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# Water & Wastewater Master Plan

May 2014

Prepared for:

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## City of Kennedale

Prepared by:

**FREESE AND NICHOLS, INC.**
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Fort Worth, Texas 76109
817-735-7300

# Water & Wastewater Master Plan
# May 2014




5/8/14

FREESE AND NICHOLS, INC.
TEXAS REGISTERED
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F-2144




5/8/14

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FNI Project Number: KEN13264

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# EXECUTIVE SUMMARY

## 1.0 Introduction

Freese and Nichols, Inc. (FNI) was retained in 2013 by the City of Kennedale to conduct a Water and Wastewater Master Plan. The goals of this project were to evaluate the capacity of the existing water and wastewater systems and to recommend a phased Capital Improvements Plan through buildout. The recommended improvements will serve as a basis for the design, construction, and financing of facilities required to meet Kennedale's water and wastewater service needs as a result of the projected population growth. The major elements of the scope of this project included:

- Develop water and wastewater hydraulic models
- Conduct field testing for water and wastewater
- Developing water and wastewater load projections
- Hydraulic evaluation and modeling of water and wastewater systems
- Identifying system improvements through buildout
- Developing a phased Capital Improvements Plan
- Preparing a Water and Wastewater Master Plan Report

## 2.0 Population

Population projections were developed based on traffic survey zone (TSZ) data provided by North Central Texas Council of Government (NCTOCG). The TSZs were clipped to match the existing and future service areas. **Table ES-1** presents the population projections for the City of Kennedale's water and wastewater service areas.

**Table ES-1: Population Projections**

| Year | Population |
|---|---|
| 2013 | 6,820 |
| 2023 | 12,469 |
| Buildout | 16,459 |

## 3.0 Water Demands

Water demands were projected for 10-year and buildout conditions based on the population projections. The projected water demands developed for the water system analysis are summarized in **Table ES-2**.

**Table ES-2: Projected Water Demands**

| Year | Average Day Demand (MGD) | Maximum Day Demand (MGD) | Peak Hour Demand (MGD) |
|---|---|---|---|
| 2013 | 1.16 | 2.61 | 5.22 |
| 2023 | 2.12 | 4.77 | 9.54 |
| Buildout | 2.80 | 6.30 | 12.59 |

## 4.0 Water System Analysis

Hydraulic analyses were performed on the distribution system under existing and future year demand conditions. The City provided existing water system data in AutoCAD that was converted to GIS and populated with attributes. A hydraulic model was constructed based on GIS data and as-built data provided by the City. Demands were allocated using recent water meter billing data. Several parameters were evaluated during the water system analysis including storage and pumping, water supply, and pressure maintenance. Two wholesale water supply options were evaluated. Option 1 is water supply from Fort Worth and Arlington, and Option 2 is water supply only from Fort Worth. The analyses were conducted for average day, maximum day, peak hour, and maximum day plus fire flow conditions.

## 5.0 Wastewater Flows

Wastewater flows were projected for 10-year and buildout conditions based on the population projections. The projected wastewater flows used for the wastewater system analysis are presented in **Table ES-3.**

**Table ES-3: Projected Wastewater Flows**

| Year | Population | Average Annual Daily Flow (MGD) | Peak Wet Weather Flow (MGD) |
|---|---|---|---|
| 2013 | 6,820 | 0.61 | 2.46 |
| 2023 | 12,469 | 1.12 | 4.49 |
| Buildout | 16,459 | 1.48 | 5.93 |

## 6.0 Wastewater System Analysis

Hydraulic analyses were performed on the collection system under existing and future year flow conditions. The model evaluates the ability of the system to adequately convey wastewater without excessively surcharging or overflowing. The City provided existing wastewater system data in AutoCAD that was converted to GIS and populated with attributes. A hydraulic model was constructed based on GIS data and as-built drawings provided by the City. The model was verified using flow monitoring data. Analyses were performed for peak wet weather conditions to determine the system's ability to convey existing and projected wastewater flows.

## 7.0 Capital Improvements Plan

Water and wastewater system capital improvement plans were developed for the City of Kennedale based on the land use assumptions. Two options were developed for the water capital improvement plan. The first option is water service from Fort Worth and Arlington, and the second option is service from only Fort Worth. The recommended improvements will provide the required capacity and reliability to meet projected water demands and wastewater flows through buildout. **Table ES-4** summarizes the costs of the capital improvement plan for the City of Kennedale.

**Table ES-4: Capital Improvement Plan Costs**

| Planning Period | Water Option 1 | Water Option 2 | Wastewater |
|---|---|---|---|
| 2013-2023 | $13,245,950 | $12,626,650 | $6,139,750 |
| 2024-Buildout | $8,412,520 | $8,689,880 | $5,680,180 |
| **Total** | **$21,658,470** | **$21,316,530** | **$11,819,930** |

# 1.0 INTRODUCTION

The City of Kennedale is a growing community located within in the Dallas-Fort Worth Metroplex. The City's water and wastewater service area consists of the existing ETJ. The service population is projected to more than double before reaching ultimate buildout conditions. Accommodating this growth in an efficient and cost effective manner while maintaining safe and reliable water and wastewater service for the citizens of Kennedale is the focus of this Water and Wastewater Master Plan.

## 1.1 SCOPE OF WORK

Freese and Nichols, Inc. (FNI) was retained in 2013 by the City of Kennedale to conduct a Water and Wastewater Master Plan. The goals of this project were to evaluate the capacity of the existing water and wastewater systems and to recommend a phased Capital Improvements Plan through buildout. The recommended improvements will serve as a basis for the design, construction, and financing of facilities required to meet Kennedale's water and wastewater service needs as a result of the projected population growth and commercial development. The major elements of the scope of this project included:

- Developing water and wastewater hydraulic models
- Conducting field testing for water and wastewater
- Developing water and wastewater load projections
- Hydraulic evaluation and modeling of water and wastewater systems
- Identifying system improvements through buildout
- Developing a phased Capital Improvements Plan
- Preparing a Water and Wastewater Master Plan Report

## 1.2 LIST OF ABBREVIATIONS

**Table 1-1** provides a list of abbreviations used in this report.

**Table 1-1: List of Abbreviations**

| Abbreviation | Full Nomenclature |
|---|---|
| CIP | Capital Improvements Plan |
| EST | Elevated Storage Tank |
| GIS | Geographic Information System |
| gpcd | gallons per capita per day |
| gpm | gallons per minute |
| GST | Ground Storage Tank |
| I/I | Infiltration and Inflow |
| MG | Million Gallons |
| MGD | Million Gallons per Day |
| PS | Pump Station |
| psi | pounds per square inch |
| SCADA | Supervisory Control and Data Acquisition |
| TCEQ | Texas Commission on Environmental Quality |
| TSZ | Traffic Survey Zone |

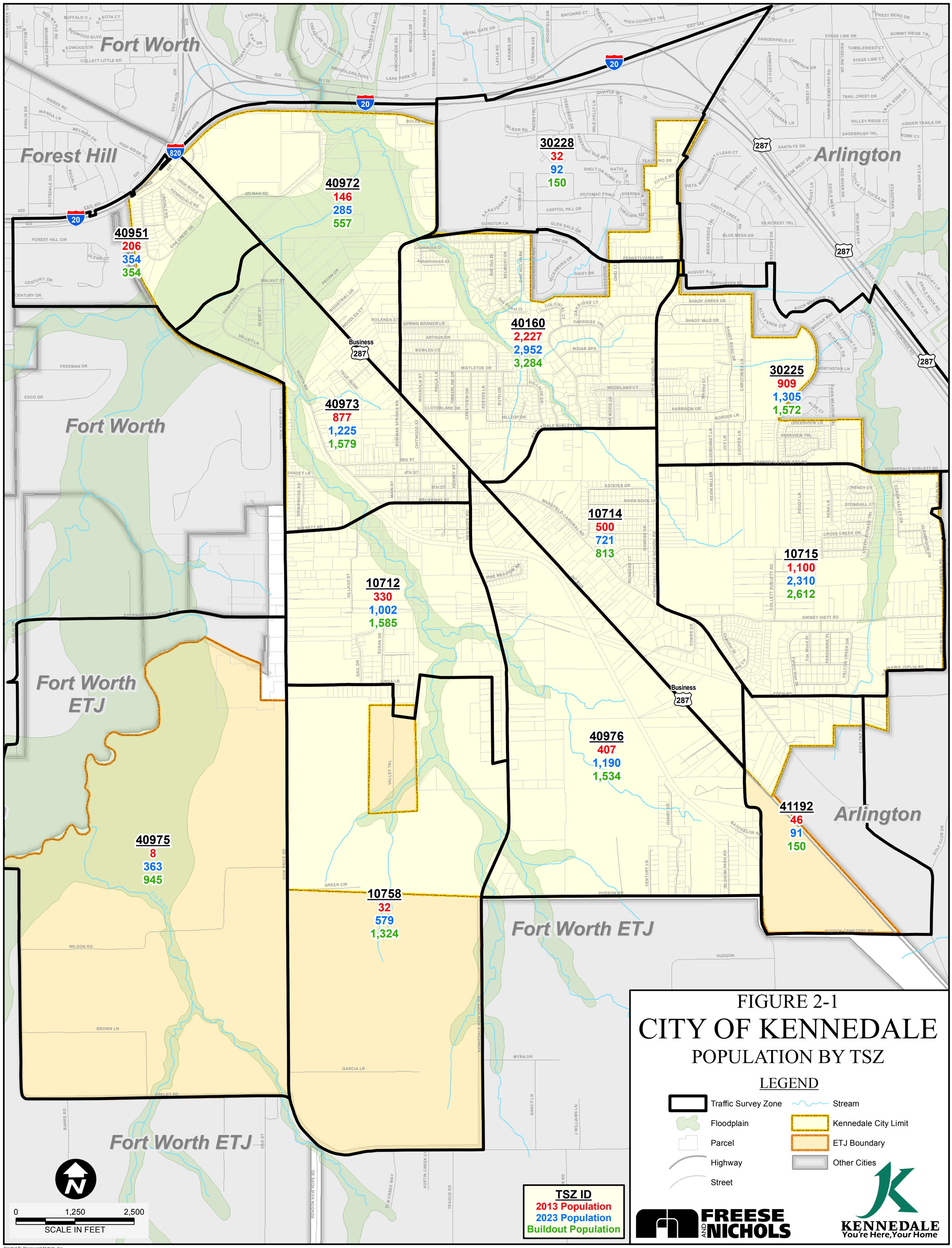
# 2.0 POPULATION

Population and land use are important elements in the analysis of water and wastewater systems. Water demands and wastewater flows depend on the residential population and commercial development served by the systems and determine the sizing and location of system infrastructure. A thorough analysis of historical and projected populations, along with land use, provides the basis for projecting future water demands and wastewater flows.

Population projections were developed based on traffic survey zone (TSZ) data provided by North Central Texas Council of Government (NCTOCG). The TSZs were clipped to match the existing and future service areas. The location of development was reviewed by analyzing existing land use and vacant land in the City. The population by TSZ was modified based on comments provided by City staff about the timing and location of development. **Table 2-1** presents the population projection for the City of Kennedale water and wastewater service area. The population projections by TSZ are shown on **Figure 2-1.**

**Table 2-1: Population Projections**

| Year | Population |
|---|---|
| 2013 | 6,820 |
| 2023 | 12,469 |
| Buildout | 16,459 |




# FIGURE 2-1
# CITY OF KENNEDALE
## POPULATION BY TSZ

LEGEND

- Traffic Survey Zone
- Stream
- Floodplain
- Kennedale City Limit
- Parcel
- ETJ Boundary
- Highway
- Other Cities
- Street

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Updated: Tuesday, April 15, 2014 8:39:24 AM

# 3.0 WATER DEMANDS

A water utility must be able to supply water at rates that fluctuate over a wide range. Yearly, monthly, daily, and hourly variations in water use occur, with higher use during dry years and in hot months. Also, water use typically follows a diurnal pattern, being low at night and peaking in the early morning and late afternoon. The rates most important to the hydraulic design and operation of a water distribution system are average day, maximum day, and peak hour. Average day use is the total annual water use divided by the number of days in the year. The average day rate is used as a basis for estimating maximum day and peak hour demands. Maximum day demand is the maximum quantity of water used on any one day of the year. Treatment and supply facilities are typically designed based on the maximum day rate. Peak hour use is the peak rate at which water is required during any one hour of the year. Since minimum distribution pressures are usually experienced during peak hour, the sizes and locations of distribution facilities are generally determined based on this condition.

## 3.1 HISTORICAL WATER DEMANDS

The City's historical water usage records were analyzed for years 2006 through 2012. The City provided daily water usage data that was used to calculate annual average day demand, maximum day to average day peaking factors, and per-capita consumption. The City of Kennedale's historical water usage is summarized in **Table 3-1**.

**Table 3-1: Historical Water Data**

| Year | Population | Average Day Demand (MGD) | Average Day Demand (gpcd) | Maximum Day Demand (MGD) | Maximum Day to Average Day Peaking Factor |
|---|---|---|---|---|---|
| 2006 | 6,150 | 0.89 | 145 | 1.74 | 1.95 |
| 2007 | 6,350 | 0.76 | 120 | 1.72 | 2.26 |
| 2008 | 6,450 | 0.90 | 139 | 1.83 | 2.04 |
| 2009 | 6,450 | 0.87 | 135 | 1.78 | 2.05 |
| 2010 | 6,763 | 1.03 | 152 | 1.91 | 1.86 |
| 2011 | 6,770 | 1.15 | 169 | 2.55 | 2.22 |
| 2012 | 6,790 | 1.06 | 156 | 2.94 | 2.77(1) |
| **Average** | - | - | **145** | - | **2.06** |
| **Maximum** | - | - | **169** | - | **2.26** |

(1) The 2012 value was excluded due to a line break that occurred on the maximum day.

## 3.2 PROJECTED WATER DEMANDS

Water demands were projected for 2013, 2023 and buildout conditions. The evaluation of historical data provided a basis for determining the design criteria used to project water demands. Historical water usage data indicated the maximum day to average day peaking factor ranged from 1.95 to 2.26 over the last seven years. The 2012 value was excluded because there was a line break on the maximum day. Therefore, a peaking factor of 2.25 was selected for future year demands. Since historical hourly flow data was not available, a peak hour to maximum day peaking factor of 2.0 was selected based on standard industry recommendations. Average day per capita demands ranged from 120 to 169 gpcd. Based on historical data, an average day demand of 170 gallons per capita per day (gpcd) was selected. The City of Kennedale design criteria and water demand projections are summarized in **Tables 3-2** and **3-3**.

**Table 3-2: Water Demand Criteria**

| Gallons per Capita per Day | Maximum Day to Average Day Peaking Factor | Peak Hour to Maximum Day Peaking Factor |
|---|---|---|
| 170 | 2.25 | 2 |

**Table 3-3: Projected Water Demands**

| Year | Average Day Demand (MGD) | Maximum Day Demand (MGD) | Peak Hour Demand (MGD) |
|---|---|---|---|
| 2013 | 1.16 | 2.61 | 5.22 |
| 2023 | 2.12 | 4.77 | 9.54 |
| Buildout | 2.80 | 6.30 | 12.59 |

# 4.0 WATER SYSTEM ANALYSIS

## 4.1 EXISTING WATER DISTRIBUTION SYSTEM

The City of Kennedale's water distribution system currently consists of a network of water lines ranging in size from 1.5-inches to 16-inches, six wells, one elevated storage tank, one standpipe, three ground storage tanks, and three pump stations. **Figure 4-1** displays the existing water distribution system for the City of Kennedale. The City receives water supplied by the City of Fort Worth at the T-3 Pump Station site. The T-3 Pump Station consists of a 0.35 MG ground storage tank, two 2,800 gpm pumps, and a 1.0 MG elevated storage tank. The City has a maximum supply of 2.5 MGD from Fort Worth per the wholesale contract. The City supplements the Fort Worth supply with well water during peak usage. FNI conducted a site visit of the City's facilities as part of the project. Photographs from the site visit are presented in **Appendix A**. Summaries of the storage and pumping facilities are shown in **Tables 4-1** and **4-2**, respectively. Information on the existing wells is presented in **Table 4-3**.

**Table 4-1: Storage Facilities**

| Name | Type | Volume (MG) | Overflow Elevation (feet) |
|---|---|---|---|
| T-1 GST | Ground | 0.75 | 689 |
| T-3 GST | Ground | 0.35 | 717 |
| T-4 GST | Ground | 0.50 | 683 |
| **GST Subtotal** | | **1.60** | - |
| T-3 EST | Elevated | 1.00 | 800 |
| T-2 Standpipe(1) | Elevated | 0.16 | 808 |
| **EST Subtotal** | | **1.16** | - |
| **System Total** | | **2.76** | - |

(1) The standpipe is considered elevated storage from 80-100 feet. The total volume of the standpipe is 0.72 MG.

**Trinity Well #4**
380 GPM
**Ground Storage Tank**
0.5 MGD Capacity
Overflow Elevation = 683'
**Booster Pump Station**
(2) 750 GPM Pumps

**Paluxy Well #2**
90 GPM
**Not in Service**

**Ground Storage Tank**
0.75 MG Capacity
Overflow Elevation = 689'
**Booster Pump Station**
(2) 500 GPM Pumps

**Trinity Well #1**
310 GPM

**Paluxy Well #1**
137 GPM

**Trinity Well #2**
330 GPM

**Standpipe**
0.72 MG Capacity
Overflow Elevation = 808'

**Elevated Storage Tank**
1.0 MG Capacity
Overflow Elevation = 800'
**Ground Storage Tank**
0.35 MG Capacity
Overflow Elevation = 717'
**Booster Pump Station**
(2) 2,800 GPM Pumps

**Trinity Well #3**
340 GPM

# FIGURE 4-1
# CITY OF KENNEDALE
## EXISTING WATER SYSTEM
### LEGEND

- 8" and Smaller Water Line
- 10" and Larger Water Line
- City of Fort Worth Water Line
- Street
- Stream
- Parcel
- City Limit
- ETJ Boundary

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0 1,100 2,200
SCALE IN FEET

Created By Freese and Nichols, Inc.
Job No.: KEN13264
Location: H:\W_WW_PLANNING\FINAL_REPORT\(Figure_4-1)-Existing_Water_System.mxd
Updated: Wednesday, May 07, 2014 8:08:32 AM

**Table 4-2: Pumping Facilities**

| Pump Station Name | Pump No. | Rated Capacity (gpm) | Rated Capacity (MGD) | Head (feet) |
|---|---|---|---|---|
| T-4 Pump Station | 1 | 750 | 1.08 | 200 |
| | 2 | 750 | 1.08 | 200 |
| | **Firm Capacity** | **750** | **1.08** | - |
| | **Total Capacity** | **1,500** | **2.16** | - |
| T-3 Pump Station | 1 | 2,800 | 4.03 | 130 |
| | 2 | 2,800 | 4.03 | 130 |
| | **Firm Capacity** | **2,800** | **4.03** | - |
| | **Total Capacity** | **5,600** | **8.06** | - |
| T-1 Pump Station | 1 | 500 | 0.72 | 140 |
| | 2 | 500 | 0.72 | 140 |
| | **Firm Capacity** | **500** | **0.72** | - |
| | **Total Capacity** | **1,000** | **1.44** | - |
| Well 2 | 1 | 330 | 0.48 | - |
| | **Firm Capacity** | - | - | - |
| | **Total Capacity** | **330** | **0.48** | - |

**Table 4-3: Existing Wells**

| Name(1) | Well Pump Capacity (gpm) |
|---|---|
| T-1 well pump | 310 |
| T-2 well pump | 330 |
| T-3 well pump | 340 |
| T-4 well pump | 380 |
| P-1 well pump | 137 |
| P-2 well pump | Not in Service |

(1) T= Trinity Well, P= Paluxy Well

## 4.2 WATER MODEL DEVELOPMENT

The City of Kennedale provided AutoCAD data showing the existing water lines. The CAD files were converted to GIS and used to develop the hydraulic model. The hydraulic model was developed in the $H_2O$Map Water software. All existing water lines were included in the hydraulic model. Distribution system facilities, such as tanks and pumps, were input to the model using data from site visits and information provided by the City. Pipes were assigned a C-factor based on the diameter and material where available. The C-factors are summarized in **Table 4-4**.

**Table 4-4: Hydraulic Model C-Factors**

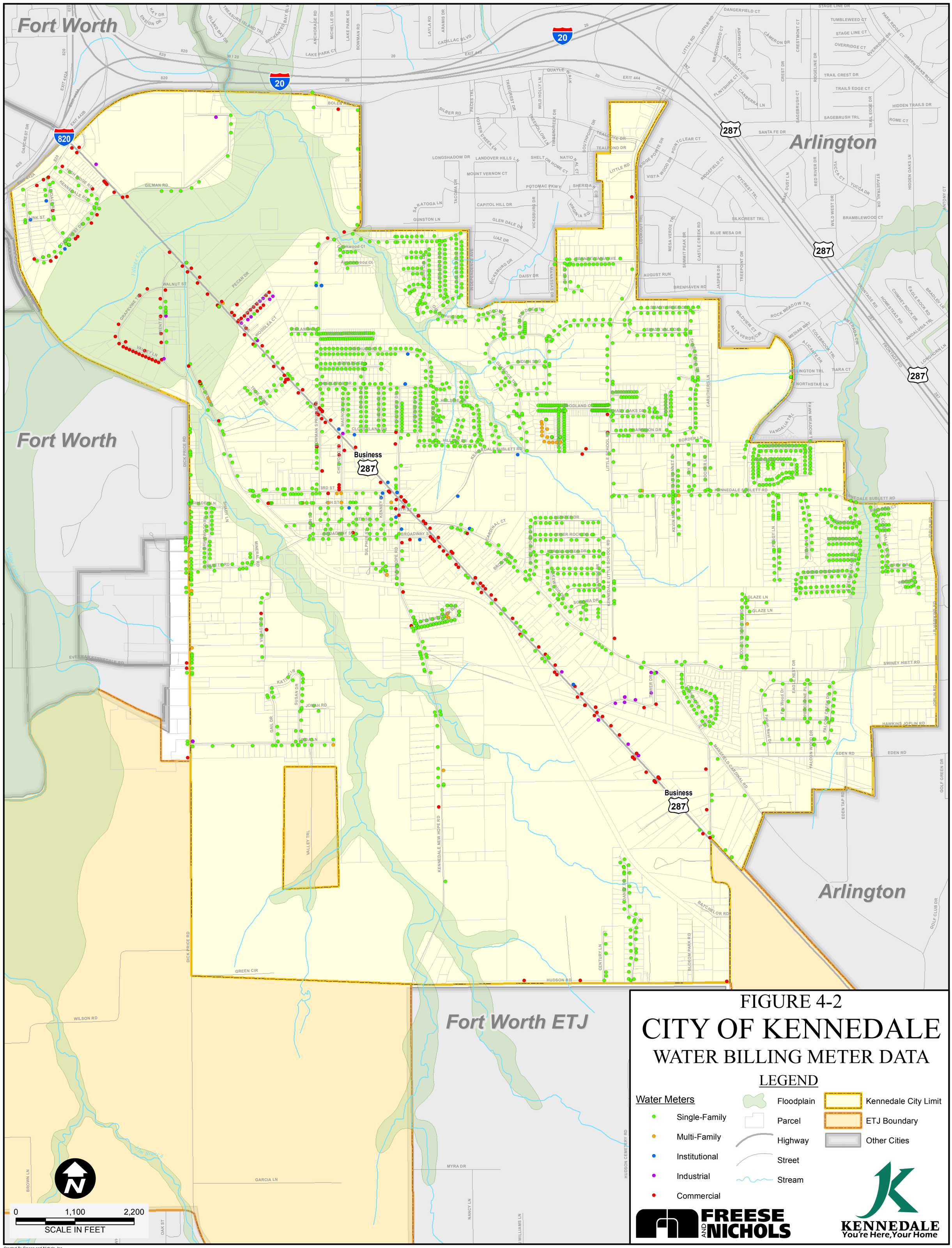
| Material | Diameter | |
|---|---|---|
| | Less than 12-inch | 12-inch and Larger |
| Cast Iron | 80 | 90 |
| Unknown | 100 | 110 |
| AC | 100 | 110 |
| C-900 | 100 | 110 |
| PVC | 120 | 130 |

The demands were allocated using recent water meter data. The active water meters from September 2013 were spatially located, and the associated consumption was assigned to the nearest model node. The water meter billing data is presented on **Figure 4-2**.

## 4.3 FIELD PRESSURE TESTING AND MODEL CALIBRATION

Field pressure testing was conducted at ten locations throughout the distribution system in July 2013 to assist in model validation. SCADA readings for tank levels and pump status were collected on an hourly basis during this time and were used to create diurnal demand curves. In order to create the curves, a mass balance of the system demand was calculated using the sum of water pumped into the distribution system from the wells and pump station and adding or subtracting the demand or supply provided by the elevated storage tank and standpipe.

The model validation time was chosen by analyzing the diurnal demand curves and finding a peak hour on a week day with no irregularities; therefore, July 17, 2013, at 7:00 AM was chosen. A peak hour demand condition was selected because it represents the system at its most stressed hydraulic state and gives a more accurate measure of headloss in the system. Operational data was used to determine system inputs such as tank levels and pump status. The model results closely matched the field pressure testing data, making the model an accurate representation of field conditions. Field pressure testing data, the diurnal curve, and a map showing the calibration results can be found in **Appendix B**.




# FIGURE 4-2
# CITY OF KENNEDALE
## WATER BILLING METER DATA

### LEGEND

**Water Meters**
- Single-Family
- Multi-Family
- Institutional
- Industrial
- Commercial

- Floodplain
- Parcel
- Highway
- Street
- Stream

- Kennedale City Limit
- ETJ Boundary
- Other Cities

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Job No.: KEN13264
Location: H:\W_WW_PLANNING\DELIVERABLES\09_Final_Report\(Figure_4-2)-Water_Billing_Meter_Data.mxd
Updated: Tuesday, April 15, 2014 8:42:15 AM

## 4.4 TCEQ REQUIREMENTS

As a public water utility, the City of Kennedale must comply with the rules and regulations for public water systems set forth by the Texas Commission on Environmental Quality (TCEQ) in Chapter 290, Public Drinking Water. The City is required to meet the TCEQ elevated storage capacity requirement of 100 gallons per connection and total storage capacity requirement of 200 gallons per connection. In addition to storage requirements, the City is also required to meet the pumping capacity requirements presented in **Table 4-5**. The City had 3,150 active connections as of September 2013. Existing storage and pumping capacities were evaluated and are summarized in **Table 4-6**. The City is currently meeting all TCEQ requirements for storage and pumping.

**Table 4-5: TCEQ Service Pumping Requirements**

| Condition | Service Pumping Capacity Requirement |
|---|---|
| If providing at least 200 gallons per connection of elevated storage | Two service pumps with a minimum combined capacity of 0.6 gpm per connection at each pressure plane. |
| If providing less than 200 gallons per connection of elevated storage | The lesser of (a) or (b): |
| | (a) Total pumping capacity of 2.0 gpm per connection |
| | (b) Total capacity of at least 1,000 gpm and the ability to meet peak hourly demands with the largest pump out of service |

Note: Capacity requirement is from 30 TAC §290.45(b)(2)(F)

**Table 4-6: Existing System TCEQ Requirements**

| Parameter | Criteria | Required Capacity | Existing Capacity | Existing Capacity Per Connection | Meets TCEQ? |
|---|---|---|---|---|---|
| Total Storage | 200 gal/connection | 0.6 MG | 3.3 MG | 1,054 gal/connection | Yes |
| Elevated Storage | 100 gal/connection | 0.3 MG | 1.2 MG | 368 gal/connection | Yes |
| Pumping | 0.6 gpm/connection | 2.7 MGD | 12.1 MGD | 2.7 gpm/connection | Yes |

## 4.5 STORAGE AND PUMPING RECOMMENDATIONS

This section summarizes an evaluation of the storage and pumping capacity for the City based on criteria developed by Freese and Nichols. These criteria are typically more stringent than TCEQ requirements and take into consideration additional factors including operational flexibility, fire suppression, system redundancy, and energy efficiency. The design criteria used to analyze elevated storage tank capacity is the volume required to provide adequate equalization storage for peak hour demands plus emergency storage for fire protection. It is typically assumed that half of the elevated storage tank capacity is used to meet peak hourly demands in excess of the maximum day rate (equalization volume), while the other half of the tank is used for fire protection and emergency conditions (fire/emergency volume). This evaluation assumes that 60% of peak hour demands will be met by pumping, and the remaining 40% will be met by system elevated storage. **Table 4-7** shows the recommended elevated storage.

**Table 4-7: Recommended Elevated Storage**

| Year | Peak Demand from Storage (MGD)(1) | Peak Volume (MG)(2) | Fire Volume (MG)(3) | Total (MG)(4) |
|---|---|---|---|---|
| 2013 | 2.09 | 0.26 | 0.63 | 0.89 |
| 2023 | 3.82 | 0.48 | 0.63 | 1.11 |
| Buildout | 5.04 | 0.63 | 0.63 | 1.26 |

(1) Equals 40% of peak hour demand
(2) Required volume to supply the peak demand for a duration of 3 hours
(3) Assuming highest fire flow required is 3,500 gpm for 3 hour duration
(4) The greater of twice the peaking volume or the peaking volume plus fire volume

The recommended firm pumping capacity was calculated based on meeting 60% of the peak hour demands. Firm pumping capacity is defined as the total available pumping capacity with the largest pump out of service. **Table 4-6** presents the recommended firm pumping capacity.

**Table 4-8: Recommended Firm Pumping Capacity**

| Year | Recommended Pumping (MGD) |
|---|---|
| 2013 | 3.13 |
| 2023 | 5.72 |
| Buildout | 7.55 |

## 4.6 WATER SUPPLY EVALUATION

Securing future water supplies is essential to support continued growth within the City of Kennedale. Eventually, the City would like to reduce reliance on groundwater and decommission wells, and additional water supply will be required. As previously described, the City currently purchases water from the City of Fort Worth and has groundwater wells. The City is contracted to take up to 2.5 MGD from the City of Fort Worth. As an alternative to increasing the amount of water purchased from Fort Worth in the future, the City tasked FNI with evaluating the feasibility of an additional water supply from the City of Arlington. Arlington has water lines located along Highway 287 with plans to upsize these lines in the future. The connection point would be at Swiney Heitt Road or Eden Road on the east side of the City. For this study, two water supply options were evaluated. Option 1 is continuing to take water from Fort Worth with additional supply from Arlington, and Option 2 is increasing supply from Fort Worth in the future. **Figures 4-3** through **4-6** show the proposed water supply alternatives. Given the close proximity to the City and the added reliability of having an additional water supplier, it is recommended that Kennedale purchase water from Arlington and Fort Worth in the future.

**Figure 4-3: Option 1, Service from Arlington and Fort Worth, Average Day Demand**

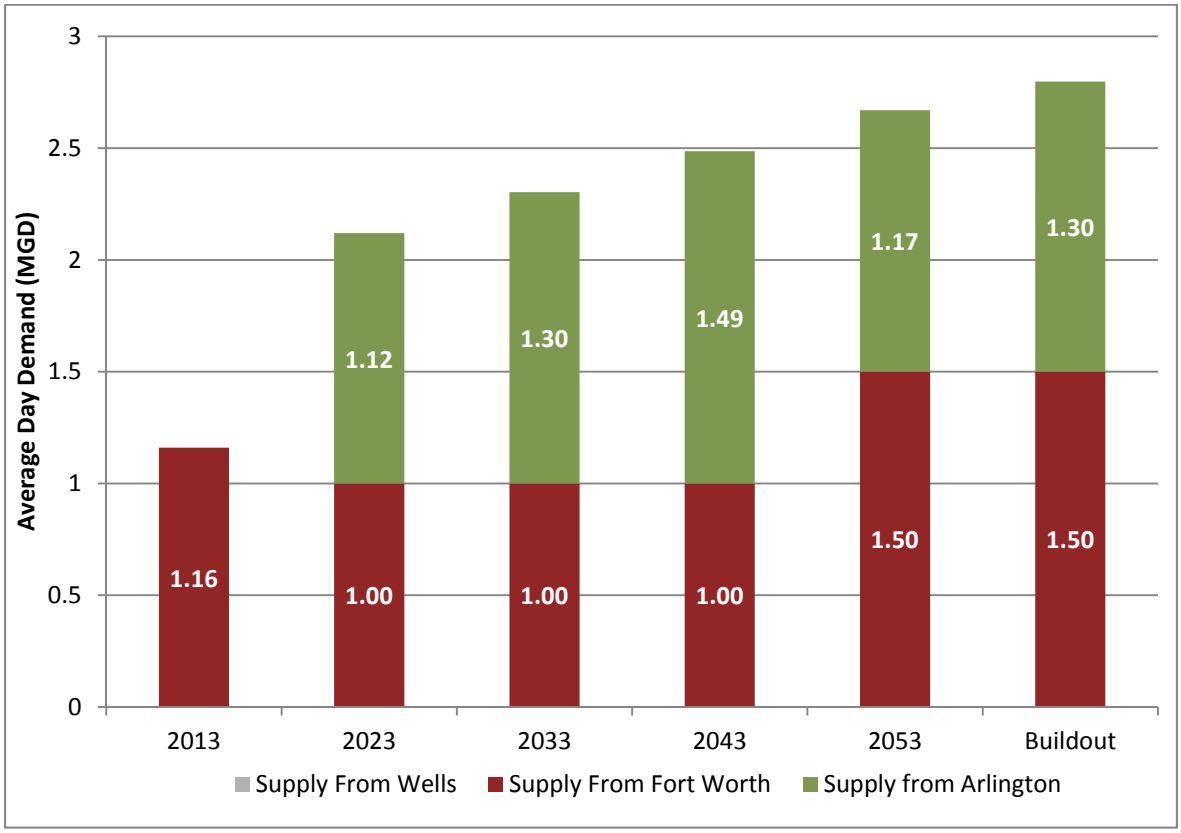


**Figure 4-4: Option 1, Service from Arlington and Fort Worth, Maximum Day Demand**

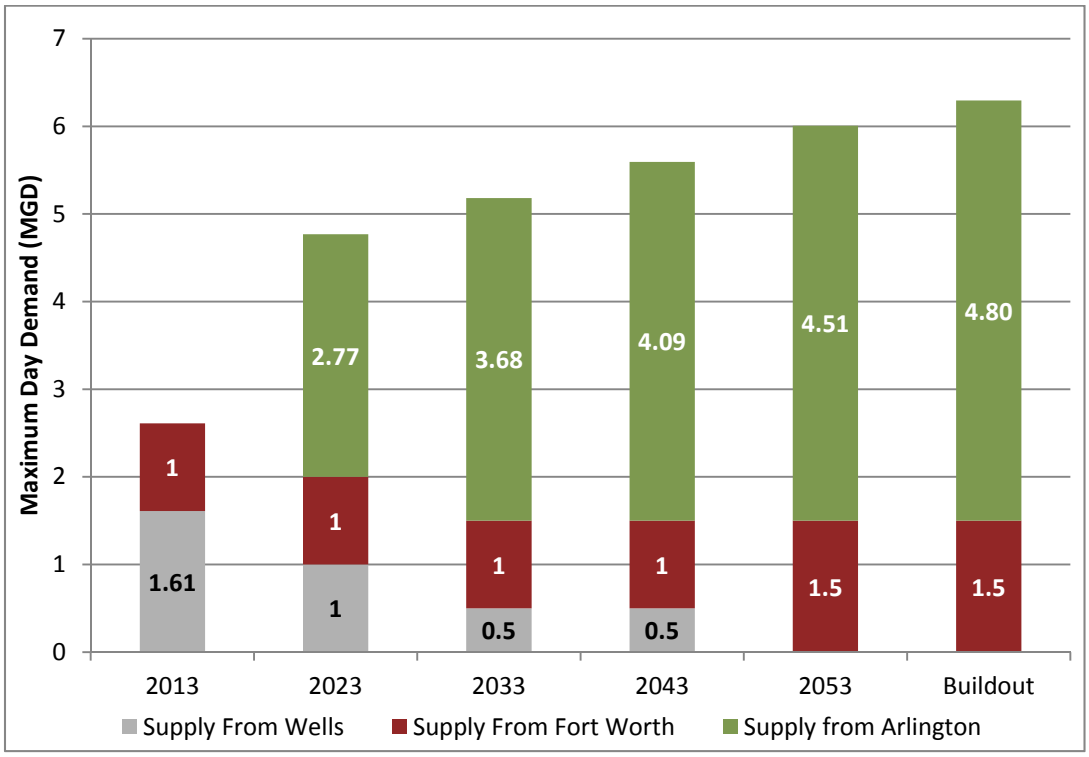
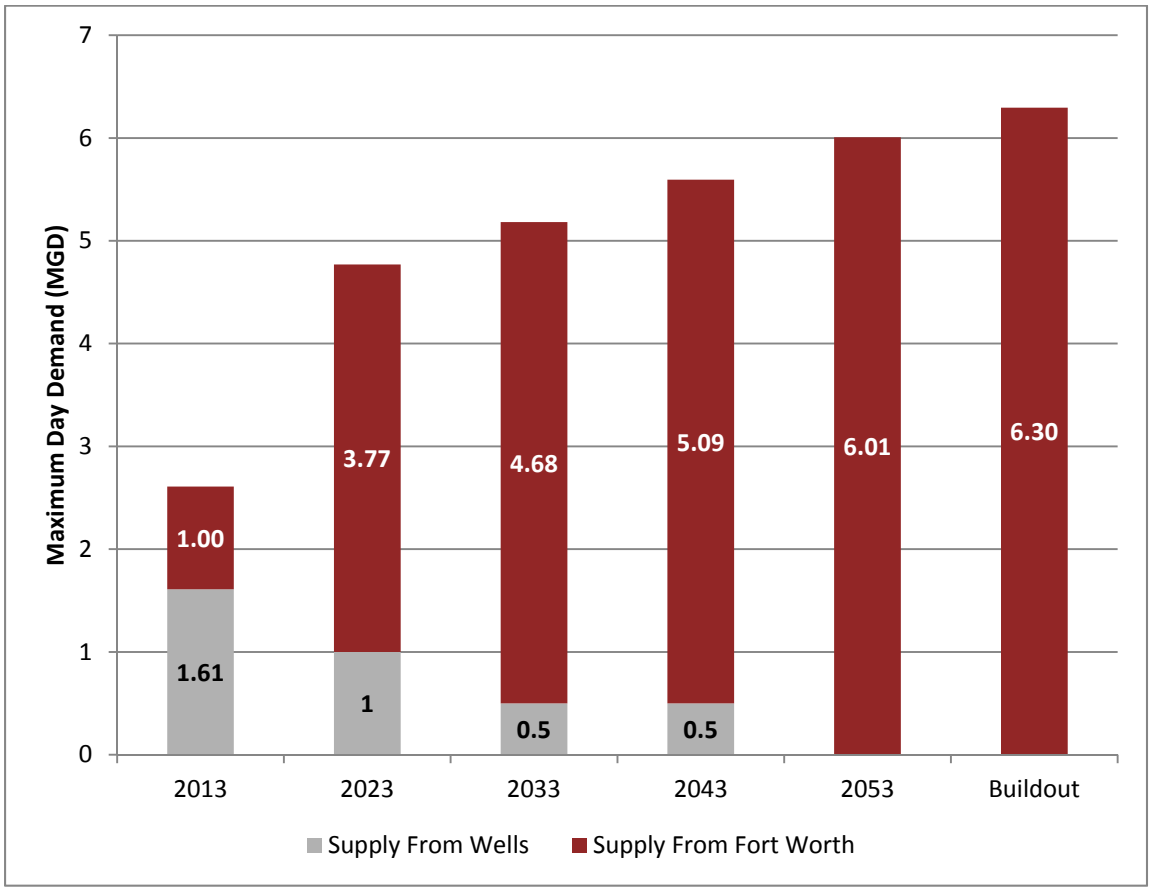



**Figure 4-5: Option 2, Service from Fort Worth, Average Day Demand**



**Figure 4-6: Option 2, Service from Fort Worth, Maximum Day Demand**




## 4.7 HYDRAULIC ANALYSIS

Hydraulic analyses were performed for the distribution system under existing and future year demands. Various hydraulic conditions were analyzed, including average day, maximum day, peak hour, and maximum day plus fire flow.

Average day model runs are used to evaluate the ability of the distribution system to fill elevated storage tanks under lower demand conditions after a peak hour event. Because of the increased volume of water being delivered to the system under relatively low demand conditions, high pressures may be experienced in areas of low ground elevation and areas near pump stations. The elevated storage tanks were assumed to be approximately 75% full for the average day model runs.

Maximum day model runs assess the ability of the system to meet demands with adequate residual pressures and maintain levels in elevated storage facilities. In a maximum day model run, the pump stations should supply enough water to meet the demand of the system, and the elevated storage tank

levels should see little change. In this condition, the elevated tanks were assumed to be approximately 95% full, providing a maximum system hydraulic grade against which the pumps would operate.

Peak hour model runs are used to assess the ability of the distribution system to maintain residual pressures. The TCEQ required minimum pressure within a distribution system is 35 psi under normal operating conditions. The peak hour analysis is also used to examine whether elevated storage drain rates are excessive. The elevated storage tanks were assumed to be approximately 50% full for the peak hour model runs.

The existing system analysis identified a few areas with low pressure along Eden Road and Kennedale Parkway. The low pressures are primarily due to lack of transmission capacity, but there are some areas with high elevations along Hudson Road that result in low pressures. There was also low available fire flow along Hudson Road and in other isolated areas due to dead-end or small diameter lines. A few lines near the standpipe showed high headloss (greater than 4 feet per 1,000 feet) under peak hour conditions. The existing system peak hour pressure results are presented on **Figure 4-7,** and the existing system available fire flow under maximum day demands is presented on **Figure 4-8**. The future system analysis was run with CIP projects. System looping and larger diameter lines improve system pressures and fire flows in most areas. The Buildout peak hour pressures and available fire flow for Option 1: Supply from Fort Worth and Arlington are presented on **Figures 4-9** and **4-10**. The peak hour pressures and available fire flow for Option 2: Supply from Fort Worth are presented on **Figures 4-11** and **4-12**.

# FIGURE 4-7

# CITY OF KENNEDALE

## EXISTING WATER SYSTEM PEAK HOUR PRESSURES

### LEGEND

*Pressure*

- Less than 35 psi
- 35 - 50 psi
- 50 - 80 psi
- Greater than 80 psi
- 8" and Smaller Water Line
- 10" and Larger Water Line
- City of Fort Worth Water Line

- Street
- Stream
- Parcel
- City Limit
- ETJ Boundary

**Trinity Well #4**
380 GPM
**Ground Storage Tank**
0.5 MGD Capacity
**Booster Pump Station**
(2) 750 GPM Pumps

**Paluxy Well #2**
90 GPM
**Not in Service**

**Ground Storage Tank**
0.75 MG Capacity
**Booster Pump Station**
(2) 500 GPM Pumps

**Trinity Well #1**
310 GPM

**Paluxy Well #1**
137 GPM

**Trinity Well #2**
330 GPM

**Standpipe**
0.72 MG Capacity
Overflow Elevation = 808'

**Elevated Storage Tank**
1.0 MG Capacity
**Ground Storage Tank**
0.35 MG Capacity
**Booster Pump Station**
(2) 2,800 GPM Pumps

**Trinity Well #3**
340 GPM

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0 1,100 2,200
SCALE IN FEET

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**Trinity Well #4**
380 GPM
**Ground Storage Tank**
0.5 MGD Capacity
**Booster Pump Station**
(2) 750 GPM Pumps

**Paluxy Well #2**
90 GPM
**Not in Service**

**Ground Storage Tank**
0.75 MG Capacity
**Booster Pump Station**
(2) 500 GPM Pumps

**Trinity Well #1**
310 GPM

**Paluxy Well #1**
137 GPM

**Trinity Well #2**
330 GPM

**Standpipe**
0.72 MG Capacity
Overflow Elevation = 808'

**Elevated Storage Tank**
1.0 MG Capacity
**Ground Storage Tank**
0.35 MG Capacity
**Booster Pump Station**
(2) 2,800 GPM Pumps

**Trinity Well #3**
340 GPM

# FIGURE 4-8
# CITY OF KENNEDALE
## EXISTING WATER SYSTEM
## AVAILABLE FIRE FLOW

### LEGEND

*Fire Flow*

- Less than 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 gpm - 3,000 gpm
- Greater than 3,000 gpm
- 8" and Smaller Water Line
- 10" and Larger Water Line
- City of Fort Worth Water Line
- Street
- Stream
- Parcel
- City Limit
- ETJ Boundary

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0 1,100 2,200
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Ridge Pointe Pump Station

Arlington Emergency Connection

Proposed 0.5 MG Elevated Storage Tank
Overflow Elev. = 800'

Paluxy Well #2
90 GPM
Not in Service
Decommission Well

Trinity Well #4
380 GPM
Decommission Well
Ground Storage Tank
0.5 MGD Capacity
Booster Pump Station
(2) 750 GPM Pumps

Ground Storage Tank
0.75 MG Capacity
Booster Pump Station
(2) 500 GPM Pumps

Paluxy Well #1
137 GPM
Decommission Well

Trinity Well #1
310 GPM
Decommission Well

From Fort Worth

Proposed 0.75 MG Ground Storage Tank

Elevated Storage Tank
1.0 MG Capacity
Overflow Elev. = 800'
Ground Storage Tank
0.35 MG Capacity
Booster Pump Station
(2) 2,800 GPM Pumps

Trinity Well #3
340 GPM
Decommission Well

Trinity Well #2
330 GPM
Decommission Well

Standpipe
0.72 MG Capacity
Overflow Elev. = 808'
Water Quality Improvements
Decommission Standpipe

Arlington Supply Point

Proposed Ground Storage Tank
1.5 MG Capacity
Proposed Pump Station
6.5 MGD Firm Capacity

Tierra Verde Elevated Storage Tank

0 1,300 2,600
SCALE IN FEET

# FIGURE 4-9
# CITY OF KENNEDALE
## BUILDOUT WATER SYSTEM
## PEAK HOUR PRESSURES
## SERVICE FROM ARLINGTON AND FORT WORTH

LEGEND

*Pressure*
- Less than 35 psi
- 35 - 50 psi
- 50 - 80 psi
- Greater than 80 psi
- Proposed Arlington Connection
- 2023 Pump Station
- 2023 Ground Storage Tank
- Buildout Elevated Storage Tank
- Proposed Water Line Improvement

- Existing Elevated Storage Tank
- Existing Ground Storage Tank
- Existing Booster Pump Station
- Water Well
- Existing 8" and Smaller Water Line
- Existing 10" and Larger Water Line
- City of Fort Worth Water Line
- Street
- Stream
- Parcel

*City of Arlington Water System*
- Existing Transfer Valve
- Elevated Storage Tank
- Ground Storage Tank
- Booster Pump Station
- 12" and Larger Water Line
- City Limit
- ETJ Boundary

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Ridge Pointe Pump Station

Arlington Emergency Connection

Proposed 0.5 MG Elevated Storage Tank
Overflow Elev. = 800'

Paluxy Well #2
90 GPM
Not in Service
Decommission Well

Trinity Well #4
380 GPM
Decommission Well
Ground Storage Tank
0.5 MGD Capacity
Booster Pump Station
(2) 750 GPM Pumps

Ground Storage Tank
0.75 MG Capacity
Booster Pump Station
(2) 500 GPM Pumps

Paluxy Well #1
137 GPM
Decommission Well

Trinity Well #1
310 GPM
Decommission Well

From Fort Worth

Proposed 0.75 MG Ground Storage Tank

Elevated Storage Tank
1.0 MG Capacity
Overflow Elev. = 800'
Ground Storage Tank
0.35 MG Capacity
Booster Pump Station
(2) 2,800 GPM Pumps

Trinity Well #3
340 GPM
Decommission Well

Trinity Well #2
330 GPM
Decommission Well

Standpipe
0.72 MG Capacity
Overflow Elev. = 808'
Water Quality Improvements
Decommission Standpipe

Arlington Supply Point

Proposed Ground Storage Tank
1.5 MG Capacity
Proposed Pump Station
6.5 MGD Firm Capacity

Tierra Verde Elevated Storage Tank

0 1,300 2,600
SCALE IN FEET

# FIGURE 4-10
# CITY OF KENNEDALE
## BUILDOUT WATER SYSTEM
## AVAILABLE FIRE FLOW
## SERVICE FROM ARLINGTON AND FORT WORTH

LEGEND

*Fire Flow*
- Less than 1,000 gpm
- 1,000 to 1,500 gpm
- 1,500 to 3,000 gpm
- Greater than 3,000 gpm
- Proposed Arlington Connection
- 2023 Pump Station
- 2023 Ground Storage Tank
- Buildout Elevated Storage Tank
- Proposed Water Line Improvement

- Existing Elevated Storage Tank
- Existing Ground Storage Tank
- Existing Booster Pump Station
- Water Well
- Existing 8" and Smaller Water Line
- Existing 10" and Larger Water Line
- City of Fort Worth Water Line
- Street
- Stream
- Parcel

*City of Arlington Water System*
- Existing Transfer Valve
- Elevated Storage Tank
- Ground Storage Tank
- Booster Pump Station
- 12" and Larger Water Line
- City Limit
- ETJ Boundary

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Proposed 0.5 MG
Elevated Storage Tank
Overflow Elev. = 800'

Trinity Well #4
380 GPM
Decommission Well
Ground Storage Tank
0.5 MGD Capacity
Booster Pump Station
(2) 750 GPM Pumps

Paluxy Well #2
90 GPM
Not in Service
Decommission Well

Ground Storage Tank
0.75 MG Capacity
Booster Pump Station
(2) 500 GPM Pumps

Trinity Well #1
310 GPM
Decommission Well

Paluxy Well #1
137 GPM
Decommission Well

Elevated Storage Tank
1.0 MG Capacity
Overflow Elev. = 800'
Ground Storage Tank
0.35 MG Capacity
Booster Pump Station
(2) 2,800 GPM Pumps

From Fort Worth

Proposed 3.0 MG
Ground Storage Tank
Add (1) 2,800 GPM Pump

Trinity Well #3
340 GPM
Decommission Well

Trinity Well #2
330 GPM

Standpipe
0.72 MG Capacity
Overflow Elev. = 808'
Water Quality Improvements
Decommission Standpipe

Arlington Emergency Connection

0 1,300 2,600
SCALE IN FEET

# FIGURE 4-11
# CITY OF KENNEDALE
## BUILDOUT WATER SYSTEM
## PEAK HOUR PRESSURES
## WITH SERVICE FROM FORT WORTH

### LEGEND

*Pressure*
- Less than 35 psi
- 35 - 50 psi
- 50 - 80 psi
- Greater than 80 psi

- Proposed Emergency Connection
- 2023 Pump Station
- 2023 Ground Storage Tank
- Buildout Elevated Storage Tank
- Existing Elevated Storage Tank
- Existing Ground Storage Tank
- Existing Booster Pump Station
- Water Well
- Proposed Water Line Improvement
- Existing 8" and Smaller Water Line
- Existing 10" and Larger Water Line
- City of Fort Worth Water Line
- Street
- Stream
- Parcel
- City Limit
- ETJ Boundary

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Proposed 0.5 MG
Elevated Storage Tank
Overflow Elev. = 800'

Paluxy Well #2
90 GPM
Not in Service
Decommission Well

Trinity Well #4
380 GPM
Decommission Well
Ground Storage Tank
0.5 MGD Capacity
Booster Pump Station
(2) 750 GPM Pumps

Ground Storage Tank
0.75 MG Capacity
Booster Pump Station
(2) 500 GPM Pumps

Paluxy Well #1
137 GPM
Decommission Well

Trinity Well #1
310 GPM
Decommission Well

Elevated Storage Tank
1.0 MG Capacity
Overflow Elev. = 800'
Ground Storage Tank
0.35 MG Capacity
Booster Pump Station
(2) 2,800 GPM Pumps

From Fort Worth

Proposed 3.0 MG
Ground Storage Tank
Add (1) 2,800 GPM Pump

Trinity Well #2
330 GPM

Trinity Well #3
340 GPM
Decommission Well

Standpipe
0.72 MG Capacity
Overflow Elev. = 808'
Water Quality Improvements
Decommission Standpipe

Arlington Emergency
Connection

0 1,300 2,600
SCALE IN FEET

# FIGURE 4-12
# CITY OF KENNEDALE
## BUILDOUT WATER SYSTEM
## AVAILABLE FIRE FLOW
## WITH SERVICE FROM FORT WORTH

### LEGEND

*Fire Flow*

- Less than 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 gpm to 3,000 gpm
- Greater than 3,000 gpm
- Proposed Emergency Connection
- 2023 Pump Station
- 2023 Ground Storage Tank
- Buildout Elevated Storage Tank
- Existing Elevated Storage Tank
- Existing Ground Storage Tank
- Existing Booster Pump Station
- Water Well
- Proposed Water Line Improvement
- Existing 8" and Smaller Water Line
- Existing 10" and Larger Water Line
- City of Fort Worth Water Line
- Street
- Stream
- Parcel
- City Limit
- ETJ Boundary

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# 5.0 WASTEWATER FLOWS

Three components comprise peak wastewater design flows: the peak dry weather flow, infiltration, and inflow. These components, along with future population, are used to develop wastewater flow projections. Average daily dry weather flows are the normal patterns of wastewater use when there is no rain event. These flows include the residential and nonresidential (industrial, commercial, and institutional) users in the system. The diurnal or 24-hour pattern of the flows will vary, generally with highest flows during the morning and late afternoon hours and lowest flows at night.

Infiltration is the seepage of groundwater into the sewer pipe and appurtenances. All infiltration is estimated as the difference between the minimum nighttime flow during dry weather-low groundwater periods and the minimum nighttime flow during high groundwater periods, which occur immediately after a storm event.

Inflow is the rainwater that enters the collection system, directly and indirectly, during and immediately following a storm event. The inflow represents storm water runoff from paved and non-paved areas from both public and private sector sources. The collection system must be able to convey the peak flow that results from design level storm events.

## 5.1 HISTORICAL WASTEWATER FLOWS

The City of Kennedale sends wastewater to the Arlington and Fort Worth wastewater systems to convey and treat the City's wastewater flows. The flow into Fort Worth's system is conveyed to the City's Village Creek WRF. The flow into Arlington's system is ultimately conveyed to TRA's Central WWTP. Historical data was provided by the City in order to calculate the average daily flow and the per-capita flow. **Table 5-1** presents the historical wastewater flows for the City of Kennedale.

**Table 5-1: Historical Wastewater Flows**

| Year | Population | Average Annual Daily Flow (MGD) | Average Daily Flow (gpcd) | Annual Rainfall (inches) |
|---|---|---|---|---|
| 2010 | 6,763 | 0.61 | 90 | 38 |
| 2011 | 6,770 | 0.42 | 62 | 23 |
| 2012 | 6,790 | 0.47 | 69 | 30 |
| **Average** | **-** | **-** | **74** | **30** |
| **Maximum** | **-** | **-** | **90** | **38** |

## 5.2 PROJECTED WASTEWATER FLOWS

The projected population was used along with average daily per-capita flows and wet weather peaking factors to project future peak wet weather flows for 2013, 2023, and buildout. Historical average per capita ranged from 62 to 90 gpcd. Because the City made significant system improvements to reduce I/I between 2007 and 2010, only data from 2010 and later was analyzed. An average per capita of 90 gpcd was selected for the average annual daily flow, and a wet weather peaking factor of 4.0 was used to calculated the peak wet weather flow. **Table 5-2** presents the projected wastewater flows. The projected peak wet weather flows by basin are presented in **Table 5-3**.

**Table 5-2: Projected Wastewater Flows**

| Year | Population | Average Annual Daily Flow (MGD) | Peak Wet Weather Flow (MGD) |
|---|---|---|---|
| 2013 | 6,820 | 0.61 | 2.46 |
| 2023 | 12,469 | 1.12 | 4.49 |
| Buildout | 16,459 | 1.48 | 5.93 |

**Table 5-3: Peak Wet Weather Flows by Basin**

| Basin Name | 2013 Flow (MGD) | 2023 Flow (MGD) | Buildout Flow (MGD) |
|---|---|---|---|
| C | 1.14 | 1.70 | 1.91 |
| A | 0.25 | 0.49 | 0.56 |
| C-1 | 0.01 | 0.03 | 0.06 |
| B-2 | 0.02 | 0.32 | 0.58 |
| B-1 | 0.16 | 0.46 | 0.64 |
| B | 0.64 | 0.92 | 1.29 |
| 25A | 0.15 | 0.28 | 0.41 |
| **Total Flow to Arlington** | **2.36** | **4.19** | **5.46** |
| D | 0.10 | 0.17 | 0.13 |
| E | 0.00 | 0.12 | 0.33 |
| **Total Flow to Fort Worth** | **0.10** | **0.30** | **0.46** |
| **Total** | **2.46** | **4.49** | **5.93** |

# 6.0 WASTEWATER SYSTEM ANALYSIS

## 6.1 EXISTING WASTEWATER COLLECTION SYSTEM

The City of Kennedale has nine major sewer basins. Currently one basin flows to the City of Fort Worth, five enter the Arlington system through the main meter, two flow to Arlington on the east side of the City, and one basin has no existing development. There is also a small number of Arlington customers that flow into the Kennedale system on the north side of the City. The City sends all of its wastewater to Fort Worth or Arlington for treatment and has no lift stations. **Figure 6-1** displays the existing wastewater collection system.

## 6.2 WASTEWATER MODEL DEVELOPMENT

A hydraulic model of the existing wastewater system was developed using H2OMap Sewer. The model uses hydraulic parameters such as manhole diameters, pipe diameters, pipe length, pipe inverts, ground elevations, wet well volumes, pump capacities, and system geometry to calculate flows and velocities under a given condition. Information on the existing system piping network was provided in AutoCAD and converted to GIS. Where as-built drawings for sewer lines were not available, TCEQ minimum slopes were assumed. Two-foot contours were used to assign rim elevations in the model. Flows were distributed to the wastewater model based on water billing data.

## 6.3 WASTEWATER SYSTEM FIELD TESTING AND MODEL VERIFICATION

Flow monitoring was conducted in the system from May 1 through June 9, 2013 at two locations in the system. For model verification, June 9, 2013, was chosen because that day had the largest rain event during the flow monitoring period representing when the system was most stressed during the field testing. The model was verified by adjusting peaking factors to match the flow monitoring data. The results of the flow monitoring and model calibration are presented in **Appendix C**.

## 6.4 HYDRAULIC ANALYSIS

Hydraulic model analyses were performed on the collection system under existing and future year flow conditions. A steady state simulation was performed under peak wet weather flows for each planning period. The model evaluates the ability of the system to adequately convey wastewater without excessively surcharging or overflowing.

Permanent Flow Meter

Kennedale 18" Connection to Arlington System

Arlington 10" Connection to Kennedale System

Arlington 10" Connection to Kennedale System

Kennedale 8" Connection to Arlington System

Kennedale 6" Connection to Arlington System

Kennedale 12" Connection to Arlington System

To Fort Worth

To Arlington

Basin 25A

Basin C

Basin B

Basin A

Basin B-1

Basin B-2

# FIGURE 6-1

# CITY OF KENNEDALE

## EXISTING WASTEWATER SYSTEM

### LEGEND

- Manhole
- 8" and Smaller Sewer Line
- 10" and Larger Sewer Line
- Fort Worth Sewer Line
- Arlington Sewer Line
- Ten-Foot Contour
- Street
- Parcel
- City Limit
- ETJ Boundary

### SEWER BASINS

- Basin A
- Basin B
- Basin B-1
- Basin B-2
- Basin C
- Basin C-1
- Basin D
- Basin 25A

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0 1,100 2,200

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Flow, depth, and velocity are important factors when analyzing the peak wet weather flow simulations. Design criteria vary, but for this study, gravity lines were recommended for consideration for replacement when the ratio of actual flow depth to the full flow depth of the pipe (q/Q) was 0.85 or greater. The flow in the line divided by the maximum capacity of the line, or q/Q, is also analyzed when looking at model results. A q/Q greater than 1.0 indicates that the wastewater main is exceeding capacity or surcharging into the manhole. The higher the q/Q ratio, the more surcharged the wastewater main will be.

When determining the size of proposed wastewater lines, gravity sewer lines were sized to maintain a minimum velocity of 2 feet/second and a maximum velocity of 8 feet/second. When sizing future lines for future wastewater loading, TCEQ Chapter 217 §217.53 (4) (j) states that "Systems shall be designed to preclude surcharge at the expected peak flow." TCEQ minimum slope requirements were utilized for new lines in undeveloped areas.

The existing system analysis showed a few areas with a q/Q greater than 1.0. These areas were primarily along North Road due to restrictions in the line diameter. The surcharged area along North Road predicted two overflows during peak wet weather events. A color-coded map was prepared to illustrate model results including q/Q value for each gravity main for the existing wastewater system analysis under peak flows. In the buildout analysis, gravity line segments with a q/Q greater than 1.0 were evaluated on a case by case basis to determine the need for a capital improvement. Surcharging was allowed in the existing gravity mains as long as the hydraulic grade line (HGL) was not within 3 feet of the rim of the manhole. The existing wastewater system analysis is presented on **Figure 6-2**.

FNI also evaluated the full flow capacity of the 12-inch wastewater line along Steeplechase Trail south of Sublett Road. The hydraulic model shows this line to have a full flow capacity of 1.03 MGD, and the projected buildout flow is 0.56 MGD. The 12-inch line can serve an additional 1,068 people or about 356 homes before reaching full flow capacity. This is based on an average day flow of 110 gpcd and a wet weather peaking factor of 4.0. Invert data was not available for the entire interceptor, so TCEQ minimum slopes were used where invert data was not available.

Permanent Flow Meter

To Fort Worth

To Arlington

Basin A

Basin B

Basin B-1

Basin B-2

Basin C

Basin 25A

# FIGURE 6-2

# CITY OF KENNEDALE

## EXISTING WASTEWATER SYSTEM ANALYSIS UNDER PEAK WET WEATHER FLOWS

### LEGEND

- Manhole
- Predicted Overflow
- Permanent Flow Meter
- q/Q ≥ 1
- 8" and Smaller Sewer Line
- 10" and Larger Sewer Line
- Street
- Stream
- Parcel
- City Limit
- ETJ Boundary

### SEWER BASINS

- Basin A
- Basin B
- Basin B-1
- Basin B-2
- Basin C
- Basin C-1
- Basin D
- Basin 25A

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0 1,100 2,200

SCALE IN FEET

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Updated: Thursday, May 01, 2014 9:14:30 AM

# 7.0 CAPITAL IMPROVEMENTS PLAN

Capital improvements plans (CIP) were developed for the City of Kennedale based on hydraulic modeling results. The recommended improvements will provide the required capacity and reliability to meet projected water demands and wastewater flows through buildout conditions. Two options were developed for the water system CIP based on the proposed water supply options. Option 1 is water service from Arlington and Fort Worth and is presented on **Figure 7-1**. Option 2 is water service from only Fort Worth and is presented on **Figure 7-2**. The wastewater CIP is presented on **Figure 7-3**. Locations shown for new mains and other recommended improvements were generalized for hydraulic analysis. Specific alignments and sites will be determined as part of the design process. It is recommended that these projects be constructed generally in the order listed; however, development patterns may make it necessary to construct some projects sooner or later than anticipated. Detailed descriptions and cost estimates for the proposed water and wastewater system projects are included in **Appendices D, E**, and **F**.

Projects associated with the treatment of water and wastewater are not included in the CIP. The City of Kennedale is a wholesale customer of Fort Worth and Arlington and therefore is not directly responsible for water and wastewater treatment improvements. Also, improvements to infrastructure that is not owned by the City of Kennedale or cost participation in wholesale provider improvements were not included as part of this CIP.

**Tables 7-1** through **7-3** summarize the costs of the water and wastewater capital improvements plan for the City of Kennedale. The costs are in 2014 dollars and include an allowance for engineering, surveying, and contingencies. Cost estimates do not include allowances for right-of-way acquisition.

**Table 7-1: Option 1 Water System Capital Improvement Plan**

| | Proj. No. | Project | Cost |
|---|---|---|---|
| 2013 - 2023 | 1 | Arlington Water Supply | $909,420 |
| | 2 | 12-inch water line south of Interstate 20 | $438,830 |
| | 3 | Standpipe Improvements | $483,000 |
| | 4 | 0.75 MG Ground Storage Tank | $1,343,430 |
| | 5 | 16-inch water line along Eden Road | $495,420 |
| | 6 | 12-inch water lines from Pump Station 3 and along Dick Price Road | $409,650 |
| | 7 | 12-inch water line between Dick Price Road and New Hope Road | $319,880 |
| | 8 | 12-inch water line along Dick Price Road | $767,460 |
| | 9 | 12-inch water line along US 287 Business and along Hudson Road | $1,235,930 |
| | 10 | 1.5 MG Ground Storage Tank and 6.5 MGD Pump Station | $3,910,230 |
| | 11 | 12-inch water line along Dick Price Road and Green Circle | $1,049,530 |
| | 12 | 12-inch water line between Swiney Hiett Road and Trinity Well #4 | $1,320,480 |
| | 13 | 12-inch water line along New Hope Road | $390,190 |
| | 14 | Arlington Emergency Connection | $172,500 |
| | | **Total 2013 - 2023** | **$13,245,950** |
| 2024 - Buildout | 15 | 16-inch water line Swiney Hiett Road | $386,120 |
| | 16 | 0.5 MG Elevated Storage Tank | $1,958,670 |
| | 17 | Decommission Standpipe | $207,000 |
| | 18 | 8-inch water lines between New Hope Road and US 287 Business | $571,830 |
| | 19 | 12-inch water line near standpipe | $158,730 |
| | 20 | 12-inch water line south of Interstate 20 and along US 287 Business | $275,840 |
| | 21 | 12-inch water lines along Dick Price Road, Garcia Lane and New Hope Road | $1,932,730 |
| | 22 | 10-inch water line west of Dick Price Road | $944,750 |
| | 23 | 10-inch water line along Wilson Road and Shelby Road in the ETJ | $1,769,850 |
| | 24 | Decommission Wells | $207,000 |
| | | **Total 2024 - Buildout** | **$8,412,520** |
| | | **Grand Total, 2013 - Buildout** | **$21,658,470** |

**Table 7-2: Option 2 Water System Capital Improvement Plan**

| | Proj. No. | Project | Cost |
|---|---|---|---|
| **2013 - 2023** | 1 | 12-inch water line south of Interstate 20 | $438,830 |
| | 2 | Standpipe Improvements | $483,000 |
| | 3 | 16-inch water line along Eden Road | $495,420 |
| | 4 | 16/20-inch water lines from Pump Station 3 and along Dick Price Road | $1,299,640 |
| | 5 | 3.0 MG ground storage tank and new pump at Fort Worth supply point | $2,792,430 |
| | 6 | Arlington Emergency Connection | $567,460 |
| | 7 | 12-inch water line between Dick Price Road and New Hope Road | $767,460 |
| | 8 | 12-inch water line along Dick Price Road | $319,880 |
| | 9 | 16-inch water line along US 287 Business and along Hudson Road | $2,363,070 |
| | 10 | 12-inch water line along New Hope Road | $390,190 |
| | 11 | 16-inch water line along Dick Price Road and Green Circle | $1,388,790 |
| | 12 | 12-inch water line between Swiney Hiett Road and Trinity Well #4 | $1,320,480 |
| | | **Total 2013 - 2023** | **$12,626,650** |
| **2024 - Buildout** | 13 | 16-inch water line along Dick Price Road | $663,510 |
| | 14 | 0.5 MG Elevated Storage Tank | $1,958,670 |
| | 15 | Decommission Standpipe | $207,000 |
| | 16 | 8-inch water lines between New Hope Road and US 287 Business | $571,830 |
| | 17 | 12-inch water line near standpipe | $158,700 |
| | 18 | 12-inch water line south of Interstate 20 and along US 287 Business | $275,840 |
| | 19 | 12-inch water lines along Dick Price Road, Garcia Lane and New Hope Road | $1,932,730 |
| | 20 | 10-inch water line west of Dick Price Road | $944,750 |
| | 21 | 10-inch water line along Wilson Road and Shelby Road in the ETJ | $1,769,850 |
| | 22 | Decommission Wells | $207,000 |
| | | **Total 2024 - Buildout** | **$8,689,880** |
| | | **Grand Total, 2013 - Buildout** | **$21,316,530** |

**Table 7-3: Wastewater System Capital Improvement Plan**

| | Proj. No. | Project | Cost |
|---|---|---|---|
| **2013 - 2023** | 1 | 15/18-inch interceptor along North Road and Dick Price Road | $1,442,480 |
| | 2 | 21-inch and interceptor in Basin C-1 | $846,690 |
| | 3 | 15-inch interceptor in Basin C | $692,210 |
| | 4 | 8-inch line along Dick Price Road | $601,200 |
| | 5 | 10/6-inch lines in Basin B-2 | $985,990 |
| | 6 | 10-inch line in Basin B-2 | $426,950 |
| | 7 | 8-inch line along Bloxom Park | $327,090 |
| | 8 | 6-inch line in Basin B-1 | $213,890 |
| | 9 | 6-inch line along Kennedale Parkway | $244,450 |
| | 10 | Flow Meter Updates | $358,800 |
| | | **Total 2013 - 2023** | **$6,139,750** |
| **2024 - Buildout** | 11 | 15-inch interceptor in Basin B | $1,049,360 |
| | 12 | 6/8-inch lines in Basin E | $1,512,510 |
| | 13 | 6/8-inch lines in Basin E | $1,341,910 |
| | 14 | 8-inch lines in Basin B-2 | $1,076,700 |
| | 15 | 8-inch lines in Basin B-2 | $699,700 |
| | | **Total 2024 - Buildout** | **$5,680,180** |
| | | **Grand Total, 2013 - Buildout** | **$11,819,930** |

Ridge Pointe Pump Station

Arlington Emergency Connection

Proposed 0.5 MG Elevated Storage Tank
Overflow Elev. = 800'

Paluxy Well #2
90 GPM
Not in Service
Decommission Well

Trinity Well #4
380 GPM
Decommission Well
Ground Storage Tank
0.5 MG Capacity
Booster Pump Station
(2) 750 GPM Pumps

Ground Storage Tank
0.75 MG Capacity
Booster Pump Station
(2) 500 GPM Pumps

Paluxy Well #1
137 GPM
Decommission Well

Trinity Well #1
310 GPM
Decommission Well

From Fort Worth

Proposed 0.75 MG Ground Storage Tank

Elevated Storage Tank
1.0 MG Capacity
Overflow Elev. = 800'
Ground Storage Tank
0.35 MG Capacity
Booster Pump Station
(2) 2,800 GPM Pumps

Trinity Well #3
340 GPM
Decommission Well

Trinity Well #2
330 GPM
Decommission Well

Standpipe
0.72 MG Capacity
Overflow Elev. = 808'
Water Quality Improvements
Decommission Standpipe

Arlington Supply Point

Proposed Ground Storage Tank
1.5 MG Capacity
Proposed Pump Station
6.5 MGD Firm Capacity

Tierra Verde Elevated Storage Tank

Note:
Proposed alignments are conceptual and subject to change.

0 1,300 2,600
SCALE IN FEET

# FIGURE 7-1
# CITY OF KENNEDALE
## OPTION 1: BUILDOUT WATER SYSTEM CAPITAL IMPROVEMENTS PLAN WITH SERVICE FROM ARLINGTON AND FORT WORTH

### LEGEND

- Proposed Arlington Connection
- 2023 Pump Station
- 2023 Ground Storage Tank
- Buildout Elevated Storage Tank
- Existing Elevated Storage Tank
- Existing Booster Pump Station
- Water Well
- 2023 Water Line Improvement
- Buildout Water Line Improvement
- Existing 8" and Smaller Water Line
- Existing 10" and Larger Water Line
- City of Fort Worth Water Line
- Street
- Stream
- Parcel
- City Limit
- ETJ Boundary

*City of Arlington Water System*

- Existing Transfer Valve
- Elevated Storage Tank
- Ground Storage Tank
- Booster Pump Station
- 10" and Larger Water Line

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Job No.: KEN13264
Location: H:\W_WW_PLANNING\FINAL_REPORT\(Figure_7-1)-Water_CIP_ARL.mxd
Updated: Wednesday, May 07, 2014 8:07:16 AM

Proposed 0.5 MG
Elevated Storage Tank
Overflow Elev. = 800'

Paluxy Well #2
90 GPM
Not in Service
Decommission Well

Trinity Well #4
380 GPM
Decommission Well
Ground Storage Tank
0.5 MG Capacity
Booster Pump Station
(2) 750 GPM Pumps

Ground Storage Tank
0.75 MG Capacity
Booster Pump Station
(2) 500 GPM Pumps

Paluxy Well #1
137 GPM
Decommission Well

Trinity Well #1
310 GPM
Decommission Well

Elevated Storage Tank
1.0 MG Capacity
Overflow Elev. = 800'
Ground Storage Tank
0.35 MG Capacity
Booster Pump Station
(2) 2,800 GPM Pumps

Proposed 3.0 MG
Ground Storage Tank
Add (1) 2,800 GPM Pump

Trinity Well #3
340 GPM
Decommission Well

Trinity Well #2
330 GPM
Decommission Well

Standpipe
0.72 MG Capacity
Overflow Elev. = 808'
Water Quality Improvements
Decommission Standpipe

Arlington Emergency Connection

From Fort Worth

Note:
Proposed alignments are conceptual and subject to change.

0 1,300 2,600
SCALE IN FEET

# FIGURE 7-2
# CITY OF KENNEDALE
## OPTION 2: BUILDOUT WATER SYSTEM CAPITAL IMPROVEMENTS PLAN WITH SERVICE FROM FORT WORTH

LEGEND

- 2023 Pump Station
- 2023 Ground Storage Tank
- Buildout Elevated Storage Tank
- Proposed Emergency Connection
- Existing Elevated Storage Tank
- Existing Ground Storage Tank
- Existing Booster Pump Station
- Water Well
- 2023 Water Line Improvement
- Buildout Water Line Improvement
- Existing 8" and Smaller Water Line
- Existing 10" and Larger Water Line
- City of Fort Worth Water Line
- Street
- Stream
- Parcel
- City Limit
- ETJ Boundary

*City of Arlington Water System*

- Existing Transfer Valve
- Elevated Storage Tank
- Ground Storage Tank
- Booster Pump Station
- 10" and Larger Water Line

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Location: H:\W_WW_PLANNING\FINAL_REPORT\(Figure_7-2)-Water_CIP_FTW.mxd
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Relocate Flow Meter and Add SCADA

10

Upsize 18" to 21"

2

To Fort Worth

To Arlington

Basin D

Basin C-1

Upsize 12" to 15"

3

1

Upsize 6/8/12" to 15/18"

Basin 25A

Basin C

Basin A

11

Basin B

Upsize 12" to 15"

4

Upsize 6" to 8"

Proposed Flow Meter to Fort Worth

12

13

To Fort Worth

Basin E

5

6

8

Basin B-1

7

9

14

15

Basin B-2

# FIGURE 7-3
# CITY OF KENNEDALE
## BUILDOUT WASTEWATER SYSTEM CAPITAL IMPROVEMENTS PLAN

### LEGEND

- 2023 Wastewater Line Improvement
- Buildout Wastewater Line Improvement

*Kennedale Existing Sewer Lines*

- 8" and Smaller Sewer Line
- 10" and Larger Sewer Line

*Arlington Existing Sewer Lines*

- 8" and Smaller Sewer Line
- 10" and Larger Sewer Line

*Fort Worth Existing Sewer Lines*

- 8" and Smaller Sewer Line
- 10" and Larger Sewer Line

- Manhole
- Permanent Flow Meter
- Proposed Flow Meter
- Street
- Ten-Foot Contour
- Stream
- Parcel
- City Limit
- ETJ Boundary

### SEWER BASINS

- Basin A
- Basin B
- Basin B-1
- Basin B-2
- Basin C
- Basin C-1
- Basin D
- Basin 25A
- Basin E

**Note:**
**Proposed alignments are conceptual and subject to change.**

0 1,300 2,600

SCALE IN FEET

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Updated: Monday, April 28, 2014 4:15:02 PM

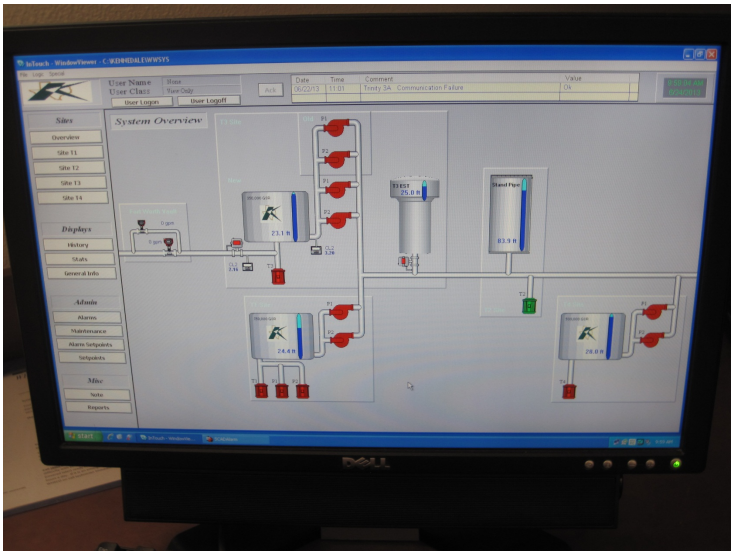
# APPENDIX A
# SITE VISIT PHOTOGRAPHS

# Standpipe

0.165 MG Elevated Storage
0.555 MG Ground Storage
Sidewater depth 100’



# SCADA



## 750,000 gallon GST at T-1



## T-3 Elevated Storage Tank (1.0 MG)

- High level 113’
- Low Level 78’



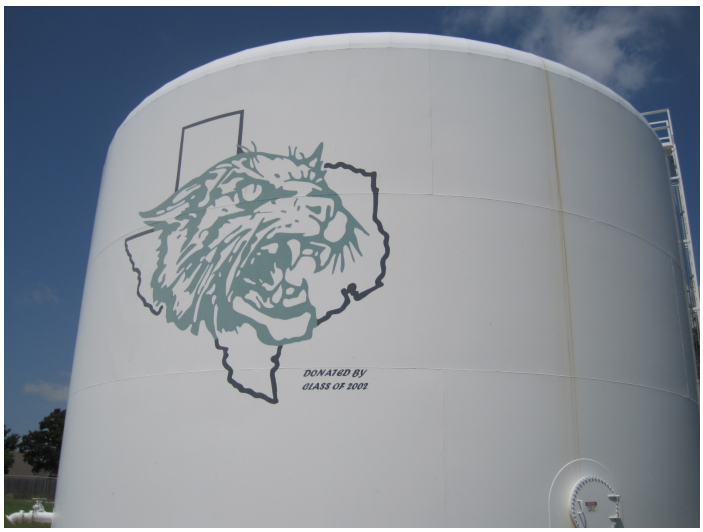
## T-3 350,000 gallon GST



## Fort Worth Meter Site



# T-4 500,000 gallon GST



# APPENDIX B
# WATER FIELD TESTING DATA
# AND MODEL CALIBRATION RESULTS

**P.R.# 1**
E. I-20 Service Rd.
P.R. ID 23018
Modeled: 79 psi
Observed: 77 psi

**P.R.# 2**
824 Pennsylvania Ave.
P.R. ID 1669
Modeled: 50 psi
Observed: 50 psi

**P.R.# 3**
206 Arthur Dr.
P.R. ID 341254
Modeled: 80 psi
Observed: 83 psi

**P.R.# 4**
436 North Rd.
P.R. ID 203271
Modeled: 84 psi
Observed: 86 psi

**P.R.# 5**
1273 Forest Green Dr.
P.R. ID 1670
Modeled: 56 psi
Observed: 57 psi

**P.R.# 6**
1244 Cross Creek Dr.
P.R. ID 1666
Modeled: 49 psi
Observed: 51 psi

**P.R.# 7**
437 E. Kennedale Pkwy.
P.R. ID 203019
Modeled: 62 psi
Observed: 62 psi

**P.R.# 8**
414 S. New Hope Rd.
P.R. ID 204228
Modeled: 74 psi
Observed: 75 psi

**P.R.# 9**
1211 Falcon Ridge Dr.
P.R. ID 1668
Modeled: 48 psi
Observed: 49 psi

**P.R.# 10**
4315 Danny Dr.
P.R. ID 341252
Modeled: 44 psi
Observed: 46 psi

***Trinity Well #4***
*380 GPM*
*Modeled: 0 MGD*
*Observed: 0 MGD*
***Ground Storage Tank***
*0.5 MGD Capacity*
***Booster Pump Station***
*(2) 750 GPM Pumps*
*Modeled: 59 psi*
*Observed: 59 psi*

***Paluxy Well #2***
*90 GPM*
***Not in Service***

***Ground Storage Tank***
*0.75 MG Capacity*
***Booster Pump Station***
*(2) 500 GPM Pumps*
*Modeled: 61 psi*
*Observed: 65 psi*

***Trinity Well #1***
*310 GPM*
*Modeled: 0.39 MGD*
*Observed: 0.39 MGD*

***Paluxy Well #1***
*137 GPM*
*Modeled: 0.20 MGD*
*Observed: 0.19 MGD*

***Trinity Well #2***
*330 GPM*

***Standpipe***
*0.72 MG Capacity*
*Overflow Elevation = 808'*

***Elevated Storage Tank***
*1.0 MG Capacity*
***Ground Storage Tank***
*0.35 MG Capacity*
***Booster Pump Station***
*(2) 2,800 GPM Pumps*
*Modeled: 47 psi*
*Observed: 48 psi*

***Trinity Well #3***
*340 GPM*
*Modeled: 0.43 MGD*
*Observed: 0.44 MGD*

**Water Model Calibration Time Period**
July 17, 2013 at 7:00 a.m.
System Demand 2.88 MGD

# FIGURE B-1
# CITY OF KENNEDALE
## EXISTING WATER SYSTEM MODEL CALIBRATION
### LEGEND

- Pressure Testing Location
- Elevated Storage
- Ground Storage
- Booster Pump Station
- Water Well
- 8" and Smaller Water Line
- 10" and Larger Water Line
- City of Fort Worth Water Line
- Fire Hydrant
- Street
- Stream
- Parcel
- City Limit
- ETJ Boundary

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0 1,100 2,200
SCALE IN FEET

Created By Freese and Nichols, Inc.
Job No.: KEN13264
Location: H:\W_WW_PLANNING\FINAL_REPORT\(Figure_B-1)-Existing_Water_System-Calibration_Results.mxd
Updated: Wednesday, May 07, 2014 8:14:45 AM

**Figure B-2**
**City of Kennedale**
**Pressure Recorder Data Combined**

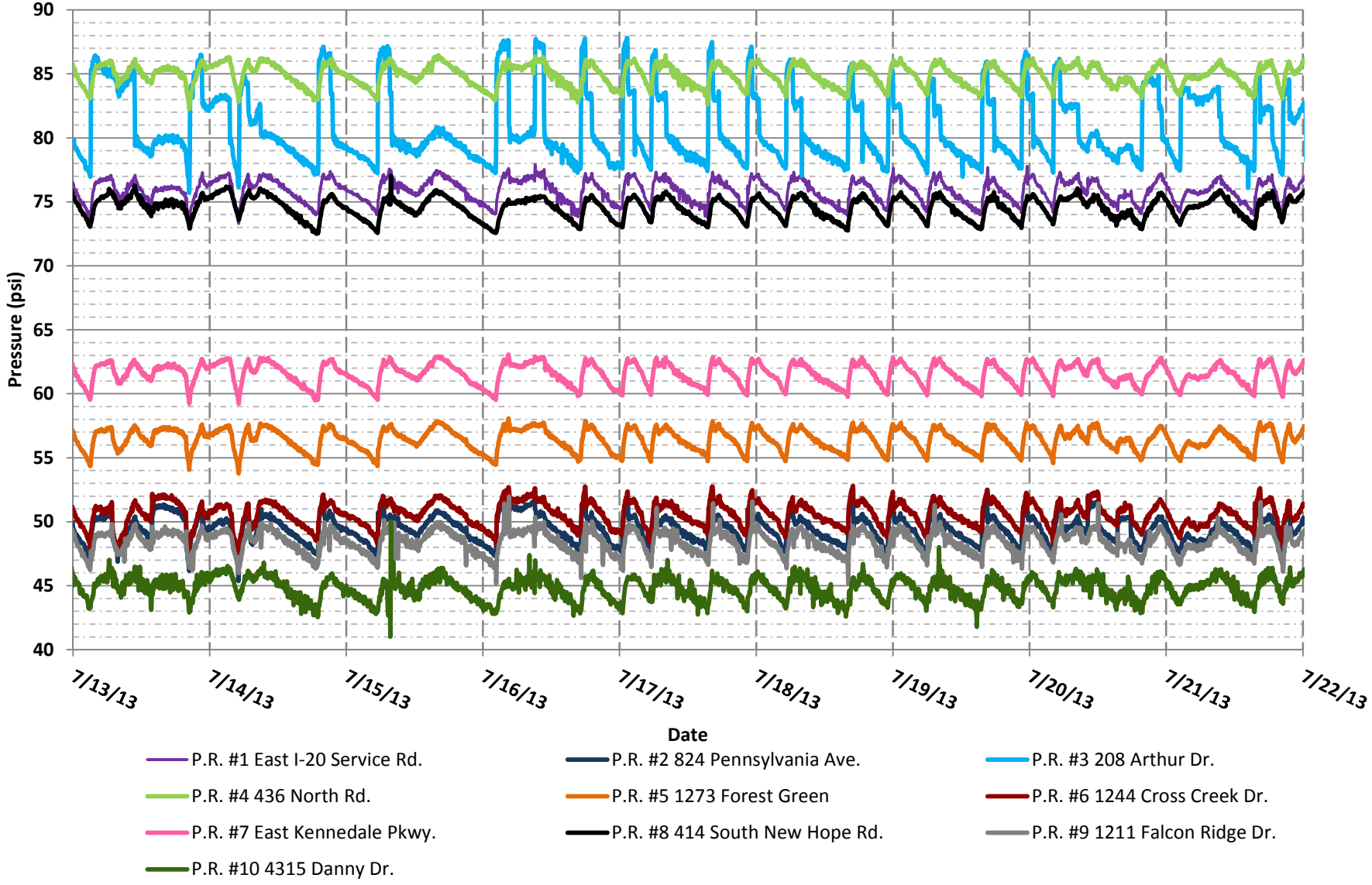


**Figure B-3**
**City of Kennedale: P.R. #1**
**Pressure Recorder ID: 203018**
**East I-20 Service Rd.**

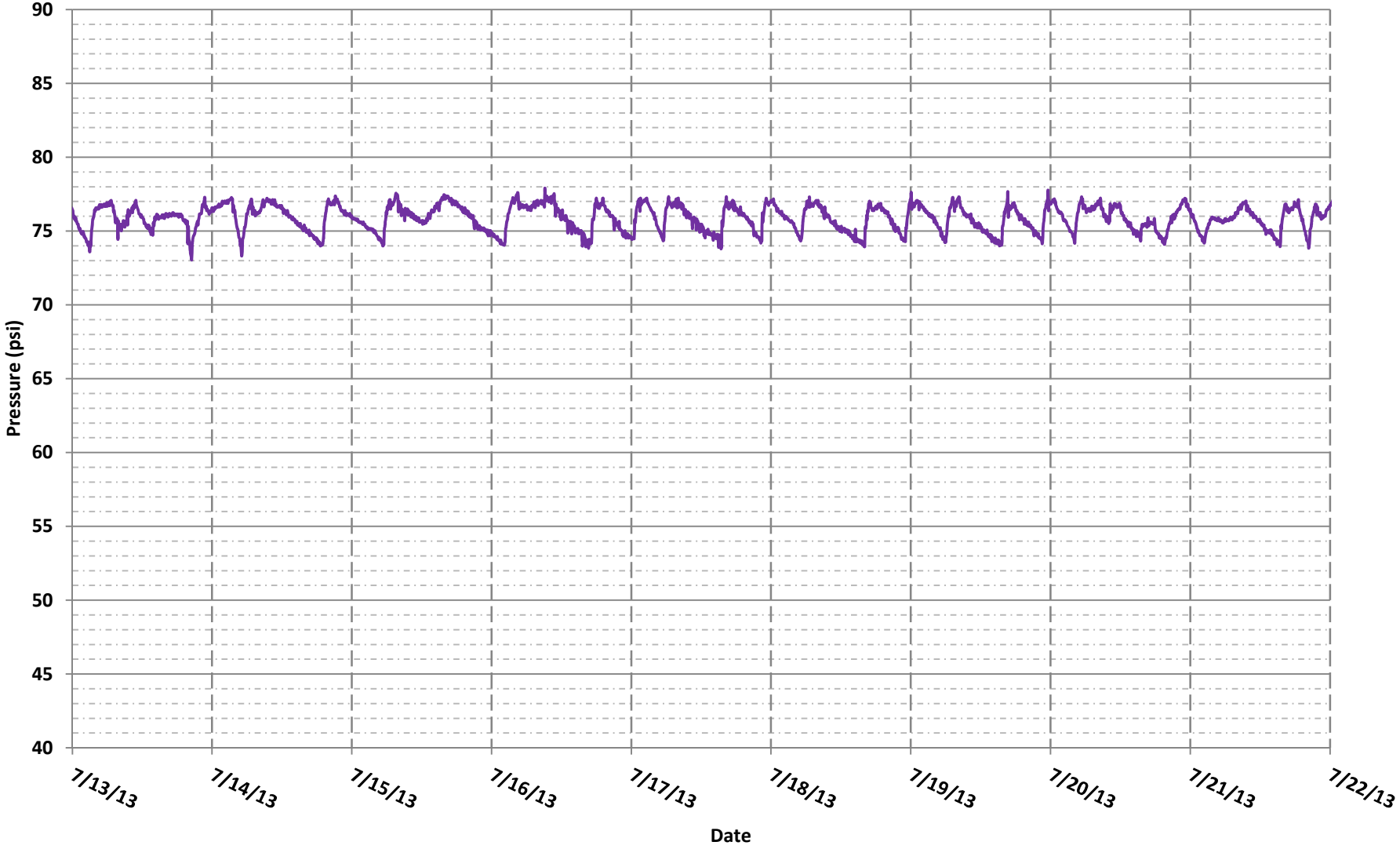


**Figure B-4**
**City of Kennedale: P.R. #2**
**Pressure Recorder ID: 1669**
**824 Pennsylvania Ave.**

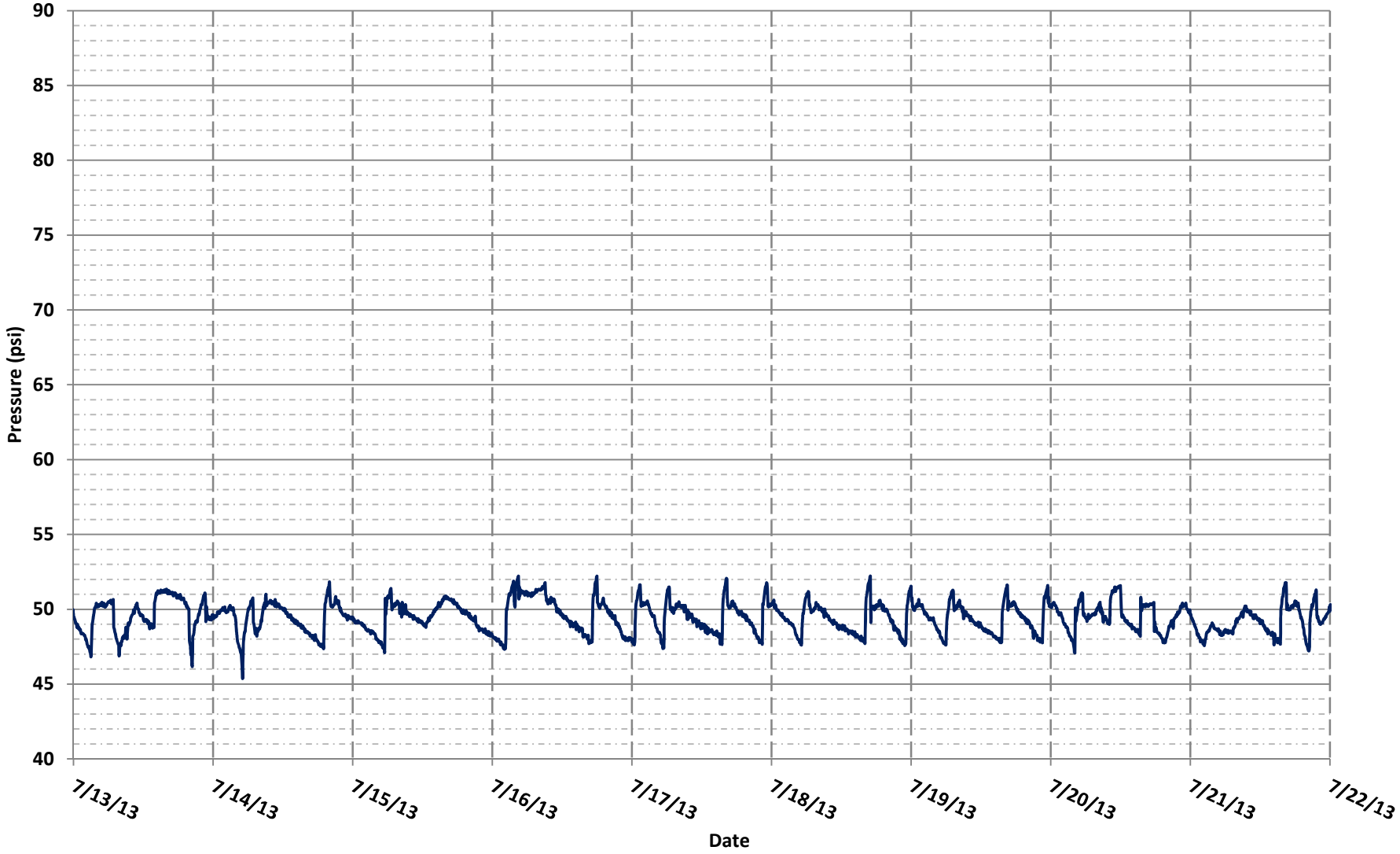


**Figure B-5**
**City of Kennedale: P.R. #3**
**Pressure Recorder ID: 341253**
**208 Arthur Dr.**

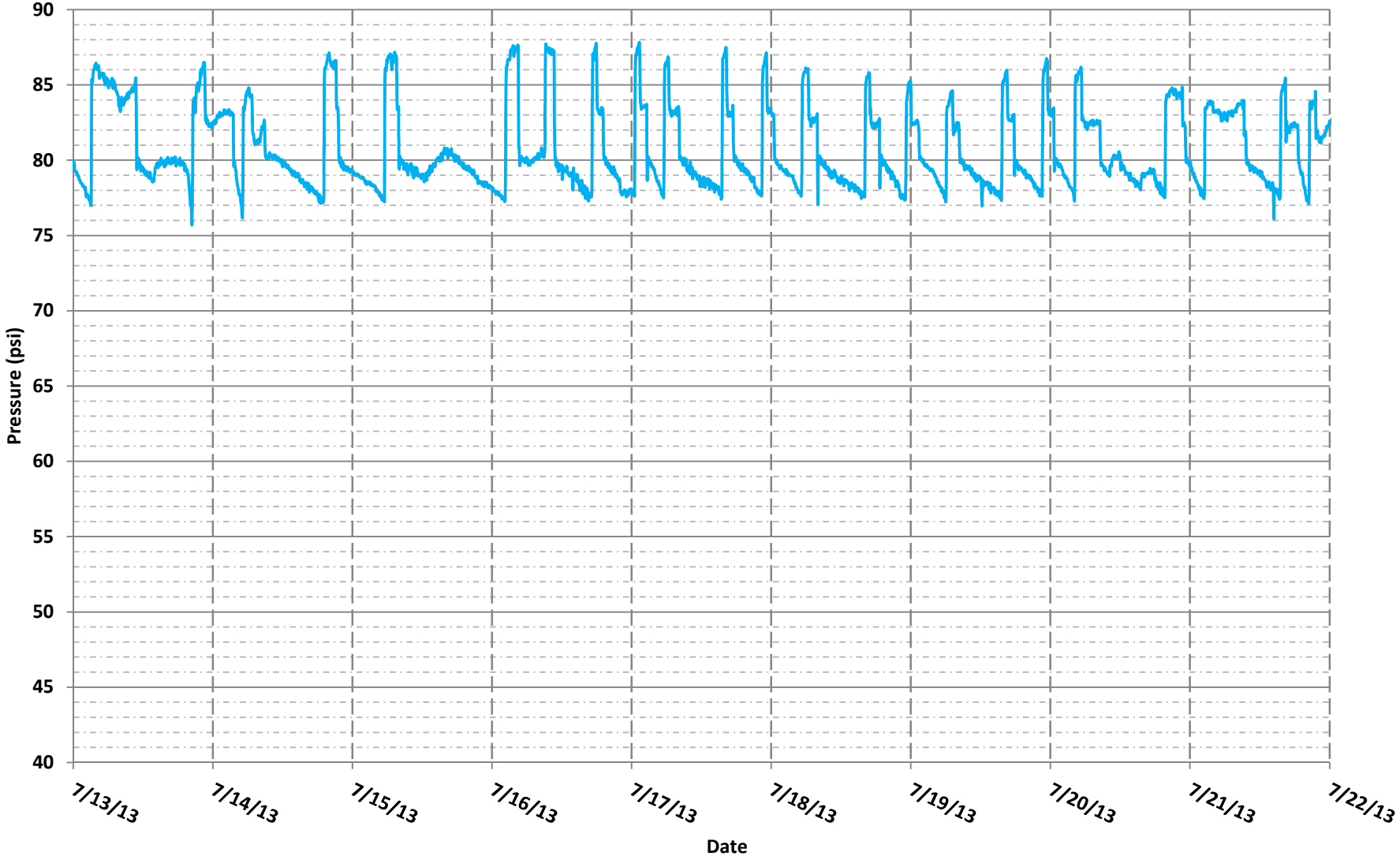


**Figure B-6**
**City of Kennedale: P.R. #4**
**Pressure Recorder ID: 203271**
**436 North Rd.**

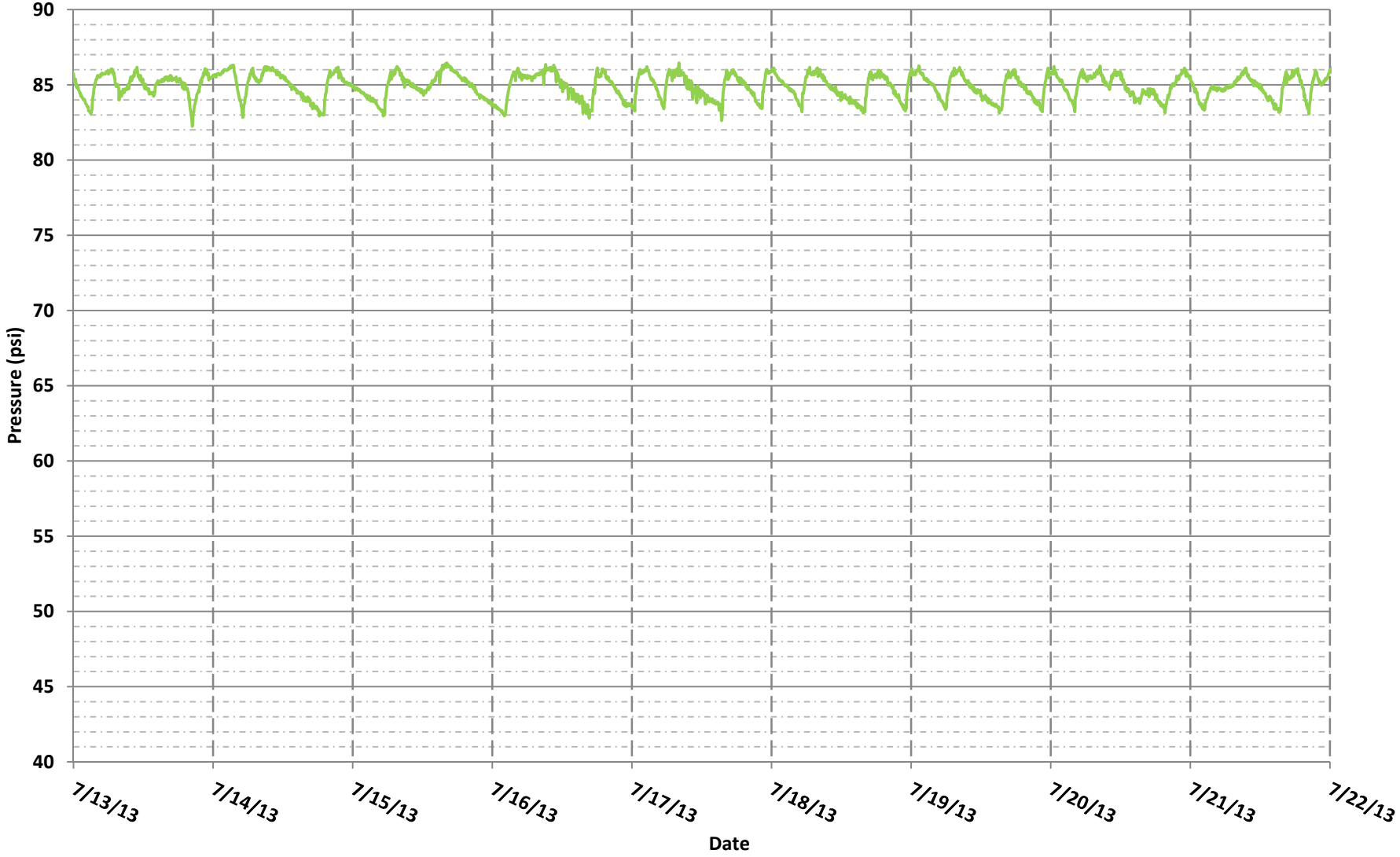


**Figure B-7**
**City of Kennedale: P.R. #5**
**Pressure Recorder ID: 1670**
**1273 Forest Green**

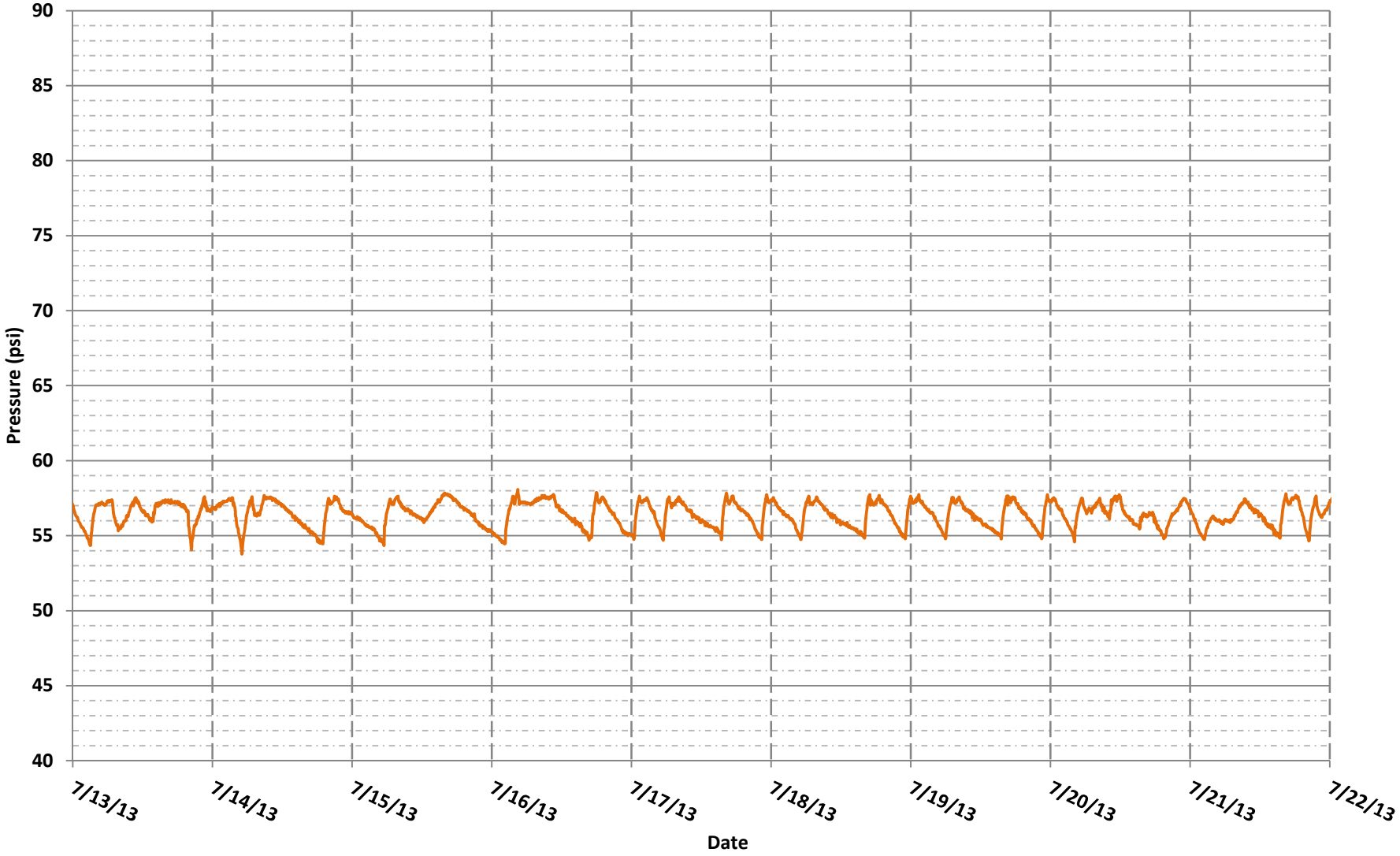


**Figure B-8**
**City of Kennedale: P.R. #6**
**Pressure Recorder ID: 1666**
**1244 Cross Creek Dr.**

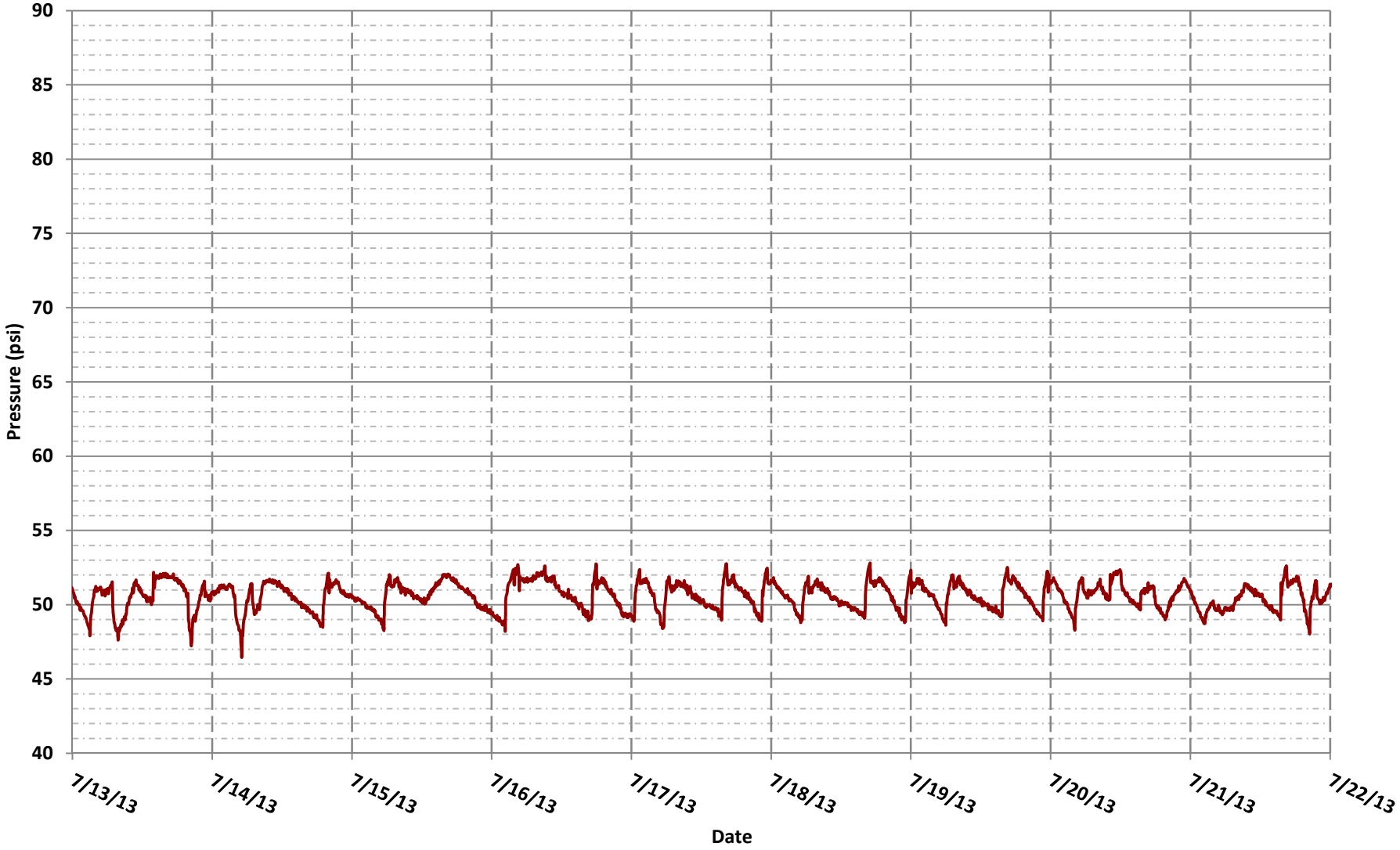


**Figure B-9**
**City of Kennedale: P.R. #7**
**Pressure Recorder ID: 203019**
**East Kennedale Pkwy.**

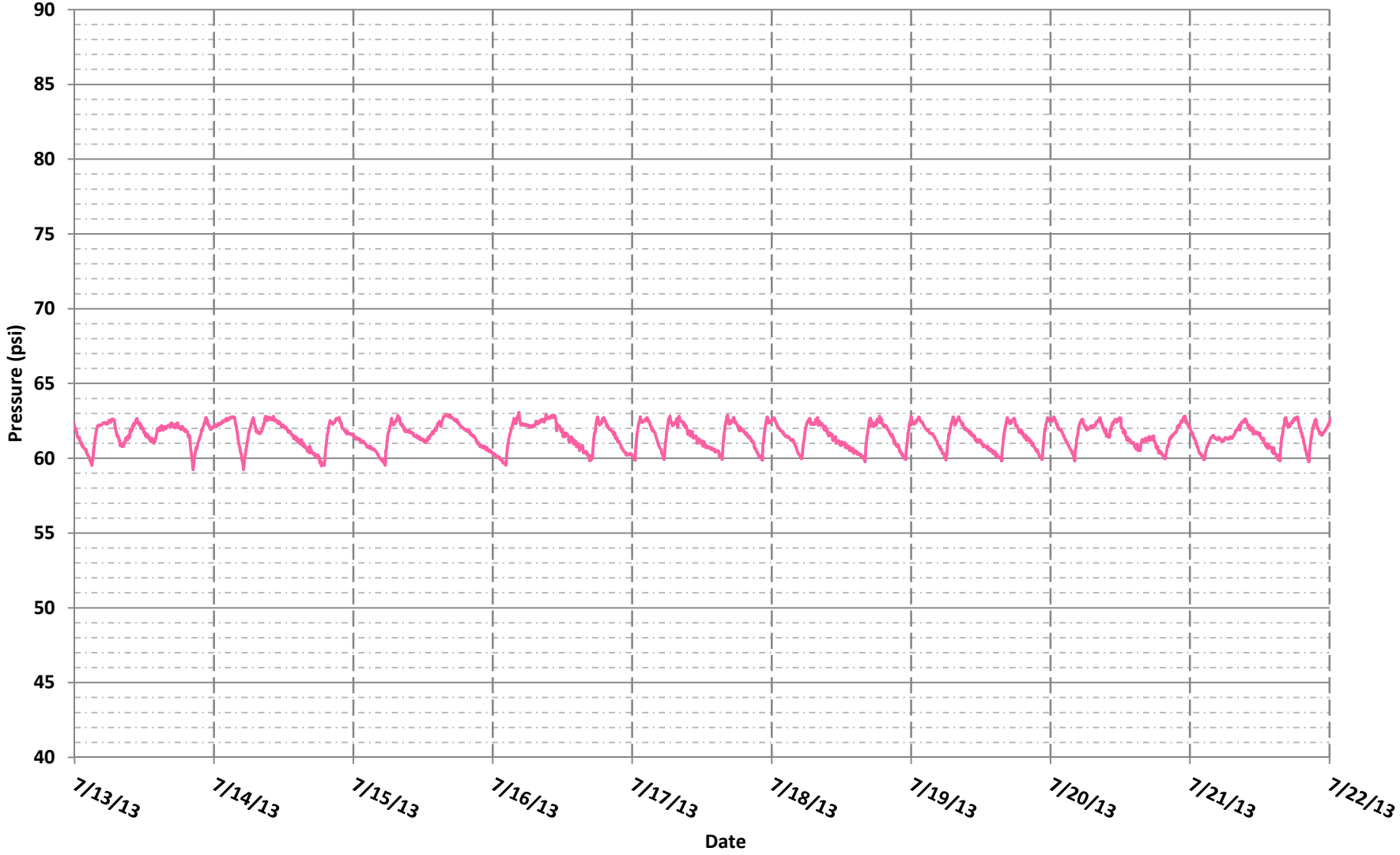


**Figure B-10**
**City of Kennedale: P.R. #8**
**Pressure Recorder ID: 204228**
**414 South New Hope Rd.**

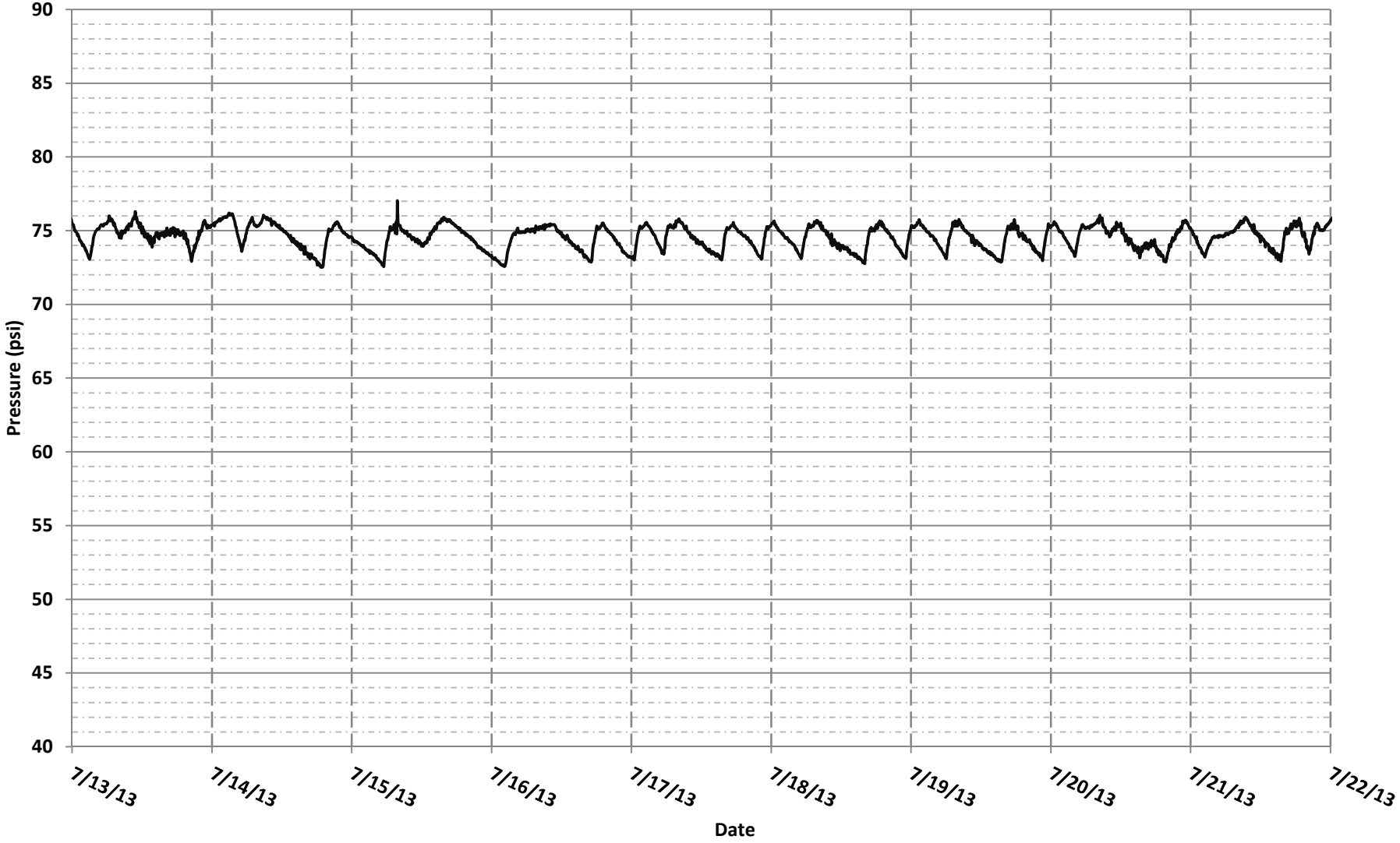


**Figure B-11**
**City of Kennedale: P.R. #9**
**Pressure Recorder ID: 1668**
**1211 Falcon Ridge Dr.**

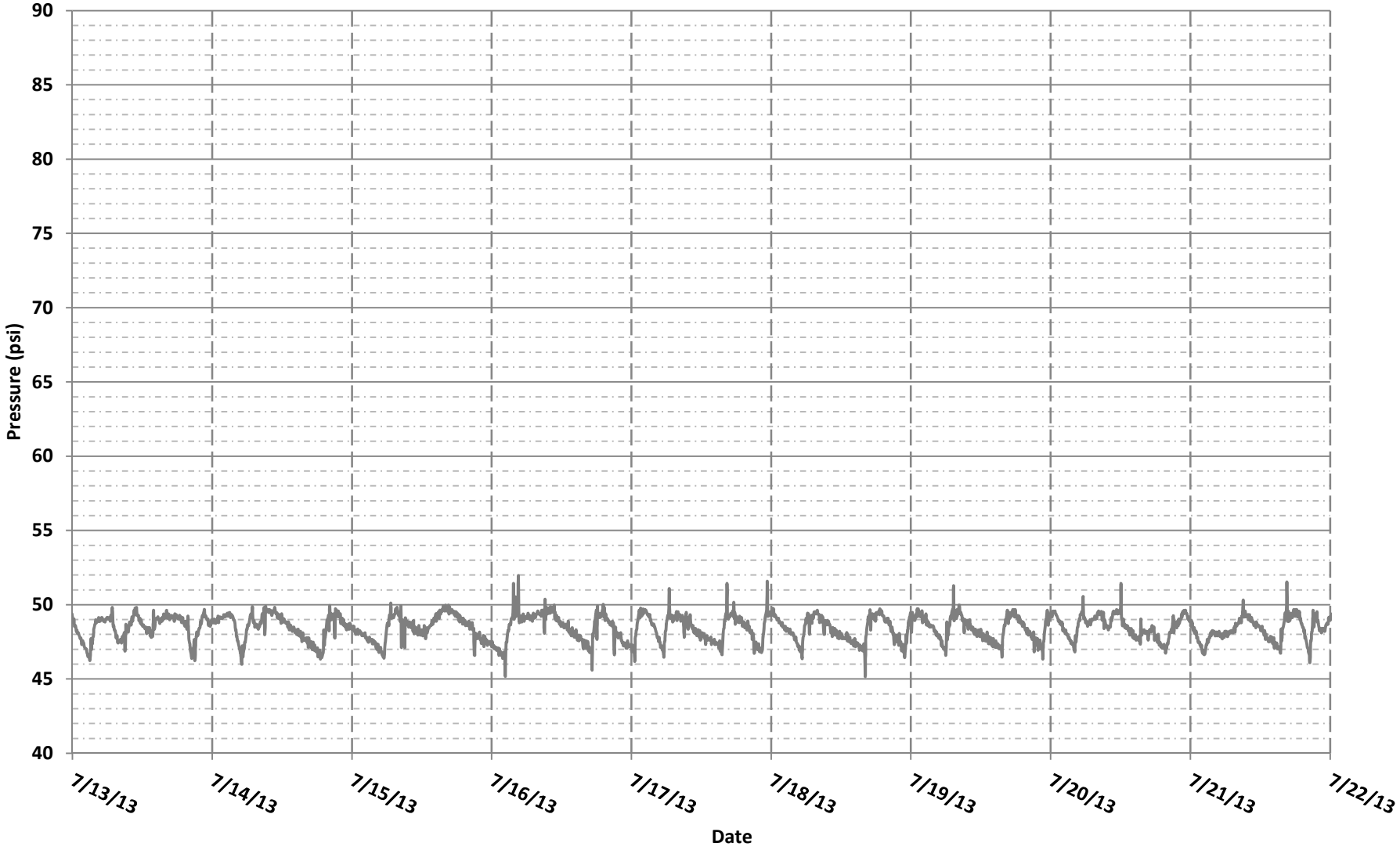
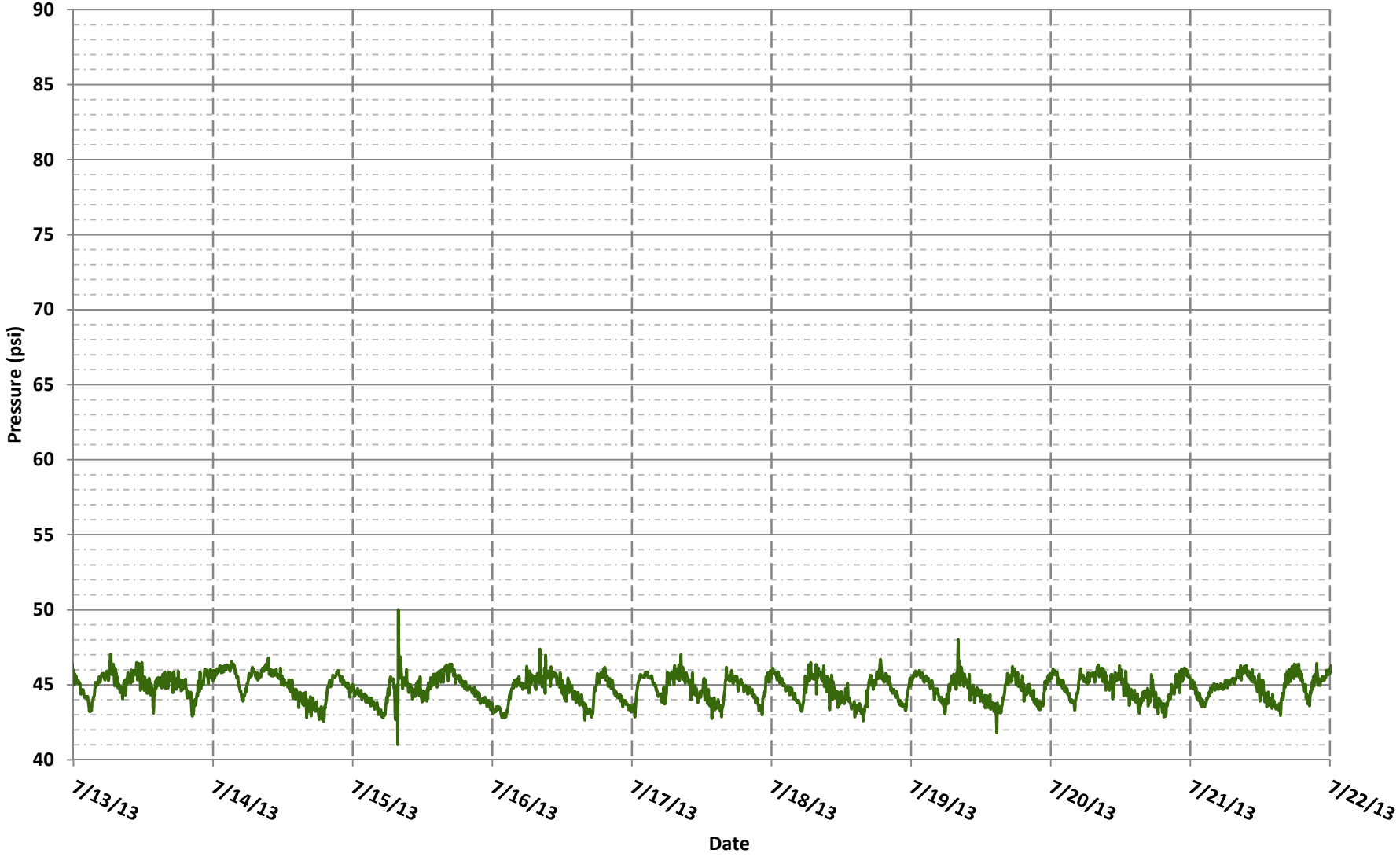
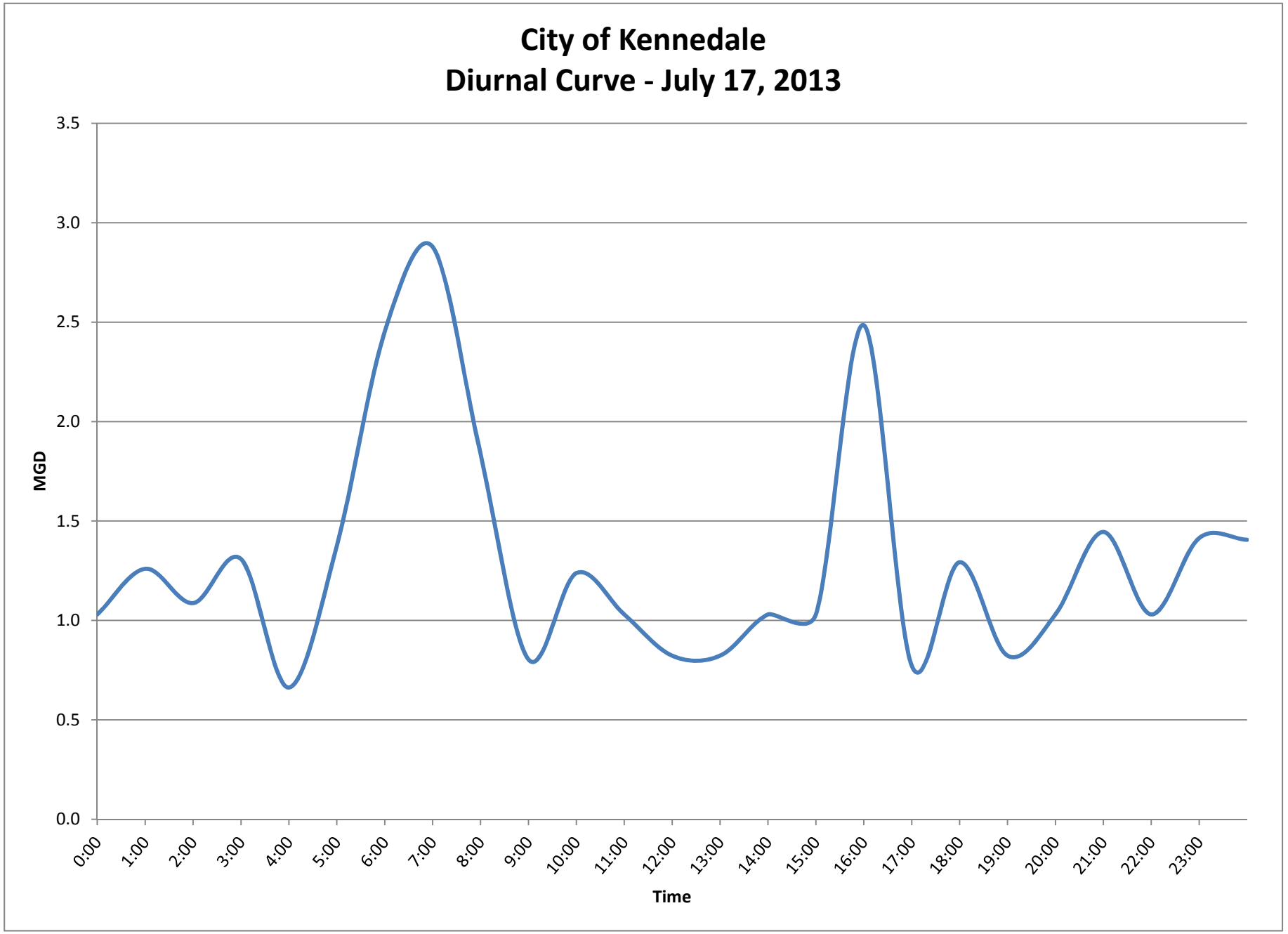


**Figure B-12**
**City of Kennedale: P.R. #10**
**Pressure Recorder ID: 341252**
**4315 Danny Dr.**




City of Kennedale
Diurnal Curve - July 17, 2013
MGD
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time

# APPENDIX C
# WASTEWATER SYSTEM FLOW MONITORING DATA AND MODEL CALIBRATION RESULTS

Permanent Flow Meter

**2010 Flow Meter Location (KEN-01)**
2010 Observed Flow: 3.16 MGD
2010 Modeled Flow: 3.13 MGD

**Flow Meter Location 2**
**Meter # KT_02**
**Observed Flow: 2.31 MGD**
**Modeled Flow: 2.31 MGD**

**2010 Flow Meter Location (KEN-03)**
2010 Observed Flow: 0.85 MGD
2010 Modeled Flow: 0.85 MGD

**Flow Meter Location 1**
**Meter # KT_01**
**Observed Flow: 0.59 MGD**
**Modeled Flow: 0.59 MGD**

**2010 Flow Meter Location (KEN-02)**
2010 Observed Flow: 0.46 MGD
2010 Modeled Flow: 0.47 MGD

To Fort Worth

To Arlington

Basin 25A

Basin C

Basin B

Basin B-1

Basin B-2

Basin A

**Wastewater Model Calibration Time Period**
October 23, 2010; Measured Rainfall of 0.76”
June 9, 2013; Measured Rainfall of 0.74”

# FIGURE C-1
# CITY OF KENNEDALE
## WASTEWATER MODEL CALIBRATION
### LEGEND

- 2013 Flow Meter Location
- 2010 Flow Meter Location
- Manhole
- 8" and Smaller Sewer Line
- 10" and Larger Sewer Line
- Fort Worth Sewer Line
- Arlington Sewer Line
- Street
- Parcel
- City Limit
- ETJ Boundary

### SEWER BASINS

- Basin A
- Basin B
- Basin B-1
- Basin B-2
- Basin C
- Basin C-1
- Basin D
- Basin 25A

FREESE AND NICHOLS

KENNEDALE You're Here, Your Home

0 1,100 2,200
SCALE IN FEET

Created By Freese and Nichols, Inc.
Job No.: KEN13264
Location: H:\W_WW_PLANNING\FINAL_REPORT\(Figure_C-1)-Existing_Wastewater_System-Model_Validation.mxd
Updated: Thursday, May 01, 2014 4:29:41 PM

# Pipe Capacity Study

*Prepared For:*

**Kennedale Water Department**

Kennedale, Texas

KENNEDALE
You're Here, Your Home

ADS ENVIRONMENTAL SERVICES®

FREESE AND NICHOLS

June 21, 2013

## ADS Letter of Transmittal

ADS ENVIRONMENTAL SERVICES®
*A Division of ADS LLC*

1300 Meridian Street, Suite 3000
Huntsville, AL 35801
www.adsenv.com

Friday, June 21, 2013

Freese and Nichols
4055 International Plaza, Suite 200
Fort Worth, Texas 76109

ADS is pleased to submit the final report for the Kennedale, TX Temporary Flow Monitoring Study, with data beginning Wednesday, May 01, 2013 and ending Sunday, June 09, 2013 . Depth, velocity and quantity data are presented in hydrograph, scattergraph and longtable format. Excel data files are included as part of the report.

Should you have any questions or comments, please contact Chuck Franklin, Senior Project Manager at the ADS Houston, TX office, at 281-933-0951 x-235.

Thank you for choosing ADS products and services to meet your flow monitoring needs.

Sincerely,
ADS ENVIRONMENTAL SERVICES

ADS LLC

An IDEX Fluid & Metering Business
Accusonic
ADS Environmental Services
Hydra-Stop

# (ADS Meter) Methodology with snapping reference

## Introduction

### Background

Freese and Nichols entered into agreement with ADS LLC to provide 40 days of flow data at two (2) metering locations with one (1) rain gauge in the city of Kennedale TX. Meters were installed April 30, 2013 and removed on June 10, 2013. Flow monitoring data presented in the report extends from Wednesday, May 01, 2013 through Sunday, June 09, 2013 .

### Project Scope

The scope of this study involved using a temporary flow monitor to quantify wastewater flow at the designated locations. Specifically, the study included the following key components:

- Investigate the proposed flow-monitoring site for adequate hydraulic conditions.
- Flow monitor installation.
- Flow monitor confirmations and data collections.
- Flow data analysis to include a capacity analysis for each monitor location.

## Equipment and Methodology

### Flow Quantification Methods

There are two main equations used to measure open channel flow: the Continuity Equation and the Manning Equation. The Continuity Equation, which is considered the most accurate, can be used if both depth of flow and velocity are available. In cases where velocity measurements are not available or not practical to obtain, the Manning Equation can be used to estimate velocity from the depth data based on certain physical characteristics of the pipe (i.e. the slope and roughness of the pipe being measured). However, the Manning equation assumes uniform, steady flow hydraulic conditions with non-varying roughness, which are typically invalid assumptions in most sanitary sewers. The Continuity Equation was used exclusively for this study.

Continuity Equation

The Continuity Equation states that the flow quantity (Q) is equal to the wetted area (A) multiplied by the average velocity (V) of the flow.

$$Q = A * V$$

This equation is applicable in a variety of conditions including backwater, surcharge, and reverse flow. Most modern flow monitoring equipment, including the ADS Models, measure both depth and velocity and therefore use the Continuity Equation to calculate flow quantities.

### Flow Monitoring Equipment

The monitor selected for this project was the ADS Flow Shark monitor. This flow

monitor is an area velocity flow monitor that uses both the Continuity and Manning's equations to measure flow.

The ADS Flow Shark monitor consists of data acquisition sensors and a battery-powered microcomputer. The microcomputer includes a processor unit, data storage, and an on-board clock to control and synchronize the sensor recordings. All of the flow meters and the rain gauge were programmed to store readings at 5-minute intervals.

Three types of data acquisition sensors are available for the Flow Shark monitor. The primary depth measurement device is the ADS quad-redundant ultrasonic level sensor. This sensor uses four independent ultrasonic transceivers in pairs to measure the distance from the face of the transceiver housing to the water surface (air range) with up to four transceiver pairs, of the available ones, active at one time. The elapsed time between transmitting and receiving the ultrasonic waves is used to calculate the air range between the sensor and flow surface based on the speed of sound in air. Sensors in the transceiver housing measure temperature, which is used to compensate the ultrasonic signal travel time. The speed of sound will vary with temperature. Since the ultrasonic level sensor is mounted out of the flow, it creates no disturbance to normal flow patterns and does not affect site hydraulics.

Redundant flow depth data can be provided by a pressure depth sensor, and is independent from the ultrasonic level sensor. This sensor uses a piezo-resistive crystal to determine the difference between hydrostatic and atmospheric pressure. The pressure sensor is temperature compensated and vented to the atmosphere through a desiccant filled breather tube. Pressure depth sensors are typically used in large size channels and applications where surcharging is anticipated. Its streamlined shape minimizes flow distortion.

Velocity is measured using the ADS V-3 digital Doppler velocity sensor. This sensor measures velocity in the cross-sectional area of flow. An ultrasonic carrier is transmitted upstream into the flow, and is reflected by suspended particles, air bubbles, or organic matter with a frequency shift proportional to the velocity of the reflecting objects. The reflected signal is received by the sensor and processed using digital spectrum analysis to determine the peak flow velocity. Collected peak velocity information is filtered and processed using field confirmation information and proprietary software to determine the average velocity, which is used to calculate flow quantities. The sensor's small profile, measuring 1.5 inches by 1.15 inches by 0.50 inches thick, minimizes the affects on flow patterns and site hydraulics.

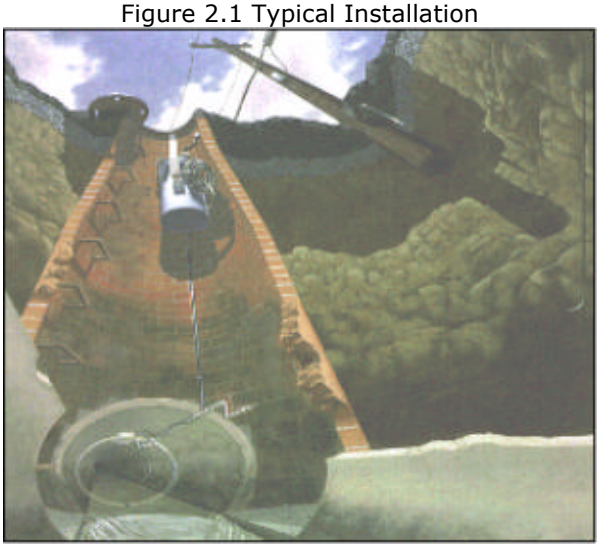
**Installation**

Installation of flow monitoring equipment typically proceeds in four steps. First, the site is investigated for safety and to determine physical and hydraulic suitability for the flow monitoring equipment. Second, the equipment is physically installed at the selected location. Third, the monitor is tested to assure proper operation of the velocity and depth of flow sensors and verify that the monitor clock is operational and synchronized to the master computer clock. Fourth, the depth and velocity sensors are confirmed and line confirmations are performed. A typical flow monitor installation is shown in Figure 2.1.

The installations depicted in Figures 2.1 are typical for circular or oval pipes up to approximately 104-inches in diameter or height. In installations into pipes 42-inches or less in diameter, depth and velocity sensors are mounted on an expandable stainless steel ring and installed one to two pipe diameters upstream of the pipe/manhole connection in the incoming sewer pipe. This reduces the affects of turbulence and backwater caused by the connection. In pipes larger than 42 inches in diameter, a

special installation is made using two sections of the ring installed one to two feet upstream of the pipe/manhole connection; one bolted to the crown of the pipe for the depth sensor, and the other bolted to the bottom of the pipe (bolts are usually placed just above the water line) to hold the velocity sensor.

Figure 2.1 Typical Installation



**Large Pipe ( > 42" Diameter)**



**Small Pipe ( 8" to 42" Diameter)**




**Data Collection, Confirmation, and Quality Assurance**

During the monitoring period, field crews visit each monitoring location to retrieve data, verify proper monitor operation, and document field conditions. The following quality assurance steps are taken to assure the integrity of the data collected:

- **Measure Power Supply:** The monitor is powered by a dry cell battery pack. Power levels are recorded and battery packs replaced, if necessary. A separate battery provides back-up power to memory, which allows the primary battery to be replaced without the loss of data.

- **Perform Pipe Line Confirmations and Confirm Depth and Velocity:** Once equipment and sensor installation is accomplished, a member of the field crew descends into the manhole to perform a field measurement of flow rate, depth and velocity to confirm they are in agreement with the monitor. Since the ADS V-3 velocity sensor measures peak velocity in the wetted cross-sectional area of flow, velocity profiles are also taken to develop a relationship between peak and average velocity in lines that meet the hydraulic criteria.

- **Measure Silt Level:** During site confirmation, a member of the field crew descends into the manhole and measures and records the depth of silt at the bottom of the pipe. This data is used to compute the true area of flow.

- **Confirm Monitor Synchronization:** The field crew checks the flow monitor's clock for accuracy.

- **Upload and Review Data:** Data collected by the monitor is uploaded and reviewed for comparison with previous data. All readings are checked for consistency and screened for deviations in the flow patterns, which indicate system anomalies or equipment failure.

## Data Analysis and Presentation

### Data Analysis

The flow monitors were programmed to collect data at 5-minute intervals throughout the monitoring period. The monitor stores raw data consisting of (1) the air range (distance from sensor to top of flow) for each active ultrasonic depth sensor pair and (2) the peak velocity. If the monitor is equipped with a pressure sensor, then a depth reading from this sensor may also be stored. When the field personnel collects the data, the air range is converted to depth data based on the pipe height and physical offset (distance from the top of the pipe to the surface of the ultrasonic sensor). The data is imported into ADS's proprietary software and is examined by a data analyst to verify its integrity. The data analyst also reviews the daily field reports and site visit records to identify conditions that would affect the collected data.

Velocity profiles and the line confirmation data developed by the field personnel are reviewed by the data analyst to identify inconsistencies and verify data integrity. Velocity profiles are reviewed and an average to peak velocity ratio is calculated for the site. This ratio is used in converting the peak velocity measured by the sensor to the average velocity used in the Continuity equation. The data analyst selects which ultrasonic pairs and/or depth sensor entity will be used to calculate the final depth information. Silt levels present at each site visit are reviewed and representative silt levels established.

Occasionally the velocity sensor's performance may be compromised resulting in invalid readings sporadically during the monitoring period. This is generally caused by excessive debris (silt) blocking the sensor's crystals, shallow flows (~< 2") that may drop below the top of the sensor or very clear flows lacking the particles needed to measure rate. In order to use the Continuity equation to quantify the flow during these periods, a Sr. Analyst and/or Engineer will use the site's historical pipe curve (depth vs. velocity) data along with valid field confirmations to reconstitute and replace the false velocity recordings with expected velocity readings for a given historical depth along the curve.

Selections for the above parameters can be constant or can change during the monitoring period. While the data analysis process is described in a linear manner, it often requires an iterative approach to accurately complete.

**Data Presentation**

This type of flow monitoring project generates a large volume of data. To facilitate review of the data, results have been provided in graphical and tabular formats. The flow data is presented graphically in the form of scattergraphs and hydrographs. Tables are provided in daily average format. These tables show the flow rate for each day, along with the daily minimum and maximums, the times they were observed, the total daily flow, and total flow for the month (or monitoring period). The following explanation of terms may aid in interpretation of the tables and hydrographs.

**DFINAL** - Final calculated depth measurement (in inches)

**QFINAL** - Final calculated flow rate (in MGD)

**VFINAL** - Final calculated flow velocity (in feet per second)

**REPORT TOTAL** - Total volume of flow recorded for the indicated time period (in MG)

# Pipe Capacity Evaluation

An evaluation of capacity in the metered pipes was conducted to allow a determination of the theoretical remaining wastewater flow capacity. It is important to note that this evaluation applies to the conditions found at the metering location and that conditions could differ at other locations along the pipe under investigation. The capacity evaluation method involves the following process:

1. Collect 5-minute interval depth and velocity data points in the pipe over the entire metering period and determine each pipe's depth vs. velocity relationship or "pipe curve" based on Manning's equation modified to include a factor allowing the effective roughness to vary with depth[1]. Generally, the pipe curve is allowed to pass through the velocity data during the highest flow regime of the day that free flow conditions persist, although adjustments can also be made when there is evidence of bottom obstructions (dead dogs)[1];

2. Determine the typical daily (as well as maximum) observed peak hourly-averaged depth and flow rate in each pipe during the metering period;

3. Calculate the maximum theoretical unobstructed flow rate for each pipe using the pipe curve generated in step 1 when each pipe's depth of flow reaches full pipe;

4. Determine remaining capacity (at typical and max observed peak flow conditions), if any, in each pipe by subtracting the maximum flow rate generated in step 3 from the current peak flow rates generated in step 2.

5. Compare ratios of current daily peak hourly flow depth to pipe diameter (percent full based on depth) and current daily peak hourly flow rate to theoretical maximum flow rate (percent full based on flow rate).

A scattergraph of hourly-averaged depth vs. velocity data points for each metered pipe is shown on the following pages for each site. The free flow operational curves for each pipe based on the fitted or empirically based Manning's equation is portrayed on the scattergraphs. The Manning equation is indicated as equation 4.1. This equation defines a commonly used theoretical relationship between depth and velocity in pipes operating under free flow conditions:

$$V = (H_c) / f(d) \bullet R^{2/3} \qquad (4.1)$$

Where,

V = velocity (ft/s).

R = hydraulic radius, defined as wetted area divided by wetted perimeter (ft).

$H_c$ = hydraulic coefficient – empirically derived from actual data or theoretically derived as $(C \bullet 1/n \bullet S^{1/2})$ where 'C' is a conversion factor, 'n' is pipe roughness at full pipe and 'S' is hydraulic slope.

F(d) = value that accounts for variable roughness as a function of depth per footnote 1.

[1] Enfinger, K.L. and Schutzbach, J.S. (2005). "Scattergraph Principles and Practice – Camp's Varying Roughness Coefficient Applied to the Manning Equation," *Proceedings of the Pipeline Division Specialty Conference*; Houston, TX; American Society of Civil Engineers: Reston, VA.

When a pipe's theoretical hydraulic operating curve is generated from the above Manning equation based on actual depth and velocity data to generate the factor, Hc, the resulting curve is termed the "Current Mannings" or "Lanfear-Coll" curve.

Site KT01

A scattergraph of hourly average data for this site is shown in Figure 4.1 wherein the pipe's theoretical pipe curve is depicted below as "Current Mannings". The data points shown are hourly averaged.

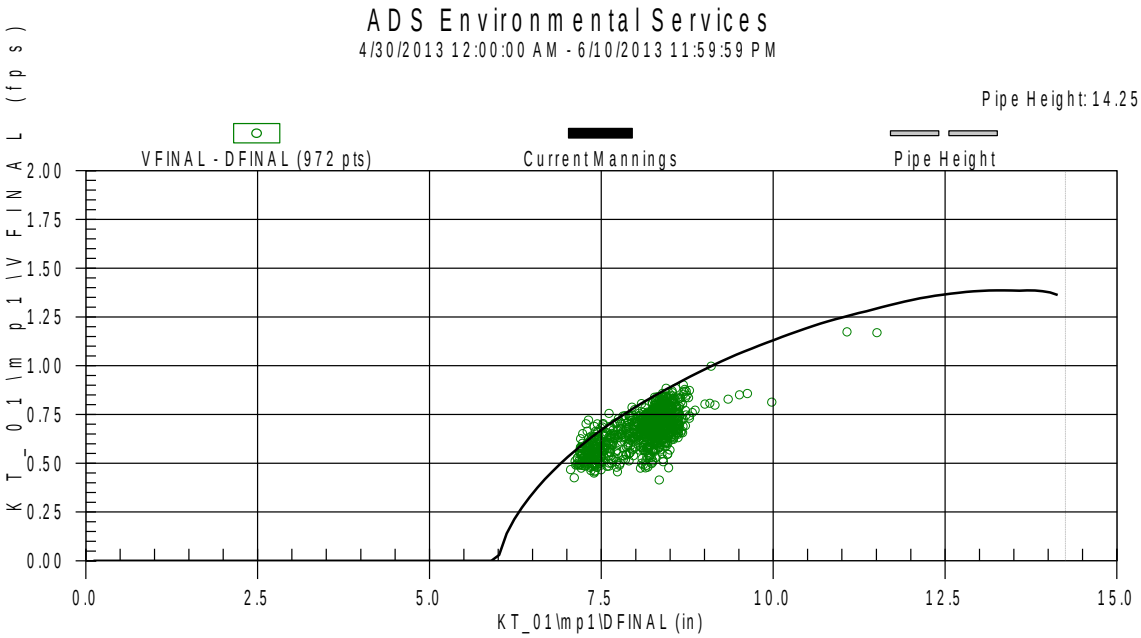



**Figure 4.1 – Capacity Scattergraph for Site KT01**

This pipe operated in free flow conditions at all times during the study period. Due to the presence of silt in this pipe, extrapolation of the data to zero velocity conditions suggests that under zero flow conditions there would be standing water (and silt) of about 6 inches. This condition decreases the available capacity (highest point on the pipe curve) of the pipe, reducing the theoretical maximum flow from that which would be available with no sediment or bottom obstructions.

Under theoretical free flow conditions, this pipe indicates a theoretical full pipe capacity of about 0.60 mgd (where the pipe curve reaches the highest point at full pipe). The typical (non rain period) daily peak hourly flow rate is 0.12 mgd and the maximum hourly peak flow observed was 0.40 mgd during a rain event on the last day of the study. Under current conditions, this line operates at 20% of effective capacity during dry weather conditions and 67% of effective capacity during maximum observed peak flow conditions.

The typical (non rain period) daily peak hourly flow depth is 8.5 inches (61% full pipe) and the maximum hourly peak depth observed was 11.5 inches (82% full pipe) on the last day of the study. These depth based capacity values (% full pipe) are higher than the flow based values indicated above due to the presence of silt.

Site KT02

A scattergraph of hourly average data for this site is shown in Figure 4.2 wherein the pipe's theoretical pipe curve is depicted below as "Current Mannings". The data points shown are hourly averaged.

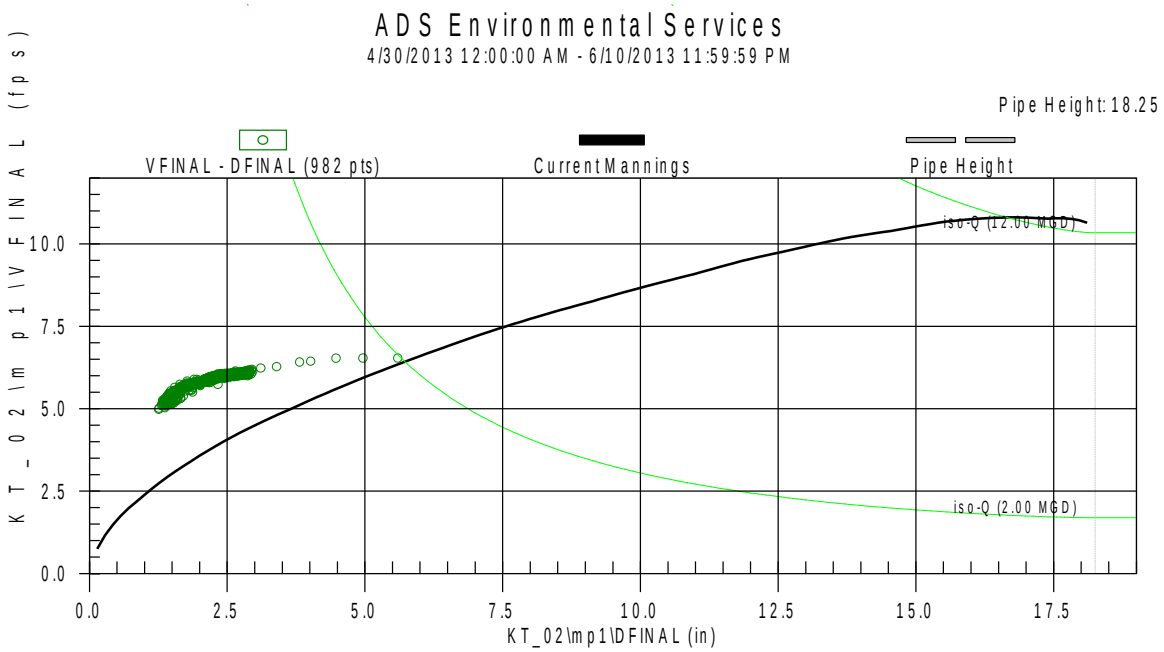



**Figure 4.2 – Capacity Scattergraph for Site KT02**

This pipe operated in free flow conditions at all times during the study period. There is evidence of mild backwater in this pipe based on the modest increase in velocity with increasing depth compared to what is theoretically expected.

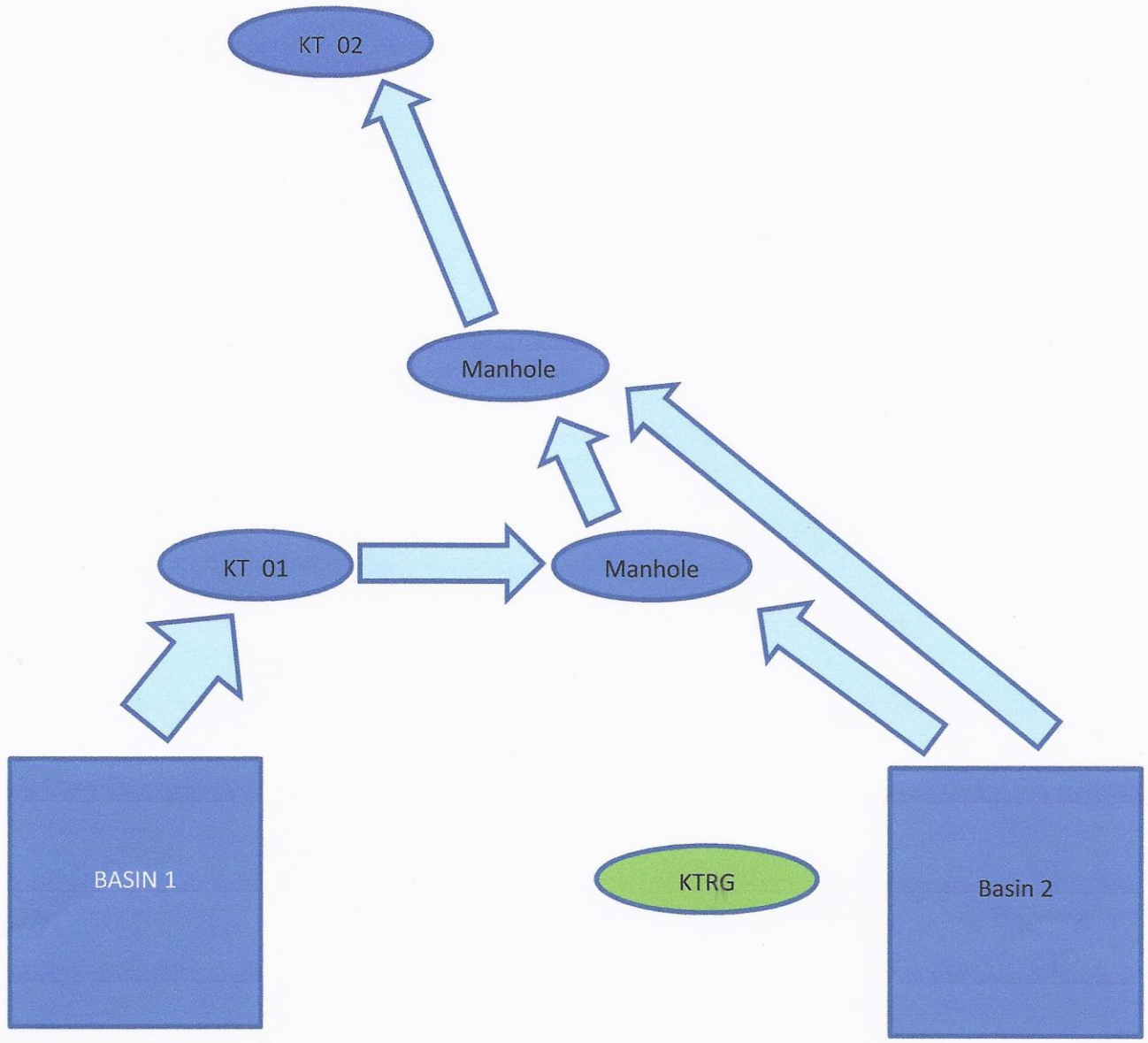
Under theoretical free flow conditions, this pipe indicates a theoretical full pipe capacity of about 12.0 mgd (where the pipe curve reaches the highest point at full pipe). The typical (non rain period) daily peak hourly flow rate is only 0.70 mgd and the maximum hourly peak flow observed was 2.0 mgd during a rain event on the last day of the study. Under current conditions, this line operates at only 6% of effective capacity during dry weather conditions and 17% of effective capacity during maximum observed peak flow conditions.

The typical (non rain period) daily peak hourly flow depth is just under 3.0 inches (17% full pipe) and the maximum hourly peak depth observed was 5.5 inches (31% full pipe) on the last day of the study. These depth based capacity values (% full pipe) are higher than the flow based values indicated above. This is due to the actual depth vs velocity data pattern (green data points on the scattergraph) operating above the estimated pipe curve during the low depth regime in which this pipe typically operates.

**Kennedale, TX Flow Schematic**

**Basin1= KT_01**

**Basin2= KT_02 – KT_01**



## Site Commentary

### Site Information

This monitoring point, KT_01 was installed to measure and study flows in Kennedale TX. A review of the hydrograph indicates a repeatable diurnal pattern on weekdays and on weekends from Wednesday, May 01, 2013 through Sunday, June 09, 2013 . A review of the scattergraph indicates that KT_01 remained in free-flow conditions throughout the monitoring period. Surcharge conditions were not observed at this location during the report period.

| KT_01 | |
|---|---|
| Site Address | Access road at old WWTP |
| Pipe Height | 14.25" |
| Silt Level | 6.00" |

### Observations

Average flow depth, velocity, and quantity observed during the study period, along with minimum and maximum data, are provided in the following table.

| Observed Flow Conditions | | | |
|---|---|---|---|
| Item | Depth (in) | Velocity (ft/s) | Quantity (MGD) |
| Average | 8.11 | 0.67 | 0.092 |
| Minimum | 7.01 | 0.24 | 0.020 |
| Maximum | 12.70 | 1.55 | 0.586 |

Please note the minimum and maximum flow rate recorded in this table may vary from those recorded on the daily and weekly tabular data. The minimum and maximum rates recorded on the daily and weekly tabular data are absolute versus average fifteen minute data.

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

### Data Quality

Data uptime observed during the monitoring period is provided in the table below.

| Percent Uptime | |
|---|---|
| Depth | 100 |
| Velocity | 100 |
| Quantity | 100 |

### Maintenance

Installation Date: April 30, 2013

Removal Date: June 10, 2013

Calibrations: April 30, 2013, May 7, 2013, & June 10, 2013

Flow depth and velocity measurements recorded by the monitor are consistent with field calibrations conducted to date and support the relative accuracy of the flow monitor at this location.

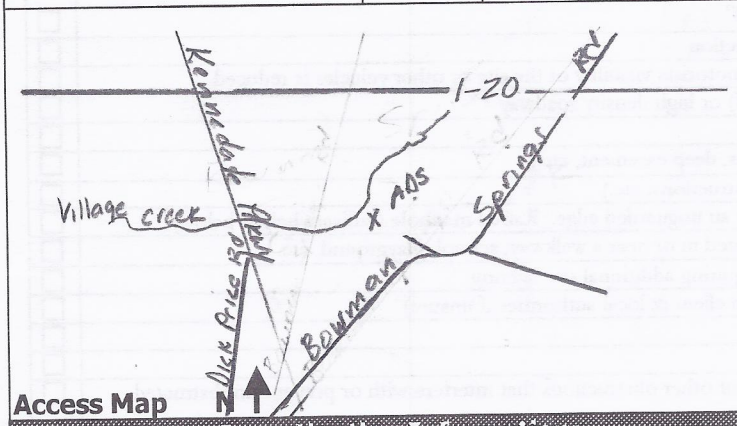
Debris was removed from the Velocity sensor during the May 7, 2013 visit.

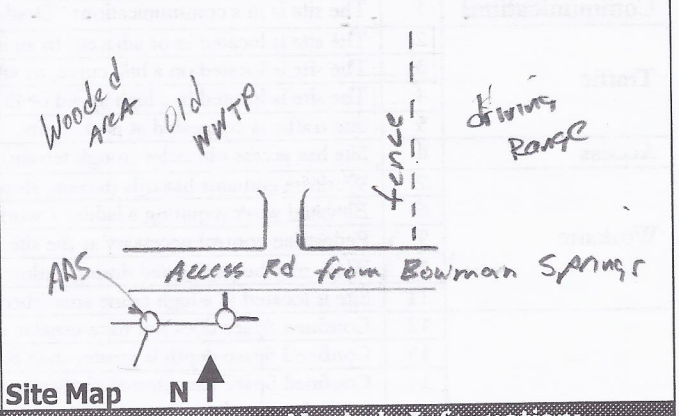
Installed 4.30.13

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# ADS Site Report — Quality Form

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project Name: Kennedale | | | City/State: TX | | FM Initials: KR | | |
| Site Name: KT-01 | Monitor Series: 5000 | | | Monitor S/N: | 20214 | | |
| Address / Location: Access Rd @ old WWTP | | | | Manhole #: | NA | | |
| | | | | Map Page #: | NA | | |
| Access: drive | Type of System: | Sanitary ☑ | Storm ☐ | Combined ☐ | Pipe Height: | 14.25 | |
| | | | | | Pipe Width: | 14.25 | |
| | | | | | Phone Number: | 166.219.50.68 | |



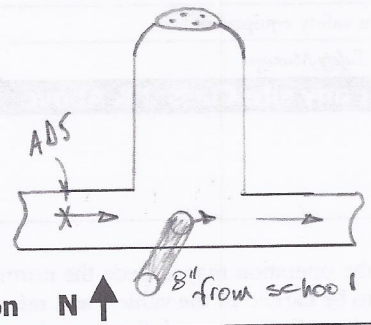

## Investigation Information:

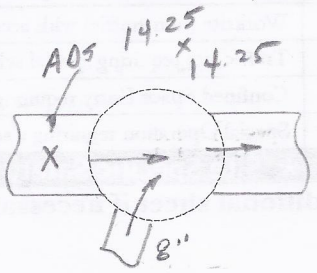
| | |
|---|---|
| Date/ Time of Investigation: | 4-30-13 @ 12:05 |
| Site Hydraulics: | slow flat surface flow |
| hydraulic constraints = silt / slow velocity | |
| Upstream Input: (L/S, P/S) | NA |
| Upstream Manhole: | DNI |
| Downstream Manhole: | TS |
| Depth of Flow (Wet Dof): | 8.5 +/- .25 |
| Range (Air Dof): | — +/- — |
| Peak Velocity: | .78 fps |
| Silt: | 3.25 Inches |

## Manhole Information:

| | | | | |
|---|---|---|---|---|
| Manhole Depth: | | | Feet | 84" |
| Manhole Material / Condition: | Concrete - good | | | |
| Pipe Material / Condition: | Clay - fair | | | |
| Mini System Character: | Residential ☑ | Commercial ☐ | Industrial ☐ | Other |
| Telephone Information: | NA | | | |
| Access Pole #: | | | | |
| Distance From Manhole: | | | Feet | |
| Road Cut Length: | | | Feet | |
| Trench Length: | | | Feet | |

## Other Information




| Installation Information | |
|---|---|
| Installation Type: | 5000 Ring |
| Sensors/Devices: | UPV |
| Surcharge Height: | 6 Feet |
| Rain Gauge Zone: | KT-RG |

| Backup | Yes | No | ? | Distance |
|---|---|---|---|---|
| Trunk | ☑ | ☐ | | |
| Lift/Pump Station | ☐ | ☑ | | |
| WWTP | ☐ | ☑ | | |
| Other | ☐ | ☑ | | |

## Additional Site Information/Comments:

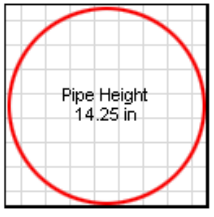
N32° 39.628'
W097° 13.753'

# SCATTERGRAPH REPORT

KT_01

**Flow Monitor**

**KT_01**

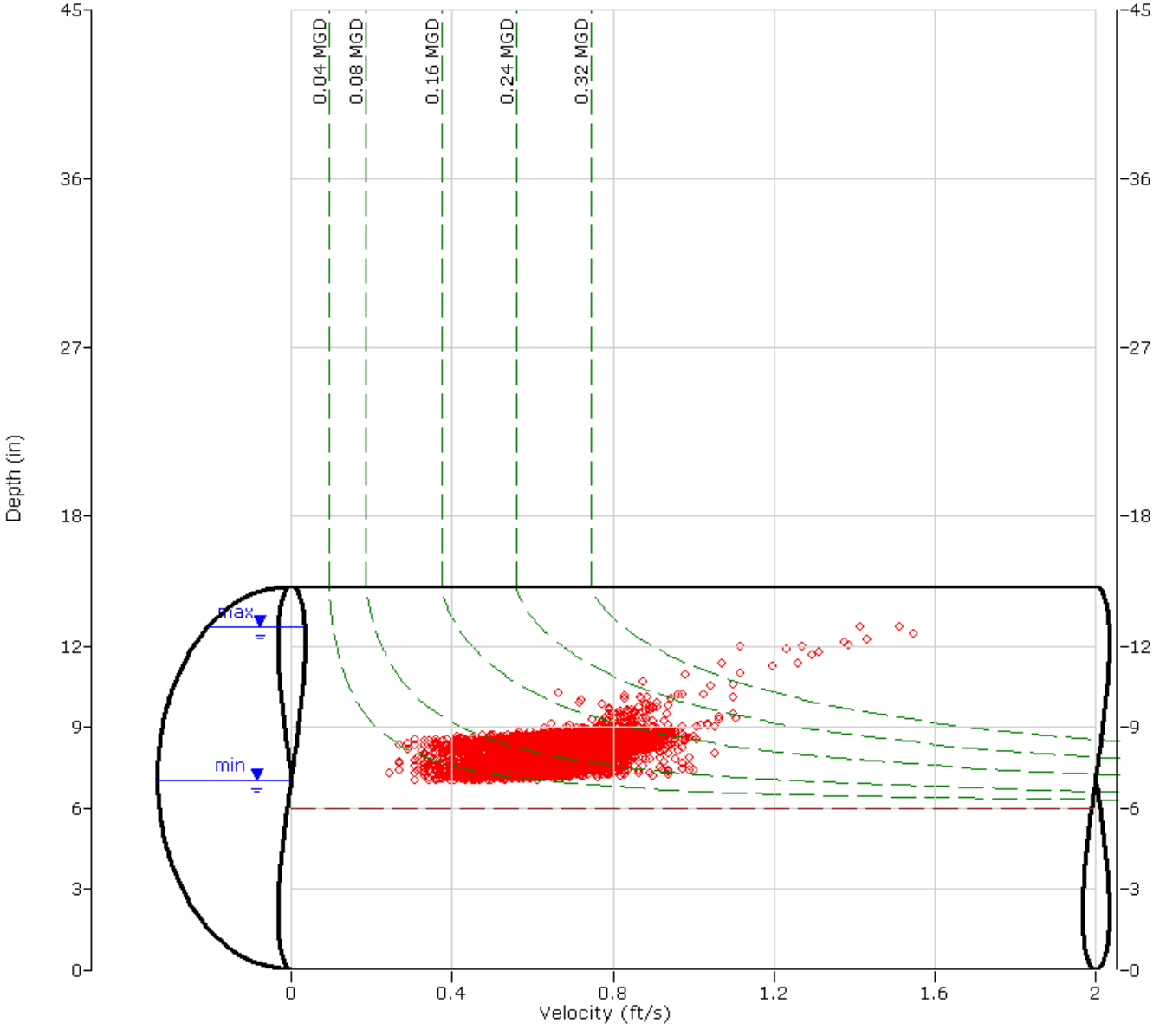



**Report Period**

5/1/2013
To
6/9/2013

**Legend**

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



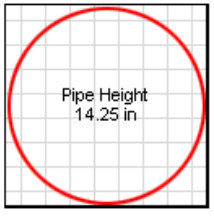

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# HYDROGRAPH REPORT

KT_01

**Flow Monitor**

**KT_01**

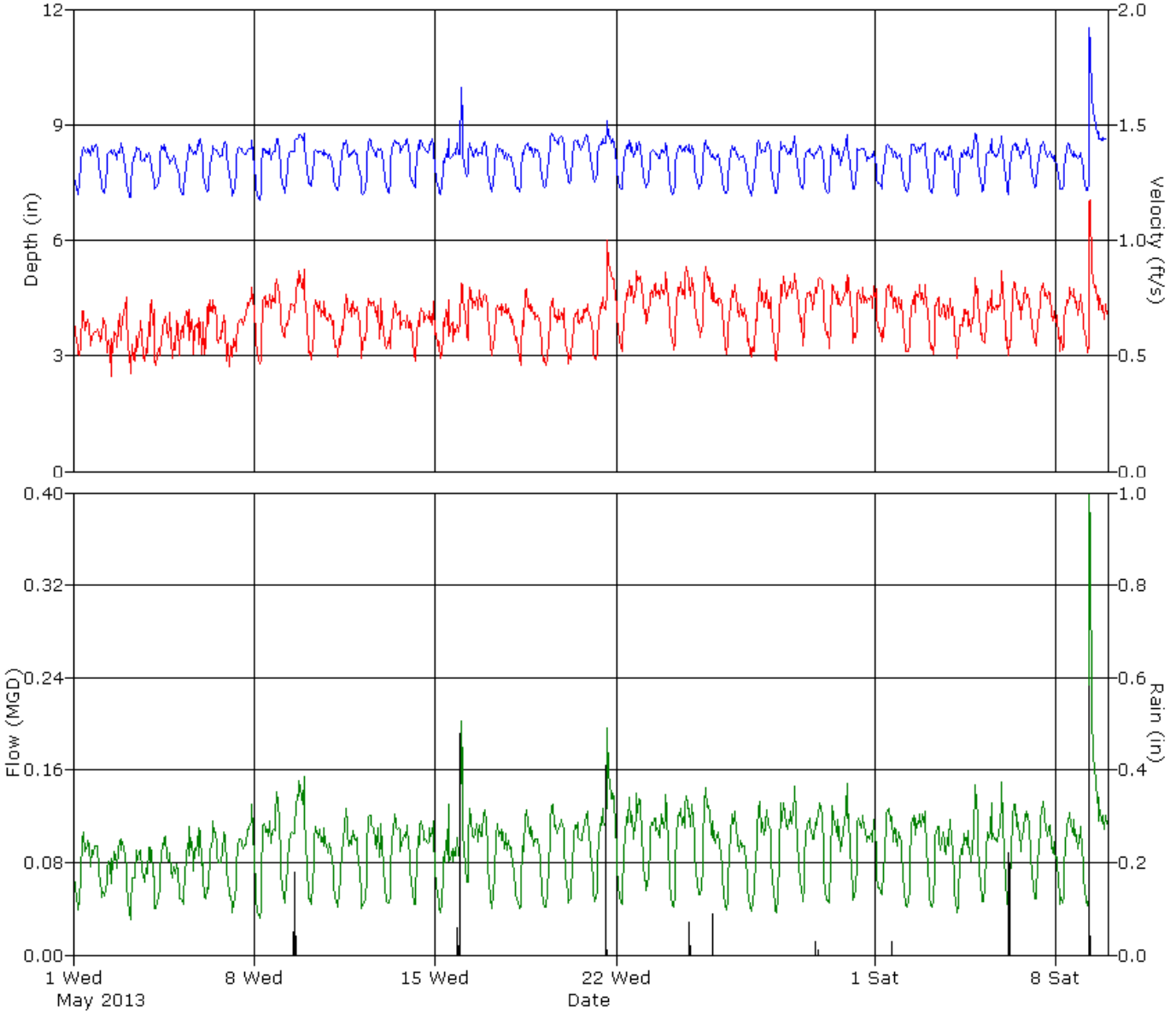



**Report Period**

5/1/2013
To
6/9/2013

**Legend**

- Depth
- Velocity
- Quantity
- Rain




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# Kennedale, TX

**Daily Tabular Report For The Period 5/1/2013 - 5/31/2013**

**KT_01, Pipe Height: 14.25 in**

## Daily Tabular Report

| Date | Depth (in) | | | | | Velocity (ft/s) | | | | | Quantity (MGD - Total MG) | | | | | | Rain (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Total | Total |
| 5/1/2013 | 05:00 | 7.06 | 21:40 | 8.69 | 8.08 | 05:25 | 0.40 | 10:50 | 0.79 | 0.61 | 05:00 | 0.029 | 20:35 | 0.124 | 0.081 | 0.081 | |
| 5/2/2013 | 05:05 | 7.15 | 21:10 | 8.68 | 8.04 | 07:45 | 0.33 | 06:20 | 0.94 | 0.59 | 03:15 | 0.034 | 19:25 | 0.138 | 0.076 | 0.076 | |
| 5/3/2013 | 05:00 | 7.02 | 10:50 | 8.65 | 7.97 | 05:00 | 0.31 | 02:45 | 1.00 | 0.56 | 05:00 | 0.020 | 13:30 | 0.125 | 0.070 | 0.070 | |
| 5/4/2013 | 04:20 | 7.29 | 13:20 | 8.64 | 8.00 | 04:20 | 0.24 | 01:25 | 1.05 | 0.59 | 04:20 | 0.020 | 13:45 | 0.144 | 0.075 | 0.075 | |
| 5/5/2013 | 05:15 | 7.14 | 20:25 | 9.11 | 8.03 | 23:10 | 0.33 | 10:00 | 0.93 | 0.61 | 04:20 | 0.030 | 20:20 | 0.164 | 0.079 | 0.079 | |
| 5/6/2013 | 05:05 | 7.23 | 21:20 | 8.65 | 8.07 | 23:30 | 0.27 | 09:40 | 0.97 | 0.63 | 02:45 | 0.030 | 21:10 | 0.147 | 0.083 | 0.083 | |
| 5/7/2013 | 05:00 | 7.08 | 22:10 | 8.67 | 8.05 | 01:55 | 0.27 | 23:15 | 0.85 | 0.63 | 04:45 | 0.024 | 22:25 | 0.142 | 0.085 | 0.085 | |
| 5/8/2013 | 05:40 | 7.01 | 21:45 | 8.83 | 8.03 | 05:25 | 0.36 | 21:45 | 0.90 | 0.68 | 05:25 | 0.024 | 21:45 | 0.162 | 0.091 | 0.091 | |
| 5/9/2013 | 04:40 | 7.20 | 22:15 | 8.86 | 8.19 | 04:25 | 0.44 | 16:40 | 0.95 | 0.72 | 05:00 | 0.034 | 22:05 | 0.171 | 0.103 | 0.103 | 0.39 |
| 5/10/2013 | 04:55 | 7.38 | 11:10 | 8.47 | 8.08 | 05:30 | 0.39 | 09:35 | 0.85 | 0.65 | 05:30 | 0.035 | 09:35 | 0.128 | 0.088 | 0.088 | |
| 5/11/2013 | 05:45 | 7.22 | 13:20 | 8.78 | 8.05 | 06:05 | 0.37 | 14:10 | 0.88 | 0.65 | 06:05 | 0.030 | 13:20 | 0.153 | 0.086 | 0.086 | |
| 5/12/2013 | 05:05 | 7.08 | 11:15 | 8.72 | 8.06 | 05:05 | 0.37 | 17:25 | 0.85 | 0.66 | 05:05 | 0.025 | 11:35 | 0.136 | 0.088 | 0.088 | |
| 5/13/2013 | 04:50 | 7.12 | 10:15 | 8.85 | 8.17 | 05:15 | 0.37 | 20:50 | 0.85 | 0.63 | 05:15 | 0.028 | 10:15 | 0.147 | 0.089 | 0.089 | |
| 5/14/2013 | 05:15 | 7.31 | 21:55 | 8.84 | 8.20 | 05:15 | 0.33 | 22:35 | 0.83 | 0.64 | 05:15 | 0.028 | 22:50 | 0.133 | 0.091 | 0.091 | |
| 5/15/2013 | 05:15 | 7.14 | 12:30 | 10.08 | 7.99 | 05:25 | 0.39 | 12:25 | 1.10 | 0.60 | 05:25 | 0.029 | 12:30 | 0.280 | 0.078 | 0.078 | 0.56 |
| 5/16/2013 | 05:55 | 7.55 | 00:15 | 10.24 | 8.33 | 06:10 | 0.47 | 00:50 | 0.96 | 0.73 | 06:00 | 0.049 | 00:50 | 0.252 | 0.109 | 0.109 | |
| 5/17/2013 | 04:50 | 7.19 | 10:05 | 8.67 | 8.04 | 04:45 | 0.40 | 13:55 | 0.85 | 0.66 | 04:45 | 0.032 | 10:20 | 0.139 | 0.087 | 0.087 | |
| 5/18/2013 | 06:50 | 7.18 | 14:15 | 8.69 | 8.06 | 07:00 | 0.37 | 11:05 | 0.91 | 0.65 | 06:30 | 0.029 | 13:10 | 0.143 | 0.087 | 0.087 | |
| 5/19/2013 | 07:20 | 7.26 | 13:55 | 9.06 | 8.25 | 07:15 | 0.33 | 13:50 | 0.86 | 0.62 | 07:15 | 0.028 | 13:50 | 0.164 | 0.092 | 0.092 | |
| 5/20/2013 | 04:50 | 7.44 | 20:05 | 8.85 | 8.29 | 03:40 | 0.35 | 17:55 | 0.85 | 0.63 | 04:55 | 0.034 | 21:40 | 0.148 | 0.093 | 0.093 | |
| 5/21/2013 | 04:55 | 7.45 | 16:15 | 9.37 | 8.33 | 05:55 | 0.37 | 16:20 | 1.11 | 0.71 | 05:55 | 0.039 | 16:20 | 0.232 | 0.109 | 0.109 | 0.42 |
| 5/22/2013 | 04:45 | 7.26 | 12:15 | 8.98 | 8.14 | 05:45 | 0.42 | 12:20 | 0.94 | 0.73 | 06:05 | 0.036 | 12:15 | 0.170 | 0.102 | 0.102 | |
| 5/23/2013 | 04:40 | 7.32 | 22:30 | 8.72 | 8.08 | 04:50 | 0.53 | 21:05 | 0.95 | 0.76 | 04:50 | 0.045 | 22:30 | 0.163 | 0.101 | 0.101 | |
| 5/24/2013 | 04:10 | 7.17 | 20:10 | 8.67 | 8.09 | 05:10 | 0.41 | 18:15 | 1.01 | 0.74 | 05:10 | 0.031 | 18:05 | 0.164 | 0.101 | 0.101 | 0.15 |
| 5/25/2013 | 05:10 | 7.25 | 11:30 | 8.71 | 8.03 | 06:15 | 0.49 | 10:25 | 0.98 | 0.74 | 05:00 | 0.043 | 11:30 | 0.167 | 0.097 | 0.097 | 0.09 |
| 5/26/2013 | 05:20 | 7.17 | 12:45 | 8.59 | 7.97 | 06:35 | 0.44 | 12:40 | 0.90 | 0.69 | 06:35 | 0.033 | 12:40 | 0.145 | 0.088 | 0.088 | |
| 5/27/2013 | 05:50 | 7.10 | 13:05 | 8.67 | 8.03 | 05:20 | 0.39 | 13:35 | 0.93 | 0.67 | 05:20 | 0.028 | 13:35 | 0.145 | 0.089 | 0.089 | |
| 5/28/2013 | 05:10 | 7.08 | 08:15 | 8.90 | 8.12 | 04:05 | 0.42 | 08:15 | 0.94 | 0.72 | 05:20 | 0.031 | 08:15 | 0.174 | 0.101 | 0.101 | |
| 5/29/2013 | 05:15 | 7.28 | 22:40 | 8.62 | 8.08 | 06:30 | 0.45 | 20:55 | 0.98 | 0.74 | 05:15 | 0.038 | 20:55 | 0.158 | 0.099 | 0.099 | 0.04 |
| 5/30/2013 | 04:45 | 7.17 | 22:20 | 8.96 | 8.06 | 05:45 | 0.43 | 22:05 | 0.94 | 0.72 | 05:55 | 0.034 | 22:05 | 0.170 | 0.096 | 0.096 | |
| 5/31/2013 | 04:05 | 7.30 | 13:35 | 8.56 | 8.07 | 04:20 | 0.45 | 00:30 | 0.91 | 0.72 | 04:20 | 0.038 | 13:40 | 0.139 | 0.096 | 0.096 | |

## Report Summary For The Period 5/1/2013 - 5/31/2013

| | Depth (in) | Velocity (ft/s) | Quantity (MGD - Total MG) | Rain (in) |
|---|---|---|---|---|
| Total | | | 2.811 | 1.65 |
| Avg | 8.10 | 0.67 | 0.091 | |

# Kennedale, TX

**Daily Tabular Report For The Period 6/1/2013 - 6/9/2013**

**KT_01, Pipe Height: 14.25 in**

## Daily Tabular Report

| Date | Depth (in) | | | | | Velocity (ft/s) | | | | | Quantity (MGD - Total MG) | | | | | | Rain (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Total | Total |
| 6/1/2013 | 06:00 | 7.31 | 10:30 | 8.62 | 8.05 | 07:00 | 0.47 | 12:05 | 0.89 | 0.71 | 07:00 | 0.040 | 12:05 | 0.143 | 0.094 | 0.094 | 0.03 |
| 6/2/2013 | 04:40 | 7.19 | 21:55 | 8.76 | 8.07 | 06:45 | 0.40 | 23:15 | 0.91 | 0.69 | 06:45 | 0.031 | 23:15 | 0.143 | 0.094 | 0.094 | |
| 6/3/2013 | 05:05 | 7.15 | 22:00 | 8.49 | 8.02 | 06:30 | 0.43 | 20:30 | 0.87 | 0.67 | 04:50 | 0.034 | 22:35 | 0.135 | 0.087 | 0.087 | |
| 6/4/2013 | 04:45 | 7.13 | 22:40 | 9.06 | 8.07 | 04:45 | 0.40 | 20:55 | 0.92 | 0.65 | 04:45 | 0.029 | 20:55 | 0.163 | 0.088 | 0.088 | |
| 6/5/2013 | 05:05 | 7.20 | 12:00 | 9.08 | 8.11 | 04:20 | 0.44 | 22:35 | 1.00 | 0.70 | 04:20 | 0.038 | 12:05 | 0.185 | 0.095 | 0.095 | |
| 6/6/2013 | 04:15 | 7.14 | 21:45 | 8.81 | 8.16 | 04:55 | 0.43 | 10:55 | 0.88 | 0.69 | 04:30 | 0.032 | 09:25 | 0.140 | 0.098 | 0.098 | 0.42 |
| 6/7/2013 | 04:20 | 7.33 | 12:20 | 8.71 | 8.10 | 05:40 | 0.42 | 17:45 | 0.91 | 0.70 | 05:35 | 0.038 | 12:20 | 0.141 | 0.095 | 0.095 | |
| 6/8/2013 | 05:45 | 7.30 | 11:40 | 8.59 | 8.02 | 07:30 | 0.42 | 16:35 | 0.96 | 0.68 | 06:20 | 0.036 | 13:45 | 0.135 | 0.090 | 0.090 | |
| 6/9/2013 | 06:35 | 7.15 | 07:50 | 12.70 | 8.70 | 06:10 | 0.43 | 07:45 | 1.55 | 0.74 | 06:10 | 0.034 | 07:50 | 0.586 | 0.137 | 0.136 | 0.74 |

## Report Summary For The Period 6/1/2013 - 6/9/2013

| | Depth (in) | Velocity (ft/s) | Quantity (MGD - Total MG) | Rain (in) |
|---|---|---|---|---|
| Total | | | 0.878 | 1.19 |
| Avg | 8.15 | 0.69 | 0.098 | |

## Site Commentary

### Site Information

This monitoring point, KT_02 was installed to measure and study flows in Kennedale TX. A review of the hydrograph indicates a repeatable diurnal pattern on weekdays and on weekends from Wednesday, May 01, 2013 through Sunday, June 09, 2013 . A review of the scattergraph indicates that KT_02 remained in free-flow conditions throughout the monitoring period. Surcharge conditions were not observed at this location during the report period.

| KT_02 | |
|---|---|
| Site Address | Access road at old WWTP |
| Pipe Height | 18.25" |
| Silt Level | 0.00" |

### Observations

Average flow depth, velocity, and quantity observed during the study period, along with minimum and maximum data, are provided in the following table.

| Observed Flow Conditions | | | |
|---|---|---|---|
| Item | Depth (in) | Velocity (ft/s) | Quantity (MGD) |
| Average | 2.27 | 5.87 | 0.498 |
| Minimum | 1.23 | 4.81 | 0.166 |
| Maximum | 6.20 | 6.74 | 2.314 |

Please note the minimum and maximum flow rate recorded in this table may vary from those recorded on the daily and weekly tabular data. The minimum and maximum rates recorded on the daily and weekly tabular data are absolute versus average fifteen minute data.

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

### Data Quality

Data uptime observed during the monitoring period is provided in the table below.

| Percent Uptime | |
|---|---|
| Depth | 100 |
| Velocity | 100 |
| Quantity | 100 |

### Maintenance

Installation Date: April 30, 2013

Removal Date: June 10, 2013

Calibrations: April 30, 2013, & June 10, 2013

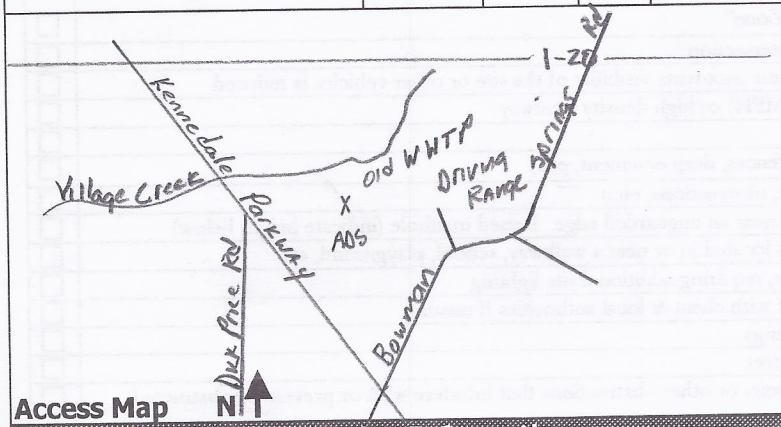
Flow depth and velocity measurements recorded by the monitor are consistent with field calibrations conducted to date and support the relative accuracy of the flow monitor at this location.

Installed 4.30.13

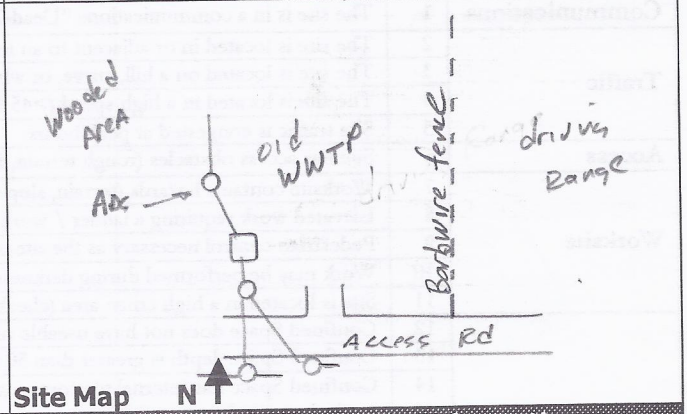
ADS ENVIRONMENTAL SERVICES

# ADS Site Report — Quality Form

| | | | | | |
|---|---|---|---|---|---|
| Project Name: Kennedale | City/State: Texas | | | FM Initials: KB | |
| Site Name: KT-02 | Monitor Series: 5000 | | | Monitor S/N: | 16243 |
| Address / Location: Access Rd @ old WWTP | | | | Manhole #: | NA |
| | | | | Map Page #: | NA |
| Access: drive | Type of System: | Sanitary ☑ | Storm ☐ | Combined ☐ | Pipe Height: 18.25 |
| | | | | | Pipe Width: 18.0 |
| | | | | | Phone Number: 166.213.163.231 |



Access Map



Site Map

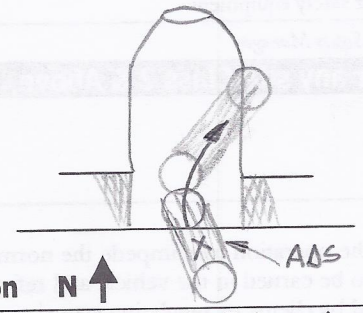
## Investigation Information:

| | |
|---|---|
| Date/ Time of Investigation: | 4-30-13 @ 10:55 |
| Site Hydraulics: | fast somewhat Rough unrestricted flow |
| Upstream Input: (L/S, P/S) | old flume |
| Upstream Manhole: | old flume |
| Downstream Manhole: | DN1 |
| Depth of Flow (Wet Dof): | 2.25 +/- .25 |
| Range (Air Dof): | — +/- |
| Peak Velocity: | 6.7 fps |
| Silt: | 0 Inches |

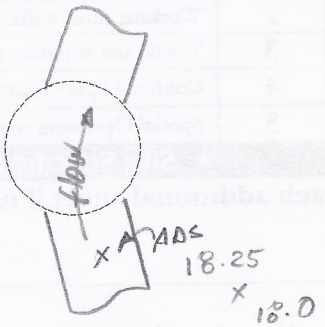
## Manhole Information:

| | | | | |
|---|---|---|---|---|
| Manhole Depth: | | | Feet | 84" |
| Manhole Material / Condition: | Concrete / fair | | | |
| Pipe Material / Condition: | clay - fair | | | |
| Mini System Character: | Residential ☑ | Commercial ☐ | Industrial ☐ | Other |
| Telephone Information: | NA | | | |
| Access Pole #: | | | | |
| Distance From Manhole: | | | Feet | |
| Road Cut Length: | | | Feet | |
| Trench Length: | | | Feet | |

## Other Information



Cross Section



Planar

| Installation Information | |
|---|---|
| Installation Type: | 5000 Ring |
| Sensors/Devices: | UPV |
| Surcharge Height: | 4' Feet |
| Rain Gauge Zone: | KT-RG |

| Backup | Yes | No | ? | Distance |
|---|---|---|---|---|
| Trunk | ☑ | ☐ | | |
| Lift/Pump Station | ☐ | ☑ | | |
| WWTP | ☐ | ☑ | | |
| Other | ☐ | ☑ | | |

## Additional Site Information/Comments:

N32° 39.645'
W097 13.755'

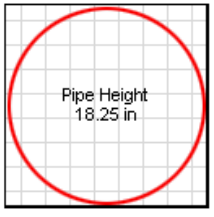
Moved Downstream of proposed location due to map corrections located 1-MH DS off old WWTP flume/vault

# SCATTERGRAPH REPORT

KT_02

**Flow Monitor**

**KT_02**

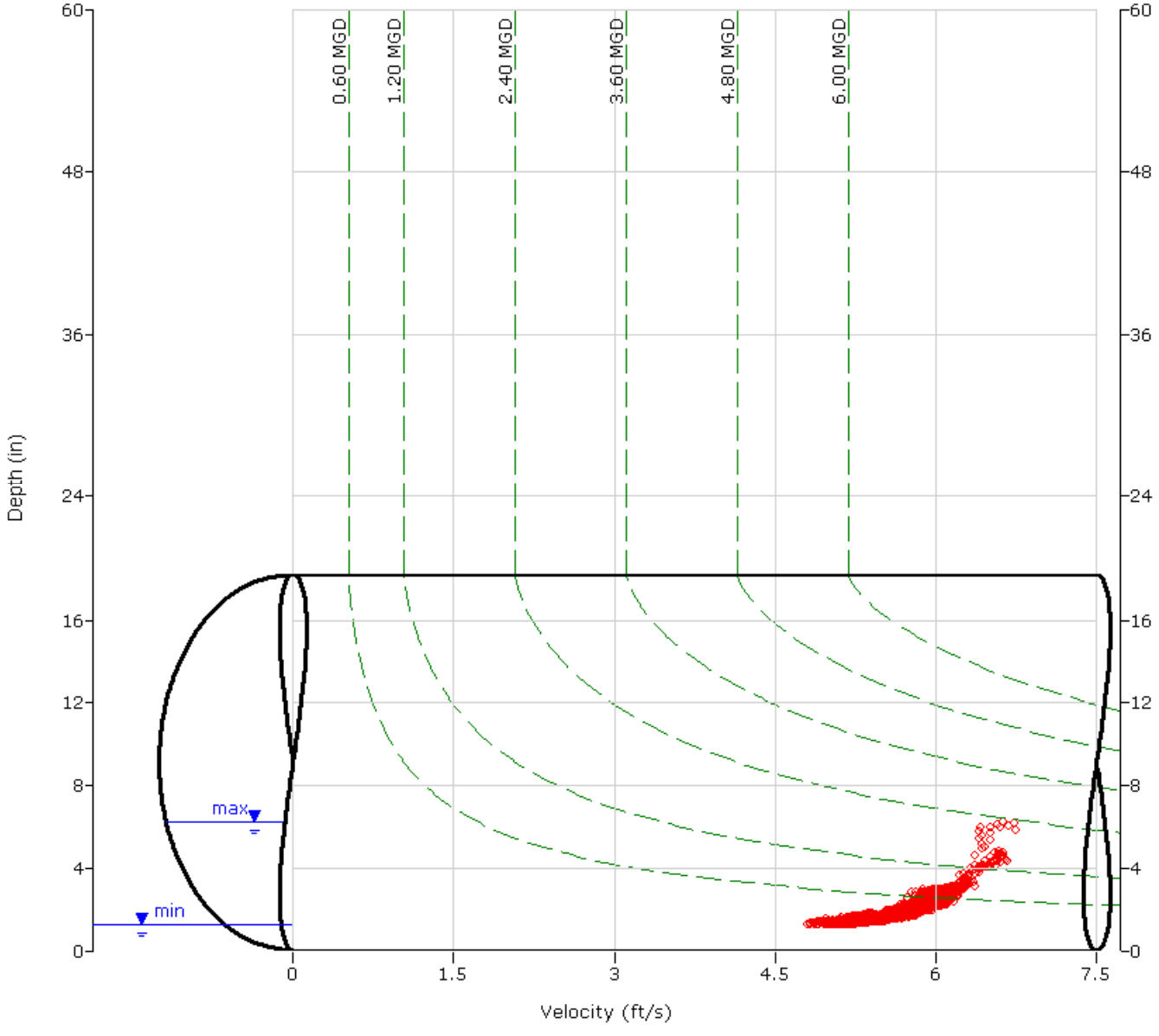



**Report Period**

5/1/2013
To
6/9/2013

**Legend**

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth




ADS ENVIRONMENTAL SERVICES

# HYDROGRAPH REPORT

KT_02

**Flow Monitor**

**KT_02**

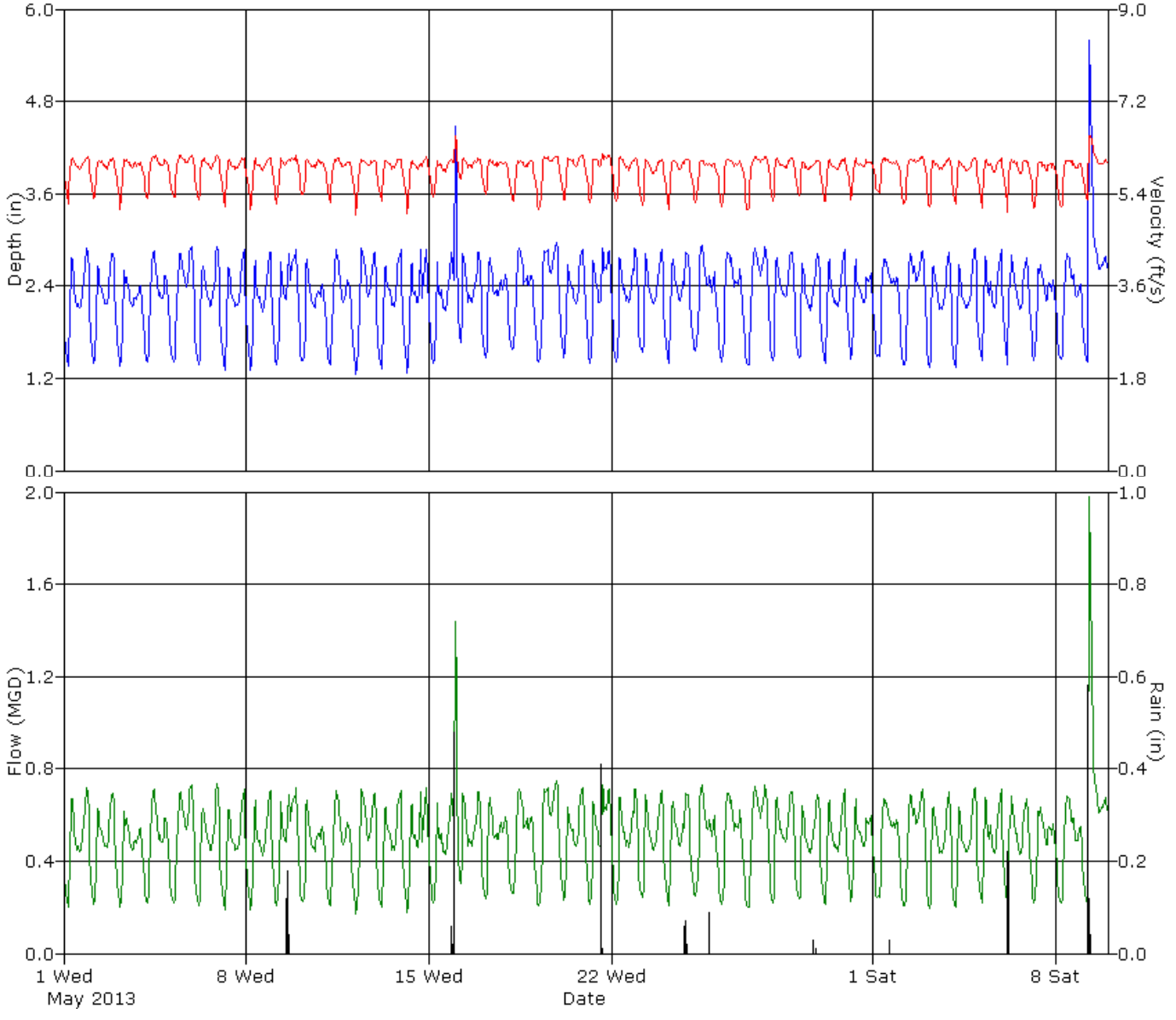
Pipe Height
18.25 in

**Report Period**

5/1/2013
To
6/9/2013

**Legend**

- Depth
- Velocity
- Quantity
- Rain




ADS ENVIRONMENTAL SERVICES

# Kennedale, TX

**Daily Tabular Report For The Period 5/1/2013 - 5/31/2013**

**KT_02, Pipe Height: 18.25 in**

## Daily Tabular Report

| Date | Depth (in) | | | | | Velocity (ft/s) | | | | | Quantity (MGD - Total MG) | | | | | | Rain (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Total | Total |
| 5/1/2013 | 04:50 | 1.31 | 21:40 | 2.95 | 2.21 | 04:50 | 4.99 | 21:45 | 6.22 | 5.88 | 04:50 | 0.184 | 21:40 | 0.752 | 0.481 | 0.481 | |
| 5/2/2013 | 04:30 | 1.35 | 21:45 | 2.90 | 2.21 | 04:55 | 5.17 | 21:10 | 6.15 | 5.87 | 04:55 | 0.202 | 21:35 | 0.720 | 0.479 | 0.479 | |
| 5/3/2013 | 04:50 | 1.30 | 07:50 | 2.85 | 2.13 | 04:40 | 4.87 | 08:05 | 6.13 | 5.84 | 04:50 | 0.183 | 07:50 | 0.704 | 0.452 | 0.452 | |
| 5/4/2013 | 05:15 | 1.38 | 10:10 | 2.93 | 2.22 | 05:20 | 5.17 | 13:25 | 6.21 | 5.89 | 05:20 | 0.209 | 10:05 | 0.741 | 0.483 | 0.483 | |
| 5/5/2013 | 05:15 | 1.38 | 21:15 | 2.97 | 2.31 | 06:10 | 5.16 | 22:55 | 6.22 | 5.90 | 06:10 | 0.208 | 20:25 | 0.754 | 0.515 | 0.515 | |
| 5/6/2013 | 05:10 | 1.34 | 21:30 | 2.95 | 2.24 | 05:00 | 5.12 | 21:30 | 6.24 | 5.89 | 04:45 | 0.199 | 21:30 | 0.757 | 0.490 | 0.490 | |
| 5/7/2013 | 04:55 | 1.24 | 22:20 | 2.93 | 2.18 | 04:55 | 4.99 | 22:30 | 6.16 | 5.85 | 04:55 | 0.170 | 22:25 | 0.738 | 0.470 | 0.470 | |
| 5/8/2013 | 05:00 | 1.26 | 21:35 | 2.96 | 2.18 | 04:30 | 4.88 | 20:45 | 6.16 | 5.84 | 05:10 | 0.178 | 21:35 | 0.745 | 0.469 | 0.469 | |
| 5/9/2013 | 04:45 | 1.36 | 07:50 | 2.91 | 2.30 | 04:40 | 5.11 | 22:20 | 6.22 | 5.90 | 04:45 | 0.201 | 22:15 | 0.737 | 0.511 | 0.511 | 0.39 |
| 5/10/2013 | 03:30 | 1.38 | 07:55 | 2.89 | 2.14 | 04:50 | 5.15 | 19:10 | 6.17 | 5.88 | 04:50 | 0.212 | 07:55 | 0.721 | 0.455 | 0.455 | |
| 5/11/2013 | 05:40 | 1.34 | 11:40 | 2.97 | 2.20 | 05:50 | 4.95 | 13:35 | 6.16 | 5.86 | 05:35 | 0.195 | 11:40 | 0.745 | 0.476 | 0.476 | |
| 5/12/2013 | 05:10 | 1.24 | 10:00 | 2.92 | 2.24 | 05:00 | 4.81 | 09:55 | 6.15 | 5.84 | 05:00 | 0.166 | 10:00 | 0.727 | 0.492 | 0.492 | |
| 5/13/2013 | 04:40 | 1.25 | 22:05 | 2.91 | 2.22 | 04:50 | 5.05 | 20:45 | 6.15 | 5.87 | 04:50 | 0.176 | 22:05 | 0.722 | 0.482 | 0.482 | |
| 5/14/2013 | 04:30 | 1.23 | 21:50 | 3.07 | 2.22 | 04:35 | 4.87 | 22:05 | 6.26 | 5.84 | 04:40 | 0.167 | 21:50 | 0.800 | 0.483 | 0.483 | |
| 5/15/2013 | 04:25 | 1.38 | 23:55 | 3.54 | 2.19 | 04:35 | 5.19 | 23:55 | 6.27 | 5.86 | 04:35 | 0.210 | 23:55 | 0.990 | 0.471 | 0.471 | 0.56 |
| 5/16/2013 | 05:20 | 1.61 | 00:15 | 4.76 | 2.54 | 05:20 | 5.64 | 01:00 | 6.67 | 6.02 | 05:20 | 0.283 | 00:15 | 1.594 | 0.604 | 0.604 | |
| 5/17/2013 | 04:25 | 1.43 | 07:55 | 2.84 | 2.24 | 04:05 | 5.32 | 08:15 | 6.16 | 5.90 | 04:30 | 0.225 | 08:15 | 0.705 | 0.488 | 0.488 | |
| 5/18/2013 | 06:20 | 1.52 | 11:50 | 2.94 | 2.32 | 06:35 | 5.17 | 13:00 | 6.15 | 5.83 | 06:20 | 0.243 | 12:40 | 0.733 | 0.510 | 0.510 | |
| 5/19/2013 | 04:55 | 1.36 | 21:05 | 3.03 | 2.39 | 04:50 | 4.93 | 10:15 | 6.20 | 5.86 | 05:25 | 0.195 | 21:05 | 0.773 | 0.540 | 0.540 | |
| 5/20/2013 | 04:10 | 1.43 | 21:35 | 2.98 | 2.29 | 04:10 | 5.18 | 19:15 | 6.20 | 5.91 | 04:10 | 0.218 | 21:35 | 0.757 | 0.506 | 0.506 | |
| 5/21/2013 | 03:45 | 1.36 | 15:25 | 3.40 | 2.32 | 04:35 | 5.11 | 15:20 | 6.36 | 5.92 | 04:30 | 0.203 | 15:25 | 0.937 | 0.519 | 0.519 | 0.42 |
| 5/22/2013 | 04:40 | 1.36 | 21:20 | 2.92 | 2.26 | 04:45 | 5.11 | 08:20 | 6.19 | 5.87 | 04:45 | 0.204 | 21:20 | 0.733 | 0.494 | 0.494 | |
| 5/23/2013 | 04:40 | 1.46 | 07:30 | 3.01 | 2.27 | 04:50 | 4.98 | 07:45 | 6.15 | 5.82 | 04:40 | 0.226 | 07:30 | 0.767 | 0.494 | 0.494 | |
| 5/24/2013 | 04:20 | 1.36 | 20:25 | 2.93 | 2.27 | 04:20 | 4.86 | 22:15 | 6.14 | 5.84 | 04:20 | 0.190 | 22:05 | 0.733 | 0.497 | 0.497 | 0.15 |
| 5/25/2013 | 05:20 | 1.52 | 11:55 | 2.98 | 2.30 | 05:30 | 5.10 | 12:15 | 6.14 | 5.83 | 05:20 | 0.238 | 11:55 | 0.752 | 0.504 | 0.504 | 0.09 |
| 5/26/2013 | 05:20 | 1.38 | 10:10 | 2.93 | 2.29 | 05:20 | 4.97 | 10:40 | 6.13 | 5.84 | 05:20 | 0.198 | 10:10 | 0.731 | 0.502 | 0.502 | |
| 5/27/2013 | 05:55 | 1.32 | 11:25 | 3.13 | 2.33 | 04:40 | 4.83 | 11:35 | 6.20 | 5.85 | 05:55 | 0.187 | 11:25 | 0.817 | 0.525 | 0.525 | |
| 5/28/2013 | 04:40 | 1.38 | 08:20 | 2.91 | 2.28 | 05:05 | 5.13 | 18:00 | 6.21 | 5.88 | 05:05 | 0.205 | 08:20 | 0.735 | 0.503 | 0.503 | |
| 5/29/2013 | 04:55 | 1.37 | 21:10 | 2.85 | 2.22 | 04:55 | 5.23 | 07:55 | 6.11 | 5.86 | 04:55 | 0.207 | 21:30 | 0.700 | 0.481 | 0.481 | 0.04 |
| 5/30/2013 | 03:55 | 1.37 | 22:20 | 3.01 | 2.23 | 05:00 | 5.07 | 22:25 | 6.21 | 5.85 | 04:35 | 0.202 | 22:20 | 0.775 | 0.484 | 0.484 | |
| 5/31/2013 | 04:10 | 1.42 | 08:05 | 2.85 | 2.23 | 04:05 | 5.17 | 08:25 | 6.16 | 5.89 | 04:10 | 0.220 | 08:05 | 0.700 | 0.485 | 0.484 | |

## Report Summary For The Period 5/1/2013 - 5/31/2013

| | Depth (in) | Velocity (ft/s) | Quantity (MGD - Total MG) | Rain (in) |
|---|---|---|---|---|
| Total | | | 15.345 | 1.65 |
| Avg | 2.26 | 5.87 | 0.495 | |

# Kennedale, TX

**Daily Tabular Report For The Period 6/1/2013 - 6/9/2013**

**KT_02, Pipe Height: 18.25 in**

## Daily Tabular Report

| Date | Depth (in) | | | | | Velocity (ft/s) | | | | | Quantity (MGD - Total MG) | | | | | | Rain (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Total | Total |
| 6/1/2013 | 06:10 | 1.42 | 10:45 | 2.82 | 2.26 | 06:10 | 5.26 | 12:40 | 6.16 | 5.90 | 06:10 | 0.219 | 10:40 | 0.694 | 0.495 | 0.495 | 0.03 |
| 6/2/2013 | 04:45 | 1.34 | 21:55 | 2.96 | 2.30 | 04:40 | 5.00 | 20:10 | 6.22 | 5.87 | 05:00 | 0.196 | 21:55 | 0.754 | 0.514 | 0.514 | |
| 6/3/2013 | 04:30 | 1.28 | 22:20 | 2.89 | 2.19 | 04:50 | 4.82 | 22:25 | 6.16 | 5.84 | 04:50 | 0.174 | 22:20 | 0.724 | 0.471 | 0.471 | |
| 6/4/2013 | 04:20 | 1.32 | 22:35 | 2.97 | 2.18 | 05:05 | 5.04 | 21:15 | 6.21 | 5.83 | 05:05 | 0.191 | 22:35 | 0.756 | 0.466 | 0.466 | |
| 6/5/2013 | 04:15 | 1.41 | 22:00 | 2.93 | 2.24 | 04:15 | 5.02 | 22:00 | 6.16 | 5.84 | 04:15 | 0.207 | 22:00 | 0.740 | 0.485 | 0.485 | |
| 6/6/2013 | 04:40 | 1.32 | 05:40 | 3.13 | 2.29 | 04:45 | 4.87 | 05:45 | 6.22 | 5.85 | 04:40 | 0.186 | 05:40 | 0.814 | 0.504 | 0.504 | 0.42 |
| 6/7/2013 | 05:00 | 1.39 | 10:05 | 2.74 | 2.22 | 04:55 | 4.99 | 22:50 | 6.09 | 5.82 | 05:00 | 0.203 | 10:05 | 0.662 | 0.476 | 0.476 | |
| 6/8/2013 | 05:50 | 1.39 | 12:00 | 2.94 | 2.24 | 05:45 | 4.99 | 11:05 | 6.16 | 5.81 | 05:45 | 0.204 | 12:00 | 0.737 | 0.484 | 0.484 | |
| 6/9/2013 | 05:20 | 1.39 | 07:50 | 6.20 | 2.74 | 05:35 | 5.16 | 08:00 | 6.74 | 5.97 | 05:15 | 0.212 | 07:45 | 2.314 | 0.695 | 0.694 | 0.74 |

## Report Summary For The Period 6/1/2013 - 6/9/2013

| | Depth (in) | Velocity (ft/s) | Quantity (MGD - Total MG) | Rain (in) |
|---|---|---|---|---|
| Total | | | 4.590 | 1.19 |
| Avg | 2.30 | 5.86 | 0.510 | |

## Site Commentary

### Site Information

Rain Gauge, KT_RG was installed to measure rain in Kennedale TX. A review of the hydrograph indicates a number of rain events during the monitoring period from Wednesday, May 01, 2013 through Sunday, June 09, 2013 .

| KT_RG | |
|---|---|
| Site Address | Access road at old WWTP |

The total recorded rainfall for the reporting period was 2.84 inches.

### Maintenance

Installation Date: April 30, 2013

Removal Date: June 10, 2013

Calibrations: April 30, 2013

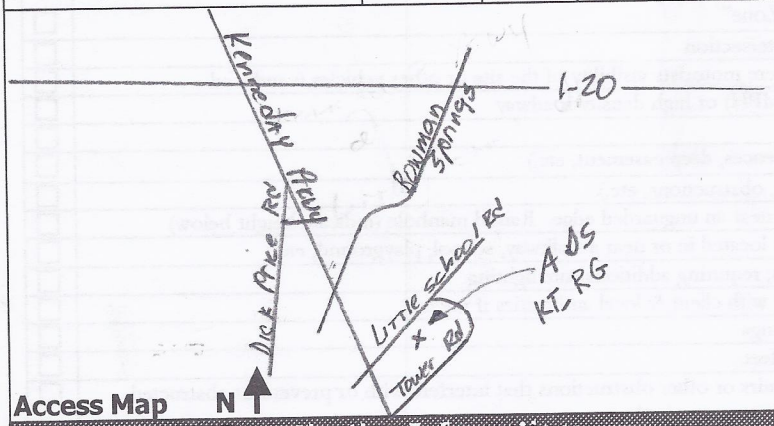
Installed 4.30.13

ADS ENVIRONMENTAL SERVICES

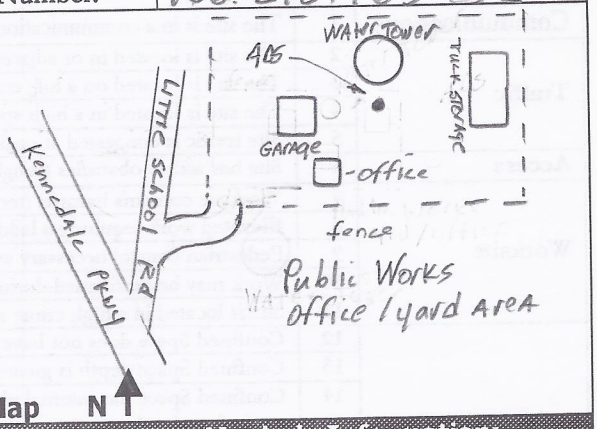
# ADS Site Report

## Quality Form

| | | | | | |
|---|---|---|---|---|---|
| Project Name: Kennedale | | City/State: Texas | | FM Initials: KR | |
| Site Name: KT-RG | Monitor Series: 5000 | | Monitor S/N: | 20606 | |
| Address / Location: 150 Littleschool dr @ Public Works office/yard | | | Manhole #: | NA | |
| | | | Map Page #: | NA | |
| Access: drive | Type of System: | Sanitary ☐ Storm ☐ Combined ☐ | Pipe Height: | NA | |
| | | | Pipe Width: | NA | |
| | | | Phone Number: | 166.213.163.252 | |



Access Map



Site Map

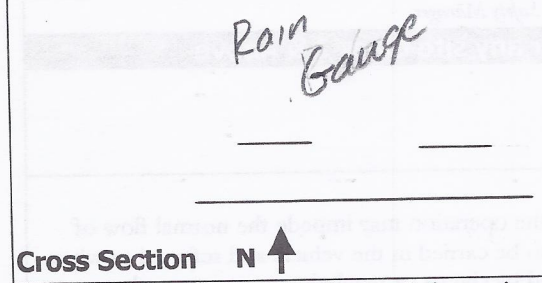
### Investigation Information:

| | |
|---|---|
| Date/ Time of Investigation: | 4-29-13 @ 8:50 |
| Site Hydraulics: | NA |
| Upstream Input: (L/S, P/S) | NA |
| Upstream Manhole: | NA |
| Downstream Manhole: | NA |
| Depth of Flow (Wet Dof): | +/- |
| Range (Air Dof): | +/- |
| Peak Velocity: | fps |
| Silt: | Inches |

### Manhole Information:

| | | | | |
|---|---|---|---|---|
| Manhole Depth: | NA Feet | | | |
| Manhole Material / Condition: | NA | | | |
| Pipe Material / Condition: | NA | | | |
| Mini System Character: | Residential ☑ | Commercial ☑ | Industrial ☐ | Other |
| Telephone Information: | | | | |
| Access Pole #: | | | | |
| Distance From Manhole: | Feet | | | |
| Road Cut Length: | Feet | | | |
| Trench Length: | Feet | | | |

### Other Information



Cross Section N



Planar N

| Installation Information | |
|---|---|
| Installation Type: | 5000 w/ Tipping bucket |
| Sensors/Devices: | RG |
| Surcharge Height: | NA Feet |
| Rain Gauge Zone: | NA |

| Backup | Yes | No | ? | Distance |
|---|---|---|---|---|
| Trunk | ☐ | ☐ | | |
| Lift/Pump Station | ☐ | ☐ | | |
| WWTP | ☐ | ☐ | | |
| Other | ☐ | ☐ | | |

### Additional Site Information/Comments:

N32° 38.242'
W097° 12.497

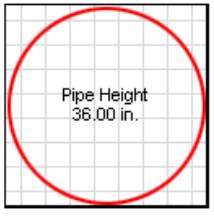
Located on electrical Box between office/Garage and Water Tower in Public Works yard.

# SCATTERGRAPH REPORT

KT_RG

**Flow Monitor**

**KT_RG**

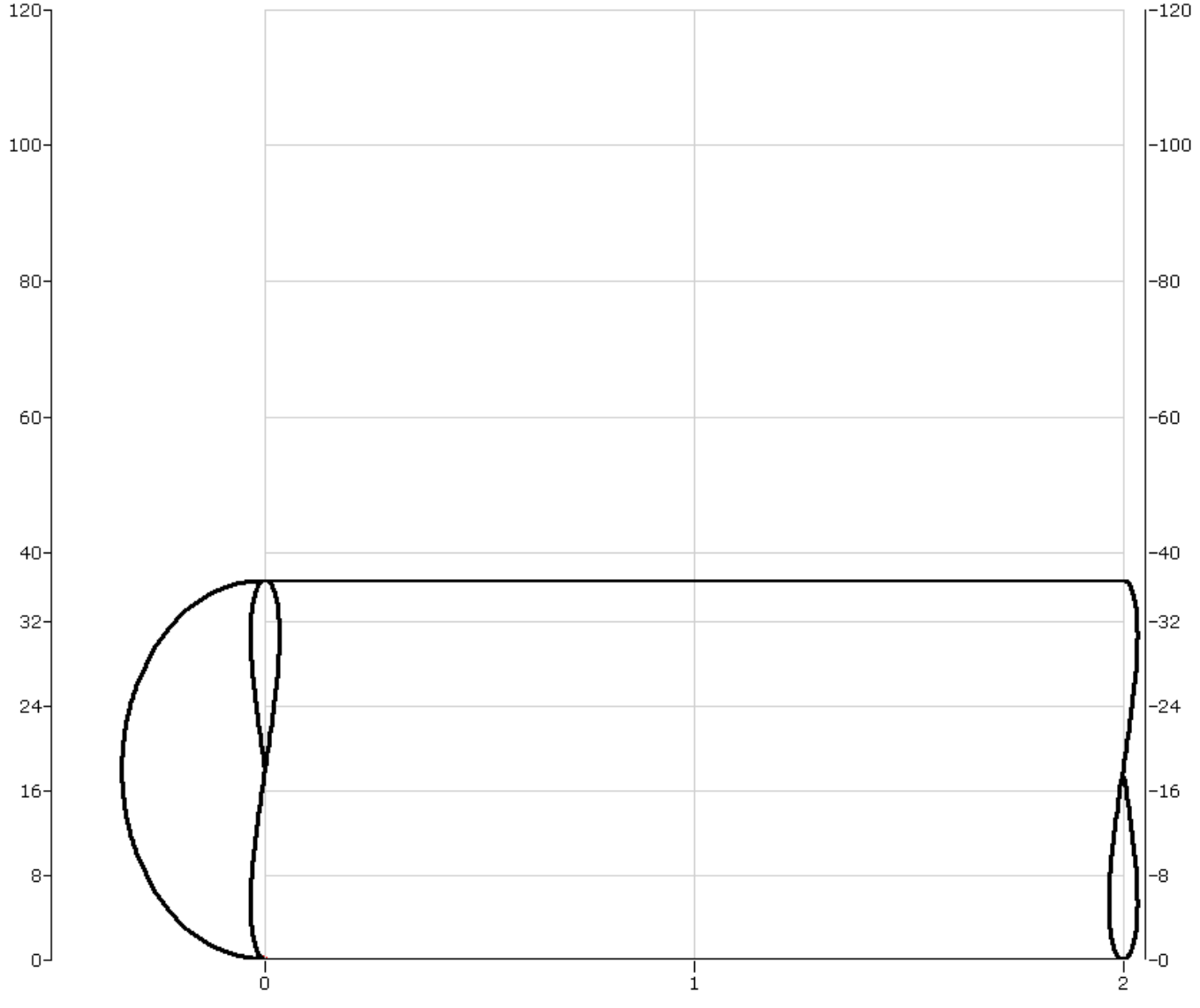



**Report Period**

5/1/2013
To
6/9/2013

**Legend**

- Iso-Q™
- Silt
- Min-Max Depth




ADS ENVIRONMENTAL SERVICES

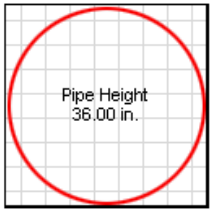
No Data Available

# HYDROGRAPH REPORT

KT_RG

**Flow Monitor**

**KT_RG**

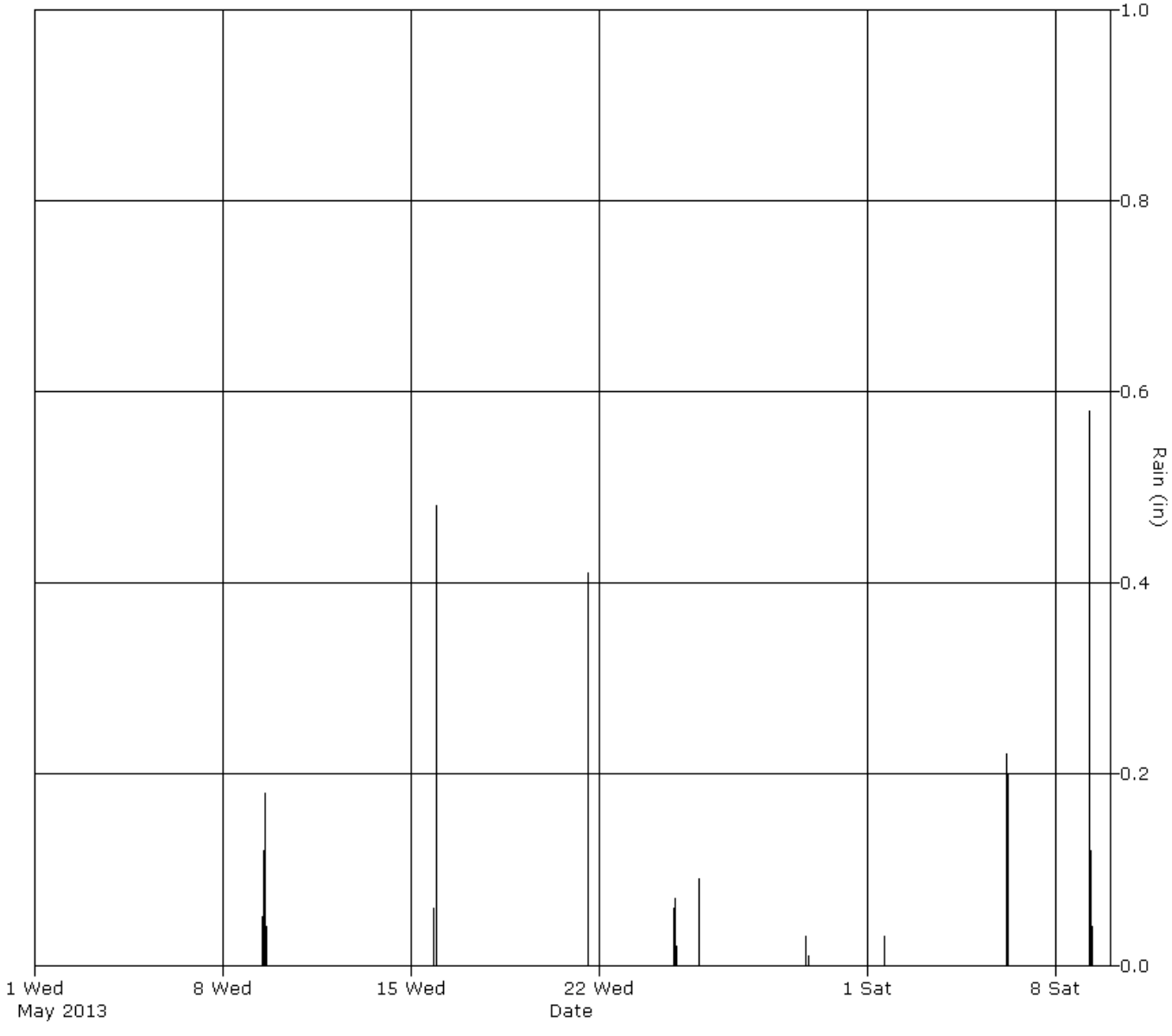



**Report Period**

5/1/2013
To
6/9/2013

**Legend**

Rain




ADS ENVIRONMENTAL SERVICES

# Kennedale, TX

**Daily Tabular Report For The Period 5/1/2013 - 5/31/2013**

**KT_RG, Pipe Height: 36 in**

## Daily Tabular Report

| Date | Depth (in) | | | | | Velocity (ft/s) | | | | | Quantity (MGD - Total MG) | | | | | | Rain (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Total | Total |
| 5/1/2013 | | | | | | | | | | | | | | | | | |
| 5/2/2013 | | | | | | | | | | | | | | | | | |
| 5/3/2013 | | | | | | | | | | | | | | | | | |
| 5/4/2013 | | | | | | | | | | | | | | | | | |
| 5/5/2013 | | | | | | | | | | | | | | | | | |
| 5/6/2013 | | | | | | | | | | | | | | | | | |
| 5/7/2013 | | | | | | | | | | | | | | | | | |
| 5/8/2013 | | | | | | | | | | | | | | | | | |
| 5/9/2013 | | | | | | | | | | | | | | | | | 0.39 |
| 5/10/2013 | | | | | | | | | | | | | | | | | |
| 5/11/2013 | | | | | | | | | | | | | | | | | |
| 5/12/2013 | | | | | | | | | | | | | | | | | |
| 5/13/2013 | | | | | | | | | | | | | | | | | |
| 5/14/2013 | | | | | | | | | | | | | | | | | |
| 5/15/2013 | | | | | | | | | | | | | | | | | 0.56 |
| 5/16/2013 | | | | | | | | | | | | | | | | | |
| 5/17/2013 | | | | | | | | | | | | | | | | | |
| 5/18/2013 | | | | | | | | | | | | | | | | | |
| 5/19/2013 | | | | | | | | | | | | | | | | | |
| 5/20/2013 | | | | | | | | | | | | | | | | | |
| 5/21/2013 | | | | | | | | | | | | | | | | | 0.42 |
| 5/22/2013 | | | | | | | | | | | | | | | | | |
| 5/23/2013 | | | | | | | | | | | | | | | | | |
| 5/24/2013 | | | | | | | | | | | | | | | | | 0.15 |
| 5/25/2013 | | | | | | | | | | | | | | | | | 0.09 |
| 5/26/2013 | | | | | | | | | | | | | | | | | |
| 5/27/2013 | | | | | | | | | | | | | | | | | |
| 5/28/2013 | | | | | | | | | | | | | | | | | |
| 5/29/2013 | | | | | | | | | | | | | | | | | 0.04 |
| 5/30/2013 | | | | | | | | | | | | | | | | | |
| 5/31/2013 | | | | | | | | | | | | | | | | | |

## Report Summary For The Period 5/1/2013 - 5/31/2013

| | Rain (in) |
|---|---|
| Total | 1.65 |
| Avg | |

# Kennedale, TX

**Daily Tabular Report For The Period 6/1/2013 - 6/9/2013**

**KT_RG, Pipe Height: 36 in**

## Daily Tabular Report

| Date | Depth (in) | | | | | Velocity (ft/s) | | | | | Quantity (MGD - Total MG) | | | | | | Rain (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Time | Min | Time | Max | Avg | Total | Total |
| 6/1/2013 | | | | | | | | | | | | | | | | | 0.03 |
| 6/2/2013 | | | | | | | | | | | | | | | | | |
| 6/3/2013 | | | | | | | | | | | | | | | | | |
| 6/4/2013 | | | | | | | | | | | | | | | | | |
| 6/5/2013 | | | | | | | | | | | | | | | | | |
| 6/6/2013 | | | | | | | | | | | | | | | | | 0.42 |
| 6/7/2013 | | | | | | | | | | | | | | | | | |
| 6/8/2013 | | | | | | | | | | | | | | | | | |
| 6/9/2013 | | | | | | | | | | | | | | | | | 0.74 |

## Report Summary For The Period 6/1/2013 - 6/9/2013

| | Rain (in) |
|---|---|
| Total | 1.19 |
| Avg | |

# APPENDIX D
# WATER SYSTEM CIP OPTION 1
# PROJECT COST ESTIMATES

# City of Kennedale Option 1

## 2013 - 2023 CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 1

**Project Description**

Arlington Water Supply

**Detailed Description**

**Connect to the Arlington water system.**

**Purpose**

This project connects to the Arlington water system to provide additional water supply. The project includes meter and vault for the connection.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 20" Pipe | 1,300 | LF | $140 | $182,000 |
| 2 | Pavement Repair | 1,300 | LF | $50 | $65,000 |
| 3 | 32" Boring and Casing | 200 | LF | $560 | $112,000 |
| 4 | Meter and Vault | 1 | LS | $300,000 | $300,000 |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $659,000 |
| | | CONTINGENCY | | 20% | $131,800 |
| | | SUBTOTAL: | | | $790,800 |
| | | ENG/SURVEY | | 15% | $118,620 |
| | | SUBTOTAL: | | | $909,420 |

**PROJECT TOTAL** **$909,420**

## Construction Project Number 2

**Project Description**

12-inch water line south of Interstate 20

**Detailed Description**

**12-inch water line south of Interstate 20 between Gilman Road and Bolen Road.**

**Purpose**

This line connects existing water lines to provide system looping and provide service along Interstate 20 and increases reliability.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 2,000 | LF | $84 | $167,987 |
| 2 | Pavement Repair | 200 | LF | $50 | $10,000 |
| 3 | 20" Boring and Casing | 400 | LF | $350 | $140,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $317,988 |
| | | CONTINGENCY | | 20% | $63,600 |
| | | SUBTOTAL: | | | $381,590 |
| | | ENG/SURVEY | | 15% | $57,240 |
| | | SUBTOTAL: | | | $438,830 |

**PROJECT TOTAL** **$438,830**

# City of Kennedale Option 1

## 2013 - 2023 CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 3

**Project Description**

Standpipe Improvements

**Detailed Description**

**This project will pump water to the top of the standpipe or modify the standpipe to function as ground storage.**

**Purpose**

This project will improve water quality at the standpipe by reducing the water age inside the standpipe.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | Standpipe Improvements | 1 | LS | $350,000 | $350,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | |
|---|---|---|
| SUBTOTAL: | | $350,000 |
| CONTINGENCY | 20% | $70,000 |
| SUBTOTAL: | | $420,000 |
| ENG/SURVEY | 15% | $63,000 |
| SUBTOTAL: | | $483,000 |

**PROJECT TOTAL** **$483,000**

## Construction Project Number 4

**Project Description**

0.75 MG Ground Storage Tank

**Detailed Description**

**This project replaces the existing ground storage tank at the T-3 Well site with a 0.75 MG Ground Storage Tank.**

**Purpose**

This project replaces an aging asset and provides additional ground storage capacity.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 0.75 MG Ground Storage Tank | 1 | EA | $450,000 | $450,000 |
| 2 | Pump Station Yard Piping and Valving | 1 | LS | $200,000 | $200,000 |
| 3 | Quick Connects | 1 | LS | $3,500 | $3,500 |
| 4 | Chemical Booster | 1 | LS | $320,000 | $320,000 |
| | | | | | |
| | | | | | |

| | | |
|---|---|---|
| SUBTOTAL: | | $973,500 |
| CONTINGENCY | 20% | $194,700 |
| SUBTOTAL: | | $1,168,200 |
| ENG/SURVEY | 15% | $175,230 |
| SUBTOTAL: | | $1,343,430 |

**PROJECT TOTAL** **$1,343,430**

# City of Kennedale Option 1

## 2013 - 2023 CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 5

**Project Description**

16-inch water line along Eden Road

**Detailed Description**

**16-inch water line along Eden Road between Mansfield Cardinal Road and US 287 Business.**

**Purpose**

This project connects existing 16-inch water lines to provide system looping and transmission capacity from the Arlington delivery point.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 16" Pipe | 1,750 | LF | $112 | $196,000 |
| 2 | Pavement Repair | 1,300 | LF | $50 | $65,000 |
| 3 | 28" Boring and Casing | 200 | LF | $490 | $98,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $359,000 |
| | | CONTINGENCY | | 20% | $71,800 |
| | | SUBTOTAL: | | | $430,800 |
| | | ENG/SURVEY | | 15% | $64,620 |
| | | SUBTOTAL: | | | $495,420 |

**PROJECT TOTAL** **$495,420**

## Construction Project Number 6

**Project Description**

12-inch water lines from Pump Station 3 and along Dick Price Road

**Detailed Description**

**12-inch water lines between Pump Station 3 and Dick Price Road. 12-inch water line along Dick Price Road south of Linda Road.**

**Purpose**

This project provides additional transmission capacity from Pump Station 3. This project also provides capacity for future growth along Dick Price Road.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 2,760 | LF | $84 | $231,840 |
| 2 | Pavement Repair | 1,300 | LF | $50 | $65,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $296,840 |
| | | CONTINGENCY | | 20% | $59,370 |
| | | SUBTOTAL: | | | $356,210 |
| | | ENG/SURVEY | | 15% | $53,440 |
| | | SUBTOTAL: | | | $409,650 |

**PROJECT TOTAL** **$409,650**

# City of Kennedale Option 1

## 2013 - 2023 CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 7

**Project Description**

12-inch water line along Dick Price Road

**Detailed Description**

**12-inch water line along Dick Price Road north of Shady Lane.**

**Purpose**

This project connects existing 12-inch water lines to provide additional transmission capacity along Dick Price Road.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 1,730 | LF | $84 | $145,286 |
| 2 | Pavement Repair | 1,730 | LF | $50 | $86,500 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $231,787 |
| | | CONTINGENCY | | 20% | $46,360 |
| | | SUBTOTAL: | | | $278,150 |
| | | ENG/SURVEY | | 15% | $41,730 |
| | | SUBTOTAL: | | | $319,880 |

**PROJECT TOTAL** **$319,880**

## Construction Project Number 8

**Project Description**

12-inch water line between Dick Price Road and New Hope Road

**Detailed Description**

**12-inch water line between Dick Price Road and New Hope Road.**

**Purpose**

This project connects existing and proposed 12-inch lines supplied by the Fort Worth Pump Station.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 5,430 | LF | $84 | $456,120 |
| 2 | Pavement Repair | 600 | LF | $50 | $30,000 |
| 3 | 20" Boring and Casing | 200 | LF | $350 | $70,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $556,120 |
| | | CONTINGENCY | | 20% | $111,230 |
| | | SUBTOTAL: | | | $667,350 |
| | | ENG/SURVEY | | 15% | $100,110 |
| | | SUBTOTAL: | | | $767,460 |

**PROJECT TOTAL** **$767,460**

# City of Kennedale Option 1

## 2013 - 2023 CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 9

**Project Description**

12-inch water line along US 287 Business and along Hudson Road

**Detailed Description**

**12-inch water line US 287 Business in the ETJ and 12-inch water line and along Hudson Road between US 287 Business and Danny Drive.**

**Purpose**

This project connects existing water lines to provide system looping and improve system pressures along Hudson Road. This project also serves future customers along US 287 Business.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 8,400 | LF | $84 | $705,600 |
| 2 | Pavement Repair | 1,700 | LF | $50 | $85,000 |
| 3 | 20" Boring and Casing | 300 | LF | $350 | $105,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $895,600 |
| | | CONTINGENCY | | 20% | $179,120 |
| | | SUBTOTAL: | | | $1,074,720 |
| | | ENG/SURVEY | | 15% | $161,210 |
| | | SUBTOTAL: | | | $1,235,930 |

**$1,235,930**

## Construction Project Number 10

**Project Description**

1.5 MG Ground Storage Tank and 6.5 MGD Pump Station

**Detailed Description**

**1.5 MG Ground Storage Tank and 6.5 MGD Pump Station at the Arlington Supply Point.**

**Purpose**

This project will increase the amount of supply Kennedale can take from Arlington.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 1.5 MG Ground Storage Tank | 1 | LS | $510,000 | $510,000 |
| 2 | 6.5 MGD Pump Station | 1 | LS | $2,000,000 | $2,000,000 |
| 3 | Quick Connects | 1 | LS | $3,500 | $3,500 |
| 4 | Chemical Booster | 1 | LS | $320,000 | $320,000 |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $2,833,500 |
| | | CONTINGENCY | | 20% | $566,700 |
| | | SUBTOTAL: | | | $3,400,200 |
| | | ENG/SURVEY | | 15% | $510,030 |
| | | SUBTOTAL: | | | $3,910,230 |

**PROJECT TOTAL** **$3,910,230**

# City of Kennedale Option 1

## 2013 - 2023 CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 11

**Project Description**

12-inch water line along Dick Price Road and Green Circle

**Detailed Description**

**12-inch water line along Dick Price Road north of Green Circle. 12-inch water line along Green Circle between Dick Price Road and New Hope Road.**

**Purpose**

This project provides system looping and allow for growth along Dick Price Road.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 8,280 | LF | $84 | $695,520 |
| 2 | Pavement Repair | 600 | LF | $50 | $30,000 |
| 3 | 20" Boring and Casing | 100 | LF | $350 | $35,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $760,520 |
| | | CONTINGENCY | | 20% | $152,110 |
| | | SUBTOTAL: | | | $912,630 |
| | | ENG/SURVEY | | 15% | $136,900 |
| | | SUBTOTAL: | | | $1,049,530 |

**PROJECT TOTAL** **$1,049,530**

## Construction Project Number 12

**Project Description**

12-inch water line between Swiney Hiett Road and Trinity Well #4

**Detailed Description**

**12-inch water line between Swiney Hiett Road and Trinity Well #4 along Collett Sublett Road and Peggy Lane.**

**Purpose**

This project upsizes the existing 6” and 8” lines, increasing transmission capacity from the Arlington supply point and to the future elevated tank.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 7,790 | LF | $84 | $654,360 |
| 2 | Pavement Repair | 5,000 | LF | $50 | $250,000 |
| 3 | 20" Boring and Casing | 150 | LF | $350 | $52,500 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $956,860 |
| | | CONTINGENCY | | 20% | $191,380 |
| | | SUBTOTAL: | | | $1,148,240 |
| | | ENG/SURVEY | | 15% | $172,240 |
| | | SUBTOTAL: | | | $1,320,480 |

**PROJECT TOTAL** **$1,320,480**

# City of Kennedale Option 1

## 2013 - 2023 CIP with service from Arlington

FREESE AND NICHOLS

## OPINION OF PROBABLE COST

## Construction Project Number 13

**Project Description**

12-inch water line along New Hope Road

**Detailed Description**

**12-inch water line along New Hope Road.**

**Purpose**

This project provides additional transmission capacity from Pump Station 3 and connects existing large diameter lines.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 2,110 | LF | $84 | $177,240 |
| 2 | Pavement Repair | 2,110 | LF | $50 | $105,500 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | |
|---|---|---|
| SUBTOTAL: | | $282,740 |
| CONTINGENCY | 20% | $56,550 |
| SUBTOTAL: | | $339,290 |
| ENG/SURVEY | 15% | $50,900 |
| SUBTOTAL: | | $390,190 |

**PROJECT TOTAL** **$390,190**

## Construction Project Number 14

**Project Description**

Arlington Emergency Connection

**Detailed Description**

**Arlington Emergency Connection**

**Purpose**

This project provides an emergency connection the Arlington water system in case of a line break. This project includes meter and vault costs.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | Emergency Connection | 1 | LS | $125,000 | $125,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | |
|---|---|---|
| SUBTOTAL: | | $125,000 |
| CONTINGENCY | 20% | $25,000 |
| SUBTOTAL: | | $150,000 |
| ENG/SURVEY | 15% | $22,500 |
| SUBTOTAL: | | $172,500 |

**PROJECT TOTAL** **$172,500**

**TOTAL** **$13,245,950**

# City of Kennedale Option 1

## 2024 - Buildout CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 15

**Project Description**

16-inch water line Swiney Hiett Road

**Detailed Description**

**16-inch water line along Swiney Hiett Road between from the proposed Arlington supply point.**

**Purpose**

This project will supply the existing and proposed 12" lines along Swiney Hiett and Collett Sublett Roads.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 16" Pipe | 2,320 | LF | $112 | $259,790 |
| 2 | Pavement Repair | 400 | LF | $50 | $20,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $279,790 |
| | | CONTINGENCY | | 20% | $55,960 |
| | | SUBTOTAL: | | | $335,750 |
| | | ENG/SURVEY | | 15% | $50,370 |
| | | SUBTOTAL: | | | $386,120 |
| **PROJECT TOTAL** | | | | | **$386,120** |

## Construction Project Number 16

**Project Description**

0.5 MG Elevated Storage Tank

**Detailed Description**

**0.5 MG Elevated Storage Tank**

**Purpose**

This project provides additional elevated storage capacity to allow for operational flexibility. This project also provides capacity for buildout needs and meet TCEQ requirements.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 0.5 MG Elevated Storage Tank | 1 | EA | $1,400,000 | $1,400,000 |
| 2 | 12" Pipe | 230 | LF | $84 | $19,320 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $1,419,320 |
| | | CONTINGENCY | | 20% | $283,870 |
| | | SUBTOTAL: | | | $1,703,190 |
| | | ENG/SURVEY | | 15% | $255,480 |
| | | SUBTOTAL: | | | $1,958,670 |
| **PROJECT TOTAL** | | | | | **$1,958,670** |

# City of Kennedale Option 1

## 2024 - Buildout CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 17

**Project Description**

Decommission Standpipe

**Detailed Description**

**Decommission Standpipe**

**Purpose**

This project decommissions the existing standpipe.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | Decommission Standpipe | 1 | LS | $150,000 | $150,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | SUBTOTAL: | | | | $150,000 |
| | CONTINGENCY | | | 20% | $30,000 |
| | SUBTOTAL: | | | | $180,000 |
| | ENG/SURVEY | | | 15% | $27,000 |
| | SUBTOTAL: | | | | $207,000 |
| **PROJECT TOTAL** | | | | | **$207,000** |

## Construction Project Number 18

**Project Description**

8-inch water lines between New Hope Road and US 287 Business

**Detailed Description**

**8-inch water line between New Hope Road and US 287 Business and 8-inch water line north of Danny Lane.**

**Purpose**

This project provides system looping and ties in a dead-end line to improve pressures and fire flow. This project also provides service to future development.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 8" Pipe | 6,310 | LF | $56 | $353,360 |
| 2 | Pavement Repair | 100 | LF | $50 | $5,000 |
| 3 | 16" Boring and Casing | 200 | LF | $280 | $56,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | SUBTOTAL: | | | | $414,360 |
| | CONTINGENCY | | | 20% | $82,880 |
| | SUBTOTAL: | | | | $497,240 |
| | ENG/SURVEY | | | 15% | $74,590 |
| | SUBTOTAL: | | | | $571,830 |
| **PROJECT TOTAL** | | | | | **$571,830** |

# City of Kennedale Option 1

## 2024 - Buildout CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 19

**Project Description**

12-inch water line near standpipe

**Detailed Description**

**12-inch water line between Swiney Hiett Road and Tower Street replaces the existing 8/10-inch line.**

**Purpose**

This line connects existing large diameter lines to provide additional transmission capacity.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 1,250 | LF | $84 | $105,004 |
| 2 | Pavement Repair | 200 | LF | $50 | $10,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $115,005 |
| | | CONTINGENCY | | 20% | $23,010 |
| | | SUBTOTAL: | | | $138,020 |
| | | ENG/SURVEY | | 15% | $20,710 |
| | | SUBTOTAL: | | | $158,730 |

**PROJECT TOTAL** **$158,730**

## Construction Project Number 20

**Project Description**

12-inch water line south of Interstate 20 and along US 287 Business

**Detailed Description**

**12-inch water line south of Interstate 20 and along US 287 Business.**

**Purpose**

This project upsizes the existing 8-inch line to improve fire flow and supply to the area.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 2,320 | LF | $84 | $194,880 |
| 2 | Pavement Repair | 100 | LF | $50 | $5,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $199,880 |
| | | CONTINGENCY | | 20% | $39,980 |
| | | SUBTOTAL: | | | $239,860 |
| | | ENG/SURVEY | | 15% | $35,980 |
| | | SUBTOTAL: | | | $275,840 |

**PROJECT TOTAL** **$275,840**

# City of Kennedale Option 1

## 2024 - Buildout CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 21

**Project Description**

12-inch water lines along Dick Price Road, Garcia Lane and New Hope Road

**Detailed Description**

**12-inch water line along Dick Price Road between Green Circle and Garcia Lane, along Garcia Lane between Dick Price Road and New Hope Road, and along New Hope Road between Myra Lane and Hudson Village Creek.**

**Purpose**

This line allows for future growth along Dick Price Road in the ETJ.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 13,280 | LF | $84 | $1,115,520 |
| 2 | Pavement Repair | 5,000 | LF | $50 | $250,000 |
| 3 | 20" Boring and Casing | 100 | LF | $350 | $35,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $1,400,520 |
| | | CONTINGENCY | | 20% | $280,110 |
| | | SUBTOTAL: | | | $1,680,630 |
| | | ENG/SURVEY | | 15% | $252,100 |
| | | SUBTOTAL: | | | $1,932,730 |

**PROJECT TOTAL** **$1,932,730**

## Construction Project Number 22

**Project Description**

10-inch water line west of Dick Price Road

**Detailed Description**

**10-inch water line west of Dick Price Road and along Wilson Road in the ETJ.**

**Purpose**

This line allows for future growth in the ETJ.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 10" Pipe | 5,180 | LF | $70 | $362,600 |
| 2 | Pavement Repair | 5,180 | LF | $50 | $259,000 |
| 3 | 18" Boring and Casing | 200 | LF | $315 | $63,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $684,600 |
| | | CONTINGENCY | | 20% | $136,920 |
| | | SUBTOTAL: | | | $821,520 |
| | | ENG/SURVEY | | 15% | $123,230 |
| | | SUBTOTAL: | | | $944,750 |

**PROJECT TOTAL** **$944,750**

# City of Kennedale Option 1

## 2024 - Buildout CIP with service from Arlington

## OPINION OF PROBABLE COST

## Construction Project Number 23

**Project Description**

10-inch water line along Wilson Road and Shelby Road in the ETJ

**Detailed Description**

**10-inch water line along Wilson Road and Shelby Road in the ETJ.**

**Purpose**

This line allows for future growth in the ETJ.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 10" Pipe | 12,950 | LF | $70 | $906,500 |
| 2 | Pavement Repair | 5,000 | LF | $50 | $250,000 |
| 3 | 18" Boring and Casing | 400 | LF | $315 | $126,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $1,282,500 |
| | | CONTINGENCY | | 20% | $256,500 |
| | | SUBTOTAL: | | | $1,539,000 |
| | | ENG/SURVEY | | 15% | $230,850 |
| | | SUBTOTAL: | | | $1,769,850 |

**PROJECT TOTAL** **$1,769,850**

## Construction Project Number 24

**Project Description**

Decommission Wells

**Detailed Description**

**Decommission existing wells.**

**Purpose**

This project decommissions the existing wells after their production capacity decreases significantly or operation and maintenance costs increase. The City will transition to surface water supply.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | Decommission Well | 5 | LS | $30,000 | $150,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $150,000 |
| | | CONTINGENCY | | 20% | $30,000 |
| | | SUBTOTAL: | | | $180,000 |
| | | ENG/SURVEY | | 15% | $27,000 |
| | | SUBTOTAL: | | | $207,000 |

**PROJECT TOTAL** **$207,000**

**TOTAL** **$8,412,520**

# APPENDIX E
# WATER SYSTEMCIP OPTION 2
# PROJECT COST ESTIMATES

# City of Kennedale Option 2

## 2013 - 2023 CIP with service from Fort Worth

## OPINION OF PROBABLE COST

## Construction Project Number 1

**Project Description**

12-inch water line south of Interstate 20

**Detailed Description**

**12-inch water line south of Interstate 20 between Gilman Road and Bolen Road.**

**Purpose**

This line connects existing water lines to provide system looping and provide service along Interstate 20 and increases reliability.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 2,000 | LF | $84 | $167,987 |
| 2 | Pavement Repair | 200 | LF | $50 | $10,000 |
| 3 | 20" Boring and Casing | 400 | LF | $350 | $140,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $317,990 |
| | | CONTINGENCY | | 20% | $63,600 |
| | | SUBTOTAL: | | | $381,590 |
| | | ENG/SURVEY | | 15% | $57,240 |
| | | SUBTOTAL: | | | $438,830 |

**PROJECT TOTAL** **$438,830**

## Construction Project Number 2

**Project Description**

Standpipe Improvements

**Detailed Description**

**This project will pump water to the top of the standpipe or modify the standpipe to function as ground storage.**

**Purpose**

This project will improve water quality at the standpipe by reducing the water age inside the standpipe.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | Standpipe Improvements | 1 | LS | $350,000 | $350,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $350,000 |
| | | CONTINGENCY | | 20% | $70,000 |
| | | SUBTOTAL: | | | $420,000 |
| | | ENG/SURVEY | | 15% | $63,000 |
| | | SUBTOTAL: | | | $483,000 |

**PROJECT TOTAL** **$483,000**

# City of Kennedale Option 2

## 2013 - 2023 CIP with service from Fort Worth

## OPINION OF PROBABLE COST

## Construction Project Number 3

**Project Description**

16-inch water line along Eden Road

**Detailed Description**

**16-inch water line along Eden Road between Mansfield Cardinal Road and US 287 Business.**

**Purpose**

This project connects existing 16-inch water lines to provide system looping and transmission capacity.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 16" Pipe | 1,750 | LF | $112 | $196,000 |
| 2 | Pavement Repair | 1,300 | LF | $50 | $65,000 |
| 3 | 28" Boring and Casing | 200 | LF | $490 | $98,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $359,000 |
| | | CONTINGENCY | | 20% | $71,800 |
| | | SUBTOTAL: | | | $430,800 |
| | | ENG/SURVEY | | 15% | $64,620 |
| | | SUBTOTAL: | | | $495,420 |

**PROJECT TOTAL** **$495,420**

## Construction Project Number 4

**Project Description**

16/20-inch water lines from Pump Station 3 and along Dick Price Road

**Detailed Description**

**20-inch water lines between Pump Station 3 and Dick Price Road. 16-inch water line along Dick Price Road north of Linda Road. 16-inch water line along Dick Price Road south of Linda Road.**

**Purpose**

This project provides additional transmission capacity from Pump Station 3. This project also provides capacity for future growth along Dick Price Road.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 20" Pipe | 3,020 | LF | $140 | $422,800 |
| 2 | 16" Pipe | 3,830 | LF | $112 | $428,960 |
| 3 | Pavement Repair | 1,800 | LF | $50 | $90,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $941,760 |
| | | CONTINGENCY | | 20% | $188,360 |
| | | SUBTOTAL: | | | $1,130,120 |
| | | ENG/SURVEY | | 15% | $169,520 |
| | | SUBTOTAL: | | | $1,299,640 |

**PROJECT TOTAL** **$1,299,640**

# City of Kennedale Option 2

## 2013 - 2023 CIP with service from Fort Worth

FREESE NICHOLS

## OPINION OF PROBABLE COST

## Construction Project Number 5

**Project Description**

3.0 MG ground storage tank and new pump at Fort Worth supply point

**Detailed Description**

**3.0 MG ground storage tank and new 2,800 gpm pump at the Fort Worth supply point.**

**Purpose**

This project provides additional pumping and storage capacity at Pump Station 3 for future growth. This project also increases the supply into the City from Fort Worth to meet buildout needs.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 3.0 MG Ground Storage Tank | 1 | EA | $900,000 | $900,000 |
| 2 | 2,800 gpm Pump | 1 | EA | $600,000 | $600,000 |
| 3 | Pump Station Yard Piping and Valving | 1 | LS | $200,000 | $200,000 |
| 4 | Quick Connects | 1 | LS | $3,500 | $3,500 |
| 5 | Chemical Booster | 1 | LS | $320,000 | $320,000 |
| | | | | | |
| | | SUBTOTAL: | | | $2,023,500 |
| | | CONTINGENCY | | 20% | $404,700 |
| | | SUBTOTAL: | | | $2,428,200 |
| | | ENG/SURVEY | | 15% | $364,230 |
| | | SUBTOTAL: | | | $2,792,430 |

**PROJECT TOTAL** **$2,792,430**

## Construction Project Number 6

**Project Description**

Arlington Emergency Connection

**Detailed Description**

**Arlington Emergency Connection**

**Purpose**

This project provides an emergency connection the Arlington water system in case of a line break in the system. This project includes meter and vault costs.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | Emergency Connection | 1 | LS | $125,000 | $125,000 |
| 2 | 12" Pipe | 1,300 | LF | $84 | $109,200 |
| 3 | 32" Boring and Casing | 200 | LF | $560 | $112,000 |
| 4 | Pavement Repair | 1,300 | LF | $50 | $65,000 |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $411,200 |
| | | CONTINGENCY | | 20% | $82,240 |
| | | SUBTOTAL: | | | $493,440 |
| | | ENG/SURVEY | | 15% | $74,020 |
| | | SUBTOTAL: | | | $567,460 |

**PROJECT TOTAL** **$567,460**

# City of Kennedale Option 2

## 2013 - 2023 CIP with service from Fort Worth

FREESE NICHOLS

## OPINION OF PROBABLE COST

## Construction Project Number 7

**Project Description**

12-inch water line between Dick Price Road and New Hope Road

**Detailed Description**

**12-inch water line between Dick Price Road and New Hope Road.**

**Purpose**

This project connects existing and proposed 12-inch lines supplied by the Fort Worth Pump Station.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 5,430 | LF | $84 | $456,120 |
| 2 | Pavement Repair | 600 | LF | $50 | $30,000 |
| 3 | 20" Boring and Casing | 200 | LF | $350 | $70,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $556,120 |
| | | CONTINGENCY | | 20% | $111,230 |
| | | SUBTOTAL: | | | $667,350 |
| | | ENG/SURVEY | | 15% | $100,110 |
| | | SUBTOTAL: | | | $767,460 |

**PROJECT TOTAL** **$767,460**

## Construction Project Number 8

**Project Description**

12-inch water line along Dick Price Road

**Detailed Description**

**12-inch water line along Dick Price Road north of Shady Lane.**

**Purpose**

This project connects existing 12-inch water lines to provide additional transmission capacity along Dick Price Road.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 1,730 | LF | $84 | $145,286 |
| 2 | Pavement Repair | 1,730 | LF | $50 | $86,500 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $231,787 |
| | | CONTINGENCY | | 20% | $46,360 |
| | | SUBTOTAL: | | | $278,150 |
| | | ENG/SURVEY | | 15% | $41,730 |
| | | SUBTOTAL: | | | $319,880 |

**PROJECT TOTAL** **$319,880**

# City of Kennedale Option 2

## 2013 - 2023 CIP with service from Fort Worth

## OPINION OF PROBABLE COST

## Construction Project Number 9

**Project Description**

16-inch water line along US 287 Business and along Hudson Road

**Detailed Description**

**16-inch water line US 287 Business in the ETJ and 16-inch water line along Hudson Road between US 287 Business and New Hope Road.**

**Purpose**

This project connects existing water lines to provide system looping and improve system pressures along Hudson Road. This project also serves future customers along US 287 Business.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 16" Pipe | 13,030 | LF | $112 | $1,459,360 |
| 2 | Pavement Repair | 1,700 | LF | $50 | $85,000 |
| 3 | 32" Boring and Casing | 300 | LF | $560 | $168,000 |
| | | | | | |
| | | | | | |
| | | | | | |

| | | |
|---|---|---|
| SUBTOTAL: | | $1,712,360 |
| CONTINGENCY | 20% | $342,480 |
| SUBTOTAL: | | $2,054,840 |
| ENG/SURVEY | 15% | $308,230 |
| SUBTOTAL: | | $2,363,070 |

**$2,363,070**

## Construction Project Number 10

**Project Description**

12-inch water line along New Hope Road

**Detailed Description**

**12-inch water line along New Hope Road.**

**Purpose**

This project provides additional transmission capacity from Pump Station 3 and connects existing large diameter lines.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 2,110 | LF | $84 | $177,240 |
| 2 | Pavement Repair | 2,110 | LF | $50 | $105,500 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | |
|---|---|---|
| SUBTOTAL: | | $282,740 |
| CONTINGENCY | 20% | $56,550 |
| SUBTOTAL: | | $339,290 |
| ENG/SURVEY | 15% | $50,900 |
| SUBTOTAL: | | $390,190 |

**PROJECT TOTAL** **$390,190**

# City of Kennedale Option 2

## 2013 - 2023 CIP with service from Fort Worth

## OPINION OF PROBABLE COST

## Construction Project Number 11

**Project Description**

16-inch water line along Dick Price Road and Green Circle

**Detailed Description**

**16-inch water line along Dick Price Road north of Green Circle. 16-inch water line along Green Circle between Dick Price Road and New Hope Road.**

**Purpose**

This project provides system looping and allow for growth along Dick Price Road.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 16" Pipe | 8,280 | LF | $112 | $927,360 |
| 2 | Pavement Repair | 600 | LF | $50 | $30,000 |
| 3 | 28" Boring and Casing | 100 | LF | $490 | $49,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $1,006,360 |
| | | CONTINGENCY | | 20% | $201,280 |
| | | SUBTOTAL: | | | $1,207,640 |
| | | ENG/SURVEY | | 15% | $181,150 |
| | | SUBTOTAL: | | | $1,388,790 |

**PROJECT TOTAL** **$1,388,790**

## Construction Project Number 12

**Project Description**

12-inch water line between Swiney Hiett Road and Trinity Well #4

**Detailed Description**

**12-inch water line between Swiney Hiett Road and Trinity Well #4 along Collett Sublett Road and Peggy Lane.**

**Purpose**

This project upsizes the existing 6” and 8” lines, increasing transmission capacity from the Arlington supply point and to the future elevated tank.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 7,790 | LF | $84 | $654,360 |
| 2 | Pavement Repair | 5,000 | LF | $50 | $250,000 |
| 3 | 20" Boring and Casing | 150 | LF | $350 | $52,500 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $956,860 |
| | | CONTINGENCY | | 20% | $191,380 |
| | | SUBTOTAL: | | | $1,148,240 |
| | | ENG/SURVEY | | 15% | $172,240 |
| | | SUBTOTAL: | | | $1,320,480 |

**PROJECT TOTAL** **$1,320,480**

**TOTAL** **$12,626,650**

# City of Kennedale Option 2

## 2024 - Buildout CIP with service from Fort Worth

## OPINION OF PROBABLE COST

## Construction Project Number 13

**Project Description**

16-inch water line along Dick Price Road

**Detailed Description**

**16-inch water line replaces existing 12-inch line along Dick Price Road south of Shady Lane.**

**Purpose**

This project provides additional transmission capacity from Pump Station 3 along Dick Price Road.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 16" Pipe | 4,025 | LF | $112 | $450,800 |
| 2 | Pavement Repair | 600 | LF | $50 | $30,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $480,800 |
| | | CONTINGENCY | | 20% | $96,160 |
| | | SUBTOTAL: | | | $576,960 |
| | | ENG/SURVEY | | 15% | $86,550 |
| | | SUBTOTAL: | | | $663,510 |
| **PROJECT TOTAL** | | | | | **$663,510** |

## Construction Project Number 14

**Project Description**

0.5 MG Elevated Storage Tank

**Detailed Description**

**0.5 MG Elevated Storage Tank**

**Purpose**

This project provides additional elevated storage capacity to allow for operational flexibility. This project also provides capacity for buildout needs and meet TCEQ requirements.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 0.5 MG Elevated Storage Tank | 1 | EA | $1,400,000 | $1,400,000 |
| 2 | 12" Pipe | 230 | LF | $84 | $19,320 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $1,419,320 |
| | | CONTINGENCY | | 20% | $283,870 |
| | | SUBTOTAL: | | | $1,703,190 |
| | | ENG/SURVEY | | 15% | $255,480 |
| | | SUBTOTAL: | | | $1,958,670 |
| **PROJECT TOTAL** | | | | | **$1,958,670** |

# City of Kennedale Option 2

## 2024 - Buildout CIP with service from Fort Worth

FREESE AND NICHOLS

## OPINION OF PROBABLE COST

## Construction Project Number 15

**Project Description**

Decommission Standpipe

**Detailed Description**

**Decommission Standpipe**

**Purpose**

This project decommissions the existing standpipe.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | Decommission Standpipe | 1 | LS | $150,000 | $150,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $150,000 |
| | | CONTINGENCY | | 20% | $30,000 |
| | | SUBTOTAL: | | | $180,000 |
| | | ENG/SURVEY | | 15% | $27,000 |
| | | SUBTOTAL: | | | $207,000 |
| **PROJECT TOTAL** | | | | | **$207,000** |

## Construction Project Number 16

**Project Description**

8-inch water lines between New Hope Road and US 287 Business

**Detailed Description**

**8-inch water line between New Hope Road and US 287 Business and 8-inch water line north of Danny Lane.**

**Purpose**

This project provides system looping and ties in a dead-end line to improve pressures and fire flow. This project also provides service to future development.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 8" Pipe | 6,310 | LF | $56 | $353,360 |
| 2 | Pavement Repair | 100 | LF | $50 | $5,000 |
| 3 | 16" Boring and Casing | 200 | LF | $280 | $56,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $414,360 |
| | | CONTINGENCY | | 20% | $82,880 |
| | | SUBTOTAL: | | | $497,240 |
| | | ENG/SURVEY | | 15% | $74,590 |
| | | SUBTOTAL: | | | $571,830 |
| **PROJECT TOTAL** | | | | | **$571,830** |

# City of Kennedale Option 2

## 2024 - Buildout CIP with service from Fort Worth

FREESE AND NICHOLS

## OPINION OF PROBABLE COST

## Construction Project Number 17

**Project Description**

12-inch water line near standpipe

**Detailed Description**

**12-inch water line between Swiney Hiett Road and Tower Street replaces the existing 8/10-inch line.**

**Purpose**

This line connects existing large diameter lines to provide additional transmission capacity.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 1,250 | LF | $84 | $105,000 |
| 2 | Pavement Repair | 200 | LF | $50 | $10,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $115,000 |
| | | CONTINGENCY | | 20% | $23,000 |
| | | SUBTOTAL: | | | $138,000 |
| | | ENG/SURVEY | | 15% | $20,700 |
| | | SUBTOTAL: | | | $158,700 |

**PROJECT TOTAL** **$158,700**

## Construction Project Number 18

**Project Description**

12-inch water line south of Interstate 20 and along US 287 Business

**Detailed Description**

**12-inch water line south of Interstate 20 and along US 287 Business.**

**Purpose**

This project upsizes the existing 8-inch line to improve fire flow and supply to the area.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 2,320 | LF | $84 | $194,880 |
| 2 | Pavement Repair | 100 | LF | $50 | $5,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $199,880 |
| | | CONTINGENCY | | 20% | $39,980 |
| | | SUBTOTAL: | | | $239,860 |
| | | ENG/SURVEY | | 15% | $35,980 |
| | | SUBTOTAL: | | | $275,840 |

**PROJECT TOTAL** **$275,840**

# City of Kennedale Option 2

## 2024 - Buildout CIP with service from Fort Worth

## OPINION OF PROBABLE COST

## Construction Project Number 19

**Project Description**

12-inch water lines along Dick Price Road, Garcia Lane and New Hope Road

**Detailed Description**

**12-inch water line along Dick Price Road between Green Circle and Garcia Lane, along Garcia Lane between Dick Price Road and New Hope Road, and along New Hope Road between Myra Lane and Hudson Village Creek.**

**Purpose**

This line allows for future growth along Dick Price Road in the ETJ.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" Pipe | 13,280 | LF | $84 | $1,115,520 |
| 2 | Pavement Repair | 5,000 | LF | $50 | $250,000 |
| 3 | 20" Boring and Casing | 100 | LF | $350 | $35,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $1,400,520 |
| | | CONTINGENCY | | 20% | $280,110 |
| | | SUBTOTAL: | | | $1,680,630 |
| | | ENG/SURVEY | | 15% | $252,100 |
| | | SUBTOTAL: | | | $1,932,730 |

**PROJECT TOTAL** **$1,932,730**

## Construction Project Number 20

**Project Description**

10-inch water line west of Dick Price Road

**Detailed Description**

**10-inch water line west of Dick Price Road and along Wilson Road in the ETJ.**

**Purpose**

This line allows for future growth in the ETJ.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 10" Pipe | 5,180 | LF | $70 | $362,600 |
| 2 | Pavement Repair | 5,180 | LF | $50 | $259,000 |
| 3 | 18" Boring and Casing | 200 | LF | $315 | $63,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $684,600 |
| | | CONTINGENCY | | 20% | $136,920 |
| | | SUBTOTAL: | | | $821,520 |
| | | ENG/SURVEY | | 15% | $123,230 |
| | | SUBTOTAL: | | | $944,750 |

**PROJECT TOTAL** **$944,750**

# City of Kennedale Option 2

## 2024 - Buildout CIP with service from Fort Worth

## OPINION OF PROBABLE COST

## Construction Project Number 21

**Project Description**

10-inch water line along Wilson Road and Shelby Road in the ETJ

**Detailed Description**

**10-inch water line along Wilson Road and Shelby Road in the ETJ.**

**Purpose**

This line allows for future growth in the ETJ.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 10" Pipe | 12,950 | LF | $70 | $906,500 |
| 2 | Pavement Repair | 5,000 | LF | $50 | $250,000 |
| 3 | 18" Boring and Casing | 400 | LF | $315 | $126,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $1,282,500 |
| | | CONTINGENCY | | 20% | $256,500 |
| | | SUBTOTAL: | | | $1,539,000 |
| | | ENG/SURVEY | | 15% | $230,850 |
| | | SUBTOTAL: | | | $1,769,850 |

**PROJECT TOTAL** **$1,769,850**

## Construction Project Number 22

**Project Description**

Decommission Wells

**Detailed Description**

**Decommission existing wells.**

**Purpose**

This project decommissions the existing wells after their production capacity decreases significantly or

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | Decommission Well | 5 | LS | $30,000 | $150,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $150,000 |
| | | CONTINGENCY | | 20% | $30,000 |
| | | SUBTOTAL: | | | $180,000 |
| | | ENG/SURVEY | | 15% | $27,000 |
| | | SUBTOTAL: | | | $207,000 |

**PROJECT TOTAL** **$207,000**

**TOTAL** **$8,689,880**

# APPENDIX F
# WASTEWATER CIP SYSTEM
# PROJECT COST ESTIMATES

# City of Kennedale

## 2013 - 2023 Wastewater CIP

## OPINION OF PROBABLE COST

## Construction Project Number 1

**Project Description**

15/18-inch interceptor along North Road and Dick Price Road

**Detailed Description**

**15-inch line along North Road between 3rd Street and Dick Price Road. 15/18-inch line along Dick Price Road between North Road and Basin C-1**

**Purpose**

This line will address an existing system capacity deficiency and provide capacity for growth by upsizing the existing 6/8/12" to a 15/18".

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 18" Pipe | 1,870 | LF | $126 | $235,620 |
| 2 | 15" Pipe | 5,380 | LF | $105 | $564,900 |
| 3 | 60" Diameter Manhole | 18 | EA | $6,000 | $108,750 |
| 4 | 24" Boring and Casing | 300 | LF | $420 | $126,000 |
| 5 | Pavement Repair | 200 | LF | $50 | $10,000 |
| | | | | | |
| | | SUBTOTAL: | | | $1,045,270 |
| | | CONTINGENCY | | 20% | $209,060 |
| | | SUBTOTAL: | | | $1,254,330 |
| | | ENG/SURVEY | | 15% | $188,150 |
| | | SUBTOTAL: | | | $1,442,480 |

**PROJECT TOTAL** **$1,442,480**

## Construction Project Number 2

**Project Description**

21-inch and interceptor in Basin C-1

**Detailed Description**

**21-inch line in Basin C-1**

**Purpose**

This line will address an existing system capacity deficiency and provide capacity for growth by upsizing the existing 18" to a 21".

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 21" Pipe | 3,420 | LF | $147 | $502,740 |
| 2 | 60" Diameter Manhole | 9 | EA | $6,000 | $51,300 |
| 3 | 34" Boring and Casing | 100 | LF | $595 | $59,500 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $613,540 |
| | | CONTINGENCY | | 20% | $122,710 |
| | | SUBTOTAL: | | | $736,250 |
| | | ENG/SURVEY | | 15% | $110,440 |
| | | SUBTOTAL: | | | $846,690 |

**PROJECT TOTAL** **$846,690**

# City of Kennedale

## 2013 - 2023 Wastewater CIP

## OPINION OF PROBABLE COST

## Construction Project Number 3

**Project Description**

15-inch interceptor in Basin C

**Detailed Description**

**15-inch line in Basin C to Basin C-1**

**Purpose**

This line will address an existing system capacity deficiency and provide capacity for growth by upsizing the existing 12" to a 15".

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 15" Pipe | 3,480 | LF | $105 | $365,400 |
| 2 | 60" Diameter Manhole | 9 | EA | $6,000 | $52,200 |
| 3 | 24" Boring and Casing | 200 | LF | $420 | $84,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $501,600 |
| | | CONTINGENCY | | 20% | $100,320 |
| | | SUBTOTAL: | | | $601,920 |
| | | ENG/SURVEY | | 15% | $90,290 |
| | | SUBTOTAL: | | | $692,210 |

**PROJECT TOTAL** **$692,210**

## Construction Project Number 4

**Project Description**

8-inch line along Dick Price Road

**Detailed Description**

**8-inch line along Dick Price Road between Goss and Averitt**

**Purpose**

This line will address an existing system capacity deficiency and replace an aging line by upsizing a 6" to an 8".

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 8" Pipe | 4,900 | LF | $56 | $274,400 |
| 2 | 48" Diameter Manhole | 12 | EA | $5,000 | $61,250 |
| 3 | Pavement Repair | 2,000 | LF | $50 | $100,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $435,650 |
| | | CONTINGENCY | | 20% | $87,130 |
| | | SUBTOTAL: | | | $522,780 |
| | | ENG/SURVEY | | 15% | $78,420 |
| | | SUBTOTAL: | | | $601,200 |

**PROJECT TOTAL** **$601,200**

# City of Kennedale

## 2013 - 2023 Wastewater CIP

FREESE AND NICHOLS

## OPINION OF PROBABLE COST

## Construction Project Number 5

**Project Description**

10/6-inch lines in Basin B-2

**Detailed Description**

**10/6-inch lines on the northwest side of Basin B-2**

**Purpose**

This line will allow for future growth in Basin B-2.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 10" Pipe | 6,330 | LF | $70 | $443,100 |
| 2 | 6" Pipe | 2,500 | LF | $42 | $105,000 |
| 3 | 48" Diameter Manhole | 22 | EA | $5,000 | $110,375 |
| 4 | 16" Boring and Casing | 200 | LF | $280 | $56,000 |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $714,475 |
| | | CONTINGENCY | | 20% | $142,900 |
| | | SUBTOTAL: | | | $857,380 |
| | | ENG/SURVEY | | 15% | $128,610 |
| | | SUBTOTAL: | | | $985,990 |

**PROJECT TOTAL** **$985,990**

## Construction Project Number 6

**Project Description**

10-inch line in Basin B-2

**Detailed Description**

**10-inch line on the northeast side of Basin B-2**

**Purpose**

This line will allow for future growth in Basin B-2.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 10" Pipe | 3,750 | LF | $70 | $262,500 |
| 2 | 48" Diameter Manhole | 9 | EA | $5,000 | $46,880 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $309,380 |
| | | CONTINGENCY | | 20% | $61,880 |
| | | SUBTOTAL: | | | $371,260 |
| | | ENG/SURVEY | | 15% | $55,690 |
| | | SUBTOTAL: | | | $426,950 |

**PROJECT TOTAL** **$426,950**

# City of Kennedale

## 2013 - 2023 Wastewater CIP

FREESE NICHOLS

## OPINION OF PROBABLE COST

## Construction Project Number 7

**Project Description**

8-inch line along Bloxom Park

**Detailed Description**

**8-inch line along Bloxom Park and east of Danny Drive.**

**Purpose**

This project will serve new development along Bloxom Park and along Hudson Road.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 8" Pipe | 3,460 | LF | $56 | $193,760 |
| 2 | 48" Diameter Manhole | 9 | EA | $5,000 | $43,250 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $237,010 |
| | | CONTINGENCY | | 20% | $47,410 |
| | | SUBTOTAL: | | | $284,420 |
| | | ENG/SURVEY | | 15% | $42,670 |
| | | SUBTOTAL: | | | $327,090 |

**PROJECT TOTAL** **$327,090**

## Construction Project Number 8

**Project Description**

6-inch line in Basin B-1

**Detailed Description**

**6-inch line in Basin B-1**

**Purpose**

This line will allow for future growth in Basin B-1.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 6" Pipe | 2,330 | LF | $42 | $97,860 |
| 2 | 48" Diameter Manhole | 6 | EA | $5,000 | $29,130 |
| 3 | 16" Boring and Casing | 100 | LF | $280 | $28,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $154,990 |
| | | CONTINGENCY | | 20% | $31,000 |
| | | SUBTOTAL: | | | $185,990 |
| | | ENG/SURVEY | | 15% | $27,900 |
| | | SUBTOTAL: | | | $213,890 |

**PROJECT TOTAL** **$213,890**

# City of Kennedale

## 2013 - 2023 Wastewater CIP

FREESE AND NICHOLS

## OPINION OF PROBABLE COST

## Construction Project Number 9

**Project Description**

6-inch line along Kennedale Parkway

**Detailed Description**

**6-inch line along Kennedale Parkway in Basin B-1**

**Purpose**

This line will allow for future growth along Kennedale Parkway.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 6" Pipe | 3,250 | LF | $42 | $136,500 |
| 2 | 48" Diameter Manhole | 8 | EA | $5,000 | $40,625 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | |
|---|---|---|
| SUBTOTAL: | | $177,125 |
| CONTINGENCY | 20% | $35,430 |
| SUBTOTAL: | | $212,560 |
| ENG/SURVEY | 15% | $31,890 |
| SUBTOTAL: | | $244,450 |

**PROJECT TOTAL** **$244,450**

## Construction Project Number 10

**Project Description**

Flow Meter Updates

**Detailed Description**

**Relocate the permanent flow meter and add SCADA**

**Purpose**

This project will increase reliability of the flow meter and provide SCADA at the site for both Kennedale and Arlington to monitor flows.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | Relocate Meter | 1 | LS | $260,000 | $260,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | |
|---|---|---|
| SUBTOTAL: | | $260,000 |
| CONTINGENCY | 20% | $52,000 |
| SUBTOTAL: | | $312,000 |
| ENG/SURVEY | 15% | $46,800 |
| SUBTOTAL: | | $358,800 |

**PROJECT TOTAL** **$358,800**

**TOTAL** **$6,139,750**

# City of Kennedale

## 2024 - Buildout Wastewater CIP

## OPINION OF PROBABLE COST

## Construction Project Number 11

**Project Description**

15-inch interceptor in Basin B

**Detailed Description**

**15-inch interceptor in Basin B along North Road south of 3rd Street.**

**Purpose**

This line will allow for future growth by increasing the capacity along North Road from a 12" to a 15".

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 15" Pipe | 5,820 | LF | $105 | $611,100 |
| 2 | 60" Diameter Manhole | 15 | EA | $6,000 | $87,300 |
| 3 | 24" Boring and Casing | 100 | LF | $420 | $42,000 |
| 4 | Pavement Repair | 400 | LF | $50 | $20,000 |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $760,400 |
| | | CONTINGENCY | | 20% | $152,080 |
| | | SUBTOTAL: | | | $912,480 |
| | | ENG/SURVEY | | 15% | $136,880 |
| | | SUBTOTAL: | | | $1,049,360 |
| **PROJECT TOTAL** | | | | | **$1,049,360** |

## Construction Project Number 12

**Project Description**

6/8-inch lines in Basin E

**Detailed Description**

**6-inch lines in Basin E along Dick Price Road and west of Dick Price Road**

**Purpose**

This line will allow for future growth along Dick Price Road and in Basin E.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 8" Pipe | 4,920 | LF | $56 | $275,520 |
| 2 | 6" Pipe | 5,670 | LF | $42 | $238,120 |
| 3 | 48" Diameter Manhole | 26 | EA | $5,000 | $132,370 |
| 4 | Pavement Repair | 3,000 | LF | $50 | $150,000 |
| 5 | Proposed Flow Meter | 1 | EA | $300,000 | $300,000 |
| | | | | | |
| | | SUBTOTAL: | | | $1,096,010 |
| | | CONTINGENCY | | 20% | $219,210 |
| | | SUBTOTAL: | | | $1,315,220 |
| | | ENG/SURVEY | | 15% | $197,290 |
| | | SUBTOTAL: | | | $1,512,510 |
| **PROJECT TOTAL** | | | | | **$1,512,510** |

# City of Kennedale

## 2024 - Buildout Wastewater CIP

## OPINION OF PROBABLE COST

## Construction Project Number 13

**Project Description**

6/8-inch lines in Basin E

**Detailed Description**

**6/8-inch lines on the southern side of Basin E**

**Purpose**

This line will allow for future growth in Basin E.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 8" Pipe | 9,370 | LF | $56 | $524,720 |
| 2 | 6" Pipe | 2,120 | LF | $42 | $89,040 |
| 3 | 48" Diameter Manhole | 29 | EA | $5,000 | $143,630 |
| 4 | 20" Boring and Casing | 600 | LF | $350 | $210,000 |
| 5 | Pavement Repair | 100 | LF | $50 | $5,000 |
| | | | | | |
| | | SUBTOTAL: | | | $972,390 |
| | | CONTINGENCY | | 20% | $194,480 |
| | | SUBTOTAL: | | | $1,166,870 |
| | | ENG/SURVEY | | 15% | $175,040 |
| | | SUBTOTAL: | | | $1,341,910 |

**PROJECT TOTAL** **$1,341,910**

## Construction Project Number 14

**Project Description**

8-inch lines in Basin B-2

**Detailed Description**

**8-inch lines on the southeast side of Basin B-2**

**Purpose**

This line will allow for future growth in Basin B-2.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 8" Pipe | 10,500 | LF | $56 | $587,970 |
| 2 | 48" Diameter Manhole | 26 | EA | $5,000 | $131,240 |
| 3 | 16" Boring and Casing | 200 | LF | $280 | $56,000 |
| 4 | Pavement Repair | 100 | LF | $50 | $5,000 |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $780,210 |
| | | CONTINGENCY | | 20% | $156,050 |
| | | SUBTOTAL: | | | $936,260 |
| | | ENG/SURVEY | | 15% | $140,440 |
| | | SUBTOTAL: | | | $1,076,700 |

**PROJECT TOTAL** **$1,076,700**

# City of Kennedale

## 2024 - Buildout Wastewater CIP

## OPINION OF PROBABLE COST

| Construction Project Number | 15 |
|---|---|

**Project Description**

8-inch lines in Basin B-2

**Detailed Description**

**8-inch lines on the southwest side of Basin B-2**

**Purpose**

This line will allow for future growth in Basin B-2.

| ITEM | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | 8" Pipe | 6,920 | LF | $56 | $387,520 |
| 2 | 48" Diameter Manhole | 17 | EA | $5,000 | $86,500 |
| 3 | 16" Boring and Casing | 100 | LF | $280 | $28,000 |
| 4 | Pavement Repair | 100 | LF | $50 | $5,000 |
| | | | | | |
| | | | | | |
| | | SUBTOTAL: | | | $507,020 |
| | | CONTINGENCY | | 20% | $101,410 |
| | | SUBTOTAL: | | | $608,430 |
| | | ENG/SURVEY | | 15% | $91,270 |
| | | SUBTOTAL: | | | $699,700 |

**PROJECT TOTAL** **$699,700**

**TOTAL** **$5,680,180**