MINISTRY OF EDUCATION AND TRAINING

HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPPORT FOR AUTONOMOUS HIGHER EDUCATION PROJECT (SAHEP)

Project code: P156849

SUBPROJECT

IMPROVING IN HIGHER EDUCATION HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

(Final)

January, 2017

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

ABBREVIATION

CSCs	Construction Supervision Consultants
DONRE	Departments of Natural Resources and Environment
EA	Environmental Assessment
ECOP	Environmental Codes of Practices
EMP	Environmental ManaMARgement Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
HUST	Ha Noi University of Science and Technology
MOET	Ministry of Education and Training
PMU	Project Management Unit
PPE	Personal protective equipment
QCTĐHN	Hanoi Capital standard
QCVN	Vietnamese standard
TOR	Terms of Reference
VND	Vietnam Dong
WB	World Bank
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

1. INTRODUCTION

1.1. Overview

The Support for Autonomous Higher Education Project (SASEP) funded by the World Bank (WB) will provide financial and technical support for three universities, namely: Hanoi University of Science and Technology, Industrial University of Ho Chi Minh City, and Vietnam National University of Agriculture. The subproject "*Autonomous higher education project on strengthening research and education in key technologies*" in Hanoi University of Science and Technology will be funded by the WB and the Vietnamese Government through investment into infrastructure construction and procurement of training and research equipment.

The project development objective (PDO) is to improve teaching, research and institutional capacity at selected autonomous universities and to strengthen national higher education system.

The objective of the subproject is to develop Hanoi University of Science and Technology to be a local leading training and research institution in science and technology in Vietnam; Concentrate the resources to improve the training and research quality and efficiency in science and technology development in the priority fields; and support to renovate the operation mechanism, comprehensive and sustainable autonomy.

1.2. Subproject components

The subproject includes four components as follows:

Component 1: ***Improved teaching*** for Electric Engineering-Electronics-Electronic Mechanics and Material Technology majors with two subcomponents:

Subcomponent 1.1: Increased teaching capacity: (1) Develop and accredit the training programs; (2) Train and improve the officials and organizations in the conferences and workshops; (3) Purchase references and learning materials.

Subcomponent 1.2: Equipment procurement for teaching: (1) Procure equipment for the offices, classrooms and labs; (2) Procure new equipment and upgrade 15 training labs;

Component 2: ***Improved research*** in the fields of Electric Engineering – Electronics - Electronic Mechanics and Material Technology; including three subcomponents:

Subcomponent 2.1: Research capacity building: (1) Setup 2-3 joint-industry research programs; (2) Establish 15 regional standardized research teams in two joint-industry fields. (3) Evaluate the science and technology capacity (by international organizations); (4) Increase the quantity and scale of research topics; (5) Increase the number of International Scientific Indexing (ISI) and Scopus.

Subcomponent 2.2: Constructing physical facilities for scientific research: construct building C7 including working offices, labs, practice rooms, meeting rooms, etc. with the area of 9,561m^2.

Subcomponent 2.3: Procurement of lab equipment for research: 16 labs of Electric Engineering- Electronics- Electronic Mechanics and Material Technology majors will be provided with new equipment.

Component 3: ***Improved institutional management***

This component includes (i) Application of integrated Information System (IT) system for higher education governance; (ii) Training for managers and administrative officers on the professional working skills and education governance skills; (iii) Establishment of student administration and academic achievement and financial management system; (iv) Digitalization of new financial management system - including the account and database; (vi) Development of salary and payment management information system; (vii) Development of science and technology database management information system; (viii) Development of intellectual property management information system.

Component 4: *Project Management*: (i) Establishment of Project Management Unit (PMU); (ii) Employment of construction consultant; (iii) Implementation of survey, review and appraisal activities; (iv) Periodic management, evaluation and surveillance; (v) Periodic or unexpected project auditing as per request of the authorities.

Basically, the subproject includes two main contents as follows: (1) Construction of C7 Building on an area of 9,561m^2 with 9 storeys, 1 basement, and construction floor area of 39,480 m^2. (2) Procurement of equipment for training and research in the fields of: Electric Engineering-Electronics- Electronic Mechanics and Material Technology.

The subproject's total investment is US$50 million, in which WB's loan is US$45 million, the institution's co-funding is US$5 million. The subproject implementation period is expected from 2017 to 2022.

According to the Vietnamese Law on Environmental Protection, an Environmental Protection Plan (EPP)[1] needs to be prepared and submitted to the Hai Ba Trung District's Office of Natural Resources and Environment for appraisal and approval. The EPP was submitted for appraisal on September 2016 and expected to be approved in February 2017. This Environmental and Social Management Plan (ESMP) is a part of the subproject's environmental assessment (EA) report, which is one of the important documents to meet the requirements of Policy on Environmental Assessment (OP/BP 4.01) of the World Bank.

The main purpose of the ESMP is to ensure that the mitigation measures to minimize the impacts proposed in the EA of the subproject are implemented. The main contents of the ESMP include a summary of the impacts of the subproject, the mitigation measures, monitoring and implementation during the construction and operation stages of the subproject to eliminate, compensate, or minimize to the extent possible the negative impacts on the environment and society. The ESMP also includes a monitoring program during the construction stage, the role of the relevant stakeholders, reporting procedures, capacity building, and implementation and budget. The ESMP shall be included into the subproject bidding and contractual documents for implementation and supervision during implementation.

1.2. Legal and technical basis for ESMP

1.2.1. Legal and national technical basis

*** Laws:**

- The 2014 Law on Environmental Protection approved on 23rd June 2014 by 7th National Assembly of the Socialist Republic of Vietnam.

- The Law on Capital No. 25/2012/QH13 approved on 21 November 2012 by 13th National Assembly of the Socialist Republic of Vietnam at its 4th session.

- The Law on Construction No. 50/2014/QH13 approved on 18th June 2014 by 7th National Assembly of the Socialist Republic of Vietnam

- The Law on Water Resources No. 17/2012/QH13 approved on 21st June 2012 by 10th National Assembly of the Socialist Republic of Vietnam at its 8th session.

*** Decrees:**

- Decree No. 18/2015/ND-CP of the Government on defining the environmental protection plan, strategic environmental assessment, environmental impact assessment and environmental protection plan promulgated on 14th February 2015.

- Decree No. 19/2015/ND-CP of the Government on defining the details of a number of Articles of the Law on Environmental Protection promulgated on 14th February 2015.

[1]Environmental Protection Plan (EPP) is a simplified EIA for small scale and low risk projects as per government EA regulation.

- Decree No. 03/2015/ND-CP of the Government on defining the environmental damage assessment promulgated on 6th January 2015.

- Decree No. 155/2016/ND-CP of the Government: sanctioning of administrative violations in the field of environmental protection, promulgated on 18th November 2016;

- Decree No. 38/2015/ND-CP of the Government: on management of waste and discarded materials, promulgated on 24th April 2015.

*** Circulars:**

- Circular No. 27/2015/TT-BTNMT of the Ministry of Natural Resources and Environment dated 29th May 2015 on strategic environmental assessment, environmental impact assessment and environmental protection commitment;

- Circular No. 36/2015/TT-BTNMT of the Ministry of Natural Resources and Environment dated 30th June 2015 on management of hazardous wastes.

- The Joint- Circular No. 63 /2013/TTLT-BTC-BTNMT of the Ministry of Finance and Ministry of Natural Resources and Environment on guiding the Government's Decree No. 25/2013/ND-CP of 29th March 2013 on environmental protection charge for wastewater.

*** Decisions**

- Decision No. 609/QD-TTg dated 25th April 2014 on approving the master plan on solid waste disposal of Hanoi Capital to 2030 with vision to 2050

- Decision No. 02/2005/QD-UBND of Hanoi City's People's Committee dated 10th January 2005 on dust minimization in construction.

- Decision No. 16/QD-UBND of Hanoi City's People's Committee dated 3rd June 2013 on general CTR management in Hanoi City.

Applicable standards and codes

- QCVN 03-MT: 2015/BNTMT National technical regulation on the allowable limits of heavy metals in the soils.

- QCVN 05-MT: 2013/BTNMT: National technical regulation on ambient air quality

- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater

- QCVN 26: 2010/BTNMT: National technical regulation on noise

- QCVN 27: 2010/BTNMT: National technical regulation on vibration

- QCVN 01:2008/BXD: National technical regulation on construction planning

- QCTĐHN 01:2014/BTNMT: Technical regulation on industrial emissions in Hanoi Capital

- QCTĐHN 02:2014/BTNMT: Technical regulation on industrial wastewater in Hanoi Capital.

- TCVN 6707:2009/BNTMT on Warning and preventative signs.

- TCVN 6706:2009/BNTMT on classification of hazardous wastes.

- TCVN 5007:2002 - Hazardous chemicals − Code of practice for safety in production, commerce, use, handling and transportation

1.2.2. The World Bank (WB) safeguard policies

(1) Project level

An environmental and social screening of the subproject was undertaken in line with the OP 4.01 and it showed that the World Bank's policy on Environmental Assessment (OP/BP 4.01) is triggered for the project. Physical Cultural Resources (OP/BP 4.11), Involuntary Resettlement (OP/BP 4.12), and Pest Management (OP 4.09) are triggered for the Project. The screening has also resulted in categorizing the project as a Category B subproject due to its moderate, site-specific, and reversible impacts which can be mitigated with readily designed measures. In

addition, the Bank's requirements on public consultation and information disclosure were followed.

(2) Subproject level

Environmental Assessment (OP/BP 4.01)[2]

Environmental Assessment (EA) is an umbrella policy for the Bank's safeguard policies. The overarching objective is to ensure that Bank-financed projects are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. The EA process is intended to identify, avoid and mitigate potential impacts of Bank operations. EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and transboundary and global environmental aspects. EA considers natural and social aspects in an integrated way.

In the Subproject, construction of a building with one basement, 9 storeys and 31 labs for training and research requires judgment, minimization and monitoring of potential adverse impacts on environment and society. According to the policy OP 4.01, an Environmental and Social Management Plan (ESMP) and Environmental Protection Plan (EPP) had been prepared as prescribed by the Vietnamese Government. The subproject's official ESMP and EPP were disclosed in the Bulletin Board of Bach Khoa Ward and website of Hanoi University of Science and Technology on 6th January 2017.

Physical Cultural Resources (OP/BP 4.11)

ESMP had included ECOP which covers a chance find procedure to address issues related to PCRs encountered during construction.

World Bank Group Environmental, Health, and Safety Guidelines[3]

World Bank-financed subprojects should also take into account the World Bank Group Environmental, Health, and Safety Guidelines4 (known as the "EHS Guidelines"). The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice.

The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group and are generally considered to be achievable in new facilities at reasonable costs by existing technology. The environmental assessment process may recommend alternative (higher or lower) levels or measures, which, if acceptable to the World Bank, become subproject- or site-specific requirements. This subproject should conform to these Guidelines.

World Bank Group Environmental, Health, and Safety Guidelines:

World Bank-financed projects should also take into account the World Bank Group Environmental, Health, and Safety Guidelines[5] (known as the "EHS Guidelines"). The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice.

The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group and are generally considered to be achievable in new facilities at reasonable costs by existing technology. The environmental assessment process may

[2]The full treatment of OP/BP 4.01 can be found at http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTSAFEPOL/0,,contentMDK:20543912~menuPK:1286357~pagePK:64168445~piPK:64168309~theSitePK:584435,00.html

[3]The EHS Guidelines can be consulted at www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines .

[5]The EHS Guidelines can be consulted at www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines.

recommend alternative (higher or lower) levels or measures, which, if acceptable to the World Bank, become subproject-or site-specific requirements. This subproject should conform to the General EHS Guidelines.

Sustainable Design Guide

The subproject is encouraged to apply the Sustainable Design during engineering design for buildings and other facilities to help protect the human health and the environment. The main objectives of sustainable design are to reduce, or completely avoid, depletion of critical resources like energy, water, and raw materials; prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and create built environments that are livable, comfortable, safe, and productive.

Buildings use resources (energy, water, raw materials, and etc.), generate waste (occupant, construction and demolition), and emit potentially harmful atmospheric emissions. Building owners, designers, and builders face a unique challenge to meet demands for new and renovated facilities that are accessible, secure, healthy, and productive while minimizing any negative impacts on society, the environment, and the economy. Ideally, building designs should result in net-positive benefits to all three areas (Source: EPA, USGBC – Leadership in Energy and Environmental Design (LEED)). See Appendix 3 for detailed guide on Sustainable Design.

1.2.3. International standard for laboratory

ISO 17025:2005. The laboratories will be constructed towards achieving ISO 17025:2005. ISO/IEC 17025:2005 specifies the general requirements for the competence to carry out tests and/or calibrations, including sampling. It covers testing and calibration performed using standard methods, non-standard methods, and laboratory-developed methods.

It is applicable to all organizations performing tests and/or calibrations. These include, for example, first-, second-, and third-party laboratories, and laboratories where testing and/or calibration forms part of inspection and product certification.

ISO/IEC 17025:2005 is applicable to all laboratories regardless of the number of personnel or the extent of the scope of testing and/or calibration activities. When a laboratory does not undertake one or more of the activities covered by ISO/IEC 17025:2005, such as sampling and the design/development of new methods, the requirements of those clauses do not apply.

ISO/IEC 17025:2005 is for use by laboratories in developing their management system for quality, administrative and technical operations. Laboratory customers, regulatory authorities and accreditation bodies may also use it in confirming or recognizing the competence of laboratories. ISO/IEC 17025:2005 is not intended to be used as the basis for certification of laboratories. Compliance with regulatory and safety requirements on the operation of laboratories is not covered by ISO/IEC 17025:2005.

2. SUBPROJECT DESCRIPTION

2.1. Subproject location

The subproject area is located within the campus of Hanoi University of Science and Technology (HUST) in Tran Dai Nghia Street, Bach Khoa Ward, Hai Ba Trung District, approximately 4km far from Hanoi Center towards the South of the City.

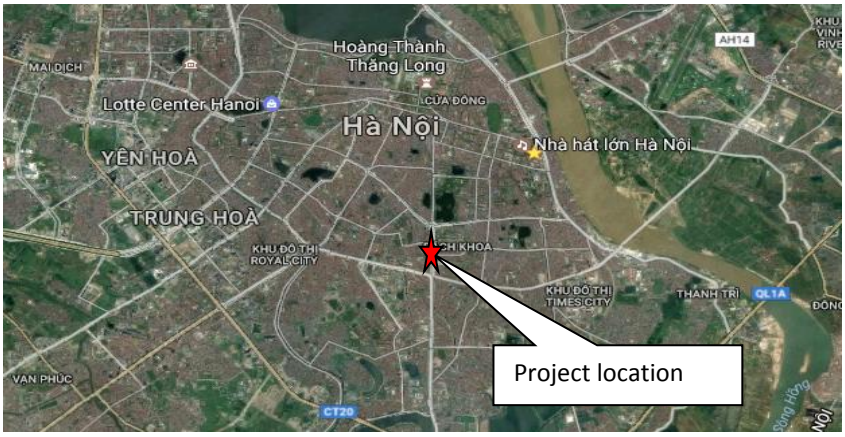


Figure 1. Subproject location

The subproject site is bordered by

+ The East: Tran Dai Nghia Street and about 50m far from the Dormitory;
+ The West: the university internal road and about 30m far from building C5 and C10;
+ The South: the university internal road and about 50m far from building D3;
+ The North: the university internal road and about 15m far from building C6;

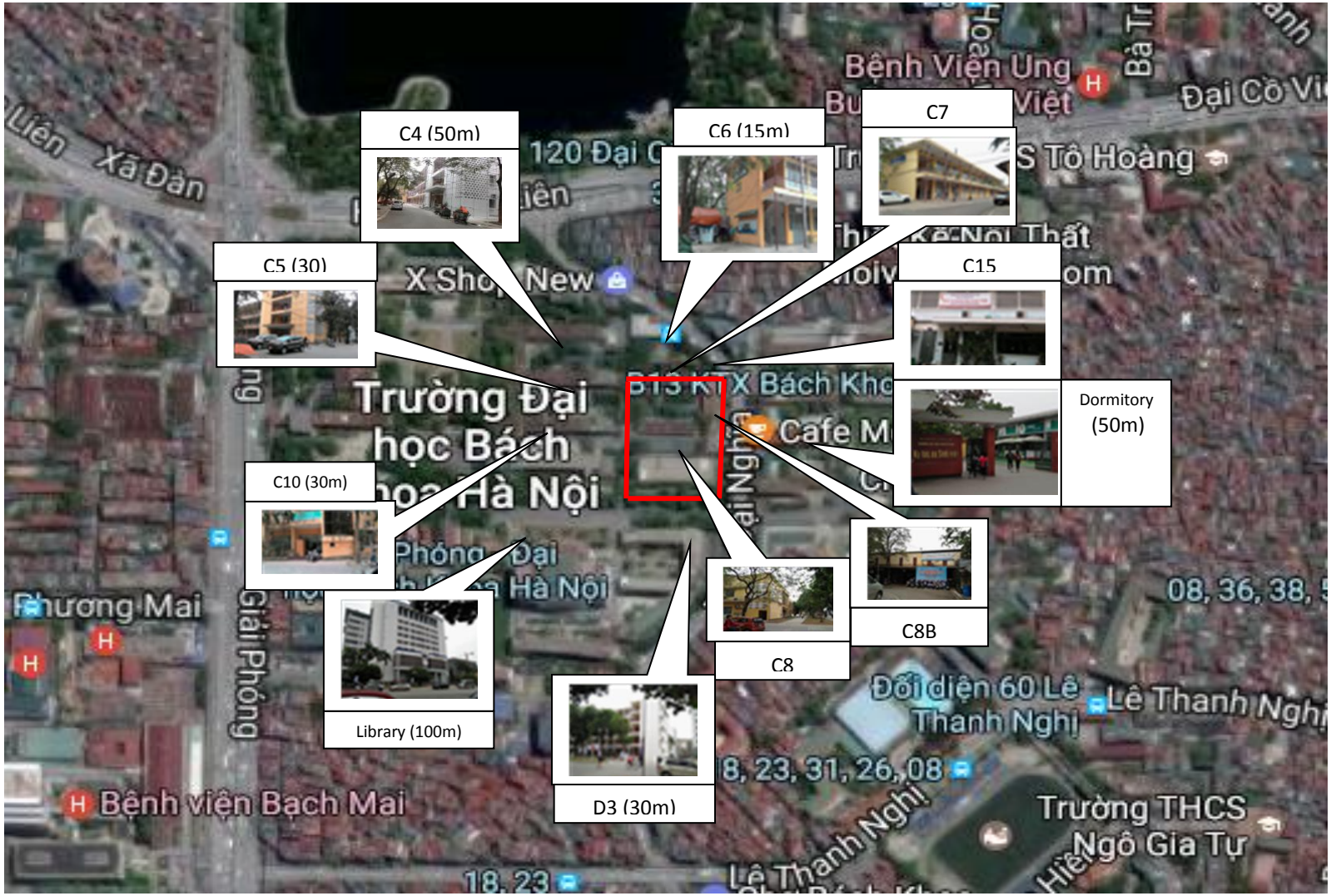


Figure 2. Subproject site and surrounding subjects

Subproject site (Distance to the subproject)

2.2. Subproject items

The subproject has 2 components that would cause the potential adverse impacts during implementation and operation, including Component 1 (Subcomponent 1.2: Procurement of equipment for 15 training labs); Component 2 (Subcomponent 2.2: Construction of building C7 and Subcomponent 2.3: Procurement of equipment for 16 research labs).

2.2.1. Construction items under Subcomponent 2.2

1. Pre-construction phase

In order to take the site for constructing building C7, 6 current reinforced concrete buildings in the university must be demolished. The area of dismantling works are described as follows:

Table 1. Number of demolished works

No.	Works	Construction area (m^2)	Use area (m^3)	Use period
1	 C7	387	463,92	1996
2	 C8	425	901,52	1996
3	 C8b	256	237,8	1999
4	 C15	289	716,84	2006
5	 Workshop room	289	352,08	2002

No.	Works	Construction area (m^2)	Use area (m^3)	Use period
6	 Transformer station	45	38	2002
	Total		**2,710.16**	

Source: Techno-economic report of the Project, 2016

Pre-construction phase is carried out within one month. Wastes from these activities are mainly wasted bricks and other construction debris to be loaded onto 10 ton truck and transported to Duyen Ha Landfill, Thanh Tri District, Hanoi, 20km far from Hanoi and discharged by URENCO Hai Ba Trung.

2. Construction phase

Construction items of building C7 as well as the numbers of students, lectures and management staffs using the construction works in Sub-component 2.2 are shown in the following table:

Table 2. Summary on the construction work items under Sub-component 2.2

No	Items	Unit	Scale	No.	Items	Unit	Scale
1	Project land area	m^2	9,561	**14**	80m^2 transformer station room	room	1
2	Construction land area	m^2	5,086	**15**	100m^2 generator room	room	1
3	Floor area	m^2	39,480	**16**	50m^2 master cabinet room	room	1
4	Institutes' Office	room	28	**17**	1,600 KVA transformer	pcs	2
5	Meeting hall	room	31	**18**	1,250 KVA generator	pcs	2
6	Working office	room	237	**19**	1000 kg elevator	pcs	4
7	Training lab	room	101	**20**	Staircase	pcs	5
8	Research lab	room	72	**21**	750m^3 clean water tank	pcs	1
9	Meeting hall	room	1	**22**	Wastewater treatment tank	pcs	2
10	Archive room	room	4	**23**	Number of students, lecturers	person	6,000
11	Dining room	room	4	**24**	Basement	storey	1
12	Student affair room	room	4	**25**	Number of storeys	storey	9
13	Toilet	room	18	**26**	Height of the works	m	36.6

Source: Techno-economic report of the Project, 2016

Building C7 also includes the technical infrastructure system: 2,164m^2 local traffic system; 700m^2 of trees and bonsais; water supply and drainage system; power supply and lighting system; communication system. Building C7 is characterized by a 3m high basement; 4.2m high first floor; 3.6m height per each 2^{nd} - 9^{th} floor and total construction height of 36.6m. The

designed works are at grade II; provided with the fire ratings of II; and resisted against the 7 grade earthquake intensity under the MSK - 64 system.

Quantity of construction materials

Table 3. Quantily of construction materials

No.	Materials	Unit	Quantity
1	Stone	Ton	27,720
2	Coarse sand	Ton	12,450
3	Cement	Ton	9,695
4	Additives, plastics	Ton	450
5	Steel and metals	Ton	3,275.3
6	Building brick	Ton	5,500
7	Fine sand	Ton	3,090
8	Wall paint	Ton	16
9	Tile	Ton	750
10	Pavestone	Ton	30
11	Road concrete	Ton	120
	Total	**Ton**	**58,156.3**

Source: Techno-economic report of the Project

Main construction activities

- Demolish 6 old buildings available at the subproject site to create 2,710.16m^3 of construction waste.
- Conduct basement earthworks: Dig 1.8m depth in the land area of 9,561m^2 to construct one basement. Excavated soil volume is 1.8m x 9,561m^2 = 17,209.8m^3
- Transport construction materials: Volume of materials to be transported is 58,156.3 tons. Transport wastes: brick and stones generated from dismantling 6 current buildings; excavated soil from basement earthworks; construction wastes.
- Prepare the mortar, concrete and form work.
- Construct building C7 with 9 storeys, one basement, reinforced concrete structure, yard, garden, path system, elevator and staircase, fire protection system, water supply and drainage system.
- Install equipment for labs.

Construction material supply sources:

- Stone: 40km far from the subproject site.
- Sand and cement: 10km far from the site.
- Commercial brick and concrete: 50km far from the site.
- Steel and metals: 60km far from the site.
- Paints and others: from primary agents right in Hanoi, about 2km far from the site.

Distance for transporting raw materials is 2-60km. Roads used to transport raw materials are mainly suburbs and inner city roads. The inner-city road is characterized by 2km length and high population density.

The number of workers in peak hours is about 150 persons. The local workers are employed to construct the subproject for 8 hours per day. Therefore, no worker camps will be required. The accommodation is arranged for 5 persons as security officers and warehouse managers who shall stay at the works 24/24. The personal washing and cleaning shall be conducted in toilets of the existing buildings surrounding the subproject.

The expected construction period is 24 months. The total investment is VND 451,213,000,000 as indicated in Table 4 below.

Table 4. Total investment for contruction of C7

No.	Activities	Expenses (VND)	Expenses (USD)
1	Works construction	289,522,100,000	13,160,095
2	Civil engineering for infrastructure	10,565,280,750	480,240
3	Construction equipment	44,610,654,000	2,027,757
4	Interior furniture	45,778,414,000	2,080,837
5	Project Management	4,748,018,709	215,819
6	Construction investment consultancy	13,159,012,173	598,137
7	Others	5,971,380,301	271,426
8	Contingencies	36,857,644,518	1,675,347
	Total	**451,212,503,702**	**20,509,659**

Exchange rate: 1 USD ~ 22,000 VND (2016)

2.2.2. Investment in laboratory equipment

Subcomponent 1.2: Inversment for 15 training labs

Training equipment for labs in the fields of Electric Engineering- Electronics- Electronic Mechanics and Material Technology will be invested. However, the list and quantity of equipment to be purchased are not yet specified. The preliminary list may be given out as follows:

Table 5. List of equipment in sub-component 1.2

No.	Name of laboratory	Equipment
I	**Electric Engineering- Electronics- Electronic Mechanics**	
1	Electric- electronic circuit labs	- Digital electronic console; - Analog digital console; - Microprocessor digital console; - Long line testing bench; - Electrical circuit and field simulation testing bench.
2	Power electronic lab and converters	- CS semi-conductor elements; - Adapter; - Adapter test kit; - Inverter set; - AC impulse sealer; - DC impulse set.
3	Electromechanical control lab	- DC electromechanical drive practice table; - Practice table for 3-phase asynchronous drive system; - Practice table for synchronous electromechanical drive
4	Electrical machine and switchgear lab	- Electrical machine; - Switchgear
5	Measurement lab	- Measurement instrument testing device; - Virtual measurement instrument; - Industrial communication; - Industrial sensor.
6	Actuator lab	- Compressed air drive console practice table; - Practice table for hydraulic drive control; - Practice table for compressed air hydraulic drive application model; - Robot control model; - Practice table for hydraulic engine position and speed control.
7	Control lab	- Introduction to Control; - Digital Control System; - Process Control System.
8	Signal digital processing lab	- Signal digital processing table; - Modeling table for signal system; - Circuit theory model; - Signal measurement table.
9	Parameter design lab	- Digital system model; - Computer architecture model; - Microprocessor; - Digital electronic table.
10	Technical and communication system lab	- Electromagnetic Field Model; - Ultra-frequency technical system console; - Wave propagation antenna; - Radio communication processor.
11	Mechanic- electronic manufacturing labs	- Dynamics system; - Signal measurement and processing system; Mechanical and electrical control system; - Electronic

No.	Name of laboratory	Equipment
		mechanical system model for production.
12	Mechanic- electronic design and simulation lab	- System modeling and design; - System simulation set; - Module designer, assembly and Mechanic- electronic control programming; - Mechanic- electronic manufacturing system.
II	**Materials technology**	
1	General materials lab	- Material test and evaluation tool kit; - Diffuser and phase transition device; - Metal material analysis.
2	Material structure and morphology lab	- Optical microscope; - Spectrometer/raman image diffuser; - Scanning electronic microscope; - Atomic Force Microscope.
3	Materials manufacturing labs	- Powder/nano materials manufacturing machine; - Two-way nano structured material manufacturing machine; - Nano fiber material manufacturing machine; - Thin film material manufacturing.
4	Materials simulation labs	- Material model; - Nano structure analyzer; - Metal characteristics analyzer.

Estimated total investment of the subproject is shown as follows:

Table 6. Details of the sub-component cost

No.	Name of Labs	Budget (USD)
I	**Electric Engineering- Electronics- Electronic Mechanics**	
1	Electric- electronic circuit labs	633,600
2	Power electronic lab and converters	437,218
3	Mechanical electrical control system lab	312,391
4	Electrical machine & switchgear lab	358,500
5	Measurement and sensor technical lab	412,900
6	Actuator lab	497,936
7	Control engineering lab	620,000
8	Signal processing lab	531,160
9	Digital system design lab	715,790
10	Technical and communication system lab	1,405,580
11	Mechanic- electronic design and simulation lab	793,860
12	Mechanic- electronic manufacturing lab	794,500
	TOTAL	**7513435**
II	**Materials technology**	
1	General materials lab	606,361
2	Materials manufacturing lab	525,374
3	Material structure analysis and morphology lab	1,240,133
4	Materials simulation lab	212,641
	TOTAL	**2,584,509**

Subcomponent 2.3: Inversment for 16 research labs

Scientific research equipment for labs in the fields of Electric Engineering- Electronics- Electronic Mechanics and Material Technology is invested. However, the list and quantity of equipment to be purchased are not specified by the subproject, the preliminary list may be given out as follows:

Table 7. Lists of equipment for Sub-component 2.3

No.	Name	Equipment

No.	Name	Equipment
I	**Electric Engineering- Electronics- Electronic Mechanics**	
1	Communication research lab	- 4G, 3G, 2G mobile terminal measurement instrument; - GNSS, Bluetootth, RFID, & NFC standard measurement analyzer; - WAN network emulator; - near-field measurement system.
2	Chip design and embedded system lab	- Machine and software for protocol analysis and decoding high-speed data forms; - High performance computer server; - PC network connection device (switch, hub, router); - High performance development kit; - Printed circuit and sample circuit manufacturing machine.
3	Biomedical engineering lab	- Noninvasive cardiovascular system evaluation; - MRI research system; - Software for processing, analyzing and displaying biomedical signals and images; - Robot recovery system.
4	3D printing and rapid prototyping lab	- 3D scanner engine and Nikon software and accessories, - Sintering furnaces, - Laser microscope system; - AD100 precision scale.
5	Mechanic- electronic design and control lab	- PC - Software design - SCADA software; - UAV-Spy Owl 200 - Research Version; - Martin UAV Bat 4; Sensors: TASE 150/200 / 300 or 400 of gimbal system with E / O, infrared camera and digital camera to take photograph with high resolution.
6	Control engineering lab	- Vision monitoring system; - Simulation and control system; - Workstations; - OPAL-RT system; - Working mechanical tools (Drilling console, Milling Tools, Mechanical Toolbox, etc.); - Automatic working tools.
7	Electric machine design and manufacturing lab	- Ansys Maxwell, Ansys RMxprt, Ansys Pexprt, Ansys SimplorerSoftware; - Motor-CAD Software; - 3-phase asynchronous AC engine testing system within the range of 0.5 kW - 14 kW. Including all basic components; - DS1104 workstation; MPG HF material testing set; - VLM Labtec micro-climate testing cabinet; Powerful configuration PC.
8	Sensor engineering lab	+ Software: ANSYS software for piezoelectric; - Sensor measurement bench; - Temperature and humidity calibration cabinet for sensor; - Ultrasonic sensor for positioning acoustic wave failures.
9	Electrical transformation engineering lab	- Testing system for electronic energy; - PSIM; Mechanical start calculation software; - Universal machine; - Electrical quality analyzer; - System (EMC).
II	**Materials technology**	
1	Ceramics materials lab	- Materials measurement system for concrete and cement; - Compressor and curve testing machine; - High pressure autoclave; - Stainless steel dryer; - Low speed polishing machine; - polarization microscope.
2	Functional polymer materials lab	- DMA; - High resolution camera; - Salt spray test chamber; - Screw extruder; - Rubber mixer; - Ozone test chamber.
3	Metal and alloy materials lab	- Vacuum induction melting furnaces; - ACR electrical system; - Plasma system for vacuum sintering; - Freezer; - Mould for SPD; - System vacuum heat treatment system.
4	Environmental catalytic materials lab	- Gas analysis system; - Vacuum extractor; - Relative humidity meter; - Gas chromatography machine.
5	Electronic materials lab	- Liquid phase plasma system; - Compact electrification system for sensor; - Target multiple sputtering system; - Standard wet Bench Teflon mixing system for clean rooms; - Automatic gas-

No.	Name	Equipment
		sensing measurement system; - QCM Q-Sense-E4 gas-operated power system; - Vacuum Probe System (4-probe)
6	Biomedical materials lab	- Deionized water machine; - Hydrothermal device; - Analytical balance; - Dryer; - Viscometer; - Ultrasonic equipment; - Drug testing device.
7	Material structure analysis and morphology lab	- Transmission electron microscope; - Energy dispersive spectrometry set; - Diffraction spectrometer; - Atomic absorption spectroscopy device; - X-ray photoelectron spectrum device; - FTIR infrared spectroscopy device.

Estimated total investment of the subproject is shown as follows:

Table 8. Details of the sub-component cost

No.	Name of Labs	Budget (USD)
I	**Electric Engineering – Electronics - Electronic Mechanics**	
1	Electric machine design and manufacturing lab	698,558.40
2	Sensor lab	567,432.92
3	Control engineering lab	490,500.00
4	Electrical transformation engineering lab	696,604.50
5	Communication research lab	1,009.80
6	Chip and embedded system lab	554,40
7	Biomedical engineering lab	589,050.00
8	3D printing and rapid prototyping lab	658,566.00
9	Mechanic- electronic design and control lab	1,711,497.70
	TOTAL	**6,976,408.52**
II	**Materials technology**	
1	Electronic materials lab	1,900,000
2	Metal and alloy materials lab	1,320,000
3	Polymer composite materials lab	710,000
4	Ceramic material lab	900,000
5	Environmental catalytic materials lab	900,000
6	Biomedical materials lab	1,000,631
7	Research program	775,000
	TOTAL	**7,505,631**

3. NATURAL ENVIRONMENTAL AND SOCIO–ECONOMIC CONDITIONS

3.1. Geological and topographical conditions

The subproject site is characterized by urban plain terrain. According to the geological survey report, the geological characteristics at the subproject site are shown in the Table 9.

Table 9. Project's geological characteristics

No.	Layer	Components	Layer thickness (m)	SPT
1	Layer 1	Upper part of bitumen concrete road base, below fine sand, gray brown and yellow brown mixed with construction waste	1	-
2	Layer 2	Semi-hard and hard gray yellow, tan and brown mahogany loam	3.4 – 3.8	10 -12
3	Layer 3	Semi-hard and hard gray yellow, tan and brown mahogany loam	7	9 - 12
4	Layer 4	Medium and fine grain compact ash gray, gray brown sand	7.4 – 11.7	9 - 20
5	Layer 5	Plastic gray brown, pink brown and brown mahogany clay sand	5.8 – 10.8	11 - 18
6	Layer 6	Liquid-liquid gray brown, light gray, ash gray loam	2.5 – 4.0	16 – 19
7	Layer 7	Compact medium-fine grain gray, ash-gray sand mixed with quartz gravels	7.2 – 14.4	19 – 23
8	Layer 8	Plastic liquid - liquid brown pink, gray-brown, gray sand clay	4.8 – 5.3	20 – 30
9	Layer 9	Compact fine grain gray, gray white sand mixed with quartz gravels	2.9 – 5.1	36 - 45

Source: Project engineering geological survey report, 2016

3.2. Hydrological, climatic conditions

The subproject area is in Hanoi which is characterized by tropical monsoon, hot, rainy, stormy climate in summer and cold, rainless or sometimes frost fog in winter. According to 2015 Hanoi Statistical Yearbook, number of sunlight hours was 1,314.8h; average humidity was 78%. The hot season starts at the end of April to the mid of September, the average temperature of months is 25.4^{o}C, the highest temperature is 38.9^{o}C (June), the maximum rainfall is 388mm (Lang Station - June), main wind direction is Southeast. The cold season starts from November to the end of next March the average temperature of months in this season is 19.5^{o}C, the lowest temperature is 18.1^{o}C (January), the lowest rainfall is 12.6mm (Lang Station - January), prevail wind direction is Northeast.

3.3. Infrastructure conditions

Within the radius of 50m surrounding the subproject site, buildings C5, C10, D3 and C6 are location of halls, research institutes and training centers to serve for teaching and learning of 2,000 students and lecturers. Especially, the entrance gate in Tran Dai Nghia Street which borders with subproject site is the main entrance of the students, lecturers and teaching staffs related high traffic density.

Buildings C10 and C5

Entrance gate in Tran Dai Nghia Street

3.4. Solid waste management system

Solid wastes of the university are divided into domestic waste and hazardous waste. The domestic wastes generated from the halls, labs, practice centers and canteens are collected into PVC 20l dustbin and loaded to the garbage truck to transport to the temporary solid waste storage area. The hazardous wastes are classified and transported to the hazardous waste store of the university. The university had signed the Contract No. 2016020135 with URENCO - Hai Ba Trung Branch to transport and treat domestic waste and hazardous solid wastes.

Dust bins.

3.5. Wastewater collection and treatment system

Hanoi University of Science and Technology has two wastewater collection and treatment systems, including: domestic wastewater and wastewater from lab and research center. Wastewater from lab and research center is collected by two ways: (1) Wastewater from C10 and C5 is collected by PCV D80 pipes to laboratory wastewater treatment system with capacity of 85m^3/day.night operated from 2015. (2) Wastewater from other labs are contained in drums V = 250l once per week or full drums. It shall be discharged to the input wastewater collection tank by officers trained about chemical safety. The output wastewater is met column B, QCVN 40:2011/BTNMT, before discharging into the city's general drainage system. Currently, such system is only operated with 70% of designed capacity.

Domestic wastewater is collected by PVC D160 pipeline into the treatment tanks. In 2016, one wastewater treatment system with capacity of 500 m^3/day and night was built; 37 wastewater treatment systems with total capacity of 1,100m^3/day and night were built 5 years ago and successfully treated the wastewater generated from the halls and labs; the domestic wastewater was treated and met column B, QCVN 14:2008/BTNMT before discharging into the city's drainage system.

Lab's wastewater treatment system
Capacity of 85m^3/day and night

Domestic wastewater treatment system
Capacity of 500 m^3/day and night

3.6. Power and water supply system

Water supply is taken from the City's running water sources managed by Hanoi Water Co., Ltd. Clean water is provided along D220 pipeline located in Dai Co Viet Street through D180 pipeline to guide water to the buildings.

Power supply is provided from the national grid through 10 transformer stations with capacity of 1,250 KVA.

3.7. Road system

The road system in the university is divided into internal and external roads. The internal roads are 8-10m wide bitumen roads to serve for local traffic within the campus.

Local road within the campus.

Tran Dai Nghia Street.

The university is surrounded by urban roads with 12-24m wide pavement with high traffic density, especially in peak hours. Many affected subjects are available in such road when the subproject is implemented such as: the Ministry of Education and Training; Civil Engineering University; National University of Economics; Bach Mai Hospital; National Otorhinolaryngology Hospital, etc., and adjacent residential areas in such road.

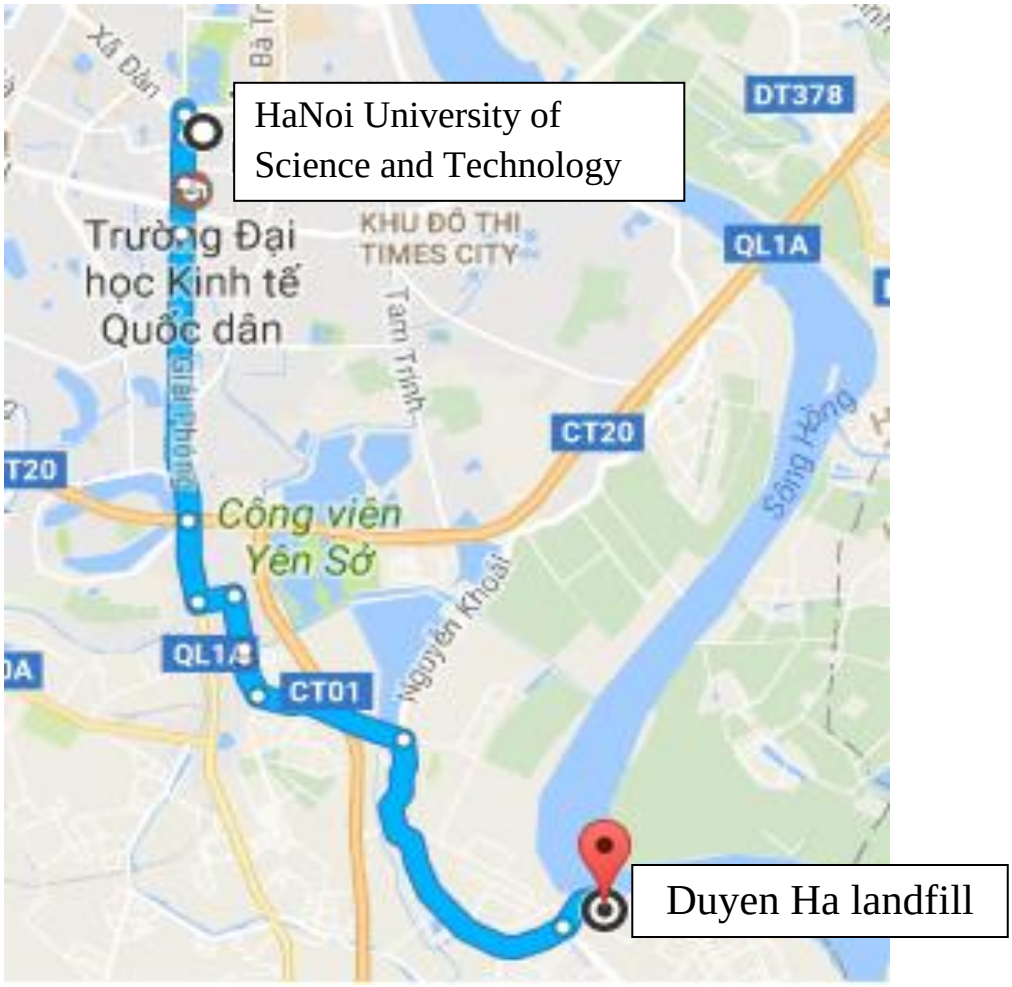


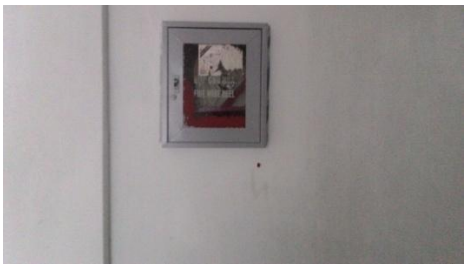
Figure 3. Waste transrpotation route

Figure 4. Sensitive areas on the contruction material and waste transportation road

3.8. Fire protection

The campus has been fully provided with fire protection measures: Hydrants arranged in the local roads; automatic fire alarming in divisions, especially labs and practice centers. Training course is held twice per year to improve the awareness of fire protection for the students, lecturers and employees.

Roadside hydrants



Fire boxes inside the buildings

3.9. Education condition

Hanoi University of Science and Technology was established in accordance with the Decree No. 147/ND dated 6th March 1956 with total employees of 1,950 persons, 1,192 lecturers and 394 teaching staffs and science researchers. Hanoi University of Science and Technology is now training approximately 40,000 students (2014), postgraduate and candidates with: Engineer in 75 majors; Master in 33 majors; Doctor in 57 majors. The Institution is now the home of 24 Departments - Institutes, 27 centers with over 200 halls, classrooms and large squares with a complete system of meeting halls. Nearly 100 labs are available, including 7 national key labs and equivalents, approximately 20 practice labs.

Hanoi University of Science and Technology need to invest in training and scientific research in the fields of Materials Technology, Mechanics, Electrical Engineering and Electronic Communication to develop the science and technology in the society, serving for socio-economic development requirements, accessing to the world's advanced qualification and developing the professional skills. Therefore, it is required to improve the synchronous technical and physical facilities, develop the advanced training programs and procedures to serve for study and creative research of the students and lecturers.

3.10. The existing components of natural environment

To assess the environmental quality in the subproject site, 3 air samples and 1 soil sample were taken on 10th December 2016, 3 air samples including 2 samples in C7 and C8 Buildings; 01 sample in dormitory's gate. The results showed that 100% of the parameters is smaller than the limits of the national standards (QCVN 05:2013/BTNMT and QCVN 26:2010/BTNTM), specifically: concentration of CO is less than 3.2 – 3.8 time; NO_2 is less than 2.1 – 2.8 times; SO_2 is less than 2.8 – 3.3 times; dust is less than 1.3 – 2.4 times; Noise is less than 1.1 - 1.3 times.

The subproject must dig 1.8m deepth soil to construct one basement. In order to determine if such soil is contaminated with toxics subtances such as heavy metals, one sample was taken in the subproject site to inspect the quality. The analysis results unveiled that Cu, Pb, Zn, Cd, As, Hg are within the allowable limits of QCVN 03-MT:2015/BTNMT. Therefore, the excavated soil of basement may be treated as general wastes.

Soil sampling

Air measurement

4. ENVIRONMENTAL AND SOCIAL IMPACTS

4.1. Pre-construction phase

4.1.1. Generic impacts

a. Air quality impacts

- ***Dust:*** generated by demoliting the old works, transporting demolished wastes. The Project Technical Economic Report showed that demolition waste volume need to be transported about 2,710.16m^3; According to the quick assessment document released by WHO, the emission coefficient is 0.1 – 1g/m^3 of wastes, then dust generated shall be 2.7kg (1g/m^3 * 2,710.16m^3 = 2.71kg). Dust diffusion time is about one month. Dust directly affects the field workers; 2,000 students and lecturers in C6, C10, C5 and D3 and the pass-by persons in the subproject site. The impact can be assessed as moderate and can be minimized during pre-construction.

- ***Air emission:*** generated by using diesel in vehicles and trucks at the site. With the waste volume of 2,710.16m^3; 388 turns of 10 ton trucks need be used to transport to Duyen Ha Landfill to discharge, 20km far from the subproject site. According to the WHO's quick assessment guideline, the emission volume of SO_2: 0.08kg; NO_x: 0.37kg; CO: 1.58kg. The affected subjects are field workers, students and lecturers studying in C5, C10, C6 and D3 as well as local residents along the road to transport wastes. The demolition time is about one month, and the impacts can be assessed as small and mitigated with measures outlined in ECOPs.

- ***Noise****:* generated by clearance using concrete breakers to demolish buildings and fences; excavators and trucks to transport demolition waste. Results of separate noise assessment for each construction and transport vehicles and as well as resonant noise are estimated and presented in Table 10.

Table 10. Resonant noise generated from active vehicles and machines

No.	Transport and equipment	Noise 1 m away from the source		Noise 20 m away from the source	Noise 50 m away from the source
		Range	Average		
1	Watering vehicles	82.0 - 94.0	88	62	54
2	Trucks	82.0 - 94.0	88	62	54
3	Dredging machines	72.0 - 84.0	78	52	44
4	Scrapers, levelers	80.0 - 93.0	86.5	60.5	52.5
5	Rollers	72.0 - 74.0	73	47	39
6	Bulldozer		93	67	59
7	Excavator	72.0 - 84.0	78	52	44
	Resonant noise		95.8	69.8	61.8
	QCVN 26/2010/BTNMT: 6:00 to 21:00 is 70 dBA; from 21:00 to 6:00 is 55 dBA;				
	Standard of Health Ministry: noise in the production area: contact time in 8 hours is 85 dBA				

Results show that the noise level is considered moderate. The construction sites are all 20 m far away from the other buildings. The shortest distance from the construction area to sensitive area only C6 (15m). Therefore, it can be said that impacts of noise due to the construction machines and equipment in the pre-construction phase are marginal and insignificant. People subject to this impact are mostly the staffs, students, lectures and construction workers.

- ***Vibration:*** The use of heavy trucks to transport materials as well as the operation of motorized vehicles in construction will cause substantial vibration in the construction sites, especially in carpeting roads and concrete piling. The forecast results are presented in Table 11.

Table 11. Vibration attenuation with distance from construction machines

No	Machines	Source vibration (r0=10m)		Vibration attenuation with distance							
				r=12m		r=14m		r=16m		r=18m	
		Laeq (dB)	Lveq (mm/s)	Laeq (dB)	Lveq (mm/s)	Laeq (dB)	Lveq (mm/s)	Laeq (dB)	Lveq (mm/s)	Laeq (dB)	Lveq (mm/s)
1	Excavator	80	1.72	70.5	0.58	61.1	0.20	51.9	0.07	42.6	0.02
2	Bulldozer	79	1.53	69.5	0.51	60.1	0.17	50.9	0.06	41.6	0.02
3	Heavy truck	74	0.86	64.5	0.29	55.1	0.10	45.9	0.03	36.6	0.01
4	Compactor	82	2.17	72.5	0.73	63.1	0.25	53.9	0.08	44.6	0.03
5	Air pressor	81	1.93	71.5	0.65	62.1	0.22	52.9	0.08	43.6	0.03
QCVN 27:2010/BTNMT, allowing 75dB from 6am ÷ 21pm and 60dB from 21pm÷ 6am.											

Source: Air pollution in urban and industrial areas, Technology Publisher, 1992

From the results in the table above within distance of 12m, the vibration levels from operating machines are higher than QCVN27:2010/BTNMT and from 14m or more the vibration falls within allowable limits. With this range the objects that will be affected include works located around the construction areas such as water supply and drainage works, electrical systems and communications. However the civil infrastructure and building are located outside the distance of 15m (Building C6) from the outer boundary of the subproject and vibration impacts are assessed to be negligible.

b. Water quality impacts

- ***Domestic wastewater:*** Arisen from the field workers' living activities. According to QCVN 01:2008/BXD, the water supply norm for worker is 48 l/person/day. With 15 workers in-charge of pre-construction, the generated domestic wastewater is about 0.72m^3/day. Components of domestic wastewater are mainly deposits, suspended solids (SS), BOD, COD and nutrients (N, P) and microorganisms affecting the receiving courses and soil. However, the wastewater receiving source is the drainage system of Hanoi City. This impact is negligible and easily managed through site management plans.

- ***Runoff:*** The maximum rainfall is 388 mm/month. Rainfall in subproject site during pre-construction is 3.7m^3 (388 mm/month * 9,561m^2). Pollutant components are mainly SS flown by rainwater. The impact period is only in rainy days within a month of pre-construction. This impact is insignificant and possibly minimized.

c. Impacts of solid wastes and hazardous wastes

- ***Domestic solid wastes*:** There are 15 people working at construction site of the subproject and the total volume of domestic solid waste is 7.5 kg/day. However, no worker camps will be arranged in the University and contractors will have to hire local workers who have accommodation in residential areas. In addition the city's garbage collectors go to the University to collect and transport waste, therefore this impact is considered insignificant.

- ***Construction solid wastes**:* According to calculations, the total volume of waste generated during pre-construction phase is about 2,710.16m^3. Its main component is broken bricks. This waste can be collected and transported to the Duyen Ha construction landfill. The impact is assesed as minor and in short-time.

- ***Hazardous wastes:*** Hazardous wastes generated in this period are mainly from maintenance, oil replacement and repair of construction machines at the site. The hazardous waste volume generated in this phase is 10kg/month. The Subproject Owner will require the construction units, all major repairs and periodic maintenance of construction machines must be carried out in garages, instead of open site. Only small response activities are allowed to be implemented at the site. Hence, this impact can be assessed as minor and possibly minimized.

d. Impacts on traffic in campus and surrounding areas: It is generated from activities of transporting the demolition wastes to the landfill. 388 turns of 10 ton trucks shall impact on the local roads in one month. 13 trips on average per day are used, adversely affecting the internal and external local traffic conditions, especially the roads along Tran Dai Nghia, Dai Co Viet and Giai Phong streets with high population and traffic density. It affects the students, lecturers, field workers and traffic safety of the local people who are living and transporting along the road. Given the densely populated area within and around the university, the impact could be assessed as moderate.

4.1.2. Site-specific impacts

Impacts from demolition work

To prepare the construction site, 6 current buildings (detailed in Table 1) with the total areas about 2,710m^2 must be demolited. Demolition work is characterised by high labour turnover, constantly changing circumstances on site, and the possible presence of several contractors. Work related hazards include:

- Dust raised by the demolition work.
- Noise and vibration caused by the machines, hand-tools, explosives, and falling/collapsing parts of the building.
- Coldness, heat, and ultraviolet rays from the sun, as a great deal of the work has to be done in the open.
- When taking the building down bit by bit, workers would have to do arduous manual work often at elevated levels. This includes hazards such as falls from height, slip, trips and falls, electric hazards, heavy loads, constrained postures, fires and explosions while operating gas cutters, oxygen lances and similar equipment.
- Knocking or pushing down a building is normally done by using an excavator or other heavy machines. These can be become instable because of overloads or uneven ground, wire ropes may break or appliances such as a demolition ball may get trapped and trying to extricate it can be a very dangerous exercise especially when it requires a worker to climb up. Hydraulic equipment is under great pressure and failing system components can cause severe injuries.
- Using explosives may affect a wide area. There is the possibility of charges that have not gone off and the structure may not have collapsed the way it was planned and is left hanging in a dangerous state of instability.

These impacts affect mainly on the workers on the construction site, students and lecturers in C6, C10, C5 and D3 and the pass-by persons in the subproject site. The impact can be assessed as moderate and can be minimized

The other site specific impacts during pre-construction are similar with that are happened in the construction phases described in **4.2.2.**

4.2. Construction phase

4.2.1. Generic impacts

a. Air quality impacts

- Dust: It is generated from operation of material transportation trucks to enter the site. 2,908 turns of 20-ton trucks are used to transport 58,156.3 tons of materials (58,156.3 tons: 20 tons/vehicle = 2,908 vehicles); average transportation distance is 30km. 2,907.8 tons of scattered materials are transported (estimated to be 5% of used materials - *Decision No. 1172/QĐ-BXD of the Ministry of Construction dated 26 December 2012 on releasing the Norm of construction estimates for the construction section;* 58,156,3 tons * 5% = 2,907.8 tons*)*, 291 turns of 10-ton

trucks are used, the average transportation distance is 20km. The construction period is 24 months, and then 6 turns of vehicles are used to enter into the site within one working days with 8 hours. Accordingly, the dust generated per day shall be 2,640kg/100km/6 turns, equivalent to 0.09g/m.s. Dust adversely affects the health of field workers as well as students, lecturers and officials working nearby. The prolong impacts during construction is assessed as moderate.

- ***Air emission:*** generated from using diesel of trucks, excavators to build basement. On average, 6 turns of vehicles to enter into the site per day with the distance of 100km per each trip. The fuel consumption norm of 20-ton truck is about 0.003 tons of diesel/10km; therefore, the fuel consumption is approximately: 0.18 tons of diesel/day. The calculated pollutant load from the construction material transportation is about 0.78 kg TSP/day, 0.18 SO_2/day, 9.9kg NO_x/ day, 5.0 kg CO/day and 2.2 kg VOC/day. These emissions affect the respiratory system and nerve system, making expoisure persons be fatigued, dizzy, headache, worry and unsafe. Affected subjects are field workers, students and lecturers studying in C5, C10, and C6 as well as local residents along the road. This impact lasts during construction and can be assessed as medium. This impact shall be minimized by proper method statements.

- ***Noise:*** Noise is mainly generated from excavators, trucks to transport construction materials and construction activities. As showed in Table 10, noise generated by the construction machines and trucks shall adversely affect the field workers, students and persons along the road, especially, the field workers working near the construction machines. For the area far ≥ 20m, the noise is within the allowable limit of QCVN 26:2010/BTNMT. However, it can be controlled and mitigated.

- ***Vibration:*** generated by construction activities from construction machines as well as pile driving and concreting activities. It will affect to the neighboring buildings and structures. As calculated in Table 11, the vibration of construction machines is within 63-82 dB at the C6 Building, 15m far from the site of the vibration source. For the receiving points far about 30m, the vibration is less than 75dB (within the allowable limit of QCVN 26:2010/BTNMT in terms of vibration and impact - Vibration due to construction and industrial production activities). The subjects affected by the vibration is field workers in the neighboring halls, and local households along the road where wastes are transported. The impact is available but small, temporary and non-continuous and mitigable.

b. Water quality impacts

- ***Construction wastewater:*** generated from concrete curing; machine repair and facility and material washing. The wastewater volume ia approximately 5 m^3/day. This wasterwater contains a large amount of sediment, suspended solids and high pH and may cause negative impacts on the receiving waterbody if it is discharged directly into the environment. However, in fact, this wastewater is re-used for curing concrete and watering the haul road and construction site. Therefore, the impacts caused by this wastewater source will be insignificant.

- ***Domestic wastewater:*** According to the subproject design report, a total of 150 people will be mobilized for construction of works. As calculated in the EPP report, the average volume of wastewater discharged is 7.5 m^3/day. As mentioned above, there is no workcamp in the University and local people will be hired as workers who live in surrouding neighborhood. Therefore a large part of this estimated amount of wastewater will be collected and treated by local system. This impact is considered minor.

- ***Runoff:*** Based on the calculation results of water runoff flow in this period in EPP report, during construction, 88.8m^3 rainwater is generated. Runoff ingredients include SSs flown by rainwater. Runoff impacts are only in rainy days to rainwater collection system of the area. However, this impact can be assessed as minor and minimized by closely mitigation measures

c. Impacts of solid wastes and hazardous wastes

***- Domestic solid wastes*:** There are 150 people working at construction site of the subproject and the total volume of domestic solid waste is 24.3 kg/day. However, no worker camps will be arranged in the University and contractors will have to hire local workers who have accommodation in residential areas. In addition the city's garbage collectors go to the University to collect and transport waste, therefore this impact is considered insignificant

- Construction solid wastes: According to calculations, the total volume of waste generated during construction is about 10,172 m^3, of which organic soil is 7,265 m^3, accounting for 71.4% of the total volume of solid waste. The solid waste will be transported to Duyen Ha landfill for treatment. This impact is considered minor.

- Hazardous wastes: Hazardous wastes generated are mainly originated from maintenance, oil replacement and repair of construction machines at the site. The total amount of hazardous waste generated in this phase is calculated about 1kg/day. Waste oil may cause pollution water and soil environment. However, this type of waste will be collected, managed and processed in accordance with regulation for collection and management of hazardous wastes issued by Ministry of Natural Resources and Environment. This impact can be assessed as minor

d. Chance finds

Basement construction requires earthworks within the subproject site, hence, the valuable antiques may be detected. However, the subproject only digs 1.8m depth at old work ground of the university, possibility of discovering valuable antiques is average. When the antiques are discovered, the chance find procedures (ECOPs) shall be applied.

e. Impacts from risks and incident accidents

- Labor accidents: In general, labor accidents may happen at any stage during construction phase, the causes include:

- Environmental pollution may cause fatigue, dizziness or fainting for workers during their work.
- The installation, construction and transport of materials with a lack of focus can cause labor accidents, traffic accidents, etc.
- Accidents due to negligence in work, lack of PPE, or due to lack of awareness of labor safety rules.

- Fire, explosion and leakage of fuel: Fire and explosion may occur in the case of transport and storage of fuel, or lack of safety of the temporary power supply system, causing the loss of life and damage to property during the construction process. The specific causes are identified as follows:

- The temporary fuel and material warehouse (gas, DO oil, FO oil, welding gas, etc.) are the source of fire and explosion. The occurrence of such incidents can cause serious damage to people, society, economy and the environment.
- Fire risk may happen when operating construction machineries, welding and vehicles using gasoline and diesel without compliance with fire regulations.
- The subproject owner will implement the fire prevention and strictly comply with measures to prevent leakage, fire or explosion. The fire prevention shall be done regularly to minimize the possibility of incidents and the levels of impact.

- Community Health and Safety Risk: Construction activities may result in a significant increase in movement of heavy vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents and injuries to local communities. Since there are households living along the transportation route in the proximity of construction site, traffic accident may happen. The incidence of road accidents involving project vehicles during construction should be minimized through a combination of education and awareness-

raising. Increased incidence of communicable and vector-borne diseases attributable to construction activities represents a potentially serious health threat to the subproject personnel and residents of local communities. Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with activities are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. Communicable diseases of most concern during the construction phase due to labor mobility are sexually-transmitted diseases (STDs), such as HIV/AIDS. This impact is considered moderate.

- Risks due to welding: Welding creates an extremely bright and intense light that may seriously injur a worker's eyesight. In extreme cases, blindness may result. Additionally, welding may produce noxious fumes to which prolonged exposure can cause serious chronic diseases. Workers work in this area face a serious risk of being injured or killed in a fire or other explosion. Besides, electric shock occurs when welders touch two metal objects that have a voltage between them, thereby inserting themselves into the electrical circuit. If a worker holds a bare wire in one hand and a second bare wire with another, electric current will pass through that wire and through the welding operator, causing an electric shock. The higher the voltage thus is the higher the risk for the electric shock to result in injury or death.These impactsare assessed as moderate and mitigable.

4.2.2. Site-specific impacts

This section assesses the site-specific impacts for both pre-construction and construction phase.

Impacts on learning and researching activities of staffs and students of the University

According to current status, lecture-rooms, offices are located in the Builidng C6 (15m far), C5, C10 (30m far), D3 (50m far). Thus, construction of works may affect learning and researching environment of lecturers, staffs and students of the University. The impacts include:

- ✓ Impacts caused by dust, exhaust and noise: as assessed in the Section of air status in the construction process, both dust and exhaust are low and within the acceptable limits in accordance with QCVN 05:2013/BTNMT. And noise in the distance of 20m or more is still within the acceptable limits in accordance with QCVN 26/2010/BTNMT. However, due to the characteristic of learning and researching environment, the contractors need to reasonably arrange construction activities to avoid use of machines causing noise in learning hours of students.
- ✓ Impacts on landscape in the learning and researching areas: for the learning and researching environment, to make students and staffs work effectively, it needs to have clean environment.

However, the impact level is assessed as insignificant and only happens during the construction process.

Risks of accident at the construction site to the University's staffs and students

Accidents are caused by trucks transporting construction materials and waste; vehicles of officers and field workers. The university's local roads are very crowded with many students, lecturers and workers; Tran Dai Nghia and Dai Co Viet roads are very busy with high population and traffic density. This cause risk of accident not only to workers who directly participate in construction activities, but also to staffs as well as students of the University. Thus, it is considered a moderate potential impact which should be paid attention by the contractor to have suitable construction plan and mitigation measures prior to commencement. Details of mitigation measures is described in the Section of mitigation measures.

Risks of accident due to workers working at high-rise building

Worker is exposed to the hazard of falling more than two meters; into operating machinery; into water or other liquid; into hazardous substances; or through an opening in a work surface.

Construction of 9-storey 36.6m high building (C7) and gathering of steel and metals may has high potential of accident due to workers working at high-rise building. There are four types of high-rise accidents, which are by scaffolding, people fall from height, struck by falling object and plant and machinery. Major of the scaffold accidents occurred were due to the use of defective materials for scaffolding and coupled with the unskilled and careless workmanship in erection of scaffolds. Everybody in the construction site has the risk to expose to fall in anywhere and anytime especially at the higher level. Lack of the safety measure at the construction sites is one of the causes the occurrence of fall accidents. Workers can be stricken by the equipment, private vehicles, falling materials, vertically hoisted materials and horizontally transported materials. The improper rigging method had caused the accident happen. Overloading is one of the factors that will cause the cranes collapse in the high-rise building construction. During the construction, the amount of allowable handling load by the crane is always not proper control by the supervisor. Accident is an event of unpredictable and it may occur due to the following causes, lack of training, improper equipment and working platform, wrong safety attitude, inadequate housekeeping, failure to use personal protective equipment, and problem procurement method and subcontracting method. The lack of training in safety and technology knowledge, workers are haven't ability and sufficient knowledge to predicts the potential risk and the way to avoid the accidents. The use of unsafe working platforms also may put workers at risk when the equipment is not properly used, maintained or stored. Construction worker's safety attitude is influence by their understanding and realizing of risk, management, safety rules and the working procedures. The unsafe actions are include do not follow the standard safety procedures, constructing barbarously and deciding to proceed work in an unsafe conditions. The poor housekeeping in the workplace can be considered as a risk factor for occupational injuries. Working without wearing any personal protective equipment may highly increase the probability for occurrence of any undesired accident. The various reason of workers refuse to wear PPE during working are such as feel uncomfortable with the gears while performing their job at site and consider it as an disturbing item to their work output. Sub-contractors usually have poor safety awareness at the construction site. Poor coordination, lack of proper instructions and misunderstanding between working trades all can lead to construction accidents. These impacts are assessed as magnitude if don't have any suitable mitigation measures.

Risk of traffic accidents within the University's campus

Because the constructed work is located inside the University's campus, near Tran Dai Nghia entrance gate, travelling of construction verhicles and activities of transporting waste materials as well as construction materials on roads inside the University's campus are inevitable. The travelling of verhicles and operation of construction machines will increase the risk of traffic accident for staffs as well as students of the University because number of students daily participating in traffic on the road is quite. Thus, this is considered as an moderate impact which need to be specially paid attetion by the contractor to have a reasonable construction method.

Risk of traffic accidents outside the University's campus

For construction materials, it is expected to be purchased from outsite with the distance from 10-60km. The transport roads will include Tran Dai Nghia, Dai Co Viet and Giai Phong to the construction site. Especially, Tran Dai Nghia road borderd in the East of the University is small and crowded, roads connecting construction site to the border roads and to construction waste material site. The travelling of verhicles and operation of construction machines will increase the risk of traffic accident for staffs as well as students of the University because number of students daily participating in traffic on the road is quite large and the road is also the bus route and bus stop No.31. Thus, this is considered as an moderate impact which need to be specially paid attetion by the contractor to have a reasonable construction method.

Risk of subsidence and damage to the existing structures

Works subsidence accidents

During the construction process of the high buildings, it may easily cause the risk of damage to surrounding works. Earthworks for subproject basement construction may cause settlement of neighboring works. Building C6 is far 15m from the construction site, C10 and C5 are far 30m may be affected. This impact may be highly if it rains. However, C7 is built on stable ground, this impact is insignificant, interrupted and possibly minimized by closely monitoring the method statements of basement.

Impacts on sensitive receptors

The construction of the different items of subproject will likely impact some sensitive receptors located in close proximity to the construction sites, including the inconvenience of access of the people when they want to visit these places; emssions and dust may become a nuisance to the local residents and cultural and religious activities; risks of traffic safety and work related accidents. The survey showed that the subproject pre-construction and construction may not only affect the studying and living activities of both officers, students of the university and the neighboring community but along the road of transporting raw materials, some sensitive receptors should be also noted. The impact level is assessed to be medium, temporary and possibly minimized.. Details of subjects within radius of 300m surrounding the Subproject site is described as follows:

Figure 5. Impacts on sensitive receptors during the pre-construction and construction phase

Subject	**Description**	**Impacts**
 University's entrance area	Bordering with the subproject; main approach gate from the dormitory to the university with high traffic density.	- Increase in traffic volume creating unsafe conditions for the students, teachers, and employees when accessing the entrance. - Increased exhaust gases, dust, noise, vibration, construction wastes, wastewater. - Risks of traffic accidents for students, teachers, employees, and local people. - Potentially damaging and interrupted access to university
 The second gate of the Civil Engineering University	Located in Tran Dai Nghia road where there are a high number of students and small shops; 200m far from the construction site .	
 Tran Dai Nghia Street	Main approach road to the construction site;, high volume of vehicles and many large and small shops along the road.	Site-specific impacts due to increased vehicle volume on the roads: - Inceased dust, noise, and vibration. - Traffic safety and jam in peak hours. - Traffic accidents due to falling of stone and soil from the subproject transportation vehicles. - Interrupted access to shops - Degrading and damaging road
	Bus stop of bus No. 31 from the HUST to Hanoi University of Mining and Geology; 100m far from the construction site	- Increased exhaust gases, dust, noise, vibration - Increase in traffic volume creating unsafe conditions for passengers - Increased exhaust gases, dust, noise, vibration

Bus stop for bus No. 31		- Risks of traffic accidents for students, teachers, employees, and local people. - Occupy the road for bus and obstruct traffic
 Building C6	15m far from the site; about 250 officers and students are currently studying and researching	- Dust, noise and emissions - Potential labor accidents - Impact on learning activities of students - Traffic safety risk when students and officers come to the building - Potential risk of damage to the building when the construction equipment and transport vehicles operate
 Building C5	30m far from the site; about 400 officers and students are currently studying and researching	
 Buiding C10	30m far from the site; about 400 officers and students are currently studying and researching	
 Buiding D3	50m far from the site, about 800 officers and students are currently studying and researching	
 Bach Khoa Kindergarten	300m far from the site, outside the university in Tran Dai Nghia road; about 50 staffs and 600 children are currently studying	- Increased dust, emissions and noise. - Potential risk of traffic accidents in the school gate - Obstructing access to school for children and parents
 Dormitory	50m far from the site, outside the university in Tran Dai Nghia road; about 3,000 students and officers are currently living.	- Dust, noise and emissions - Impact on living activities officers and students - Traffic safety risk - Interrupted access to domitory
 Shops	7 small shops near the entrance gate on Tran Dai Nghia road, 10m far from the site	- Dust, noise and emissions - Impact on business activities - Traffic safety risk - Interrupted access to the shops

 Bach Mai hospital  National Economics University  National University of Civil Engineering	On the costruction materials and waste transportation roads	- Increased dust, emissions and noise. - Potential risk of traffic accidents - Obstructing access to Universities for students - Obstructing activities to visit and work in hosiptal

4.2.3. Social impacts during pre-contruction and construction phases

Social issues

Social impacts may be caused mainly related to mobilization of workers from other localities to the subproject area. Community disturbance caused by increased level of dust and noise, traffic disruption and increased safety risks and disruption of existing public services may arise.

Construction of the building C7 will mobilize up to 150 employees working. Mobilization of workers from other localities may lead to conflicts between the workers, students and local people living in the subproject area due to differences in behavior and customs, jobs and income, traditions, or if the workers get involved in gambling, drinking and prostitution.

The construction activities of work items will affect the working schedule of students and lecturers. Households who are trading at the University entrance gate. Particularly, business and incomes of roadside shops may be affected or even reduced. Conflicts between construction teams and local people may arise due to disturbance to urban landscapes, increased localized dust levels and safety risks, traffic obstruction, income reduction, etc. So that, level of social impacts medium and can be mitigated.

Safety and occupational health of workers

Earthworks, loading and unloading materials, operation of construction plants such as excavators, cranes, trucks, welders, and concrete mixers all have potential accident risks or pollution affecting workers if there are no control measures.

The storage and usage of fuels such as power, gas, petrol contains accident risks related to electrical shock, fire, explosion, leakage etc., and pollution which will affect the health and safety of workers.

There are safety risks associated with working at construction sites with various types of materials and machines, equipment, and with many vehicles passing by. Other site risks include

working at height while construction buildings, or working deep under the ground while excavating Laboratory pond aquaculture.

In addition, weather factors need to be taken into account during construction such as high temperature in the summer when the outdoor temperature may reach 38°C that can also cause health risks to the workers.

In conclusion, the risk level of these social impacts is assessed as medium and can be mitigated.

4.3. Operation phase

When the subproject is completed, 31 training and research lab will be go to the operation phase. 28 offices; 31 meeting halls and squares; 237 working rooms for officers and lecturers; 173 classrooms and practice places for 6,000 students and lecturers will be used. They will create some impacts on environmental and social conditions.

4.3.1. Generic impacts

a. Air quality impacts

- Traffic activities: Air pollutants emit from vehicles of 6,000 students and officers to C7. Main emissions are NO_2, CO, CO_2, SO_2... from vehicles using gasoline and. Emissions directly affect the officers, employees, students and local people along the roads. This impact is long-time and possibly minimized.

- Operation of power generator: There are 2 generators will be inversted for C7 with capacity of 1,250 kVA for standby in case of power outage. Emissions contain dust, SO, NO, CO, VOC, etc. Air pollutant loads are negligible and interrupted when power outage. The officers, lecturers and students in C7 will be impacted. However, this impact is minor and can be controlled by applying sustaible mitigation measures

b. Noise and vibration

When the subproject is put into operation, the operation of various machines, especially electrical, electronic and mechanical machines shall create very high noise and vibration such as: 98dBA, 85dBA and 80dBA for press, lathe and generator, respectively, internal engine, etc. Noise affects the practice students and lab managers. Such impact is interrupted, temporary and possibly minimized.

c. Water environment

- Domestic wastewater

C7 is built to serve studying, researching and working for about 6000 people and therefore domestic wastewater is mostly generated from the toilets. The wastewater volume is specifically calculated in the EPP and total wastewater volume generated each day reaches 120 m^3/day. This wastewater volume will be collected into a septic tank built underground of the building for treatment, then will be discharged to the domestic treatment system to meet type B, QCVN14:2008/BTNMT, before discharging to the city drainage system. This impact is assessed as low and easily minimized.

- Storm water runoff

When the C7 is put into use, the ground will be cleared, and storm water is mostly from house roofs, surrounding concrete and asphalt grounds. There are separated storm water collection and drainage systems (separated from wastewater system). Therefore, this volume is not considered as a pollution source and can be discharged directly to the city drainage system. This impact is inconsiderable.

d. Solid waste and hazardous waste

- Domestic waste

Domestic solid waste from C7 in the operation phase is inorganic (including scrap paper, newspapers, nylons, etc.) and some other organic solid wastes (mostly food leftovers brought by staffs and students). As calculated, there are about 6000 staffs, students and guests each day, therefore the average domestic solid waste generated is 3 tons/day. Total volume of solid waste will be collected by URENCO - Hai Ba Trung Branch everyday. Therefore, this impact is also marginal.

- Hazardous wastes

Hazardous solid waste includes battery, neon bulb... The estimated hazardous waste is about 30kg/day. It causes non-aesthetics for the university, affecting the air quality and water environment. However, this impact can be minimized by signing the contract with URENCO - Hai Ba Trung Branch for collection and treatment.

4.3.2. Site-specific impacts

Toilet management

When the building C7 is put into use, many people will gather here for working and studying. Therefore, toilets may cause risks to the environment if they are not regularly cleaned and managed. Toilets without regular cleaning will generate hazardous gases (H_2S, NH_3,..) and cause stinks and also increase development of mosquitoes, flies and diseases, which has impacts on air environment, and health of teachers, students, and guests. However, for the current structures, the University is hiring staffs who are in charge of cleaning inside the campus, lecture halls and also toilets. Therefore, the impacts are inconsiderable

Basement management

***- Ventilation failure of basement*:** Failure occurs when the basement gathers very high density of vehicles simultaneously operating and ventilation system is damaged. Failure affects the students and lecturers whom vehicles are parked here. Such failure is interrupted at the beginning or at the end of the session; and possibly minimized by maintenance and service of basement ventilation system.

- Inundation of basement: The incident occurs in case of heavy rain and the basement pumping system is failed. It affects the property and life of students and lecturers. Such impact is interrupted and possibly minimized by standby response measures.

Management of labs and practical rooms

According to the subproject design, 21 labs in the fields of Electric Engineering - Electronics and Mechanics and 11 materials technology labs are used in the operation phase. Most of labs (21 labs) don't use chemicals and water for training and reaserching except remaining 11 materials technology labs. At the labs, storage and usage of chemicals is on the regular basis. Therefore, it is likely to have potentials risks on management and chemical usage. Impacts and risks are assessed below:

- Air emssions

21 labs in the fields of Electric Engineering - Electronics and Mechanics and 11 materials technology labs are initiated to traning on mechanical manufacturing, analysis of material structure, system simulation design with operation of various plants and equipment. Machines such as CNC lathe, CNC drilling machine, welding machine, then it shall release dust, SO_2, NO_x, CO, and metal steam, etc. If the machines are not technically operated, chemicals are leaked or accidents are available, the practice students and managers hereof shall be directly affected. However, most of such machines are equipped with synchronous devices and regular maintenance. This impact can be assessed as minor and possibly mitigated.

- Wastewater

Laboratory wastewater is generated by experiments, washing laboratory instruments of 11 labs of the Institutes and Research Centers. The amount of generated waste water is estimated about 1,4m^3/day. Ingredients, nature and concentration of lab wastewater are unstable but varied depending on frequency, quantity, type and training activities, etc. Its characteristics are heavy metals, high oxidization agents. Lab wastewater directly affects on water receiving sources. This impact is prolong and continuous. However, it can be minimized is assessed as minor because it is treated to qualify with QCTĐHN 02:2014/BTNMT column B before discharging to the city drainage system.

- Hazardous waste

Various solid wastes generated from practice rooms and research centers: electrical engineering, electronics, mechanical and materals technology tests. The following generated volume of some hazardous wastes are generated in accordance with the existing conditions of the Institutes and Centers.

Table 12. Hazardous waste volume generated from the current Institutions

Origin	Generated waste	Quantity
Mechanical lab	Used wax and machine grease	0.1 kg/day
Mechanical lab	Greasy cloth from production or maintenance of plants and equipment	1 kg/day
Office	Waste cartridge	1 unit/day
Electrical lab	Lighting fluorescent lamp	5 bulbs (40W)/day
Electrical lab	Electronic board	0.1 kg/day
	Electrical board and capacitor	0.1 kg/day
Material lab	Waste chemicals	0.1 kg/day
	Defective test products	1 kg/day

Hazardous wastes from teaching, traning and researching of students and lecturers cause non-aesthetics, affect on the air quality and water environment. The hazardous waste impacts are minimized when the university has signed the contract with URENCO - Hai Ba Trung Branch for collection and treatment. It is assessed as moderate.

- Risk of chemical leak

Each Institute and Research Center has particular trainings and researches, therefore each lab/practical room is different and so are the chemicals. These chemicals are in solid, liquid and gas states (mostly solid and liquid) and stored in closed bottles. When chemicals are used, gas emitted from the chemical into the air is unavoidable. In addition, practicing/studying mixture of chemicals to create new ones or crushing samples by using chemicals also generates gases into the surrounding environment (acid steam, Clo, H_2S, NH_3,....). These gases with high concentration will directly make impacts on health of staffs as well as students in the lab. However, this impact can be totally mitigated and eliminated if labs develop management programs and apply detailed prevention measures. These impacts are small, in long-term.

- Safety risks when using chemicals

When using chemicals, safety is prioritized in all labs because if people get direct exposure to chemicals, they may get burnt, have skin corrosion, and negative impacts on respiratory system, mucosa, etc. Possible unsafety in using chemicals including:

- ✓ Not using protective equipment when using chemicals (gloves, face masks) leads to direct exposure of chemicals on skin and its steam affecting people's respiratory system.
- ✓ Chemicals have low quality, expire or do not have labels and specific instructions, which leads to misuse and have unpredictable chemical reactions.
- ✓ Careless storage and usage of chemicals leads to breakage and overflow, which causes impacts on environment and health of staffs/students, even can cause fire incidents.

- ✓ That management of chemicals when not in use does not meet standards and comply with instructions of each chemical kind also changes chemicals and is unsafe for users.

Generally, impacts listed above depend on conditions and management capacity of labs and are assessed as moderate and long-term. However, these impacts can completely be controlled and mitigated during the operation phase.

- Safety in operating machines and equipment

Most of the listed devices are generated by electricity and require strict and precise operation procedures. Therefore, if operation of these devices is not ensured, some potential risks may occur such as short circuit, or false of devices leading to false of findings. Therefore, to control this impact, before operation, the University should set up suitable management and usage plans to ensure safety. This impact is assessed as minor.

- Electric explosion and short-circuit

The University is in need of huge electricity demand for studying, especially operation of machines used in the labs or practical rooms especially on 2121 labs in the fields of Electric Engineering - Electronics and Mechanics. Thus, potential risks of electricity insecurity is likely to happen while materials used in the labs are combustible such as papers, tables, chairs, books, chemicals, etc. Fire prevention is always prioritized by the University leadership. This impact is assessed as minor and mitigable.

5. IMPACT MITIGATION MEASURES

5.1. Generic impact

As part of the Environmental and Social Management Plan (ESMP) for the subproject these general measures have been translated into a standard environmental specification to be incorporated into bidding and contract documents. These are referred to as Environmental Codes of Practice (ECOPs), and will be applied to mitigate typical impacts of the subproject's civil works during the pre-construction and construction phase.

The ECOPs describe typical requirements to be undertaken by contractors and supervised by the construction supervision consultant during construction. The ECOPs will be incorporated into the bidding and contract documents (BD/CD) annexes. The measures identify typical mitigation measures for the following aspects:

- Impacts of dust;
- Air pollution;
- Noise and vibration;
- Water pollution;
- Solid waste;
- Chemicals or hazardous wastes;
- Traffic management;
- Interruption to utility services;
- Restoration of affected areas;
- Worker and public Safety;
- Communication with local communities about subproject environmental issues;
- Health and Safety for workers and the public;
- Chance finding procedures
- Fire hazard due to accident.

Table 13. Generic mitigation measures

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
1. Impacts of dust	- The Contractor is responsible for ensuring compliance with relevant Vietnamese legislation with respect to ambient air quality. - The Contractor shall ensure that dust generation is mitigated and will not annoy local people and implement measures to control dust concentration in order to maintain safe working place and minimize disturbance to surrounding residences/houses. - Material loads shall be suitably secured during transportation to prevent the scattering of soil, sand, materials or dust. - Exposed soil and material stockpiles shall be protected against wind erosion and the location of stockpiles shall take into consideration the prevailing wind directions and locations of sensitive receptors - Dust masks should be used where dust levels are excessive.	- Decision No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection - QCVN 05: 2013/MONRE: *National technical regulation on ambient air quality* - QCTĐHN 01:2014/BTNMT: *Hanoi Technical Regulation on Industrial Emission of Inorganic Substances and Dusts*	Contractor	PMU, CSC
2. Air pollution	- All vehicles must comply with Vietnamese regulations controlling allowable emission limits of exhaust gases. - Vehicles in Vietnam must undergo a regular emissions check and get certified named: "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT; - There should be no burning of waste or construction materials (for example: asphalt, etc.) on site.		Contractor	PMU, CSC
3. Noise and	- The contractor is responsible for compliance with the relevant	- QCVN	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
vibration	Vietnamese legislation with respect to noise and vibration. - All vehicles must have appropriate "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT; to avoid exceeding noise emission from poorly maintained machines. When needed, measures to reduce noise to acceptable levels must be implemented and could include silencers, mufflers, acoustically dampened panels or placement of noisy machines in acoustically protected areas. - Avoiding or minimizing transportation through or processing material in community areas (like concrete mixing).	26:2010/BTNMT: *National technical regulation on* noise - QCVN 27:2010/BTNMT: *National technical regulation on vibration*		
4. Water pollution	- The Contractor must be responsible for compliance with the relevant Vietnamese legislation relevant to wastewater discharges into watercourses. - Portable or constructed hygienic toilets must be provided on site for construction workers. Wastewater from toilets as well as kitchens, showers, sinks, etc. shall be discharged into a conservancy tank for removal from the site or discharged into municipal sewerage systems; there should be no direct discharges to any water body. - Wastewater over standards set by relevant Vietnam technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors. - Implement measure to collect, redirect or block municipal wastewater disposed from surrounding houses to properly dispose and ensure that local blocking or flooding are minimized. - Before construction, all necessary wastewater disposal permits/licenses and/or wastewater disposal contract have been obtained. - At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed or effectively sealed off.	- 14:2008/BTNMT: *National technical regulation on domestic wastewater;* - QCTĐHN 02:2014/ BTNMT: *Hanoi Technical Regulation on Industrial Wastewater*	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
5. Solid waste	- Before construction, a solid waste control procedure (storage, provision of bins, site clean-up schedule, bin clean-out schedule, etc.) must be prepared by Contractors and it must be carefully followed during construction activities. - Before construction, all necessary waste disposal permits or licenses must be obtained. - Measures shall be taken to reduce the potential for litter and negligent behavior with regard to the disposal of all refuse. At all places of work, the Contractor shall provide litter bins, containers and refuse collection facilities. - Solid waste may be temporarily stored on site in a designated area approved by the Construction Supervision Consultant and relevant local authorities prior to collection and disposal through a licensed waste collector, for example, URENCO - Hai Ba Trung Branch in urban areas or local environment and sanitation companies. - Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. - No burning, on-site burying or dumping of solid waste shall occur. - Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc shall be collected and separated on-site from other waste sources for reuse, for use as fill, or for sale. - If not removed off site, solid waste or construction debris shall be disposed of only at sites identified and approved by the Construction Supervision Consultant and included in the solid waste plan.	- Decree No. 38/2015/ND-CP on solid waste management	Contractor	PMU, CSC
6. Chemicals or hazardous wastes	- Chemical waste of any kind shall be disposed of at an approved appropriate landfill site and in accordance with local legislative requirements. The Contractor shall obtain needed disposal	- Decree No. 38/2015/NĐ-CP dated 24/04/2015 on waste	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	certificates. - The removal of asbestos-containing materials or other toxic substances shall be performed and disposed of by specially trained and certified workers. - Used oil and grease shall be removed from site and sold to an approved used oil recycling company. - Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery shall be collected in holding tanks and removed from site by a specialized oil recycling company for disposal at an approved hazardous waste site. - Unused or rejected tar or bituminous products shall be returned to the supplier's production plant. - Relevant agencies shall be promptly informed of any accidental spill or incident. - Store chemicals appropriately and with appropriate labeling. - Appropriate communication and training programs should be put in place to prepare workers to recognize and respond to workplace chemical hazards. - Prepare and initiate a remedial action following any spill or incident. In this case, the contractor shall provide a report explaining the reasons for the spill or incident, remedial action taken, consequences/damage from the spill, and proposed corrective actions.	and scrap management - Circular No. 36/2015/TT-BTNMT on management of hazardous substance		
7. Traffic management	- Before construction, carry out consultations with local government and community. - Significant increases in number of vehicle trips must be included in a construction plan before approved. Routings, especially of heavy vehicles, need to take into account sensitive sites such as schools,	- Law on traffic and transport No. 23/2008/QH12; - Decree 46/2016/ND-CP on administrative penalty for traffic	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	hospitals, and markets. - Installation of lighting at night must be done if this is necessary to ensure safe traffic circulation. - Place signs around the construction areas to facilitate traffic movement, provide directions to various components of the works, and provide safety advice and warning. - Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions - Avoid material transportation for construction during rush hour. - Passageways for pedestrians and vehicles within and outside construction areas should be segregated and provide for easy, safe, and appropriate access. Signpost shall be installed appropriately in both water-ways and roads where necessary.	safety violation - Law on construction No. 50/2014/QH13; - Circular No. 22/2010/TT-BXD on regulation on labour safety in construction		
8. Interruption to utility services	- Planned and unplanned interruptions to water, gas, power, internet services: the Contractor must undertake prior consultation and contingency planning with local authorities about the consequences of a particular service failure or disconnection. - Coordinate with relevant utility providers to establish appropriate construction schedules. - Provide information to affected households on working schedules as well as planned disruptions (at least 15 days in advance) - The contractor should ensure alternative water supply to affected residents in the event of disruptions lasting more than one day. - Any damages to existing utility systems of cable shall be reported to authorities and repaired as soon as possible.	- Decree No. 167/2013/ND-CP on administrative penalty for violations related to social security, order and safety issues	Contractor	PMU, CSC
9. Restoration of affected areas	- Temporary acquired areas to make warehouse, cable pulling site, etc. are used for a short period of time, site facilities, workers' camps, stockpiles areas, working platforms and any areas	- Decree No. 167/2013/ND-CP on administrative penalty	Contractor	Compliance reported by CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	temporarily occupied during construction of the subproject works shall be restored using landscaping, adequate drainage. - All affected areas shall be landscaped and any necessary remedial works shall be undertaken without delay. These works may be green-spacing, roads, bridges and other works to original existing etc. - Soil contaminated with chemicals or hazardous substances shall be removed and transported and buried in waste disposal areas in accordance with regulations; - Restore all roads caused by the subproject activities to their original state or better.	for violations related to social security, order and safety issues		
10. Worker and public Safety	- Contractor shall comply with all Vietnamese regulations regarding worker safety. - Prepare and implement action plan to cope with risk and emergency. - Preparation of emergency aid service at construction site. - Training workers on occupational safety regulations - If blasting is to be used, additional mitigation measures and safety precautions must be outlined in the ESMP. - Ensure that ear pieces are provided to and used by workers who must use noisy machines such as piling, explosion, mixing, etc., for noise control and workers protection. - During demolition of existing infrastructure, workers and the general public must be protected from falling debris by measures such as chutes, traffic control, and use of restricted access zones; - Install fences, barriers, dangerous warning/prohibition site around the construction area which showing potential danger to public people; - The contractor shall provide safety measures as installation of	- Decree No. 167/2013/ND-CP on administrative penalty for violations related to social security, order and safety issues	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	fences, barriers warning signs, lighting system against traffic accidents as well as other risk to people and sensitive areas			
11. Communication with local communities about subproject environmental issues	- Maintain open communications with the local government and concerned communities; the contractor shall coordinate with local authorities (leaders of local wards or communes) for agreed schedules of construction activities at areas nearby sensitive places. - Copies in Vietnamese of these ECOPs and of other relevant environmental safeguard documents shall be made available to local communities and to workers at the site. - Disseminate subproject information to affected parties (for example local authority) through community meetings before construction commencement; - Provide a community relations contact from whom interested parties can receive information on site activities, subproject status and subproject implementation results; - Provide all information, especially technical findings, in a language that is understandable to the general public and in a form of useful to interested citizens and elected officials through the preparation of fact sheets and disclosure, when major findings become available during subproject phase; - Monitor community concerns and information requirements as the subproject progresses; - Respond to telephone inquiries and written correspondence in a timely and accurate manner; - Provide technical documents and drawings to PC's community, especially a sketch of the construction area and the ESMP of the construction site; - Notification boards shall be erected at all construction sites providing information about the subproject, as well as contact	- Decree No. 167/2013/ND-CP on administrative penalty for violations related to social security, order and safety issues	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	information about the site managers, environmental staff, health and safety staff, telephone numbers and other contact information so that any affected people can have the channel to voice their concerns and suggestions.			
12. Health and Safety for workers and the public	- HIV/AIDS within 2 weeks prior to the commencement of packages for construction items lasting at least 6 months. - Provide training in first-aid skill and first-aid kit to workers and site engineer - Regularly exam worker's health to ensure occupational health - Provide workers with PPE such as masks, gloves, helmets, shoes/boots, goggles, safety belt, etc. and enforce wearing during working especially working at heights and in dangerous areas. - Limit or avoid working in extreme weather conditions, e.g. too hot, heavy rain, strong wind, and dense fog. - Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. - Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hotwork on tanks or vessels that have contained flammable materials.	- Directive No. 02 /2008/CT-BXD on labour safety and sanitation in construction agencies; - Circular No. 22/2010/TT-BXD on regulation on labour safety in construction - QCVN 18:2014/BXD: Technical regulation on safety in construction	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	- Safely install power lines at offices and in construction sites and do not lay connectors on the ground or water surface. Electric wires must be with plugs. Place outdoor electric panels in protection cabinets. - Limit vehicle speed at 5km/hour at construction site and 20km/h on transportation routes across local resident areas. - Install fences, barriers for dangerous warning/prohibition sites around the construction area which show potential danger to the public. - Provide safety measures as installation of fences, barriers warning signs, lighting system against traffic accidents as well as other risk to people and sensitive areas. - Provide sufficient lighting when carrying out construction activities at night. - Locate noise-generating sources and concrete mixing plants far enough from and downwind of residential areas and camps. - Store fuels and chemicals in areas with impermeable ground, roofs, surrounding banks, and warning signs at least 50 m far from and downwind of residential areas and the camps. - Provide training in fire-fighting to workers and fire-extinguishers for the camps. - Prepare an emergency plan for chemical/fuel spill incident risk before construction begins. - Provide the camps with sufficient supplies of clean water, power, and sanitary facilities. There must be at least one toilet compartment for every 25 workers, with separate toilets for males and females. Workers' beds must be provided with mosquito nets so as to prevent dengue fever. Temporary tents will be unacceptable. - Clean camps, kitchens, baths, and toilets and sanitize regularly, and			

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	**Supervision**
	keep good sanitation. Provide dustbins and collect wastes daily from the camps. Clear drainage ditches around the camps periodically. - Stop all construction activities during rains and storms, or upon accidents or serious incidents.			
13. Chance finding procedures in case of finding objects with historical or cultural values	- If the Contractor discovers archeological sites, historical sites, remains and objects, including graveyards and/or individual graves during excavation or construction, the Contractor shall: - Stop the construction activities in the area of the chance find; - Delineate the discovered site or area; - Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities or the Department of Culture and Information takes over; - Notify the Construction Supervision Consultant who in turn will notify responsible local or national authorities in charge of the Cultural Property of Viet Nam (within 24 hours or less); - Relevant local or national authorities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values; - Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage; - If the cultural sites and/or relics are of high value and site	- Law on cultural heritage No. 28/2001/QH10; - Amended and supplemented Law on cultural heritage No. 32/2009/QH12; - Decree No 98/2010/ND-CP dated 21/09/2010 on guideline to implement Cultural Heritage Law.	Contractor, supervising consultant cooperates to implement Cultural Information Department Contractor, Owner and local Authority	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	preservation is recommended by the professionals and required by the cultural relics authority, the Project's Owner will need to make necessary design changes to accommodate the request and preserve the site; - Decisions concerning the management of the finding shall be communicated in writing by relevant authorities; - Construction works could resume only after permission is granted from the responsible local authorities concerning safeguard of the heritage.			
14. Fire hazard due to accident	- Comply with the national law and regulation on fire prevention and fight extinguishing. - Prepare an emergency preparedness plan for fire hazard control. - Equip the substation with enough number of fire extinguishers. - Frequently examine equipment to detect and repair fire hazard. - Train operation staff on fire prevention and fire control.	Decree 46/2012/ND-CP	-	-

5.2. Site specific mitigation measures

5.2.1. Pre-consruction and construction phase

Table 14 presents site-specific impacts and mitigation measures that are not addressed through the general measures in the ECOPs, because the severity or site- specific nature of the impacts and mitigation measures required.

Table 14.Site-specific mitigation measures in the pre-consruction and construction phase

Site-specific impacts issues	Specific mitigation measures	Responsi-bility	Super-vised
Impacts from demolition work	- Carefully check the building to ensure no one is in it before dismantling - Do roadblocks created a safe distance around the building before dismantling - Apply spacing dismantling construction safety if wall collapse without causing the accident		

Site-specific impacts issues	Specific mitigation measures	Responsi-bility	Super-vised
	- Apply a safe dismantling measures, such as using grab, removed from the top down - Water to reduce dust during dismantling - Appoint guardian during dismantling - Conduct proper training to all workers, make better assignment of responsibility and proper planning prior to job execution - All safety requirements must be followed and make ensure that all parties involved adhere to the quality standards of the demolition process.		
Impacts on learning and researching activities of staffs and students of the University	The construction activities may affect the study and research environment of the faculties and students. Therefore, the contractors need to implement the following measures: - Inform all HUST staffs and students of construction schedule and place so they can arrange their study and research schedules accordingly. - The contractors need to coordinate closely with the University to know the study and research schedules in order to arrange the operation schedule of the noisy machinery accordingly. - Minimize the operation of machinery during class and lab sessions, all machinery at rest for more than 2 minutes must be turned off. - The transport schedule of materials must avoid the starting and ending times of classes. - The construction and material transporting equipment can only operate according to the plan. The machineries are prohibited to roam around. - All equipment and machinery on site must be maintained regularly. Do not use outdated machinery without proper registration because the amount of emission and noise will exceed the limits; - Minimize the operation of numerous equipment at the same time to reduce the compounded impact from them - Do not set up concrete mixing station in the subproject area; - Do not store equipment and material outside the construction site, the storage area needs to be far from the students' and faculties' classroom and research areas - It's prohibited for the transports to be overloaded, dropping material on the road. When in transit, materials must be covered, preventing dust and material from spreading to the environment - On the solid waste transport route, when passing any residential area or within the school boundaries, there	Contractor	PMU, CSC

Site-specific impacts issues	Specific mitigation measures	Responsi-bility	Super-vised
	must be a speed limit and a ban on air horn. - Around each construction site, the contractors must have solid fencing (possibly tin) with minimum height of 2m and a gate. - The contractors must manage their workers strictly, workers are prohibited from affecting the students' classroom and research activities. - The worker camps must be far from the students' routes, classrooms, and research areas. - All contractors must regularly clean up around the construction sites as well as the transport routes to not affect the landscape and the students' study environment. - The construction sites and material transport routes must be watered regularly, especially on dry-weather days. When the buildings reach certain heights, it's mandatory to use dust nets around the scaffold areas from the ground floor to the highest floor of the buildings;		
The risks of labor accidents in the construction site to the University's staffs and students	Because the construction site is located within the University, where there are a lot of staffs and students working and learning. Therefore, safety during construction must be constantly monitored. To minimize the risks, the subproject must implement the following mitigation measures at all sites: - Before construction, the contractors must plan to use methods that ensure the technical, design, and safety requirements. - Around each construction site, the contractors must have solid fencing (possibly tin) with minimum height of 2m and a gate to ensure construction safety; - When the buildings reach certain heights, it's mandatory to use safety nets for dust and falling objects. The nets must be installed around the scaffold areas from the ground floor to the highest floor of the buildings; - Do not store equipment and material outside the construction sites, the storage areas need to be far from the classrooms and research areas. - The construction sites must have numerous safety and warning signs. - The construction unit must have people on watch, especially when there are vehicles entering and exiting the construction sites. - It's strictly prohibited to scatter materials and wastes to the environment, affecting traffic safety in the area. - At night, the construction sites must have adequate lighting and warning lights.	Contractor	PMU, CSC

Site-specific impacts issues	Specific mitigation measures	Responsi-bility	Super-vised
	- The contractors must ensure that all workers have had training on labor safety and sanitation - All workers must have full safety equipment and they must use all of the safety equipment during work. - The construction monitoring consultants must be present regularly and monitor the contractors complying with the construction techniques, labor safety and sanitation requirements		
Fall Risks due to working at heights	- Workers are responsible to wear or use at all the times of any protective equipment or clothing which provided by the constructors. - Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area; - Proper use of ladders and scaffolds by trained employees; - Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines; - Appropriate training in use, serviceability, and integrity of the necessary PPE; and - Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall - Constructors should ensure that the training program is provided for all workers in construction work and make sure them particular attention towards to the safety issues - Providing instrument for new workers, implement daily toolbox checking, regular training to management level and supervision team regarding safety awareness at construction site, safety introduction awareness campaign site monthly meeting - Regular safety inspection	Contractor	PMU, CSC
Traffic safety risks within the University	For the traffic activities in the subproject area, the following mitigation measures: - The contractor must prepare a detailed plan and method to transport waste material, leveling and constructing materials within the university, routes to the disposal site, minimizing the impacts on the university traffic. - The transport routes need to avoid the busy areas, especially the central road and road connecting the departments, lecture halls/students' research and learning areas. In the cases where it's unavoidable, it's prohibited to transport during the starting and ending time of classes. These routes must be cleaned to not affect the students' traffic activities. - The transport of equipment and material needs to avoid busy periods, especially the classes' starting and ending	Contractor	PMU, CSC

Site-specific impacts issues	Specific mitigation measures	Responsi-bility	Super-vised
	times. - All transport routes must have traffic safety and speed limit signs for all (including the university's staffs and students). For the construction machinery and material transport vehicles, the speed limit is 5km/h within the university. - All vehicles exiting the construction sites (including non-material-transport vehicles) must be wheel-cleaned before exiting the sites. - The transport routes inside the university must be lit at night, especially the routes with many students crossing. - The contractors must regularly send people to sweep and clean (at least 3 times a day: in the morning, afternoon, and at night) along the material transport routes inside the university and water the roads during dry-weather day. Send people to direct traffic at busy points when there are material transport vehicles or machineries passing, especially at the construction site gates.		
Traffic safety risks outside the University	During the material and waste transport, the following mitigation methods must be implemented: - The contractors must prepare a thoughtful transport plan before construction to minimize traffic congestion. - Notice the Hai Ba Trung district government and citizens along Tran Dai Nghia road on the material transport plan. - Organize the incoming and outgoing traffic, avoid narrow streets to minimize traffic congestion. Do not transport during rush hours, classes' starting and ending times. - The drivers must have the necessary licenses. Regularly remind the drivers to comply with the traffic laws, not to speed or break traffic laws and have measures such as pay cut if they do. - The drivers must not use any stimulants, alcohol at work, and must not work overtime. - Send staffs to direct traffic when there's traffic congestion on Tran Dai Nghia road if there's subproject transport activities - For the transport equipment and vehicles, maintenance must be implemented regularly and the contractors must ensure that all vehicles meet the traffic safety requirements. - All vehicles are strictly prohibited to be overloaded, before every trip, the material in transport must be covered completely - Regularly send staffs to monitor traffic along the transport route, if any material scatters on the road, the	Contractor	PMU, CSC

Site-specific impacts issues	Specific mitigation measures	Responsi-bility	Super-vised
	contractor has to send staffs to clean up immediately. At the "sensitive" spots along the transport route, the mitigation measures will be proposed separately in the table below.		
The risk of subsidence, damaging the existing works	- Prior to the construction, the construction contractors, supervision consultants and PMU (HUST) should coordinate with (relevant) managers of C6, C5, C10 and D3 to examine the current status of the surrounding works, the existing transport routes that will be used for transport of construction materials, and other existing works surrounding the construction sites to form the basis of assessment and compensation (if there are any damages caused by the Subproject) and proper preparation of the construction plan. - All of contractors are required to prepare their construction plans, plans to utilize construction equipment and transport vehicles to avoid the present of multiple construction equipment at the same time to minimize the impact on surrounding buildings. - All contractors are strictly prohibited from gathering construction equipment and vehicles outside the subproject area and especially on the road from Tran Dai Nghia street - During construction, contractors are required to manage construction materials properly to not leak them outside the construction sites and affect the area, especially the irrigation canals. - Restricting the construction and material transport on rainy days to minimize the damages to surrounding buildings, especially the transport routes...	Contractor	PMU, CSC

The construction process will be likely to affect part of these works' activities, including the people's safety and access to these places; smoke and dust as nuisance to residents and cultural and religious works that can be affected by the subproject operations are listed in Table 15.

Table 15. Impact mitigation measures on sensitive receptors at the construction site

Subject	Impact	Mitigation measures	Responsibility	
			Implemented by	Supervised by

Subject	Impact	Mitigation measures	Responsibility	
			Implemented by	Supervised by
 University's entrance area  The second gate of the Civil Engineering University	- Increase in traffic volume creating unsafe conditions for the students, teachers, and employees when accessing the entrance. - Increased exhaust gases, dust, noise, vibration, construction wastes, wastewater. - Risks of traffic accidents for students, teachers, employees, and local people. - Potentially damaging and interrupted access to university	- Put and maintain bulletin boards at the construction site, containing the following information: full name and phone number of the Contractor, Site Manager, Supervision Consultants and Subproject Owner, duration and scope of work. - Construct metal fence with height ≥ 3 m surrounding the site to minimize dust diffusion out of the site, adversely affecting the local people. - Construction warning signs and traffic instruction signs are to be set up to ward off road users from entering or passing by the construction site. - Arrange barriers, warning signs and indicators at night time and diverse the traffic as necessary. - Water the site at least twice a day on dry days at 9 a.m and 3 p.m to minimize the dust. - Do not load to a height of 10cm higher than the truck body and cover the truck so as not to spill out and scatter materials onto roads, giving rise to dust and endangering road users. - Clean up the transport vehicles before leaving construction site. - Assign staff to guide the traffic during transportation, unloading, and loading of construction materials, equipment, and wastes, and during rush hours. - Do not park vehicles in the roads longer than necessary. Maintain the required speed limit and do not overuse horn.	Contractor	PMU, CSC

Subject	Impact	Mitigation measures	Responsibility	
			Implemented by	Supervised by
		- Periodically registry and supervise the quality of transport vehicles as required by the government regulations. - Comply with the traffic safety regulations while participating traffic. - Clean up wastes dropped off on road.		
 Tran Dai Nghia Street	Site-specific impacts due to increased vehicle volume on the roads: - Inceased dust, noise, and vibration. - Traffic safety and jam in peak hours. - Traffic accidents due to falling of stone and soil from the subproject transportation vehicles. - Interrupted access to shops - Degrading and damaging road	- Construction equipment with loud noise will not operate near residential areas at night. - Gathering construction equipment and materials outside the construction sites are strictly prohibited. - Minimize simultaneous operation of multiple equipment on site to minimize the synergetic impacts of equipment. - Install 2m tall or more corrugated metal fences to separate the construction sites and the surrounding areas. - Material/Dustproof nets are required from the base to the highest point of the building. - Install safety warning signs around the construction site, especially at the entrances of sites, at listed sensitive areas, and at the beginning and the end of the road. - Regular humidify the construction site and surrounding areas. - Traffic regulators are necessary when means of transport enter and leave the construction sites.		

Subject	Impact	Mitigation measures	Responsibility	
			Implemented by	Supervised by
 Bus stops for bus No. 31, 100 m far from the subproject site	- Increased exhaust gases, dust, noise, vibration - Increase in traffic volume creating unsafe conditions for passengers - Increased exhaust gases, dust, noise, vibration - Risks of traffic accidents for students, teachers, employees, and local people. - Occupy the road for bus and obstruct traffic	- Inform the management of bus No. 31 of the construction schedule, possible impacts on the bus route, and mitigation measures. - Arrange barriers, warning signs and indicators at night time and diverse the traffic as necessary. - Avoid transportation of construction materials and wastes in narrow roads and don't operate in peak hours. - Do not interfere with the bus line. - Request the drivers to comply with the traffic regulations, especially not to overspeed and overuse of horn. - Driver is strictly prohibited from drinking before operating the vehicles.	Contractor	PMU, CSC
 Building C6  Building C5  Buiding C10  Buiding D3	- Dust, noise and emissions - Potential labor accidents - Impact on learning activities of students - Traffic safety risk when students come to class rooms - Potential risk of damage to the	- Construction equipment with loud noise will not work during class hours. - Gathering construction equipment and materials near lecture buildings is strictly prohibited. - Minimize simultaneous operation of multiple equipment on site to minimize the synergetic impacts of equipment. - Install 2m tall or more corrugated metal fences to separate the construction sites and the surrounding areas. - Material/Dustproof nets are required from the base	Contractor	PMU, CSC

Subject	Impact	Mitigation measures	Responsibility	
			Implemented by	Supervised by
	building when the construction equipment and transport vehicles operate	to the highest point of the building. - Install safety warning signs around the construction site, especially in areas where students often pass through. - Regular humidify the construction site and surrounding areas. - Traffic regulators are necessary when means of transport enter and leave the construction sites.		
 Bach Khoa Kindergarten  Dormitory	- Increased dust, emissions and noise. - Potential risk of traffic accidents in the school gate - Obstructing access to school for children and parents	- Notify the Kindergarten's and Domitory management units about the contruction plan and disclosure potential impacts and mitigation measures of the subproject at the bulletin board - Construction equipment with loud noise will not operate near residential areas at night. - Gathering construction equipment and materials outside the construction sites are strictly prohibited. - Minimize simultaneous operation of multiple equipment on site to minimize the synergetic impacts of equipment. - Install 2m tall or more corrugated metal fences to separate the construction sites and the surrounding areas. - Material/Dustproof nets are required from the base to the highest point of the building. - Install safety warning signs around the construction site, especially at the entrances of sites, at listed sensitive areas, and at the beginning and the end of	Contractor	PMU, CSC

Subject	Impact	Mitigation measures	Responsibility	
			Implemented by	Supervised by
		the road. - Regular humidify the construction site and surrounding areas. - Traffic regulators are necessary when means of transport enter and leave the construction sites.		
 Shops	- Dust, noise and emissions - Impact on business activities - Traffic safety risk Interrupted access to the shops	- Construction equipment with loud noise will not operate near residential areas at night. - Gathering construction equipment and materials outside the construction sites are strictly prohibited. - Minimize simultaneous operation of multiple equipment on site to minimize the synergetic impacts of equipment. - Install 2m tall or more corrugated metal fences to separate the construction sites and the surrounding areas. - Material/Dustproof nets are required from the base to the highest point of the building. - Install safety warning signs around the construction site, especially at the entrances of sites, at listed sensitive areas, and at the beginning and the end of the road. - Regular humidify the construction site and surrounding areas. - Traffic regulators are necessary when means of transport enter and leave the construction sites.	Contractor	PMU, CSC
  Bach Mai hospital National Economics University  National University of Civil Engineering	- Increased dust, emissions and noise. - Potential risk of traffic accidents - Obstructing access to Universities for students - Obstructing activities to visit and work in hosiptal		Contractor	PMU, CSC

5.2.2. Operation phase

Toilets management

- ✓ Sanitation workers will be arranged to clean up regularly to prevent bad odor.
- ✓ Sewers and snorkels will be checked regularly to prevent congressional and odors.
- ✓ Ventilation fans and windows will be installed to prevent odor.

The Hanoi Urban Environment Company will be hired to pump out sludge in septic tank regularly and provide effective transport and treatment solutions for the domestic wastewater

Basement management

Basement ventilation includes both methods of exhaust suction and fresh air supply depending on ventilation conditions. It is possible to provide fresh air to ensure fresh oxygen for persons. The Project has only one basement, hence, the Project Owner selects the natural ventilation in combination with forced ventilation. Number of fans is arranged in basement: 105 fans/storey; Characteristics of fans: Centrifugal fan; capacity of 0.37-200kw; voltage of 220-380 v; air flow: 700 – 130.000 m^3/h; pressure: 200 – 2000 Pa; CT3, Inox steel

For inundation of basement, the subproject has inverst a barrier to prevent water runoff to the basement. During the design stage, architects also consider some indictors for green building to reduce all negative impact from the building operation.

Air quality management in labs

All labs of the university will be equipped by modern equipment: modern suction fan and ventilation system; hazardous gas suction cabinet; solvent steam with treatment system (absorbed by active charcoal) before discharging to the environment, minimizing the emissions from labs.

Practice rooms and research centers have been equipped by modern machines such as CNC lathe, CNC drill, welding machine, etc… Most of machines are synchronously provided and fitted with protection system. Hence, noise, dust and emission shall be minimized. The additional invested system mainly related to electrical engineering, electronics and mechanical electronics shall be provided with suction and absorption systems for welding gas before discharging to the environment.

2. Wastewater treatment

Domestic wastewater

To treat domestic wastewater generated from C7, 2 JOKASOU tanks shall be further constructed with total capacity of 200 m^3/day and night. Post-treatment domestic wastewater meets QCVN 14:2008/BTNMT column B and then to be pumped to manholes and discharged into the city's drainage system. Diagram of domestic wastewater collection and treatment during subproject operation is described as follows:

Description

JOKASOU treatment device is structured by 6 chambers, including anaerobic chambers No. 1 & 2 (provided with anaerobic microbiology support), aerobic chambers No. 3 & 4 (provided with aerobic microbiology support which is provided with oxygen), settling and filtering chamber No. 5 and sterilization chamber No. 6 Among which, chamber 1 has the largest capacity, used to contain wastewater and regulate the concentration of substances available in the wastewater, while the chamber 6 is designed within chamber 5 to save space. Water is moved through chambers by PVC piping system.

Wastewater flows to the buffer surface of anaerobic chambers No. 1. The anaerobic decomposition reactions are sharply occurred, decomposition major of organic matters by taking nutrients for growth. Water continues flowing to chamber 2, where the decomposition occurs like chamber 1.

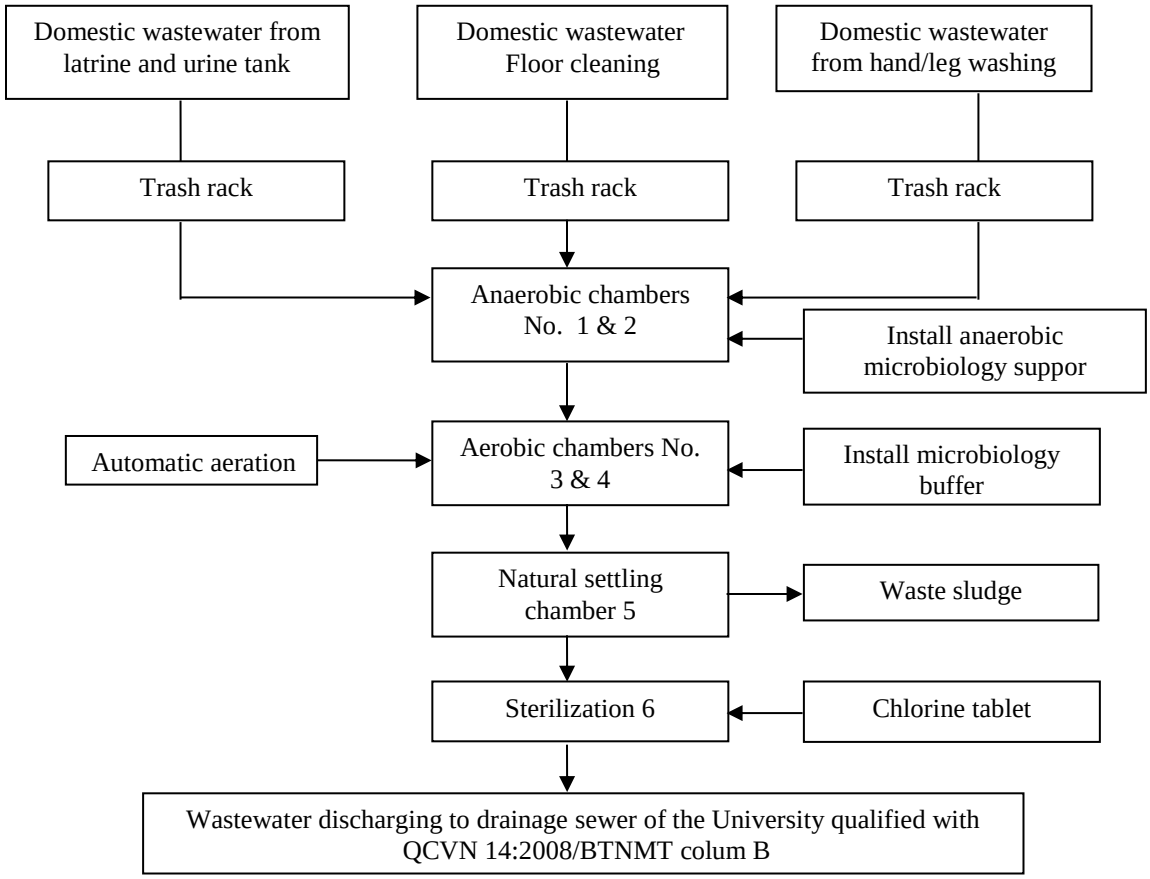


Figure 6. Wastewater treatment technology diagram by JOKASOU block combination

Wastewater which is anaerobically treated from chamber 2 shall be overflown to chamber 3. Here, air is blown from air vent near the support. The microbiological buffer is provided with abundant oxygen sources and the nitrification is initiated to eliminate ammoniac and nitrite out of water ingredients. Going in parallel with nitrification process, phosphatization is conducted to remove phosphor in hazardous compound forms. Wastewater in chamber 3 is partially returned to chamber 1 of the device to ensure the continuous operation of equipment in case wastewater is not available at chamber 1.

Water from chamber 3 flows to chamber 4. Here, the oxygen is provided not as much as that in chamber 3. Therefore, the aerobic treatment less occurs. In this chamber, nitrification is started to remove remaining ammoniac and nitrate out of the water components. The absolute aerobic treatment processes are applied to continue removing all nitrate base components $(NO_3)^{2-}$ out of the wastewater. Operator shall adjust the smooth operation of the chamber to favorably conduct the

nitrate reactions. Nitrate reactions may crease nitro (N_2) in atomic form and it is discharged to the environment in the form of emissions.

After aerobic treatment in chamber 4, wastewater shall be flown to settling and filtering chamber 5 and partially returned to chamber 1. In such chamber 5, wastewater is naturally settled, the insoluble deposits are gradually settled into the bottom. After settling, wastewater is flown to chamber 6 and sterilized by chloride table (cheap and convenient chemicals in accordance with the domestic wastewater treatment requirements). Post-treatment water shall be discharged to the manhole out of the site.

Post-treatment wastewater is completely qualified with QCVN 14:2008/BTNMT (column B) - National Technical Regulations on Domestic Wastewater.

Lab wastewater

In 2015, the lab wastewater treatment system with the capacity of 85m^3/day.night had been gone to operation. Currently, the system's capacity of 70% has been exploited against the design capacity hence the wastewater from research centers will be treated in this system.

Wastewater is collected into drums V=250l in research-practice area. When it is full, it shall be discharged to the storage tank of lab wastewater treatment system (behind C10 building) for further treatment before discharging. The concerned officer or carriers of such wastewater must be trained and disseminated with chemical safety and wastewater.

Wastewater collected from various sources contains oil and greases Oil and grease available in the wastewater shall obstruct the later treatment process, hence, it must be separated. Such wastewater contained in the "oily wastewater" tank shall be treated by oil separator. Such device operates in accordance with the principle of air floating (DAF-Disolved Air Floangting). Oil and grease available in the wastewater to be separated shall be put into container. Depending on the collected waste oil and grease, it may be preliminarily dried and transported to incinerator for heat salvage. Post-oil separation wastewater shall be flown into container and preliminarily treated with the wastewater containing cyanide and printing ink. Here, the pollutants are treated with various wastewater before next treatment steps are applied.

- Description

Step 1: Wastewater containing printing ink and organic matters

Printing ink included in the wastewater is generally diversified, but mostly printing ink from cartridges of printer and fax machine. Generally, such wastewater contains organic colorants, metal oxides, anti-mould agents, ant-fading agents, humectants, etc., especially "permanent" magnetic substances due to magnetically contamination during printing. The treatment process of such chemicals is mainly used by strong oxygen agents to decay the organic mattes into CO2 and water. Wastewater containing printing in is general included with wastewater containing cyanide and organic matters. The aeration and inclusion of oxidation reactors are introduced to the treatment tank to handle the concerned substance group.

Organic solvent may be soluble, less soluble or not in water. If it is not soluble, it shall float or deposit into the bottom of wastewater block. In such two cases, the organic solvents like oil and grease and DAF oil separator may be used to remove it. In case the wastewater contain the soluble organic solvents or emulsion with water without separation by oil separator, it shall be contained with water tank containing printing ink and cyanide to oxidizing the organic matters like printing ink wastewater.

Metal oxides in ink (colorants) may be easily deposited in the form of oxide or hydroxide while the oxidization in the tank or the next steps may be treated in the combined block tank.

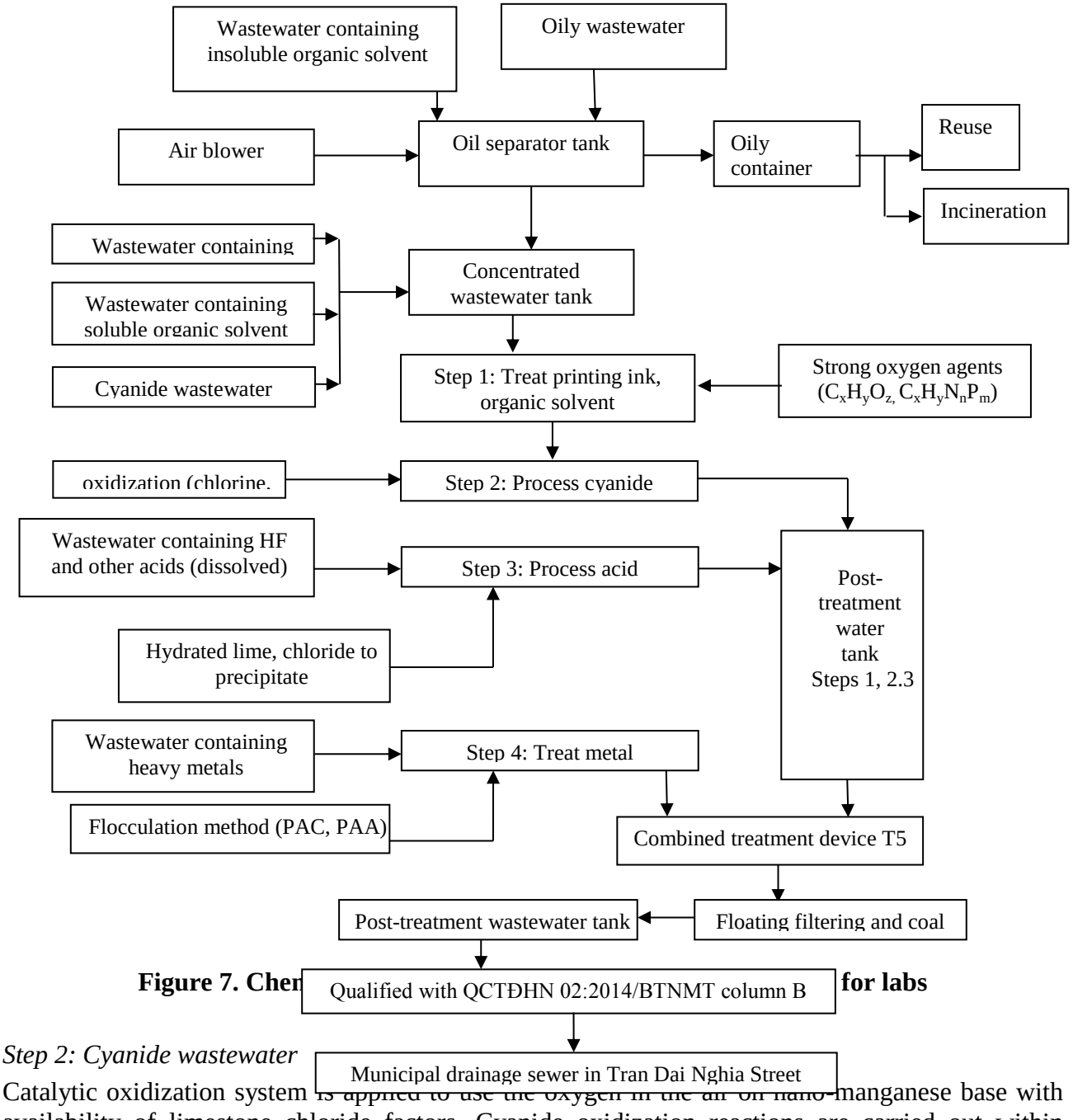


Figure 7. Chem for labs

Step 2: Cyanide wastewater

Catalytic oxidization system is applied to use the oxygen in the air on nano-manganese base with availability of limestone chloride factors. Cyanide oxidization reactions are carried out within relatively high pH range (pH>10).

Step 3: Wastewater containing HF and other acids.

Wastewater containing HF with contents to 55% of quantity shall be applied with hydrated limestone or limestone chloride to deposit CaF_2 from HF. For concentration of 50%, it must be dissolved to 100 times or more to obtain the concentration of 0.5%. In HF wastewater tank, pump is

provided to drive magnetically with propeller along teflon, depending on the case to pump HF to the cyanide wastewater tank, organic solvent and printing ink to moderate (reduce pH) and react with hydrated chloride then pump to the combined tank for flocculation purpose. If HF is sufficiently dissolved (0.1-0.5%), it may be directly pumped to neutralization chamber of the combined treatment tank to neutralize HF before flowing to flocculation chamber and conduct the flocculation and sedimentation of CaF_2 and other precipitations. The treatment of wastewater containing strong acids is only to conduct the neutralization reaction. The neutralization substance is lime stone.

Step 4: Wastewater containing heavy metals

The treatment tank of wastewater containing heavy metal ions shall be combined with OH- ions through metal hydroxide reaction and flocculation to the bottom tank. Aluminum and iron salts as flocculation agent are used to separate to form the less soluble hydroxides which may absorb the suspended matters as well as flocculants, forming large items to easily separate out of the waster thanks to the sedimentation.

In order to increase the deposition efficiency, high-molecular compounds - flocculation additives may be used. It may quickly block the hydroxide particles and settle, so -called as deposit agents. Such agents are used as polyacrylamide (PAA).

In the chrome removal tank Wastewater containing Cr^{6-} must be pumped to Crome removal chamber to completely convert Cr^{6-} to Cr^{3-} before flocculation Used chrome killer is $FeSO_4.7H_2O$ or $NaHSO_3$.

Post-treatment waste water is flown to combined treatment tank where reaction compartments T5-2 and T5-1 are passed and it is then flown to the deposition chamber to retain impurities and floating contaminants available in the waste water after reaction. Wastewater is continued flowing to floating filtering and coal filtering tank. Then, wastewater is flown to post-treatment wastewater tank. Wastewater qualified with QCTĐHN 02:2014/BTNMT column B is discharged to the Institution's drainage sewer and the city's drainage sewer.

According to the analysis results of treated wastewater on Sept 2016, all pollutant parameters of the treatment system were met the QCVN 40:2011/BTNMT column B. It means that this current laboratory treatment system can treat completely effective laboratory wastewater generated from the subproject the future.The detail is shown in Table 16:

Table 166. Output characteristics of laboratotry wastewater treatment system

No	Parameters	Unit	Results	QCTĐHN 02:2014/BTNMT (column B)
1	Temperature	oC	33	40
2	Odor	Pt/Co	57	150
3	pH	-	7.3	5.5 - 9
4	BOD_5 (20^oC)	mg/l	27	50
5	COD	mg/l	43	150
6	TSS	mg/l	48	100
7	As	mg/l	0.001	0.1

No	Parameters	Unit	Results	QCTĐHN 02:2014/BTNMT (column B)
8	Hg	mg/l	0.001	0.01
9	Pb	mg/l	0.002	0.5
10	Cd	mg/l	KPH	0.1
11	Cr (VI)	mg/l	0.05	0.1
12	Cr (III)	mg/l	0.33	1
13	Cu	mg/l	1.0	2
14	Zn	mg/l	1. 3	3
15	Ni	mg/l	0.1	0.5
16	Mn	mg/l	0.61	1
17	Fe	mg/l	1.15	5
18	CN-	mg/l	0.002	0.1
19	Phenol	mg/l	0.056	0.5
20	Oil and grease	mg/l	4.5	10
21	Sulfure	mg/l	1.05	0.5
22	Florua	mg/l	3.4	10
23	$N\text{-}NH_4^+$	mg/l	1.8	10
24	TN	mg/l	45	40
25	TP	mg/l	1.07	6
26	Cl^-	mg/l	768	1000
27	Pesticide (organic Chlor)	mg/l	KPH	0.1
28	Pesticide (organic Photphate)	mg/l	KPH	1
29	PCB	mg/l	0.001	0.01
30	Coliform	Vi khuẩn/100ml	3.359	5000
31	Radiation α	Bq/l	0.001	0.1
32	Radiation β	Bq/l	0.01	1.0

3. Hazardous waste

Although the hazardous waste volume from laboratories is not much, but they have impacted negatively on the environment, therefore they should be collected, transported and handled by the competent authorities. Before the laboratories are going in operation, the should:

- Registry the generators and hazardous waste with Hanoi Department of Natural Resources and Environment while building the temporary storage of hazardous waste in accordance

with Circular 36/2015/TT BTNMT dated 30/06 2016 of Ministry of Natural Resources and Environment.

- Signing the contract with functional units for collection and handling of hazardous waste
- Fully equip for all the laboratories, practical laboratories of faculties and centers about hazardous waste containers
- Building and sticking rules for collection and management of all hazardous waste in general and other types of chemical peel packaging in particular in every lab
- Prohibiting throw mixed hazardous wastes and other solid waste
- Chemical waste from laboratories must be kept under strict safety regulations about chemical and biological substances. These regulations must be disseminated to those working in the laboratory;
- All types of hazardous waste must be labeled as prescribed;

Measures to minimize leakages of chemical fumes

- ✓ Small amount of laboratory fumes are leaked regularly. Therefore first priority is given to air ventilation for the labs. Besides, labs are equipped with ventilation fan and chemical fume hoods to ensure laboratory users' health.
- ✓ Laboratory fumes collection and treatment: Laboratory desks/areas will be arranged reasonably. Those experiments involving volatile chemicals will be conducted in separate area equipped with fume extractor ensuring all smoke and chemical fumes sucked entirely. In the labs where sample digestion and research are conducted a separate ventilated cabinet system will be installed for the sample digestion and the fumes will be sucked out with the fume extractor system.

Figure 1. Chemical fume hood, ceiling-mounted fume hood and chemical fume extractor

Risk prevention from usage of laboratory chemicals and instruments

To reduce risks from usage of laboratory chemicals:

- ✓ Chemical storage room should be arranged separately, preservation depends on its chemical and management staffs are assigned clearly;
- ✓ Chemicals have verified origin, expiration date and quality assurance for analysis;
- ✓ Do not enter chemicals overly to avoid prolonged inventory and unsafety for management;
- ✓ Teachers or guiders should monitor closely during chemical preparation or using by students;

- ✓ Staffs or students should be equipped fully or wear lab coat before entering especially related to chemicals;
- ✓ Make up a record for every laboratory noting entered chemicals, its expiration, precautions, etc.;
- ✓ For used-up chemicals, its bottle/package need to be collected thoroughly and taken into a system for collection and treatment of hazardous waste;
- ✓ Chemical oral suction is strictly prohibited;
- ✓ Regal training on laboratory safety for staffs.

Safe operation of equipment and machines

- ✓ All staffs who operate equipment and machines must be trained, technical transfer before operation
- ✓ Absolutely no staffs/students/trainees who are not being trained participate to operate equipment
- ✓ On each equipment, must have a table to guide the used process
- ✓ Write a diary to follow all daily activities of equipment
- ✓ All equipment must be maintained regularly and periodically, checked the safety and accuracy of equipment
- ✓ The power supply for each equipment must be tested before installation and it must be install own automated system
- ✓ Depending on the equipment, but the majority of equipment must be placed in rooms with stable humidity. Therefore, these rooms are often installed air conditioning systems
- ✓ Absolutely chemicals must not be diluted and stored near the equipment. Only use chemicals in accordance with instructions of the equipment

Measures to prevent electrical incidents and short-circuit

- ✓ Design and install the electrical system with full electrical safety equipment such as fire-resistant materials, automatic circuit breaker to protect overload & short circuit, electrical leakage protection, etc.
- ✓ Design and arrange work items to comply with the safety rules for firefighting and prevention system, install fire protection, firefighting and prevention system inside and outside, is approved by the competent authority about the record of firefighting and prevention.
- ✓ Remind and propagate regularly about firefighting and prevention safety rules; Organize regular training and drills for firefighting and prevention.

Social impact mitigation measures

Table 177. Framework of social action plan for the subproject

Contents	Objectives/Outputs	Proposed action	Implementing agencies	Indicators	Remarks
Access to public works	Secure the health of staffs, lecturers and students as well as local residents; Create landscape,	Detailed design, Technical drawings	PMU Local authorities Consultants	Increased number of students by improving/expanding the learning environment.	Cost estimation and detailed design are conducted by the

Contents	Objectives/Outputs	Proposed action	Implementing agencies	Indicators	Remarks
	workspace; Reduce pollution from wastewater			Facilitated economic development for the subproject area	consultants
Sexually Transmissible Infections (STI) risk	Reduce exposure to STIs due to increasing inflows during construction	Incorporate intervention measures for raising awareness of HIV/AIDS contractor's bid documents	PMU Contractors Local authorities Consultants	Measures for interventions and raising awareness of STIs included in contractor's bid documents	Implementation and monitoring activities will be carried out by detailed design consultants and implementation consultants
Labor	The contract for contractors should include provisions to ensure the health and occupational safety; no wage discrimination between women and men, prevention of child labor; and compliance with labor laws and relevant obligations of international treaties Maximize the employment of women and the poor in the process of construction	The contract of contractors is reviewed to ensure that the provisions relating to occupational health and safety (OH & S) and gender equality Priority for women and the poor in unskilled work.	PMU Social and political organizations (Youth Union, Women's Union,...) Centre for employment information Local authorities Contractors Consultants	Provisions relating to: i) OH & S; ii) promoting gender equality and preventing gender discrimination; and iii) prevention of use of child labor are included in the contractor's contract. The number of local workers according to the gender Men and women will receive equal remuneration for equal work;	Monitoring activities will be carried out by the DDIS consultant Excluding costs as part of its monitoring DDIS activities

Impacts on community safety and health

- The contractors are required to comply with Circular No. 22/2010/TT-BXD by the Ministry of Construction on labor safety in construction operations;
- In case of epidemic outbursts, the Subproject shall cooperate closely with the local government to carry out the required mitigation and control measures;
- Fence centralized construction sites with solid materials of at least 2m high;
- Place warning signs and fence open pits and ditches to prevent accidents;
- Sufficient lighting will be provided when construction is carried out at night;
- Apply speed limit of 20km/h within 200m from the construction;
- Where possible, place machines generating high level of noise as far as possible from residential houses and public areas so as noise level and be kept below 70dBA;
- Use static compacting when the road base is constructed near areas with many households and weak temporary works to restrict vibration;

- The subproject will cooperate with the local health agency in developing and implementing plans for control of diseases among workers.

6. ROLES AND RESPONSIBILITIES FOR ESMP IMPLEMENTATION

6.1. ESMP implementation arrangement

ESMP during construction requires the involvement of several stakeholders and agencies, each with different roles and responsibilities including hust, PMU, DONRE (Hanoi Department of Natural Resources and Environment), the Contractors, the Construction Supervision Consultant (CSC), and local communities.

To ensure effective implementation of the ESMP, the following actions will be carried out during the implementation of the subproject:

During the detailed design and tender documentation making

- During the detailed design of technical specifications and preparation of bidding contract documents for each contract, the technical design consultant will incorporate into these bidding and contractual documents the parts of the EMP specific to that contract, as well as the specific measures identified in the EMP.
- In preparing the bidding and contract documents, make an effort to ensure that the contractors are aware of the safeguard obligation and commit to comply.

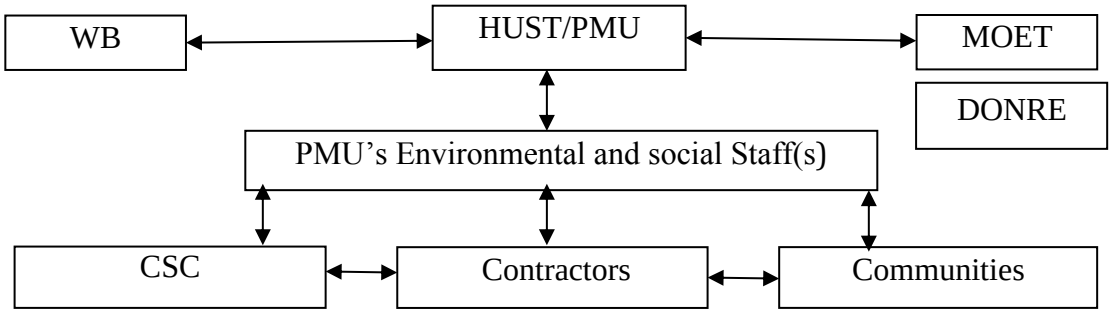


Figure 8. ESMP implementation structure

6.2. Environmental protection responsibilities

The roles and responsibilities of the key parties and their relationships regarding the implementation of the ESMP are described as follows:

Table 188. Environmental protection responsibilities

Community/ Agencies	Responsibilities
PMU	- PMU will be responsible for monitoring the overall subproject implementation, including environmental compliance of the subproject. PMU will have the final responsibility for ESMP implementation and environmental performance of the subproject during the construction and operational phases.Specifically, the PMU will: (i) closely coordinate with local authorities in the participation of the community during subproject preparation and implementation; (ii) monitor and supervise ESMP implementation including incorporation of ESMP into the detailed technical designs and bidding and contractual documents; (iii) ensure that an environmental management system is set up and functions properly; (iv) be in charge of reporting on ESMP implementation to the DONRE and the World Bank. - In order to be effective in the implementation process, PMU will assign Environmental

Community/ Agencies	Responsibilities
	Staff(s) (ES) to help with the environmental aspects of the subproject.
PMU Environmental and Social Staff(s) (ES)	- The ES is responsible for monitoring the implementation of the World Bank's environmental and social safeguard policies in all phases and process of the subproject. Specifically, ES will be responsible for: (i) helping PMU incorporate ESMP into the detailed technical designs and civil works bidding and contractual documents; (ii) helping PMU incorporate responsibilities for ESMP and supervision into the TORs, bidding and contractual documents for the Construction Supervision Consultant (CSC) and other safeguard consultant (IEMC) as needed; iii) providing relevant inputs to the consultant selection process; (iv) reviewing reports submitted by the CSC and safeguard consultants; (v) conducting periodic site checks; (vi) helping the PMU on solutions to handle social issues of the subproject; and vii) preparing environmental and social performance section on the progress and review reports to be submitted to the MOET, DONRE and the World Bank.
Construction Supervision Consultant (CSC)	- The CSC will assgin Environmental and Social Staff(s) and will be responsible for routine supervising and monitoring all construction activities and for ensuring that Contractors comply with the requirements of the contracts and the ECOP. The CSC will engage sufficient number of qualified staffs (e.g. Environmental Engineers) with adequate knowledge on environmental protection and construction subproject management to perform the required duties and to supervise the Contractor's performance. - The CSC will also assist the PMU in reporting and maintaining close coordination with the local community.
Contractor	- The contractor will assign Environmental and Social Staff(s) to carry out Environmental and Social mitigation measures proposed in ESMP. - Based on the approved environmental specifications (ECOP) in the bidding and contractual documents, the Contractor is responsible for establishing a Contractor ESMP (CESMP) for each construction site area, submit the plan to PMU and CSC for review and approval before commencement of construction. In addition, it is required that the Contractor get all permissions for construction (traffic control and diversion, excavation, labor safety, etc. before civil works) following current regulations. - The Contractor is required to appoint a competent individual as the contractor's on-site *Safety and Environment Officer (SEO)* who will be responsible for monitoring the contractor's compliance with health and safety requirements, the CESMP requirements, and the environmental specifications (ECOP). - Take actions to mitigate all potential negative impacts in line with the objective described in the CESMP. - Actively communicate with local residents and take actions to prevent disturbance during construction. - Ensure that all staffs and workers understand the procedure and their tasks in the environmental management program. - Report to the PMU and CSC on any difficulties and their solutions. - Report to local authority and PMU and CSC if environmental accidents occur and coordinate with agencies and keys stakeholders to resolve these issues.
Local community and students of HUST	- Community and students of HUST: According to Vietnamese practice, the community has the right and responsibility to routinely monitor environmental performance during construction to ensure that their rights and safety are adequately protected and that the mitigation measures are effectively implemented by contractors and the PMU. If unexpected problems occur, they will report to the CSC and PMU.

Community/ Agencies	Responsibilities
MOET, Hanoi People's Committees, DONRE	- Oversee implementation of subproject under recommendations of MOET/DONRE and PMU to ensure compliance of Government policy and regulations. MOET/DONRE is responsible for monitoring the compliance with the Government environmental requirements.

7. ENVIRONMENTAL COMPLIANCE FRAMEWORK

7.1. Environmental Duties of the Contractor

The contractor firstly shall adhere to minimize the impact that may be result of the subproject construction activities and secondly, apply the mitigation measures under ESMP to prevent harm and nuisances on local communities and environment caused by the impacts in construction and operation phases.

Remedial actions that cannot be effectively carried out during construction should be carried out on completion of the works (and before issuance of the acceptance of completion of works)

The duties of the Contractor include but not limiting to:

- Compliance with relevant legislative requirements governing the environment, public health and safety;
- Work within the scope of contractual requirements and other tender conditions;
- Organize representatives of the construction team to participate in the joint site inspections undertaken by the Environmental Staffs of the CSC;
- Carry out any corrective actions instructed by the Environmental Staffs of the PMU and CSC;
- In case of non-compliances/discrepancies, carry out investigation and submit proposals on mitigation measures, and implement remedial measures to reduce environmental impact;
- Stop construction activities, which generate adverse impacts upon receiving instructions from the Environmental Staffs of PMU and CSC. Propose and carry out corrective actions and implement alternative construction method, if required, in order to minimize the environmental impacts; Non-compliance by the Contractor will be cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of the ES of PMU and CSC.

7.2. Contractor's Safety, Social and Environmental Officer (SEO)

he contractor shall be required to appoint competent staff(s) as the Contractor's on-site safety, Social and environmental officer (SEO). The SEO must be appropriately trained in environmental management and must possess the skills necessary to transfer environmental management knowledge to all personnel involved in the contract. The SEO will be responsible for monitoring the contractor‘s compliance with the ESMP requirements and the environmental specifications. The duties of the SEO shall include but not be limited to the following:

- Carry out environmental site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to pollution control and adequacy of environmental mitigation measures implemented;
- Monitor compliance with environmental protection measures, pollution prevention and control measures and contractual requirements;
- Monitor the implementation of environmental mitigation measures;

- Prepare audit reports for the site environmental conditions;
- Investigate complaints and recommend any required corrective measures;
- Advise the contractor on environment improvement, awareness and proactive pollution prevention measures;
- Recommend suitable mitigation measures to the contractor in the case of non-compliance. Carry out additional monitoring of noncompliance instructed by the ES of PMU and CSC
- Inform the contractor and ES (of PMU and CSC) of environmental issues, submit contractor's ESMP Implementation Plan to the ES of PMU and CSC, and relevant authorities, if required;
- Keep detailed records of all site activities that may relate to the environment.

7.3. Environmental and Social Supervision during Construction (CSC)

During construction phase, a qualified CSC reporting to the PMU shall carry out the environmental supervision. The CSC will assign environmental and social staff(s), will be responsible for inspecting, and supervising all construction activities to ensure that mitigation measures adopted in the ESMP are properly implemented, and that the negative environmental impacts of the subproject are minimized. The CSC shall engage sufficient number of Environmental Supervision Engineers with adequate knowledge on environmental protection and construction subproject management to perform the required duties and to supervise the Contractor's performance. Specifically ES of CSC will:

- Review and assess on behalf of the PMU whether the construction design meets the requirements of the mitigation and management measures of the ESMP,
- Supervise site environmental management system of contractors including their performance, experience and handling of site environmental issues, and provide corrective instructions;
- Review the ESMP implementation by the contractors, verify and confirm environmental supervision procedures, parameters, monitoring locations, equipment and results;
- Report ESMP implementation status to PMU and prepare the environmental supervision statement during the construction phase; and

7.4. Compliance with legal and contractual requirements

The constructions activities shall comply not only with contractual environmental protection and pollution control requirements but also with environmental protection and pollution control laws of the Socialist Republic of Viet Nam.

All the works method statements submitted by the Contractor to the CSC and PMU for approval to see whether sufficient environmental protection and pollution control measures have been included.

The CSC and PMU shall also review the progress and program of the works to check that relevant environmental laws have not been violated, and that any potential for violating the laws can be prevented.

The Contractor shall copy relevant documents to the SEO and the ES of CSC and PMU. The document shall at least include the updated work progress report, the updated work measure, and the application letters for different license/permits under the environmental protection laws, and all the valid license/permit. The SEO and the ES shall also have access, upon request, to the Site Log-Book.

After reviewing the documents, the SEO or the ES shall advise the PMU and the contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the SEO or the ES concludes that the status on license/permit application and any environmental protection and pollution control preparation works may not comply with the work measure or may result in potential violation of environmental protection and pollution control requirements, they shall advise the Contractor and the PMU accordingly.

7.5. Compliance with legal and contractual requirements

In the compliance framework, if non-compliance with environmental regulations are discovered by CSC/ES/PMU during the site supervision, 2% values of interim payment of the contractor of this month will be held back. The Contractor will be given a grace period (determined by CSC/PMU) to repair the violation. If the Contractor performs the repairs within the grace period (confirmed by CSC/PMU), no penalty is incurred and keeping money will be pay. However, if the Contractor fails to successfully make the necessary repairs within the grace period, the Contractor will pay the cost for a third party to repair the damages (deduction from keeping money).

In case of CSC/PMU not detected of non-compliance with environmental regulations of the contractor, they will be responsibility payment to repair the violation.

7.6. Reporting Arrangements

ESMP monitoring and reporting requirements are summarized in Table 19.

Table 199. Regular Reporting Requirements

No.	Report Prepared by	Submitted to	Frequency of Reporting
1	Contractor to the Employer	PMU	Once before construction commences and monthly thereafter
2	Construction Supervision consultant (CSC)	PMU	Weekly and monthly
4	Community Monitoring	PMU	When the community has any complaint about the subproject safeguards implementation
5	PMU	DONRE/MOET	Every six-month
6	PMU	WB	Every six-month

PMBs' report on environmental performance/compliance of the subproject should be included in the progress report submitted to the NPT before each subproject implementation support mission and must include sufficient information on: i) preparation and disclosures of environmental safeguards instruments for subprojects; ii) incorporation of new subproject EMPs in the bidding and contractual documents; iii) monitoring and supervision of EMP implementation by the contractor, the construction supervision engineer, and the PCs; iv) any challenges in safeguardimplementation, solutions, and lessons learned.

8. ENVIRONMENTAL MONITORING PROGRAM

8.1. Objectives of the environmental monitoring program

Implementation plan of monitoring program is divided into 2 phases: Design phase is the preparation phase; subproject construction; subproject operation. Mitigation measures determined during subproject preparation must be completed by the designer before construction. The proper design results must be included into the contractor's bids.

During construction phase, some mitigation measures must be carried out before construction such as training for contractor and construction Supervision Company. The detailed implementation plan for mitigation measures must be given out to be applied at site on commencement date. Such requirement is also available in the Bidding Documents and such plan shall be inspected by PMU.

8.2. Review of contractor's documents

ESMP's Implementation Plan must be prepared by the contractor and inspected by PMU before the Bids are submitted. All documents submitted by the contractor are appraised in accordance with the subproject requirements and CSE. Any changes in documents must be accepted by the environmental officer and CSE. Such documents must be continuously updated.

8.3. Environmental monitoring criteria

8.3.1. Environmental monitoring plan

a. Construction phase

During subproject preparation and construction, the environmental monitoring is carried out by the Project Owner, concretely:

Table 200. Location, parameters and frequency of air ambiance monitoring during construction

Symbol	Location	Parameter/frequency	Comparative standards
Ambient air environment monitoring			
KK1	Construction site	CO, SO_2, NO_2, total dust and noise, temperature. 6 months/time	- Industrial hygiene standards (promulgated the Decision No. 3733/2002/QĐ-BYT-10/10/2002 of the Ministry of Health) - QCVN 05:2013/BTNMT: National technical regulation on ambient air quality - QCVN 26:2010/BTNMT: National Technical Regulation on Noise in public and residential area
KK2	Area C10		
KK3	Area C5		

b. Operation phase

When the subproject is put into operation, the monitoring is carried out by the Project Owner.

Table 211. Location, parameters and frequency of wastewater during the operation

No.	Symbol	Location	Parameter/frequency	Comparative standards
Wastewater monitoring Frequency: 3 months/time				
1	JK1	Post-treatment wastewater at JOKASOU1 system	pH, BOD,TSS, TS, Sulfur, Ammoniac, Nitrate, oil and grease, total surface active agents, Phosphate (PO_4^-) Total coliform	QCVN 14: 2008/BTNMT (column B)
2	JK2	Post-treatment wastewater at JOKASOU2 system		
3	NT	Post-treatment wastewater at lab's waste water treatment system	pH, BOD_5, COD, TSS, TDS, total N, total P, As, Cd, Cr^{6-}, Cr^{3-}, Cu, Fe, Hg, Mn, Ni, Pb, Sn, Zn, ammoniac, nitrate, phosphate, cyanide, phenol, mineral oil and grease, sulfur, fluoride, chloride, residual chloride and coliform.	QCTĐHN 02:2014/BTNMT column B
Solid waste and hazardous waste monitoring Frequency: 6 months/time				
1	CTR	Domestic waste, office waste	- Collect, classify and treat	Decree No. 38/2015/NĐ-CP
2	CTNH	Hazadous waste	- Collect, classify, storage and treat	Circular No. 36.2015/TT-BTMT

8.3.2. Social monitoring plan

i) Social monitoring plan during construction

Table 222. Social monitoring plan during construction

No.	Form	Site	Frequency	Basis
I	**OSH monitoring**			
1	Environmental hygiene	- Construction site - Worker camping area - Material mobilization areas	3 months/ time	- Quantity and conditions of cleaning tools - First aid box - Medical works - Number of infectious and contamination cases - Communication plan on community health
2	Labor safety	- Construction site - Worker camping area - Material mobilization areas	3 months/ time	- PPEs - Safety signs - Number of accidents

9. CAPACITY BUILDING PROGRAM

9.1. Technical Assistance support for the implementation of safeguards

An assessment of safeguards implementation capacity of existing PMU staffs indicate that PMU staffs have limited knowledge on WB safeguard requirements as well as limited knowledge of

environment and social issues. Such lack of capacity represents a risk to subproject implementation of safeguards requirements contained in the ESMP and, as required by the WB policy, is to be addressed through capacity building. Therefore, it is proposed to provide capacity building through technical assistance that will support the PMU during the implementation of the safeguards requirements. The technical assistance will provide the necessary technical support the PMU in its work with contractors as well as other entities involved in the implementation of the ESMP.

The scope of the technical assistance would cover support from experts and training that would cover both the knowledge on safeguards requirements and procedures for the subproject as well as training that covers both specific knowledge on safeguard procedures and requirement for the subproject staffs, consultants, and national contractor would be important. This would include, for example, assistance in the preparation of documents and implementation of training program on environmental management and environmental monitoring for contractors, CSC and relevant staffs of PMU (environmental staffs and coordinators of packages) to do their tasks. It would also include assisting the PMU's environmental staffs with the review of contract documents on the bidding packages for construction items of the subproject to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements as well as provide general environmental guidance as requested by the PMU to enhance overall subproject implementation and performance.

Given the nature, locations, and scale of construction, it is anticipated that the safeguard technical assistance support and training will be provided at least during the first 3 years of the subproject implementation. The WB safeguard specialists will participate in the capacity building in particular in the training activities as appropriate.

9.2. Training programs proposed

Table 27 below provides examples of the basic trainings for safeguards during subproject implementation. The training programs will be developed and delivered by the Technical Assistance team for the implementation of safeguards for the PMU training. The PMU with the support of the Technical Assistance team for the implementation of safeguards will provide the training to contractors, CSC and other groups.

Other more specific and tailored training will be developed and agreed upon between PMU and the Technical Assistance team for the implementation of safeguards during subproject implementation based upon an reassessment of needs and the status of safeguards implementation.

- ✓ *Target groups for the training:* include PMU staffs, ESU staffs, field engineers, CSC, construction contractors, local authorities, and community representatives in the subproject area. Training of workers and drivers is the responsibility of the contractor.
- ✓ *Training schedule:* At least 1 month before the construction of the first contract. The training can be adjusted in line with the implementation schedule of the sub subproject/contracts.
- ✓ *Training frequency*: The basic training programs proposed in Table 23 will take place every six months on a yearly basis and its content updated and adapted to implementation issues. Training frequency and content will be reassessed during implementation depending on needs. It is foreseen that the training program for PMU staffs will continue until year three of implementation. Three days of training for CSC and contractors are also planned to take place twice a year on an annual basis for at least two years.

Table 233. Training Programs for Capacity Building on Environmental Supervision and Management

I. Objects	SUBPROJECT MANAGEMENT UNIT (PMU)
Training course	Environmental supervision, monitoring and reporting
Participators	Environmental staffs and technical staffs
Training Frequency	Soon after subproject effectiveness but at least 1 month before the construction of the first contract. The follow-up training will be scheduled as needed.
Time	Four days of training twice a year to be repeated on a yearly basis until year three of implementation
Content	- General environmental management relating to subproject including requirements of WB, MOET, DONRE, cooperating with relevant enterprises - Requirements on environmental supervision; - Supervision and implementation of mitigation measures; - Community participation in environmental supervision - Guide and supervise contractor, CSC, and community representatives in implementation of environmental supervision. - Forms used in environmental supervision; - Risk response and control; - Other areas to be determined; - Receiving approach and submit forms.
Responsibilities	PMU, with support of the Technical Assistance team for the implementation of safeguards
II. Objects	**CSC, CONTRACTOR, COMMUNE/WARDS AUTHORITIES, COMMUNITY REPRESENTATIVES**
Training course	Implementation of mitigation measures
Participators	CSC; on-site construction management staffs; environmental staffs of contractor; commune/ward/group authorities
Training frequency	After bidding, update based on requirements
Time	Three days of training for CSC and contractors and two days of training for other also to be repeated twice a year on an annual basis depending on needs
Content	- Overview of environmental monitoring; - Requirements of environmental monitoring; - Role and responsibilities of contractors and CSC - Content and methods of environmental monitoring; - Response and risk control; - Propagate monitoring forms and guide how to fill in the forms and risk report; - Other areas to be determined; - Preparation and submission of report
Responsibilities	PMU with support of the Technical Assistance team for the implementation of safeguards
III. Objects	**COMMUNITIES AND WORKERS**
Training course	Environmental sanitation and safety
Participators	Representatives of community and/or worker leaders (as appropriate)
Training frequency	As appropriate
Time	One-day presentation and one-day on-the job training twice a year to be repeated on a per needs basis
Content	- Preliminary presentation on environmental protection and environmental overview - Key issues that require community and workers attention to minimize safety risks (roads, equipment, machines, etc.) as well as reduce pollution (dust, fume gases, oil/grease spill, waste management, etc.) - Management of environmental safety and sanitation in work sites and worker

I. Objects	SUBPROJECT MANAGEMENT UNIT (PMU)
	camps; - Mitigation measures at construction site and work camps; - Safety measures on electricity, mechanical, transportation, air pollution; - Other areas to be determined; - Procedures to deal with emergency situation
Responsibilities	Contractor, PMU

10. ESMP COST ESTIMATION

10.1. Cost for mitigation measures by contractor

Expenditure for implementing ESMP includes the main financial resources, covering the environmental monitoring expenses and expenses for implementing the mitigation measures. The expenses of implementing the mitigation measures have been included into the expenditure for implementing construction subprojects on environmental protection works and measures.

10.2. Cost for monitoring the ESMP implementation

Table 244. Cost for ESMP implementation

No.	Contents	Unit	Quantity	Unit (USD)	Amount (USD)
I/	**Expert remuneration**				**7,566.4**
1	Team leader	Month	3	1,061.9	3185.8
2	Environmental expert	Month	3	796.5	2,389.4
4	Support officer (3 persons x 3 months)	Month	9	221.2	1,991.2
II	**Sample analysis**				**597.3**
1	Wastewater	Sample	3	132.7	398.2
2	Air sample	Sample	3	66.4	199.1
III	**Office supplies**				**929.2**
1	Office materials		3	88.5	265.5
2	Printing		3	177.0	531.0
3	Communications		3	44.2	132.7
IV	**General and administrative expenses (50%)**	**%**	**50**	**9,955.8**	**4,977.9**
	Total (I-II-III-IV-V)				19,018.1
	Pre-tax	%	6		1,141.1
	VAT	%	10		2,015.9
	Total (rounded)				**14,071**

10.3. Cost for training and capacity building

Table 255. Cost for capacity building training

Contents	Applicable subject	Quantity	Expenses (USD)	Financial sources
Training on food safety, labor	Workers and	All	50 persons x	Included in contract

Contents		Applicable subject	Quantity	Expenses (USD)	Financial sources
safety and environmental protection		technicians of contractor	employees	9USD/person = 450USD	made and entered by and between the Project Owner and the stakeholders
Environmental Management Training	Control of waste sources	PMU officer	3 persons	22USD/person x 3 persons = 66USD	Included in contract made and entered by and between the Project Owner and the stakeholders
	ESMP and risk control	PMU officer	3 persons	22USD/person x 3 persons = 66USD	Included in contract made and entered by and between the Project Owner and the stakeholders
	Environmental monitoring	PMU officer CSC	8 persons (including 3 PMU officers and 5 CSCs)	22USD/person x 8 persons = 176USD	Included in contract made and entered by and between the Project Owner and the stakeholders
	Awareness enhancement and access to environmental legislation system	PMU officer CSC	8 persons (including 3 PMU officers and 5 CSCs)	22USD/person x 8 persons = 176USD	Included in contract made and entered by and between the Project Owner and the stakeholders
	CSC	CSC	5 persons	5 persons x 45/person = 225 USD	Included in contract made and entered by and between the Project Owner and the stakeholders
Training CBS		Ward officer	2 persons/ward x 1 ward = 2 persons	2 persons x 45USD/person = 90USD	Included in contract made and entered by and between the Project Owner and the stakeholders
Total (USD)				**1,249**	

11. GRIEVANCE REDRESS MECHANISM (GRM)

Complaints relating to any subproject's problems will be solved through negotiations to achieve the consensus. A complaint will go through three Stages before it can be transferred to the court. The enforcement unit will pay all administrative and legal fees relating to the acceptance of complaints. This cost is included in the subproject budget.

Complaint procedures and resolution will be performed as follows:

The first level *People's Committee of ward/commune*. An affected household is to take his/her complaint to any member of the People's Committee of the ward/commune, through the ward head or directly to People's Committee of ward, in written or oral form. The said member(s) of the People's Committee will inform the People's Committee of the ward on the complaint. The People's

Committee of Ward will work directly in person with the said affected household and will decide on the settlement of the complaint 5 days after receiving such complaint. The Secretariat of the People's Committee of the relevant ward is responsible for documenting and recording all the complaints that it is handling.

After the Ward People's Committee issues its decision, the relevant household can make an appeal within 30 days. In case a second decision has been issued but the said household is still not satisfied with such decision, such household can appeal to the municipal (city) People's Committee (CPC).

The second level *the CPC*. Upon receiving a complaint from a household, the CPC will have 15 days after receiving the complaint to resolve the case. The CPC is responsible for filing and storing documents on all complaints that it handles.

When the CPC has issued a decision, the household can make an appeal within 30 days. In case a second decision has been issued and the household is still not satisfied with such a decision, they can appeal to the Hanoi People's Committee.

The third level The Hanoi People's Committee (HPC). Upon receiving a complaint from the household, the HPC will have 30 days after receiving the complaint to resolve the case. The HPC is responsible for filing and storing documents for all complaints to be submitted.

After the HPC has issued a decision, the household can appeal within 45 days. In case a second decision has been issued and the household is still not satisfied with such decision, they can appeal to the court within 45 days. The HPC will then have to pay the compensation into an account.

The Forth Level Provincial Court. In case a complainant brings his/her case to a provincial court and the court rules in favor of the complainant, the provincial authorities will have to increase the compensation up to such a rate as may be ruled by the court. In case the court's ruling is in favor of the HPC, the complainant will be refunded the amount of money that has been paid to the court.

The decision ruling the settlement of complaints will have to be sent to complainants and concerned parties, and shall be publicly posted at the headquarters of the People's Committee of the relevant level. The complainant will receive such ruling three days after the result of complaint resolution at the ward/commune/town level has been decided upon and 7 days at the district or provincial level.

Personnel: The environmental staffs chosen by the PMU will design and maintain a database of the subproject-related complaints from affected households, including information such as: the nature of the complaint, the source and date of receipt of the complaint, the name and address of the complainant, action plan, and current status.

For oral complaints, the receiving/mediator board will record these requests in a complaint form at the first meeting with the affected person. Contractor and Construction Supervision Consultant:

During construction, the GRM will also be managed by the contractors under supervision of the CSC. The contractors will inform the affected communities and communes about the GRM availability to handle complaints and concerns about the subproject. This will be done via the community consultation and information disclosure process under which the contractors will communicate with the affected communities and interested authorities on a regular basis. Meetings will be held at least quarterly, monthly information brochures will be published, announcements will be placed in local media, and notices of upcoming planned activities will be posted, etc.

All complaints and corresponding actions undertaken by the contractors will be recorded in subproject safeguard monitoring reports. Complaints and claims for damages could be lodged as follows:

- Verbally: direct to the CSC and/or the contractors' safeguard staffs or representatives at the site offices.
- In writing: by hand-delivering or posting a written complaint to specified addresses.
- By telephone, fax, e-mails: to the CSC, the contractors' safeguard staffs or representatives.

Upon receipt of a complaint, the CSC, the contractors' safeguard staffs or representatives will register the complaint in a complaint file and maintain a log of events pertaining to it thereafter, until it is resolved. Immediately after receipt, four copies of the complaint will be prepared. The original will be kept in the file, one copy will be used by the contractor's safeguard staffs, one copy will be forwarded to the CSC, and the fourth copy to the PMU within 24 hours since receipt of the complaint.

Information to be recorded in the complaint log will consist of:

- The date and time of the complaint.
- The name, address and contact details of the complainant.
- A short description of the complaint.
- Actions taken to address the complaint, including contact persons and findings at each step in the complaint redress process.
- The dates and times when the complainant is contacted during the redress process.
- The final resolution of the complaint.
- The date, time and manner in which the complainant was informed thereof.
- The complainant's signature when resolution has been obtained.

Minor complaints will be dealt with within one week. Within two weeks (and weekly thereafter), a written reply will be delivered to the complainant (by hand, post, fax, e-mails) indicating the procedures taken and progress to date.

The main objective will be to resolve an issue as quickly as possible by the simplest means, involving as few people as possible, and at the lowest possible level. Only when an issue cannot be resolved at the simplest level and/or within 15 days, will other authorities be involved. Such a situation may arise, for example, when damages are claimed, the to-be-paid amount cannot be resolved, or damage causes are determined.

World Bank Grievance Redress Mechanism*:* Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported subproject may submit complaints to existing subproject-level grievance redress mechanism or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address subproject-related concerns. Subproject affected communities and individuals may submit their complaints to the WB's independent Inspection Panel which determines whether harms occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the WB's attention, and Bank Management has been given an opportunity to respond.For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit www.worldbank.org/grs. For information on how to submit complaints to the World Bank Inspection Panel, please visitwww.inspectionpanel.org.

12. PUBLIC CONSULTATION AND INFORMATION DISLCOSURE

12.1. Objectives of public consultation

The subproject's public consultation required during ESMP was implemented. The community involvement and consultancy meetings were carried out to: Provide the useful information and better understand about the subproject and its potential impacts and improve the subproject as necessary; Allow the controversy issues to appear early; Facilitate to quickly solve the problems; Facilitate to set up the transparent procedures to implement the proposed subproject and create the accountability and awareness on local ownership during subproject performance. The affected groups and local NGOs were notified in accordance with WB's action policy (OP 4.01) on EIA; the involvement was required during subproject preparation to some extent and regularly recommended as a part of implementation.

12.2. Public Consultation Results

i) Participants

Because the subproject is situated within the campus of Hanoi University of Science and Technology, it is surrounded by the studying and researching areas of the institution. However, the subproject implement still causes some impacts on local socio-economic activities. Therefore, the Project Owner selected the public consultation plan at Bach Khoa ward, including: The People's Committee of the ward, Vietnam Fatherland Front and mass organizations (Veteran association, women' association and youth association);

Representatives of leaders, lecturers and students in the centers and research institutes in the subproject site: were the directly affected persons by the subproject; Centre for Research and Development of High Technology; CGCN; Centre for Training and new technology renovation; Space and Underwater Research Institute.

ii) Method of public consultation

Meeting was held with the aforesaid respondents, including: local authorities, local mass organizations; institutes and research centers to be directly affected by the subproject. The opinions were released after the Project Owner presents the report: Overview about the contents and main items of the subproject, financial resources for implementation. The consultant presents the ESIs of the subproject. The consultant presents the ESMP, including the mitigation measures and implementation plans. The environmental incidents and ESIs in the past had been consulted.

iii) Public consultation results and feedback of the Project Owner

The subproject was completely supported by the local authority of Bach Khoa Ward, representatives of the leaders and students from the Research Institutes and Centers. The available works and structures in the land lot had been degraded and the investment in implementing the subproject to build a new works was essential. However, the environmental hygiene, especially noise and smoke and road damages should be reliably prevented; quick construction should be applied to satisfy the schedule; the traffic divergence should be applied to avoid traffic jam and ensure the security order when many students gather here.

Table 266. Summary of public consultation results

Date, location	Participants	Opinions of the participants	Feedback of the Subproject Owner
I	**The local authority of Bach Khoa Ward**		

9th December 2016, 8h, Bach Khoa Ward	- The People's Committee of the Ward - Vietnam Fatherland Front - Veteran association, - Women's association, - Youth association - Number of participants 17 persons	- The Subproject Owner was proposed to take the mitigation measures and ensure the traffic safety when the waste and material trucks enter into the residential areas.	- The Subproject Owner will request the construction units to arrange at least 2 persons to control the traffic in rush hour. The Subproject Owner should contact with the Public Transport Unit to setup the warning sign and traffic lamp at the university's entrance.
		- The Subproject Owner should take the measures to water the road every day to minimize dust in the road section surrounding the ward's residential area.	- The Subproject Owner will arrange to hire truck from Hai Ba Trung District's Urban Environmental Company to wash the road twice per day (on the morning and afternoon).
		- When the workers are mobilized, the local authority must be contacted to register the temporary residence and manage the human resources.	- The Subproject Owner will request the construction unit to obtain the HR follow-up records and contact with the ward's People's Committee for temporary residence registration.
		- The Subproject Owner should take the mitigation measures to minimize the wastes from scattering in road, causing blockage of drainage road in Tran Dai Nghia road.	- The Subproject Owner will request the carriers to use canvas to cover the truck body; establish two-person cleaning team to clean the scattered soil and stones in the road.
		- When the accidents are available, the People's Committee must be notified to supervise and handle the accidents.	- The Subproject Owner is committed to report the People's Committee and find out the corrective measures for the accidents and release the official dispatch to complete and recover the available accidents.
		- During subsubproject construction and operation, the periodic environmental monitoring reports must be submitted to the People's Committee to supervise the existing conditions of the environment.	- The Subproject Owner is committed to strict adherence to the subsubproject's monitoring programs and submission of environmental monitoring report to the People's Committee once every 6 months.
II	**Institutes and research centers**		
9th December 2016; 14h; PMU	- School of Transportation Engineering - Center for Research and Application - CGCN - Centre for	- The specific schedule must be worked out so that the units may displace to new location.	- The Subproject Owner shall post the specific work schedule notice during the subsubproject preparation and construction out of the site.
		- The institution is proposed to comply with the set schedule during subsubproject performance.	- The Subproject Owner shall sign the contract with the contractor and closely supervise the subsubproject schedule.

	Training and New Technology Renovation - Space and Underwater Research Institute - Number of participants 17 persons	- When the functions are arranged, the divisions should consult the units to arrange the utilities properly.	- The Subproject Owner shall request the subsubproject design contractor to work closely with the units to be displaced in new C7 building to design properly.
		- The measures should be applied to cover the subsubproject site to prevent the waste from scattering out of the site.	- The Subproject Owner shall request the construction contractor to construct the corrugated sheet barrier and grid to cover the high-rise storeys during subsubproject construction.
		- The specific wastewater collection and treatment measures must be taken.	- The Subproject Owner will prepare the wastewater treatment plan by 2 Jokasou tanks with 100m^3/tank for wastewater treatment
		- The student and officer safety must be secured when they enter into the subsubproject	- The Subproject Owner will request the contractor to take the labor safety measures and arrange the site safeguard officer.
		- The subproject must be publicly notified to the students and officers of the university for acknowledgment and supervision.	- The subproject construction plans shall be posted in the bulletin board and website of the university regarding the subproject details.
III	**The Students**		
9th December 2016; 15h30; PMU	Students represent for: - School of Transportation Engineering - Center for Research and Application - CGCN - Centre for Training and New Technology Renovation - Space and Underwater Research Institute - Number of participants: 15 persons	- The mitigation measures must be applied to prevent the wastes from scattering in the road near to the site.	- The carriers are required to use canvas to cover the truck body; establish two-person cleaning team to clean the scattered soil and stones in the road. - The metal fencing walls must be setup surrounding the subproject - The net should be used to cover the high-rise storeys.
		- The student safety must be secured when they enter into the entrance at Tran Dai Nghia road.	- The Contractors will required to take the labor safety measures and arrange the site safeguard officer.
		- The subproject must be publicly notified to the students of the university for acknowledgment and supervision.	- The subproject shall be posted in the bulletin board and website of the university regarding the subproject details.
		- The subproject construction warning signs must be arranged.	- The institution shall arrange the warning signs and persons to guide the students.

	
Mr. Hoang Minh Son - Rector delivered his speech.	
	

Figure 9. Consultancy meeting in the subproject

12.3. Information disclosure

The first draft ESMP in Vietnamese had been published at the offices of Hai Ba Trung district and the HUST on November 28, 2016 for public consultation. Basing themselves on the contents of the ESMP, the local people could get the Subproject information and contribute their opinions/comments on environmental issues of the Subproject. The final draft ESMP in Vietnamese language was published at the offices of Hai Ba Trung district, Ministry of Education and Training and HUST on January 7th 2017.

The final draft ESMP in English was disclosed through the World Bank's Operations Portal on January 10th 2017.

APPENDIX

APPENDIX 1: LABORATORY SAFETY MANUAL- PRINCIPLES AT WORK IN THE LABORATORY

To ensure safety and avoid unfortunate situations when working in the laboratory, each faculty staffs, lecturer, student, trainee and PhD student must master the required procedures and rules. The equipment and the use of personal protection are extremely necessary.

Before starting operations one must master 15 general regulations for working in the laboratory.

I.LABORATORY REGULATIONS

1) Conduct experiment only with the presence of lecturers and laboratory technicians.
2) Read the directions carefully and think before conducting experiments.
3) Know where the safety equipment is stored.
4) Wear laboratory coat.
5) Wear goggles.
6) Hair is neatly tied.
7) Clean experiment table before starting an experiment.
8) Never taste laboratory chemicals.
9) Do not eat or drink in the laboratory.
10) Do not look into the test tube.
11) In case of chemical spillage or accidents, immediately notify lecturers and/or laboratory technicians.
12) Wash the skin when exposed to chemicals.
13) If the eye contacts with chemical, wash the eye immediately.
14) Dispose of laboratory waste in the designated places as directed.
15) If there is any inquiry, please ask the laboratory head.

II. LABORATORY RULES:

1. Everyone who works in the lab (laboratory) should be trained and examined of labor safety rules, processes, rules and technical measures to ensure workplace safety.
2. Respect working discipline, workplace sanitation and guidance from the responsible staffs. No stranger or overtime working is allowed, except for pre-agreed permission from the lab head and HUST security department.
3. Read carefully the document, understand all the details of the experiment before performing and anticipate problems that may occur for proactive prevention.
4. During conducting experiments carefully observe and record the data for the experiment report. After completion, clean and neatly arrange equipment and laboratory instruments.
5. In addition to the general provisions mentioned above, the specific provisions are applied to each laboratory depending on the nature of the experiments to ensure absolute safety for persons and property in the lab.

III. LABORATORY SAFETY RULES

All experiments using volatile substances, having unpleasant smells, toxic gases or concentrated acids must be conducted in a fume hood or well-ventilated place. Characteristics the chemicals used in the laboratory such as toxicity, risks of fire and explosion should be well comprehended to avoid mistakes when conducting experiments, leading to unfortunate consequences.

3.1. Working with toxic agents:

- In chemistry lab there are common but highly toxic chemicals, such as HCN, NaCN/KCN, Me_2SO_4, Hg, $HgCl_2$, CO, Cl_2, Br_2, NO, NO_2, H_2S, NO_2,... or substances used in organic synthesis such as CH_3OH, C_5H_5N pyridine, THF, benzene, toluene, acrylonitrile, aniline, HCHO, CH_2Cl_2...
- Do not smellchemicals directly;smell them in a distance using hand waving.
- After work wash your face, hands and utensils (use soap).
- Store chemicalscarefully.

3.2. Working with flammable substances:

- Flammable, volatile substances such as Et_2O, Me_2CO, ROH, kerosene, gasoline, CS_2, benzene, etc. can be heated or distilled in a water or air bath on the sealed electric stove.
- Do not place near heat sources, circuit breakers,...
- When conducting crystallization from flammable solvents separate instruments must be used with the reflux condenser.

3.3. Working with explosive substances:

- When working with substances such as H_2, alkali (metal & liquid), $NaNH_2$/KNH_2, concentrated acid, explosive organic matters (especially polynitro)... as well as when working under low or high pressure, protective glasses (made of organic glass) must be worn to protect the eyes and the important parts on the face.
- Do not bow to the boiled liquids or heated solids to prevent chemical splash (not well noticed issue). When heating the solution in a test tube use holder and always turn the tube mouth away from body, especially when heating concentrated acid or alkaline. Apprehend storing place and proficient use of firefighting tools and first aid medicine box in case of accidents for prompt and effective control.

IV. WORKING WITH CHEMICALS

4.1. Experiments with toxic substances

- In the laboratory there are many toxins such as mercury (Hg), white phosphorus (P), carbon oxide (CO), hydrogen sulfide (H_2S), phenol (C_6H_5OH), formic acid (HCOOH), benzene (C_6H_6), chlorine (Cl_2), nitrogen dioxide (NO_2), etc...
- The experiments with hazardous substances should be conducted with small amounts of chemicals, work in a well ventilated area and good posture.

Note: do not taste chemical and master common chemical smelling practices.

4.2. Experiment with caustic and burning substances:

- Carefully perform experiments with concentrated alkaline, acid, alkali metals, phenols etc.to avoid contact to hands, clothing, especially the eye (use goggles).
- When diluting H_2SO_4 acid carefully pour the acid into the water slowly and stir it well but not vice versa.
- When heating a solution of these substances comply with the rules of chemical heated in vitro

4.3. Experiment with flammable substances

- There are flammable substances such as alcohol, gasoline, Benzene, acetone ether... in the laboratory.
- Use small amount in experiment keep solutions away from the flames.... do not heat them directlyover fire, use water bath instead.
- Do not use large pot to store these substances and keep them away from fire sources (eg Bunsen burner, electric stove...)

- Use alcohol burner in compliance with the defined rules.

4.4. Experiments with explosives:

The explosives often found in laboratories are nitrate salts, chlorate salts etc.... These substances should be kept away from fire sources and carefully blended in accordance with the proper ratio of the volume. Wear protective gauges in experiment; high risk experiments are not allowed. When such gases as H_2, C_2H_2, CH_4, etc are burnt... their purity must be tested to avoid mixing with oxygen creating dangerous explosive mixture. Do not put large amount of sodium into the water as this will cause a fire and explosion accident.

How to test:

Collect H_2 gas through H_2O into the small test tubes. Use finger to cover the tube containing H_2 and put the tube mouth near an alcohol burner. When opening the tube, the mixture of H_2 gas and O_2 (in the air) will fire with pretty loud sound. Continue this process until no loud sound is heard to gain the pure H_2.

Use of glassware:

- Carefully put glass tube through the button to avoid cracking.
- Do not put hot water, boiling water into the cold or room temperature glass container.
- If finger is cut by broken glass bleed off the toxic substance for few seconds before washing with 90^o alcoholand applying bandage.
- Broken glass instruments should be collected separately from other waste.

V. NOTES FOR TOXIC PREVENTION IN CHEMICAL LABORATORY

5.1. Toxic precaution

- Each chemical laboratory should be equipped with protective facilities such as gowns, rubber gloves, goggles, ventilators etc.
- Carefully read labels and understand toxicity signs when using chemicals. Keep in mind how to take and smell chemicals. In the process of experimenting with toxic escaping fumes such experiment should be conducted in a well ventilated area or in fume hood.

5.2. Explosion and fire precautions

- Each laboratory should prepare sufficient means of fire prevention and fighting: fire extinguishers, sand, water containers, sacks, buckets etc. Laboratory staffs should understand the principles of firefighting and especially master the principles of storing and using explosive chemicals, flammable and explosive fire symbols on the label on the chemical containers. When a fire or explosion occur quickly determine the causes to propose suitable remedial measures.
- In cases when accidents happen all employees must apply first aid rules for the victims before transferringto the medical facility.

5.3. First aid for chemical accidents

In case of burns:

- For burns by flammable solvents such as benzene, acetone (C_6H_6, CH_3COCH_3etc....) use wet cloths over the burnt part, then apply sand or wet burlap to extinguish the fire. Do not use water to wash the burns; instead use potassium permanganate soaked gauze ($KMnO_4$ 1%) or carefully apply picric acid H_3BO_3 2% on burn wounds.
- For concentrated alkali burns, caustic soda, caustic potat (NaOH, KOH): Use clean water to wash the wound several times, then wash with 5% acetic acid solution. If the eye contacts with alkaline it must be washed with clean water several times then boric acid solution (H_3BO_3 2%).
- For concentrated acid burns like sulfuric acid, nitric (H_2SO_4, HNO_3...): First wash with clean water several times, then use 5% of ammonia or 10%s olution of $NaHCO_3$, to remove the acid (do not use soap to wash the wound). If If the eye contacts with acid it must be quickly washed thoroughly several times with clean water and distilled water then sodium hydrogen carbonate ($NaHCO_3$) 3%.

- For burns by phosphorus (P): First wash the burn with copper sulfate solution ($CuSO_4$) 2%. Do not use ointments or vaseline. Then apply gauze soaked with copper sulfate 2% solution or aqueous potassium permanganate ($KMnO_4$) 3% on the wound. This type of burns takes longer time to recover, be aware of infection.

In case of poisoning:

- Drinking acid by mistake: First let the victim drink ice water, crushed egg shells (1/2 spoon in the cup of water) and drink slowly magnesium oxide powder (MgO) mixed with water (29 grams in 300 ml of water). Do not use purge.
- *Poisoned by absorbing alkali (ammonia, caustic soda...):* first have the victim drink diluted vinegar (2% acetic acid) or lemon juice. Do not drink purge.
- *Poisoned by digesting mercury compounds,* first have the victim vomit and drink milk with egg whites. Then have the victim drink activated charcoal.
- *Poisonedbywhite phosphorus*: first have the victim vomit, then drink copper sulfate solution ($CuSO_4$) 0.5 grams in a liter of water and iced water. Do not drink milk, egg whites, oil because these substances solute phosphorus.
- *Poisoned by lead mixture*: have the victim drink sodium sulfate (Na_2SO_4) 10% or magnesium sulfate ($MgSO_4$) 10% in warm water because these substances will form a precipitate with lead. Then drink milk with the egg whites and activated charcoal.
- *Poisoned due to inhalation of toxic gases such as chlorine, bromine..* (Cl_2, Br_2): carry the victim to open space, loosen waistband, breath in a small amount of ammonia or 90^0 alcohol mixed with ammonia.
- *Poisoned from breathing hydrogen sulfide, carbon oxides...* (H_2S, CO): lay the victim in open space and breath in pure oxygen for breathing and apply artificial respiration if necessary.
- *+ Poisoned by overinhaling ammonia*: let the victim inhale hot water steam, then drink lemon juice or diluted vinegar.

Fire fighting in the laboratory

a. Water:

- Water is effective in wetting, cooling, extinguishing and preventing fire from spreading when sprayed onto the material near the fire. It is best to use a small jet of water with droplet size of 0.3-0.8mm.
- Water is effective in extinguishing fire of the conventional solids: wood, paper, coal, rubber, cloth and some water-soluble liquid (organic acid, acetone, low ranking alcohol)

<u>Do not use water when:</u>

- Extinguishing fire in powered equipment as this will destroy other equipment.
- There are substances reactive with water in the fire area.
- Extinguish the fire and liquid hydrocarbons dissolved in water which is lighter than water density. These substances will float on the water and the fire will spread.
- Fire by oil, high temperature liquids or melting solids. It is dangerous to use water which will cause boiling, exploding or foaming.

b. CO_2 tank: Pressurized CO_2 (often 60atm) will evaporate and cover the fire by dry snow forms when released.

<u>Advantages:</u>

- Easy to use, especially in the small fire, CO_2 is not harmful for machinery and equipment, including electrical equipment.
- The amountof CO_2 is determined by weighing the tank.

Do not use CO_2 tank in the following cases:

- burning clothes (because cold CO_2 will harm exposed skin)
- fire by alkali metal, magnesium, substances capable of separating oxygen (peroxide, chlorate, potassium nitrate, permanganate,...), the organometallic liquids such as aluminum alkyl (however CO_2 can be used for the alkali metal and organometallic substances in organic solvents)
- CO_2 is less effective when extinguishing fire of decaying materials.

c. Portable chemical foam tank:

Powder extinguisher (eg, sodium carbonate and additives, ammonium phosphate and additives, or some other substance) + compressed inert gas in a small bottle mounted on the extinguisher.

Usage:

- Overturn the tank, $NaHCO_3$ reacts with sulfuric acid generating CO_2 foam that insulates air from fire and cools fired objects.
- when there are no other means of extinguishing fires, or other means areineffective.
- Most effective for extinguishing fires of alkali metals, alkaline earth, organometallic, metal hydride...
- Less toxic, little or no damage to equipment, no risk of electrocution.

Disadvantages:

- Powder cover should be thick enough for the fire not be resumed.
- Foam with acid and salt → good electrical conductivity→ only use when power is disconnected.
- Do not use in places where substances can react with water to cause explosions, fires and gas separation, corrosive gas, heat...(eg peroxide chemicals, hyrua, carbide, andrit, organometallic...)
- Do not use in places where chemicals can corrode or damage due to fire-fighting foam.
- Best for extinguishing largefires when other means are less effective.
- The usage range can vary depending on powder type loaded in the tank:For example, sodium bicarbonate is not used for alkali metal fires because when heated it decomposes into CO_2 and H_2O, the remaining material interacts with hot alkali metal and make the fire stronger.

d. Asbestos fabric:

- Only used for extinguishing small fires ($<1m^2$). Incombustible asbestos cloth, separating the oxygen with fire → extinguishing fire. Only cover asbestos cloth over the fire when the temperature is lowered to avoid fire resuming from flammable materials.
- To cool down quickly, spray CO_2 foam on asbestos cloth to extinguish burning cloth on body.
- Use wet cloth, thick woolen cloth or wet blanket to put out the fire of clothes on body.

However, usage of asbestos material is restricted as it can be toxic to humans.

e. Dried sand: Dry sand can be used to extinguish the fire containing small amounts of liquids, solids when water can not be used.

VI. FIRST AID FOR INJURY AND POISONING IN LABORATORY:

- The general instruction is given as different specific solutions are applied by cases.
- Easy access must be secured to laboratory medicine cabinet. Medicine cabinets usually contain bandages, alcohol iodine, ointments, solutions of $KMnO_4$ 3%, $CuSO_4$, $NaHCO_3$ 2%, CH3COOH 1%, tannin solution in alcohol...

First-aid kits in chemistry lab

First-aid kits in chemical laboratories should be in the most appropriate place and managed by lab staffs. The kit cabinet includes:

- Tools: medical cotton, gauze, bandages, tweezers, scissors, syringes.

- Drugs.
- hemostatic drugs: alcohol iodine 5% solution
- antiseptic drugs: potassium permanganate solution ($KMnO_4$ 5%), alcohol 400
- burn treating drugs: sodium bicarbonate (NaHCO3) 5% ammonia solution (NH_4OH) 2%, copper sulfate solution ($CuSO_4$) 2%, solution of acetic acid (CH_3COOH) 2%.
- assisting drugs: vitamin B1, C, K, glucose or saccharose sugar...
    + When contacting with concentrated acid (H_2SO_4, HNO_3, HCl, HOAc,...) or bromine, phenol, wash with strong running water for a few minutes, then use cotton dipped with $NaHCO_3$ 2% or tannin in alcohol covering up the burn.
    + When the eye contacts with chemicals it must be washed with water several times before the victim being hospitalized immediately.
    + If poisoned by breathing too much gases such as Cl_2, Br_2, H_2S, CO,... the victim must be carried to the open space immediately. When poisoned with metals such as As, Hg,... or cyanide the victim must be transferred immediately to the hospital for emergency treatment.

The laboratory always stores a certain amount of chemicals that may be spread into the air and exposed to staffs.Also while performing experiment, chemicals interact and react with each other; reckless operations will lead to unfortunate consequences.

APPENDIX 2: ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT SYSTEMIN LABORATORY

I. CHEMICAL MANAGEMENT PROGRAM

One of the most important components of a laboratory safety program is chemical management. Prudent chemical management includes the following processes.

1.1. Chemical Procurement

Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved. The standard further Vietnam Government that "No container should be accepted without an adequate identifying label. Preferably, all substances should be received in a central location." These procedures are strongly recommended. Personnel should be trained to identify signs of breakage (e.g., rattling) and leakage (e.g., wet spot or stain) on shipments and such shipments should be refused or opened in a hood by laboratory staffs.

Some organizations have specific purchasing policies to prohibit unauthorized purchases of chemicals and other hazardous materials. The purchaser must assume responsibility for ownership of the chemical.

Because of the possibility of a chemical leak or release and subsequent exposure, chemical shipments should only be received by trained personnel in a laboratory or central receiving area with proper ventilation. Neither administrative offices nor the mail room is appropriate for receipt or opening of chemical shipments.

When preparing to order a chemical for an experiment, several questions should be asked:

- What is the minimum amount of this chemical that is needed to perform the experiment? Is it available elsewhere in the facility? Remember, when ordering chemicals, less is always best. Prudent purchasing methods will save storage space, money, and disposal costs. Larger containers require more storage space and will incur additional disposal costs if the chemical is not used.
- Has the purchase been reviewed by thechemical hygiene officer (CHO) to ensure that any special requirements can be met?
- Is the properpersonal protective equipment (PPE) available in the laboratory to handle this chemical?
- What are the special handling precautions?

- Where will the chemical be stored in the laboratory?
- Does the laboratory chemical hood provide proper ventilation?
- Are there special containment considerations in the event of a spill, fire, or flood?
- Will there be additional costs or considerations related to the disposal of this chemical?

1.2 Chemical Storage

To lessen risk of exposure to hazardous chemicals, trained laboratory personnel should separate and store all chemicals according to hazard category and compatibility. In the event of an accident involving a broken container or a chemical spill, incompatible chemicals that are stored in close proximity can mix to produce fires, hazardous fumes, and explosions. Laboratory personnel should read the Material Safety Data Sheet (MSDS) and heed the precautions regarding the storage requirements of the chemicals in the laboratory.

To avoid accidents, all chemical containers must be properly labeled with the full chemical name, not abbreviations, and using a permanent marker. All transfer vessels should have the following label information:

- Chemical name,
- Hazard warnings,
- Name of manufacturer
- Name of researcher in charge, and
- Date of transfer to the vessel.

Incoming chemical shipments should be dated promptly upon receipt, and chemical stock should be rotated to ensure use of older chemicals. It is good practice to date peroxide formers upon receipt and date again when the container is opened so that the user can dispose of the material according to the recommendations on the MSDS. Peroxide formers should be stored away from heat and light in sealed airtight containers with tight-fitting, nonmetal lids. Test regularly for peroxides and discard the material prior to the expiration date.

When storing chemicals on open shelves, always use sturdy shelves that are secured to the wall. Use secondary containment devices (i.e., chemical-resistant trays) where appropriate. Do not store chemicals in the laboratory chemical hood, on the floor, in the aisles, in hallways, in areas of egress, or on the benchtop. Chemicals should be stored away from heat and direct sunlight

Only laboratory-grade explosion-proof refrigerators and freezers should be used to store properly sealed and labeled chemicals that require cool storage in the laboratory. Periodically clean and defrost the refrigerator and freezer to ensure maximum efficiency. Domestic refrigerators and freezers should not be used to store chemicals; they possess ignition sources and can cause dangerous and costly laboratory fires and explosions. Do not store food or beverages in the laboratory refrigerator.

Highly hazardous chemicals must be stored in a well-ventilated secure area that is designated for this purpose. Cyanides must be stored in a tightly closed container that is securely locked in a cool dry cabinet to which access is restricted. Protect cyanide containers against physical damage and separate them from incompatibles. When handling cyanides, follow good hygiene practices and regularly inspect your PPE. Use proper disposal techniques..

Flammable liquids should be stored in approved flammable-liquid containers and storage cabinets. Observe National Fire Protection Association, International Building Code, International Fire Code, and other local code requirements that limit the quantity of flammables per cabinet, laboratory space, and building. Consult the local fire marshal for assistance, if needed. Store odiferous materials in ventilated cabinets. Chemical storage cabinets may be used for long-term storage of limited amounts of chemicals.

Rooms that are used specifically for chemical storage and handling (i.e., preparation rooms, storerooms, waste collection rooms, and laboratories) should be controlled-access areas that are identified with appropriate signage. Chemical storage rooms should be designed to provide proper ventilation, two means of access/egress, vents and intakes at both ceiling and floor levels, a diked floor, and a fire suppression system.

If flammable chemicals are stored in the room, the chemical storage area must be a spark-free environment and only spark-free tools should be used within the room. Special grounding and bonding must be installed to prevent static charge while dispensing solvents

1.3 Chemical Handling

Important information about handling chemicals can be found in the MSDS. A comprehensive file of MSDSs must be kept in the laboratory or be readily accessible online to all employees during all work shifts. Trained laboratory personnel should always read and heed the label and the MSDS before using a chemical for the first time. Laboratory personnel should be familiar with the types of PPE that must be worn when handling the chemical. Ensure that the ventilation will be adequate to handle the chemicals in the laboratory. One should be familiar with the institutional Chemical Hygiene Plan (CHP) and Emergency Action Plan (EAP) so that appropriate actions are taken in the event of a chemical spill, fire, or explosion.

1.4 Chemical Inventory

The Occupational Safety and Health Administration (OSHA). Stored chemicals should be examined periodically (at least annually) for replacement, deterioration, and container integrity. Thus, a system for maintaining an accurate inventory of the laboratory chemicals on campus or within an organization is essential for compliance with local and state regulations and any building codes that apply. There are many benefits of performing annual physical chemical inventory updates:

Ensures that chemicals are stored according to compatibility tables,

- eliminates unneeded or outdated chemicals,
- increases ability to locate and share chemicals in emergency situations,
- updates the hazard warning signage on the laboratory door,
- promotes more efficient use of laboratory space,
- checks expiration dates of peroxide formers,
- ensures integrity of shelving and storage cabinets,
- encourages laboratory supervisors to make “executive decisions” about discarding dusty bottles of chemicals,
- repairs/replaces torn or missing labels and broken caps on bottles,
- ensures compliance with all federal, state, and local record-keeping regulations,
- promotes good relations and a sense of trust with the community and the emergency responders,
- reduces the risk of exposure to hazardous materials and ensures a clean and healthful laboratory environment, and
- may reduce costs by making staffs aware of chemicals available within the organization.

Every laboratory should maintain an up-to-date chemical inventory. A physical chemical inventory should be performed at least annually, or as requested by the CHO. Although the software that is used to maintain the inventory and the method of performing the chemical inventory will vary from one institution to another, ultimately, the chemical inventory should include the following information:

- Chemical name,
- Chemical Abstract Service number,
- Manufacturer,
- Owner,
- Room number, and
- Location of chemical within the room.

Note that the chemical name should be listed with its synonyms. This will allow for cross-indexing for tracking of chemicals and help reduce unnecessary inventory.

Important safety issues to consider when performing a chemical inventory are:

- Wear appropriate PPE and have extra gloves available.
- Use a chemical cart with side rails and secondary containment.
- Use a laboratory step stool to reach chemicals on high shelves.
- Read the EAP and be familiar with the institution's safety equipment.
- If necessary cease all other work in the laboratory while performing the inventory.

Once the inventory is complete, use suitable security precautions regarding the accessibility of the information in the chemical inventory. For example, precautions should be taken when the database shows the location of Department of Homeland Security (DHS) Chemicals of Interest in excess of DHS threshold quantities.

1.5 Transporting, Transferring, and Shipping Chemicals

It is prudent practice to use a secondary containment device (i.e., rubber pail) when transporting chemicals from the storeroom to the laboratory or even short distances within the laboratory. When transporting several containers, use carts with attached side rails and trays of single piece construction at least 2 in. deep to contain a spill that may occur. Bottles of liquids should be separated to avoid breakage and spills. Avoid high-traffic areas when moving chemicals within the building. When possible, use freight elevators when transporting chemicals and do not allow other passengers. If you must use a general traffic elevator, ask other passengers to wait until you have delivered the chemicals.

Always ground and bond the drum and receiving vessel when transferring flammable liquids from a drum to prevent static charge buildup. Use a properly operating chemical fume hood, local exhaust, or adequate ventilation, as verified by monitoring, when transferring PHSs.

All outgoing domestic and international chemical shipments must be authorized and handled by the institutional shipper. The shipper must be trained in U.S. Department of Transportation (DOT) regulations for ground shipments and must receive mandatory International Air Transport Association training for air shipments. DOT oversees the shipment of hazardous materials and has the authority to impose citations and fines in the event of noncompliance.

1.6 Chemical Waste

All chemical waste must be stored and disposed of in compliance with applicable of VietNam Government, and institutional regulatory requirements. Waste containers should be properly labeled and should be the minimum size that is required. There should be at least 2 in. of headspace in the liquid waste container to avoid a buildup of gas that could cause an explosion or a container rupture.

II. EMERGENCY PROCEDURES

2.1 Fire Alarm Policy

When a fire alarm sounds in the facility, evacuate the laboratory immediately via the nearest exit. Extinguish all Bunsen burner and equipment flames. If the fire originates in your laboratory, follow all institutional policies regarding firefighting and suppression. Check restrooms and other areas with possible limited audio or visual notification of an alarm before exiting the facility. Where necessary, provide assistance to persons with disabilities to ensure they are able to exit the facility.

2.2 Emergency Safety Equipment

The following is a guide to safety equipment found in a laboratory

1. A written EAP has been developed and communicated to all personnel in the unit. The plan includes procedures for evacuation, ventilation failure, first aid, and incident reporting.
2. Fire extinguishers are available in the laboratory and tested on a regular basis. If a fire extinguisher is activated for any reason, make an immediate report of the activity to the CHO, fire marshal, or appropriate individual responsible for fire safety equipment so that the fire extinguisher is replaced in a timely manner.

3. . Eyewash units are available, inspected, and tested on a regular basis
4. . Safety showers are available and tested routinely
5. Fire blankets are available in the laboratory, as required. Fire blankets can be used to wrap a burn victim to douse flames as well as to cover a shock victim and to provide a privacy shield when treating a victim under a safety shower in the event of a chemical spill.
6. NOTE: Laboratory personnel should be taught that fire blankets can be dangerous if used incorrectly. Wrapping a fire blanket around a person on fire can result in a chimney-like effect that intensifies, rather than extinguishes, the fire. Fire blankets should never be used on a person when they are standing.
7. First-aid equipment is accessible, whether through a kit available in the laboratory or by request through the organization
8. Fire alarms and telephones are available and accessible for emergency use
9. Pathways to fire extinguishers, eyewash units, fire blankets, first-aid kits, and safety showers are clear.

2.3 Chemical Spill Policy

Laboratory personnel should be familiar with the chemical, physical, and toxicological properties of each hazardous substance in the laboratory. Consult the label and the MSDS prior to the initial use of each hazardous substance. Always use the minimal amount of the chemical and use caution when transporting the chemical. In the event of an accidental chemical release or spill, personnel should refer to the following general guidelines

Most laboratory workers should be able to clean up incidental spills of the materials they use. Large spills, for example, 4lit or more, may require materials, protective equipment, and special handling that make it unsafe for cleanup by laboratory workers themselves. Lab workers should be instructed to contact EHS personnel to evaluate how to proceed with spill cleanup

In the event that the spill material has been released to the environment, notify EHS personnel immediately. A release to the environment includes spills directly into a drain or waterway or onto land, such as grass or dirt

Low-flammability and low-toxicity materials that are not volatile (e.g., inorganic acids and caustic bases)

1. Decontaminate any victim at the nearest safety shower or eyewash unit. Take other appropriate action as described in the MSDS.
2. Notify appropriate personnel immediately.
3. Limit or restrict access to the area as necessary
4. Wear PPE that is appropriate to the degree of hazard of the spilled substance
5. Use chemical spill kits that contain an inert absorbent to clean up the affected area if this action can be accomplished without risk of additional injury or contamination to personnel. If the spill is located on the laboratory floor, be aware that some absorbents can create a slipping hazard.
6. Dispose of contaminated materials according to institutional policy.
7. Complete an incident report and submit it to the appropriate office or individual
8. Label all phones with emergency phone numbers.

Flammable solvents of low toxicity (e.g., diethyl ether and tetrahydrofuran)

1. Decontaminate any victims at the nearest safety shower or eyewash unit. Take other appropriate action as described in the MSDS.
2. Alert all other personnel in the laboratory and the general vicinity of the spill.
3. Extinguish all flames and turn off any sparkproducing equipment. If necessary, turn off power to the laboratory at the circuit breaker. The ventilation system must remain operational.

4. Immediately notify appropriate personnel.
5. Limit or restrict access to the area as necessary.
6. Wear PPE that is appropriate to the degree of hazard of the spilled substance.
7. Use spill pillows or spill absorbent and nonsparking tools to soak up the solvent as quickly as possible. Be sure to soak up chemicals that have seeped under equipment and other objects in the laboratory. If the spill is located on the laboratory floor, be aware that some absorbents can create a slipping hazard.
8. Dispose of contaminated materials according to institutional policy.
9. Complete an incident report and submit it to the appropriate office or individual.

Highly toxic materials (e.g., dimethylmercury)

1. Alert all trained laboratory personnel in the laboratory and the general vicinity of the spill and immediately evacuate the area.
2. Decontaminate any victims at a safety shower or eyewash unit in a safe location. Take other appropriate decontamination action as described in the MSDS.
3. Immediately notify appropriate personnel.4
4. Limit or restrict access to the area as necessary.
5. Do not attempt to clean up the spill. EHS personnel will evaluate the hazards that are involved with the spill and will take the appropriate actions.
6. Only EHS personnel and appropriate outside industrial hygienists are authorized to decontaminate the area and dispose of the contaminated waste.
7. Complete an incident report and submit it to the appropriate office or individual.

2.4 Accident Procedures

In the event of an accident, follow all institutional policies for emergency response and notify the internal point of contact for laboratory safety and local emergency responders. All accidents involving personal injury, however slight, must be immediately reported according to your institution's procedure. Provide a copy of the appropriate MSDS to the attending physician, as needed. Complete an accident report and submit it to the appropriate office or individual within 24 hours of the incident.

III. EMPLOYEE SAFETY TRAINING PROGRAM

Newly hired employees or students working in a laboratory should be required to attend basic safety training prior to their first day. Additional training should be provided to laboratory personnel as they advance in their laboratory duties or when they are required to handle a chemical or use equipment for the first time

Safety training should be viewed as a vital component of the laboratory safety program within the organization. The organization should provide ongoing safety activities that serve to promote a culture of safety in the workplace that will begin when the person begins work and will continue for the length of their tenure. Personnel should be encouraged to suggest or request training if they feel it would be beneficial. The training should be recorded and related documents maintained in accordance with organizational requirements.

Training sessions may be provided in-house by professional trainers or may be provided via online training courses. Hands-on, scenario-based training should be incorporated whenever possible. Safety training topics that may prove to be helpful to laboratory personnel include

- use of CHPs and MSDSs,
- chemical segregation,
- PPE,
- safety showers and eyewash units,

- first aid and cardiopulmonary resuscitation,
- chemical management,
- gas cylinder use,
- fire extinguisher training,
- laser safety, and
- emergency procedures.

APPENDIX 3. SUSTAINABLE DESIGN GUIDE

Optimize Site Potential

Sustainable site planning should consist of a whole system approach that seeks to:

- Minimize development of open space through the selection of disturbed land, re-use of brown-field sites, and retrofitting existing, buildings;
- Provide wildlife corridors if possible on a base, campus or facility-wide scale. Link natural areas to the greatest extent possible so that contiguous areas allow for undisturbed wildlife movement;
- Consider energy implications and carbon emissions in site selection and building orientation;
- Control erosion through improved grading and landscaping practices;
- Use native plants and remove existing invasive plants;
- Reduce heat islands through building design methods, minimizing impervious surfaces, and using landscaping;
- Minimize habitat disturbance;
- Reduce, control, and treat surface runoff;
- Restore the health of degraded sites by improving habitat for indigenous species through appropriate native plants, climate-adapted plants, and closed-loop water systems;
- Locate the building in walkable distance to a range of stores and services, particularly grocery stores;
- Incorporate transportation solutions along with site plans that acknowledge the need for bicycle parking, carpool staging, and proximity to mass transit. Encourage alternatives to traditional commuting;
- Consider site security concurrently with sustainable site issues. Location of access roads, parking, vehicle barriers, and perimeter lighting, among others are key issues that must be addressed; and
- Work closely with lighting designer to reduce security lighting and its associated light pollution. With overly bright security lighting, often the "bad guys" can safely stage operations just out of range, invisible to the security personnel whose eyes are adjusted to the overly bright immediate environment.

Optimize Energy Use

During the facility design and development process, building project must have a comprehensive, integrated perspective that seeks to:

- Reduce heating, cooling, and lighting loads through climate-responsive design and conservation practices;
- Employ renewable energy sources such as day-lighting, passive solar heating, photovoltaic, geothermal, and groundwater cooling;
- Specify efficient heating, ventilating, and air-conditioning (HVAC) and lighting systems that consider part-load conditions and utility interface requirements;

- Optimize building performance by employing energy modeling programs and optimize system control strategies by using occupancy sensors CO_2 sensors and other air quality alarms;
- Monitor project performance through a policy of commissioning, metering, annual reporting, and periodic re-commissioning; and
- Integrate water saving technologies to reduce the energy burden of providing potable water.

Protect and Conserve Water

The protection and conservation of water must be considered throughout the life of the building. Facility owners and developers must seek to:

- Use water efficiently through high efficiency fixtures, elimination of leaks, water conserving cooling towers, and other actions;
- Balance the energy and water conservation strategies in cooling tower through water and air side economizers and the use of off-peak cooling as appropriate;
- Improve water quality. For example, storm water settling ponds, kitchen grease-traps, eliminate garbage disposals, and lead-bearing products in potable water;
- Recover non-sewage and gray-water for on-site use (such as toilet flushing and landscape irrigation, and more generally, consider the water quality requirements of each water use);
- Establish waste treatment and recycling centers;
- Apply the Best Management Practices for Water Conservation;
- Follow Environmental Protection Agency (EPA) Technical Guidance on Implementing the Storm water Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act hydrology requirements to maintain or restore predevelopment hydrology of the property with regard to the temperature, rate, volume and duration of flow.

Optimize Building Space and Material Use

As early as during conceptual design and design-development stages, the project must have a comprehensive, integrated perspective that seeks to:

- Salvage and utilize existing facilities, products, and equipment whenever possible, such as historic structures, previous brown-field or grey-field sites, and reconditioned fixtures and furnishings;
- Design facilities adaptable for different uses during their life cycle incorporating building components that can be disassembled, and reused or recycled;
- Reduce overall material use through optimizing building size and module;
- Evaluate the environmental preferability of products using lifecycle thinking and lifecycle assessment (LCA)
- When new materials are used, maximize their recycled content, especially from a post-consumer perspective;
- Specify materials harvested on a sustained yield basis such as lumber from third-party certified forests;
- Limit the generation of construction and demolition (C&D) materials, encourage the separation of waste streams, and ensure that reuse and recycling is done in an environmentally acceptable manner during the construction, renovation, and demolition processes;
- Eliminate the use of materials that pollute or are toxic during their manufacture, use, or reuse;
- Give preference to locally produced products and other products with low embodied energy content; and
- Encourage success of operational-waste recycling through planning in the design-development phase.

Enhance Indoor Environmental Quality (IEQ)

During the facility/renovation design and development process, the project must have a comprehensive, integrated perspective that seeks to:

- Facilitate quality IEQ through good design, construction, commissioning, and operating and maintenance practices;
- Value aesthetic decisions, such as the importance of views and the integration of natural and man-made elements;
- Provide thermal comfort with a maximum degree of personal control over temperature and airflow;
- Supply adequate levels and quality of ventilation and outside air for acceptable indoor air quality;
- Prevent airborne bacteria, mold, and other fungi, as well as radon, through building envelope design that properly manages moisture sources from outside and inside the building, and with heating, ventilating, air-conditioning (HVAC) system designs that are effective at controlling indoor humidity;
- Use materials that do not emit pollutants or are low-emitting;
- Assure acoustic privacy and comfort through the use of sound absorbing material and equipment isolation;
- Control disturbing odors through contaminant isolation and removal, and by careful selection of cleaning products. Pursue energy efficient strategies to remove harmful odors while recovering the energy used in conditioning the interior environment;
- Create a high-performance luminous environment through the careful integration of natural and artificial light sources; and
- Provide quality water.

Optimize Operations and Maintenance Practices

Throughout the building's life cycle, operations and maintenance should seek to:

- Train building occupants, facilities managers, and maintenance staff in sustainable design principles and methods that will minimize system failures;
- Purchase cleaning products and supplies that are resource-efficient, bio-degradable and safer for both janitorial staff and building occupants, and thereby improving indoor air quality;
- Test sensor control points on a regular basis to ensure energy efficiency is not compromised;
- Use automated monitors and controls for energy, water, waste, temperature, moisture, and ventilation;
- Reduce waste through source reduction and recycling to eliminate off-site disposal;
- Minimize travel by supporting telecommuting programs and enabling a mobile work environment;
- Perform scheduled energy audits and re-commissioning of systems; and
- When updating a facility or its systems, choose higher efficiency equipment, durable materials that will withstand storms and other natural events, and improve the tightness of the building envelope if feasible.