The Standard

A Periodic Newsletter from Environmental Standards, Inc.
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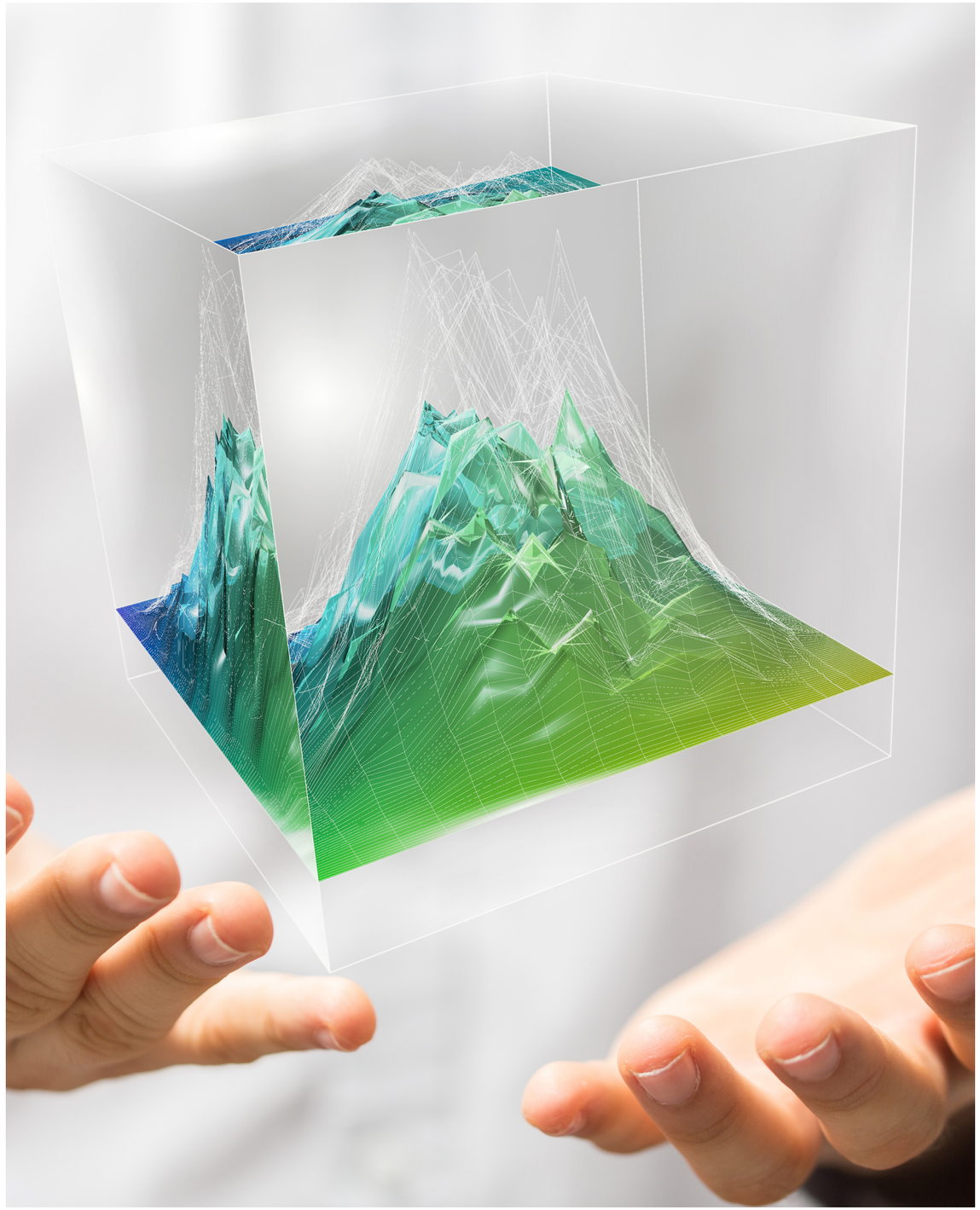
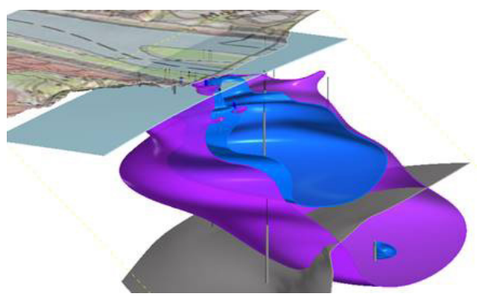


A PARADIGM SHIFT IN THE WAY WE VIEW 3D VISUALIZATION

Have you ever thought about visualizing your site data in three dimensions (3D)? Are you unsure about the value and worried about eating up lots of time and project budget? Worry no more. A new batch of sophisticated 3D Visualization and Analysis (3DVA) tools have dramatically altered the equation in favor of implementing high-value 3DVA across all stages of the project life-cycle to accelerate geoscience projects. These new programs can create models in less time and with more features, including vastly enhanced live model outputs to clients. The learning curve is also much less steep – the tools are much more user friendly. As 3DVA tools have evolved, their potential applications have increased. They are no longer just pretty, expensive pictures. They are powerful tools for communicating, identifying data gaps, reducing risk, and for institutional knowledge transfer and storage.

Environmental Standards, Inc. (Environmental Standards) offers insightful and differentiating 3DVA services to support its geoscience, information management, and chemistry practices to enhance project delivery in a multitude of ways. Our expert-level staff are some of the most proficient in the industry.



Some specific benefits of 3DVA include:

- Analyze site history quickly and completely
- Streamline development of subsurface conceptual models
- Support consensus-building and collaborative problem solving
- Identify data gaps
- Reduce decision risk
- Optimize sampling locations and excavation areas
- Drive project planning and development of remedial strategies
- Reduce long-term project costs
- Visualize and quantify impacts of treatment systems/remedial actions
- Create powerful, effective presentations and narrated animations of site processes

3DVA not only helps with data evaluation, but also helps bridge the gaps among consultants, clients, regulators, and the public by presenting easy-to-understand visualizations of complex site processes and treatment/cleanup plans. Vivid 3D graphics and animations convey critical information in easy-to-understand terms. The human brain thinks and understands in 3D. Seeing your site data combined with historical data and graphics for the first time in 3D can be revelatory. A well-developed 3D model allows Project Teams to build confidence that the conceptual site model is well understood and everyone is on the same page. This confidence generates cost savings and efficiencies throughout the project life-cycle:

- Proposal - Show site understanding quickly from synthesizing historical data in 3D

“The drawing shows me at one glance what might be spread over ten pages in a book.”

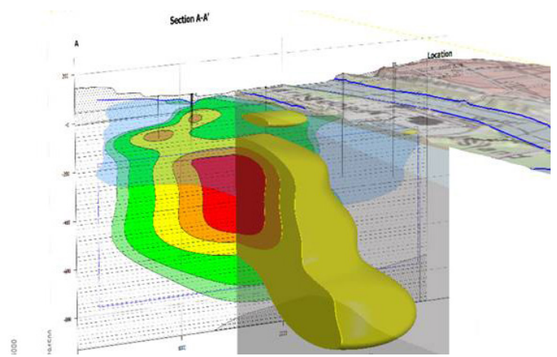
–Ivan Turgenev

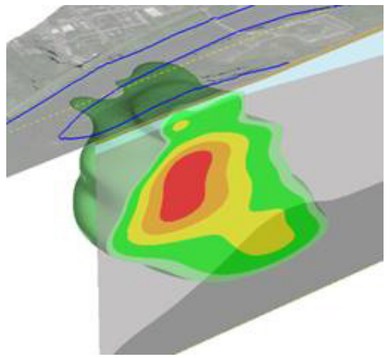
- Project Planning - Use existing 3D data to focus subsequent work
- Remedial (Site) Investigation (RI) - Create 3D conceptual site model, calculate impacted volumes
- Feasibility Study (FS) - Evaluate remedial alternatives by first visualizing in 3D
- Remedial Design (RD) - Refine and display chosen remedial approach in 3D
- Remedial Action (RA) - Optimize remedial approach in near real-time by visualizing changing data sets
- Operations and Maintenance (O&M) - Evaluate O&M results and present in 3D

Environmental Standards' staff has provided 3DVA services for a wide range of applications:

- Environmental Site Assessment and Risk Assessment
- Remedial Design and Implementation
- Contaminant Transport and Groundwater Model Visualization
- Air Quality Modeling
- High-Resolution Site Characterization
- Mass Flux/Mass Discharge
- Brownfields/Redevelopment
- Permitting and Compliance
- Stormwater Management
- Pipeline Installation and Monitoring
- Geothermal Visualization
- Infrastructure/Civil Works Projects

At Environmental Standards, we see an industry moving towards 3DVA eventually becoming standard practice on most geoscience projects, and not just as a special add-on service. Just like geographic information system/computer-aided drafting (GIS/CAD) maps are now used to store spatial data on virtually every project, there is no reason these same data should not be stored from the outset in a 3D format – to





reflect their origination in our 3D world. Our conceptualization of 3DVA is that it is a tool just like GIS or a Microsoft® Excel® spreadsheet that is used to analyze data more efficiently and add value for clients. It just happens to be an extremely powerful tool that can provide incredible new insights and perspectives on your geoscience projects. We believe that this paradigm shift in the approach to 3DVA is a powerful differentiator for Environmental Standards and positions us as leaders and innovators within the industry.

Jonah Jackson has over 18 years of experience on groundwater and remediation projects leveraging state-of-the-art visualization and data management tools to solve complex environmental problems, with a focus on the visual articulation of complex data sets to activate key decisions. To discuss how 3DVA can benefit your projects, you can reach Jonah at jjackson@envstd.com.

Marcellus Shale Coalition Dissolved Gas Method Update - Phase III Testing

Testing under Phase III of the Marcellus Shale Coalition (MSC) Dissolved Methane investigation was initiated in early January, 2018. This study is a continuation of the round-robin dissolved methane evaluation conducted by the MSC during 2014-2015 (Phase I) and 2016 (Phase II). Recommendations from the earlier phases included the need for a study to work with the laboratories with significant deviation from phases and ultimately also the development of a commercially available reference standard. The earlier phases identified calibration and differences between sample and standard handling as the primary source of bias. For this Phase III study, synthetic methane reference standards were prepared by Environmental Service Laboratories (ESL; Indiana, Pennsylvania). The samples were then labeled and shipped to each of the participating laboratories for methane analysis. Three reference laboratories and eight non-reference laboratories were included in the study. The non-reference laboratories were chosen from the prior phases as those laboratories with significant bias from the accepted value. These laboratories were instructed to carefully self-diagnose their procedures, use the prepared and known concentration standards, and identify the procedures, activities, and/or techniques that are causing the bias.

A Phase III report has recently been drafted. The draft describes the steps taken to prepare the reference standards, and the metrics used to verify the usability of those standards. The draft report also describes the laboratory procedures influencing the variability observed with dissolved methane concentrations. Further, the report will highlight laboratory best practices for the analysis of dissolved light gases from domestic water well samples to support a publishable analytical method.

CBD: Is DEA Scheduling Justified?

In the United States, the federal Controlled Substances Act (CSA), 21 USC 812, controls substances that are psychoactive or otherwise have abuse potential. This Act controls all stages of the manufacturing and supply chain processes for controlled substances, and governs the transport and handling of these substances, including control of the substances once received by patients.

Controlled substances are classified into one of five classification groups or "schedules," organized based on each substance's medical efficacy, and abuse/addictive potential. One general rule under the CSA is that a substance, and any other chemical compounds or products derived from that substance, require the same classification or schedule. Schedule I substances are those that do not have a clinically accepted medical use, present a lack of safety under medical supervision, and have a high potential for abuse. Schedule II compounds have been approved by the Food and Drug Administration (FDA) for medical use, but still have a high potential for abuse and may result in a physical/psychological dependence on the drug. This schedule includes most opioids and stimulants.

For a substance to be considered acceptable for medical use, and ultimately moved from Schedule I to Schedule II, the Drug Enforcement Administration (DEA) has developed a set of criteria that must be satisfied through a comprehensive evaluation during the FDA's drug-approval processes. These include:

- The drug's chemistry must be known and reproducible;
- There must be adequate safety studies;
- There must be adequate and well-controlled studies proving efficacy;
- The drug must be accepted by qualified experts;
- The scientific evidence must be widely available.

According to the American Herbal Pharmacopeia , three different strains (species) of the cannabis plant (*i.e.*, marijuana [alternatively spelled marihuana]) have been identified:

1. *Cannabis sativa* L.
2. *Cannabis indica* Lam.
3. *Cannabis ruderalis* Janisch.

The language in the CSA defining the term "marihuana," is specific to the *Cannabis sativa* L. strain, "and every compound, manufacture, salt, derivative, mixture of such plant." It appears that the hundreds of individual cannabinoid compounds which the cannabis plant contains, including *delta*-9-tetrahydrocannabinol (referred to as THC here forth) the psychoactive component of cannabis and cannabidiol (CBD), another major cannabinoid, are included in the definition for marijuana, and are consequently listed as Schedule I controlled substances.

Tetrahydrocannabinols are the only group of cannabinoids listed separately in the Code of Federal Regulations (CFR), while CBD is controlled as a Schedule I substance only by definition; as a "derivative" or "compound" of marijuana. Even though CBD and THC have been assigned the same DEA Schedule, there is a significant difference in the effect each of these compounds has on the human body. THC activates the endogenous cannabinoid receptors (CB1 and CB2), with the activation of the CB1 receptor being responsible for the psychoactive properties that it triggers; CBD, on the other hand, does not directly activate those receptors at the doses currently being studied in clinical trials, and as a result, is considered non-psychoactive.

Is CBD guilty by association?

Since 1996, 29 states and the District of Columbia have enacted laws which approve the use of medical cannabis, and another 17 states allow cannabis-based products that are high in CBD and low in THC. In 2013, the Department of Justice (DOJ) issued a memo stating that it was not a federal priority to take enforcement action against individuals or businesses acting in accordance with state cannabis laws. The "Farm Bill" was initially passed in 1933 as part of Roosevelt's New Deal programs designed to help Americans cope with the Great Depression. The 2014 iteration of the "Farm Bill" (7 USC 5940) authorizes institutions of higher education or State Departments of Agriculture to grow "industrial hemp," which is defined per the Bill as Cannabis sativa L., having a THC concentration ≤ 0.3%. Certain states have interpreted the bill as providing the authorization to license independent and private cultivators who grow hemp, extract the CBD, and sell those extracts on the open market. Since the passing of the 2014 Farm Bill, the therapeutic potential of CBD has been increasingly explored, resulting in an increased parallel interest in the cultivation of the hemp variety of cannabis from which the cannabinoid is extracted and formulated into an oil-based product (*e.g.*, "CBD oil"). The CSA does not define hemp, but does make exempt certain parts of the cannabis plant (*i.e.*, stalk, fiber, sterilized seeds, and any preparations from those materials) from the definition of "marihuana."

In August of 2016, the U.S. Department of Agriculture (USDA), in consultation with the DEA, FDA, and Department of Health and Human Service (DHHS), issued a Notice clarifying that the Farm Bill did not remove industrial hemp from Schedule I status. In December of 2016, what appeared to be a response to the increase in production of CBD oil and other marijuana extracts, the DEA introduced 21 CFR Part 1308, "Establishment of a New Drug Code for Marihuana Extract," which states that marijuana extracts are to be provided with a separate DEA code from marijuana and THC, but those extracts are to remain as Schedule I substances. Under 21 CFR 1038, marijuana extracts are de-

(Continued on Page 12, see "DEA Cannabis")

(DEA Cannabis, Continued from Page 11)

fined as, "… an extract containing one or more cannabinoids that has been derived from any plant of the genus Cannabis, other than the separated resin (whether crude or purified) obtained from the plant." Although it might be theoretically possible to produce a CBD extract (oil) that contains absolutely no amount of other cannabinoids, the DEA was not aware of any industrially utilized methods that have achieved this result at the time 21 CFR 1038 was passed. In summary, if a CBD extract contains one or more cannabinoids, the drug code may be different, but the extract will still be defined as "marijuana" and considered a Schedule I controlled substance, if extracted from any cannabis plant. The intent of the new law may not be enforceable based on the initial definition of marijuana as stated above.

Is the scheduling of CBD justified, and will it ever change? At its 39th meeting of the Expert Committee on Drug Dependence (ECDD), the World Health Organization (WHO), the health agency of the United Nations, explained that there is no existing evidence indicating CBD is likely to be abused or to have other ill effects compared to those substances that are Schedule I controlled substances. The ECDD further concluded that current information does not justify scheduling of CBD, postponing a more comprehensive review of CBD and preparations using CBD until May of this year, when the committee will undertake a comprehensive review of cannabis and cannabis-related substances. Depending on what comes from this review, the current scheduling of CBD as a Schedule I controlled substance may be determined to be unjustified by WHO, and rescheduling could commence.

Historically, a few cannabinoid-based products have been rescheduled from Schedule I to Schedule II following FDA approval in the U.S. Several CBD products are currently in ongoing clinical trials, but a comprehensive evaluation of CBD, in compliance with one of the FDA's drug-approval processes under the Food, Drug, and Cosmetic Act, warrants the appropriateness of its current scheduling be reviewed. If the safety and efficacy data are favorable and FDA approval is granted for CBD (or preparations of CBD), perhaps then, the DEA will look to reschedule this cannabinoid under the CSA. For now, cannabis and its constituent cannabinoids, including CBD from any source including hemp, remain as Schedule I controlled substances and appear to be subject to DEA enforcement, justified or not.

Stay tuned …

CCR: Understanding LEAF Methods and US EPA Guidance

The US EPA's guidance document describing the application of the Leaching Environmental Assessment Framework (LEAF) has now been in place for 9 months. This framework consists of four US EPA leaching methods codified in SW-846 as Methods 1313 through 1316. The LEAF tests are designed to measure fundamental leaching behavior of solid substrates with provisions in the methods for monolith materials and have been applied to Coal Combustion Residuals (CCR) requirements. They are significant in that the US EPA methods do not determine a pass/fail as is used in toxicity characteristic leaching procedure (TCLP) and synthetic precipitation leaching procedure (SPLP). Instead, the LEAF leaching endpoints include available content, maximum release, solubility, and leachate pH that can be extrapolated to site conditions for conceptual site model development.

Details on how to prepare and interpret the results are provided in the Guidance, but require significant planning steps and technical expertise in chemistry and geosciences to implement. Though other fundamental leaching tests are available (*e.g.*, from ASTM), the LEAF methods provide a larger range of testing conditions (pH, liquid-to-solid ratios), yet the cost for performing a full suite of LEAF tests is significant. Environmental Standards, Inc. has been involved with quality assurance review and implementation of leaching methods, including those codified under the LEAF Guidance. Environmental Standards has prepared a White Paper on this Guidance for clients that describes how to interpret LEAF results, includes example costs, and how to best incorporate critical planning and ongoing assessment in a program that includes using these methods. There are important best-practices that we have learned when using leaching methods, especially the LEAF approach, as they are not used for pass/fail decision making.

Update to US EPA Method 325b for Benzene Fenceline Monitoring

In April 2016, Environmental Standards Inc. outlined errors in Equations 12.5 and 12.6 within US EPA Method 325b included in the Final Rule (December 1, 2015) under 40 CFR 63, Appendix A. Those errors were acknowledged by the US EPA, which has been investigating the derivation of these equations. The US EPA has not yet revised the method with updated equations, but the Industry, and ExxonMobil specifically, chose to apply for approval of an alternative test procedure (August, 2017). In the alternative test procedure letter, ExxonMobil requested the following:

- Simplifying the correction for temperature and pressure.
- Setting the collection time to 13-15 days, in place of the strict 14-day limit specified by the methods.
- Clarifying the number of co-located (duplicate) and field blank samples.
- Clarifying how to use co-located results when calculating the ΔC value for each sampling period.

In September 2017, in response to that request by ExxonMobil, the US EPA provided a revised equation to replace Equations 12.5 and 12.6 in Section 12.2 of Method 325b.

This equation removes the requirement to correct for pressure:

$$Cc = 10^6 \times \frac{M_{measured}}{U_{NTP} \times \left[\frac{Tss}{298}\right]^{\frac{1}{2}} \times t}$$

Where Cc = the concentration of target compound at normal ambient temperature and pressure, (µg/m3), Mmeasure = the mass of compound as measured on the sorbent tube (µg),
UNTP= Diffusive uptake rate at normal ambient temperature and pressure (mL/min),
t = Sampling duration (minutes), and
Tss : Average temperature during the collection period at the sampling site (K).

The US EPA also allowed a 13-15 day sample collection range under circumstances that make collection at 14 days unsafe. However, the reason must be recorded and reported in the next routine reporting cycle. US EPA also provided clarification for the number of co-located and field blank samples as well as instrumentation quality control samples.

INTEGRATED DATA MANAGEMENT

Chemistry and Data Management Working Together

From sample planning to reporting, the cooperative efforts of Quality Assurance Chemists and Data Managers provide a better, more efficient work product for the client.

Sample Planning

From the moment the decision to collect samples is made, QA Chemists and Data Managers begin coordinating efforts. QA Chemists help clients define analytical procedures, from laboratory selection to constituents of concern; from bottleware requirements to matrix definitions; from preservatives to holding times. These analytical decisions that can only be made with the assistance of highly trained QA Chemists, and making them BEFORE the first sample is collected, are paramount.

Sample Collection

Sample collection is where the rubber meets the road. The bottles have been selected and preserved, the laboratories have been chosen, and the constituents are waiting to be found, or not. QA Chemists maintain technical oversight of sample collection activities by orchestrating the symphony of moving parts - Error strike though and initial? What's that say? Who ordered this? Where did this bottle go? QA Chemists help answer all those questions during the chaos. By acknowledging and accepting the changeability of the sample collection environment, QA Chemists and Data Managers work together to help guide all parties through the turmoil.

Sample Receipt & Analysis

If your samples arrive broken or above temperature requirements, the field work was for naught. Even if the samples arrive in perfect condition, the maze of analytical laboratory procedures might well leave your samples as the Minotaur at the center. QA Chemists are on the case from the moment the samples arrive at the laboratory right through to data reporting. Established laboratory relationships and the most knowledgeable chemistry group in the industry ensure that no sample goes unlogged, no analysis goes un-run, and no form goes uncompleted. As QA Chemists wrestle with questions about aliquots and dilution factors, Data Managers are keeping tabs. When did the laboratory receive the samples? How long has it been? What's the turn-around-time? The laboratory is HOW LATE?!? With a custom-built analytical tracking system, Data Managers can answer all those questions and proactively identify discrepancies.

Now it's time for Data Managers to take the lead. Electronic data deliverables, (EDDs), allow Data Managers to import complex laboratory data into a standardized, centralized, data management system, and then to provide the data to clients in a usable, readable format. While Data Managers are looking at the bits and bytes of the laboratory data, QA Chemists are diving into the technical results. Do we need a Level II or a Level IV hardcopy package? Does the client require paper, or will electronic suffice? Is there a legal hold on this project or can we recycle the paper when we are complete?

Data Review

Using EDDs, custom reports and years of experience, Data Managers ensure data correctness and completeness ensuring the data are ready for review. Following completeness checks and correctness review, Data Managers use custom software to apply data qualification and reason codes to laboratory data for EDD reportable elements. These elements include holding times, blank contamination, surrogate recovery review, spike accuracy and duplicate precision. Each data step brings data closer to the ideal of quality and reliability. QA Chemists can then comb through every number, every qualifier, every hand annotation, and every comment. Data are tagged, qualified, described, and explained. Finally, all that description is entered into the data management system, ready for data export and reporting.

Conclusion

The environmental sample lifecycle is complex. Finally, with multiple vendors, multiple laboratories, multiple samplers and multiple regulatory agencies, keeping tabs on data from start to finish can be compared to herding cats. The partnership of data management and chemistry allows clients to use the data as they apply to their specific needs and lets Environmental Standards do the herding.