DIVISION 2

LAND PLANNING AND SITE WORK

2.1 GENERAL

2.1.1 Airport Layout Plan: The Airport Layout Plan (ALP) is a scaled graphic presentation of existing and ultimate airport facilities, as approved by the Federal Aviation Administration (FAA). Reference is made to FAA Advisory Circular (AC) 150/5070-6A for ALP requirements. The ALP is a public document, which serves as a record of land and facility requirements, both present and future, as well as a source document for land use proposals. All proposed capital improvements must comply with the ALP. Any such project must be submitted through the Building Official to the FAA to determine if the project is in compliance with the ALP or if the ALP can be changed to accommodate the proposed project. Refer to Division 1 for airspace application. For detailed information concerning the most current ALP, consult the Airport Contact.

2.1.2 Site Plans: A site plan shall be prepared for all relevant projects. The site plan shall delineate all existing and proposed facilities and features. The site plan shall provide a clear schematic of the intended land use, project or building layout, site and project dimensions, access points, proximity to existing structures, etc. This plan will be used to initiate coordination among the Airport departments, the FAA and tenants adjacent to the site. The site plan is also used to initiate changes to the ALP and to address potential line-of-sight issues. The maximum building or equipment heights shall be indicated on the site plan prior to determining line-of-sight acceptability. A traffic impact analysis will be required for all landside development projects that will change the vehicular traffic on any landside roadways. A landscape plan for each site shall also be submitted with the site plan.

2.1.3 Site Work: Site work includes clearing, grubbing, grading, drainage, paving, and special site development structures. All site work shall be designed and conducted to improve the overall aesthetics of the Airport and to promote future development.

2.1.4 Site Preparation: The site shall be prepared preserving the natural character of the terrain by minimum disturbance of existing ground forms, with the objective to develop an attractive, suitable and economical project site. Surface and subsurface flow from storm water shall be diverted away from buildings and pavements to prevent undue saturation of the subgrade that could damage structures and weaken pavements.

2.2 ENVIRONMENTAL

2.2.1 Storm Water Pollution Prevention Plan: For projects disturbing greater than one acre, a Storm Water Pollution Prevention Plan, including an erosion control plan, must be submitted to the Building Official along with a signed Notice of Intent before a construction permit will be granted. See the "Environmental Compliance Checklist for Construction or Sign Permit" for additional information, including requirements for projects disturbing less than one acre. Erosion control measures shall be designed and implemented to effectively prevent discharge of sediments to the storm drain system and receiving waters. Care shall be taken in the design and implementation of such measures to ensure that a safety hazard, such as ponding water on a roadway, does not occur.

2.2.2 Storm Water Quality: All new or renovated facilities must be designed to minimize the impact of storm water discharges on the environment and assure that the facility can be operated in compliance with environmental laws and regulations. The facility Operator is the company, agency, or entity that will have operational control of daily activities at the facility following the issuance of a Certificate of Occupancy/Use.

As one example, all new or renovated facilities must be designed so as to eliminate contamination of storm water, or at a minimum, reduce contamination of storm water runoff below the federal discharge benchmarks defined by federal law (65 FR 64767) and any subsequent applicable federal regulation, as well as those in the TPDES storm water permit and any subsequent

applicable state regulation.

2.2.2.1 Preliminary Actions: In order to ensure compliance with the above-described objectives, the Operator shall submit the following documents along with any application for a construction permit to construct or renovate a facility from which there will be storm water discharge:

1. Documents, prepared by the Operator, describing the type and nature of all activities to occur at the site that could potentially impact storm water quality.
2. Documents, prepared by the Operator, detailing the operational controls that will be implemented at the facility. This could possibly be in the form of an operational storm water pollution prevention plan (SWPPP), or the format could be less structured. In any case, the operational measures/restrictions to be employed at the facility must be clearly stated.
3. A certification, sealed by the design engineer, stating that "Based upon the above representations made by the Operator, the proposed structural controls will impel storm water discharged from the facility to meet EPA benchmark standards."

2.2.2.2 Construction Permit Issued: Upon submittal of the three requested documents, the Operator shall satisfy the requirements of these procedures and be allowed to commence facility construction (consistent with the requirements of all other sections).

2.2.2.3 Post-Construction Procedures: Following construction of the facility, the Building Official will issue a Temporary Certificate of Occupancy/Use. After at least 3 months of regular operation at the facility, the Board's Environmental Affairs Department (EAD) may elect to conduct testing to verify the efficacy of the operational and structural controls. If EAD determines that testing is not necessary, EAD will notify the Building Official of this decision, so that a final Certificate of Occupancy/Use can be issued. If EAD elects to conduct testing, EAD personnel will select appropriate pollutant parameters, select a collection event, collect storm water samples, send the samples out for analysis and provide the results in the form of a Storm Water Quality Report. EAD is committed to ensuring that initial testing and reporting will be completed in less than 9 months after the start of regular operations at the facility.

2.2.2.3.1 Acceptable Test Results: If the testing indicates adherence with all EPA benchmark parameters, EAD will send a notification to the Building Official that no further action is required, and if all other requirements have been satisfied, the Building Official will issue a final Certificate of Occupancy/Use.

2.2.2.3.2 Unacceptable Test Results: If the testing indicates that any EPA benchmark parameter has been exceeded, the project may not be closed out until the Operator has remedied the problem to the satisfaction of EAD. EAD will send correspondence to the Building Official when satisfied with the remedies proposed by the Operator. If the Operator has failed to remedy the problem to the satisfaction of EAD within 6 months after notification thereof, then the facility will be subject to continued monitoring by EAD at the Operator's expense.

2.2.2.3.3 Continued Monitoring at Operator's Expense: Monitoring will continue until the problem has been remedied to the satisfaction of EAD. Monitoring costs may include labor, supplies, equipment, laboratory charges, and analysis associated with the collection of grab and composite samples from all discharges from the facility. The samples may be analyzed for any pollutants identified in the benchmark standards.

2.2.2.4 Spill Prevention Control and Countermeasures Plan: Facilities may be subject to Spill Prevention Control and Countermeasures Plan (SPCC) regulations at 40 CFR 112. The design of any new or renovated facility must include a submittal by the Operator with a formal determination as to whether SPCC is required; and if so, the design must incorporate the measures specified at 40 CFR 112 or any subsequent applicable federal or state regulation.

2.2.3 Excavated Soil Materials: Excavated materials must be managed and disposed of in

accordance with applicable environmental regulations. Projects that involve subsurface drilling or the excavation, stock piling or movement of soils require a soil management plan that details procedures to be employed to ensure proper handling and disposal. No excavated material or concrete rubble may be removed from the Airport without approval from DFW Airport Environmental Affairs Department. Submit requests through the Building Official.

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2.2.4 Sanitary Sewer Discharges - Discharges to the Airport Sanitary Sewer System (SSS) shall be in accordance with the current legal standards of the Texas Commission on Environmental Quality (TCEQ) or of any governmental body having legal authority to set such standards.

2.2.4.1 Any proposed on-site disposal method such as a septic tank and drain field shall be subject to Airport approval as well as any and all required county or state health department permit procedures. Any system so approved and permitted shall be designed, installed and operated in accordance with "Construction Standards for Private Sewage Facilities" of the TCEQ.

2.2.4.2 Sanitary Sewage Discharge Standard - Admissible wastes discharge into the SSS is defined herein as admissible discharges. Waste discharges into the SSS that are prohibitive, are defined herein as prohibitive discharges.

2.2.4.3 Admissible Discharges - Wastes discharged into the SSS shall consist only of wastewater, properly shredded garbage and other wastes which the system is capable of handling, so that:

2.2.4.3.1 Effluent from the SSS meets the current legal standards of the TCEQ or of any governmental body having legal authority to set standards for such effluents.

2.2.4.3.2 The SSS is not damaged to the extent to cause unnecessary repairs or replacements resulting in increased operation and maintenance expenses.

2.2.4.4 Prohibitive Discharges - To enable the highest degree of treatment in the most economical manner possible, and to comply with Federal and State regulations, certain solids, liquids and gases are hereby prohibited from entering the SSS in excess of standards as set by Federal and State regulations. The prohibitive discharges listed below shall apply at the points of entry.

2.2.4.4.1 Federal and state regulatory agencies periodically modify standards on prohibitive discharges. Therefore, revisions to, additions to, or deletions from the items listed in this section will become necessary to comply with these latest standards.

2.2.4.4.2 No discharge of any of the following shall be allowed into the SSS at a point of entry: Storm water, ground water, roof runoff, sub-surface drainage or water originating from downspouts, yard drains, yard fountain and ponds, or lawn sprays. If the character of the wastewater from any manufacturer or industrial plant, building or other premises is such that it will damage the SSS, or cannot be treated satisfactorily in the SSS, the wastewater shall be prevented from entering the SSS.

2.2.4.4.3 No discharge of any of the following substances, materials, waters or wastes into the SSS shall be allowed:

1. Any liquid having a temperature higher than 150 degrees Fahrenheit;
2. Any water or wastes which contain wax, grease, oil, plastic or other substance that will solidify, or become discernibly viscous at temperatures between 32 to 150 degrees Fahrenheit;
3. Any solids, slurries or viscous substances of such character as to be capable of causing obstruction to the flow in sewers, or other interference with the proper operation of the SSS, such as ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, whole blood, paunch manure, hair and fleshlings, entrails, lime residues, slops, chemical residues, paint residues or bulk solids.
4. The maximum allowable suspended solids is 250 mg/l and the BOD shall be less than 250

mg/l;

5. Any solids, liquids, or gases which by themselves or by interaction with other substances may cause fire or explosion hazards, or in any other way be injurious to persons, property, or the operators of the SSS;
6. Any garbage that has not been properly comminuted or shredded;
7. Any noxious or malodorous substance which, either singly or by interaction with other substances, is capable of causing objectionable odors, or hazard to life, or forms solids that will cause obstructions to flow, or creates any other condition deleterious to structures or treatment processes, or requires unusual provisions, alteration, or expense to handle such substance. The maximum allowable hydrogen sulfide is 0.1 mg/l;
8. Any waters or wastes having a pH less than 6.0 or greater than 10.0 or having any corrosive property capable of causing damage or hazards to structures, equipment, or personnel of the SSS;
9. Any wastes or waters containing suspended or dissolved solids of such character and quantity that unusual attention or expense is required to handle such materials in the SSS;
10. Any waters or wastes containing a toxic or poisonous substance, such as plating or heat-treating wastes, in sufficient quantity to injure or interfere with any wastewater treatment process, to constitute a hazard to humans or animals, or to create any hazard in the receiving waters of the Wastewater Treatment Plant;
11. Any wastes or waters exceeding the concentrations listed below:

    a. Antimony greater than 0.01 mg/l
    b. Arsenic greater than 0.05 mg/l
    c. Barium greater than 5.0 mg/l
    d. Beryllium greater than 0.01 mg/l
    e. Bismuth greater than 0.5 mg/l
    f. Boron greater than 1.0 mg/l
    g. Cadmium greater than 0.01 mg/l
    h. Chromium (hexavalent) greater than 0.05 mg/l
    i. Chromium (trivalent) greater than 5.0 mg/l
    j. Cobalt greater than 1.0 mg/l
    k. Copper greater than 1.0 mg/l
    l. Cyanides greater than 1.0 mg/l
    m. Fluorides greater than 1.5 mg/l
    n. Hydrogen Sulfide greater than 0.1 mg/l
    o. Iron greater than 0.3 mg/l
    p. Lead greater than 0.1 mg/l
    q. Manganese greater than 1.0 mg/l
    r. Mercury greater than 0.005 mg/l
    s. Molybdenum greater than 1.0 mg/l
    t. Nickel greater than 1.0 mg/l
    u. Phenol greater than 0.005 mg/l
    v. Selenium greater than 0.02 mg/l
    w. Silver greater than 0.1 mg/l
    x. Tin greater than 1.0 mg/l
    y. Uranylion greater than 5.0 mg/l
    z. Zinc greater than 5.0 mg/l

12. Any free or emulsified oil and grease exceeding, on analysis, an average of 100 mg/l (834 pounds per million gallons) of either, or both, or combinations of free or emulsified oil and grease if it appears probable that such wastes:

    a. can deposit grease or oil in the sewer lines in such manner to clog the sewers;
    b. can overload skimming and grease handling equipment;
    c. are not amenable to bacterial action or other treatment processes then being employed by Airport and will, therefore, pass to the receiving waters without being affected by normal wastewater treatment processes;
    d. can have deleterious effects on the treatment process due to excessive quantities.

13. Any radioactive wastes greater than the allowable releases as specified by current National Institute of Standards & Technology handbooks dealing with the handling of and release of radioactivity.
14. Significant industrial users, as defined by the United States Environmental Protection Agency, shall comply with Chapter 6, “Environmental Rules and Regulations” of the DFW Airport Rules and Regulations.

2.3 STORM DRAINAGE

2.3.1 Drainage of Unpaved Areas Adjacent to Buildings - Unpaved areas adjacent to buildings shall be sloped to direct surface water and roof drainage away from buildings at a minimum slope of five (5%) percent in the first ten (10) feet of horizontal distance. Unpaved areas shall be permanently stabilized with vegetative cover to prevent erosion and soil loss. Surfaces paved with concrete or bituminous pavement shall have a slope of not less than 0.5 percent in the direction of drainage, to prevent ponding.

2.3.2 Drainage of Unpaved Areas not Occupied by Buildings - Portions of the site not occupied by buildings or pavement shall have adequate continuous slopes to drain toward watercourses, drainage swales, roadways, and storm drainage inlets. Drainage swales or channels shall be sized and sloped to accommodate the design runoff. Sheet flow across sidewalks is allowable. The concentrated runoff shall be carried under walkways in pipes or by suitable sidewalk drains. Swales shall be used to intercept water at the top and bottom of banks where large areas are drained. To provide positive drainage, a slope of not less than two (2%) percent for turfed areas is desirable. Slopes shall be designed to ensure non-erosive runoff velocities. Turf banks, where required, shall be graded to permit the use of gang mowers, providing a maximum slope of four (4) horizontal to one (1) vertical. The tops and bottoms of all slopes shall be gently rounded in a transition curve for optimum appearance and ease of maintenance.

2.3.3 Landside Storm Drainage - Storm drainage design in those areas referred to as the "Landside" shall be governed by the latest edition of the Texas Department of Transportation (TxDOT) Hydraulic Manual. Minor head losses in storm drain systems as well as other coefficients presented in this Design Criteria Manual shall supersede those presented in the TxDOT Hydraulic Manual where they differ. In instances where a conflict arises between the Landside Design and the Air Operations Area (AOA) Design, the more conservative criteria shall govern.

2.3.4 Determination of Design Discharge - In order to properly determine the design storm runoff for a given installation, consideration must be given to the design storm rainfall, the runoff coefficient as affected by the surface condition and by the geometry of the watershed, plus the influence of the time of concentration. The runoff coefficients and minimum inlet times (time of concentration) to be used in determining runoff shall be documented for review and approval. Adjustments to the runoff coefficients may be required to account for future buildout conditions. The rational formula shall be used for drainage areas up to approximately two hundred (200) acres. Other methods presented in the TxDOT Hydraulic Manual are to be used for runoff from drainage areas greater than two hundred (200) acres.

2.3.5 Drainage Report - All drainage designs shall be contained in a Drainage Report and shall be submitted to the Airport Contact for review and approval. The Drainage Report shall be in such form as to provide the basis for timely and consistent review and will be made a part of the permanent record for future evaluation. The drainage report shall contain the following:

1. Description and plan of existing drainage facilities.
2. Description and plan of proposed drainage facilities (which may be half size reduction of preliminary or final design plans).
3. Drainage area map.
4. Description of analysis.
5. All calculations associated with the determination of runoff coefficients, volume of runoff, time of concentration, inlet size, culvert or pipe size and elevation of hydraulic gradient and any other items pertinent to the drainage design.
6. Consideration of drainage alternatives and recommended facilities.
7. A certification signed and sealed by a professional engineer registered in the State of Texas that

the design procedure is in full compliance with the requirements of these criteria.

8. Description of measures taken for velocity dissipation to ensure non-erosive velocities at points of discharge.
9. Description of measures taken for velocity dissipation to ensure non-erosive velocities at points of discharge.
10 All calculations associated with the drainage design shall be included in tabular form in the final design plans.
11. The drainage area map shall be no smaller than a one (1) inch equals two hundred (200) feet scale, and show all streets, building pads and other existing and proposed features. The drainage area map shall show the boundary of the drainage area contributing runoff into the proposed system. The area shall be further divided into numbered sub-areas to determine flow concentration points or inlet location(s). Drainage area maps shall show streets, land-use and land-use boundaries, existing ground elevations on two (2) foot contours, and a summary table of peak design flows for sub-areas with acreage, runoff coefficient, and inlet time shown.
12. Quantity and direction of design flow within streets, alleys, natural and manmade drainage ways and at all system intersections shall be clearly shown on the drainage area map. Existing and proposed drainage inlets, storm drainage systems and drainage channels shall be clearly shown and differentiated on the drainage area map.

2.3.6 Flow in Gutters - The permissible spread of water into the street or thoroughfare shall in all cases govern the hydraulic capacity of a given street. On multiple lane roadways, the permissible spread of water will not close more than one (1) travel lane in each direction. For two (2) lane roadways, the water shall be limited to 1/2 of each lane width.

2.3.7 Storm Drain Inlets - Various charts are available in the Drainage Manual that shall be used to determine the capacity and efficiency of the particular type of inlet chosen. When designing inlets, freedom from clogging or from interference with traffic shall take precedence over hydraulic considerations. Precast units may be used for load bearing applications only with the approval of the Airport Contact.

2.3.8 Placement of Manholes and Inlets - Manholes or combination manholes and inlets shall be placed wherever necessary for clean-out and inspection purposes. Place manholes at changes in direction, junctions of pipe runs, and at intervals of three hundred (300) to five hundred (500) feet in long pipe runs where the size or direction is not changed. The invert of the manhole section shall be rounded to match the inverts of the pipes entering the manhole in order to reduce eddying and resultant head losses. For manholes that are larger than the incoming or outgoing pipes, expansion losses can sometimes be significant. The use of heavy duty manholes may be required in some cases depending on location and shall be coordinated with the Airport Contact.

2.3.9 Flow in Storm Drains and Their Appurtenances - Storm drains shall be designed to have a minimum mean velocity of 2.5 feet per second flowing full. Velocities greater than thirteen (13) feet per second shall be avoided.

2.3.10 Design of Closed Storm Drainage System - In the preparation of hydraulic designs, a thorough investigation shall be made of all existing structures and their performance on the waterway in question. The design frequency for all new closed drainage systems shall be 10 years with a combined 100-year emergency overflow as required herein. The total capacity of the drainage facility, including surface flow within limits of available right-of-way or easements, shall be equal to or greater than the runoff of a storm of 100-year design frequency. Shall the 100-year storm runoff exceed the capacity of the above design, then the closed storm system shall be designed based on a minimum 25-year frequency, or larger, to develop a 100-year emergency overflow system. The hydraulic gradient shall be calculated for all storm drain lines and culverts and shall not be designed above the entrance flowline of any inlet. The permissible difference between the hydraulic gradient and top-of-curb is normally two (2) feet.

2.3.11 Design and Analysis of Open Channels - Backwater analysis is to be developed for major channels to establish water surface elevation and to avoid adverse impacts on adjacent properties. All new channels shall be designed using the one hundred (100) Year Design Frequency HEC-2 Water Surface Profiles Method as presented in the U.S. Army Corps of Engineers, Water Resources Support

Center or alternate methodology as approved by the Airport Contact. Channels shall be concrete lined for velocities over 7.5 feet per second. A 2'-0" freeboard will be incorporated into the design calculations.

2.3.12 Design of Culverts - Drainage culverts shall pass storm flow from the upstream side of highway, road or railroad to the downstream side without causing excessive backwater head and without creating excessive downstream velocities. The designer shall keep the discharge velocities within safe limits (usually 6 feet per second) while selecting the most economical structure that will provide satisfactory service. Methods presented in the TxDOT Hydraulic Manual shall be used with the 100-Year design frequency.

2.3.13 Manholes, Catch Basins, Inlets and Inspection Holes

2.3.13.1 Mortar: Mortar shall consist of one part portland cement and two parts sand. The portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.

2.3.13.2 Concrete: Plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of ACI 301-99.

2.3.13.3 Precast Concrete Pipe Manhole Rings: Precast concrete pipe manhole rings shall conform to the requirements of ASTM C 478. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches nor more than 48 inches.

2.3.13.4 Frames, Covers and Grates: The castings shall conform to one of the following requirements:

1. Gray iron castings: ASTM A 48, Class 30B and 35B.
2. Malleable iron castings: ASTM A 47.
3. Steel castings: ASTM A 27.
4. Structural steel for grates and frames: ASTM A 283, Grade D.
5. Ductile iron castings: ASTM A 536.
6. All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.
7. Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic but which will allow easy removal for access to the structure.
8. All castings shall be thoroughly cleaned and given two coats of approved bituminous paint. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A 123. Bituminous paint shall be black.

2.3.13.5 Placement and Treatment of Castings, Frames, and Fittings: All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the Engineer, and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

2.3.13.6 When frames or fittings are to be placed upon previously constructed masonry, the bearing surface or masonry shall be brought true to line and grade and shall present an even bearing surface in order that the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans or as directed and approved by the Engineer. All units shall set firm and secure.

2.3.13.6.1 After the frames or fittings have been set in final position and the concrete or mortar has been allowed to harden for 7 days, then the grates or covers shall be placed and fastened down.

2.3.13.7 Steps: The steps or ladder bars shall be gray or malleable cast iron or galvanized steel or wedge locking, steel reinforced rubber encased. The steps shall be the size, length, and shape

shown on the plans and those steps that are not galvanized shall be given a coat of bituminous paint, when directed.

2.3.13.7.1 The steps shall be installed as indicated on the plans or as directed by the Engineer. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is poured. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least 7 days. After this period has elapsed, the steps shall be cleaned and painted, unless they have been galvanized.

2.3.13.7.2 When steps are required with precast concrete pipe structures, they shall be cast into the sides of the pipe at the time the pipe sections are manufactured or set in place after the structure is erected by drilling holes in the concrete and cementing the steps in place.

2.3.13.7.3 When steps are required with corrugated metal structures, they shall be welded into aligned position at a vertical spacing of 12 inches.

2.3.13.7.4 In lieu of steps, prefabricated ladders may be installed. In the case of brick or concrete structures, the ladder shall be held in place by grouting the supports in drilled holes. In the case of metal structures, the ladder shall be secured by welding the top support and grouting the bottom support into drilled holes in the foundation or as directed.

2.3.13.8 Concrete Structures: Concrete structures shall be built on prepared foundations, conforming to the dimensions and form indicated on the plans. The construction shall conform to the requirements specified in ACI-301-99. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the Engineer before the concrete is poured. All invert channels shall be constructed and shaped accurately so as to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped downward toward the outlet.

2.3.13.9 Precast Concrete Pipe Structures: Precast concrete pipe structures shall conform to the requirements of ASTM C 478 and shall be constructed on prepared or previously placed slab foundations and shall conform to the dimensions and locations shown on the plans. All precast concrete pipe sections necessary to build a completed structure shall be furnished. The different sections shall fit together readily, and all jointing and connections shall be cemented with mortar. The top of the upper precast concrete pipe member shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow. The metal steps which are embedded or built into the side walls shall be aligned and placed at vertical intervals of 12 inches. Metal steps which are embedded or built into side walls shall be aligned and placed as shown on the plans, and, as required by Federal Law, conform to OSHA requirements. When a metal ladder replaces the steps, it shall be securely fastened into position.

2.3.13.10 Inlet and Outlet Pipes: Inlet and outlet pipes shall extend through the walls of the structures for a sufficient distance beyond the outside surface to allow for connections but shall be cut off flush with the wall on the inside surface, unless otherwise directed. For concrete or brick structures, the mortar shall be placed around these pipes so as to form a tight, neat connection.

2.3.14 Pipe Materials for Storm Drains and Culverts

1. Reinforced Concrete Pipe: ASTM C 76.
2. Reinforced Concrete D-Load Pipe: ASTM C 655.
3. Reinforced Concrete Arch Pipe: ASTM C 506.
4. Reinforced Concrete Elliptical Pipe: ASTM C 507.
5. Precast Reinforced Concrete Box Sections: ASTM C 789 and C 850.
6. Bituminous-Coated Structural Plate Pipe, Pipe Arch, and Arches: AASHTO M 167 & 243.
7. Aluminum Alloy Structural Plate for Pipe, Pipe Arch, and Arches: AASHTO M 219.
8. Polyvinyl Chloride (PVC) Pipe: ASTM D 3034.

9. Corrugated Polyethylene Drainage Tubing: AASHTO M 252.
10. Corrugated Polyethylene Pipe 12 to 24 Inches in Diameter: AASHTO M 294.

2.3.15 Concrete Pipe Cradles - Concrete for pipe cradles shall have a minimum compressive strength of 2000 psi at 28 days and conform to the requirements of ASTM C 94.

2.3.16 Rubber Gaskets - Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C 43. Rubber gaskets for PVC shall conform to the requirements of ASTM F 477. Rubber gaskets for zinc-coated steel pipe and precoated galvanized pipe shall conform to the requirements of ASTM D 1056, for the "E " closed cell grades.

2.3.17 Pipe Joint Mortar - Pipe joint mortar shall consist of one part portland cement and two parts sand. The portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.

2.3.18 Oakum - Oakum for joints in bell and spigot pipe shall be made from hemp (Cannabis Sativa) line, or Benares Sunn fiber, or from a combination of these fibers. The oakum shall be thoroughly corded and finished.

2.3.19 Poured Filler - Poured filler for joints shall conform to the requirements of ASTM D 1190.

2.3.20 Plastic Gaskets - Plastic gaskets shall conform to the requirements of AASHTO M 198 (Type B).

2.3.21 Pipe Bedding – Bedding for rigid pipe shall conform to one of the following classes:

Class A: Continuous concrete cradle.

Class B: Bed of granular materials having a thickness of at least 6 inches below the bottom of the pipe and extending up around the pipe for a depth of not less than 30 percent of the pipe's vertical outside diameter. The layer of bedding material shall be shaped to fit the pipe for at least 10 percent of the pipe's vertical diameter and shall have recesses shaped to receive the bell of bell-and-spigot pipe. The bedding material shall be sand or selected sandy soil conforming to the following:

SIEVE	**% PASSING**
2 inch	100
1 inch	90-100
1/2 inch	50-80
No. 4	30-60
No. 100	0-5

Class C: Class C bedding shall consist of bedding the pipe in it's natural foundation to a depth of not less than 10 percent of the pipe's vertical outside diameter. The bed shall be shaped to fit the pipe and shall have recesses shaped to receive the bell of bell-and-spigot pipe.

2.3.22 Bedding, Flexible Pipe: Pipe bedding for flexible pipe, the bed shall be roughly shaped to fit the pipe, and a bedding blanket of sand or fine granular material shall be provided as follows:

Pipe Corrugation Depth	Minimum Bedding Depth
1/2 inch	100
1 inch	90-100
2 inches	50-80
2-1/2 inches	30-60

2.3.23 Bedding, PVC and Polyethylene Pipe: For PVC and polyethylene pipe, the bedding material shall consist of coarse sands with a maximum particle size of ¾-inch. For pipe installed under paved areas, no more than 12 percent of the material shall pass the No. 200 sieve. For all other areas, no more than 50 percent of the material shall pass the No. 200 sieve. The bedding shall have a thickness of at least 6 inches below the bottom of the pipe and extend up around the pipe for a depth of not less than 12 inches.

2.3.24 Deflection - Longitudinal deflection at each pipe joint shall not exceed one degree in any direction

2.4 PIPE UNDERDRAINS

2.4.1 Pipe Design - The pipe shall be designed for the application, and shall meet at least one of the following appropriate requirements.

1. Perforated Vitrified Clay Pipe	ASTM C 700
2. Perforated Concrete Pipe	ASTM C 444
3. Porous Concrete Pipe	ASTM C 654
4. Polymer Precoated Perforated Corrugated Steel Pipe	ASTM A 762
5. Perforated, Laminated Wall Bituminized Fiber Pipe	ASTM D 2418
6. Smooth-Wall Perforated PVC Pipe	ASTM F 758
7. Poly (Vinyl Chloride)(PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings	ASTM F 949

2.4.2 Mortar - Pipe joint mortar shall consist of one part portland cement and two parts sand. The portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.

2.4.3 Seals - Elastomeric seals shall conform to the requirements of ASTM F 477.

2.4.4 Porous Backfill - Porous backfill shall be free of clay, humus, or other objectionable matter, and shall conform to the gradation in Table 1 when tested in accordance with ASTM C 136.

TABLE 1. GRADATION OF POROUS BACKFILL

Sieve Designation (square openings)	Percentage by Weight Passing Sieves	
	Porous Material No. 1	Porous Material No. 2
1-1/2 inch	---	100
1 inch	---	90-100
3/8 inch	100	25-60
No. 4	95-100	5-40
No. 8	---	0-20
No. 16	45-80	---
No. 50	10-30	---
No. 100	0-10	---

2.4.4.1 When two courses of porous backfill are specified in the plans, the finer of the materials shall conform to particle size tabulated herein for porous material No. 1. The coarser granular material shall meet the gradation given in the tabulation for porous material No. 2.

2.4.5 Prefabricated Underdrains: Prefabricated underdrains shall consist of a nonwoven, needle-punched, polyolefin geotextile, tightly encapsulating an internal polyolefin core. The product shall allow the entry of water from all sides of the core and shall be designed to minimize fabric intrusion into the core. When a one-sided core is used, the core shall have at least 5% of its area in unobstructed inflow through the back or shoulder side and at least 65% on the front or pavement side. The prefabricated underdrains shall conform with the following requirements:

2.4.5.1 Core material shall have a water absorption of 0.05% at 24 hours when tested in accordance with ASTM D 570; and shall show no fungus growth when tested in accordance with ASTM G 21.

2.4.5.2 Filter fabric shall have a tensile strength of 90 lbs. minimum and an elongation of 50% when tested in accordance with ASTM D 4632; a burst strength of 150 psi minimum when tested in accordance with ASTM D 3786; a puncture strength of 45 psi minimum when tested in accordance with ASTM D 3787; permeability of 0.20 cm/sec when tested in accordance with ASTM D 4491; and shall retain 70% of its strength when subjected to UV Radiation in accordance with ASTM D 4355. The filter fabric shall show no fungus growth when tested in accordance with ASTM G 21.

2.4.5.3 Geocomposite underdrains shall have a compressive strength of 55 psi minimum with a 12% maximum deformation when tested in accordance with ASTM D 1621. Geocomposite Underdrains shall also be able to carry a flow rate of 15 GPM/ft width in soil environment when tested in accordance to ASTM D 4716.

2.4.5.4 The underdrain system shall include fittings and materials needed to make splices and outlets compatible with Schedule 35 and Schedule 40 PVC pipe.

2.4.6 Slotted Drains: The slotted drain shall consist of a corrugated metal conforming to the requirements of ASTM A 760. The corrugated metal drain shall be 14 gage. The spacers in the slot shall be 3/16" steel.

2.4.6.1 The slotted drain system shall include fittings, materials and appurtenances needed to make splices and outlets compatible with RCP Pipe and shown on the plans.

2.4.6.2 Cleanouts for slotted drains shall have no-hub connections. Access frame shall be round, coated cast iron with heavy-duty scoriated secured cover, Josam Series 58850, or approved equal. The PVC pipe shall have a threaded end and a threaded plug.

2.4.7 Excavation for Pipe Underdrains: The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but shall not be less than the external diameter of the pipe plus 6 inches on each side. The trench walls shall be approximately vertical.

2.4.7.1 Where rock, hardpan, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least 4 inches. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 6 inches in uncompacted depth to form a uniform but yielding foundation.

2.4.7.2 Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The engineer shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

2.4.7.3 Excavated material not required or acceptable for backfill shall be disposed of by the Contractor as directed by the Engineer. The excavation shall not be carried below the required depth; when this is done, the trench shall be backfilled with material approved by the Engineer and compacted to the density of the surrounding earth material.

2.4.7.4 The bed for the pipe shall be so shaped that at least the lower quarter of the pipe shall be in continuous contact with the bottom of the trench. Spaces for the pipe bell shall be excavated accurately to size to clear the bell so that the barrel supports the entire weight of the pipe.

2.4.7.5 The Contractor shall do such trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. Unless otherwise provided, the bracing, sheathing, or shoring shall be removed by the Contractor after the completion of the backfill to at least 12 inches over the top of the pipe. The sheathing or shoring shall be pulled as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material.

2.4.8 Installing Pipe Underdrains

2.4.8.1 Clay or Concrete Pipe. The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. When bell and spigot pipe is used, the bells shall be laid upgrade. If tongue and groove pipe is used, the groove end shall be laid upgrade. Holes in perforated pipe shall be placed down, unless otherwise shown on the plans. Set pipe firmly and accurately to line and grade so that the invert will be smooth and uniform. Pipe shall not be laid on frozen ground.

2.4.8.2 Metal and Fiber Pipe. The metal pipe shall be laid with the separate sections joined firmly together with bands, with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. Any metal in the pipe or bands not protected thoroughly by galvanizing shall be coated with a suitable asphaltum paint.

2.4.8.2.1 The sections of bituminized-fiber pipe shall be securely fastened together with suitable fittings. When the fiber couplings are tapered, they shall provide a tight, driven fit.

2.4.8.2.2 During installation, the asphalt-protected pipe shall be handled without damaging the asphalt coating. Any breaks in the bitumen or treatment of the pipe shall be refilled with the type and kind of bitumen used in coating the pipe originally.

2.4.8.3 PVC Pipe. PVC pipe shall be installed in accordance with the requirements of ASTM D 2321.

2.4.8.4 All Types of Pipe. The upgrade end of pipelines, not terminating in a structure, shall be plugged or capped as approved by the Engineer.

2.4.8.4.1 Unless otherwise shown on the plans, a 4-inch bed of granular backfill material shall be spread in the bottom of the trench throughout the entire length under all perforated pipe underdrains.

2.4.8.4.2 Pipe outlets for the underdrains shall be constructed when required or shown on the plans. The pipe shall be laid with tight-fitting joints. Porous backfill is not required around or over pipe outlets for underdrains. All connections to other drainage pipes or structures shall be made as required and in a satisfactory manner. If connections are not made to other pipes or structures, the outlets shall be protected and constructed as shown on the plans.

2.4.8.5 Manufacturer's Representative: For prefabricated underdrains and slotted drains, the manufacturer's representative shall be present at the beginning of the installation as required by the Construction Manager or Contractor and shall remain on site until released by the Engineer.

2.5 ROADS

2.5.1 Design Reference - The latest edition of the Texas Department of Transportation (TxDOT) Highway Design Division Operations and Procedures Manual contains the basic design criteria standards and guidelines that will be the reference document for the future roadway projects at the Airport unless otherwise specified. Deviation from these criteria will not be allowed without written approval from the Airport Contact.

2.5.1.1 The following minimum criteria applies to all non-airfield roadways within the DFW Airport boundaries. Deviations from these requirements require approval from the Airport Contact.

Classification	Roadway Width
Freeway	400 Feet
Primary Arterial	150 Feet
Secondary Arterial	120 Feet
Local Road	70 Feet

2.5.2 Roadway Thickness - The typical roadway pavement section consists of eight (8) inch thick continuously reinforced concrete pavement, five (5) inches of cement treated base and nine (9) inches of lime treated subgrade at 6% to 8% lime by weight. All curbs shall be poured monolithic with the roadway pavement alternate roadway pavement section consists of eight (8) inch thick continuously reinforced concrete pavement, five (5) inches of asphalt base and nine (9) inches of lime treated subgrade at 6% to 8% lime by weight.

2.5.3 Design Speeds - The Design Speed represents the maximum safe speed that can be maintained over a section of roadway and is influenced by the required posted speed limit, terrain, functional road classification and economic considerations. All design criteria shall be commensurate with selected design speeds. All selected design speeds shall be presented to the Airport Contact for review and approval prior to final design.

2.5.3.1 Freeway - Currently, International Parkway is the only designated major arterial on the Airport outside of the various state highways. The posted speed limit on International Parkway is fifty-five (55) mph except where the speed limit is reduced for safety reasons. The posted speed limit on the various state highways is regulated by TxDOT and may be subject to change.

2.5.3.2 Primary Arterial System - Airfield Drive is considered a primary arterial and is currently posted at forty-five (45) mph throughout.

2.5.3.3 Secondary Arterial System - Posted speed limits of 30-35 mph with intercommunity, intrametro area traffic movement.

2.5.3.4 Collector System - The posted speed limit for collector roads and continuous frontage roads shall be thirty (30) mph.

2.5.3.5 Local Road System - This type of local access road provides a direct access to abutting property (parking lots, Terminals, lease sites, etc.) for local traffic circulation movements and shall have posted speed limits of thirty (30) mph with forty-five (45) mph transitions at the north and south ends.

2.5.3.6 Ramps - The design speed for on and off ramps shall be determined in accordance with TxDOT criteria. Under conditions of restricted geometrics on certain ramp connections, the design speed shall not be less than twenty-five (25) mph.

2.5.4 Design Vehicles

2.5.4.1 Size and Weight - The physical and operating characteristics of an authorized vehicle of designated type establishes roadway design controls to accommodate the vehicle of that type. All new and major reconstruction roadways shall be designed to meet minimum requirements set forth for WB-50 design vehicles, unless waived by the Airport Contact, in which case the design vehicle shall be single-unit (SU) truck as an absolute minimum. TxDOT has established minimum turning paths for these design vehicles to be used as controls in geometric design. It is vitally important that fire-fighting and other emergency equipment be capable of maneuvering on all circulation roads.

2.5.4.1.1 Load limits shall conform to the minimum requirements set forth for Federal and State highways.

2.5.4.2 Turning Radii - All turning radii shall be designed to accommodate the wheel path of the critical design vehicles without encroachment of curbs. The minimum design radius at intersections is 30 feet. Minimum design radius at driveways shall be fifteen (15) feet.

2.5.5 Alignment

2.5.5.1 Stopping Sight Distance - Safe stopping sight distance shall be established using wet pavement conditions and, as the controlling design vehicle, the passenger car with eye height at 3.5 feet and object height of 0.5 feet. Design values shall be in accordance with the requirements listed in the TxDOT Manual.

2.5.5.2 Horizontal Curvature - The maximum degree of curvature shall conform to the design values listed in the TxDOT Manual for a particular design speed.

2.5.5.3 Superelevation - The maximum rate of superelevation is 0.06 feet per foot.

2.5.5.4 Vertical Curvature - Length of vertical curves is determined by the algebraic sum of gradients and the design speed. The K-values listed in the TxDOT Manual for crest curves and sag curves shall be used in calculating the minimum required lengths of vertical curves.

2.5.5.5 Ramp Geometry - All on and off ramps and direct connections to arterials shall be designed for one (1) lane of traffic operation with provisions for emergency parking.

2.5.5.6 Maximum Grades - The maximum grade of ramps is six (6) percent.

2.5.5.7 Minimum Grades - The minimum grade of ramps is 0.5 percent.

2.5.6 Obstruction Clearances

2.5.6.1 Clear Zones - A clear, unobstructed, relatively wide and flat (4:1 or flatter slope) area beyond the edge of the travel lane is required for all new and major reconstruction projects.

2.5.6.2 Horizontal Clearances - Horizontal clearances shall be measured from edge of the travel lane to the face of obstruction such as column, bent cap or wall. Horizontal clearance shall be in accordance with the Texas Department of Transportation, Highway Design Division, Operations and Procedures Manual.

2.5.6.3 Culvert headwalls and other drainage systems shall have appropriate safety treatments.

2.5.6.4 Vertical Clearances - The minimum vertical clearance for arterial and collector roads shall be sixteen (16) feet six (6) inches over the usable roadway including shoulders. Minimum vertical clearance for all other roadways shall be fourteen (14) feet six (6) inches. These clearances provide provision for future resurfacing.

2.5.7 Cross Section Elements

2.5.7.1 Pavement Width - The minimum standard lane width of twelve (12) feet shall apply to all roadway systems under this section, including ARFF roads except ramps where a minimum standard lane width of fourteen (14) feet shall be used. Bi-directional two- lane roads without usable shoulders require a total pavement width of not less than thirty-four (34) feet.

2.5.7.2 Shoulders - On major, high design speed (equal to or greater than 50 mph), uncurbed facilities, a minimum traversable shoulder width of ten (10) feet is required.

2.5.7.2.1 On one-lane ramps, shoulders shall be placed on each side of the travel lane for a combined effective width to allow a stalled or stopped vehicle to be passed. Outside shoulders shall be a minimum of six (6) feet, and inside shoulders a minimum of two (2) feet.

2.5.7.2.2 Six (6) inch curbs shall be used primarily on collector, service roads, and other low speed (less than 50 mph) type facilities. They shall not be used in connection with high speed facilities, expressways, ramp areas. Where needed for drainage purposes at ramps, curbs shall be mountable type. On two-lane, two-way roads, a minimum of two (2) feet on each side for curb and gutter shall be included in the total width of the roadway.

2.5.7.3 Speed Change Lanes - This section shall apply to auxiliary lanes with respect to median openings and at-grade intersections supplementary to through traffic movements.

2.5.7.3.1 The required length of the auxiliary lanes and size of median opening for turning vehicles shall be in accordance with applicable standards as outlined in the TxDOT Manual.

2.5.7.4 Cross Slope - The standard cross slope on all new paving projects and major reconstruction paving projects is ¼ inch per foot of pavement width.

2.5.7.5. Special Features - It is recognized that certain conditions will require the use of features not described in this Manual. The design of these features, shall be based on good engineering practice for the specific feature and based on similar designs used by nearby municipalities or State agencies. The design shall consider the functional characteristics of the installation as well as the familiarity of the driver with the installation.

2.5.8 Roadway Signs - The design of signs for roadways shall be in accordance with the Texas Manual for Uniform Traffic Control Devices, latest edition. The signs, posts, breakaway features and foundations shall conform to TxDOT Standards. The erection of signs on bridge structures will require prior written approval from the Airport Contact. For additional requirements, refer to the "***DFW Sign Design Manual"***.

2.6 EXCAVATION FOR STRUCTURES

2.6.1 All excavation for structures and structure footings shall be made to the lines and grades or elevations shown on the plans. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximate only; and the Engineer may order, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.

2.6.2 Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation, and excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

2.6.3 All bracing, sheathing, or shoring shall be performed as necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws.

2.6.4 Unless otherwise provided, bracing, sheathing, or shoring involved in the construction of this item shall be removed after the completion of the structure. Removal shall be effected in a manner which will not disturb or mar finished masonry.

2.6.5 After each excavation is completed, the Contractor shall notify the Engineer to that effect; and concrete or reinforcing steel shall be placed after the Engineer has approved the depth of the excavation and the character of the foundation material.

2.7 BACKFILL FOR STRUCTURES

2.7.1 After a structure has been completed, the area around it shall be filled with approved material, in horizontal layers not to exceed 8 inches in loose depth. For areas under pavement and safety areas, compact to 95% to 100% of the Standard Proctor Density, in accordance with ASTM D 698. For all other areas, compact to 93% of the Standard Proctor Density. Moisture content shall be held to a range of from 1% below to 3% above optimum. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Engineer.

2.7.1 Backfilling shall not be placed against any structure until permission is given by the Engineer. In the case of concrete, such permission shall not be given until the concrete has been in place 7 days, or until tests made by the laboratory under supervision of the Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it. Sufficient strength shall be interpreted as being 75% of the design strength, or the strength expected to be obtained in 7 days, whichever is greater.

2.8 SITE ELEMENTS

2.8.1 Retaining Walls - Wherever slopes must be steeper than a slope of 4:1 (four horizontal units to one vertical unit), the use of retaining walls will usually be required. Either vertical or battered wall faces are acceptable. Exposed concrete may be required to be buff color with surface texture matching that of adjacent buildings. Trenching or sprinkler systems shall not be allowed in the passive soil area.

2.8.2 Fencing

2.8.2.1 Leased Property Fencing - All fencing on leased property is the responsibility of the Tenant and shall be aesthetically pleasing. This can be accomplished by use of material matching or similar to adjacent structures. Chain link fencing shall be screened with plantings where appropriate.

2.8.2.2 AOA Fencing – Security fencing shall be constructed at locations adjacent to the Air Operations Areas (AOA) with no openings or gaps in excess of 4 inches (may be 4 to 6 inches below gates) and shall consist of the following components:

2.8.2.2.1 Fence and Gates – Six (6) feet in height of number 10 gage, 2-inch galvanized steel chain link mesh with three (3) strands of number 12 gage, four point barbed wire mounted above the fence with an outward extension of forty five (45) degrees. Any water crossings or outfalls shall have coverage equal in strength and durability to the actual fence. Fence posts shall be installed on ten (10) feet centers maximum. Post, rails and braces shall be zinc-coated steel sized in accordance with the table below. Hinges and latches shall be zinc-coated. Concrete retaining walls six feet or higher will only require the barbed wire extensions.

Use and Section	Nominal Outside Diameter (Inches)	Normal Weight per Foot (+/- 10% Tolerance)	
		Type I	Type II
End corner and pull posts			
Fabric height of 6'-0", round	2.375	3.65	3.12
square	2.00	2.60	
Over 6'0", round	2.875	5.79	4.64
, square	2.50	5.10	
Rails and post braces	1.66	2.27	1.83
Intermediate Posts For Fabric Heights	Nominal Outside Diameter (Inches)	Normal Weight per Foot (+/- 10% Tolerance)	Normal Weight per Foot (+/- 10% Tolerance)
6'-0" and less, round	1.90	2.72	2.28
'C' Section	1.875	2.28	2.28
Over 6'-0", round	2.375	3.65	3.12
C Section	2.25	2.64	2.664

2.8.3 AOA Signs - The Airport Board will furnish sign graphics in the form of a master suitable for photographic enlargement. Signs shall be constructed of screen-printed reflective vinyl film on a .080 inch anodized aluminum panel. Anchor signs to fence fabric with #6 galvanized wire ties.

2.8.3.1 Fence Signs - Warning signs shall be affixed to the fence on centers of 200 feet maximum and at each turn of the fence of 45 degrees or greater. Signs shall be 24 inches in height by 30 inches in width. Fence sign graphics will include the Airport brand and the following copy: "Air Operations Area – No Trespassing" Sign specifications approved by the DFW Airport Department of Public Safety can be obtained from the DFW Airport Sign Shop.

2.8.3.2 Gate Signs – All AOA gates will be assigned a gate number by the Energy and Asset Management Department. Sign specifications approved by the DFW Airport Department of Public Safety can be obtained from the DFW Airport Sign Shop.

2.8.4 Concrete Mow Strip – A concrete mow strip 36 inches in width shall be installed at all permanent fencing. The concrete strip shall be four (4) inches in thickness and reinforced with flat 6-inch by 6-inch, W2.9 X W2.9, welded wire fabric. Place on two-inch sand cushion. Provide contraction joints spaced four (4) feet on center and pre-molded one half (1/2) inch expansion joint material spaced at thirty-two (32) feet on center.

2.8.5 Post and Cable System – A post and cable system shall be installed in all areas where vehicles have unobstructed access to fences and gates adjacent to runways and taxiways. Acceptable systems shall be CASS tm system by Trinity Industries, Inc., Brifen Wire Rope Safety Fence by Brefin USA or an approved equal.

2.8.6 Concrete Traffic Barriers – Concrete traffic barriers (CTB) shall be installed on the AOA side of

AOA gates parallel to and three feet from the gate.

2.8.7 Gate Locks – All unmanned AOA gates shall be equipped with an electronic lock and key system and shall comply with CFR 49, Section 1542.207. Provide Intellikey Stand-Alone System compatible with Intellikey ASC 4000 System or approved equal. The system shall utilize an audit trail and provide access control by user, time, date and location. The system shall be constructed of weatherproof stainless steel and utilize a captive chain in the locking mechanism that automatically compensates for sags and misalignment.

2.8.8 AOA Fence Screening and Equipment – Screenings shall not be attached to AOA fencing. A separation dimension of 10 feet shall be maintained between the AOA fence and any movable objects such as equipment.

2.8.9 AOA Gate Barriers – At manned AOA gates, when barriers are required by DFW Airport DPS, provide a surface mounted barricade system equal to Delta Scientific Corporation (TW2015) or Natsatka Barrier, Inc. as follows:

1. Hydraulic or pneumatic controlled barricade system with one-inch thick, eighteen-inch high metal plate in specified length to act as a physical barrier to entry or exit when in the raised position.
2. Provide surface-mounted, above grade installation.
3. The system shall be crash rated based on US Corps of Engineers acceptance criteria of at least 5,000 pounds at 30 miles per hour.
4. The barricade shall be automatically lowered to allow passage of authorized vehicles by card swipe through the Airport Board's Automatic Access Control System (AACS), and the barricades shall be capable of being operated by authorized personnel pushing a button inside the guard station.
5. The barricade shall have a minimum height in the up position of 21 inches, and when lowered shall be less than 2" in height.

2.8.10 AOA Guard Stations – Guard houses are required at manned AOA gates equal to Model DA75Sw as manufactured by Port-A-King Building Systems, Earth City, Mo.

2.8.11 Flagpoles - Flagpoles shall be cone tapered aluminum, dark bronze anodized finish, with all standard fittings. Flagpoles shall be adequately supported and provided with lightning protection. All flagpoles shall conform to height restrictions per Section 4.5.3 Height Restrictions, contained in the document, "Urban Design Criteria Manual for Central Terminal Areas."

2.8.12 Trash Handling - Space shall be provided for trash handling devices and containers depending on the size, location and type of trash which is to be disposed. Design plans shall indicate the proposed method(s) for trash disposal. All equipment used for handling, storage, or compaction of trash which may be in the public view shall be screened. Equipment shall be finished in a color to match other painted building equipment. Also, the dumpster type containers shall be oriented for ease of approach by truck. All trash containers shall be covered or otherwise enclosed to prevent access by wildlife and high winds. No open topped trash containers are permitted within the Air Operations Area, unless thoroughly protected from jet blast and high winds.

2.8.13 Fire Lane Markings: Fire lanes shall be marked with a six (6) inch painted red stripe. The words "FIRE LANE NO PARKING" shall be stenciled in white paint, four (4) inch high letters with a ¾-inch stroke. The interval between stenciled signs shall be adequate to inform the public of the existence of the fire lane but in no event shall the interval be greater than twenty (20) feet. Markings shall be on each side of the designated fire lane. The shade and type of paint shall comply with State of Texas specifications for traffic paint.

2.8.14 Security Gates and Other Security Devices Across Fire Apparatus Access Roads: All automatic gates and devices across required fire apparatus access roads shall open upon activation of building fire alarm system and remain open until such time that the fire alarm is reset, or; shall open with a signal from a 3M Opticom system. The gate shall also open from a signal received from a DFW

Airport Board Signal Receiving Device (SRD), or; DFW Airport Board Selected Vehicle Device (genie). All automatic gates and devices shall incorporate a fail-safe manual backup or release. All gates and devices shall permit the safe exit of emergency vehicles at all times.

2.8.15 Walks - Pedestrian concrete walks shall be constructed between buildings and other essential locations where such a need may occur. The minimum standard width for sidewalk pavement shall be four (4) feet with proper cross slope for adequate drainage. The minimum standard walkway pavement shall be of four (4) inch thick concrete reinforced with flat 6-inch X 6-inch, W2.9 x W2.9, welded wire fabric on a minimum two (2) inch sand cushion. Rolled wire fabric will not be permissible as walkway or other reinforcing. Provide contraction joints spaced every four (4) feet (approximate). Premolded one-half (½) inch expansion joint material spaced at thirty-two (32) feet is required.

2.9 SANITARY SEWER AND PRETREATMENT SYSTEM

2.9.1 General Information - This chapter defines general design criteria that applies to the design of exterior utilities at DFW Airport.

2.9.1.1 It is recommended that a cementitious fill material be considered as a back fill material for all trenches occurring under any roadway, runway, taxiway, shoulders or parking lot. Good engineering practice, scheduling, construction demands (material set time) and any future excavation requirement shall be considered in selecting the proper material.

2.9.1.2 Existing utility information is available through the Airport Maintenance Department. However, it shall be expressly understood that the DFW Airport Board cannot accept responsibility for the locations shown on "as-built" drawings. It shall be the designer's responsibility to verify locations or the adequacy of file information prior to design and construction of utility extensions, duct banks, conduits or connections to such facilities.

2.9.1.3 Wherever possible, disposal of sewage shall be by gravity to the Sanitary Sewer System (SSS). Airport mains shall be extended as required to establish gravity flow disposal. Ejector type pumps will only be allowed when gravity connection to the SSS is not possible. On-site disposal will only be allowed in remote Airport areas where mains do not exist or cannot be extended for gravity or ejector disposal.

2.9.1.4 Wastewater mains shall have slopes that allow the flows to achieve velocities of 3.0 fps, if possible. The minimum velocity shall not fall below 2.0 fps. Slopes that will create a flow velocity in excess of 10.0 fps shall be avoided.

2.9.2 Sanitary Sewer System - All proposed connections to the SSS shall be described by plans and specifications from the user end of the lateral to actual connection to the Airport main. Manholes shall be cast-in-place reinforced concrete and installed every three hundred (300) feet, at connections to mains and at 45 degree and 90 degree changes in main runs. Manhole covers shall have “Sanitary Sewer” imprinted on them.

2.9.2.1 No permanent Airport facility requiring sanitary sewage disposal shall be opened, occupied, or operated without an approved permanent lateral connection to an Airport main or a specifically approved alternative.

2.9.2.2 Approved materials for gravity flow sanitary sewer pipe are: ASTM D2241 SDR 26, AWWA C900, C905 PVC pipe, or ASTM D 2680 PVC pipe. ASTM D 2680 PVC pipe shall not be used for pressurized mains. The minimum lateral size shall be six (6) inches in diameter. All lateral to main connections shall be made at a manhole. SDR-35 PVC is highly discouraged and requires approval prior to being specified. Elastomeric gaskets shall also meet ASTM D 2000.

2.9.2.3 Testing: Prior to testing, all sanitary sewer lines must be inspected with a video system and a copy of the tape submitted to Airport Development Utilities for approval. After approval of the tape, all installed SSS pipe must be tested so that the completed system will have a zero (0) exfiltration loss per two (2) hours, where the hydrostatic head at the design hydraulic grade line is no less than

four (4) feet of test stack with the height of the test stack matching the highest elevation of the SSS. A pneumatic test at 3 psi may be substituted for the hydrostatic test to substantiate the exfiltration criteria. The air pressure shall be equivalent to the comparable hydrostatic test pressures.

2.9.2.4 Manholes must be vacuum-tested with a negative pressure of 3 psi, maintaining a zero (0) pressure drop for five minutes.

2.9.2.5 SSS Lift Stations shall include a minimum of two (2) submersible electrically operated sewage pumps with low level shutoff, high level alarm and intermediate level sensors required for pump cycling. Pumps shall be manufactured to safely pump wastewater.

2.9.2.6 Wet-pits shall be concrete, cast-in-place with access for inspection and pump maintenance.

2.9.2.7 Lift Stations shall be located with due consideration for screening, maintenance access and emergency access.

2.9.2.8 The AWWA C900, C905, or P303 reinforced concrete cylinder pipe (RCCP) is required for all pressurized applications. All pressurized pipe shall be installed within casings under roadways, taxiways, and runways. Casing pipe shall be RCCP or PVC (schedule 80 or AWWA C900). Steel casings can be used with proper cathodic protection as described in CHAPTER 11 – Corrosion Control. Corrugated steel pipe shall not be used as casing pipe. All pipe installed within sleeve will require RACI – spacers on four (4) feet center.

2.9.2.9 Longitudinal deflection at each pipe joint shall not exceed one degree in any direction.

2.9.2.10 Bedding for Sanitary Sewer System: After trench has been cut to a depth below the barrel of the pipe a distance of three inches, the bedding shall be brought to a point =slightly above grade with compacted sand. Bell holes shall be formed, if required, a trough scooped out to grade and the pipe laid and jointed as specified. The sand shall then be brought up in uniform layers of either side of the pipe and over the pipe to a point 12 inches above the top of the pipe. Density shall be at least 90 percent of maximum density as determined by ASTM D 698. Moisture content shall be within minus 2 to plus 4 of optimum.

2.9.3 PreTreatment Waste System: The Pretreatment system, formerly referred to as the Industrial Waste System shall only be used for the handling of storm water. The design shall take into consideration the usage charges associated with all discharges to the Pretreatment system.

2.9.3.1 Permissible Discharges: Process water discharges to the Pretreatment system are explicitly forbidden. Process water is defined in the Clean Water Act, and includes, but is not limited to: apron and ramp washdown, fuel spills, sanitary sewage, deicing pad runoff, and aircraft and vehicle wash water.

2.9.3.2 The Pretreatment system may handle discharges that contain excessive pollutant concentrations that would otherwise be directed to the storm water system. Typically the system is used to transport first flush storm runoff that contains elevated levels of pollutants. The Pretreatment system has occasionally handled non-permissible discharges (e.g. emergency overflow relief line for deicing storage tanks), such uses shall only be allowed by written authorization of the EAD vice president.

2.9.3.3 Prior to any connection to the Pretreatment system an engineering analysis shall verify that there is available incremental capacity in the system to handle the proposed discharges for all non-emergency discharge conditions. The anticipated characteristics of the discharge shall be compliant with the Pretreatment Rule contained in the Airport's Code of Rules & Regulations.

2.9.3.4 Equipment and Material: PTWS pipe shall meet the requirements of AWWA C900 PVC, C905 PVC or designed and manufactured in accordance with the applicable provisions of ASTM D 2680 and D 3212. The pipe will be joined using Elastomeric gasketed joints meeting ASTM D 3212 or solvent weld joints meeting ASTM D 2855-90, ASTM D 2564-90 and/or ASTM D2235-90 or latest

edition. The AWWA C900, C905 or P303 Reinforced Concrete Cylinder Pipe (RCCP) is required for all pressurized applications. All pressurized pipe shall be installed within casings under roadways, taxiways and runways. Casing pipe shall be installed RACI-spacers or equivalent, RACI-spacers on four (4) foot centers. Steel casing pipe can be used with proper cathodic protection as described in Chapter 11 - Corrision Control. Corrugated steel pipe shall not be used as casing pipe.

2.9.3.4.1 All PTWS pipe installed will be tested so that the completed pipe system will have a zero (0) exfiltration loss per two (2) hours, where the hydrostatic head at the design hydraulic grade line is no less than four (4) feet of test stack with the height of the test stack matching the highest level of the PTWS. A pneumatic test may be substituted for the hydrostatic test to substantiate exfiltration criteria. Maintain 3 psi for 5 minutes with zero (0) psi drop.

2.9.3.4.2 PTWS Lift Stations shall include a minimum of two (2) submersible electrically operated sewage pumps with low level shutoff, high level alarm and intermediate level sensors required for pump cycling. Pumps shall be manufactured to safely pump wastewater.

2.9.3.4.3 Wet-pits shall be concrete, cast-in-place with access for inspection and pump maintenance.

2.9.3.4.4 Lift Stations shall be located with due consideration for screening, maintenance access and emergency access.

2.9.3.4.5 Manholes shall be cast-in-place reinforced concrete without embedded steps. Manholes shall be installed at every 300 feet, at connections to mains and at 45 degree and 90 degree changes in runs. Ring and cover shall be cast iron, twenty-four (24) inch diameter and adjusted to finish grade or existing ground elevation, as appropriate. Coves shall have “Waste System” imprinted on them. Joints shall be sealed to prevent infiltration and exfiltration. Existing Pre-treatment Waste system manhole covers may be stamped “Industrial Waste”, “Industrial Waste System”, or “PTWS”. Old covers shall be replaced as encountered with new covers stamped as indicated above.

2.10 DEICING RUNOFF COLLECTION SYSTEM

2.10.1 Pipe: High Density Polyethylene Pipe (HDPE) conforming to AWWA C901 and AWWA C906. Force mains shall be minimum DR 11 and gravity lines shall be minimum DR 17. Pipe shall be of the type and size designated on the plans or in the proposal. Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D3350-99 with a minimum cell classification of PE345464C. Pipe CL. sizes 4” to 24” shall be available in both steel pipe sizes (IPS) and ductile iron pipe sizes (DIPS). Pipe O.D. sizes 26” to 54” shall be available in steel pipe sizes (IPS). Pipe shall have a manufacturing standard of ASTM D3035 and be manufactured by an ISO 9001 certified manufacturer. The pipe shall contain no recycled compounds except that generated in the manufacturer’s own plant from resin of the same specification from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects. Pipe shall be DR17 unless otherwise specified on plans.

2.10.2 Butt Fusion Fittings: Butt fusion fittings shall be in accordance with ASTM D3261 and shall be manufactured by injection molding a combination of extrusion and machining, or fabricated from HDPE pipe conforming to this specification. All fittings shall be pressure rated to provide a working pressure rating no less than that of the pipe. Fabricated fittings shall be manufactured using a McElroy Datalogger to record fusion pressure and temperature. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained as part of the quality control. The fitting shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

2.10.3 Electrofusion Fittings: Electrofusion Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99 and be the same base resin as the pipe. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055

2.10.4 Flanged and Mechanical Joint Adapters: Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99 and be the same base resin as the pipe. Flanged and mechanical joint adapters shall have a manufacturing standard of ASTM D3216. All adapters shall be pressure rated to provide a working pressure rating no less than that of the pipe.

2.10.5 Mechanical Restraint: Mechanical restraint for HDPE may be provided by mechanical means separate from the mechanical joint gasket-sealing gland. The restrainer shall provide wide, supportive contact around the full circumference of the pipe and be equal to the listed widths. Means of restraint shall be machined serrations on the inside surface of the restrainer equal to or greater than the listed serrations per inch and width. Loading of the restrainer shall be by ductile iron follower that provides even circumferential loading over the entire restrainer. Design shall be such that restraint shall be increased with increases in line pressure.

2.10.5.1 Serrated restrainer shall be ductile iron ASTM A536-80 with a ductile iron follower; bolts and nuts shall be corrosive resistant, high strength alloy steel.

2.10.5.2 The restrainer shall have a pressure rating of, or equal to that of the pipe on which it is used or 150 psi which ever is lesser. Restrainers shall be JCM Industries, Sur-Grip or pre-approved equal.

Nominal Size	Restraint Width	Serrations per Inch
4”, 6”	1-1/2”	8
8”, 10” & 12”	1-3/4”	8

2.10.5.3 Pipe stiffeners shall be used in conjunction with restrainers. The pipe stiffeners shall be designed to support the interior wall of the HDPE. The stiffeners shall support the pipe’s end and control -the ‘necking down” reaction to the pressure applied during normal installation. The pipe stiffeners shall be formed of 304 or 316 stainless steel to the HDPE manufacturers published average inside diameter of the specific size and DR of the HDPE. Stiffeners shall be by JCM Industries or pre-approved equal.

2.10.6 Manholes - Manholes for deicing runoff collection system waste lines shall be constructed in accordance with the details shown on the plans and in accordance with the requirements of paragraph 2.3.13 Manholes, Catch Basins, Inlets and Inspection Holes.

2.11 POTABLE WATER SUPPLY - All proposed connections to or extensions of the Airport Potable Water Systems (PWS) shall be described by plans, specifications and contract requirements, including details of connections at the user side of the meter and the actual connections to the Airport main.

2.11.1 General - Material and construction for potable water main additions or extensions shall be accomplished in accordance with the "Standard Specifications for Public Works Construction", North Central Texas Council of Governments, latest edition (hereafter referred to as the "NCTCOG Specs") unless otherwise revised or altered by requirements of this Manual.

2.11.2 Water Flow Tests - Tests must be conducted to verify residual pressures and water flow in coordination with DFW Energy & Utilities Services.

2.11.3 Plans and Specifications - Plans and specifications for all facilities requiring potable water service shall contain complete contract requirements for the furnishing and installation of a metered water service including the actual connection to the Board's distribution system. Dual water services, connected to separate isolable sections of the PWS, shall be provided where water usage requirements are such that forty-eight (48) hour maintenance or emergency repair interruptions cannot be tolerated or required for fire protection.

2.11.4 Emergency Water Supply - All buildings shall have an emergency water supply connection for supplying potable water to the facility whenever the domestic water service line is drained for repairs.

2.11.5 Service Lines - All service lines shall be adequately sized to provide a minimum of twenty (20) psig residual pressure at a 1200 gpm flow rate. Normal main static pressures may be verified with DFW Energy & Utilities Services.

2.11.6 Pipe Casing Required - All pressurized pipe shall be installed within casings under roadways, taxiways and runways. Casing pipe shall be RCCP or PVC (Schedule 80 or AWWA C900). Steel casing pipe can be used except that steel has to be cathodically protected. Corrugated steel pipe shall not be used as casing pipe.

2.11.7 Separation of Water Lines from Wastewater Lines - Water line shall be spaced and separated from wastewater lines by nine (9) feet as required by TCEQ regulations. If this separation is unattainable, the replacement of the existing main must be considered on the basis of age, the existence of non-pressure joints and the overall condition of the main.

2.11.8 Friction Loss in Mains - Mains are to be sized to ensure less than one (1) foot of head loss per thousand (1,000) feet of main, at a Hazen Williams coefficient of C=110.

2.11.9 Bends - All bends shall be restrained both horizontally and vertically by the placement of concrete thrust blocks and meta-lug restraint joint.

2.11.10 Longitudinal Deflection - Longitudinal deflection at each pipe joint shall not exceed one degree in any direction.

2.11.11 Pipe Material - Potable water lines shall conform to the following material requirements:

1. Polyvinyl Chloride (PVC) Pressure Pipe one (1) to three (3) inches in diameter shall conform to ASTM D 1785, or type (K) copper.
2. Polyvinyl Chloride (PVC) Pressure Pipe greater than four (4) inches and up to twelve (12) inches in diameter shall conform to AWWA C900 Class 200, DR 14. Pipe shall be furnished in ductile iron equivalents.
3. Polyvinyl Chloride (PVC Pressure Pipe greater than or equal to fourteen (14) inches and up to twenty-four (24) inches in diameter shall conform to AWWA C905, Class 235, DR 18 for and shall be furnished in cast iron equivalents.
4. Ductile Iron Pipe (DIP) shall be Class 51 DIP conforming to AWWA C150, AWWA C151 and having a cement mortar lining conforming to AWWA C104.
5. Fittings for PVC and DIP pipe shall conform to C-153 Class 350 compact ductile iron.
6. Cast Iron Pipe and Fittings, utilized in PVC pipe installations shall be cathodically protected in accordance with the Chapter 11 – Corrosion Control.

2.11.12 Water Meters - Water meters shall be sized in accordance with good design practice for the service intended. Meters specified shall be compatible with electronic data collection equipment to enable on-site electronic collection of meter readings. Water usage shall be recorded on both a visual odometer and in an electronic memory.

1. Meters up to two (2) inches in size shall be multi-jet type with magnetic drive and sealed registers. These water meters shall meet or exceed the requirements of AWWA C708 for Cold Water Meters - Multi-jet Type.
2. Meters greater than two (2) inches shall be turbine type. These water meters shall meet or exceed the requirements of AWWA Class II Turbines standard.
3. Registers for all meters shall read in straight U.S. Gallons.
4. Water meters shall be Badger.
5. Meters shall be constructed of compatible metals throughout to prevent any corrosive reaction between component metals.

2.11.12.1 Positive Displacement Meters With Electronics

Pit or Vault Application:

5/8" x ¾ M-25 Badger Meter with RTR and Pit Electronics with 3' lead (Specify wire length if more than 3' needed)

1" M-70 Badger Meter with RTR and Pit Electronics with 3' lead (Specify wire length if more than 3' needed)

1-1/2" M-120 Badger Meter with Test Plug and RTR and Pit Electronics with 3' lead (Specify wire length if more than 3' needed)

2" M-170 Badger Meter with Test Plug and RTR and Pit Electronics with 3' lead (Specify wire length if more than 3' needed)

Mechanical room or Interior Room Application

5/8" x ¾ M-25 Badger Meter with RTR and Outdoor Remote NOT PREWIRED (Specify lead wire length if more than 25' needed)

1" M-70 Badger Meter with RTR and Outdoor Remote NOT PREWIRED (Specify lead wire length if more than 25' needed)

1-1/2" M-120 Badger Meter with Test Plug RTR and Outdoor Remote NOT PREWIRED (Specify lead wire length if more than 25' needed)

2" M-170 Badger Meter with Test Plug RTR and Outdoor Remote NOT PREWIRED (Specify lead wire length if more than 25' needed)

2.11.12.2 Turbine Meters With Electronics

Pit or Vault Application

1-1/2" T160 Badger Turbo Meter with Strainer RTR and Pit Electronics (Specify lead wire length if more than 3' needed)

2" T200 Badger Turbo Meter with Strainer RTR and Pit Electronics (Specify lead wire length if more than 3' needed)

3" T450 Badger Turbo Meter with Strainer RTR and Pit Electronics (Specify lead wire length if more than 3' needed)

4" T1000 Badger Turbo Meter with Strainer RTR and Pit Electronics (Specify lead wire length if more than 3' needed)

6" T2000 Badger Turbo Meter with Strainer RTR and Pit Electronics (Specify lead wire length if more than 3' needed)

8" T3500 Badger Turbo Meter with Strainer RTR and Pit Electronics (Specify lead wire length if more than 3' needed)

10" T5500 Badger Turbo Meter with Strainer RTR and Pit Electronics (Specify lead wire length if more than 3' needed)

12" T6200 Badger Turbo Meter with Strainer RTR and Pit Electronics (Specify lead wire length if more than 3' needed)

16" T6600 Badger Turbo Meter with Strainer RTR and Pit Electronics (Specify lead wire length if more than 3' needed)

Mechanical Room or Interior Application

1-1/2" T160 Badger Turbo Meter with Strainer RTR and Outdoor Remote NOT PREWIRED (Specify lead wire length if more than 25' needed)

2.11.13 Meter Boxes - Meter boxes or vaults shall be specified for each meter. Meter locations shall be identified on the plans and shall be outside the facility served and at a location that is at all times accessible to utility personnel and service equipment. Construction details shall be shown on the plans including the details of all internal piping. Piping details shall include a minimum requirement of two (2) isolating valves, the meter, and any necessary additional fittings required to remove or service the water meter without closing valves at any location other than at the meter box. All installations requiring three (3) inch or larger meters shall be provided with a bypass line with gate valve and arranged such that the bypass can provide unmetered service to the facility during periods of time when the meter is being serviced or replaced. All meter boxes or vaults containing three (3) inch or larger meters shall be free draining or be provided with a sump pump which discharges into the nearest storm drain. All drainage design for meter vaults shall be coordinated and approved by DFW Energy & Utilities Services. Meter boxes and vaults shall have cast iron or steel deck plate covers as required to provide adequate service access to the meter location. Where the weight of the cover or cover sections exceed twenty-five (25) pounds, the meters shall be provided with sensor extension cable for mounting the sensor on the side of the box or vault which shall be easily readable through a small access door in the cover.

2.11.14 Backflow Preventors - Where the service line provides potable water for a domestic service and also connects with other closed or chemically treated systems that could foreseeably contaminate the potable water line, a backflow preventor shall be installed. Drains off the backflow preventor assembly shall be drained to the sanitary sewer. Taps to mains, to provide water for fire protection or other closed pipe systems, shall have a double check valve assembly at the fireline tap. An alternate method of backflow prevention consisting of a twelve (12) inch air gap between an unrestricted overflow of an atmospheric makeup tank and the source of water is also acceptable. All double check and reduced pressure backflow preventers must be certified for operation after installation by a TCEQ certified tester.

2.11.15 Reduced Pressure Backflow Preventors – All pressure reducing backflow preventors that are installed to protect high-hazard services from backflowing must be tested annually from the date they are installed and certified. Examples of high-hazard services are:

1. Aspirators
2. Autoclaves
3. Sterilizers
4. Lab bench equipment
5. Sewage pumps
6. Sewage ejectors
7. Fire fighting systems (with toxic liquid foam concentrates)
8. Connections to sewer pipe
9. Irrigation systems with chemical additives
10. Trap primers

2.11.16 Wall or Floor Penetrations - In meter vaults or mechanical rooms where a potable water or fire line penetrates wall or slab install "Link-Seals" to prevent moisture infiltration.

2.11.17 Tapping Water Mains - Where services require the tapping of any existing reinforced concrete cylinder water distribution main, the Designer shall specify that the Contractor employ a qualified specialty contractor to perform this service. Tapping of all water mains shall be done in accordance with AWWA standards and coordinated with DFW Energy and Utilities Services. The tap shall be performed only at the horizontal tangent of the main in conjunction with either a tapping gate valve with a dielectric insulating gasketed flange or a corporation stop. Gate valves shall be in accordance with Section 2.10 .4.8 Purging and Sterilization of Water Mains. Standards and corporation stops shall be Mueller H-15000 or approved equal.

2.11.17.1 Tapping sleeves with tapping valves shall be used whenever possible for connections to existing mains in order to avoid water service interruptions. Size on size taps are allowed up to

twelve (12) inches, e.q. 12" x 12", 8" x 8", etc. Sizes less than one standard pipe size taps are the largest allowed on 16 inch and larger connections, e.q. 16" x 12", 16" x 8", 16" x 6".

2.11.17.2 Type “D” connections for mains that are designed to cross each other shall be utilized.

2.11.17.3 A new valve shall be installed at the point of connection for water main extensions to facilitate testing and chlorination of the new main prior to its placement into service.

2.11.18 Exposed Pipe - All ferrous piping exposed in meter vaults or boxes shall be equipped at both entrances and exits to the vault or boxes with a dielectric insulating coupling. All ferrous piping exposed in meter vaults or boxes shall be coated with Mobilzine 7 or approved equal with a dry film thickness of two (2) to three (3) mils., applied to clean dry surfaces and as recommended by the manufacturer of the paint. Link seals shall be specified for all penetrations in meter vaults.

2.11.19 Temporary Water Service (Backflow Preventer) - All temporary construction water services shall be provided with a line sized backflow preventer double check valve assembly. Services shall not be initiated until backflow prevention devices have been approved by the Building Official.

2.11.20 Purging and Sterilization of Water Mains - Before any newly constructed water main will be permitted to be placed into service in the potable water supply, it shall be flushed or purged, sterilized and tested to assure compliance with TCEQ standards.

2.11.20.1 Water pipe disinfection shall be in accordance with the following:

2.11.20.2 Flushing - Provisions shall be made to flush the pipe with potable water until all dirt, sludge, and debris are removed. If flushing is unsuccessful, the pipe must be purged.

2.11.20.3 Purging - Purging shall be accomplished by passing an appropriate sized "Polly-Pig(s)" through the pipe.

2.11.20.4 The design shall make provisions for preparing the pipe for the installation and removal of "Polly-Pig(s)" as required.

2.11.20.5 Sterilization - Sterilization of the main shall be accomplished by injecting calcium hypochlrite into one end of the line until water released from the other end indicates a chlorine residual of fifty (50) PPM. All valves shall then be closed and the solution shall be allowed to disinfect the pipe for at least twenty-four (24) hours. Provisions shall be made for disposing all chlorinated water into the sanitary sewer system directly after the completion of the sterilization process.

2.11.20.6 Disinfection and sterilization shall be performed in accordance with AWWA C601, latest edition.

2.11.21 Valves and Hydrants - This section covers the materials and installation of all valves and hydrants of various types, and their appurtenances.

2.11.21.1 Gate Valves: Gate valves shall be non-rising stem, solid-wedge gates with cast iron body and bronze mountings. Unless otherwise specified, valves three (3) to twelve (12) inches in size with working pressures of 200 psi or less shall be in strict accordance with American Water Works Association Standard Specification for "Gate Valves for Ordinary Water Works Service," designation C509, latest revision. Gate valves with resilient seated gates in accordance with AWWA C509, latest edition, are preferred.

2.11.21.1.1 Flanges for valves shall be drilled to match connecting flanges. All flanges shall conform to the standard specification of the American National Standards Institute. Flanges shall be Class 125 for all pipe, fittings, and valves three (3) to twelve (12) inches in diameter with a working pressure of 200 psi or less and flange bolts shall be coated for corrosion control.

2.11.21.1.2 Buried valves shall be mechanical joint, or push-on rubber gasket joint bell for pipe

spigots, unless otherwise specified.

2.11.21.1.3 All gate valves shall be non-rising stem unless otherwise indicated, and shall turn counterclockwise to open. Valves shall be provided with a handwheel operator unless otherwise designated. Valves or corporation stops for buried service shall be provided with two (2) inch square nut operator and shall be installed with extension stems where required to extend operating nut to within twelve (12) inches of the finished grade.

2.11.21.2 Valve Stacks and Vaults - Valves or corporation stops buried in the ground shall be provided with cast iron valve stacks of proper dimensions to fit over the valve bonnets, and to extend to the finished ground line in paved areas or slightly above finished grade in other areas. Tops shall be complete with covers and shall be adjustable. Valve stacks shall be set vertical and concentric with the valve stem. A concrete pad shall be poured around all valve stacks when not in paved areas. Valves sixteen (16) inches and larger shall be installed in a vault.

2.11.21.3 Blocking Under Valves - All gate valves twelve (12) inches and larger which are buried shall rest on a concrete pad. Pad shall extend for the full width of the trench to the back of the bell (or flange). Concrete shall be 2000 psi for blocking valves.

2.11.21.4 Bronze Gate Valves - Gate valves two (2) inches and smaller shall be all bronze, non-rising stem, with wedge disc and screwed ends. Unless otherwise indicated, they shall be for 300 psi working pressure, Crane No. 437 or equal.

2.11.21.5 Outlet Valves - Blind flanges or plugs, as applicable, shall be furnished and installed on all valves located at outlet points or terminal points where the water main does not continue. Deadend main structures shall be avoided whenever possible. If unavoidable, deadend mains shall be designed to accommodate periodic flushing. The following two (2) design alternatives shall be considered:

1. Locate a fire hydrant less than fifty (50) feet from the main's end;
2. Install a flush point at the main's end.

2.11.21.6 Air Release Valves - Manual air release valves shall be located on each side of main line valves and at other applicable locations and shall be comprised of a main line corporation stop, Mueller H-15025, brass service fittings as required, a curb stop, Mueller H-15275 and soft copper pipe with flared fittings. A nylon isolation bushing shall be installed between the main and corporation stop. Automatic air release (and vacuum release) valves shall be installed at high points on mains.

2.11.21.7 Surface Boxes - Surface box for manual air release where required shall be cast iron box and lid, twelve (12) inches deep and twelve (12) inches in diameter Trinity Valley Iron and Steel No. 4465 or approved equal. Raised letters on the cover shall read "WATER".

2.11.21.8 Fire Hydrants - Fire hydrants shall be 5-¼ inch Waterous "Pacer" or approved equal. hydrants shall be a break away traffic model with six (6) inch mechanical joint shoe to be buried at five (5) feet except where different depth is shown in the hydrant schedule.

1. Subsurface hydrants are not allowed for use on the airport except when approved by the Bureau of Fire Prevention. Subsurface (or flush-mount) fire hydrants shall be Mueller Dresser flush type models or approved equal with box and cover.
2. Hydrants shall have one four (4) inch pumper nozzle and two 2-½ inch hose nozzles with National Standard Threading. All hydrants will be fitted with (supplied and installed by the contractor) a four (4) inch "Quick Coupler Adapter" as manufactured by Hydra-Storz, part number Hyst-4040ST-CAP. Operation shall be by National Standard Pentagon nut, 1-½ inch flat to point, open to left, by not more than eight (8) or nine (9) full turns of the operating nut. Hydrants shall meet the requirements of AWWA C502.
3. Blocking and Drainage - Concrete blocking shall be poured behind hydrants against undisturbed earth. Washed gravel shall be placed appropriately around the shoe of the hydrant to effectively drain the hydrant barrel.

4. Quantity and Spacing Adequate fire hydrants shall be provided for each structure such that any point on the perimeter of the structure can be reached by a hose laid outside the structure of a length not to exceed three-hundred (300) feet. The maximum spacing for fire hydrants along roadways is two hundred and fifty (250) feet.
5. Isolation for Maintenance - All fire hydrants shall be isolated from the main waterline and from other water services by installation of a gate valve between the main waterline and the fire hydrant in order to facilitate repair of the fire hydrant without having to shut off the main waterline.
6. Fire Hydrant Service Lines - Service lines shall be adequately sized to provide a minimum fire flow and duration in accordance with the Fire Code and in areas where no buildings are located shall be capable of sustaining 2500 GPM with a twenty (20) psig residual pressure.
7. Cathodic Protection - All fire hydrants shall be cathodically protected.

2.11.21.9 Thrust Blocks - Concrete with a minimum strength of two thousand (2,000) pounds per square inch in twenty-eight (28) days shall be placed for blocking at each change in direction of the pipe line, in such manner as will substantially brace the pipe against undisturbed trench walls. All fittings shall be wrapped in poly prior to thrust block placement to allow future removal of concrete without damage to fittings. Concrete blocking shall have been in place four (4) days prior to testing the pipe line. Thrust blocks shall be used at:

1. Changes in direction, as at tees and bends.
2. Changes in size, as at reducers.
3. Changes in elevation, as at tees and bends (concrete block anchors preferred).
4. Stops, as at a dead end.
5. Valves, where thrusts may be expected.

2.11.21.9.1 At all points where wet connections are made to existing lines, the tapping connection fittings shall be supported by blocking up to the spring line with two thousand (2,000) psi concrete.

2.12 LANDSCAPE IRRIGATION SYSTEM

2.12.1 General - Installation of automatic watering systems is required for the entire area along International Parkway, the infield areas and the Terminal Green Belts. Outlying areas such as the secondary service roads in support areas, perimeter planting areas, and airfield grass areas do not require sprinkler systems. However, truck watering of trees in these areas will be necessary for the first two (2) years after initial planting.

2.12.2 Sleeving - It is important that all irrigation related sleeving be installed for newly-developed areas so that sprinkler systems can be incorporated without the disruption of transportation systems. It is required that PVC (polyvinyl chloride) piping be used in general planting areas.

2.12.3 Approved Manufacturers - All irrigation materials and equipment are to be manufactured by “Rainbird” or approved equivalent. This provides common equipment throughout the Airport, allowing maintenance personnel to make necessary repairs while maintaining a quality system. All pipe and fittings shall be schedule 40 PVC.

2.12.4 Irrigation Controllers - All irrigation controllers shall be “Rainbird” stainless steel cabinet models, such as the ESP-SAT-TW-SS controllers or an approved equivalent. All irrigation satellite controllers must be connected to a Cluster Control Unit (CCU) by a two-wire path (Maxicable or PE-39 “telephone type” wire). All new sites must have a CCU with stainless steel cabinet with two-wire path to each satellite controller. Each CCU must have a Maxicom compatible freeze sensor and rain sensor.

2.12.5 Freeze Sensors - Freeze sensors shall be Hunter Industries “Freeze-Clik” or approved equivalent (temperature set point at 3°C +/- 2°C (37°F), 24 VAC 6 amp rating, closed above 3°C and open below 3°C). Freeze sensor shall be mounted at a height and location that is out of direct sunlight and where free outdoor air circulation is possible. Each freeze sensor must be attached by a two-wire path (of no lighter gauge than 20 AWG) to a Rainbird M51300 Sensor Decoder. Sensor decoders must be housed in the base of a stainless steel controller cabinet (within an existing satellite controller

cabinet, a CCU cabinet, or a separately installed cabinet). The sensor decoder shall be also connected to the Maxicom two-wire path.

2.12.6 Rain Sensors - Rain sensors shall be Rainbird Rain Counter model number S-300 or approved equivalent (tipping bucket / magnetic reed switch style; rainfall per tip: 0.01”). Each rain sensor must be attached by a two-wire path (of no lighter gauge than 20 AWG) to a Rainbird M51200 Pulse Decoder. Pulse decoders must be housed in the base of a stainless steel controller cabinet (within an existing satellite controller cabinet, a CCU cabinet, or a separately installed cabinet). The pulse decoder shall be also connected to the Maxicom two-wire path.

2.12.7 Wiring - Wiring shall be 12 gauge-UF irrigation wire using 3M brand “DBY” or “DBR” connectors.

2.12.8 Maintenance Equipment - Maintenance equipment shall consist of Rainbird manufactured equipment. “Rainbird Maxicom” type or approved equivalent shall be used for computer-controlled systems.

2.12.9 Gate Valves - All gate valves of four (4) inch or three (3) inch size shall be Mueller or equivalent with standard cube head on stem. Valve stack shall be standard cast iron or equivalent with appropriate cast iron lid. Electric remote control valves shall be “Rainbird” GB-Series valves or an approved equivalent. All electric valves shall be enclosed in a standard 10-inch valve box.

2.12.10 Large Grass Areas - The large open grass areas along International Parkway shall be irrigated with rotor type heads distributing water from forty (40) to ninety (90) feet in diameter, depending on the available pressure. Sprinklers of substantial construction, such as “Rainbird” 900 or 950 Eagle or Falcon heads or approved equivalent, shall be used to withstand the abuse normally associated with heavy maintenance equipment. These rotor heads shall be on KBI Schedule 80 swing joints or equivalent.

2.12.11 Small Grass Areas - Small grassed areas, which occur adjacent to roadway paving, shall be sprinkled with smaller diameter pop-up heads so that close control can be maintained on wind blown mist. All pop-up spray heads shall be “Rainbird” 1800 Series, or approved equivalent, with appropriate nozzles and nozzle screens.

2.12.12 Groundcover Irrigation – Groundcover areas along International Parkway and in the fields shall be irrigated according to the size of the planting areas and obstructions within these areas. The groundcover underplanting for the Tree Crepe Myrtles will require “Rainbird” 1812 Series with appropriate spacing and proper nozzles, to provide adequate coverage. Large open plantings of groundcover shall incorporate rotor type heads such as “Rainbird” 5000 Series rotors, model 5004, or approved equivalent with proper nozzles for proper coverage.

2.12.13 Quick Coupler Valves - Flush lawn quick coupler valves, “Rainbird” 33D or approved equivalent, shall be provided in all landscape planted areas. They shall be located so that all trees and planting areas can be reached by a one hundred (100) foot length of hose.

2.12.14 Irrigation piping shall not be installed on top of roadway slopes or along retaining wall toes, unless cut-off valves are positioned at lower levels and away from structure.

2.12.15 Deflection - Longitudinal deflection at each pipe joint shall not exceed one degree in any direction.

2.12.16 Pipe Bedding: After trench has been cut to a depth below the barrel of the pipe a distance of three inches, the bedding shall be brought to a point slightly above grade with compacted sand. Bell holes shall be formed, if required, a trough scooped out to grade and the pipe laid and jointed as specified. The sand shall then be brought up in uniform layers of either side of the pipe and over the pipe to a point level with the top of the pipe. Density shall be at least 90 percent of maximum density as determined by ASTM D 698. Moisture content shall be within minus 2 to plus 4 of optimum.

2.12.17 Temporary Irrigation - Temporary irrigation systems used to establish the growth of turf in airfield areas require special considerations. Approval by the Operations Department is necessary prior to final design.

2.13 NATURAL GAS AND LP GAS - Plans for proposed buildings or additions to facilities requiring natural gas service shall be submitted to the local gas company for review of demand requirements and available service limits.

2.13.1 Any necessary main extensions or alterations shall be installed in accordance with the recommendations of the local natural gas company, other applicable sections of this Design Criteria Manual and the appropriate plumbing code requirements.

2.13.2 Proposed buildings or additions to facilities requiring gas service to be provided by on-site LP gas storage, connection and distribution shall be designed and installed in accordance with the requirements of the "LP Gas Safety Rules and Regulations" of the Texas Railroad Commission, Austin, Texas, NFPA 58 and the Fire Code. Use of LP gas may occur only after specific approval of Airport Contact.

2.14 FUELING SYSTEMS

2.14.1 Design of the Fuel System shall meet or exceed the Airport Fire Code..

2.15 LICENSE AGREEMENTS - All proposed additions or extensions to existing Airport mains, natural gas mains, telephone, FAA, or electric ducts, conduits or direct bury cables shall be installed within existing licensed areas, where possible. If existing licensed areas are not adequate, additional licenses will be required.

2.15.1 Minimum licensed area for one (1) utility when licensed area is adjacent to existing licensed area is five (5) feet. Minimum licensed area for one utility when licensed area is not adjacent to existing licensed area is fifteen (15) feet. Minimum licensed area for one (1) utility and drainage pipeline is twenty (20) feet.

2.15.2 Sharing of existing and proposed licensed areas is encouraged. Minimum licensed area widths for more than one facility will be determined by the utilities involved.

2.15.3 The Lessee shall be responsible for furnishing a land survey describing any requested or required License Agreement.

2.16 SPECIAL AIRFIELD DESIGN STANDARDS

2.16.1 General Information - This section covers all applicable facilities within the Air Operations Area (AOA) that shall be planned, designed and constructed in accordance with current Federal Aviation Administration (FAA) standards and criteria. These consist of Federal Aviation Regulations (FAR's) and Advisory Circulars (AC's) current editions. Copies may be obtained from the FAA Southwest Regional Office and U.S. Department of Transportation.

2.16.2 In some cases, the AC's offer the Designer a range of criteria, in which case this Design Criteria Manual will establish minimum standards to be used at the airport. If there are design criteria decisions to be made which are not covered in the respective AC or this Manual, the project Designer will make recommendations to the Airport Contact on a case-by-case basis.

2.16.3 Critical Design Aircraft – The Critical Design Aircraft (CDA) shall be identified for each project, however the standard is Airplane Design Group VI (ADG) per AC 150/5300-13. Changes from this standard may be made pertaining to any of the following elements:

1. Runway Length - The CDA will be furnished by the Airport Contact.
2. Width, Clearances and Separations of Runways, Taxiways and Parking Aprons - The CDA, or its associated Airplane Design Group per AC 150/5300-13, will be recommended by the

Designer based on traffic forecasts furnished by the Airport Contact or Tenant Airline.

3. Pavement Design - The CDA will be furnished by the Airport Contact.

2.16.4 Review by the Director of Operations of all AOA ADG standards shall be accomplished prior to final design.

2.16.5 Geometrics – All airfield geometry shall conform to the current Airport Layout Plan (ALP). Detailed geometry not included or referenced on the ALP shall conform to the requirements in AC 150/5300-13 and other relevant AC's. All filets for "Cockpit-over Centerline steering will be designed in accordance with AC 150/5300-13.

2.16.6 Line of Sight: All runways and runway safety areas shall conform to the line-of-sight criteria of AC 150/5300-13. Taxiways under the control of the Air Traffic Control (ATC) Towers shall be in full view of the tower cab full length and width. An ATC Tower Line-of-Sight (Shadow) Study shall be prepared to determine the line-of-sight acceptability. Ramp control towers may require line-of-sight studies for aircraft parking areas and taxilane intersections.

2.16.6.1 - Line-of-sight considerations may also be required when facilities are planned and designed near, or in the vicinity of, FAA NAVAIDS. Prior to commencement of airfield construction, a "DFW Airport Board Airspace Review Application" shall be completed with appropriate information and exhibits required by the FAA on which FAA can conduct an Aeronautical Study of the proposal – (reference AC 70/7460-2 and FAR Part 77). Non-AOA projects will require an Airspace Form for staging areas, batch plants, construction cranes and other related items. Construction activities (temporary stationary objects) shall be reviewed through the Airports Local Airspace Review Program administered by the Board.

2.16.6.2 No construction activity shall commence until the Airspace Study is completed and comments have been incorporated into the project plans and specifications.

2.16.7 Gradients and Slopes – All paved and turfed areas on the airfield AOA shall conform to the requirements of AC 150/5300-13, and as supplemented by the following criteria:

2.16.7.1 Side slopes on excavation (cut) and embankment (fill) areas outside of runway and taxiway safety areas shall have a slope no steeper than four (4) horizontal to one (1) vertical.

2.16.7.2 All topography and above ground objects, except those required by function for navigation, shall be clear of the imaginary surfaces of FAR Part 77 and shaped or designed to avoid line-of-sight problems and interferences with Airport navigational instruments and facilities. Objects that are within safety areas shall comply with FAR Part 139.

2.16.7.3 The standard crowns (transverse slope) on runways and taxiways shall be one percent, except where flatter grades are necessary due to intersection transitions, in which case they shall be a minimum of 0.5 percent.

2.16.7.4 All paved runway shoulders and taxiway shall be paved with a minimum of one percent to a maximum of five (5) percent surface gradient. The desirable slope is two (2) percent. The maximum slope shall not be used without approval of the Airport Contact. The edge of pavement to edge of shoulder conform joint shall be at the same elevation (no pavement lip).

2.16.7.5 Pavement gradients on aircraft parking aprons shall be 0.5 percent min., except where conforming or transitioning to existing facilities, and except for fifty (50) feet from Terminal buildings at the gate and parking positions which shall be one(1) percent to conform to NFPA Standard 415 on "Aircraft Fueling Ramp Drainage."

2.16.7.5.1 Gradients, slopes, and object clearing criteria for "Obstacle Free Zones", "Runway and Taxiway Safety Areas," and "Runway Protection Zones" shall conform to the standards of AC 150/5300-13 for the respective critical aircraft or mix of aircraft.

2.16.8 Air Operations Area (AOA) Storm Drainage - Storm drainage design of the Airport in those areas referred to as the AOA shall be governed by AC 150/5320-5. Additional DFW storm drainage design criteria and requirements are located in Section 2.3.3 - Storm Drainage. In those instances where a conflict shall arise between the landside design and the AOA design, the more conservative criteria shall govern.

2.16.8.1 Hydrology - For drainage areas less than two hundred (200) acres the Rational Method is acceptable for determining the amounts of rainfall and runoff in the AOA to be used as a basis for drainage system designs. The Rainfall Intensity Curves presented in the Weather Bureau Technical Paper No. 40 shall be used. The storm interval as presented in AC 150/5320-5 shall be used.

2.16.8.2 Computation, Collection and Disposition of Runoff - For projects inside the AOA, the rational method shall be used in the determination of runoff for a drainage area of two hundred (200) acres or less. The Designer shall contact the Airport Contact for the method to be used in determining runoff from drainage areas larger than two hundred (200) acres. The coefficients that are utilized in the rational formula, as well as charts for surface flow time calculations, are presented in AC 150/5320-5. A topographical map shall be prepared of existing conditions, preferable with a two (2) foot contour intervals as well as a detailed plan showing proposed and ultimate layout of the runways, taxiways, aprons, and building areas with the finished contours drawn to an one (1) foot interval or less. With the addition of various basins, storm pipelines and drainage sketched upon the detailed plane, it will become a working drawing for drainage considerations at the site. Open channel calculations will be in accordance with the FAA Manual procedures utilizing various nomographic solutions presented in AC 150/5320-5. The conveyance analysis and design of culverts in the AOA, shall be in accordance with the Texas Department of Transportation Hydraulic Manual. Minor losses shall be calculated by methods presented in Section 2.3.3.9 – Design of Closed Storm Drainage System.

2.16.8.3 The Drainage System – Some of the considerations to be used in the design of the drainage system are: construction, pollution control (e.g. oils, greases, first flush pollutants, glycol, etc.), erosion controls, maintenance of the system, and provision for apron waste. The detention or retention of water on the AOA shall not be allowed. Drainage systems within the AOA shall be enclosed systems since open channels may create a hazard to ARFF response equipment and attract wildlife. In areas where apron waste, deicing fluids, lavatory truck spills, or fuel spills may be an issue, provisions shall be made in the storm drain systems design for the interception of environmental pollutants during both wet and dry weather. Contaminated runoff with pollutant concentrations greater than EPA's benchmarks shall be directed through appropriate pollution abatement equipment or retained for enhanced treatment. The system must ensure that a reasonably foreseeable spill of an environmental contaminant, during both wet and dry weather, is passively contained such that no contaminant is discharged to waters of the state.

2.16.9 Runway Exits

2.16.9.1 High Speed Exit Taxiway – Locations shall be as shown on the Airport Layout Plan. The geometric layout shall either match existing high speed exit taxiways on the Airport or conform to AC 150/5300-13. Larger-than-standard fillet radii shall be investigated where traffic "backturns" are anticipated.

2.16.9.2 Right Angle Connector Taxiway – Right angle intersections shall meet the requirements of cockpit-over-centerline steering and shall conform to the requirements of AC 150/5300-13.

2.16.10 Runway and High Speed Exit Taxiway Grooving – All runway and taxiway grooving shall conform to AC 150/5320-12C. Slurry from sawing must be vacuumed as part of the sawing operation and disposed of off the Airport property. Final cleanup shall include flushing by water.

2.16.11 Aprons – Where holding aprons are included in the project scope, the overall location and geometric layout will be furnished by the Airport Contact. Widths, clearances, fillet radii and other details not furnished shall conform to AC 150/5300-13, or as recommended by the Designer and approved by the Airport Contact.

2.16.11.1 Aircraft parking aprons shall be based on an "Apron Utilization Plan". Apron utilization criteria, including wingtip clearance, shall be approved by the Airport Contact and must be within the maneuvering limits of the Aircraft Characteristics Manual of the Critical Design Aircraft. Aircraft service pits shall be located to minimize impact on Portland Cement Concrete (PCC) pavement joint performance.

2.16.12 Pavement Design – Pavement design for all aircraft worth pavements shall be based on FAA methodology and requirements in AC 150/5320-6. Standard sections exist for the various aircraft pavements encountered at the Airport. Deviation from these standard sections required the submittal of a pavement report prepared by a qualified geotechnical and materials engineering firm and a pavement section design sealed by a professional engineer registered in the State of Texas and the approval of the Airport Contact. All emergency (ARFF) roads, tenant (tug) roads and other service roads shall conform to the design criteria in Section 2.4 - Roads.

2.16.12.1 Pavement Type - All airfield pavements shall be rigid Portland Cement Concrete (PCC) pavement, except blast protective pavement shoulders and blast pads. Blast protective pavement type shall be recommended by the Designer based on an occasional pass by the critical maintenance or Aircraft Rescue and Fire Fighting (ARFF) equipment.

2.16.12.2 Subgrade, Soils and Pavement Testing Investigation Program – Each project Designer shall prepare a recommended soils program for Airport Contact review and approval. A final soils report shall be submitted with the final construction documents.

2.16.12.3 Subgrade Treatment – All subgrades shall be lime-treated. The thickness of the treated subgrade and quantity of lime shall be specified in the soils report submitted by the Designer.

2.16.12.4 Underdrains – An underdrain/edge drain system is required on all pavement sections unless recommended otherwise by the Designer. If underdrains are not recommended, the Designer shall present the basis on which they are not recommended and submit to the Airport Contact for approval. System layout, elements, and design shall be designed based on soils investigation results, pavement function, and other relevant factors and parameters.

2.16.12.5 Subbase and Base Course – All full strength airfield pavements shall include a nine (9) inch Cement Treated Base course as a minimum.

2.16.12.6 Portland Cement Concrete Pavement (PCC) – PCC shall be designed based on 750 psi flexural strength at twenty-eight (28) days. All pavements shall be reinforced with steel. Keyways will not be allowed. Surface texture may be burlap drag, broom, or other approved micro-texture, except that all runways and high speed exits shall be grooved by sawing.

2.16.12.7 Asphalt Pavement – Asphalt pavement shall not be used except as blast protective pavement on shoulders and blast pads. Mix design proportions and criteria may be either FAA P-401 (AC 150/5370-10) or Texas Department of Transportation Specification No. 340 with approval. All joints between concrete and asphalt shall be sawed and sealed to retard moisture intrusion and vegetation growth.

2.16.13 Pavement Marking – Pavement marking of runways, taxiways, taxilanes and other paved areas within aircraft operations areas shall conform to AC 150/5340-1H and be approved by the Airport Contact and DFW Energy & Utilities Services.

2.16.14 Turfing – Composition and application of seed fertilizer and sod shall be coordinated with the Airport Contact. The placement of all turfing adjacent to paved shoulders and blast pavement shall be 1-1/2 inches below the pavement surface.

2.16.15 Site Preparation for NAVAIDS – Design criteria for NAVAID critical areas shall conform to AC 150/5300-13. FAA NAVAIDS access roads shall be a minimum of ten (10) feet wide. Airport facilities will be checked for compliance with FAA electromagnetic standards. See FAA Advisory Circular AC 70/7460-2.

2.16.16 Safety and Security During Construction – The Designer shall coordinate with DFW Energy & Utilities Services through the Project Manager, regarding all safety and security provisions of the project. Other considerations, depending on the project scope, include interim or temporary pavement marking and lighting, and required Special Provisions to fit the project. Provisions must be made for and included in all contract documents pertaining to safety during construction, construction sequencing, access to the site, Contractor's staging area, haul routes, barricades, fencing, traffic control, etc. AC 150/5370-2, FAA Southwest Regional Order 5200.5b, and DFW Rules and Regulations for Maintenance and Construction on the AOA contains the means by which construction may be accomplished within the AOA.

2.16.17 Construction Specifications – All airfield construction contract documents shall be prepared in accordance with AC 150/5370-10A. The non-technical (front end "boiler plate") portion (including Notice to Bidders, Instructions to Bidders, Proposal Forms, Bid Schedule Forms, Bond Forms, General and Special Provisions, etc.) of the contract documents shall be prepared based on guidance and direction from the Airport Development Department and as coordinated with the Airport Contact.

2.16.18 Aircraft Rescue and Fire Fighting (ARFF) Roads - This pavement section is typically seven (7) inches of continuously reinforced concrete pavement on nine (9) inches of lime treated subgrade.

2.16.18.1 Load Limits: The minimum vehicle load limit for Fire Apparatus Access Roads is 53,000 lbs. The minimum vehicle load limit for A.O.A. fire apparatus access roads is 113,000 pounds. All bridges and elevated roads shall conform to this requirement.

2.16.18.2 Turning Radius: The external turning radius (wall to wall) shall not be less than fifty-seven (57) feet. The internal radius shall be no less than thirty-five (35) feet. The turn at no time will be less than twenty-two (22) feet wide.

2.16.18.3 Grade: The maximum grade change of any portion of a fire apparatus access road shall not exceed ten (10) feet of rise per hundred (100) feet of run.

-- END OF DIVISION --