Fiscal Year 2011 Annual Report on Operational Findings for North Bosque River (Segment 1226) Continuous Monitoring Project

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Introduction and Background

The purpose of this report is to provide an annual update to the operational findings and recommendations made by site operators at the Texas Institute for Applied Environmental Research (TIAER), Tarleton State University from operation of two real-time monitoring stations in the North Bosque River watershed as part of the on-going process to make improvements to the real-time monitoring operational process and future real-time installations. Both of the TIAER operated stations are part of the Continuous Water Quality Monitoring Network (CWQMN) program and the Environmental Monitoring Response System (EMRS) pilot program of the Texas Commission on Environmental Quality (TCEQ).

TIAER first entered into contract with the TCEQ in March 2006 to operate and maintain an EMRS station (CAMS 725) located on the North Bosque River at State Highway 6, near Clairette, Texas. In September 2007, TIAER was contracted by TCEQ to operate another station (CAMS 702) located on the North Bosque River at Riverside Road near the City of Clifton's pumping station in Clifton, Texas. Both stations were originally part of the EMRS pilot project, but were re-classified as CWQMN stations due to the spatial distance from known nonpoint sources in the upper portion of the watershed. The TCEQ and TIAER present contractual agreement extends TIAER operation and maintenance of the two CAMS location through August 31, 2012.

It should be noted that the TCEQ has an extended history and great expertise in operating continuous water quality monitoring stations. Their early efforts at continuous monitoring of nutrients began nearly a decade ago and included stations in the North Bosque River watershed. As a result of their successful efforts in this arena, TCEQ has well established standard operating procedures and protocol for these stations.

Furthermore, TIAER staff underwent several months of training under the tutelage of TCEQ staff prior to being allowed to operate and maintain these two stations without close supervision.

TIAER benefited greatly from the prior experience of TCEQ in operating and managing these types of stations. It will be apparent to the reader of this report that TIAER's "lessons learned" from over five years of operating CWQMN/EMRS stations and recommendations for improvements to the real-time operational process and future installations represent only a fine tuning of a few aspects of a highly effective operation.

Station Equipment and Setup

Each station that TIAER operates is equipped with an enclosed, portable, climate-controlled trailer that serves as an enclosure for the Auto Analyzer, ZENO Data Logger, desktop computer, telemetry equipment, chemical standards and reagents, and various supplies. A submersible pump is used to convey water from the stream to the trailer sample pot; consequently allowing a sub-sample representative of the streams' surface water to be collected by the Auto Analyzer for analysis. Water quality parameters

monitored at both stations include water temperature, specific conductance, dissolved oxygen, pH, turbidity, nitrate (NO_3-N), ammonia (NH_3-N), total reactive phosphorus, and water level. Test results are transferred via a telephone land line to the TCEQ MeteoStar/LEADS system.

The equipment setup is similar for both stations with only minor differences. However, CAMS 725 is located on a bridge (Figure 1) instead of the traditional streambank installation similar to CAMS 702 (Figure 2).

Maintenance and Operation

Routine maintenance procedures were performed weekly at each station with more in-depth procedures performed at regular intervals (i.e., every 14, 28, and 90 days) based on TCEQ standard operating procedures listed in the Quality Assurance Project Plan for the Continuous Water Quality Monitoring Network Program (TCEQ, 2011). Remote data quality assurance checks were performed daily from the TIAER office, via telephone modem, to ensure the system was working properly or to identify system or telemetry malfunctions. Onsite troubleshooting of system malfunctions was performed as needed.

Figure 1 Monitoring installation at CAMS 725

Figure 2 Monitoring installation at CAMS 702

Operational Findings

The following is an update of operational findings or "lessons learned" based on experiences encountered through June 2011 by TIAER site operators of two real-time monitoring stations (CAMS 702 and CAMS 725) located on the North Bosque River. Recommendations for improvements to the operational process and future installations also are included in this section. In most instances, measures have been taken to rectify the findings and address the recommendations.

- **Manufacturer's technical assistance response time needs to occur in a timely manner.**

On multiple occasions, onsite attempts to contact a manufacturer's repair technician by phone to assist with troubleshooting efforts were unsuccessful. Occasionally, follow-up replies (phone or email) by the manufacturer's repair technician to assistance requests did not occur for several days. Instances requiring an onsite repair visit from the manufacturer's repair technician took even longer; several weeks in some cases. There were a few instances were the technician could not complete the work due to inadequate tools or parts. These occurrences resulted in extended periods of specific sensor or complete system down time. It should be noted that improvement in this area of the

project has occurred. More specifically, follow-up replies by technicians to assistance requests are now nearly same-day.

- **Learning curve for new technology can be steep and no replacement for hands-on experience.**

Learning to operate the auto analyzer and troubleshoot system malfunctions is a time intensive process. While procedures and instructions were in place for guidance, time, patience, and experience proved to be the most valuable and necessary components in the learning process, particularly with troubleshooting efforts. These components apply to technical assistance from the manufacturer as well. On one occasion, the site operator was eventually successful in troubleshooting an issue that the manufacturer's repair technician could not correct, even after a site repair visit.

Troubleshooting efforts were difficult due to the numerous system components and the need for some or all of these parts to function simultaneously for any given analytical process. In some instances, a peristaltic pump, pinch valve, or sensor board would not completely fail, but work intermittently resulting in multiple troubleshooting attempts. Another occasion revealed development of a small hole in the system tubing resulting in the inclusion of small air bubbles into the system that eventually affected sensor response. However, these experiences have increased the operator's knowledge of and familiarity with the monitoring equipment, which has been valuable in subsequent troubleshooting efforts; eliminating the need for a site visit by a repair technician in some cases. As with any complex instrumentation, there is no substitute for extensive, hands-on experience with troubleshooting issues or equipment malfunctions that equip the operator to be more proficient in dealing with future troubleshooting events and minimizing down time when malfunctions arise.

- **Specific supplies are needed to conduct timely onsite repairs.**

Several instances of system down time or data loss occurred due to lack of certain tools or supplies needed for repairs. While it may be inappropriate for the site operator to possess all of the supplies or equipment utilized in the monitoring system, it was discovered and recommended that certain frequently used parts and pieces of equipment that are vital to the overall operation of the system be issued to the site operator. Examples of beneficial parts and supplies for an operator to have readily available include, but are not be limited to, nitrate tips, pinch valves, PVC pipe, PVC glue and fittings, and electrical soldering equipment. It should be noted that this issue has been addressed, and subsequent instances have occurred whereby possession of these parts by the site operator allowed for more timely repairs resulting in a dramatic decrease in system down time and, in some cases, alleviated the need for a site repair visit by TCEQ personnel.

- **Monitoring system modifications may be necessary at certain stations to maintain operational status.**

At CAMS 725, the external non-modified waste hose had to be rerouted though the trailer wall to maintain a positive drain to prevent line blockage from silt or ice. Additionally, it was discovered that an externally mounted sample pot is easier to service while performing maintenance procedures, but needs to be insulated because extended periods of freezing temperatures can cause icing in the sample pot (Figure 3). It is recommended that future monitoring installations include an externally mounted, insulated sample pot to better facilitate sample pot maintenance.

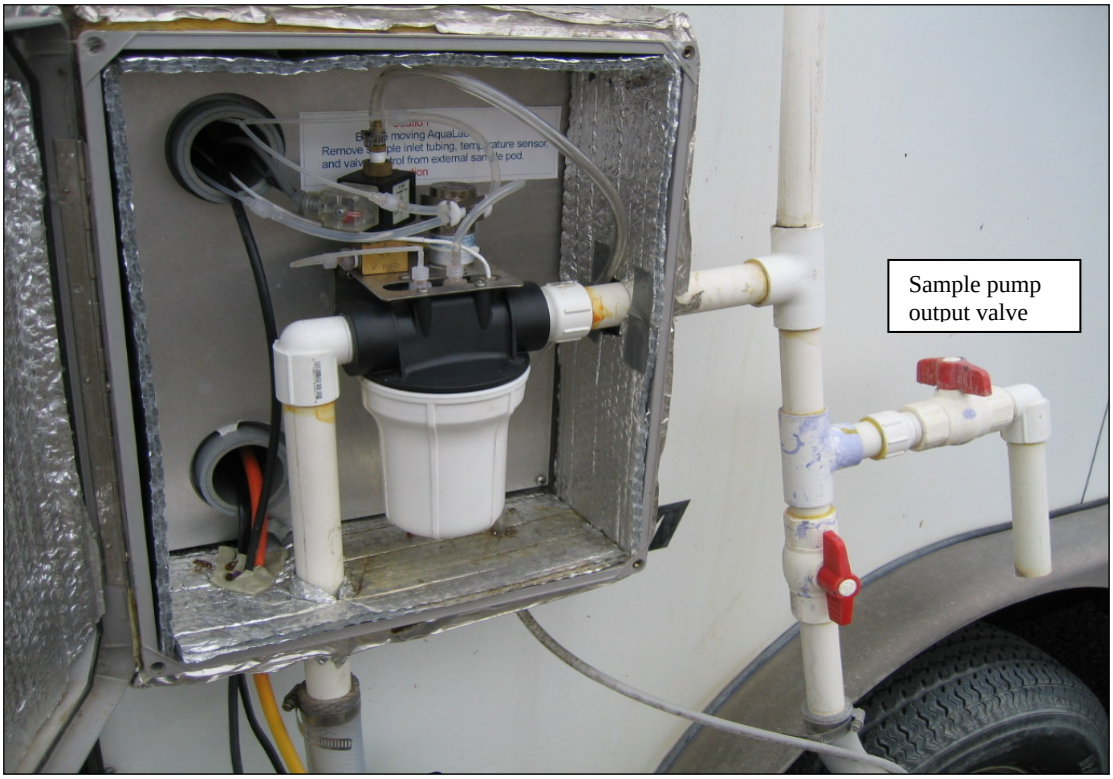

Figure 3 Insulated sample pot housing (with insulating door open) and sample pump output valve at CAMS 725

Routine measurement of the external sample pump output by the site operator is necessary to measure sample volume delivery to the sample pot and is typically measured at the end of the sample exhaust hose located downstream from the sample intake. Dense vegetation and a steep streambank presented safety concerns for sample pump output measurements underneath the bridge at CAMS 725. Modification to the sample exhaust line by installation of a valve immediately after the sample pot housing (see Figure 3) proved to be effective in allowing the site operator to safely measure the sample pump output.

The In-Situ Level TROLL sensor at CAMS 725 was installed on a bridge support pier, near mid-stream, during extremely low stream levels (almost dry streambed). After installation and upon return of base flow at this site, it was discovered that the sensor was located at a depth (> 5 feet below stream surface) that was too deep to perform periodic maintenance. It is recommended that stream level sensors be installed with accessibility for maintenance a consideration.

- **Some site locations are difficult to monitor and require ongoing site development.**

As mentioned earlier, the trailer at CAMS 725 is located on a bridge no longer used for through traffic. Because of the location of the trailer above the river, this type of setup requires the external pump and hose to be suspended from the bridge by steel cables. Further, the intake to the pump should be located within a portion of the stream that has definite downstream movement, avoiding areas of eddies. For this location the initial sample pump placement was midstream. While this installation may be effective for most situations, midstream placement of the pump resulted in exposure to debris during high flow storm events (Figure 4). Trial and error revealed that pump placement slightly offset from mid-channel, but still in an area of the stream with definite downstream movement of water, was in an area less likely to be snagged by debris.

Figure 4 Log entangled with pump during high flow event at CAMS 725

- **Need to periodically evaluate site locations**

While not strictly an operations issue, monitoring data from CAMS 702 (Clifton) site have resulted in numerous ammonia nitrogen (NH_3-N) concentrations that produced a "high trigger" e-mail notification to selected individuals. These high NH_3-N concentrations have not been successfully linked to any known sources discharging into the North Bosque River. The CAMS 702 site is located in a small impoundment behind an instream dam from which the City of Clifton periodically pumps water to its off-channel drinking water supply reservoir. TCEQ staff are concerned that the high concentrations may result from agitation and resuspension of bottom sediments when pumps are in use and transferring

water between impoundments. While due diligence was exercised in the original site selection process of CAMS 702, additional information obtained after site installation and operation now bring the location into question. Convenience and accessibility were among the major considerations in selecting this site. There is, however, a growing concern that factors associated with the impoundment and transfer pumps that were not considered in the site selection process are negating the positive aspects of the site due to the occurrence of "high trigger" NH_3-N concentrations that can not be associated with sources (e.g., elevated flows during stormwater runoff).

The site locations should be reevaluated and adjustments made. Whether or not this site should be relocated is a decision that still needs to be made. This ongoing decision process is in keeping with the recommendation to periodically evaluate acceptability of site locations and representativeness of water quality data being collected at a site.

- **External sample pump anchoring system for traditional streambank installations may need to be redesigned**.

The original anchoring system for the external sample pump at the CAMS 702 site consisted of an aluminum "track" that extended into the stream to anchor the external sample pump (Figure 5). This system elevated the sampling hose approximately 12" above the ground leaving the entire system susceptible to damage from floating debris and strong water currents during high flow storm events. On two separate occasions (November 2009 and February 2010), high flow storm events damaged the tract and rendered the system inoperable (Figure 6).

Figure 5 Original track anchoring system for external pump at CAMS 702

Figure 6 Damaged track at the CAMS 702 site

In an effort to minimize the anchoring system's exposure to floating debris, TIAER staff fabricated and installed a low-profile anchoring system (Figure 7). This system consists of a 1-½" structural pipe frame (set in concrete) that runs along the ground and into the stream. Steel rods were driven into the streambank to secure the sample intake hose and power cord (Figure 8). Because this system places all components closer to the ground, the effects of floating debris and water current forces during high flow storm events are lessened compared to the "track" system. To date, this has proved to be an effective anchoring system.

- **Suspension of sampling during extended periods of freezing temperatures.**

Historically, short-term (nightly) freezing temperatures have not affected the operation of either CAMS site. However, on one occasion a system shut-down was encountered during a multiple day, extreme freezing temperature (below 26 °F) event. It was observed that during this extended period of freezing temperatures, residual water droplets in the external non-modified waste hose would accumulate and freeze. This ice accumulation would eventually result in a clogged hose which created back-pressure throughout the system and eventually trigger a water- ingress alarm designed to shut the system down. It was determined that best professional judgment should be used to determine when an extended period of extreme freezing temperatures is anticipated, thus, warranting suspension of sampling.

Figure 7 Steel anchoring system at CAMS 702

Figure 8 Steel post securing sample hose and power cable at CAMS 702

Summary

Operating and maintaining continuous water quality monitoring sites can be a challenging task and is a process that continues to evolve. TCEQ's expertise in continuous water quality monitoring and established operating procedures was very beneficial to TIAER's training and operation of the two real-time monitoring stations. Several findings were identified and discoveries or recommendations made during the operational period by the TIAER site operators and are presented to assist TCEQ's efforts to improve an established and effective real-time monitoring program. These findings included untimely manufacturer's technical support, a steep learning curve for operators of this technology, benefits of experience and hands-on encounters with the day-to-day problems to reduce down time of instrumentation, specific supply needs for operators to decrease down time, needed modifications to the monitoring system to improve reliability and safety, ongoing site development to reduce down time, need to periodically evaluate each site location, need to install a low-profile external sample pump anchoring system at traditional stream bank installations, and need to temporarily suspend all sampling whenever extended periods of extreme, freezing temperatures are anticipated. TCEQ has been very responsive in addressing these findings and recommendations as they have been brought to their attention. Improvements and corrective actions to address these findings have been implemented, which have resulted in increased operational efficiency and a higher percentage of data recovery.

References

TCEQ, Texas Commission on Environmental Quality. 2011. Quality Assurance Project Plan for Continuous Water Quality Monitoring Network Program, Revision 5. Monitoring Operations Division, TCEQ, Austin, Texas.