

## Effectiveness of Environmental Management and Monitoring Efforts in Reducing Pollution Impacts

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### ARTICLE HISTORY

Received : 2026-01-23  
Revised : 2026-02-04  
Accepted : 2026-04-27

#### Keywords:

effectiveness, Environmental Impact Assessment (EIA), environmental pollution, C-mining



### ABSTRACT

This study aims to analyze the effectiveness of the implementation of Environmental Management Efforts (UKL) and Environmental Monitoring Efforts (UPL) in reducing the impact of environmental pollution on C-type mining businesses (gravel and gravel). The study used a qualitative approach with data collection methods through in-depth interviews, field observations, and UKL-UPL document reviews. The research informants numbered ten people consisting of one key informant from the Kuantan Singingi Regency Environmental Service, one key informant from the Riau Province Environmental and Forestry Service, and eight additional informants from village governments and communities around the mining operational area. The results of the study indicate that the implementation of UKL and UPL has been carried out administratively in accordance with the approved documents, but its effectiveness in reducing the impact of environmental pollution is still not optimal. Various gaps were found between the normative provisions of UKL-UPL and the actual conditions in the field, particularly in aspects of waste housekeeping, dust and noise control, wastewater management, road infrastructure restoration, and the implementation of occupational safety and health. The main inhibiting factors include weak internal company supervision, limited commitment to technical implementation, and minimal transparency of information to the public. Meanwhile, supporting factors include the existence of clear regulations and the role of government oversight. Efforts to improve the effectiveness of UKL-UPL can be achieved through strengthened oversight, increased business capacity, consistent implementation of environmental management and monitoring, and increased involvement and transparency of information with affected communities.

## 1. INTRODUCTION

The mining sector plays a strategic role in supporting Indonesia's economic development, particularly through its contribution to regional income, infrastructure development, and employment creation. In many regions, especially at the local level, C-category mining activities such as sand, gravel, and stone extraction are considered essential drivers of economic growth and sources of Regional Original Revenue (PAD). These activities not only stimulate economic circulation within local communities but also contribute to the development of supporting infrastructure and the enhancement of local workforce capacity. According to Bridge (2004), extractive industries such as mining are often positioned as engines of regional development, particularly in resource-rich areas. However, the sustainability of these benefits depends largely on how environmental impacts are managed and mitigated.

Despite its economic significance, C-category mining is frequently associated with substantial environmental degradation. Mining activities often result in land degradation, deforestation, disruption of soil structure, and increased erosion, which can lead to sedimentation in water bodies. In addition, mining operations contribute to water pollution through the discharge of untreated wastewater and to air pollution due to dust emissions generated by excavation processes and transportation activities. Hilson (2002) emphasizes that small- and medium-scale mining operations are among the most significant contributors to localized environmental degradation, particularly in developing countries. These environmental impacts not only threaten ecosystem balance but also have direct implications for public health and environmental sustainability. Studies by Moran

(2004) further highlight that mining-related pollution can have long-term and sometimes irreversible consequences for water quality and ecosystem health.

Beyond environmental concerns, mining activities also create complex social challenges. The expansion of mining operations often leads to land use conflicts, displacement of local communities, and disruption of traditional livelihoods that depend on natural resources. Communities that previously relied on agriculture, fisheries, or forest resources may lose access to these resources due to environmental degradation and land conversion. Bebbington (2008) argues that extractive industries frequently reshape local socio-economic structures, often creating unequal distributions of benefits and burdens. As a result, mining activities can exacerbate social inequality, reduce economic resilience among local populations, and weaken social cohesion. These conditions underline the importance of integrating social considerations into environmental management policies.

To address the potential environmental impacts of business activities, including mining, the Indonesian government has established regulatory instruments such as Environmental Management Efforts (UKL) and Environmental Monitoring Efforts (UPL). These instruments are designed for business activities that do not require a full Environmental Impact Assessment (AMDAL) but still have the potential to affect the environment. The UKL-UPL framework is regulated under Law Number 32 of 2009 concerning Environmental Protection and Management and further elaborated in Government Regulation Number 22 of 2021. In principle, these instruments serve not only as administrative requirements but also as practical tools to ensure that business activities are conducted in an environmentally responsible manner. According to Glasson et al. (2012), environmental management instruments are effective only when they are implemented as continuous processes rather than as one-time compliance documents.

However, the effectiveness of UKL-UPL implementation in practice remains a significant concern. Although many companies have fulfilled administrative requirements by preparing UKL-UPL documents and submitting periodic reports, the actual implementation in the field often does not fully align with the planned environmental management measures. Several studies indicate that environmental management practices tend to be procedural and compliance-oriented rather than outcome-oriented. Cashmore (2004) explains that environmental assessment tools often fail to achieve their intended objectives due to weak integration between planning and implementation stages. This condition is characterized by a gap between documented plans and actual practices, where environmental management efforts are carried out only to meet regulatory obligations without achieving substantial improvements in environmental quality.

Weak supervision, limited institutional capacity, insufficient technical expertise, and lack of commitment from business actors are among the key factors contributing to this issue. In addition, community participation in environmental monitoring and decision-making processes remains limited, reducing transparency and accountability in environmental management. According to Reed (2008), effective environmental governance requires active stakeholder participation to ensure accountability and sustainability. Without community involvement, environmental policies often lack legitimacy and fail to address local concerns effectively.

The gap between normative provisions and field implementation raises critical questions regarding the effectiveness of UKL-UPL as an environmental management instrument. While the regulatory framework provides a comprehensive guideline for managing environmental impacts, its practical application often fails to deliver the expected outcomes in terms of pollution reduction and environmental protection. In many cases, environmental monitoring is conducted regularly, but the results are not effectively utilized to improve management practices. This indicates that UKL-UPL has not yet functioned optimally as an integrated system that connects planning, monitoring, evaluation, and continuous improvement.

Although previous research has examined the implementation of UKL-UPL in various sectors, most studies tend to focus on specific aspects such as regulatory compliance or document preparation. There is still limited research that comprehensively analyzes the effectiveness of UKL-UPL from a systemic perspective, particularly by integrating implementation quality, monitoring systems, supervision mechanisms, and environmental performance outcomes. This indicates a clear research gap, especially in understanding how UKL-UPL functions as a holistic system in reducing environmental pollution in specific local contexts, such as C-category mining areas.

Based on this gap, this study offers a novel contribution by examining the effectiveness of UKL and UPL implementation through an integrated analytical framework. The study not only evaluates the administrative and

technical implementation of environmental management but also analyzes the role of supervision as a mediating factor in determining environmental outcomes. This perspective provides a more comprehensive understanding of the factors that influence the success of environmental management policies.

Therefore, this study aims to analyze the effectiveness of UKL and UPL implementation in reducing environmental pollution impacts, identify the supporting and inhibiting factors in their implementation, and formulate strategies to improve environmental governance in mining activities.

## **2. LITERATURE REVIEW**

Environmental management has become a central issue in the study of sustainable development, particularly in sectors with high ecological risks such as mining. In principle, environmental management refers to a systematic effort to control, prevent, and mitigate environmental impacts arising from human activities. According to Barrow (2006), environmental management is not only concerned with technical control of pollution but also involves policy, institutional capacity, and stakeholder interaction in ensuring sustainable outcomes. This perspective emphasizes that environmental problems cannot be addressed solely through regulatory frameworks but require integrated approaches that combine technical, social, and governance dimensions.

Within the context of environmental governance, Environmental Impact Assessment (EIA) and its simplified forms, such as Environmental Management Efforts (UKL) and Environmental Monitoring Efforts (UPL), are widely recognized as key instruments for managing environmental risks. Glasson et al. (2012) define environmental assessment instruments as structured processes that aim to predict, evaluate, and mitigate the environmental consequences of development activities. In Indonesia, UKL-UPL serves as an alternative to full-scale environmental impact assessment for activities with moderate environmental risks. These instruments are designed to ensure that business operations incorporate environmental considerations into their planning and implementation processes.

However, the effectiveness of environmental management instruments such as UKL-UPL largely depends on how they are implemented in practice. While regulatory frameworks often provide comprehensive guidelines, their success is influenced by institutional capacity, enforcement mechanisms, and stakeholder commitment. Cashmore (2004) argues that environmental assessment tools frequently face a “performance gap,” where the intended objectives of environmental protection are not fully achieved due to weak implementation and limited integration into decision-making processes. This gap highlights the importance of evaluating not only the existence of environmental policies but also their practical effectiveness.

In the mining sector, environmental management is particularly challenging due to the nature of extractive activities, which inherently involve significant alteration of natural landscapes. Mining operations can cause land degradation, water contamination, and air pollution, with long-term impacts on ecosystems and human health. Hilson (2002) emphasizes that mining activities, especially at small and medium scales, often lack adequate environmental management practices, leading to cumulative environmental damage. This condition is further complicated by the fact that mining activities are often located in rural or remote areas where monitoring and enforcement are limited.

Environmental monitoring is a crucial component of environmental management systems, as it provides data for evaluating the effectiveness of management efforts. According to Moran (2004), monitoring should not be viewed as a routine administrative task but as a continuous process that informs adaptive management. Effective monitoring requires not only accurate data collection but also the capacity to interpret data and implement corrective actions. However, in many cases, monitoring activities are conducted merely to fulfill reporting requirements, without being used as a basis for improving environmental performance.

Another important factor influencing the effectiveness of environmental management is supervision or enforcement. Supervision ensures that environmental regulations are complied with and that violations are addressed appropriately. Gunningham (2009) highlights that effective environmental regulation requires a combination of enforcement strategies, including command-and-control approaches, economic incentives, and voluntary compliance mechanisms. Without strong supervision, environmental management instruments such as UKL-UPL risk becoming symbolic tools that do not produce tangible environmental improvements.

In addition to institutional factors, stakeholder participation plays a critical role in environmental management. Community involvement can enhance transparency, accountability, and local relevance of

environmental policies. Reed (2008) argues that participatory approaches in environmental decision-making lead to more effective and sustainable outcomes, as they incorporate local knowledge and address community concerns. In the context of mining, community participation is particularly important because local populations are often directly affected by environmental impacts.

Despite the theoretical importance of participation, its implementation in environmental management practices is often limited. In many cases, communities are not adequately involved in the planning and monitoring processes of environmental management, resulting in a lack of trust and reduced effectiveness of environmental policies. This issue is particularly relevant in the implementation of UKL-UPL, where community involvement is often minimal and limited to formal consultation processes.

Previous studies on UKL-UPL implementation in Indonesia have identified several challenges, including weak institutional coordination, limited technical capacity, insufficient budget allocation, and low compliance among business actors. However, most of these studies tend to examine these issues in isolation, without integrating them into a comprehensive framework. There is still limited research that systematically analyzes the interaction between implementation quality, monitoring systems, supervision mechanisms, and environmental outcomes.

Furthermore, existing studies often focus on general environmental management practices without paying specific attention to sectoral characteristics, such as those found in C-category mining. Each sector has unique environmental risks and management requirements, which should be considered in evaluating the effectiveness of environmental management instruments. The lack of sector-specific analysis represents a significant gap in the literature.

### **3. METHOD**

This research uses a descriptive qualitative approach because the data collected is non-numerical and aims to deeply understand the effectiveness of the UKL-UPL implementation within a social and environmental context. The research was conducted in natural conditions with the researcher as the key instrument, employing purposive sampling, method triangulation, and inductive data analysis that emphasizes the meaning of phenomena rather than generalization (Sugiyono 2019). The research locations include PT Gunung Alam Perkasa, Kuantan Singingi Regency, as well as the Riau Province and Kuantan Singingi Regency Environmental Services, which were selected based on the potential environmental impact of sirtu mining activities. Data collection was done thru interviews (Riduwan 2012), documentation (Arikunto 2013), non-participant observation, and environmental quality measurement. Data analysis was conducted using the interactive model of Miles and Huberman thru the stages of reduction, presentation, and drawing conclusions iteratively (Sugiyono 2018; Haryoko et al. 2020).

### **4. RESULT AND DISCUSSION**

#### **Effectiveness of Implementing UKL and UPL in Reducing the Impact of Environmental Pollution Around the Operational Area**

##### **a. Quality of Environmental Impact Assessment Implementation**

Analysis of the effectiveness of the UKL and UPL implementation shows that these instruments have been implemented not only as an administrative requirement but also as a technical effort for environmental management. Based on interviews with supervisors and stakeholders, control measures at the source of the impact have been implemented according to the UKL document and can be physically observed in the field (Gunawan Nurdianto, 2025). However, consistent implementation remains a constraint, especially when production activities increase, as emphasized by the provincial environmental impact controller (Syahrul, 2025). Public perception indicates an improvement in environmental conditions, although impacts such as dust still occur under certain circumstances (Hendra, 2025; Rahman, 2025). This finding aligns with T. F. P. Sari et al. (2016), who emphasized weak consistency as the main factor contributing to the low effectiveness of the Environmental Impact Assessment (EIA).

The existence and functionality of the wastewater treatment plant (WWTP) are considered quite effective in controlling water pollution, as evidenced by the fulfillment of most environmental quality standard parameters (Gunawan Nurdianto, 2025; Syahrul, 2025). The community also experienced an improvement in water quality, which was clearer and had fewer complaints compared to before (Mariam, 2025; Sulaiman, 2025). However,

under certain conditions such as high rainfall and increased production loads, the performance of the wastewater treatment plant approaches the threshold, indicating limitations in capacity and operational consistency. Meanwhile, waste housekeeping practices have been implemented, but they are not yet fully consistent, as evidenced by the continued presence of hazardous waste and operational waste in the mining area (Gunawan Nurdianto, 2025). This condition aligns with Margareta Hunter et al. (2017) and Kambuaya et al. (2020), who emphasize the importance of consistency and periodic evaluation.

The existence of the green belt has, in principle, met the requirements of the Environmental Impact Assessment (EIA), but its effectiveness is still limited due to inadequate area and maintenance. The community and village officials believe that the presence of buffer vegetation has not yet significantly reduced dust and environmental disturbances, and hope for expansion, especially around residential areas (Sulaiman, 2025; Hendra, 2025; Nuraini, 2025). This finding is consistent with Parnika et al. (2024), who stated that suboptimal buffer zones will reduce the effectiveness of impact control. Overall, the implementation of UKL and UPL is in the fairly effective category, but there is still a gap between normative regulations and field practice. Increased effectiveness requires strengthening corporate commitment, oversight, and consistency in implementation (T. F. P. Sari et al., 2016; Kambuaya et al., 2020).

#### **b. Quality of Environmental Impact Assessment Implementation**

Environmental Monitoring Efforts (UPL) are an important instrument in the UKL-UPL system, aiming to ensure that business activities proceed according to the environmental impact management plan. Normatively, the EIA requires parameter suitability, standardized testing methods, and the use of accredited laboratories to ensure the validity and reliability of the data produced. The interview results indicate that companies have generally met these requirements administratively and technically, as stated by environmental supervisors and environmental impact controllers (Gunawan Nurdianto, 2025; Syahrul, 2025). However, this fulfillment still tends to be procedural, as data consistency and in-depth analysis of monitoring results are not yet optimal. This condition indicates a gap between the normative goals of UPL as an evaluative tool and field practices that are more focused on formal compliance.

Adherence to the monitoring schedule is another indicator in assessing the quality of the UKL-UPL implementation. Overall, companies are considered to have carried out monitoring and reporting according to the schedule set in the UKL-UPL document, as stated by district and provincial supervisors (Gunawan Nurdianto, 2025; Syahrul, 2025). However, this compliance still emphasizes the timeliness of reporting rather than the continuity of evaluating and following up on monitoring results. The community and village government stated limitations in information regarding the monitoring schedule and results, so the benefits of monitoring have not been directly felt (Rahman, 2025; Sulaiman, 2025). This finding aligns with Aliff (2023) and T. F. P. Sari et al. (2016), who emphasize that schedule adherence is often administrative and not substantive.

The completeness and quality of monitoring data are crucial aspects of the effectiveness of the Environmental Impact Assessment (EIA). Company monitoring reports essentially contain data from environmental parameter measurements, but the analysis is still predominantly descriptive and administrative (Gunawan Nurdianto, 2025; Syahrul, 2025). Inconsistent data format and depth across periods make it difficult to continuously evaluate pollution trends. Additionally, the limited access of the community and village government to monitoring data indicates low information transparency (Sulaiman, 2025; Hendra, 2025; Mariam, 2025). This condition confirms that data completeness has not been accompanied by substantive utilization as a basis for environmental management decision-making, as also emphasized by T. F. P. Sari et al. (2016) and Kambuaya et al. (2020).

#### **c. Monitoring & Reporting**

Monitoring and reporting are strategic stages in the environmental management cycle, serving as a mediator between planning and the results of environmental impact control. In the context of Environmental Impact Assessments (UKL) and Environmental Management Plans (UPL), monitoring and reporting are not only understood as administrative obligations, but also as a mechanism for continuous evaluation of the effectiveness of environmental management. Normatively, business actors are required to submit reports on time, attach supporting documents, follow up on monitoring results, and update environmental permits if there are changes in business activities. The interview results indicate that the UKL-UPL reports have generally been submitted on time and according to schedule (Gunawan Nurdianto, 2025; Syahrul, 2025). However, this timeliness still reflects administrative compliance rather than a substantial evaluative function, as also stated by Aliff (2023).

The completeness of the report attachments is an important indicator in ensuring the technical and scientific accountability of the UKL and UPL reports. In general, the company's reports have been completed with laboratory test results and other supporting documents in accordance with regulations (Gunawan Nurdianto, 2025; Syahrul, 2025). Nevertheless, this completeness has not been fully accompanied by in-depth and integrated analysis. The report appendices still serve as formal proof of compliance, without adequate data processing to

support environmental management evaluation and recommendations. This condition aligns with the findings of T. F. P. Sari et al. (2016), who stated that UKL-UPL reports are generally complete in format but weak in substantive analysis. As a result, the role of reporting as an instrument for controlling environmental impact has not been optimal.

The effectiveness of monitoring and reporting is also highly determined by the follow-up on monitoring findings and the updating of environmental permits when business changes occur. The interview results indicate that follow-up on monitoring findings is still weak and often normative without measurable action plans (Gunawan Nurdianto, 2025; Syahrul, 2025). The public rarely knows whether environmental findings are actually followed up on (Rahman, 2025). Additionally, environmental permit updates have not always been carried out immediately when there are changes in activities, potentially leading to inconsistencies between documents and operational practices (Gunawan Nurdianto, 2025). This finding aligns with Kambuaya et al. (2020) and ASy-Syifaa and Hasibuan (2023), who emphasize that weak follow-up and permit renewal significantly diminish the effectiveness of UKL-UPL.

#### **d. Effectiveness of Supervision (Mediator)**

Environmental monitoring is a strategic element that determines the effectiveness of implementing UKL and UPL as pollution control instruments. Supervision serves to ensure that the provisions of the UKL-UPL are not only met administratively, but are actually and consistently implemented in the field. In this study, supervision is positioned as a mediating variable that connects environmental planning and monitoring with the outcome of reduced pollution impact. The effectiveness of supervision was analyzed thru the number and intensity of inspections, findings of violations and sanctions, the speed of follow-up, and cross-agency coordination. The interview results indicate that inspections have been conducted routinely and incidentally according to the supervisors' capabilities (Gunawan Nurdianto, 2025; Syahrul, 2025), but their frequency is still limited due to resource constraints, as also found by Kambuaya et al. (2020).

Monitoring findings indicate that the function of detecting UKL-UPL violations has been operational, particularly in terms of administrative and technical implementation on the ground (Gunawan Nurdianto, 2025). However, the enforcement of sanctions against these findings is still relatively weak and dominated by a mentoring and warning approach, so the coercive power of supervision is not yet optimal (Syahrul, 2025). The public believes that weak sanctions reduce the deterrent effect and do not have a real impact on environmental improvement (Rahman, 2025). Additionally, the speed of follow-up on monitoring findings is considered inconsistent due to procedural and bureaucratic constraints, which often delays the handling of environmental issues (Gunawan Nurdianto, 2025; Hendra, 2025). This condition is in line with the findings of T. F. P. Sari et al. (2016) and Aliff (2023).

Cross-agency coordination in the supervision of UKL and UPL has been carried out, especially between district DLH and provincial DLHK, but it has not been systematic and sustainable (Gunawan Nurdianto, 2025; Syahrul, 2025). The involvement of village governments and communities in supervision is still limited, so supervision tends to be sectoral and less participatory (Sulaiman, 2025). Overall, the effectiveness of supervision can be assessed as functioning adequately normatively, but not yet optimally substantively. Limitations in inspection intensity, weak enforcement of sanctions, slow follow-up, and insufficient cross-agency coordination have resulted in the supervisory role as a mediator for UKL and UPL not being fully effective in mitigating the impact of environmental pollution, as also emphasized by ASy-Syifaa and Hasibuan (2023).

#### **e. Human Resources & Budget Capacity**

Human resource (HR) capacity and budget support are fundamental factors that act as moderating variables in determining the effectiveness of UKL and UPL implementation. Normatively, successful environmental management and monitoring require an adequate number of personnel, appropriate technical competence, continuous training, and proportional budget support. The interview results indicate that the number of environmental officers is still limited and not proportionate to the area and the number of business activities being monitored (Gunawan Nurdianto, 2025). This limitation is also recognized at the provincial level as a structural constraint in improving the quality of environmental supervision (Syahrul, 2025). This condition indicates a gap between ideal needs and actual human resource capacity in the field, as also emphasized by Kambuaya et al. (2020).

From a competency and capacity development perspective, environmental human resource training has been conducted, but the intensity and hours of training are still limited. Training tends to be infrequent and highly dependent on budget availability, so it is only attended by a portion of the officers (Gunawan Nurdianto, 2025; Syahrul, 2025). This condition impacts disparities in technical competencies, particularly in the analysis and interpretation of environmental monitoring data. Compared to the ideal provision that requires continuous capacity building, this condition indicates that training has not yet become an optimal strategic instrument. These findings are consistent with T. F. P. Sari et al. (2016), who stated that low training intensity contributes to poor quality of

environmental monitoring and reporting implementation.

Budgetary and supporting facility limitations further strengthen the role of human resources and budget as limiting factors for the effectiveness of UKL and UPL. Limited environmental budgets restrict the frequency of field supervision and monitoring and must compete with other programs in budget planning (Gunawan Nurdianto, 2025; Syahrul, 2025). Additionally, the limited availability of spare parts and laboratory reagents hinders the sustainable operation of environmental monitoring (Gunawan Nurdianto, 2025). This condition aligns with the findings of Aliff (2023) and ASy-Syifaa and Hasibuan (2023), which confirm that budget and technical facility limitations significantly weaken the effectiveness of the Environmental Impact Assessment (EIA), even tho it has been normatively fulfilled.

**f. Environmental Performance – Wastewater (Output)**

Environmental performance in terms of wastewater management is the most tangible output indicator for assessing the effectiveness of UKL and UPL implementation, as it directly reflects the environmental management's ability to reduce pollution. Normatively, wastewater quality must meet the standards set thru the main parameters of BOD, COD, TSS, and oil and grease. The interview results indicate that the wastewater performance at the research site still faces various non-conformities with these quality standards. The analysis was conducted by comparing regulatory provisions with the actual conditions in the field based on information from environmental supervisors, environmental impact controllers, and local communities. Thus, wastewater performance achievements serve as an objective basis for assessing the effectiveness of the UKL and UPL in reducing environmental pollution impacts.

For the BOD and COD parameters, the monitoring results show that the effluent quality standards were exceeded in several periods. Environmental supervisors stated that BOD and COD values still exceed the threshold, especially when wastewater discharge increases (Gunawan Nurdianto, 2025; Syahrul, 2025). This condition indicates that the wastewater treatment system has not yet been able to optimally reduce the organic and total pollutant load. The community also experiences the impact of declining water body quality thru odor, color changes, and reduced water availability for daily needs (Rahman, 2025; Mariam, 2025). This finding aligns with the research by T. F. P. Sari et al. (2016) and Kambuaya et al. (2020), which confirms that exceeding BOD and COD levels is an indicator of poor wastewater management performance in the implementation of UKL-UPL.

Inconsistencies were also observed in the TSS and oil and grease parameters. TSS values were reported to still exceed quality standards, especially during high rainfall and increased production activity, indicating limitations in the WWTP's performance in controlling suspended solids (Gunawan Nurdianto, 2025; Syahrul, 2025). The community observed the turbidity of the river water and the appearance of an oily layer on the water's surface as a direct impact of waste disposal (Hendra, 2025; Rahman, 2025). This condition is consistent with the findings of Aliff (2023) and ASy-Syifaa and Hasibuan (2023), who stated that TSS and oil and grease are difficult parameters to control. Overall, the wastewater performance indicates that the UKL and UPL have not been effective in substantially reducing pollution.

**Table 5. Comparison of Wastewater Quality Standards and Findings at the PT. Gunung Alam Perkasa Mining Site**

Parameter	Wastewater Quality Standards (mg/L)	Field Findings (mg/L)	Compliance with Standards	Environmental Implications
<b>BOD</b> (Biochemical Oxygen Demand)	≤ 30	45 – 65	Non-compliant / Exceeds standard	Reduces dissolved oxygen levels, potentially causing the death of aquatic biota and generating unpleasant odors.
<b>COD</b> (Chemical Oxygen Demand)	≤ 100	150 – 220	Non-compliant / Exceeds standard	Indicates a high load of organic and inorganic pollutants that are not optimally treated.
<b>TSS</b> (Total Suspended Solids)	≤ 30	60 – 120	Non-compliant / Exceeds standard	Increases water turbidity, disrupts photosynthesis, and causes sedimentation in water bodies.
<b>Oil and Grease</b>	≤ 10	15 – 25	Non-compliant / Exceeds standard	Forms a layer on the water surface, inhibits oxygen diffusion, and damages the aquatic ecosystem.

**g. Environmental Performance – Air/Particulate Matter (Output)**

Environmental performance in terms of ambient air quality, specifically for TSP, PM10, and PM2.5 parameters, is a crucial output in the implementation of UKL and UPL because it directly impacts public health. Normatively, air quality monitoring aims to ensure that particulate concentrations remain below quality standards. However, the interview results indicate an increase in dust during periods of high activity (Gunawan Nurdianto, 2025), which is supported by the statement that "dust is still the main complaint of the surrounding community" (Syahrul, 2025). Community perceptions also confirm this condition, such as "dust is often seen flying around" (Hendra, 2025) and "the air feels heavier and dustier" (Mariam, 2025). This finding indicates that particulate emission control thru UKL-UPL has not been optimal, which is consistent with previous research findings (Sari et al., 2016; Kambuaya et al., 2020).

Beside air quality, environmental noise is an important parameter in assessing the performance of UKL and UPL. Interview results show that noise levels increase at certain times (Gunawan Nurdianto, 2025), and although administrative reports are available, "it's still quite disturbing on the ground" (Syahrul, 2025). Public perception reinforces this condition, including "the sound of the engines is often heard even in residential areas" (Sulaiman, 2025) and "at nite, the noise is more disturbing" (Hendra, 2025). Compared to noise quality standards, this condition indicates non-compliance at certain times. Overall, environmental performance in terms of air and noise indicates that the implementation of UKL and UPL has not been effective in terms of output, which was also found in previous research (Sari et al., 2016).

**Table 6. Comparison of Ambient Air Quality and Noise Standard Limits with Field Findings**

<b>Parameter</b>	<b>Environmental Quality Standards</b>	<b>Field Findings</b>	<b>Compliance with Standards</b>	<b>Environmental and Health Implications</b>
<b>TSP (Total Suspended Particulate)</b>	≤ 230 µg/m <sup>3</sup> (24-hour)	300 – 420 µg/m <sup>3</sup>	Non-compliant / Exceeds standard	Reduces air quality, causes respiratory tract irritation, and impairs visibility.
<b>PM10</b>	≤ 150 µg/m <sup>3</sup> (24-hour)	180 – 260 µg/m <sup>3</sup>	Non-compliant / Exceeds standard	Risks causing respiratory disorders, especially in children and the elderly.
<b>PM2.5</b>	≤ 65 µg/m <sup>3</sup> (24-hour)	80 – 130 µg/m <sup>3</sup>	Non-compliant / Exceeds standard	Fine particles can penetrate the lungs and bloodstream, increasing the risk of cardiovascular diseases.
<b>Environmental Noise (Residential Area)</b>	≤ 55 dBA	60 – 80 dBA	Non-compliant / Exceeds standard	Causes discomfort, sleep disturbances, and psychological stress within the community.

**h. Public Health Impact (Output/Proxy)**

Public health impact is an important output indicator in assessing the effectiveness of Environmental Management Efforts (UKL) and Environmental Impact Assessment (UPL), as it reflects the success of environmental pollution control on human health. Normatively, the Environmental Impact Assessment (EIA) is expected to reduce health complaints, particularly respiratory problems. However, the interview results indicate that these complaints still occur frequently. Community leaders stated that "people often complain of cough, shortness of breath, and runny nose, especially when there is a lot of dust" (Hendra, 2025), while village officials confirmed that "residents frequently complain of respiratory illnesses, especially in children and the elderly" (Sulaiman, 2025). This condition is reinforced by the statement that complaints increase during the dry season (Mariam, 2025), indicating a link between dust and health problems.

From the perspective of environmental supervisors, it was stated that "community complaints regarding health still exist, even tho the company has implemented UKL and UPL" (Gunawan Nurdianto, 2025), and that "administratively, there are no reports of extraordinary events, but community health complaints still need to be addressed" (Syahrul, 2025). Public perception also indicates a decline in health conditions, such as "since this activity started, my health feels more disturbed" (Hendra, 2025) and "I rarely used to get a cough before, but now I get it more often" (Mariam, 2025). These findings indicate that the effectiveness of UKL-UPL in protecting public health is still limited, consistent with previous research confirming that complaints of respiratory infections can be an indicator of poor environmental performance as an output of UKL-UPL (Sari et al., 2016; Kambuaya et al., 2020).

**i. Outcome – Reduced Pollution**

Impact Public health impact is an important output indicator in assessing the effectiveness of UKL and UPL implementation because it reflects the success of environmental pollution control on human health. Normatively, the Environmental Impact Assessment (EIA) is expected to reduce health complaints, particularly

respiratory tract disorders. However, the interview results indicate that these complaints are still relatively frequent. Community leaders stated that "people often complain of cough, shortness of breath, and runny nose, especially when there is a lot of dust" (Hendra, 2025), while village officials confirmed that "residents frequently complain of respiratory illnesses, especially in children and the elderly" (Sulaiman, 2025). This condition is reinforced by the statement that complaints increase during the dry season (Mariam, 2025), indicating a link between increased dust and public health disturbances.

From the perspective of environmental supervisors, it was stated that "community complaints regarding health still exist, even tho the company has implemented UKL and UPL" (Gunawan Nurdianto, 2025), and that "administratively, there are no reports of extraordinary events, but community health complaints still need to be addressed" (Syahrul, 2025). Public perception also indicates a decline in health conditions, such as "since this activity started, my health feels more disturbed" (Hendra, 2025) and "I rarely used to get a cough before, but now it's more frequent" (Mariam, 2025). These findings indicate that the effectiveness of UKL-UPL in protecting public health is still limited, consistent with previous research stating that complaints of respiratory infections can be an indicator of poor environmental performance as an output of UKL-UPL implementation (Sari et al., 2016; Kambuaya et al., 2020).

### **Factors Inhibiting and Supporting the Implementation of UKL and UPL**

The implementation of UKL and UPL is influenced by various supporting and inhibiting factors that interact within the context of environmental policy implementation. Conceptually, the success of environmental instruments is determined by structural, institutional, resource, and social context factors (Dale & Haeuber, 2001). In this study, the effectiveness of the Environmental Impact Assessment (EIA) was assessed as moderately effective but not yet optimal, indicating a dynamic between planning and field practice. The main supporting factors include the company's normative commitment to fulfilling reporting obligations and implementing basic management in accordance with environmental documents. This finding aligns with Nasution (2020), who emphasized that normative compliance is the initial foundation for implementing the Environmental Impact Assessment (EIA), although it requires substantive motivation to avoid being merely administrative (Gunningham et al., 2003).

Other supporting factors are the availability of environmental management facilities and infrastructure, as well as the presence of government oversight. Basic facilities such as liquid waste management, dust control, and greening enable the technical and measurable implementation of UKL and UPL, as emphasized by Prihatiningtyas (2019). Additionally, oversight by the county's DLH and the province's DLHK, although limited in intensity, serves as an external control mechanism that encourages corporate compliance (Gunningham et al., 2003). Positive public perception of improved environmental conditions also strengthens the social legitimacy of implementing the UKL-UPL and reduces the potential for conflict. This aligns with the concept of social license to operate, which emphasizes the importance of community acceptance in the sustainability of environmental management (Brownlie, 2017).

On the other hand, a number of inhibiting factors limit the optimization of UKL-UPL, including the dominance of the administrative approach, limited human resources and budget capacity, weak integration of UKL and UPL, and limited intensity of supervision and public participation. Environmental Impact Assessments (EIAs) are still oriented toward fulfilling reporting obligations rather than substantial environmental performance, as also found by Garuda et al. (2020). Limitations in technical competence and budget hinder management innovation (Rahmad & Aulia, 2021; Nasution, 2020), while the weak utilization of UPL data reduces the adaptive nature of environmental management (Spellerberg, 2005). Overall, these findings confirm the need for capacity building, integration, and participation to sustainably improve the effectiveness of UKL-UPL.

### **Strategies or Efforts to Enhance the Effectiveness of UKL and UPL**

Implementation Improving the effectiveness of UKL and UPL implementation is a strategic step to ensure that environmental management and monitoring do not stop at administrative compliance, but are oriented toward a real reduction in pollution impacts. Theoretically, the effectiveness of environmental management is determined by the quality of policy implementation, the capacity of implementing actors, and sustainable evaluation and feedback mechanisms (Dale & Haeuber, 2001). The research results indicate that the Environmental Management Plan (UKL) has been implemented according to the document, but it is still procedural. Therefore, the UKL needs to be strengthened as an active environmental management instrument that focuses on controlling the main sources of impact, such as waste treatment and emission control, as emphasized in environmental management theory (Spellerberg, 2005).

The next effort is to strengthen the function of the UPL as a tool for evaluation and decision-making, as well as to increase integration between the UKL and UPL. Regular environmental monitoring has not been fully utilized to analyze trends in environmental quality changes and adjust management actions. In fact, the theory of adaptive environmental management emphasizes that monitoring should be the basis for learning and adjusting

management strategies (Dale & Haeuber, 2001). The weak integration of UKL–UPL means that the results of the UPL have not been systematically used to improve the UKL, as also identified by Prihatiningtyas (2019). Therefore, an operational mechanism is needed to ensure that the results of the UPL directly serve as the basis for improving environmental management.

Improving the effectiveness of UKL-UPL also requires strengthening human resource capacity, budget support, supervision, and community involvement. Competent human resources supported by continuous training are a prerequisite for the successful implementation of environmental policies (Spellerberg, 2005), while environmental budgets need to be viewed as strategic investments to reduce long-term risks and costs (Gunningham et al., 2003). Additionally, consistent monitoring and transparency of environmental information can enhance accountability and compliance (Brownlie, 2017). The environmental impact assessment (EIA) also needs to be directed toward achieving environmental outcomes, not just administrative procedures (Nasution, 2020), so that pollution control is effective and sustainable.

## 5. CONCLUSIONS

Based on the findings of this study, it can be concluded that the implementation of Environmental Management Efforts (UKL) and Environmental Monitoring Efforts (UPL) in C-type mining activities at PT Gunung Alam Perkasa has generally fulfilled administrative requirements in accordance with the approved environmental documents. However, its effectiveness in reducing environmental pollution impacts remains suboptimal in substantive terms. This is evidenced by the exceedance of several environmental quality parameters, including BOD, COD, TSS, air particulate matter, and noise levels, which continue to affect environmental quality and public health. These findings indicate a clear gap between administrative compliance and actual environmental performance in the field.

Furthermore, the effectiveness of UKL-UPL implementation is shaped by the interaction between supporting and inhibiting factors. Supporting factors include the presence of clear regulatory frameworks, the availability of environmental management documents, and government oversight. In contrast, major constraints consist of limited human resources, inadequate budget allocation, weak integration between management and monitoring activities, an administrative-oriented approach, and limited community participation and transparency. This condition suggests that UKL-UPL implementation is still largely compliance-driven rather than outcome-oriented toward sustainable environmental improvement.

Therefore, enhancing the effectiveness of UKL-UPL requires a more comprehensive and outcome-based approach. This can be achieved through strengthening supervision mechanisms, improving both the capacity and quantity of human resources, optimizing the use of monitoring data as a basis for decision-making, and ensuring stronger integration between UKL and UPL within the environmental management cycle. In addition, increasing transparency and community participation is essential to reinforce accountability and social legitimacy. Through these efforts, UKL-UPL can function more effectively as an instrument for sustainable environmental management and pollution control.

## 6. ACKNOWLEDGEMENT

The author would like to thank the Environmental Service of Kuantan Singingi Regency, the village government, and the community of Teberau Panjang Village, Gunung Toar District, for their support and information during the research data collection process. Appreciation is also extended to all parties who provided constructive input and suggestions in the preparation of this manuscript. This contribution is very meaningful in improving the quality and depth of the analysis in this research..

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