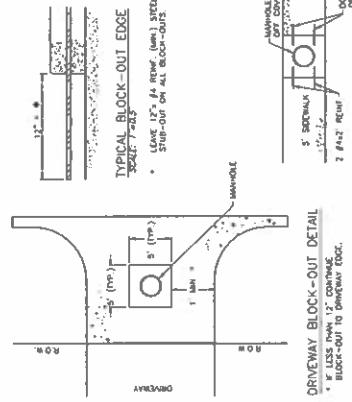


REVISIONS		DATE	NAME
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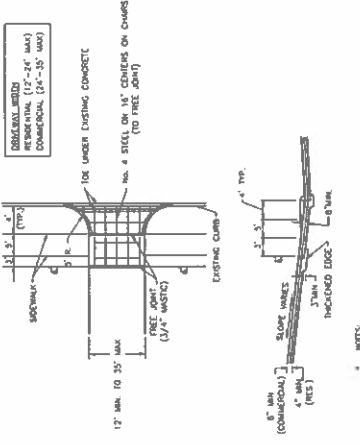
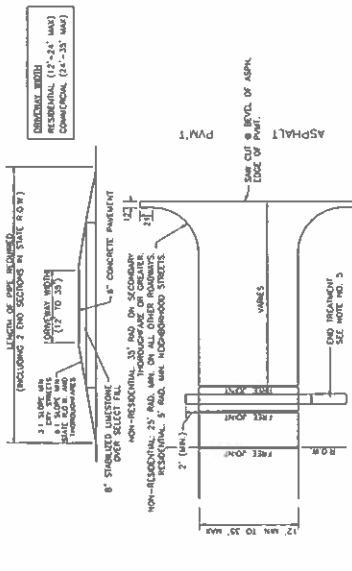
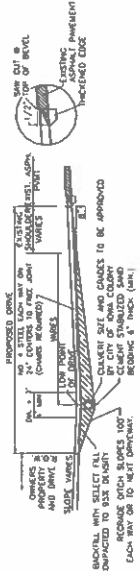
CITY OF IOWA COLONY, TEXAS		 CITY OF IOWA COLONY	
STANDARD DETAILS			
PAVING DETAILS			
SHEET 1			
PROJECT TITLE:		CITY OF IOWA COLONY	
DESIGN BY:		CITY OF IOWA COLONY	
CHECK BY:		CITY OF IOWA COLONY	
DATE:		DATE:	
SHEET NO.:		SHEET NO.:	
APPROVED BY:		APPROVED BY:	
DATE:		DATE:	

CITY OF IOWA COLONY, TEXAS
STANDARD DETAILS

6 SIDEWALK BLOCK-OUT DETAIL



3 CONCRETE DRIVEWAY TO CURB AND GUTTER STREET



- 1) CITY STREET ONLY NO CUTOUTS ARE REQUIRED ON THE STATE HIGHWAYS.
- 2) ALL CUTOUTS MUST HAVE BARRICADES INSTALLED UNTIL CUTOUTS ARE POSED.
- 3) ALL COMMENTS ON STATE R.D.W. REQUIRE TRAFFIC CONTROL PLAN PRIOR TO BEGINNING CONSTRUCTION.

1. NOTES:
2. ALL DISCOUNTS IN STATE ROLLS REQUIRE NEGOTIATED COVERED PLAN MEMBERS TO BECOME CONTRIBUTION.
3. "SOME COT AT LEVEL OF ADMIN." (NO FURTHER THAN LINE CODE STATE)
4. STATED SAVED TO BE DEDUCTED PLUS 2' AND ABOVE TOP ROLL ON PART
5. SPECIAL AND TREATMENTS ARE REQUIRED ON ALL CURVE IN THE HORIZONTALS

NOTES

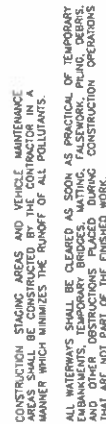
- 1) DISTANCE BETWEEN ROW MUST CONSIST OF 8" STABILIZED BASE WITH 2" ASPHALTIC TOP COURSE.
- 2) DISTANCE BETWEEN ROW MUST BE 10'.
- 3) ALL CONCRETE IN STATE MUST BE REINFORCED WITH #4 REBAR.
- 4) ALL CONCRETE CONSTRUCTION SHALL BE DONE IN ACCORDANCE WITH THE LATEST EDITION OF THE MICHIGAN DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAYS.
- 5) STABILIZED SAND TO BE DUMPER QUALITY 2" ABOVE TOP BELL ON PIPE.
- 6) STABILIZED SAND TO BE DUMPER QUALITY 2" ABOVE TOP BELL ON PIPE.
- 7) ALL DRAINAGE TREATMENTS ARE REQUIRED ON ALL CULVERTS IN THIS ROW.

*CROSS SLOPE FROM BACK OF CURB TO EDGE OF SIDEWALK AND FROM EDGE OF SIDEWALK TO THE PROPERTY LINE. SMALL BC AT 2% MINIMUM MAXIMUM CROSS SLOPE. UNLESS APPROVED OTHERWISE BY WRITING. FOR GRASED SURFACES SMALL BC 2:1.

NOTE: 1. MAINTAIN SALT STENCE AND 500 FOR 2 YEARS MINIMUM OR UNTIL LOT SALT.
2. SALT CONCENTRATION MUST BE MAINTAINED FROM SALT TO CLINIC TO PREVENT

* IF LESS THAN 12" CONTINUE BLOCK-OUT TO DRIVEWAY FOOT.





- TYPES OF FILTER DAMS**
1. TYPE 1 (NON-REINFORCED)
 - a. HEADING GROUNDS TO TOP OF FILTER DAM.
 - b. TOP WIDTH = 2' (MINIMUM).
 - c. SLOPES = 2:1 (MAXIMUM).
 2. TYPE 2 (REINFORCED) ROCKS. MEASURE VERTICALLY FROM EXISTING GROUND TO TOP OF FILTER DAM.
 - a. TOP WIDTH = 2' (MINIMUM).
 - b. SLOPES = 2:1 (MAXIMUM).
 3. TYPE 3 (REINFORCED) ROCKS. MEASURE VERTICALLY FROM EXISTING GROUND TO TOP OF FILTER DAM.
 - a. TOP WIDTH = 2' (MINIMUM).
 - b. SLOPES = 3:1 (MAXIMUM).
 4. TYPE 4 (GABION) ROCKS. MEASURE VERTICALLY FROM EXISTING GROUND TO TOP OF FILTER DAM.
 - a. TOP WIDTH = 2' (MINIMUM).
 - b. SLOPES = 3:1 (MAXIMUM).
- B. CONSTRUCT FILTER DAMS ACCORDING TO THE FOLLOWING CRITERIA UNLESS SHOWN OTHERWISE ON THE PLANS.**
1. TYPE 2 AND 3 FILTER DAMS SECURE WITH 20 GAUGE HEXAGONAL DRINKINGS.
 2. PLACE GRANULAR FILL ON THE WIRE MESH ON HEIGHT AND SLOPES SHOWN ON PLANS OR AS SPECIFIED BY THE SLOPES.
 3. 3-5 INCHES FOR ROCK FILTER DAM TYPES 1, 2 AND 4.
 4. 4-8 INCHES FOR ROCK FILTER DAM TYPE REFER TO SLOPE AND GRANULAR FILL DAM SECTION NO. 02378
 5. FOLD WIRE MESH AT UPSTREAM SIDE OVER DOWNSTREAM FILL AND TIGHTLY SECURED TO ITSELF ON THE DOWNSTREAM FILL.
 6. BY STAPLES, SECURE OR STAKE MESH TO STREAM BED PRIOR TO AGGREGATE PLACEMENT.
 5. SEE HOW SPECIFICATION SECTION NO. 02364-FILTER DAMS FOR FURTHER INFORMATION.
 6. FOOT HIGHER THAN CENTER OF DECEASED AREA AT SLOPE.

CITY OF IOWA COLONY, TEXAS
STANDARD DETAILS

NO.	REVISIONS	DATE	NAME
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3			
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5			

CITY OF IOWA COLONY, TEXAS STANDARD DETAILS



**CITY OF
IOWA
COLONY**

PROJECT TITLE		FORM STANDARD	
DRAWING NO.	SHEET DESCRIPTION	SHEET NO.	SHEET TOTAL
101	STORM WATER POLLUTION PREVENTION DETAILS - 2	1	1
DATE	APPROVED BY		

STORM WATER POLLUTION PREVENTION DETAILS SHEET 2

APPENDIX B

COVER SHEET SIGNATURE BLOCK

CITY OF IOWA COLONY

DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

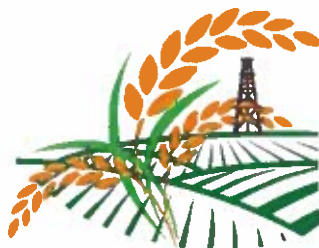
THIS IS TO CERTIFY THAT THESE PLANS HAVE BEEN FOUND TO BE IN GENERAL
COMPLIANCE WITH THE CURRENT REQUIREMENT ESTABLISHED BY
THE CITY OF IOWA COLONY.

ROBERT HEMMINGER, CITY MANAGER

DATE

DINH HO, P.E., CITY ENGINEER

DATE



**CITY OF
IOWA
COLONY**

NOTE: CITY APPROVAL VALID FOR ONE YEAR AFTER DATE OF SIGNATURES

APPENDIX C

TITLE BLOCK

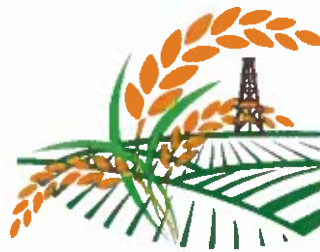
CITY OF IOWA COLONY

DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

THIS IS TO CERTIFY THAT THESE PLANS HAVE BEEN FOUND TO BE IN GENERAL
COMPLIANCE WITH THE CURRENT REQUIREMENT ESTABLISHED BY
THE CITY OF IOWA COLONY.

DINH HO, P.E., CITY ENGINEER

DATE



**CITY OF
IOWA
COLONY**

NOTE: CITY APPROVAL VALID FOR ONE YEAR AFTER DATE OF SIGNATURES

APPENDIX D

DESIGN MODIFICATION FORM

CITY OF IOWA COLONY DESIGN CRITERIA MODIFICATION FORM

Modifications to standards identified in the Design Criteria Manual may be permitted by the City of Iowa Colony's City Engineer. The modification proposal must be submitted by a Professional Engineer licensed by the State of Texas and shall follow generally accepted engineering standards for traffic, sidewalk and other infrastructure applicable, and such proposal contains the following information and substantiates the findings. If an appeal to the City of Iowa Colony City Engineer decision is requested, the City Council (hereinafter referred to as "the City") will review that appeal.

PROJECT NAME: _____

This entire form must be completed in its entirety. If form is submitted incomplete, it will be administratively rejected.

PROJECT ENGINEER: _____

SUBMITTAL DATE: _____

SUBDIVISION NAME: _____

**MODIFICATION
LOCATION:**

1. Set forth the proposed deviation to the technical standard.

SPECIFIC PROPOSED DEVIATION FROM TECHNICAL STANDARD:

2. Set forth the impact such deviation has on speed differential and street capacity, the likelihood of accidents, the long term maintenance and operation effect, the degree of functionality and efficiency, the technological advancements involved, and other relevant matters.

IMPACT OF DEVIATION:

3. Show a comparison of the technical standard to the proposed deviation with respect to overall safety and quality, speed differential, street capacity, existing and projected accidents, long-term maintenance and operation, degree of functionality, degree of efficiency, technological advancements, and other relevant matters.

COMPARISON OF TECHNICAL STANDARD TO PROPOSED DEVIATION:

4. Describe all mitigating improvements that reduce the negative impact of the proposed deviation on overall safety and quality, speed differential, street capacity, accident occurrences, long-term maintenance and operation, degree of functionality, degree of efficiency and demonstrating the degree to which the proposed deviation detrimentally affects the foregoing. Other relevant factors, including technological advances, should be explained by describing how they will affect the proposed development. Mitigating improvements can include but are not limited to, traffic control devices, pavement improvements, added acceleration or deceleration lanes or reservoirs, and other on-site improvements.

MITIGATING IMPROVEMENTS THAT REDUCE NEGATIVE IMPACT:

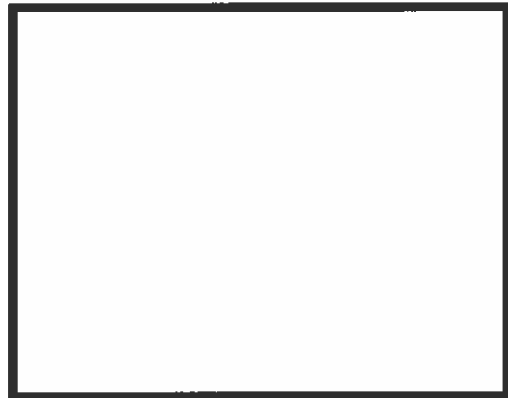
SUMMARY & CONCLUSION/RECOMMENDATION FOR MODIFICATION:

List of Supporting Documentation Attached?

Yes _____

No _____

Seal of Professional Engineer:



City Use ONLY

Reviewed By:

Date _____

**Modification Request Approved / Denied By:
Copies of Backup Information/Notes Attached**

City Engineer _____

Date _____

Texas Water Development Board Contract Number: 2000040016
City of Iowa Colony Master Drainage Plan



Figure G-3 View of survey Location "B"



Figure G-4 Cross section view of survey Location "B"

Texas Water Development Board Contract Number: 2000040016
City of Iowa Colony Master Drainage Plan



Figure G-5 Survey Location "C"



Figure G-6 Cross Section view of survey location "C"

Texas Water Development Board Contract Number: 2000040016
City of Iowa Colony Master Drainage Plan



Figure G-7 View of survey location "D"



Figure G-8 Cross section view of survey location "D"

Texas Water Development Board Contract Number: 2000040016
City of Iowa Colony Master Drainage Plan

Existing bridge/culvert crossings that were surveyed along South Hayes are shown in the figures below. The crossings are identified as F, G, H, I, J, & K. Refer to the **Exhibit G-1** at the end of this Appendix for locations.



Figure G-9 View of survey location "F"



Figure G-10 Cross section view of survey location "F"

Texas Water Development Board Contract Number: 2000040016
City of Iowa Colony Master Drainage Plan



Figure G-11 View of survey location "G"



Figure G-12 Cross section view of survey location "G"



Figure G-13 View of survey location "H"



Figure G-14 Cross section view of survey location "H"

Texas Water Development Board Contract Number: 2000040016
City of Iowa Colony Master Drainage Plan



Figure G-15 View of survey location "I"



Figure G-16 Cross section view of survey location "I"

Texas Water Development Board Contract Number: 2000040016
City of Iowa Colony Master Drainage Plan



Figure G-17 View of survey location "J"



Figure G-18 Cross section view of survey location "J"

Texas Water Development Board Contract Number: 2000040016
City of Iowa Colony Master Drainage Plan



Figure G-19 View of survey location "K"



Figure G-20 Cross Section view of location "K"

Appendix H – Benefit-Cost Analysis Tables

Table B1. Structural Damage Function

Flood Depth (in)	Flood Depth (ft)	Residential Average Home (\$ per 2500 sq ft)	Commercial		
			Average (\$ per sq ft)	Industrial (Light) (\$ per sq ft)	Hospital/School (\$ per sq ft)
1"	0.08	29,580.05	2.24	2.03	2.12
2"	0.17	29,673.85	3.34	2.99	3.23
3"	0.25	32,316.60	4.45	3.95	4.34
4"	0.33	42,540.02	5.55	4.92	5.45
5"	0.42	50,029.10	6.66	5.88	6.56
6"	0.50	57,419.98	7.76	6.85	7.67
7"	0.58	61,120.93	8.86	7.81	8.78
8"	0.67	64,822.99	9.97	8.77	9.89
9"	0.75	68,523.94	11.07	9.74	11.00
10"	0.83	72,223.80	12.18	10.70	12.11
11"	0.92	75,925.85	13.28	11.67	13.22
12"	1.00	79,626.81	14.38	12.63	14.33
13"	1.08	81,021.20	15.17	13.33	15.12
14"	1.17	82,415.58	15.96	14.03	15.91
15"	1.25	83,809.97	16.74	14.73	16.70
16"	1.33	85,204.36	17.53	15.42	17.49
17"	1.42	86,598.74	18.32	16.12	18.29
18"	1.50	87,993.13	19.10	16.82	19.08
19"	1.58	89,387.52	19.89	17.52	19.87
20"	1.67	90,781.90	20.68	18.22	20.66
21"	1.75	92,176.29	21.46	18.92	21.45
22"	1.83	93,570.68	22.25	19.62	22.24
23"	1.92	94,965.06	23.04	20.32	23.03
24"	2.00	96,359.45	23.82	21.01	23.83
25"	2.08	97,022.62	24.42	21.54	24.41
26"	2.17	97,685.79	25.02	22.06	24.99
27"	2.25	98,348.96	25.61	22.58	25.58
28"	2.33	99,012.13	26.21	23.10	26.16
29"	2.42	99,675.30	26.81	23.62	26.74
30"	2.50	100,338.47	27.41	24.14	27.33
31"	2.58	101,001.64	28.00	24.67	27.91
32"	2.67	101,664.82	28.60	25.19	28.50
33"	2.75	102,327.99	29.20	25.71	29.08
34"	2.83	102,991.16	29.80	26.23	29.66
35"	2.92	103,654.33	30.39	26.75	30.25

Flood Depth (in)	Flood Depth (ft)	Residential Average Home (\$ per 2500 sq ft)	Commercial		
			Average (\$ per sq ft)	Industrial (Light) (\$ per sq ft)	Hospital/School (\$ per sq ft)
36"	3.00	104,317.50	30.99	27.28	30.83
37"	3.08	105,128.25	31.63	27.80	31.54
38"	3.17	105,939.01	32.27	28.32	32.25
39"	3.25	106,749.77	32.91	28.84	32.95
40"	3.33	107,560.52	33.55	29.36	33.66
41"	3.42	108,371.28	34.19	29.88	34.37
42"	3.50	109,182.04	34.84	30.41	35.08
43"	3.58	109,992.79	35.48	30.93	35.78
44"	3.67	110,803.55	36.12	31.45	36.49
45"	3.75	111,614.30	36.76	31.97	37.20
46"	3.83	112,425.06	37.40	32.49	37.91
47"	3.92	113,235.82	38.04	33.02	38.61
48"	4.00	114,046.57	38.68	33.54	39.32
>48"	> 4.0	187,585.68	61.06	42.45	76.41

Table H2. Number of Structures Inundated

Structure Type	Number of Structures Inundated									
	Existing					CIP				
	500-Year	100-year	50-year	10-year	500-Year	100-year	50-year	10-year	500-Year	10-year
Commercial	60	35	33	22	55	35	32	20	49	31
Industrial	2	1	1	0	2	1	1	0	1	0
Residential	1713	1075	867	313	1655	1007	808	235	1368	656
Critical Infrastructure	0	0	0	0	0	0	0	0	0	0
Total No. of Inundated Structures	1775	1111	901	335	1712	1043	841	255	1418	687
Removed Residential Struct.										
					58	68	59	78	345	211
Removed Structures										
					63	68	60	80	357	214
No. of Structures with Reduced Damages										
					973	666	-	-	1610	956
										-

Table H3. Expected Damages to Structures Based on Flood Depth (Baseline Condition)

Structure Type	Expected Damages to Structures based on Flood Depth									
	Existing					CIP				
	500-Year	100-year	50-year	10-year	500-Year	100-year	50-year	10-year	500-Year	10-year
Commercial	\$8.5 M	\$6.1 M	\$5.3 M	\$3.2 M	\$8.3 M	\$5.9 M	\$5.0 M	\$2.4 M	\$8.1 M	\$4.6 M
Industrial	\$0.1 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.1 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M
Residential	\$117.5 M	\$66.3 M	\$49.3 M	\$16.9 M	\$112.4 M	\$61.5 M	\$44.9 M	\$13.0 M	\$90.5 M	\$33.7 M
Critical Infrastructure	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M	\$0.0 M
Total Damages (\$)	\$126.2 M	\$72.4 M	\$54.7 M	\$20.1 M	\$120.9 M	\$67.5 M	\$49.8 M	\$15.4 M	\$98.6 M	\$38.3 M
Benefits per Storm Event (\$)										
					\$5.3 M	\$5.0 M	\$4.8 M	\$4.7 M	\$27.6 M	\$16.3 M
									\$19.6 M	\$7.0 M

Table H4. Estimated length of roads Inundated (Miles)

	Total Road (mi)	Length of Inundated Road (mi)			
		Existing		Alternative	
		500-YR	100-YR	500-YR	100-YR
Road Inundated	126.55	39.99	25.76	39.07	35.38
Road Removed from Inundation				1.57	4.61
					6.57

Table H5. Estimated length of roads Inundated (Miles)

	Average SVI of Study Area	Average SVI of Buildings Inundated per Event			
		Existing		Alternative	
		500-YR	100-YR	500-YR	100-YR
SVI	0.459	0.452	0.457	0.452	0.455
Change in Average SVI			0.000	0.001	0.003
					0.005

Table H6. Day & Night Populations at Risk

	Population at Risk									
	Existing					CIP				
	500-Year	100-year	50-year	10-year	500-Year	100-year	50-year	10-year	500-Year	10-year
Day Population at Risk	717	311	263	103	656	301	257	92	517	240
Night Population at Risk	1614	1002	803	332	1565	959	755	287	1403	653
Average Population at Risk	1166	657	533	218	1111	630	506	190	960	447
Benefit - Population Removed from Risk	Day				61	10	6	11	200	14
	Night				49	43	48	45	211	168
	Average				55	27	27	28	206	91
									87	74

Table H7. Farm & ranch land inundated (sq. mi)

Agricultural Land Use Type	Total Area in Study Area (sq. mi)	Inundated Area (sq. mi)					
		Existing			CIP		
		500-YR	100-YR	500-YR	100-YR	500-YR	100-YR
Hay/Pasture	13.80	9.52	6.91	9.42	6.62	8.90	5.58
Cultivated Crops	4.65	2.37	1.72	2.35	1.59	2.18	1.45
Total Inundated Agricultural Land	18.45	11.88	8.62	11.77	8.21	11.08	7.02
		Removed Inundated Hay/Pasture		0.10	0.29	0.62	1.33
		Removed Inundated Cultivated Crops		0.01	0.12	0.19	0.27
		Total Agricultural Land Removed		0.11	0.41	0.81	1.60

Table H8. Benefit-Cost Ratio

Benefit-Cost Ratio Calculations (Project Life 30-years)			
Variable	CIP	Alt	
Capital Cost (Includes Design) (\$)	\$110.98 M	\$278.96 M	
Operation & Maintenance Costs (\$/30 yrs)	\$8.25 M	\$18.83 M	
Summary of Expected Benefits over the Project Lifetime			
Benefit to Residential Structures	\$7.32 M	\$19.77 M	
Benefit to Commercial Structures	\$0.99 M	\$1.07 M	
Benefit to Industrial Structures	\$0.00	\$10,868.15	
Benefit to Agricultural Land	\$0.00	\$0.00	
Total Expected Benefits* (\$/30 yrs)	\$8.31 M	\$20.84 M	
BCR	0.07	0.07	

*Does not include monetized benefits for roadway and agricultural land