APPLICATION FOCUS

Tailings Dams IoT Remote Monitoring

GEOSENSE

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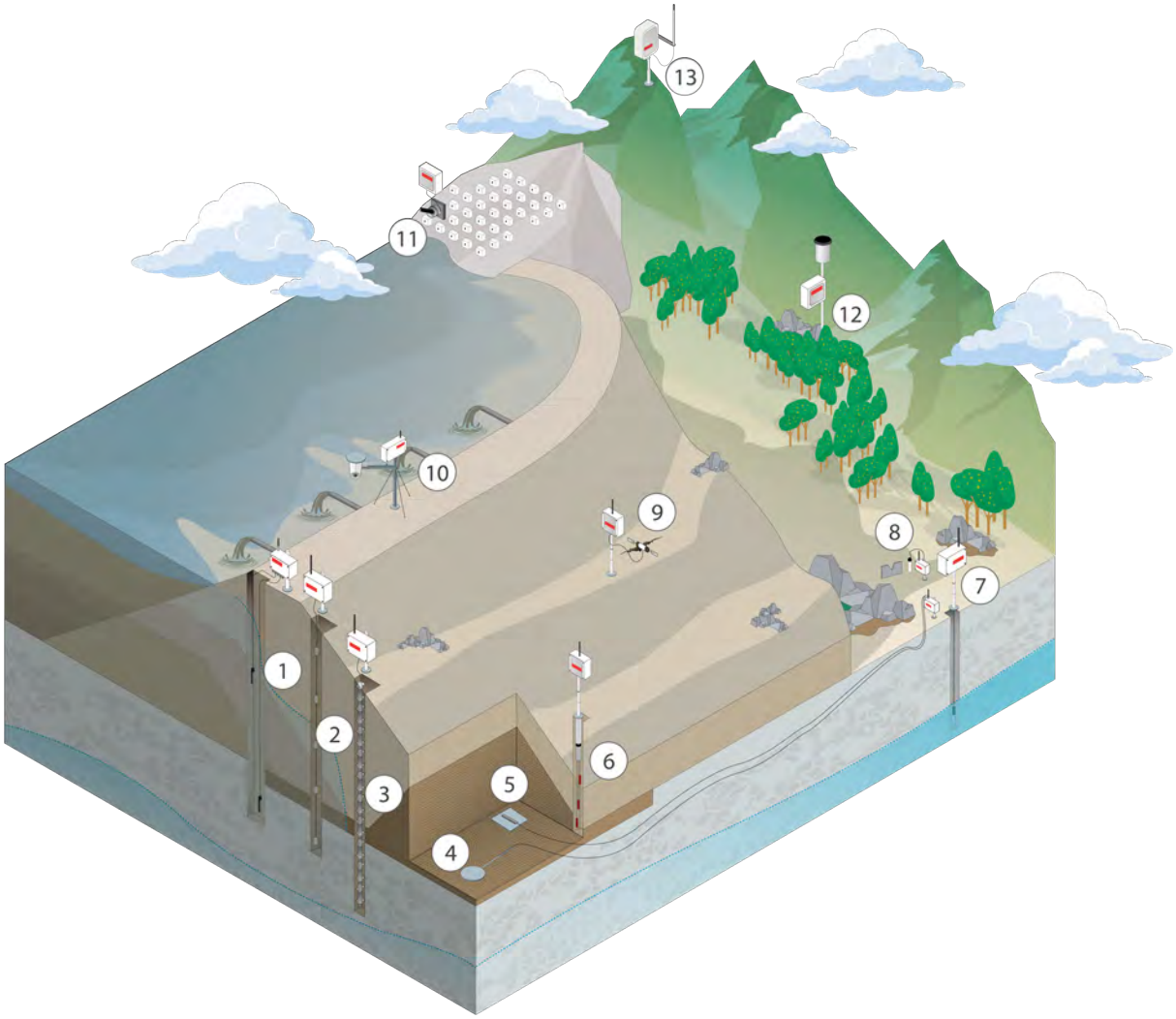
Tailings Dams IoT Remote Monitoring



	LOCATION	MONITORING PARAMETER	INSTRUMENT	WIRELESS UNITS
1	Embankment/Foundation	Pore Water Pressure, Phreatic Surface	VW Piezometer	VW 5-Channel
2	Embankment	Temperature	VW Thermistor String	VW 5-Channel
3	Embankment	Horizontal Displacement	In-Place Inclinometer	Digital
4	Foundation Interface	Earth Pressure	Total Pressure Cell	VW 1-Channel
5	Foundation Interface	Settlement	VW Liquid Settlement Cell	VW 1-Channel
6	Embankment	Vertical Deformation	Multi-Point Borehole Extensometer	VW 5-Channel
7	Sub-Surface	Water Quality	Water Quality Probe	Digital
8	Embankment/Foundation	Seepage	Weir Monitor V-Notch Weir	VW 1-Channel
9	Embankment	Surface Displacement	VW Crack Gauge	VW 5-Channel
10	Reservoir Level	Water Level	VW Piezometer (Vented)	VW 1-Channel
11	Abutments	Load In Anchorage	VW/Strain Gauge Load Cell	VW 5-Channel, Piconode
12	Environment	Rainfall	Rain Gauge	Piconode
13	Central Data Acquisition	All	All Sensors	Gateway

Tailings dam infographic by Worldsensing

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5 Ways that Wireless Monitoring Systems Improve the Safety of Tailings Dams

Wireless monitoring systems provide a real-time, continuous flow of data enabled through reliable, long-distance, low-energy and low-maintenance technologies. We look at why a wireless monitoring system is a key tool to properly monitor tailings dams to prevent and manage failures.

1. Improves knowledge of the most critical potential failure mechanisms

Tailings dam failures can originate from overloads, anomalous behaviour of the material used to build the dam (normally tailings), or from problems with the drainage mechanisms, which result in an increase of pore water pressure, and therefore a loss of resistance.

They can also result from poor monitoring systems. With manual or wired in-situ readings, operators do not have sufficient data to gain a clearer picture of the main factors playing a role in failure mechanisms. This massively increases risks in and around tailings dams, as those supervising the area cannot predictively act in order to stop potential failures.

> The amount of data and regularity with which it is collected through wireless monitoring solutions provides a solid basis for a correct risk analysis, and for building risk-potential models. This is key for long-term risk-planning and for understanding critical failure mechanisms.

2. Detects situations that are likely to trigger a failure of the dam

Real-time data-gathering means that operators have continuous knowledge of the dam's status. It also means that they can very quickly build 'normative' models of how the dam should be behaving, meaning that any anomalies are flagged up as soon as they occur.

> Wireless monitoring systems permit for the implementation of corrective measures as soon as possible, preferably before any kind of incident can take place.

This is key not only to reducing risk and saving human lives but also to a business' profit margins. Post-incident remedial action and the downtime of the dam cost significantly more than predictive maintenance activities.

3. Serves as a tool for designing the dam's growth

Accumulated data-sets gathered through wireless monitoring devices are key to the successful future planning of the dam's growth.

With a wireless monitoring solution, operators can use solid data to implement models that show the future probable status of the dam and its environs, and allow them to plan more accurately for any possible future changes and incidents within the context of its growth.

4. Provides a sound basis for the establishment and implementation of the proper response in case of a failure involving human hazards

> Equipped with the ability to model future incidents and predictively respond, operators can establish set responses to particular incidents that regularly happen, and set up crisis contingency plans in the case of an emergency.

This is all enabled through the constant relay of precise data about the status of different parts of the tailings dam.

5. Provides long-term monitoring with very little maintenance

Manual maintenance of sensors and data-loggers – and more – is in itself incredibly risky, meaning that maintenance of a monitoring solution must be minimal.

> A monitoring system that is both long-term and low-maintenance is absolutely critical for tailings dam environments.

This requires durability so that equipment can survive in sometimes very harsh physical conditions; longevity of battery life, so that equipment does not need to be placed frequently; and long-distance transmittance, so that it can continuously relay data from difficult, hard to reach environments over long periods of time.

Read the full article at Worldsensing Blog

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Instruments

1
10

VW Piezometer

Piezometers measure pressure to monitor pore water pressure, the phreatic water level within the dam embankment and reservoir water level. Pore water pressure monitoring is used to assess the stability of the embankment and high pore pressures can be a precursor to slope instability. The reservoir level drives the phreatic surface in addition to increasing pressure on the embankment. High pore pressures in the foundation can cause heave where seepage forces create a zero effective stress condition.

2

Thermistor String

This consists of a cylinder of high strength steel with 3 to 5 vibrating wire strain sensors mounted parallel to the longitudinal axis and arranged equidistant around the circumference to measure compression of the cylinder under load. They are manufactured with a centre hole to accommodate anchors, rock bolts and tendons.

3

In-Place Inclinometer

In-Place Inclinometers measure tilt.
When placed within the dam embankment they monitor horizontal displacements which if excessive can lead to instability and failure.

4

Total Pressure Cell

Vibrating wire Total Earth Pressure Cells are used to measure stress acting on a plane surface.
When installed at the foundation interface and combined with a piezometer the effective stress of the soil can be calculated and thus it's stability.

5

VW Liquid Settlement Cell

Vibrating wire Liquid Settlement System measures displacement vertical displacement.
When installed at the interface settlement or heave of the dam foundation can be monitored.

6

Multi-point Borehole Extensometer

Vibrating wire Multi-point Borehole Rod Extensometers measure vertical displacement.
They are used to measure vertical deformations at various depths within the dam body which allows for settlement predictions and monitoring during and post construction.

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Instruments

7

Water Quality Probe

Multi-parameter water quality sensors measure a range of properties including conductivity, temperature and pressure. Installed within wells at several locations downstream of the dam they can identify any leakage of environmentally damaging chemicals and allow remedial action to be taken.

8

Weir Monitor & V-Notch Weir

The V-notch & vibrating wire Weir Monitor are used to measure flow.
Seepage flow is a critical component of monitoring as increases in flow indicate that either the phreatic surface has become too high or that internal erosion and potential piping is occurring which could lead to failure.

9

VW Crack Gauge

Vibrating Wire Crack Meters measure displacement. When installed on embankment berms they can detect surface movements which could be the pre-cursor of internal erosion and possible piping.

11

Anchor Load Cell

Vibrating Wire and Strain Gauge Anchor Load Cells measure load on ground anchors.
Where abutments need to be stabilised ground anchors can be used which should be monitored to confirm their integrity and any change in load due to ground failure.

12

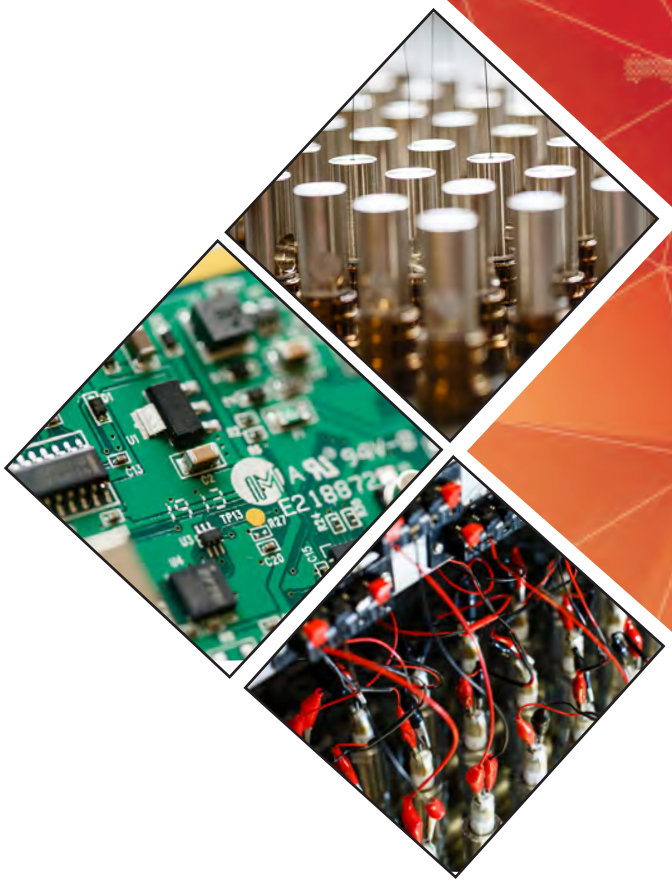
Rain Gauge

A Rain Gauge measure the amount of precipitation which is often a triggering factor influencing the stability of soil embankments.

13

Gateway & Nodes

The Gateway is the central hub for gathering the raw data from all sensors via the wireless Nodes from where it is transferred via the Internet to various third party data visualisation software including sensemetrics and Geo-Axiom.



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Specifications may change without prior notice

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