



CMT Multilevel System*

Model 403



This multilevel system is reliable, easy to install and inexpensive. It provides site assessors with a better understanding of three-dimensional groundwater flow and the distribution of contaminants in the subsurface. Remediation strategies can then be targeted more precisely, focusing efforts in the most effective manner.

The CMT Multilevel System makes the accurate monitoring of contaminant plumes much more affordable. It provides detailed vertical as well as horizontal data. Monitoring zones are set where needed and the single tube design allows reliable seals between zones.

Two systems are available. The 1.7" (43 mm) OD polyethylene tubing, segmented into seven channels, allows groundwater monitoring at up to 7 depth-discrete zones. The 3-Channel System uses the same material and construction, but it is only 1.1" (28 mm) in diameter. This narrow tube was developed for smaller diameter installations, especially direct push where the annulus for seal placement is narrow.

Advantages of the CMT Multilevel System

- Low cost and easy to install and use
- No joints – one smooth surface for easy, effective sealing
- Up to 7 depth-discrete zones in a single tube
- Locate ports and seals exactly where desired
- Installs quickly in large direct push casing and boreholes
- One 7-Channel CMT System can be completed by two people in under 3 hours, 3-Channel even faster
- Borehole not left open to allow cross contamination
- Isolated zones ensured using sand and bentonite layers or 3-Channel Cartridges – reliable and inexpensive
- Minimizes the risk of producing new contaminant pathways



* Solinst and CMT are registered trademarks of Solinst Canada Ltd.

* Patents #6,865,933, #2,260,587

Advantages of Multilevel Systems

- Provide the most accurate 3-D assessment of a site
- Vital to understanding vertical contaminant distribution
- Allow documentation of changes in the concentration and delineation of contaminant plumes
- Low cost compared to multiple individual wells
- Minimize site disturbance

Research has shown that contaminant plumes are often thin and highly stratified. It has also been documented that traditional monitoring wells, with long screened intervals blend the groundwater over the entire length of the screen**. This can mask the true contaminant concentrations and distribution. Multilevel wells with short screened intervals overcome this problem. This high-resolution data gives unprecedented definition of the subsurface contamination, resulting in more effective and less expensive remediation. Water quality data from short-screened wells yield high quality, defensible data.

Multilevel Monitoring is Essential

Multilevels provide the most reliable, detailed data for accurate 3-D site assessment. Important advantages include:

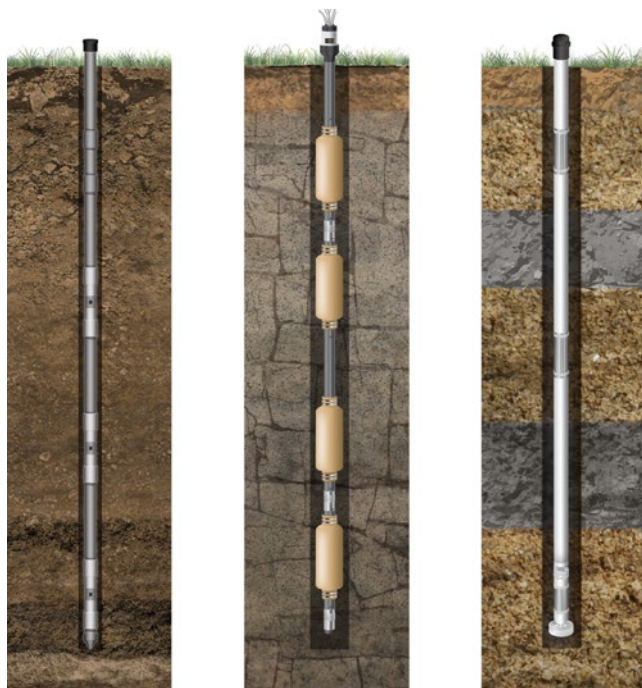
Eliminates contaminant mixing in long screened wells – which averages out heads and contaminants, masks narrow zones of contamination and vertical variations, underestimates the extent and concentration levels due to dilution. Multilevels monitor discrete intervals.

Prevents biases due to ambient flow – cross communication of contaminants can occur when different zones in a borehole are not isolated. Properly sealed multilevels avoid ambient flow within a well.

Provides data for Mass Flux Calculations – Calculating the contaminant concentration and flow rate helps determine the maximum contaminant concentration and risk to receptors. A transect of multilevels across the groundwater flow path provides data for mass flux calculations.

Allows optimized remediation design – Using data from multilevels to accurately define the thickness, concentration variations and extent of a plume.

Saves Cost – through reduced permitting and drilling costs; and because narrow tubes allow smaller purge volumes, reduced disposal costs, efficient low flow sampling and rapid response to pressure changes, all reduce field time.



615ML Multilevel Drive-Point Piezometer

401 Waterloo System

403 CMT® System

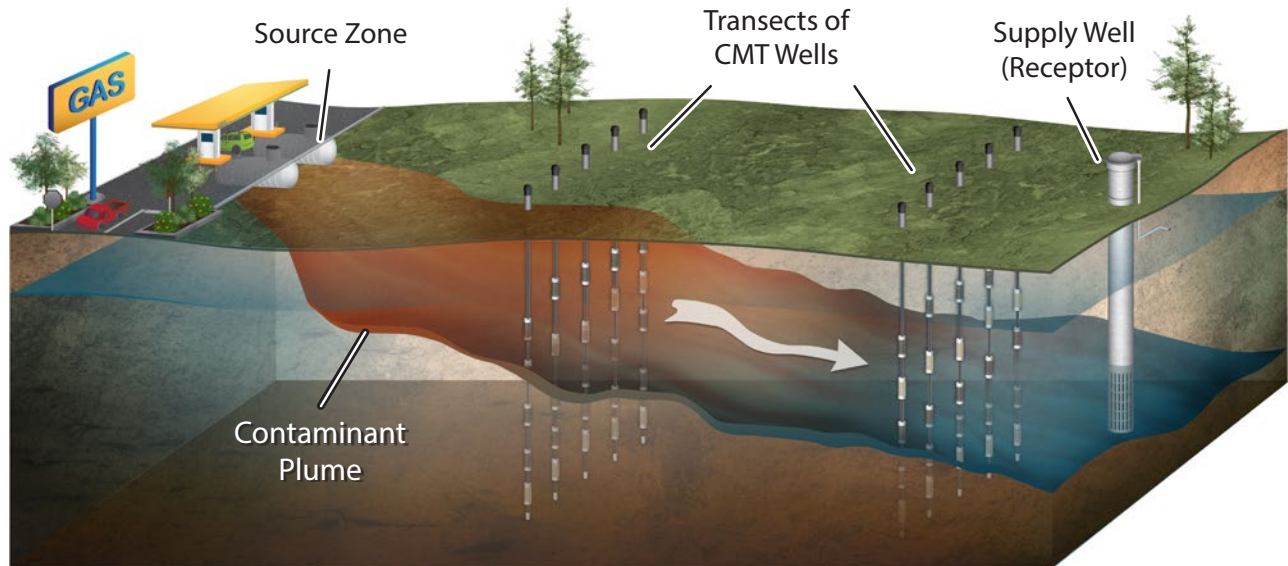
Solinst Multilevel Groundwater Monitoring Systems

In addition to the 403 CMT System, Solinst Manufactures two other multilevel systems, each suited to different environments and applications.

The 615ML Multilevel Drive-Point Piezometer has stainless steel monitoring ports connected using 3/4" NPT steel drive pipe and couplings. Dual barb stems allow the connection tubing to create up to 3 or 6 monitoring zones, depending on tubing size. Drive-Point Multilevel Systems can be installed simply using direct push methods, including a manual slide hammer. These systems are easy to transport with portable sampling and level monitoring options (see Model 615ML Data Sheet).

The 401 Waterloo System uses modular components of various casing lengths, sampling ports, and optional packers that are connected to form a sealed casing string. Pumps and/or transducers can be dedicated to each port. All instrument tubing and cabling is contained within these modules and collected at the top of the system at a wellhead manifold. The Waterloo System is ideal for long-term monitoring in bedrock and cased boreholes, and has been used to depths of 1000 ft. (300 m) (see Model 401 Data Sheet).

**Elci et al (2001). Implications of observed and simulated ambient flow in monitoring well. *Ground Water* 39, no. 6: 853-862



CMT Transects for Mass Flux Assessment

CMT (Continuous Multichannel Tubing)

A multilevel well that uses a continuous length of multichannel tubing has the advantage over other multilevels in that there are no joints. This significantly reduces the time and cost of installing wells and at the same time increases the reliability of the system. The CMT is very simple and convenient to use, as it gives full flexibility as to where monitoring zones are located.

The number and location of ports may be determined in advance, or after drilling the borehole. A Port Cutting Guide is used to create a port in a given channel, at the specified depth to be monitored. A plug is positioned and sealed in the channel just below the port opening and a stainless steel screen is fixed in place over the port to prevent fines from entering. Each channel is also sealed at the bottom of the tubing to avoid cross communication between monitoring zones.



Mechanical Plugs Seal Channels Securely

One CMT System - Two Sizes		
Features	7 Channel	3 channel
Tubing diameter	1.7" (43 mm)	1.1" (28 mm)
Monitoring zones	up to 7	up to 3
Channel diameter	6-Pie: 0.4" (10 mm) 1-Hex: 3/8" (9.5 mm)	3-Hex: 3/8" (9.5 mm)
Channel volume	40 mL/ft. 30 mL/ft. (center)	30 mL/ft.
Installation options	Sand & bentonite backfill Natural formation collapse	Bentonite & sand cartridges Sand & bentonite backfill Natural formation collapse
Coil lengths (Coil 4 ft. dia.)	100 ft. (30 m), 200 ft. (60 m) & 300 ft. (90 m)	100 ft. (30 m), 200 ft. (60 m) & 500 ft. (150 m)
Centralizer sizes (other sizes optional)	4.4" standard (112 mm)	3.3" standard (84 mm)
Borehole diameter recommended for backfill installations	4" (100 mm) and larger	3.5" (89 mm) and larger
Borehole diameter for installations with seal and sand cartridges	N/A	2.8" - 3.5" (71 mm - 89 mm)

3-Channel Sand and Bentonite Cartridges

For direct push installation of the 3-Channel System, the annulus available is often too small to accurately place sand and bentonite layers. Therefore, bentonite cartridges have been developed to give reliable seals between zones, and accompanying sand cartridges to complete the installation.

These cartridges are approximately 2.4" (61 mm) in diameter and will fit inside various direct push drill rods. Ideally, the borehole diameter these bentonite cartridges are used in should not exceed a nominal 3.5" (90 mm), to ensure proper expansion and sealing.



3-channel CMT Sand and Bentonite Cartridges



Typical 3-Channel CMT Installation in Overburden with Bentonite and Sand Cartridges



Typical 3 or 7-Channel CMT Installation using Layers of Bentonite and Sand Backfilled from Surface

Monitoring CMT Multilevel Wells

Water levels and samples can be accurately obtained using the following quality Solinst instruments:

Water Levels: The narrow, laser marked cable Model 102 Water Level Meter and 102M Mini Water Level Meter with a 4 mm (0.157") diameter P4 Probe can be used to monitor water levels in any CMT channel. It is narrow enough to be used along side a pump in the same channel.

Samples: Sampling can be performed using the Solinst Peristaltic Pump, which has a suction lift limit of approximately 7.5 m (25 ft). The Mini Inertial Pump can be used with inexpensive polyethylene tubing to depths of 15 m (50 ft), or using PTFE tubing to depths of 45 m (150 ft).

The Micro Double Valve Pump (DVP) is ideal for low flow VOC sampling in narrow applications. The Micro DVP is made of flexible PFAS-free PTFE or polyethylene tubing which is 3/8" (9.5 mm) in diameter. A manifold at the surface has a quick-connect fitting for attachment to the Solinst Electronic Control Unit and a bypass for easy sample collection. Operation is easy, as the Electronic Control Unit has built in pre-sets. A multi-purge manifold is also available for the Micro DVP, for depths up to 73 m (240 ft).

Vapor Samples: A special Vapor Wellhead Assembly can be used to obtain depth discrete vapor samples.



Model 102 Water Level Meter



Model 410 Peristaltic Pump



Mini Inertial Pump 1/4" (6 mm)



Model 464 Electronic Control Unit



Model 408M DVP 3/8" (9.5 mm)



Model 403 Vapor Wellhead

CMT Field Applications

- Identify vertical as well as horizontal contaminant distribution with transect monitoring
- Ideal for shallow wells in high water table environments
- Multilevel water sampling and level monitoring in unconsolidated soils or bedrock
- Dewatering impact assessments at construction & mining sites
- Mass transport calculations and mass flux estimation
- Monitoring of natural attenuation or remediation processes, and documentation of its effectiveness
- VOC, MTBE and Perchlorate monitoring at NAPL sites
- Determination of the best location for reactive barrier walls, the Waterloo Emitter and other remediation methodologies
- Vapor monitoring with special wellhead seals
- Helps optimize design and performance assessment of remedial options



Nineteen 7-Channel CMT Systems were installed inside a manufacturing facility to characterize and monitor a plume beneath the building that is migrating off site. Systems were installed using sonic drilling to 30 m (100 ft) depths. Challenging geology made drilling and installation tricky, however, all Systems were installed in two weeks.



CMT Systems were installed at the bottom of a bay to measure submarine groundwater discharge. Eight 7-Channel CMT Systems were installed, with custom modifications to suit the open water application. Watertight wellheads had to be custom built to allow for sampling from the surface of the bay using a peristaltic pump.

CMT Training Programs

Solinst offers CMT courses that provide both instruction and hands-on training for CMT construction and installation. Contractors who attend and complete the course are “Trained CMT Contractors” and can be listed on the Solinst website at: www.solinst.com/Prod/403/training.html

As well as the Environmental Drilling Contractors who are training to become “Trained CMT Contractors”, attendees often include regulators, consultants, and Solinst Distributors and their clients. In some states, these training courses qualify for continuing education credits.

Courses are offered at various environmental conferences throughout the year, such as those put on by the NGWA, Battelle and others. For larger groups Solinst can set up a training session at the group’s own facility.

Please contact Solinst should you wish to attend or set up a training session.



CMT Installation and training as part of a “Multilevel Course” given by the University of Cranfield at Silsoe, U.K., in conjunction with Waterra (UK), British Geological Survey & Norwest Holst.



Instructing drilling contractors and consultants on CMT installation techniques at Battelle Bio-Symposium, Baltimore, Maryland.



The first CMT contractor training course, conducted at the NGWA Expo in Las Vegas, December 2004. Contractors are being instructed on proper port construction.



Outdoor installation/ demonstration at premises of Parrat-Wolff, Environmental and Geotechnical Drilling Services, Syracuse, New York.