

Initial Environmental Examination

Project Number: 49387-002
Grant Number: 0599-LAO
August 2020

Lao People's Democratic Republic: Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project

Vientiane Province:
Vang Vieng Landfill Improvements

Prepared by the Ministry of Information, Culture and Tourism for the Asian Development Bank.

This initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature. Your attention is directed to the 'term of use' section of this website.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

CURRENCY EQUIVALENTS

(30 June 2020)

Currency Unit	–	kip (KN)
KN1.00	=	\$ 0.00011
\$1.00	=	KN 8.881

ABBREVIATIONS

DED	-	Detail Engineering Design
DICT	-	Department of Information Culture and Tourism
DPWT	-	Department of Public Works and Transport
DOF	-	Department of Agriculture and Forestry
EA	-	environmental assessment
EIA	-	environment impact assessment
ECC	-	environmental compliance certificate
ECO	-	environmental control officer
EMP	-	environment monitoring plan
EA	-	executing agency
GMS	-	Greater Mekong Subregion
HDPE	-	High-density polyethylene
HH	-	Household
IA	-	implementing agency
IEE	-	initial environmental examination
IFD	-	Intensity, Frequency, and Duration
EO	-	environmental officer
IUCN	-	International Union for Conservation of Nature
Lao PDR	-	Lao People's Democratic Republic
MOA	-	Ministry of Agriculture and Forestry
MICT	-	Ministry of Information, Culture and Tourism
MONRE	-	Ministry of Natural Resources and Environment
MPWT	-	Ministry of Public Works and Transport
O&M	-	operation and maintenance
PET	-	Polyethylene terephthalate
PMCES	-	Project Management and Civil Engineering Support Consultant
PIU	-	project implementation unit
PCU	-	project coordination unit
REA	-	rapid environment assessment
SLF	-	Sanitary Landfill Facilities
SS	-	safeguard specialist
TSS	-	Total Suspended Solids
UDAA	-	Urban Development and Administration Authority
UNFCC	-	United Nations Framework Convention on Climate Change
UXO	-	Unexploded Ordnance
WREA	-	Water Resources and Environment Agency

WEIGHTS AND MEASURES

km:	kilometer
kg:	kilogram
ha:	hectare
mm:	millimeter

NOTE

In this report, "\$" refers to US dollars unless otherwise stated.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
I. INTRODUCTION	7
A. Background to Updated IEE	7
B. Assessment Context	7
C. Structure of the report	7
II. POLICY, LEGAL, AND REGULATORY FRAMEWORK	7
A. National Environmental Laws, Strategies, and Policies	7
B. National Forest Management	9
C. National Environmental Assessment Procedure & Directives	11
D. ADB Safeguard Policy	11
III. DETAILED DESIGN OF IMPROVEMENTS TO SOLID WASTE MANAGEMENT	12
A. Vang Vieng Sanitary Landfill	12
B. Climate Change Mitigation and Resilience	22
C. Improved Solid Waste Collection	28
IV. DESCRIPTION OF AFFECTED ENVIRONMENT	30
V. PUBLIC CONSULTATION	38
A. Identification of Stakeholders	38
B. Discussion Guide	38
C. Summary of Public Consultation	39
VI. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATIONS	42
A. Subproject Benefits	42
B. Subproject Impacts and Mitigation	42
C. Induced and Cumulative Impacts	48
D. Climate Change	48
E. Comprehensive Corrective Environmental Action	48
VII. INFORMATION DISCLOSURE AND PUBLIC GRIEVANCE MECHANISM	48
APPENDIX A: RESULTS OF IBAT ANALYSES OF SUBPROJECT AREA	52
APPENDIX B.1: PUBLIC CONSULTATION PARTICIPANTS IN VANG VIENG	53
APPENDIX C: DECREE 520 (2007) ON SOLID WASTE MANAGEMENT IN LAO PDR	57

LIST OF TABLES

Table 1: Projected total septage from HH in Vang Vieng.....	16
Table 2: Maximum Number of PCU per km to Trigger 100,000CO ₂ e/a.....	25
Table 3: Rainfall curve for Vientiane.....	27
Table 4: Soil type from the 3 boreholes drilled during ECA site investigation	32
Table 5: Soil type from the 8 boreholes drilled in PPTA phase	32
Table 6: Water table depth at test boreholes at dumpsite.....	33
Table 7: Groundwater quality at existing dumpsite	34
Table 8: Common Fishes of Nam Song Fisheries	36
Table 9: Projected Population of Vang Vieng Districts.....	37
Table 10: Guiding Questions and Information Requests for Stakeholder Consultations	38
Table 11: Environmental components used to guide stakeholder discussions.....	39
Table 12: Summary of key views of stakeholders of Vang Vieng subproject	40

LIST OF FIGURES

Figure 1: Location of Vang Vieng landfill.....	12
Figure 2: Vang Vieng landfill and access road	13
Figure 3: Plan view of upgraded Vang Vieng sanitary landfill	14
Figure 4: Lagoon-based horizontal view of leachate treatment.....	15
Figure 5: Location of utility buildings, MRF, and hazardous waste storage.....	18
Figure 6: Building housing Material Recovery Facility (MRF)	19
Figure 7: Plan view of MRF	20
Figure 8: Cross sectional view of a ventilation pipe.....	24
Figure 9: Basic Flare arrangement.....	24
Figure 10: Consultation process in Ban Phonvieng, August 2019	30
Figure 11: Existing Vang Vieng dumpsite.....	31
Figure 12: Cross section of the Cell 1	33
Figure 13: Conservation and protected forests of Vientiane province.....	35
Figure 14: Vang Vieng Landfill seen from above	36
Figure 15: Grievance Redress Mechanism Process.....	50

EXECUTIVE SUMMARY

The Detailed Engineering Design (DED) of the subproject of the Second Greater Mekong Subregion (GMS) Tourism Infrastructure for Inclusive Growth Project (TIIGP-2) that will improve solid waste management in Vang Vieng, Lao PDR has been prepared. The TIIGP-2 will develop small scale infrastructure to improve tourist facilities and develop and strengthen management capacity to enhance tourism at different locations in Lao People's Democratic Republic (PDR), Cambodia, and Viet Nam.

Presented herein is the updated Initial Environmental Examination IEE¹ of the DED of the Vang Vieng solid waste management subproject. The updated environmental management plan for the subproject has been reported separately. The upgraded solid waste management subproject consists of two main components:

- (i) upgrading of existing town dumpsite to a modern Sanitary Landfill (SLF); and
- (ii) improvements to solid waste collection and management in Vang Vieng and vicinity.

The SLF will consist of the following main components:

- (i) four lined waste cells to be constructed serially over time;
- (ii) a leachate collection and treatment system;
- (iii) a septage treatment system;
- (iv) a hazardous waste disposal cell²;
- (v) a materials recovery facility (MRF) to modernize waste recycling;
- (vi) office, utility/storage buildings, and onsite waste loaders/movers; and
- (vii) an upgraded 0.8km concrete access road to SLF.

Improved solid waste collection will consist of:

- (i) new compactor and vacuum trucks;
- (ii) urban garbage bins of various sizes;
- (iii) expanded catchment for solid waste collection;
- (iv) new staff to work with Urban Development and Administration Authority (UDAA) and operator of SLF; and
- (v) training and capacity development of existing and new solid waste management staff.

Subproject Benefits

Upgraded solid waste management in Vang Vieng will expand affordable solid waste collection services in Vang Vieng town and surrounding villages. New garbage trucks, vacuum trucks, and modern waste processing facilities at the SLF will improve sanitation in the community. The modern lined waste cells of the SLF will protect the environment and reduce greenhouse gas emissions. The MRF at the SLF will improve the safety and efficiency of solid waste recycling. The new septage treatment facility at the SLF will receive greater volumes of septic tank sludge from the community that will be stored and treated safely, and hazardous waste will be isolated and stored safely in the SLF. The subproject will benefit more than 60,000 residents in Vang Vieng District and its hotels and guesthouses.

¹ ADB, 2018. IEE of Lao People's Democratic Republic: Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project.

² It was informed by UDAA during site visit that medical waste is managed directly by the hospital and relevant health authorities.

Potential Impacts

The Vang Vieng solid waste management improvement subproject is confirmed as Category B for environment pursuant to the SPS (2009). The potential impacts of the subproject are restricted to the short-term disturbances of the construction phase. Subsequent management of the SLF will create long-term operational impacts, for which mitigation actions must be defined in the EMP. Negative impacts associated with the pre-construction phase of the subproject are negligible because no resettlement or land acquisition will be required.

Construction Phase

The impact of the construction of the new SLF and the upgrading of the 0.8km access road to the SLF are restricted to the short-term disturbances created by the civil works activities (e.g., excavation, grading, drilling, building erection, material transport and truck traffic). The potential short-term environmental impacts will consist of dust, noise, contamination of soil and the adjacent seasonal stream from heavy equipment maintenance and erosion, solid and liquid construction waste, increased risk of traffic and risk of traffic accidents, reduced local access to the area, increased risk of public and worker injury, and periodic local drainage and flooding events. Other potential impacts of construction phase are contamination of groundwater from the excavations of waste cells, and depending on size of outside worker population, potential social problems with local community. No external borrow pits will be required during construction because all required soil will be obtained on site of SLF.

Operation Phase

The potential impacts of the operation of the completed SLF will arise from: (i) increased vehicle traffic along the upgraded access road, (ii) potential groundwater pollution from waste cells or leachate treatment system; and (iii) worker injury from operation of new trucks and equipment at the landfill. Solid waste and domestic wastewater from the MRF and worker offices could become a problem if required Operations and Maintenance (O&M) budgeting is not provided to maintain the septic tank systems of the facilities. While significantly reduced from the present dumpsite, odour from the operation of the new SLF will be emitted which may affect the nearest village of Ban Phongvieng. During stakeholder consultations it was informed that UDAA will provide a 'living fence' to suppress odour from the landfill towards Ban Phongvieng, planting a dense line of trees with sufficient canopy. The village is located 1 km away.

The increased vehicle traffic along the upgraded access road will increase risk of vehicle accidents and collisions, and potentially increase noise and dust. Speed limits must be clearly posted and enforced along the access road. Sufficient clear signage must be installed at intersection of access road and NR 13 that warn motorists that trucks turn in/out of landfill access road. Posted speed limits along the upgraded access road to the SLF must be enforced to prevent accidents. Sufficient annual O&M budget should be provided to maintain all compactor and vacuum trucks and all other gas powered vehicles and equipment in good working order to reduce air pollution and occupational hazards. Wetting agents (such as water and calcium chloride) should be periodically applied to the access road and landfill areas to control dust and wind-blown debris.

The above mitigations support the comprehensive IFC EHS guidelines (2007) for Construction and Decommissioning, Toll Roads, and Waste Management Facilities including solid waste and hazardous (hospital) management. The guidelines address the full cycle of solid waste management starting with waste prevention & minimization, collection & transport, recycling and reuse, treatment, storage and disposal, and monitoring.

Groundwater quality at two select test boreholes at the SLF should be monitored regularly to ensure groundwater is not contaminated by the waste cells, or leachate treatment system,

septage treatment cell or hazardous waste cell. The MRF and working conditions of any waste pickers at the landfill site needs to be reviewed regularly to ensure that the original equipment, and the working conditions of the pickers are safe. Methane production at the LFG collection system on the closed capped existing waste cell should be monitored to determine LFG production, and to ensure that the LFG capture system is working properly.

A major O&M and training program will be developed with the municipality and residents of Vang Vieng to create awareness and to institute and support the requirement that wet and dry solid waste is separated at source. The function of the new MRF requires that wet waste must not be mixed with solid waste when the solid waste arrives at the MRF for separation and recycling. Thus, the improvements to solid waste management will need to include separate or dual compartment compactor trucks to collect separated dry and wet solid waste, as well as placement of roadside bins that separate wet from dry solid waste.

Pursuant to Outputs 2 and 3 of the TIIG Project, the adoption of the Asean Tourism Standards (e.g., Clean Tourist City Standard, Green Hotel Standard, & Public Toilet Standard) and capacity development for Tourism Destination Management, respectively, will specifically manage for clean tourist sites in Vang Vieng. Solid waste collection and management will be addressed which is the single most important requirement at all sites.

Climate Change

The Climate Vulnerability and Risk Assessment (CVRA) prepared for the FS design identified key climate change mitigation and resilience measures that have been addressed by the DED. Greenhouse gas (GHG) emissions from SLF should be minimized, but the landfill is receiving less than 500 tons of waste per day, with significant organic content, which will not make it commercially viable to recover and utilize landfill gas. However, in order to minimize GHG emissions to the atmosphere, it should be considered to use landfill gas flaring, safely disposing the flammable constituents, particularly methane, and to control odour nuisance, health risks and adverse environmental impacts. More efficient landfill together with flaring will help reducing the GHG emission. Furthermore, stormwater drainage at the SLF and along upgraded access road will be designed to accommodate projected increases in maximum rainfall in climate change. The concrete surface of the SLF access road will be resilient to projected increased maximum summer air temperatures with climate change.

Conclusions

The updated IEE concludes that the DED of the subproject combined with information on the affected environments is sufficient to identify the scope of the project's potential environmental impacts. Changes to environmental or social receptor data have not occurred, thus the subproject will remain Category B for environment and will not require further detailed environmental impact assessment (EIA).

The separate, updated EMP for the upgraded solid waste management system in Vang Vieng and vicinity provides an impact mitigation plan, environmental monitoring plan, and specifies institutional responsibilities and capacity needs for sound environmental management of the subproject. The EMP will be included with the construction package tender documents to allow contractors to develop their contractor EMPs (CEMP).

I. INTRODUCTION

A. Background to Updated IEE

1. The second Greater Mekong Subregion (GMS) Tourism Infrastructure for Inclusive Growth Project (TIIG) will develop small scale infrastructure to improve tourist facilities and develop and strengthen management capacity to enhance tourism at selected locations in Lao PDR, Cambodia, and Viet Nam. In Lao PDR, seven subprojects were selected for implementation in Champasak and Vientiane Provinces, and the IEE and EMPs of the feasibility designs of the seven subprojects were prepared³.

2. Provided herein is the IEE of the Solid Waste Management Improvements subproject in Vang Vieng, Vientiane province which has been updated to meet the detailed design (DED) of the subproject⁴. The Environmental Management Plan (EMP) for the subproject has also been updated and reported separately.

3. The impact of improved solid waste management in Vang Vieng is sustainable, inclusive, and more balanced tourism development in the Vang Vieng area as envisaged in the *ASEAN Tourism Strategic Plan 2016–2025*. Similarly, the unchanged subproject outcome is increased tourism competitiveness with the primary project output being improved urban and rural solid waste and environmental services and management with secondary outputs defined by: (i) strengthened capacity to implement ASEAN tourism standards; and (ii) strengthened institutional arrangements for tourism destination management and infrastructure operation and maintenance (O&M).

B. Assessment Context

4. The project is further confirmed as category B for environment pursuant to ADB's 2009 *Safeguard Policy Statement*⁵ and recent Good Practice Sourcebook.⁶ The impact footprint of the subproject remains the same and consists of the major environmental improvements to existing dumpsite, and waste collection system of Vang Vieng. The potential adverse environmental impacts will be restricted to short-term disturbances during the construction phase. Moreover, the impact footprint of the upgraded landfill and access road will be significantly cleaner and protective of the environment.

C. Structure of the report

5. The updated IEE of the Improvements to Solid Waste management in Vang Vieng follows the format as set out in Appendix 1 of the SPS (2009). The structure of the separate EMP is modified slightly for inclusion with contractor tender documents.

II. POLICY, LEGAL, AND REGULATORY FRAMEWORK

A. National Environmental Laws, Strategies, and Policies

6. The national framework for the governance of environmental matters in Lao PDR includes a comprehensive set of environmental and natural resources related laws and regulations. Several government agencies are involved in environmental management.

³ Footnote #1

⁴ Re-designing of Vang Vieng Landfill Site, Waste Concern Consultants, June 2020.

⁵ ADB. 2009. Safeguard Policy Statement. Manila.

⁶ ADB. 2012. Environmental Safeguards, A Good Practice Sourcebook, Draft. Manila.

7. In 2011, the Ministry of Natural Resources and the Environment (MONRE) was created by merging the Water Resource and Environment Administration (WREA) with departments of the National Land Management Authority (NLMA) and portfolios of other ministries including the Geology Department, and the Forest Conservation and Divisions within the Ministry of Agriculture and Forestry (MAF). The policies, laws relevant to environmental protection are listed below.

1. Laws

- Law on Environmental Protection as Amended No. 29/NA (2012)
- Law on Industry No. 01/99/NA (1999)
- Law on Hygiene, Prevention and Health Promotion No.01/NA (2001)
- Law on Water and Water Resources (1996)
- Law on Land (2003)
- Law on Roads No.203/PSD (2016)
- Law on Forestry (2007)
- Law on Cultural, Historical and Natural Heritage (2005)
- Law on Fisheries (2010)
- Law on Wildlife and Aquatic Ecology (2007)

2. Strategies, Plans and Policy

- The 7th National Social and Economic Development Plan (NSED) (2011-2015)
- Decree on Preservation of Cultural, Historical and Natural Heritage (1997)
- Decree on the Protection Forest (2010)
- National Forestry Strategy to 2020 (FS2020)
- National Biodiversity Strategy to 2020 & Action Plan to 2010 (NBSAP)
- Gibbon Conservation Action Plan 2011-2020
- Urban Master Plan (2001) No. 58/PM
- National Water Resources Strategy and Action Plan [draft]
- Strategy on Climate Change (2010)
- National Adaptation Programme of Action to Climate Change (NAPA) (2009)
- Strategic Plan on Disaster Risk Management in Lao PDR (2020, 2010) and Action Plan (2003-2005)
- Ministerial Instruction on the Process of Initial Environment Examination (IEE) of the Investment Projects and Activities No.8029/MONRE (2013)
- Ministerial Instruction on Environmental and Social Impact Assessment (ESIA) Process of the Investment Projects and Activities No.8030/MONRE (2013)
- Manual of Environmental Impact Assessment Procedures for Road Projects in the Lao PDR (1997).
- Regulation and Guidelines for the Environmental Assessment of Road Projects (1999), MPWT.
- Environmental Impact Assessment for Industry and Processing Handicraft Order No. 1222/MIH (2005)
- Regulation on EIA for Road Projects (2004)
- Decree on Compensation and Resettlement of People Affected by Development Projects (2006) and
- Technical Guideline on Compensation and Resettlement of People Affected by Development Projects (2013)

3. International Agreements

8. The Lao PDR Government is party to international multilateral environmental agreements. Agreements pertaining to the project are listed below.

- World Heritage Convention (WHC) March 20, 1987
- United Nations Framework Convention on Climate Change (UNFCCC), 4 January 1995
- Agreement on The Cooperation for The Sustainable Development of The Mekong River Basin (Mekong Agreement), April 5, 1995
- Convention on Biological Diversity (CBD), September 20, 1996
- Montreal Protocol on Substances that Deplete the Ozone Layer, August 21, 1998
- Kyoto Protocol to United Nations Framework Convention on Climate Change (1998)
- Stockholm Convention on Persistent Organic Pollutants (POPs), March 5, 2002
- ASEAN Agreement on Transboundary Haze Pollution, June 10, 2002
- International Plant Protection Convention (1997)

4. Environmental Standards & Criteria

9. National standards and criteria exist for drinking water quality, surface and groundwater quality, soil quality for agriculture, air quality and noise level standards, and wastewater discharge standards for BOD, NH₃-N, Total Suspended Solids (TSS), and pH. Specific standards are also available for certain chemical use by factories. The existing standards are found in the National Environmental Standard Order No. 2734/PMU-WREA (2009)

B. National Forest Management

10. Some subproject components are located adjacent to forested areas. The five primary forest types or categories with respect to forest preservation and development are defined below⁷. The forested areas adjacent to the project location is labelled as production forest and is consequently utilized for timber and non-timber forestry products (fruits, materials ,etc.)

1. Protection Forests

11. Protection forests are forests classified for the function of environmental protection defined by water resources, river banks, road sides, preventing soil erosion, protecting soil quality, strategic areas for national defense, and protection from natural disasters.

a. Activity Restrictions

12. Protected forests are further stratified into *total protected zones* and *controlled use zones*. The *total protected zone* is usually steep sloped, contains water resources including forests along rivers, roads and other areas with high risk of environmental degradation. These areas must be protected from activities such as crop rotation, cutting, or burning, tree removal, housing construction, extraction of soil, stones, or mining

13. The *controlled use zone* is the forest area without a perceived high risk of environment impacts. These areas must be protected like the total protection zone, but people can use wood and forest products according to the management plan. For example, Article 5 of the Forestry Law would apply which indirectly encourages the utilization of forests for research, tourism and recreational purposes.

⁷ From Law of Forests (2007)

2. Conservation or Reserved Forests⁸

14. Conservation forests are forests classified for the purposes of conserving nature, preserving plant and animal species, forest ecosystems and other valuable sites of natural, historical, cultural, tourism, environmental, educational and scientific research experiments. Conservation forests exist at the national, provincial, district and village levels.

a. Activity Restrictions

15. Like protected forests, conservation forests are divided into zones defined by *total protection zones, controlled use zones, corridor zones and buffer zones*. The *total protection zone* is the forest area that is main habitat, feeding and breeding place for various wild animals and it is the place of diverse and dense vegetation. In this zone, it is strictly prohibited to conduct any forestry activity, to harvest any forest products, including unauthorized entry in this zone. Examples are core zones of national parks or nature reserves.

16. The *controlled use zone* is the forest area adjacent or close to the total protection zone. These areas must be protected like the *total protection zone*, but people can use wood and forest products according to the local management plan.

17. The *corridor zones* are managed areas for preserving tracts of forest to provide passage for animals between two conservation forests or between a conservation forest and another category of forest to preserve existing biodiversity and to increase the general wildlife population. In this zone, it is prohibited to cut trees, conduct forestry activities or any other activity that may obstruct or destroy the passage for the animals. The *buffer zones* are managed areas for preventing any encroachment and destruction in the conservation forest.

3. Production Forests

18. Production forests are natural forests and/or planted forests that are actively utilized for wood production, and for wood and non-timber forestry product-related livelihoods to satisfy the requirements of national socio-economic development and people's living.

19. Two other managed forest categories which reflect the overall goal of the Government on forest restoration through community based forest management are *Regeneration Forests and Degraded Forests*⁹.

4. Regeneration Forest

20. Regeneration forest is young fallow forest classified for regeneration and maintenance so that it increases in maturity toward a stage of natural equilibrium.

5. Degraded Forests

⁸ Conservation forests commonly referred as reserved forests during discussions with agencies and village heads

⁹ From NAFRI, 2007

21. Degraded forest has been heavily damaged to the extent that land is barren without trees. The forest is classified for tree planting and/or allocation to individuals and organizations for tree planting, permanent agriculture and livestock production, or for other purposes.

C. National Environmental Assessment Procedure & Directives

22. Pursuant to the Environmental Protection Law (2012), development projects and operations that have the potential to affect the environment shall require environmental assessment in accordance with the regulations of MONRE (previously WREA).¹⁰ MONRE is responsible for environmental management and monitoring, and the issuance of an Environmental Compliance Certificate (ECC) as per the Ministerial Instructions on the Process of IEE of the Investment Projects and Activities No.8029/MONRE (2013) and on ESIA Process of the Investment Projects and Activities No.8030/MONRE (2013).

23. The Project Owner in Lao PDR is the Ministry of Information Culture and Tourism (MICT). The MICT is required to conduct the initial environmental assessment (IEE) in accordance with the MONRE Directive. The provincial department (DONRE) screens the project to determine whether the project is categorized as Group 1 or Group 2. Group 1 projects require an IEE and Group 2 projects an Environment and Social Impact Assessment (ESIA). For Group 2 projects, the project owner prepares a Scoping Report and Terms of Reference to be reviewed and approved by MONRE. Group 1 projects are approved at the provincial level (DONRE) and Group 2 projects at the national level (MONRE).

24. The technical and procedural aspects of above regulations and directives were recently combined into the UNDP-UNEP supported and MONRE-sponsored Environmental Impact Assessment Guidelines for Lao PDR (2012), which has been followed by the *draft* IEE guidelines (2013).¹¹ The 2012 EIA and 2013 draft IEE guidelines support the recently promulgated Decree on Environmental Impact Assessment (2010). The IEE guidelines for Lao PDR meets the IEE requirements of the ADB SPS (2009).

25. The Lao PDR's environmental assessment process does not dictate a formal timeline for the approval process for a project IEE/EIA, only the series of process steps. MONRE confirmed that there is not a formal timeline for the preparation and approval of an IEE or EIA, but that the normal timeline for the approval of an IEE or EIA as well as a RP and IPP after documents submission to MONRE is approximately 45 days. The environmental assessment process is completed after detailed engineering design. ECC for subprojects should be obtained prior to construction contract award.

D. ADB Safeguard Policy

26. The ADB Safeguard Policy Statement and Sourcebook (ADB 2009, 2012) clarifies the rationale, scope and content of an EA which is supported by ADB's Good Practices Sourcebook (2012). Projects are initially screened using a Rapid Environmental Assessment (REA) Checklist to determine the level of assessment that is required. Projects that cause significant or major environmental impacts that are irreversible, diverse or unprecedented and/or affect an area larger than the sites or facilities subject to physical works are classified as Category A. For these, an Environmental Impact Assessment (EIA) is required. Projects which have potential adverse impacts that are less adverse than those of category A, which are site-specific, largely reversible, and for which mitigation measures can be designed more readily than for category A projects are classified as Category B. For these, an IEE is required. Lastly, projects that are likely to have minimal or no negative environmental impacts are classified as Category C. For these, environmental implications need to be reviewed.

¹⁰ WREA now incorporated in the new MONRE

¹¹ MONRE 2012, 2013

III. DETAILED DESIGN OF IMPROVEMENTS TO SOLID WASTE MANAGEMENT

27. The principle detailed designs (DED)¹² of the Vang Vieng Solid Waste Management Improvements subproject are presented below. Improvements to solid waste management consist of two main components defined by:

- (1) Upgrading existing dumpsite to a sanitary landfill including access road; and
- (2) improved solid waste collection in Vang Vieng town and vicinity.

A. Vang Vieng Sanitary Landfill

28. The Sanitary Landfill (SLF) is located 11 km southeast of the Municipality of Vang Vieng (Figure 1 and Figure 2). It occupies a gently sloped hilly area that rises to the west along a northwest trending ridge. The area is underlain by weathered volcanic rocks. The SLF will be constructed within the area of the present dumpsite which was commissioned in 2007.

Figure 1: Location of Vang Vieng landfill

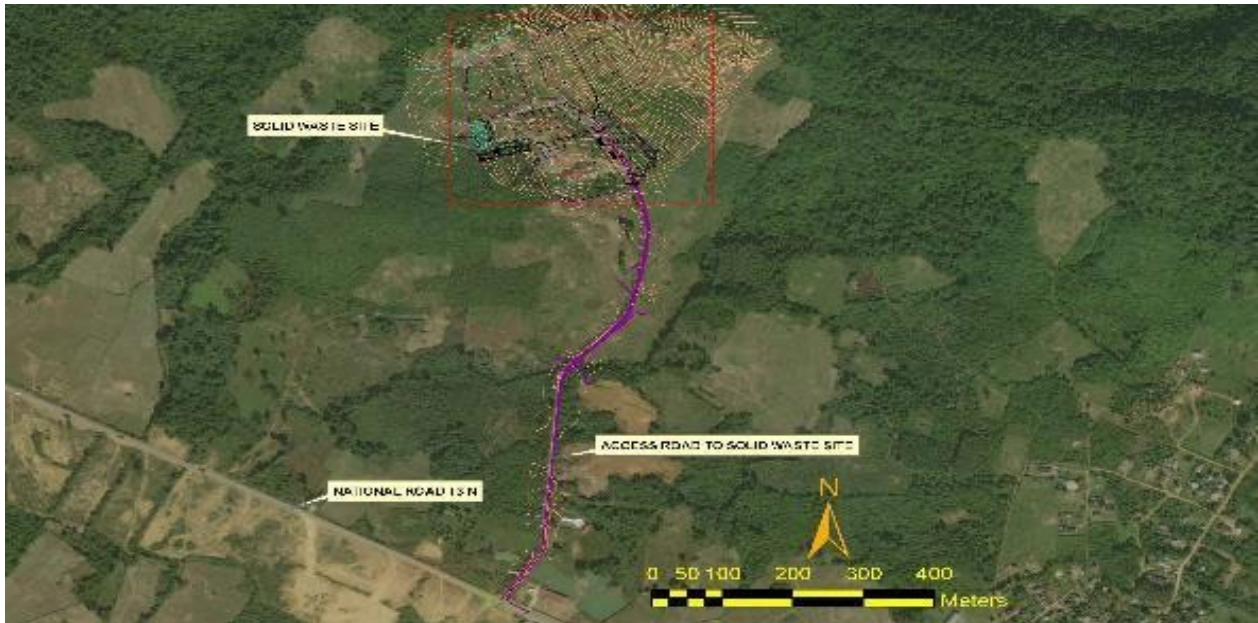


Source: *Environmental Compliance Audit Report, February 2020.*

During site visit, conducted in August 2019, it was clear that the surrounding areas of the landfill is a mixture of gardens, production forest and paddy-fields, however with a buffer area between the specific landfill area and agriculture / forest production land.

¹² Description and drawings adapted from Footnote #5 including Annex A: Solid Waste Management Memo.

Figure 2: Vang Vieng landfill and access road



Source: Environmental Compliance Audit Report, February 2020.

29. The gently sloping southwest sector of the dumpsite site (1.7 ha, 17%) is now covered by solid waste of thickness ranging from 0.5 to 7m. The remaining gently sloping northwest sector covers about 3 ha (32%) and is overlain with 0.5 to 1m of waste. The eastern, sloping sector of about 4.6 ha (49%) has not been used for disposal. A seasonal stream drains the area immediately north of the property.

30. Figure 3 shows the plan view of SLF which consists of the following major components:

- (i) four (4) lined waste cells that will be constructed over time starting with Cell 1;
- (ii) existing waste moved and contained in a capped closed cell;
- (iii) passive leachate treatment system¹³;
- (iv) septage treatment cell;
- (v) hazardous waste cell;
- (vi) Material Recovery Facility (MRF);
- (vii) two administration and service buildings; and
- (viii) upgraded access and internal roads.

31. The existing solid waste at the dumpsite will be bulldozed into a large cell at the south of the property which will be capped. The capped cell of existing waste will be located at the southern area of landfill shown at bottom of Figure 3.

32. During the PPTA and the subsequent Environmental Compliance Audit (ECA) carried out in December 2019, boreholes were drilled for checking of groundwater depth and quality. The data are presented in next chapter on the Description of Affected Environment.

¹³ Passive water treatment systems are systems that do not require the ongoing addition of chemical reagents to conduct treatment, following a process of anaerobic decomposition. As a result these systems have low running and maintenance costs, are long term treatment options and require minimal supervision.

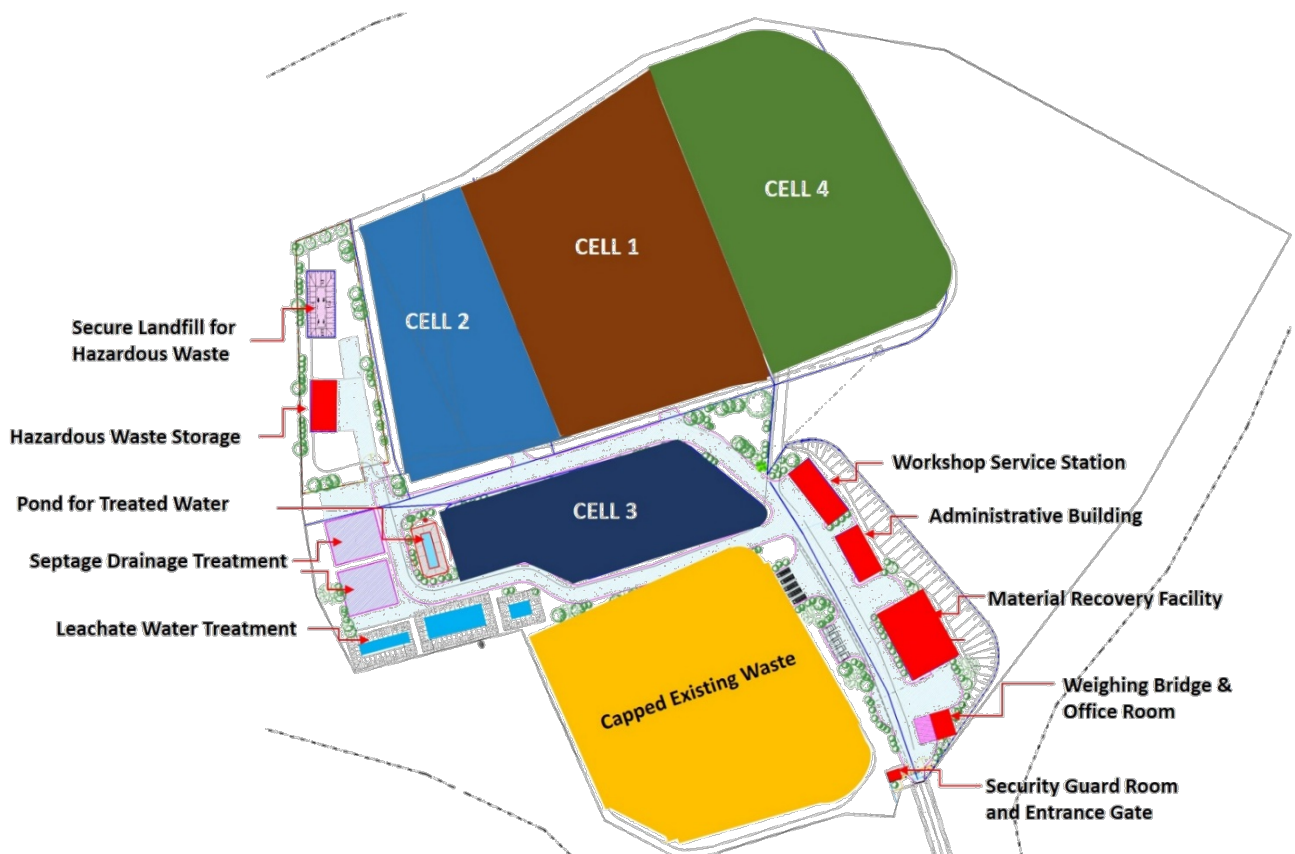
33. Test drilling revealed that the entire area is underlain by a mixture of clay material defined by a sequence of 3 to 4 layers of clay with gravel, sand and silt fractions. The presence of sand, gravel and silt fractions is believed to provide permeability to the clay. Bedrock of hard sandstone was encountered only at the BH8 borehole which occupies the sloping section of the area.

34. The water table at the dumpsite is shallow (0.5 -1.5m) at boreholes BH1 (at Cell 2), BH7 and BH5 (at Cell 1), whereas, at boreholes BH2, BH6, BH3, and BH4, the depth of the water table ranges from 2.5 - 4m. As per ADB guidelines, the minimum difference between the base of the landfill and the groundwater table should be 1 meter. Consequently, no excavation should be allowed for Cell 1 and Cell 2. The waste cells require a High-density polyethylene (HDPE) liner which satisfy international requirements for the design and construction of a sanitary landfill.

35. The four (4) waste cells will have a combined capacity of about 400,000 to 450,000 m³, depending on the final height of the landfill. This will allow for a minimum of 20 years of operation. The net average height of landfill is 7.5 m which means Cell 1 will have to cover an area of approximately 8,800 m² which has formed the basis of the design. For the anticipated 20-year lifespan of the SLF, an area of approximately 45,000 m² is needed assuming an average net landfill height of 9m.

36. Waste cells will be developed from the central-east area to the west. Given the shallow water table no excavation of soil must be done at Cell 1 to avoid contact with or contamination of the groundwater at this part of the site. Cell 3 will be placed south of Cell 1 and 2 and Cell 4 will be located east of Cell 1. No external borrow pits will be required for the development of the 4 waste cells.

Figure 3: Plan view of upgraded Vang Vieng sanitary landfill



From Conceptual Design, Ramboll. June 2020

The upgraded plan for the SLF suggests the following locations of specific facilities: 1) Hazardous waste storage; 2) Pond for Treated Water; 3) Septage Treatment facility; 4) Leachate Water pond; 5) Service station and administrative buildings; 6) Material recovery facility; and 7) Internal road.

37. Cell development will be from the central east to west side of site. Cell 3 will be placed south of Cell 1 and 2, and Cell 4 will be located east of cell 1 and partly on top of this as presented in cross sections.

38. The cells will be lined using a synthetic liner of HDPE of 2mm thickness. The liner must have a foundation of stable soil without large stones, to be achieved by compacting and levelling existing soil and trim out large rocks and stones. Furthermore, a levelling layer of sand or fine gravel of min. 100 mm is added. The liner must be adequately anchored in all sides. Maximum slope for the liner foundations will be 1:3.

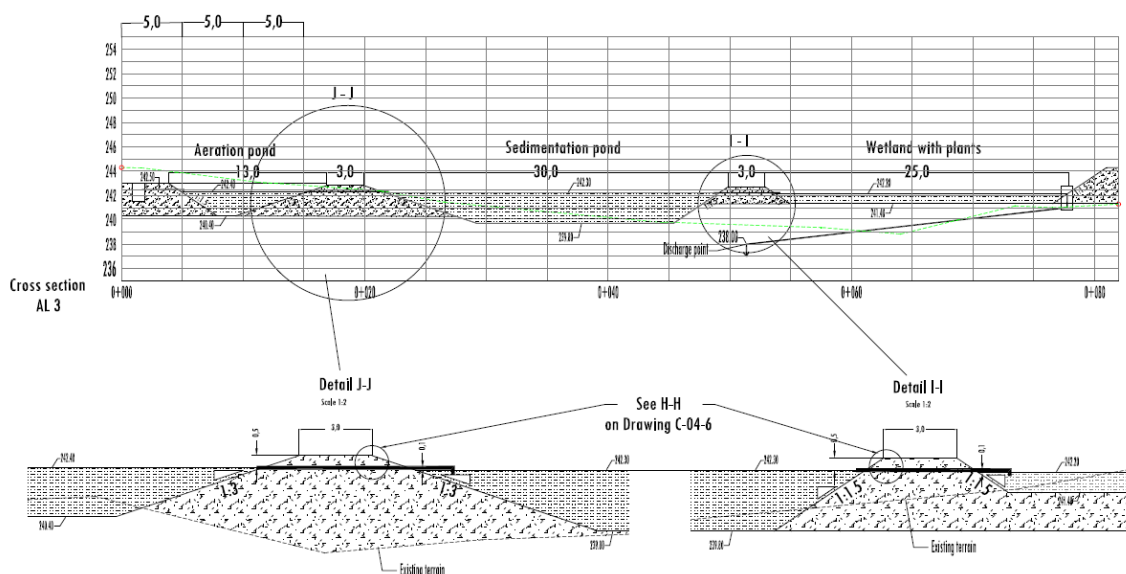
1. Leachate Treatment

a. Treatment options

39. Leachate must be minimized through strict and planned separation of rain and surface runoff water from waste cell seepage. Several treatment methods are available from advanced and expensive membrane technologies to simple biological treatment. From practical experience under similar conditions, low-tech, biological methods such as aeration and subsequent sedimentation is suitable under the local conditions of Vang Vieng. A lagoon-based leachate treatment system should be used. The sequence is presented below.

40. The leachate treatment facility will be located at the lower lying area in the southwestern corner of the site (Figure 3). Figure 4 shows a horizontal view of the leachate ponds. The lagoon based leachate will follow the following sequence: Anaerobic decomposition, followed by facultative pond, then aerobic pond, and finally maturation/oxidation pond. From the maturation pond, the treated leachate can be re-circulated in the landfill and partly evaporated.

Figure 4: Lagoon-based horizontal view of leachate treatment



From Detailed Engineering Design, Ramboll, July 2020

b. Design Criteria

41. Based on review of many relevant studies and practical results in various leachate treatment plants, it is concluded that the most suitable, feasible and appropriate treatment will be a combination of the following design measures and criteria:

- The dimensioning water volume will be equal to the average max. rainfall per month, multiplied with the landfill area
- The retention time in the aerated lagoon will be min. 1 day at max. flow and will be equipped with aerators based on propellers on rafts
- Retention time in sedimentation lagoon will be 3 days at max. flow. Aeration lagoon will be 2 m deep and the sedimentation pond will be 2.5 m deep.
- There will be a third step with a shallow wetland polishing pond with plants, 0.8 m deep and with 1 day retention time at peak flow.
- The aeration and sedimentation ponds must have HDPE liner at the bottom, to be protected by a filter fabric throughout the pond area.

2. Septage Treatment

42. The expanded plan view of the septage disposal cell at the SLF is shown in Figure 4, located in the Western part of the landfill. This allows space for unloading area for vacuum trucks.

43. In Vang Vieng, most houses have their own septic tanks, while hotels usually have large septic tanks. The tanks are not emptied on regular basis, rather mainly when the owner reports tanks to be full. Private companies provide clean-out services with a roaming septic truck in each town. The collected sludge is reportedly emptied into the lot owned by the septage collector.

41. Septage is the accumulated sludge in septic tanks and is characterized by a very high content of organic pollution which is potentially infectious due to a high bacteria content. Normally it has a bad odour when fresh. Septage normally has a TSS (dry matter) of 1-5 % requiring de-watering as an important treatment step.

a. Design Criteria

42. Assuming an average collected volume of septage from each Household (HH) of about 2m³, the projected total volume for households can be calculated (**Table 1**). For Vang Vieng, it is assumed that the collection of septage from individual households and large establishments will be undertaken at an interval of about five (5) years.

Table 1: Projected total septage from HH in Vang Vieng

Septage Collection (m ³)/year	2020	2025	2030	2035	2040
Rest of Vang Vieng	3,926	4,339	4,797	5,302	5,861
Vang Vieng core area	1,663	1,839	2,032	2,247	2,483
Vang Vieng Groups	5,589	6,178	6,829	7,549	8,344

Source: PMCES, 2020

b. Treatment of septage

43. Various treatment and disposal methods are available for the treatment of septage such as stabilization lagoons, aerobic and anaerobic digestion, other biological and chemical treatment, and composting. Based on the local conditions and review of relevant studies and practical results in various septage treatment plants, it is concluded that the most feasible and appropriate treatment is a passive treatment system in a constructed wetland with vertical filtered flow in two (2) septage treatment ponds (Figure 3).

44. In the dual cell treatment system septage will be drained through a filter material to the bottom of the system. Special (narrow leaved) cattail plants will enhance the evaporation and treatment of the sludge. The liquid that drains from the system will be transferred to the leachate treatment plant for co-treatment. The septic treatment facility has been located away from the other facilities to avoid potential odor problems.

a. Assumed capacity

45. The constructed wetland should be emptied for dried septage sludge every second year. With an initial TSS of 1-5%, it is assumed that approx. 5% of the original septage volume is left after 2 years. The site will allow for a limited size of the septage treatment ponds. The septage ponds will each have a planned volume capacity of 200m³, 400m³ in total and 200 m³/year. This will allow an annual flow of 4000m³ of septage to the ponds. The septage will be drained through the filter material to a bottom drainage system. Special (narrow leaved) cattail plants will enhance the evaporation and treatment of the sludge. The liquid drained out will be transferred to the leachate treatment plant for co-treatment.

46. For Vang Vieng this will allow for receiving septage from the urban core for the whole period of 20 years. Initially, the facility may receive some 70% of the septage from all Vang Vieng districts, being reduced to 48% of these after 20 years.

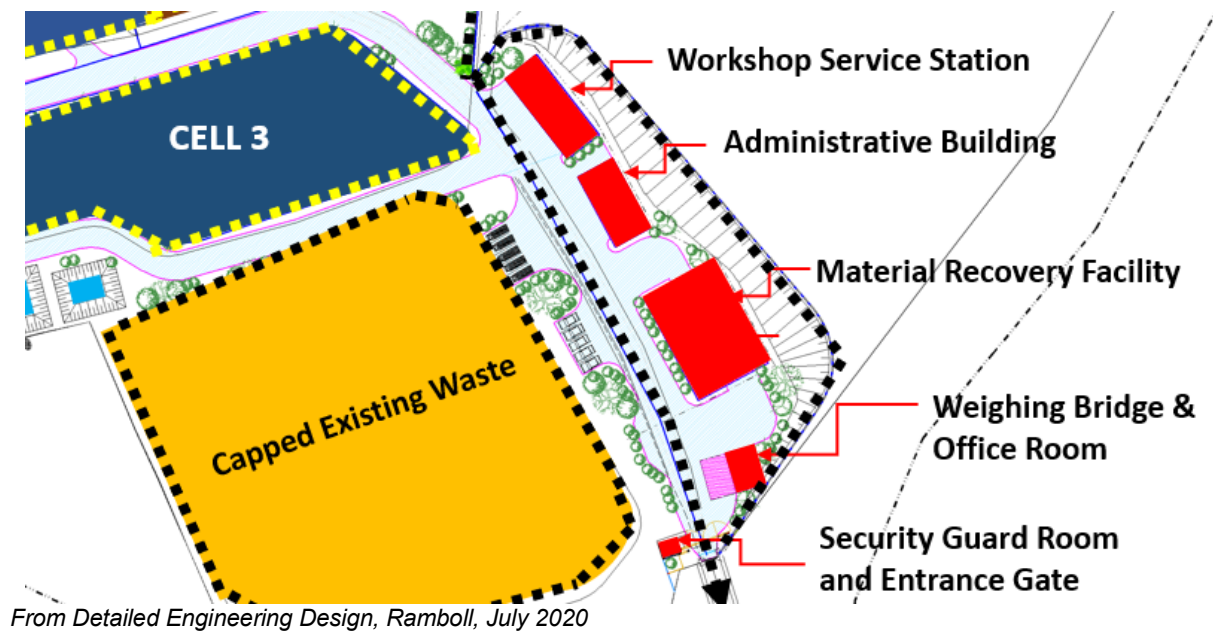
3. Material Recovery Facility, hazardous waste, and utility buildings

47. Figure 5 provides an expanded plan view of the location of the MRF, hazardous waste storage, and service and administration buildings.

a. Material Recovery Facility

48. The Materials Recovery facility (MRF) will be housed in a single story building (Figure 6 and Figure 7). The MRF will be established based on the requirement that a segregated waste collection system will be implemented. This system of segregation will ensure that only dry, potentially recyclable materials will be delivered to the MRF. Recycling facilities which receive mixed waste subsequently turn into smelly and unsanitary stockpiles of unprocessed, poorly segregated biodegradables and dirty recyclables. A major O&M and training program will be developed and implemented to create awareness and educate the Vang Vieng municipality and local community on the need to separate wet and dry solid waste at source to ensure the new MRF only receives dry solid waste for sorting and recycling. The planned MRF will not be able to handle wet waste which is intended to be dumped directly into the waste cells upon arrival at the SLF. The improvements to solid waste collection for the SLF will need to include separate or dual compartment trucks to collect and transport segregated dry and wet waste. Roadside garbage bins also need to separate wet and dry solid waste

Figure 5: Location of utility buildings, MRF, and hazardous waste storage



b. Current recycling

49. As observed at the dumpsite, waste pickers recover Polyethylene terephthalate (PET), hard plastics, plastic sheets and carton and metal cans. With the exception of glass, these materials comprise about 20% of the waste generated in Vang Vieng. Paper is not recovered at the dumpsite which is attributed to the likely recycling of paper at source, and ongoing mixed waste collection which degrades the paper quality. The pickers do not recover the glass bottles in response to the low price and/or nearly absence of demand for this material.

50. The MRF will be designed in accordance with the following criteria:

- The MRF will have a floor area of at least 500 m². This will facilitate the processing of 3 to 5 tons of dry, potentially recyclable waste. The higher end will allow it to handle the expanded collection coverage 5 years after the establishment of the landfill.
- The MRF will only accept dry, source segregated waste. Mixed waste will not be accepted into the MRF. This way the sorting process will be easier. A sorting table is provided for manual sorting and segregation of inorganic recyclables (paper, carton, PET, hard plastic, etc.). This will ensure ergonomically work positions for the workers who would otherwise have to work in a bending or sitting position.
- The MRF will record the amount of incoming and outgoing waste for monitoring purposes and for regular validation of the facility mass balance.
- The MRF is part of an integrated solid waste management system and should not be established as a stand-alone facility.
- The MRF will operate 8 hours a day from Mondays through Fridays.

51. The general layout of the MRF in Figure 7 shows the following features:

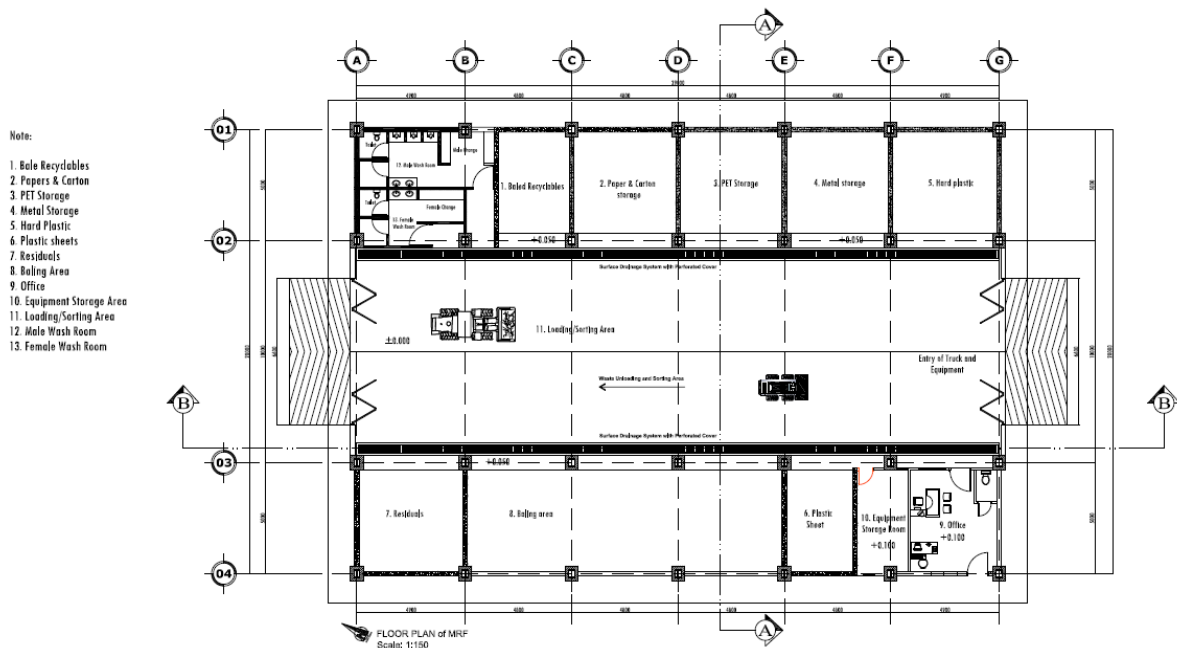
- Centrally located waste loading and sorting area
- Separate storage for the metals, plastics, paper/card and residuals.
- Baling area
- Equipment room
- Small office
- Peripheral drainage system
- Washroom area for waste pickers including septic system

- Basic equipment such as baler, pay loader, weighing scales and wheeled bins
- Recording system for the weights of the incoming waste and outgoing residual and recyclable materials
- Fire fighting equipment needs to be available in MRF

52. The MRF will have the following functions:

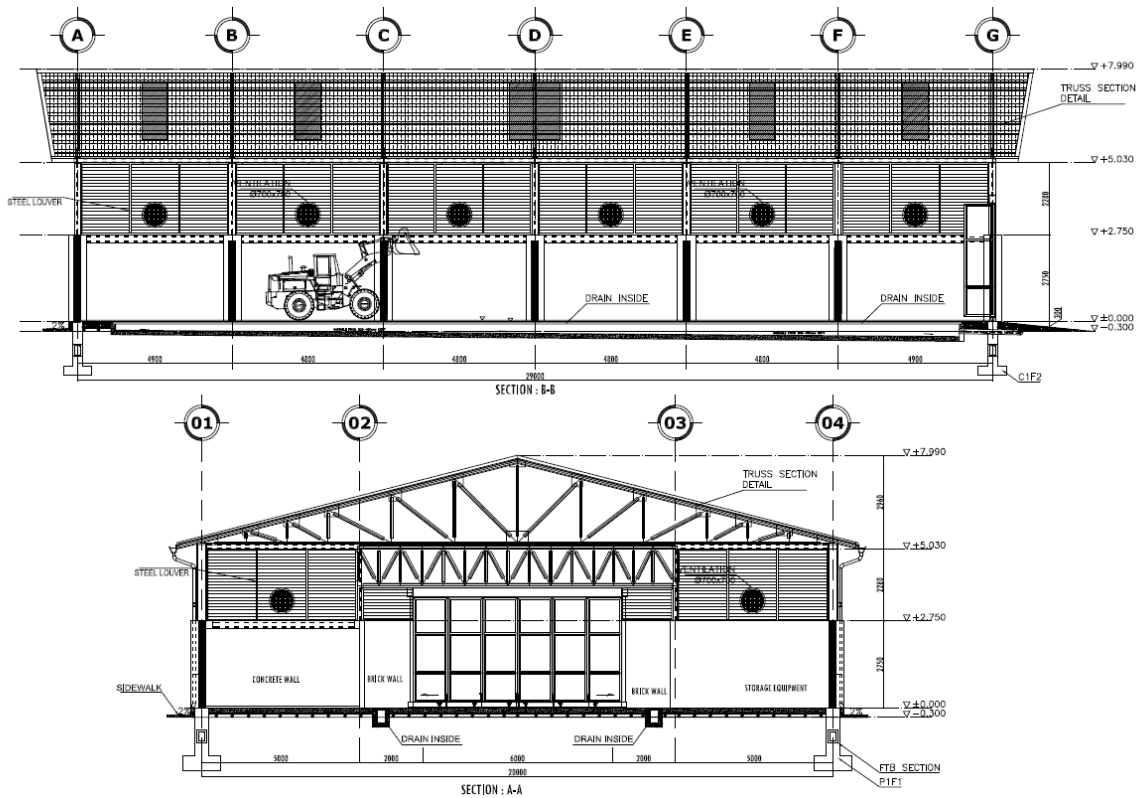
1. Facilitate recovery of recyclable materials from the collected waste for subsequent sale to recycling buyers/centers.
2. Reduce the amount of waste that will be disposed into the sanitary landfill and therefore contribute to the extension of the operational life of the disposal facility.
3. Sorting table for manual sorting and segregation of inorganic recyclables (paper, carton, PET, Hard plastic, etc.), ergonomically correct for the waste pickers during the sorting process.
4. Provide a safe, sanitary environment, and systematic means of recovering the recyclables in contrast to the current dirty method of sorting mixed waste in an exposed environment.
5. After training, provide employment for current waste pickers in MRF. Waste picking on the waste cells may be disallowed by Vang Vieng authorities. However, the MRF makes waste picking unnecessary.

Figure 6: Building housing Material Recovery Facility (MRF)



From Detailed Engineering Design, Ramboll, July 2020

Figure 7: Plan view of MRF



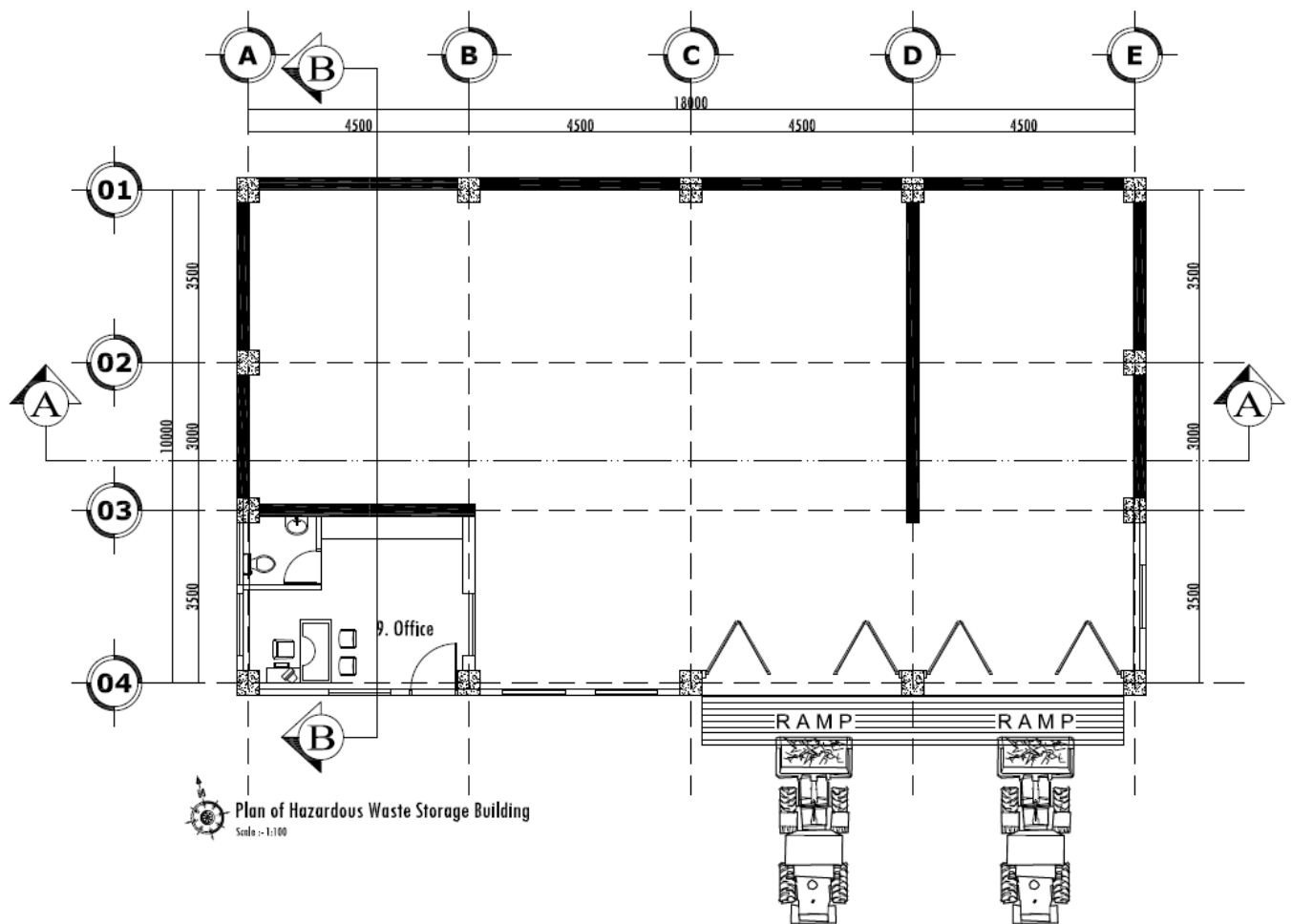
From Detailed Engineering Design, Ramboll, July 2020

c. Hazardous Waste

53. A separate secure landfill area for inorganic (non-reactive) hazardous waste will be established at the site, in a protected fenced area with a separate entry to avoid contamination of general waste. This is located in the North-Western side of the landfill site, as can be seen in Figure 5. The SLF area is too small for a separate treatment facility for hazardous waste. However, a covered storage area and a small secure disposal area has been included at the SLF for organic and reactive hazardous waste allowing for storage of such waste until more centralized solutions are available in the country.¹⁴ The actual scope of the two types of hazardous waste produced by Vang Vieng municipality defined above must be determined. Infectious and chemical waste (syringes etc.) from the Vang Vieng healthcare facilities should be pre-treated at source before being transported to SLF. Hospitals also incinerate some of their waste on site.

¹⁴ The Government of Lao PDR has yet to formulate any wider regulation on integrated waste management strategy. This would allow the government to introduce preventive measures targeting all producers of waste including reduction, reuse and recycling (3R), which would also cover management of hazardous waste.

Figure 8. Plan of the Hazardous Waste Storage Building



From Detailed Engineering Design, Ramboll, July 2020

4. Storm Water Diversion

54. Runoff from the adjacent hilly areas including flow through adjacent stream during rainy season will be diverted away and around SLF and waste cells through a peripheral network of collection canals which will eventually discharge into the natural drainage below the landfill site. In the reviewed and updated design, storm water outfall has been outlined in the Western part of the landfill site, allowing a water run-off in accordance with the terrain and prevailing hydrometeorological conditions including climate change (see below).

5. Administration and Services

55. The SLF will have separate administration and services support buildings (*Note: figures of the administration and service buildings of the SLF will be included once the detailed design has been finalized and approved*). Support facilities will include offices, a small laboratory, kitchen, staff wardrobes and washrooms with septic system, a workshop, equipment storage, and waste collection truck parking and maintenance area. Record keeping will include incoming waste and will be kept in the administration building which will be equipped with filing cabinets, printers and audiovisual technology.

a. Reception of waste

56. Upon arrival at the SLF all waste trucks will register at the gate and then at the administration area with the types and volumes (m³) of waste inspected and recorded before

proceeding to the active cell tipping area. It is at reception where the waste content will be visually assessed to ensure that only permitted waste types are accepted for disposal. Non-permitted materials will be rejected. A traffic system shall be devised to regulate movement of vehicles and equipment. An area at the SLF has been allocated for the future installment of weighing bridge.

6. Access roads

57. The existing 0.8 km access road to the SLF from NR 13 will be upgraded with a 6m concrete carriage way and improved drainage. Widened passing areas for opposing trucks will be included at approximately 150m intervals. The internal roads of SLF will also be upgraded with 4m concrete carriageways with improved drainage throughout the SLF property.

58. Criteria for design of the internal road is that it must follow the existing alignment, vertical curvature and width of the road to avoid resettlement issues.

59. The Lao PDR National Road Design Manual of April 2018 will be applied for the access road upgrades including drainage with additional consideration of climate change (see below).

60. The SLF access and internal roads are non-public roads with limited traffic (less than 50 vehicle passes). However, the roads will frequently receive heavy trucks. They have been classified as Class VI roads for mountainous/rolling terrain, with 1.5 lane, for a maximum speed of 40 km/hour for single axle maximum loads 9.1 tons. This will allow a full adaptation to the existing vertical and horizontal alignment of the existing access road

7. Ancillary

61. Other components of the SLF which are included in the principal design are the following:

1. Gate with guard
2. 2m high perimeter fence with barbed wire on top
3. Monitoring wells (2) – at BH1 and BH4.
4. Washing bay at the entrance
5. Water from water reservoir located above site, based on gravity based water supply
6. 22 kV transmission line from the NR13.

B. Climate Change Mitigation and Resilience

62. The detailed designs of the Improvements to Solid Waste Management in Vang Vieng have addressed the key required climate change mitigation and resilience measures that were identified by the Climate Risk and Vulnerability Assessment¹⁵ (CRVA) of the feasibility design of this subproject of the TIIG. Both in relation to climate change mitigation and to minimize odour issues it is planned to plant a dense line of trees around the perimeter of the SLF, with sufficient canopy to depress odour. It furthermore contributes to reduction of aerosols and GHG emission.

63. A key climate change mitigation measure would be to install a landfill gas (LFG) extraction system to capture and remove greenhouse gases (primarily methane). Climate change resilience addresses the design and operation of vulnerable components of the SLF including peripheral stormwater drainage around/away from SLF, and adequate drainage for

¹⁵ ADB 2018, Supplementary Appendix of TA9090: Climate Risk and Vulnerability Assessment (CRVA) of TIIG subprojects in Lao PDR and Cambodia.

the upgraded access and internal SLF roads. However, the Vang Vieng landfill is receiving less than 500 tons of waste per day, with significant organic content, which will not make it commercially viable to recover and utilize landfill gas. In order to minimize GHG emissions to the atmosphere, it should be considered to use landfill gas flaring as an alternative to landfill gas extraction, safely disposing the flammable constituents, particularly methane, and to control odour nuisance, health risks and adverse environmental impacts. A more efficient landfill together with flaring will reduce the GHG emission.

1. Landfill Gas Management

64. The maximum amount and quantities of potential gas to be extracted from Vang Vieng landfill, based on the projected amounts of solid waste to be landfilled and with the current waste composition.

a. Landfill gas generation and potential extraction

65. There are several theoretical models for estimating LFG quantities generated over time and for estimating how much can be extracted. The models are based on assumed solid waste quantities that are landfilled every year in a certain period. The LFG estimates has been used for a theoretical LFG generation at the Vang Vieng SLF. Almost all LFG knowledge and practical/operational experience indicate that the accuracy of theoretical model estimates are limited because there are so many unexpected results and conditions occurring in the actual operation of a SLF over time. As a consequence, the DED of Vang Vieng SLF has based assumptions on extensive operational experience from a large number of LFG plants in operation for more than 20 years. From this experience, the realistic potential for LFG extraction is in the range of 40-75 % of the theoretically generated LFG quantities. When the landfill is designed for LFG extraction it is assumed that approximately 60% of the total LFG being generated can be extracted.

66. It is projected that the annual total LFG quantities (normal m³) potentially generated together with the estimated quantities extracted (and potential utilized) in a LFG facility under optimized conditions for Vang Vieng SLF.

68. The initial LFG quantities produced in the *new* cells of the Vang Vieng SLF will initially be limited. From practical - operational experience it is generally not recommended to start installing a LFG facility until the LFG production is above 200,000 Nm³/year or 20-30 Nm³/hour due to operational and adequate flaring concerns, and until the landfill contains minimum 60-80,000 tons of solid waste. As per best practices guideline¹⁶ only landfills receiving more than 500 t per day with significant organic content will be commercially viable for landfill gas recovery and utilization. Before this condition is reached any LFG facility will be difficult to operate continuously and with stable production.

69. This condition is not met at Vang Vieng landfill and LFG recovery and use from this landfill site will not be viable. Furthermore management and operation of an LFG installation system will require a high extent of management capacity, which is not met existing among UDAA and district environmental authorities. Management training will provide some level of capacity, however given the specialized operational nature of the operation and management, this will not deemed as a viable option.

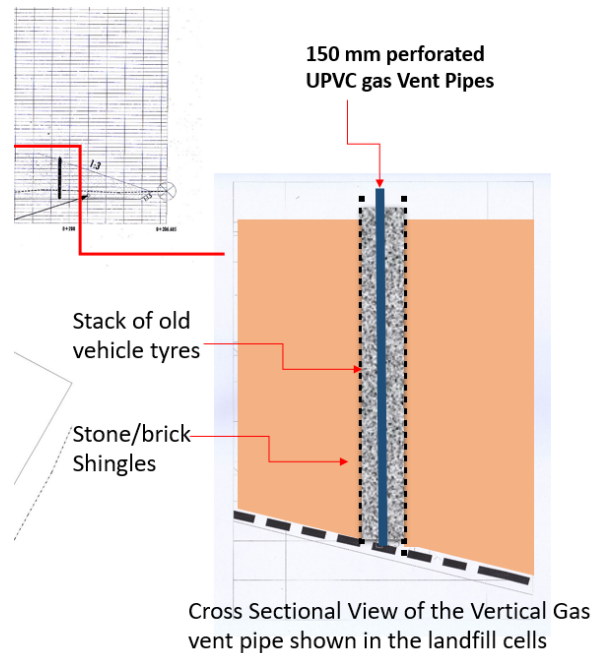
b. Landfill Gas Ventilation / Flaring

70. Gas ventilation is necessary as means to control the landfill gas, which represents a fire or explosive threat and must be controlled to protect the landfill property. Gas ventilation is

¹⁶ World Bank Waste Guidelines (2004)

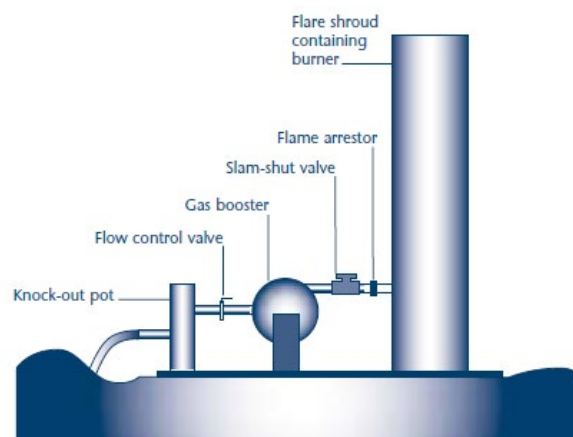
carried out as follows: 1) during site preparation the landfill side slopes are lined with impermeable clay to curtail lateral migration of the gases to escape to the atmosphere; 2) rock-filled, wire mesh wrapped or perforated / slotted HDPE of appr. 1 m in diameter are installed and located below the ground surface to serve as conduits for gas movement within the landfill. Vertical wells of appr. 1 m diameter are created throughout the landfill (appr. every 0.1 hectare). The Figure 8 below shows a cross sectional view of a ventilation pipe in the landfill cells.

Figure 8: Cross sectional view of a ventilation pipe



71. Another alternative to gas ventilation, is to consider landfill gas flaring as an option to manage GHG gas emission and control the gas from explosions. The purpose of the flaring is to dispose of the flammable constituents, particularly methane and this way also control odour nuisance, health risks and adverse environmental impacts. The technology of a landfill gas flare is conceptually very simple: landfill gas is brought into contact with a supply of air and ignited. A variety of configurations of conduits and chambers can be used for the purpose of flaring. It however comprises a number of basic elements in addition to piping, valves and the body of the flare, see Figure 9 for the principles of the flaring system.

Figure 9: Basic Flare arrangement



72. The basic elements for flaring are:

- Gas cleaning/conditioning before the flare to remove moisture and possibly impurities;
- A blower or booster developing the head of pressure needed to feed the landfill flare;
- Flame arrestors in the landfill gas feed line to prevent flash-back of the flame down the pipe;
- Control method over the flow rate of landfill gas to the burner and possibly to over the supply of combustion air;
- An ignition system to light the gas mixture on start-up;
- A flame detector to check that ignition has been successful and combustion is taking place.

2. Vehicle emissions

74. The GHG emissions from roads was established based on the guidance provided in the ADB Environment Safeguards - a Good Practice Sourcebook (2012). If the traffic expressed as passenger car units per day (PCU/day) is below the numbers indicated in Table 2 in a representative year, the emissions in that year are unlikely to exceed the 100,000 tons CO₂e threshold.

Table 2: Maximum Number of PCU per km to Trigger 100,000CO₂e/a

Length of Road. (km)	PCU/day	Length of Road. (km)	PCU/day
10	76,000	50	23,000
20	57,000	60	19,000
30	38,000	70	16,000
35	33,000	90	13,000
40	28,000	100	11,000

Source: ADB Environment Safeguards - a Good Practice Sourcebook (2012)

75. The total length of the upgraded access road is only 0.8km. Increased traffic in Vang Vieng, along NR 13 and the access road from the increased trip frequencies of the new compactor and vacuum trucks, and SLF staff will be well below 50,000 PCU/day, which produces well under the 100,000 tons/a GHG threshold.

3. Planting of Living Fence

76. Site surveys at the SLF and its vicinity and responses from consultations have shown that smell and odour problems are considered a problem for the local community and villages, especially Ban Phongvieng, located 1 km from the SLF. An effective mitigation measure to minimise the odour issues are plants, to function as living fences. The ideal would be to plant fastgrowing scrub or bamboo trees, ensuring species with sufficient canopy. As mentioned in the Operation Phase, UDAA will be responsible for carrying out the planting and ensuring it to be a dense line of trees.

4. Climate change resilience

77. The objective of the DED was to provide cost effective, climate-resilient measures for the Vang Vieng solid waste improvements subproject by adapting the infrastructure to the impacts of climate change and climate variability. The climate resilience activities fall under two outputs:

Output 1: Infrastructure adapted to extreme weather conditions due to climate change,

Output 2: Increased resilience of project infrastructure to long term climate change.

a. Caveat

78. Factors considered in making engineering adjustments for Vang Vieng subproject for climate change included cost-effectiveness, current climate variability and potential future risk. It is important to note that existing climate change impact assessments are insufficient to provide a scientific probability of future climate change, and therefore, the civil engineering adjustments based on expected future changes are difficult to calculate quantitatively. A margin of safety risk factor is therefore applied instead.

79. The following are relevant: (i) climate change trends and projections; (ii) impacts of climate change on hydrology, ecology, and soil; (iii) natural environment including topography, geology, land use, and climate hazards; (iv) social environment including poverty levels and population density; (v) built environment; and (vi) hazards risk mapping.

80. Engineering designs, standards and guidelines are selected to withstand climate change along with proposed amendments. The Lao PDR Ministries currently use a set of standards and guidelines for engineering design which may not fully consider long-term implications of climate change. Available materials and studies of climate change scenarios and consequences in the Vang Vieng region have been assessed and conclusions and recommendations addressed.

b. Climate change resilience for Vang Vieng subproject

81. The Vang Vieng subproject considers climate resilience adaptation measures to reduce adverse impact of climate risk through:

- a) the improvement and upgrading of storm water drainage for access and internal roads; and
- b) establishment of adequate leachate treatment plant.

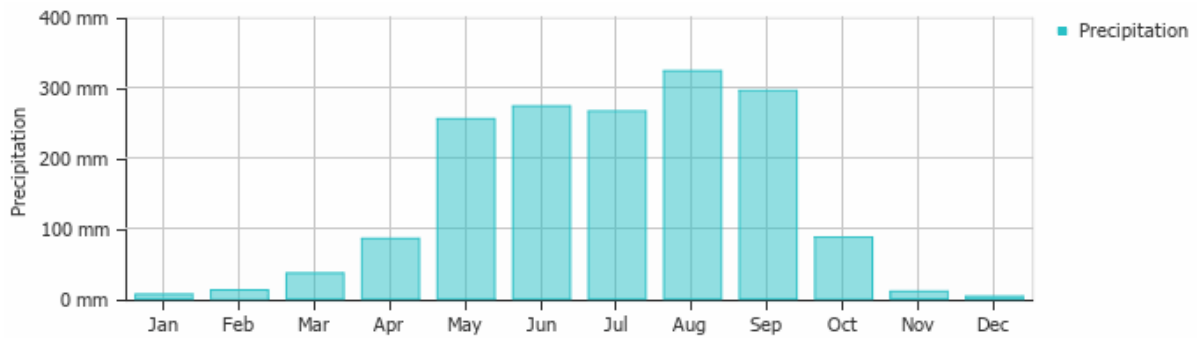
82. In the DED, the drainage system is ensuring that rain and stormwater will not come into contact with leachate or wastewater. The leachate pond is properly enclosed and drainage channels are distanced from the ponds. As a summary, adaptation of climate change for the storm drainage and the leachate treatment plants in general has been designed according to the following criteria:

- An increase of annual precipitation of 5% (climate change portion)
- Flooding of structures for 50 year return period + a freeboard of 50cm (dependent on local conditions) reflecting an increase of annual precipitation of 5% (climate change portion)
- Design of storm water culverts and canals for 10 year return period
- All infrastructure should have a lifespan of minimum of 100 years.

c. Rainfall

83. Mean monthly precipitation for Vientiane is shown in **Table 3** which is comparable to the rainfall pattern for Vang Vieng. The rainfall curve is to be used for sizing the SLF peripheral drainage canals and road culverts for intense short rainfall events.

Table 3: Rainfall curve for Vientiane



From: *weather-and-climate.com*

84. Rainfall data for Vang Vieng have been collected for a selection of years between 1935 and 2007. The average annual rainfall was 3621 mm/year and the extreme maximum was 1533 mm/month (August 1938) while the average maximum rainfall of that period was 791 mm/month. Monthly evaporation data for Vang Vieng have been collected for 2002-2006 with average evaporation of 780 mm/year and monthly evaporation between 26 mm and 119 mm / month.

d. Computation of storm water drainage flow

85. The Rational Method is used for the calculation of peak discharges for the design of the road drainage for the subproject. The Rational Method is the most commonly method used internationally for calculation of run-off in urban and rural areas.

The Rational Method Equation is defined as: $Q=c \cdot I \cdot a \cdot k$,

- Q = peak discharge, l/sec
- c = runoff coefficient
- I = rainfall intensity (l/sec/ha)
- a = area of contributing basin (ha)
- k= climate factor for future increase in precipitation.

86. The future annual increase in precipitation is assumed to be 5% (k=1.05) according to Appendix 7 of ADB CTDP4: Climate Proofing of Infrastructure.

e. Computation of storm water drain sizes

87. The Manning Formula is used for calculation of storm water drain sizes. The Manning's Formula is one of the most commonly method used internationally as follows:

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

- V = mean velocity (m/sec)
- N = Manning coefficient
- R = hydraulic radius (m)
- S = friction slope (m/m)

f. Design Criteria for components

88. The lifetime of the culverts, canals, buildings and infrastructure should not be less than 100 years. The following design parameters for stormwater have been applied:

- i) Monthly average temperature 24°C
- ii) 10-year return period for precipitation to be used to calculate the required capacity of the peripheral storm water drainage canals.
- iii) Minimum slope of 0.5 per cent for gravity transfer as a general requirement

C. Improved Solid Waste Collection

89. Vang Vieng generates approximately 34 tons of solid waste daily, however, only about 6 to 7 tons of mixed waste are actually collected and disposed at the existing dumpsite. The present collection system is managed by the Urban Development Administration Authority (UDAA) and covers only the six (6) villages of the central section of Vang Vieng. The UDAA operates two (2) open trucks with a total capacity of 18m³ and a skip jack truck. The open trucks complete five (5) trips per day every week while the skip jack truck completes six (6) trips per day per week.

1. Design Criteria for Waste Collection

90. The following criteria should be adopted for the waste collection system of Vang Vieng:

1. The system should develop collection coverage in accordance with the following schedule: 50% from 2021-2025; 70% from 2026 to 2030 and 90% from 2031 and beyond.
2. Segregated waste collection should be implemented once the proposed SLF becomes operational. Waste shall be classified into wet waste/biodegradable and dry waste/potentially recyclable. Appropriately colored bins will be used to hold the corresponding waste types.
3. Collection of biodegradable waste should be carried out twice a week in urban areas. Collection of biodegradable waste should be at least once a week in rural areas. The frequency of collection may be increased depending on the volume of waste.
4. Collection of dry waste should be carried out once a week in central Vang Vieng and once every 2 weeks for the surrounding rural areas.
5. Vang Vieng should have at least three (3) new 10m³ compactor trucks to allow expansion collection coverage, while Vang Vieng have requested two (2) new 10m³ compactor trucks and one open collection truck. The trucks will be complemented by HDPE bins with sizes ranging from 120 to 660 liters. Both compacting trucks and bins must have provisions for mechanical loading of waste into the compactor trucks. The 660 liter bins will primarily be deployed at designated communal collection points at the rural areas and low income urban areas.
6. In Vang Vieng, the three (3) new trucks will complement the current fleet of two (2) old open trucks and the skip jack truck.
7. Different levels of collection services should be introduced, with doorstep collection in areas paying higher fees, and fewer, centralized collection points in low-income areas, paying lower fees. In general communal containers should be located at a density allowing for maximum of 100 m of walking for households.
8. Communal collection will be employed at the outer districts of Central Vang Vieng. The arrival of the collection vehicles at the collection points will be announced at short intervals through an acoustic signal (special horn, bell etc.),

9. In addition to door-to-door collection, remaining waste collection will be done only at designated points in the city and district which are known to local residents and establishments.
10. The schedule and route of the collection trucks must be disseminated to the entire Vang Vieng area.
11. Vang Vieng will have a 1 x 8m³ and 1.5m³ septage collection trucks (with vacuum tanks).

a. Recommended Collection System for Vang Vieng

1. Waste collection at Vang Vieng should preferably be run by a private company which is strictly managed and monitored by the municipality or city. However, local preferences may be different, thus a subsequent institutional study should be conducted to clarify the issue.
2. Sets of bins will be deployed at designated collection points. Bins for biodegradable and dry/potentially recyclable wastes shall be designated for these collection points.
3. Bins and containers will be included in the tender documents which must adequately serve the core areas initially.
4. Segregated waste collection at source shall be strictly enforced.
5. Collection of wet biodegradable waste shall be done twice a week for central Vang Vieng and once a week for rural districts. Collection of dry and potentially recyclable waste shall be done once a week in central Vang Vieng and once every two (2) weeks in rural areas.
6. Waste will be collected at the designated times and locations along the curb except for establishments with door to door arrangements in the urban area.
7. Waste at the rural areas and in low-income urban areas shall be collected at the designated community collection points.
8. The system shall utilize a fleet of compactor trucks for waste collection complemented by HDPE bins which can be mechanically lifted.
9. Recovery of recyclables from waste bins and collection trucks during collection shall not be allowed due to serious reduction of efficiency.
10. Mixed waste in general shall not be collected.
11. As introduced above, a major O&M program and campaign will be needed to create and sustain awareness with the municipality and the community of the need for wet/dry solid waste segregation at source, and to ensure knowledge of what constitutes recyclable material.
12. Treatment and collection of healthcare waste: It is the plan to incinerate healthcare waste at the upgraded SLF. At the moment, healthcare waste is incinerated at the health facilities and hospital, however the incinerator capacity and quality is not sufficient or safe. The healthcare waste will be safely transported to the SLF hazardous waste storage building, to the designated incinerator, located here.

IV. DESCRIPTION OF AFFECTED ENVIRONMENT

91. The environmental baseline information was obtained primarily from existing reports and available data provided by the provincial environment agencies including the provincial Department of Natural Resources and Environment (DONRE), and Department of Agriculture and Forestry (PAFOs). Discussions with national counterpart agencies in Vientiane also provided additional information where relevant. In addition to applying available data/information, and information obtained in meetings with provincial and national agencies, the subproject area in Vang Vieng was visited to inspect the specific environments that will be affected by the subproject components.

92. The description of affected environment is defined by natural, land use, and cultural features. While focus is on the Vang Vieng subproject area, regional information is included where necessary for important context. The potentially affected social, economic, and demographic features of the subprojects are provided in detail in separate social safeguards documentation.

93. Lao PDR is 236,800 km² and situated in the centre of the South East Asian peninsula between 13°54' and 22°30'N and between 100°05' and 106°38'E. The landlocked country which extends approximately 1,000 km at its longest length in a northwest to southeast direction is bordered by Cambodia in the south, Thailand and Myanmar in the west, the Peoples Republic of China (PRC) in the north, and Viet Nam to the east. Vientiane Province in which Vang Vieng is located is one of 17 provinces forming Lao PDR.

94. Vientiane Province lies directly north of Vientiane Capital. The province covers an area of 15,927 km². It shares its borders with Xayaboury Province to the west, Luang Prabang Province to the north, Xieng Khouang Province to the northeast, Borikhamxay Province to the east and Vientiane Capital and Loei Province in Thailand to the south.

95. The existing Vang Vieng dumpsite where the upgraded managed landfill will be constructed is located at 18°52',04"N and 102°30',15"E. The short access road (0.8km) to the dumpsite that will be upgraded extends south to NR#13 at 18°51',37"N and 102°30',12"E. The nearest sensitive receptor is Ban Phongvieng village in which the second round of public consultations on the subproject were conducted in October 2018, with UDAA, DoNRE and village representatives participating. Updated consultation was conducted in August 2019. The village is on NR-13 approximately 1km from the existing dumpsite.

Figure 10: Consultation process in Ban Phonvieng, August 2019



96. The area influenced by the Improvements to Solid waste Management in Vang Vieng is defined by the area of the existing dumpsite, the solid waste collection area catchment of Vang Vieng town and outlying areas including the waste truck route to the dumpsite. The existing dumpsite is located in scattered agricultural land and scrub forest. The nearest settlement is more than 1 km to the southeast. The targeted impact area is a cleaner sanitary landfill area and a cleaner and healthier urban and peri-urban Vang Vieng environment.

1. Climate

97. Mean annual temperature is about 26.6°C with a mean maximum of 31.6 °C and mean minimum of 21.5 °C. The monsoon-influenced climate produces average annual rainfall of around 1,936mm with higher averages in specific areas.

2. Topography, Geology, and Soils

98. Vang Vieng town lies at an elevation of around 240 masl with mountainous area to the east and west reaching over 1,520 masl. Based on the National Geographic Department's geological map (2008), the Vang Vieng subproject areas comprises Quaternary fluvial sand, silts and clays in the Nam Song valley interspersed with Lower Permian marine limestone karsts. Table 4 shows the soil type below the existing dumpsite is a mix of clay sand and gravel. The soil type was determined from the 8 test boreholes drilled (BH1-8) at the dumpsite (Table 5)

Figure 11: Existing Vang Vieng dumpsite



Temporary houses for waste pickers. Consultations and interviews have concluded that all waste pickers stay permanently in the surrounding villages, and do not live at the landfill site.

Table 4: Soil type from the 3 boreholes drilled during ECA site investigation

Parameter	Type of Soil	Depth of test	Grain size distribution (mm)								
			2.0-5.0	1.0-2.0	0.5-1	0.25-0.5	0.1-0.25	0.05-0.1	0.01-0.05	0.005-0.01	<0.005
Unit		m	%	%	%	%	%	%	%	%	
Method	TCVN 4198:1995										
BH 10	SBHS-1.1	Hill soil/Silt mixed with small debris	3.0 -3.5	76.1	3.4		12.3				8.2
	SBHS-1.2	Silt mixed with small debris	7.5 - 8.0	72.9	11.7		10.0				5.4
BH 12	SBHS-2.1	Silt mixed with small debris	6.0 - 6.5	76.0	9.2		13.7				1.1
	SBHS-2.2	Silt clay	10 -11	66.5	8.9		23.3				1.3
BH 13	SBHS-3.1	Silt mixed with small debris	2.8-3.0	64.4	16.1		11.2				8.3
	SBHS-3.2	Silt clay	10 -11	56.0	9.5		33.9				0.6

Ref *Soil description and classification, U.S. Department of Agriculture*
Soil Permeability, FAO
 From Environmental Compliance Audit Report, VSDI. January 2020

Table 5: Soil type from the 8 boreholes drilled in PPTA phase

Depth (m)	BH1	Depth (m)	BH2
0 to 1.5	Sandy clay with gravel	0 to 2	Sandy clay with gravel
1.5 to 3.5	Sandy clay with fine gravel	2 to 6	Sandy clay
3.5 to 15.5	Silty clay	6 to 12	Gravelly clay
		12 to 21	Silty clay
BH 3		BH4	
0 to 3	Sandy clay with gravel	0 to 6	Sandy clay with gravel
3 to 13	Gravelly clay	6 to 8	Silty sand
13 to 22.5	Boulders	8 to 12	Sandy clay
22.5 to 28.5	Silty clay	12 to 30	Silty clay
28.5 to 30	Sandstone	30 to 42	Sandstone
BH5		BH6	
0 to 3	Sandy clay with gravel	0 to 3	Sandy clay with gravel
3 to 9	Sandy clay	3 to 7	Gravelly clay
9 to 20	Silty clay	7 to 12	Sandy clay
20 to 21	Sandstone	12 to 21	Silty clay
BH7		BH8	
0 to 1	Organic soil	0 to 6	Gravelly clay
1 to 13	Gravelly clay	6 to 7.5	Sandy clay
13 to 21	Silty clay	7.5 to 10.5	Silty clay
		10.5 to 21	Sandstone

From Initial Environmental Examination, PPTA, Norconsult, Dec. 2018

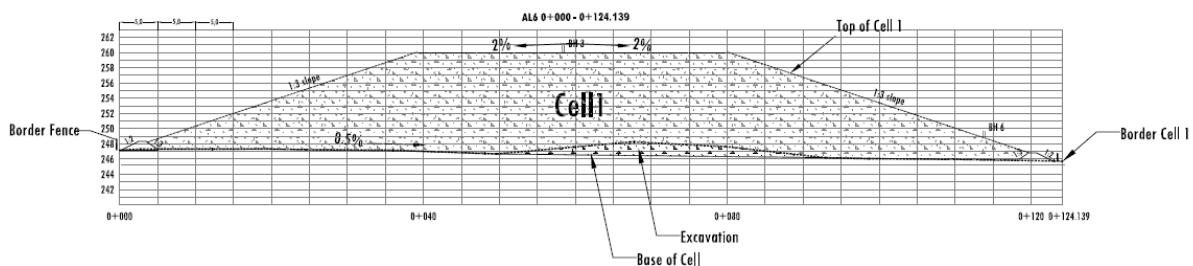
3. Water resources

99. The main water body within the Vang Vieng subproject area is the Nam Song. Originating in Phoukeo, the 80-km river flows through Vang Vieng District for most of its length (36 km) and discharges into the Nam Ngum reservoir some 40 km to the southeast of Vang Vieng town via a diversion weir. The river's catchment area covers 180,434 ha with more than 70% of this area within Vang Vieng District. The river provides livelihoods for farming, fishing, tourism and water supply. The water quality of Nam Song is a concern due to the increasing population and industrial and tourism developments.

4. Water table and groundwater quality at dumpsite

100. The depth of the water table (Table 6) and quality of groundwater (Table 7) were determined at the 8 test boreholes drilled at the existing dumpsite (Figure 3). The water table is very shallow at boreholes located at the flat section of the dumpsite (at BH1, BH7 and BH5). This condition limits the depth of excavation for the proposed cells particularly at the northern section of Cell 1 where the water table was less than 1m. In the case of Cell 1, the option is to place the cell liner on top of the graded ground surface to avoid intersection with the groundwater. Cell 1 will have height of up to 8 m and will cover an area of appr. 10,360 m², the cell will have 1:3 side slope. The design basis has been developed subsequent to detailed analysis of the groundwater depths. The details of the landfill cell is shown in Figure 12.

Figure 12: Cross section of the Cell 1



From Detailed Engineering Design, Ramboll, July 2020

Table 6: Water table depth at test boreholes at dumpsite

Location	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8
	Outside of SLF footprint	Within Cell 2	Within Cell 4	Northeast of Cell 4	Within Cell 1	Within Cell 1	South of Cell 2, outside of SLF footprint	Southeast of Cell 4
Date	Static Water Level (mbgs)							
Aug-06		7.5						
Aug-07	0	2				4.5		
Aug-08	0	2.4				2.5		
Aug-09	0	3.48				3.44		
Aug-10	0	4.02				3.68	0.6	
Aug-11	0	3.8				2.6	0	
Aug-12	0	3.4	8.3			3	0	
Aug-13	0	3.52	7.2		0.87	3.06	0.32	5.1
Aug-14	0	3.62	4.7		0.71	3.02	0.19	0.76
Aug-15	0	3.61	4.83		1.06	3.12	0	0.86

Aug-16	0	3.92	4.92		1.21	3.27	0.12	1.24
Aug-17	0	3.42	3.9		0.84	2.87	0	0.72
Aug-18	0	3.39	4.52		0.74	2.93	0	3.92
Aug-19	0	3.15	4.37	2.6	0.6	2.66	0	3.7

From Initial Environmental Examination, PPTA, Norconsult, Dec. 2018

Table 7: Groundwater quality at existing dumpsite

Par	Hg	Cd	Pb	Ni	Zn	Cu	Cr (VI)	Fe	Cl ⁻
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Method	SMEWW 3112B: 2012	SMEWW 3113B: 2012	SMEWW 3113B: 2012	SMEWW 3113B: 2012	SMEWW 3111B: 2012	SMEWW 3111B: 2012	TCVN 6658: 2000	SMEWW 3111B: 2012	TCVN 6194:1996
¹ WHO's DWS	0.001	0.003	0.01	0.02	3	2	0.05		
² Laos SWS					5	1		0.5	250
	0.001	0.01	0.05		15	1.5		1	600
GW-01	<0.0002	<0.0002	<0.0002	<0.0007	0.048	<0.03	<0.002	0.047	10.08
GW-02	<0.0002	<0.0002	<0.0002	<0.0007	<0.03	<0.03	<0.002	<0.02	5.67
GW-03	<0.0002	<0.0002	0.003	<0.0007	0.106	<0.03	<0.002	0.106	6.16
GW-04	<0.0002	<0.0002	0.007	<0.0007	0.207	<0.03	<0.002	0.031	5.82
GW-05	<0.0002	<0.0002	0.003	<0.0007	0.136	<0.03	<0.002	0.325	4.89
GW-06	<0.0002	<0.0002	0.003	<0.0007	0.095	<0.03	<0.002	0.129	4.25
GW-07	<0.0002	<0.0002	0.005	<0.0007	0.212	<0.03	0.003	0.084	9.93
GW-08	<0.0002	<0.0002	0.007	<0.0007	0.325	<0.03	<0.002	0.871	15.37
GW-09	<0.0002	<0.0002	0.006	<0.0007	0.280	<0.03	<0.002	<0.02	10.29
Min	<0.0002	<0.0002	<0.0002	<0.0007	<0.03	<0.03	<0.002	<0.02	4.250
Median	<0.0002	<0.0002	0.003	<0.0007	0.172	<0.03	<0.002	0.106	6.160
Max	<0.0002	<0.0002	0.007	<0.0007	0.325	<0.03	0.003	0.871	15.370

1. World Health Organization's Drinking Water Standards

2. Lao's Drinking Water Standards

From Environmental Compliance Audit Report, VSDI. January 2020

01. The water table at BH2, BH6, BH3 and BH4 ranges from 2.6 to 4.4 meters. This condition will allow a deeper excavation for the cells which will translate to additional space for waste.

102. There is a seasonal stream that flows along the eastern boundary of the landfill site. Water samples were taken from the stream above (GW-01 and below (GW-02) the landfill. The water quality data are listed in **Table 7** and discussed below.

103. Inspection of the groundwater quality data in Table 7¹⁷ indicates that the impact of the existing dumpsite on groundwater quality is inconclusive. The low concentrations of heavy metals and other parameters at the boreholes which meet almost all of the Lao National and WHO standards suggest that the clay-based soil underlying the dumpsite has prevented leachate seepage to the water table. However, the high concentrations of coliform bacteria and oil and grease at BH2 & BH3, and BH1, BH3, & BH7, respectively, are unexpected and not easily explained. Groundwater contamination from coliform bacteria and oil and grease normally does not occur from dumpsites. The presence of coliform in the adjacent seasonal stream samples (SW1 and SW2) is expected given local livestock grazing. However, the high level of grease in the stream station above the dumpsite (SW1) is also not expected due to the apparent absence of these substances. The author agrees that repeating the groundwater

¹⁷ Sampling conducted by borehole driller. Laboratory analyses conducted by National University of Laos.

Figure 14: Vang Vieng Landfill seen from above



From Detailed Engineering Design, Ramboll, July 2020

b. Land Resources

107. Land use in Vang Vieng subproject area is dominated by residential areas and paddy fields, though minor upland cultivation area still can be observed along the access road to Kaeng Yui waterfall. Land along Nam Song river is densely occupied by hotels and guesthouses to accommodate tourists, especially the shoreline on the east side of the river. The east side of river has been subjected to some infilling for hotel development in the city center which has extended north along the river. As indicated above the land surrounding the existing dumpsite is scrub forest of low value, belonging to production forest category.

6. Biodiversity

108. Vang Vieng subproject area is urbanized with existing tourism developments. Provincial forestry and DoNRE personnel confirmed that there are no known rare or endangered species occurring in the subproject area. Cited common animal groups present include squirrels, fowl and other birds, lizards, snakes and occasionally deer. Aquatic species in the Nam Song include varieties of fish (Table 8).

Table 8: Common Fishes of Nam Song Fisheries¹⁸

No	Lao Name	Scientific Name	Common Name
1	ບາເຄິງ	<i>Mystus wyckioides</i>	Redtail catfish
2	ບາແຂ້	<i>Bagarlus bagarius</i>	Groonch
3	ບາກົດ	<i>Mystus nemurus</i>	Long whiskers catfish
4	ບາຫຼາດ	<i>Mastacembeius armatus</i>	Tiretrack spiny eel
5	ບາປາກ	<i>Barbodes gonlonotus</i>	Pa Pak
6	ບາຈາດ	<i>Deauratus</i>	Pa Chat

¹⁸ From PAFA, Vientiane Province, 2017

7	ປາຄີລາມ	<i>Labiobarbus siamensis</i>	Pa Khilarm
8	ປາຄຶງ	<i>Hemibagrus wyckioides</i>	Asian red-tail catfish
9	ປາມັນ	<i>Gyrinocheilus pennocki</i>	Pa Mun
10	ປາຫາງແດງ	<i>Tor sinensis</i>	Pa Daeng
11	ປາຜາ	<i>Amphotistius laosensis</i>	Pa Fa
12	ປາເຊືອມ	<i>Ompok bimaculatus</i>	Pa Sieum
13	ປາກົດ	<i>Hemibagrus nemurus</i>	Pa Kot
14	ປາຂາວ	<i>Puntius brevis</i>	Pa Khao
15	ປາສູດ	<i>Hampala dispar</i>	Pa Sout
16	ປາດູກ	<i>Clarias batrachus</i>	Pa Douk
17	ປາເກັດແລບ	<i>Hypothalmichthys molitrix</i>	Pa Ket Lap
18	ປາຄໍ້	<i>Channa striata</i>	Pa Khor
19	ປານິນ	<i>Oreochromis niloticus</i>	Pa Nin
20	ປາກິນຫຍ້າ	<i>Ctenopharyngodon idella</i>	Pa Kin Gnar

7. Provincial Heritage

109. Vientiane province has 11 cultural heritage sites (Three-color Buddha and Ma La Stupa (circa 1590AD) in Toulakhom District; Viengkham temple (circa 1350AD) and Buddha's footprint in Viengkham district; Buddha cave (circa 928AD), Wat Gnat Temple, and Koneke Stupa (circa 1600AD) in Phonhong District; Wat Pa Na Nin, Wat Pha Baht Sun Pa Tong, and Wat Gnai Pa Hoat as well as five historical heritage sites (King Fa Gnum's City Moat, Ancient boat, King Anouvong's Cave, Long Chaeng Fog Mountain, and Meuang Meun Ancient Temple). None of these sites are close to the Vang Vieng dumpsite.

8. Demographics

110. Vientiane Province has a total population of 444,916 (as of end 2016) in 11 districts, 433 villages with a population density of 28 persons/km². The Lao ethnic group are the majority at 65.08% of the population followed by the Hmong at 18.03% and the Khmu at 16.64%.

111. Vang Vieng District's economic growth has continued with district income totaling 1,077.7 billion Kips (US\$134.7 million) in 2015-16 equivalent to a GDP per capita of 18.7 million Kips (US\$2,337.50), with 287.8 billion Kips from agriculture and forestry, 235.1 billion Kips from industry and handicrafts and 554.8 billion Kips from the service sector.

112.

Table 9 shows the projected population of Vang Vieng Districts from 2018 to 2040. It shows that the central Vang Vieng, where most of the tourists go, account only for 12% of the total population of the Vang Vieng districts.

Table 9: Projected Population of Vang Vieng Districts

Year	2018	2020	2025	2030	2035	2040
Rest of Vang Vieng	60841	63329	70002	77378	85531	94543
Central Vang Vieng	8963	9330	10313	11400	12601	13929
Vang Vieng	69804	72658	80314	88777	98132	108473

From PMCES, 2020

V. PUBLIC CONSULTATION

113. Stakeholder consultations were repeated for the DED of the subproject in line with the requirements of meaningful consultation as stipulated by the SPS (2009). The consultation strategy embodied the principles of transparency, participation, and inclusiveness to ensure that affected and marginalized groups such as women, and the poor, were given equal opportunities to participate in the design of the project. The stakeholder consultations on environment issues Vang Vieng took place in October 2018 and were conducted via the following two avenues of inquiry and data collection:

1. As part of the household and village leader interviews conducted by the social development team with provincial agencies and other stakeholders conducted by social development team; and
2. Separate interviews of provincial and national environmental management agencies conducted by the international environmental specialist.

A. Identification of Stakeholders

67. Stakeholders were identified and engaged with a participatory manner. Stakeholder communication to date has focused on institutional stakeholders, affected communities, and persons directly affected by proposed subproject interventions. Project stakeholders include:

- Institutional stakeholders including the (i) project implementing units (PIU) (ii) provincial and national agencies, and town business leaders;
- Communities living along the subproject areas who will benefit or be adversely affected, and who have an interest in the identification and implementation of measures to avoid or minimize negative impacts; and
- Vulnerable and/or marginalized groups who have an interest in the identification and implementation of measures that support and promote their involvement and participation in the project.

B. Discussion Guide

114. Five general open-ended questions (Table 10) guided stakeholder discussions.

Table 10: Guiding Questions and Information Requests for Stakeholder Consultations

<ol style="list-style-type: none">1. What will be the benefits of the improved solid waste management? Please list benefits of project.2. Do you have any environmental concerns with the subproject? Please list environmental concerns about subproject.3. Do you any have environmental concerns with the construction activities of the subproject? Please list environmental concerns of construction phase activities.4. Do you have environmental concerns about the completed operation phase of the completed subproject? Please list environmental concerns about the operation of completed subproject.5. Do you think the subproject design or operation should be changed to prevent negative environmental, or community impacts? Please list changes to subproject that you think will prevent or reduce negative environmental, or community impacts?

115. To help guide the discussions on environmental issues and concerns of subprojects a list of environmental components (Table 11) was introduced to the stakeholders ahead of the question and answer period.

Table 11: Environmental components used to guide stakeholder discussions.

<ul style="list-style-type: none"> • drinking water quality and availability • surface water quality and quantity • groundwater quality and quantity • air quality • climate • land and soil quality • trees, other vegetation, • terrestrial resources e.g., forests, 	<ul style="list-style-type: none"> • terrestrial and aquatic animals, e.g., fish, birds, small mammals • ecological protected areas (e.g., national parks, wildlife sanctuaries), • land and coastal zone uses (e.g., agriculture, fisheries, forestry, navigation, aquaculture, commercial, other), • public safety • public movement and access • physical cultural values (e.g., pagodas, cemeteries, monuments)
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

C. Summary of Public Consultation

116. A summary of the key concerns and issues that were identified during the stakeholder consultations for the improvements to solid waste management in Vang Vieng are summarized in Table 12. The list of meeting participants are reproduced in Appendix B.

117. The stakeholder consultations showed overall positive support for the project. The follow-up stakeholder consultations that may be required during detailed design phase will begin with a review of the issues and mitigations initially identified by the stakeholders.

Table 12: Summary of key views of stakeholders of Vang Vieng subproject

	Issues /concerns	Project response/action
Benefits of subprojects identified	<ul style="list-style-type: none"> - Reduction the odor, pollution and insects in the village and school. - Better for villager’s health nearby the landfill area. - Landfill site improvement will make the town cleaner - Improved waste management and collection service - Solving the problem of illegal waste dumping. 	
	Issues /concerns	Project response/action
Pre-construction project design & impact assessment	<ul style="list-style-type: none"> - Proper detail design needed which incorporates lessons learned from other similar projects - Location selection must be finalized. - Easy detours around construction sites on access road must be put in place to maintain normal vehicle flow. - The finalized DED should be reviewed and agreed among local authorities and project design team before more on to the construction phase. 	<ul style="list-style-type: none"> - The draft final DED is based on international and national experience with the design and future management of SLFs. The current absence of a SLF in Lao PDR has been considered in the DED. - The location of the SLF including access road is same as existing dumpsite and access road. Design of locations of waste collection will be improved and expanded in and outside Vang Vieng. - Detours around construction points along access road to SLF are included in DED. Permanent truck passing points will be installed along finished access road. - The draft final DED will be sent to IA (DPWT, DICT) and UDAA and DONRE for detailed review for ultimate agreement on the DED amongst all national and local concerned parties. - The DED of scope of improved solid waste management (SLF and waste collection system) will be well understood by local authorities before construction initiated.
Construction phase	<ul style="list-style-type: none"> - The proper detail designs must be implemented - Proper documentation and agreement with local authorities must be in place before construction - Open and fair procurement of new contractor(s) is needed ahead of and during construction 	<ul style="list-style-type: none"> - The detailed design of upgraded managed landfill has followed international standards (e.g., IFC/EHS) for landfills which includes SLF components, equipment, and training of UDAA staff for operation of completed SLF. - Contractor procurement will follow ADB standard procedures for international procurement of contractors. - The local DPWT, UDAA, and DONRE authorities will be directly involved with finalizing detailed designs which will specify agreements

	Issues /concerns	Project response/action
	<ul style="list-style-type: none"> - Well planned construction materials transportation logistics and scheduling must be implemented during construction - Potential risk of blocking natural drainage during construction water course during construction - Public safety during construction phase is a concern. - Proper technical supervision of workers and construction implementation 	<p>amongst the parties for construction implementation including scheduling and responsibilities .</p> <ul style="list-style-type: none"> - The DED and the EMD of the subproject specifies required measures during construction and operation phase to protect surface waters and prevent drainage problem/flooding, and ensuring public and worker safety - As per ADB requirements, an international engineering firm will supervise the construction and handover of the completed solid waste management system to the district environmental authorities and UDAA of Vang Vieng
Operation phase	<ul style="list-style-type: none"> - Insect and odour prevention - Creation of environmental friendly landfill is very important. - Priority the local worker to join the landfill management programs. - Operation and maintenance plan - Equipment and vehicle for operation. 	<ul style="list-style-type: none"> - The design of an SLF including the Vang Vieng SLF prevents significant odour by regularly covering waste cells with soil. The components of Vang Vieng SLF (i.e., lined waste cells, MRF, leachate treatment system, septage treatment, and hazardous waste management) are designed to protect the air and water environments above ground and the soil and groundwater below ground. New waste compactor trucks will be closed, and new and expanded solid waste collection system will include closed waste bins at may new locations in Vang Vieng for waste disposal and pick-up. - Management of the SLF including MRF will use local workers, and will include a comprehensive O&M plan and budget for UDAA which will follow extensive training on SLF management. - The O&M plan and budget for SLF will include the maintenance of new trucks and equipment which will occur at the onsite SLF services and equipment maintenance building.

October 10-14, 2018 + August 21-22, 2019

VI. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATIONS

A. Subproject Benefits

118. The new SLF and upgraded waste collection for Vang Vieng will greatly improve solid waste management in Vang Vieng and nearby villages. It will assist the district authorities implement the sub-decree on Solid Waste Management (April 1999). The new compactor garbage trucks, vacuum trucks, MRF, and landfill gas (LFG) flaring technology at the new SLF will improve sanitation and reduce greenhouse gas.

119. The current collection system is inadequate for the increasing amount of solid waste that is being produced in the town and vicinity. Garbage piles along streets and in alleys are becoming a major issue for local residents and tourists. At the existing dumpsite the randomly dispersed piles of garbage are not sufficiently contained resulting in litter blown outside the dump boundary. The ad hoc waste recycling by waste pickers is not efficient resulting in pickers not realizing the full potential income from recycled materials that would become more attractive to buyers if sufficient amounts of different and less contaminated materials were stockpiled.

120. The MRF will improve the safety and efficiency of solid waste recycling only if an appropriate segregated collection of waste is implemented and maintained. The new septage treatment facility at SLF and greater number of vacuum trucks will allow much more septic tank sludge from Vang Vieng to be managed and treated safely, and hazardous waste at the SLF will be isolated and managed safely. The improvements and expansion of waste collection will greatly increase the living and aesthetic environment of Vang Vieng. Overall, the subproject will benefit about approximately 60,000 residents and 300 businesses directly and indirectly.

B. Subproject Impacts and Mitigation

121. The assessment of potential impacts of the detailed design (DED) of improved solid waste management in Vang Vieng is structured by the three main phases of implementation defined by *Pre-construction Phase*, *Construction Phase*, and *Operation Phase*.

1. Pre-construction phase

122. The potential social impacts of the DED were reviewed. The second series of public consultations carried out September 2019 – January 2020 confirmed that compensation will be required for waste pickers because of the loss of income. The separate environmental management plan (EMP) for improvements to solid waste management has been updated to meet the DED accordingly.

2. Construction Phase

123. The impacts of the construction phase of the improvements to solid waste management in Vang Vieng are restricted to the short-term disturbances created by the civil works activities (e.g., excavation, grading, drilling, building erection, material transport and truck traffic) that will be conducted to upgrade the 0.8km access road and for the construction of the different components of the SLF. The potential short-term environmental impacts will consist of dust, noise, contamination of soil and the adjacent seasonal stream from heavy equipment maintenance and erosion, solid and liquid construction waste, increased risk of traffic and risk of traffic accidents, reduced local access to the area, increased risk of public and worker injury, and periodic local drainage and flooding events. Other potential impacts of construction phase are possible disruption of waste picking and recycling, contamination of groundwater from the excavations of waste cells, and depending on size of outside worker

population, potential social problems with local community. No external borrow pits will be required during construction because all required soil will be obtained on site of SLF.

a. Mitigation measures

124. Measures to mitigate and manage potential construction impacts identified above are summarized below. The regulations on construction in Lao PDR are not well developed. The construction guidelines developed by the MOF¹⁹, and when necessary appropriate regulations or guidelines of the IFC/World Bank Environment, Health, and Safety Guidelines (2007) should be followed. Specifically the EHS guidelines for Construction and Decommissioning, Toll Roads, and Waste Management Facilities

125. The mitigation measures provided below will be articulated in the separate environmental management plan (EMP) for the improvements to solid waste management in Vang Vieng. The EMP will be appended to the construction package tender documents for the contractor(s) to prepare their site-specific construction EMPs (CEMPs) which will be submitted to the project management and civil engineering support consultant (PMCES) and the PIU in Vang Vieng for review and approval prior to construction. Monitoring will be carried out by the PMSC during the construction period.

126. **Air pollution control.** Contractors shall include all necessary measures to prevent or minimize air pollution and dust development by implementing the following air quality control measures. These mitigation measures are applicable to all construction activities of the SLF, and SLF access road and are also described in the World Bank Group's EHS guidelines.

- (i) Assign daily haulage schedules along NR 13 and up to SLF access road to avoid high local traffic times (e.g., early morning late day).
- (ii) Spray wetting agents such as water or calcium chloride (CaCl₂) regularly on access road and approach sections of NR 13, and inside SLF site roads when needed to suppress dust. A water truck should be on site every day for this purpose;
- (iii) Cover material aggregate stockpiles with dust shrouds or tarpaulins.
- (iv) Minimize the storage time of construction and excavation wastes on site by regularly removing them off site weekly.
- (v) Site concrete batching stations at least 300 m downwind of the any village.
- (vi) Install wheel washing equipment or conduct wheel washing manually at the exit of the SLF and access road to prevent trucks from carrying mud or dusty substance on to NR 13s.
- (vii) Keep construction vehicles and machinery in good working order, institute monthly service schedules, and turn off engines when not in use.
- (viii) Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered completely with a tarpaulin.
- (ix) In periods of high wind, dust-generating operations shall not occur within 200 m of the local residential areas. Special precautions need to be applied in the vicinity of sensitive receptors such as schools, kindergartens and hospitals.
- (x) Unauthorized burning of construction and demolition waste material and refuse should be prohibited.

127. **Construction noise.** Contractors will be required to implement the following mitigation measures for construction activities to meet Lao PDR and IFC/WHO recommended environmental noise standards and to protect local villages. Some measures are generic and

¹⁹ (MOF, 2009) School Construction Guidelines

are applicable to all construction sites and activities. They represent good practice and are effective measures and are in line with IFC's EHS guidelines as above.

- (i) During daytime construction, the contractor will ensure that: (1) noise levels from equipment and machinery conform to the IFC EHS noise standards, and properly maintain machinery to minimize noise; (2) equipment with high noise and high vibration are not used near village or township areas and only low noise machinery or the equipment with sound insulation is employed; (3) sites for concrete-mixing plants and similar activities will be located at least 300 m away from the nearest house and school; and (4) temporary noise barriers such as high sheet metal fences will be installed around the equipment to shield local villages.
- (ii) No construction activities are allowed between the 20:00 and 06:00.
- (iii) Regularly monitor noise levels with a meter at construction site boundaries. If noise standards are exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation.
- (iv) Provide the construction workers with suitable hearing protection (ear muffs) according to the worker health and safety requirements of Lao PDR.
- (v) Control the speed of bulldozer, excavator, crusher and other transport vehicles travelling on site, adopt noise reduction measures on equipment, step up equipment repair and maintenance to keep them in good working condition.
- (vi) Limit the speed of vehicles travelling on site (less than 8 km/h), forbid the use of horns unless absolutely necessary, minimize the use of whistles.
- (vii) Maintain continual communication with the villages and communities near the construction sites, and avoid noisy construction activities during school examination periods.

128. **Pollution of seasonal stream.** The contractors will implement the following measures to prevent pollution of the seasonal stream to the northeast of the SLF boundary.

- (i) Portable toilets that are provided on the SLF site for construction workers will be placed away and downslope from the stream, ideally on opposite side of SLF site.
- (ii) Construction machinery and equipment at the SLF site will be repaired and washed away minimum 50m from the stream.
- (iii) Material stockpiles will be covered to prevent wind and or runoff erosion to the stream.
- (iv) Dedicated fuel storage areas must be established on concrete pads at least 300m away and downslope from the stream. Contractors should be required to have an emergency plan to handle fuel and oil spillage.
- (v) Earthen berms should be constructed between the stream and all construction during all earthworks activities to prevent soil erosion and sedimentation of stream.

129. **Earthworks & soil erosion mitigation.** The contractors will implement the following measures related to earthwork management. Note that no external borrow pits will be required.

- (i) Construct intercepting ditches and drains to prevent runoff entering construction sites, and diverting runoff from site to existing drainage.
- (ii) Construct temporary internal sedimentation ponds in SLF site to contain soil loss and runoff from the earthworks activities.
- (iii) Limit construction and material handling during rainfall and wind events.
- (iv) Stabilize all cut slopes mined for fill on south side of SLF and other erosion-prone working areas.
- (v) Aggregate stockpiles on SLF property and along 0.8km access road shall be short-term, placed in sheltered and guarded areas near the actual construction

- sites, covered with tarpaulins, and sprayed with water during dry and windy weather conditions.
- (vi) Immediately restore, level and plant landscape on temporary occupied land upon completion of construction works.

130. **Ecological impacts.** The contractors will implement the following measures to prevent ecological impact during construction:

- (i) Preserve existing vegetation where no construction activity is planned.
- (ii) Protect existing trees, scrub vegetation/bushes, and grasses during construction; where a tree, however small, has to be removed or an area of grassland disturbed, replant trees and re-vegetate the area after construction.
- (iii) Remove trees or shrubs only as the last resort if they impinge directly on the permanent works or necessary temporary works.
- (iv) Prior to commencement of construction, tag and conspicuously mark all the trees to be preserved to prevent damage to these trees by construction workers.
- (v) Construction workers are prohibited from capturing any wildlife in the project areas.
- (vi) Re-vegetate cut slopes of south side of SLF with native shrubs, grass species, and scrub trees to prevent erosion, and trees along access road alignment.

131. **Occupational health and safety.** The construction industry is considered hazardous due to the many potentially hazardous operations that are conducted. The contractor will implement adequate precautions to protect the health and safety of construction workers, and the public along NR 13, the access road. and in nearby villages. Contractors will manage occupational health and safety risks by applying the following measures:

- (i) To prevent or minimize injury of construction workers and the public, directives of the Lao PDR National Occupational Safety & Health (OSH) Programme (2010) that the Ministry of Labour and Social Welfare (MLSW) established with the OSH model program developed by the International Labour Organization (ILO). The IFC/World Bank Environment, Health, and Safety Guidelines (2007) for Construction and Decommissioning, Toll Roads, and Waste Management Facilities that govern the safe and orderly operation of civil works should be added as supplementary guidance if needed.
- (ii) COVID-19: To protect the health and safety of workers as well as communities, a project-level COVID-19 risk assessment should be carried out. All contractors should be requested to update or prepare respective health and safety (H&S) plans, addressing COVID-19 health risks. These H&S plans should be aligned with any government regulations and guidelines on COVID-19 prevention and control.
- (iii) Additional care following pre-construction UXO clearing must be taken to ensure that sites for all earthworks (e.g., excavations, trenches) that are suspected to have unexploded ordnance (UXO) are surveyed again by the military prior to construction. If such ordnance is detected clearing work will need to be decommissioned prior to undertaking civil works.
- (iv) Construction site sanitation: (1) Contractor shall provide adequate and functional systems for sanitary conditions, toilet facilities, waste management, and worker living and cooking facilities on or near SLF property. Disinfection of toilets and refuse piles and timely remove solid waste must occur; (2) Extermination of rodents on SLF at worker camp must occur at least every 3 months, and extermination of mosquitoes and flies when they become a problem; (3) Provide public toilets in accordance with the requirements of labor management and sanitation departments in the living areas on construction site, and appoint designated staff responsible for cleaning and disinfection; (4) Work camp wastewater shall be discharged into a septic tank which is emptied regularly as needed.

- (v) Occupational safety: (1) Provide safety hats and safety shoes to all construction workers; (2) Provide safety goggles to workers doing concrete paving of access road; (3) Provide ear plugs to workers operating or working near noisy equipment. The OHS directives of the IFC EHS guidelines for Construction and Decommissioning, Toll Roads, and Waste Management Facilities should be applied to supplement existing Lao national OHS
- (vi) Food safety: Inspect and supervise food hygiene in canteen on site regularly. Canteen workers must have valid health permits.
- (vii) Disease prevention, health services: (1) All contracted workers for SLF and access roads upgrades shall undergo a medical examination which should form the basis of any obligatory health/accident insurance and welfare provisions that may be included in worker contracts. The contractors shall maintain records of health and welfare conditions for each person contractually engaged; (2) Establish health clinic at location where workers are concentrated, which should be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents; (3) Specify the person(s) responsible for health and disease prevention, and for creating awareness and understanding of worker population.
- (viii) Social conflict prevention: No major social risks and/or vulnerabilities are anticipated as a result of the project. As much as possible, the project construction workers will be engaged locally. Contractors be required prioritize: (1) employ local people for construction; (2) ensure equal opportunities for women and men, (3) pay equal wages for work of equal value, and to pay women's wages directly to them; and (4) not employ child or forced labor.
- (ix) Include fire prevention and control measures such as provision of fire fighting equipment and ensuring adequate water supply particularly in case of spontaneous combustion at existing waste dump during waste transfer.

132. **Community health and safety.** The contractors will implement the following measures:

- (i) Temporary traffic management: A traffic control and operation plan for NR 13 and the SLF access road will be prepared together with the local Vang Vieng traffic police prior to initiation of construction. The plan shall include provisions for diverting or scheduling construction traffic to avoid peak traffic hours, regulating traffic at road intersection of NR 13 and SLF access road with an emphasis on ensuring public safety through clear signs, and controls.
- (ii) Information disclosure: Residents of Ban Phongvieng village that is 1km away, and residents and businesses of Vang Vieng will be informed in advance through media of the construction activities, given the dates and duration of expected traffic disruption.
- (iii) SLF construction site and access road: Clearly marked signs will be placed on NR 13 at intersection with SLF access road warning people of potential dangers such as moving vehicles, hazardous materials, excavations etc. and raising awareness on safety issues. Heavy machinery will not be used after day light on access road and all such equipment will be returned to its overnight storage area/position before night. Entire SLF boundary will be made secure, discouraging access by members of the public through appropriate fencing. Open excavations along access road should be fenced, and trenches covered where local public walk or vehicles must cross.
- (iv) Developing a 'living fence' to suppress and reduces odour from the landfill towards Ban Phongvieng, planting a dense line of trees with sufficient canopy. The village is located 1 km away.

137. **Climate change mitigation**

As the gas production does not warrant a direct source of electricity generation, in order to avoid uncontrolled release to the atmosphere, the gas should be flared off. Flares are useful to help control excess gas extraction spikes, and in order to mitigate the emission of methane and hydrocarbons, a simple open flare system should be installed. Landfill gas flaring will help to safely dispose of the flammable constituents of excess gas particularly methane, and to control odour nuisance, health risks and adverse environmental impacts reducing the GHG emission.

138. **Other environmental protection and improvement technologies**

The Vang Vieng SLF will provide a leachate treatment system to contain and detoxify the leachate seep from the engineered waste cells. The waste cells will be lined with synthetic HDPE material to prevent any possible contamination of groundwater. A septage treatment facility will also be installed at SLF to treat household and business septic tank sludge which to date has been mostly dumped along roadside ditches. The SLF will also be able to receive and isolate hazardous waste. A modern materials recovery facility (MRF) will be constructed at the SLF to improve the safety and quality of solid waste recycling activities.

3. Operation Phase

139. The potential impacts of the operation of the completed SLF will arise from: (i) increased vehicle traffic along the upgraded access road, (ii) potential groundwater pollution from waste cells or leachate treatment system; and (iii) worker injury from operation of new trucks and equipment at the SLF. Solid waste and domestic wastewater from the MRF and worker offices could become a problem if required operations and maintenance (O&M) budgeting is not provided to maintain the septic tank systems of the facilities.

140. The increased vehicle traffic along upgraded access road and NR 13 will increase risk of vehicle accidents and potentially increase noise and dust. Sufficient clear signage must be installed at intersection of access road and NR 13 that warn motorists that trucks turn in/out of landfill access road. While reduced from the present dumpsite, odour from the operation of the new SLF will be emitted which may affect the nearest village.

141. Posted speed limits along the upgraded access road to the SLF must be enforced to prevent accidents. Sufficient annual O&M budget should be provided to maintain all compactor and vacuum trucks and all other gas powered vehicles and equipment in good working order to reduce air pollution and occupational hazards. Wetting agents (such as water and calcium chloride) should be periodically applied to the access road and landfill areas to control dust and wind-blown debris.

142.. The above mitigations should support the comprehensive IFC EHS guidelines (2007) for Waste Management Facilities, and Toll Roads. The guidelines address the full cycle of solid waste management starting with waste prevention & minimization, collection & transport, recycling and reuse, treatment, storage and disposal, and monitoring. The EMP will further elaborate the requirements of the IFC guidelines.

143.. Groundwater quality at boreholes at BH4, and BH2 at the SLF (Figure 3) should be monitored regularly to ensure local groundwater is not contaminated by the waste cells, or leachate treatment system, septage treatment cell or hazardous waste cell. The MRF and working conditions of any waste pickers at the landfill site needs to be reviewed regularly to ensure that the original equipment, and the working conditions of the pickers are safe. Methane production at the LFG collection system on the closed capped existing waste cell should be monitored to determine LFG production, and to ensure the LFG capture system is working properly.

C. Induced and Cumulative Impacts

144. There are no anticipated induced or cumulative negative impacts of the operation of the new SLF and improved solid waste collection system in Vang Vieng.

D. Climate Change

145. The DED responded to the issues of climate change mitigation and resilience of the subproject that were identified in the separate Climate Vulnerability and Risk Assessment (CVRA) that was prepared for the FS of the subproject.

E. Comprehensive Corrective Environmental Action

146. The upgraded design and future operation of the new SLF along with improved solid waste collection (including septage and hazardous waste) for Vang Vieng and vicinity provides a corrective action that exceeds the requirements of the current national SWM directives listed below.

- 1) Decree No 520 / TCPC, (dated 23 Feb 2007), on Disposal Site Selection, Design, and Management, Articles 4-10; and
- 2) Draft Decree on SWM 2009 [not approved in 2018].

147. The components of the new SLF and improved solid waste collection in Vang Vieng provide significant improvements to environmental protection and quality of the affected environment that exceed requirements specified by Articles 4-10 of Decree 520 above which are detailed in Appendix C.

148. The above directives plus other site and waste type information, views of local community of existing dumpsite, and local groundwater and soil quality that is provided in Chapters II and IV of this updated IEE were specified in the ECA and ground water quality study that were identified in the original IEE of the FS design of the subproject. The DED of improvements to solid waste management in Vang Vieng, the soil and groundwater quality data, and this updated IEE represent the comprehensive corrective action of the subproject, and main result of the ECA.

VII. INFORMATION DISCLOSURE AND PUBLIC GRIEVANCE MECHANISM

149. As presented in Chapter V, the DED of the improvements to solid waste management in Vang Vieng was introduced to affected stakeholders during the second series of public consultations on the subproject. Similar to the first public consultations on the FS of the subproject, verbal and visual presentations of the improvements to solid waste management in Vang Vieng were provided to the same key stakeholders ahead of the facilitated consultation discussions.

150. The formal disclosure of information of the subproject in the Lao language to affected persons and stakeholders that occurred for the FS and now the DED of the subproject confirms the intention of continued information disclosure and stakeholder involvement as the project is implemented. As part of the project's stakeholder communication strategy, regular information exchange with stakeholders is required throughout construction and operation phase of the subproject.

151. The updated IEE provided here and the separate EMP will be easily available to stakeholders in written form and translated into Lao language when updated. The updated IEE will be available on provincial DICT web sites, DICT offices, and at UDAA offices. Similarly, all project reporting with specific reference to stakeholder consultation minutes,

environmental monitoring, and reports on EMP implementation released by the EA/PIU should be available at the same offices and web sites. The updated IEE and EMP will also be available on the ADB web site. At the start of construction of the subproject the public consultation and information disclosure process will continue. After implementation of the Vang Vieng subproject begins, all environmental and EMP reporting submitted by the EA/PIU will also be available on the ADB web site.

152. The well-defined grievance redress and resolution mechanism will be implemented to address any affected stakeholder's grievances and complaints regarding environment or social issues in a timely and satisfactory manner. All stakeholders will be made fully aware of their rights, and the detailed procedures for filing grievances and an appeal process will be published through an effective public information campaign. The grievance redress mechanism and appeal procedures will also be explained in a project information booklet (PIB) that will be distributed to all stakeholders.

153. Stakeholders or persons affected by the subproject are entitled to lodge complaints regarding any environmental or social issue. Stakeholder complaints can be made verbally or in written form.

154. A Grievance Committee will be organized in Vang Vieng, and the nearby villages of Ban Phongvieng and Ban Khuanmark to the SLF and in Vang Vieng town comprising local leaders designated for such tasks. The designated officials shall exercise all efforts to settle affected stakeholder issues at the village level through appropriate community consultation. All meetings shall be recorded by the grievance committee and copies shall be provided to affected stakeholders. A copy of the minutes of meetings and actions undertaken shall be provided to the DICT, PIU, DONRE, and ADB upon request.

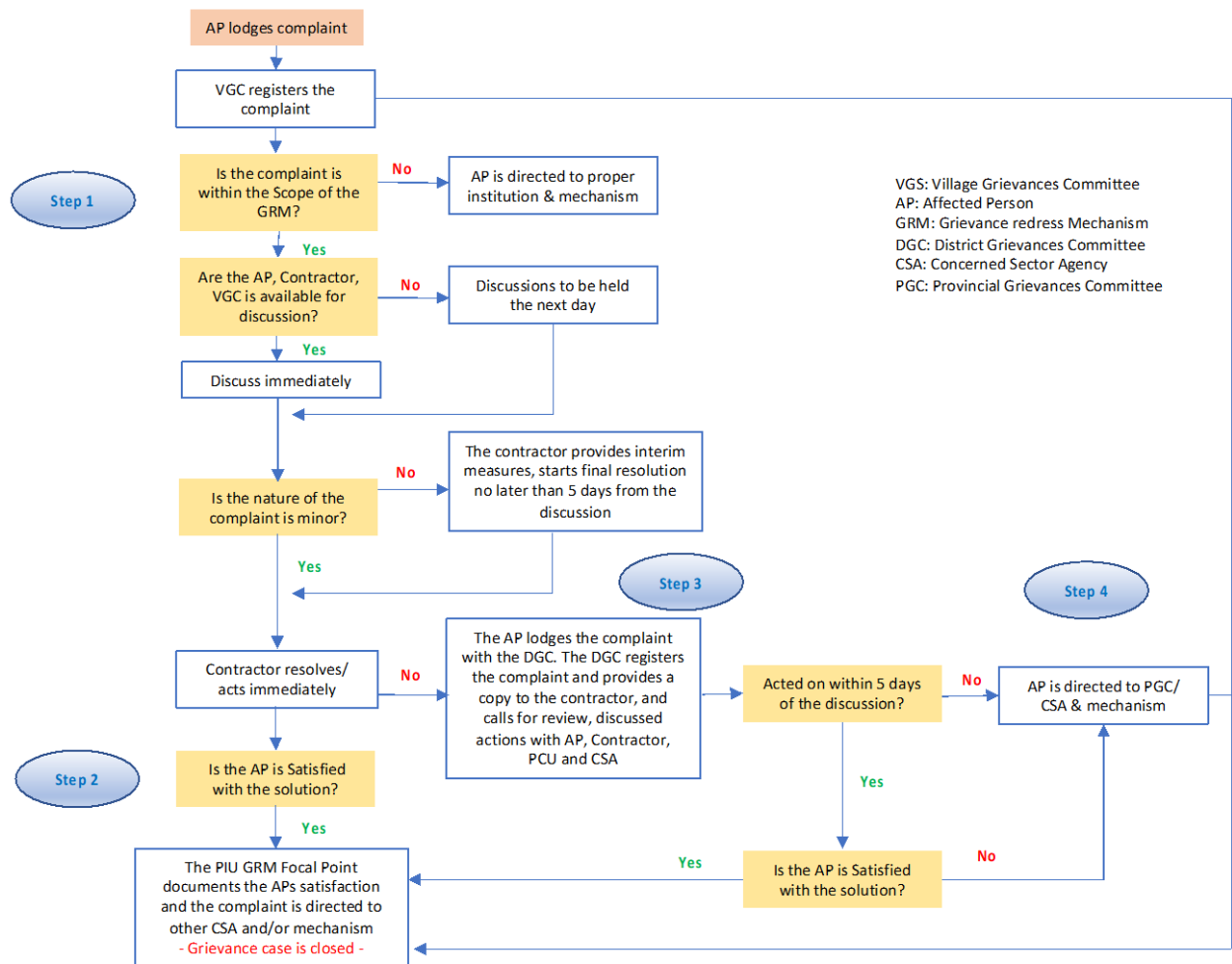
155. The procedures for grievance redress are set out below. The procedure described below applies to both social and environmental issues and is consistent with the legal process for resolution of disputes in Lao PDR, and exemplifies the desired collaboration among the different levels of government as recently described by Decision 7536/MONRE (2012). The PMU will have overall responsibility of ensuring the GRM is active and successful at the subproject level. Individual affected persons will be able to enter the GRM at a construction site by simply using the telephone hotline that is clearly posted at each construction site. Conversely, an affected person can contact the PMU directly at the PMU office, or annexes established at the subproject areas. The EA with assistance from the PMU is responsible to ensure that the government grievance system is successfully applied, and if needed, modified to integrate with the context of the individual subprojects.

- i) Stage 1: Complaints from affected stakeholders for the first time shall be lodged verbally or in written form with the village head or commune leader. The complaints shall be discussed with the affected stakeholder and the designated Head of Grievance Committee or members of the committee. It will be the responsibility of the Head of Grievance Committee to resolve the issue within 15 days from the date the complaint is received. All meetings shall be recorded and copies of the minutes of meetings will be provided to APs.
- ii) Stage 2: If no understanding or amicable solution can be reached or if no response is received from the grievance committee within 15 days from filing the complaint, the affected stakeholder can elevate the case to the District Grievance Committee. The District Grievance Committee is expected to respond within 15 days upon receiving the affected stakeholder's appeal.
- iii) Stage 3: If the affected stakeholder is not satisfied with the decision of the District Office, or in the absence of any response, the APs can appeal to the Provincial

Grievance Committee (PGC). The PGC will review and issue a decision on the appeal within 30 days from the day the complaint is received.

- iv) Stage 4: If the affected stakeholder is still not satisfied with the decision of the PGC or in the absence of any response within the stipulated time, the affected stakeholder's, as a last resort may submit his/her case to the provincial court. The court will address the appeal by written decision and submit copies to the respective entities which include the DICT, DONRE, DGC/PGC and the affected stakeholder. If, however, the affected stakeholder is still not satisfied the court's decision, the case may be elevated to the provincial court. If, however, the decision of the provincial court is still unsatisfactory to the affected stakeholder, the affected stakeholder may bring the complaints to the Higher Court.

Figure 15: Grievance Redress Mechanism Process



156. The PMU with support from the PSC will be responsible for checking the procedures and resolutions of grievances and complaints. The PMU must have expertise and experience in social and environmental issues associated with infrastructure developments. The PMU may recommend further measures to be taken to redress unresolved grievances. The Project Management & Civil Engineering Support Consultant (PMCES) will provide the necessary training to improve grievance procedures and strategy for the grievance committee members when required.

157. The executing agency (Ministry of Information, Culture and Tourism (MICT)) will shoulder all administrative and legal fees that will be incurred in the resolution of grievances and complaints if the affected stakeholder wins the case. Other costs incurred by legitimate complaints will also be refunded by the project if the affected stakeholder wins their case.

158. In cases where affected stakeholder do not have the writing skills or are unable to express their grievances verbally, the affected stakeholder can seek assistance from civil society organizations, DONRE staff, or other family members, village heads or community chiefs to have their grievances recorded in writing, and to have access any environmental or social surveys or valuation of assets, to ensure that where disputes do occur, all the details have been recorded accurately enabling all parties to be treated fairly. Throughout the grievance redress process, the responsible committee will ensure that the concerned affected stakeholder is provided with copies of complaints and decisions or resolutions reached.

159. If efforts to resolve disputes using the grievance procedures remain unresolved or unsatisfactory, affected stakeholder has the right to directly discuss their concerns or problems with the ADB Southeast Asia Department through the ADB Lao PDR Resident Mission (LRM). If APs are still not satisfied with the responses of LRM, they can directly contact the ADB Office of the Special Project Facilitator (OSPF).

APPENDIX A: RESULTS OF IBAT ANALYSES OF SUBPROJECT AREA



Proximity report generated by the Integrated Biodiversity Assessment Tool

Site name	Vang Vieng
Latitude/Longitude	18° 55' 50" North, 102° 26' 37" East
Date generated	1st December 2017
Generated by	Asiandb
Company	ADB

Protected Areas and Key Biodiversity Areas

The following sites are found within the selected buffer distances:

Features within 2 km

There are no features within 2 km.

Features within 10 km

There are no features within 10 km.

Features within 20 km

There are no features within 20 km.



Proximity report generated by the Integrated Biodiversity Assessment Tool

Site name	Vang Vieng Dumpsite
Latitude/Longitude	18° 52' 6" North, 102° 30' 14" East
Date generated	1st December 2017
Generated by	Asiandb
Company	ADB

Protected Areas and Key Biodiversity Areas

The following sites are found within the selected buffer distances:

Features within 2 km

There are no features within 2 km.

Features within 10 km

There are no features within 10 km.

Features within 20 km

There are no features within 20 km.

Handwritten signature or initials in the top right corner.

ບັນຊີລາຍຊື່ຜູ້ເຂົ້າຮ່ວມ ປະຊາບັນດາພະນັກງານ ທີ່ເປັນສະມາຊິກຂອງ ວິໄນ ລາວ ທີ່ມີສະໜັບສະໜູນ ການເປັນສະມາຊິກຂອງ ວິໄນ ລາວ ທີ່ມີສະໜັບສະໜູນ
 ທີ່... ວິໄນ ລາວ ທີ່ມີສະໜັບສະໜູນ ຕັ້ງວັນທີ... 12/11/2018. ວັງວັງ, ວິໄນ ລາວ

ລ/ດ	ຊື່ ແລະ ນາມສະກຸນ	ຕຳແໜ່ງ	ມາຈາກພາກສ່ວນ	ໂທລະສັບ	ລາຍເຊັນ
1	ທ. ວິໄນ ລາວ	ນາຍົກ	ວິໄນ ລາວ	0905918149	[Signature]
2	ທ. ວິໄນ ລາວ	ນາຍົກ	ວິໄນ ລາວ	53079444	[Signature]
3	ທ. ວິໄນ ລາວ	ນາຍົກ	ວິໄນ ລາວ	55605119	[Signature]
4	ທ. ວິໄນ ລາວ	ນາຍົກ	ວິໄນ ລາວ	55723106	[Signature]
5	ທ. ວິໄນ ລາວ	ນາຍົກ	ວິໄນ ລາວ	51007797	[Signature]
6	ທ. ວິໄນ ລາວ	ນາຍົກ	ວິໄນ ລາວ	28184148	[Signature]
7	ທ. ວິໄນ ລາວ	ນາຍົກ	ວິໄນ ລາວ	58282562	[Signature]
8	ທ. ວິໄນ ລາວ	ນາຍົກ	ວິໄນ ລາວ	22022898	[Signature]
9	ທ. ວິໄນ ລາວ	ນາຍົກ	ວິໄນ ລາວ	55521852	[Signature]
10	Don Matisse consultant		PMG/ANB		[Signature]
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					

පාලන වාර්තාව

දි. 13/10/2015 අවසන් වර්ෂ

අ/අ	අයුතු ප්‍රවේශය	වර්ගය	ප්‍රවේශය	මුදල	වර්ගය
1	2.27.2015	විද්‍යා	විද්‍යා	5856270	කුඩා
2	2.27.2015			5856270	කුඩා
3	2.27.2015				කුඩා
4	2.27.2015			97026511	කුඩා
5	2.27.2015		විද්‍යා		
6	2.27.2015		වි		
7	2.27.2015		වි		
8	2.27.2015		වි		
9	2.27.2015		වි		
10	2.27.2015		වි		
11	2.27.2015		වි		
12	2.27.2015		වි		
13	2.27.2015		වි		
14	2.27.2015		වි		
15	2.27.2015		විද්‍යා		
16	2.27.2015		විද්‍යා		
17	2.27.2015		වි		
18	2.27.2015		වි		
19	2.27.2015		වි		
20	2.27.2015		වි		
21	2.27.2015		වි		
22	2.27.2015	විද්‍යා	විද්‍යා	56962883	කුඩා
23	2.27.2015	විද්‍යා	විද්‍යා		කුඩා
24	2.27.2015		වි		
25	2.27.2015		විද්‍යා		
26	2.27.2015		විද්‍යා		
27					
28	2.27.2015	විද්‍යා	විද්‍යා	9949998	කුඩා
29	2.27.2015	විද්‍යා	විද්‍යා	5555001	කුඩා
30	2.27.2015	විද්‍යා	විද්‍යා	20229000	කුඩා
31	2.27.2015	විද්‍යා	විද්‍යා	20229000	කුඩා
32	2.27.2015	විද්‍යා	විද්‍යා	9960000	කුඩා
33	2.27.2015	විද්‍යා	විද්‍යා	5579751	කුඩා
34	2.27.2015	විද්‍යා	වි	55102205	කුඩා
35	2.27.2015	විද්‍යා	විද්‍යා	4956014	කුඩා
36	2.27.2015	විද්‍යා	විද්‍යා	5811150	කුඩා
37	2.27.2015	විද්‍යා	විද්‍යා	91241240	කුඩා

මුළු වටිනාකම: 20229000

Appendix B.2

Participants at review mission public consultations – August 2019

Meeting at UDAA/PIU Vang Vieng – 21 August 2019:

No	Name of stakeholder	Organisation	Position
1	Mr. Sisomphou Phimmeuang	District of Public Work and Transport, DPWT	Head of DPWT
2	Mrs. Hatsadee Khounsy	Vang Vieng District UDAA	Vice President of UDAA
3	Mr. Phouthasone	UDAA	Technical Specialist
4	Mr. Bounheuang Phanthasith	PMCES	Environmental Specialist
5	Mrs. Charlotte Seidenberg	PMCES	Environmental Specialist
6	Mr. Khamtanh Bounmany	PMCES	Social Specialist

Consultation with Vang Vieng community Stakeholders – 21 August 2019:

No.	Name of stakeholder	Organisation	Position
1	Mr. Sisomphou Phimmeuang	Vangvieng District UDAA	Vice President of UDAA
2	Mr. Hatsadee Khounsy	District of the Public Work and Transport	Head of the DPWT
3	Mr. Phouthasone	UDAA	Technical
4	Mr. Bounheuang Phanthasith	PMCES	Environmental Specialist
5	Mrs. Charlotte Seidenberg	PMCES - Ramboll	Environmental Specialist
6	Mr. Khamtanh Bounmany	PMCES	Social Specialist
7	Mr. SomsayChanphilavong	Phonevieng Village	Head Village
8	Mr. Khanty	Khanmak Village	Deputy Village Head
9	Mr. Bountay Sipaseuth	DoNRE	Head of Group
10	Mrs. Pome Vongsapaseuth	Khanmak Village	Head of Village
11	Mrs. Khanthaly	Khanmak Village	Head of Women Union
12	Mr. Siphone Silamthavong	Phonevieng Village	Deputy Village Head
13	Mr. Phoukeo	Khanmak Village	Village member
14	Mrs Xay	Khanmak Village	Village member
15	Mrs. Phetsamone	Phonevieng Village	Deputy Head of Village Woman Union
16	Mrs. Phone Chanthavongsa	Phonevieng Village	Deputy Head of Village Woman Union
17	Mrs. Bounkong Xaysomphan	Phonevieng Village	Deputy Village Head

APPENDIX C: DECREE 520 (2007) ON SOLID WASTE MANAGEMENT IN LAO PDR

Key Articles of Agreement on the Ministerial Landfill Management, by Department of Public Work and Transportation, Ministry of Public Work and Transportation, February 2007.

Article 04: Landfill Identification

All established organization and authorities at the province, district and urban area should be installed the landfill. The adequate area of the landfill should be provided and sufficient to the waste volume.

Article 05: Environmental Impact Assessment

The planning of the landfill construction should be conformed with the local sanitation regulation, and to conduct the feasibility study and environment impact assessment which to compliance with the regulation of the Laos environmental impact assessment. The construction will be commenced after getting the environmental compliance certification.

Article 06: Condition on Selecting the Landfill Location

The selection of the landfill location should be conformed with the condition below:

1. To locate far from the city or urban area at least 7 Km of the flat area, or 5 Km at the steep location (in the special case should not less than 3 Km)
2. To locate far from the air-port about 3 Km
3. To locate far from the historical place or article subject not less than 1 Km
4. To local far from the community houses, river, stream, leak, irrigation channel, wetland, pond, reservoir and groundwater where it has been used and not less than 300 m.
5. Not to locate at the upstream river and wind direction (compare to the village or nearby community)
6. Not to locate at the flood area during the rainy season
7. Not to locate at the sensitive erosion area or the steep hill more than 30 % of surface

Article 07: Ground Water Protection

The soil quality of the landfill cell should have a good quality and not able to impermeable and lowest level of the waste pit should be higher than the groundwater level during the rainy season at least 2 m. In the special case, the lowest level of the waste pit is higher than the groundwater level less than 2 m which the technical design and construction need to be careful and followed all the standard mentioned in Article 10 of item 8 of this agreement strongly.

Article 08: Landfill Location Approval

1. The landfill location at the urban area should be official endorsed by the local authorities of the province and/or related capital authority, which there is the DPWT whom will study and propose under the agreement of the Health Department and Technology Sciences and environment Office.
2. The dumpsite location of the village level or community level which should be official endorsed by the related district authorities, the District PWT will study and propose under the agreement of the related sectors.

Article 10: Standard of Landfill Design with Sanitation Concern

The design of the landfill should conform with the below standards:

1. Waste pit have to have the adequate area for collecting the waste volume and could be operated more than 10 years.
2. The waste pit should be far from the conserved road at least 200 m, (in the special case should not less than 50m), should have the bank protection and planting the trees around the pit in order to prevent the wind and environmentally friendly.
3. To provide the adequate soil for waste cover through the end of operate durations (soil could be inside the landfill or from other borrow pit)
4. In case to have a stream, canal or dry season canal around the landfill area, the drainage line should be inverted off the landfill site or drainage to another place off the landfill.
5. To change the surface water level at the landfill in order to change the water way of the rain off the landfill and to prevent the flooding in the landfill

6. To have a proper drainage system and wastewater treatment pond in order to allow the rain water and wastewater from the waste pit to be treated by applying the biological science process before discharge to the natural canal or pond (this for the large landfill at the urban area or large town)
7. The waste pit area should be compacted and graded with the sufficient slope, which to allow the leachate flowable to the wastewater treatment plants.
8. In case, the groundwater locates at the lowest deep of the waste pit less than 2m, the waste pit surface should be the clay soil which could block the leak/permeable wastewater less than 30 cm or cover by other materials which it could prevent the leaking wastewater.
9. To provide the ventral gas system which caused by the spoil wastes in the pit, except if the engineer could finalize that is not high level of gas in the landfill which it will not cause further gas explode.
10. To provide the fence around the landfill and the close gate in order to prevent the outsiders and unknown transported truck and to prevent the cattle into the waste pit.
11. To provide the access road to the landfill and internal access road inside the landfill which it could be used in all season, and to ensure that truck could simple transport the wastes into the landfill.
12. To provide the office and facility structures including the toilet and other facilities to clean the landfill.
