Water Filtration Guide

TECHNICAL BULLETIN

When assessing water for potential contaminants of concern, field technicians are faced with the question of whether to filter or not filter for specific analytical parameters in their testing programs. This guide provides recommendations with reference to regulatory guidance and requirements across Canada, in support of your projects' intended data quality objectives.

Background

Maxxam receives water samples from sites that vary from landfill monitoring, contaminated sites, mine operations, industrial effluent and many more. “Water” may include: drinking water, industrial wastewater, surface water, or ground water. In some cases, data will be submitted to regulators for compliance purposes and in other cases, it is for preliminary investigations with less concern for legal defensibility. Given this background, it is unreasonable to set a single filtration recommendation to meet all sampling programs. What is important is that, as part of your data quality objectives, you define what you want the laboratory to measure.

The Science of Filtration

Depending on the sample preparation procedure, contaminants in water can be measured as “total”, “dissolved”, “mobile” or “suspended”. Samples can be analyzed unfiltered and preserved (“total”), or filtered with a wide range of filter sizes from 0.2 µm to 5 µm to measure “suspended”, “mobile” or “dissolved” parameters. Historically, groundwater has been analyzed for dissolved constituents with the objective of measuring mobile contaminant levels. Surface water, drinking water and wastewater are typically measured as “total” with no filtration in order to estimate total contaminant exposure or loadings.

We have however, seen this general approach change over the years where the analysis is designed to measure a specific form of an analyte which may have different toxicity. This list of exceptions to the historical rules continues to grow. As an example, in Alberta, regulators often request groundwater in a drinking water aquifer to be analyzed both as “total” and “dissolved”. This is requested presumably to evaluate the risk of transporting metals through particulate matter > 0.45 µm.

As a general guide, provincial regulatory standards indicate which parameters are to be analyzed as “dissolved” thus requiring filtration prior to analysis. The most common parameters measured as “dissolved” that require filtration include:

- Dissolved Metals
- Dissolved Mercury
- Dissolved Chromium VI
- Dissolved Organic Carbon (DOC)
- Dissolved Phosphorus (phosphate)
- Chlorophyll A
- Dissolved Nitrogen

Groundwater

USEPA guidance consistently states that filtration for groundwater samples is not acceptable to correct for improperly designed or constructed monitoring wells, inadequate well development, inappropriate sampling methods, or poor sampling techniques. The reality is, that in many regions in Canada, introducing particulate into monitoring wells is unavoidable due to clay and till geology. To arrive at dissolved or mobile concentrations, filtration is required.

The term “dissolved” is a bit of a misnomer, as in the case of metals, truly dissolved or free ion forms of metals would exclude any particle sizes > 1 nm (the size of typical hydrated metal ions). A “dissolved” metals analysis is meant to address the concern of increased environmental mobility through groundwater systems which may eventually reach a receptor.

The particle size considered “mobile” remains the subject of significant technical debate within the technical community. 0.45µm has emerged as the default filter size, with very little available science to support this approach. It has found its way into most Provincial regulatory documents and CCME. Interestingly enough, field filters are available in sizes from 0.2 µm – 5 µm. Field filtration supplies can be obtained from a number of suppliers. View a list of Waterra groundwater filters.

Organics

Low solubility organic compounds including hydrocarbons, PCBs, PAHs and dioxins are not suitable for filtration, whether in the field or at the laboratory. Several studies, including those conducted by Maxxam have demonstrated that these organic compounds sorb to the filtration media, which leads to biased, low results. As such, the laboratory results for these organics should be considered as “total”. This leads to a significant challenge where laboratory results for low solubility compounds such as benzo(a)pyrene and PCBs routinely exceed solubility limits.

Most jurisdictions do not permit decanting of the sample to segregate suspended particulate as this can also lead to biased, low data. Many organic compounds are hydrophobic and tend to adhere to the interior surface of the glass and are left behind when decanted. Most groundwater field filters are constructed of polyethersulphone material, which is organic-based and has a strong affinity to sorb organic compounds. Water soluble organics such as phenols and phenoxyacid herbicides may be suitable for filtration. Contact the laboratory.

Field Filtration vs Lab Filtration

Canadian regulatory guidance consistently recommends and in some cases prescribes field filtration for specific tests in groundwater. Surface water filtration in the field versus laboratory appears to be less prescriptive. With changes to oxygen, temperature and pH post collection, some elements (such as iron) are known to precipitate out of solution, which leads to significantly biased low data if not field filtered and preserved immediately. This is of particular concern in groundwater, which is why regulators often prescribe field filtration.

Filtration of surface water can be accomplished through a number of techniques and we recommend consulting CCME guidance for details. One option suitable for low turbidity samples is field syringe filtration. In all cases, field filtration will provide the most representative and highest quality data. However, for ultra-low level methods it is often difficult to field filter without introducing contamination.

Where field filtration just is simply not an option, Maxxam offers laboratory filtration (where local regulations allow). Maxxam will filter and preserve as soon as practical upon receipt. Note that in some jurisdictions there are prescriptive timelines in which filtration/preservation must be done after sampling, for example, in Quebec, samples must be filtered and preserved in the lab within 24 hours of sampling.

For our lab filtration rate structure, please refer to the table at the end of this guide.

Special Filtration Considerations

Dissolved Organic Carbon (DOC)

Dissolved Organic Carbon is composed of a diverse array of compounds, predominantly humic substances, and is found in most natural groundwater. It is imperative to ensure that the field filters you are using do not contribute background DOC.

In our experience, organic based filters will release background organic carbon above laboratory reporting limits. Organic filters are typically proofed by the supplier, however only for metals and mercury. We recommend that you work with your field filter supplier to select the right filter for your application. As with any filters, we recommend including a filter blank in your QA/QC plan to ensure that any “hits” in filtered samples are not coming from the filter itself.

Dissolved Aluminum in Surface Water (Ontario PWQO)

Ontario Surface Water Guidelines (PWQO), require that surface water samples that are to be tested for aluminum be filtered with a 0.2 µm filter prior to analysis to provide a "clay free" sample. Filtering the sample prior to analysis isolates the forms of aluminum that are toxic to aquatic life in low pH regimes. Inorganic aluminum, particularly inorganic monomeric aluminum, is the form considered to be most toxic in acid stressed environments, organic aluminum being relatively nontoxic.

Filtering with a 0.2 µm filter reduces the amount of clay bound and organic monomeric aluminum, which can bias results high compared to the guideline value. Please refer to Ontario MOE's comprehensive rationale document for more details.

Dissolved Hexavalent Chromium (Chromium VI)

Chromium VI in neutral or acidic media is a strong oxidizing agent which reacts with organic carbon and oxidizable metals such as ferrous iron forming trivalent chromium. Without immediate preservation in the field, results will be significantly biased low. Field filtration should occur as soon as possible after sampling followed by immediate preservation with base which stabilizes the chromium VI.

Dissolved Mercury

CCME Volume IV Table 3B indicates to field filter for mercury and that mercury must field preserved. Because delaying preservation can create a potentially low bias, field filtration is highly recommended for dissolved mercury in order to accommodate immediate field preservation. If field filtration is not possible, it can be done at the laboratory, however, results will be qualified with a cautionary note. It is important to note that in some jurisdictions local regulations **do not permit** lab filtration for mercury.

Provincial Regulatory Position on Filtering

Maxxam has reviewed each Provincial regulatory guidance or Protocol document and have summarized the findings below for quick reference:

British Columbia

REFERENCE	EXCERPTS FROM REGULATORY REFERENCE DOCUMENT
BC CSR Lab Method Manual, Sample Preservation and Holding Time Summary Table, Nov 2015	• Dissolved ICPMS Metals and Mercury to be field filtered. If lab filtered, data must be qualified. • BC CSR hold time and preservation table does not indicate field filtration is required for Chromium VI, but does require immediate preservation. • Dissolved phosphorus may be filtered in the field or lab without qualifiers. • If not field-preserved, water samples for total metals analysis must be acidified at the lab in their original containers by addition of HNO_3 (within 14 days of sampling), then equilibrated at least 16 hours prior to sub-sampling or analysis (otherwise, qualify as "received unpreserved"). This approach is also applicable to dissolved metals if field filtered but not preserved. Not applicable to mercury.

Ontario

REFERENCE	EXCERPTS FROM REGULATORY REFERENCE DOCUMENT
R153 Analytical Protocols, July 2011 Provincial Water Quality Objectives, Feb 1999 Practices for the Collection and Handling of Drinking Water Samples, April 2009	• Groundwater must be filtered for ICPMS Metals, Hg and CrVI. If lab filtered, data must be qualified by the lab. • Hg (0.45 µm) and Aluminum (0.2µm) require filtration prior to analysis. • *"Drinking water samples shall not be filtered in the field or at the laboratory prior to analysis. As it is not expected that the consumer filters their water prior to drinking it, unfiltered samples will provide a more representative sample of what the consumer is drinking."*

Quebec

REFERENCE	EXCERPTS FROM REGULATORY REFERENCE DOCUMENT
Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés. Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques, Juillet 2017	• Metals including CrVI are recommended to be field filtered and preserved. • It is important to note that on page 3 of Guide d'intervention, it is indicated that if samples ARE NOT filtered on site, they must be at the lab and filtered and preserved within 24 hours of sampling.

Jurisdictions following CCME

REFERENCE	EXCERPTS FROM REGULATORY REFERENCE DOCUMENT
Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment, Volume 4, 2016	• CCME defines field filter as: *"Where required, water samples must be filtered using 0.45 µm membrane filter as soon as possible after sampling and immediately preserved (if preservation is required)." Note: 0.45 µm pore size is the default filter pore size used to separate dissolved species, unless otherwise specified in the method for a given parameter.* • *"Dissolved Metals, Including Mercury, Methylmercury and Hexavalent Chromium - In general, ground waters requiring these tests are field filtered and preserved. Surface waters and potable waters are usually preserved unfiltered and analyzed for total metals. Samples requiring analysis for dissolved metals, mercury, methylmercury, or hexavalent chromium in groundwater are field filtered through a 0.45 µm filter immediately followed by field preservation… In the event of field filtration/preservation is not possible, samples may be filtered and preserved as soon as possible at the laboratory. However, this deviation must be indicated on the Certificate of Analysis with a cautionary note that values may not reflect concentration at the time of sampling. Note that in some jurisdictions, lab filtration for dissolved metals is not permitted. Unfiltered, preserved samples are not suitable for laboratory filtration."* • Unpreserved holding time for hexavalent chromium is stated at 24 hours in Table 3B. • Refer to Table 3B: Water Sample Handling and Storage Requirements for more details on filtration and preservation of specific parameters.

2018 Laboratory Filtration Fee Schedule

PARAMETER	FILTER SIZE	$ PER SAMPLE (INCLUDES FILTER COST + LABOUR)
Metals (ICP, ICPMS, etc.)	0.45 µm	$10.00 Additional filtration fees may apply if additional parameters are requested
Mercury*	0.45 µm	
Aluminum (Ontario PWQO)	0.2 µm	
Dissolved Organic Carbon	0.45 µm	
Dissolved Hexavalent Chromium*	0.45 µm	
Dissolved Nutrients (phosphorous, nitrogen, COD)	0.45 µm	
Chlorophyll A	0.45 µm (1.2 µm in Quebec)	

* Field filtration and preservation is highly recommended due to low bias from delayed preservation. If samples are lab filtered, results will be qualified with a cautionary comment. It is important to note that some jurisdictions do not allow lab filtration of these parameter.

Note: The filter type is compatible to regional requirements, regulations, parameters and analytical methods. Maxxam has provided a summary of the filtering requirements for the convenience of our customers. Maxxam assumes no liability for the information contained within the document and we recommend consulting official regulations where appropriate.

About Us

Maxxam is a leading North American provider of analytical services and solutions to the energy, environmental, food, Industrial Hygiene and DNA industries. We are a member of the Bureau Veritas Group of companies – a world leader in testing, inspection and certification services. We support critical decisions made by our customers through the application of rigorous science and the knowledge and expertise of over 2,500 employees.

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