RAW MATERIALS POLICY

Water Watchdogs

Guide to Community-Based Water Monitoring

PowerShift

What This is About

Mining can severely pollute rivers, lakes, and groundwater. During the extraction and processing of ores, sludge, heavy metals, chemicals, and other pollutants can enter water bodies. This can render drinking water unusable and endanger people, animals, plants, and entire ecosystems.

Community-based water monitoring helps communities detect changes in water quality early on, systematically document observations, and thus take action against pollution. The goal is not merely to measure, but to collect data that is comparable, well-documented, and as representative as possible.

Good monitoring always answers a clear question, for example: Are water quality values worse downstream of a mine than upstream? Do noticeable changes occur after rainfall events? Are there indications of acidic, metal-laden, or sediment-contaminated inflows?

This guide is intended for local communities, groups, and organizations that wish to establish a simple yet robust monitoring program for surface waters. It focuses on planning the monitoring, selecting monitoring sites and parameters, conducting sampling, quality assurance, and the evaluation and use of results.

Why is community-based monitoring so effective?

- **High credibility of results for communities:** Communities monitor and document changes in their own living environment themselves.
- **Early detection of damage:** Long-term data sets reveal gradual changes.
- **Complement to government oversight:** Monitoring can fill gaps when authorities do not provide sufficient oversight.
- **Strengthening participation and rights:** Data can be used for consultation processes, complaints, and political processes.
- **Political leverage**: Well-documented results strengthen advocacy, campaigns, and in some cases, legal action.

Community-based monitoring combines local knowledge with technical observation. It can help make environmental impacts visible, identify risks early, and demand accountability.

Five Basic Rules

1. Define the Objective
Before each sampling, it must be clear why measurements are being taken and how the results will be used later.

2. Plan for Comparison Sites
In addition to the suspected pollution site, at least one reference point upstream of the mining activity and points downstream are needed to highlight differences.

3. Keep Time and Location Consistent
Water quality varies spatially and temporally. Therefore, whenever possible, take measurements at the same points, in the same order, and under similar conditions (such as at a similar time of day).

4. Safety First
Only take samples where safe access is possible. Do not take samples in the event of acute danger, severe flooding, unstable slopes, or health risks.

5. Document Everything Immediately
Record the location, photos, weather, time, water level, odor, color, turbidity, and all measurement values immediately.

Step-by-Step Guide

Step 1: Define a Goal

Step 2: Develop a Monitoring Plan

Step 3: Select Relevant Parameters

Step 4: Preparation Before the Field Day

Step 5: Safety in the Field

Step 6: Conduct Sampling in the Field

Step 7: Document Everything

Step 8: Ensure Quality

Step 9: Evaluate and Interpret Data

Step 10: Communicate and Utilize Results

Step 1:

Define a Goal

Start with a clear research question. The more precisely the objective is formulated, the easier it is to determine sampling points, parameters, and sampling frequency. Objectives should be as specific, measurable, realistic, and time-bound as possible.

A generally formulated objective might, for example, be: To determine whether mining activities in the watershed are leading to a deterioration in water quality in the watercourse.

A more specific objective could be: To collect water samples monthly at three sampling sites over a three-month period, as well as after heavy rainfall, to compare changes in pH, conductivity, turbidity, and other selected parameters upstream and downstream of the mine.



Step 2:

Develop a Monitoring Plan

Determine Sampling Sites

The selection of suitable monitoring sites is crucial for the validity of the monitoring. The locations should be representative of the water body, allow for safe access, and align with the monitoring objectives.

In mining contexts, a simple core network is often sufficient:

- A reference site upstream of the impact area/mine
- A location directly downstream of the suspected source of contamination or at a discharge point
- Another location further downstream

This allows you to compare whether and how water quality changes along the watercourse.

It is important not to take measurements in stagnant water zones, back-eddies, or directly in visible wastewater plumes. In flowing water bodies, sampling should ideally be done where the water is well-mixed and has the highest flow velocity. Sediment should not be disturbed in the process. The measurement depth should always be consistent and documented.

Determine the Timing, Frequency, and Duration

How often measurements are taken depends on the monitoring objective. For a simple community program, a fixed schedule is recommended, such as **monthly baseline samples**, supplemented by **additional samples during special events**.

Particularly important times are:

- after specific weather events (depending on the context, e.g., heavy rain)
- after overflows or leaks
- in the event of noticeable discoloration or turbidity
- in the event of odors
- in the event of animal or fish deaths
- after prolonged dry spells

Long-term data collection is particularly valuable because it reveals trends and recurring patterns.

Plan Resources Realistically

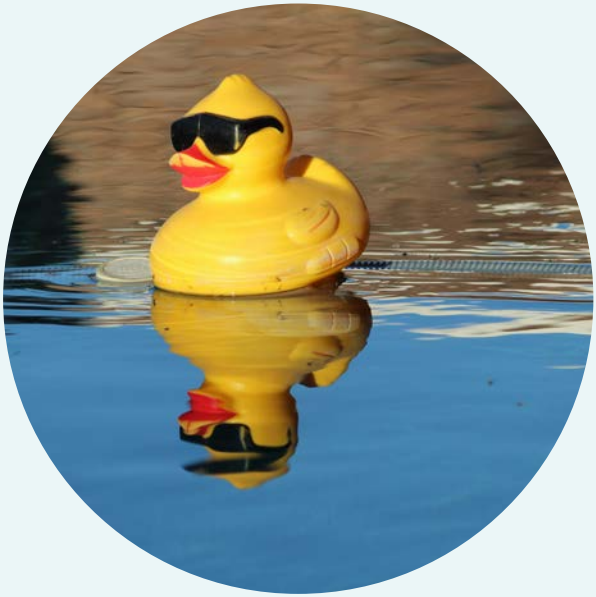
A monitoring program must be tailored to the available time, budget, and equipment. A small, ongoing program is often more useful than a one-time large-scale operation. It is better to have a few fixed locations that are sampled regularly using the same protocol than to conduct many irregular individual measurements.

Step 3:

Select Relevant Parameters

The selection of parameters should be directly tailored to the research question.

For community-based water monitoring in a mining context, it is particularly useful to focus on **easily measurable on-site values**, **general site observations**, and **a few targeted parameters** that can be tested using test kits and verified through laboratory tests if abnormalities are detected.



On-Site Values:

Flow Velocity

Flow velocity describes how fast water moves in a stream or river. It is usually expressed in meters per second (m/s). It is important for water monitoring because it influences how quickly substances are transported, diluted, or deposited in the water.

In the mining context, flow velocity is particularly relevant because contaminated water, sediments, or dissolved substances from tailings piles, mine water, or retention basins can be transported varying distances and at varying speeds depending on the current. At high flow velocities, pollutants can quickly reach downstream areas. At low flow velocities, fine particles and metals bound to them are more likely to settle.

Why do we measure this?

Flow velocity helps us estimate how potential pollutants spread in the water and where sediments or pollutants might be deposited.

How do we measure this?

Using a floating object, such as a small ball or a rubber duck: Measure a known distance along the waterway, place the object in the water at the starting point, and time how long it takes to reach the end point. The flow velocity is then calculated from this. Example: You let the rubber duck float 5 meters, and it takes 20 seconds to do so.

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5 m ÷ 20 s = 0.25 m/s
```

The flow velocity is therefore 0.25 m/s.

On-Site Values:

Temperature

Water temperature is a key parameter in water monitoring. It influences nearly all physical, chemical, and biological processes in the water body and is therefore essential for correctly interpreting other measurements.

For example, as the temperature rises, less oxygen dissolves in the water. At the same time, many biological (e.g., growth of aquatic organisms) and chemical processes occur more rapidly. This can alter water quality and stress animals and plants in the water. Many species are sensitive to temperature changes, so the composition of communities can also shift.

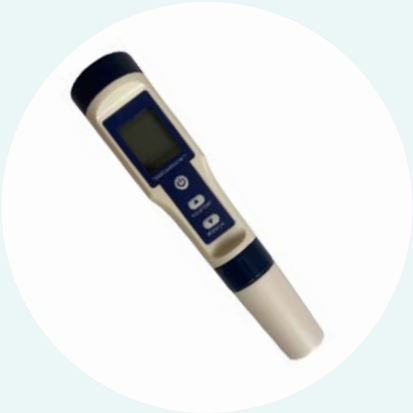
Other measured values are also related to temperature. For example, a low pH value combined with a higher water temperature causes metals to be released more easily from sediments or rock into the water. This is particularly important in the context of mining.

Why do we measure this?

Temperature is a simple yet crucial parameter. It helps us detect changes in the water early on and better understand other measurements.

How do we measure it?

With a waterproof thermometer



On-Site Values:

pH Value

The pH value indicates whether water is acidic, neutral, or alkaline. The scale ranges from 0 to 14. A value of 7 is neutral; values below 7 are acidic; values above 7 are alkaline.

The pH value is particularly important for monitoring in a mining context because acidic or significantly altered values can indicate pollution. When water becomes acidified due to mining, metals can leach more easily from rock and sediments and enter streams, rivers, or groundwater. Highly alkaline pH values, on the other hand, can indicate industrial discharges, residues from the processing of raw materials, cement or lime dust, and other chemical pollution.

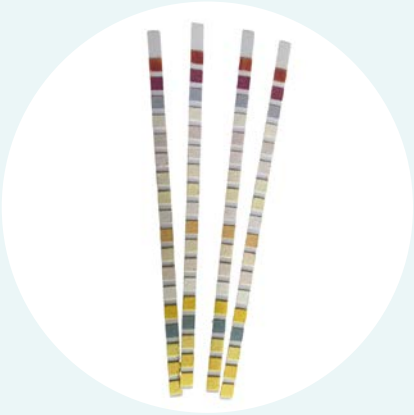
In natural waters, the pH value is often between approximately 6.5 and 8.5. This range is optimal for the growth of most aquatic organisms. Significant deviations from this range can indicate environmental changes or the introduction of pollutants. A significantly altered pH value can also harm animals and plants in the water.

Why do we measure this?

The pH value helps to detect pollution early and record indications of acidic mine drainage or other mining-related inputs.

How do we measure it?

With a pH meter or test kit



On-Site Values:

Conductivity

Conductivity indicates how many dissolved salts, minerals, or metals are present in the water. The more dissolved ions there are in the water, the higher the conductivity. Since conductivity increases with temperature, measuring devices with temperature compensation should be used. The values are then reported as µS/cm at 25 °C and are more easily comparable.

In a mining context, conductivity is particularly useful because it can indicate inputs from wastewater, seepage water, or contaminated sediments. Rising values can be a sign that additional substances are entering the water. However, it does not indicate which substances are in the water, only that the amount of dissolved substances has changed.

Below 100 µS/cm	very low in minerals
100 – 300 µS/cm	relatively low mineralization
300 – 800 µS/cm	typical for rivers
over 1,000 µS/cm	rather high, possible influence from mining
2,790 µS/cm	limit value for drinking water in Germany

Why do we measure this?

Conductivity is easy to measure and serves as a good early warning indicator for changes in water quality. High conductivity values (as a guideline: from approx. 1,000 µS/cm or very sharp increases compared to previous measurements) are often associated with elevated concentrations of dissolved ions, such as sulfate, and can be an indication of acidic mine water in mining regions.

How do we measure it?

With a conductivity meter

On-Site Values:

Water Hardness

Water hardness describes how much calcium and magnesium are dissolved in the water. It is usually expressed in milligrams of calcium carbonate per liter (mg/L $CaCO_3$). Most of the time, flowing waters fall within a range classified as medium-hard to hard (50–300 mg/L $CaCO_3$). The specific thresholds for when a water body is considered "soft" or "hard" are not uniformly defined and vary by country and application. For the assessment of flowing waters, a comparison with natural background values in the respective region is therefore often decisive.

It is important for water monitoring because it influences how stable a water body is in response to pH changes and how toxic certain metals are to aquatic organisms. This is particularly relevant in a mining context: In hard water, metals such as copper or zinc are often less bioavailable (i.e., absorbable) and thus usually less toxic. In soft water, however, heavy metals can be harmful even at low concentrations.

Why do we measure this?

Water hardness helps us assess the potential impacts of metal contamination more realistically.

How do we measure it?

With a test kit or drop test

On-Site Values:

Turbidity

Turbidity describes how clear or cloudy water is. It is caused by fine suspended solids in the water, such as silt, clay, organic matter, or small particles from overburden and sediments.

In the context of mining, turbidity is particularly important because earthworks, tailings piles, construction sites, retention basins, or heavy rainfall can cause large amounts of sediment to be washed into water bodies. In addition, pollutants and metals can become bound to fine particles and thus be transported along with the water.

Why do we measure this?

Turbidity is an important indicator of sediment input and other changes in the water.

How do we measure it?

With a turbidity tube



On-Site Values:

Alkalinity

Alkalinity describes how well water can buffer acids. It therefore indicates how resistant a body of water is to acidification and how stable the pH value remains when acidic substances enter the water. The higher the alkalinity, the better a body of water can compensate for such inputs. For flowing waters, values between 50–200 mg/L $CaCO_3$ are considered well-buffered.

Alkalinity is important for community-based water monitoring because it helps us better understand pH values. Two bodies of water can have the same pH value but react differently to new stressors. A body of water with low alkalinity can "tip" more quickly even with small additional inputs than a body of water with high alkalinity.

In a mining context, this is particularly relevant because acidic inputs from waste rock, mine water, or contaminated sediments can alter the pH value. If alkalinity decreases, the water body loses its buffering capacity and becomes increasingly unable to neutralize acids. This can be an early warning sign of incipient acidification or acidic mine drainage.

Why do we measure this?

Alkalinity is an important supplementary parameter to pH, conductivity, and water hardness. It helps to better assess a water body's sensitivity to acidic inputs and to detect early signs of acidification in a mining context.

How do we measure it?

With a test kit or drop test



General Site Observations

In addition to measured values, simple observations are also important. These include:

- Water color
- Odor
- Foam formation
- Oil film
- Silt plumes
- Orange, red, or white deposits
- Dead fish or other conspicuous organisms

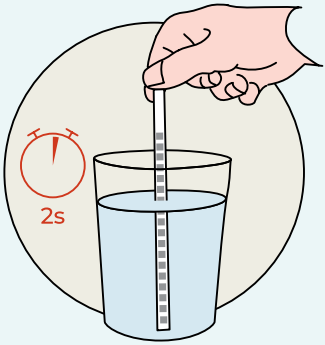
Such observations should be described in the sampling log and, if possible, photographed.



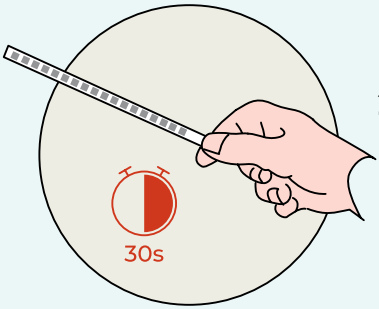
Measurements with Test Kits and Laboratory Tests

Special test kits are available for many parameters, allowing even non-experts to take samples. These include, for example, sulfate, copper, lead, and mercury.

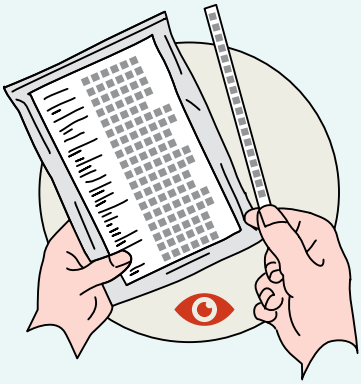
Easy to Use



1 Dip the strip into the water sample for 2 seconds.



2 Hold the strip horizontally for 30 seconds to ensure an accurate reading.



3 Compare the strip to the color chart and take appropriate action.

Test strips are also available for other parameters, such as arsenic, nickel, or cadmium; however, these often have a higher margin of error. For some heavy metals (e.g., uranium, vanadium, or barium), no test strips are available.

Useful but limited: Test kits are excellent for long-term, quick, and cost-effective screenings in community monitoring. However, they do not replace reliable laboratory analysis. If a sample shows a highly abnormal value using a test kit, a laboratory sample should always follow, if possible, to confirm the result.

Which laboratory parameters are appropriate depends on the specific mining project and its geology. Therefore, it should be determined in advance which substances are likely to be relevant there. It is important to gather basic information about the mining project: Which raw material is being mined? What methods are being used? This information often already provides insight into potential contamination.

Additionally, communities can draw on publicly available environmental reports, experiences from similar mining projects, and dialogue with local authorities, civil society organizations, or scientific institutions.

Step 4:

Preparation Before the Field Day

Good preparation helps avoid mistakes and ensure data quality. Each sampling site and each sample needs a unique name or code. This code should always follow the same structure. This allows sampling logs, photos, and later data tables to be clearly assigned. Ideally, it always consists of the same components, for example: `ST-Amazon-UP-20260514-01`

Project Code	River Name	Monitoring Station	Date	Sample Number
ST*	Amazon	UP**	20260514	01

* ST = Abbreviation for “Stream Team”

** Examples of possible monitoring site abbreviations:
UP: upstream of the mine/suspected source of contamination
DN: downstream of the mine/suspected source of contamination

Important: Always use the code exactly the same way—on the sampling log, the photos, and in the data table.

Basic equipment includes:

- ☐ Sampling log 1
- ☐ Waterproof pen 2
- ☐ GPS or smartphone with location tracking
- ☐ Clean sample containers 3
- ☐ Measuring instruments 4
- ☐ Clean disposable gloves 5
- ☐ Folding ruler 6
- ☐ Laboratory documentation, if samples are being sent in
- ☐ Cooler (for lab samples)

Measuring instruments must be cleaned and checked before use. Cleaning the sampling equipment is also essential to ensure that samples are not contaminated by residues from previous uses.

If samples are sent to a laboratory, the following points should be clarified beforehand:

- Bottles required and sample volumes
- Preservation
- Detection limits
- Refrigeration
- Maximum storage times
- Shipping
- Forms and Chain of Custody (documented sample transfer chain)



After the field day: The results from each *Water Sampling Log* (see Step 7 on page 6) can be transferred to a simple data spreadsheet (Excel, OpenOffice, etc.).



Step 5:

Safety in the Field

The safety of all involved takes priority. Potential risks should be assessed before and during sampling. These include slippery banks, strong currents, unstable slopes, chemical hazards, extreme weather conditions, or remote locations.

Important basic rules:

- Never work alone.
- Choose safe access routes.
- Wear appropriate clothing and protective gear.
- Carry communication devices.
- Carry first-aid supplies.
- Stop sampling if the situation is unsafe.



Step 6:

Conduct Sampling in the Field

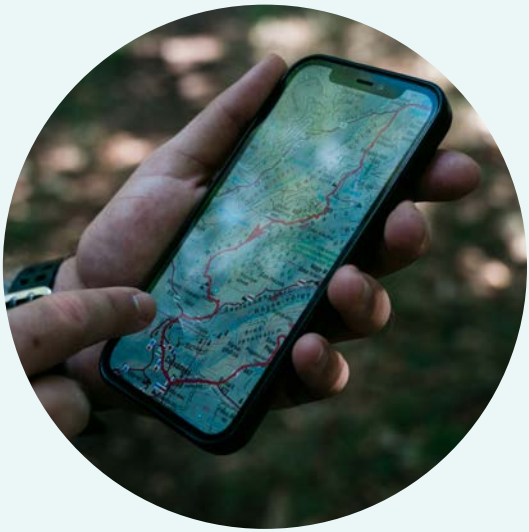
A simple standard procedure helps ensure that measurements are comparable:

1. Check safety and use only safe access points.
2. Document the location: Record the time, weather, water level, and any visible anomalies.
3. Take photos and document the sampling point via GPS.
4. Take a water sample without introducing any contamination of your own and, if possible, without stirring up bottom sediment, and always at the same depth.
    a) Measure on-site parameters (water temperature, pH, etc.).
    b) Measure additional parameters (e.g., heavy metals) using test kits.
5. For laboratory samples: Take the sample and label it immediately, cool it, and prepare it for transport.

For flowing waters, the sample should be taken where the water is well mixed, if possible. The sediment at the bottom of the water body should not be disturbed. Floating matter (e.g., leaves, pieces of wood, foam, oil films, plastic debris, or algae) should, if possible, not be included in the sampling device. If laboratory bottles have been prepared or preserved by the laboratory, they generally should not be rinsed out. In case of doubt, follow the laboratory's instructions.

Guidelines for Proper Sampling

- Avoid entering the water whenever possible.
- Water samples from flowing water bodies are collected as grab samples using sampling devices.
- Thoroughly rinse all suitable sampling devices several times beforehand with the water to be sampled, and, if necessary, their temperature adjusted to match the water temperature.
- Ensure no contaminants enter the sampling device (e.g., by carelessly wiping it off or placing it on the ground).
- Immerse the sampling device in the upper third of the water body's total depth (ideally approx. 10–20 cm below the water surface).
- Hold sampling vessel opening in the direction of the current.



Step 7:

Document Everything

Good documentation is a central part of monitoring. Even a simple field form is sufficient, provided the same information is recorded each time.

Every sampling log should include at least:

- Abbreviation for monitoring site
- Photos and GPS data
- Date and time
- Name of the person taking the sample
- Weather conditions
- Water level or flow velocity
- On-site measurements
- General Site observations (e.g., odor, water color)
- Test kit results
- For laboratory samples: Sample ID and notes on transport, refrigeration, and handover

The more complete the documentation, the easier it will be to evaluate the results later. It also makes sense to agree on a standardized vocabulary beforehand for parameters such as weather conditions or odor (e.g., sunny/cloudy/foggy, etc.).

Water Watchdogs

Water Sampling Log

Sample Code: ST-Amazon-UP-2026-05-14-01

Date and Time: 14.05.2026, 12:15 Name of Sampler: John Smith

GPS Data: 5°30'59.2"N 73°24'32.1"E	Weather conditions: sunny
Location code / monitoring station: UP	Perceived Temperature: warm
Water level: Low	Wind: light wind

Parameter Block I: Measured On-Site Values

Flow velocity (m/s)	0.25
Water temperature	21°C
pH-Value	7.2
Conductivity	900 µS/cm
Water hardness	180 mg/L $CaCO_3$
Alkalinity	110 mg/L $CaCO_3$
Turbidity	40 cm

Parameter Block II: General Site Observations

Ripearian zone	Trash
Water color	Brownish
Smell / Odor	earthy
Foam	⊗ yes ○ no
Oil film	○ yes ⊗ no
Silt plumes	○ yes ⊗ no
Deposits	⊗ yes ○ no
Dead fish / noticeable organisms	○ yes ⊗ no

Parameter Block III: Test Kit Results

Arsenic:	0 mg/L	Cadmium:	0 mg/L	Nickel:	0 mg/L
Lead:	0 mg/L	Cobalt:	0 mg/L	Mercury:	0 mg/L
Chromium:	0 mg/L	Copper:	0 mg/L	Sulfate:	200 mg/L
Iron:	0 mg/L	Manganese:	0 mg/L	Zinc:	0 mg/L

Location Code
UP (upstream)
DN (downstream)

Weather Conditions
sunny
cloudy
overcast
rainy
snowy
foggy
windy
stormy
dry
changing

Water Level
low
normal
high
very high
flooded

Perceived Temperature
cold
cool
mild
warm
very warm
hot
humid

Wind
calm
light wind
windy
strong wind
stormy

Riparian Zone
Forest
Meadow
Agriculture
Industrial area
Residential area
Litter

Water color
clear / colorless
slightly yellowish
greenish
brownish
gray / gray-brown
milky / whitish
black / dark

Smell
odorless
sewage-like
earthy
chemical
musty
chlorine
decaying
rotten
fishy
other

Water Sampling Log is available for download at:
power-shift.de/water-watchdogs

Step 8:

Ensure Quality

For your data to be taken seriously, it must be traceable and as robust as possible. The most important aspect of quality assurance is consistency: same points, same depth, same order, same equipment, same documentation.

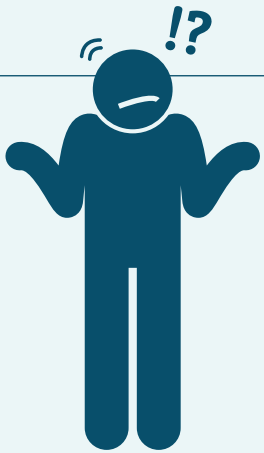
For a simple community program, the following are particularly useful:

- Checking the measuring devices
- Thorough cleaning between locations
- Clear labeling of all samples
- Repeat measurements at selected locations
- Duplicate samples, if possible
- Blind samples as needed to check for contamination
- Comparison of field values with laboratory results

Common Sources of Error

- Incorrect measurement point or inaccurate location description
- Sample mix-ups due to poor labeling
- Inappropriate or contaminated equipment
- Sediment resuspension during sampling
- Sampling in non-representative peripheral areas
- Missing data on weather, water level, or time
- For laboratory samples: delayed transport to the lab and insufficient cooling or improper preservation

But don’t worry: such errors can often be avoided through good preparation and clear procedures.



Step 9:

Evaluate and Interpret Data

The simplest evaluation is a systematic comparison of:

- above versus below
- dry versus wet conditions
- non-event days versus event days (e.g., heavy rain)
- individual locations over extended periods

A single outlier is not yet proof. A recurring pattern, on the other hand, is very meaningful—especially when measurements, observations, photos, and lab results align.

It is also important to interpret the values in context. A low pH value can have different effects when considered in conjunction with temperature and water hardness than when viewed in isolation. Elevated conductivity, combined with visible deposits or high turbidity, may indicate contamination more strongly than a single measurement.

If possible, unusual results should be compared with applicable guidelines, environmental quality standards, or drinking water standards. For surface waters in Europe and Germany, requirements from the Water Framework Directive and the Surface Water Ordinance apply in particular. For community monitoring, however, it is most important to highlight systematic differences and changes.

Step 10:

Communicate and Utilize Results

Monitoring is not just data collection, but also a tool for environmental justice, transparency, and political advocacy.

Results can be used for:

- informing one's own community
- discussions with authorities
- complaints and reports
- consultation and permitting processes
- political demands
- public relations and campaigns
- in some cases, legal action

Well-documented data strengthens the position of communities and can help hold companies and authorities accountable.

A Realistic Minimum Program

During the first month, a “trial run” is recommended, involving not just one sample but several. This allows for practice in handling the equipment and recording the measurement values. Afterward, for many communities, small-scale, ongoing monitoring makes more sense than a one-time large-scale operation. A practical minimum program might look like this:

- Three fixed sampling points
- Sampling: once a month
- Additional samples following specific events (e.g., heavy rain)
- On-site measurement of pH, conductivity, temperature, hardness, alkalinity, and turbidity
- Document visible observations (e.g., foam formation, oil film) with photos
- Take samples using test kits
- If values are abnormal: Verification via laboratory analysis

It is important that this program is consistently implemented in the same way over several months. Only then can a basis for comparison be established that reliably demonstrates whether a body of water is systematically changing.

Simple Reaction Traffic Light



Green

No significant differences between upstream and downstream of the mine or between older and current samples. Continue scheduled monitoring.



Amber

Individual notable values or visible changes. Take follow-up samples promptly and, if possible, arrange for laboratory verification.



Red

Sudden significant changes, visible discharges, fish mortality, highly abnormal pH values, unusually high conductivity, massive turbidity, or an overflow event. Document immediately, take comparison samples if safe to do so, and notify the responsible authorities.

In Short

Good community data does not result from as many individual measurements as possible, but from clear questions, good reference sites, proper sampling, reliable documentation, and, if necessary, collaboration with a laboratory. This makes monitoring a practical tool for protecting water bodies, identifying risks, and advocating for environmental justice.



Notes

Notes

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About PowerShift?
We show pathways out of the climate crisis. Our goal is an ecologically and socially just world. Through comprehensive research, we scrutinize political processes, identify the problems of an unjust global economic system and develop alternative courses of action. Through advocacy, we urge political decision-makers to create the necessary policy frameworks for change. We organize actions and campaigns and forge strong networks – with other organizations, social movements and citizens. Together, we make our voices heard!

PowerShift