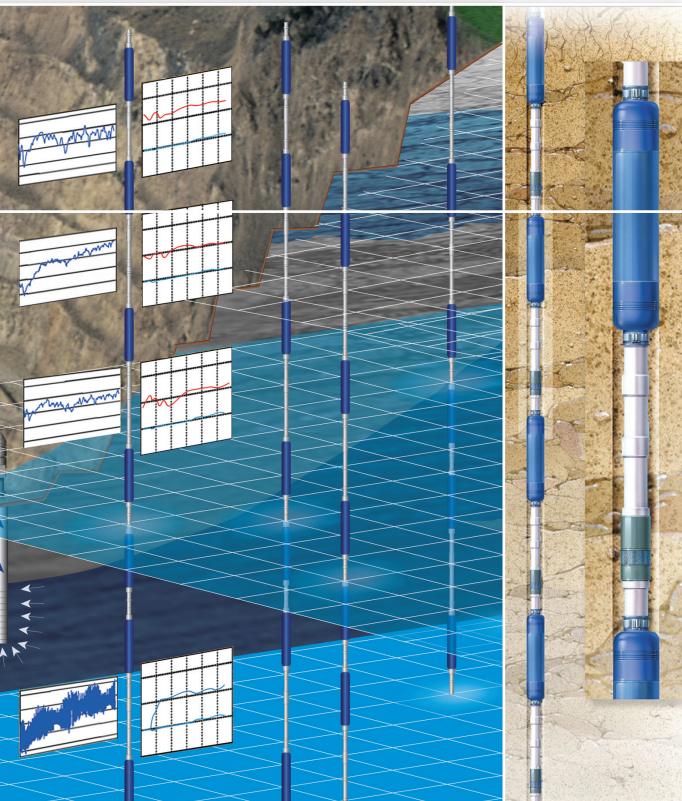
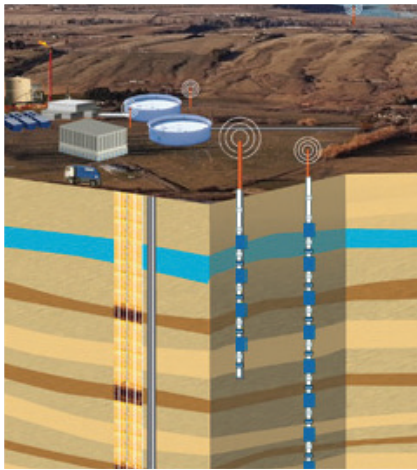


Westbay System

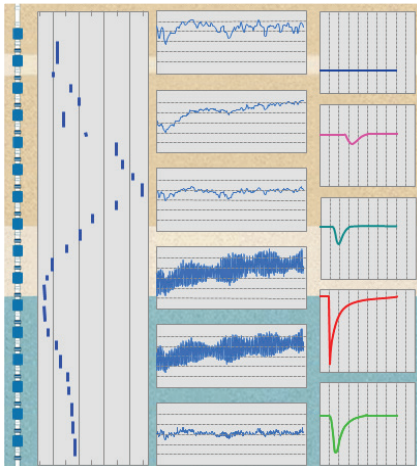


Multilevel Technology for Subsurface Characterization and Monitoring

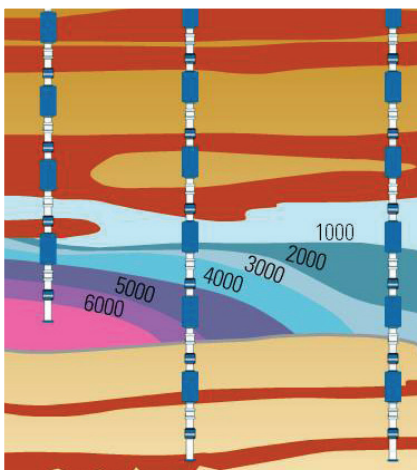
Is Groundwater Monitoring Important?



Environmental monitoring for unconventional oil and gas



4D subsurface characterization using Westbay technology



Characterization of contamination plume using Westbay System

WHY GROUNDWATER MONITORING?

Groundwater is an essential resource of great social, environmental and economic importance. With continuous population growth and industrial expansion impacting the state of groundwater around the world, implementing comprehensive groundwater management strategies is critical.

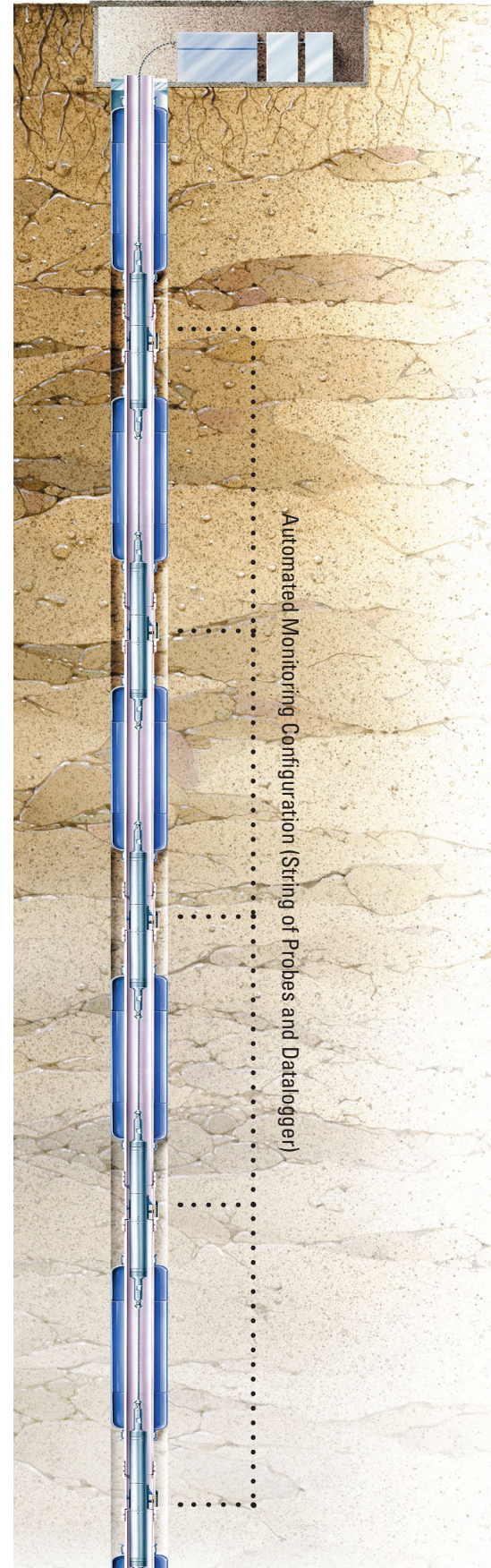
As an essential component of water management, groundwater monitoring networks are designed to optimize the collection of vast amounts of field data during the life of a project. Collection, analysis, and management of water levels and water quality parameters provide fundamental baseline information necessary for identifying potential risks and managing groundwater as a sustainable resource.

Groundwater monitoring networks:

- provide baseline data to map the spatial and temporal distribution of water quality
- identify short-term changes to groundwater flow from pumping, natural recharge and discharge, agricultural and industry use
- isolate impacts to groundwater from contaminant spills and releases
- present early warning of potential risks and the need for mitigation measures
- offer real-time accounting of water use and compliance with regulatory guidelines

OUR SOLUTION

Since 1978, the Westbay* System has provided its clients with a cost-effective, multilevel monitoring technology designed for long-term groundwater monitoring and data acquisition. The Westbay System is designed for collecting subsurface data at any number of discrete positions within a single well. Under even the most complex hydrogeologic conditions, this completely customizable system is a cost-effective, reliable solution that surpasses traditional monitoring methods.



Westbay System

Flexible, industry-tested design offers
Superior Performance

OVERVIEW

The Westbay System is a completely versatile, multilevel monitoring technology that allows testing of hydraulic conductivity, monitoring of fluid pressure and collection of fluid samples from multiple zones within a single borehole. Designed for reliability and defensibility, the Westbay System can accommodate a wide variety of borehole conditions including diameter, depth, temperature and chemistry considerations.

Westbay System advantages:

- obtain measurements and samples at any number of discrete locations along a single borehole
- collect samples without purging
- designed for long-term monitoring
- engineered to operate at great depths
- reduced drilling and installation costs, with minimal site disturbance
- removable probes allow for convenient calibration and servicing
- built-in defensible QA/QC procedures

WELL COMPLETIONS

Westbay Systems are engineered with a unique, customizable casing system. The casing system is available in two sizes (MP38 and MP55) and manufactured from plastic or stainless steel to fit various borehole dimensions and operational requirements. Hydraulically-inflated packers and/or backfill provide engineered seals between monitoring zones, preventing unnatural flow and cross-contamination. Valved ports in the zones provide access for monitoring, sampling and hydraulic testing.

Westbay Systems can be installed in a number of different ways to suit geologic conditions, drilling methods, and project objectives.

Completion methods include:

- packers in open borehole
- packers through temporary casing
- packers in a cased well
- packers in cemented and perforated well
- direct backfill

WESTBAY SYSTEM PROBES

A variety of probes are available for use with the Westbay System. Reliable, accurate, and portable wireline-operated probes can be lowered into the casing system and used to:

- measure groundwater pressure
- test hydraulic parameters
- collect samples in-situ
- perform system specific tests

COLLECTING GROUNDWATER SAMPLES

Westbay Systems offer the unique ability to collect discrete fluid samples at formation pressure. For sample collection the probe and sample container are lowered to the desired depth, where the sample is collected into the container. The probe and container are then retrieved to the surface for further analysis.

Westbay System sampling allows you to:

- collect samples with minimal disturbance and without repeated purging
- maintain samples at formation pressure
- monitor pressure during sampling
- document quality assurance

1 PACKERS

- Engineered seal in a range of borehole sizes
- No dedicated inflation lines
- Controlled hydraulic inflation with record of pressure and volume
- Quality control tests to confirm performance at any time after installation

2 MEASUREMENT PORT

- For fluid pressure measurements, fluid sampling and low-k testing

3 PUMPING PORT

- For purging, hydraulic conductivity testing, and quality control testing.



Accurate, reliable long-term monitoring delivers *Definitive Results*

MEASURING GROUNDWATER PRESSURE

Westbay pressure probes can be used to take periodic, manual measurements of in-situ fluid pressures or to automatically monitor pressures using telemetry.

With a single probe, pressures are measured one port at a time. The output from the probes is digitized and transmitted through a rugged but lightweight wireline to a control unit at the surface. By attaching a standard laptop to the interface, data can easily be downloaded and stored for interpretation and analysis.

For automated multilevel measurements of fluid pressures, a string of pressure probes can be distributed down the well with each probe located at a selected measurement port. Each probe has a unique identity, allowing them to be polled individually or simultaneously by the datalogger.

Westbay Systems allow you to:

- measure pressure at multiple locations in a single well
- measure manually or automatically
- redeploy probes in alternate locations
- select from a variety of logging modes
- perform in-situ calibration checks
- document quality assurance

TESTING HYDRAULIC PARAMETERS

Westbay technology provides many effective methods for evaluating and testing the hydraulic characteristics of a site.

Discrete monitoring ports offer the unique ability to observe and record details within a single well.

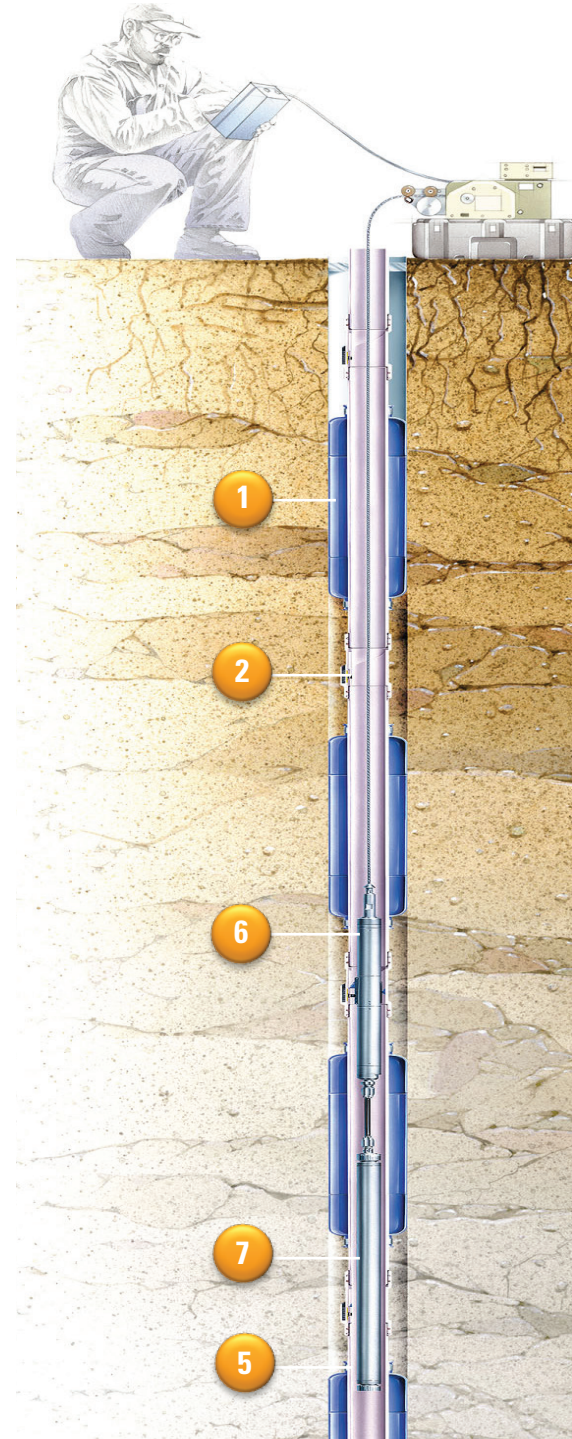
Westbay Systems allow you to:

- observe detailed distributions of groundwater pressures
- observe the effects of pumping tests or changes in barometric pressures
- gain insight into permeability variations
- generate a stress in a monitoring zone and observe responses of neighbouring zones and wells

A number of qualitative and quantitative tests can be performed to determine the hydraulic parameters of formation materials or to verify the operation of the system.

- single-zone tests
- slug tests
- pulse-interference tests
- constant-head tests
- vertical interference tests
- cross hole tests
- tracer tests

As part of a complete environmental monitoring project, Westbay Systems are engineered to meet the rigorous demands of a wide range of operations. Westbay Systems provide the highest level data quality necessary to support critical decisions.



4 CENTRAL ACCESS CASING

- Made of plastic (PVC) or stainless steel
- Two sizes: 38 mm [1.5 in], 55 mm [2.2 in]
- Operational capability to depths of 1,200m [4,000 ft]

5 SEALED CONNECTIONS

- All casing connections sealed by o-rings

6 SAMPLER PROBE

- Independently controlled sampling valve
- Silicon strain-gauge pressure transducer
- Location/activation mechanism compatible with Westbay System

7 SAMPLE CONTAINER

- Maintains sample pressure during recovery
- Easy to clean



Applications

Groundwater Resource Management

- Groundwater basin management
- Manage aquifer recharge operations
- Seawater intrusion
- Detailed long-term monitoring

Contaminant Site Investigations

- Site characterization
- Plume delineation
- Remediation design and performance monitoring

Geologic Repositories

- Site characterization
- Determine feasibility of underground disposal site

Geotechnical Projects

- Monitoring of pore pressure, slope stability for tunnels, subsidence and drainage
- Groundwater pressure monitoring at large dams

Mining

- Pre-feasibility planning and support
- Subsurface characterization and monitoring
- Acid rock drainage assessment and control
- Monitoring of leach operations
- Environmental impact assessment and site closure
- Sub-permafrost groundwater monitoring

Unconventional Oil and Gas

- Site characterization to reduce risk and minimize regulatory pushback
- Evaluation of water management alternatives
- Optimum placement, design and construction of injection wells
- Compliance monitoring and minimization of cross-contamination
- Closure design and performance monitoring

Features and Benefits

Features

- Unlimited number of monitoring zones in a single well
- Additional data at small incremental cost
- Sealed monitoring zones
- Collect water samples without repeated purging
- Automated pressure monitoring at multiple depths
- Wide suite of hydraulic test methods
- Removable and upgradeable probes
- Improved security
- Excellent field quality control procedures
- Custom components available to meet operational requirements

Benefits

- Improve understanding of hydrogeological conditions and contaminant transport
- Minimize drilling cost and time
- Reduce site disturbances
- Minimize wellbore storage effects
- Minimize cross-contamination
- Increase confidence in data
- Reduce health, safety and environmental risks



Operating worldwide since 1978

Over 2000 wells installed



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Sergio Desuque
sdesuque@shaletechsolutions.com
Ph: +54-9-11-4434-6216
Arce 215, Piso 29 A, Buenos Aires,
ARGENTINA

www.westbay.com