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TREAT Raw Data
Explanation of Limitations
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The purpose of the The Removal Efficiency & Assessment of Treatments ("TREAT") study is to investigate the efficiency of the treatments at the Buckman Regional Water Treatment Plant ("BRWTP," or "the Plant") with respect to contaminants that may occur in the Rio Grande upriver from the Buckman Direct Diversion ("BDD"). The study is intended to "practically confirm all theoretical evaluations of the efficiency of plant" (*see **T**HE **R**EMOVAL **E**FFICIENCY & **A**SSESSMENT OF **T**REATMENTS -- TREAT Study at Buckman Regional Water Treatment Plant*, hereinafter referred to as "TREAT Study Summary"). The duration of the study is three years. Sampling of the river, the diversion, finished water, and various points within the treatment works occurred at different seasons and under different source conditions (e.g., high turbidity vs low turbidity) in an attempt to explore the limits of the Plant's treatment. Further explanation of the TREAT study, including sampling locations and requested methods to analyze the samples, can be found in the TREAT Study Summary.

To date, four TREAT sampling events have occurred – March, May, and September of 2016, and April 2017. The sampling and analysis results from the four events are tabulated in the accompanying "TREAT Raw Data" document. The data in the table are those reported by the various laboratories used to analyze the data, with no corrections, exclusions, changes, or commentary. See *Procedures for Evaluation of Buckman Regional Water Treatment Plant TREAT Raw Data – June 3, 2018* for details on how the table was created and data were evaluated. It is common to assess raw data such as this against the objectives of the study, the anticipated and unanticipated uncertainties, sampling and analysis issues and challenges, assumptions made, quality and reliability of the data, and other factors. Assessment is therefore a crucial step in making sense of the data (i.e., What do the data mean?) and particularly so when controlled factors change within a study. This document is intended to explain the accompanying TREAT Raw Data table, including what factors may limit the use of the data for decision-making.

<u>Data Quality Objectives and Planning</u>

Establishing "Data Quality Objectives," or "DQOs," is a standard and industry-accepted way of approaching problems revealed by and understood with data. The "DQO Process" is particularly well-suited for studies that are heavily data-driven. DQOs help us determine the type, quality, and quantity of data needed to reach defensible decisions or make estimates. The U.S. Environmental Protection Agency ("EPA") has a number of guidance documents on using the DQO process. Other federal agencies (e.g., Department of Defense, the Department of Energy, the National Aeronautics and Space Administration) have adopted the DQO process as well. Most environmental professionals use some version of the process, even if they call it something else.

The process of developing DQOs addresses eight primary areas of concern:

- Organization: Identification and involvement of the project manager, sponsoring organization and responsible official, project personnel, stakeholders, scientific experts, and others (e.g., all customers and suppliers). This step also identifies the decision-makers and personnel who

should develop, review, and ultimately approve individual documents that support study activities.

- Project Goal: Description of the project goal, objectives, and study questions and issues.
- Schedule: Identification of project schedule, resources (including budget), milestones, and any applicable requirements (e.g., regulatory requirements, contractual requirements).
- Data Needs: Identification of the type of data needed and how the data will be used to support the project's objectives.
- Criteria: Determination of the quantity and quality of data needed and specification of performance criteria for measuring quality.
- Data Collection: Description of how and where the data will be obtained (including existing data) and identification of any constraints on data collection.
- Quality Assurance ("QA"): Specification of needed QA and quality control ("QC") activities to assess the quality performance criteria (e.g., QC samples for both field and laboratory, audits, technical assessments, performance evaluations).
- Analysis: Description of how the acquired data will be analyzed (either in the field or the laboratory), evaluated (i.e., QA review/verification/validation), and assessed against their intended use and the quality performance criteria.

DQOs inform how sampling and analysis is planned for and conducted. The TREAT Study Summary addressed many, but not all, of the items required to establish study DQOs. The DQO process will be improved in subsequent sampling events. Some of the more significant challenges to interpreting the existing TREAT data are addressed below.

<u>Quality Assurance and Quality Control ("QA/QC")</u>

Development of a Quality Assurance Project Plan ("QAPP") is a critical step to address each QA item identified in the DQO process. Like DQOs, QAPPs are a standard and industry-accepted way of addressing data quality before a study is conducted. EPA describes the QAPP as a "blueprint" for making sure the study generates data that can be reliably used for a specific decision or purpose. This includes design of the study such that data generation (e.g., sampling and analysis) is conducted to reduce and identify uncertainties, that analysis is appropriate given the objectives, and that procedures are put in place to conduct appropriate QC after the data are received. The QAPP also should provide some explanation of how certain study design decisions were made, and the rationale behind those decisions.

For the first four TREAT sampling events, a QAPP was not developed. The user is urged to consider that not all standard QA/QC procedures may have been followed in the TREAT study, and to exercise caution with any decisions made based on the TREAT Raw Data accordingly.

<u>Sampling</u>

Sampling methodologies, handling, and custody should be addressed either in a QAPP or a separate Sampling and Analysis Plan ("SAP"). Procedures for collecting samples, identification of the sampling methods and equipment, preservation requirements, decontamination procedures, and material required for sampling should be codified in a formal written document. The SAP should also address contingencies in the event sampling cannot be conducted as anticipated. Sample handling and custody procedures used between and including the collection of the sample and the delivery of the sample to the analytical laboratory are also included in the SAP. The SAP also ensures the activity can be repeated in the field, thus helping make the study reproducible.

Some elements of a SAP were incorporated into the TREAT Study Summary. However, for the first four TREAT sampling events a formal SAP was not developed. The user is urged to consider that not all standard sampling procedures may have been followed in the TREAT study, and to exercise caution concerning any decisions made on the TREAT Raw Data.

Analytical Methods and Detection Limits

The QAPP or SAP also addresses the analytical methods to be used in a study using environmental samples. Analytical method selection is crucial to ensure both that the chemicals of interest can be detected (if present), and that the desired detection limits can be achieved by the method and laboratory instrumentation available. The methods used in the first two TREAT sampling events were outlined in Section VII of the 2015 MOU Annual Report. However, neither a QAPP nor a SAP were created for any of the TREAT sampling events to date; analytical methods used – and particularly the detection limits achieved – may not have been those requested or those that would be appropriate.

Because the study was conducted "…to investigate the efficiency of the treatments at the [plant]" and to "…explore the limits of [plant's] treatments" the detection limits were requested to be as low as possible. However, such extremely low detection limits as used in the TREAT study are in many instances at or even below the laboratories' ability to reliably determine whether or not a reported detection is accurate, much less their ability to quantify the amount. Such an approach sacrifices data quality, which in turn reduces the reliability of the results and the user's ability to make sound decisions.

In spite of these important limitations, the TREAT Raw Data can be useful to help elucidate questions about the presence or absence of certain chemicals (albeit at extremely low concentrations), or about subtle concentration trends that may be revealed as water flows through and is treated by the treatment works. These questions can only be answered with subsequent sampling where data quality and low detection limits are balanced appropriately. The user is urged to consider these data as preliminary at best and requiring confirmation (e.g., through subsequent sampling).

Analytical Laboratory Selection

As discussed above, controlling as many variables as possible is important in conducting any scientific study or experiment. In the case of the TREAT study, one important control was changed between the second and third sampling events – the analytical laboratory. The first two rounds of samples (and metals from the fourth round) were analyzed mostly by Hall Environmental Analysis Laboratory ("HEAL") and its subcontractors; the subsequent samples were analyzed by ALS Global Laboratories ("ALS"). Even though different laboratories may use the same EPA-approved methods, they have different instrumentation, calibration and tracer substances, and different laboratory environments. In fact, the TREAT Raw Data table shows that in many cases they even have very different detection limits, limiting

the usefulness of these data. It is therefore not advisable to compare the results of the first two sampling events with those of the two subsequent events.

Analytical Laboratory QC Results

Because of the extremely low detection limits requested for radionuclides, ALS reported some detections for radionuclides below the method and instrumentation limits in which the laboratory has confidence. This results in two significant areas of uncertainty and the results should be considered estimates only. First, any deviation from the reported limit – even one that is thousands of times smaller than the method detection limit – is a significant ***deviation***, even though the number itself is miniscule. Secondly, in some cases ALS reported detections in its method blanks (i.e., the presumably target radionuclide-free sample, analyzed as a QC sample at or near the same time the collected sample was analyzed) at or above the result of the collected sample. The extent to which the sample results were influenced by the method blank is therefore unclear. These data should be used only to guide design of the fifth and subsequent TREAT sampling events and further confirmation sampling using appropriate detection limits to achieve the desired data quality.

Metals: Dissolved vs. Totals

Generally, the total concentration (i.e., amount) of metal in a water sample is quantified by submitting an unfiltered sample. The dissolved concentration is a component of the total concentration, and should be less. For TREAT Raw Data, dissolved metal concentration greatly exceeded total metals concentration in several instances, with some concentrations up to 10 times that of the totals value. This discrepancy is complicated by ALS having a higher percentage of dissolved metals concentrations that were higher than the total metals results compared to HALL. While some variance is to be expected (especially at extremely low concentrations), and detection limits are different for the total and dissolved analyses (which exaggerates the differences between the different metals concentrations) these results raise significant questions about sampling, analysis, or both. TREAT Raw Data for metals should be considered preliminary at best, and subject to resampling with careful QA/QC procedures in place.

Documentation

Uncertainties associated with the four TREAT sampling events reduce the reliability of the TREAT Raw Data and do not allow sound decision-making. However, the lack of rigorous documentation concomitantly reduces the ability of technical staff, management, peer reviewers, and decision-makers to determine the root cause of these uncertainties. Corrections or modifications to the design of future sampling events are more difficult to make as it is unclear what procedures were followed during the first four TREAT sampling events. Additionally, reproducibility of the study is made near impossible. TREAT Raw Data should therefore be considered preliminary and subject to confirmation through future sampling and analysis that is well-documented and follows the DQO process.