Solutions On Site Monitoring of environmental factors in brownfields Ghelari

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Abstract*— Monitoring is implemented in compliance with a set of rules of law: land use planning, pollution control procedures, etc. The main role of monitoring is to highlight whether an objective function meets the requirements at the time of its approval. Monitoring program will be coordinated with measures to minimize applied during the project implementation, namely: to provide feedback on the environmental authorities and the authorities imposed a decision on efficiency measures, to identify the need for initiation and implementation of action before damage occurs irreversible environmental. During the operation, will meet exactly all the provisions of environmental legislation in force. During the entire phase of decommissioning, demolition and construction of an industrial site, there would be a monitoring technology that aimed at reducing hazards and site restoration. Also in the remedial phase of the environment to check the quality of material treated, will be an environmental quality monitoring. Solutions on an industrial site monitoring helps to identify pollution and environmental impact. In Ghelari mining area has been taken as a case study sub-areas were established to monitor the perimeter points affected by pollution and monitoring of the environment. Through continuous monitoring of the environment can be established and remedial measures in the area affected by industrial activity

***Keywords*—environmental factors, environmental management, ecosystem restoration, disused industrial sites, iron ore, network monitoring mining, ore, pollution monitoring**.

I. INTRODUCTION

Pollutants monitoring is part of the environmental management system, is the basis for decision making knowingly conducted to develop environmental management strategies. To ensure a convincing decision, it is essential to ensure that measurements reflect the full reality. Thus, data must be well defined and documented qualitatively. [2]

Sampling methodology and analysis of samples are as important as the results of the measurements themselves.

Objectives include monitoring systems, optimization issues, verification and compliance with legislative requirements such as allowable limits for emissions into the environment.

Monitoring plans are designed and implemented to collect data on air and water quality and pollutant discharges significant Brownfield's sites. Items include a monitoring plan:

- selection of significant parameters,

- method of sampling and transport of samples, is sampling point specification, frequency, type and quantity of samples and testing equipment,

- analysis of samples, or, as an alternative, continuous monitoring;

- format for reporting results.

Background levels of pollutants such as metals are measured in air, water and soil, along with other parameters and preset frequency points, using equipment and methods specified. The objective is to collect and analyze representative samples capable of showing data used in the environmental management system. To ensure acceptable levels of substance is made predictions of pollutant concentrations using models and emissions data from several major sources.

Distinguish the following approaches to Brownfield's sites monitoring:

- basic monitoring designed to investigate those parameters that characterize the current situation and its development on the site location disposed,

- monitoring of Brownfield's sites, for characterizing the impact generated during implementation of remedial measures,

- post remediation monitoring required demonstrating a longer period of time, the effect of closure. [2]

An overview of designing a monitoring scheme for mining, quarrying and processing plants, industrial sites will be decommissioned, is shown in Fig 1.

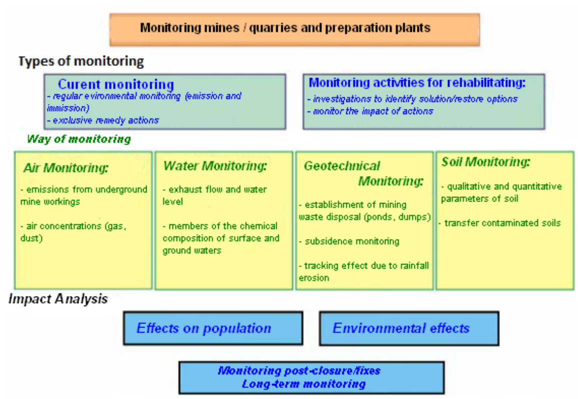

Figure 1 Monitoring scheme for industrial sites will be decommissioned

After closure and decommissioning, monitoring data will show the effects of closure activities on environmental factors. Monitoring data can decide on the following:

- performing construction work on some fixes made to store mining waste;
- implementation of corrective action, where air and water quality does not meet forecasts.

II. MONITORING METHODS

Objectives determine the choice of monitoring sites, parameters, frequency and monitoring methodologies, for example, by visual inspection of the site, collecting samples and making measurements, all part of the monitoring procedure.

Number of sites to be monitored, the number of parameters monitored for each location, frequency of measurements or number of samples collected, determining the scope of monitoring. [12]

Types of pollution sources of Brownfield's sites define the parameters to be monitored.

Sampling frequency depends on the rate of change of the measured data. (Table 1) in areas with clear succession of seasons, the seasonal change largely determines the ranges of determination. A sampling interval set at a time can be shortened or extended by examining a first set of results. Operating cycle of a mine requires regular examination.

Table 1 Typical sampling frequency for monitoring

Sampling frequency	Parameters, factors or periods for which is apply
continue	sunlight period, flows
daily	rainfall
weekly	piezometric levels near active water wells
monthly	surface water sedimentation rates
quarterly	regional piezometric levels
biannual	terrestrial flora
from 1 to 3 years	soil analysis, terrestrial fauna, aquatic vegetation

Water flow rates usually are measured continuously and data are stored locally or transmitted via telemetry. Meteorological data will be recorded daily.

Piezometric levels in the vicinity of the active wells are recorded weekly.

Sampling and analysis of water and rate of sedimentation in water courses are often conducted with a monthly frequency. Hydrostatic level and groundwater quality can be tested every three months.

Habitats are reviewed every three months and terrestrial flora every six months. Soil chemical analysis, examining terrestrial fauna and aquatic habitats could be performed with a frequency of one to three years.

With the decommissioning of a mine site, sampling intervals are usually extended by compatibility with changes and forecast models.

2.1. Monitoring of surface stability [2, 12]

Depending on local conditions of exploitation, concrete measures will be applied. Based on existing conditions after mining activity, will take measurements and periodic updates of the situation on the surface.

Measured data to be recorded, assessed and mapped at a scale of 1:500 or 1:1000 through isoline's.

The following issues will be pursued in particular, to the extent that this is necessary: the state land area of influence of underground mining works to date; degree of compaction of embankment material sinks, suites, subsidence cones etc. Tracking morphological appearance of periodic change of state land located within the mining work is done by instrumental measurements (topographic). Also, be alert and verification measures to ban access to danger zones.

Compaction of embankment material underlines the visual observations, measurements and evaluation, as appropriate, the quantity of embankment to be completed. Frequency is quarterly monitoring of surface.

In areas which are predicted occurrence of subsidence phenomena will be installed with fixed observation networks connected to the monitor. Density measurement and frequency of measurements must be determined according to the risk they pose to underground work area land. Volumes will be evaluated and subsidence cones.

2.2. Water Monitoring

Concentrations of pollutants in groundwater and surface variations may record time due to: seasonal weather changes, erosion phenomena landfill mining, human activities, including remedial measures applied.

To avoid uncontrolled waste water entering the aquifer systems and/or surface emissaries will ensure implementation of measures, taking into account local conditions:

Monitoring results will be the basis to establish technical and organizational measures for groundwater protection and emissaries.

2.3. Air Monitoring

Air quality surveillance is especially significant during rehabilitation monitoring. Normally, all pollutants should be monitored. In practice, only significant pollutants will be monitored. A quality management system analyzes usually probable emission sources and ambient receptors studied area, then selecting pollutants to be monitored. [8, 13]

Table 2 water monitoring parameters

Monitoring sites and methods	Parameter
piezometric installation, as required, at different levels	Hydrostatic level of groundwater
points of discharge of surface and groundwater sources, surface water discharge	flow, qualitative and quantitative indicators of pollutants
emissaries system:- *natural*: rivers, streams; - *artificial*: canals and ditches	flow, qualitative and quantitative indicators of pollutants
retention basins, ponds, industrial ponds	qualitative and quantitative indicators of pollutants

Locations of monitoring stations are determined by the local air receivers. Usually it establishes a network of monitoring stations that are estimated by the levels of pollutants. In cases seeking the determination of ambient concentrations generated by a source or a combination of sources will be referred to a monitoring station to measure background.

Monitoring can be continuous or may be performed at various intervals, determining the maximum and average values for the measuring period analyzed.

Post-closure monitoring of air quality is: explosive gas emission control and/or toxicity of surface-underground work related to closed mines and adjacent areas, tracking emissions of explosive gases and/or toxic in the soil the influence of mining works closed tracking emissions of gas from the surface dumps and tailings ponds.

Firedamp mines will be closed to check yearly roadworthiness of explosion protection devices.

Periodicity determinations will be quarterly, unless additional risks posed situations in which rhythm control will be intensified.

2.4. Monitoring dumps and tailing ponds

One of the objectives of environmental remediation activities is to ensure long term stability of the embankment structures system. This objective can be accomplished taking into account the results of geotechnical investigations and stability calculations, and by implementing appropriate measures to stabilize.

Stability of tailing ponds and waste rock dumps depends on factors such as angle of friction, the degree of saturation, groundwater level, water pressure in pores, the cross section geometry, parameters of material strength (shear strength) and Foundation and the safety coefficient determined.

Impoundment monitoring strategy involves issues presented in the table 3.

In accordance with best practices available in mine waste management, several actions are applied to ensure long term stability of these structures relate to: monitoring procedures, operational plan, monitoring and maintenance of water balance, measurements subsidence movements, use and inclinometers' piezometer, seismic monitoring.

Operating plan, including monitoring and maintenance: organizational issues concerning the safety of tailings ponds; contingency plan in case of accidental pollution, classification in accordance with the consequences of dam failure, storage and more constructive processing tailings, environmental data, references to data monitoring authorizations and existing reports.

Basis of all monitoring activities is to develop a monitoring plan. It consists of a list of all measurements in certain time.

Monitoring plan typically includes the planning of inspections and audits/analysis, etc.

Monitoring plan typically includes the following: description of the objectives pursued by individual parameters monitoring, criteria for evaluating results, identifying individuals (Figure 2) planning analysis plan.

The following procedures are part of best available techniques in monitoring the stability of tailing ponds and waste rock dumps:

Table 3 monitoring strategy for the structures of tailing ponds or impoundments

Physical stability	
Access	*Visual* ▪ Inspection ditches/beams/fencing /warning signs
▪ Surface stability	*Visual* ▪ Wanted erosion and seepage areas
▪ Impoundment stability	*Visual* ▪ Wanted cracks on crest of wave slope at the foot of the slope projections and signs of undermining and seepage ▪ It erosion by seepage and piping system failures *Topographical and/or instrumental observations in critical cases* ▪ Sedimentation and deformation degree external degree of seepage, internal deformations ▪ Tools: determining the level of groundwater piezometric, inclinometer, topographic surveys, groom sedimentometric
▪ Dam Erosion	*Visual* ▪ *Searching areas of erosion, dejection cones, seepage* *Sampling* ▪ Samples of drainage water for determining the level of suspended solids
▪ Spillways	▪ Measurement of degree of discharge ▪ Flow measuring instruments
Chemical stability	
▪ Acid water generation and/or solubilise metals tailings ▪ sterile processing reagents presence	*Collecting and analyzing samples* ▪ Coating, tailings ▪ Water flow ▪ Seepage ▪ Water drainage ▪ Surface water/groundwater downstream
Vegetation	
▪ Stabilizing vegetation	▪ Section, density, coverage, diversity, photos, recovery

• In tailing ponds are monitored: the water quality and quantity of seepage through the dam body, hydrostatic level of groundwater, pore pressure, movements in the crown of the tailings dam and processing, data on seismic stability of the dam and the formation geological foundation, dynamic pore pressure and liquefaction of a tailings storage procedures for processing.

• In rock stockpiles will be monitored: the geometry of stairs and slopes, drainage water from the dump, pore pressure.

In addition, it will be performed: visual inspection of vegetation and erosion, annual review and/or geotechnical analysis, independent audits, safety assessments. [2, 10]

In the post closure monitoring frequency of certain activities could be reduced following a rigorous assessment of the situation and geotechnical analysis by independent expert's dam stability.

Meteorological data needed to assess the water balance of cover systems for waste rock dumps deposited on beaches and tailings will be produced daily or monthly from the nearest weather station. [2, 5]

Therefore, monitoring activities will include:

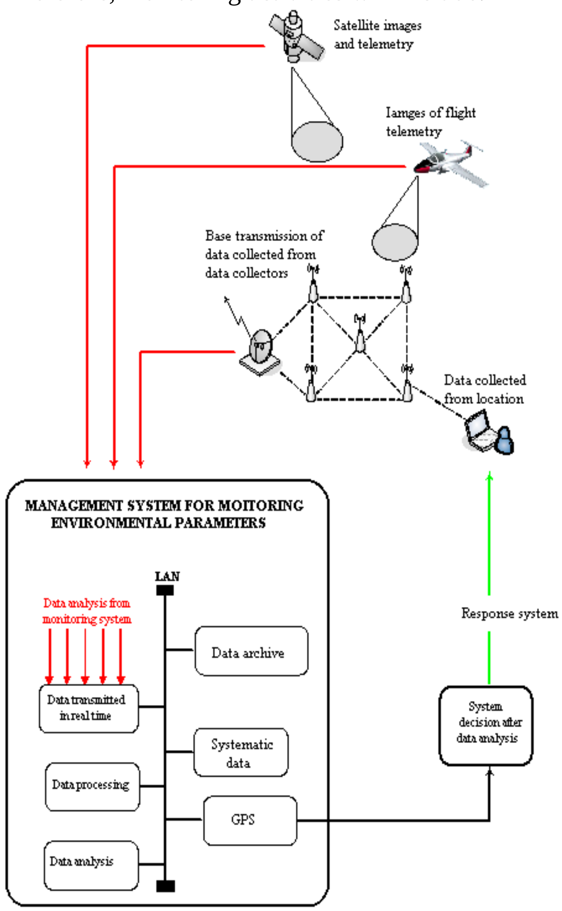

Figure 2 monitoring, data processing, evaluation and reporting of data

1. Regular visual inspection at least every six months, TMF system, including all important physical components, such as Pond dam, tailings plateau, lateral drainage system, areas immediately adjacent to the foot of the dam area. These inspections will include a regular photographic documentation every six months and after any particular weather event or earthquake.

2. Setting reference points on crest of wave slopes and dam, to carry out regular geodetic measurements, for example, once a month.

3. In some cases, installation of piezometric measurements to carry out regular (monthly or weekly) in hydrostatic levels and body mass of tailings dam. The objectives considered critical, for example, following floods and landslides, etc. In piezometric tubes can be installed and automatic recording devices. [5]

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4. Installing inclinometers (preferred solution) or blood pressure in areas where dam stability could be affected as a result of flooding or landslides. With this geotechnical instrumentation can monitor internal deformation of the dam, allowing for application of preventive measures. Intervals of making measurements in this case depend on the nature of the potential hazard.

The data obtained will be recorded, stored in electronic form and stored as a reference in a structured database.

Table 4 monitoring parameters stability tailing ponds and restoration work and time spent monitoring

Parameter	Closing Time	Post-closure period	Comments
Supernatant water from the tailings pond system (if present), strengthening the processing tailings and coating installation	Few years to remove water from the tailings pond, 2 to 10 years for building and installing the coating layer (or more depending on geotechnical properties of tailings processing). Pond water level will be monitored weekly, daily or continuously Evolution of the consolidation process will be monitoring annual measurement, see also Table 5	2 years for vegetation maintenance, 10 years to see successfully stabilized by topsoil, 5-20 years for monitoring the consolidation processes. Monitoring intervals can be longer than the closing phase, depending on the degree of modification of monitored parameters	We suggest using a „dry rehabilitation. Estimates depend on the geotechnical property processing tailings and their consolidation. If there is instability of soil covering (slopes) and vegetation may require corrective action.
Dam TMF	1-3 years for readjustment and recovery. Details of monitoring are found in Table 5	The time depends on the regulations on dam stability. Details of monitoring are found in Table 5 Monitoring intervals can be longer than the closing phase, depending on the degree of modification of monitored parameters	Vegetation will be monitored to ensure reducing erosion.

2.5. Monitoring ecosystems

In the mining perimeter Ghelari combination of ecosystem monitoring data will refer to the following:

a. Climate: daily minimum temperature, maximum daily temperature, temperature at a predetermined one hour of the day, e.g. 9:00 am, relative humidity, wind speed, wind direction, during periods of sunlight, rainfall, evaporation regime, nebulosity.

b. Terrestrial life environments, including: terrestrial flora (variety and abundance of species, chemical parameters) terrestrial fauna (variety and abundance of species, chemical parameters).

c. Life aquatic environments, including: physical and chemical characteristics of surface water and groundwater data on use of water, for example, quantities and flows captured and downloaded sediments from rivers and lakes (clogging /degradation, measurements made over sections of the water bodies as part of monitoring the clearance), aquatic flora, invertebrate fauna, environment.

Table 5 frequency monitoring and analysis of relevant parameters' terms of stability and settling ponds rock stockpiles in closing stages

Relevant parameter	Frequency measurement
Hydrostatic level of groundwater	Monthly or weekly
Pore pressure	Monthly or weekly
Movements in the canopy and processing tailings dam	Annual or quarterly
Seismic parameters	Whichever product
Dynamic pore pressure	Annual
Geometry stairs and slopes	Semester
Visual inspection	Semester
Analysis tailing ponds/dam	Annual
Independent audit	Every 5-10 years
The safety evaluation of existing dams	15-20 years
Geotechnical analysis (dumps)	Every 2 years

d. Noise: This parameter is generally significant only during closure activities. Noise assessment is carried out in relation to existing standards on protecting the public by day and night.

2.6. Monitoring soil quality

Monitoring soil quality will be achieved through investigation will be to highlight the potential accumulation of pollutants in soil, vertical migration of their buffering capacity and permeability. [2, 5]

Investigations will consist of sampling and analysis in specialized laboratories, aiming at following characteristics: chemical composition of soil (concentration of anions, cations, pH, metals, etc., organic compounds, microorganisms) soil moisture (excess or deficit) deep groundwater, the physical structure (porosity, mineral skeleton network, texture) of stored gas composition, soil erosion, soil humus content and its nature, thickness.

Soil quality assessment will be made on the basis of soil studies and land on direct observations.

2.7. Monitoring vegetation in the perimeters of closed mines

Monitoring vegetation in the mine closed perimeters will consider the following biological and physiological mass planted trees, the growth and development of plants and seedlings, annual biomass growth; dendrological usual measurements (height, diameter, density), resistance during strong winds, diseases and pests, berry production, intensity of photosynthesis (leaf color), evapotranspiration.

III. MONITORING BROWNFIELD'S SITES

Brownfield's sites aimed at monitoring the evolution of soil quality, stability green land, water quality and air chambers, after ecological reconstruction works. [69]

Assessing the effectiveness of measures designed to protect the environment, a system to track the quality of environmental factors.

System monitors include environmental factors:

✓ SOIL: monitoring soil quality by taking soil samples and laboratory analysis of their specialty, after completion of development of the land and playing their original state, the progress of vegetation on land areas furnished by sowing.

✓ AIR: Air quality will be followed by taking periodic samples of gaseous pollutants (particulate matter-aerosols), the perimeter of the premises.

✓ WATER: Monitoring the environmental factor concerns the periodic monitoring of mine water quality by sampling will be analyzed in a laboratory specialist to determine the chemical composition.

3.1. Brownfield's site monitoring works

Sampling

Soil sampling will be done quarterly and regular physical-chemical analysis (pH, humus, heavy metals) in their lab environment. [6]

Values obtained from measurements will be recorded in a register, thus making up the database needed to assess soil quality in perimeter development site analysis, after completion of ecological restoration.

Sampling of air – sampling of particulate matter will be made monthly in the first year of fixed perimeter established sites (1 sample/site) while aiming at a series of meteorological data.

Results obtained from tests carried out in specialized laboratory and other observations made during sampling air will be recorded in a register, representing thus the database needed to assess the air quality of the perimeters green development.

Water sampling will be done in mine water monthly during the first year after greening, and then quarterly over the next three years will analyze the contents of particulates, fixed residue, sulphates, COD-Cr, heavy metals, calcium, magnesium, sodium, potassium, alkalinity, conductivity and pH.

Results obtained from tests and other observations made during sampling water will be recorded in a register, representing thus base

IV. GHELARI INDUSTRIAL SITE DESCRIPTION

Exploitation area is located in East Ghelari in Ghelari village, town located approx. 20 km W-SW from the city of

Hunedoara. Ghelari Mining, Mining is part of the Poiana Rusca Teliuc Branch of the MINVEST Deva. Ghelari The Central Mine was operated one of the largest iron ore deposit in Romania.

The production of the mine Ghelari consisted of: underground mining and transport of iron ore to the processing plant, operation of iron ore mining was Ghelari lower central field, preparation of iron ore processing plant Teliuc.

Ghelari mining sector has been operating in the following areas of the mining perimeter: area perimeter center, located in the town Ghelari, the Front II Govâjdiei Valley, the front and located in Teliuc, Teliuc processing plant, located in the village Teliucu Lower, 3km from Hunedoara.

V. DESCRIPTION OF THE ACTIVITY OF ORES

The specific activity quarry Ghelari Central Mine consisted sideritic iron ore extraction underground mining by various methods, each method based on project type, approved by the competent fora. (Figure 3.) Central Ghelari mining field, surface area of between Lucas and quarry horizons of Shaft No. opened first. 1 (horizons I - IV) and then open (horizons VI - VIII), is now completely closed, reserves were exhausted, with the exception of pillars of the pit, mining machine house, hall compressors and written off to reserves (sideritice poorly mineralized limestone).

Figure 3. Ghelari Quarry old iron ore

VI. ORE PREPARATION WORK

Teliuc processing plant is located on the left bank of the river Cerna, that the road linking the city of Hunedoara Teliuc village at a distance of about 3 km de Hunedoara. [11]

During preparation plant operation Teliuc tailings resulting from the process was stored in three ponds:

- tailing dam no 1, put into service with the commissioning of the plant in 1965, located on the opposite slope plant location,


Figure 4. Tailing dam nr. 1

- tailing dam no 2 şi 3, located at a distance of about 5 km from the processing plant Valea Podului.

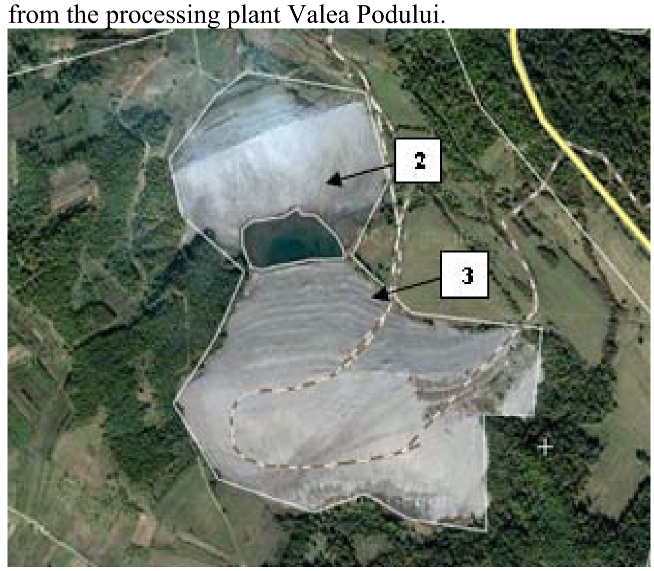

Figure 5. Tailing dams nr. 2 şi 3 on Valea Podului

Currently no longer operating the processing plant and the tailings pond is malfunction. [11]

VII. PROPOSALS TO CREATE A REGIONAL MONITORING NETWORK

Romanian monitoring system comprises two activities, namely:

- operational, data collection, warning of accidental pollution and measures of protection
- to characterize the long-term environmental quality, assessment of development trends and protection measures appropriate. [7]

In terms of the organization of the integrated monitoring system, starting from the nature and type of parameters should be monitored by this system, there are the following specific elements:

1. surveillance networks for immission
2. pollution emission control,
3. evaluation and control of the overall effectiveness of environmental protection measures.

The Company shall prepare the quarterly and annual report for each branch, where relevant the results of inspections and measurements performed by a trained staff.

The report covers four areas:

- management and consumption,
- the environmental situation and emissions,
- occupational health and job security,
- displaced households.

a. Monitoring the impact of mining on the ground is achieved through the annual exploitation.

b. Monitoring the impact of mining on air measurements are made at each mining unit, the pollutants produced each time emphasizing the degree to overcome the maximum allowable concentrations.

c. Monitoring the impact of mining on water is carried in the same manner as recorded air monthly quantities of pollutants discharged into

d. Monitoring the impact of mining on human settlements is, in particular Ghelari mine area, the processing plant and tailing ponds Teliuc no. 1, 2 and 3.

The purpose of knowledge of the environment and natural resources, in order to substantiate appropriate decisions for sustainable development of society, necessary pollution control systems. For the area affected by mining activity Ghelari, recommended a comprehensive system for obtaining quality data environment, based on long-term measurements at a set of parameters and indicators, designed to provide the possibility to control pollution.

Designing an improved information system for management, the promotion of automatic data processing unit at the economic, operational, branch and company, has the following objectives:

1. improving existing information system to increase its workability,
2. determining what tasks need to address the current computer system design,
3. defining the requirements to extend process automation and the use of computers
4. by knowing the environmental parameters and status of the production process at any time. Location, ongoing work, supported by high-volume mining Ghelari held within the perimeter, and thus requires knowledge of the factors and continuous monitoring of environmental parameters and especially their variation under influence of the production. In these circumstances it is necessary to take all measures for the protection of soil, air, water and ecosystem protection.

Depending on the individual sources of pollution and areas affected by environmental factors, has proposed the creation of laboratories for environmental, meteorological stations and fixed stations Sampling. In order to determine the distribution of pollutants and estimate their negative influence in the area of production and surrounding areas, as well as for designing measures to limit the production and dissemination, using a computer diagrams plot the spread of contaminants. To reach izonoxe drawing diagrams are required:

1. Equipment: computers with large memory capacity (PC Pentium 260), automatic drawing facility type plotter. [2]
2. Mathematical models and programs (SURPAC 2000 MONITOR, SWIFT/486, GIS).
3. Physico-chemical data such as: physical-chemical features of the harm (density and temperature of the contaminant at its release, pressure, flow, etc.. The point of industrial facility that emits pollutants into the atmosphere), details of the release of pollutants, atmospheric conditions area (wind speed and direction, atmospheric stability, temperature, etc.) maximum limits for each of the hazards considered.

Based on these data, known by calculation and design is simulated automatically, depending on the size change of variables: wind speed and direction, atmospheric stability, temperature, etc. Based on these findings that a management information system must have the following characteristics: to allow the collection, transmission and processing of data in real time so that it can be decided in due time, the data are not affected by errors, to allow proper distribution of tasks and monitoring their achievement, to be adaptable.

To obtain quality information, each dispatcher mining personnel must be prepared for this purpose and to be equipped with appropriate equipment:

- synoptic panels on which to display visually and recorded environmental parameters and operating factors of main equipment of the process streams
- automatically calculate and display the output achieved from the beginning of exchange on each machine individually and cumulatively on the mining;
- show deviations production program - environmental parameters change during the exchange
- other technical and economic data.

In the Poiana Rusca Teliuc Mining Subsidiary, will dispatch appropriate personnel equipped with the necessary equipment and collection centralization of data mining and branch level.

Because environmental monitoring is a complex organizational structure should be adapted to the mining and branch level, as shown:

Level mining:

- creation of two compartments:

1. procurement compartment houses, lands, environmental restoration and documentation,
2. a department of land and land assets.

There will also work:

- rehabilitation of the land form teachers and reconstruction of demolished households
- each responsible mining cadastre
- land demarcation staff
- environmental control station operators;

The proposed organizational structure to obtain the data necessary for making appropriate decisions to reduce the impact of mining activity.

7.1. Ghelari mining area monitoring

Forecast evolution of pollution is based on basic data, ie all the results of measurements made on land and will provide a basis for studies (including impact), research, projects, etc. operation. It is imperative that these data should be submitted in data banks.

In carrying out an effective monitoring program must consider the three approaches: *visual observation, exploration and/or sampling and investigation*.

Instrument checks are qualitative observations of conditions are obvious and consist of simple quantitative metrics such as reading a ruler or a measuring cylinder standard.

Prospecting and sampling involves measuring a sufficient number of points to establish a zonal distribution of the parameters taken in the study.

Investigation includes equipment installed for regular observations or other instruments for continuous or periodic data collection.

Monitoring points are located in sensitive environmental areas, or near, areas affected by the rehabilitation program. These individual points may have one or several types of facilities. Complex projects or activities in sensitive areas will require more monitoring points.

A long-term monitoring program implemented during the development of the perimeter and continued until closing, will decrease the frequency of the samples after the termination (close) activity, while in case of dismantling this frequency should increase. Whenever there is significant change in environmental conditions will bring an additional monitoring.

Ghelari area, which is the subject of this study will be to establish a system for monitoring the impact that environmental pollution can be established. The three environmental factors studied are water, air and soil, but may also include flora and fauna.

Figure 4 presents Ghelari area where monitoring is highlighted by the observation locations of sensitive sites. Monitoring points are located both upstream, downstream and particularly in every mining area in the study.

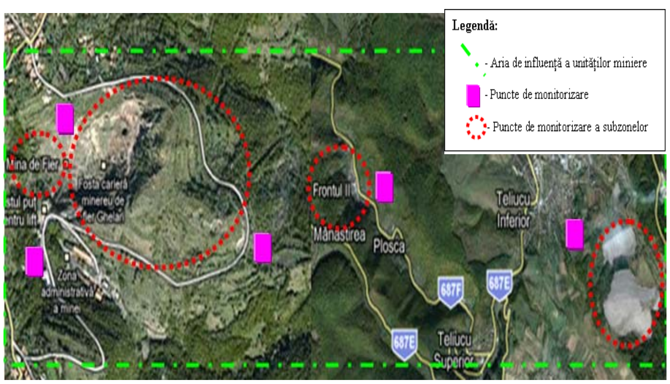

Figure 6. Ghelari mining area monitoring

The upstream provides basic data about the quality and quantity of water reaching the area, while those downstream are located where it is necessary to ensure proper water quality.

VIII. CONCLUSIONS

Industrial site decommissioning plan should include technical solutions that meet the following requirements:

a) covering the years 1000 to working with a high probability;

b) functional coverage is certainly at least 300 years.

Creating a system for acquisition and processing of data collected during monitoring at national level and their inclusion in systems for tracking the parameters of existing national environmental. Leads to oversight in the environmental factors of Brownfield's sites.

Prediction methods can assess the consequences for the environment by Brownfield's sites, and establish measures to mitigate their effects.

- Ghelari mining area environmental monitoring should be based on a set of environmental quality data, data arising from long-term and continuous measurements of its parameters and indicators
- by creating a regional monitoring network will be able to monitor and control the impact of mining activity in the Ghelari mining and intervene to stop the pollution;
- information system is needed to achieve the following: computational techniques, databases, methods, techniques, procedures and data processing programs and not least specialists
- to obtain information on the environmental quality of the area is Ghelari will arrange an environmental laboratory and a meteorological station with appropriate equipment.
- field will be located fixed stations monitoring the environmental factors, and personnel performing sampling and field measurements will be equipped with mobile stations.

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