SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Regional Wet Weather Characterization Program, Permit Term Four

Monitoring Program and Quality Assurance Project Plan for Wet Weather Equipment Deployment and Sampling Protocol: 2018–2021

Prepared for:

North Central Texas Council of Governments
P.O. Box 5888
Arlington, Texas 76005-5888

Prepared by:

Atkins
17304 Preston Road, Suite 1300
Dallas, Texas 75252

Texas Board of Professional Engineers
Certificate of Registration Number F-474

May 1, 2018

Table of Contents

Page

Page

Appendices

Tables

Figures

Acronyms and Abbreviations

BMP	Best Management Practice
CDMA	code division multiple access
DFW	Dallas-Fort Worth
EDD	electronic data deliverable
EPA	Environmental Protection Agency
FSO	Field Sampling Organization
LCD	liquid crystal display
MS4	Municipal Separate Storm Sewer System
NBS	National Bureau of Standards
NCTCOG	North Central Texas Council of Governments
NTTA	North Texas Tollway Authority
NWSWFO	National Weather Service Weather Forecast Office
PPE	personal protective equipment
QA	quality assurance
QAPP	Quality Assurance Project Plan
RWWCP	Regional Wet Weather Characterization Program
QC	quality control
TMDL	Total Maximum Daily Load
TCEQ	Texas Commission on Environmental Quality
TPDES	Texas Pollutant Discharge Elimination System
TxDOT	Texas Department of Transportation
USGS	U.S. Geological Survey
UTC	Coordinated Universal Time

1.0 Introduction

1.1 Background

Since 1996, a regional storm water monitoring program has been ongoing in the Dallas-Fort Worth (DFW) metropolitan area among the seven largest cities and major transportation agencies for compliance with Federal and State storm water permit requirements. During the initial permit term (1996–2001), seven municipalities (Dallas, Fort Worth, Arlington, Irving, Garland, Plano and Mesquite) and the Dallas and Fort Worth Districts of the Texas Department of Transportation (TxDOT) received joint approval from U.S. Environmental Protection Agency (EPA) for a regional monitoring program which utilized the assistance of a shared consultant team and the United States Geological Survey (USGS) to sample and analyze 22 outfalls primarily from small watersheds of a predominantly single land use type. The Participants listed above worked through the North Central Texas Council of Governments (NCTCOG) to form a regional partnership and strategy to conduct wet-weather monitoring activities for the regional monitoring program.

The sample collections served to characterize typical urban runoff from limited land use types, and were useful for estimating general pollutant loadings. However, they did not directly evaluate impacts on actual receiving streams.

1.1.1 Second Permit Term

In the second permit term (2005–2010), the permit was administered by the Texas Commission on Environmental Quality (TCEQ) and implemented through NCTCOG and a consultant team led by Atkins. Approval was obtained to utilize in-stream stations for the regional monitoring program to more directly assess the impact of storm water within receiving streams. The revised program was termed the Regional Wet Weather Characterization Program (RWWCP) and was added as an option in Part IV.A.3 of the Texas Pollutant Discharge Elimination System (TPDES) Municipal Separate Storm Sewer System (MS4) permits issued to the Phase I North Central Texas governmental entities. The primary goal of the in-stream monitoring program was to obtain baseline data on receiving streams in the DFW Metroplex for use in determining long-term water quality trends. Since the RWWCP language existed outside of each permit, it allowed greater flexibility for making changes to the program. During this second permit term, the North Texas Tollway Authority (NTTA) joined the regional program. All other participants remained the same, except for the TxDOT-Fort Worth District who became a co-permittee with the cities of Fort Worth and Arlington and were no longer required to conduct wet weather monitoring. According to the original RWWCP protocol, municipal Participants collected data from three sampling sites in the watershed (typically upstream, midstream and downstream) and the transportation agencies collected data from two sites (upstream and downstream stations only). Samples were collected quarterly from each site during a qualifying rain event and were analyzed for 18 parameters.

As an added component, the City of Fort Worth selected the Representative Rapid Bioassessment Monitoring Option (Part IV.A.2) in their permit, which allowed the chemical sampling frequency to be reduced from four times per year per site to once per year per site. In its place, two bioassessments were conducted each year at a minimum of nine sites. These bioassessments were based on protocols developed by the EPA. A summarization of this bioassessment data was included along with the chemical data in the annual regional monitoring report each year of the permit term.

1.1.2 Third Permit Term

In the third permit term (2011–2016), the Cities of Arlington, Dallas, Fort Worth, Garland, Irving, Mesquite and Plano, together with the North Texas Tollway Authority and TxDOT-Dallas District agreed to continue their regional partnership and work cooperatively through the NCTCOG and Atkins to develop a revised RWWCP. This revised plan effectively monitored at least 50% of each entity's jurisdictional area by the end of the permit term. This extension of jurisdictional coverage allowed a reasonable assessment of each entity's jurisdictional watersheds while also achieving a balance among the various goals of obtaining valid scientific information, meeting permit compliance, and addressing what is practicable for each entity. The primary goal of the RWWCP during this permit term was to continue the assessment of urban impact on receiving stream water quality and to document any improvement presumably resulting from local BMP implementation. The data collected during this permit term built upon the set of regional water quality data collected under the previous term needed for meaningful trend analysis. Since assessing the impact of urban runoff on receiving stream quality is a primary focus of this program, assessing the biological integrity of the streams was deemed fundamental in the third term. During the third term, 24 watersheds were chemically monitored and 12 watersheds were bioassessed across the region, with substantial overlap between the two sampling approaches.

At the end of the third permit term's sampling effort, a final summary report was prepared by Atkins to assess the sampling effort. The report found that in more than half of the watersheds sampled had high bacteria exceedances, with the average number of nine exceedances in these watersheds. Stream degradation was noted by Atkins' monitoring team in about half of the sampled watersheds based on the data analyzed, and additional monitoring was recommended at these sites.

The report analyzed each of the monitored watersheds, and looked at characteristics specific to each watershed. This approach provided more usable information for each entity, and each individual watershed's information can be reviewed and used to implement BMPs and other monitoring practices in the future. Many of the watersheds that were studied in the third term were classified as high priorities to be studied again due to the data was collected during the third term. The watersheds that were classified as high priority were generally those with stream degradation, those with high number of exceedances of criteria of monitored parameters, and those with existing TMDLs.

Taking into account each watershed's characteristics and evaluating the RWWCP as a whole, Atkins made various recommendations for modifying the RWWCP in the next term, including the following that were applied to the proposal:

- Focus on Impaired Waterbodies –This suggestion is supported by TCEQ and EPA feedback provided to NCTCOG and the monitoring Participants. Atkins suggests a focus on monitoring impaired water bodies will also help with TMDL efforts already underway in the area.
- Rapid bio-assessment improvements – Rapid bio-assessments should continue to be part of the RWWCP, and entities that are not currently completing RBAs should be encouraged to do so. Atkins recommends that the parameters that are recorded during bio-assessment chemical monitoring activities be expanded to include/match those of the wet weather monitoring to allow for easier comparison.

- Revise monitored pollutants: Pesticides and Herbicides – During the third permit term, Carbaryl was chosen to replace Diazaon that was undetected in the second permit term. Carbaryl was not detected in any watershed during the third permit term, and therefore was recommended that it no longer be monitored for the fourth permit term. Suggestions for replacement are dieldrin or atrazine.
- Revise monitored pollutants: indicator bacteria – Remove total coliforms from list of monitoring parameters. There is no recognized correlation between total coliforms and fresh water pathogens by TCEQ or EPA.
- Revise monitored pollutants: nutrients – Add ammonia nitrogen, nitrate nitrogen, and ortho-phosphate to the monitoring parameters for wet weather chemical monitoring. These additions would allow for better comparisons between bioassessment and wet weather chemical monitoring results.
- Revise monitored pollutants: metals – For the Duck Creek, Johnson Creek, and White Rock Creek (headwaters) subwatersheds, it is recommended that sampling of dissolved fractions of metals is conducted in order to determine the concentration of bioavailable metals.

Many of these recommendations were incorporated in the proposal for the fourth permit term.

1.1.3 Current (Fourth) Permit Term

For the current permit term (2018 to 2022), the cities of Arlington, Dallas, Fort Worth, Garland, Irving, Mesquite, and Plano and the NTTA agreed to continue their regional partnership to work cooperatively through the NCTCOG to develop a revised regional monitoring program. TxDOT obtained a statewide permit incorporating both the Dallas and Fort Worth Districts, which removed the requirement to conduct wet weather monitoring. The revised regional monitoring program, which was approved by the TCEQ in 2017, incorporates the recommendations from the previous program outlined above.

The municipal regional Participants proposed to continue to use a sampling plan that will effectively monitor at least 50% of their jurisdictional area by the end of the permit term. As in the previous term, in-stream watershed monitoring will be continued to obtain greater statistical robustness of the data by increasing the sampling at each location for a minimum of two years. The Participants will maintain fixed sampling stations to the extent practicable. This will enable the data to be examined for trends and show improvements or decline in water quality within the fixed sampling period.

Watersheds that will be monitored were prioritized based on TMDLs and 303d streams which were in watersheds that cover the jurisdictional area of the municipalities. Participants proposed to monitor in these impaired waterbodies in order to better assess the impacts of storm water on these impaired streams. It is primarily the same area monitored during the previous permit terms with some additional watersheds.

In October 2017, a consultant team led by Atkins and including subconsultants Freese and Nichols, Inc. and Dougherty Sprague Environmental, Inc. was reselected to continue providing regional storm water monitoring services. Atkins will perform a variety of storm water monitoring compliance activities for the Cities of Arlington, Garland, Irving, Mesquite, and Plano, along with NTTA including storm water monitoring, bioassessments, and a BMP Analysis and Evaluation Plan. The bioassessment monitoring plan and BMP Analysis and Evaluation Plan will be provided in separate submittals. This document defines procedures for storm water sampling, sampling equipment and deployment, field trip preparation, sample retrieval,

laboratory analysis, and post-sampling activities. Dallas and Fort Worth are part of the approved regional monitoring plan; however, this document is specific to the storm water monitoring activities for the Cities of Arlington, Garland, Irving, Mesquite, Plano, and NTTA.

1.2 Purpose of this Document

The purpose of this document is to fulfill the TPDES permit requirement held by the Cities of Arlington, Garland, Irving, Mesquite, Plano, and NTTA, and to provide instructions for the NCTCOG consulting staff on storm water sampling, sampling equipment and deployment, field trip preparation, sample retrieval, laboratory analysis, and post-sampling activities for the current permit term (2018 through 2022). This document will allow storm water monitoring to be conducted in an effective, consistent, and efficient manner. Results obtained from the monitoring described in this document will be submitted to the NCTCOG to meet compliance obligations for the TPDES permit holders. Data collected under this protocol will be used to assess wet weather in-stream conditions.

1.3 Organization of Document

The remainder of this document includes separate sections addressing different aspects of the monitoring protocol for the project.

Section 2.0 – Roles and Responsibilities: Describes the roles and responsibilities of all project participants.

Section 3.0 – Site Information: Provides information about the site locations and precipitation and hydrologic information.

Section 4.0 – Sampling Equipment: Provides an overview of the sampling equipment and programming requirements, including automatic sampler deployment and equipment protection procedures.

Section 5.0 – Sampling Strategy and Collection Procedures: Describes field trip preparation, mobilization, sample retrieval procedures, monitoring constituents, and quality assurance (QA)/quality control (QC) field samples to be obtained.

Section 6.0 – Sample Handling and Documentation: Describes information regarding chain-of-custody requirements and containers and preservatives.

Section 7.0 – Precipitation Monitoring: Describes the precipitation monitoring approach, including equipment, locations, maintenance, calibration, and data management.

Section 8.0 – Flow and Pollutant Load Estimations: Describes the methodology to be used to calculate flows and pollutant loads.

Section 9.0 – Laboratory Analysis: Provides laboratory sample preparation and data reports information.

Section 10.0 – Quality Assurance Project Plan: Outlines the required field and laboratory quality assurance procedures to be used.

Section 11.0 – Post-Sampling Activities: Discusses equipment maintenance, data management and retrieval, and redeployment of equipment.

Section 12.0 – Health and Safety: Addresses the health and safety of field sampling staff, including personal protective equipment and anticipated hazards, and provides emergency contact information.

Section 13.0 – References: Includes a list of references used to prepare this document.

2.0 Roles and Responsibilities

The names and responsibilities of the organizations involved in the orchestration and implementation of the regional storm water monitoring program are described in this section.

2.1 Monitoring Organization

The NCTCOG represents several municipalities in the Greater Dallas-Fort Worth Metroplex. Participating municipalities in this monitoring plan include the Cities of Arlington, Garland, Irving, Mesquite, and Plano, and the roadway authority of NTTA.

2.2 Monitoring Plan Developer

The monitoring plan was developed by Atkins. During the development of the monitoring plan, the plan developer is responsible for:

- Making updates and revisions to the monitoring plan according to *"The North Central Texas Regional Wet Weather Characterization Plan Proposal for the Fourth Permit Term"* (NCTCOG, 2017) and comments requested by the monitoring organization.
- Reviewing monitoring results and assisting the monitoring organization in implementing the monitoring plan.
- Assisting NCTCOG in coordinating the storm water activities of all involved organizations.

2.3 Field Sampling Organization

The Field Sampling Organization (FSO) will be Atkins, assisted by subconsultants Freese and Nichols, Inc. and Dougherty Sprague Environmental, Inc. The FSO will be responsible for executing the storm water monitoring activities as defined in this monitoring plan. Activities include monitoring equipment installation, maintenance, and calibration; sample collection; preparing the required reports; conducting the required equipment maintenance; validation tasks; QA tasks; and data reporting activities. The FSO will:

- Coordinate monitoring activities with participants on equipment delivery and pickup.
- Contract and coordinate with the analytical laboratory, contractors, and subconsultants necessary for implementation of the monitoring plan.
- Provide needed logistical support to field sampling crews, establish a communication network, and schedule and coordinate monitoring activities.
- Oversee or conduct field monitoring activities in accordance with the approved monitoring plan/ quality assurance project plan (QAPP).
- Prepare and maintain all field records and QA/QC forms.
- Receive, review, manage, and validate all laboratory reports.
- Prepare and submit all collected data to NCTCOG in accordance with protocol requirements and enter into the regional program monitoring database.

- Store hard copies.
- Assist in the review of annual reports.

2.4 Analytical Laboratory

The laboratory will be responsible for conducting QA tasks, laboratory analysis of samples, and reporting in accordance with the Sections 5.4, 6.0, 9.0, and 10.0 of the monitoring plan. The laboratory will also:

- Review monitoring plan/QAPP.
- Verify that all samples delivered to the laboratories meet applicable QA requirements listed in approved QAPP.
- Process and prepare composite and grab samples for analyses of the monitoring constituents listed in Section 5.4 of this monitoring plan.
- Analyze collected samples according to the methods listed in Section 5.4 of this monitoring plan.
- Conduct all necessary QA testing according to Section 10.0 of this monitoring plan.
- Report test results and QA data to the FSO according to Section 9.0 of this monitoring plan.

2.5 Communications Protocol

Communications within Atkins and between the subcontractors will be conducted by the Project and Task Managers or designated personnel. Managers and appropriate subcontractor staff will be copied on scope or policy issues along with day-to-day messages regarding the weather.

Communications to and from NCTCOG and the sampling teams will be conducted through Derica Peters of NCTCOG (or delegate) and Chad Richards (Atkins) for regional monitoring-related items, including sampling activities and laboratory results. Designated staff will be copied on scope and policy issues.

Sampling personnel may be divided into multiple field teams and office leaders if necessary. Each field team will consist of one field team leader and one field assistant. The office leader will remain in communication with the field team leaders and liaise between the field teams and the laboratory. The office leader will remain aware of potential weather and traffic concerns and alert the field teams as needed.

3.0 Site Information

This section describes the monitoring site locations that have been chosen for storm water monitoring during the calendar years of 2018–2021.

3.1 Site Locations

The watershed maps and deployment locations are provided in Appendix A.

3.2 Precipitation and Hydrology Information

All sites are located within the Dallas-Fort Worth Metroplex, which is approximately 250 miles north of the Gulf of Mexico. The climate is a mix of subtropical with humid, hot summers, and continental with wide ranges in annual temperature extremes. Rain occurs in the winter months associated with Pacific and Arctic cold fronts and in the summer months with thunderstorm activity. Rainfall occurs most frequently at night, with the highest amounts falling during the months of May and October (National Weather Service Weather Forecast Office [NWSWFO], 2011).

Rainfall records (1981–2010 data from NWSWFO, 2011) from the atmospheric monitoring station located at the Dallas-Fort Worth International Airport report a normal annual rainfall amount of 36.14 inches. Figure 3-1 shows each month with its corresponding normal rainfall volume.

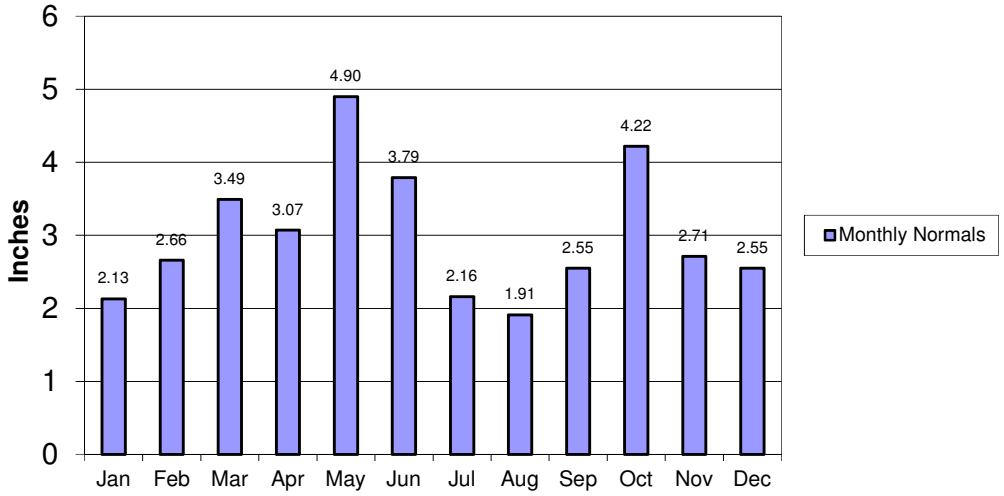


Figure 3-1 Monthly Distribution of Normal Rainfall Patterns (NWSWFO, 2011)

3.3 2018–2019 Monitoring Stations

The following are the monitoring station locations for each entity and the associated watersheds.

Arlington – Johnson Creek and Fish Creek – Mountain Creek Lake

- Johnson Creek at Six Flags (AR1801/1901)
- Fish Creek at SH 360 (AR1802/1902)

Garland – Duck Creek

- Duck Creek at Shiloh Bridge (GA1801/1901)
- Duck Creek between Forest North and South (GA1802/1902)
- Duck Creek under La Prada Bridge (GA1803/1903)

Irving – Delaware Creek

- Delaware Creek at Sowers Road (IR1801/1901)
- Delaware Creek at Oakdale (IR1802)

Mesquite – South Mesquite Creek and North Mesquite Creek

- North of New Market Road (MS1801)
- North Mesquite Creek at Edward's Church (MS1802)

Plano – Spring Creek

- Spring Creek at 16th Street (PL1801)

NTTA – Cottonwood Branch – Hackberry Creek and Cottonwood Creek – Mountain Creek Lake

- Unnamed Tributary at SH 161 North of Gateway Drive (NT1801)
- Cottonwood Creek at SH 161 South of Dickey Road (NT1802)

Maps and photos of the sites may be found in Appendix A. The equipment located at each station is discussed in detail in Section 4.0.

3.4 2020–2021 Monitoring Stations

This subsection will be finalized prior to the monitoring activities of 2020.

4.0 Sampling Equipment

This section presents an overview of the sampling equipment and deployment.

4.1 Overview of Equipment

Storm water monitoring equipment to be utilized at the sites includes:

- ISCO 6712 Automatic Sampler and Suction Line
- ISCO 730 Bubbler Flow Module and Bubbler Line
- ISCO CDMA Cellular Phone System
- ISCO 674 Rain Gauge (upstream sites only)

The storm water sampling will be conducted using an ISCO 6712 automatic sampler. The automatic sampler uses a battery-powered peristaltic pump to draw water through a strainer and flexible sample tube. The storm water sample will be collected using four 1-gallon glass containers located within the automatic sampler housing. Sampling will be triggered by a quantifiable increase in water surface elevation within the stream conveyance channel within a one-hour window. A 730 Bubbler Flow Module will be attached to a tube connected to the automatic sampler to monitor the water level increase. A computer processor with LCD display will allow programming of sampler functions, such as collection intervals and sample volumes, and additional data recording. A CDMA Cellular Phone System will be used on one sampler within the designated watershed to notify field crews that the sampling routine has been initiated. The cellular phone system is used only as an option to alert staff. A deep-cycle marine battery will provide power to the automatic sampler and related equipment. At applicable sites where a clear view of the sky is available, solar panels may be installed to provide a trickle charge to the deep-cycle marine battery. Vendor literature is provided in Appendix B.

Data from the ISCO 674 Rain Gauge, 6712 automatic sampler, and 730 Bubbler Flow Module will be downloaded during sample collection and reported with the laboratory data or, during dry periods, downloaded on a monthly basis by the FSO.

4.2 Automatic Sampler Deployment

4.2.1 Pump and Sample Bottle Housing

The automatic sampler will be located on a stable and flat surface within a storm water sample shelter. The equipment will be securely fastened by a steel cable to a solid object, such as a tree or earth anchor, to prevent removal by high flood events or vandals. The equipment will be located downstream of the solid object and the chain will have no slack. The automatic sampler and battery will be anchored suitably so that they are not tipped over by wind or water.

4.2.2 Suction Line

The automatic sampler will be located outside the conveyance and above the normal water surface elevation. The sampler pumps typically can provide about 25 to 28 vertical feet of suction lift. Placing the sampler higher will cause lower velocities than the 2 feet per second needed to collect representative samples, especially when considering solids content. Excessive elevation lift can also cause sampling to fail. Placing the sampler at longer horizontal distances will result in large friction losses along the sampler tube.

Where possible, the strainer or suction line intake will be located near the center of a straight length of channel. Soils, vegetation, and debris present in earthen channels can clog the collection tube intake. The suction line intake must not be clogged by debris and the suction line must not be displaced. To achieve this, the intake will be securely fastened above the streambed with the open end of the intake pointing downstream. The intake may be fastened to a steel stake or reinforcing bar driven into the center of the stream channel or attached to the side of the channel. Wire, cable ties, or hose clamps will be used to fasten the intake to the steel stake or sides of the channel. The tubing will not be crimped and vertical loops that can trap water in the tubing will be avoided.

4.2.3 Bubbler Module and Tubing

The 730 Bubbler Module uses a differential pressure transducer and a flow of bubbles to measure liquid levels up to 10 feet. The bubbler is unaffected by wind, fluctuations in air or liquid temperatures, turbulence, foam on the surface, corrosive chemicals, debris, oil, floating grease, or lightning. The bubbler tube will be secured similar to the suction line intake. Wire, cable ties, or hose clamps will be used to fasten the bubbler tubing to the steel stake. The tubing will not be crimped.

The bubbler module will be calibrated by measuring the depth of water and adjusting the reading to match as described in the vendor manual. The bubbler line will be routed and secured so that it does not disturb the flow. The mounting hardware will not be over-tightened to avoid kinking the tubing or restricting the airflow.

4.2.4 Sample Jar Installation and Securing

Sample jars will be set in the wire basket located in the bottom of the automatic sampler housing and positioned so the jar locations correspond to the numbers designated for collection. The wire retainer frame will be placed over the four jars and secured in place with the bungee cords located in the bottom of the automatic sampler housing.

4.2.5 Programming

The automatic sampler will be programmed to collect sample aliquots during storm events when the 730 Bubbler Module detects a quantifiable increase in water surface elevation (for example, 1-inch rise) within the stream conveyance channel within one hour. The automatic sampler will be programmed with three different activity modes: Disabled, Enabled, and Shut Down.

The automatic sampler will begin in "Disabled" mode. When the bubbler module detects a quantifiable rise in the stream channel within a one-hour window, the automatic sampler will switch from "Disabled" to "Enabled" mode. The sampler will perform a sample tube-cleaning routine consisting of an air purge followed by a tubing rinse. The sampler will then fill the first of the four 1-gallon glass containers located within the housing of the automatic sampler, which is considered time "0" in the programming sequence. The automatic sampler will collect an additional 0.5-gallon aliquot in the second 1-gallon glass container at time "0"; 0.5-gallon aliquots will be collected every 30 minutes after the sampler was enabled at time "0" up to 120 minutes.

The sampler will continue to take aliquots until 120 minutes has passed from the start of sample collection. Afterwards, the automatic sampler will "Shut Down." At the end of the programming sequence, aliquots will have been collected at 0 minutes, 30 minutes, 60 minutes, 90 minutes, and 120 minutes. Sample container one, or the grab sample container, will contain one 1-gallon aliquot, sample containers two and three will contain two 0.5-gallon aliquots, and sample container four will contain one 0.5-gallon aliquot.

Figures 4-1 through 4-4 provide a flow chart for programming of the samplers with 1 inch (as an example) used as the quantifiable rise to trigger the sample.

The most upstream site in each watershed will be equipped with an ISCO 674 Rain Gauge and CDMA Cellular Phone System. When the automatic sampler becomes "Enabled," an alarm will be sent to the FSO that the sampler has started sample collection activities.

4.2.6 Calibration and Testing

The automatic samplers will be calibrated and tested upon deployment. Sample volumes, depth measurements, and sampler programming will be verified. Volume calibration is described in Section 4.12 of the Teledyne ISCO 6712 Portable Samplers Installation and Operations Guide (Teledyne Isco, 2016). Calibration of the 730 Bubbler Module is described in the Teledyne ISCO 730 Bubbler Module Installation and Operations Guide (Teledyne Isco, 2013). These guides can be downloaded from www.isco.com.

4.2.7 Equipment Protection

Failure of the automatic sampler can occur from power failure, programming error, flood damage, theft, vandalism, or environmental conditions. Every effort will be taken to prevent failure and to protect the automatic sampler. Sufficient input will be obtained from ISCO technicians to reduce incidences of failure due to programming errors. The automatic sampler and battery will be hidden from view, secured with locks and cables, and enclosed in a shelter to reduce the possibility of theft or vandalism.

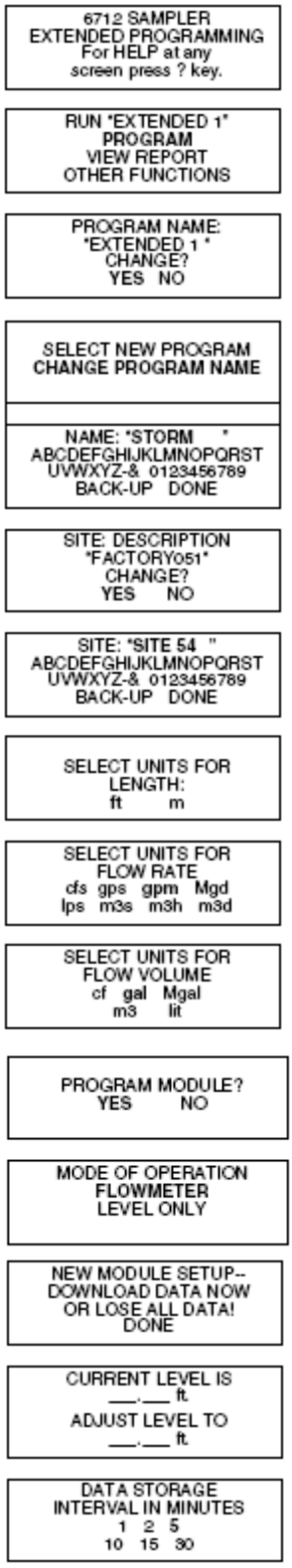


Figure 4-1
Automatic Sampler Programming Flowchart Part 1

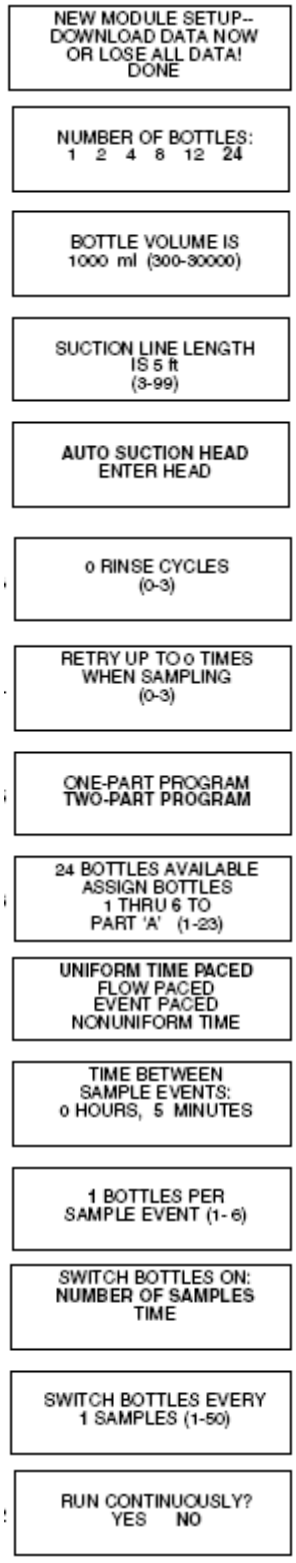


Figure 4-2
Automatic Sampler Programming Flowchart Part 2

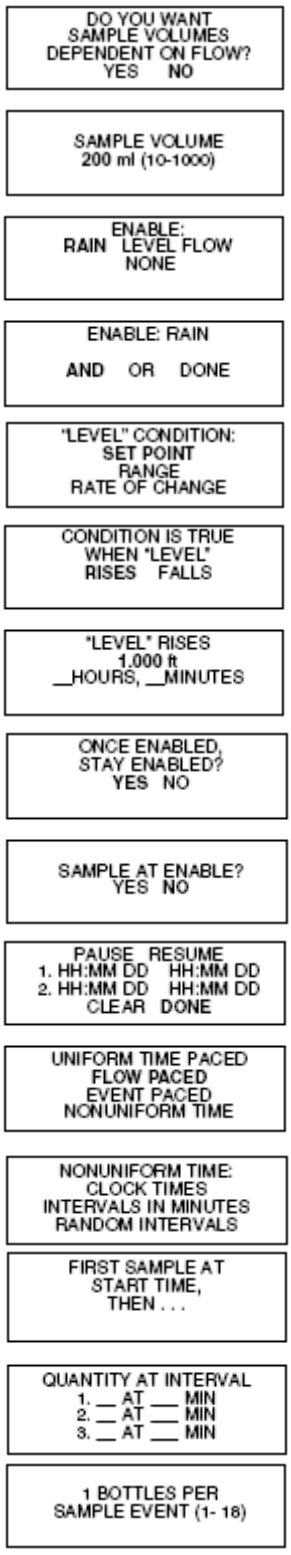
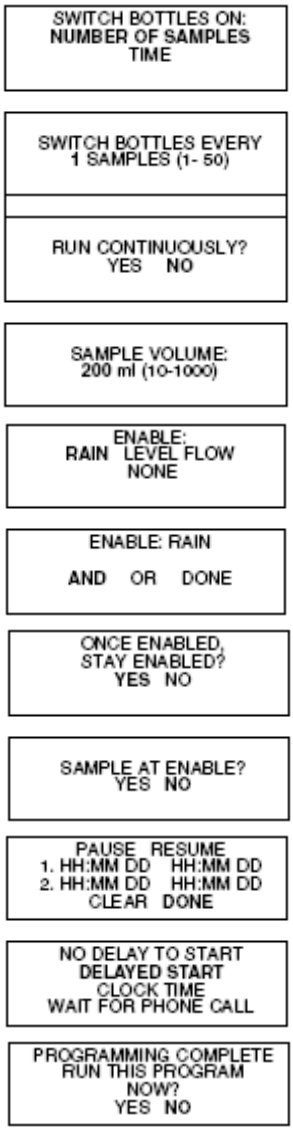


Figure 4-3
Automatic Sampler Programming Flowchart Part 3



Select NUMBER OF SAMPLES

Enter 2 **(It may ask you this after the next step depending on the programming set-up)**

Select NO (We want 3 bottles per event and 2 samples per bottles)

Enter 1850

Select 'A' DONE

Select DONE

Select YES

Select YES

Select DONE

Select NO DELAY TO START

Select YES

Figure 4-4
Automatic Sampler Programming Flowchart Part 4

5.0 Sampling Strategy and Collection Procedures

This section describes the strategies and procedures for collecting storm water samples.

5.1 Field Trip Preparation

The following procedures (as a minimum) will be followed to ensure successful field data collection at each of the 21 sampling locations selected for calendar years 2018–2021. At all times, the FSO will observe all the safety features and protocols described in Section 12.0 to ensure a safe field campaign.

5.1.1 Weather Monitoring

Current and forecasted weather will be monitored on a continuous basis to better anticipate field sampling collection events. Larger rainfall events result in increases in water surface elevations at downstream sites.

The depth of rainfall in the previous 24-hour period can be obtained by visiting the website http://www.intellicast.com. Go to "Current" and "Precipitation," and select the map titled "Daily." Click on the Dallas-Fort Worth area (OK-Lawton Region) on the map to obtain a contour map of precipitation depth for the Dallas-Fort Worth Metroplex for the previous 24 hours. The precipitation depth is from 1200 hours Coordinated Universal Time (UTC) of the previous day to 1200 hours UTC of the current day.

Current weather forecasts can be obtained from National Weather Service website (http://www.weather.gov/) by entering the city name or zip code.

5.1.2 Storm Event Requirements

A qualifying storm event is defined as one that satisfies the following requirements:

1. Rainfall Volume: 0.10 inch, minimum
2. Antecedent Dry Period: 72 hours, minimum
3. Stream Level: Quantifiable rise within 1 hour

Rainfall volume is the total amount of rainfall in inches within the contributing watershed of a monitoring station. The "antecedent dry period" is defined as the period prior to a storm event in which no greater than 0.10 inch of rainfall has occurred. This dry period allows build-up of constituents on the ground surface that can be washed off by the next storm event during the "first flush." The quantifiable rise in stream level within a one-hour time span will be determined by visual observation, level sensors (i.e., bubbler module), stream gauges, or other methods of determining water level. The grab sample and the first composite aliquot will be collected during the "first flush," which is defined as the 30-minute period following a quantifiable rise in the stream level.

5.2 Mobilization

The details of when the field mobilization should occur and safety issues are discussed in this section. For full details on safety precautions, consult Section 12.0.

5.2.1 When to Mobilize

Field mobilization will occur when: (1) there is rainfall at the sampler deployment location, and (2) the water level increases by a quantifiable amount at the conveyance. This information is recorded by the bubbler module and can be obtained by querying the automatic sampler unit through the cell phone modem. If an automatic sampler does not have cell phone query capability, the mobilization will be initiated based on notification from another sampler within the particular watershed where the sampler is currently located, a nearby Internet rain gauge, or weather bands tracked on radar from the Internet.

Field mobilization will be conducted 24 hours a day, on weekdays or during holidays and weekends, unless prior arrangements with NCTCOG have been made.

5.2.2 Team Assembly

The office leader may assemble multiple teams in one day. Each field team will consist of two people for safety, the field team leader and the field assistant. Field personnel will gather necessary equipment, checklists, and logbooks and travel to the site when mobilization has been authorized. Field personnel will print out the required checklists for each sampling site they are expected to visit, as well as several additional forms. These forms may be found in Appendix C. Field personnel will attempt to arrive as soon as the storm event starts in the event the sampler is not working correctly.

5.2.3 Equipment Assembly

Field personnel will go through the mobilization checklist (Appendix C) for all the equipment needed for the field trip, making sure that equipment (including the vehicles) is in good working condition and that there is sufficient gas for the field trip.

5.2.4 Equipment

The following equipment will be gathered for the collection of the storm water samples:

- Maps
- Site description and driving directions to each site
- Checklists and data forms
- Calibrated pH/temperature/specific conductivity meter
- Digital photo capturing device
- Writing instruments (pens and sharpies)
- Rain gear
- Rubberized boots
- Flashlight
- Cell phone
- Picture identification, insurance information, and contact information of office colleagues

- Water and ice for field staff (optional)
- Chain-of-custody forms (Appendix D)
- Lab sample transfer ice chest and bubble wrap
- Jumbo zip-lock freezer bags
- Ice for samples
- Extra sample containers, lids, and deep cycle battery
- Keys for shelter locks and gates, where applicable

5.2.5 Laboratory Notification

The FSO office leader will notify the laboratory of the mobilization effort and provide them with the expected number of samples.

5.2.6 Tailgate Safety Meeting

A tailgate safety meeting will be conducted prior to every monitoring event to review the anticipated site hazards. All meeting information will be placed into the project file.

5.3 Sample Retrieval

Immediately after the occurrence of a qualified sampling event, samples will be retrieved from the sampling sites. This section describes procedures upon arrival at the sampling site, including sample collection from the automatic sampler, field documentation, sampler dismantling, and transport of water samples to the laboratory for analysis.

5.3.1 Vehicle Parking and Safety

The storm water monitoring sites will be readily accessible from existing state or city street rights-of-way. FSO field personnel will not park in private driveways or on private property.

For detailed parking and safety instructions, see Section 12.0. The FSO will park the truck in such a manner as to avoid being stuck in soft off-road soils. The sampling vehicle will be locked during the sampling activities.

5.3.2 Right of Entry

FSO field personnel will carry a laminated authorization letter from NCTCOG.

5.3.3 Automatic Sampler

At each site, FSO field personnel will check the automatic sampler to verify that it is enabled and is actively taking samples. The automatic sampler contains four 1-gallon glass sample containers. The automatic sampler will fill the first sample container with 1 gallon of water immediately when triggered and also immediately place in the subsequent container a 0.5-gallon aliquot. The sampler will continue to take

0.5-gallon aliquots every 30 minutes after the initial sample for 120 minutes. The automatic sampler display will notify field personnel that sampling is complete. At the end of the programming sequence, aliquots will have been collected at 0 minutes, 30 minutes, 60 minutes, 90 minutes, and 120 minutes, for a total of three full jars and one half jar. Sample container one, or the grab sample container, will contain one 1-gallon aliquot, sample containers two and three will contain two 0.5-gallon aliquots, and sample container four will contain one 0.5-gallon aliquot. When the collection is completed, sample containers one, two, and three will each contain 1 gallon, and sample container four will contain 0.5 gallon.

Field Documentation

FSO field personnel will be responsible for documenting site conditions using the Field Condition and Sample Station checklists provided in Appendix C. The following information should be included:

- Site Details
  - Participant
  - Location
  - Name of receiving water body
- Field Conditions
  - Antecedent dry period
  - Visible construction activities observed near the site (if applicable)
- Current Field Conditions
  - Date
  - Time begin and finish sample collection activities
  - Current air temperature
  - Current cloud condition
- Precipitation Data
  - Event ID (user-provided name for the precipitation event)
  - Monitoring station for event (rain station used to gather precipitation data)
  - Storm description
  - Duration (start date and time – end date and time)
  - Total storm precipitation
  - Peak 1-hour precipitation rate
- Storm Event Collection Data
  - Flow start time (time at the beginning of the flow event, typically the time preceding a quantifiable rise in the stream depth in response to a rain event)

  - Flow end time (time at the end of a flow event, typically the time when the recession limb of the hydrograph is <2 percent of the peak or is within 10 percent of the pre-storm base flow, whichever is greater, but also may be the time preceding the next rain event from which water quality samples were not collected)
  - Peak depth (maximum depth measurement in feet obtained between the flow start time and flow end time)
  - Mean depth (the average of the depth measurements obtained between the flow start time and flow end time)

- Sample Documentation at Each Sampling Station
  - Chain-of-custody (Appendix D)
  - Sample identification number for composite sample
  - Description of the sample characteristics (e.g., turbid, clear, oil sheen)
  - Estimated water volume in sample containers
  - Number of total aliquots
  - Time first aliquot sample collected
  - Time last aliquot sample collected
- Collection of Field QA Samples
  - Sample identification number and sample type of field QA samples collected

5.3.4 Storm Water Sample Collection

The storm water samples will be collected from within the automatic sampler enclosure by removing the top half of the ISCO unit. The sample containers will be capped and removed.

Each sample bottle will be uniquely identified, labeled, and documented in the field at the time of collection. Samples will be identified with a unique series of letters and numbers that indicate the location and date that the sample was collected. The following labeling system will be used:

The first two characters will indicate the participant for which the sample was collected. "AR" will be used for Arlington sites, "GA" will be used for Garland sites, "IR" will be used for Irving sites, "MS" will be used for Mesquite sites, "NT" will be used for the NTTA sites, and "PL" will be used for the Plano sites.

The next four digits will indicate the site number and associated calendar year in which it was sampled. The first two digits will indicate the year that the sample was collected. An example for 2018 would be "18." This is followed by the site location in regard to where it is located in the watershed. All sites upstream will start with "01," mid-stream sites will be characterized as "02," and downstream "03." For example, the downstream site in Garland sampled in calendar year 2018 will be labeled "GA-1803."

The next digit will indicate the sampling season during which the sample was collected. "1" will be used for January 1 through March 31, "2" will be used for April 1 through June 30, "3" will be used for July 1 through September 30, and "4" will be used for October 1 through December 31.

The last digit will indicate the sample bottle number. "A" will be the first grab sample container, and "B" will represent bottle 2, "C" will represent bottle 3, and "D" will represent bottle 4.

To summarize, the code GA-1802-1-B would identify the second bottle container collected during the January 1 through March 31 season at the midstream station from Garland's 2018 watershed.

5.3.5 Equipment Malfunction

In the event that the automatic equipment malfunctions, a sample may be collected manually by obtaining grab samples from the stream into the four clean 1-gallon glass sample containers. Field personnel should fill the first sample container with 1 gallon of water immediately following storm flow and also immediately obtain a 0.5-gallon grab sample aliquot in the subsequent container. Field personnel should continue to take 0.5-gallon grab sample aliquots every 30 minutes after the initial sample for 120 minutes. At the end of the sampling sequence, aliquots will have been collected at 0 minutes, 30 minutes, 60 minutes, 90 minutes, and 120 minutes, for a total of three full jars and one half jar. Sample container one, or the grab sample container, will contain one 1-gallon aliquot, sample containers two and three will contain two 0.5-gallon aliquots, and sample container four will contain one 0.5-gallon aliquot. When the collection is completed, sample containers one, two, and three will each contain 1 gallon, and sample container four will contain 0.5 gallon. The grab samples will be collected using a pre-cleaned bucket that will be triple rinsed with the water to be sampled or distilled water between each sample collection. Field personnel should also note approximate water levels in a field logbook during the sampling sequence.

5.3.6 Missed and Unusable Samples

If a sample is determined to be missed or unusable for purposes of submittal to the State, the FSO will conduct a re-sampling effort. If inadequate time or insufficient rainfall occurs during the remaining permit term, a letter will be provided to NCTCOG by the FSO (and potentially the laboratory) explaining the cause of the missed sample. An additional sample will be collected during the next quarter.

5.3.7 Sampler Dismantling

The automatic sampler will be dismantled along with the battery and removed to the truck. The enclosures will remain at the sites until the last quarterly samples are collected.

5.3.8 Sample Transport

Following the collection of water samples from each site, the FSO field personnel will call the office leader at the earliest opportunity to report the sample collection status. This information will be relayed to the laboratory. FSO field personnel will transport the water quality samples preserved in ice to maintain a temperature of 4ºC to the laboratory.

5.4 Monitoring Constituents

Table 5-1 lists the constituents to be monitored and analyzed in this project.

Table 5-1 Constituents to be Monitored

Constituent	Analysis Location	Method	Detection Limit	Holding Time
E coli	Laboratory	SM9223B	10 colonies/100 mL	6 hours
Oil and grease	Laboratory	EPA 1664A	1.7 ppm	28 days
pH	Field	Probe	-	Immediately
Temperature	Field	Probe	-	Immediately
Specific Conductance	Field	Probe	-	Immediately
Biochemical Oxygen Demand (BOD)	Laboratory	SM5210B	3 ppm	48 hours
Chemical Oxygen Demand (COD)	Laboratory	SM5220D	1 ppm	28 days
Total suspended solids (TSS)	Laboratory	SM2540D	2 ppm	7 days
Total Dissolved Solids (TDS)	Laboratory	SM2540C	5 ppm	7 days
Total arsenic	Laboratory	EPA 200.7	0.0005 ppm	6 months
Total chromium	Laboratory	EPA 200.7	0.003 ppm	6 months
Total copper	Laboratory	EPA 200.7	0.002 ppm	6 months
Total lead	Laboratory	EPA 200.7	0.0005 ppm	6 months
Total zinc	Laboratory	EPA 200.7	0.005 ppm	6 months
Dissolved phosphorus	Laboratory	EPA 200.7	0.005 ppm	48 hours
Orthophosphate	Laboratory	EPA 300	0.03 ppm	48 hours
Total phosphorus	Laboratory	EPA 200.7	0.05 ppm	6 months
Ammonia Nitrogen	Laboratory	SM4500NH3B	0.05 ppm	28 days
Total nitrogen	Laboratory	SM4500-N	0.05 ppm	28 days
Nitrate Nitrogen	Laboratory	EPA 300	0.03 ppm	48 hours
Atrazine	Laboratory	EPA 619	0.0005 ppm	7 days

5.5 QA/QC Field Samples

FSO personnel will collect QA/QC samples on 10 percent of the samples collected. QA/QC checks will include the following:

Field Duplicates – Consists of obtaining a second analytical result for a scheduled sample. Duplicate results will be analyzed to monitor intra-laboratory precision of data. The laboratory will obtain duplicates from the composite containers of the auto-samplers by sub-sampling the composite volume remaining after the initial sub-sampling. The composite containers will need a minimum volume of 2½ gallons in order to collect and analyze duplicate samples. TTI Laboratories will be responsible for receiving, labeling,

analyzing, documenting, and reporting these duplicates from the composite sample containers noted by FSO field staff.

Trip Blanks – Consists of de-ionized water that is carried with the FSO staff during sample collection in sample containers. They will be collected to evaluate if cross-contamination occurs during sample transport.

1-Gallon Composite Bottle Blanks – Composite container blanks will be collected by pouring de-ionized water into laboratory-cleaned 1-gallon containers. This liquid will then be sub-sampled into laboratory containers for analysis. This will test the effectiveness of decontamination procedures used by the laboratory to clean reused 1-gallon containers. FSO field staff will document the identification number of the container blank collected.

QA/QC field sample types, locations, collection schedule, and container requirements are listed in Table 5-2.

Table 5-2 QA/QC Field Sample Collection

Type	Collection Schedule	Container
Field Duplicates	10% of qualified sampling events	From composite and grab containers when volume allows
Trip Blanks	10% of qualified sampling events	1-gallon glass
Bottle Blanks	10% of qualified sampling events	1-gallon glass

The FSO will label and note the identification number of all QA/QC samples collected and the type of QA/QC samples collected.

QA/QC samples will be identified with an extension placed at the end of the sample ID. "FD" will be used to identify field duplicates, "TB" will be used to identify trip blanks, and "BB" will be used to identify bottle blanks.

6.0 Sample Handling and Documentation

This section describes the manner in which samples will be handled and tracked from the time of sample collection/retrieval to laboratory analysis.

6.1 Containers and Preservatives

All composite and grab samples will be extracted by the laboratory into sub-samples for various constituent analyses or as duplicate samples. The laboratory will place sub-samples into containers meeting the requirements of the analytical method to be performed. Additional preservatives will be added by the laboratory if required by the specific analytical method. Sample preservation is to prolong the stability of the constituents and ensure that the levels of constituents in the collected samples match as closely as possible the levels in storm water at the sample location.

6.2 Chain-of-Custody

A chain-of-custody document must accompany each sample. Samples must be under the custody of field personnel until relinquished to a representative of the laboratory. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession, (2) it is in their view after being in their possession, (3) it was in their possession and they locked it up, or (4) it is in a designated secure area.

After the samples have arrived at the laboratory, they should remain under the custody of the laboratory.

Each person receiving or relinquishing custody of the samples must sign and date the chain-of-custody when transfer of sample custody occurs. Documentation of sample possession must include the following:

- Sample description/identification
- Date and time of sample collection
- Type of sample (composite or grab)
- Preservative used
- Sample container type
- Analyses required
- Name of collector(s)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory
- Bill of lading or transporter tracking number (if applicable)

Preformatted chain-of-custody forms should be used to document the transfer of samples to the laboratory and the analysis to be conducted on each bottle. A sample chain-of-custody is provided in Appendix D.

7.0 Precipitation Monitoring

This section describes the manner in which precipitation amounts at the project sites will be monitored and recorded.

7.1 Rain Gauges

Tipping bucket rain gauges will be used at one site per watershed to monitor and record rainfall measurements. The tipping bucket rain gauges will be located at the most upstream sampling station within each watershed. On-line rain gauges will be used for the remainder of the sites.

7.1.1 Rain Gauge Description

The tipping bucket rain gauge to be installed at one site per watershed will provide accurate rainfall measurements from 0.01 to 22 inches per hour. The rain gauge will be mounted inside a steel cylinder and have an opening on top to collect rain. Rain falls through a screen into a funnel. From the funnel, rain collects in one side of a two-chambered plastic bucket mounted on jeweled pivots. When rain fills the chamber, the bucket tips, draining the water and exposing the other chamber to fill. When that chamber fills, the bucket tips back and the process begins anew. Each time the bucket tips from one side to the other a magnet passes over a reed switch, momentarily closing the normally open contacts. This contact closure provides a short-duration output pulse from the rain gauge for each 0.01 inch of rain. Vendor literature on the ISCO 674 rain gauge is provided in Appendix B.

7.1.2 Data Retrieval

The ISCO rain gauges will be compatible with the data logging equipment so that FSO field personnel will be able to monitor rainfall measurements and easily download recorded data during each site/sampling visit or at a minimum of once monthly. The rain gauge will connect to the data logger at each station and the data logger will store rainfall measurements. Data will be extracted from the data logger by the FSO while on-site. Data will be cleared from the data logger after it has been extracted by a prompt from the FSO.

7.1.3 Rain Gauge Maintenance

All connections from the ISCO rain gauge to the data logger should be inspected to ensure that the connections are secure. FSO field personnel should remove the rain gauge cover at least quarterly and check to see that dust, bird excrement, insect matter, or other debris has not affected the operation of the gauge. If debris is observed, the gauge should be cleaned in accordance with the vendor's recommended practices.

7.1.4 Rain Gauge Calibration

All rain gauges are factory-calibrated and adjusted. FSO personnel should not attempt to make adjustments to the jeweled pivot screws of the ISCO rain gauge as the jewel bearings may be damaged. If calibration is necessary, the equipment vendor will be contacted.

8.0 Flow and Pollutant Load Estimates

The annual pollutant loading from each watershed will be estimated for the parameters monitored during runoff events using the following equations:

Conventional Parameters:

Annual Pollutant Loading (lb) = Estimated Mean Annual Pollutant Concentration (mg/L) x 2.2046 x 10^{-6} (conversion factor) x Estimated Annual Flow Volume (L)

Bacteria:

Annual Pollutant Loading (billion colonies) = Estimated Mean Annual Pollutant Concentration (colonies/100 mL) x 1.0 x 10^{-8} (conversion factor) x Estimated Annual Flow Volume (L)

The Estimated Mean Annual Pollutant Concentration will be calculated by taking the average of the pollutant concentrations collected through in-stream storm water monitoring within each watershed per year.

The annual flow volume will be estimated using the annual precipitation and annual flow equations developed for each watershed. Sample annual flow equations are provided in Appendix E and will be updated, if necessary, prior to estimating the annual pollutant loading for the annual report. The annual precipitation will be estimated for each watershed by utilizing rain gauges located both at the monitoring site and nearby locations, where available.

The annual flow equations were developed using four methods. The first method is referred to as Reference Watershed and utilizes the regional frequency analysis approach (through U.S. Geological Survey [USGS] data obtained from nearby reference watersheds) to predict mean annual discharge using drainage area, slope, and imperviousness as definable basin characteristics. The second method is referred to as Historical Regression and utilizes mean annual discharge data from a USGS historical gage and nearby precipitation data to develop a regression equation to forecast mean annual discharge based upon precipitation amounts. The third method is referred to as Interpolation and utilizes USGS gages upstream and/or downstream of the location of interest to interpolate data collected from the gage. The fourth method is referred to as Gaged and utilizes a USGS gage located at the sampling location.

The annual load estimates for each of the parameters monitored will be calculated for the annual report. The annual load calculation as described above is based on the assumption that the dry weather portion of the annual flow volume is insignificant and that the pollutant concentrations observed during the storm events are representative of storm events occurring throughout the year.

9.0 Laboratory Analysis

9.1 Laboratory Sample Preparation

TTI Environmental Laboratory (http://www.ttilabs.com/) in Arlington [(817) 861-5322] will be alerted that weather conditions exist that may require collection of samples. This will be accomplished as soon as field crews are aware of the potential for rain so that the laboratory can prepare for receipt and analysis of samples. After sample collection, the laboratory will be informed that samples are being transported to the laboratory to allow them to have someone receive the samples for adding preservatives and to begin necessary analyses within specified holding times.

9.2 Lost or Inadequate Samples

The laboratory will notify the FSO and the FSO will notify NCTCOG immediately if a sample is lost or is determined to be inadequate according to the communication protocol specified in Section 2.5. The FSO will conduct a re-sampling effort for lost or inadequate samples according to Section 5.3.5.

9.3 Data Reports

The laboratory will submit data reports. Laboratory data reports will contain final results for blanks and recoveries, methods of analysis, detection limits, quantification levels, accuracy and precision data, MS/MSD data, laboratory method and equipment blank data, and limits of instrument calibration. In addition, special analytical problems or modifications of specified methods will be noted.

The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Consequently, most analytical results will contain no more than two significant figures. Concentrations in liquids will be expressed in terms of weight per unit volume (e.g., milligrams per liter). Reported detection limits will equal the concentration in the original matrix corresponding to the low-level instrument calibration standard after accounting for concentration, dilution, and/or extraction factors.

The laboratory will also provide:

- Hard copies of chains of custody
- Hard copies of sample receipt and log-in data
- Hard copies of analytical results
- Hard copies of quality control data
- Hard copies of narrative reports for each analytical batch that describe deviations from specifications in this scope of work and summarize QC data

10.0 Quality Assurance Project Plan

To achieve the overall monitoring objectives, data obtained during each sampling event must be accurate and precise. Additionally, samples potentially contaminated by external sources in the field or laboratory must be identified. This section defines QA procedures and requirements for the project.

10.1 Field Quality Assurance

Field QA is essential to providing accurate, representative samples of the water quality being monitored. Thus, it is important that field personnel be trained in proper sample collection procedures, including the use and programming of automatic samplers and sample handling procedures. FSO personnel collecting field samples will follow all field procedures outlined in Section 5.0.

10.2 Laboratory Quality Assurance

The FSO will utilize TTI Laboratories to analyze samples collected. The laboratory will certify the precision and accuracy of all analytical data and document all phases of sample handling, data acquisition, data transfer, report preparation, and report review.

10.2.1 Reference Materials and Reagents

Whenever possible, primary reference materials for instrument calibration, QC spikes, and performance evaluations will be obtained from the National Bureau of Standards (NBS) or the Environmental Protection Agency. In the absence of available reference materials from these organizations, other reliable sources will be sought. Such secondary reference materials may be used for these functions provided that they are traceable to an NBS standard.

Laboratory reagent quality will be sufficient to minimize or eliminate detectable concentrations of analytes in laboratory blanks. Furthermore, reagents will not contain other contaminants that interfere with sample analysis.

10.2.2 Laboratory Data Management

10.2.2.1 Laboratory Data Collection

In addition to the data recorded in field logbooks and chain-of-custody forms, data that describes sample processing will be recorded in laboratory notebooks. Laboratory notebooks will contain the following information:

- Date of processing
- Sample numbers
- Case number
- Analyses performed
- Calibration data

- QC samples
- Concentrations/dilutions required
- Instrument readings
- Special observations
- Analyst's signature

10.2.2.2 Laboratory Data Logging

TTI laboratories will utilize an established system for sample check-in, tracking of samples through the laboratory, assignment of laboratory analyses, and sample check-out. The system will provide for management review of all laboratory data before the issuance of laboratory reports. The review will be accomplished on two levels: (1) review of raw data for each analysis, and (2) review of the final results to check for consistency or agreement of the results between all parameters.

10.2.2.3 Laboratory Data Reduction

For methods that utilize a calibration curve, sample responses will be applied to the linear regression line to obtain an initial raw result that will be factored into equations to estimate the concentration in the original sample. Rounding will only be performed after the final result has been obtained to minimize rounding errors. Copies of the raw data and the calculations used to generate the final results will be retained on file to allow reconstruction of the data reduction process at a later date if necessary.

At the completion of a set of analyses, all calculations will be completed and checked by the analyst. The associated QC data will be entered onto QC charts. If all data is acceptable, the data summaries will be submitted to the laboratory project manager for review. If QC samples do not meet acceptance criteria, the appropriate laboratory project manager will be notified, and corrective action will be taken as specified in Section 10.2.3.

10.2.2.4 Laboratory Data Review

System reviews will be performed at all levels. The individual analyst will constantly review the quality of data through calibration checks, QC sample results, and performance evaluation samples. These reviews will be performed prior to submission to the laboratory project manager.

The laboratory project manager will review data for consistency and reasonableness with other data and will determine if QA/QC program requirements have been satisfied. Selected hard copy output of data, such as chromatograms and spectra, will be reviewed to verify that results were interpreted correctly. Unusual or unexpected results will be reviewed and a resolution will be made as to whether the analysis should be repeated. In addition, the laboratory project manager will recalculate selected results to verify the calculation procedure.

10.2.3 Corrective Actions

An analysis will be considered to be out of control when it does not conform to the QA/QC protocols specified by this document, applicable methods, or standard operating procedures. When an analysis is

out of control, the analyst who identifies the problem will document the occurrence and notify the laboratory project manager. The analyst, working with the laboratory project manager, will determine the cause of the problem and take appropriate corrective action. Analysis may not resume until the problem has been corrected. Restoration of analytical control will be demonstrated by generating satisfactory calibration and/or QC sample data.

Data generated concurrently with an out-of-control system will be evaluated for usability in light of the nature of the deficiency. If the deficiency does not impair the usability of the results, the data will be reported and the deficiency noted in the laboratory data report (e.g., a constituent is detected in a laboratory blank but not in sample analyses). Where sample results are impaired, the FSO project manager will be notified. After the error has been corrected, the analysis will be rerun and the data can be reported. The laboratory project manager will outline the error and the corrective action in a QA report. If the cause of the error cannot be identified, the laboratory project manager will summarize the procedures and QA/QC used to analyze the sample and provide a statement of validity for the sample results.

Problems encountered during the field activities will be reported by the designated FSO field staff as soon after discovery as possible. The Atkins project manager will be responsible for ensuring that corrective actions produce satisfactory results in a timely manner. Outcomes of those actions and their effect or potential effect on the data will be reported to Atkins and NCTCOG.

Results of performance or systems audits or internal QC analyses may trigger corrective action within the designated laboratory and Atkins project team. However, it is generally the responsibility of the laboratory analyst or Atkins field personnel to initiate laboratory or field corrective actions, respectively.

11.0 Post-Sampling Activities

11.1 Equipment Maintenance

The FSO will perform maintenance activities after each mobilization. The FSO will clean field equipment and store in an accessible location at one of the FSO's storage facilities. Equipment cleaning procedures are described in the Teledyne ISCO 6712 Portable Samplers Installation and Operation Guide available at www.isco.com. Distilled water should be used for the equipment cleaning. All sample containers will be cleaned by the laboratory. Prior to the next quarter of sampling, the equipment will be returned to the site. Routine maintenance will be performed on the equipment, including replacing the auto-sampler composite containers and preparing the sampling stations for the next storm event. The shelter integrity will also be checked. The maintenance checklist in Appendix C will be used to guide and record the maintenance activities.

11.2 Data Management

The FSO will be responsible for the data management that will cover data storage systems, data handling, data validation and analysis, and data reporting.

An electronic data deliverable (EDD) will be established to store digital information such as laboratory analytical data and field recorded measurements. Hard-copy data from field sheets, log books, and computer outputs will be scanned as an electronic copy for backup.

The FSO will be responsible for the data validation that will be performed on field and laboratory data prior to submittal to the NCTCOG. Reports received from the laboratory will be reviewed for consistency and completeness. Reports will also be checked for the requested analyses and QA activities performed by the laboratory. Corrective actions will be initiated if inconsistencies or problems are encountered with submitted reports.

A data reporting schedule will be developed with NCTCOG. All validated sample collection data will be submitted to the NCTCOG in a pre-approved database or report format. Data will be reported in both hard copy and electronic formats. The data will also be input into the regional monitoring program database.

11.3 Floods and Retrieval of Equipment

FSO personnel will be aware of flood warnings and watches as posted by the National Weather Service. If flooding is anticipated, the FSO will make every effort to travel to the sampling equipment and remove it from watersheds where the flooding is expected. If the equipment is submerged or dangerous conditions threaten field personnel, the equipment may be abandoned and retrieved when the conditions subside.

11.4 Redeployment of Equipment

The automatic samplers will be serviced by the FSO and redeployed prior to each sampling quarter. The samplers will be serviced following the guidelines established by Teledyne Isco (2013 and 2016). These guides are available for download at www.isco.com. After collection of the last quarterly sample, all

equipment will be removed and returned to the storage facility for cleaning and repairs, as necessary, before deploying to new sampling locations.

12.0 Health and Safety

This section is provided to assist field personnel in the safe performance of water quality data collection. Field work requires an awareness of potential hazards and knowledge of basic safety procedures. Atkins will provide health and safety documentation for this project to field personnel. Prior to the start of any work activity conducted by Atkins, all personnel participating in the work will review the applicable documentation to ensure full understanding of the job task, its associated hazards, and all applicable mitigation measures. All personnel must acknowledge this understanding and their intent to fully comply with all health and safety requirements by signing the provided Acknowledgement page.

12.1 Basic Safety Preparation

Basic preparations will be routine before every sampling activity. At a minimum, a trip plan should be completed for each field trip and left at a designated location in each consultant's office. The trip plan should include the following information:

- Field trip participants
- Departure and return times
- Contact phone numbers
- Basic itinerary, including where and when sampling will be performed

Field work must be done in pairs. FSO field staff will consider carrying the following safety equipment during sample collection activities:

- Rubber boots
- Safety vests, hard hats, and steel-toed shoes
- Amber warning light for vehicle
- Reflective traffic cones
- Bug repellent
- First aid kit
- Flashlight and spare batteries
- Cellular phone
- Rain gear
- Hat/sunscreen/sunglasses
- Drinking water/sports drinks
- Tool box with basic tools
- Latex gloves
- Antibacterial soap or hand cleaner
- Distilled water, 1 gallon

- List of emergency phone numbers/office contacts

The FSO will carry a packet of general safety information in each vehicle that contains the following materials:

- Emergency phone numbers
- Picture identification cards, insurance information, and project identification sheets
- Laminated work authorization from the NCTCOG
- Locations of emergency facilities (hospitals and police and fire departments)

12.2 Hazards

Atkins has developed and continually updates job safety instructions for known hazards and activities. Atkins will issue instructions to field personnel and provide updated instructions as necessary as part of the health and safety documentation provided to field personnel.

12.3 First Aid Equipment and Supplies

A first aid kit will be located within the vehicle located at the project sites during sample collection. The first aid kit must include at a minimum: snakebite kit, potable distilled water, bandages, scissors or knife, antiseptic, bee sting kit, and allergic reaction to insect bite kit.

Other required procedures to reduce injury include:

- Confined entry will not be conducted.
- Stream reaches must not be entered below the water level during sample collection, during a rainstorm, or when rain is imminent. FSO field staff must be aware of flash flood warnings and remain in contact with FSO office staff.
- Appropriate lighting equipment will be carried to illuminate potential hazards. The stream banks may be muddy and slippery.
- Care must be taken when handling the heavy composite and grab containers.

12.4 Selection of PPE

The selection of the personal protective equipment (PPE) will be done per site/field activity and after a thorough evaluation of the hazards involved at the site during each phase of the operation.

Recommended and required PPE is comprised of the following:

- Latex gloves when handling storm water samples
- Raingear
- Rubber boots

- Safety vest – reflective
- Coveralls or work clothing
- Work gloves

12.5 Nearest Hospital Information

Locations and information for the nearest hospitals for the various sampling sites are located in Appendix F.

12.6 Emergency Contact Information

Emergency contacts are listed below:

FIRE*	9-1-1
POLICE*	9-1-1
NATIONAL SPILL RESPONSE CENTER	(800) 424-8802
HOSPITAL	See Appendix F
AMBULANCE*	9-1-1

* Local Area Police and Fire will respond to a 9-1-1 call.

13.0 References

North Central Texas Council of Governments (NCTCOG). 2017. The North Central Texas Regional Wet Weather Characterization Plan Proposal for the Fourth Permit Term. 2017. Arlington, Texas.

National Weather Service Weather Forecast Office (NWSWFO). 2011. *National Weather Service Weather Forecast Office Dallas/Fort Worth, TX*. http://www.srh.noaa.gov/fwd/.

Teledyne Isco. 2016. 6712 Portable Samplers Installation and Operation Guide. Revision KK. February 2016. Lincoln, NE.

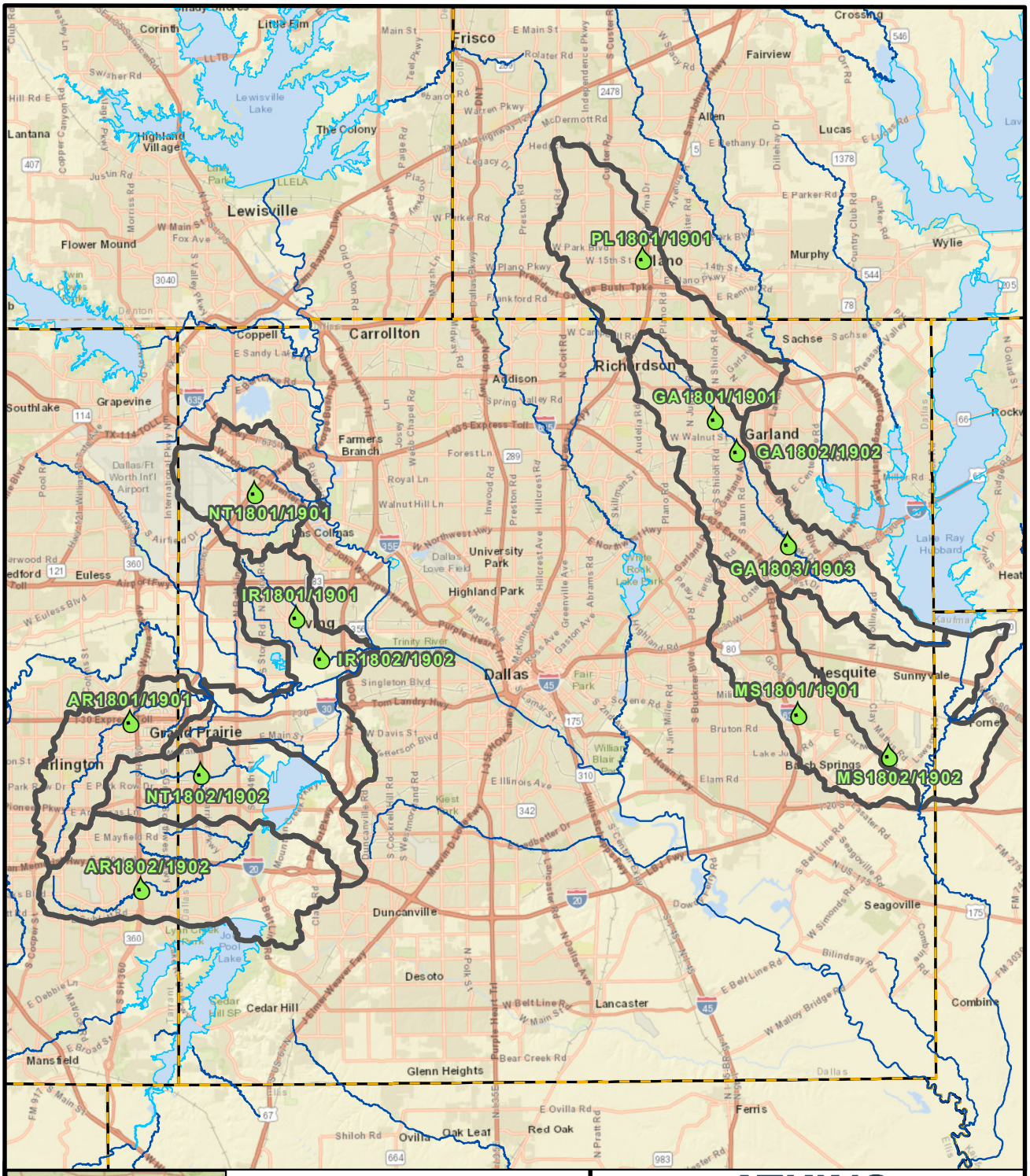
Teledyne Isco. 2013. 730 Bubbler Module Installation and Operation Guide. Revision M. October 2013. Lincoln, NE.

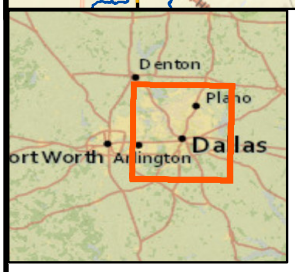
Appendix A

Sampling Locations

Monitoring Station Map

2018-2019





- Monitoring Station
- Stream Segments
- Waterbody
- Watershed
- County Boundary

Datum: NAD 1983
Projection: State Plane
Texas North Central
Units: Feet
Basemap: ESRI Streets

0 3 6 Miles

ATKINS
Member of the SNC-Lavalin Group

Monitoring Stations
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Permit Term Four

Collin, Tarrant, and Dallas Counties, Texas

Job No.: 100060260	Scale: 1 " = 6 miles
Prepared By: ATKINS/WHIT6392	Date: May 01, 2018

N:\Clients\M_N\NCTCOG\100060260\geo\figs\sampling.mxd

Esri, DeLorme, HERE, USGS, Intermap, iPC, NRCAN, METI, TomTom. World Street Map. March 2014.
1:379,900; generated by Atkins; using ArcMap. <http://server.arcgisonline.com/ArcGIS/rest/services/World_Street_Map/MapServer> (01 May 2018)

City of Arlington

2018 - 2019 Sites

Johnson Creek and Fish Creek – Mountain Creek Lake Watersheds

Johnson Creek at Six Flags

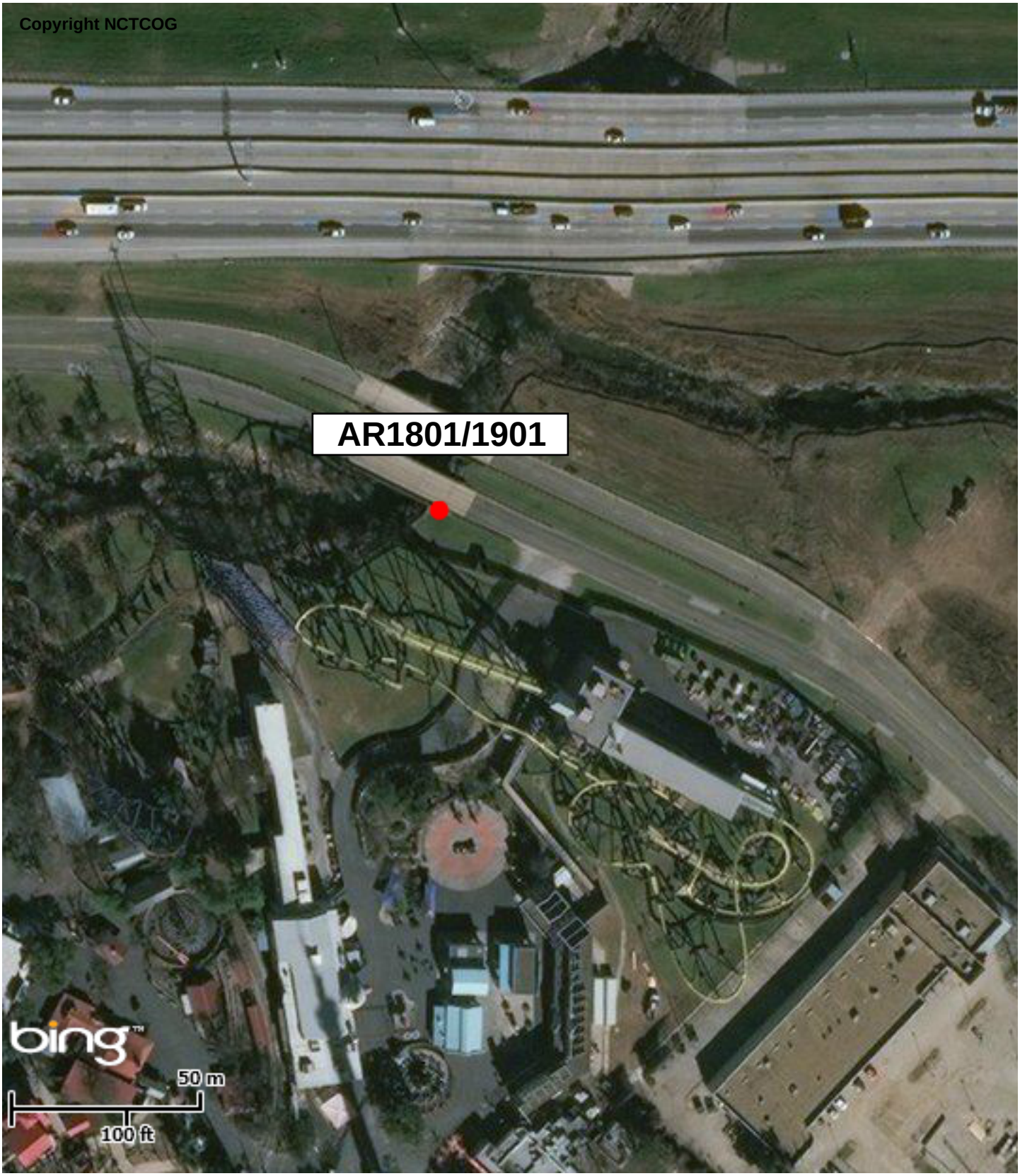
AR1801/1901

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N



North Central Texas Council of Governments

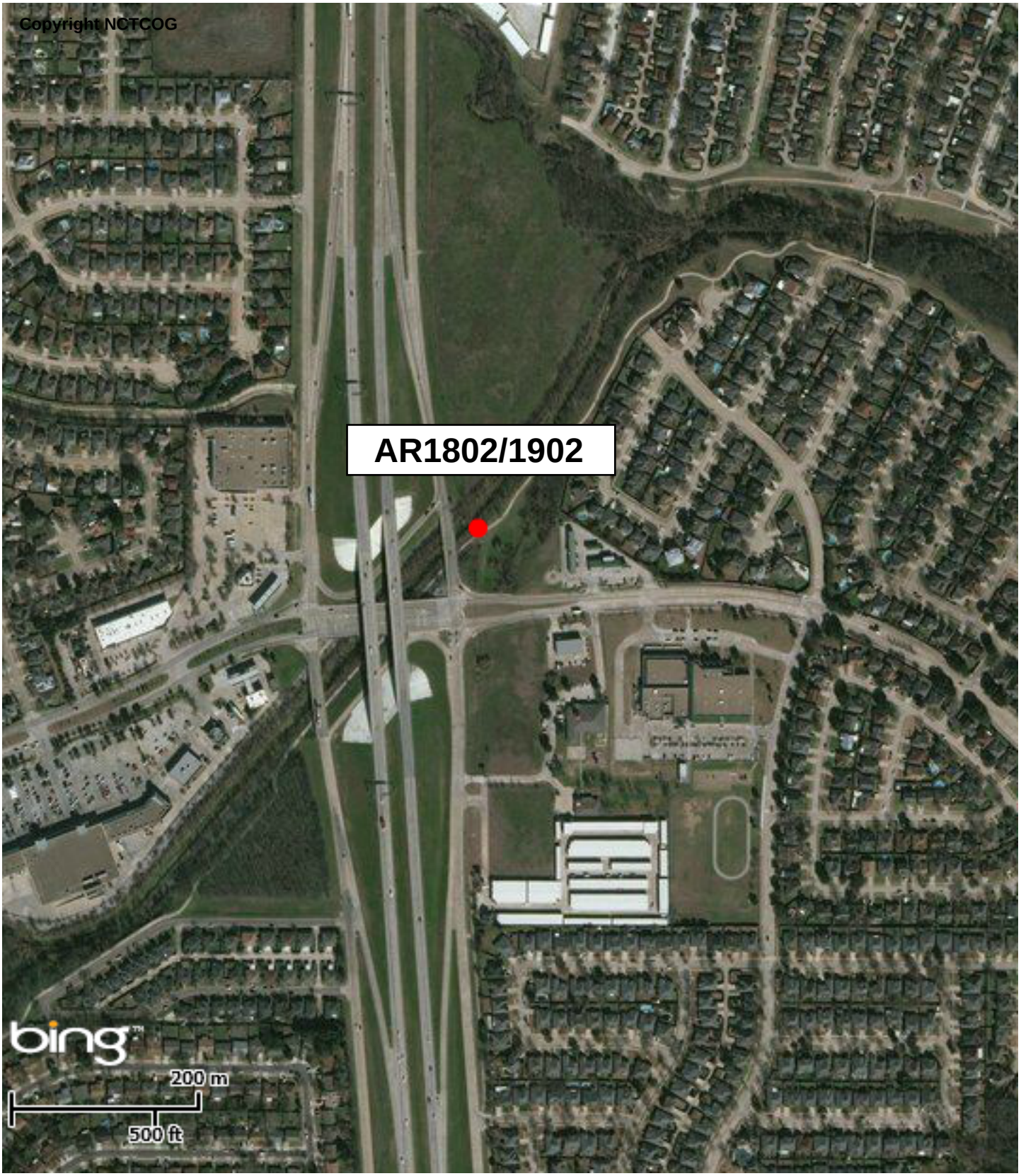
DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Fish Creek at SH360

AR1802/1902



North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/20/17 Time: 09:49

Location Name/Number: ARL 003 - Johnson Creek @ Copeland

Nearest Cross Street/Location Description: East Copeland & Six Flags Drive

Entity (Circle One): (Arlington) Garland Irving Mesquite NTTA Plano

GPS Latitude/Longitude: 32°45'31.72"N, 97°04'09.41" W

Receiving Water: West Fork Trinity

Data for locating automated samplers:

Ease of Installation ~ Native or Existing Location / Bench ~ (Need to construct Location / Platform / Base

Describe: Flat surface present, slight leveling needed

Ease of channel/sample area access and safety: ~ Describe either (YES) or NO

Describe: Easy access to box location. Tube maintenance more difficult. Almost vertical rip-rap to water surface.

Conveyance Information:

Conveyance Type & Size (Example: (Unlined Channel), Grassy Swale, Open Channel Chute, etc.)

Describe: Rip-rap on east bank (right bank) & west bank.

Vegetative Cover ~ High ~ (Medium) ~ Low

Describe: Trees growing out of rip-rap. Grass area well-maintained

Visibility from the Right-of-Way ~ High Visibility ~ (Low Visibility) ~ None

Describe: Set below bridge elevation, low visibility from road

Public Access ~ (Yes) ~ No

Describe: At gate to Six Flags, (employee gate)

Evidence of Public Use ~ Yes ~ No (Circle all that apply, or describe)

Cans (Bottles) ~ Paper ~ Food Products ~ Rubble ~ Wood ~ Brush ~ Graffiti ~ Transient Community

Describe: Minimal debris

Evidence of Normal Surface Water Elevation (Yes) ~ No ~ Depth >2' inches/(feet)

Describe: _____

Perennial Flow Presence ~ High (Medium) ~ Low ~ Depth >2' inches/(feet)

Describe: _____

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water ~20'
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample ~20'
(Recommended to be less than 25 feet)

Other Site Features of Importance: Road construction of Copeland (~~East~~ westbound). East bound access only. SWP3 BMP's in place

Tree and Branch removal needed.

Notes: _____

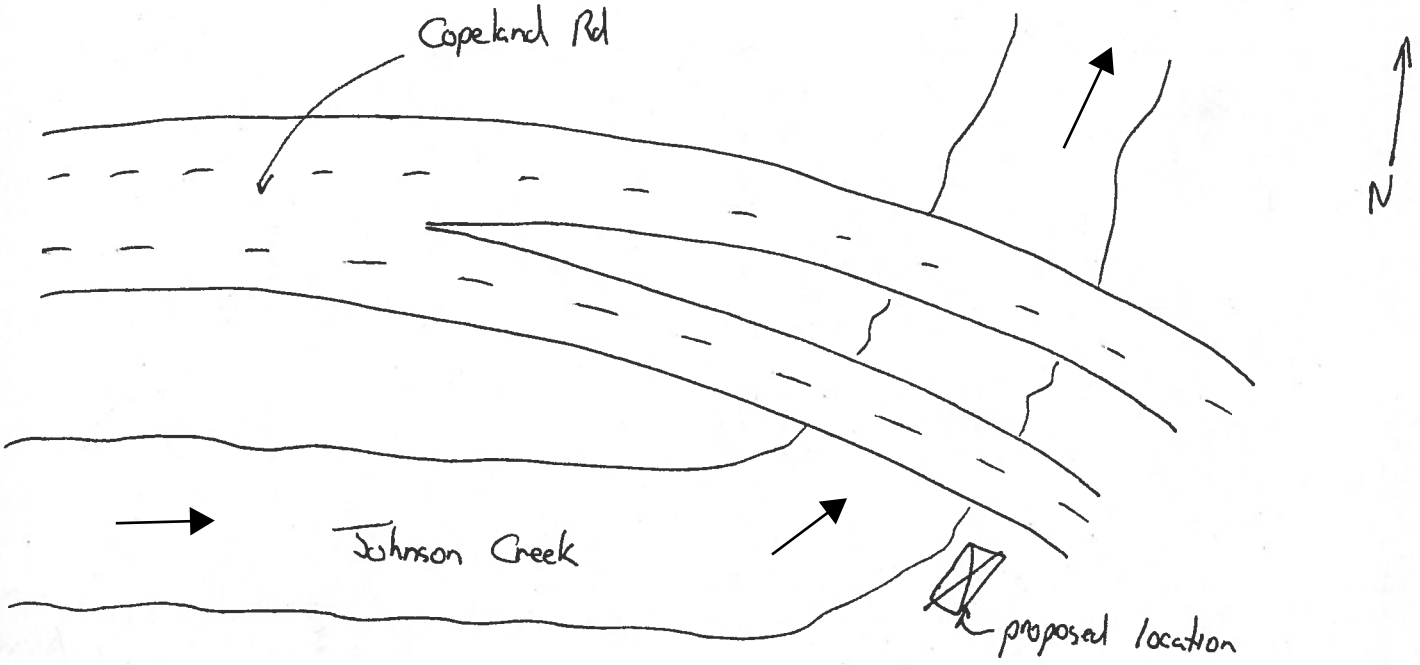
Provide Site Visit Attendee Name(s) and Company/Entity:

Brigette Gibson - City of Arlington

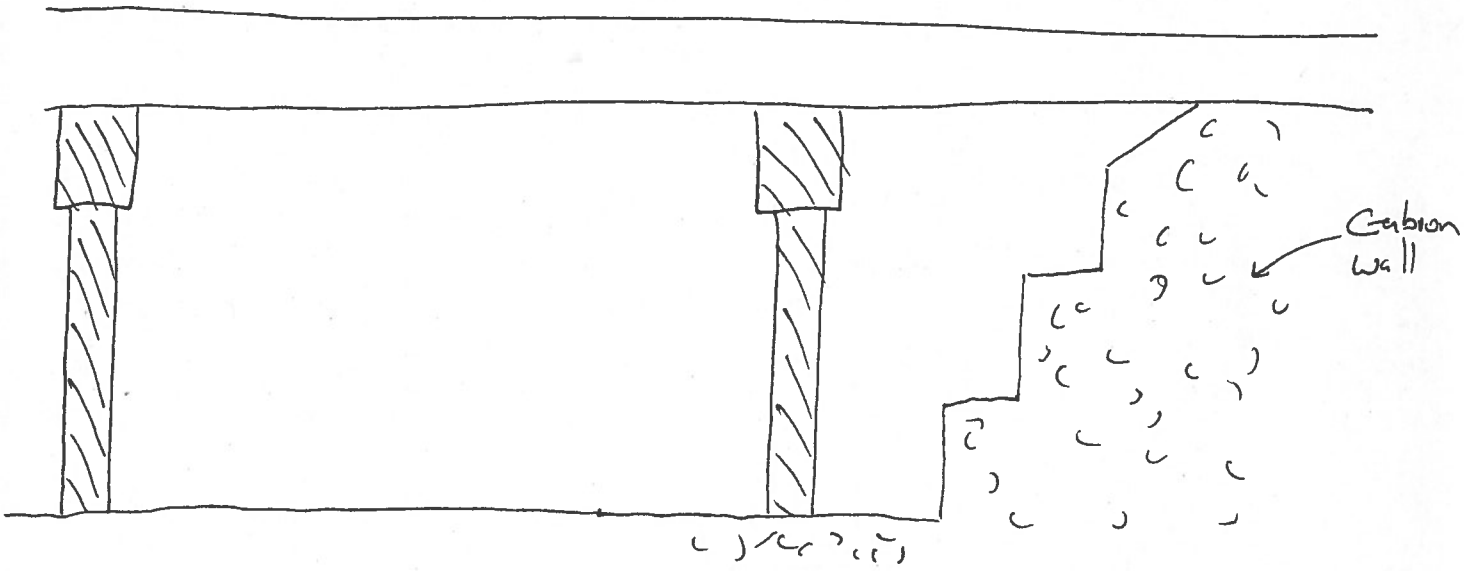
Ryan Deal - FNI

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/20/17 Time: 11:06

Location Name/Number: ARL-004 - Fish Creek @ 360

Nearest Cross Street/Location Description: Kingswood Blvd. / SE Green Oaks Blvd. & SH-360

Entity (Circle One): (Arlington) Garland Irving Mesquite NTTA Plano

GPS Latitude/Longitude: 32°39'44.47"N, 97°03'41.31" W

Receiving Water: West Fork Trinity

Data for locating automated samplers:

Ease of Installation ~ Native or Existing Location / Bench ~ (Need to construct Location / Platform / Base)

Describe: Brush clearing needed, somewhat level ground

Ease of channel/sample area access and safety: ~ Describe either (YES) or NO

Describe: Access off of SE Green Oaks Blvd. Next to Trinity Trail system

Conveyance Information:

RD

Conveyance Type & Size (Example: ~~Unlined~~ Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: ~~Natural stream channel~~ Lined channel (concrete)

Vegetative Cover ~ (High) ~ Medium ~ Low

Describe: Good riparian buffer

Visibility from the Right-of-Way ~ (High Visibility) ~ (Low Visibility) ~ None

Describe: Low from roadway, high from trail

Public Access ~ (Yes) ~ No

Describe: Trail System

Evidence of Public Use ~ Yes ~ No (Circle all that apply, or describe)

(Cans) ~ (Bottles) ~ (Paper) ~ (Food Products) ~ Rubble ~ Wood ~ (Brush) ~ Graffiti ~ Transient Community

Describe: In Channel, does not appear to be from trail

Evidence of Normal Surface Water Elevation ~ (Yes) ~ No ~ Depth <2" (inches)/feet

Describe:

Perennial Flow Presence ~ High ~ Medium ~ (Low) ~ Depth <2" (inches)/feet

Describe:

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water ~35'
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample ~6'
(Recommended to be less than 25 feet)

Other Site Features of Importance: Heavy brush, trail access. Vandalism likely

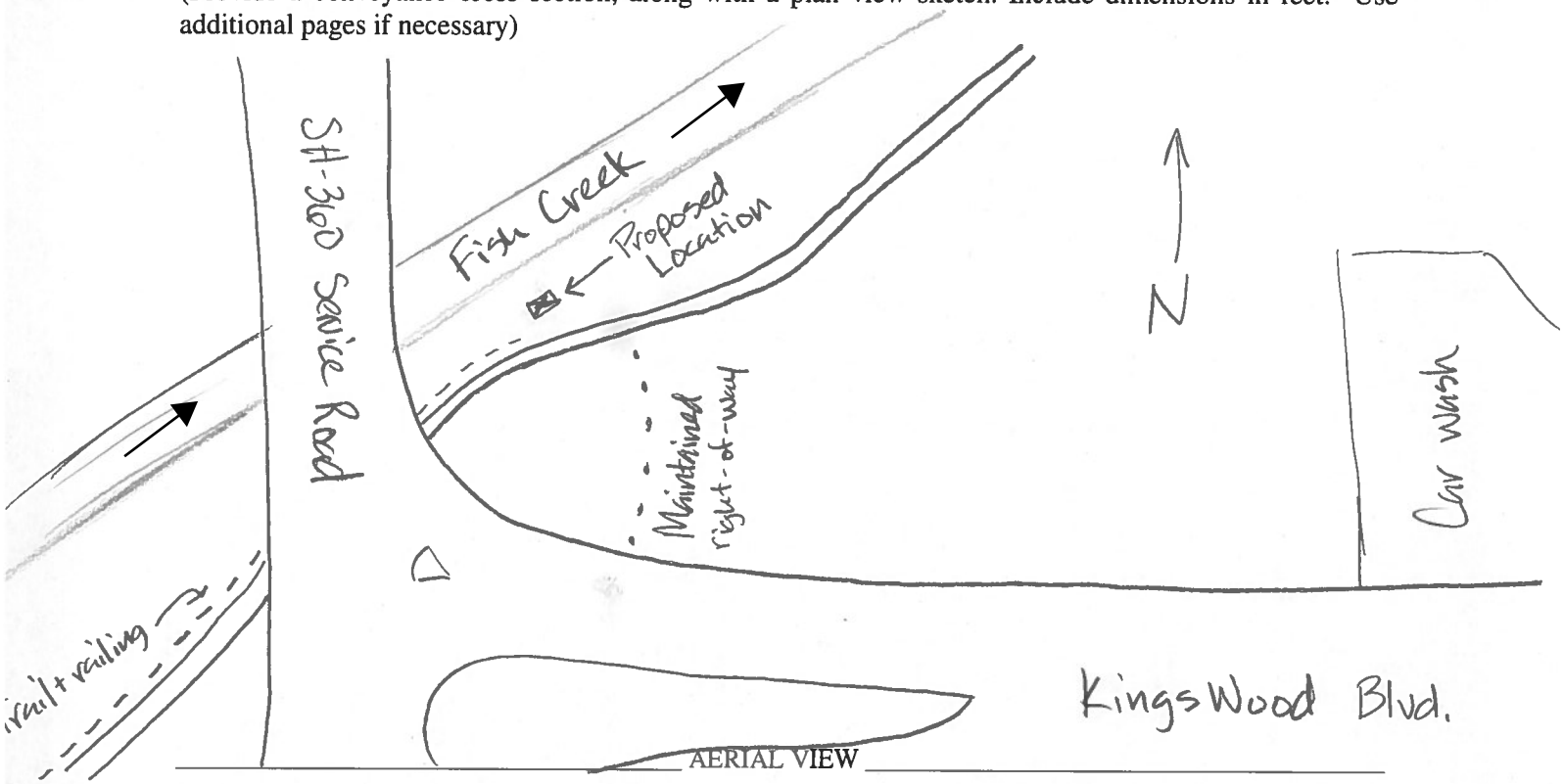
Notes:

Provide Site Visit Attendee Name(s) and Company/Entity:

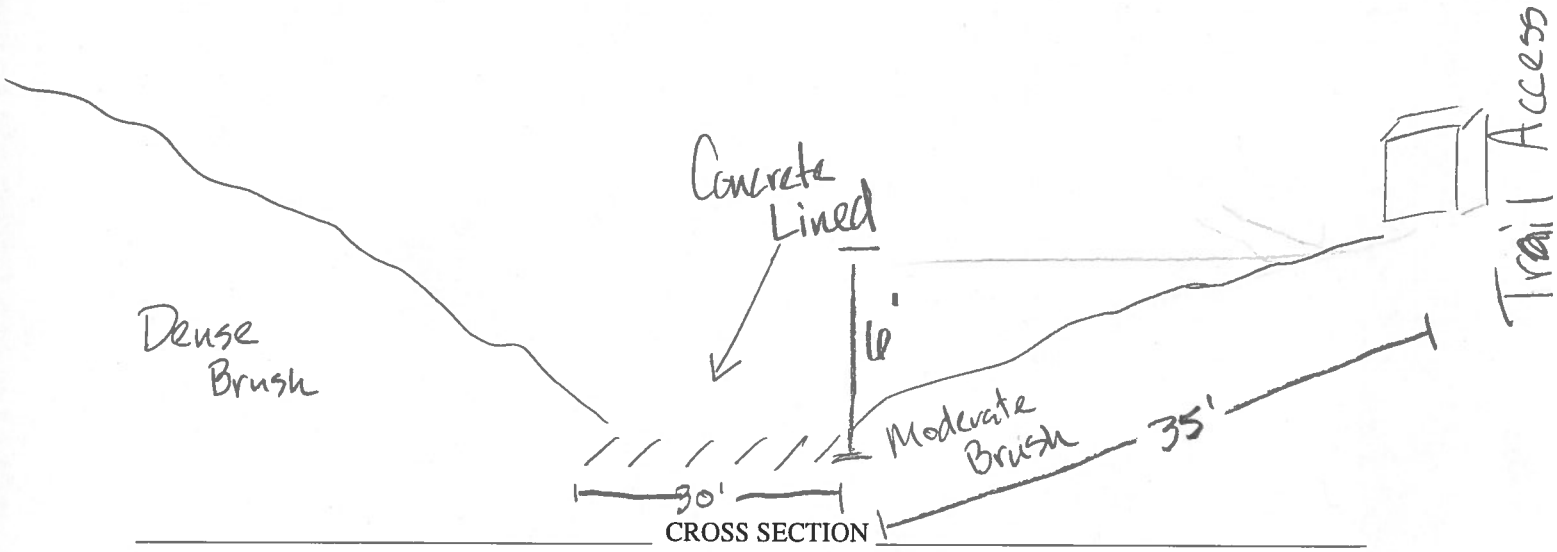
Brigette Gibson - City of Arlington
Ryan Deal - FNI

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

City of Garland

2018 - 2019 Sites

Duck Creek Watershed

Duck Creek at Shiloh Bridge

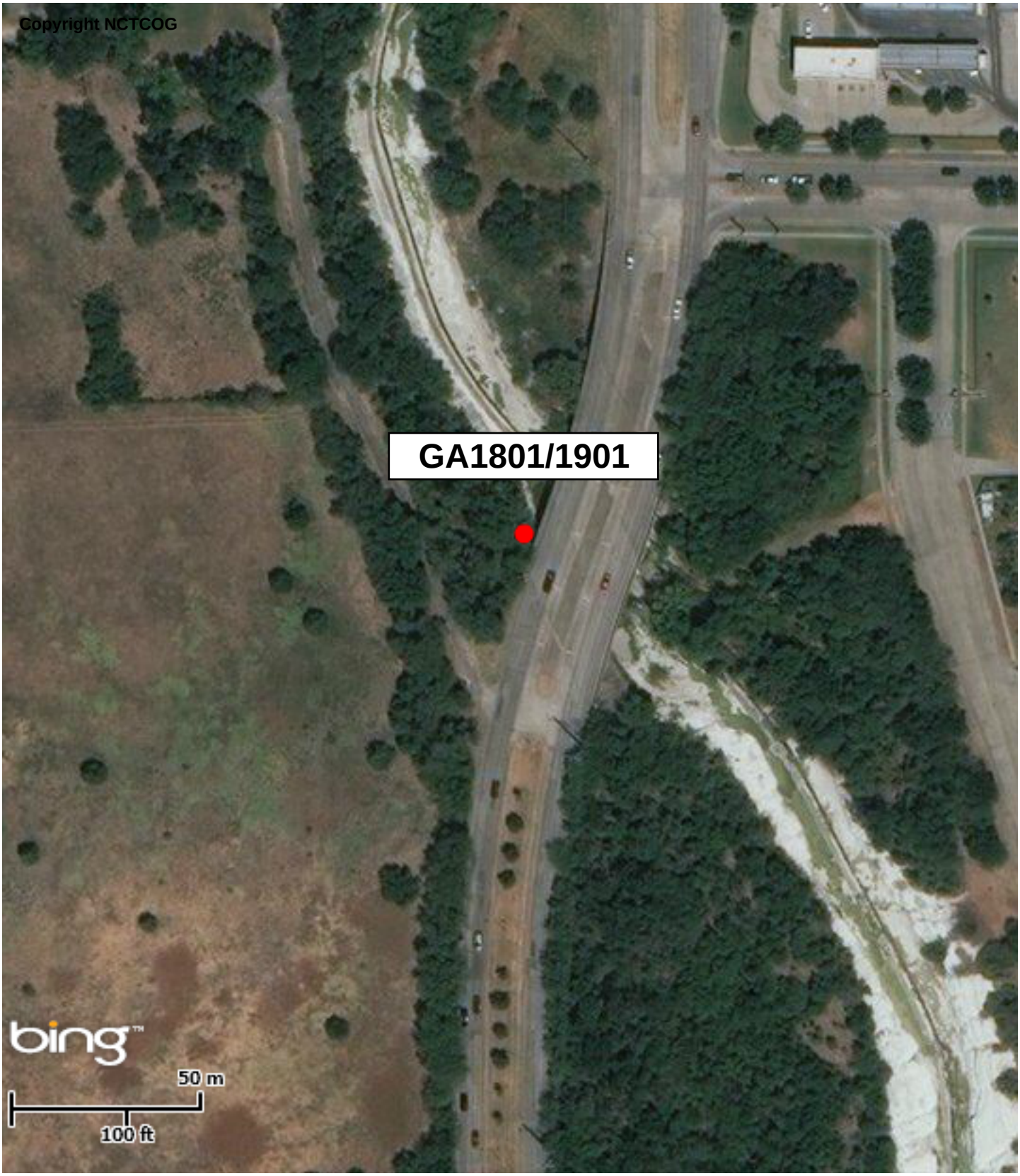
GA1801/1901

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N



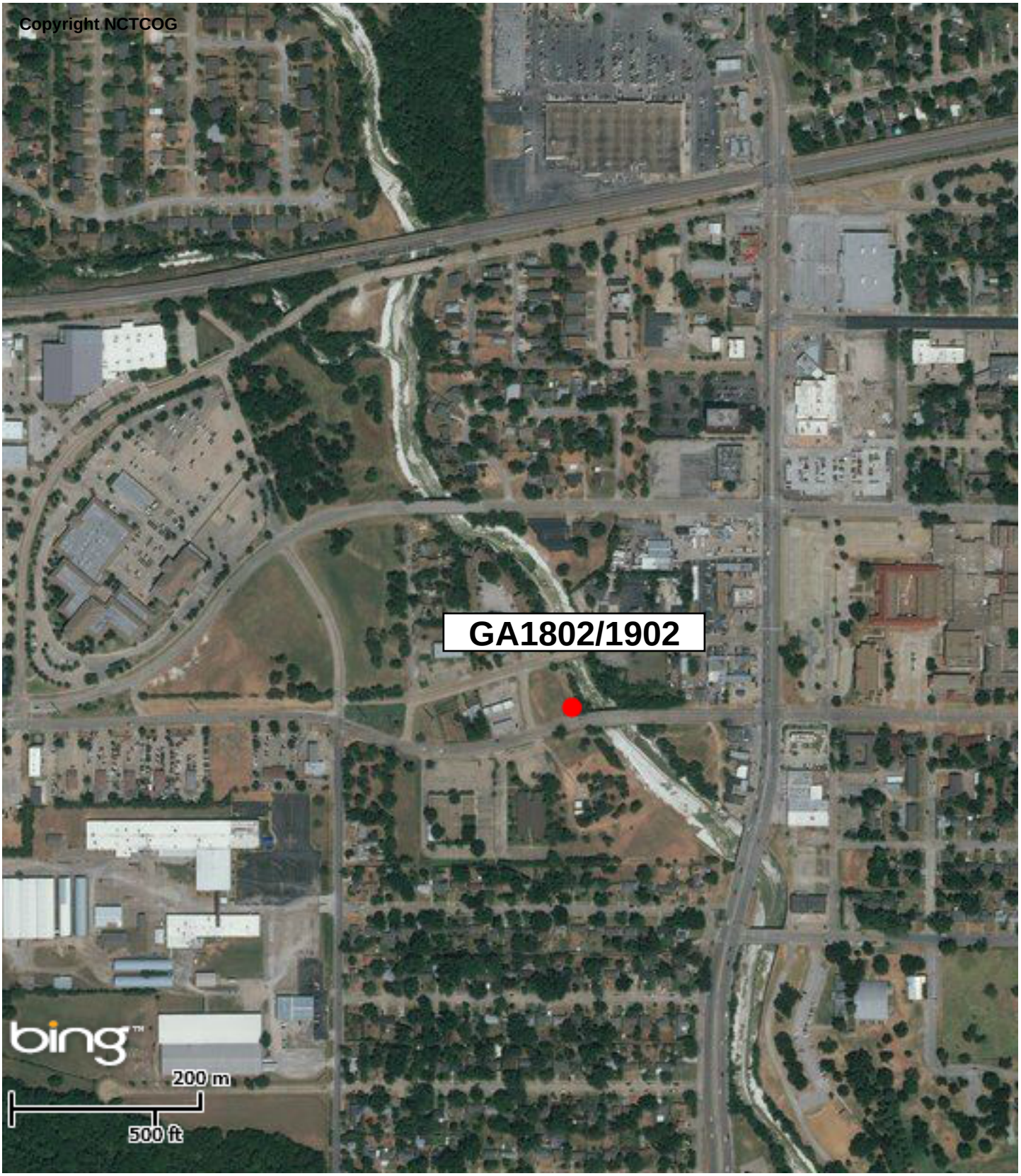
North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Duck Creek between Forest North and South GA1802/1902



North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Central Texas Council of Governments

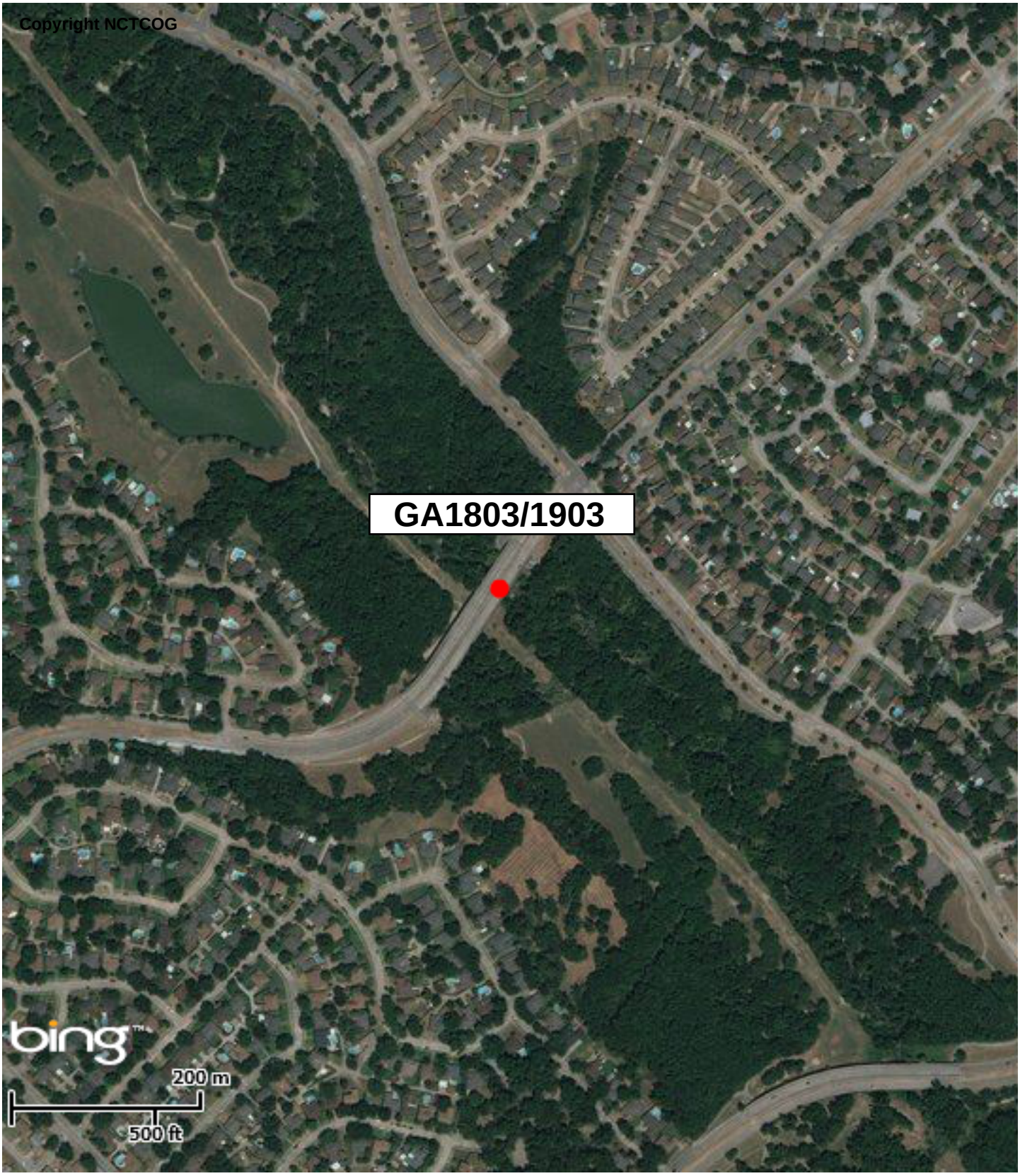
DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Duck Creek under La Prada Bridge

GA1803/1903



North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/15/17 Time: 9:00 AM

Location Name/Number: Site F Shiloh GA 01A

Nearest Cross Street/Location Description: N. Shiloh Road

Entity (Circle One): Arlington (Garland) Irving Mesquite NTTA Plano

GPS Latitude/Longitude: 32.928232° / -96.665222°

Receiving Water: Duck Creek

Data for locating automated samplers:

Ease of Installation ~~Native or Existing Location~~ / Bench Need to construct Location / Platform / Base

Describe: Level area above rock ledges from previous shelter

Ease of channel/sample area access and safety: Describe either (YES) or NO

Describe: Walk next to roadway; park on west side of Shiloh, south of bridge on small road in grass

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: Rock channel, unlined, natural, minimal sediment deposits; channel not expected to shift

Vegetative Cover (High) Medium Low

Describe: Lots of vegetation on top of bank; some clearing required

Visibility from the Right-of-Way High Visibility (Low Visibility) None

Describe: SW side of bridge

Public Access Yes (No)

Describe: Only from bridge; very little public use

Shiloh

Evidence of Public Use (Yes) No (Circle all that apply, or describe)

(Cans) (Bottles) (Paper) Food Products Rubble (Wood) Brush Graffiti Transient Community

Describe: Some trash located on top of bank

Evidence of Normal Surface Water Elevation (Yes) No Depth ~3 (inches)/feet

Describe: Water about 3 inches deep on bottom of concrete apron

Perennial Flow Presence High (Medium) Low Depth ~3 (inches)/feet

Describe: Moderate flow; riffles upstream and downstream

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water 25 ft
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample 24 ft
(Recommended to be less than 25 feet)

Other Site Features of Importance: Kinley - Horn development adjacent Plans submitted to City for subdivision.

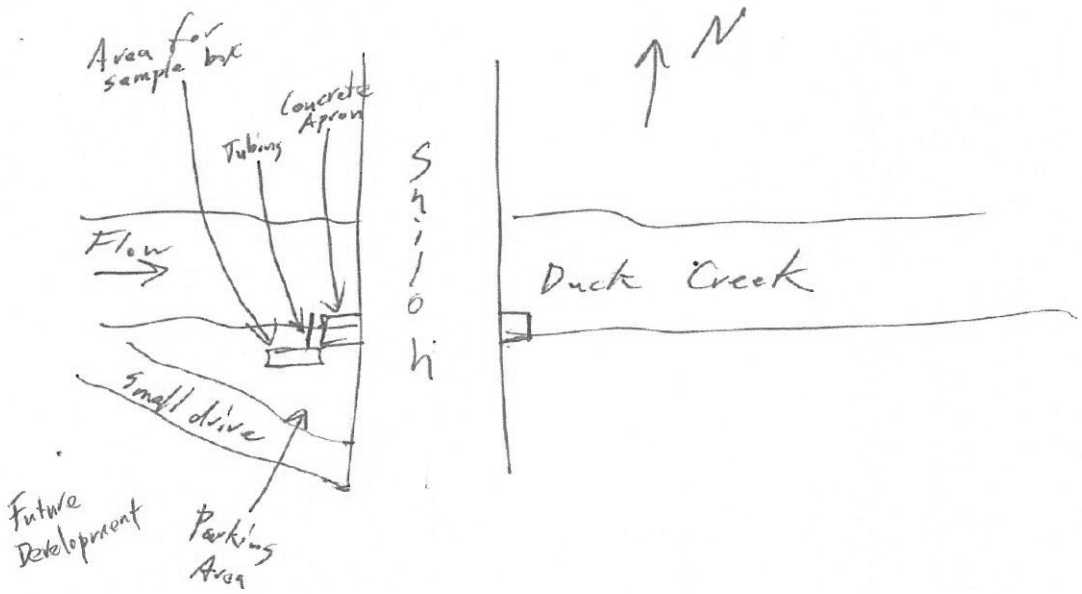
Notes:

Provide Site Visit Attendee Name(s) and Company/Entity:

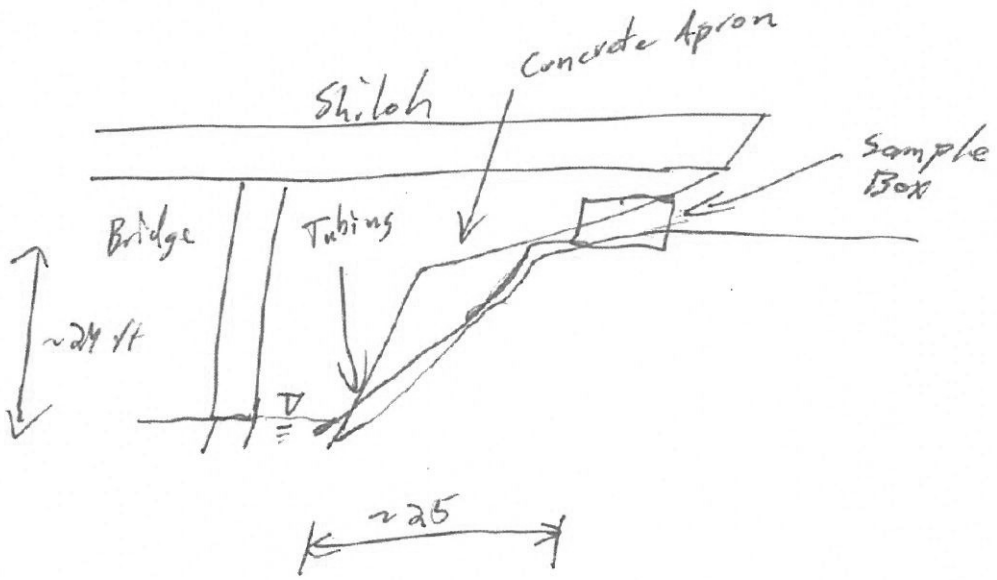
Wayne Wolverton - City of ~~Plano~~ Garland
Mike Wilson - City of ~~Plano~~ Garland
Chad Richards - Atkins

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/15/17 Time: 9:15 AM

Location Name/Number: Site G Forest Lane GA 02A

Nearest Cross Street/Location Description: S. Forest Lane

Entity (Circle One): Arlington (Garland) Irving Mesquite NTTA Plano

GPS Latitude/Longitude: 32.909388° / -96.650556°

Receiving Water: Duck Creek

Data for locating automated samplers:

Ease of Installation (Native or Existing Location / Bench) Need to construct Location / Platform / Base

Describe: Top of bank level from previous installation

Ease of channel/sample area access and safety: Describe either (YES) or NO

Describe: Drive onto grass area off of Keim Street b/w Forest Lane bridges

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: Rock bottom; earthen sides; gradual side slope on west bank

Vegetative Cover High Medium (Low)

Describe: Low on west bank; medium near channel bottom

Visibility from the Right-of-Way (High Visibility) Low Visibility None

Describe: Located b/w bridges in open area

Public Access (Yes) No

Describe: May get pedestrian traffic crossing b/w Forest Lane North and South

Forest Lane

Evidence of Public Use Yes (No) (Circle all that apply, or describe)

Cans Bottles Paper Food Products Rubble Wood Brush Graffiti Transient Community

Describe: Very little trash; some remnants of old sampling lines

Evidence of Normal Surface Water Elevation (Yes) No Depth 3 inches/feet

Describe: Mostly shallow on west side

Perennial Flow Presence High (Medium) Low Depth 3 (inches)/feet

Describe: Moderate flow present; channel very wide; mostly shallow with few pools

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water 30 ft
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample 25 ft
(Recommended to be less than 25 feet) Almost TOB

Other Site Features of Importance: Rock channel bottom with minimal sediment deposits; wide channel; flow stream not expected to shift

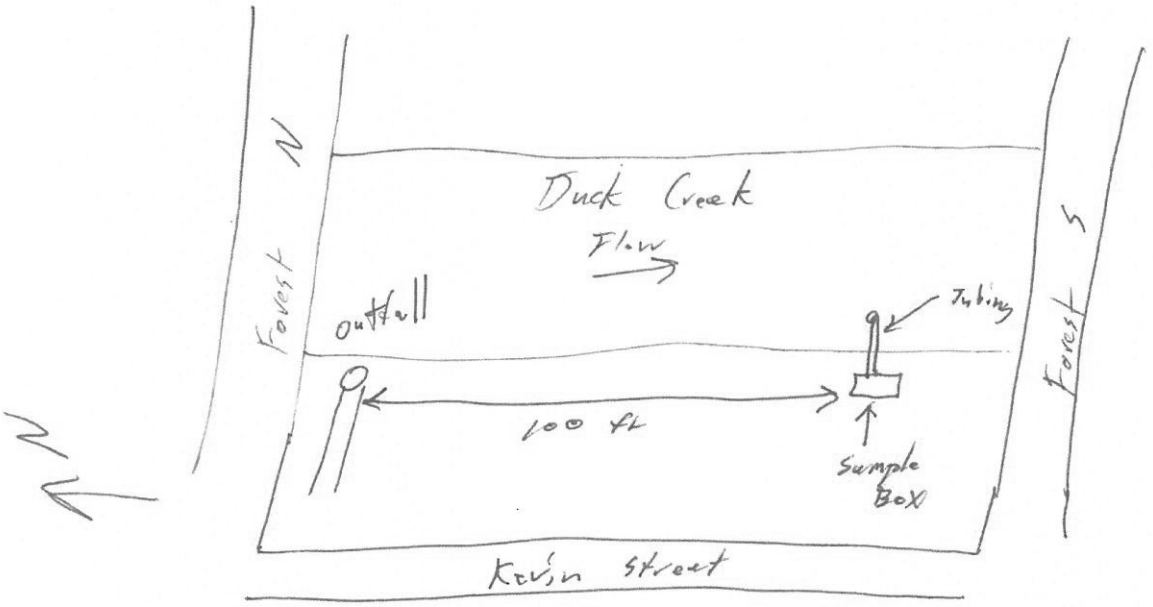
Notes: Previous installation near manhole

Provide Site Visit Attendee Name(s) and Company/Entity:

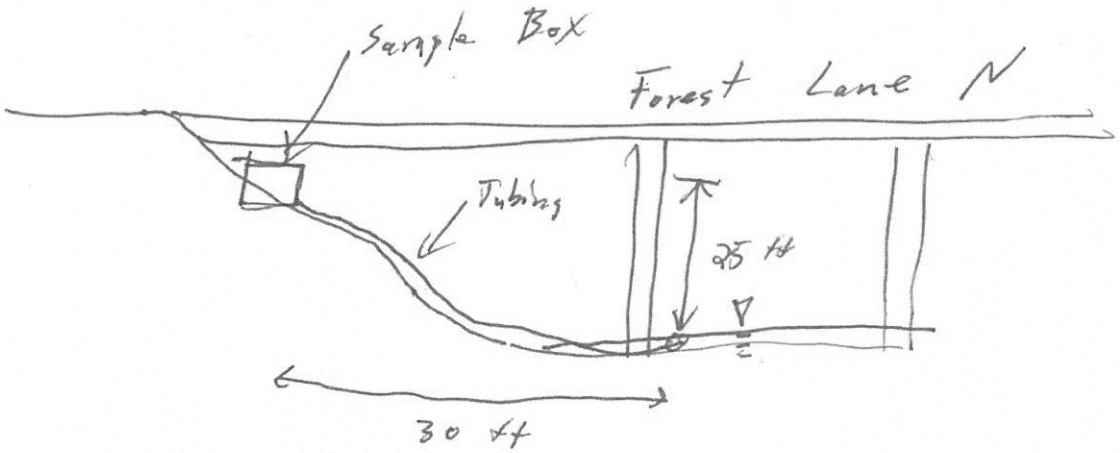
Wayne Wolverton - City of Garland
Mike Wilson - City of Garland
Chad Richards - Atkins

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/15/17 Time: 9:50

Location Name/Number: Site H La Prada GA 03 A

Nearest Cross Street/Location Description: La Prada Drive

Entity (Circle One): Arlington (Garland) Irving Mesquite NTTA Plano

GPS Latitude/Longitude: 32.855468° / -96.616894°

Receiving Water: Duck Creek

Data for locating automated samplers:

Ease of Installation (Native or Existing Location / Bench) Need to construct Location / Platform / Base

Describe: Secure to top of bank on gabions.

Ease of channel/sample area access and safety: Describe either (YES) or NO

Describe: Access down sidewalk and gravel road; do not park under bridge when wet

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: Unlined channel with gravel bottom

Vegetative Cover High Medium (Low)

Describe: None under bridge; medium on sides of bridge

Visibility from the Right-of-Way High Visibility (Low Visibility) None

Describe: Visible from walking / bike trails

Public Access (Yes) No

Describe: Trails cross by area

La Prada

Evidence of Public Use (Yes) No (Circle all that apply, or describe)

(Cans) Bottles (Paper) Food Products (Rubble) Wood Brush (Graffiti) Transient Community

Describe: Evidence of use under bridge

Evidence of Normal Surface Water Elevation (Yes) No Depth ~3 (inches)/feet

Describe: Deep pool on west side of bridge; becomes shallower under bridge and goes to another deep pool downstream

Perennial Flow Presence (High) Medium Low Depth ~3 inches/(feet)

Describe: Moderate to high flow through channel

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water 25 ft
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample 20 ft
(Recommended to be less than 25 feet)

Other Site Features of Importance: Place sampler on upstream side to run conduit to pool

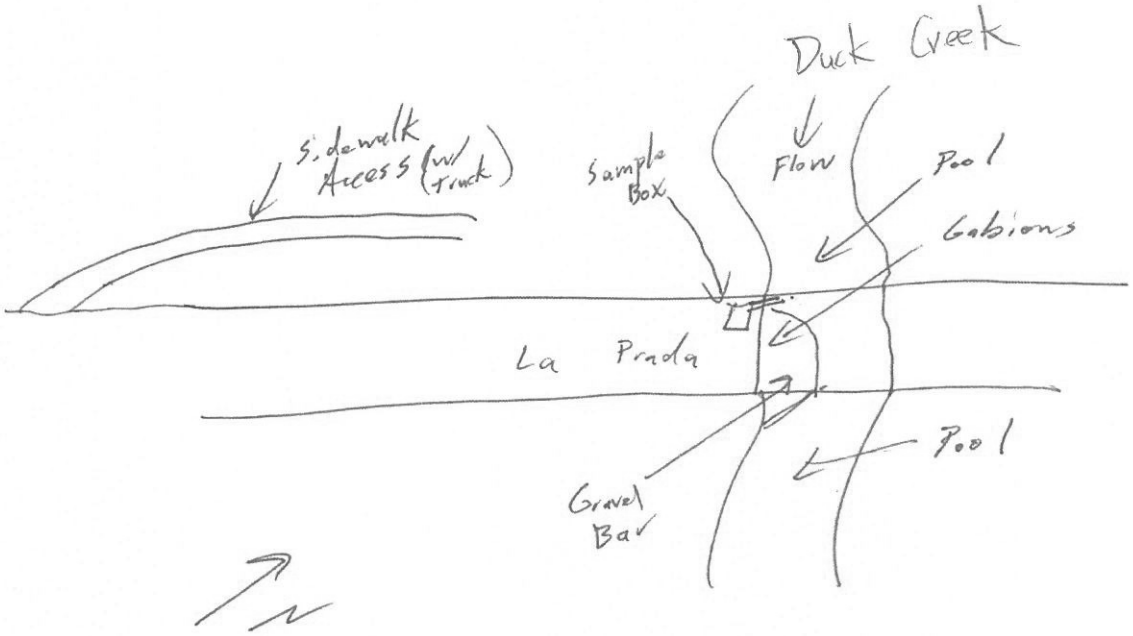
Notes:

Provide Site Visit Attendee Name(s) and Company/Entity:

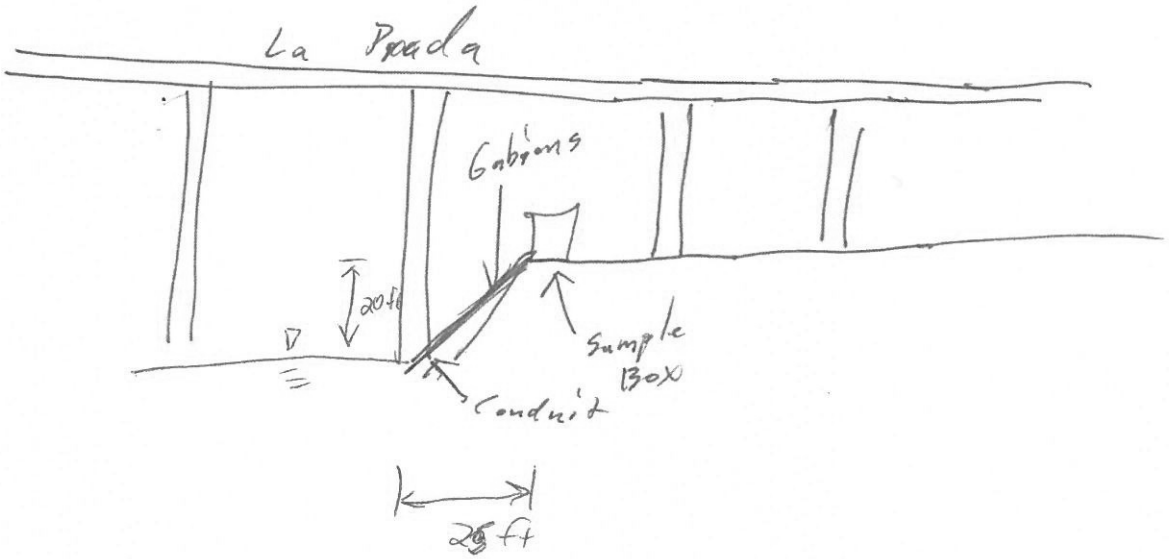
Chad Richards - Atkins
Mike Wilson - City of Garland
Wayne Wolverton - City of Garland

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

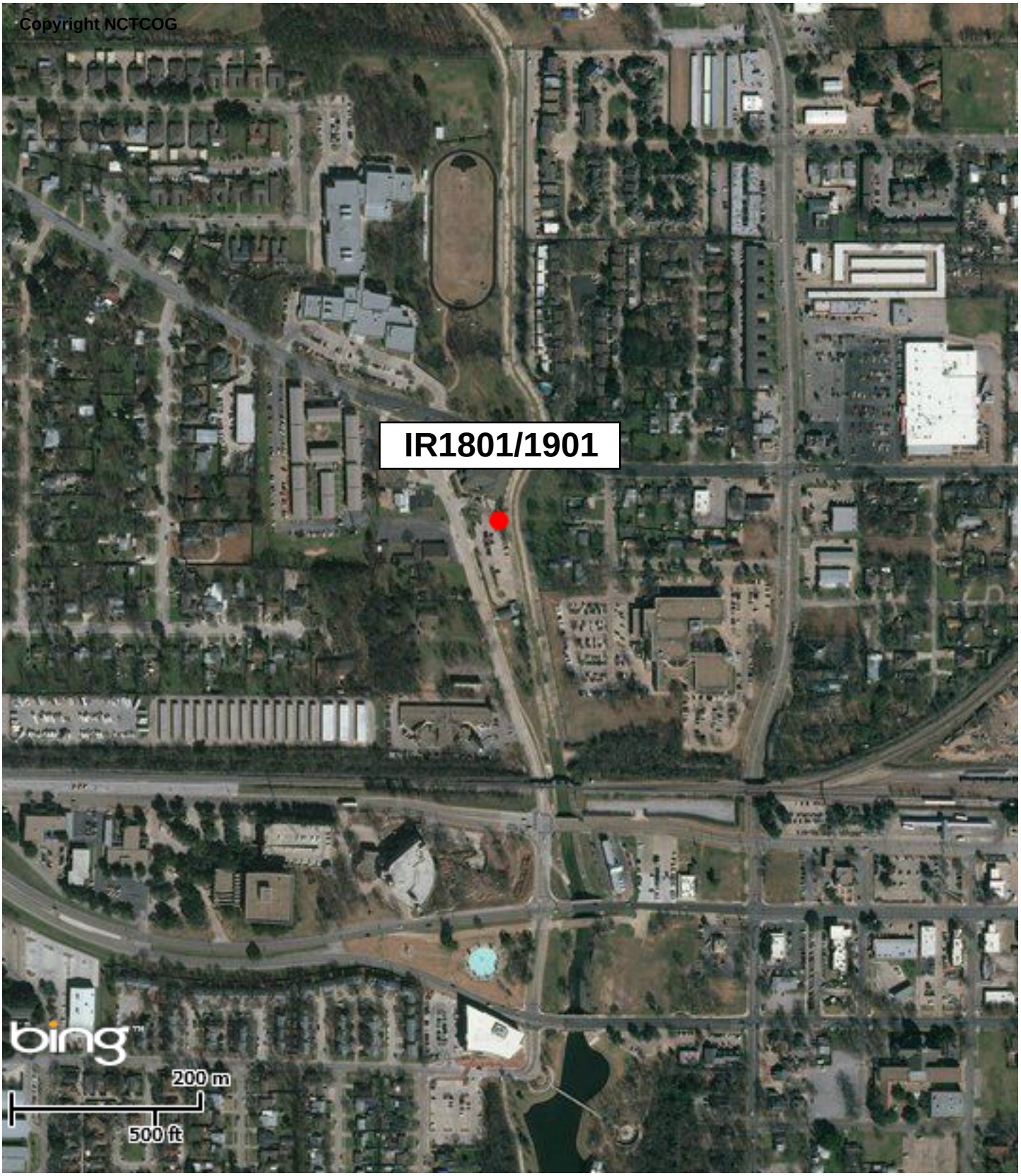
City of Irving

2018 - 2019 Sites

Delaware Creek – West Fork Trinity Watershed

Delaware Creek at Sowers Road

IR1801/1901



North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Central Texas Council of Governments

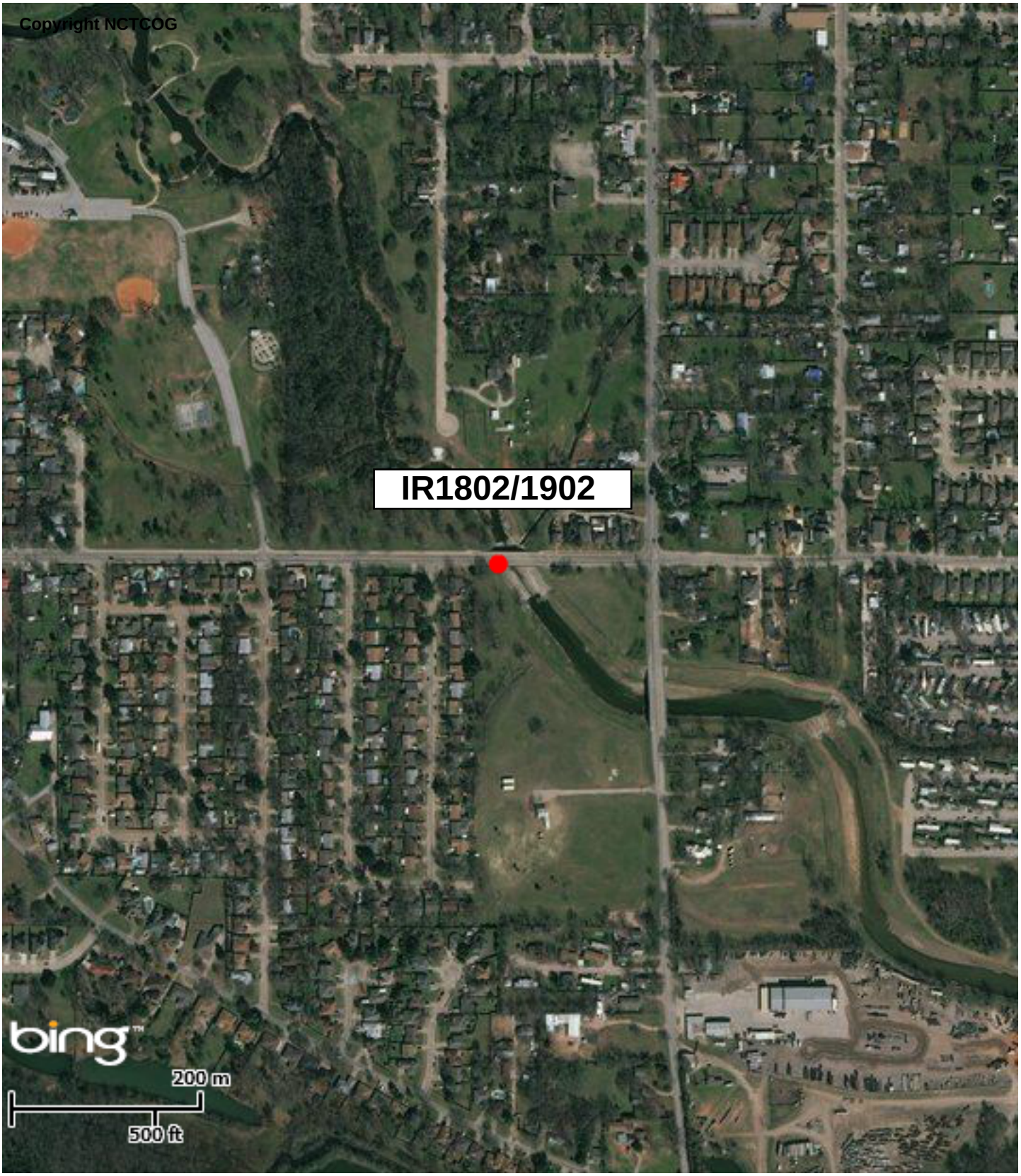
DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Delaware Creek at Oakdale

IR1802/1902



North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/13/17 Time: 10:01

Location Name/Number: Delaware Alternative 1 - Sowers Road

Nearest Cross Street/Location Description: _____

Entity (Circle One): Arlington Garland (Irving) Mesquite NTTA Plano

GPS Latitude/Longitude: 32.918N , 96.953N

Receiving Water: West Fork Trinity

Data for locating automated samplers:

Ease of Installation ~ (Native or Existing Location / Bench) ~ Need to construct Location / Platform / Base

Describe: Well maintained grass cover

Ease of channel/sample area access and safety: ~ Describe either (YES) or NO

Describe: Parking lot access & limited veg.

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: Concrete lined channel

Vegetative Cover ~ High ~ Medium ~ (Low)

Describe: No veg in channel

Visibility from the Right-of-Way ~ (High Visibility) ~ Low Visibility ~ None

Describe: Easily seen from Sowers Road

Public Access ~ (Yes) ~ No

Describe: Parking lot adjacent to site

Evidence of Public Use ~ Yes ~ No (Circle all that apply, or describe)

Cans ~ Bottles ~ Paper ~ Food Products ~ Rubble ~ Wood ~ Brush ~ Graffiti ~ Transient Community

Describe: _____

_____

Evidence of Normal Surface Water Elevation ~ Yes ~ No ~ Depth <6" inches/feet

Describe: _____

_____

Perennial Flow Presence ~ High ~ Medium ~ Low ~ Depth 6" inches/feet

Describe: _____

_____

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water ~35-40'
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample ~10'
(Recommended to be less than 25 feet)

Other Site Features of Importance: _____

_____

_____

_____

_____

_____

Notes: _____

_____

_____

_____

_____

_____

_____

_____

Provide Site Visit Attendee Name(s) and Company/Entity:

Jeff Shiflet - City of Irving

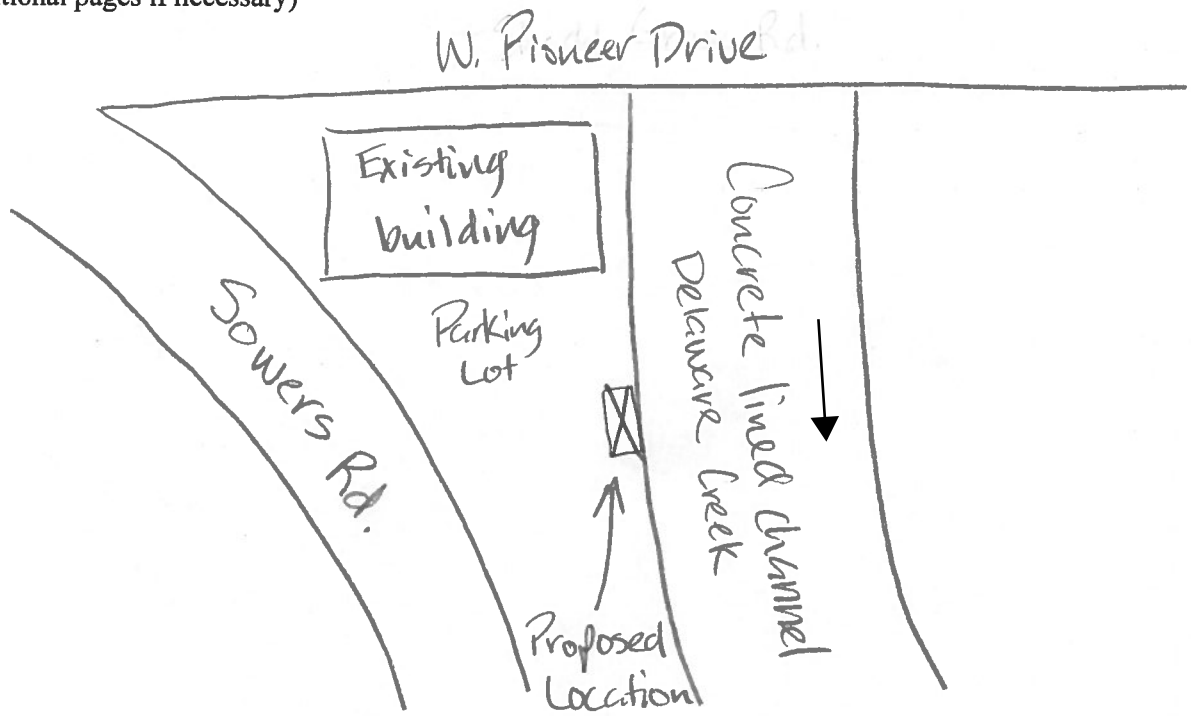
Ryan Deal - FNI

_____

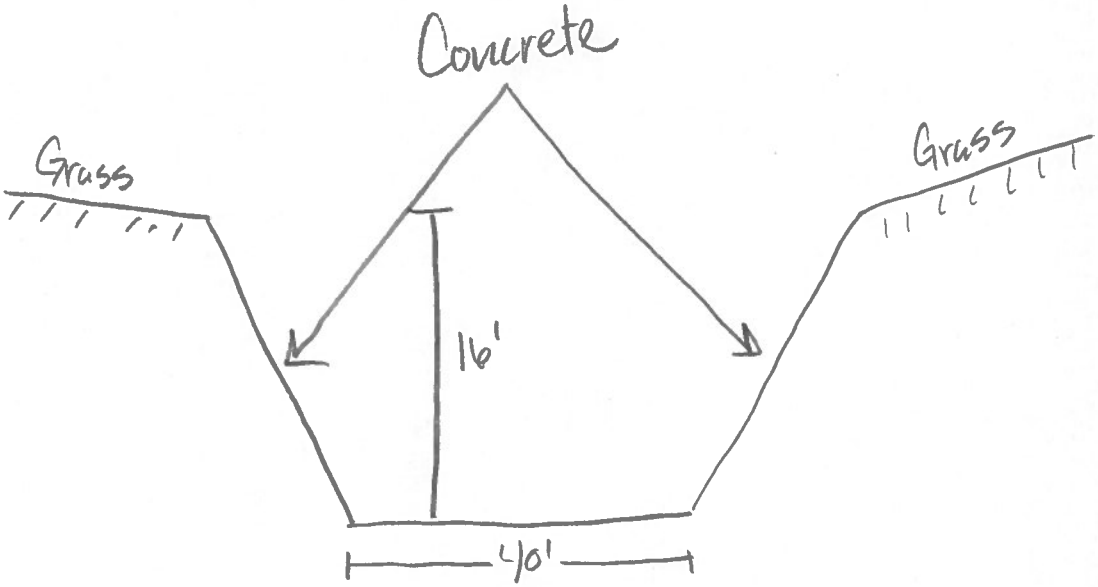
_____

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/13/17 Time: 10:35

Location Name/Number: IR 004 - East Oakdale Road @ Delaware Creek

Nearest Cross Street/Location Description: South Nursery Road

Entity (Circle One): Arlington Garland (Irving) Mesquite NTTA Plano

GPS Latitude/Longitude: 32.794N , 96.936W

Receiving Water: West Fork Trinity

Data for locating automated samplers:

Ease of Installation ~ (Native or Existing Location / Bench) ~ Need to construct Location / Platform / Base

Describe: Slightly maintained grass area

Ease of channel/sample area access and safety: ~ Describe either (YES) or NO

Describe: Adjacent to E. Oakdale Rd.

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: Concrete lined channel

Vegetative Cover ~ High ~ Medium (~ Low)

Describe: No veg. in channel

Visibility from the Right-of-Way ~ (High Visibility) ~ Low Visibility ~ None

Describe: Along E. Oakdale Rd.

Public Access ~ (Yes) ~ No

Describe: Sidewalk + Residential access

Evidence of Public Use ~ (Yes) ~ No (Circle all that apply, or describe)

Cans ~ Bottles ~ (Paper) ~ Food Products ~ Rubble ~ Wood ~ Brush ~ Graffiti ~ Transient Community

Describe: Paper debris, small amount

Evidence of Normal Surface Water Elevation ~ Yes ~ No ~ Depth <1 (inches)/feet

Describe:

Perennial Flow Presence ~ High ~ Medium ~ (Low) ~ Depth <1 (inches)/feet

Describe:

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water ~60'
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample ~15-20'
(Recommended to be less than 25 feet)

Other Site Features of Importance: Stormwater outlet @ site

Notes: After speaking with Jeff Shiflet, he mentioned that this location has had theft of solar panels in the past. The city of Irving had to move the sampler off of the main road.

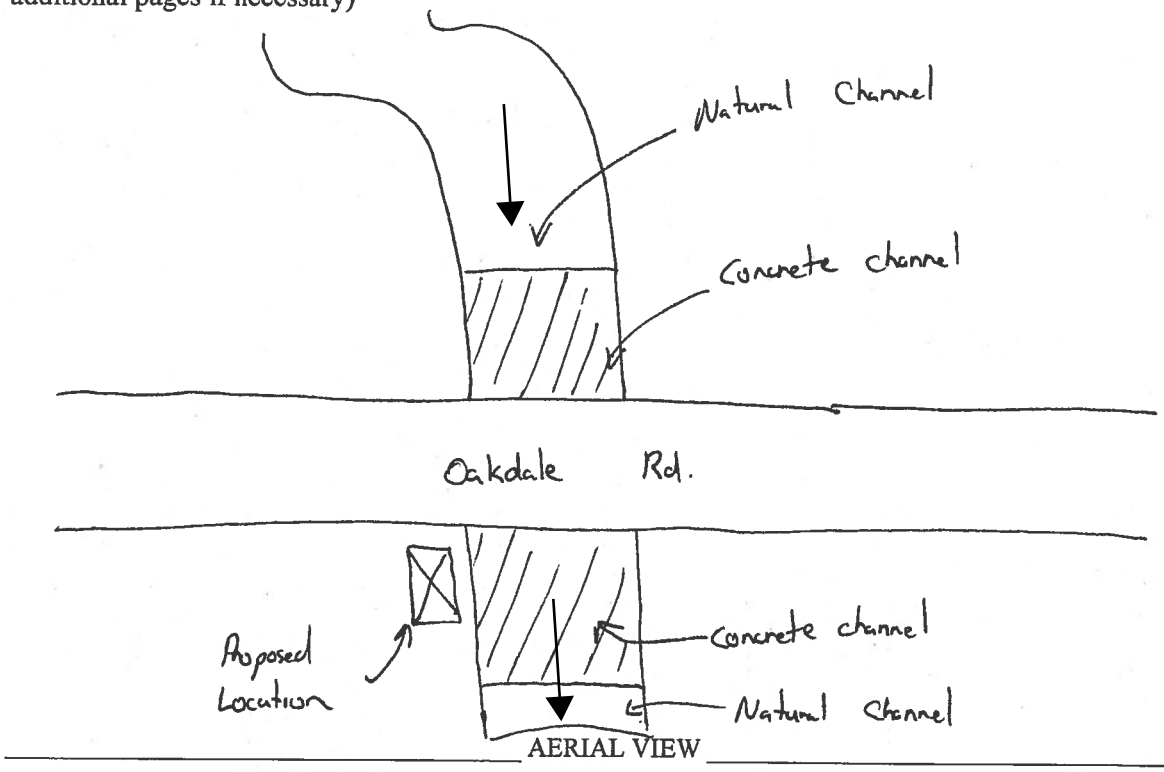
Provide Site Visit Attendee Name(s) and Company/Entity:

Jeff Shiflet - City of Irving

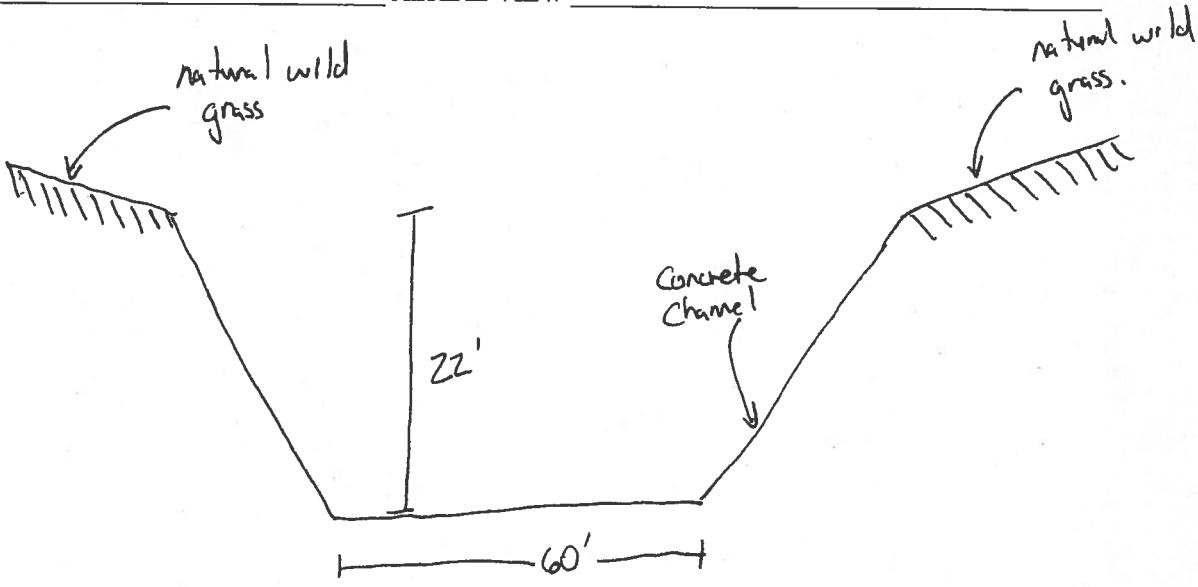
Ryan Deal - FNI

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

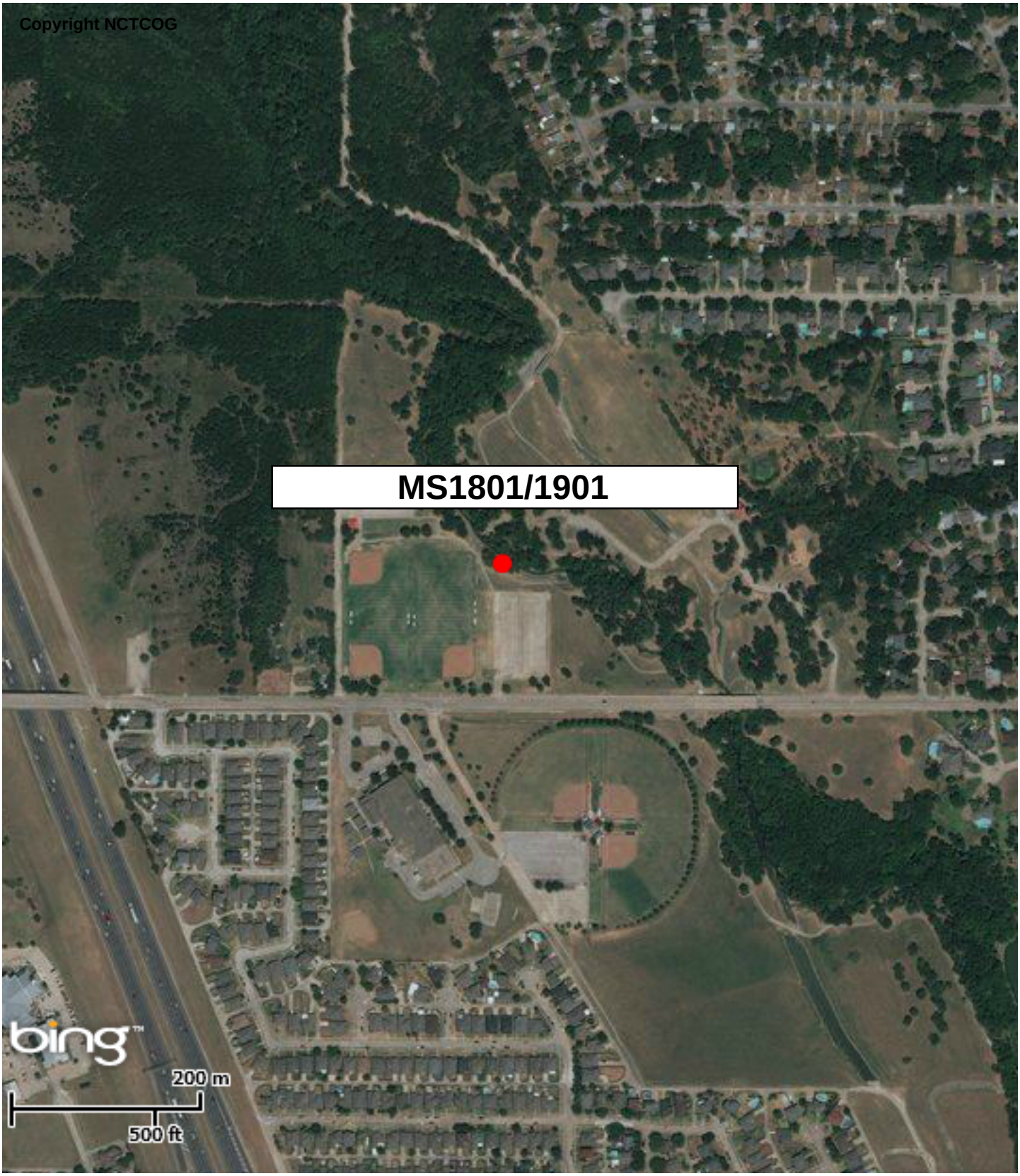
City of Mesquite

2018 - 2019 Sites

South Mesquite Creek and North Mesquite Creek Watersheds

North of New Market Road

MS1801/1901



North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Mesquite Creek at Edward's Church
MS1802/1902

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/9/17 Time: 0950 AM

Location Name/Number: NTES-001 North of New Market Rd (Paschall Park)

Nearest Cross Street/Location Description: New Market Road

Entity (Circle One): Arlington Garland Irving (Mesquite) NTTA Plano

GPS Latitude/Longitude: 32.75725° -96.6119444

Receiving Water: South Mesquite Creek

Data for locating automated samplers:

Ease of Installation ~ (Native or Existing Location / Bench) ~ Need to construct Location / Platform / Base

Describe: Pre-existing location. Explore platform option due to flooding

Ease of channel/sample area access and safety: ~ Describe either (YES) or NO

Describe: Pre-existing top of bank location. Access via parking lot and trail to the south.

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: Multi-lined; Shelter location. Side has concrete side slope other bank is natural. Bottom is a mix of concrete & rock + sediment

Vegetative Cover ~ High ~ Medium (Low) Moderately steep slope.

Describe: Well maintained grass

Visibility from the Right-of-Way ~ (High Visibility) ~ Low Visibility ~ None

Describe: None from road / High for park / trail patrons

Public Access (Yes) No

Describe: Baseball park; Trail; Park users

Evidence of Public Use ~ Yes ~ (No) (Circle all that apply, or describe)

Cans ~ Bottles ~ Paper ~ Food Products ~ Rubble ~ (Wood) ~ (Brush) ~ Graffiti ~ Transient Community

Describe: ~~Rubbish~~ K-S typical upstream floatables

Evidence of Normal Surface Water Elevation ~ (Yes) ~ No ~ Depth ~6-15" inches/feet

Describe: Evidence of recent rain

Perennial Flow Presence ~ High ~ Medium ~ (Low) ~ Depth ~6-15" inches/feet

Describe: See above

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water ~20-25ft
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample ~10-11ft
(Recommended to be less than 25 feet)

Other Site Features of Importance: Existing site with Shelters already in place.

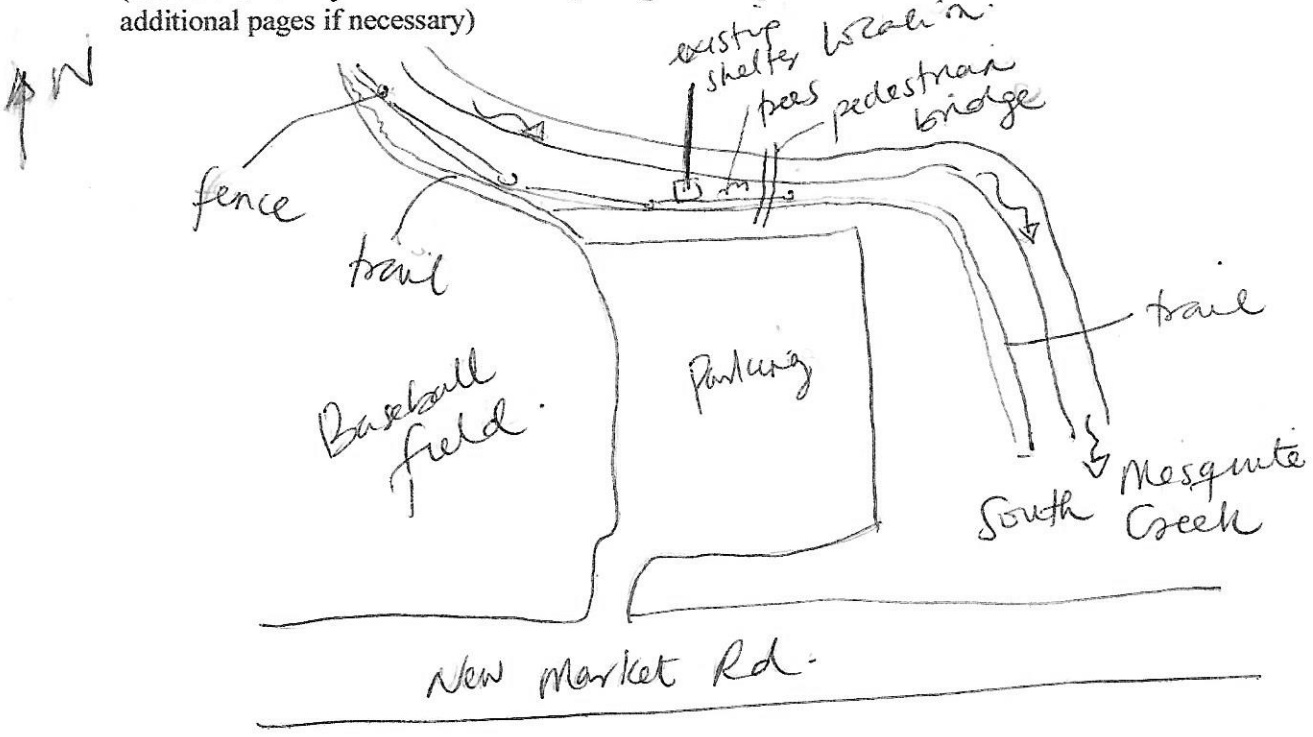
Notes:

Provide Site Visit Attendee Name(s) and Company/Entity:

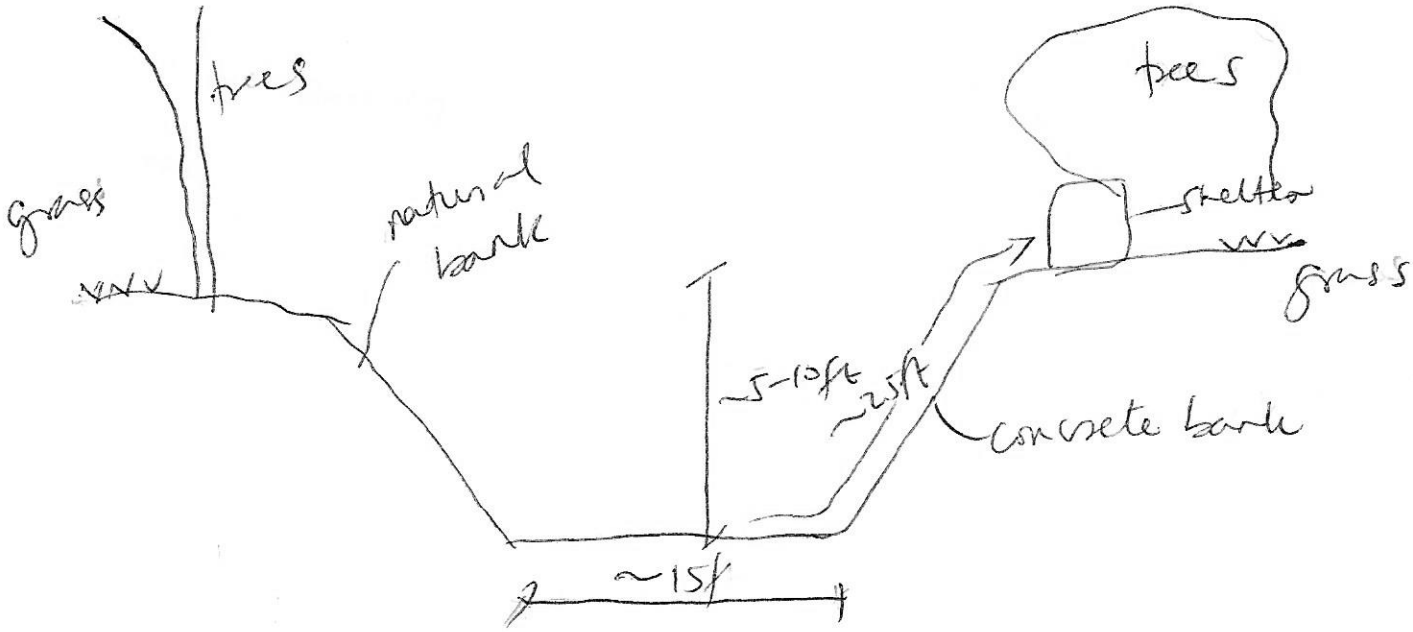
Robert Byrom (City of Mesquite)
Kofi Sam (ATKINS)

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/9/17 Time: 1011 AM

Location Name/Number: MES-002 N Mesquite Creek @ Edwards Church

Nearest Cross Street/Location Description: Edwards Church Road

Entity (Circle One): Arlington Garland Irving (Mesquite) NTTA Plano

GPS Latitude/Longitude: 32.7321111°, -96.5505

Receiving Water: N Mesquite Creek

Data for locating automated samplers:

Ease of Installation ~ (Native or Existing Location / Bench) ~ Need to construct Location / Platform / Base

Describe: Pre-existing location. Explore platform option due to potential flooding

Ease of channel/sample area access and safety: ~ Describe either (YES) or NO

Describe: Pre-existing top of bank location. north of bridge. Park on ROW dirt driveway east of creek. Access via north side foot

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: Natural channel; natural/earthen bank with rock/mesh lined lower bank bottom.

Vegetative Cover ~ High ~ Medium ~ (Low)

Describe: Low grass/brush

Visibility from the Right-of-Way ~ High Visibility ~ (Low Visibility) ~ None

Describe: Visible from side walk

Public Access ~ (Yes) ~ No

Describe: Side walk south of shelter location.

Evidence of Public Use ~ Yes ~ (No) (Circle all that apply, or describe)

Cans ~ Bottles ~ Paper ~ Food Products ~ Rubble ~ Wood ~ Brush ~ Graffiti ~ Transient Community

Describe: Instream wood/timber/logs and sediment

Evidence of Normal Surface Water Elevation ~ (Yes) ~ No ~ Depth ~7 to 8-12" inches/~~feet~~

Describe: moderate flow; recent rain

Perennial Flow Presence ~ High ~ Medium ~ (Low) ~ Depth _____ inches/feet

Describe: See above

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water ~50ft
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample ~5-7ft
(Recommended to be less than 25 feet)

Other Site Features of Importance: Existing site with shelters already in place.

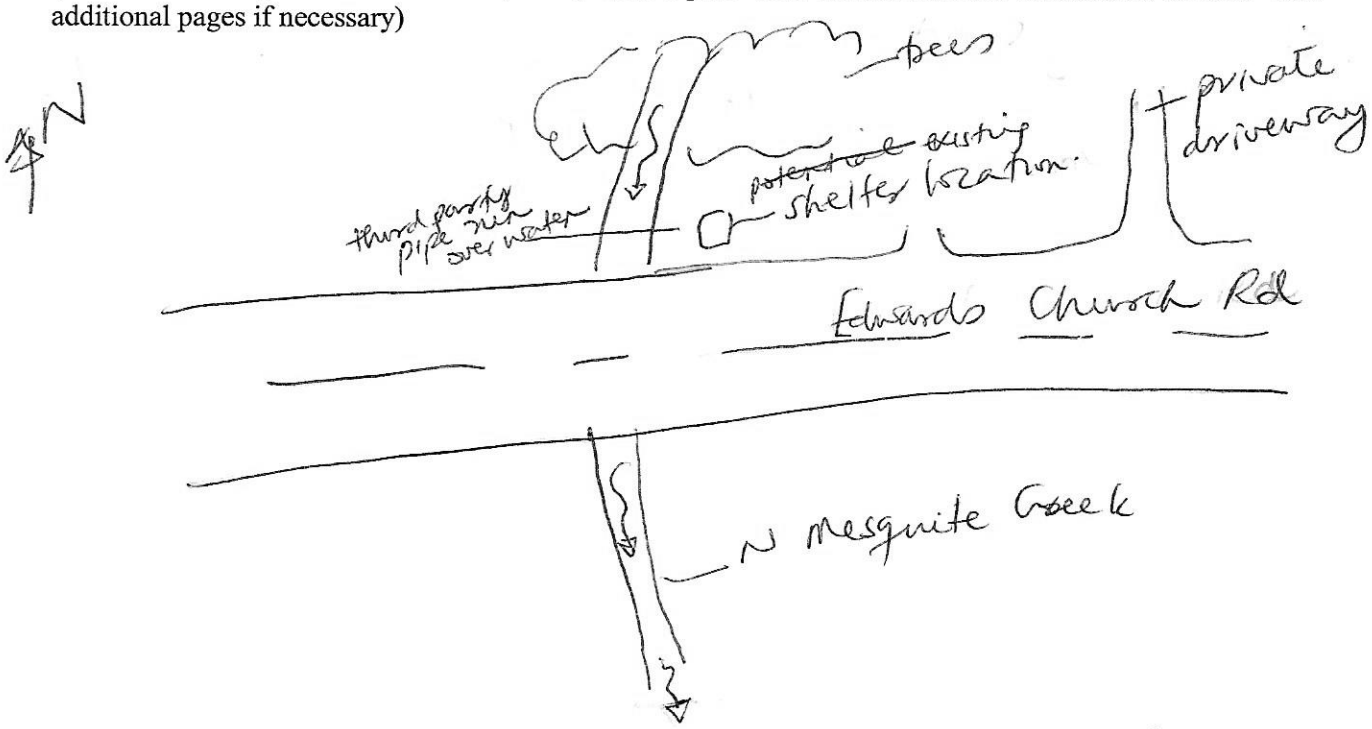
Notes:

Provide Site Visit Attendee Name(s) and Company/Entity:

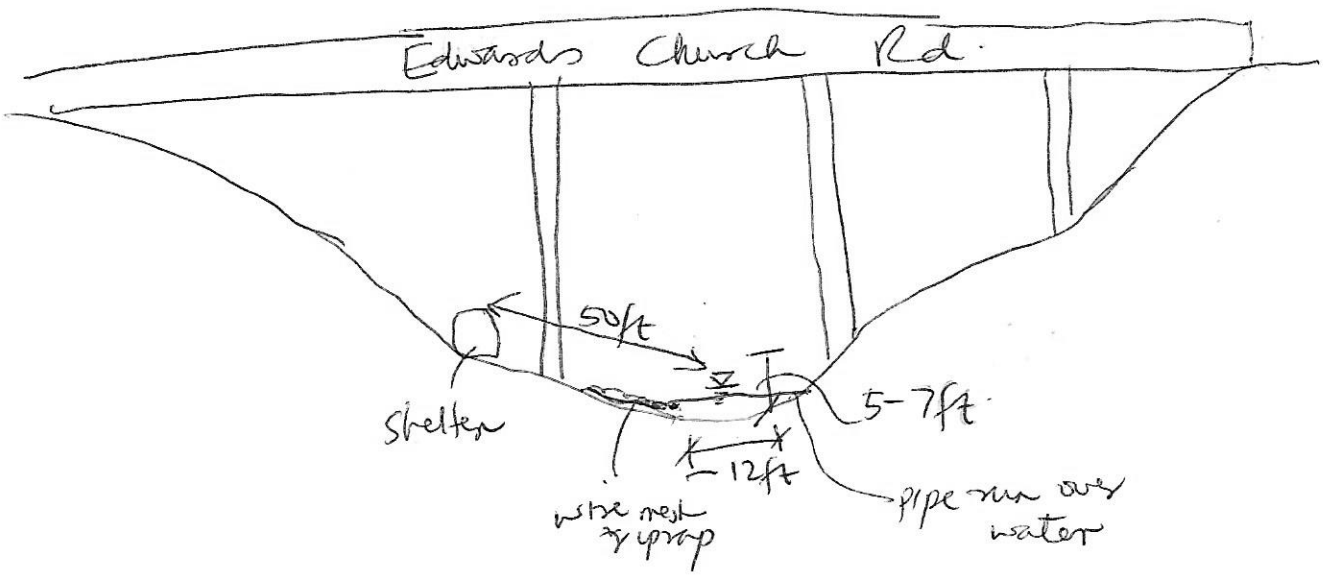
Robert Byrom (City of Mesquite)
Kofi Sam (ATKINS)

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

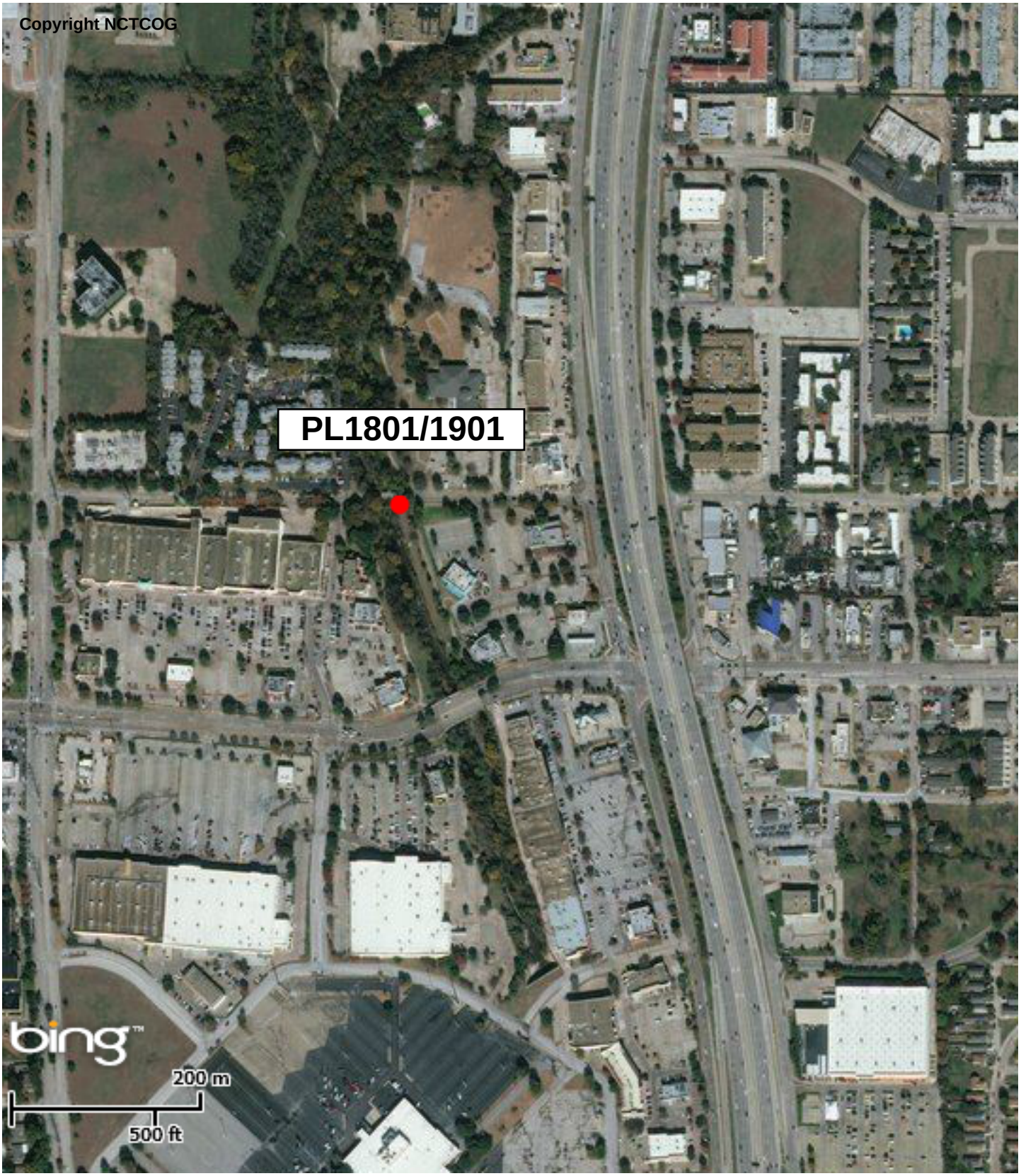
City of Plano

2018 - 2019 Sites

Spring Creek Watershed

Spring Creek at 16th Street

PL1801/1901



North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/16/17 Time: 10:15 AM

Location Name/Number: Spring Creek @ 16th Street PL01B

Nearest Cross Street/Location Description: 16th Street

Entity (Circle One): Arlington Garland Irving Mesquite NTTA (Plano)

GPS Latitude/Longitude: 33.021317° / -96.712406°

Receiving Water: Spring Creek

Data for locating automated samplers:

Ease of Installation (Native or Existing Location / Bench) Need to construct Location / Platform / Base

Describe: Concrete base / platform on sanitary line (existing)

Ease of channel/sample area access and safety: Describe either (YES) or NO

Describe: Harrington Park; parking lot access to site

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: Natural, unlined, open channel with rock bottom

Vegetative Cover High Medium (Low)

Describe: Some brush, manicured grass at top of bank, trees near stream

Visibility from the Right-of-Way (High Visibility) (Low Visibility) CR None

Describe: Visible from roadway

Public Access (Yes) No

Describe: ~~From trail~~ Adjacent to walk/bike trail

Evidence of Public Use (Yes) No (Circle all that apply, or describe)

(Cans) Bottles (Paper) Food Products (Rubble) Wood (Brush) (Graffiti) Transient Community

Describe: Trash present under bridge and in adjacent areas

Evidence of Normal Surface Water Elevation (Yes) No Depth ~1 (inches)/feet

Describe: Uniform depth under bridge crossing

Perennial Flow Presence High (Medium) Low Depth ~1 (inches)/feet

Describe: Uniform flow near proposed location

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water 30 ft
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample 20 ft
(Recommended to be less than 25 feet)

Other Site Features of Importance:

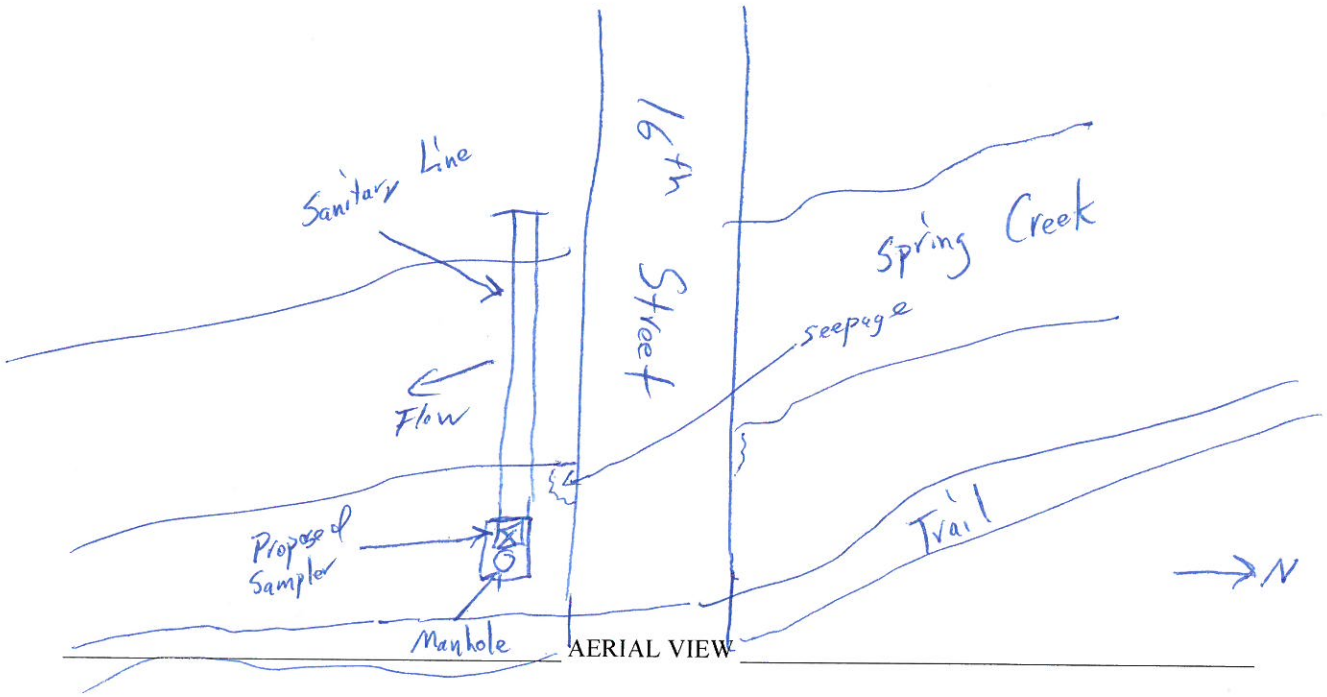
Notes: Evidence of overflow event from sanitary manhole (stains on manhole); seepage occurring under bridge

Provide Site Visit Attendee Name(s) and Company/Entity:

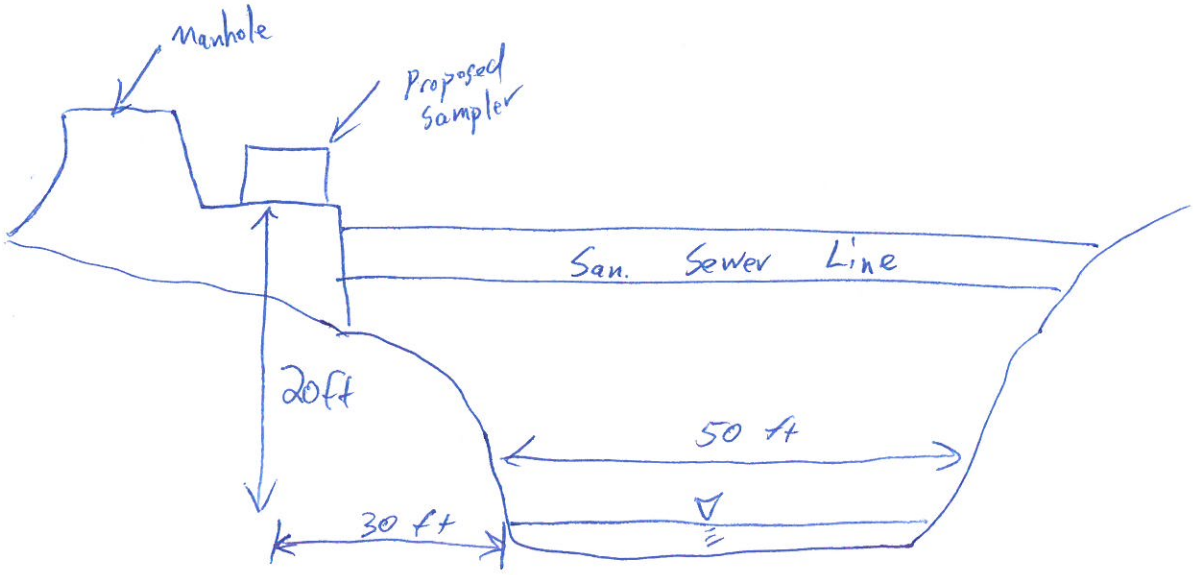
Chad Richards - Atkins
Mayra Lopez - NCTCOG
Heather Firn - City of Plano

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

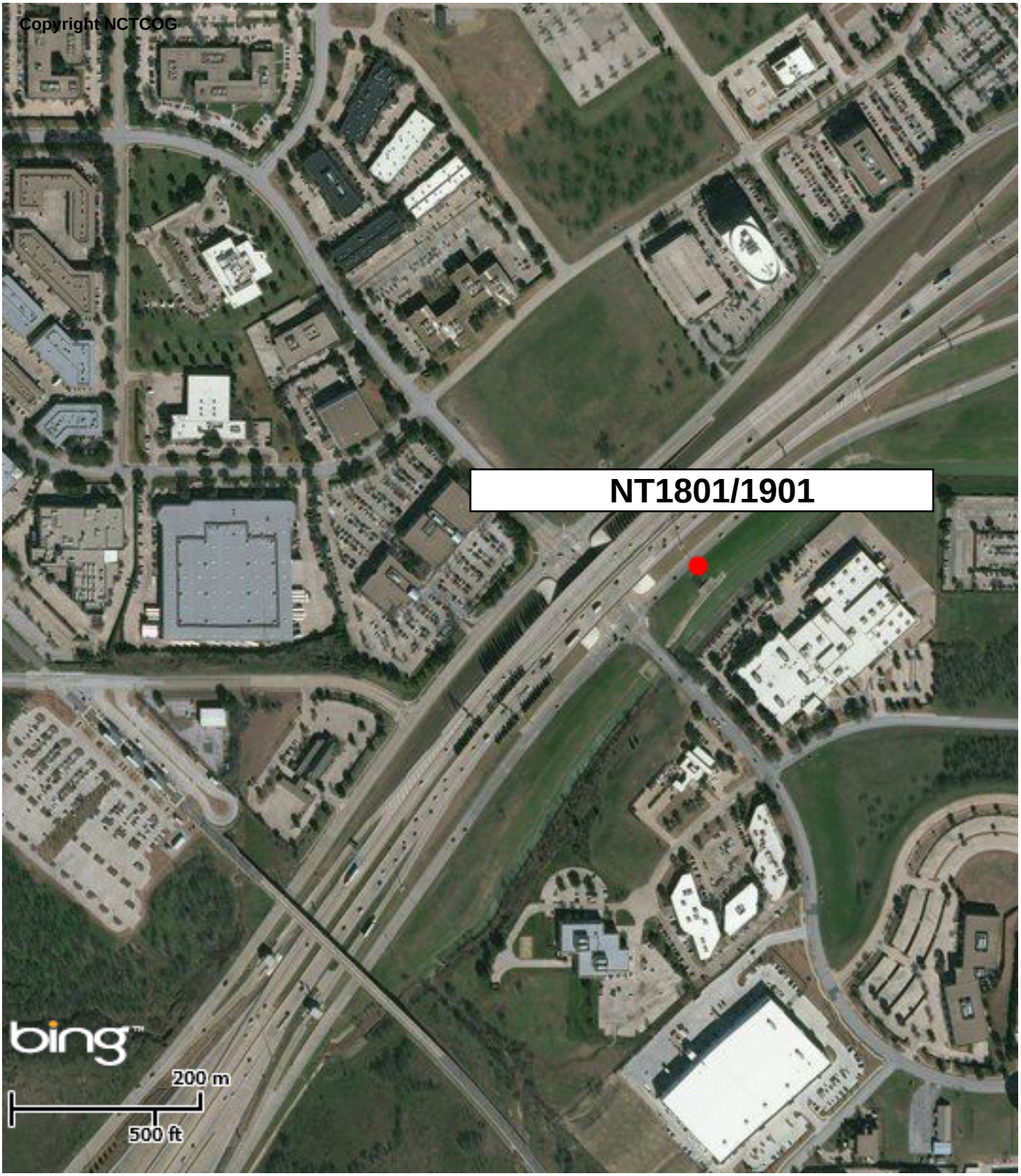
NTTA

2018 - 2019 Sites

Cottonwood Branch – Hackberry Creek and Cottonwood Creek – Mountain Creek Lake Watersheds

Unnamed Tributary at SH161 N of Gateway Drive

NT1801/1901

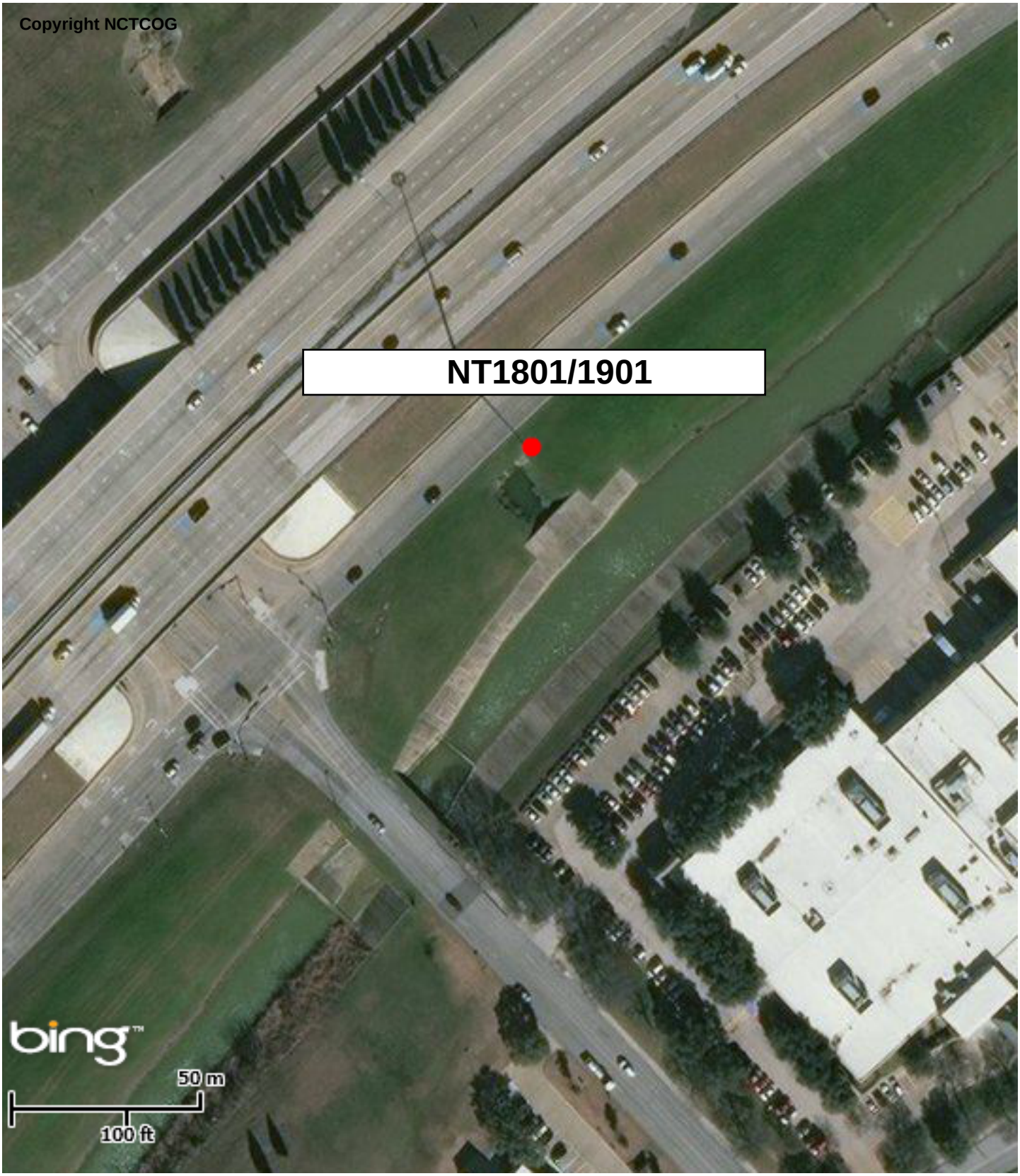


North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N



North Central Texas Council of Governments

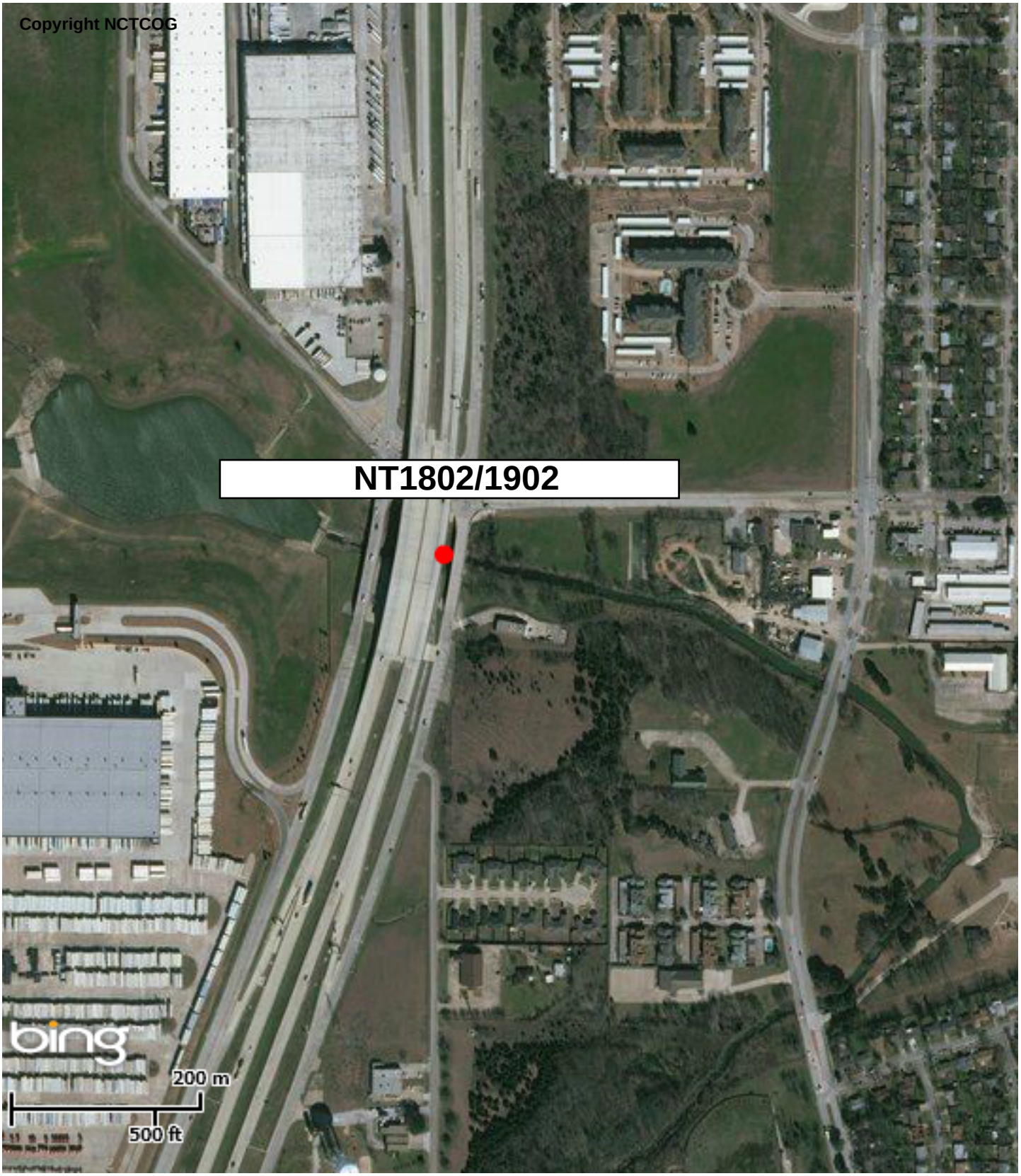
DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Cottonwood Creek at SH161 S of Dickey Road

NT1802/1902



North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

North Central Texas Council of Governments

DFWMaps.com

DISCLAIMER
This data has been compiled for NCTCOG.
Various official and unofficial sources were used to gather this information. Every effort was made to ensure the accuracy of this data, however, no guarantee is given or implied as to the accuracy of said data.

N

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/3/17 Time: 1258 PM

Location Name/Number: NTTA-001B

Nearest Cross Street/Location Description: PGBT E Northof Gateway Dr

Entity (Circle One): Arlington Garland Irving Mesquite (NTTA) Plano

GPS Latitude/Longitude: 32.899808, -96.980065

Receiving Water: Unnamed Tributary to Hackberry Creek

Data for locating automated samplers:

Ease of Installation ~ [Native or Existing Location / Bench] ~ Need to construct Location / Platform / Base

Describe: level ground on top of bank

Ease of channel/sample area access and safety: ~ Describe either (YES) or NO

Describe: Park on grass adjacent to culvert or in parking lot south of location and walk to site.

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: 4-~~box~~ Pipe culvert apron with concrete bottom & sides serves as forebay into concrete lined trib to Hackberry Creek

Vegetative Cover ~ High ~ Medium (Low)

Describe: Well maintained grass cover

Visibility from the Right-of-Way ~ [High Visibility] ~ Low Visibility ~ None

Describe: Vehicular traffic visibility

Public Access ~ (Yes) ~ No

Describe: Vehicular traffic visibility

Evidence of Public Use ~ Yes ~ (No) (Circle all that apply, or describe)

Cans ~ Bottles ~ Paper ~ Food Products ~ Rubble ~ Wood ~ Brush ~ Graffiti ~ Transient Community

Describe: No sign of public use

Evidence of Normal Surface Water Elevation ~ (Yes) ~ No ~ Depth 1" inches/feet

Describe: 1" depth on concrete apron drops to about 2' forebay

Perennial Flow Presence ~ High ~ Medium ~ (Low) ~ Depth 1" - 2' inches/feet

Describe: see above

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water ~15ft
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample ~5ft
(Recommended to be less than 25 feet)

Other Site Features of Importance:

Notes:

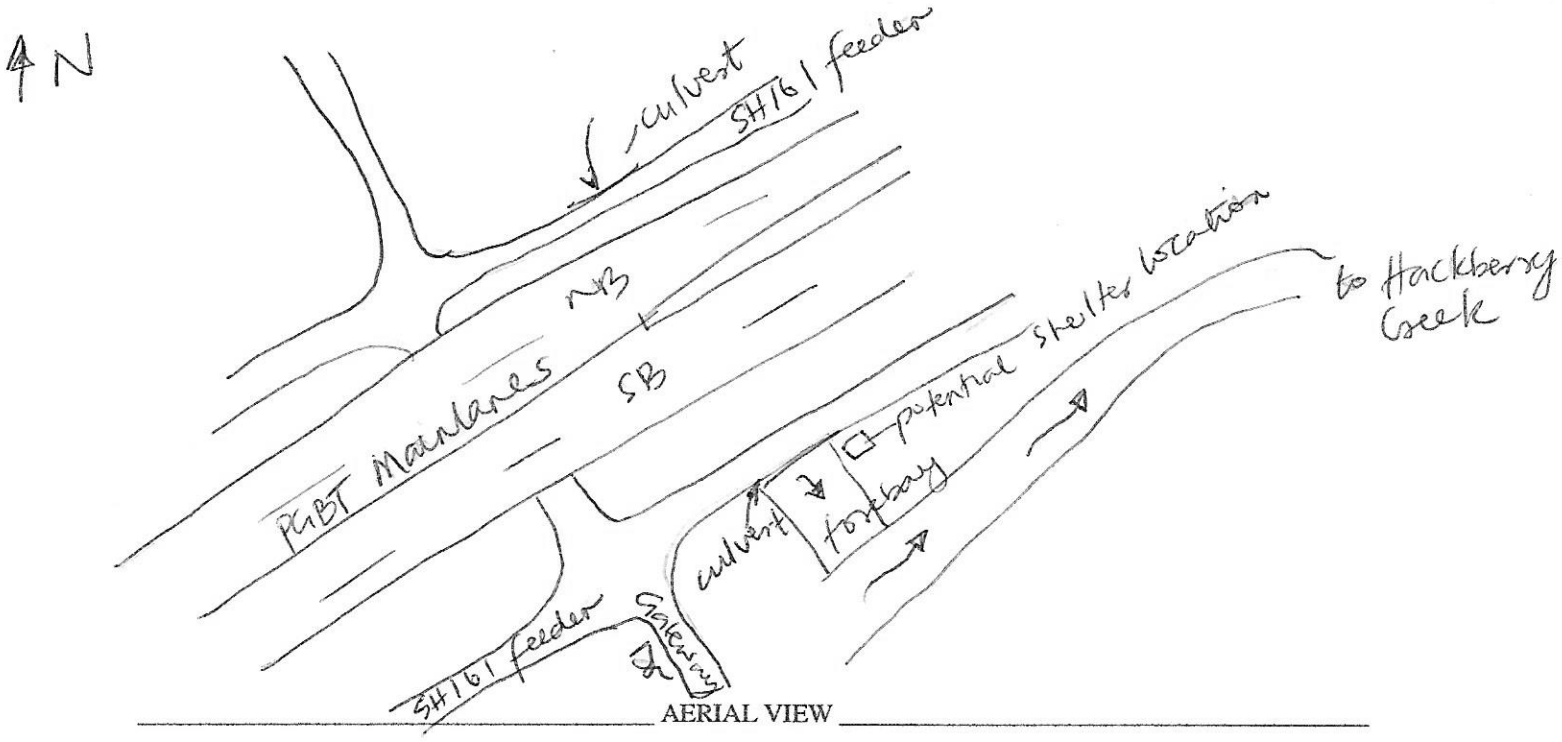
Provide Site Visit Attendee Name(s) and Company/Entity:

Moss Fennell (VRX) On behalf of NTTA

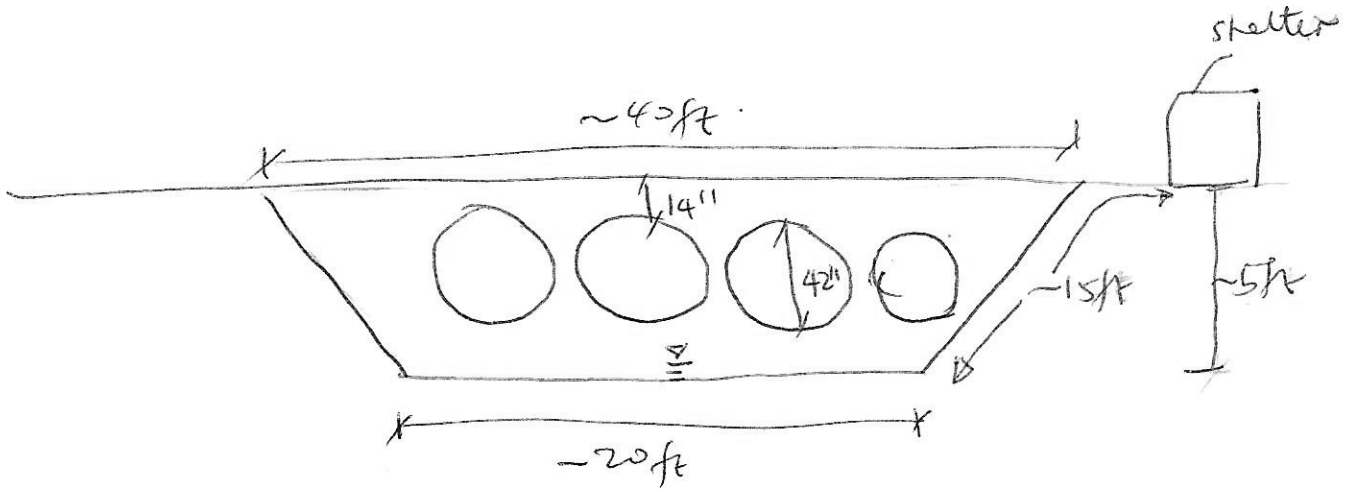
Kofi Sam (ATKINS)

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date: 11/3/17 Time: 1124 AM

Location Name/Number: NTTA-002

Nearest Cross Street/Location Description: PGBT @ South of Dickey Rd

Entity (Circle One): Arlington Garland Irving Mesquite (NTTA) Plano

GPS Latitude/Longitude: 32.728181, -97.01946

Receiving Water: Cottonwood Creek

Data for locating automated samplers:

Ease of Installation ~ (Native or Existing Location / Bench) ~ Need to construct Location / Platform / Base

Describe: level grassed; south of creek; east of gravel swales Explore bench

Ease of channel/sample area access and safety: ~ Describe either (YES) or NO

Describe: Park in paved area south of proposed location next to gravel swale

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: Natural grass lined channel with rocks in bottom

Vegetative Cover ~ High ~ Medium ~ (Low)

Describe: Low at top of bank; some medium brush in channel; poison ivy dotted on bank

Visibility from the Right-of-Way ~ High Visibility ~ (Low Visibility) ~ (None)

Describe: Not visible to vehicular traffic but to transient community

Public Access ~ (Yes) ~ No

Describe: See public use

Evidence of Public Use ~ (Yes) ~ No (Circle all that apply, or describe)

(Cans) ~ Bottles ~ (Paper) ~ Food Products ~ Rubble ~ (Wood) ~ (Brush) ~ Graffiti ~ (Transient Community)

Describe: typical instream floatables plus a transient person sleeping under bridge

Evidence of Normal Surface Water Elevation ~ (Yes) ~ No ~ Depth ~4" inches/feet

Describe: Rapid low flow within multiple forks that converge under feeder bridge. Dam structure / reservoir upstream

Perennial Flow Presence ~ High ~ Medium ~ (Low) ~ Depth ~4" inches/feet

Describe: see above.

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water 40-50ft
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample ~10-15ft
(Recommended to be less than 25 feet)

Other Site Features of Importance:

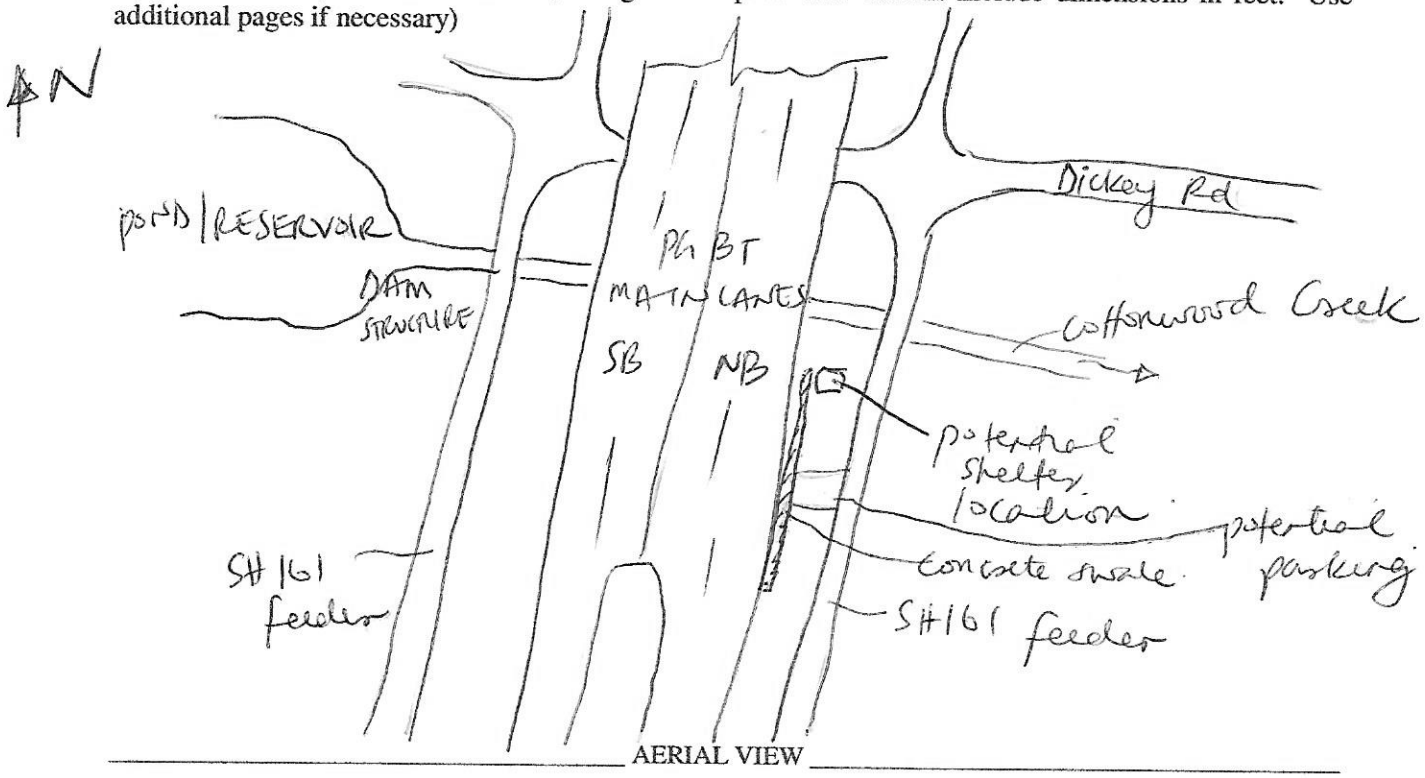
Notes:

Provide Site Visit Attendee Name(s) and Company/Entity:

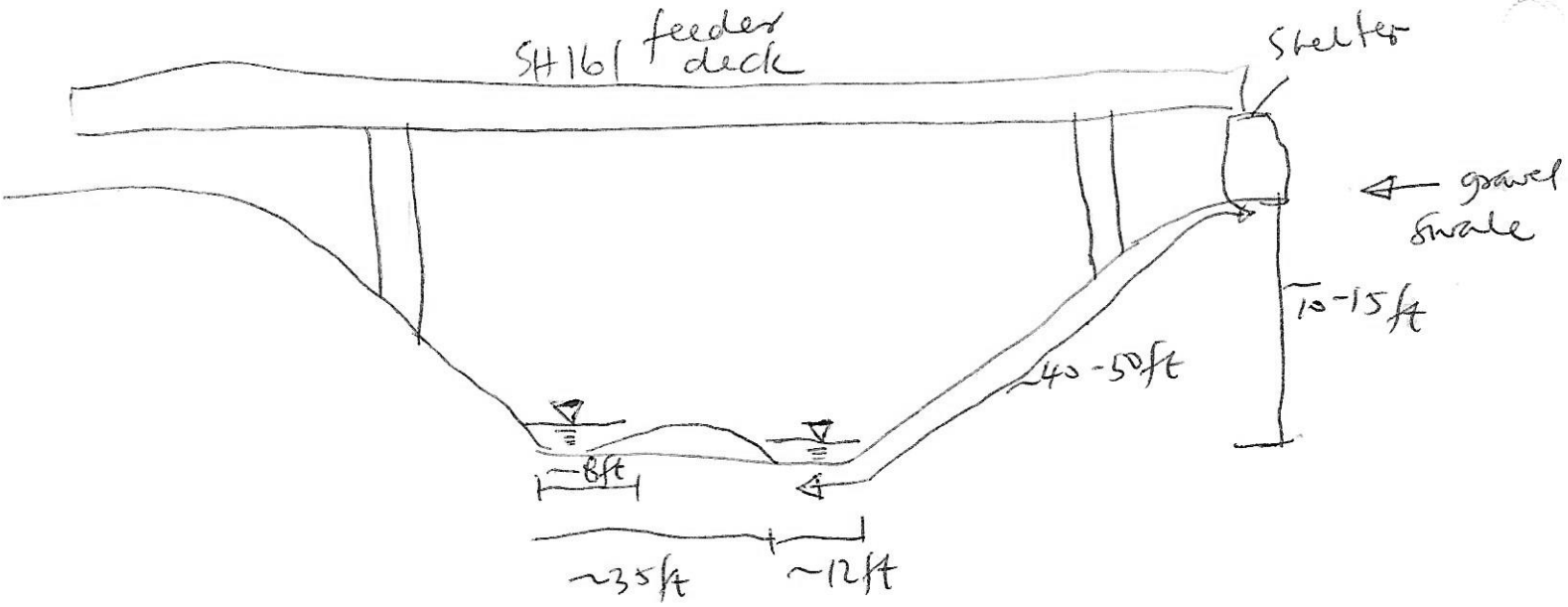
Moss Fennell (VRX) On behalf of NTTA
Kofi Sam (ATKINS)

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)



AERIAL VIEW



CROSS SECTION

Facing: Upstream / Downstream (Circle One)

Appendix B

Vendor Literature

Isco Product Data

Isco 6712C Compact Portable Sampler

Isco's 6712C Compact Portable Sampler delivers the advanced capabilities of our industry standard 6712 Sampler in a smaller package, allowing use where full-size samplers won't fit. Like the full-size 6712, the compact version uses Isco's advanced 6700 Series Controller, a device that allows you to select from a variety of programming modes, assuring the most suitable routine for your application. Programming is fast and simple, with on-line help just a key stroke away.

The environmentally-sealed 6712 controller delivers maximum accuracy and easily handles all of your sampling applications, including:

- wastewater effluent
- stormwater monitoring
- CSO monitoring
- permit compliance
- pretreatment compliance

In the Standard Programming Mode, the controller walks you through the sampling sequence step-by-step, allowing you to choose all parameters specific to your application. Selecting the Extended Programming Mode lets you enter more complex programs.

This comparison photo, showing the 6712C with mini base (left) and Isco's full-sized Portable Sampler (right), illustrate the broad scope of sampler configurations Isco offers to suit your particular sampling needs.

An optional telephone modem allows programming changes and data collection to be performed remotely, from a touch-tone phone. It also has dial-out alarm features.

Versatile, Tough, and Reliable

A tapered design and narrow 18-inch (45.7 cm) diameter allows use in small or offset manholes. Choose from five bottle configurations to suit a variety of sampling routines.

Isco's 6712C Compact Portable Sampler carries a NEMA 4X, 6 (IP67)corrosion-proof rating for submersible, watertight, dust-tight,and corrosion-resistant service.

Superior capability, rugged construction, and compact size, make this sampler ideal for size-restricted applications.

All 6712 Samplers share the following features:

Advanced Delivery System

The 6712's peristaltic pump delivers samples at the EPA-recommended velocity of 2 ft/sec., even at head heights of 26 feet. At a head height of 3 feet, line velocity is 3 ft/sec. No other automatic sampler achieves this level of performance!

Our patented* pump revolution counter tells you when tubing should be replaced. Changing tubing is a snap; there are no pump covers, collars or tools to slow you down. An exclusive safety interlock removes power from the pump when it's opened.

Step-by-Step Programming

This feature walks you through the sampling sequence and allows you to choose all parameters specific to your application:

- When to start
- What volume to collect
- How to distribute samples
- If samples are to be time- or flow-paced.

You can easily enter complex programs to suit your unique needs. Available routines include:

- Pause and resume for intermittent discharge flow monitoring
- Sampler pacing by time, non-uniform time, flow or external event
- Random interval sample collection

Convenient Data Retrieval

Every 6712 Sampler is also a powerful data logger. Sampling, flow, rainfall, and other water quality data can be stored in its 512 KB memory.

Data may be retrieved directly into a Flowlink® 4 equipped PC in three ways:

- Via cable connection
- Remotely, via Isco's 2102 Wireless Communication System
- By phone, using our optional built-in modem

SDI-12 Interfacing

The 6712 functions as a SDI-12 logger and connects to any sensor that fully implements the protocol standard.

Display window showing SDI-12 connection status.

In addition, Isco has defined extended commands to enable "plug and play" communications and ease of programming. These commands are implemented by the sensor manufacturer. Data are identified and logged by their specific type.

Expand your monitoring capabilities with these products and accessories.

Contact Isco or your Isco Representative to receive specific literature and prices on the following items.

Telephone Modem

A factory-installed option that lets you set up and make programming changes, or collect data from your 6712 sampler from the comfort of your office.

581 RTD (Rapid Transfer Device)

Slim enough to fit in your shirt pocket, yet rugged enough to withstand submersion, the 581 RTD lets you quickly retrieve and transfer data without taking your laptop computer into the field.

ProPak™ Disposable Sample Bags

Isco's patented ProPak bags eliminate the expense of washing and storing bottles, while taking away worries about contamination from previous samples. The bags are available with a 1000 ml capacity, or in a 2-gallon version for composite sampling.

Flowlink Software

Isco's advanced Flowlink® 4 for Windows Data Management Software harnesses the power of Microsoft Windows® to retrieve, import, compare, and analyze data, generate advanced charts and graphs, create comprehensive reports, and more.

700 Series Modules

Our 700 Series Modules let you adapt your 6712 sampler for a variety of jobs. These compact modules are environmentally sealed and may be added to your 6712 system at any time.

701 – pH and Temperature Module
Combines accurate pH and temperature monitoring in one module. It will also activate your 6712 Sampler at a user-elected pH or temperature range.

710 – Ultrasonic Flow Module
Uses our field-proven ultrasonic level sensor that doesn't require submersion in the flow stream.

720 – Submerged Probe Flow Module
Provides accurate measurement at sites where wind, steam, foam, turbulence, or air temperature fluctuations exist. Suitable for small channels, it accurately senses pressure even when covered with silt and sand.

730 – Bubbler Flow Module
Get the dependability and accuracy of Isco bubbler flow meters in a miniaturized package. The 730 is unaffected by changing stream conditions, and level measurement remains accurate despite temperature fluctuations or exposure to harsh chemicals.

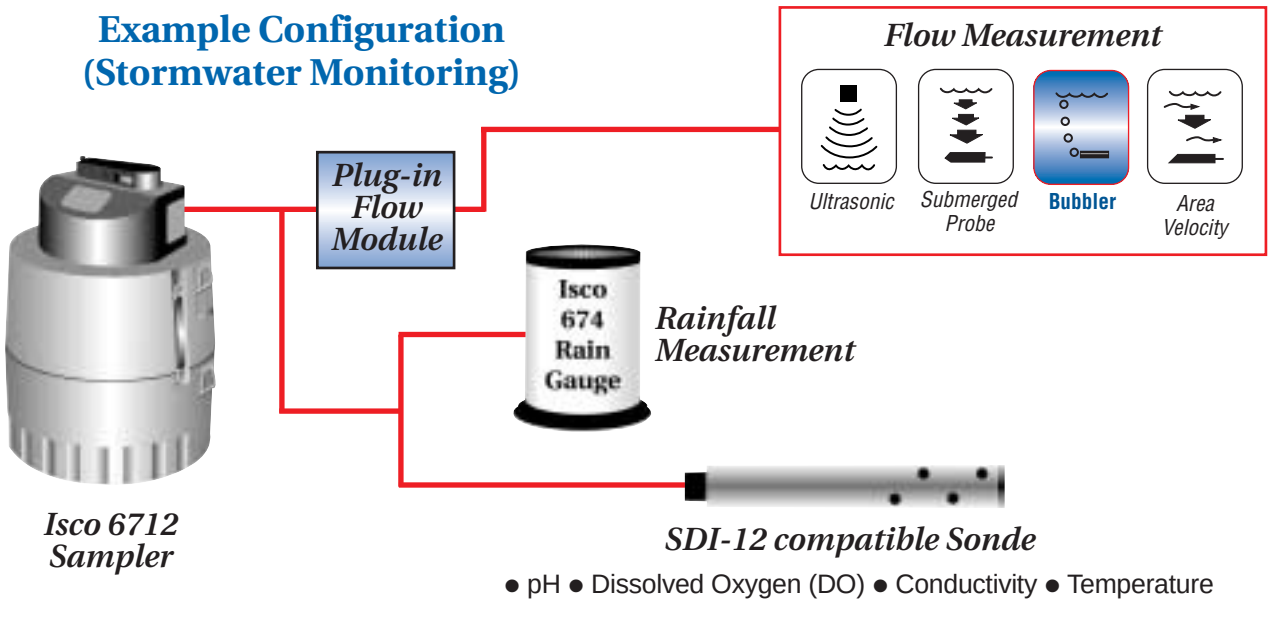
750 – Area Velocity Flow Module
Gives greater accuracy where weirs and flumes are not practical, and where submerged, full pipe, surcharged, and reverse flow conditions may occur. And, you don't have to estimate the slope and roughness of the channel.

780 – Smart 4-20 Module
Add intelligence to a simple analog signal. Flow rates are displayed in actual volume units, not merely a percent of full scale. Any linear 4-20 mA input can be characterized by using the 780. The information can be stored and retrieved for later analysis.

Integrated Water Monitoring

Isco 6712 Samplers feature "plug and play" connection with SDI-12 compatible measuring devices - including multi-parameter sondes from leading manufacturers. Combined with the 6712's standard 512 KB of memory, enough for more than 200,000 stored readings. SDI-12 networking gives you great flexibility for logging environmental data, and for "smart sampling" event notification, triggered on any combination of up to 16 inputs.

Example Configuration (Stormwater Monitoring)



Isco 6712C Compact Portable Sampler Specifications

Sampler

Height	27.6 in.	70.1 cm
Diameter	17.7 in.	45.1 cm
Weight (Dry/Less Battery)	31 lbs.	14 kg
Material	High-strength ABS plastic outer shell Stainless steel hardware	
Power Requirements	12 VDC	

Pump

Intake Purge	Adjustable air purge before and after each sample.	
Tubing Life Indicator	Provides a warning to change pump tubing.	
Intake Suction Tubing		
Length	3 to 99 ft.	1 to 30 m
Material	Vinyl or Teflon® lined	
Inside Dimension	⅜ in.	1 cm
Pump Tubing Life	Typically 1,000,000 pump counts	
Maximum Suction Lift	28 ft.	8.5 m
Typical Repeatability	±5 ml or ±5% of the average volume in a set	
Typical Line Transport Velocity at head heights of:		
3 ft. (0.9 m)	3.0 ft./s	0.91 m/s
10 ft. (3.1 m)	2.9 ft./s	0.87 m/s
15 ft. (4.6 m)	2.7 ft./s	0.83 m/s
Liquid Presence Detector	Non-wetted, non-conductive sensor detects when liquid sample reaches the pump to automatically compensate for changes in head heights.	

Controller

Weight	13 lbs.	5.9 kg
Dimensions	10.3 x 12.5 x 10 in.	26 x 31.7 x 25.4 cm
Operational Temperature	32° to 120°F	0° to 49°C
Enclosure Rating	NEMA 4X, 6	IP67
Program Memory	Non-volatile ROM	
Flow Meter Signal Requirements	5 to 15 volt DC pulse or 25 millisecond isolated contact closure.	
Number of Programmable Composite Samples	1 to 999 samples.	
Real Time Clock Accuracy	1 minute per month, typical	

Software

Sample Frequency Selection	1 minute to 99 hours 59 minutes, in 1 minute increments. Non-uniform times in minutes or clock times 1 to 9,999 flow pulses
Sampling Modes	Uniform time, non-uniform time, flow. *(Flow mode is controlled by external flow meter pulses.)*
Programmable Sample Volumes	10 to 9,990 ml in 1 ml increments
Sample Retries	If no sample is detected, up to 3 attempts; user selectable
Rinse Cycles	Automatic rinsing of suction line up to 3 rinses for each sample collection
Program Storage	5 sampling programs
Sampling Stop/Resume	Up to 24 real time/date sample stop/resume commands
Controller Diagnostics	Tests for RAM, ROM, pump display, and distributor

Ordering Information

Description	Part Number
6712C Compact Portable Sampler Includes controller with 512 KB RAM, top cover, center section, base, distributor arm, instruction manual, pocket guide.	**68-6710-071**
6712C Compact Portable Sampler with Mini Base (Includes items described above)	**68-6710-141**

Note: *Power source, bottle configuration, suction line, and strainer must be ordered separately. Other options and accessories are also available. Contact Isco or your Isco Representative for complete information.*

The 6712 Controller is an SDI-12 logger. Manual pump operations are now located on the front panel keys.

The 6712C Compact Portable Sampler features Isco's exclusive bottle carrier to make bottle changing and transportation a snap.

ISCO®
www.isco.com

Isco, Inc.
4700 Superior St.
Lincoln, NE 68504 USA
Phone: (402) 464-0231
USA & Canada: (800) 228-4373
Fax: (402) 465-3022
E-Mail: info@isco.com

Isco Flowlink® 5 Software

Isco's Flowlink is the premier flow data management software. Flowlink 5's advanced analysis, editing, and reporting, assure continued industry leadership.

Easy instrument configuration

Set up the following Isco instruments — on-site or remotely:

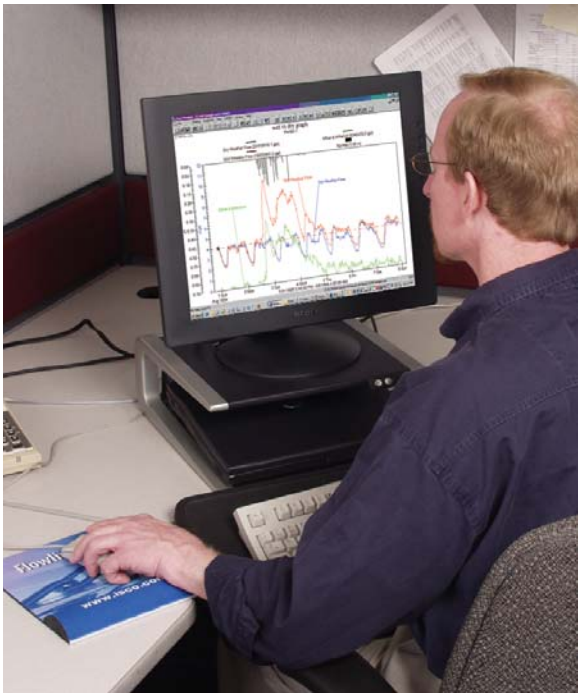
- 2100 Series Flow Modules
- 4100 Series Flow Loggers
- 4200 Series Flow Meters
- 676 Logging Rain Gauge systems

Enhance battery life by scheduling specific "run times" for communication modules.

Save configuration time by cloning when a flowmeter is replaced, or conditions are similar at another site.

Data handling options

Download data on site to your laptop PC, Isco 581 Rapid Transfer Device (RTD), or Isco 2101 Field Wizard.



Collect data from 2100 Series modules remotely via an Isco 2102 Wireless Module, 2103 Telephone or 2103c Cell Phone Modem.

Collect data from Isco 4200 Series Flow Meters and 6700 Series Samplers with voice modems.

Automate data collection.

Display default graphs immediately after data retrieval to quickly assess site conditions.

Import CSV-formatted data from non-Isco instruments.

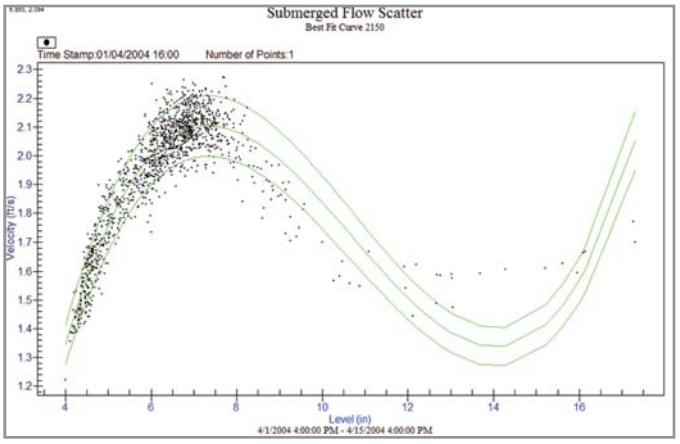
Convert Flowlink 4 files to Flowlink 5.

Archive data to a zipped file on a network drive and back up your database to insure against loss.

Data Presentation

- Drag and drop data onto graphs and tables.
- Generate graphs with up to four panes, with multiple data types in each pane.
- Display rainfall.
- Display sample events.
- Display scatter plots. Generate a best-fit curve with limits for analysis.
- Add text boxes to label events.
- Generate vertical lines that span all panes for accurate values of different parameters at specific times.
- Generate horizontal lines to distinguish points outside limits.

Scatter Plot

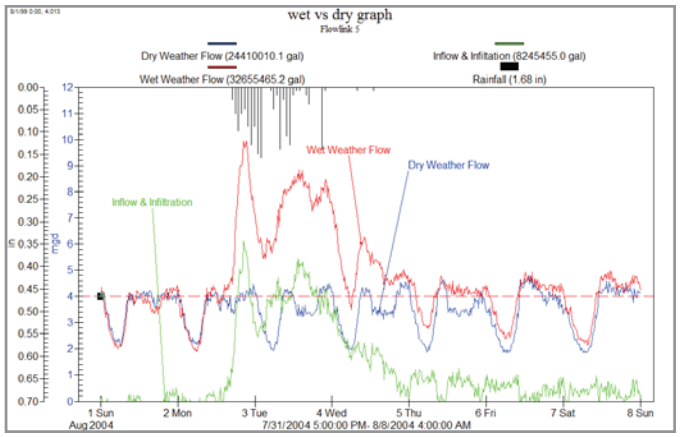


Generate flow channel performance pictures. Add upper and lower limits to indicate fitness of data by a percentage of offset, or test fitness of data using Manning Formula coefficients.

Advanced Data Analysis

- Calculate average, minimum, maximum, and total accumulated values.
- Compare data from multiple sites.
- Use series formulas to know the relation between sites or parameters.
- Zoom vertically and horizontally.
- Generate reference curves for wet weather analysis or problem identification.
- Compare flows using the continuity equation and Manning formula.

Wet vs. Dry Comparison



Create reference curves (blue line) for comparisons. Import rain data (inverted from top of graph) to help see the relationship between rainfall and I&I.

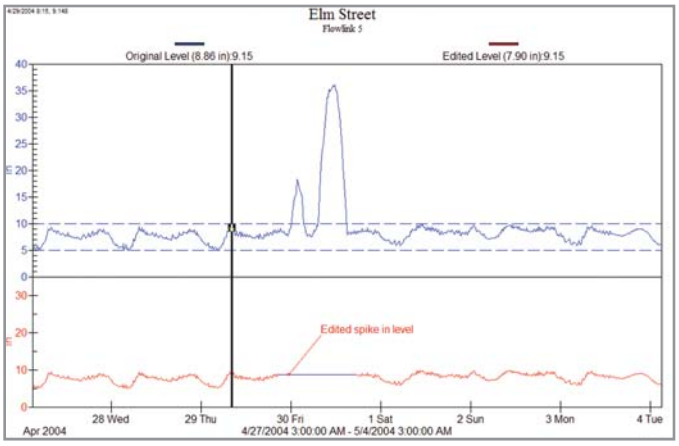
Editing Capability

External noise, site conditions, etc, can adversely affect data quality. Also, data from flow meters lacking Isco's exceptional stability can be corrected for calibration or temperature drift.

- Edit data with constant offset, fixed offset, proportional, time, or auto-correct functions.
- Edit data values by dragging them to correct values or by selecting multiple data values in a block, then applying corrections.
- Adjust scatter plot data within limits, or to the centerline of the best fit curve.
- View changes in a graph or table after editing.
- Copy, paste, cut, and insert.
- Show modified data in a different color.

.

Edited Graph



The erroneous spikes shown above would skew calculations. Simply highlight them and click "auto-correct".

Reporting

- Include Flowlink graphs and tables in Microsoft Word®, Excel®, and PowerPoint® with object linking and embedding (OLE).
- Exported into CSV format for analysis in spreadsheet programs. Export graphs and tables in HTML or PDF format.
- Automatically retrieve data, print graphs and tables, import/export data, and run command-line driven programs.

Printable Table

Min/Max/Avg Flow rates

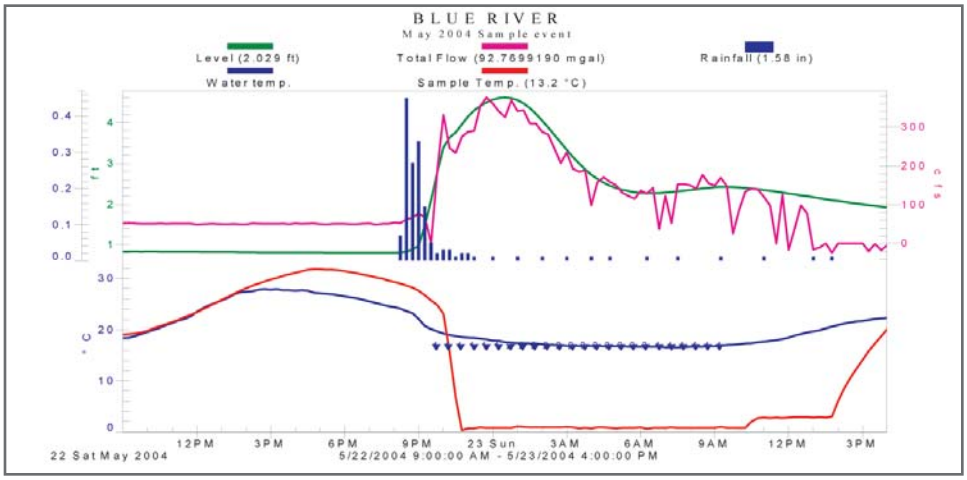
Flowlink 5

Date/Time	Average Flow Rate (gpm)	Minimum Flow Rate (gpm)	Time of Minimum Flow Rate	Maximum Flow Rate (gpm)	Time of Maximum Flow Rate
4/16/2004 3:00:00 AM	350	150	3:30:00 AM	480	7:15:00 AM
4/17/2004 3:00:00 AM	360	170	3:30:00 AM	500	9:00:00 AM
4/18/2004 3:00:00 AM	360	170	2:30:00 AM	510	8:45:00 PM
4/19/2004 3:00:00 AM	350	160	3:30:00 AM	510	6:00:00 PM
4/20/2004 3:00:00 AM	360	160	3:45:00 AM	510	8:00:00 PM
4/21/2004 3:00:00 AM	370	160	3:00:00 AM	500	9:00:00 PM
4/22/2004 3:00:00 AM	360	170	3:00:00 AM	500	8:15:00 PM
4/23/2004 3:00:00 AM	370	170	2:30:00 AM	480	7:30:00 PM
4/24/2004 3:00:00 AM	360	160	4:00:00 AM	500	9:15:00 AM
4/25/2004 3:00:00 AM	380	180	4:00:00 AM	490	10:15:00 AM
4/26/2004 3:00:00 AM	360	170	2:45:00 AM	510	8:00:00 PM
4/27/2004 3:00:00 AM	350	160	3:00:00 AM	490	6:45:00 PM
4/28/2004 3:00:00 AM	360	160	3:30:00 AM	490	9:15:00 PM
4/29/2004 3:00:00 AM	400	180	3:15:00 AM	640	12:15:00 AM
	Average Flow Rate (gpm)	Minimum Flow Rate (gpm)	Time of Minimum Flow Rate	Maximum Flow Rate (gpm)	Time of Maximum Flow Rate
	360	150	4/16/2004 3:30:00 AM	640	4/30/2004 12:15:00 AM
	Total 7357556.6 gal				

Convert graphical data to tabular with one click. Statistical functions are summarized beneath each column. Flowlink scales tables to your printed page.

Sampler Compatibility

Integrate data from Isco's 6700 Series, or Avalanche samplers, with flow meter data for comprehensive analysis and reporting.



Upper pane shows level, flow rate and rainfall. Lower pane shows events (blue triangles) for each sample, with stream water and sample temperatures. Conductivity, pH, dissolved oxygen, etc., can also be displayed.

Flowlink 5 Computer Requirements

Operating System	Microsoft Windows 98, NT, 2000, and XP	Disk Drive	CD ROM
Microprocessor	133 MHz Pentium® or equivalent	Monitor	SVGA, 800 x 600 resolution
RAM	32 Mbytes[1] (recommended)	Printer	Color (recommended)
Hard Drive	100 Mbytes free space available for program data[2] (recommended)	Communication	Serial or USB[3] port with Isco Interrogator Cable, Hayes ™ compatible telephone modem

[1] System must meet the minimum hardware requirements for the selected operating system.
[2] Estimate based on a database with 15 sites, each having 3 data sets (e.g., level, velocity, and flow rate), each set having a 15-minute reading interval, with the database archived every 6 months.
[3] Requires customer-supplied USB to RS-232 adapter/converter cable.

NOTE: A Flowlink 3 database can be opened in Flowlink 5 after conversion, using Isco's Site Converter software (included with Flowlink 5).

ISCO®
Water is life. Protect it.

Teledyne Isco, Inc.
4700 Superior Street
Lincoln, NE 68504 USA
Phone: (402) 464-0231
USA & Canada: (800) 228-4373
FAX: (402) 465-3022
e-Mail: info@isco.com
Internet: www.isco.com

Isco Product Data

Isco 730 Bubbler Flow Module

Bubbler level sensing provides the most accurate measurement

Isco 730 Bubbler Flow Modules use an internal air compressor to force a metered amount of air through a bubble line submerged in the flow channel. By measuring the pressure needed to force air bubbles out of the line, the water level is accurately determined. The 6700 Series or Avalanche Sampler then converts the level into flow rate.

The 730 provides accurate measurement in a variety of conditions. It is suitable for small channels, and it is not affected by wind, steam, foam or turbulence. And, because only the bubble tube contacts the flow, corrosive chemicals are not a problem. Automatic bubble line purging prevents clogging. The 730 also resists damage by lightning and debris, making it ideal for stormwater applications.

Automatic drift compensation makes Isco bubbler flow meters the most accurate level measurement technology. In standby applications, such as stormwater runoff monitoring, Automatic drift compensation also allows the 730 to maintain calibration for extended periods.

Standard Features

- Bubbler line is unaffected by flow stream composition
- Automatic Drift Compensation provides high accuracy and maintains calibration in standby applications such as stormwater monitoring
- Built-in flow conversions for most applications, including weirs and flumes, Isco flow metering inserts, Manning formula, data points, or equation for special situations
- During the program's operation, current flow and level values are viewable on the sampler's LCD display
- All level data stored in the sampler is available for later retrieval, reporting, and graphing using Isco Flowlink® software

Applications

- Level and flow measurement in shallow streams, and/or where lightning and debris may occur
- Trigger sampling based on flow or level
- Flow-proportioned sample collection
- Treatment-capacity analysis
- River and stream gauging

Simply plug in one of the environmentally-sealed modules to expand monitoring capabilities. They can easily be added or changed in the field.

Specifications

730 Module		
Size *(H x W x D)*	4.9 x 5.7 x 2.0 in	12.4 x 14.5 x 5.1 cm
Weight	1.5 lbs	0.7 kg
Material	Polystyrene	
Enclosure	NEMA 4X, 6	IP67
Power *(provided by 6700 Series Sampler)*	9 to 14V DC	
Program Memory	Non-volatile, programmable flash; can be updated via interrogator port on 6700 Series Sampler using a PC	
Level Measurement Data Storage Interval *(programmable through 6700 Series Sampler)*	1, 2, 5, 10, 15, or 30 minutes	
Operating Temperature	32° to 120°F	0° to 49°C
Storage Temperature	0° to 140°F	-18° to 60°C

Bubbler				
Range	0.01 to 10 ft.		0.003 to 3.05 m	
Level Measurement Accuracy *Linearity, Repeatability, and Hysteresis at 77°F (25°C)*	**Level***	**Error**	**Level***	**Error**
	0.1 to 5.0 ft	±0.005 ft	0.03 to 1.52 m	±0.002 m
	0.1 to 7.0 ft	±0.01 ft	0.03 to 2.13 m	±0.003 m
	0.1 to 10 ft	±0.035 ft	0.03 to 3.05 m	±0.011 m
Temperature Coefficient *Maximum error over compensated temperature range (per degree of temperature change)*	**Level***	**Error**	**Level***	
	0.01 to 5.0 ft	±0.0006 x level x temperature change from 77°F	0.003 to 1.52 m	±0.00108 x level x temperature change from 25°C
	0.01 to 10 ft	±0.0005 x level x temperature change from 77°F *where level is measured in feet*	0.003 to 3.05 m	±0.0009 x level x temperature change from 25°C *where level is measured in meters*
Automatic Drift Correction	After a 5-minute warm up period, zero level is corrected to ±0.002 ft. (±0.0006 m) at programmed intervals between 2 and 15 minutes			
Operating Temperature	32° to 120°F		0° to 49°C	
Compensated Temperature	32° to 140°F		0° to 60°C	

**Actual vertical distance between the end of the bubble tube and the liquid surface.*

Ordering Information

Description	Part Number
730 Bubbler Flow Module	**68-6700-050**
730 Accessories	
Flow Metering Inserts	
6 in. (150 mm) Insert	**68-3230-005**
8 in. (200 mm) Insert	**68-3230-006**
10 in. (250 mm) Insert	**68-3230-007**
12 in. (300 mm) Insert	**68-3230-008**

Teledyne Isco, Inc.
4700 Superior Street
Lincoln NE 68504 USA
Phone: (402) 464-0231
USA and Canada: (800) 228-4373
Fax: (402) 465-3022
E-Mail: info@isco.com
Internet: www.isco.com

Isco Product Data

Isco 674 Rain Gauge

Connects directly to 6712 and Avalanche™ Samplers, 4200 Flow Meters, and 4100 Flow Loggers

The 674 rain gauge features a precision tipping bucket and 3-point leveling system for easy setup.

The Isco 674 Rain Gauge is a precision instrument that uses a tipping bucket design for rainfall measurement. It has an 8-inch diameter orifice and is factory-calibrated to tip at either 0.01 inch or 0.1 mm of rainfall. With a 674 Rain Gauge connected, an Isco flow meter or sampler will:

- Store rainfall data in internal memory for retrieval and analysis with Isco Flowlink® Software
- Activate sampling based on rainfall
- Plot graphs and print reports of rainfall data on the flow meter's built-in printer

Applications

A 674 rain gauge connected to an Isco 6712 or Avalanche sampler is ideal for collecting rainfall data as well as runoff-triggered samples at remote monitoring sites.

- Stormwater runoff monitoring
- TMDL and Watershed surveys
- Inflow and infiltration studies
- cMOM and CSO/SSO programs (Sewer overflow monitoring and prevention)
- General rainfall measurement

Standard Features

- Three-point leveling and integral bubble level make it easy to align the rain gauge for maximum accuracy.
- Sapphire jewel bearings on the tipping bucket are spring-loaded to prevent damage to the bearings and ensure consistent operation over a wide temperature range.
- Screens cover all openings to prevent leaves, insects, and other debris from clogging the gauge.
- Included 50-foot cable connects directly to compatible Isco flow meters and samplers.

Isco 674 Rain Gauge Specifications	
Type:	Tipping bucket
Compatible equipment:	Isco 6700, 6712, and Avalanche Samplers, 4200 Series Flow Meters, 4100 Series Flow Loggers
Connect cable:	50 ft. (15.2 m), 2 conductor with 4-pin plug
Bearings:	Spring-loaded sapphire jewel
Orifice Diameter:	8 in. (20 cm)
Sensitivity:	English - 0.01 inch; Metric 0.1 mm
Accuracy:	English - ±1% at 2 in/hour; +3%/-4% up to 5 in/hour Metric - ±1.5% at 5 cm/hour; +3.5%/-9% up to 13 cm/hour
Capacity:	English – 22 inches/hour Metric – 38 cm/hour
Output Signal:	Contact closure of at least 50 millisecond duration
Switch Type:	Hermetically sealed magnetic proximity switch. Normally open, 200V DC, 0.5 A maximum.
Height:	13 in. (33 cm)
Diameter:	9.5 in. (24 cm) (at mounting base)
Weight:	10 lbs. (4.5 kg)
Operating Temperature:	32° to 140°F (0° to 60°C)
Storage Temperature:	-40° to 140°F (-40° to 60°C)

The 674 Rain Gauge connects to any 6700 Series or Avalanche Sampler, 4200 Series Flowmeter, or 4100 Series Flow Logger. Rainfall data logged on the host instrument can be analyzed with Flowlink 4 Software.

Ordering Information

The 674 rain gauge includes a 50 ft (15 m) cable for connection to an Isco 6700, 6712, or Avalanche Sampler, 4200 Series Flow Meter, or 4100 Series Flow Logger. Specify English or Metric version.

Description	Part Number
674 Rain Gauge	
English - Tips every 0.01 inch of rainfall	60-3284-001
Metric - Tips every 0.1 mm of rainfall	68-3280-001

Isco, Inc.

4700 Superior Street
Lincoln NE 68504 USA
Phone: (402) 464-0231
USA and Canada: (800) 228-4373
Fax: (402) 465-3022
E-Mail: info@isco.com
Internet: www.isco.com

CDMA
Digital Cellular Modem System
Special Product Application #1489

TELEDYNE ISCO
A Teledyne Technologies Company

SPA Instruction Sheet
60-5314-626 Revision A

Overview

The CDMA digital cellular modem system from Teledyne Isco (part #60-5314-489) is designed for use with the 6700 Series Samplers (remote data access/commands, outgoing text messaging), and the 4100/4200 Series Flow Meters (remote data access only).

The system uses service providers Alltel, Verizon, and Telus (Canada)*.

Text Messaging

The digital text messaging function can dial out to up to 3 different phone numbers (from a single service provider) when an alarm condition has been met. The text message states which alarm condition has been met, and the phone number of the modem.

Remote Operation

You can call the sampler using a command program like Hyper Terminal and send commands such as: changing the sample rate/volume, starting/stopping a program, taking manual samples, etc. For a complete list of available remote commands, see “Computer Operation > Menu Control” in the Remote Operation section of the sampler’s Installation and Operation Guide.

Antenna Options

One of 3 antenna types is included with your system, also specified when ordering:

- The **external, magnetic mount whip** antenna (part #60-5314-606) is 6 feet long and 3 inches tall. The external whip antenna is for general use, and is especially desirable when the system is stored within an enclosure.
- The **internal** antenna is useful in maintaining low visibility of the system.
- The **external “hockey puck”** antenna (part #60-5314-605) is 10 feet (3m) long, and used primarily in manhole applications.
  The antenna is buried next to the manhole, in a hole bored into the pavement, at a depth leaving the top of the antenna flush with the street.
  An adjoining hole is drilled through the manhole collar for the antenna’s cable. To complete installation, fill the holes in with cement.

Sampler Programming

For alarm programming, see “Dial Out Alarms” in the Extended Programming section of the sampler’s Installation and Operation Guide.

After the phone number(s) for dial out have been entered, the sampler display will prompt you to enter first the modem’s phone number, then the TAP (Telocator Alphanumeric Protocol) service number, and then the parameter settings for that number (baud rate, data bits, parity, stop bits).

To program this information into the sampler, perform the following steps:

1. At the prompt, enter the phone number of the digital cellular modem.
2. To find your cell phone’s TAP service number and parameter settings, go to **http://www.avtech.com/Support/TAP/index.htm**.

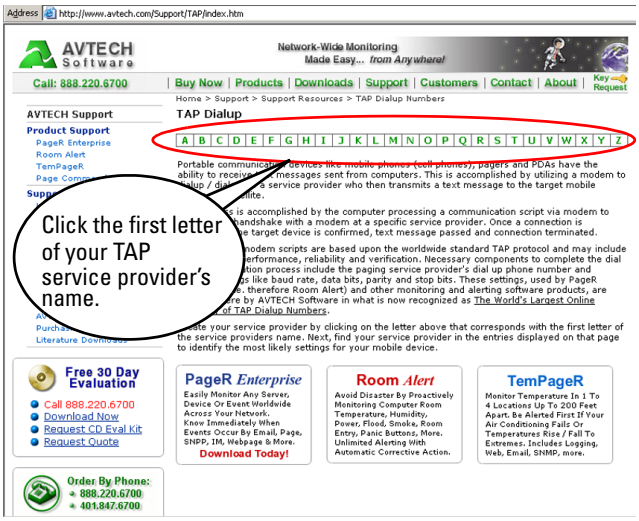


Figure 1: TAP Service Provider Screen Locating your service provider

3. Click on the letter corresponding with the first letter of the name of the service provider for your text message enabled hip phone.
4. On the next screen, locate your service provider’s name in the left column and program the correct TAP number and parameters into the sampler.

*Additional service providers may be available. Contact the factory for information.

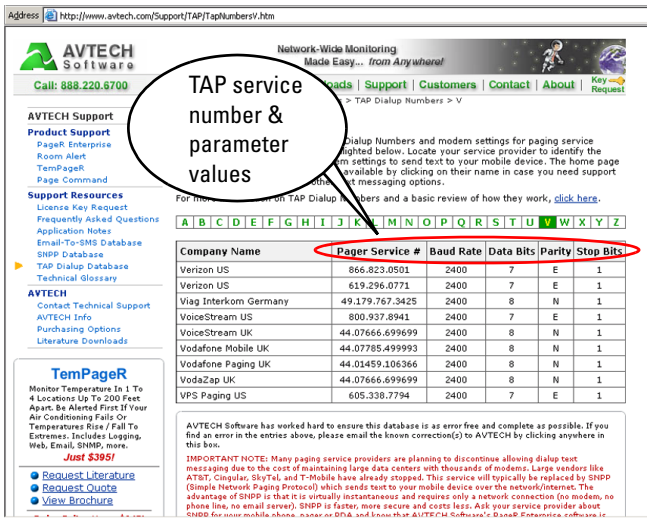


Figure 2: TAP Service Parameters Program phone number and parameters into your sampler

Installation

To install the cellular system:

1. Connect the modem to the interrogator port of the sampler or flow meter with the 10-foot cable provided with the system.

☑ *Note*

Connecting either the serial output or an interrogator cable to the sampler disables an internal modem, if one is installed.

2. Connect the antenna cable's SMA connector to the modem (if it is external).
3. Using a computer running Isco's Flowlink software and the baud rate set to 9600, call the system's modem to establish proper function.

Last modified December 5, 2005

Teledyne Isco, Inc.
P.O. Box 82531, Lincoln, Nebraska, 68501 USA
Toll-free: (800) 228-4373 • Phone: (402) 464-0231 • Fax: (402) 465-3091
E-mail: info@isco.com

AMERESCO SOLAR
Green • Clean • Sustainable

40W Photovoltaic module 40J

This line of modules is the direct result of over three decades of design, manufacturing and use. Attending to every detail in the design and manufacture of our products, our process controls and testing methods have optimized module life and electrical energy production.

Ameresco Solar's off-grid module line offers the following features and benefits:

► Built to last
From mountaintops to off-shore platforms, on weather stations in the bitter cold of Antarctica and on telephone signal repeaters in the hot Australian outback, the technology has been proven in the harshest environments.

► Accessible junction box for off-grid connections
J-type junction box has accessible terminals for easier module interconnections in off-grid applications, and it allows fitting cable glands for various sections.

► Thick, durable scratch resistant back sheet
The thick back sheet provides extra insulation and increased resistance to protect your module against rough handling. Made of white polyester, it ensures longer term performance and increased energy production.

► High reliability
Cell interconnections and diode placement use well-established industry practice and are field-proven to provide excellent reliability.

► Quality and certifications
ISO 9001 factory certification ensures that our manufacturing facilities use proven manufacturing and quality control processes.

Certified to IEC 61215 and 61730

Certified to UL1703 and ULC1703
Certified for use in Class 1, Division 2 Hazardous locations

Conforms with European Directive 2006/95/EC

Photographs are intended to portray typical module appearance, actual module appearance may vary.

40W PHOTOVOLTAIC MODULE - 40J

Electrical characteristics

	[1] STC 1000W/m²	[2] NOCT 800W/m²
Maximum power (P_{max})	40W	29W
Voltage at P_{max} (V_{mpp})	17.9V	15.9V
Current at P_{max} (I_{mpp})	2.23A	1.83A
Short circuit current (I_{sc})	2.32A	1.88A
Open circuit voltage (V_{oc})	22.1V	20.1V
Module efficiency	11.4%	
Tolerance (P_{max})	±10%	
Nominal voltage	12V	
Efficiency reduction at 200W/m²	<5% reduction (efficiency 10.8%)	
Limiting reverse current	2.54A	
Temperature coefficient of I_{sc}	0.105%/°C	
Temperature coefficient of V_{oc}	-0.360%/°C	
Temperature coefficient of (P_{max})	-0.45%/°C	
[3] NOCT	47±2°C	
Maximum series fuse rating	6A	
Maximum system voltage	50V	
Application class (according to IEC 61730:2007)	Class C	

1: Values at Standard Test Conditions (STC): 1000W/m² irradiance, AM1.5 solar spectrum and 25ºC module temperature
2: Values at 800W/m² irradiance, Nominal Operation Cell Temperature (NOCT) and AM1.5 solar spectrum
3: Nominal Operation Cell Temperature: Module operation temperature at 800W/m² irradiance, 20ºC air temperature, 1m/s wind speed

Mechanical characteristics

Solar cells	36 crystalline silicon cut cells connected in series
Front cover	High transmission 3.2mm (1/8th in) glass
Encapsulant	EVA
Back cover	White polyester
Frame	Silver anodized aluminum
Junction box	IP65 with 4 terminal screw connection block; accepts PG 13.5, M20 13mm (½") conduit, or cable fittings accepting 6-12mm diameter cable. Terminals accept 2.5-10mm² (8-14 AWG) wire
Dimensions	655 x 537 x 50mm / 25.8 x 21.1 x 2in
Weight	5.75kg / 12.7lbs

All dimensional tolerances within ±1% unless otherwise stated.

Warranty*

- ► Free from defects in materials and workmanship for 2 years
- ► 90% min. power output over 12 years
- ► Optional 25 years available

* Refer to warranty document for terms and conditions.

Certification

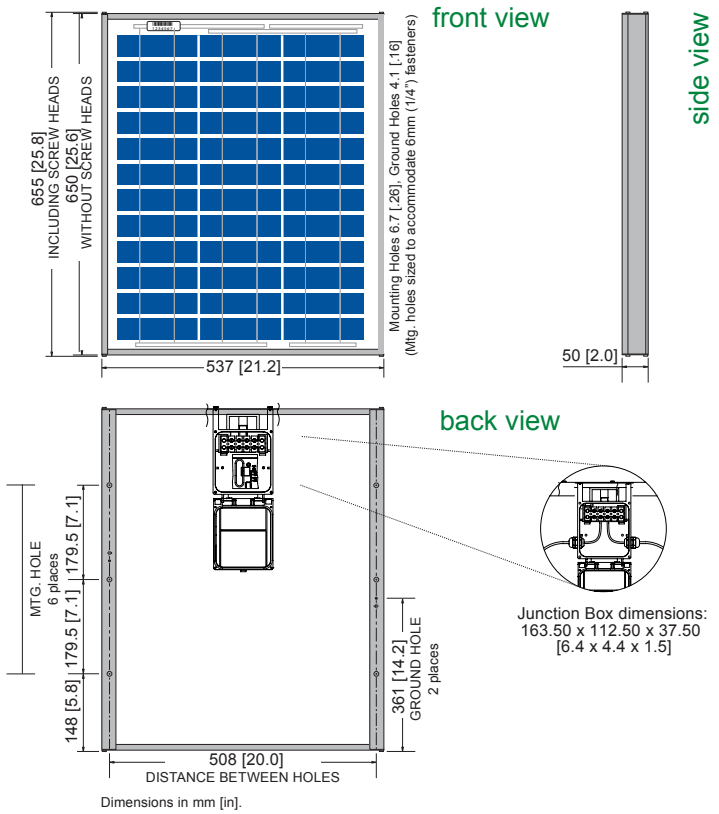
Certified according to the extended version of the IEC 61215 (ed.2), EN 61215:2005-08 (Crystalline silicon terrestrial photovoltaic modules - Design qualification and type approval).

Certified according to IEC 61730-1 and IEC 61730-2 (ed.1), EN 61730-1:2007-05 and EN 61730-2:2007-05. (Photovoltaic module safety qualification, requirements for construction and testing).

Listed to UL 1703 & ULC ORD-C1703 Standard for Safety by Intertek ETL. Class C Fire Rating.

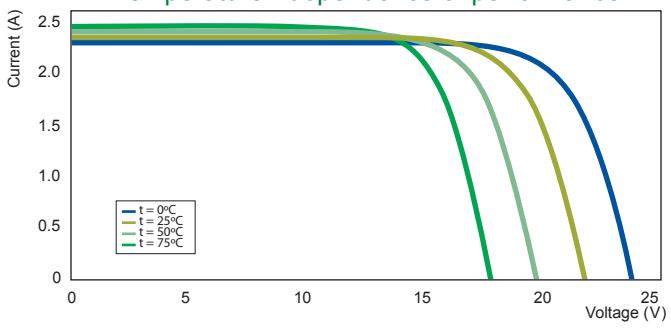
Approved by Intertek ETL according to FM 3611, Dec 2004, and according to CAN/CSA C22.2 No. 213-M1987, 1st Edition, Reaffirmed 2004, for use in a Class I, Division 2, Group A, B, C, D Hazardous (Classified) Location.

AMERESCO SOLAR
Green • Clean • Sustainable

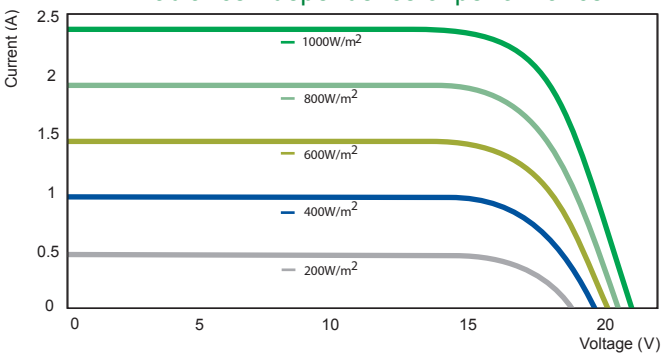


Dimensions in mm [in].

Temperature - dependence of performance



Irradiance - dependence of performance



For more information, call 855-43-SOLAR or visit www.amerescosolar.com.

Appendix C

Checklists

Candidate Wet Weather Sampling Site Evaluation Checklist
And Data Collection Form
North Central Texas Council of Governments
Regional Wet Weather Characterization Program
Fall 2017

Date:_____ Time: _____

Location Name/Number:_____

Nearest Cross Street/Location Description: _____

Entity (Circle One): Arlington Garland Irving Mesquite NTTA Plano

GPS Latitude/Longitude:_____/_____

Receiving Water: _____

Data for locating automated samplers:

Ease of Installation ~ Native or Existing Location / Bench ~ Need to construct Location / Platform / Base

Describe: _____

Ease of channel/sample area access and safety: ~ Describe either YES or NO

Describe: _____

_____

Conveyance Information:

Conveyance Type & Size (Example: Unlined Channel, Grassy Swale, Open Channel Chute, etc.)

Describe: _____

_____

Vegetative Cover ~ High ~ Medium ~ Low

Describe: _____

_____

Visibility from the Right-of-Way ~ High Visibility ~ Low Visibility ~ None

Describe: _____

_____

Public Access ~ Yes ~ No

Describe: _____

_____

Evidence of Public Use ~ Yes ~ No (Circle all that apply, or describe)

Cans ~ Bottles ~ Paper ~ Food Products ~ Rubble ~ Wood ~ Brush ~ Graffiti ~ Transient Community

Describe: _____

_____

Evidence of Normal Surface Water Elevation ~ Yes ~ No ~ Depth _____ inches/feet

Describe: _____

_____

Perennial Flow Presence ~ High ~ Medium ~ Low ~ Depth _____ inches/feet

Describe: _____

_____

Estimation of Automated Sampler, Sample Collection Criterion:

Estimate of maximum linear horizontal distance (in feet) of tubing needed to reach water _____
(Recommended to be less than 30 feet)

Estimate of maximum vertical distance (in feet) needed to collect sample _____
(Recommended to be less than 25 feet)

Other Site Features of Importance: _____
_____
_____
_____
_____
_____

Notes: _____
_____
_____
_____
_____
_____
_____

Provide Site Visit Attendee Name(s) and Company/Entity:

_____
_____
_____
_____

Site Sketch(s):

(Provide a conveyance cross section, along with a plan view sketch. Include dimensions in feet. Use additional pages if necessary)

_____ AERIAL VIEW _____

_____ CROSS SECTION _____

Facing: Upstream / Downstream (Circle One)

NCTCOG STORMWATER SAMPLE COLLECTION
MOBILIZATION CHECKLIST

Municipality: (Circle One): Arlington Garland Irving Mesquite NTTA Plano

Date: _____ Name(s) of sampling team:_____

Confirm Qualified Storm Event		
1. Time since last rainfall (____ Days)		
2. Rain gauge & samplers functioning	Y	N
3. Rainfall amount _____ Rain gauge used _____		
Stations Active (List Stations Activated by Storm Event) Arlington: Garland: Irving: Mesquite: NTTA: Plano:		

Gather Required Field Equipment				
☐ Field Equipment Box (Latex gloves, first-aid kit, see MP/QAPP)				
☐ Chain of Custody for Samples				
☐ Sample Collection Call (Atkins, Lab, Field Team)				
☐ Waders/Rubber Boots/Rain Coat/ High Visibility Vest				
☐ Digital Camera for Photo Documentation				
Containers, Labels and Ice for Samples	Grab (1) ☐	Comp (2) ☐	Comp (3) ☐	Comp (4) ☐
Temperature/pH/Conductivity meter calibrated?			Y	N

Final Preparation		
1. Is severe weather forecast for site? (Check NOAA and Local Websites for details – i.e. www.noaa.gov, etc.)	Y	N
2. Notified Atkins office personnel of trip and return time?	Y	N
3. Notify lab?	Y	N

NCTCOG STORMWATER SAMPLE COLLECTION CHECKLIST

Date: _____ Name: _____

Station ID: _____ Station Name: _____

Entity: (Circle One): Arlington Garland Irving Mesquite NTTA Plano

Current Field Conditions

- Time begin sample collection activities: _____

  Time end sample collection activities: _____
- Ambient air temperature: _____ °F
- Current cloud condition:

  □ Fog □ High Clouds □ Partly Cloudy □ Cloudy □ Clear

  □ Other: _____
- Current weather condition:

  □ Sunny □ Light Rain □ Heavy Rain □ Snow/Sleet/Hail

  □ Windy □ Thunderstorms □ Severe Storms □ Other –
- Construction activities w/n the drainage area: Y N
- Observed rise: Y N

  □ Estimate: _____

  Describe: _____

Comments: _____

_____

Electronic Equipment Check
Sampler □ No error messages present (list error messages with comments) □ Sampling complete and sampler “disabled”.
Rain Gauge □ Functioning and data recorded for duration of storm
Level □ Functioning and data recorded for duration of storm
Comment:

Grab Sample Documentation		
Grab sample collected appropriately during first flush?	Y	N
Time collected: _____ (e.g., 2100)		
pH _____ Conductivity _____ Temperature _____ ***If any of the following conditions are observed call or text 713-501-4569 immediately.*** o pH outside of 6-9su range o Conductivity less than 50 umhos/cm or greater than 500 umhos/cm\ o Abnormal temperature o Abnormal color o Oil sheen o Odor: sewage, sulfur, sour, petroleum, natural gas		
Estimated volume in grab bottle: _____gal (at least 0.5 gal)		
Qualitative description of sample characteristics: □ Turbid □ Clear □ Oil Sheen □ Debris □ Algae □ Other:		
Sample bottles labeled and placed on ice?	Y	N
Comment:		
Composite Sample Documentation		
Sub-samples collected appropriately throughout storm duration?	Y	N
Time Collected 1 of 2 Bottle 2: _____ (e.g., 2100) 2 of 2 Bottle 2: _____ (e.g., 2100) 1 of 2 Bottle 3: _____ (e.g., 2100) 2 of 2 Bottle 3: _____ (e.g., 2100) 1 of 2 Bottle 4: _____ (e.g., 2100)		
Actual volume w/n 20% of expected volume?	Y	N
Qualitative description of the sample characteristics (can be more than one): □ Turbid □ Clear □ Oil Sheen □ Debris □ Algae □ Other:		
Sample bottles labeled and placed on ice?	Y	N
Comment:		
Rainfall Documentation		
Time since last rainfall _____ days Rainfall amount _____ in. Rain gauge used _____		
Additional comments.		

NCTCOG MAINTENANCE CHECKLIST
FOR MONITORING STATIONS

Municipality: (Circle One): Arlington Garland Irving Mesquite NTTA Plano

Date: _____ Name: _____

Intake Port (when accessible):

- ☐ Tubing opening cleaned of debris.
- ☐ Sample tubing in good condition and anchored securely.
- ☐ Defective tubing replaced (as needed).
- ☐ Debris and sediment removed from the immediate vicinity of the intake port and along the tubing line.
- ☐ Sample strainer cleaned periodically with a brush.

At Sampling Station:

Sampler

- ☐ Sample container dismantled successfully.
- ☐ Connectors at the back of the controller capped tightly.
- ☐ Controller power cable connected.
- ☐ Tubing in contact with the peristaltic pump inspected and in good condition.
- ☐ Tubing replaced (as needed after 1,000,000 pump counts).
  - o Number of counts _____.
- ☐ Sample tubing in good condition (no cracks, visible obstructions, kinks)
- ☐ Sample tubing joint connections in good condition (no leak)
- ☐ Programmable controller display and keyboard in good condition

- ☐ Sampler firmly plugged into power supply and receiving power
- ☐ Desiccant bag within the controller case inspected and recharged/ replaced (as necessary)
- ☐ Error messages reported by the sampler investigated and remedied
- ☐ Connections inspected to ensure that they are secure

Shelter

- ☐ Sampling shelter exterior inspected and in good condition (no cracks, vandalism, etc.)
- ☐ No debris/waste inside or around shelter
- ☐ Shelter door and lock operational

Rain Gauge

- ☐ Rain gauge clear of debris (if applicable)
- ☐ Connection to sampler in good condition (if applicable)

Cell Phone

- ☐ Cell phone antenna attached to shelter (if applicable)
- ☐ Connection to sampler in good condition (if applicable)

Temporary Power

- ☐ Battery sufficiently charged to complete one sampling event
- ☐ Battery connections tight to battery probes?

Equipment Calibration

- ☐ Bubbler level calibrated
- ☐ Sample volume calibrated

NCTCOG STORMWATER MONITORING
LABORATORY DELIVERABLES CHECKLIST

Date: _____ Reviewer:_____
Municipality: (Circle One): Arlington Garland Irving Mesquite NTTA Plano

Event ID: *STATION ID*-_____

Hard Copy Deliverable
Cover Page ☐ The proper event ID, type of sample analyzed and date of report specified on cover
Results ☐ The proper event ID, contact, sample location, date laboratory received and laboratory contact specified on analysis results page ☐ Matrix specified is consistent with the sample taken ☐ Sample holding times consistent with MP/QAPP ☐ Laboratory analyses match analytes requested on COC ☐ Laboratory methods match methods requested in MP/QAPP ☐ Units reported match units requested in MP/QAPP ☐ Proper MDL/MAL achieved Note exceptions:
Lab QA/QC ☐ The proper event ID and date of analysis specified on analysis results page ☐ Flagging criteria clearly defined ☐ QA/QC sample results are within acceptable levels ☐ Other QA/QC performed are acceptable (i.e. cone splitter blanks, etc.) List of other QA/QC items: _____ Note exceptions and flagged samples: Note exceptions and flagged samples:
Additional Material ☐ Proper COC copy attached ☐ Sample Protocol Nonconformance Worksheet attached, if applicable

Appendix D

Chain-of-Custody

800 106th Street
Arlington, Texas 76011

TTI ENVIRONMENTAL LABORATORIES

CHAIN OF CUSTODY RECORD

NELAP ACCREDITED TNI LABORATORY

Telephone: (817) 861-5322
FAX: (817) 261-1717
www.ttilabs.com

Page_____of_____

CLIENT NAME: Atkins	CLIENT CONTACT: Chad Richards
CLIENT ADDRESS: 17220 Katy Freeway, Building 1, Suite 200	PHONE: (281) 529-4200
CITY, STATE, ZIP: Houston, TX, 77094	FAX: (281) 493-1047
P.O. NO.	EMAIL: chad.richards@atkinsglobal.com
	QUOTE NO.

PROJECT NO.	PROJECT NAME	SAMPLER'S NAME
100060260	NCTCOG RSWMP	

LAB NO.

ON ICE ☐ YES ☐ NO

TEMP.OF COOLERS °C: 3 | | 4 | >

CUSTODY SEAL

Cooler: ☐ Y ☐ | ☐ Y ☐

SEAL INTACT

Cooler: ☐ Y ☐ | ☐ Y ☐

Sample Collection Date (Ex:mm/dd/yyyy)	Time (Ex:hh:mm)	(C)omp (G)rab	Matrix[1]	Sample Description	No. / Type Containers[2] VOA	1 LT.	A/G	P/O	4 OZ	PRES.[3]	E. coli	Oil and Grease	BOD5\COD\TSS\TDS	Tot. Pb/Tot. Zn/Tot. Cr	Tot. As/Tot. Cu	Diss. & Tot. P/Ortho P./Tot. N	Ammonia N./Nitrate N.	Atrazine			DRY WT.	TRRP	HOLD[4]	TTI Lab ID
		C	W	A 3.7 L				G			✓	✓												
		C	W	B,C,D 3.7L				G					✓	✓	✓	✓	✓	✓						

TURNAROUND TIME:

☑ STANDARD 5 Business Days ☐ 50% RUSH 3 Business Days ☐ 100% RUSH 1Business Day / ASAP* ☐ E.R. 300% RUSH Same Day / ASAP*

1. MATRIX: WW-Wastewater; W-Water; S-Soil; SD-Solid; L-Liquid; A-Airbag; C-Charcoal Tube; SL-Sludge; O-Oil
2. CONTAINERS: VOA-40ml vial; A/G-Amber or Glass 1 Liter; 4 oz-Glass Wide Mouth; P/O-Plastic or G
3. PRES.: 1-None; 2-1:1 HNO_3; 3-1:1 HCL; 4-1:1 H_2SO_4; 5-NaOH; 6-Ice; 7-Other_____
4. HOLD: Lab will hold samples for 30 (thirty) days.

Relinquished by (Signature)	Date	Time	Received By: (Signature)	Date	Time
Relinquished by (Signature)	Date	Time	Received By: (Signature)	Date	Time
Relinquished by (Signature)	Date	Time	Received By: (Signature)	Date	Time

REMARKS: ☐ TTI Drop Off ☐ TTI Pickup

Clients delivery of samples to TTI constitutes acceptance to reimburse TTI as per the terms and conditions listed in the price schedule.

Appendix E

Annual Flow Equations

Currently In Development

To Be Submitted Separately

Appendix F

Nearest Hospital Information

Station ID	Hospital	Directions
AR1801/1901	**Texas General Hospital** 2709 Hospital Blvd Grand Prairie, TX 75051 (469) 999-0000	1. Head southeast on E Copeland Rd toward Six Flags Dr 2. Slight right onto TX-360 Frontage Rd/N Watson Rd 3. Use the middle lane to turn left onto the ramp to E Abram St 4. Continue onto E Abram St 5. Turn right onto Osler 6. Turn left onto Howell 7. Turn right onto Stewart 8. Turn left at the 1st cross street onto Hospital Blvd Destination will be on the right
AR1802/1902	**Texas General Hospital** 2709 Hospital Blvd Grand Prairie, TX 75051 (469) 999-0001	1. Head north on S State Hwy 360 2. Use the left lane to take the ramp onto TX-360 N 3. Merge onto TX-360 N 4. Take the exit toward Abram St 5. Merge onto S Watson Rd 6. Turn right onto Prairie Oaks Dr 7. Turn right onto Osler Dr 8. Turn left onto Stewart Dr 9. Turn right at the 1st cross street onto Hospital Blvd Destination will be on the right
GA1801/1901	**Texas Health Presbyterian Hospital Dallas** 8200 Walnut Hill Ln Dallas, TX 75231 (214) 345-6789	1. Head south on N Shiloh Rd 2. Turn right onto Forest Ln 3. Keep left to stay on Forest Ln 4. Continue straight onto Skillman St 5. Continue straight to stay on Skillman St 6. Turn right onto Walnut Hill Ln 7. Turn left onto Main Cir 8. Enter the traffic circle Destination will be on the right
GA1802/1902	**Texas Health Presbyterian Hospital Dallas** 8200 Walnut Hill Ln Dallas, TX 75231 (214) 345-6789	1. Head east on Forest Ln toward S Garland Ave 2. Turn right at the 1st cross street onto S Garland Ave 3. Turn right onto W Kingsley Rd 4. Continue onto Walnut Hill Ln 5. Turn left onto Main Cir 6. Enter the traffic circle Destination will be on the right
GA1803/1903	**Baylor Scott & White Medical Center - Lake Pointe** 6800 Scenic Dr, Rowlett, TX 75088 (972) 412-2273	1. Head northeast on La Prada Dr toward Duck Creek Dr 2. Turn right onto Duck Creek Dr 3. Turn right onto Broadway Blvd 4. Turn left onto E Interstate 30 5. Use the left lane to take the ramp onto I-30 E 6. Take exit 64 for Dalrock Rd 7. Continue onto Dalrock Rd 8. Turn right onto Woodlake Dr 9. Turn left onto Scenic Dr 10. Sharp left to stay on Scenic Dr Destination will be on the right

IR1801/1901	**William P. Clements Jr. University Hospital** 6201 Harry Hines Blvd Dallas, TX 75390 (214) 633-5555	1. Head north on N Sowers Rd toward W Pioneer Dr 2. Turn left onto W Pioneer Dr 3. Turn right onto N MacArthur Blvd 4. Turn right onto W Airport Fwy 5. Use the left lane to take the ramp onto TX-183 E 6. Merge onto TX-183 E 7. Use the right lane to merge onto I-35E S 8. Take exit 432B for TX-356/Commonwealth Dr 9. Merge onto N Stemmons Fwy 10. Slight left toward N Stemmons Fwy 11. Turn left onto N Stemmons Fwy 12. Turn right onto Record Crossing Rd 13. Turn left 14. Turn left 15. Sharp left Destination will be on the right
IR1802/1902	**William P. Clements Jr. University Hospital** 6201 Harry Hines Blvd Dallas, TX 75390 (214) 633-5555	1. Head east on E Oakdale Rd toward S Nursery Rd 2. Turn left at the 1st cross street onto S Nursery Rd 3. Turn right onto E Shady Grove Rd 4. Use the right lane to turn slightly right onto E Irving Blvd 5. Slight right onto the TX-356 E ramp 6. Merge onto TX-356/Irving Blvd 7. Use the left 2 lanes to turn left onto Commonwealth Dr 8. Use any lane to turn left onto N Stemmons Fwy 9. Turn right onto Record Crossing Rd 10. Turn left 11. Turn left 12. Sharp left Destination will be on the right
MS1801/1901	**Dallas Regional Medical Center** 1011 N Galloway Ave Mesquite, TX 75149 (214) 320-7000	1. Head south toward New Market Rd 2. Turn left onto New Market Rd 3. Turn left onto S Beltline Rd 4. Continue straight onto S Bryan Belt Line Rd 5. Turn left onto Park Ln 6. Turn left onto N Galloway Ave Destination will be on the right
MS1802/1902	**Dallas Regional Medical Center** 1011 N Galloway Ave Mesquite, TX 75149 (214) 320-7000	1. Head east on Edwards-Church Rd toward Waterway Dr 2. Turn left onto Clay Mathis Rd 3. Turn left onto E Scyene Rd 4. Continue onto E Main St 5. Turn right onto N Bryan Belt Line Rd 6. Turn left onto Park Ln 7. Turn left onto N Galloway Ave Destination will be on the right
PL1801/1901	**Medical City Plano** 3901 W 15th St Plano, TX 75075 (972) 596-6800	1. Head west on W 16th St 2. Turn left onto Alma Dr 3. Turn right onto W 15th St/Norman F Whitsitt Pkwy 4. Turn right onto Coit Rd 5. Turn right 6. Sharp left Destination will be on the right
NT1801/1901	**Medical City Las Colinas** 6800 N MacArthur Blvd Irving, TX 75039 (972) 969-2000	1. Head northeast on State Hwy 161 N 2. Turn right onto N MacArthur Blvd 3. Turn left Destination will be on the right

NT1802/1902	**Texas General Hospital** 2709 Hospital Blvd Grand Prairie, TX 75051 (469) 999-0000	1. Head north on Robinson Rd 2. Slight left toward State Hwy 161 S 3. Turn left onto State Hwy 161 S 4. Turn right onto W Marshall Dr 5. Turn right onto S Great SW Pkwy 6. Turn left onto Hospital Blvd Destination will be on the left