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What are detection limits (DL) and reporting limits (RL)

Analytical machines that test for chemicals in soil, air, water, and other matrices and the science behind them, analytical chemistry, have limits to their accuracy, precision, sensitivity to chemicals. Detection limits, reporting limits, and limits of quantitation are all names for various limits that describe the lowest concentrations of chemicals that can be observed with any degree of confidence. Unfortunately, there is no universal standard for defining these limits. However, it is important that they exists because they communicate to the end user of analytical chemistry data the performance of a particular laboratory, test method, and/or analyst. In making environmental decisions, it is important to understand the inherent limitations of the information you are using and paying for.

For purposes of environmental regulation, the United States Environmental Protection Agency (USEPA) defines a detection limit in Code of Federal Regulations (CFR) 40 CFR 136, Appendix B, revision 1.11. This appendix to federal regulations specifies specific steps laboratories must follow to define a detection limit. However, regulators, consultants, and property owners rarely see detection limits on laboratory reports ordered from commercial analytical laboratories. More often, laboratories use *reporting limits* to describe the concentration of chemicals in the environment (or rather samples from the environment). So what's the difference between detection limits and reporting limits?

Reporting limits are typically set by commercial analytical laboratories at concentration levels above detection limits. Reporting limits may or may not be based on statistically determined detection limits or limits or quantitation (LOQ). More often than not, they are built in safety factors that allows commercial laboratories to easily handle variability associated with analyzing samples from a wide variety of sources with different possible complicating factors (such as matrix effects). Commercial laboratories more often than not run a variety of samples from different sites and matrices. It would be too time consuming to statistically determine the detection limit for each individual sample.

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Why should I care about reporting limits?

It is common for commercial analytical laboratories to have reporting limits that are above the concentration you are interested in seeing down to. For example, if you are testing water samples for vinyl chloride and are concerned about meeting a regulatory limit of 0.5 µg/L, then you will want to make sure the analytical laboratory has reporting limits below 0.5 µg/L. This way, you will be able to *see* whether a concentration of vinyl chloride detected in your sample is above the regulatory limit of concern.

On the other hand, if your reporting limit is above a regulatory limit, say 1.0 µg/L in this example, it may be possible that your sample is contaminated to a level above the regulatory limit, but you would never know it. For example, it is possible that 1) the regulatory limit you are concerned about is 0.5 µg/L, 2) your sample actually contains a concentration of 0.7 µg/L, and 3) your analytical laboratory has a reporting limit of 10 µg/L. In this case, the laboratory report will read *Non-Detect* which may lead you to conclude your sample is clean only to find out later that the groundwater beneath your site is above regulatory limits. This may happen because a future investigator comes along using lower reporting limits that do not mask the detection of contaminants. This detail may end up costing tens or hundreds of thousands of dollars, particularly on large sampling programs where hundreds of samples are being analyzed.

How do I make sure I get the right reporting limits?

It is important to specify what reporting limits you need for each chemical your analytical laboratory will test for you *before* you order your analyses. The best place for this is in your purchase order or contract with the analytical laboratory. It is not uncommon for a laboratory to test for a suite of similar chemical compounds and to use the same reporting limit for all the compounds in the suite. However, this may not be sufficient for your needs if you are concerned about very low regulatory limits for one of chemicals in this suite. If you specify what reporting limits you need, the laboratory may be able to pick a more appropriate analysis method to suit your needs.

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