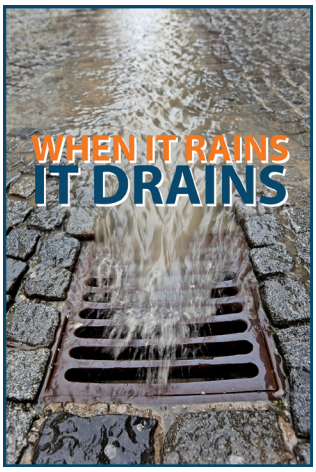
BROOKS APPLIED LABS

Advanced Analytical Services for the Determination of Heavy Metals in Stormwater

Due to the improvements already achieved in treating and monitoring industrial process wastewater and municipal sewage discharges, nonpoint source pollution has been identified by the US EPA and many state environmental agencies as the leading cause of persistent water quality impairment.

Nonpoint source pollution occurs primarily as a result of the surface runoff from precipitation, commonly referred to as stormwater, mobilizing and transporting contaminants into our lakes, rivers, wetlands, and estuaries.

These pollutants can accumulate in receiving waters and sediment, adversely affecting the overall health of aquatic ecosystems and threatening the beneficial use of many water resources.



Of particular interest are several common heavy metals that have been demonstrated to severely impact water quality.

Substantial amounts of heavy metals are deposited and mobilized by transportation (vehicle exhaust, brake linings, etc.), construction (soil erosion, exposed metal, etc.), and other industrial activities (power plants, cement kilns, etc.), and since precipitation is also naturally mildly acidic it has the potential to dissolve and transport these toxic surface pollutants to receiving waters.

Consequently, significant concentrations of cadmium, chromium, copper, lead, mercury, nickel, and zinc are frequently found in stormwater, especially in highly developed areas.

With no verified biological role in higher organisms and a tendency to bioaccumulate, chronic exposure to excessive amounts of cadmium (Cd) is linked to kidney and bone diseases in wild birds.

Chromium (Cr) may be an essential micronutrient, but at elevated concentrations it is a known mutagen, teratogen, and carcinogen.

Toxic to phytoplankton that form the base of aquatic food chains, copper (Cu) has also been shown to inhibit the olfactory systems of salmonid fish, reducing their ability to escape from predators or navigate their return to spawning grounds.

Lead (Pb) is another heavy metal with no functional biological role that is highly toxic to both humans and aquatic life.

Mercury (Hg) contamination alone is the basis for the largest number of water quality impairments, but even in trace amounts it will rapidly bioaccumulate when converted to methylmercury – a powerful neurotoxin that is responsible for nearly all of the fish consumption advisories in the nation.

Exposure to elevated levels of nickel (Ni) and zinc (Zn) has been shown to severely affect fish gill function, leading to potentially significant declines in certain fish populations.

Since densely populated areas are largely covered by buildings, roads, parking lots, and other impervious surfaces that restrict the natural drainage of precipitation, flood control efforts in many urban settings rely upon a series of carefully managed stormwater systems, or municipal separate storm sewer systems (MS4), to rapidly channel stormwater into surface waters or retention impoundments.

With ever increasing development, the problem of heavy metals in stormwater is only growing more severe.

In response, regulatory agencies across the nation have implemented stormwater management programs in compliance with the National Pollutant Discharge Elimination System (NPDES) and the Clean Water Act to monitor for and eventually reduce heavy metal pollution from stormwater.

In addition to MS4 operators, construction sites in excess of one acre and large industrial facilities are generally also required to implement stormwater monitoring and pollution prevention plans.

These plans typically employ various approved Best Management Practices (BMP) to facilitate the removal of heavy metals from stormwater before it reaches receiving waters, such as media filter drains, vegetated filter strips, constructed wetlands, sand filtration, and bioretention.

However, there are already thousands of waterbodies across the nation listed for impairment due to heavy metals from stormwater sources. Once listed, Total Maximum Daily Load (TMDL) studies to identify the total pollutant loading that a waterbody can receive and still meet water quality standards must be performed.

With the expansion of NDPES stormwater regulations to smaller municipalities and construction activities, such TMDL studies are increasingly designed to incorporate as many nonpoint sources, including stormwater, as is feasible.

Analyzing stormwater samples for heavy metals in order to demonstrate compliance with various types of discharge

permits is typically a fairly routine matter since the required limits are rarely set below what can be easily achieved using relatively common and inexpensive analytical methods.

However, in order the evaluate and compare the effectiveness of specific BMP installations under varying conditions or acquire data with sufficient accuracy and precision to be useful in TMDL studies, far more sensitive analytical methods are required.

At Brooks Rand Labs we utilize analytical methods that were developed by the EPA specifically for the determination of heavy metals with sufficient accuracy and precision to measure concentrations at ambient levels.

These highly specialized methods require ultra-clean laboratory facilities, reagents, and instrumentation in order to minimize or eliminate contamination that could easily exceed ambient concentrations and result in elevated method detection limits (MDL).

For example, by utilizing EPA Method 1638: Determination of Trace Elements in Ambient Waters by ICP-MS – in conjunction with an interference removal technology such as a Dynamic Reaction Cell – we are able to achieve some of the lowest MDLs for heavy metals commercially available.

Example MDLs (µg/L)	
Cd	0.002
Cr	0.009
Cu	0.011
Ni	0.03
Pb	0.015
Zn	0.028

Additionally, as one of the few laboratories that participated in the development and validation of EPA Method 1631: Mercury in Water by Oxidation, Purge and Trap, and CVAFS and EPA Method 1630: Methylmercury in Water by Distillation, Aqueous Ethylation, Purge and Trap, and CVAFS, we have unparalleled experience performing these ultra-sensitive methods in order to measure concentrations at sub parts-per-trillion levels.

Example MDLs (ng/L)	
Hg	0.15
MeHg	0.010

To learn more about our ultra-low detection limits and how they can benefit your projects, contact us today.

EPA 1669: Ultra-Clean Sampling

In order to monitor for compliance with the increasingly stringent ambient water quality criteria required by the Clean Water Act, the EPA developed a number of performance-based analytical methods specifically for the measurement of metals at ultra-trace levels (low-ppb to low-ppt). These include EPA 1630 (methylmercury), EPA 1631 (low-level total mercury), EPA 1632 (arsenic speciation), EPA 1638 (metals by ICP-MS), and EPA 1640 (metals in seawater by ICP-MS).

During the development of these methods, the EPA found that one of the greatest difficulties in obtaining reliably accurate data for metals at low-level concentrations was due to sample contamination. Therefore, samples to be analyzed by any of the above methods must also be collected according to the procedures described in EPA Method 1669.

Similarly performance-based, EPA 1669 requires special procedures to minimize and monitor for contamination, including the use of ultra-clean pre-tested sample collection containers and other field-sampling equipment, a two-person sample collection procedure ("clean hands/dirty hands"), and the collection of extensive field quality control samples (equipment blanks, field blanks, field duplicates, etc.). Brooks Rand Labs has extensive experience related to performing EPA 1669 and routinely provides certified ultra-clean sampling equipment, on-site sample collection services, and sample collection training courses.

EPA 1640: Metals in Seawater

For environmental projects that require the determination of various trace metals in seawater, acquiring reliable measurements can be challenging. The elevated levels of salts in seawater can lead to severe analytical interferences and significant dilutions are often required to analyze samples by routine methods, which can easily result in detection limits that far exceed the concentrations of target analytes.

Developed specifically to provide reliable measurements of metals at ambient levels in seawater, EPA Method 1640 provides for a number of preconcentration techniques, combined with analysis by ICP-MS, to overcome the interferences presented by elevated concentrations of salts and other interfering components of seawater. Consequently, ultra-low detection limits can be achieved and the most subtle differences in metals concentrations can be determined.

While the method was originally developed for ambient levels of metals in seawater, it has been increasingly used for monitoring metals concentrations in receiving waters impacted by stormwater discharges. In addition to the metals specified by the method, we have further developed the technique to include many more of the analytes often targeted in seawater projects. Nationally certified per NELAP and DoD ELAP to perform EPA 1640, Brooks Rand Labs offers our clients a distinct level of experience performing this highly complex method.

To learn more about our innovative and customized analytical methods and/or our highly specialized mercury speciation capabilities and how they can benefit your projects, contact us today. Please visit our website at **www.brooksapplied.com**, email us at **info@brooksapplied.com** or call **206-632-6206**.