

Environmental Impact Assessment

Project Number: 41924
May 2014
Document Stage: Final

Nam Ngiep 1 Hydropower Project (Lao People's Democratic Republic)

Appendix I: Applicable Standards

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Appendix I

**Agreement on National Environmental
Standards of Lao PDR, 2009**

I.1 DRINKING WATER QUALITY STANDARDS

Lao PDR current standards for drinking water of the Lao PDR are provided below for reference.

Table I.1.1 Bacteriological Parameter

Parameters	Units	Concentration ¹	CA - Annex C Concentration ²	WHO ³ (Drinking Water Quality Guideline)	EPA ⁴ (Human Health, Consumption of Water & Organism)
Faecal Coliform	MPN/100ml	0	0	-	-
Total Coliform	MPN/100ml	<2.2	<2.2	-	-
Enterovirus	MPN/100ml	0	0	-	-

Source:

- 1 Refer to Agreement on the National Environmental Standard, Lao PDR 2009
- 2 Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.8 Drinking Water Quality Standards, Bacteriological Parameters
- 3 Refer to Guidelines for Drinking-water Quality, WHO 2008
- 4 Refer to National Recommended Water Quality Criteria - Correction, EPA 822-Z-99-001, 1999

Table I.1.2 Physical-Chemical Parameters

Parameters	Symbol	Unit	Concentration ¹		CA - Annex C Maximum Concentration ²	WHO ³ (Drinking Water Quality Guideline)	EPA ⁴ (Human Health, Consumption of Water & Organism)
			Minimum	Maximum			
Aluminium	Al ³⁺	mg/l	0.1	0.2	0.2	<0.1	-
Ammonia	NH ₃	mg/l	0.5	1.5	1.5	1.5	-
Chloride	Cl ⁻	mg/l	200	250	250	250	-
Copper	Cu ²⁺	mg/l	1.0	2.0	2.0	2	1.3
Iron	Fe ²⁺ and Fe ³⁺	mg/l	0.3	<1	<1	0.3	0.3
Manganese	Mn ²⁺	mg/l	0.1	0.5	0.5	<0.1	0.05
Sodium	Na ⁺	mg/l	200	250	250	200	-
Sulphate	SO ₄ ²⁻	mg/l	200	250	250	250	-
Hydrogen Sulphide	H ₂ S	mg/l	0.05	0.1	0.1	0.05-0.1	-
Conductivity	EC	µS/cm	-	<1,000	<1,000	-	-
Total dissolved solids	TDS	mg/l	500	600	600	600	-
Sodium Chloride	NaCl	mg/l	100	300-350	300-350	-	-
pH	pH	-	6.5	8.5	8.5	6.5-8	5-9
Temperature	T	°C	25	35	35	-	-
Hardness	-	mg/l	50	300	300	100-300	-
Turbidity	-	NTU	-	<10	<10	<5	-
Taste and Odour	-	-	-	Acceptable	Acceptable	-	-
Colour	-	TCU	-	5	5	<15	-
Residual Chlorine (if Chlorine disinfection is used)	Cl ₂	mg/l	-	<0.2	<0.2	5	-

Source:

¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009

² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.8 Drinking Water Quality Standards, Physical-Chemical Parameters

³ Refer to Guidelines for Drinking-water Quality, WHO 2008

⁴ Refer to National Recommended Water Quality Criteria - Correction, EPA 822-Z-99-001, 1999

Table I.1.3 Health Significant Chemical Parameters

Parameters	Symbol	Unit	Maximum Concentration ¹	CA – Annex C Maximum Concentration ²	WHO ³ (Drinking Water Quality Guideline)	EPA ⁴ (Human Health, Consumption of Water & Organism)
Antimony	Sb ³⁺	mg/l	0.005	0.005	0.02	0.0056
Arsenic	As ³⁺	mg/l	0.01-0.05	0.01-0.05	0.01	0.000018
Barium	Ba ²⁺	mg/l	0.7	0.7	0.7	1.0
Boron	B	mg/l	0.50	0.50	2.4	-
Cadmium	Cd ²⁺	mg/l	0.003	0.003	0.003	0.0088
Chromium	Cr	mg/l	0.05	0.05	0.05	-
Cyanide	CN ⁻	mg/l	0.07	0.07	0.07	0.14
Fluoride	F ⁻	mg/l	1.5	1.5	1.5	-
Lead	Pb	mg/l	0.01	0.01	0.01	-
Mercury	Hg	mg/l	0.001	0.001	0.006	-
Nitrate	NO ₃	mg/l	50	50	50	10
Nitrite	NO ₂	mg/l	3	3	3	-
Selenium	Se	mg/l	0.01	0.01	0.04	0.17

Source:

¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009

² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.8 Drinking Water Quality Standards, Health Significant Chemical Parameters

³ Refer to Guidelines for Drinking-Water Quality, WHO 2008

⁴ Refer to National Recommended Water Quality Criteria – Correction, EPA 822-Z-99-001, 1999

Table I.1.4 Priority Parameters

Parameters	Symbol	Unit	Maximum Concentration ¹	CA - Annex C Maximum Concentration ²	WHO ³ (Drinking Water Quality Guideline)	EPA ⁴ (Human Health, Consumption of Water & Organism)
Iron	Fe	mg/l	<1	<1	0.3	0.3
Manganese	Mn	mg/l	<0.5	<0.5	<0.1	0.05
Arsenic	As	mg/l	<0.05	<0.05	0.01	0.000018
Fluoride	F ⁻	mg/l	<1.5	<1.5	1.5	-
Nitrate	NO ₃ ⁻	mg/l	50	50	50	10
Nitrite	NO ₂ ⁻	mg/l	3	3	3	-
Nitrite Nitrogen	NO ₂ -N	mg/l	1	1	-	-
pH	pH	-	6.5-8.5	6.5-8.5	6.5-8	5-9
Coliform	-	MPN/100m l	0	0	-	-
Conductivity	EC	µS/cm	1,000	1000	-	-
Residual Chlorine (if Chlorine disinfection is used)	Cl ₂	mg/l	0.2	0.2	5	-
Total Hardness	-	mg/l	<300	<300	100-300	-
Turbidity	-	NTU	<10	<10	<5	-
Taste and Odour	-	-	Acceptable	Acceptable	-	-

Source:

¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009

² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.8 Drinking Water Quality Standards, Priority Parameters

³ Refer to Guidelines for Drinking-water Quality, WHO 2008

⁴ Refer to National Recommended Water Quality Criteria - Correction, EPA 822-Z-99-001, 1999

I.2 GROUNDWATER QUALITY STANDARDS

Lao PDR current standards for groundwater are provided below for reference.

Table I.2.1 Volatile Organic Compound

No.	Substances	Unit	Standard Value ¹	CA - Annex C Maximum Concentration ²	N.J.A.C. 7:9C Ground Water Quality Standards ³
1	Benzene	mg/l	0.005	0.005	0.0002
2	Carbon Tetrachloride	mg/l	0.005	0.005	0.0004
3	1,2-Dichloroethane	mg/l	0.005	0.005	0.0003
4	1,1-Dichloroethylene	mg/l	0.007	0.007	0.001
5	Cis-1,2-Dichloroethylene	mg/l	0.070	0.070	0.07
6	Trans-1,2-Dichloroethylene	mg/l	0.1	0.1	0.1
7	Dichloromethane	mg/l	0.005	0.005	-
8	Ethylbenzene	mg/l	0.7	0.7	0.7
9	Styrene	mg/l	0.1	0.1	0.1
10	Tetrachloroethylene	mg/l	0.005	0.005	0.0004
11	Toluene	mg/l	1	1	0.6
12	Trichloroethylene	mg/l	0.005	0.005	0.001
13	1,1,1 Trichloroethane	mg/l	0.2	0.2	0.03
14	1,1,2 Trichloroethane	mg/l	0.005	0.005	0.003
15	Total Xylenes	mg/l	10	10	1

Source:

¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009

² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.9 Groundwater Quality Standards

³ Refer to Department of Environmental Protection, New Jersey Administration Code, 2010

Table I.2.2 Heavy Metals

No.	Substances	Unit	Standard Value ¹	CA – Annex C Maximum Concentration ¹	N.J.A.C. 7:9C Ground Water Quality Standards ²
1	Cadmium	mg/l	0.003	0.003	0.004
2	Hexavalent Chromium	mg/l	0.05	0.05	-
3	Copper	mg/l	1	1	1.3
4	Lead	mg/l	0.01	0.01	0.005
5	Manganese	mg/l	0.5	0.5	0.05
6	Nickel	mg/l	0.02	0.02	0.1
7	Zinc	mg/l	5	5	2
8	Arsenic	mg/l	0.01	0.01	0.00002
9	Selenium	mg/l	0.01	0.01	0.04
10	Mercury	mg/l	0.001	0.001	0.002

Source:

- ¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009
- ² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.9 Groundwater Quality Standards
- ³ Refer to Department of Environmental Protection, New Jersey Administration Code, 2010

Table I.2.3 Pesticides

No.	Substances	Unit	Standard Value ¹	CA - Annex C Maximum Concentration ²	N.J.A.C. 7:9C Ground Water Quality Standards ³
1	Chlordane	mg/l	0.0002	0.0002	0.00001
2	Dieldrin	mg/l	0.00003	0.00003	0.000002
3	Heptachlor	mg/l	0.0004	0.0004	0.000008
4	Heptachlor Epoxide	mg/l	0.0002	0.0002	0.000004
5	DDT	mg/l	0.002	0.002	0.0001
6	2,4-D	mg/l	0.03	0.03	0.07
7	Atrazine	mg/l	0.003	0.003	0.003
8	Lindane	mg/l	0.0002	0.0002	-
9	Pentachlorophenol	mg/l	0.001	0.001	0.0003

Source:

- ¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009
- ² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.9 Groundwater Quality Standards
- ³ Refer to Department of Environmental Protection, New Jersey Administration Code, 2010

Table I.2.4 Other Parameters

No.	Substances	Unit	Standard Value ¹	CA - Annex C Maximum Concentration ¹	N.J.A.C. 7:9C Ground Water Quality Standards ²
1	Benzo[a]pyrene	mg/l	0.0002	0.0002	0.00005
2	Cyanide	mg/l	0.2	0.2	0.1
3	Polychlorinated biphenyls	mg/l	0.0005	0.0005	0.00002
4	Vinyl Chloride	mg/l	0.002	0.002	0.00008

Source:

- ¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009
- ² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.9 Groundwater Quality Standards
- ³ Refer to Department of Environmental Protection, New Jersey Administration Code, 2010

I.3 GROUNDWATER QUALITY STANDARDS FOR DRINKING PURPOSES

Lao PDR's current standards for groundwater for drinking purposes are provided below for reference. The values of each parameters of groundwater quality standards similar to the Water Environment Partnership in Asia (WEPA).

Table I.3.1 Physical Parameters

Characteristics	Parameters	Symbol	Unit	Permitted Standard Value ¹		Permitted Standard Value ²		WEPA Standard ³	
				Suitable	Maximum	Suitable	Maximum	Suitable Allowance	Maximum Allowance
Physical	Colour	-	Platinum-Cobalt (Pt-Co)	5	15	5	15	5	15
	Turbidity	-	JTU	5	20	5	20	5	20
	Total solids	TS	mg/l	≤600	1,200	≤600	1,200	≤600	1,200

Source:

¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009

² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.10 Groundwater Standards for Drinking Purposes

³ Refer to Ground water Quality Standards for Drinking Purposes, WEPA, URL: http://www.wepa-db.net/policies/law/thailand/std_gw_for_drinking.htm

Table I.3.2 Chemical Parameters

Characteristics	Parameters	Symbol	Unit	Permitted Standard Value ¹		Permitted Standard Value ²		WEPA Standard ³	
				Suitable	Suitable	Suitable	Maximum	Suitable Allowance	Maximum Allowance
Chemical	Acidity	pH	-	7.0-8.5	6.5-9.2	7.0-8.5	6.5-9.2	6.5-8.5	6.5-9.2
	Iron	Fe(ii), Fe(iii)	mg/l	≤0.5	1	≤0.5	1	≤0.5	1
	Manganese	Mn ²⁺	mg/l	≤0.3	0.5	≤0.3	0.5	≤0.3	0.5
	Copper	Cu ²⁺	mg/l	≤1.0	1.5	≤1.0	1.5	≤1.0	1.5
	Zinc	Zn ²⁺	mg/l	≤5.0	15	≤5.0	15	≤5.0	15.0
	Sulphate	SO ₄ ²⁻	mg/l	≤200	250	≤200	250	≤200	250
	Chloride	Cl ⁻	mg/l	≤250	600	≤250	600	≤250	600
	Fluoride	F ⁻	mg/l	≤0.7	1	≤0.7	1	≤0.7	1.0
	Nitrate	NO ₃ ⁻	mg/l	≤15	45	≤15	45	≤45	45
	Total Hardness as CaCO ₃	Total	mg/l	≤300	500	≤300	500	≤300	500
	Non-carbonate hardness as CaCO ₃	Non CaCO ₃	mg/l	≤200	250	≤200	250	≤200	250
	Arsenic	As ³⁺ , As ⁵⁺	mg/l	None	0.05	None	0.05	None	0.05
	Cyanide	CN ⁻	mg/l	None	0.1	None	0.1	None	0.1
	Lead	Pb ²⁺	mg/l	None	0.05	None	0.05	None	0.05
	Mercury	Hg	mg/l	None	0.001	None	0.001	None	0.001
	Cadmium	Cd ³⁺	mg/l	None	0.01	None	0.01	None	0.01
	Selenium	Se(iv)	mg/l	None	0.01	None	0.01	None	0.01

Source:

¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009

² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.10 Groundwater Standards for Drinking Purposes

³ Refer to Ground water Quality Standards for Drinking Purposes, WEPA, URL: http://www.wepa-db.net/policies/law/thailand/std_gw_for_drinking.htm

Table I.3.3 Bacteria Parameters

Characteristics	Parameters	Symbol	Unit	Permitted Standard Value ¹		Permitted Standard Value ²		WEPA Standard ³	
				Suitable	Maximum	Suitable	Maximum	Suitable Allowance	Maximum Allowance
Bacteria	Coliform bacteria	Coliform	MPN/100 ml	<2.2	<2.2	<2.2	<2.2	<2.2	-
	E. coli bacteria	E. coli	MPN/100 ml	None	None	None	None	None	-
	Standard plate count	-	Colonies/ml	≤500	-	≤500	-	≤500	-

Source:

¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009

² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.10 Groundwater Standards for Drinking Purposes

³ Refer to Ground water Quality Standards for Drinking Purposes, WEPA, URL: http://www.wepa-db.net/policies/law/thailand/std_gw_for_drinking.htm

I.4 AMBIENT SURFACE WATER QUALITY STANDARDS

Deviation from these standards will only be allowed with the prior written approval of MONRE on a case by case basis, where the Company is able to demonstrate to MONRE's reasonable satisfaction that such deviation is caused by the inherent nature of the Nam Ngiep river or by the initial impoundment of the reservoir during the appropriate period as approved by MONRE. In applying for MONRE's approval, the Company shall clearly specify and justify all parameters, the proposed temporary standards for such parameters and the period during which such temporary standards are proposed to be in force together with appropriate monitoring plans and proposed steps promptly to address and resolve any failure to meet temporary standards. For the avoidance of doubt, the Company remains at all times responsible for Adverse Impacts related to approve deviations from the Ambient Water Quality Standards caused by the initial impoundment.

Table I.4.1 *Ambient Surface Water Quality Parameter*

Parameters	Units	Standard Value ¹	CA – Annex C Standard ²	EPA ³ (Freshwater CCC)
pH		5-9	5-9	6.5-9
Dissolved Oxygen	mg/l	6.0	>6.0	-
BOD ₅	mg/l	1.5	1.5	-
COD	mg/l	5.0	5.0	-
Nitrogen as nitrate (N-NO ₃)	mg/l	<5.0	5.0	-
Nitrogen as ammonia (N-NH ₃)	mg/l	0.2	0.2	-
Sulfate	mg/l	-	500	-
Total coliform bacteria	MPN/ml	5,000	5,000	-
Total faecal coliform	MPN/ml	1,000	1,000	-
Phenols	mg/l	0.005	0.005	-
Arsenic (As)	mg/l	0.01	0.01	0.15
Cadmium (Cd) CaCO ₃ ≤ 100 mg/l	mg/l	0.005	0.005	0.00025
Cadmium (Cd) CaCO ₃ ≥ 100 mg/l	mg/l	-	0.05	-
Chromium (VI) (Cr ⁶⁺)	mg/l	0.05	0.05	0.011
Copper (Cu)	mg/l	0.1	0.1	0.009
Cyanide	mg/l	0.005	0.005	0.0052
Lead (Pb)	mg/l	0.05	0.05	0.0025

Parameters	Units	Standard Value ¹	CA – Annex C Standard ²	EPA ³ (Freshwater CCC)
Mercury (Hg)	mg/l	0.002	0.002	0.00077
Nickel (Ni)	mg/l	0.1	0.1	0.052
Zinc (Zn)	mg/l	1.0	1.0	0.12
Manganese (Mn)	mg/l	1.0	1.0	-
Alpha \rightarrow Radioactivity	Becquerel/l	0.1	0.1	-
Beta \rightarrow Radioactivity	Becquerel/l	1.0	1.0	-
Total Organochlorine	mg/l	0.05	0.05	-
DDT	mg/l	1.0	1.0	0.000001
Alpha-BHC	mg/l	0.02	0.02	-
Dieldrin	mg/l	0.1	0.1	0.000056
Aldrin	mg/l	0.1	0.1	-
Heptachlor and Heptachlor Epoxide	mg/l	0.2	0.2	0.0000038
Endrin	mg/l	None	0	0.000036

Source:

¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009

² Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.11 Ambient Surface Water Quality Standards

³ Refer to National Recommended Water Quality Criteria – Correction, EPA 822-Z-99-001, 1999

I.5 EFFLUENT STANDARDS

The Company is responsible for compliance with applicable effluent standards. This applies to all effluents and runoff from Project activities, facilities, installations as well as discharges from resettlement sanitation and drainage.

Selected standards are listed below. All other parameters shall comply with the Lao National Standards and IFC Guidelines whichever is stricter.

Deviation from these standards will only be allowed

- (i) with the prior written approval of MONRE, and in circumstances where the Company and its contractors have applied an appropriate waste water treatment system used by international construction contractors in Lao PDR and applicable to the construction site or
- (ii) if the water from any Project activities does not have an adverse effect on the existing water quality or
- (iii) to the extent that the deviations are present as a result of the existing water quality.

Table I.5.1 Effluent Standards

Parameters	Units	Maximum Concentration ¹	Guideline Value ²	CA - Annex C Guidelines ³	Maximum Permission Limits ⁴
pH	-	6-9.5	6-9	6-9	6-8
Biochemical Oxygen Demand - BOD	mg/l	40	30	30	50
Chemical Oxygen Demand - COD	mg/l	-	125	125	100
Total suspended solids	mg/l	40	50	50	100
Oils and grease	mg/l	5	10	10	10
Phenol	mg/l	0.3	-	0.5	0.2
Cyanide	mg/l	0.1	-	0.1	0.1
Ammonia -N	mg/l	4	-	10	10
Total Nitrogen	mg/l	-	10	10	10
Total phosphorus	mg/l	-	2	2	10
Residual chlorine	mg/l	1.0	-	0.2	1.0

Parameters	Units	Maximum Concentration ¹	Guideline Value ²	CA - Annex C Guidelines ³	Maximum Permission Limits ⁴
Total coliforms	MPN/100ml	-	400	<400	-
Temperature increase	°C	-	-	<3	-
Arsenic	mg/l	0.25	-	0.1	0.2
Cadmium	mg/l	0.03	-	0.05	0.1
Chromium	mg/l	0.1	-	0.1	1.0
Copper	mg/l	0.5	-	0.3	1.0
Fluoride	mg/l	15	-	20	-
Iron	mg/l	2.0	-	2	10
Lead	mg/l	0.2	-	0.2	0.1
Mercury	mg/l	0.005	-	0.002	0.001
Nickel	mg/l	0.2	-	0.5	1.0
Selenium	mg/l	-	-	0.1	1.0
Silver	mg/l	0.1	-	0.5	0.5
Sulfides	mg/l	1.0	-	1	1.0
Zinc	mg/l	1.0	-	0.5	5
Total Toxic metals	mg/l	-	-	5-10	-

Source:

¹ Refer to Agreement on the National Environmental Standard, Lao PDR 2009

² Refer to IFC's General EHS Guideline: Environmental, 2007

³ Refer to Concession Agreement - Annex C - Appendix 2 Standard, 1.13 Effluent Standards

⁴ Refer to The National Environment (Standards For Discharge of Effluent into Water or on Land) Regulations, 1999

I.6 NOISE STANDARDS

Noise emission and ambient noise levels shall be in compliance with the Lao National Environmental Standard for noise as provided below for reference.

Table I.6.1 Noise Standards

Standards Method of Measurement	Standards Method of Measurement
Maximum Sound Level (L_{max}) should not exceed 115 dB(A)	Maximum Sound Level (L_{max}) should not exceed 115 dB(A)

Source: Refer to Agreement on the National Environmental Standards of Lao PDR, 2009

Table I.6.2 Noise Standards for Other Places

Type of Area	Standard Value in dB(A) ¹			WHO Guideline ² in dB(A) (Specific Environments)	
	6.00-18.00	18.00-22.00	22.00-6.00	Indoor	Outdoor
Quiet areas: hospitals, libraries, treatment places, kindergarten and schools	50	45	40	#1- 35	55
Residential areas: hotels and houses	55	55	45	30-35	45
Commercial and service areas	70	70	50	70-85	70-85
Small industrial factories located in residential areas	70	70	50	70	70

Source:

¹ Refer to Agreement on the National Environmental Standards of Lao PDR, 2009

² Refer to Guidelines for Community Noise of WHO, 1999

Note: #1 = As low as possible

I.7 AIR QUALITY STANDARDS

Air emission and ambient air levels shall be in compliance with the Lao National Environmental Standard for ambient air quality standard as provided below for reference.

Table I.7.1 Ambient Air Quality Standards

Parameters	Symbol	Average Time Unit ¹ : mg/m ³					Method of Measurement	WHO Guideline ² µg/m ³	NAAQ ³ (USEPA) µg/m ³
		Hour			1 month	1 year			
		1 hr	8 hr	24 hr					
Carbon monoxide	CO	30	10.26	-	-	-	Non dispersive infrared detection	-	0.2 ^b
Nitrogen dioxide	NO ₂	0.32	-	-	-	-	Chemiluminescence method	40 ^a	100 ^a
Sulphur dioxide	SO ₂	0.78	-	0.30	-	0.10	UV Fluorescence (1hr, 24hr, 1yr) or Pararosaniline (1hr, 4hr)	20 ^c	50 ^a
Total suspended Particulate	TSP	-	-	0.12	-	0.05	Gravimetric	100 ²	NA ^c
Particulate Matter less than 10 microns	PM-10	-	-	0.12	-	0.05	Gravimetric or Beta Ray or Taper Element Oscillating Microbalance or Dichotomous	50 ^c	100 ^c
Ozone	O ₃	0.20	-	-	-	-	Chemiluminescence or UV Absorption Phoptometry	100 ^b	100 ^b
Lead	Pb	-	-	-	1.5	-	Atomic Absorption Spectrometer	-	0.5 ^a

Source:

¹ Refer to Agreement on the National Environmental Standards of Lao PDR, 2009

² Refer to WHO: Air Quality Guideline, 2005

³ Refer to NAAQS, 2009

Note: a Annual mean
b 8-hr mean
c 24-hr average

I.8 VIBRATION STANDARDS

The vibration standard was not mentioned in the Lao PDR national standard and international standard guideline. Therefore, to compare the results of measuring in construction activities of the Project such as blasting plant and quarry, the guideline for vibration standards from Mining and Quarry in Thailand is proposed in *Table I.8.1*.

Table I.8.1 *Vibration from Mining and Quarry Standard*

Frequency (Hertz)	Velocity (mm/s)	Displacement (mm)
1	Not Exceed 4.7	Not Exceed 0.75
2	Not Exceed 9.4	Not Exceed 0.75
3	Not Exceed 12.7	Not Exceed 0.67
4	Not Exceed 12.7	Not Exceed 0.51
5	Not Exceed 12.7	Not Exceed 0.40
6	Not Exceed 12.7	Not Exceed 0.34
7	Not Exceed 12.7	Not Exceed 0.29
8	Not Exceed 12.7	Not Exceed 0.25
9	Not Exceed 12.7	Not Exceed 0.23
10	Not Exceed 12.7	Not Exceed 0.20
11	Not Exceed 13.8	Not Exceed 0.20
12	Not Exceed 15.1	Not Exceed 0.20
13	Not Exceed 16.3	Not Exceed 0.20
14	Not Exceed 17.6	Not Exceed 0.20
15	Not Exceed 18.8	Not Exceed 0.20
16	Not Exceed 20.1	Not Exceed 0.20
17	Not Exceed 21.4	Not Exceed 0.20
18	Not Exceed 22.6	Not Exceed 0.20
19	Not Exceed 23.9	Not Exceed 0.20
20	Not Exceed 25.1	Not Exceed 0.20
21	Not Exceed 26.4	Not Exceed 0.20
22	Not Exceed 27.6	Not Exceed 0.20
23	Not Exceed 28.9	Not Exceed 0.20
24	Not Exceed 30.2	Not Exceed 0.20
25	Not Exceed 31.4	Not Exceed 0.20
26	Not Exceed 32.7	Not Exceed 0.20
27	Not Exceed 33.9	Not Exceed 0.20
28	Not Exceed 35.2	Not Exceed 0.20
29	Not Exceed 36.4	Not Exceed 0.20
30	Not Exceed 37.7	Not Exceed 0.20
31	Not Exceed 39.0	Not Exceed 0.20
32	Not Exceed 40.2	Not Exceed 0.20
33	Not Exceed 41.5	Not Exceed 0.20
34	Not Exceed 42.7	Not Exceed 0.20
35	Not Exceed 44.0	Not Exceed 0.20
36	Not Exceed 45.2	Not Exceed 0.20
37	Not Exceed 46.5	Not Exceed 0.20
38	Not Exceed 47.8	Not Exceed 0.20
39	Not Exceed 49.0	Not Exceed 0.20
40	Not Exceed 50.8	Not Exceed 0.20

Source: Pollution Control Department (PCD), Ministry of National Resources and Environment, Thailand