



АГЕНТСТВО МЕЖДУНАРОДНЫХ ИССЛЕДОВАНИЙ

ИННОВАЦИОННЫЕ ПОДХОДЫ К РЕШЕНИЮ СОВРЕМЕННЫХ ПРОБЛЕМ: КОМПЛЕКСНЫЙ АНАЛИЗ И ПРАКТИЧЕСКАЯ РЕАЛИЗАЦИЯ

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shows that 72 % of motorbikes are over 10 years old, emitting 2 - 4 times more than new motorbikes. Modelling predicts that removing 500,000 old vehicles would reduce 15,000 tonnes of CO₂ / year, reducing TSP emissions from transport by 30–40 % by 2030.

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Vu Thi Lan Anh

Doctor of Environmental, Hanoi University of Mining and Geology,
Hanoi, Vietnam

Dang Thi Ngoc Thuy

Doctor of Philosophy, Hanoi University of Mining and Geology,
Hanoi, Vietnam

ENVIRONMENTAL IMPACT ASSESSMENT OF LAND EXPLOITATION FOR LANDFILL MATERIAL IN QUAN CHU TOWN, DAI TU DISTRICT, THAI NGUYEN PROVINCE

Annotation

Economic development is an inevitable need of each locality and country. To meet the demand for landfill materials for constructions in Thai Nguyen province, as well as create jobs and stable income for local workers as well as develop the socio - economy; contribute to increasing the State budget through paying taxes and prescribed fees, land

exploitation is necessary. However, the exploitation process has many impacts on the environment and people such as impacts of dust, emissions, impacts due to subsidence and landslides. Therefore, the research team applied a combination of field survey methods; sample collection and analysis methods; rapid assessment methods to assess the current environmental status of the landfill mine area in Quan Chu Town, Dai Tu District, Thai Nguyen Province. In addition, with a project area of 20.96 hectares of exploitation, the mine's exploitable reserves are 3,810,984 m³; The exploitation period is 5 years, the exploitation technology is direct excavation of soil for filling material, the research team assessed the specific impacts in the project stages and proposed mitigation solutions for the purpose of sustainable development.

Keywords

Land exploitation, environmental impact, Thai Nguyen.

1. Introduction

To meet the demand for filling materials for construction and construction works and the potential of soil minerals as filling materials in Quan Chu town, Dai Tu district, Thai Nguyen Provincial People's Committee has auctioned the right to exploit soil minerals as filling materials. Group II investment projects are projects with the risk of negative impacts on the environment and must prepare an Environmental Impact Assessment report to ensure the proposed environmental tasks: (1) Minimize environmental impacts from socio - economic development activities, (2) Manage domestic solid waste, industrial solid waste, hazardous waste, (3) Manage, improve and enhance environmental quality.

The project uses a total area of 20.96 hectares (*Fig.1*), including 20.96 hectares of exploitation, 0.25 hectares of settling pond and 0.04 hectares of auxiliary area limited by points as shown in the drawing. The mine's exploitable reserves are 3,810,984 m³; the first year's exploitation capacity is 550,000 m³ / year, from the second to the fifth year is 783,000 m³ / year. The project is implemented in 5 years, including 4.4 years of exploitation, 1 month of basic construction and 6 months of environmental improvement and restoration. Exploitation technology: direct excavation of soil for filling material. The parameters of the exploitation system are as follows: height of the exploitation layer $H = 5$ m; Height of the ending layer $H_{kt} = 10$ m; The slope angle of the exploitation layer is 57° ; The slope angle of the ending layer is 57° ; the width of the finished mining layer is 3.5 m; The minimum width of the working layer is 20 m.



Figure 1. Project implementation location

2. Research method

The research team applied research methods including field survey, sample collection and analysis, and rapid assessment method.

2.1. Field survey

The research team conducted a field survey when conducting an environmental impact assessment to determine the status of the project area as a basis for identifying natural objects that may be affected (*Fig. 2*). From there, propose pollution mitigation measures that are accurate, practical and feasible.



Figure 2. Field survey

2.2. Sample collection and analysis

Environmental sampling was conducted on November 13, 2024 (*Fig.3*), including: 3 soil samples, 3 air samples, 1 groundwater sample and 2 surface water samples. The sample analysis time is from November 13, 2024, to November 28, 2024.

Locations for sampling air, soil, surface water and groundwater of the Project are as follows:

Table 1 - Environmental sampling locations

No.	Symbol	Coordinates VN - 2000	
		X	Y
1	D1	2379767	417997
2	D2	2379477	418430
3	D3	2379650	418649
4	KK1	2379767	417997
5	KK2	2379477	418430
6	KK3	2379650	418649
7	NN	2379794	418305
8	NM1	2379202	418391
9	NM2	2378354	419473



a) Air sampling



b) Soil sampling



c) Water sampling

Figure 3. Sampling of environmental status at the Project

Methods of environmental quality analysis according to Vietnamese standards and regulations are listed in the following table:

Table 2. Methods of environmental quality analysis

No.	Parameter	Analytical Method
Air quality analysis		
1	Temperature	QCVN 46:2012 / BTNMT
2	Humidity	QCVN 46:2012 / BTNMT
3	Wind speed	QCVN 46:2012 / BTNMT
4	TSP	TCVN 5067:1995
5	NO ₂	TCVN 6137:2009
6	SO ₂	TCVN 5971:1995
7	CO	TTP.SPT.KXQ.01
8	Noise (LAeq)	TCVN 7878 - 2:2010
Soil quality analysis		
1	As	US EPA Method 3051A + SMEWW 3114B:2017
2	CD	US EPA Method 3051A + US EPA Method 7000B
3	Pb	US EPA Method 3051A + US EPA Method 7000B
4	Zn	US EPA Method 3051A + US EPA Method 7000B
5	Hg	US EPA Method 3051A + SMEWW 3112B:2017
Water quality analysis		
1	pH	TCVN 6492:2011
2	Permanganate index	TCVN 6186:1996
3	TDS	TTP.SDN.N.01
4	CaCO ₃	TCVN 6224:1996
5	NH ₄ ⁺ _ N	TCVN 6179 - 1:1996
6	NO ₃ ⁻ _ N	TCVN 6180:1996
7	Cl ⁻	TCVN 6194:1996
8	F ⁻	SMEWW 4500 - F -. B&D:2017
9	SO ₄ ²⁻	SMEWW 4500.SO ₄ ²⁻ E:2017

No.	Parameter	Analytical Method
10	As	SMEWW 3114B:2017
11	Fe	TCVN 6177:1996
12	Coliforms	SMEWW 9221B:2017

2.3. Rapid assessment method

Used to estimate the load of pollutants generated during construction and project implementation (mainly estimating the load of gas and dust).

3. Research results

3.1. Current environmental status

* Ambient air quality

The results of ambient air analysis of the project area are in Table 3.

Table 3 - Results of air quality analysis

No.	Parameter	Unit	Result			QCVN 05:2023 / BTNMT
			KK1	KK2	KK3	Average 1 hour
1	Temperature	°C	30.1	31.2	30.8	-
2	Humidity	% RH	63.9	64.2	64.4	-
3	Wind speed	m / s	0.5	0.6	0.8	-
4	TSP	µg / Nm ³	241.4	197.9	197.7	300
5	NO ₂	µg / Nm ³	54.0	54.6	53.6	200
6	SO ₂	µg / Nm ³	51.3	56.0	59.0	350
7	CO	µg / Nm ³	KPH	KPH	KPH	30,000
8	Noise (LAeq)	dBA	63.2	60.1	64.9	70

Comments: The table above shows that the air quality indicators are within the allowable standard limits of QCVN 05:2023 / BTNMT. Noise is within the allowable standard of QCVN 26:2010 / BTNMT.

* Soil quality

The results of soil sample analysis of the Project area are shown in Table 4.

Table 4 - Results of soil environmental quality analysis

No.	Parameter	Unit	Result			QCVN 03:2023 / BTNMT
			D1	D2	D3	Type 1
1	As	mg / kg	0.109	0.133	0.111	25
2	Cd	mg / kg	0.70	-	0.70	4
3	Pb	mg / kg	25.3	15.6	11.4	200
4	Zn	mg / kg	58.9	81	74.4	300
5	Hg	mg / kg	-	-	-	12

Note: QCVN 03:2023 / BTNMT Type 1: includes agricultural land, aquaculture land, salt - making land, residential land, land for producing construction materials and making pottery.

Table 4 shows that heavy metals in the soil are all lower than the permissible standards. In general, the heavy metal content in the soil of the Project meets environmental requirements.

** Surface water quality*

There are no rivers or streams flowing through the project area, so samples were taken for analysis at pond locations in the West and South outside the project area. The analysis results are as follows:

Table 5 - Results of surface water sample analysis

No.	Parameter	Unit	Result		QCVN 08:2023 / BTNMT
			NM1	NM2	Table 3 - Level B
1	pH	-	7.32	7.45	6 ÷ 8.5
2	BOD ₅	mg / l	6.90	5.90	≤ 6.0
3	COD	mg / l	18.7	15.6	≤15.0
4	DO	mg / l	5.2	5.3	≥ 5
5	TSS	mg / l	69	52	≤ 15
6	NH ₄ ⁺ _ N	mg / l	0.17	0.15	0.3
7	NO ₃ ⁻ _ N	mg / l	1.27	0.837	-
8	PO ₄ ³⁻ _ P	mg / l	0.205	0.19	-
9	Fe	mg / l	-	-	0.5
10	Total grease	mg / l	0.6	0.6	5
11	Coliforms	MPN / 100 ml	2.8 x 10 ³	2.4 x 10 ³	≤ 5000

Note: Table 3 - Level B: Limit values of parameters in surface water for classifying the water quality of lakes, ponds, lagoons and protecting aquatic habitats. Level B: Average water quality.

The above table shows that most parameters are within the allowable standard limits of QCVN 08:2023 / BTNMT table 3, level B. TSS parameter exceeds the allowable standard by 4.6 times; COD exceeds 1.2 times.

** Groundwater quality*

The results of groundwater sample analysis are shown in Table 6.

Table 6 - Results of groundwater quality analysis

No.	Parameter	Unit	NN	QCVN 09:2023 / BTNMT
1	pH	-	6.91	5.8 ÷ 8.5
2	Permanganate index	mg / l	-	4
3	TDS	mg / l	329	1,500

4	Hardness in CaCO ₃	mg / l	49.5	500
5	NH ₄ ⁺ _ N	mg / l	0.17	1
6	NO ₃ ⁻ _ N	mg / l	0.928	15
7	Cl ⁻	mg / l	14.2	250
8	F ⁻	mg / l	0.13	1
9	SO ₄ ²⁻	mg / l	4.19	400
10	As	mg / l	-	0.05
11	Fe	mg / l	0.11	5
12	Coliforms	MPN / 100 ml	-	3

Note: QCVN09:2023 / BTNMT - National technical regulation on groundwater quality.

All groundwater analysis indicators are within the allowable standard limits of QCVN 09:2023 / BTNMT.

3.2. Environmental impact assessment due to project activities

3.2.1. During the project's basic construction implementation phase

- Solid waste includes:

+ Plant biomass during clearing is about 89.95 tons.

+ Construction workers' domestic solid waste is about 6 kg / day, mainly composed of leftover food, plastic packaging, boxes...

+ Generates some types of hazardous waste such as greasy rags, spilled grease... about 1 kg / month.

- Wastewater:

+ Domestic wastewater is generated at about 0.6m³ / day, the main pollutants include residues, suspended solids, organic substances, nutrients (N, P) and pathogenic bacteria.

+ Rainwater overflow occurs with volume 2.71 m³ / s.

- Dust and emissions from land clearing, road construction, pavement opening; transportation of construction materials; fuel combustion of motor vehicle engines.

b) During the project operation phase

* Wastewater:

+ Domestic wastewater generated is about 0.6 m³ / day.

+ The largest amount of water generated from washing wheels out of the mine boundary is about 1.87m³ / day, the main pollutants are suspended substances and turbidity.

+ Rainwater overflows at 2.71 m³ / s, carrying soil, rocks, and pollutants that threaten to affect surface water sources in the area.

* Dust, exhaust gas:

+ Dust and emissions from mining, excavation and transportation of soil; main components are CO_x, NO_x, SO₂...

Table 7 1 Estimated amount of dust generated during mine operations

Year	Volume (tons / year)	Coefficient (kg / ton)	Emissions (kg / year)	Emission load (mg / m ² .s)
First	959,750	0.17	163,157.50	0.054
2,3,4,5	1,366,335	0.17	232,276.95	0.077

Table 82 Emissions generated from the use of Diesel oil

Fuel consumption			Pollution emission (Es, mg / m ² .s)			
Diesel oil (l / year)	lubricant, grease (kg)	Total (tons / year)	CO	SO ₂	NOx	Dust
421,493	5,757	386.24	0.0171	0.0061	0.0336	0.0026

With a dust pollution load of 3.81 kg / (vehicle.km), the amount of dust generated on the road is:

Table 9 - Dust load on the transport route

Year	Number of vehicles / days	Load (kg / km.hour)	Load (mg / ms)
First	133	136	0.4
From year 2 to year 5	190	194	0.5

This dust source will directly affect the ecosystem on both sides of the transportation route and the people along the road.

+ Environmental restoration phase after exploitation ends: Dust and emissions from dismantling and moving construction works and the operation of vehicles and equipment serving leveling, digging holes for planting trees, and transporting for environmental restoration; main components include dust, CO_x, NO_x, SO₂.

* Solid waste:

+ Domestic solid waste generated from project activities is about 6.0 kg / day, mainly composed of packaging, bottles, leftover food; septic tank sludge generated is about 1 m³ / year.

+ Hazardous waste (oily rags, waste grease, waste fluorescent bulbs, engine oil, gearbox oil...) about 13.62 kg / year.

1.5.1 3. 2.2. Project environmental protection works and measures

* *Wastewater collection and treatment system*

- Domestic wastewater workers are treated by 01 Jokaso domestic wastewater treatment system with a capacity of 1.0m³ / day and night.

- Rainwater overflow: build trapezoidal ditches with dimensions: surface width 0.7m; bottom width 0.3m; ditch depth 0.4m.

- For car wash water: the project to build a car wash bridge with an area of 15m² reinforced concrete structure, built on the transport road, near the boundary of mine. In this area, arrange a bridge to wash the wheels, undercarriage and hand spray nozzles.

* *Measures to reduce dust and emissions*

- Use a 4m³ water truck twice a day, at a rate of 0.5 l / m², cover the truck body and wash the wheels before leaving the mine boundary.

- Plant trees on both sides of the road at 2m / tree, plant in 2 alternating rows; plant trees at the auxiliary area.

- Use high - performance construction machinery and equipment, and limit operations during peak hours.

** Facilities, measures for collection, storage, management and treatment of solid waste*

- Construction solid waste is collected and classified by type, scrap materials are used as firewood or for on - site leveling.

- Hazardous solid waste: for the number of rags contaminated with grease, they are collected in containers with lids, labeled and placed in the waste storage warehouse on the auxiliary area. After the completion of construction, the Project Owner will contract with a competent unit to transport and dispose of them in accordance with regulations.

** Measures to reduce noise and vibration*

- The mine's technical department regularly checks the operating status of equipment and checks for wear and tear. Regularly maintain and replace damaged parts promptly.

- Arrange appropriate working hours, minimize the number of workers present in places with high noise.

** For environmental risks and incidents*

- Comply with labor safety regulations.

- There are signs indicating construction sites and dangerous areas.

- Do not carry out leveling or excavation when it rains.

- Ensure safety rules in labor and fire prevention, safety regulations on transport loads...

- Provide full labor protection equipment, organize periodic health check - ups for workers...

- Assign specialized staff to monitor and manage environmental issues.

4. Conclusion

Through the assessment of the current environmental status of the landfill area in Quan Chu town, Dai Tu district, Thai Nguyen province, the environmental quality of the project is relatively good. The parameters are all within the allowable limits. However, the results of surface water environmental monitoring show that: TSS parameter exceeds the allowable standard by 4.6 times; COD exceeds the allowable standard limit by 1.2 times (QCVN 08:2023 / BTNMT table 3, level B). The exploitation period of the project is short (5 years), the level of impact during the operational phases is insignificant. However, there are still potential impacts on the surrounding environment such as dust from excavation and transportation activities, and increased water turbidity. In addition, due to the climatic characteristics of the project area with heavy rain, there is a risk of subsidence and landslides. Therefore, the project owner needs to apply mitigation measures such as covering the means of transport and exploitation to ensure compliance with the design.

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МЕЖДУНАРОДНЫХ
ИССЛЕДОВАНИЙ**
<https://ami.im>

e-mail: info@ami.im

**AGENCY
OF INTERNATIONAL
RESEARCH**
+7 347 29 88 999