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PFLUGERVILLE
T E X A S

ENGINEERING DESIGN MANUAL & CONSTRUCTION STANDARDS

Prepared By:

City of Pflugerville Engineering Department

November 2014 Edition



ENGINEERING DESIGN MANUAL

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ENGINEERING DESIGN MANUAL

SECTION 1 – GENERAL PROVISIONS

DG1.0 COORDINATION

- A. The Commission, City Council, and City Engineer shall do their utmost to ensure that actions taken under these guidelines shall conform to the City's Comprehensive Master Plan as well as City standards, codes, and ordinances.
- B. The City has adopted various ordinances and master plans, which address various requirements not explicitly included in the Engineering Design Standards, including, but not limited to the following. The Engineer is responsible for understanding and complying with the City's current ordinances and master plans, including but not limited to:
 - a. Building Code
 - b. Water Master Plan
 - c. Wastewater Master Plan
 - d. Reclaimed Water Master Plan
 - e. Comprehensive Plan
 - f. Unified Development Code
 - g. Flood Damage Prevention
 - h. Parks & Open Space Master Plan - Trails Master Plan
 - i. Impact Fee
 - j. Master Transportation Plan
 - k. Zoning
 - l. Code of Ordinances
- C. The City may amend the Engineering Design Manual and Construction Standards. In order to ensure that the design engineer has the City's latest design standards, they are directed to the City's website to acquire the City's most current version. The website will include a Record of Revisions to identify any revisions to the Standards.
- D. In addition to Engineering Design Manual, all engineering design shall reference and incorporate, as necessary, all federal, state and other jurisdictional entity requirements.

DG1.1 DEFINITIONS

- A. For the purpose of these guidelines, the following terms and words are defined as indicated below:
 - 1. "Electric Utility lateral lines" mean those electric lines from which Electric Utility service lines emanate.
 - 2. "Electric Utility service lines" mean those electric lines that directly

provide service to a customer.

3. “Multi-family” means, for purposes of these guidelines, any development which proposes more than one living unit on one lot, excluding duplexes.

- B. The following terms used herein shall be defined in the same manner as they are defined in the City Unified Development Code:

1. “Capital Improvement Program” or “CIP”
2. “City”;
3. “City Engineer”;
4. “Commission”;
5. “Comprehensive Master Plan”;
6. “Conservation Area”; “Extraterritorial Jurisdiction” or “ETJ”;
7. “Legal Description”;
8. “Park” or “Park Area”;
9. “Parkland”;
10. “Pedestrian and Bicycle Facilities”;
11. “Person”;
12. “Plat”;
13. “Street”;
14. “Subdivider”;
15. “Subdivision”;
16. “Waterway”.
17. “Lot”;
18. “Setback”;
19. “Square foot dimensions – SF”;
20. “Use”
21. “Development”

DG1.2 PLANS AND SPECIFICATIONS

- A. The plans and specifications for subdivision and site development improvements, including, but not limited to, water and wastewater facilities and street and drainage improvements, shall be drawn by a licensed engineer on plan-profile sheets and shall either be accompanied by a separate specifications document for each set of plans or clearly reference and demonstrate in the plans that they are complying with the City of Pflugerville Construction Standards. All specifications shall be in accordance with the current City of Pflugerville Construction Standards and Subdivision Code or Site Development Code, as applicable, as approved by the City Engineer. City of Pflugerville Standard Details (in electronic format) are available on the City’s Development Services/Engineering Section webpage
- B. The plans and specifications shall be presented in a manner which provides for a timely and efficient review.

- C. During the review process, the City Engineer may grant a waiver from the requirements of these guidelines in specific cases where, owing to special conditions, a literal enforcement of the provisions of these guidelines would result in unnecessary hardship, the requirement does not appear to be reasonably applicable in the specific case, or compliance with the requirement would result in an undesirable situation; and in his/her opinion, such a waiver would not be contrary to the public interest or would not destroy the intent of the provisions of these guidelines. Waiver requests from the Engineering Design Manual and Construction Standards shall be in accordance with the following process:
1. Waiver requests shall be submitted in writing to the City Engineer for consideration prior to work being performed concerning the waiver.
 2. All waiver requests shall be submitted to the City Engineer in writing prior to the actual performance of the work. Said requests shall specify the guideline or criteria from which a waiver is requested, rationale and supportive technical data justifying the waiver request.
 3. The City Engineer shall render a decision to the waiver request in writing no later than 14 calendar days from receipt of the waiver request.
 4. The applicant may appeal in writing the decision of the City Engineer to the Director of Development Services within 7 calendar days of the City Engineer's decision. The written appeal must include the rationale for the appeal and an alternative with supportive technical data.
 5. The Director of Development Services shall render a decision to the waiver request in writing no later than 7 calendar days from receipt of the appeal request.
 6. The applicant may appeal in writing the decision of the Director of Development Services to the City Manager within 7 calendar days of the Director's decision. The written appeal must include the rationale for the appeal and an alternative with supportive technical data.
 7. The City Manager shall render a decision to the waiver request in writing no later than 16 calendar days from the receipt of the appeal request.
 8. The decision of the City Manager is final and concludes the appeal process.
- D. A grant of a waiver for material, design, or method of construction shall not affect or relieve the Design Engineer of the obligation and responsibility of such material, design, method of construction, or any additional information as deemed necessary by the City Engineer for intended purposes.

DG1.3

CONSTRUCTION PROCESS

- A. A project will not be authorized to start construction until the formal issuance of subdivision or site development permit. The contractor must schedule a pre-construction meeting with the Engineering Department prior to the commencement of construction.

A site/subdivision may request a Site Disturbance Permit prior to the

issuance of a subdivision or site development permit for early grading and clearing in accordance with the procedures outlined in subchapter 3 of the Unified Development Code.

- B. During construction of the project, if the contractor or design engineer desire to make formal changes to the approved subdivision or site plan, the design engineer of record must submit the proposed revisions to the Development Services Department for review and approval prior to the commencement of any revised work in accordance with the procedures outlined in subchapter 3 of the Unified Development Code.

DG1.4

FINAL ACCEPTANCE

- A. A project will not be considered for final acceptance by the City of Pflugerville until the following items are completed:
1. A final walkthrough is conducted and all subsequent punchlist items are satisfactorily completed. Final walkthroughs will not be conducted until all dry utilities are completed.
 2. One (1) set of electronic and two (2) sets of printed record drawings are submitted to the City of Pflugerville.
 - a. Electronic plan sets must be in the Adobe pdf format.
 - b. Printed plan sets shall consist of one (1) 22" x 34" full size construction plan set and one (1) 11" x 17" half size construction plan set.
 3. An Engineer's Concurrence Letter is submitted to the City of Pflugerville.
 4. A Two (2) Year Warranty Bond in the amount of 35% of all public infrastructure construction costs for the subdivision project is submitted to the City of Pflugerville. A One (1) Year Warranty Bond in the amount of 35% of all public construction costs for CIP projects are to be submitted to the City of Pflugerville.
 5. Acceptance letters from all other applicable entities (Travis County, Utility Districts, etc.) or letters indicating all outstanding items for acceptance have been completed if City of Pflugerville acceptance is a prerequisite.
 6. Copy of the contractor's final pay-application for all associated public infrastructure constructed.
 7. Public infrastructure Testing Reports.
 8. Prior to subdivision acceptance, the design engineer/developer shall submit to the City of Pflugerville documentation that the subdivision was inspected by TDLR or a registered accessibility specialist (RAS) and the subdivision is in compliance with the requirements of the Texas Architectural Barriers Act (TABAA).
- B. Requests for partial or conditional acceptance of projects will not be considered by the City of Pflugerville.

DG1.5

EFFECTIVE DATE

- A. The provisions herein adopted shall take effect October 14, 2014 (effectively immediately)

END OF SECTION

ENGINEERING DESIGN MANUAL

SECTION 2– STREETS

DG2.0 GENERAL

- A. Unless otherwise approved by the City Engineer, concrete curbs shall be provided on all streets and shall be constructed in accordance with current City of Pflugerville Construction Standards.
- B. All street signs and pavement markings shall be required at all intersections. Signs shall conform to current City sign standards and the standards set forth in the latest edition of the Texas Manual on Uniform Traffic Control Devices (TMUTCD) for Streets and Highways.
- C. The crowns for undivided roadways shall not exceed a 2 percent cross slope.
- D. The crown height and location may be varied if the City Engineer finds that pedestrian and vehicular safety will be enhanced by the variance and that the variance will not impede traffic progression.
- E. Any proposed pedestrian crossings without a stop condition must incorporate additional roadway notification signage in accordance with the latest addition of the Texas Manual on Uniform Traffic Control Devices for Streets and Highways.
- F. Standard City of Pflugerville details shall be used for all street construction. Where City of Pflugerville details do not apply or provide insufficient information, the City of Austin Transportation & Texas Department of Transportation details can be referenced.

DG2.1 PAVEMENT WIDTH

- A. Pavement widths shall be measured from face of curb to face of curb.
- B. Pavement width for different street classifications shall be in accordance with Table 2.1.
- C. Cul-de-sac's shall meet the following requirements:
 - 1. Except for Industrial Streets, cul-de-sac's must be constructed so that the closed end has a paved section of at least eighty (80) feet in diameter and a total street right-of-way of at least one-hundred (100) feet in diameter.
 - 2. For Industrial Streets, the cul-de-sac must be constructed so that the closed end has a paved section of at least one-hundred (100) feet in

diameter and a street right-of-way of at least one-hundred-fifty (150) feet in diameter.

3. Cul-de-sac radii must conform to Travis County ESD 2 design criteria.
4. For any local street proposing a centerline deflection of 90 degrees, an exterior bulb out or elbow of the street section must be provided in accordance with minimum cul- de- sac diameter as stated in this section.

Table 2.1 STREET DESIGN REQUIREMENTS

Classification	ROW	Travel Lanes	Pavement Width	Median Width	Curve Radius	Design Speed	Curb Return Radius	Maximum Grade
Major Arterials	120'	6	76'	16' min.	2,000	50	25	7%
Minor Arterials	100'	4	56'	16' min.	940	45	25	7%
Major Collectors	70'	4	48'	n/a	465	35	25	10%
Minor Collectors	60'	2	40'	n/a	465	35	25	10%
Local Streets	50'	2	30'	n/a	300	30	25	15%
Industrial Streets	80'	4	60'	n/a	2,000	35	40	8%
Typical Rural	70'	2	22'	n/a	300	30	25	10%
Rural Collector	100'	3	34'	n/a	465	35	40	10%

- D. The pavement shall be centered in the ROW. Additional ROW may be required to allow for a continual and consistent curb base behind the curb. However, where roadway construction proposed in existing ROW, the City Engineer may allow for the pavement to be off-set if the acquisition of future ROW will provide the necessary curb base.
- E. A roadway median for a Major or Minor Arterial Street shall have a typical cross-section width of sixteen (16) feet minimum. The exact widths and design shall be subject to approval by the City Engineer, who shall take into consideration safety, maintenance, effect on nearby property, and the existing median width of connecting streets.

DG2.2 VERTICAL DESIGN

- A. The maximum permitted street grade shall conform to Table 2.1.
- B. The minimum permitted grade for streets with curbs and gutters shall be one-half of one percent (0.5%).

- C. Changes in vertical gradient shall be by means of vertical curves. Maximum grade breaks of 0.8 percent or less may be used without a vertical curve.
- D. Grades approaching an intersection shall not exceed six percent (6%) for a distance of fifty (50) feet from the intersecting gutter line.
- E. Guardrails conforming to Texas Department of Transportation guidelines are required for all bridges and culverts.
- F. Stopping Sight Distance (SSD) must be provided for all Vertical curves. SSD is a function of design speed, perception-reaction time, and deceleration rate and shall be design in accordance with the guidelines in AASHTO's latest edition of A Policy on Geometric Design of Highways and Streets.
- G. The sight distance at all intersections shall meet or exceed the minimum for stopping and shall conform to the latest edition of the AASHTO design requirements.
- H. Super elevation of curves is not permitted.

DG2.3

HORIZONTAL DESIGN

- 1. Street characteristics including right of way and pavement width must conform to Table 2.1.
- 2. Street intersections shall intersect at ninety degree (90^0) angles. Intersection approaches for Arterials and Collectors shall remain perpendicular for a minimum distance equal to the corresponding design speed Stopping Sight Distance (SSD).
- 3. When the classification of the roadway changes as it crosses an intersecting street, the design of both the approaches shall maintain the characteristic of the higher classification.
- 4. The through lane(s) on one approach shall align with the receiving lane(s) on the other side of the intersection. If pre-existing physical encroachments make an offset necessary, a through lane can be offset no more than three feet (3') and must incorporate the required striping and signage per the TMUTCD.

A. Median, Left-Turn Lane

- 1. Median openings may be constructed to serve non-residential drives provided that any opening meet the minimum spacing requirements per the City of Pflugerville Unified Development Code.
- 2. Left-turn lanes are required within the median for each opening. The design of median openings and left-turn lanes shall be incorporated to provide for driver safety.

3. All single left-turn lanes constructed on a divided roadway of ultimate cross section width shall be a minimum of eleven feet (11') wide. Where double left-turn lanes are provided, each left-turn lane shall be a minimum of ten feet (10') wide.
4. Minimum storage requirements are listed in Table 2.2. Storage requirements may be increased based upon actual and projected traffic demands as reported in a Traffic Impact Analysis.
5. Concrete pavers, stamped concrete or any other type paver as approved by the City Engineer is required at the median opening.

Table 2.2: Minimum Left-Turn Lane Design Requirements

Roadway Type (On)	Roadway Type (At)	Turn Lane Width(s) (ft) ⁽¹⁾	Length of Full- Width Storage (ft)	Taper Specifications		
				Length (ft)	R ₁ (ft)	R ₂ (ft)
A,B	A,B	11	150	100	505	505
C,D,F	A,B,C,D,F	11	100	50	250	250
A, B,C,D,F	Non- Residential Driveway	11	100	50	250	250
TxDOT Road	A,B,C,D,E,F and Non- Residential Driveway	See TxDOT's Roadway Design Guide Specifications ⁽²⁾				
SH 45/130 Frontage Road	A,B,C,D,E,F and Non- Residential Driveway	Apply TxDOT Specifications to SH 130				

A= Major
Arterial
B= Minor
Arterial
C= Major Collector
D= Minor Collector
E= Local Roadway

1. Double left-turn lanes-10 ft lanes permitted for dual lefts
2. Turn lane designs shall meet TxDOT Access Management requirements

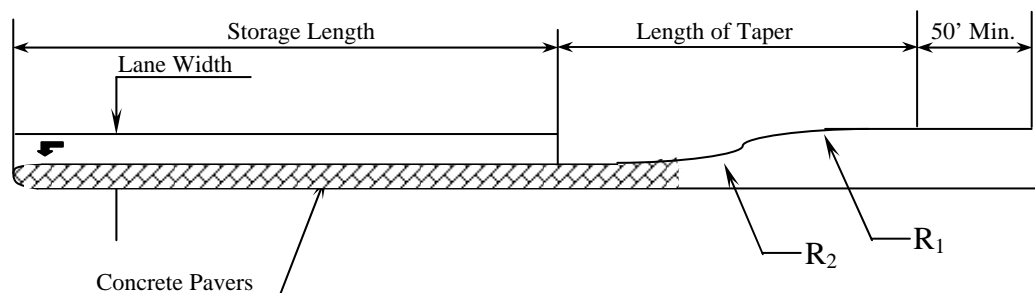


FIGURE 2.1: Typical Left Turn Lane Dimensions

6. Median openings shall accommodate all turning paths and crosswalks. Turning paths shall be designed in accordance with a WB-50 vehicle.

7. The length of a median opening shall not be less than sixty feet (60').
8. Minimum median opening and driveway separation distances shall conform to the requirements as stated in the City of Pflugerville Unified Development Code.

B. Right Turn Lane, Deceleration Lane

1. All right-turn and deceleration lane storage areas shall be at least eleven feet (11') wide.
2. Any proposed right turn lane or deceleration lane may require the dedication of additional right of way at the intersection.
3. Right-turn lane and deceleration lane Pavement Markings must be in accordance with the latest edition of the TMUTCD.
4. Minimum storage requirements shall be determined based on Table 2.2 or a submitted Traffic Impact Analysis design.
5. A minimum tangent section of thirty feet (30') shall be provided between the preceding driveway or cross street curb return and the taper of a deceleration lane.

DG2.4 PAVEMENT DESIGN

- A. Refer to the City of Austin Transportation Criteria Manual for pavement design procedures.
- B. A soil evaluation report by a registered professional engineer shall be required. The soil evaluation report shall be submitted in connection with the plans and specifications for street improvements. All soil evaluation reports shall include an analysis of sulfate levels in the soil. A pavement design which includes lime stabilization shall be included in the Geotechnical Report. An Eades Grim (lime series) test is required for all geotechnical reports recommending lime stabilization.
- C. Existing soil reports for an area may be utilized given the existing report is less than 10 years old from the formal submission date of the new roadway.
- D. The base and lime sections shall be extended 3-feet behind the back of curb for all street sections.
- E. Lime stabilization shall be used unless a qualified Geotechnical Report indicates that sulfate levels in the soil prevent otherwise. Table 2.3 shall be used for determination of the use lime stabilization:

Table 2.3 LIME STABILIZATION REQUIREMENTS		
Risk of	Range of Soil	Recommended Action

Adverse Effects	Sulfate (ppm)	
Minimal Risk	<3,000	Follow good mix design and construction practices. If soluble sulfates are detected, lime slurry should be used in lieu of dry lime. Adequate water (optimum for compaction plus at least 3%) should be used for mixing.
Moderate Risk	3,000-5,000	Follow good mix design and construction practices explicitly. Mixing water should be at least 3% to 5% above optimum for compaction. Lime slurry should be used in lieu of dry quicklime or hydrated lime.
Moderate to High Risk	5,000-8,000	Follow same guidelines as recommended for soils of moderate risk. Before treating, laboratory tests shall be performed to determine swell potential.
High to Unacceptable Risk	>8,000	Not recommended for lime stabilization

- F. Lime may be placed dry or in slurry form. Application shall be as outlined in Items 260 and 263 of TxDOT's Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, latest edition. The application of lime shall be such that the following criteria are achieved:
1. Subgrade shall have a pH of 12.4 or higher prior to compaction.
 2. The compressive strength of the subgrade shall be 150 psi or higher.
 3. The subgrade shall have less than 1% swell.
- G. At a minimum, all streets shall be paved with :
1. A minimum of eight (8) inches of flexible base compacted to one-hundred (100%) percent maximum density in accordance with Test 99 of the American Association of State Highway and Transportation Officials, latest revision, or as recommended by the soil evaluation report, and two (2) inches of compacted hot mix asphaltic concrete (HMAC) in accordance with City of Pflugerville and Texas Department of Transportation specifications.
 2. Type D HMAC is required for use on all local roadways and minor arterials.
- H. Prime coat is required, and shall comply with City of Pflugerville and Texas Department of Transportation specifications.

DG2.5

PUBLIC RIGHT-OF-WAY VISIBILITY REQUIREMENTS

- A. Adequate sight distance at the intersection of a thoroughfare and a proposed thoroughfare, driveway, or alley must be provided. This sight distance is provided through the use of Corner Visibility Triangles and/or Sight Line

Triangles. All intersection visibility requirements shall meet the guidelines for Intersection Sight Distance in AASHTO's latest edition of "A Policy on Geometric Design of Highways and Streets".

1. No fence, wall, screen, sign, structure, foliage, hedge, tree, bush, shrub, berm, driveways, parking, drive aisles, or any other item either man-made or natural shall be erected, planted, or maintained in a position that will obstruct or interfere with a driver's clear line of sight within a corner visibility triangle or a sight line triangle.
2. The City has the right to prune or remove any vegetation within City right-of-way, including within the corner visibility triangle, and within sight line triangle easements, to abate a safety hazard and/or a nuisance.

END OF SECTION

ENGINEERING DESIGN MANUAL

SECTION 3– SIDEWALKS, PEDESTRIAN AND BICYCLE FACILITIES

DG3.0

GENERAL

- A. Sidewalks shall be required along the curb line of both sides of every street. Curb ramps for wheelchair and pedestrian access shall be required at each intersection of a sidewalk and a street where a vehicle stop situation is delineated.
- B. Construction plans which include pedestrian facilities shall be submitted to the Texas Department of Licensing and Regulation (TDLR) and receive TDLR approval/certification prior to construction, if applicable. Construction of pedestrian facilities shall conform to current City of Pflugerville Construction Standards, Texas Accessibility Standard Regulations and the American with Disabilities Act Standards.
- C. Residential lots and lots that are adjacent to Local Streets and Minor Collectors shall have sidewalks at least four (4) feet in width and accommodate a five (5) feet by five (5) feet turnaround every 250-linear feet. Residential driveways are suitable locations for a turnaround provided the driveway slope meets ADA design requirements. Commercial lots and lots that are adjacent to Major and Minor Arterial Streets, Major Collectors, and Industrial Streets shall have sidewalks at least six (6) feet in width.
- D. Sidewalks shall conform to the following standards:
 - 1. Be located parallel to the curb line and not exceed 2% cross slope;
 - 2. Have a continuing, common, non-slip surface that is not interrupted by steps or abrupt changes in level; and
 - 3. Have a gradual adjustment in level when approaching an intersecting street or parking area with a common level at the point of such intersection.
 - 4. Be doveled into existing curbing, as applicable.
- E. All slopes within the right-of-way must be 3H:1V or greater.
- F. Pedestrian and bicycle facilities shall be constructed in conformance with current City Standard Details, have barriers to prevent motor vehicle access, and have pavement markings in conformance with the current edition of the Manual on Uniform Traffic Control Devices for Streets and Highways.
- G. Pedestrian handrails conforming to the latest edition of the Texas Department of Transportation standards are required wherever the grade adjacent to a

sidewalk or pedestrian and bicycle facility exceeds 4H:1V with a vertical drop greater than one (1) foot.

- H. A solar flashing light, see Standard Details SD-46 and SD-46A, shall be installed on each side of the roadway where a proposed hike and bike trail crosses either a major collector, arterial or industrial collector street.

END OF SECTION

ENGINEERING DESIGN MANUAL

SECTION 4– DRAINAGE

DG4.0

GENERAL

- A. The design of all storm drainage facilities shall be in accordance with these guidelines and the current City of Austin Drainage Criteria Manual (COA DCM). Where conflicts between these guidelines and the COA DCM occur, these guidelines shall govern.
- B. The Owner / Developer shall be responsible for complying with all Texas Pollutant Discharge Elimination System (TPDES) requirements, as well as securing any required permits.
- C. Drainage easements or right-of-way shall be dedicated to the public for all designated FEMA floodplain and for upstream drainage areas in excess of 64 acres of the project site. Easements and right-of-way shall include all drainage, open or enclosed, to the limits of the one-hundred (100) year floodplain as calculated under fully developed conditions in accordance with the COA DCM. Additional easements shall be required, as necessary, to provide continuous access for purposes of maintenance.
- D. Where possible, drainage shall be facilitated by means of paved sections or by use of swales to drain lots into a street without necessitating drainage easements being placed through a lot. The depth of a swale shall be that required for drainage with a minimum longitudinal slope toward a street or drainage easement of one-half of one (0.5%) percent
- E. Peak runoff rates shall not be increased at any point downstream for the two (2), twenty-five (25), and one-hundred (100) year storms. The regulation of peak runoff rates to allowable levels as determined by the provisions of this policy shall be achieved by storage on-site or off-site or by participation in the construction of a regional stormwater management facility.
- F. All drainage facilities shall be designed to minimize the potential for erosion at the outfall.
- G. Drainage facilities and their access ways may not be located across lot lines but must instead be located adjacent to lot lines.
- H. All earth structures shall be compacted to 95% minimum density. Earth slopes shall not exceed 3H:1V. The flowline of all earth structures shall include a pilot channel where a one (1) percent longitudinal slope is not achievable.
- I. All proposed drainage facilities must be designed so that runoff will not gather in pools and become stagnant or foul.

- J. Any drainage system design based upon aerial survey contours shall be verified with ground field data by a licensed surveyor.
- K. All drainage systems within public rights-of-way or public easements shall be constructed in accordance with these guidelines and the City of Pflugerville Construction Standards Manual.

DG4.1

RUNOFF COMPUTATION

- A. Runoff computations must be prepared by a licensed engineer authorized by education and experience to perform such calculations.
- B. Runoff calculations are required with the preliminary plan to the extent needed to verify that the proposed easements are adequate to contain the runoff as required above.
- C. Runoff calculations shall be included with all subdivision and site development construction plans. All existing and proposed hydrologic conditions including but not limited to drainage areas, time of concentration, impervious cover coefficients, twenty-five (25) year and (100) year flow values and rainfall intensities shall be illustrated on the construction plans. Runoff calculations shall be included for pre-development conditions as well as post-development conditions for the two (2) year, twenty-five (25) year and (100) year storms. If runoff for post-development conditions exceeds runoff for pre-development conditions for any of the referenced storms, detention shall be required to reduce peak runoff flows to at or below peak runoff flows for pre-development conditions. If detention is required, runoff calculations for post-development conditions with detention shall be included as well as calculations for proposed detention facilities.
- D. For drainage areas less than 100 acres, the Rational Method may be used for runoff computations in accordance with the COA DCM. For areas larger than 100 acres, a hydrograph methodology using the Soil Conservation Service unit hydrograph shall be used. When the runoff from two or more drainage areas is to be combined, the same methodology must be used for both areas and the methodology should be appropriate for both. The design engineer may utilize the SCS method for areas under 100 acres if so desired.

DG4.2

STORMWATER CONVEYANCE

- A. Runoff computation for runoff conveyance shall be based on a fully developed drainage area or watershed.
- B. All concrete structures shall have a minimum flowline slope of 0.4%. Earth structures shall have a minimum flowline slope of one (1%) percent.
- C. All drainage facilities including street curbs, gutters, inlets and ponds shall be

designed to intercept and transport runoff from the one-hundred (100) year frequency storm. Storm sewers and inlets on grade may be designed to intercept and convey runoff from the twenty-five (25) year storm provided that the runoff from the one-hundred (100) year storm does not exceed the gutter capacity.

- D. All public storm sewer systems and channels are required to be profiled in the construction plans. All profiles must illustrate the twenty-five (25) year and one-hundred (100) year hydraulic grade lines.
- E. Proposed hydraulic calculations including but not limited to the peak flow rate, depth of flow, hydraulic grade lines, critical depth and velocity values for the twenty-five (25) year and one-hundred (100) year storm events shall be provided in the construction plans.

DG4.3

STREETS

- A. Where storm sewers are required, inlets shall be located to intercept runoff where the depth of runoff will exceed the top of curb. A minimum curb inlet length of 10-feet is required for inlets located with the City right of way.
- B. Gutter and inlet capacity will be calculated in accordance with the COA DCM. Inlets shall have a throat height of five (5) inches and shall be designed so as to conform to City Construction Standards.
- C. No lowering of the standard street crown height shall be allowed for the purpose of obtaining additional hydraulic capacity. Similarly, curb heights may not be raised to increase the hydraulic capacity of a street.
- D. Each curb inlet must incorporate the required transition per city standard detail on the upstream and downstream ends. No driveway shall be located within the curb inlet transitions. Waivers to this requirement due to construction or other conflicts must be submitted and approved by the City Engineer.

DG4.4

STORMSEWER

- A. Pipe for storm drains shall be Class III reinforced concrete pipe (RCP) and shall have a minimum cover of 18". For cover (less than 18"), or for excessive height of backfill, pipe for storm drains shall be Class IV or Class V RCP. All storm drain located within a pavement section shall be placed below any proposed base and lime stabilization. In no case shall a storm sewer have less than one (1) foot of cover over the top of the pipe.
- B. Pipe for storm drains shall be constructed to the bank of the receiving drainway and shall have a minimum cover of eighteen (18) inches over the top of the pipe. Energy dissipation is required at all storm sewer outlets connecting to an earthen drainage way.

- C. Storm sewer in right-of-way shall be located 5' from the street centerline to the center of the pipe on the opposite side of the street from the alignment of the wastewater line. An alternate location within the right of way may be submitted to and approved by the City Engineer.
- D. Pipes shall be joined such that the soffits of the pipes are at the same elevation.
- E. Manholes (inlets or junction boxes) shall be provided at all confluences greater than 45 degrees, at the junction of three or more lines, at a junction where the downstream pipe size changes. Due to equipment restraints, every point within the storm drain must be a maximum of 250 feet from an access point for drains 30 inches in diameter or smaller. For storm drains greater than 30 inches in diameter, manholes shall be placed so that there is a maximum distance of 300 feet to an access point. Design of manholes shall conform to the current City Construction Standards. Storm inlets may be considered access points for a storm drain system.
- F. Maximum velocity in the storm drain trunk line is 20 feet/second (ft/s). There is no maximum velocity for storm drain laterals.
- G. Proposed vertical drop manholes shall not exceed 3-feet in elevation difference.

DG4.5

CHANNELS

- A. Any proposed earthen channel must have a minimum of 3H:1V side slopes. Channels with a longitudinal slope of less than one (1) percent must incorporate a concrete pilot channel in the design of the channel.
- B. Wherever possible, outfalls from storm sewers into natural drainage ways shall enter at the grade of the natural drainage channel. The outfall shall be designed to provide adequate protection against erosion with application of concrete or mortared rock rip rap, erosion blankets and tow walls.
- C. Major structures such as box culverts and bridges shall be designed to carry a one-hundred (100) year frequency storm.
- D. Maximum permitted velocity in a grass lined channel shall be 6 feet/second (ft/s). Velocities in excess of 6 ft/s must be mitigated by energy dissipation.

DG4.6

CULVERTS AND BRIDGES

- A. Construction plans for box culverts, bridges and related structures may be adaptations of the Texas Department of Transportation (TxDOT) Standards.
- B. For culverts and bridges conveying runoff in excess of 1,200 cfs, the predicted water surface elevation shall be one (1) foot lower than the low

chord or the structure.

- C. Culverts and pond outlet structures shall incorporate a minimum 2-foot tow wall below finished grade at the upstream and downstream portions of the structure.

DG4.7

FLOODPLAINS

- A. For areas of flow with less than 64 acres of contributing area, no floodplain shall be defined; however, with regards to the drainage requirements contained in these guidelines, a concentrated flow discharge may necessitate the dedication of a drainage easement. When considering the capacity of any facilities, the downstream conditions must be considered.
- B. In all cases where a floodplain determination is required, the determination shall be based on the projected full development of all properties contributing to the point of consideration. It is the responsibility of the design engineer to coordinate with the City of Pflugerville in order to determine, based on the most accurate information available, what the fully-developed drainage area is.
- C. Floodplain limits shall be determined by a backwater analysis. The direct-step method of calculating water surface profiles is required. The HEC-2 and HEC-RAS computer programs may be used for calculating the water surface profile.
- D. For natural waterways of less than 64 acres, a backwater analysis is required when downstream structures will impede the flow of runoff, or where irregularities in the shape of the channel create significant energy losses.
- E. When a project to modify a natural channel is proposed, the design engineer should check and adhere to any requirements of Section 404 of the Clean Water Act. If required, a permit should be obtained from the U.S. Army Corps of Engineers by the design engineer.
- F. Any design within or modification of a designated FEMA floodplain must be in accordance with criteria stated in the City of Pflugerville Floodplain Ordinance.

DG4.8.A

STORMWATER CONTROLS

- A. All development is responsible for controlling its storm water runoff by ensuring that no increase in peak runoff will occur and there is no negative impact to upstream or downstream properties. All detention ponds shall control the increase in runoff for the two (2) year, twenty-five (25) year and one- hundred (100) year storms. In addition, all ponds must convey runoff from the one- hundred (100) year, assuming fully-developed upstream conditions.

- B. All earthen ponds are required to have a minimum 4-foot embankment top width.
- C. The design engineer or developer must provide an approved Texas Commission on Environmental Quality (TCEQ) Texas Water Rights permit for any proposed onsite wet-pond or modification of an existing agricultural stock tank intended to provide detention that is to be dedicated to the City of Pflugerville. If a Texas Water Permit is not warranted for the improvement, the design engineer must submit official correspondence from TCEQ explaining a Texas Water Permit is not required.

DG4.8.B METHODOLOGY

Where detention ponds are utilized for stormwater management, a hydrograph routing methodology is required to analyze the adequacy of the proposed structure. The Soil Conservation Service (SCS) unit hydrograph shall be used. The times of concentration or lag times used in the analysis shall be calculated using the methodology of TR-55 or the Uplands Method described in NEH-4. The runoff curve numbers used shall be calculated based on the actual soil class in the analysis area and the actual proposed and probable impervious cover. The City of Austin 24-hour rainfall distributions shall be utilized for precipitation. The HEC-1, HEC HMS, PondPak, or TR-20 computer programs are accepted programs for utilizing the SCS hydrographs.

DG4.8.C DESIGN CONSIDERATIONS

- A. The minimum freeboard and embankment requirements shall be those outlined in the COA DCM.
- B. Ponds which serve public facilities or which are to be maintained by public entities must meet the maintenance requirements outlined in the latest version of the COA DCM and in Section 4.8.D of these guidelines.
- C. All detention facilities shall be designed to allow complete drainage within 24 hours.

DG4.8.D ADDITIONAL MAINTENANCE REQUIREMENTS

- A. All existing and proposed drainage facilities within or utilized by a development must meet the following requirements for access and maintenance:
 - i. Any barrier-type fences must be in accordance with the City of Pflugerville Unified Development Code. A barrier type fence is required on structures with a slope steeper than 3H:1V side slopes.
 - ii. A 10-foot maintenance access path is required around the perimeter of public

detention ponds and on one side of proposed channels. Any access strip entering a public pond shall not have a grade steeper than 15%, be constructed of concrete, and shall be designed to the horizontal geometric standards of a local street.

- iii. A standard driveway approach with gate is required for any drainage access way connecting to a public roadway.

END OF SECTION

ENGINEERING DESIGN MANUAL

SECTION 5– WATER

DG5.0

GENERAL

- A. The subdivider shall provide all water lines required to properly serve each non-drainage lot of the subdivision and to ensure that existing and/or new water facilities can supply the required demand at the desired pressure for both domestic use and for fire protection. The subdivider shall bear all costs for extending water service from existing City water lines that have sufficient capacity to serve the subdivision. All water lines and service connections shall conform to the current City Construction Standards, Texas Commission on Environmental Quality Regulations, requirements of the Texas Department of Health and the fire insurance standards of the State Board of Insurance.
- B. The subdivider may have to upsize or extend proposed water lines in accordance with the City's overall Water Master Plan. The City may participate in the cost of upsizing any infrastructure necessary to serve adjacent area.
- C. Community impact fees, tap fees, and water meter deposits must be paid to the City of Pflugerville prior to the issuance of a building permit.
- D. The Owner / Developer shall be required to obtain approval from other utility companies prior to installing any new water facility improvements.
- E. Water connections shall be made readily available to proposed park sites with water lines located along the street frontage of the park. The subdivider must demonstrate that there is sufficient water line capacity available to serve the park.
- F. Public water mains must be constructed within public right-of-way or a public water easement. Easements for water mains shall be a minimum of 15 feet wide, or twice the depth of the main, measured from finished grade to pipe flow line, whichever is greater. Mains shall be centered on the easement. The City's or designated agent's right to use the water line easement property is exclusive, whereby the property owner shall not convey to others any right to use all or part of the easement property.
- G. All water line construction and installation shall conform to the City of Pflugerville technical specifications.
- H. Water line infrastructure may not cross lot lines unless a proper easement is designated or Unified Development Agreement is approved and recorded.

- I. Connection to the City water system per City of Pflugerville city ordinances 54-7-15-74 and 62-1-20-75:
 1. Each house or building within the limits of the city and the City of Pflugerville Water Certificate of Convenience and Necessity (CCN) shall be separately and independently connected only with the city water system and no other source of water where there is a city water main within 100-feet of any lot line on which such house or building is situated. An auxiliary building or buildings to the main house or building on any lot may receive water service from the same connection that services the main house or building on a lot.
 2. It is further provided that the sale, delivery, purchase, receipt or use of private well water, from or to any property served by the city water system, is prohibited and shall be deemed a violation. This shall not be construed as prohibiting the use of such private well water for non-household purposes by the property on which such well is situated.

DG5.1 GENERAL DESIGN REQUIREMENTS

- A. Piping for water mains and connections shall be in accordance with current City Construction Standards and Texas Commission on Environmental Quality Regulations (Texas Administrative Code Title 30, Part 1, Chapter 290). All pipe and fittings shall be new and shall conform to the current standards of the American Water Works Association.
- B. All water mains shall extend to the border of the proposed subdivision. A valve, plug and concrete block shall be provided on the end of each said main such that an extension of the main can be made without removing said main from service. All service lines shall be extended to lot lines.
- C. Public water lines shall be at least eight (8) inches in diameter.
- D. At the intersection of water distribution lines, the number of valves shall be the same as the number of radiating lines [three (3) valves for tee connections and four (4) for cross connections]. Valves shall be located at the Point of Curve (PC) or the Point of Tangency (PT) of the nearest property line. Valves shall be provided on all water mains so that not more than 500-feet of main must be removed from service at one time for repairs in commercial and industrial areas and not more than 800-feet in residential areas. At dead ends, gate valves shall be located one pipe length (minimum 10 feet) from the end points of the main. All valves shall conform to the current standards of the American Water Works Association.
- E. Blow-off valves shall be installed at the end of all dead-end water mains to facilitate flushing.
- F. If water lines twelve (12) inches in diameter or larger are required to be

installed, the plans shall show lines and grades in both plan and profile. Lines smaller than twelve (12) inches must be shown in plan view and detailed to clearly show the depth of bury under streets, drainage channels and culverts, other utilities, etc.

- G. For mains sixteen (16) inches in diameter or larger and on smaller mains where appropriate, hydrants or drain valves shall be placed at low points and on the up-slope side of all valve locations.
- H. For water mains sixteen (16) inches in diameter or larger and on smaller mains where appropriate, combination air valves will be placed at all high points and air/vacuum valves shall be placed at the down-slope side of all valve locations.
- I. Water lines shall have a minimum forty-eight 48 inches of cover measured from either the top of the pipe or valve actuating nut (whichever is applicable) to the finished ground surface. Water lines shall maintain a minimum eighteen (18) inches vertical separation from all other utilities. When eighteen (18) inches cover is not attainable, encasement of water line is required.
- J. Connections of new mains to existing mains shall be made with a full-body tapping sleeve. A tapping sleeve will not be allowed if the materials and conditions of the existing main preclude tapping.
- K. Water lines greater than twenty-four (24) inches in diameter shall be ductile iron type.
- H. All water lines shall have a minimum slope of 0.10%.
- I. Where water pressures are determined to be above 80 psi, service connections shall incorporate individual pressure reducing valves (PRV).
- J. To prevent contamination of the potable water system from stagnant water in dead end potable water service lines (e.g., private fire systems, private fire mains, sections for future use, etc.), the installation of an approved backflow prevention assembly is required on the private side of the City water meter. If the dead end potable water service line is unmetered, then an approved detector backflow prevention assembly is required at a point on the dead end potable water service line where no more than 100 gallons of water volume in the service line is reached. The 100 gallon threshold is determined by calculating the volume of water that would be contained in the service line as measured from the connection to the City's water main and the location of the approved backflow prevention assembly.
- K. Steel encasement is required for all proposed public water line bores within the City of Pflugerville right-of-way or public easement.

- L. One living unit equivalent (LUE) shall be assumed to be 700 gallons per day for average day demand, 1,855 gallons per day for peak day demand, and 3,150 gallons per day for peak hour demand. Once single-family dwelling shall be considered to require one (1) LUE. Other uses are assumed to have a demand as defined in the table below. However, where the demand is based on floor area, in no event will the demand be considered to be less than one (1) LUE.

Use	Demand
One (1) single-family residence, one modular home	1 LUE one mobile home
One (1) duplex	2 LUE's
Multi-family (traditional apts, condo, townhomes) 10 units/acre or greater	0.5 LUE's per unit
Hotel or motel	0.5 LUE's per room
Office	1 LUE/3,000 sf of floor
Office/warehouse	1 LUE/4,000 sf of floor
Retail/Shopping Center	1 LUE/1660 sf of floor
Restaurant/Cafeteria	1 LUE/200 sf of floor
Hospital	1 LUE per bed
Rest Home	1 LUE/1,250 sf of floor
Church (Worship Services Only)	1 LUE/12,500 sf of floor
High School or Middle School, including gym*	1 LUE /13 students and cafeteria
Elementary School, including gym and cafeteria*	1 LUE/15 students

*Per student values for schools shall reflect full occupancy, including portable structures.

DG5.2

FIRE PROTECTION

- A. All fire protection lines and devices shall be design in accordance with the requirements of Travis County Emergency Service District No. 2.
- B. Threading on fire hydrant outlets shall be the National Standard Hose Thread.
- C. Fire hydrants shall be installed at intersections of two (2) streets and between intersections where necessary at distances not in excess of six-hundred (600) feet between hydrants in residential areas and not more than three-hundred (300) feet in commercial and industrial areas. All fire hydrants shall be standard three-way, post-type, dry barrel hydrants, be in compliance with American Water Works Association Standards, have at least six (6) inch connections to mains, and have at least five and one quarter ($5\frac{1}{4}$) inch valve openings. All hydrant leads shall be 6 inch ductile iron pipe. Fire hydrants shall conform to the current City Construction Standards.
- D. For fire flow conditions, the maximum velocity shall not exceed 10 fps and the minimum static pressure shall not be less than 20 psi. For single-family

and duplex development, a minimum of 1,000 gpm is required. For development other than single-family and duplex development, the minimum flow rate shall be in accordance with the latest edition of the City of Pflugerville Fire Code and this section. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.

- E. A computer water system modeling analysis to verify the capacity of water service and illustrating minimum fire flow requirements as stated above must be submitted for review at time of subdivision construction plan submittal or site plan submittal as determined by the Travis County Emergency Service District No. 2 Fire Code Official. The water system modeling analysis must be approved prior subdivision construction plan or site plan approval and permit issuance.

END OF SECTION

ENGINEERING DESIGN MANUAL

SECTION 6– WASTEWATER

DG6.0

GENERAL

- A. Septic tanks shall only be permitted in accordance with the City of Pflugerville Unified Development Code.
- B. The subdivider shall provide all wastewater lines required to properly serve each non-drainage lot of the subdivision and to ensure that existing wastewater lines and facilities can adequately serve the subdivision. The subdivider shall bear all costs for extending existing City wastewater lines and wastewater facilities to have sufficient capacity to serve the subdivision. All wastewater lines and service connections shall conform to current City Construction Standards, Texas Commission on Environmental Quality Regulations and the requirements of the Texas Department of Health.
- C. The subdivider may have to upsize or extend proposed wastewater lines in accordance with the City's overall wastewater master plan. The City may participate in the cost of upsizing any infrastructure necessary to serve adjacent area.
- D. Community impact fees, tap fees, and water meter deposits must be paid to the City of Pflugerville prior to the issuance of a building permit.
- E. The Owner / Developer shall be responsible for obtaining approval from other utility companies prior to installing any new wastewater facility improvements.
- F. Wastewater connections shall be provided to proposed public park sites with lines located along the street frontage of the park. The subdivider must demonstrate that there is sufficient wastewater line capacity available to serve the park.
- G. Public wastewater lines must be constructed within public right-of-way or a public wastewater easement. Easements for wastewater lines shall be a minimum of 15 feet wide, or twice the depth of the line, measured from finished grade to pipe flow line, whichever is greater. Mains shall be centered on the easement. The City's or designated agent's right to use the wastewater easement property is exclusive, whereby the property owner shall not convey to others any right to use all or part of the easement property.
- H. All wastewater line construction and installation shall conform to the City of Pflugerville technical specifications.

GENERAL DESIGN REQUIREMENTS

- A. Piping for wastewater lines shall be polyvinyl chloride (PVC) SDR 26 with elastomeric joints and be at least eight (8) inches in diameter. The minimum house connection size shall be six (6) inches in diameter. All pipe and accessories shall be new. PVC pipe shall conform to American Society of Testing Materials, Standard D3034. PVC sewer pipe joints shall comply with American Society of Testing Materials, Standard D3212. All pipe shall be installed in accordance with current City Construction Standards.
- B. Manholes shall be constructed at all changes in direction, sewer line intersections and termination points of lines, but in no case shall the distance between manholes exceed four-hundred (400) feet. Curved wastewater mains are prohibited.
- C. All manholes shall be coated with 80 mil of Raven Lining System, Sewpercoat, ARC Concrete Coating System, or approved equal. The City Inspector shall inspect each manhole prior to application of coating system.
- D. Sewer manholes shall be a nominal four (4) feet in diameter and be made of precast concrete. Steps shall not be provided. All manholes shall have eccentric cones. Manhole lids shall be East Jordan Iron Works Product Number NCR02-1762 SAN SW with the City of Pflugerville Logo and the words "Sanitary Sewer" cast into the lid as shown in Detail WW-07. The outside diameter of the lid shall be thirty-two (32) inches. All manholes shall be installed in accordance with current City Construction Standards.
- E. All sewer mains shall meet a minimum velocity of two feet per second (2 fps), flowing full or one-half full based on Manning's formula and utilizing an "n" value of 0.013. The minimum grade for an 8" line shall be 0.33 percent. The maximum velocity during the peak wet weather flow condition is not to exceed ten feet per second (10 fps).
- F. The separation between wastewater mains and other utilities shall be in accordance with the Rules adopted by the Texas Commission on Environmental Quality.
- G. Pipe crown elevations of mains flowing into manholes shall be 0.1 feet above the crown of the out-flowing main.
- H. Wastewater lines shall have a minimum of 48 inches of cover below the actual subgrade.
- I. Any wastewater line eight (8) inches in diameter or larger shall show lines and grades in both plan and profile.

- J. Gravity sewer lines shall be designed so that peak dry weather flows (PDWF) do not exceed 50% of the pipe capacity and peak wet-weather flows (PWWF) do not exceed 75% of the pipe capacity.

- K. The PDWF shall be calculated by the formula:

$$\text{PDWF} = \frac{18 + (0.0206(F))^{0.5}}{4 + (0.0206(F))^{0.5}} \times F$$

where F = average dry-weather flow = 270 gal/day/LUE with total LUEs determined per Section 5.1 of these guidelines.

- L. The PWWF shall be determined as the sum of the PDWF and the inflow and Infiltration (I/I). The I/I shall be assumed to be 750 gpd/acre of the drainage area of the service area.

DG6.2

LIFT STATIONS

- A. Prior to design, three (3) copies of a detailed engineering report shall be submitted to the City of Pflugerville Engineering Department for review and approval of the lift station and all related line work. The engineering report shall include the following:
- Justification for the proposed lift station. The report must clearly show that gravity lines are not available and not economically feasible and that the number of lifts stations has been minimized. This justification must include a cost benefit analysis of gravity versus lift station project including 30 years of operation and maintenance of the proposed system.
 - A master development plan for the service area (including offsite upstream basins) shall be prepared. This plan shall include a map showing the location of the lift station, the service area, the boundaries of the drainage basin and the location of the nearest existing wastewater interceptor with that basin.
 - Engineering calculations and data described in Section 10 of the City of Pflugerville Engineering Design Manual shall be contained in the engineering report.
 - The engineering report shall be approved by the City of Pflugerville Engineering Department prior to beginning preparation of the plans and specifications.
- B. Prior to construction, complete sets of plans in accordance with the public improvements application shall be submitted to the City of Pflugerville for review and approval. These plans and specifications shall be prepared, sealed, signed and dated by a Registered Professional Engineer licensed to practice in Texas and shall be in compliance with the approved engineering report. The plans and specifications for the lift station shall also include all related line work and a comprehensive site plan including any required access road(s) and easement(s).

- C. All drawings and specifications for lift stations within the City of Pflugerville ETJ and within the Pflugerville CCN, submitted for review and approval, must demonstrate compliance with current City of Pflugerville design criteria and standard lift station specifications. Approval of the lift station plans and specifications does not imply the City of Pflugerville will accept the lift station for operation and maintenance.
- i. With the City wastewater CCN area the following lift stations may be submitted for review and approval:
 - a) Submersible or grinder pump facilities with rated horsepower no greater than 40 BHP for the largest pump.
 - b) For installation with a required rated horsepower greater than 40 BHP the City prefers wet/dry well type installation. However, submersible non-clog pump facilities with a rated horsepower of between 25 BHP and 40 BHP may be considered on a case by case basis. The design engineer must submit cost comparisons for submersible versus wet/dry well installations. The cost comparison should include initial station costs, pump replacement costs, installation costs and all operation and maintenance cost including energy costs over the life of the station. The comparison should assume a typical service life for submersible pumps.

END OF SECTION

ENGINEERING DESIGN MANUAL

SECTION 7– POLLUTION CONTROL

DG7.0

GENERAL

- A. The purpose of this section is to provide a resource document and policy to protect land and water resources from the adverse effects of erosion and sedimentation and to promote compliance with the City of Pflugerville's Municipal Separate Storm Sewer System (MS4) Phase II permit. Additionally, the criteria have been fashioned to complement the language of the Texas Pollution Discharge Elimination System (TPDES) General Permit (TXR150000).
- B. The conversion of land from its natural state or agricultural use to urban use can accelerate the processes of erosion and sedimentation. These accelerated processes can negatively impact natural resources such as drinking water supply, aquatic life, floodplain capacity, natural beauty, and recreational resources. As additional development and urban growth takes place in the City of Pflugerville, the City's natural resources will experience accelerated degradation if erosion and sedimentation is not properly controlled. The protection of these natural resources is easier and less expensive than their restoration.
- C. Construction activities that discharge storm water runoff into or adjacent to any surface water of the state are regulated by the State of Texas under the Construction General Permit (CGP) (TXR150000). The governing agency is the Texas Commission on Environmental Quality (TCEQ). Construction related sediment is a significant pollutant of streams, lakes, ponds and reservoirs. Sedimentation can also carry pesticides, phosphates and many other chemical pollutants which can be carried to the waterway and reduce the quality of water.
- D. Erosion can be quite destructive and can threaten property, roads, utilities, infrastructure, and structures. During most development/construction projects, the major period for erosion potential exists between the time of existing vegetation removal at commencement of site work and the time of construction completion or final revegetation. There are numerous activities associated with construction and land development that accelerate the rate of erosion. Virtually all of these activities involve the removal of vegetation and/or disturbance of the native geologic structure. Appropriate planning and implementation of these activities and preventative measures will reduce the adverse impact upon the site and the environment in general. Construction activities are regulated according to the area of land disturbed.

- E. The erosion and sediment best management practices (BMPs) included in Appendix A (BMP Technical Specifications) provide several methods to address the dual problems of erosion and sedimentation, they are in no way an exhaustive list of possible actions; and alternative site specific methods may be required to adequately control the problems. The City shall approve BMPs not included in the manual prior to their use.

DG7.1

EROSION AND SEDIMENT CONTROL POLICY

- A. The City of Pflugerville Erosion and Sedimentation Control policy shall govern the planning, design, installation, maintenance and inspection of temporary and permanent erosion and sedimentation controls associated with development/redevelopment/construction within the City in accordance with this section and Chapter 158, Storm Water Pollution Control Ordinance. This policy is the official criteria required by the TPDES MS4 Phase II permit, and such strives to comply with all federal and state mandates associated with the permit.
- B. Erosion and sediment BMPs are required for all construction, (conducted with or without a permit) and all other activities for which land clearing, trenching, or grading is a part. It is the intent of City of Pflugerville policy to closely parallel the requirements set forth in the Texas Pollution Discharge Elimination System (TPDES) Construction General Permit (TXR150000), the City of Pflugerville's MS4 Phase II Permit and any applicable updates to National Pollution Discharge Elimination System (NPDES) or TPDES.
- C. The policy objectives are to:
 - 1. Ensure Municipal Separate Storm Sewer System (MS4) Phase II Permit & TPDES Construction General Permit Compliance.
 - 2. Minimize the erosion and sedimentation of soil resulting from construction activities in streams, creeks, lakes, waterways, storm drains, etc.
 - 3. Protect and improve the quality of surface water, minimize flooding hazards and maintenance cost associated with excessive sedimentation and erosion in storm drains and waterways.
 - 4. Preserve and protect existing vegetation to the greatest extent possible, particularly native plant and wildlife habitats.
 - 5. Provide for revegetation of sites to minimize environmental impacts of construction activity.

DG7.2 TEMPORARY STABILIZATION CONTROLS

- A. Temporary controls shall be used during construction to prevent the erosion of soil and sedimentation of waterways until restoration is complete. Temporary controls shall be used in accordance with the City of Pflugerville Construction Standards.

DG7.3 FINAL STABILIZATION CONTROLS

- A. The subdivider shall restore all areas within public right-of-ways and public easements that have been disturbed as a result of construction activities. Such areas shall be returned to pre-disturbed conditions or better. New open areas or facilities within the public right-of-ways or public easements shall be covered with a minimum of four (4) inches of topsoil prior to the application of grass seed. Grass seed shall be applied in accordance with Figure 7.8, hereof.

Figure 7.8		
RESEEDING STANDARDS		
Time Of Year	Seed Type	Amount of Seed per 1,000 S.F.
October – February	Unhulled Bermuda or	1 lb.
	Winter Rye	3 lbs.
March – September	Hulled Bermuda	1 lb.

- B. Seedlings shall be watered until uniform growth is established. During the first two (2) months after application of the seed, the planted area shall be irrigated or sprinkled at ten (10) day intervals in a manner that will not erode the topsoil but at a rate sufficient to thoroughly soak the soil to a depth of six (6) inches. Rainfall occurrences of one-half ($\frac{1}{2}$) inch or greater shall postpone the watering schedule by ten (10) days.
- C. Restoration shall be considered to be acceptable when the grass has grown to a height of at least one-half ($\frac{1}{2}$) inch and covers ninety (90%) percent of the area with bare spots no greater than ten (10) square feet.
- D. The City Engineer may grant a variance for right-of-way or public easement restoration (regarding DG7.3.C) as related to the City's construction acceptance process provided equivalent permanent stabilization measures formally agreed upon by the subdivider/developer and the City are in place prior to the City final acceptance. Examples of such equivalent measures are as follows:

1. Installation of additional silt fence near areas which may be prone to

erosion as identified by City Engineer or designated staff. All additional silt fence will be maintained by the subdivider/developer and will put forth all possible efforts to restore that right of way. At the time of right of way restoration per specification DG7.3.C and final inspection by the City Engineering Department, the silt fence will be removed.

2. A geotextile soil retention blanket placement within affected areas as defined by City Engineer or designated staff.
3. Additional rock berms located near potential drainage erosion areas as defined by City Engineer or designated staff.

DG7.4

PLANS AND COMPUTATIONS

- A. Implementation of an effective erosion and sedimentation control plan requires a project management approach where responsibility is assigned during each phase to assure proper design, installation, maintenance, inspection, and when necessary, repair or replacement of controls during the construction. The project owner/developer, engineer and contractor are all integrally involved in this process from start to finish. In addition, an understanding by the responsible individuals of the complete process required to design and implement erosion and sedimentation controls will assist them in preparing appropriate plans, speed the review and approval process, result in fewer on-site changes and problems, and provide the appropriate degree of protection for the environment.
- B. The following section presents the minimum requirements for the planning, design, construction, operation and maintenance of erosion and sedimentation control facilities. A Design professional may select an appropriate BMP control method or combinations of methods or structures described in Appendix A, Technical Specifications and is responsible for both the adequacy and implementation of an effective erosion and sedimentation control plan (ESCP). Following the end of construction activities, the developer/owner, contractor and engineer are responsible for ensuring proper erosion and sedimentation control until all areas are stabilized.

DG7.4.1

SITE PLAN REVIEW

- A. To ensure that all applicable new development and redeveloped sites conform to the pollution control performance standards of this chapter, the developer/owner and engineer shall comply with the following as related to project review, approval, and enforcement procedures that include:
 1. Engineer/Owner/Developer shall submit revised site plan

- when changes are made to the ESCP for re-approval and
2. Engineer/Owner/Developer shall submit Record Drawings or 'as-built' certifications required for storm water controls within 90 days of completion of a project.
- B. Site plan reviews, as submitted by Engineer/Owner/Developer, shall comply with the procedures described in the Unified Development Code.
- C. Project applicant shall meet the performance standards and ensure long-term maintenance as required by Engineering Design Manual Erosion and Sedimentation Control.

DG7.4.2 EROSION AND SEDIMENTATION CONTROL PLAN

- A. All projects disturbing natural conditions are required to plan, design, and implement BMPs to minimize erosion and sedimentation to the greatest extent practicable. All activities requiring a permit shall submit an erosion and sedimentation control plan that identifies, addresses and minimizes to the City's Engineering Department satisfaction, all potential sources of sediment and other construction related pollution.
- B. Erosion and Sedimentation plan shall include:
1. A comprehensive plan addressing limits of disturbance, phasing, temporary and permanent erosion and sedimentation BMPs that comply with all applicable Federal, State and Local regulations.
 2. Construction standards to illustrate, review and construct the BMPs that minimize erosion and sedimentation to the maximum extent practicable; (and where appropriate, correlate with and outlined in the ESCP).
 3. The general direction of flow of storm water drainage entering and leaving the site. If the drainage patterns will be altered, both the existing and proposed drainage patterns shall be shown.
 4. A description of how run-on storm water will be handled, including sheet flow entering the site from adjoining property.
 5. A description and the location of any environmentally sensitive area that is located on the site or that adjoins the site and that will receive storm water directly from the site.

6. The location of any Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map 100-year floodplain boundaries, floodway boundaries, or FEMA Velocity Zone boundaries that encroach on the site. A preliminary boundary line may be used with a preliminary plat. The ESCP shall be amended prior to filing of a final plat, once a final boundary determination has been made.
7. A description and location of all temporary control measures that will be implemented during construction to control erosion, sedimentation, and the discharge of pollutants into the City's MS4.
8. Standards and schedules for maintenance and replacement for all temporary and permanent BMPs in the plans.
9. Standards for topsoil, vegetative materials and vegetation BMPs in the plans.
10. Computations for BMPs that rely on detention, sedimentation, filtration, diversion and velocity control.
11. A Licensed Professional Engineer shall sign, seal and date the erosion and sedimentation plan and engineering computations with competence in this area as required by Texas Engineering Practice Act, Section 137.

DG7.4.3 DESIGN REQUIREMENTS:

A. Storm Water Pollution Prevention Plan

1. One of the requirements of the TCEQ TPDES Construction General Permit (TXR150000), for any development, redevelopment and construction, is to develop and implement a Storm Water Pollution Prevention Plan (SWPPP). The purpose of the SWPPP is to provide guidelines for minimizing sediment and other pollutants that may originate on the site, from flowing into municipal storm systems, or jurisdictional waters during construction. The plan shall address the principal activities known to disturb significant amounts of ground surface during construction. A Notice of Intent (NOI) or Construction Site Notice (CSN) shall be submitted to the City's Engineering Department prior to the start of construction activity.

2. The storm water management controls included in the SWPPP shall focus on providing control of pollutant discharge practical approaches that use readily available techniques, expertise, materials, and equipment.
3. An ESCP is required for all development that disturbs one quarter (1/4) acre or more and shall meet the requirements in the Checklist for ESCP as noted in Appendix B.

B. Best Management Practices (BMPs)

1. It is the responsibility of the engineer to design BMPs that address site specific conditions using appropriate design criteria for the City of Pflugerville. The source of the design criteria shall be referenced in the ESCP.
2. To preserve the existing natural resources in the City of Pflugerville and promote sustainable development, demonstration of compliance with the Site Layout permanent BMP is required in the ESCP for all developments. Factors to be considered are lots oriented and designed to minimize change in grade, drainage systems designed to minimize change in time of concentration, and street layouts designed to minimize extent of pavement.
3. In addition to the Site Layout BMP, the following minimum number of BMPs shall be provided:

BMP Requirements		
Disturbance	No. of BMPs (minimum)	
	Temporary	Permanent
< ¼ acre Disturbed Area	2	None
¼ acre ≤ Disturbed Area < 1 acre	2	Varies
1 acre ≤ Disturbed Area < 20 acres	3	1 or 2
≥ 20 Acres	3	2

4. Examples of factors that shall be considered when evaluating and selecting permanent controls for a development include:
 - a. Effect of the development on runoff volumes and rates
 - b. Potential pollutants from the development
 - c. Percent of site treated by the BMP
 - d. Effectiveness of the BMP on potential pollutants from the development
 - e. Natural resources on the site

- f. Configuration of site (existing waterways, topography, etc.)

C. The following items are acceptable permanent BMPs for subdivisions:

1. Vegetated swales – Vegetated swales may be used if drainage design criteria are met and acceptable to the City Engineer. Vegetated swales shall be designed with a trapezoidal cross section and a gentle slope that yields a maximum velocity of 2 fps for the 2-year storm event. The engineer shall evaluate flow depths to verify no upstream flooding is caused by the vegetated swale during larger events. Design capacity of the swales is as specified in the Drainage Requirements as specified by the Engineering Design Manual.
2. Dedication of the 100-year drainage easement – Dedication of the 100-year fully urbanized floodplain as a public drainage easement with the creek left in its natural condition will be considered one BMP credit.
3. Landscaping – A landscape plan sealed by a landscape architect shall be submitted with the ESCP to receive BMP credit. Landscaping may be on individual and/or commonly owned lots and unpaved open space and shall include canopy-type trees at least 3 inches of caliper at time of planting. Refer to the Landscaping section in the Unified Development Code for an approved tree list. Ornamental subdivision entry-way plantings are not eligible. The landscape plan shall identify the party responsible for the installation of planting and maintenance until residence is purchased by an individual homeowner. A permanent or temporary irrigation system may be necessary to establish plantings.
4. Detention ponds – Detention may be achieved by surface ponds or subsurface structures. Detention ponds and structures shall be evaluated for the 2-, 25-, and 100-year storm events using post-development land use to verify that no structure flooding will be caused by the detention. Outfalls for detention ponds shall be designed to prevent clogging of the intake. The pond shall also be designed in accordance with other criteria in the City of Austin Drainage Criteria Manual.
5. Dedication of a private linear open space will count as one BMP credit.
6. Low Impact Development Methods – Allowed at the discretion of the City Engineer.
 - a. Low Impact Development (LID) Methods such as rain

- gardens, rain barrels,
- b. Cisterns on individual lots and/or bio-retention or bio-detention facilities on common areas which treat all post-construction areas. The vegetated LID features shall consist of native plantings or plantings consistent as recommended by a Licensed Landscape Architect

DG7.4.4 INSTALLATION, MAINTENANCE AND INSPECTION CONSTRUCTION PROCEDURES

- A. Proper installation, maintenance, and inspection of the approved control methods during the construction of a project are the final steps in assuring effective control of erosion and sedimentation. Implementation requires the combined efforts of the project engineer, contractor, owner, city inspectors, and, when needed, reviewers working together to achieve the best feasible control.
 - 1. The contractor shall install, inspect and maintain all BMPs according to the approved erosion and sedimentation control plan (and/or SWPPP as appropriate).
 - 2. The contractor shall report any identified problem areas to the design engineer for recommended additions or revisions to the erosion and sedimentation control plan.
 - 3. The design engineer shall modify the plan as needed to minimize erosion and sedimentation to the maximum extent practicable. Any revised plan requires City Engineer approval.
 - 4. The owner, contractor and design engineer are responsible for installing and maintaining BMPs in a manner that complies with all applicable Federal, State and Local regulations.
 - 5. At the City Engineer's request, Contractor's inspection reports for all BMPs shall be provided to the City.
 - 6. Upon establishment of vegetation to City Standards, the Contractor shall remove all temporary BMPs, after to City acceptance of Public Infrastructure.
- B. Construction BMPs
 - 1. Structural and non-structural BMPs may be used for controlling pollutants for storm water discharges from small and large sites. Structural BMPs shall comply with Appendix A specifications in the latest edition of the City of Pflugerville Engineering Design Manual and Construction Standards. If the most appropriate BMP is not shown in the City of Pflugerville standard details, the design engineer shall submit a detail, calculations and references for design of the BMP to the Department of Engineering for review and approval.

2. The following are acceptable temporary BMPs for use during construction:

a) Non-Structural

- i. Minimizing the area of disturbance – The area of disturbance as shown by the limits of construction shall utilize the most efficient space to minimize disturbance of existing area for a proposed development site.
- ii. Preserving existing vegetation – This is a preferred BMP. When areas of existing vegetation are to be preserved, the areas shall be delineated on the plans, and the plans shall include notes stating that temporary chain-link fencing shall be installed to protect the vegetation.

b) Structural Examples

- i. Silt Fence
- ii. Triangular Filter Dike
- iii. Inlet Protection Barriers
- iv. Storm Inlet Sediment Traps
- v. Rock Berms
- vi. Stabilized Construction Entrance
- vii. Sedimentation Traps
- viii. Vegetated Buffer Strips
- ix. Temporary Detention Structure
- x. Hydromulch Seeding
- xi. Diversion Dikes
- xii. Diversion Dikes and Swales

3. Technical Specifications for structural BMPs can be found in Appendix A. These are suggested construction BMPs and it is the responsibility of the design engineer to select and design appropriate construction BMPs for each site.

4. The Design Engineer shall include any relative City of Pflugerville standard detail EC-01 through EC-10.

5. Any onsite temporary staging area shall include silt fence immediately adjacent to the downstream boundary limits. Silt fence shall adhere to the City of Pflugerville standard detail EC-02.

6. Staging areas or temporary stock piles are not allowed within

designated FEMA flood zones and shall be located a minimum of 20-ft beyond any designated creek, waterway, or floodplain.

C. Waste and Hazardous Material Controls

1. Covered containers shall be provided for waste construction materials and daily trash. Hazardous material shall be stored in a manner that prevents contact with rainfall and runoff. Onsite fuel tanks and other containers of motor vehicle fluids shall comply with the latest applicable TCEQ requirements for storm water pollution controls during construction.
2. The SWPPP shall require federal, state and local reporting of any spills and releases of hazardous materials greater than the regulated Reportable Quantity (RQ) and reporting to the City of Pflugerville Engineering Department and Public Works Department of all spills and releases to the storm drainage system.
3. All trash enclosures must drain to sewer connections.

D. Temporary Stabilization

1. Portions of a site that have been disturbed, but where no work will occur for more than 21 days shall be temporarily stabilized as soon as practicable, and no later than 14 days, except when precluded by seasonal arid conditions, or prolonged drought. A written request to the City Engineer shall be submitted for approval of exceptions.
2. Temporary stabilization shall consist of providing a protective cover, designed to reduce erosion on disturbed areas. Temporary stabilization may be achieved using temporary seeding, soil retention blankets, hydro-mulches and other techniques that cover 100 percent of the disturbed areas until either final stabilization can be achieved or until further construction activities take place.
3. Perimeter controls such as silt fence, vegetated buffer strips or other similar perimeter controls are intended to act as controls when stabilization has not occurred. Perimeter controls may remain in place during temporary stabilization.

E. Final Stabilization

1. Final stabilization within the public right-of-ways (ROWs) shall conform to Section DG7.3 Stabilization on private property may consist of soil cover as vegetation, geo-textiles or mulch. For stabilizing vegetated drainage ways, sod or seeded soil retention blankets shall be used. Hydromulch will not be allowed in vegetated swales, channels or other drainage ways.

2. The plan for final stabilization shall be coordinated with permanent controls in the ESCP and with landscaping plan if applicable.

F. Notice of Intent (NOI) or Construction Site Notice (CSN)

1. If applicable, copies of the NOI/CSN shall be sent to the Engineering Department.

G. TCEQ Site Notice

1. A signed copy of the Construction Site Notice or NOI shall be posted at the construction site in a location where it is readily viewed by the general public during all construction activity.

H. Notice of Termination (NOT)

1. All primary operators shall submit a copy of the NOT to the City Engineer after construction has been accepted.

I. Inspection and Maintenance during Construction

1. The primary operator shall construct all controls required by the SWPPP. The primary operator shall have qualified personnel inspect the controls at least every two weeks during construction and within 24 hours after a storm event of 0.5 inches, or greater. At a minimum, inspection may be performed every 7 days with no additional inspection after rain events.
2. Certified inspection reports shall be retained as part of the SWPPP on site. Within seven days of the inspection, controls identified as damaged or deteriorated shall be repaired or replaced, as appropriate. Controls shall also be routinely cleaned or repaired to maintain adequate functionality.
3. Changes, repairs and/or additions shall be made to the controls within 7 days to prevent discharges from the site. The primary operator shall implement procedures to remove discharges from all portions of the storm drainage system including streets, gutters, inlets, storm drain, channels, creeks, ponds, etc.

J. Construction and Maintenance

1. The owner shall construct all permanent BMPs and is responsible for maintenance of the BMPs. When the BMP falls within a drainage easement, the plat or separate instrument dedicating the easement shall include a statement of the owner's responsibility for maintenance.

DG7.4.5 POST CONSTRUCTION STORM WATER MANAGEMENT PLAN

- A. The following shall be addressed when permanent BMPs have been installed during construction:
- B. The Developer shall prepare a post construction maintenance and operation manual that describes the function and operation for each permanent stormwater facility to ensure compliance with the City of Pflugerville Engineering Design Manual and Construction Standards.
- C. The Developer shall prepare a schedule for when and how often inspection will occur to ensure proper function of the stormwater facility. The schedule shall also include periodic inspections to ensure proper performance of the facility between scheduled clean outs.
- D. The Developer shall ensure that all stormwater facilities undergo, at the minimum, an annual inspection to document the maintenance and repair needs and ensure compliance with the requirements of this ordinance and accomplishments of its purposes.
- E. The program shall require that controls are in place that will infiltrate evapotranspire, or harvest and use stormwater from the site to meet the performance standards as determined by the City of Pflugerville to protect water quality.

END OF SECTION

ENGINEERING DESIGN MANUAL

SECTION 8– TRAFFIC IMPACT ANALYSIS

DG8.0 GENERAL REQUIREMENTS

- A. The report shall be prepared by a professional engineer licensed to practice in Texas and trained and experienced in the application of traffic engineering.
- B. Call Pflugerville Development Services Department to set up a scoping meeting to discuss project limits prior to counts. An email correspondence with attached pdf maps maybe acceptable in lieu of meeting
- C. Any previous traffic study relating to a development that is more than 2 years old may be required to be updated unless the Director of Planning determines the conditions have not changed significantly.
- D. Any prepared TIA shall incorporate traffic counts and determinations for the following:
 - 1. At completion of opening of initial phase
 - 2. 5 years after opening of initial phase
 - 3. 20 years after opening of initial phase
- E. A special Neighborhood Traffic Analysis may be utilized rather than items b & c above as determined by the Director of Planning.
- F. A traffic impact analysis report must conform to the requirements of this chapter of the City of Pflugerville Engineering Design Manual and Unified Development Code.
- G. The Director of Planning may waive the requirement to submit a TIA in accordance with the City of Pflugerville Unified Development Code.

DG8.1 REPORT CONTENTS

- A. An executive summary covering:
 - 1. The proposed site development
 - 2. Methodology
 - 3. Data Used
 - 4. Major Findings of the analysis
 - 5. Recommended Mitigation measures proposed, if necessary.
 - 6. A vicinity map: showing the location of the proposed development in relation to the transportation system or the area and location maps with turn counts broken down with am & pm peaks.

- B. A complete description of the proposed development, including:
 - 1. A site plan
 - 2. The total size and nature of the entire proposed development
 - 3. The proposed location and traffic control of all proposed access points
- C. A brief description of the current (and proposed. If applicable) land users adjacent to the site.
- D. A description of the study area for the Traffic Impact Analysis as defined by all proposed site access points and shall include:
 - 1. Roadway names, locations and functional classifications
 - 2. Intersection lane configurations & traffic control
 - 3. Pedestrian, bicycle, and transit facilities
- E. Discussion of Assumptions and Methodology:
 - 1. Distributions. Default value is to assume site distribution will be the same split as existing conditions. Call out any exceptions to this used.
 - 2. Cap on total combined trip reduction (pass-by and internal capture)
 - 3. Growth factors- provide analysis of both 0% growth rate and estimated% growth rate.
- F. Existing traffic volumes (measured within the previous six months and adjusted to reflect current conditions) and operational analysis for all study intersectionsincluding:
 - 1. Average intersection delay
 - 2. Level of Service
 - 3. Volumes/capacity ratios
 - 4. Queue length analysis
- G. If a recent traffic count for an affected street is not available, the Director of Planning may require the applicant to conduct a traffic count.
- H. Accident data summary and analysis within the study area for the most recent available three year period. Accident data can be obtained through City of Pflugerville Police Department, Department of Public Safety or Texas Department of Transportation.

I. Complete trip generation estimates for all phases and land uses of the proposed development should be calculated with the following requirements:

1. The most recent edition of the ITE publication Trip Generation Manual should be used.
 2. The specific trip generation figures that are used for calculations should be noted in the report.
 3. If the ITE manual does not contain adequate data or the proposed land use is unique, a trip generations study can be conducted and its results used in place of the ITE manual.
-
- a. Trip Generation shall be based upon the proposed land use and density. A.M. peak, P.M. peak and total daily site-generated traffic must be calculated using an independent variable or determinant which has been confirmed by the transportation planner before the TIA is prepared. The applicant must identify and justify the applicability of the trip rates used. Gross square footage is the usually accepted determinant for retail projects. The number of dwelling units is the most often accepted determinant for residential uses. A table of proposed land uses must also be included in each TIA report for review.
 - b. Trip generation rates shall be adopted from the Trip Generation: An Informational Report, most recent edition, Institute of Transportation Engineers, 1099 14th St., NW, Suite 300 W, Washington, DC 20005-3438.
 - c. Average weekday trip rates shall be used in estimating total daily trips generated unless otherwise indicated by staff in defining the scope of study. Weekend or other trip rates shall also be required if the peak hour does not occur on an average weekday. The average trip rate for peak hour of adjacent street traffic shall be used to estimate A.M./P.M. peak hour traffic entering and exiting the site. Guidelines in the Trip Generation manual shall be used for determining whether to use average trip rates or equations.
 - d. If the TIA is filed in conjunction with a site plan review, trip generation shall be based upon the uses and intensities identified on the site plan. If a site plan is not available, trip generation shall be based upon the maximum allowable density for the most intensive use.
 - e. Reductions for internal capture, pass-by and transit usage should be discussed with the staff in defining the scope of study and must be supported by adequate documentation. No reductions in trip rates may be made for driveway turning movements unless it can be documented that

certain trips will not use the driveway. Guidelines contained in the Trip Generation manual or other approved sources shall be used to document internal capture and pass-by trips.

- J. Trip distribution of the trip generation information should be performed using directional trip distribution patterns based on historical data. A figure showing the trip distribution pattern will be submitted as part of the study.
 - 1. Percentages for directional distribution of the site generated traffic must be well referenced. The basis for directional attraction shall largely rely on the following information:
 - a. Marketing Study
 - b. Subarea Transportation Study
 - c. City or State Travel Demand Estimation
 - 2. If the above information is not available, a traffic study for determining directional attraction is required to address the area that is surrounded by the nearest arterial streets. The traffic study must be consistent with the procedures established for calculating trip distribution in Quick-Response Urban Travel Estimation Techniques and Transferable Parameters, NCHRP 187, Transportation Research Board.
- K. Forecast traffic volumes and performance evaluation (including average delay, levels of service, and volume-to-capacity ratios) for the study intersections without development of the site for the five-year future.
- L. Forecast traffic volumes and performance evaluation, including the propose development traffic for all study intersections in the year that full build-out is expected to occur, as well as for the five-year future after build-out.
- M. Safety analysis of the proposed site accesses, including sight distance (both stopping sight distance and intersection sight triangle) and operational characteristics.
- N. Analysis of the right-and-left turn-lane warrants, queue lengths, acceleration lanes, throat lengths, channelization, and other characteristics of the site-access driveways as appropriate.
- O. Comparison of the location and spacing if the proposed site-access driveways with City of Pflugerville standards and the standards of the Texas Department of Transportation, if necessary.

- P. Analysis of the parking needs of the proposed development, the adequacy of the proposed facilities to meet those needs as appropriate, and the conformance of the proposed parking facilities to applicable standards.
- Q. Description and analysis of mitigation measures necessary to bring identified intersections and locations into compliance with the applicable standards. Include analysis showing that these measures will bring these locations into compliance and Include signal, turn lane, or other warrant analysis as appropriate. Provide figures of: Existing peak hour volumes, site generated peak hour volumes, future peak hour volumes, trip distribution
- R. An appendix which includes:
 - 1. Copies of raw traffic count data used in the analysis;
 - 2. Calculation sheets and/or computer software output for Levels of Service, delay & volume-to-capacity ratio calculations in analysis;
 - 3. Warrant worksheets for signals, turn lanes, signal phasing, all-way stops, and other proposed measures a appropriate.
- R. Appendix reports and raw data files of printouts, warrant studies, count data shall be submitted on a CD and not by paper submittal. So shall models within HCS or Synchro.

DG8.2

STANDARDS

- A. All signalized and all-way stop controlled intersections shall operate at a Level of Service “D” or better with a Volume/Capacity ration of 0.95 or Less. Other un-signalized intersections (including un-signalized private accesses) shall operate at Level of Service “E” or better for major street left turns on side street approaches. Although LOS “F” may be allowed if the movement has a relatively low volume-to-capacity ratio and there are no known safety problems at the intersection.
- B. Acceptable analysis methods include the most recent Highway Capacity Manual or Synchro.
- C. Signal timing used in capacity or progression analysis shall be use the same cycle length as is currently in use at the intersection. Unless specifically noted otherwise, and shall not exceed 120 seconds. Signal timing shall provide adequate green time for pedestrian crossings.
- D. At driveways on arterials or collector roadways, deceleration/turn lanes may be required. Additional right of way may also be required to accommodate the deceleration/turn lanes. Right turn deceleration lanes shall be provided for all driveways with projected peak hour right turn

volumes at least 50 or greater vehicles per hour during any peak hours period. Right turn storage lengths shall be sized to the number of vehicles expected to queue in the lane during an average peak period. Required right turn storage and transition lengths are found in the City of Pflugerville Engineering Design Manual. On TxDOT roadways refer to the TxDOT Roadway Design Manual and Access Management Manual for right turn lane requirements.

- E. Peak Hour factors less than 0.75 or greater than 0.90 shall not be used unless justified by specific counts at that location.
- F. All tube counts shall be a minimum of 48 hours.
- G. Provide four copies of the Traffic Impact Analysis report for City of Pflugerville Staff review.

DG8.3

APPROVAL

- A. The following standards have been set to ensure that traffic impact studies are reviewed quickly. The City's goal is to complete 90 percent of all studies at or before the review times shown.
- B. After the Planning staff and/or the Engineering staff has completed their review, and all issues related to the report have been addressed, an approval letter/e-mail from the Planning staff will be provided to the Applicant. This letter/e-mail will outline any conditions, stipulations or mitigation related to the approval of the project. Upon approval of the TIA or TIS report, two (2) signed and sealed hard copies of the finalized report shall be submitted to the Development Services Office along with a CD of all pertinent files.
- C. For projects with proportionate share mitigation improvements, public hearings or a Local Development Agreement (LDA), additional work and coordination may be necessary prior to the Planning staff's final determination of "sufficiency" which permits the Planning Department's scheduling of the public hearing.
- D. If traffic-related issues are not addressed, or there are continued disagreements between the Applicant and the Review staff which would not allow the project to be approved, the Director of Planning may initially recommend denial until issues are resolved. However, to minimize this occurrence, follow procedures listed.

E. ACTIONS BASED ON THE RESULTS OF A TIA

- 1. Based on the results of the TIA and recommendations/actions by the Development Services Department, the City as appropriate, may determine that the TIA is adequate to support one or more of the following actions:

- a. approve the development request, if the project has been determined to have no significant impact or where the impacts can be adequately mitigated;
- b. approve the development request, subject to a phasing plan;
- c. recommend study of the Master Transportation Plan to determine amendments required to increase capacity;
- d. recommend amendment of the City's Capital Improvement Plan relative to the construction of needed improvements; or
- e. deny the development request, where the impacts cannot be adequately mitigated.

END OF SECTION

ENGINEERING DESIGN MANUAL

SECTION 9– MISCELLANEOUS DESIGN GUIDELINES

DG9.0 SURVEY REQUIREMENTS

- A. All subdivision and site development construction plans shall reference two (2) benchmark of known vertical and horizontal coordinates set to the State Plane Coordinate System. If benchmarks are not readily available to the project site, new benchmarks shall be set. Any existing benchmark monuments damaged by development construction shall be replaced by the contractor/developer at no cost to the City.
- B. New or replaced benchmark Monuments shall be brass disc about 2 ½” inch diameter and are marked “City of Pflugerville Bench Mark No. nnnn.”
- C. Lot markers shall be of iron pipe or reinforcing steel, one-half ($\frac{1}{2}$) inch or larger in diameter and at least eighteen (18) inches in length, placed at each corner of all lots, flush with the average ground elevation, or countersunk, if necessary, to avoid being disturbed.

DG9.1 UNDERGROUND UTILITY LINES

- A. All new telecommunication utility lines and all new electric utility lateral and service lines and wires shall be placed underground, except as otherwise herein provided. All such utilities shall be installed outside of the City of Pflugerville Right of Way in a public utility easement (P.U.E.) or specific use easement.
- B. Where electrical service is to be placed underground, electric utility service lines for street or site lighting shall also be placed underground.
- C. All electrical, cable television, and telephone support equipment (transformers, amplifiers, switching devices, etc.) necessary for underground installations in subdivisions shall be pad mounted or placed underground in a public utility easement rather than a right-of-way.
- D. Nothing herein set forth shall prohibit or restrict any utility company from recovering the difference between the cost of overhead facilities and underground facilities. The subdivider shall be required to reimburse the utility company for such cost differential.
- E. Each utility company whose facilities are subject to the provisions of this ordinance shall develop policies and cost reimbursement procedures with respect to the installations and extension of underground service.
- F. Telephone and cable television lines may be constructed overhead where

overhead electric utility lines are permitted.

- G. Notwithstanding the provisions of this ordinance, temporary construction service may be provided by overhead utility lines and facilities without obtaining a variance or exception from the provisions hereof.
- H. All utility installations regulated by the provisions set forth herein shall conform with all City of Pflugerville ordinances and regulations, as well as the regulations and specifications of the applicable utility companies.

DG9.2 PUBLIC UTILITY EASEMENTS

- A. A ten (10) foot public utility easement (P.U.E.) is required adjacent to all public street frontage. The P.U.E. shall be non-exclusive and shall be used for public utility purposes, including placement, construction, installation, replacement, repair, maintenance, relocation, removal and operation of a public utility easement included but not limited to water, wastewater, telecommunication, gas, electric, drainage and television cable necessary to adequately serve a subdivision. Where feasible, easements shall be along a front or rear lot line, but when deemed to be warranted by the City Engineer and the City Council, such easements may be permitted across a lot or along side lot lines.

DG9.3 STREET LIGHTS

- A. Street lights shall be provided by the subdivider and shall conform to the latest edition of the Illuminating Engineering Society Handbook and the City of Pflugerville Unified Development Code.
- B. Street light lamps shall be downcast, full cutoff and utilize high pressure sodium luminaires or LED unless the Planning Director or City Engineer determine otherwise.
- C. At the discretion of the Planning Director or City Engineer, decorative luminaires may be used to emphasize specific areas. It shall be the fiscal responsibility of the developer for any additional infrastructure cost associated with installation of decorative luminaires.
- D. Street lights and associated facilities shall be provided by the Developer, installation completed and operational prior to the acceptance of the Public Improvements.
- E. Street lights shall not be located further than 300 feet apart on a local and collector roadways and shall not be further apart than 250 feet on arterial roadways.
- F. A streetlight shall be placed at every street intersection, in every cul-de-sac,

at every intersection of a street with a trail, at neighborhood mail box unit locations or similar pedestrian gathering places; and at any other location as deemed by the Planning Director or City Engineer.

- G. The same lamp or light source type shall be used for the same or similar types of lighting throughout a Development. As approved by the Planning Director, different lamps or light sources may be used within a Development when they are consistent with each other in style and color.
- H. Street Lighting shall be provided for all private driveways in excess of 200 feet in length. The developer or subdivider shall be fiscally responsible for power usage affiliated with street lighting on private driveways.
- I. Street light intensity (wattage) shall be in accordance with the Table 9.1.

Street Light Wattages and Heights

Table 9.1

Wattage	Luminaire Height	Roadway Classification
100	25'	Local, Minor Collector, Rural
150	30'	Major Collector, Industrial, Minor Arterial
250	30'	Major Arterial

DG9.4 CONSERVATION AREAS

- A. All streets, utilities, drainage improvements, and buildings shall be constructed and located so as to protect conservation areas designated in the Comprehensive Master Plan.

DG9.5 LANDSCAPE REQUIREMENTS

- A. Refer to the City of Pflugerville Unified Development Code for Landscape Requirements.

DG9.6 TREE PRESERVATION

- A. Tree preservation shall be in accordance with Tree Technical Manual. Tree Preservation Standards as required by the Code of Ordinances as well as the City of Pflugerville Construction Standard Details shall govern for design of trees for projects. Tree Protection Notes can also be found in the Standard Details of the City of Pflugerville Erosion Control Standards.

DG9.7 THIRD PARTY AGREEMENTS

- A. Any proposed private development agreements involving either the owner/subdivider/applicant or contractor or private land owner shall hold harmless the City of Pflugerville. A copy of any executed said agreement shall

be furnished to the City of Pflugerville.

END OF SECTION

ENGINEERING DESIGN MANUAL

SECTION 10 – LIFT STATION GUIDELINES

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LIFT STATIONS

Section A. General Requirements

1. As required by the current version of the City of Pflugerville Engineering Design Manual, a consultant or developer who proposes to construct a lift station and force main system shall prepare a present value analysis of the cost of constructing gravity mains compared to the cost of the lift station/force main system. This analysis shall show that the lift station installation cost plus 30 years of operational and maintenance expenses would be less than the cost of the gravity mains. Lift stations will only be considered a viable option if the cost analysis clearly shows that the gravity sewers are not economically feasible. Lift stations will not be allowed where an acceptable alternative gravity route exists.
2. Design the lift station to consider the potential for expansion to **build-out densities**. The design of the lift station shall incorporate a wet well sized for the ultimate capacity of the water shed. The lift station design shall consider both the total number of acres and number of Living Unit Equivalents (LUE) to be developed. The flow capacities are determined in accordance with applicable chapters and sections of Texas Commission on Environmental Quality (TCEQ) Chapter 217 “Design Criteria for Sewerage Systems” dated August 28th 2008 or the latest edition of the City of Pflugerville Engineering Design Manual.
3. **All sanitary sewer lift stations shall be submersible type.** Suction lift self primer and package type lift stations may be approved by the City on a case-by-case basis depending on station size/capacity, wet well depth, head requirements and motor horsepower. Table 1 outlines the allowable design criteria for each type of pump station:

TABLE 1
PUMPING STATION DESIGN CRITERIA

Station Type	Maximum Motor Horsepower	Maximum Wet Well Depth
Suction-lift/Self-priming* (If approved on a case-by-case basis)	No restrictions	17 feet
Submersible**	No restrictions	No Restrictions
Packaged Lift Stations (If approved on a case-by-case basis)	5 HP	13 feet

* Design Engineer will evaluate Total Suction Lift and NPSH values at all different operating points (i.e. one pump running, two pumps, three pumps, etc.) to ensure the pumps will not cavitate in any scenario. Maximum wet well depth shall not exceed 17 feet. Total suction pipe length shall not exceed 22 feet.

** The 5 feet distance could be greater depending on pump size and City approval.

4. All lift stations shall be designed to meet the requirements of these City of Pflugerville Lift Station Design and Construction Guidelines, and also meet or exceed the requirements

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of TCEQ 217.60, 213 Subparts A and B (for lift station over Edwards Aquifer Recharge, Transition or Contributing Zones), the latest edition of the NFPA National Electrical Code (NEC), latest edition of the National Electrical Safety Code (NESC), Occupational Safety and Health Administration (OSHA) 2007 or latest editions, and contemporary industry practices. A lift station application shall include final construction plans, a design engineering report and complete set of specifications prepared by or under the direct supervision of a Texas Licensed Professional Engineer. All design information shall be signed, sealed, and dated by a Texas Licensed Professional Engineer. The lift station site layout shall show the proposed grades.

5. Lift stations located over the Edwards Aquifer Recharge, Contributing and Transition Zone shall be designed and constructed to ensure that bypassing of any sewage does not occur (TCEQ Chapter 213, Subchapter A §213.5I(3)I). All lift stations shall be designed to meet the requirements of these Design Guidelines and meet or exceed TCEQ Chapter 217, Subsection C from §217.59 to §217.68.
6. The firm pumping capacity of all lift stations shall be such that the expected peak flow can be pumped to its desired destination. Firm pumping capacity is defined as lift station total pumping capacity with the largest pumping unit out of service, or with either one or two pumps out of service (see Table 3). **The firm pumping capacity shall be greater than the expected Peak Wet Weather Flow.**
7. Lift Station site layouts shall consider clearances for unimpeded maintenance operations. The area surrounding the lift station components including, but not limited to, the wet well, pump and motor slabs, valve slabs, generator, electric service rack and tower shall be large enough to permit heavy equipment and vehicles ample room to maneuver. The lift station site shall be designed to allow maintenance vehicles to have direct access to the wet well, electric controls, generator and tower.
8. **Access Road Design in Residential or Commercial Developments:** The lift station shall have an access road, either temporary or permanent, located in a dedicated right-of-way or public easement. The access road surface shall have a minimum width of 12 feet and the pavement shall meet City of Pflugerville roadway standards. Crushed stone, flexible base or similar materials are not considered all weather materials and will not be accepted. The access road surface, either shall be designed to be above the water level caused by a 100-year storm event. The design shall limit the slope to no more than 8 percent (8%) and grade break to 0.8 percent (0.8%) and provide soil erosion protection to prevent collection of sedimentation along the access road. Inside the boundary of a proposed residential development, design of the access road, shall minimize turns and achieve the straightest possible alignment. If a straight access road is not provided, the City will determine whether or not an adequate turnaround is required to allow a 55 foot 18 wheeler tanker truck to safely turn around depending on wet well size, influent flow and site location. The turnaround shall meet the same pavement standard for the access road. Lift Stations access within a proposed commercial development shall be closely coordinated with the City early in the design. The City preference is for an exclusive driveway and paved access road that will be for City use only. This access road shall have a straight horizontal alignment, and shall be paved and configured to preclude the public from blocking the City access to the station. It shall be a minimum of 12 feet wide without any interference with, but not limited to vehicles, landscape,

curbs, posts, bollards, fences, parking stalls, striping, and above grade appurtenances, etc. If these design conditions cannot be satisfied, then the lift station may have to be designated as a private lift station, and maintenance of all sewer facilities within the commercial boundary shall be maintained by the property owner or a legally designated association.

9. Provide an access gate with 12-foot clearance to allow access by large maintenance equipment. Lift stations with relatively long driveways must include pole gates at the entrance of the driveway. Turnarounds may be required for stations constructed along heavily traveled streets. Allow sufficient space for large maintenance vehicles to have unhindered access to the wet well, generator, tower, by-pass and on-site manhole. Entries located parallel to the roadway should also be considered. Lift stations are not allowed within the street right-of-way.
10. The lift station, including all electrical and mechanical equipment, shall be protected from a 100-year flood event including wave action, and remain fully operational during such event. Provide floodplain evaluations (HEC-RAS) and a letter dated, signed and sealed by a Texas Professional Engineer certifying the site is protected from the 100-year flood event.
11. Provide protection of the lift station, including mechanical and electrical equipment, from access by any unauthorized person. The lift station shall be enclosed within a resistant a minimum 8 feet high masonry wall. Acceptable masonry materials shall be in accordance with the City of Pflugerville Unified Development Code.
12. Provide a reinforced concrete base slab, or other appropriate feature, sized adequately to counteract buoyancy, and provide supporting design calculations. The concrete slabs of top of wet well, electrical rack, tower foundation and generator (when required) shall be 4" to 6" higher than the adjacent pavement.
13. The lift station site shall be completely paved. The pavement section shall be either concrete (preferred) or asphalt pavement meeting the City of Pflugerville standard specifications, and the design shall be prepared by a Texas Professional Engineer. The pavement design shall consider loading exerted by a 55 foot, 18 wheeler, and 80,000 pound tanker truck. The pavement shall be shaped to the lines, grades, and typical sections that are on the approved construction plans. If trees are to remain in the paved area, leave a circular pervious area with a minimum 12-inch clearance around tree, and make sure the trees will not impede maintenance vehicle access.
14. Design shall provide for ¾-inch minimum freeze proof water service with hose bib vacuum breaker attached to the hose connection. It shall be located within 10-foot radius of wet well.
15. Design shall provide for permanent structure enclosing the electrical service rack that will provide a minimum 8.0 foot vertical clearance., Due to the variety of soil conditions in the region, Design engineer must perform soil, foundation and structural analysis to ensure the structure will withstand winds of up to 90 MPH. The structure detail shown in the standard drawings is provided for illustration purposes and reflects the foundation minimum dimensions. No open side canopy will be allowed.

16. Provide engineering calculations of potential for hydrogen sulfide generation in force main and wet well, and provide recommendations to prevent and/or control generation of odors. As a standard practice, wet well retention time, and force main flush time shall not exceed 180 minutes. If the development is phased, this analysis shall be made for both initial and final phases. It is recommended for Design Engineers to coordinate with the City during the early stages of the lift station design, this way different alternatives can be evaluated. It is the City's preference to keep all pumps the same size and not to depend on Variable Frequency Drives for initial conditions, but in some cases this may be the only solution. Parallel force mains of different size must be evaluated to satisfy conditions for initial and final development.
17. All exposed pipe, valves, and fittings outside the wet well shall receive after installation a 100% solids epoxy coating system with a top coat system of urethane, suitable for the environment. Prior to application, prepare surfaces in accordance with manufacturer's instructions. Any reference to cleaning in the manufacturer's instructions shall be understood to refer to the applicable SSPC specifications. Thickness, mixing and application shall be in accordance with manufacturer instructions. Apply finish coat in accordance with the color-coding set forth in Table 2, below. Approved manufacturers are Tnemec, Carboline, Sherwin-Williams, PPG, and M.A.B. Paints.
18. All pump discharge pipe and fittings within wet well, except SS 316 and PVC, shall receive after installation, a 100% solids coal tar epoxy coating system. Thickness, mixing and application shall be in accordance with Manufacturers instructions. Prior to application, prepare surfaces in accordance with manufacturer's instructions. Any reference to cleaning in the manufacturer's instructions shall be understood to refer to the applicable SSPC specifications. Approved manufacturers are Tnemec, Carboline, Sherwin-Williams, PPG, and M.A.B. Paints.
19. Landscaping is encouraged for Lift Stations within proximity to residential areas and pedestrian areas. Landscaping shrubs, trees and other acceptable materials shall be in accordance with the City of Pflugerville Unified Development Code. Any proposed landscaping of a public lift station requires a License Agreement for Maintenance. All maintenance shall be the responsibility of the easement grantor or association.
20. Any electrical service for the lift station must be incorporate underground per the City Unified Development Code. Aerial service will not be permitted.
21. Lift station site shall be located or designed in a manner that will be protected from storm runoff entering the lift station site, and that will allow storm water to drain away from lift station site.
22. Lift station shall be placed at a sufficient distance from developed areas and designed with adequate odor control measures to limit the detection of odors within the developed area to an acceptable level.
23. Engineer shall ensure the specifications require the Contractor to submit minimum 3 hard copies and one electronic copy (in pdf) of the Operation and Maintenance Manuals of all

equipment to the City Inspector. Operation and Maintenance Manuals shall detail the following, but not limited to, technical data, performance levels, specifications, parts description, installation, operation and maintenance of electrical, mechanical, and instrumentation components.

TABLE 2
CITY OF PFLUGERVILLE LIFT STATION COLOR CODES

TYPES OF EQUIPMENT	COLOR
1. Pump Suction Piping (if required) 2. Header and Force Main Piping 3. Pump/Motors and Mounts (if apply) 4. Potable Water Line 5. Compressed Air Line (where used) 6. Power Conduit 7. Control/Instrumentation Conduit 8. Recycle water pipe	Desert Sand – Pantone No.431 U Desert Sand – Pantone No. 431 U Desert Sand – Pantone No.431 U Avalon Blue – Pantone Number 558 C Green – Pantone Number 349 Orange – Pantone Number 166 Yellow – Pantone Number 109 Purple – Pantone Number 521 C

Section B. Wet Well Design

1. Dimensions: Minimum 72” in diameter; larger as necessary to accommodate submersible pumping equipment, piping, supports, emergency storage volume and to support pump cycle times as indicated in Table 4. Depth of wet wells shall consider, but not limited to all the following: emergency storage volume, adequate submergence of submersible pumps, and suction piping for self priming or dry pit pumps (if approved). Fiberglass reinforced polyester (FRP) wet wells shall be installed for diameters up to 18 feet, unless prior arrangements have been made with and approved by the City to install precast concrete wet wells, and dry vaults.
2. Emergency Storage: Size the wet well to provide sufficient volume within the wet well, excluding the capacity of sanitary collection system upstream from the lift station. Emergency storage capacity shall be supported by engineering calculations. Design wet well emergency storage for the following capacities, using Average Daily Flow:

For lift stations within Edwards Aquifer Recharge and Contributing Zones: 60-minutes of wet well storage plus a generator, or

2) For lift stations over the Edwards Aquifer Transition Zone: City staff will evaluate the site location, water stream proximity, remoteness, and geographical features to determine if the lift station site shall be treated as if it were over the EARZ, or

3) For lift stations outside the Edwards Aquifer Recharge, Contributing and Transition Zones: 60-minutes of wet well storage plus a generator, or 120 minutes of wet well storage without generator. The City will evaluate and determine if a generator is required. (See Section J “Emergency Provisions”).

For calculation purposes, the wet well emergency storage level begins at the Lead Pump On level until wet well level is 2 feet below spill level elevation. Spill level elevation is determined by the manhole upstream of wet well with the lowest top elevation, or by the wet well top slab elevation, whichever is lower.

3. The lift station design shall minimize odor potential. Locate incoming wet well gravity pipe to reduce turbulence. Minimize detention times in wet well during all phases of development. If detention times are greater than 180 minutes, the City may require odor control measures based on evaluation of, but not limited to phasing considering construction phasing, prevailing wind direction, and proximity to neighborhoods. If odor control measures are needed, it shall consist of a chemical drum scrubber with top mounted blower to absorb odorous compounds for oxidizing. The drum scrubber shall be designed to operate at 99.5% gas removal. The design specification shall be prepared by the drum scrubber and media supplier. Approved manufacturer is Purafil, or an approved equal.
4. The wet well floor shall be sloped toward the pump intakes and have a smooth finish (see Standard Drawings) in order to become a self cleaning wet well. There shall be no wet well projections that will allow deposition of solids under normal operating conditions. Include anti-vortex baffling on all lift stations with greater than 3 MGD (2,083 gpm) Peak Wet Weather Flow.
5. When permitted by the City, construction of concrete wells shall include a full monolithic structure or a precast wet well structure with monolithic base. Design engineer shall evaluate the thicknesses of wet well wall and slabs, but the following thicknesses shall be met as minimum: wet well wall thickness 10 inches, wet well base slab 12 inches and wet well top slab 10 inches.
6. Line interior of concrete wet wells with a 100% pure calcium aluminate premix lining system. Surface preparation, thickness, mixing and application shall be in accordance with the manufacturer's instructions. Wet well joints shall be sealed per the manufacturer's recommendations. Approved manufacturer is Sewpercoat, or approved equal.
7. The bottom of the excavation for the wet well structure shall be a level subgrade approximately 18 inches of crushed stone below the bottom of the wet well structure and native soils shall be compacted with excavation equipment for the installation of 6 inches of flexible base to support the base of the structure. Compaction of native soil and flexible base shall achieve minimum ninety-eight (98%) of the maximum dry density as determined by the TXDOT testing method Tex 113-E.
8. 3,000 psi reinforced concrete shall be installed around wet well exterior to an elevation of 1/3 the total depth of the wet well structure, as measured from the well bottom up. The remaining 2/3 shall be backfilled with flowable fill. Wet well manufacturer shall design the wet well thickness.
9. Use 16 mesh 316 Stainless Steel screens on passive ventilation, gooseneck type, to prevent the entry of birds or insects into wet well. Mechanical and electrical equipment in the wet well shall be NFPA Class 1, Division 1 construction type. Size the passive ventilation to vent

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at a rate equal to the maximum pumping rate of the station and not exceed 600 fpm through the vent pipe. The minimum air vent size shall be 4-inch diameter, and it shall be made of stainless steel 316. Vent outlets shall be at least 1 foot above the 100-year flood elevation. All screening shall be installed in a manner that will allow for future replacement.

10. Incorporate hoisting equipment, or access for hoisting equipment, for removal of pumps, motors, valves, etc. into the design. The City will determine if hoisting equipment shall be included in the design, depending on size of equipment. When required by the City, hoisting equipment will include overhead crane.
11. All accessory hardware in wet well including but not limited to chains, cables, bolts, nuts, fasteners, brackets, anchor bolts, washers, cable holders and slide rails, shall be 316 stainless steel.
12. The distance between the bottom of the wet well and the bottom of the gravity invert pipe shall be between 5 and 7 feet. If distances greater than 7 feet are required the gravity invert pipe must tie to wet well via drop pipe.
13. Wet Well Testing. An Exfiltration test must be performed immediately after the wet well has been backfilled and compacted. Exfiltration shall not exceed 0.0142 gal/hr per foot diameter per foot depth. The test must be done by plugging the gravity invert and filling up the wet well with water to either 1-foot below the wet well top slab, or up to the manhole lid with the lowest elevation below top slab. (This level must be clearly temporarily marked in the wet well internal wall). Once the wet well is filled, it must be left for stabilization for 48 hours minimum prior to beginning the Exfiltration test. After the stabilization period, the wet well must be refilled up to the mark to begin the test. The test shall be done for two hours minimum, and no water may be added to the wet well during the test period. The Exfiltration test must be determined by measuring the amount of water required to raise the wet well level back to the mark at the end of the test period. The maximum allowable water loss to pass the test is determined by the following equation:

$$\text{Water Loss (gallons)} = 0.0142tDh$$

Where:

t = test time period (2 hours)

D = wet well diameter (in feet)

h = water level depth within wet well (in feet)

If the Exfiltration test fails the Design Engineer must work with the Contractor to determine all the necessary corrective actions to reduce the exfiltration. Once the repairs are completed, the test shall be repeated. The wet well will pass the test when the exfiltration is equal or less than the allowable water loss. The City Inspector, Contractor and Design Engineer shall witness the complete Exfiltration test. Design Engineer shall provide a certified letter showing the results of the exfiltration test to the City inspector. The certification letter shall include a description of all steps taken to complete the exfiltration test, including water loss, wet well level mark, and any corrective actions taken if a prior test failed.

Section C. Pumping Equipment Design

1. Provide the required number of pumps, and adequate controls to alternate all pumps (See Table 3 for minimum number of pumps required).
2. All pumps, regardless of station design, shall be electric, centrifugal non-clogging units capable of passing incompressible spheres as indicated in Table 3 (Minimum Sphere Pass), and shall have no less than 4-inch diameter suction and discharge openings. Semi chopper, vortex or grinder pumps may be accepted on case-by-case basis. Single phased systems will not be permitted.

TABLE 3
MINIMUM NUMBER OF PUMPS REQUIRED

Peak Wet Weather Flow	Minimum Number of Pumps	Minimum Sphere Pass
500 gpm or less	● 2 Pumps: 1 Lead, 1 Standby †	3-inch
Between 501 and 2500 gpm	▲ 3 Pumps: 1 Lead, 1 Lag, 1 Standby †	3-inch
2500 - 3000 gpm	■ 4 Pumps: 1 Lead, 2 Lag, 1 Standby ‡	4-inch

NOTES: All pumps including Standby must alternate constantly.

● Lead Pump will discharge more than the Peak Wet Weather Flow.

▲ Lead Pump with Lag Pump will discharge more than the Peak Wet Weather Flow.

■ Lead Pump with Lag Pumps will discharge more than the Peak Wet Weather Flow.

† One standby pump required only.

‡ Two standby pumps required due to magnitude of flow.

3. Self priming pumps (if approved) shall include inspection and cleanout plates located both on suction and discharge sides of each pump, to facilitate locating and removing blockage-causing materials unless the pump design accommodates easy removal of the rotation elements.
4. Specify pump motors suitable for continuous operation and inverter-duty type (suitable for soft starters and variable frequency drives) at full nameplate load while the motor is completely submerged, partially submerged, totally non-submerged for submersible pumps.
5. Pumps shall be capable of meeting all system hydraulic conditions without overloading the motors. In addition, a minimum of 5-hp motor is required, unless prior arrangements have been made and approved by the City. Submit pump head capacity and system curves to the City, along with the lift station plans. Base the curves on the total of static head, friction losses through force mains, headers and pump risers. Pump duty point for nominal design flow shall be within 75% and 115% range of pump's flow at Best Efficiency Point (B.E.P). This condition shall be satisfied for at least one and two pumps in operation. Points outside this range will be evaluated by the City and may be approved based upon performance, average energy consumption per month (kW-hr/month), etc.

7. All lift stations shall operate automatically based on the water level in the wet well. Locate wet well level control device as indicated in Standard Drawings. Level control device and float switch shall be fully accessible without the need for personnel entering the wet well.
8. Submersible Pumping Stations.
 - a. The lift station shall consist of submersible centrifugal sewage pumps, stainless steel 316 guide rail system, wet well access, discharge seal and elbow, motor control center, starters, liquid level control system, SCADA monitoring system, and all hardware necessary to provide a complete working system. Every integral component of the guide system shall be stainless steel 316, which includes the following but not limited to: guide rails, brackets, fittings, bolts, nuts, fasteners, adapters, attachments, etc. Flanged discharges are not allowed.
 - b. Impellers shall consist of cast stainless steel or ductile iron. Mechanical Seals shall consist of Tungsten Carbide. Silicon Carbide seals will be evaluated and approved by the City on case-by-case basis.
 - c. Motor insulation shall be Class H, be inverter duty type, and have a minimum service factor of 1.15.
 - d. Pump duty point shall be within 75% to 115% range of pump's flow at Best Efficiency Point (BEP) for one and two pumps in operation as to achieve the maximum efficiency possible, and no substitutions will be accepted after City approval of the Lift Station construction plans and Engineering report. Designer shall consider different combinations of pumps, impellers and pipe sizes including discharge and force main piping in order to achieve the pump operating criteria and maximum efficiency. The Utility Services Regulations, Section 11.4.4 requires Energy Calculations which mean the engineering report shall prove the proposed pump is the most efficient option. Exemptions may be considered on a case-by-case. Approved pump manufacturers are KSB or approval equal.
 - e. Sealing of the pump unit to the discharge connection shall be a machined metal to metal water tight, hydraulically sealed contact.
 - f. The proposed elevation of all critical components shall be shown in the Drawings including, but not limited to pump intake line inverts, control and alarm levels, top of the wet well, top of the dry well, influent line invert(s).
 - g. Pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.
 - h. All electrical equipment/panels and controls shall be above ground.
 - i. All cables shall be continuous (no splices allowed), and intended for wastewater service applications.

Section D. Station Piping

1. Each pump shall be separated and immersed according to manufacturer recommendation, and

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have a separate suction pipe (for non-submersible pumps if approved). Pipe reducers installed at discharge base of submersible pumps or suction port of non-submersible pumps shall be eccentric type. Eccentric reducers installed horizontally on suction pipes shall be installed with flat side up to preclude air entrapment. Reducers installed at discharge header shall be concentric reducer. Pipes in wet wells of suction lift pumps shall be equipped with a turndown type flared intake and consist of ductile iron or SS 316.

2. The design shall consider surge effects and provide protection where necessary. Surge relief shall be contained in the system. If a surge relief valve is needed, it shall be installed in the exact position shown in the Standard Drawings. Design engineer must include in design the detail shown in sheet DD-903-03, 1 of 5 and fill the blanks.
3. Floor drains from valve vaults to wet wells shall be designed to prevent gas from entering the valve vault (if valve/pump vaults are approved). Such designs shall include flap valves, "P" traps, submerged outlets, or a combination of these devices.
4. Provide metal manufactured pipe supports for pipes as indicated in Standard Drawings, and where else needed.
5. Lift station piping shall be D.I. and shall have flanged connections to allow for removal of pumps and valves without interruption of the lift station operations. Wall penetrations shall be designed to allow for pipe flexure while excluding exfiltration or infiltration. Pipe suction velocities (if self priming pumps are approved) shall be between 3.0 and 3.5 feet per second at pump nominal design flow.
6. Use forty-five (45) degree cast iron elbows for pump discharge piping turns where the force main bends toward the ground.

Section E. Station Valves

1. Gate Valves: Install a gate valve on the upstream side of each check valve. Gate valves shall be resilient wedge, flanged joints, conforming to the applicable requirements of ANSI/AWWA C509, and shall be handled and installed in accordance with the recommendations set forth in the appendix to ANSI/AWWA C509 and the recommendations of the manufacturer. All interior and exterior ferrous metal surfaces of valves and accessories shall be shop coated for corrosion protection. If the full-closing valve is other than a rising stem gate valve, the valve shall include a position indicator to show its open or closed position. Approved manufacturers are Clow F-6102, Mueller A-2360, Kennedy 4561/4701, and American Flow Control – Series 2500.
2. Check Valves: A flanged, non-slamming check valve shall be installed on the discharge side of each pump and on by-pass quick connector, followed by a full-closing isolation valve on each pump. Check valves shall be swing type with an external lever and minimum pressure rating of 250 psi. Approved check valve manufacturers are Clow Style 106LW, Mueller #2600-6-01, Kennedy IBBM Swing Check Valve, American "50" Line with Weight and

Lever.

3. Butterfly valves, tilting disc check valves, or other valves utilizing a tilting disc in the flow line are not allowed.
4. Air/Vacuum Release Valves: shall be mounted on common header and all high points along force mains. Air/Vacuum release valves shall be rated for raw sewage, have a minimum 2" inlet, and be provided with flush ports. Valves shall be sized for intended system hydraulics, with related sizing calculations included in engineering report. Air release valves shall be mounted on isolation valves. The air release pipe shall be a minimum of 1-inch PVC Sch. 40, and it shall be installed in a manner that doesn't represent a tripping hazard, and it shall be solidly fastened; unless embedded in concrete slab, and shall discharge into wet well. Liquid shall not accumulate within air release pipe. Air/Vacuum release valves shall have a PVC or stainless steel 316 body. Approved manufacturer is A.R.I Model S-020 or equivalent.
5. Surge Relief Valves: When required, surge relief valve size shall be selected based on Firm Pumping Capacity flow. It shall be rated for raw sewage service, and it shall have isolation valve on the inlet side. Opening setting shall not exceed 5 psi above normal operating pressure of the system at header when firm pumping capacity flow is being discharged. Surge relief pipe shall be routed back to either wet well or manhole next to wet well. Engineering report must include analysis and reference information showing how the valve was selected. When the analysis shows dangerous surge pressure at firm pumping capacity, a surge relief valve will be included in the design in addition to the soft starters.

Section F. Force Main

1. Install the Force Main at least 4 feet below finished ground surface, and higher than the gravity inlet line elevation.
2. Metallic detector Tape must be laid in the same trench as the force main. The detector tape must be located above and parallel to the force main. The detector tape must bear the label "PRESSURIZED WASTEWATER" continuously repeated in at least 1.5-inch letters.
3. Provide plan and profile of the force main in plans.
4. Install an isolation gate valve on all force mains, located immediately before they turn toward the underground.
5. Minimize the number of peaks and valleys along the Force Main profile to limit the accumulation of gases. All high points shall have 2-inch minimum air and vacuum release valves rated for raw sewage. Plans must include the air release valve installation detail.
6. Force Mains shall transition into a gravity line within a manhole via drop manhole as to minimize turbulence. The crowns of the force main and outlet gravity line shall match where possible, with bench grouting installed to direct flow into the outlet with a minimal change in the gravity flow angle to minimize turbulence.

7. Minimum force main size will be 4-inch (except for grinder pumps); however, size Force Mains so that flow velocity is between three (3.0) and three and a half (3.5) feet per second (velocities slightly above 3 feet per second are recommended) with one pump in operation. Maximum flow velocities shall be four and a half (4.8) feet per second with two pumps in operation and six (6.0) feet per second with three pumps in operation. For lift stations with more than 2 pumps, flow velocities may be as low as two (2.0) feet per second with one pump in operation, but when three or more pumps operate a flow velocity equal to, or greater than five (5.0) feet per second must be generated.
8. All pipe material shall consist of either Ductile Iron Pipe Size (DIPS), Iron Pipe Size (IPS) or approved other. All pipe and fittings shall be high density polyethylene pipe and made of virgin material, and shall have a minimum working pressure rating of 150 psi. The pipe shall be manufactured from a High Density High Molecular weight polyethylene compound which conforms to ASTM D 1248 and meets the requirements for Type III, Class C, Grade P-34, Category 5, and has a PPI rating of PE 3048. Solid wall pipe shall be produced with a plain end construction for heat-joining (butt fusion) conforming to ASTM D 2657; no flanged or slip-on joints will be accepted.
9. All lift stations located over Edwards Aquifer Recharge and Contributing Zones shall be designed with double barrel force mains to provide full redundancy. Lift Stations over the Edwards Aquifer Transition Zone, and Lift Stations outside Edwards Aquifer Recharge, Contributing and Transition Zones but with either Peak Wet Weather Flows of 1,200+ gpm or force main lengths of 5,000+feet will be evaluated by the City to determine if double barrel force mains will be required. Double barrel force mains shall be connected (above ground) to the common header through a wye fitting, and an isolation gate valve shall be provided for each force main immediately after the wye. Double barrel force mains shall be designed to provide full redundancy.
10. Force mains pressure rating shall be at least 1.333 times greater than the pressure generated by instantaneous pump stoppage due to a power failure under maximum pumping conditions as determined by dynamic pressure analysis, but in no case shall be rated less than 150 psi. Design engineer must include an analysis showing the maximum surge pressure for such conditions in the engineering report, and provide a solution to prevent a force main break.
11. A force main average flush time analysis must be included in the engineering report. Average flush time shall not exceed 180 minutes. See section L, paragraph C.12 for example calculation.
12. Combination Air/Vacuum Release Valves must be installed in a dry vault with a minimum inner diameter of 6 feet and with a minimum 30-inch access opening. Location of force main and air release valve within dry vault must be in a manner that will provide safe working space and safe access. See Standard Drawings. Show in plans GPS coordinates of all air release valves installed along force mains.
13. Force mains must be tested by filling with water and pressurizing to 50 psi above force main nominal rated pressure. Force main must hold the test pressure for 4 hours.

14. A leak test must be also performed, and the leakage rate must not exceed 10 gallons per inch diameter per mile of pipe per day when the force main is pressure tested.
15. Install isolation plug valves at least every 2,000 feet to facilitate initial testing and subsequent maintenance and repairs. Show GPS coordinates of each plug valve on the plans. Confirm such GPS coordinates in Record Drawings or As-build drawings.

Section G. Electrical Equipment

1.01 GENERAL

- A. The General Conditions and Requirements, Special Provisions, are hereby made a part of this section.
- B. The Electrical Drawings and Specifications under this section shall be made a part of the contract documents. The Drawings and specifications of this contract, as well as supplements issued thereto, information to bidders and pertinent documents issued by the Owner's representative are a part of these drawings and specifications and shall be complied with in every respect. All of the above documents will be on file at the office of the Owner's representative and shall be examined by all bidders. Failure to examine all documents shall not relieve the responsibility or be used as a basis for additional compensation due to omission of details of other sections from the electrical documents.
- C. Furnish all work, labor, tools, superintendence, material, equipment, and operations necessary to provide for a complete and workable electrical system as defined by the contract documents.
- D. Be responsible for visiting the site and checking the existing conditions. Ascertain the conditions to be met for installing the work and adjust bid accordingly.
- E. It is intent of the contract document that upon completion of the electrical work, the entire system shall be in a finished, workable condition.
- F. All work that may be called for in the specifications but not shown on the drawings; or, all work that may be shown on the drawings but not called for in the specifications, shall be performed by the Contractor as if described in both. Should work be required which is not set forth in either document, but which work is nevertheless required for fulfilling of the intent thereof; then, the contractor shall perform all work as fully as if it were specifically set forth in the current documents.
- G. The definition of terms used throughout the contract documents shall be as specified by the following agencies:

1. Underwriters Laboratories
2. National Electrical Manufacturers Association
3. American National Standard Institute

4. Insulated Power Cable Engineers Association
5. National Electrical code
6. National Fire Protection Association

H. Pre-approved electrical contractors are as follows:
T.Morales - (254) 793-4344
Suntech Electric – (512) 339-7888

Any electrical contractor other than the named pre-approved system supplier must submit a pre-bid submittal document twenty-one (21) days prior to project bid date. Provide four (4) bound copies, with tabbed dividers and contents organized and presented as hereinafter specified.

1. Pre-Bid approval does not exempt the Contractor from meeting all the requirements of the Contract Documents nor does it give any prior acceptance of any equipment, software or services. The Contract Documents are the final authority for acceptance of the work provided. The Pre-Bid Submittal is not a part of the contract documents and as such does not exempt the Contractor from the requirements of contract submittals described hereinafter.
2. Information contained in the Pre-Bid Submittal shall be considered public information. All data submitted will become and remain the property of the Owner; none will be returned.
3. The Engineers decision as to pre-bid approval shall be final. The Consulting Engineer shall be considered the sole judge of the merits of the alternate system and shall indicate pre-approval of the alternate system via a written addendum to the specifications prior to the actual bid date.
4. The right is reserved to reject any and all proposals, to waive any informality, irregularity, mistake, error or omission in any proposals received and to accept the proposal, as determined by the Engineer or Owner, deemed most favorable to the Owner's interests:
5. Listing of firm's history.
6. Listing of personnel to be used on the project including job titles and resumes.
7. List of equipment owned by contractor for use on this project.

8. Certificates of all insurance complete with expiration dates.
9. Project personnel: Identify all system supplier personnel with resumes who could be assigned to this project.
10. Describe provisions for service, technical assistance and re-placement parts for the proposed project. Include the contractors 1-800-toll free number.
11. Provide installation list of at least 20 locations of previous similar projects including telephone numbers, functional description, and contact personnel.

1.02 PERMITS, CODES AND UTILITIES

- A. Secure all permits, licenses, and inspections as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, rules, regulations and contract requirements bearing on the work.
- B. The minimum requirements of the electrical system installation shall conform to the latest edition of the National Electrical Code as well as state and local codes.
- C. Codes and ordinances having jurisdiction and specified codes shall serve as minimum requirements; but, if the Contract Documents indicate requirements which are in excess of those minimum requirements then the requirements of the Contract Documents shall be followed. Should there be any conflicts between the Contract Documents and codes, or any ordinances, report these with bid.
- D. Determine the exact requirements for the utility service connections and metering facilities as set forth by the utilities that will serve the project, and pay for and perform all work as required by those utilities.

1.03 STANDARDS

- A. All materials and equipment shall conform to the requirements of the Contract Documents. They shall be new, free from defects, and they shall conform to the following standards where these organizations have set standards:
 1. Underwriters Laboratories, Inc. (UL)
 2. National Electrical Manufacturer's Association. (NEMA)
 3. American National Standards Association. (ANSI)
 4. Insulated Cable Engineers Association. (ICEA)
- B. All material and equipment, of the same class, shall be supplied by the same

manufacturer unless specified to the contrary.

- C. All products shall bear UL labels where standards have been set for listing.

1.04 SHOP DRAWINGS AND SUBMITTALS

- A. Shop drawings shall be taken mean detailed drawings with dimensions, schedules, weights, capacities, installation details and pertinent information that will be needed to describe material or equipment in detail.
- B. Submittals shall be taken to mean catalog cuts, general descriptive information, catalog numbers and manufacturer's name.
- C. Submit for review in sextuplet within sixty (60) days after notice to proceed, all shop drawings and submittals as hereinafter called for. If shop drawings and submittals are not received in sixty (60) days, the Owner's representative reserves the right to go directly to the manufacturer for the information and any expense incurred shall be borne by the contractor.
- D. Review of submittals or shop drawings shall not remove the responsibility for furnishing materials or equipment of proper dimensions, quantity and quality; nor will such review remove the responsibility for error in the shop drawings or submittals.
- E. Failure to process submittals or shop drawings on any item and/or items specified shall make the Contractor responsible for the suitability of the item and/or items, even though the item and/or items installed appear to comply with the Contract Documents.
- F. Assume all costs and liabilities which may result from the ordering of any material or equipment prior to the review of the shop drawings or submittals, and no work shall be done until the shop drawings or submittals have been reviewed. In case of correction or rejection, resubmit until such time as they are accepted by the owner's representative and or engineer and such procedures will not be cause for delay. Contractor shall have two submittal reviews after which contractor can be charged by owner and or engineer an hourly rate to review submittals. After final review, supply up to six (6) copies, if requested.
- G. Submittals and shop drawings shall be compiled from the manufacturer's latest product data. Should there be any conflicts between this data and the Contract Documents, report this information for each submittal and/or shop drawing.
- H. Contractor shall clearly indicate which items are to be used. Shop drawings and submittals will be returned and unchecked if the specific items proposed are not clearly marked, or if the general contractor's approval stamp is omitted.

- I. When requested, furnish samples of materials for acceptance review. If a sample has been reviewed and accepted, then that item of material or equipment installed on the job shall be equal in quality to the sample; if it is found that the installed item is not equal then replace all such items with the accepted sample equivalent at no additional cost to owner.
- J. Materials to be submitted are as follows:
 - 1. Safety Switches
 - 2. Wiring devices
 - 3. Wire
 - 4. Conduit and Fittings
 - 5. Lighting fixtures
 - 6. Lift Pumps Control Panel
 - 7. Generator
 - 8. Automatic Transfer Switch

1.05 ACCEPTANCE AND SUBSTITUTIONS

- A. All manufacturers named are a basis as a standard of quality and substitutions of any equal product will be considered for acceptance. The judgment of equality of product substitution shall be made by the Engineer.
- B. Substitutions after award of contract shall be made only within sixty (60) days after the notice to proceed. Furnish all required supporting data. The submittal of substitutions for review shall not be cause for time extensions.
- C. Where substitutions are offered, the substituted product shall meet the product performance as set forth in the specified manufacturer's current catalog literature, as well as meeting the details of the Contract Documents.
- D. The details on the drawings and the requirements of the specifications are based on the first listed item of material or equipment; if any other than the first listed materials or equipment is furnished, then assume responsibility for the correct function, operation, and accommodation of the substituted item. In the event of misfits or changes in work required, either in this Section or other Sections of the Contract, or in both; bear all costs in connection with all changes arising out of the use of other than the first listed item specified.

1.06 EXCAVATION AND BACKFILLING

- A. Do all excavating and backfilling necessary for the installation of the work. This shall include shoring and pumping in ditches to keep them dry until the work in

question has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed.

- B. All excavations shall be made to the proper depth, with allowances made for floors, forms, beams, piping, finished grades, etc. Ground under conduits shall be well compacted before conduits are installed.
- C. All backfilling shall be made with selected soil; free of rock and debris and shall be pneumatically tamped in six (6") inch layers to secure a field density ratio of 90%.
- D. All excavated material not suitable and not used in the backfill shall be removed offsite at the Contractors expense.
- E. Field check and verify the locations of all underground utilities prior to any excavating. Avoid disturbing these as far as possible. In the event existing utilities are broken into or damaged, they shall be repaired so as to make their operation equal to that before the trenching was started at no additional cost to owner.
- F. Where the excavation requires the opening of existing walks, drives, or other existing pavement, these facilities shall be cut as required to install new lines and to make connections to existing lines. The sizes of the cut shall be held to a minimum consistent with the work to be installed. After installation of new work is completed and the excavation has been backfilled in accordance with above, repair existing walks, drives or other existing pavement to match existing installation.

1.07 CUTTING AND PATCHING

- A. Cutting and patching required under this section shall be done in a neat workmanlike manner. Cutting lines shall be uniform and smooth.
- B. Use concrete saws for large cuts in concrete and core drills for small round cuts in concrete.
- C. Where openings are cut through masonry walls, provide lintel or other structural supports to protect the remaining masonry. Adequate support shall be provided during the cutting operation to prevent damage to masonry.
- D. Where large openings are cut through metal surfaces, attach metal angles around the opening.
- E. Patch concrete openings that are to be filled with non-shrinking cementing compound. Finish concrete patching shall be troweled smooth and shall be

uniform with surrounding surfaces.

1.08 WATERPROOFING

- A. Provide waterproof flashing for each penetration of exterior walls and roofs.
- B. Flashing for conduit penetrations through built-up roofs shall be made with pitch pans filled with pitch. Conduit penetrations through poured concrete roofs shall be made with sleeves and annulus caulked.
- C. Penetrations through walls at below ground elevations shall be waterproofed by conduit sealing fittings or other methods as indicated.
- D. Interiors of raceways that are likely to have water ingress such as runs from handholes into below-grade installations shall have waterstops installed to prevent water from entering into installations.

1.09 EQUIPMENT PROTECTION

- A. Provide suitable protection for all equipment, work and property against damage during construction.
- B. Assume full responsibility for material and equipment stored at the site.
- C. Conduit openings shall be closed with caps or plugs during installation. All outlet boxes and cabinets shall be kept free of concrete, plaster, dirt, and debris.
- D. Equipment shall be and tightly sealed against entrance of dust, dirt, and moisture.

1.10 CLEAN-UP

- A. Remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work, clean equipment and the entire installation so as to present a first class job suitable for occupancy. No loose parts or scraps or equipment shall be left on the premises.
- B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer, or with an approved paint.
- C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt, and debris.

1.11 TESTS

- A. All equipment shall put through a trial run-in test to ascertain the performance complies with the intent of the specifications. All-in tests shall be made in the presence of the Engineer. All cables shall have an insulation test performed using 600 volt megger.
- B. Cables installed with an insulation reading less than 500 megohms shall be removed and new cable installed and retested at no additional cost to the owner. Cables installed with an unacceptable insulation reading shall be removed and new cable installed and retested at no additional cost to the owner.
- C. No later than two weeks prior to startup an electrical inspection shall be coordinated by contractor with City of Pflugerville. Any punch list items generated from this inspection must be completed prior to contacting ~~WCID No.17~~ for startup.
- D. The following is a check list to be completed by the contractor before owner's representative and or engineer are called to start up and or final inspection. If all items on the check list are not completed prior to the start up and or final inspection, the owner and or engineer may charge the contractor an hourly rate for inspections until job is completed. This check list is general and only provides a list of the minimum to be completed before owner and or engineer are called for final inspection and or startup. The contractor is still responsible for any and all other items to be installed as set forth by the drawings and specifications that are not on this list.

INSPECTION CHECK LIST

Item to Inspect	Yes	No	N/A	Comments
Wet Well				
Access cover installed properly				
All construction debris removed from wet well				
Safety net installed and secured properly				
Guide rails installed correctly				
Pumps sitting on base 90° properly				
Pump cables routed properly				
Pump cables secured properly				
Chains are stainless steel				
Chains installed and properly secured				
Pumps travel on rail properly				
Pumps fit through access hatch properly				
Confirm proper pump rotation				
Pumps slide down rails properly				
Pumps seat properly				
Discharge piping properly installed				
Inverts installed properly				
Float rack installed properly				
Floats installed and secured properly				
Stilling-well installed properly				

(Revised 9/02/14)

Transducer installed and secured properly

Transducer adjusted to proper depth

Minimal slack in wet-well stainless steel

Vent properly installed with screen

Valve Vault

Access cover installed properly

All construction debris removed from valve vault

Ladder installed

1/4" pipe test ports in proper location

1/4" valves installed on test ports

Check valves properly installed

Gate valves properly installed

Air relief valve properly installed

Floor drain installed and working properly

All pipe supports properly installed

Item to Inspect	Yes	No	N/A	Comments
Generator				
No construction debris inside generator cover				
Coolant Levels				
Hoses & Connections				
Fan Drive Pulley in Fan				
Fan Belts				
Jacket Water Heater				
Water Pump				
Fuel/Tank				
Water Separator				
Fuel Lines & Connections				
Fuel Filters				
Fuel Pressure				
Air Filter				
Air Inlet System				
Turbocharger				
Exhaust Manifold				
Exhaust System				
Oil Level				
Oil Pressure				

Crankcase Breather				
Batteries				
Battery Charger				
Starting Motor				
Alternator				
E-Stop				
Control Panel				
ATS				

Voltage Output (note voltage)				
Proper Phase				
Transfer Switch				
Turn off station main power				
Did generator start?				
Did transfer switch to emergency?				
Ran pumps on generator power?				
Turn station power back on				
Did transfer switch back to normal?				
Did generator shut down properly?				
Did operator receive alarm?				

Item to Inspect	Yes	No	N/A	Comments
General Inspection				
Control panel rack installed properly				
Panel lighting installed and working properly				
All other panels on rack installed properly				
Alarm light installed, working and visible				
All above grade conduit is aluminum				
All unistrut is stainless steel				
All hardware is S.S.				
Yard lights installed and workerly properly				
Control Panel				
Control panel wired correctly				
Proper incoming voltage from utility company (note voltage)				
Proper incoming voltage from generator (note voltage)				
Check proper operation of back-up floats				
Check proper operation of Liquid Level Controller				
Junction Box at Wet Well				
Junction box installed properly				
Junction box properly vented (including screens)				
Excess cable removed				
All cables from wet well sealed with CGB's				
All conduits sealed between junction box and panel				

(Revised 9/02/14)

Term strip installed properly				
All wires properly labeled				
Tug test all wires				

City of Pflugerville Start-Up Check List

Project Name: _____ Inspection Date: _____

General Contractor: _____ Representative: _____

Inspector: _____

Item to Inspect	Yes	No	N/A	Comments
WET				
WELL				
COATED AND CLEAN				
PUMPS AND WIRING INSTALLED				
FLOATS AND TRANSDUCER INSTALLED				
STILLING WELL INSTALLED				
RAILS AND BRACKETS INSTALLED				
DOOR OPENS PROPERLY WITH SAFETY NET				
VENT WITH SCREEN				
VALVE VAULT				
VALVES, PIG PORT AND CHECK VALVES WITH ARMS INSTALLED				
2" AIR RELEASES INSTALLED AND PLUMBED TO DRAIN				
ACCESS DOOR OK WITH PIG PORT				
PIPING PAINTED AND VAULT CLEANED				
GAUGES INSTALLED				
CONTROL PANEL / TRANSFER SWITCH AND MAIN DISCONNECT				
ROOF INSTALLED PROPERLY				
LIGHTS INSTALLED CORRECTLY				
RED LIGHT CAN BE SEEN FROM STREET				
ALL WIRING, CONDUIT, AND HUBS INSTALLED CORRECTLY				
ALL WIRING LABELED				
GENERATOR				
4 HOUR LOAD TEST ON SITE				
DIESEL TANK FULL				
WATER				
HOSE BIB WITH RPZ IN GRAVEL				
MISCELLANEOUS ITEMS				
ALL CONCRETE DONE/FENCE INSTALLED AND ABLE TO BE LOCKED AFTER STARTUP				
FORCE MAINS - TWO WAY CLEANOUTS, CHECKED				
MAIN LINE VALVE OPEN				
CLEANOUTS CLOSED				
AIR RELEASES WORKING TO THE END OF THE LINE				
PRE STARTUP COMPLETED BY ALL CONTRACTORS				

Lift Station Overall Start-Up Result (circle one) PASS FAIL

Disclaimer: The above checklist is a general checklist for The City of Pflugerville Lift Station related items. This list provides the various minimums that we require. The contractor is responsible for any items found that may not be on this list.

(Revised 9/02/14)

1.12 RECORD DRAWINGS

- A. At the start and during the progress of the job, keep one separate set of blue-line prints for making construction notes and mark-ups.
- B. Show conduit routing and wiring runs as constructed and identify each.
- C. Record all deviations from the Contract Documents.
- D. Submit set of marked-up drawings for review.

1.13 OPERATIONS AND MAINTENANCE MANUALS

- A. Six (6) weeks prior to the completion of the project, compile an operations and maintenance manual on each item of equipment. These manuals shall include detailed instructions and maintenance, as well spare parts lists.
- B. Contractor is to submit one (1) hard copy and one (1) copy on CD-ROM Containing PDF versions of the operations and maintenance manuals for review.

PART 2 PRODUCTS

2.01 RACEWAYS

- A. Above ground conduit shall be schedule 40 aluminum and shall comply with Article 346 of NEC and U.L. standard UL-6.
- B. Below grade conduit shall be non-metallic rigid PVC Schedule 40, rated 90 degrees Celsius and conform to NEMA TC-2 and UL-651 Standards, transitions to above ground to be made with PVC coated hot dipped rigid steel conduit.
- C. Connections to motors shall be made using liquid tight flexible conduit and shall consist of galvanized flexible interlocking steel core with thermoplastic cover.

2.02 CONDUIT FITTINGS

- A. NEMA 1 lock nuts for indoor rigid metallic conduit shall be galvanized steel.
- B. Outdoor field applied hubs for sheet metal enclosures shall be galvanized steel ring, nylon throat, threaded NPT insert and shall be MYERS "SCRU-TITE", or equal.
- C. Conduit hubs for non-metallic enclosures shall be fiberglass polyester reinforced with galvanized steel core, complete with lockout and grounding bushing and shall be Square D Type NH, or equal.

- D. Rigid metallic conduit chase nipples, slip fittings, unions, reducers shall be hot dipped galvanized steel.
- E. Rigid metallic conduit grounding bushings shall be hot dipped galvanized steel with threaded hub, nylon insulated throat, and ground lug.
- F. Liquid tight flexible conduit fittings shall be hot dipped galvanized steel body with internal locking ring.

2.03 CONDUIT BODIES AND BOXES

- A. Conduit bodies such as "C", "LB", "T" and the like pulling fittings shall be sand-cast copper free aluminum. Covers shall be gasketed cast metal with stainless steel cover screws and clamp style attachment. Furnish Crouse-Hinds Form 7, or equal.
- B. Conduit bodies such as "GUA", "GUAT", "GUAL", and the like pulling/splicing fittings shall be copper free aluminum with cast metal covers. All such conduit bodies shall be Crouse-Hinds GU/EA series, Appleton "GR" series, equal.
- C. Cast metal outlet boxes, pull boxes, and junction boxes whose volume is smaller than 100 cubic inches, and cast metal device boxes, shall be sand-cast copper free aluminum. All boxes shall have threaded hubs. Furnish Crouse-Hinds "FD" style Condulets, Appleton "FD" style Unilets, or equal.
- D. Covers for cast metal boxes shall be gasketed cast metal covers with stainless steel screws.

2.04 WIRE AND CABLE

- A. All conductors shall be soft-drawn, stranded annealed copper that meets ANSI 44, ASTM B3-74/38-72.
- B. Insulation for all 480V conductors in sizes larger than #3/0 AWG shall be insulated with ethylene propylene rubber and shall have chlorosulfonated flame retardant outer jacket. All such wire shall be type RHH, RHW, USE, VW-1. Furnish okonite "Okolon", Rockbestos "Firewall", or equal.
- C. Insulation for all 480V conductors in sizes #3/0 AWG and smaller shall be cross-linked polyethylene. Furnish type RHH, RHW, USE wire, Okonite "X-Olene", GE "Vulkene", or equal.
- D. All power signal-conductor cables shall be factory pigmented black insulation.

- E. Insulation for all 120/240V conductors, insulated equipment grounding conductors and control conductors shall be type THWN For dry and wet locations; maximum operating temperature shall be 75°C (THWN). UL listed as gasoline and oil resistant. PVC insulation with nylon outer jacket. Meet UL 83 and Federal Spec J-C-30B.
- F. Multiconductor shielded cables shall be polyethylene insulated tinned copper conductors within an aluminum-polyester shield tinned copper drain wire and a chrome PVC jacket. Shield shall provide 100% coverage. Cables shall be UL style 2092 and shall be Beldon Beldfoil #8760 or equal, with number of conductors shown.
- G. Multiconductor signal cables shall consist of twisted pairs of insulated copper conductors, size and number of pairs as indicated, with a petroleum-polyethylene compound which fills all cable interstices, a non-hygroscopic core tape, .005" copper shield and a polyethylene jacket. Cable shall be manufactured to REA Specification PE-39 for REA designation BJCF cables and shall be Okonite type KTC-F or equal.
- H. Multiconductor cords shall consist of rubber insulated high-strained copper conductors contained within a neoprene jacket. Furnish type SJO/300V class for 120/240V class applications.

2.05 CONNECTORS

- A. Power connectors shall be insulated tap connectors. Furnish NSI Polaris connectors with no equals.
- B. Insulated spring-wire connectors, "wire-nuts", for small building wire taps and splices shall be plated spring steel with thermoplastic jacket. Connector shall be rated at 150 degrees Celsius continuous. Furnish 3M "Hyflex", T&B "PT" or equal.
- C. Insulated set-screw connectors shall consist of copper body with flame-retardant plastic insulated shield. Furnish Ideal, T&B, or equal.
- D. Connectors for control conductor connections to screw terminals shall be crimp-type with vinyl insulated barrel and tin-plated copper ring-tongue style connector. Furnish T&B "Sta-kon", 3M "Scotchlok", or equal.

2.06 INSULATING PRODUCTS

- A. Tape products shall be furnished as hereinafter specified and shall be Plymouth, Okonite, F.E., 3M, or equal.

- B. General purpose electrical tape shall be 7 mil thick stretchable vinyl plastic, pressure adhesive type, "slipknot Grey", 3M Scotch 33+, or equal.
- C. Insulating void-filling tape and high voltage bedding tape shall be stretchable ethylene propylene rubber with high-tack and fast fusing surfaces. Tape shall be rated for 90 degrees Celsius continuous, 130 degrees Celsius overload, and shall be moisture-proof void filling tape shall be "plysafe", 3M Scotch 23, or equal.
- D. High temperature protective tape shall be rated 180 degrees Celsius continuous indoor/outdoor, stretchable, self-bonding silicone rubber. High temperature tape shall be "Plysil #3445", 3M Scotch 70, or equal.
- E. Insulation putty filler-tape shall be Plymouth #2074, 3M, or equal.

2.07 LABELS

- A. Colored banding tape shall be 5 mil stretchable vinyl with permanent solid color. Color shall be as hereinafter specified. Tape shall be Plymouth "Slipknot 45", 3M Scotch #35, or equal.
- B. Numbered marking labels shall be colored vinyl markers, T&B, Brady, or equal.
- C. Cable identification labels shall be water resistant polyester with blank write-on space, T&B, Brady, or equal.
- D. Buried conduit marking tape for marking path of buried conduits shall be a four (4") inch nominal width strip of polyethylene with highly visible, repetitive marking "BURIED CONDUIT", or similar language, along its length.
- E. Nameplates shall be micarta lamicoid material, 1/6" thick, black background with white engraving. Attachment means shall be made with a minimum of two self-tapping stainless steel screws.

2.08 GROUNDING DEVICES

- A. Exothermally welded joints shall be made with Enrico "cadweld".
- B. Ground bus connectors shall be Square D type "LU", OZ Type "XLH", or equal.
- C. Conduit grounding bushings shall be as specified under CONDUIT FITTINGS.

2.09 SUPPORTING DEVICES

- A. Mounting hardware, nuts, bolts, lock washers, and washers shall be grade 304

stainless steel.

- B. All equipment supports and mounting structures shall be fabricated as shown on drawings.
- C. Plastic saddles for supporting buried conduits shall be interlocking type that provides separation between conduits vertically and laterally and between bottom of conduits and trench floor.

2.10 MISCELLANEOUS MATERIAL

- A. Double bushing for insulating wiring through sheet metal panels shall consist of mating male and female threaded phenolic bushings. Phenolic insulation shall be high-impact "ABB", Gedney type "ABB", or equal.
- B. Cable grips shall be stainless steel, grip-type wire mesh with machined metal support. Furnish Kellems, Appleton, or equal products.
- C. Conduit pull-cords for use in empty raceways shall be glass-fiber reinforced tape with foot-marked along its length. Furnish Thomas, Greenlee, or equal products.
- D. Conduit thread coating compound shall be conductive, non-galling, and corrosion-inhibiting. Furnish Crouse-Hinds type "STL", Appleton type "ST", or equal.
- E. Wire pulling compound shall be non-injurious to insulation and to conduit and shall be lubricating, non-crumbling, and non-combustible. Furnish Gedney "Wire-Quick", Ideal "Yellow", or equal.
- F. Plastic compound for field-coating of ferrous material products shall be PVC in liquid form that sets-up semi-hard upon curing. Furnishing Rob Roy "rob Kote", Sedco "Patch Coat", or equal.
- G. Zinc spray for coating electro galvanized steel products shall be Research Laboratory type "LPS", Mobil "Zinc-spray", or equal.
- H. Splicing kit shall be provided with insulating and sealing compound to provide a moisture-tight splice. Provide Scotchcast Series 82 or equal splicing kit.

2.11 LIGHTING

- A. Fixture lamps shall be furnished.
- B. Each fixture shall be complete with its appropriate hardware, finish trim, and appurtenances as required for a finished installation.

2.12 WIRING DEVICES

- A. All wiring devices shall be specification grade and shall meet NEMA WD 1-1971 requirements. Furnish following types unless otherwise indicated.
- B. Two-pole, 3-wire grounding, 15A/125V, NEMA 5-15R duplex receptacle shall be Arrow-Hart #5662-S, Hubbel #5262, or equal.
- C. Two-pole, 3-wire grounding, 20A/125V, NEMA 5-20R duplex receptacle shall be Arrow-Hart #5739-S, Hubbell #5362, or equal.
- D. GFI receptacle shall be duplex receptacle in a duplex body containing reset and test push-buttons. Furnish Square D "GFSR", or equal.
- E. Two-pole, 3-wire grounding, #20A/250V NEMA 6-20R single receptacle shall Arrow-Hart #5861, Hubbell #5461, or equal.
- F. Single-pole, single throw, 20A toggle switch shall be Arrow-Hart #1791, Hubbell #1221, or equal.
- G. Single-pole, double throw (three-way) 20A toggle switch shall be Arrow-Hart #1994, Hubbell #1224, or equal.
- H. Double-pole, double-throw (four-way) 20A toggle switch shall be Arrow-Hart #1994, Hubbell #1224, or equal.
- I. Double-pole, single-throw 29A toggle switch shall be Arrow-Hart #1992, Hubbell #1222, or equal.
- J. Single-pole, double-throw, momentary/centeroff, 20A toggle switch shall be Arrow-Hart #1995, Hubbell #1556, or equal.
- K. Door switch, single-throw pressure sensitive shall be Pass & Seymour #1205, or equal.

2.13 PANELBOARDS

- A. Panel boards shall have voltage, overcurrent devices and features as indicated.
- B. Breakers shall be plug-on type, trip-free. Multiple breakers shall be provided with a common internal trip which opens all poles simultaneously and with a single operating handle for all poles. Handle ties between breakers are not acceptable.
- C. Breakers for 480V distribution panels shall be rated at least 14000 amps I.C., and

breakers for 120/240V panels shall be rated at least 10,000 amps I.C.

- D. Provide ground bus inside each cabinet.
- E. Enclosures shall be NEMA 4X stainless steel surface mounted cabinet with gasketed, hinged door, inside gutter trim and with door mounted directory pocket.

2.14 DRY-TYPE TRANSFORMERS

- A. Dry-type transformers shall have continuous KVA and voltage characteristics as shown.
- B. Enclosures shall be stainless steel.
- C. Copper coils shall be provided with NEMA standard taps in high voltage windings.
- D. Furnish Square D or equal dry-type transformers.

2.15 SAFETY SWITCHES

- A. Safety switches shall be fused or non-fused as indicated. Each fused type switch shall be equipped with class R refection clips.
- B. Switch mechanism in each safety switch shall be quick-make, quick-break, heavy-duty type that meets Federal Specification W-S-865C.
- C. Enclosures shall be NEMA types as indicated. NEMA 4X types shall be stainless steel with gasketed door and stainless steel hardware.
- D. Conduit hubs for NEMA 4X enclosed safety switches shall be steel body type with fiberglass reinforced polyester covering and with grounding bushing inside.
- E. Conduit hubs for NEMA 3 and NEMA 4 enclosures shall be water-tight threaded hubs with grounding bushing inside.
- F. Each enclosure shall be equipped with ground lug.
- G. Where indicated furnish disconnect switches with switch handle activated auxiliary control disconnect contact rated 10 amp make, 6 amp break 120V A. C., 35% p.f.
- H. Where indicated furnish NEMA 4X safety switches with integrally mounted pilot operators.

- I. NEMA 1,3,4 or 12 enclosed safety switches shall be Square D or equal.
- J. NEMA 4X safety switches shall be stainless steel.

2.16 EMERGENCY GENERATOR

A. GENERAL:

Contractor shall furnish and install complete outdoor weather proof enclosed emergency power supply systems consisting of diesel engine-generators, automatic transfer switches and associated controls and wiring as shown on the drawings and specified herein. Generator shall be Holt cat generator system or approved equal.

B. RATING:

Rating of the diesel engine-generator set shall be based on operation of the set when equipped with all necessary operating accessories such as radiator, fan, air cleaners, lubricating oil pump, fuel transfer pump, fuel injector pump, jacket water pump, governor, charging alternator, alternating current generator, and exciter regulator. The diesel engine-generator set shall be capable of producing at least XXX KW at 0.8 power factor standby rating or sized as required for the loads shown in the generator loading schedule on the plans, at 480/277 Volts, 3 phase, 4 wire, 60 HZ.

C. SUBMITTALS:

Contractor shall submit the following information:

1. Drawings of the diesel generator set offered hereunder. Literature describing the diesel engine generator set and indicating its current production status.
2. Drawings and/or literature describing auxiliary equipment to be furnished.
3. The following data in tabulated form:
 - a. Make of engine
 - b. Number of cylinders
 - c. Bore, inches (millimeters)
 - d. Stroke, inches (millimeters)
 - e. Piston displacement, cubic inches (liters)
 - f. Piston speed, feet per minute (liters/mim.) at rated RPM
 - g. BMEP rated KW output
 - h. Make and type of generator
 - i. Generator electrical rating, KVA or KW .8 power factor
 - j. Number and type of bearings
 - k. Exciter type
 - l. Generator insulation class and temperature rise
 - m. Parts and service support
 - n. Engine manufacturer's certified engine BHP curve and certified gen set fuel consumption curve

- o. Electrical loading and performance calculations
- 4. Foundation design for each location

D. ENGINE SPECIFICATIONS:

1. TYPE- The engine shall be compression ignition engine. It shall be a four stroke cycle, water cooled, solid-injection engine of either vertical in-line or V-type.
2. HORSEPOWER- Certified engine horsepower curves shall submitted showing the manufacturer's approval of the engine rating for generator set standby and prime power application. Special ratings or "maximum" ratings will not be acceptable.
3. SPEED- The engine shall not exceed 1800 RPM at normal full load operation.
4. FUEL- The engine fuel shall be capable of satisfactory performance on a commercial grade of distilled petroleum fuel oil such as No. 2 diesel fuel.
5. GOVERNOR- The engine speed shall be controlled by an electronic or hydraulic governor to maintain constant speed from no load to full load. The frequency at any constant load, including no load, shall remain within a steady state band width of +0.25% of rated frequency. The governor shall not permit frequency modulation (defined as the number of times per second that the frequency varies from the average frequency in cyclic manner) to exceed one cycle per second.
6. FUEL SYSTEM- Furnish and install a double walled 142 UL Listed base mounted fuel tank with sufficient capacity for 24 hours operation at full load complete with a fuel level gauge and one (1) full tank of fuel.
7. LUBRICATION- The engine shall have a gear-type lubricating oil pump for supplying oil under pressure to main bearings, crank-pin bearings, piston pins, timing gears, camshaft bearings, and valve rocker. Threaded spring-on type full flow lubricating oil filters, conveniently located for servicing, shall be provided. Filters shall be equipped with a spring loaded bypass valve to insure oil circulation if filters are clogged.
8. AIR CLEANERS- The engine shall be provided with one or more dry type replaceable element, air cleaners.
9. STARTING- The engine shall be equipped with a electric starting system of sufficient capacity to crank the engine at a speed which will allow diesel starting of the engine. Lead acid batteries shall be furnished having sufficient capacity for cranking the engine for at least 40 seconds at firing speed in the ambient temperature specified. A battery rack and necessary cables and clamps shall be provided. A suitable battery charging alternator shall be provided with sufficient capacity to recharge the batteries back to normal starting requirements quickly. An automatic battery trickle charger (5 amp capacity minimum) shall be provided to maintain the batteries at full capacity.
10. ENGINE INSTRUMENTS- An engine or generator mounted instrument

panel shall contain the following gauges for proper engine surveillance and maintenance:

- a. Engine Coolant Temperature
 - b. Engine Lube Oil Pressure
 - c. Engine Lube Oil Temperature
 - d. Engine Running Hourmeter
 - e. Battery Charging Indicator
 - f. Engine Fault Indicator for Oil Pressure, Coolant Temperature, and Engine Overspeed
 - g. Fuel Level
11. COOLING- The engine shall be furnished with a cooling system having sufficient capacity for cooling the engine when the diesel generator set is delivering full-rated load at the ambient temperature and altitude. The engine shall be equipped with an engine driven, centrifugal-type water circulating pump and thermo-static valve to maintain the engine at recommended temperature level. The engine cooling system shall include one or more spin-on type engine water filters which will treat the coolant and prevent corrosion and scale deposits inside the cooling system. The engine cooling system shall be filled with a minimum concentration of 33% ethylene glycol. The engine shall be equipped with a radiator, 240 Volt single phase engine block heater, blower fan, and close fitting venturi shroud of a type and capacity recommended by the engine manufacturer. A rigid guard shall enclose both top and sides of all moving parts between the engine and radiator.
12. EXHAUST SYSTEM- A suitable silencer, of the Critical type shall be furnished with the engine.
13. SAFETY CONTROLS- The engine shall be equipped with automatic safety controls which will shut down the engine in the event of low lubricating oil pressure, high coolant temperature, engine overspeed, engine overcrank, and make electrical contacts for alarm light on the control panel. In addition, pre-alarm signals for high coolant temperature and low lube oil pressure shall be provided.
14. MOUNTING- The engine and generator shall be equipped with suitable full length sub-base for mounting the engine generator unit on a concrete foundation. The engine shall be equipped with spring type vibration isolators between the sub-base and the concrete foundation unless they are integrated into genset design.
15. ATTENUATED ENCLOSURE- The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, sound attenuated enclosure mounted on the fuel tank base.
- a. A weather resistant, sound attenuated enclosure of steel with electrostatically applied powder coated baked polyester paint. The enclosure shall have a resulting sound level of 78 dba @ 23ft with

the genset running under full load. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.

- b. Enclosure Sound Attenuation: Acoustical foam shall be provided between all supports and inside doors and sound baffles on air intake and air discharge.

E. GENERATOR SPECIFICATION

1. CONSTRUCTION- The generator shall be a brushless, revolving field type, coupled directly to the engine flywheel through a flexible driving disc for positive alignment. The generator housing shall bolt directly to the engine flywheel housing. The generator housing shall have a single ball bearing support for the rotor. The rotor shall be dynamically balanced up to 25% overspeed. The generator shall comply with NEMA standard MG-1978, Parts 16 22. Insulation shall be class B or F as recognized by NEMA. The rotor and stator temperature rise for the class insulation being furnished, and as measured by the resistance method at the voltage specified shall be in accordance with NEMA standard MG-116.40 and MG1-22.40 for standby (prime power) operation. The generator shall be fully guarded per NEMA MG1-1.25. The rotating brushless exciter shall incorporate a full wave, three phase rotating rectifier with hermetically sealed, metallic type, silicon diodes to supply main field excitation. A multiplate selenium surge protector shall be connected across the diode network to protect against transient conditions. The rotor shall be layer wound with thermosetting epoxy between each layer plus a final coat of epoxy for moisture and abrasion resistance. Amortisseur windings shall be integral with the rotor coil support. The rotor shaft bearing shall be shielded type with provisions for easy servicing through grease pipes which extend to the exterior of the generator frame. The bearing shall be designed for a minimum B-10 bearing life of 40,000 hours. The stator winding shall be of 2/3 pitch design to eliminate the third harmonic wave form distortion and minimize the harmful neutral circulating current when operation in parallel. The stator windings shall be given five dips and bakes of varnish plus a final coating of epoxy for moisture and abrasion resistance. The wave form harmonic distortion shall not exceed 5% total RMS measured line to line at rated load. The generator shall be furnished with an end mounted, ventilated load connection box such that load conductors can enter the bottom of the junction box. The voltage regulator shall be of the solid state construction type with SCR control. It shall be mounted inside the generator terminal box or in the control cabinet. A built-in voltage adjusting rheostat shall provide 10% voltage adjustment.
2. GENERATOR SET PERFORMANCE- The voltage regulation from no

load to rated shall be within a bank of +1% of rated voltage. The steady state voltage stability shall remain within a 0.5% band of rated voltage. Steady state voltage modulation shall not exceed one cycle per second. The regulator printed circuit board and power control diodes shall be hermetically sealed for moisture protection. For any addition of load up to and including 100 percent of rated load, at 0.8 power factor, the voltage dip shall not exceed 20% of rated voltage for the loads shown on the plans. The voltage shall recover to and remain within the steady state band in not more than 5.0 seconds. The frequency regulation from on load to rated load shall be in accordance with that defined by the engine governor performance. For any addition of load up to 100% of rated load, the frequency shall recover to the steady state frequency band within 6.0 seconds. The balanced telephone influence factor (TIF) shall not exceed 50. Alternator shall be equipped with permanent magnet or AREP excitation for improved motor starting capabilities.

F. CONTROL EQUIPMENT AND ACCESSORIES

1. GENERATOR CONTROL PANEL- The generator control panel shall be mounted on the generator terminal box in a NEMA-1 enclosure by means of vibration isolators and contain, at a minimum, a voltmeter, ammeter, frequency meter, combination ammeter-voltmeter phase selector switch, and engine instrumentation. Accessory equipment shall be provided on the generator control panel:
 - a. Alarm Lights
 - b. Pre-Alarm Features per NFPA 76A
 - c. Watt-meter
 - d. Automatic Start Control with Cycle Cranking

The basic panel shall be equipped with minimum features as follows:

1. Enclosure - NEMA 1
 2. AC Ammeter - 3 1/2 inch (89mm) dial type, 2% accuracy
 3. Ac Voltmeter - 3 1/2 inch (89mm) dial type, 2% accuracy
 4. Frequency Meter -3 1/2 inch (89mm) dial type, 2% accuracy
 5. Ammeter/Voltmeter Phase Selector Switch
 6. Three Current Transformers
 7. Solid State Circuit Breaker
 8. Nameplates, Control Wiring, Fuses, and Terminal Blocks
 9. Global alarm dry contacts for genset run & genset failure.
2. OVERLOAD PROTECTION CIRCUIT BREAKER- A main line molded case 3-pole circuit breaker shall be installed as a load circuit interrupting and protection device. It shall operate both manually as an isolation switch and automatically during overload and short circuit conditions. The trip unit for each pole shall have elements providing inverse time

delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriter's Laboratories, National Electric Manufacturer's Association, and National Electric Code. The circuit breaker shall be mounted in NEMA-1 type enclosure in or adjacent to the generator control panel.

3. **AUTOMATIC START-STOP SYSTEM-** The engine starting panel shall automatically provide a minimum of four cranking and three rest periods. Operation shall be initiated by the closing of contacts in the automatic transfer switch. The automatic starting panel control switch shall include the positions of "Automatic", "Off", and "Test". The automatic starting panel shall contain 24-volt alarm lights energized by the safety controls. A 24-volt visual light shall also be energized if the engine has started by the end of the final cranking cycle. The panel and selector switch shall be mounted in the generator control panel. A green light shall indicate when the selector switch is in the "automatic" power.
- G. **TESTING-**All performance and temperature rise data submitted by the manufacturer above and shall be the result of actual test of the same or duplicate generator. Temperature rise data shall be the result for full load, 0.8 power factor heat runs at the rated voltage and frequency. This testing shall be done in accordance with MIL-STD-705 and IEEE standard 115. Before the equipment is installed, a factory test log of the generator set showing a minimum of 3/4 hour testing with 1/2 hour at 100 percent rated load at 0.8 power factor, continuously, shall be submitted to the purchaser. Voltage and frequency stability and transient response at 1/4, 1/2 and full load shall also be recorded. Normal preliminary engine and generator tests shall have been performed before unit assembly. Prior to acceptance of the installation, the equipment shall be subjected to an onsite test at full load with resistive load banks for a minimum of 4 hours. All consumables necessary for this test operation shall be furnished by the contractor. Any defects which become evident during this test shall be corrected by the contractor at this own expense.
- H. The contractor shall contract with Holt Power Systems of San Antonio, Texas. Generator shall be Caterpillar with no equals. Contact Mr. Ed Moseley or Mr. Tom Tarbox at Holt Power Systems (210) 648-8407.

2.17 AUTOMATIC TRANSFER SWITCHES

- A. A Service Entrance Rated transfer switch shall be installed and rated at XXX amperes at 480 Volts and 60 HZ and be mechanically held and

electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred and capable of manual operation by one person. The switch shall be mechanically and electrically interlocked to ensure one of the two positions - normal or emergency. The switch shall be applicable to 50 Hz or 60 Hz and suitable for all common voltages from 110 to 600. Switch shall be service entrance rated and housed in a NEMA 4X stainless steel enclosure and shall conform with the provisions of Underwriter's Laboratories 1008 Standards and meet the National Electric Code (NEC) requirements for critical applications.

Accessories- Transfer switches shall be equipped with the following accessories:

- a. Time delay, normal to emergency, (adjustable 0.6 to 60 seconds)
- b. Time delay, emergency to normal, (adjustable 0.6 to 60 seconds)
- c. Time delay on engine cooling, (fixed, non-adjustable 5 minutes, -1 to +2 minutes tolerance)
- d. Time delay on engine starting, (adjustable 0.5 to 60 seconds)
- e. A test switch to simulate a normal power source failure
- f. Pilot contact to initiate engine starting controls
- g. Pilot lights to visually indicate the transfer switch position
- h. Relay contacts as required plus one spare set of normally open and normally closed relay contacts
- i. Provide solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period.

Automatic transfer switch shall be ASCO with no equals.

PART 3: INSTALLATION

3.01 RACEWAYS

- A. Install the conduit system to provide the facility with the utmost degree of reliability and maintenance free operation. The conduit system shall have the appearance of having been installed by competent workmen. Kinked conduit, conduit inadequately supported or carelessly installed, do not give such reliability and maintenance free operation and will not be accepted.
- B. Raceways shall be installed for all wiring runs except as otherwise indicated.
- C. Conduit sizes, where not indicated, shall be N.E.C. code-sized to accommodate the number and diameter of wires to be pulled into the conduit. Unless otherwise indicated, 3/4" trade-size shall be minimum size conduit.
- D. Unless otherwise noted, conduit runs shall be installed exposed. Such runs shall

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be made parallel to the lines of the structure. Where aluminum conduit or supporting devices come in contact with concrete, the conduit and or supporting devices shall be coated with zinc chromate or other suitable coating to prevent galvanic action.

- E. Conduit runs installed below-grade in earth shall be PVC. Use manufacturer's approved cement for joining couplings and adapters. Runs shall be installed so that tops of conduits are a **MINIMUM OF TWENTYFOUR (24") INCHES BELOW FINISHED GRADE**. Support conduits runs on plastic spacers and encase conduits with 2500 PSI reinforced concrete. Concrete shall be a minimum of 3" beyond conduits on all sides. Cover top of concrete with red colored concrete dye backfill to finished grade with selected soil that is free from clods, debris, rocks and the like. Pneumatically tamp backfill in six (6") inches to eight (8") inches below finished grade, install continuous run of "BURIED CABLE" marking taped. Contractor shall coordinate inspections by Cleary Zimmermann (210) 447-6100 before concrete is poured and before conduit runs are backfilled.
- F. Below-grade to above-grade upturns in non-metallic runs shall be made with PVC coated rigid metallic conduit.
- G. Rigid metallic conduit runs shall have their couplings and connections made with screwed fittings and shall be made up wrench-tight. Check all threaded conduit joints prior to wire pull.
- H. All conduit runs shall be watertight over their lengths of run except where drain fittings are indicated. In which cases, install specified breather-drain fittings.
- I. Plastic jacketed flexible steel conduit shall be used to connect wiring to motors, limit switches, bearing thermostats, and other devices that may have to be removed for servicing. Unless otherwise indicated, maximum lengths of flex shall be six (6') feet.
- J. Each flex connector shall be made-up tightly so that the minimum pull-out resistance is at least 150 lbs.
- K. Empty conduits shall have pull-tape installed. Identify each terminus as to location of other end. Use blank plastic waterproof write-on label and write information on each label with waterproof ink. Cap exposed ends of empty conduit with plastic caps.
- L. Conduit runs into boxes, cabinets, and enclosures shall be set in a neat manner. Vertical runs shall be set plumb. Conduits set cocked or out of plumb will not be acceptable.
- M. Conduit entrances into equipment shall be carefully planned. Cutting away of enclosure structure, torching out sill or braces, and removal of enclosure structural

members, will not be acceptable.

- N. Use approved hole cutting tools for entrances into sheet metal enclosure. Use of cutting torch or incorrect tools will not be acceptable. Holes shall be cleanly cut and they shall be free from burrs, fagged edges, and torn metal.
- O. All raceways shall be swabbed clean after installation. There shall be no debris left inside. All interior surfaces shall be smooth and free from burrs and defects that would injure wire insulation. All conduits shall be sealed after cable installation with electrical insulation putty.

3.02 CONDUIT BODIES AND BOXES

- A. Conduit bodies such as "LB", "T", etc., shall be installed in exposed runs of conduit wherever indicated and where required to overcome obstructions and to provide pulling access to wiring. Covers for such fittings shall be accessible and unobstructed by the adjacent construction.
- B. Covers for conduit bodies installed shall be gasketed cast metal type.

3.03 RACEWAY SUPPORT

- A. All raceway systems shall be adequately and safely supported. Loose, sloppy and inadequately supported raceways will not be acceptable. Supports shall be installed at intervals not greater than those set forth under Article 300 of N.E.C., unless shorter intervals are otherwise indicated, or unless conditions require shorter intervals of supports.
- B. Surface mounted runs of conduit on concrete or masonry surfaces shall be supported off the surface by means of aluminum slotted channels and conduit clamps. Attach each slotted channel support to concrete surface by means of two (2) 1/4" diameter stainless steel bolts into drilled expansion shields. Coat surface contacting concrete or masonry with zinc chromate.
- C. Conduit runs that are installed along metallic structures shall be supported by means of beam clamps or other methods as may be indicated. Coat each beam clamp with PVC prior to installation.
- D. Below-grade conduits shall be supported with plastic saddles.

3.04 WIRING

- A. Conductors shall be sized as shown and where no size is indicated, the conductor size shall be size #12 AWG.

- B. Insulation for all 120/240V conductors, insulated equipment grounding conductors and control conductors shall be type THWN For dry and wet locations; maximum operating temperature shall be 75°C (THWN). UL listed as gasoline and oil resistant. PVC insulation with nylon outer jacket. Meet UL 83 and Federal Spec J-C-30B
- C. All 480V wiring in sizes larger than #3/0 shall be made with type RHH, RH, USE, VW-1 wire with stranded copper conductors that has EPR insulation and flame retardant jacket.
- D. All 480V wiring in sizes #3/0 and smaller shall be installed with type RHH, RHW, USE insulated stranded copper conductors.
- E. Branch circuits may be spliced for receptacle, lighting and small appliances load inside appropriate junction boxes. All control and power cables shall be run continuous without splices except where approved by the engineer.
- F. Except as otherwise specified, taps and splices for receptacle, lighting and small appliances shall be made with insulated spring wire connectors. Such connectors in damp or wet locations shall be further insulated with an envelope of stretched piece of EPR tape around each wire to fill the interstices between the wires. Then, apply one-half lapped layer of electrical tape over all.
- G. Motor connections and all taps and splices other than for receptacle and lighting shall be made with the appropriate NSI Polaris series connectors.
- H. Control wiring connections to stud type and screw type terminals shall be made with ring-tongue type crimp connectors. Label each terminal jacket with wire marking label at each connection.
- I. Each wire connection shall be made up tightly so that resistance of connection is as low as equivalent length of associated conductor resistance.
- J. Phase label black pigmented power wires with color banding tape. Color of tape applies shall be that specified below.

CONDUCTOR	120/240V SYSTEMS	480V SYSTEMS
Phase A	Black	Brown
Phase B	Red	Yellow
Phase C	Blue	Purple
Neutral	White	Gray
Equipment Ground	Green	Green

- K. Numbered labels shall be installed to identify circuit numbers from panel boards. Install labels on each wire in each panelboard, junction, and pullbox, and device

connection.

- L. Label each wiring run with write-on waterproof labels inside each motor control center and in service switchboard. Install write-on label ties around wire group at conduit entrance and write-on label the wire size, and service.
- M. Install numbered marking on each control wiring termination at each terminal strip and at each device. Do this in motor control center, terminal cabinets, safety switches, remote controllers, pilot operators, and instrumentation equipment. Number selected shall correspond to number on terminal strip.
- N. All wiring inside enclosures will be neatly trained and laced with nylon tie-wraps.
- O. All wiring shall be installed in raceways unless otherwise noted; however, no wire shall be drawn into a conduit until all work of a nature which may cause injury is completed. Do not exceed wire and cable manufacturer's recommended pulling tensions. A cable pulling compound shall be used as a lubricant and its composition shall not affect the conductor or its insulation.

3.05 WIRING DEVICES

- A. Install wiring devices where indicated. Wiring devices shall be type as indicated.
- B. Each wiring device shall be set with axis plumb and installed with yoke screw so as to adequately support device yokes to the box.
- C. Device boxes shall be cast metal condulets or equal.
- D. Use ganged boxes for ganged devices.
- E. Each device box shall be equipped with specified cast metal cover.

3.06 GROUNDING

- A. Each item of equipment shall be adequately and thoroughly grounded. Comply with Article 250 of N.E.C., except where higher standards of grounding have been specified.
- B. Equipment grounding conductors (EGC) shall be installed where indicated. These wires shall be green colored in sizes #6 AWG and smaller and green banded in larger sizes.
- C. EGC runs into equipment and shall be grounded to equipment bus where available, or to equipment ground lugs.
- D. Where grounding type bushings are installed, bond EGC thereto and furthermore

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ground each bushing lug to equipment ground bus or ground lug, or ground rod.

- E. In each motor terminal box, install equipment ground lug and connect EGC thereto.
- F. In each floodlight pole, install ground connector to pole and bond to conduit bushing and to EGC in branch circuit.

3.07 LABELING

In addition to requirements for labeling as specified throughout this section, install as follows:

- A. Phase band each power wire and cable with colored banding tape. Do this at each termination.
- B. Apply numbered wire marking labels to control wires; power wiring in panelboards, pull and junction boxes, and at outlets to identify circuit numbers. Each control wire shall be labeled at each connection.
- C. Apply write-on identification labels to wiring sets in each hand-hole to identify function. Use waterproof labels.
- D. Apply write-on identification labels to empty conduits to identify each with information as to terminus of other end and also trade size of conduit.
- E. Install micarta nameplates with engraving to identify function and/or load served for the following:
 - 1. Panelboards
 - 2. Overcurrent Devices
 - 3. Safety Switches
 - 4. Control Panel
 - 5. Automatic Transfer Switch
 - 6. Float Switch Junction Box

Micarta nameplates shall be attached with stainless steel screws, use two (2) per each nameplate.

Submit for review a schedule for engraving along with size for each proposed micarta nameplate. Do not fabricate nameplate until review has been completed.

- F. Type circuit directory information on circuit directory cards on all panelboards and laminate.

CONTROL & INSTRUMENTATION

PART 1: GENERAL

1.01 SCOPE

- A. Furnish and install electrical equipment in the locations shown on the plans.
- B. Furnish and install instrumentation and control systems as indicated on the plans.
- C. Products and installations shall comply with the electrical section specifications.
- D. Contractor to coordinate his construction activities with the local electrical utility.

1.02 EQUIPMENT FIELD SERVICE

- A. Provide the services of factory trained personnel to assist in the installation and start-up of the control system.

1.03 MANUFACTURER QUALIFICATIONS

- A. Pump control panels are to be manufactured by an approved manufacturer.
- B. Approved pump control panel manufacturers are as follows:
 - 1. Pump Solutions – contact James Mansfield 512-809-2302
 - 2. TMT Solutions – contact Terrance Sullivan 512-878-9389
 - 3. Control Panel USA
- C. Any pump control panel manufacturer other than the named approved manufacturer desiring to be approved must submit to the engineer for approval a pre-bid submittal document no later than twenty-one (21) days prior to project bid date. Submissions that fail to include a complete submittal as detailed shall be deemed unresponsive. Approval does not exempt the Contractor from meeting all the requirements of the Contract Documents nor does it give any prior acceptance of any equipment, software or services. The Contract Documents are the final authority for acceptance of the work provided. Information contained in the Pre-Bid Submittal shall be considered public information. All data submitted will become and remain the property of the Owner; none will be returned. The Engineer's decision as to pre-bid approval shall be final. The Consulting Engineer shall be considered the sole judge of the merits of the pump control panel manufacturer and shall indicate pre-approval of the control panel manufacturer

via a written addendum to the specifications prior to the actual bid date. The right is reserved to reject any and all proposals, to waive any informality, irregularity, mistake, error or omission in any proposals received and to accept the proposal, as determined by the Engineer or Owner, deemed most favorable to the Owner's interests. Provide four (4) bound copies, with tabbed dividers and contents organized and presented as hereinafter specified.

1. Listing of firm's history.
2. Listing of personnel to be used on the project including job titles and resumes.
3. Certificates of all insurance complete with expiration dates.
4. Describe provisions for service, technical assistance and re-placement parts for the proposed project. Include the company's 1-800-toll free number.
5. Provide installation list of at least 30 locations of previous similar projects including name and telephone numbers of Owner and Consulting Engineer, functional description, and contact personnel.
6. Provide a "statement of compliance" detailing paragraph by paragraph bill of material, parts list and schematic drawing to be used on this project, along with his compliance or exception to these specifications.
7. Provide a product performance data sheet for each proposed component in the system (i.e. antennas, radios, coaxial cables & arrestors, remote unit equipment, central terminal unit equipment, power supplies, time delays, relays, pilot devices, instruments, surge arrestors, controllers, and the various sensors required).
8. UL 508A Certification.

PART 2: PRODUCTS – PUMP CONTROL PANEL

2.01 REMOTE PILOT OPERATORS

- A. Remote pilot operators, "RPD" devices, shall be furnished for remote control of indicated motor and other remote control functions.
- B. RPD Devices, such as start, stop push-buttons, pilot lights, and selector switches shall consist of heavy-duty oil-tight operators. Pushbuttons, selector switches, and pilot lights are to be multi-light industrial type. Pilot lights shall be transformer type, push to test, complete with bulbs. Pilot lights shall be equipped with the indicated colored lenses.
- C. Each RPD device shall be equipped with engraved plastic surround to identify functions. Legend plates shall be provided for devices mounted on the door. The plates shall be manufacturer's standard with lettering indicated on the plans and of the same manufacture as the respective pushbutton, selected switch, or pilot light. Provide all legend and name plates as per the plans.

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- D. Remote pilot operators shall be Eaton or approved equal.
- E. Control relays are to be lighted, socket type as manufactured by IDEC RR series. Sockets are to be of the same manufacture as the relay, single level and DIN rail mountable.

2.02 ENCLOSURE

- A. All enclosures shall be stainless steel NEMA-3R/12 Type compliant for outdoor installations, with heat barriers and gasketed. The enclosure shall be double door dead front configuration manufactured with 304 stainless steel. Each enclosure shall include a water drip shield over the door. Stainless steel heat shields shall be provided on top, front and sides of the control panel and attached with stainless steel hardware.
- B. Panels are to be constructed to the approximate dimensions and instrument arrangement as shown on the plans. Submit alternate arrangements and recommendations to the Engineer for review (21) days prior to the bid date. All instruments, devices and wiring are to be arranged such that everything can be installed, removed and serviced through the door.
- C. Wire entering the panels is to enter via conduits with bushings. All wiring is to be terminated on terminals located on an interior panel prior to being connected to any instrument or switch. Wiring shall be NEMA Class B.
- D. Each panel is to be equipped with a print pocket for storing a complete set of plastic laminated control panel drawings.
- E. Panel doors and inner doors are to have heavy gauge 304 stainless steel continuous hinges. Hinges and doors are to be capable of supporting weight of equipment mounted on doors. Mounting channels and interior panels are to be provided in the cabinets for mounting terminals, relays, etc.
- F. The panel is to be completely assembled and wired at the factory such that installation can be accomplished by connecting field wiring to terminal strips located on the lower portion of the interior panel.
- G. Panels located indoors are to be NEMA 12 conforming to UL508A, JIC Standard EGP-1-1967. Panels located outdoors are to be NEMA 3R 304 stainless steel construction conforming to UL508A, JIC Standard EGP-1-1967. Panels are to be constructed from minimum 14 gauge steel. Seams are to be continuously welded with no holes or knockouts. Doors are to have rolled lip around three sides and are to be equipped for padlocking. Doors on outdoor enclosures are to have

stainless steel clamps to provide a water-tight seal. All doors are to have an oil resistant gasket. A full size steel back panel is to be provided inside each enclosure. Relays, terminal blocks, etc., are to be mounted on the back panel. Provide heat shields where noted on the plans.

- H. Inner doors are to be 304 stainless steel construction. Inner doors shall have two 304 stainless steel full turn latches and close flush against the center post. Inner doors are to be equipped with a plexiglass barrier to protect operator from accidental contact with electrical wiring while servicing the cabinet. Barriers will be mounted to 4.5 inch stand offs to allow sufficient room for component wiring.
- I. All holes for mounting components on enclosure, inner doors, and back panel shall be drilled and tapped. Wire duct shall be mounted to the back panel with nylon insulating fasteners. Cut, punch or drill cutouts for face-of-panel mounted instruments and smoothly finish with rounded edges. Provide steel stiffeners on the inside of the panel walls as may be required to prevent deflection due to instruments, operation of equipment, or opening/closing of doors. Use 0.25 inch high by 1 inch wide by 0.5 inch deep minimum stiffeners and tack weld to the panel.
- J. Provide internal condensation and freezing protection with thermostatically controlled heater on outdoor enclosures. Thermostat should be adjustable between 40 degrees F to 80 degrees F.
- K. Provide all control cabinets over 18" wide with a fluorescent light in each section having a wire guard. Provide complete with limit switch to activate light when door is opened.
- L. Provide exhaust fan and stainless steel ventilation louvers. Provide a thermostat to operate the exhaust fan. Furnish louvers with replaceable filters.

2.03 SUBMERSIBLE LEVEL TRANSDUCER

- A. In general, the transducer shall sense the liquid level or pressure variation and convert these variations into a linear analog output 4-20 Ma. Endress Hauser with no equals.
- B. Required features:
 - 1. The liquid level or pressure shall be sensed by a level transducer certified by FM, UL, ULC, ABS; CE compliant to EN 61000-6-4:2001 and EN 61000-6-2:2001. This transducer has an IP68 and NEMA 6P housing

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protection rating. The units are designed for installation in:

- a. Class I, Division I, Groups A, B, C, and D hazardous locations.
 - b. Class II, Division I, Groups E, F, and G hazardous locations.
 - c. Class III, Division I, hazardous locations.
2. Level Ranges:
 - a. 2.5 thru 700 ft H₂O for vented gage reference
 - b. 10 thru 700 ft H₂O for sealed gage reference
 - c. 35 thru 700 ft H₂O for absolute reference
 3. Static Accuracy: +/- 1.0 percent FSO (includes the combined errors due to nonlinearity, hysteresis and non-repeatability on a Best Fit Straight Line basis at 25 degrees C per ISA S51.1).
 4. The pressure sensing element shall incorporate a four active arm Wheatstone Bridge strain gage diffused directly into a silicon diaphragm.
 5. The sensing element shall exhibit no measurable hysteresis, withstand overpressures up to 200 percent and have a life expectancy of 20 million cycles.
 6. The transducer shall operate from a DC supply, between 9 and 30 VDC, unregulated.
 7. The transducer shall have on-board signal conditioning and include over voltage and reverse polarity protection. It shall have attached a dual-channel zener barrier featuring a narrow profile of just 12.5 mm to maximize control panel space. The barrier shall be available in positive or negative polarity, and snap on for easy installation and maintenance. Diodes shall be oriented in the opposite direction for the negative polarity versions.
 8. Wetted materials: 316 SS or Titanium; Delrin®; Viton®
 9. Transducer Diameter: 1 inch maximum.
 10. Factory-attached polyurethane or Tefzel jacketed water block cable with non-stretch Kevlar stiffeners, cable shield wrap and vent tube for atmospheric reference with moisture barrier, along with water tight molded cable seal.
 11. Cable length: User specified, with continuous lengths up to 2500 feet.
 12. User-installable open-faced port end cap shall be supplied for maximum contact with the liquid media and to prevent clogging of the sensor. Optional end caps available.
 13. A Series 810 Super Dry Vent Filter shall be shipped with all submersible transducers with a vented gage pressure format. The 810 is warranted for one year before replacement is required. An aneroid bellows assembly must be provided to prevent condensation from forming in the vent tubing.
 14. Surge/lightning over voltage protection at both the sensor and electrical connection points will be provided and carry a lifetime warranty against over voltage.

2.04 LEVEL CONTROLLER

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- A. The level controller shall operate from the 4-20 mA input signal provided by the pressure transducer. The controller shall have a liquid crystal display (LCD) to show the water level during normal operation and setpoint values during calibration.
- B. The level controller shall have eight user-adjustable trip setpoints. As the water level rises above each trip point setting, the front panel LED for that level shall illuminate, and the corresponding output relay shall energize.
- C. The level controller shall have two 4-20 mA outputs, which track the 4-20 mA input. These signal outputs shall be re-scalable to different ranges of level by the user. A test control, that simulates an input signal, shall be available on the front panel. This test control is useful for checking the trip setpoints, and overall system operation.
- D. Power shall be supplied with pigtail from UPS battery backup.
- E. Level controller shall be a Allen Bradley with 4 expansion modules with no equal.

2.05 ELAPSED TIME METERS

- A. The elapsed time meters shall be a round meter, 120 VAC, 60 HZ, with no face labels.
- B. The elapsed time meters shall be installed for each motor and shall measure in increments of hours and be non-resettable. Furnish Eagle Signal Controls H Series time totalizer or approved equal.

2.06 SURGE PROTECTION

- A. Surge protection shall be by series connected transient voltage surge suppressor with encapsulated Optimal Response Network circuitry (20 kA per mode / 60 kA total peak surge current) and Enhanced Sine wave Tracking for virtual elimination of ring wave type transients.
- B. Surge protection shall be designed for use at ANSI/IEEE Categories A, B, and C with susceptibility up to all exposure levels to protect sensitive/critical loads fed by a single electrical circuit.

- C. Surge protection shall have a 25 year warranty with unlimited free replacement.
- D. Surge protection shall be listed UL1449 2nd Edition (Feb. 9, 2007 Rev.) and CUL.
- E. Surge protection shall be Sine Wave Tracking, Terminal Connected, 120 VAC, and 15 Amps.

2.07 FLOATS

- A. The float shall be a direct acting switch. Each float contains a single pole mercury switch which actuates when the longitudinal axis of the float is horizontal, and deactuates when the liquid level falls 1” below the actuation elevation.
- B. The float shall be a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable shall be permanently connected to the enclosed mercury switch and the entire assembly shall be encapsulated to form a completely water tight and impact resistant unit. The float shall be suspended with built in weight. The float shall be equipped with one normally-open and one normally-closed contact.

2.08 INTRINSICALLY SAFE FLOAT RELAY

- A. The intrinsically safe float relay shall be a multiple channel device used to provide a safe and reliable means of controlling loads from hazardous locations without releasing sufficient energy under normal or abnormal conditions to cause ignition of a flammable or combustible atmospheric mixture while in its most easily ignited concentration. An isolated output shall turn on when the corresponding control switch input from the hazardous location is activated.
- B. The intrinsically safe float relay shall be 120VAC and shall be 4-channel.

2.09 VIBRATING HORN

- A. Panel mount vibrating horn shall be provided, NEMA Type 4X. Horn shall be heavy duty die-cast housing. It shall have an operating range of -20% to +10%

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of nominal voltage. Horn shall have 18" (457mm) wire with molex connector. It shall have and adjustable output of 78 to 103 dB and a 400 hour rating at 50% duty cycle.

2.10 ADDITIONAL COMPONENTS

- A. In addition to the above specifications, each pump control panel shall be as follows:
1. All motor controllers shall be solid state soft start Eaton and over current devices and conductors shown shall be minimum sizes, confirm all external loads prior to manufacture.
 2. Each pump control panel shall be equipped with pull-apart terminal blocks.
 3. Control wiring and associate control devices in each pump control panel shall be furnished intrinsically safe for operation in its intended environment.
 4. Provide electronic ambient-compensated overloads for each motor controller. Each overload block shall be wired as indicated. Overload blocks shall be adjustable from 80% to 115% of their nominal value. Where indicated, provide overloads with auxiliary contacts. Selection of overloads shall be determined by the full-load current of motors to be supplied.
 5. Each pump control panel shall be equipped with a ground bus.
 6. Main buses shall be, three-wire, rated for 480V operation.
 7. Each main entrance of each pump control panel shall be equipped with circuit breaker. Main circuit breaker shall be molded case magnetic only type rated 50,000 AIC symmetrical at 600V A.C. Breaker shall have an adjustable trip range of 2 ½ to 5 times breaker rating.
 8. All control relays shall be industrial type each with 10-amp, 120V rated contacts. Each contact shall be field convertible. Each relay shall have open-close position indication. Relay coils shall be rated 120V A.C. continuous duty, including the latch type relay coils.
 9. Motor branch circuit over current protection shall be motor circuit protectors, unless otherwise indicated. Each "MCP" shall have adjustable current setting pickup. Minimum I.C. of each MCP shall be 22 KA rms symmetrical amps. Motor circuit protectors shall be provided with 120V A.C. shunt trip.

3.01 SCADA SYSTEM

- A. The SCADA RTU shall be located in the pumps control panel as shown on electrical plans. The contractor shall verify in the presents of the owner's

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representative that the SCADA system is operating properly and communicating with the owner's other SCADA equipment.

- B. A **Mandatory** SCADA Contractor basic RF study shall be submitted prior to start of construction. This study is to include the following:
1. A table of signal strengths and signal to noise ratio at a minimum of 5 varying heights from 15 to 50 feet above the project elevation.
 - a. If the Districts minimum signal goals cannot be met within this height range, the contractor shall test at higher elevations, where applicable, or propose an alternative method of communication.
 2. Documentation on how the proposed site will be integrated with the rest of the RF system.
 - a. Path taken to get back to the specific endpoint (FIU, etc)
 - b. Equipment used (antenna type, gain, etc)
 - c. Details on alternative method of communication.
 3. Contractor shall ensure that proposed install will comply with all applicable laws, provide a list of any potential permits needed, or cause interference with other nearby utilities.
 4. Contractor shall recommend optimal install height and configuration as part of this package.
 5. The District shall use this information to make an informed decision about desired radio installation method.
 6. District radio signal minimums:
 - a. RSSI (Signal Strength) -90 dmW or better
 - b. SNR (Signal to Noise Ratio) 20 dB or better
- C. SCADA startup shall be done in two phases, local startup and remote startup.
1. Local startup
 - a. All operations are to be tested locally onsite.
 2. Remote startup
 - a. Contractor has a maximum of 48 hours from completion of local startup to demonstrate to the owner's representative that the telemetry is working at the main office.
 - b. Addressing must be provided at this time for the owner's alarming systems.

Section J. Emergency Provisions

1. Lift Stations shall be designed to insure that no discharges of untreated wastewater will occur at the lift station or any point upstream of the collection system due to loss of power or mechanical failure within the operating time frames defined in this section. All lift stations shall be provided with service reliability based on the following paragraphs:
2. An audio-visual alarm system (red flashing light and horn) shall be provided for all lift stations. The audiovisual alarm shall be activated only by wet well high level alarm, by both level controller and high level float switch.
3. Emergency (quick-connection) pump by-pass system shall be provided at all lift stations.
Connection shall be sized according to station and header pipe size (4, 6 or 8 inches), and shall consist of a gate valve and adapter flange with camlock “quick-disconnect” male fitting with dust cap. Provide a check valve to allow flow only in the Force Main discharge direction.
4. Lift stations equipped with soft starters must be provided with a full voltage by-pass starter to by-pass the soft starter units should they become damaged. The motor control panel must be provided with a selector switch that will allow operating the motors through soft starter or regular starter.

Section K. Safety Requirements

1. Overhead Wires. Do not run overhead wires over lift station site. Overhead wires include, but are not limited to, primary and secondary electric lines, electric service drop, and cable and telephone lines. If a secondary overhead electric service drop is required to feed the lift station, the service pole must be located in a place where the service drop will be at least: 10 feet away from the structure, 20 feet away from wet well, header piping and generator, and 40 feet away from SCADA tower structure.
2. Electric Conduits and Small Pipes. Eliminate tripping hazards from electric conduits and small pipes across the surface of the lift station. They must be buried in the ground or embedded in concrete slabs.
3. Arc Flash Analyses. Include an Arc Flash Analysis in engineering report. Reduce arc flash Hazard/Risk Rating to Category 2 if they originally are Category 3 or 4 by making adjustments to circuits. Electric panels must include proper warning labels.
4. Bollards. Install bollards to protect equipment located at the end of driveways, or in tight locations. If lift stations are adjacent to streets or driveways, install bollards between the equipment and the street. Removable bollards in buried sleeves are acceptable.

5. Design shall include a freeze proof emergency eyewash and shower station located within 10-foot radius of wet well.
6. One or more lockable aluminum hatch covers with anti-slip top surface shall be installed in the wet well cover for access to the wet well, pumps, floats and level control devices. Minimum hatch dimensions shall be 3 feet by 4 feet, or as required; allowing plentiful clearance for removal of submersible pumps and access to wet well. Hatch safety grate shall be installed to provide fall protection and shall consist of aluminum material. Safety Grate shall be designed to have gaps of not more than 5 inches, and to be flush with the top of the wet well concrete slab. Black and yellow strips shall be painted around access hatch using Epoxy Enamel (Tnemec, or equal) coating system. Also a "Caution! Fall Hazard." sign shall be painted/stenciled on all four sides of the hatch. Coating requirements and thickness shall be in accordance with Manufacturer's recommendations.
9. No fixed ladders are permitted in the wet well; however when used elsewhere, ladders shall be aluminum with non-skid rungs and must comply with all other of OSHA 1910.27, Fixed Ladders requirements.