

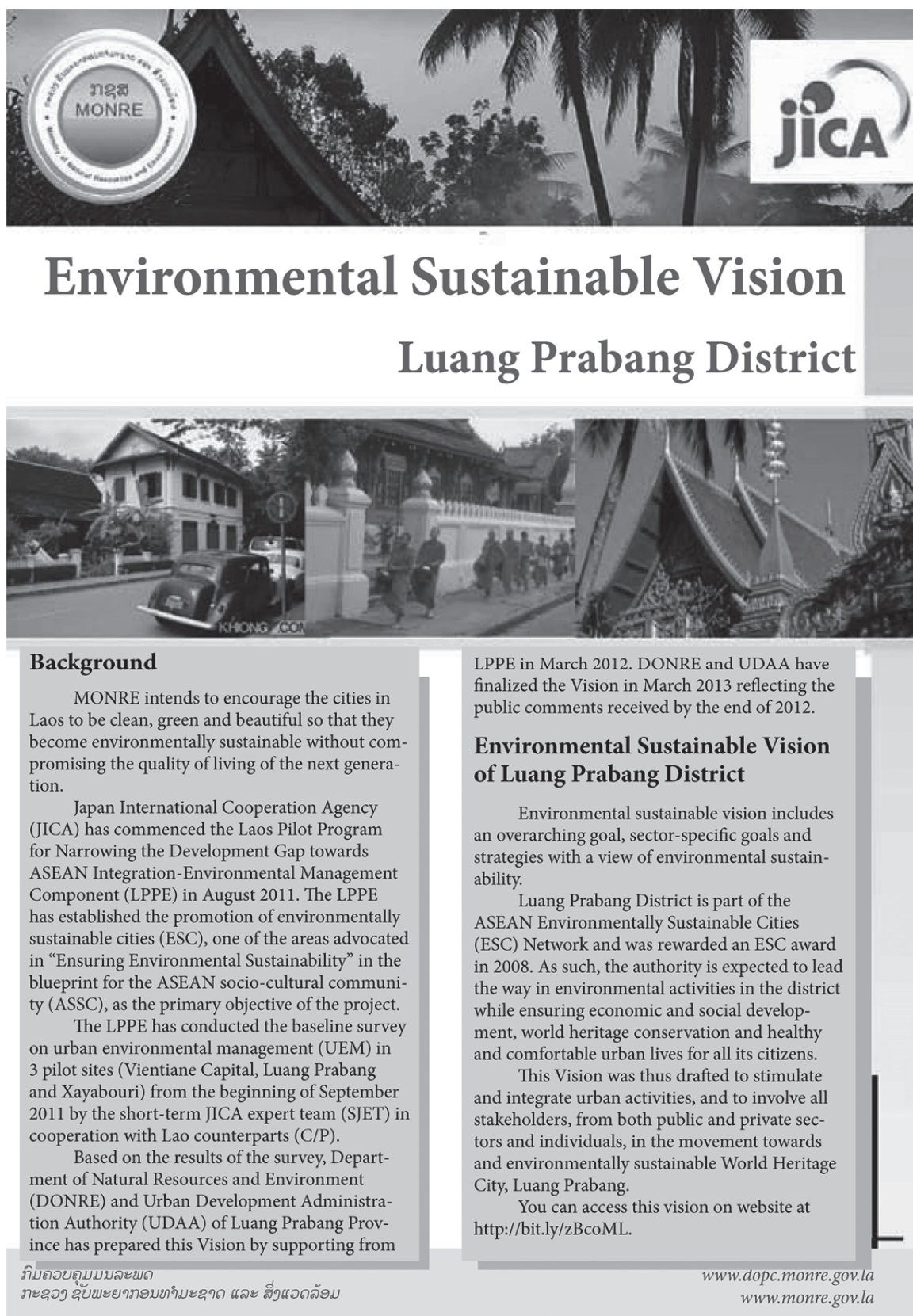
Supplement 2

(Appendices for Luang Prabang District)

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Appendix 1. ESC Vision

ESC Vision of LPB was printed in a 4-page brochure of A3 size shown as below.





Vision for an Environment

Construct Luang Prabang to be greener environment

Sub-sector	Goal 2020	Strategy	
SOCIO-ECONOMIC ENVIRONMENT	1. Land Use	<ul style="list-style-type: none"> ● Regulation of land-use is enforced according to urban development plan and illegal construction is controlled. 	<ul style="list-style-type: none"> → Authorization of land use plan. → Enforcement of land use regulation. → Control and revelation of illegal construction.
	2. Traffic and Road Condition	<ul style="list-style-type: none"> ● Road network in rural area is improved for people to access the main road in rainy season. 	<ul style="list-style-type: none"> → Survey of current road condition in rainy season by DPWT and UDAA. → Allocation of government budget
	3. Urban Environmental Management Policy Implementation	<ul style="list-style-type: none"> ● Effective and practical capacity development (capacity building) is conducted to promote urban environmental management by implementation of 5-year Environmental Management Action Plan 	<ul style="list-style-type: none"> → 5-year Environmental Management Action Plan is realized. → Capacity development is carried out continuously since it is prioritized in each environmental action plan of MONRE and DONRE of LPB.
	4. Poverty	<ul style="list-style-type: none"> ● Millennium Development Goal is achieved according to poverty eradication program. 	<ul style="list-style-type: none"> → Review of poverty eradication program. → The situation of poverty is studied in rural area of LPB District.
	5. Landscape	<ul style="list-style-type: none"> ● Current aesthetic urban landscape is conserved according to urban development plan. 	<ul style="list-style-type: none"> → Review of urban development plan from the viewpoint of landscape conservation.
	6. Gender	<ul style="list-style-type: none"> ● The quality of life of people is improved by eliminating gender unbalance in the various education levels especially to succeed the millennium development goal. 	<ul style="list-style-type: none"> → Awareness of gender unbalance in the various education level is enhanced through activities of Women's Union.
	7. Children's Right	<ul style="list-style-type: none"> ● The Socio-economic Development Plan of LPB District is realized and 98% of children can go to school. Moreover, 95% of children can continue to study from first grade to fifth grade. 	<ul style="list-style-type: none"> → Primary schools are constructed in some of the villages who have no school. → Allocation of government budget for school teachers.
	8. Cultural Heritage	<ul style="list-style-type: none"> ● MoICT instructs developers in cooperation with DPWT to protect cultural heritages against urban development. 	<ul style="list-style-type: none"> → National and provincial cultural heritages are designated as necessary.
	9. Health	<ul style="list-style-type: none"> ● Health care service can be accessed even in remote rural area in LPB District. 	<ul style="list-style-type: none"> → The situation of villagers who cannot access to primary health care is surveyed. → Medical kits are provided to the villagers who cannot go to health care center.
	10. Environmental Awareness	<ul style="list-style-type: none"> ● People follows rules and regulations to make the city clean and beautiful. 	<ul style="list-style-type: none"> → Rules and regulations are clearly explained to people. → Useful education tools are developed and utilized.
	11. Stormwater Management	<ul style="list-style-type: none"> ● Flood area is managed according to the urban development plan to reduce impact on environment. 	<ul style="list-style-type: none"> → Review of urban development plan from the viewpoint of flood control. → Flood management plan is formulated newly.
	12. Biodiversity	<ul style="list-style-type: none"> ● Natural environment abundant in biodiversity to be protected is conserved positively. 	<ul style="list-style-type: none"> → District Biodiversity Conservation Area in LPB District is monitored strictly to prevent illegal cutting. → Reforestation is promoted.

Environmentally Sustainable Luang Prabang District

... and ensure safe and prosperous living with the world heritage in the core.

Sub-sector	Goal 2020	Strategy	
NATURAL ENVIRONMENT	13. Forest Resources	<ul style="list-style-type: none"> ● Illegal felling is monitored and controlled regularly. ● Reforestation is conducted continuously. 	<ul style="list-style-type: none"> → Budget allocation and staff training are urgently implemented to monitor and control illegal cutting. → Reforestation is promoted.
	14. Urban Green Area	<ul style="list-style-type: none"> ● The green areas located in World Cultural Heritage Site are managed properly for citizens to enjoy them. 	<ul style="list-style-type: none"> → The area of public urban parks is extended so that citizens can enjoy accessible green.
	15. Nature Reserve	<ul style="list-style-type: none"> ● Conservation Forest is managed according to the fundamental rule. 	<ul style="list-style-type: none"> → The protected areas are strictly protected by management of relevant organization.
	16. Global Warming	<ul style="list-style-type: none"> ● Concrete action plan is prepared and implemented. 	<ul style="list-style-type: none"> → Concrete action plan is prepared and implemented.
SOCIO-LIVING ENVIRONMENT	17. Air Quality	<ul style="list-style-type: none"> ● Open burning on the agricultural land is reduced. 	<ul style="list-style-type: none"> → Open burning on agricultural land is controlled.
	18. Water Quality	<ul style="list-style-type: none"> ● The environmental functions of wetland in the urban area are preserved. 	<ul style="list-style-type: none"> → Wetland management is incorporated in the land use planning. → Regular monitoring system is established to analyze the status of water quality. → The capacity of the government staff in charge of water quality management is strengthened.
	19. Safe Drinking Water	<ul style="list-style-type: none"> ● The target concerned with water supply in the Socio-economic Development Plan is achieved and the rate of access safe drinking water approaches 95% in LPB District. 	<ul style="list-style-type: none"> → Water supply service area is expanded according to the Socio-economic Development Plan year by year. → DPWT and UDAA support the state company of water supply to make investments for business expansion.
	20. Sanitation	<ul style="list-style-type: none"> ● Latrines are introduced in the schools, for ethnic group communities and tourism places. ● Wastewater treatment is improved. 	<ul style="list-style-type: none"> → Survey of actual sanitary condition in rural area and in ethnic groups. → Improvement of wastewater treatment system
	21. Soil Contamination	<ul style="list-style-type: none"> ● The system of monitoring and controlling pesticide and chemical fertilizer according to the new regulation is strengthened and proper amount of them is utilized in agricultural land. 	<ul style="list-style-type: none"> → Personnel, equipment and budget are prepared to monitor and control pesticide and chemical fertilizer according to the new regulation. → Capacity development of staff → Procurement of equipment → Allocation of government budget.
	22. Solid Waste Management	<ul style="list-style-type: none"> ● A sound solid waste management system is established in harmony with the city environment. 	<ul style="list-style-type: none"> → "3Rs" are promoted at generation sources. → Waste collection system is improved through the strengthening of collection service capacity and enhancement of public cooperation. → Final disposal system is improved to mitigate adverse impacts on the surrounding areas. → Healthcare waste management is improved. → An official document that defines the solid waste management system is drafted.
	23. Accident	<ul style="list-style-type: none"> ● Traffic accidents decrease year by year. ● There are little accidents because of overloading with passengers in the boat. 	<ul style="list-style-type: none"> → Traffic control, vehicle maintenance, safety education and training of drivers and campaign of traffic safety for students are conducted continuously. → Overloading with passengers is controlled.



How the Vision was made

The first step was gaining an overall understanding of the current urban environmental status by baseline survey related to urban environment conservation. During survey period from September to December 2011 by DONRE, UDAA of Luang Prabang District and experts dispatched by JICA, the information was collected and analyzed to present conditions of urban environment management according to the 29 sector categories as shown below.

Social Environment

1. Local economy
2. Land use
3. Traffic and road condition
4. UEM policy
5. Poverty
6. Ethnic people
7. Landscape
8. Gender
9. Children's rights
10. Cultural heritage
11. Health
12. Environmental awareness

Natural Environment

1. Stormwater Management
2. Biodiversity
3. Forest resources
4. Urban green area
5. Nature reserve
6. Global warming
7. Mineral resources development

Socio-Living Environment

1. Air quality
2. Water quality
3. Safe drinking water
4. Sanitation
5. Soil contamination
6. Solid waste management
7. Noise/vibration
8. Land subsidence
9. Odor
10. Accident

The second step was "scoping" based on the results of the current status assessment of each sector and a checklist for issue finding. 23 sectors were selected as those which require further actions in light of environmental sustainability.

The next step was to define a vision. As mentioned earlier, a vision is a short statement to express the future desired image of Luang Prabang district. It should be concise and impressive, but also narrative and self-explanatory. In setting the Vision, we took a due account of the characteristics of Luang Prabang which enjoys historical and touristic assets and peaceful culture. Under the Vision, goals were set for each sector and strategies were proposed to achieve the Goal.

Procedure Afterward

Submitted comments and our responses through website: <http://bit.ly/zBcoML>.

The vision will serve as a foothold to develop further action plans and projects in Luang Prabang district, although it will not be a binding document for any plans or projects.

Under the LPPE project, several pilot projects will be developed from this vision and implemented until year 2015. Although LPPE's projects are mostly for the waste sector, the Luang Prabang district intends to plan and carry out pilot projects for other sectors by making the best lessons learnt from the LPPE.

For details of the LPPE, please contact at: lppepcdteam@hotmail.com

Appendix 2. Action Plan for Improvement of Solid Waste Management

1 Introduction of Action Plan Formulation

1.1 Formulation Procedure

The national guidelines for environmentally sustainable cities (ESC_GL) states that an action plan (A/P) is to be formulated through the process flow as shown in the figure below.

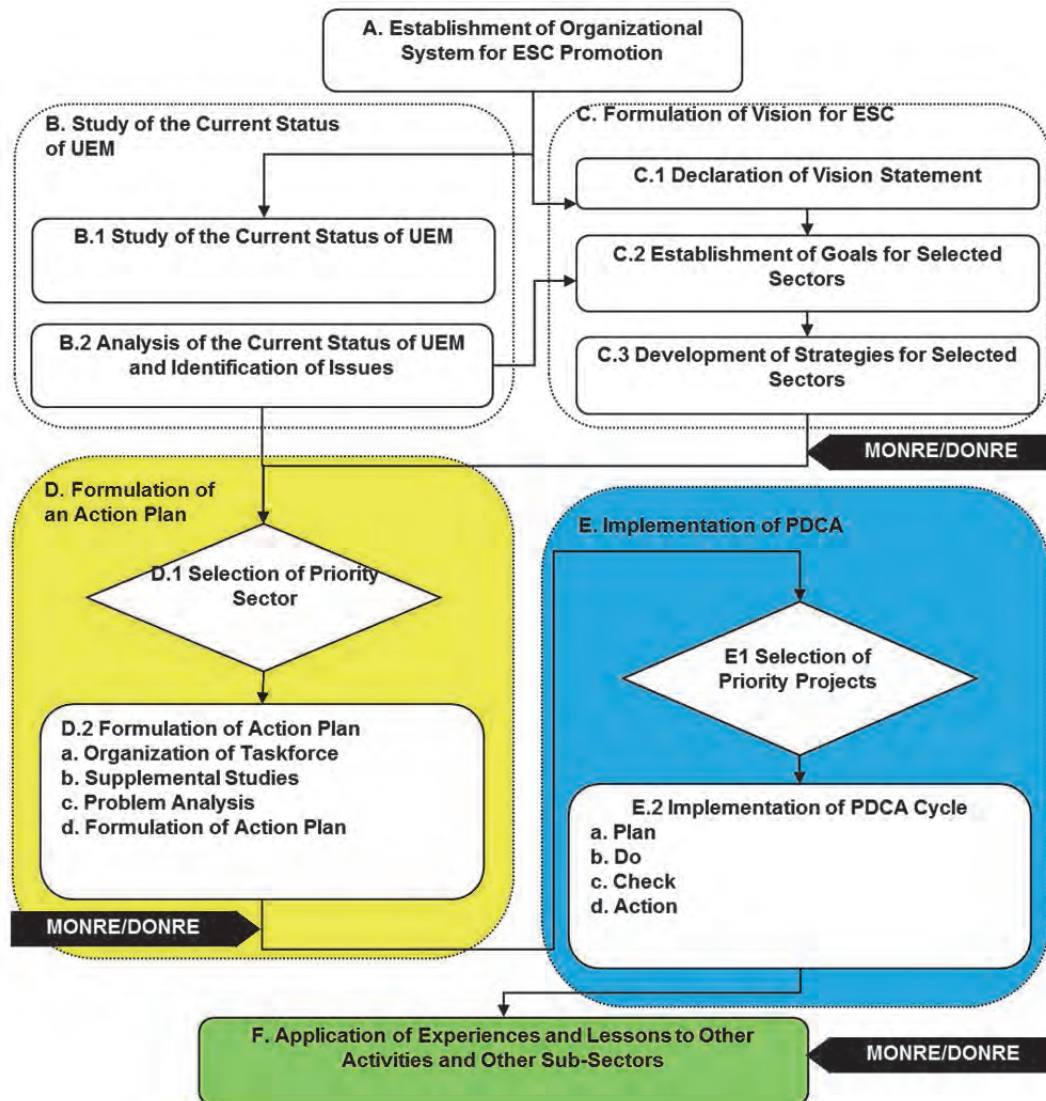


Figure 1. Process Flow for ESC and Action plan

1.2 Structure of the A/P

As shown in the figure above, the A/P is the final output of Process Flow D, and only priority projects in the A/P will proceed to Process Flow E. In other words, the projects in the A/P which are not given priority will be suspended without any clear commitment of implementation. Therefore,

practically speaking, the A/P as an output of Process Flow D can be a simple framework leaving the detailed planning work to Process Flow E.

Accordingly, in case of A/P formulation for LPB by LPPE, the output of Process Flow D is rather a framework of the A/P. On the contrary, taking account of technical and financial input available through the LPPE, most of the activities that were able to start by LPPE were considered to be the priority projects and all their plans were formulated. Consequently, the A/P Framework and a package of plans of individual priority projects compose the A/P (see Figure 2).

Chapter 2 is going to show the A/P Framework after describing how it was formulated according to the Process Flow of D. Chapter 3 is a series of plans of priority projects, for which LPPE's assistance is available by 2015.

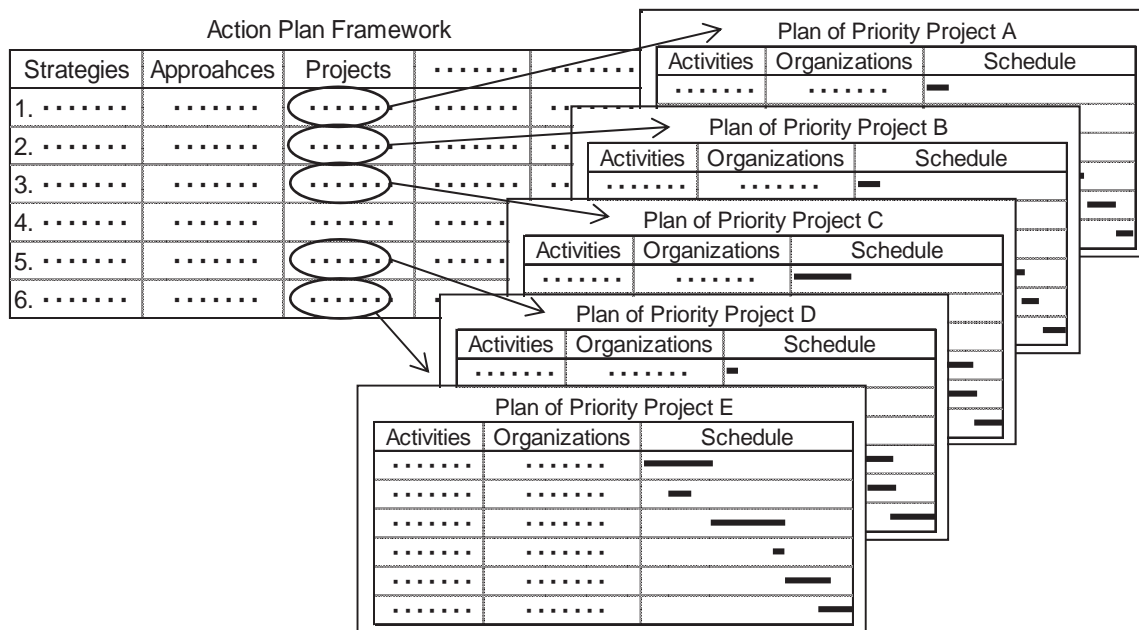


Figure 2. Structure of the Action Plan

2 The Framework of the A/P

2.1 Selection of Priority Sector (D.1 of ESC_GL)

After the formulation of the ESC vision of LPB, the ESC promotion team, which consisted of DONRE, UDAA and DPWT of LPB, selected SWM as a priority sector for ESC promotion by February 2012.

2.2 Organization of Taskforce (D.2a of ESC_GL)

After the SWM sector was selected as the priority sector of ESC promotion for LPB, the ESC promotion team organized a taskforce for the improvement of SWM in LPB consisting of DONRE, DPWT, UDAA and SJET, considering their roles and responsibilities in the area of SWM. The taskforce was chaired by the deputy director general of DONRE.

2.3 Implementation of Supplemental Studies (D.2b of ESC_GL)

The taskforce decided to conduct supplemental studies to understand the current SWM for formulation of the A/P. The supplemental studies included waste amount and composition study, waste collection study, final disposal site study, recyclables dealer study and healthcare waste management study.

The main features on SWM identified by the studies are shown below. Further details about the study results were shown in the Supplemental Report of March 2012.

Table 1. Waste Generation Rate in LPB

Area	Waste Generation Rate (g/capita/day)
Urban Area	569
Suburban Area	766
Weighted average	654

Kitchen Waste	39
Wood	30
Paper	6
Plastics	8
Glass	2
Textile	4
Metal	1
Leather, rubber	1
Inert (sand and stone)	4
Others	5
Total	100

Table 2. Waste Composition in LPB

Waste Types	Composition (%)
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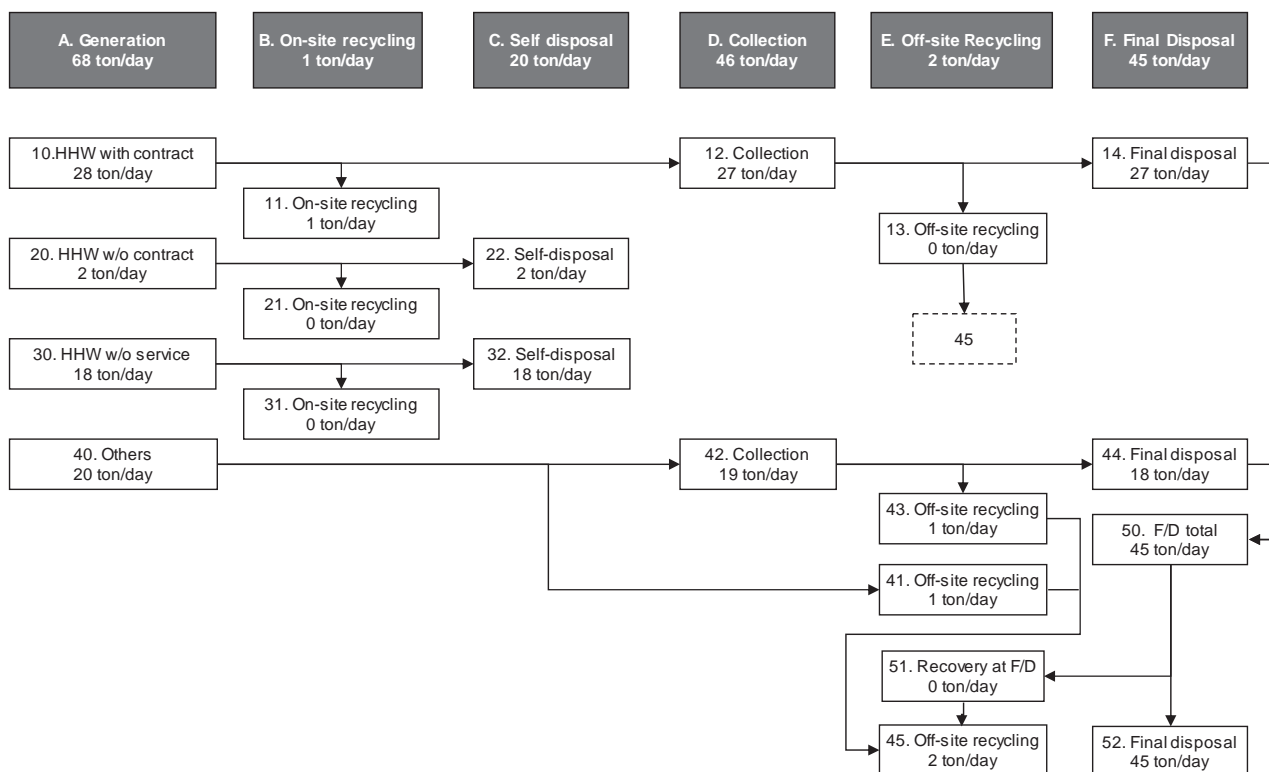


Figure 3. Waste Stream in LPB

2.4 Problem Analysis (D.2c of ESC_GL)

Results of the supplemental studies were analyzed to identify the current problems. Proper understanding of the problems is significantly effective to make a feasible plan. The specific problems related to the Goal of the SWM sector, “A Sound SWM is established in harmony with the city environment”, were identified as shown below.

- ✓ Low recycling rate: Only 4.4 (3/68) % of the total waste generation was recycled. The waste recycled at households was only 1.5 (1/68) %. This could be raised more with the fact that as much as 69% of waste generated at households was kitchen waste and garden waste, which were organic and compostable.
- ✓ Insufficient coverage of waste collection service: The waste collection contract covered only 58.3 (28/48) % of waste generated at households. As a result, as much as 29 (20/68) % of waste was disposed of by households (self-disposal).
- ✓ Open dumping operation: The final disposal site was almost a simple waste dump without proper management and even sludge from septic tanks is directly dumped together with general waste without any treatment. The site was giving serious adverse impacts on surrounding area and difficult to manage during the rainy seasons.
- ✓ Improper healthcare waste management: Infectious waste was disposed of at the final disposal site without proper treatment and posing health risks to the staff of site operation and the waste pickers.

2.5 Formulation of Action Plan (D.2d of ESC_GL)

Upon consideration of the results of the supplementary studies and the Goal of SWM sector, the strategies developed in Process Flow C were reviewed and 5 strategies were re-established. Also, the condition of the A/P was set as below.

Goal: A sound solid waste management system is established in harmony with the city environment and development.

Target Year: 2020

In view of these goal and target year, necessary approaches were proposed under the each strategy so as to facilitate the formulation of the specific projects.

Strategy 1: "3Rs" are promoted.

Approach 1.1: "3Rs" are promoted at on-site to reduce waste generation amount.

Approach 1.2: Recycling is promoted at off-site by composting.

The methodology to promote 3Rs varies, but it can be mainly classified into two, on-site and off-site, as shown in the waste stream (Figure 3). Approach 1.1 is to promote on-site 3Rs primarily expecting the contribution of general households. On the other hand, Approach 1.2 promotes off-site 3Rs by organic waste composting with the expectation for the large organic waste generators including hotels and restaurants to become major players and to appeal to the tourists.

Strategy 2: Waste collection system is improved through the strengthening of collection service capacity and enhancement of public cooperation.

Approach 2.1: Existing collection and discharge system is improved.

Approach 2.2: Waste collection service area is expanded.

The issue regarding waste collection is different depending on whether the area has collection service or not. In the area with collection service, the issue is the inconvenience in waste discharge for the families along narrow alleys, which is then causing improper behavior of household waste management. In the area without collection service, how to extend the service is the concern.

Strategy 3: Final disposal system is improved to mitigate adverse impacts on the surrounding areas.

Approach 3.1: The final disposal site is managed properly to dispose of waste properly.

Approach 3.2: Sludge from septic tanks is treated properly to mitigate impacts to surrounding aquatic environment.

The final disposal site in LPB receives general waste and sludge from septic tanks and those requires respective technical procedures and facility. Two approaches listed above are to improve the management of both kinds of waste.

Strategy 4: Healthcare waste management (HCWM) is improved.

Approach 4.1: Healthcare waste (HCW) is transferred properly to prevent the expansion of infectious pathogen in the town.

Approach 4.2: HCW is disposed of properly to prevent the expansion of infectious pathogen at the disposal site.

Due to the presence of infectious items, HCW must be disposed of in a safe manner and the safe disposal in turn requires appropriate collection and transfer of HCW. In this light, HCWM is considered to have a transfer stage and a disposal stage, both of which are addressed by individual approaches.

Strategy 5: Institutional system to support the above improvements is established.

Approach 5.1: The responsibilities that the relevant stakeholders should bear to achieve a goal of solid waste management are clarified.

Approach 5.2: Financial system necessary for proper SWM is improved.

SWM involves wide range of stakeholders including governmental organizations, private sectors, and the general public. Approach 5.1 is to ensure their collaboration and to optimize their coordination. Further, Approach 5.2 attempts to strengthen the financial basis for SWM, as any technical solutions of SWM are only effective when they are sustainably operated and maintained with a financial background.

In order to materialize these approaches, specific projects are proposed for each of the approaches. The A/P Framework, consisting of strategies, approaches and projects, is thus produced as shown in Table 3.

Table 3. A/P for the Improvement of SWM in LPB for Year 2020

Strategies	Approaches	Projects	Activities	Local Responsible Organizations	Time Schedule		
1."3Rs" are promoted.	1.1 "3Rs" are promoted on-site to reduce waste generation amount.	1.1.1. Reduction of kitchen waste and garden waste at households	Project planning	DONRE, UDAA	By June 2012		
			Planning of PP	DONRE, UDAA	By June 2013		
			Implementation of PP	DONRE, UDAA	By October 2015		
			Dissemination of PP	DONRE, UDAA	Nov 2015 to 2020		
		Integrated in the "Primary Collection System Project", 2.1.1 and 2.1.2, Strategy 2					
		1.1.2. Recyclable waste separation at generation sources	a. Waste separation project	Project planning	DONRE, UDAA	By July 2014	
				Planning of PP	DONRE, UDAA	By September 2014	
		1.1.3 Avoidance of the use of excess packages such as plastic shopping bags	a. Eco-basket project	Implementation of PP	DONRE, UDAA	By October 2015	
				Dissemination of PP	DONRE, UDAA	Nov 2015 to 2020	
			b. Eco-bag project	Project planning	DONRE, UDAA	By June 2012	
	Planning of PP			DONRE, UDAA	By August 2013		
	1.2 Recycling is promoted off-site by composting	1.2.1. Reduction of kitchen waste from hotels and restaurants	Implementation of PP	DONRE, UDAA	By October 2015		
			Dissemination of PP	DONRE, UDAA	Nov 2015 to 2020		
			Project planning	UDAA, DONRE	By June 2012		
			Planning of PP	UDAA, DONRE	By October 2013		
2. Waste collection system is improved through the strengthening of collection service capacity and enhancement of public	2.1 Existing collection and discharge system is improved.	2.1.1 Improvement of existing collection system	Implementation of PP	UDAA, DONRE	By October 2015		
			Dissemination of PP	UDAA, DONRE	Nov 2015 to 2020		
			2.1.2 Improvement of existing waste discharge system	Project planning	UDAA, DONRE	By December 2012	
				Planning of PP	UDAA, DONRE	By August 2013	
	2.2 Waste collection service area is expanded.	2.2.1 Waste collection service planning	Implementation of PP	UDAA, DONRE	By October 2015		
			Dissemination of PP	UDAA, DONRE	Nov 2015 to 2020		
			2.2.2 Waste collection using 5m3	Baseline Survey	UDAA, DONRE	By December 2012	
				Drafting the Plan	UDAA, DONRE	By August 2013	
2.2.2 Waste collection using 5m3	2.2.2 Waste collection using 5m3	Review and Detail Planning	UDAA, DONRE	By October 2015			
		Implementation of Plan	UDAA, DONRE	Nov 2015 to 2020			
2.2.2 Waste collection using 5m3	2.2.2 Waste collection using 5m3	Project planning	UDAA	By December 2012			
		Dissemination of PP	UDAA, DONRE	Nov 2015 to 2020			

cooperation.		containers	Planning of PP	UDAA	By August 2013	
			Implementation of PP	UDAA	By October 2015	
			Dissemination of PP	UDAA	Nov 2015 to 2020	
		2.2.3 Waste collection using collection vehicles	Project planning	UDAA	By Oct 2015	
			Vehicle procurement	UDAA	By Nov 2015	
			Contract negotiation	UDAA	From Oct 2015	
Collection service provision	UDAA		From Dec 2015			
3. Final disposal system is improved to mitigate adverse impacts on the surrounding areas.	3.1 The final disposal site is managed to dispose of waste properly.	3.1.1 Proper management of existing final disposal site.	Project planning	UDAA, DONRE	By June 2012	
			Planning of PP	UDAA, DONRE	By December 2012	
			Implementation of PP	UDAA, DONRE	By October 2015	
		3.1.2. Proper management of waste pickers and improvement of their working conditions	Project planning	UDAA, DONRE	By June 2012	
			Planning of PP	UDAA, DONRE	By December 2012	
			Implementation of PP	UDAA, DONRE	By October 2015	
	3.2 Sludge from septic tanks is treated properly to mitigate impacts to surrounding aquatic environment.	3.2.1. Development and management of the treatment facility for the sludge from septic tanks	Management of waste pickers	UDAA, DONRE	Nov 2015 to 2020	
			Project planning	UDAA, DONRE	By June 2012	
			Planning of PP	UDAA, DONRE	By December 2012	
		3.2.1. Development and management of the treatment facility for the sludge from septic tanks	Implementation of PP	UDAA, DONRE	By October 2015	
			Operation and Maintenance	UDAA, DONRE	Nov 2015 to 2020	
			Operation and Maintenance	UDAA, DONRE	Nov 2015 to 2020	
4. Healthcare waste management (HCW) is improved.	4.1 Health care waste (HCW) is transferred properly to prevent the expansion of infectious pathogen in the town.	4.1.1. HCW collection system establishment	Project planning	DONRE, DOH, UDAA	By February 2013	
			Planning of PP	UDAA, DOH, DONRE	By April 2013	
			Implementation of PP	UDAA, DOH, DONRE	By October 2015	
		4.2 HCW is disposed of properly to prevent the expansion of infectious pathogen at the disposal site.	4.2.1. HCW treatment and disposal system establishment	Dissemination of PP	UDAA, DOH, DONRE	Nov 2015 to 2020
				Project planning	DONRE, DOH, UDAA	By February 2013
				Planning of PP	UDAA, DOH, DONRE	By April 2013
	4.2.1. HCW treatment and disposal system establishment	Implementation of PP	UDAA, DOH, DONRE	By October 2015		
		Dissemination of PP	UDAA, DOH, DONRE	Nov 2015 to 2020		
		Dissemination of PP	UDAA, DOH, DONRE	Nov 2015 to 2020		
	5. Institutional system to support the above improvements be established	5.1 The responsibilities that the relevant stakeholders should bear to achieve a goal of solid waste management are clarified.	5.1.1 Consensus building among stakeholders	Project planning	UDAA, DONRE, DOH	By February 2013
				Planning of PP	UDAA, DONRE, DOH	By April 2013
				Implementation of PP	UDAA, DONRE, DOH	By October 2015
Dissemination of PP				UDAA, DONRE, DOH	Nov 2015 to 2020	
Dissemination of PP				UDAA, DONRE, DOH	Nov 2015 to 2020	

	5.2 Financial system necessary for proper SWM is improved.	5.2.1 Financial System Improvement	Project planning	UDAA, DONRE, DOH	By February 2013
			Planning of PP	UDAA, DONRE, DOH	By April 2013
			Implementation of PP	UDAA, DONRE, DOH	By October 2015
			Dissemination of PP	UDAA, DONRE, DOH	Nov 2015 to 2020

PP: Pilot Project

3 Plans of the Priority Projects of the Action Plan

According to the Process Flow, the next process is to select priority projects from the A/P. Taking account of the availability of assistance from LPPE, most of the projects were considered to be the priority projects. The exception was Project 2.2.3 “waste collection by collection vehicles”, as this project was only possible with additional collection vehicles. Nevertheless, it was put into practice with the grant assistance by the Government of Japan.

The following sections describe the plans of the priority projects, which comprise the A/P together with the A/P Framework.

3.1 Strategy 1: 3Rs Promotion

Approach 1.1: “3Rs” are promoted at on-site to reduce waste generation amount.

Project 1.1.1: Reduction of kitchen waste and garden waste at households

Because of the large proportion of organic component, composting is deemed to be a plausible solution to reduce waste to be discharged from the generation sources. Project 1.1.1 is to promote composting at the generation sources and is called **On-site Composting Project**. The plan of the project is shown in the table below and the activities up to 2015 of LPPE are considered to be a PP.

Area of PP: B. Vat That, B. Pong Vane, B. Pakham (38 households, estimated 210 people)

Target of PP: The rate of the households that continue on-site compost to all the households that started on-site compost in all the pilot villages is 50%.

After the completion of the PP by LPPE, DONRE and UDAA shall disseminate the PP to other area of LPB based on the lessons learned from the PP.

Table 4. Plan of On-site Composting Project

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, SJET	■				
	Set up concept	DONRE, UDAA, SJET	■				
Planning of PP	Study and selection of pilot area	DONRE, UDAA, SJET	■				
	Study of composting method	SJET		■			
	Procurement of equipment	SJET		■			
	Preparation of education tools	DONRE, UDAA, SJET		■			
Implementation of PP	Delivery of equipment and instruction of method	DONRE, UDAA, SJET		■	■		
	Monitoring and awareness raising	DONRE, UDAA, SJET			■	■	■
	Evaluation of the PP	DONRE, UDAA, SJET				■	
	Suggestion for dissemination	SJET				■	
Dissemination of PP	Planning of dissemination	DONRE, UDAA				■	
	Dissemination to other area	DONRE, UDAA				■	■

Project 1.1.3: Avoidance of the use of excess packages such as plastic shopping bags

The most favorable waste management will be to cut the possibility to generate waste in the first place. This does not require not only waste disposal but also waste reuse or waste recycling. What the general public can do for this is, however, not many, but one approach that is relatively easy to try is to avoid using excess packages such as plastic shopping bags. Project 1.1.3 is therefore selected as a priority project and two projects are derived: **Eco-basket Project** and **Eco-bag Project**.

a. **Eco-basket Project**

For the general households, baskets are preferred than bags as the baskets can be washed and cleaned. The plan of the eco-basket project is shown in the table below. The activities up to 2015 are considered to be a PP of LPPE.

Area of PP: B. Vat Thaat, B. Pakham, Ta Heua Market (182 households, estimated 1,000 people+ 500 people in the market)

Target of PP: The rate of the households that refuse plastic bags as many as possible to all the households in all the pilot villages is 30%.

After the completion of the PP by LPPE, DONRE and UDAA shall disseminate the PP to other area of LPB based on the lessons learned from the PP.

Table 6. Plan of Eco-basket Project

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, SJET	■				
	Set up concept	DONRE, UDAA, SJET	■				
Planning of PP	Study and selection of pilot area	DONRE, UDAA, SJET	■				
	Procurement of equipment	SJET		■			
	Preparation of education tools	DONRE, UDAA, SJET		■			
Implementation of PP	Delivery of equipment and instruction of use	DONRE, UDAA, SJET		■	■		
	Monitoring and awareness raising	DONRE, UDAA, SJET			■	■	■
	Evaluation of the PP	DONRE, UDAA, SJET				■	
	Suggestion for dissemination	SJET				■	
Dissemination of PP	Planning of dissemination	DONRE, UDAA				■	
	Dissemination to other area	DONRE, UDAA					■

b. Eco-bag Project

This is the project to prepare eco-bags for tourists for their shopping of souvenirs. There is an expectation that the tourists of LPB are environmentally sensitive and the use of eco-bags is easy to be understood. The activities up to 2015 are considered to be a PP of LPPE.

Area of PP: LPB district

Target of PP: More than 30 hotels/guesthouses participate in the project.

After the completion of the PP by LPPE, DONRE and UDAA shall disseminate the PP to other hotels and guesthouses in LPB based on the lessons learned from the PP.

Table 7. Plan of Eco-bag Project

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, SJET	■				
	Set up concept	DONRE, UDAA, SJET	■				
Planning and prepraiaion of PP	Study and selection of pilot area	DONRE, UDAA, SJET	■				
	Procurement of equipment	SJET		■			
	Preparation of education tools	DONRE, UDAA, SJET		■			
Implementation of PP	Delivery of equipment and instruction of use	DONRE, UDAA, SJET		■			
	Monitoring and awareness raising	DONRE, UDAA, SJET			■	■	■
	Evaluation of the PP	DONRE, UDAA, SJET				■	
	Suggestion for dissemination	SJET				■	
Dissemination of PP	Planning of dissemination	DONRE, UDAA				■	
	Dissemination to other hotels and guesthouses	DONRE, UDAA					■

Approach 1.2: Recycling is promoted at off-site by composting.

Project 1.2.1: Reduction of kitchen waste from hotels and restaurants

The project to reduce the final disposal amount of kitchen waste from hotels and restaurants is called **Off-site Composting Project**. Organic waste of hotels and restaurants, which generate organic waste in bulk, is collectively composted in a facility installed at the final disposal site. The activities up to 2015 are considered to be a PP of LPPE.

Area of PP: LPB district

Target of PP: More than 30 hotels / restaurants participate in the project.

After the completion of the PP by LPPE, UDAA and DONRE shall disseminate the PP to other based on the lessons learned from the PP.

Table 8. Plan of Off-site Composting Project

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	UDAA, DONRE, SJET	■				
	Set up concept	UDAA, DONRE, SJET	■				
Planning of PP	Study and selection of pilot area	UDAA, DONRE, SJET	■				
	Study of composting method	SJET		■			
	Procurement of equipment	SJET		■			
	Preparation of education tools	UDAA, DONRE, SJET		■			
Implementation of PP	Delivery of equipment and instruction of method	UDAA, DONRE, SJET		■			
	Contents analysis of the compost	SJET			■		
	Monitoring	UDAA, DONRE, SJET			■	■	
	Evaluation of the PP	UDAA, DONRE, SJET				■	
	Suggestion for dissemination	SJET				■	
Dissemination of PP	Planning of dissemination	DONRE, UDAA				■	
	Dissemination to other hotels and restaurants	DONRE, UDAA					■

3.2 Strategy 2: Waste Collection System

Approach 2.1: Improvement of existing collection and discharge system

Project 2.1.1: Improvement of existing collection system

Project 2.1.2: Improvement of existing waste discharge system

Approach 2.1 has two projects: one is for waste collectors and the other for waste generators. These two are combined to one priority project called **Primary Collection System Project**, and its activities up to 2015 of LPPE are planned as a PP.

Wheeled waste bins are provided to the groups of households who live along streets inaccessible for the waste collection vehicles. The bins are managed by those households on a rotating basis. The household on duty during a particular period collects waste from other households of the group and brings the bin to the nearest waste discharge point on a collection day.

Besides, a discharge rule which is set up by the project promotes the households to separate recyclable waste in order to minimize the amount of waste to be collected and transported to the disposal site. The residents shall separate the recyclables to sell it to dealers so as not to discharge them on regular waste collection service.

Area of PP: B. Huaxieng, B. Thadbosoth, B. Apay, B. Viengmay, B. Naviengkham, B. Viengsay (262 households and one temple, about 1450 people)

- Target of PP:
1. The activities of the existing collection improvement and the promotion of recyclables discharge PP are implemented in one or more new villages under the instruction of the UDAA and DONRE.
 2. Waste management groups are established in the pilot villages of the primary collection system project.
 3. The rate of the cooperating households to all the households covered by the existing primary collection system project is more than 70%.
 4. The rate of the households that separately discharge recyclable waste to all the households covered by primary collection service project is more than 70%.

After the completion of the PP by LPPE, UDAA shall extend the primary collection system based on the lessons learned from the PP.

Table 9. Plan of Primary Collection System Project

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	SJET, UDAA, DONRE	■				
	Set up concept	SJET, UDAA, DONRE		■			
Planning and Preparation PP	Study and selection of pilot area	SJET, UDAA, DONRE		■			
	Collection system determination	SJET, UDAA, DONRE		■			
	Procurement of equipment	SJET		■			
	Preparation of education tools	SJET, UDAA, DONRE		■			
Implementation of PP	Delivery of equipment and instruction of method	UDAA, DONRE, SJET		■			
	Monitoring and awareness raising	UDAA, DONRE, SJET			■	■	
	Pre-dissemination	UDAA, DONRE			■		
	Evaluation of the PP	UDAA, DONRE, SJET				■	
	Suggestion for dissemination	SJET				■	
Dissemination of PP	Planning a roadmap to 2020	UDAA					■
	Dissemination to the priority area	UDAA					■
	Dissemination to the other area	UDAA					■

Approach 2.2: Expansion of waste collection service area

Project 2.2.1: Waste collection service planning

Waste collection service plan is indispensable to expand waste collection service from the mid to long term viewpoint. Starting from the analysis of present situation such as the waste collection service coverage status, waste collection amount and others, the project should stipulate the policy regarding where to be covered by the target year. The activities up to 2015 are considered to be a PP of LPPE.

Target Area: Whole Luang Prabang district, 117 villages (17,799 households, predicted about 98,330 people in 2020)

Target of PP: A waste collection and transportation plan is formulated

After the completion of the PP by LPPE, UDAA shall regularly review and update the plan in case of necessity based on the lessons learned from the PP.

Table 10. Plan of Waste Collection Service Planning Project

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Baseline Survey	The first determination of present waste stream flow-chart	SJET, UDAA, DONRE	■				
	Detailed survey	SJET, UDAA, DONRE	■				
Drafting the Plan	Sharing the survey result among stake holders	SJET, UDAA, DONRE		■			
	Discussion and consideration internally by the local authority	UDAA		■			
	Drafting the plan in rough scale	SJET, UDAA, DONRE		■			
Review and Updating the Plan	Monitoring and watching the progress concerned about solid waste management	UDAA			■	■	
	Reviewing and detail planning comparing between the draft and latest situation	UDAA					■

Project 2.2.2: Waste collection using 5m3 containers

Waste collection using 5m3 containers is one of the effective ways to extend the collection service, if the service provider already possesses a container transporter (skip loader). It is effective to provide the service in remote area where frequent collection service using collection vehicles is not feasible due to long distance and less waste amount. In the city center, it is also convenient both for institutions that generate large volume of waste and for the collection service providers. Substituting the existing collection service using the collection vehicles with container collection service can indirectly contribute to service expansion since the collection vehicles can be used for other new areas.

Project 2.2.2 therefore aims to expand the collection service by UDAA using 5m3 waste containers. The activities up to 2015 are considered as a PP of LPPE.

Number of Pilot Containers: 10

Target of PP: 10 units of 5m3 waste containers are assembled and they are placed in accordance with the container placement plan.

After the completion of the PP by LPPE, UDAA shall disseminate the PP to other area of LPB based on the lessons learned from the PP.

Table 11. Plan of project of waste collection using 5m3 containers

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	SJET, UDAA, DONRE	■				
	Set up concept	SJET, UDAA, DONRE		■			
Planning and Preparation PP	Procurement of equipment	SJET		■			
	Construction the facility	SJET		■			
	Study and training of assembling	SJET		■			
	Drafting the container placement plan	SJET, UDAA, DONRE		■			
Implementation of PP	Assembling the 10 containers	UDAA		■			
	Negotiation and contract with the customers	UDAA			■	■	■
Dissemination of PP	Planning a roadmap to 2020	UDAA					■
	Dissemination to the priority area	UDAA					■
	Dissemination to the other area	UDAA					■

3.3 Strategy 3: Final disposal system is improved to mitigate adverse impacts on the surrounding areas

Approach 3.1: The final disposal site is managed to dispose of waste properly.

Project 3.1.1: Proper management of existing final disposal site

The project to conduct the proper management of existing final disposal site is selected as a priority project and its activities up to 2015 is planned as a pilot project.

Target Area: KM8 existing disposal site

- Target of PP:
1. An operation plan of the final disposal site is formulated.
 2. The final disposal site is operated in accordance with the operation plan.
 3. The final disposal site is monitored by the final disposal site monitoring committee once a year.

After the completion of the PP by LPPE, UDAA shall carry out operation and maintenance of existing final disposal site while DONRE shall continue site monitoring based on the lessons learned from the PP.

Table 12. Plan of the Project for the Proper Management of Existing Final Disposal Site

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	UDAA, SJET,	■				
	Set up concept	UDAA, SJET,	■				
Planning of PP	Identify and study the pilot area at KM8 existing final disposal site	UDAA, SJET,	■				
	Formulation of improvement plan of infrastructure at KM8 existing final disposal site	UDAA, SJET,	■				
	Formulation of draft operation plan at KM8 existing final disposal site	UDAA, SJET,		■			
	Formulation of operation plan reflecting the Grant aid project	UDAA, SJET,		■	■	■	
Implementation of PP	Improvement of KM8 existing final disposal site and procurement of heavy machinery	SJET		■			
	Proper operation of KM8 existing final disposal site	UDAA, SJET		■	■	■	
	Monitoring	DONRE, SJET	▲	▲	▲	▲	
	Evaluation of the PP	SJET				■	
	Suggestion for continuation	SJET				■	
Operation and maintenance	Operation and maintenance of existing final disposal site	UDAA					■
	Site monitoring	DONRE					▲

Project 3.1.2: Proper management of waste pickers and improvement of their working conditions

The project to manage waste pickers and improve their working conditions is selected as a priority project. As they often work nearby the heavy machinery operating at the waste dumping point, the management of their activities is important for their safety and for proper site operation.

The project plan is shown in the table below and the activities up to 2015 were considered to be a PP of LPPE.

Target Area: KM8 existing disposal site

- Target of PP:
1. A management plan of waste pickers is formulated.
 2. The waste pickers working conditions is improved in accordance with the management plan.
 3. The management of waste pickers is monitored by waste pickers meeting.

After the completion of the PP by LPPE, DONRE and UDAA shall continue the activities of the PP based on the lessons learned from the PP.

Table 13. Plan of the Project for the Proper Management of Waste Pickers and Improvement of their Working Conditions

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	UDAA, SJET	■				
	Set up concept	UDAA, SJET	■				
Planning of PP	Identify the waste pickers	UDAA, SJET	■				
	Formulation of management and improvement plan	UDAA, SJET	■				
Implementation of PP	Management of Waste Pickers and Improvement of their Working Conditions	UDAA, SJET	■				
	Waste pickers meeting	UDAA, DONRE, SJET	▲	▲		▲	
	Evaluation of the PP	SJET				■	
	Suggestion for continuation	SJET				■	
Management of waste pickers	Management of Waste Pickers and Improvement of their Working Conditions	UDAA					■
	Waste pickers meetings	DONRE, UDAA					▲ ▲ ▲

Approach 3.2: Sludge from septic tanks is treated properly to mitigate impacts to surrounding aquatic environment

Project 3.2.1: Development and management of the treatment facility for the sludge from septic tanks

The project to introduce and manage the proper treatment facility for the sludge from septic tanks is selected as a PP of LPPE. The project plan is shown in the table below. The activities up to 2015 are considered to be a PP of LPPE.

- Area of PP: KM8 existing disposal site
- Target of PP:
1. An operation plan of the treatment facility for the sludge from septic tanks is formulated.
 2. The treatment facility for the sludge from septic tanks is operated in accordance with the operation plan.
 3. The treatment facility for the sludge from septic tanks is monitored by the final disposal site monitoring committee once a year.

After the completion of the PP by LPPE, UDAA shall carry out operation and maintenance of the sludge from septic tanks while DONRE shall continue site monitoring based on the lessons learned from the PP.

Table 14. Plan of the Project for the Development and Management of the Treatment Facility for the Sludge from Septic Tanks

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	UDAA, SJET	■				
	Set up concept	UDAA, SJET	■				
Planning of PP	Identify and study the pilot area at KM8 existing final disposal site	UDAA, SJET	■				
	Formulation of improvement plan of infrastructure	UDAA, SJET	■				
	Formulation of draft operation plan of treatment facility for the sludge from septic tanks	UDAA, SJET		■			
	Formulation of operation plan reflecting the Grant aid project	UDAA, SJET		■	■	■	
Implementation of PP	Establishment of treatment facility for the sludge from septic tanks	SJET		■			
	Proper operation of treatment facility for the sludge from septic tanks	UDAA, SJET		■	■	■	■
	Monitoring	DONRE, SJET	▲	▲	▲	▲	
	Evaluation of the PP	SJET				■	
	Suggestion for continuation	SJET				■	
Operation and maintenance	Operation and maintenance of treatment facility for the sludge from septic tanks	UDAA					■
	Site monitoring	DONRE					▲

3.4 Strategy 4: Improvement of Healthcare Waste Management (HCWM)

Approach 4.1: Healthcare waste (HCW) is transferred properly to prevent the expansion of infectious pathogen in the town.

Project 4.1.1: HCW collection system establishment

The project to establish the collection and transportation system of HCW and monitoring system is selected as a priority project. The plan of the project is shown in the table below. The activities up to 2015 are considered to be a PP of LPPE.

Target hospitals of PP: 4 Main hospitals of LPB, namely Provincial Hospital, Military Hospital, Chinese Hospital, International Chinese Hospital

Target of PP: 1. A healthcare waste collection, treatment and disposal plan for the target hospitals is formulated.

2. Healthcare waste from the target hospitals is collected, treated and disposed of in accordance with the aforementioned plan.

After the completion of the PP by LPPE, UDAA, DOH and DONRE shall extend the system to receive HCW from other hospitals based on the lessons learned from the PP.

Table 15. HCW Collection System Establishment Project

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, DOH, SJET	■				
	Set up concept	SJET, DONRE, DOH, UDAA,	■				
Planning of PP	Study and selection of pilot hospitals	DONRE, SJET, DOH, UDAA,	■				
	Preparation of collection and transportation PP plan	SJET, UDAA, DOH, DONRE	■				
Implementation of PP	Procurement of a HCW collection vehicle	SJET		■			
	Preparation of education tools	SJET, DOH, DONRE, UDAA		■			
	Implementation of separated HCW collection	UDAA, DOH, DONRE, SJET			■	■	■
	Monitoring and awareness raising	DOH, DONRE, UDAA, SJET			■	■	
	Evaluation of the PP	SJET, DOH, UDAA, DONRE				■	
	Formulation of collection and transportation plan	SJET, UDAA, DOH, DONRE			■	■	
	Suggestion for expansion	SJET, UDAA, DOH, DONRE				■	
Dissemination of PP	Instruction to medical institutions	DOH, DONRE, UDAA				■	■
	Implementation of separated HCW collection	UDAA, DOH, DONRE,				■	■

3.5 Strategy 5: Establishment of Institutional System to Support PPs Implementation

Approach 5.1: The responsibilities that the relevant stakeholders should bear to achieve a goal of solid waste management are clarified.

Project 5.1.1: Consensus building among stakeholders

The project to codify the responsibilities of each stakeholder and build consensus is selected as a priority project. The plan of the project is shown in the table below. The activities up to 2015 are considered as a pilot project of LPPE, whereby roles and responsibilities in other PPs for Strategies 1 to 4 are clarified.

Area of PP: LPB

Target Activities: Codification of the responsibilities of each stakeholder regarding PPs of LPPE for Strategies 1 to 4.

Target of PP: Regulation on the responsibilities of stakeholders for improved SWM is prepared and/or drafted.

After the completion of the PP by LPPE, DONRE together with UDAA shall apply the lessons learned from the PP to other consensus building activities for the improvement of SWM in LPB.

Table 17. Plan of the Project for Consensus Building among Stakeholders

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, DOH, SJET	■				
	Set up concept	SJET, UDAA, DONRE, DOH	■				
Planning of PP	Study on the needs of consensus building for PPs	SJET, UDAA, DONRE, DOH	■	■			
	Preparation of draft consensus building plan	SJET, UDAA, DONRE, DOH		■	■		
Implementation of PP	Implementation of PPs	UDAA, DONRE, DOH, SJET		■	■	■	■
	Monitoring and awareness rising	DONRE, UDAA, DOH, SJET			■	■	
	Evaluation of the PP	SJET, UDAA, DONRE, DOH				■	
	Suggestion for expansion	SJET, UDAA, DOH, DONRE				■	
Dissemination of PP	Study on the needs of consensus building	DONRE, UDAA, DOH				■	■
	Preparation of draft consensus building plan	DONRE, UDAA, DOH				■	■
	Implementation of the plan	DONRE, UDAA, DOH				■	■
	Completion of the consensus building plan	DONRE, UDAA, DOH				■	■

Approach 5.2: Financial system necessary for proper SWM is improved.

Project 5.2.1: Financial System Improvement

The project to improve the financial system necessary for SWM improvement is selected as a priority project. The plan of the project is shown in the table below. The activities up to 2015 are planned as a pilot project as below.

Target Area: LPB

Target Activities: Financial system improvement proposals regarding PPs of LPPE for Strategies 1 to 4.

Target of PP: Proposal for financial system improvement necessary for SWM improvement is prepared.

After the completion of the PP by LPPE, the administrative organizations that need its financial system improvement shall apply the lessons learned from the PP to other financial system improvement for SWM in LPB.

Table 18. Plan of the Financial System Improvement Project

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, DOH, SJET	■				
	Set up concept	SJET, UDAA, DONRE DOH	■				
Planning of PP	Study on the needs of financial system improvement for PPs	SJET, UDAA, DONRE, DOH	■	■			
	Preparation of draft financial system improvement plan	SJET, UDAA, DONRE, DOH	■	■	■		
Implementation of PP	Implementation of PPs	UDAA, DONRE, DOH, SJET		■	■	■	■
	Monitoring and awareness raising	DONRE, UDAA, DOH, SJET			■	■	
	Evaluation of the PP	SJET, UDAA, DONRE, DOH				■	
	Suggestion for expansion	SJET, UDAA, DOH, DONRE				■	
Dissemination of PP	Study on the needs of financial system improvement	UDAA, DONRE, DOH				■	■
	Preparation of draft financial system improvement plan	UDAA, DONRE, DOH				■	■
	Implementation of the plan	UDAA, DONRE, DOH				■	■
	Completion of the financial system improvement plan	UDAA, DONRE, DOH				■	■

Appendix 3. Pilot Projects (PPs)

Table 3-1. Pilot Projects in LPB

Strategy 1. "3Rs" are promoted.	
Approach 1.1 "3Rs" are promoted on-site to reduce waste generation amount.	
1.1.1 Reduction of kitchen waste and garden waste at households	
1.1.2 Recyclable waste separation at generation sources	a. Waste separation project b. School recycling project
1.1.3 Avoidance of the use of excess packages such as plastic shopping bags	a. Eco-basket project b. Eco-bag project
Approach 1.2 Recycling is promoted off-site by composting	
1.2.1 Reduction of kitchen waste from hotels and restaurants	
Strategy 2. Waste collection system is improved.	
Approach 2.1 Improvement of existing collection and discharge system	
2.1.1/2.1.2 Primary collection system	
Approach 2.2 Expansion of waste collection service area	
2.2.1 Waste collection service planning	
2.2.2 Waste collection using 5m ³ containers	
Strategy 3. Final disposal system is improved.	
Approach 3.1 The final disposal site is managed to dispose of waste properly.	
3.1.1 Proper management of existing final disposal site	
3.1.2 Proper management of waste pickers and improvement of their working conditions	
Approach 3.2 Sludge from septic tanks is treated properly to mitigate impacts to surrounding aquatic environment.	
3.2.1 Development and management of the treatment facility for the sludge from septic tanks	
Strategy 4. Health care waste management is improved.	
Approach 4.1 HCW is collected properly.	
4.1.1 HCW collection system establishment	
Approach 4.2 HCW is disposed of properly.	
4.2.1 HCW treatment and disposal system establishment	
Strategy 5. Institutional system to support the above improvements is established.	
Approach 5.1 The responsibilities that the relevant stakeholders should bear to achieve a goal of solid waste management are clarified.	
5.1.1 Consensus building among stakeholders	
Approach 5.2 Financial system necessary for proper SWM is improved.	
5.2.1 Financial system improvement	

Strategy 1. "3Rs" are promoted.

Approach 1.1: "3Rs" are promoted on-site to reduce waste generation amount.

1.1.1 Reduction of kitchen waste and garden waste at households

1. Project Purpose and Summary

The purpose of this project is to reduce household's organic waste such as kitchen and garden waste at generation source in Luang Prabang District.

After pilot households were selected from 3 pilot villages, home composting was introduced to the households in order to encourage them to reduce the amount of discharged waste at home.

2. General Concept

DONRE and UDAA were selected as a main C/P and had discussions with SJET in order to design the project plan. Since the main actor of promotion and expansion of on-site composting should be transferred from SJET to C/P transitionally, project's phase was decided to be divided into two: Phase I, which is mainly managed by SJET with a purpose of OJT to C/P and Phase II, which is mainly managed by C/P.

Table 3-2. Outline of the Plan for Reduction of kitchen waste and garden waste at households PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, SJET	■				
	Set up concept	DONRE, UDAA, SJET	■				
Planning of PP	Study and selection of pilot area	DONRE, UDAA, SJET	■				
	Study of composting method	SJET		■			
	Procurement of equipment	SJET		■			
	Preparation of education tools	DONRE, UDAA, SJET		■			
Implementation of PP	Delivery of equipment and instruction of method	DONRE, UDAA, SJET		■			
	Monitoring and awareness raising	DONRE, UDAA, SJET			■	■	■
	Evaluation of the PP	DONRE, UDAA, SJET				■	
	Suggestion for dissemination by C/P	SJET				■	

3. Planning

a. Study and selection of pilot area

a.1 Study of kitchen and garden waste at households

According to the Waste Amount and Composition Survey (WACS) conducted in September 2011 in Luang Prabang District, organic waste makes up 69% of the total amount of waste at the households. Details of the survey results are shown as below.

Table 3-3. Waste Generation Rate in LPB

Area	Waste Generation Amount (g/capita/day)
Urban Area	569
Suburban Area	766
Weighted average	654

Table 3-4. Waste Composition in LPB

Waste Types	Composition (%)
Kitchen Waste	39
Wood	30
Paper	6
Plastics	8
Glass	2
Textile	4
Metal	1
Leather, rubber	1
Inert (sand and stone)	4
Others	5

Most of the households did not separate their organic waste and ~~total discharged them together with~~ other waste. However, some of the households separated their kitchen waste and fed their domestic animals with it.

a.2 Selection of pilot area

After the consideration, three pilot villages below were selected by C/P because the households in those villages generally have land large enough to place composting containers.

1. Pakham village
2. VatThaat village
3. Pongvane village

b. Study of composting method

After SJET had considered the pilot households' living environment, life style, discharged waste types, maintenance method of compost and so on, two methods of composting were chosen: one using barrels with holes called "barrel composting" and another using worms called "worm composting". The chart below shows differences of the two methods.

	Pros	Cons
Barrel composting	<ul style="list-style-type: none"> • Almost all organic waste can be used. • Without special equipment; it can be easily started. 	<ul style="list-style-type: none"> • As water does not drain well; moisture adjustment is required. • Odor and maggot often occurs. • In order to promote aerobic fermentation, air should be taken into the barrel by mixing inside of the barrel regularly.
Worm composting	<ul style="list-style-type: none"> • Hardly smells. • Worm itself or liquid that comes from the compost can be fed to domestic animals. 	<ul style="list-style-type: none"> • Waste that can be used is limited. • Temperature adjustment and dryness prevention are needed; it cannot be left for a long time. • Once all worms die, it would be difficult to restart composting unless the worms are procured again.

c. Procurement of equipment

In April 2013, SJET procured 10 barrels and 43 worm bins. For good drainage and ventilation, holes were drilled at the side and the bottom of barrels. As for the worm bins, bins of Vientiane Capital type could not be found in Luang Prabang District, so other types of container (plastic baskets and washtubs) were procured according to the instructions of a worm composting expert.

d. Preparation of equipment

In May 2013, SJET made two kinds of composting handbook: barrel composting handbook and worm composting handbook.

4. Implementation

a. Delivery of equipment and instruction of method

In May 2013, kick-off ceremony of the on-site composting PP was held by DONRE and UDAA and composting lesson for the pilot households were given at the square in front of Taheua Market. After the demonstration of composting was given by SJET, equipment and the handbooks of Phase I were delivered to the pilot households.

The handbooks were revised in accordance with the households' opinion and monitoring results. The revision of the barrel composting handbook was completed in February 2014 and the worm one was completed in March 2014.

By using the revised handbooks aforementioned, composting lessons for the pilot households of Phase II were provided at each pilot village in March 2014. C/P of UDAA acted as the main instructor. After the lessons, equipment and the handbooks for Phase II were delivered to the pilot households.

b. Monitoring and awareness raising

After the delivery of the equipment, DONRE and UDAA conducted monitoring regularly. For publicizing and raising people's awareness, households' implementation of the composting was reported and aired by Lao National TV.

In January 2015, a worm composting video was produced so that C/P could continue dissemination activities after the completion of the project.

5. Evaluation and Achievements

Achievement status of the PP is shown in the chart below.

Indicator	Means of Verification	Achievement Status
Indicator 2.1. 3Rs are promoted.		
1. All barrels and bins are disseminated by Dec 2014 and kept monitored until the end of the project by C/P.	1. LPPE Progress Report and Monitoring Report	Achieved. All composting equipment was delivered by December 2014 and have been monitored by C/P continuously.
Indicator 3.2. The residents participate to the 3Rs activities.		
1. The rate of the households that continue on-site compost to all the households that started on-site compost in all the pilot villages: 50%	1. MONRE Monitoring Report and Information from the chief of the village	Achieved. As of March 2015, 66% of the households still continue on-site composting.

In conclusion, the project purpose was achieved.

6. Suggestion for the Post-Project Activities

a. Characteristics of the households that tend to continue the composting

According to the monitoring results, characteristics of the households that have high opportunity

for continuing the composting were considered as follows:

Barrel composting

- Households that have gardens.
- Households that like to grow plants.
- Households that can easily get some materials for moisture adjustment, such as rice bran, saw dust, dry leaves, etc.

Since the barrel composting doesn't require any special equipment, people can easily get started. However, some households had to stop the composting because they didn't control moisture and then maggots appeared inside the barrel. Therefore, it would be necessary for C/P to explain the importance of moisture control to the households and let them drain water out from the waste before putting it into the barrel and put some materials for the moisture adjustments properly.

Worm composting

- Households that have gardens.
- Households that like to raise animals.
- Households that have domestic animals or fishes.
- Someone in the households likes fishing.

Since the worm itself and the liquid comes from the compost can be fed to animals, households that have domestic animals tend to keep their motivation for composting. Hence, having domestic animals should be considered as one of criteria for the selection of new pilot households.

On the other hand, some households had to stop the composting because they consumed too much worms for feeding their domestic animals or for fishing and the number of worms was drastically decreased. Therefore, it would be necessary for C/P to explain the objectives of the composting clearly during the instruction and even after the implementation, C/P is recommended to remind the households of the objectives again when they go monitoring.

Characteristics of the households that can be applied for both composting methods is that the person who raised his/her hands to join the PP usually stays in the house and has enough time to take care of the compost. In case that the person who is interested in composting is usually out of his/her house in the daytime, the compost tends to be left for long unless there is other family member who can look after it instead. This situation made some households' composts become too wet or too dry.

Especially in the case of Pongvane village, most of the pilot households are farmers and their compost tends to be left during the farmers' busiest season. As a result, some households had to stop the worm composting because all of their worms were dead. However, some households that moved their compost containers to their farms tend to be able to continue the composting, because they can put their farms' vegetable scraps into the compost and use the compost directly to their farms as a soil conditioner.

When C/P disseminates the on-site composting to new households, the households' occupation or lifestyle should be considered. The households also have to make the following conditions clear before they begin the composting.

- Where will the compost be placed in the house? Is the place suitable for the composting?
- Who will be in charge of the composting in the family?

- When and how will that person take care of the compost?

b. Making a monitoring system by households

In order to keep the household composting, it is necessary to monitor regularly and give right advices to the households before or after problems happen. However, as the number of C/P and their budget is limited, it would be very difficult for C/P to visit every pilot household frequently. One of the solutions of this problem is as follows:

1. Several neighboring composting households are grouped.
2. Participant who manages compost very well, or who is very eager in the composting is selected as a group leader.
3. C/P instructs the group leader on the maintenance and monitoring method.
4. The group leader checks the condition of other members' compost and instructs them directly if there is any problem.

1.1.2 a. Waste separation project

This PP was carried out as part of the PP “2.1.1/2.1.2 Primary collection system”, thus described together with it.

1.1.2 b. School recycling project

1. Project Purpose and Summary

The purpose of this project is to promote recycling by separating and collecting recyclable waste in school in LPB.

After two pilot schools were selected, those schools were instructed to collect recyclable wastes separately in each class and keep them inside the storages in the schools. After the storages are full, the schools sell the recyclables to collection company in order to promote recycling.

2. General Concept

DONRE and UDAA were selected as a main C/P and had discussion with SJET in order to design the project plan. After that, DONRE and UDAA had discussion with the two pilot schools and made a suitable plan for each school.

Table 3-5. Outline of the Plan for School Recycling PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project planning	Set up project management system	DONRE, UDAA, SJET			■		
	Set up concept	DONRE, UDAA, SJET			■		
Planning and preparation of PP	Study and selection of pilot area	DONRE, UDAA, SJET			■		
	Study of separation, collection and selling method	DONRE, UDAA, SJET			■		
	Procurement of equipment	SJET			■		

	Preparation of education tools	SJET			■		
Implementation of PP	Delivery of equipment and instruction of method	SJET			■		
	Monitoring and awareness raising	DONRE, UDAA, SJET				■■■■■■■■■■	■■■■■■■■■■
	Evaluation of the PP	DONRE, UDAA, SJET				■	
	Suggestion for dissemination by C/P	SJET				■	

3. Planning

a. Study and selection of pilot area

a.1 Study of current situation of recycling

According to the basic line survey conducted by SJET in November 2011, it was found that the recycling rate of LPB is 5.9%.

In May in 2014, SJET visited candidate sites and found as follows:

1. Most of students tend not to bring water bottle from their house. They buy drinks in plastic bottles (PET bottles) at their schools and drink them inside the schools, and finally just throw away the bottles as not recyclable waste but general waste.
2. Schools would like to decrease the amount of their waste. They think that the promotion of recycling in the schools would be very effective because students can learn about environment, and the schools can utilize the money by selling the recyclables.
3. Recycling companies would like to get a large amount of recyclable waste at once in order to reduce their collection cost.

a.2 Selection of pilot school

Two pilot schools below were nominated by C/P. SJET had visited those schools with C/P and agreed to choose them as the pilot schools.

1. Santiphab Secondary School (3,578 students, 74 classes)

This school has been conducting PET bottle recycling activity. Usually the PET bottles are stored in the class rooms and students bring them to the school yard every Thursday. About 60kg of PET bottles are collected every week. Teachers buy them at 1,000kip/kg and the money will be saved in the Class Fund. The PET bottles that the teachers buy from the students are stored in a small room. When the room is full, the school calls the collection company and sells them at 1,800kip/kg. The balance of 800kip goes to the school's common budget.

The school doesn't force the students to bring PET bottles from their houses. Only PET bottles consumed at the school are collected. The school requests woven wire storage because the current room of storage is too small. In addition to that, the storage will be a symbol of the activity.

2. Pongkham Secondary School (600 students, 14classes)

There was no recycling activity, but the school teachers were keen to start. It was because most of teachers of this school were from Santiphab School and worked for the commencement of PET bottle collection there. However, the school did not have a storage area. PET bottles used to be collected before and stored in the back yard, but they were stolen. The collection system they assumed was that every day the students would put the PET bottles into separation waste bins

before leaving the school, and the teachers would bring them to the storage.

b. Study of separation, collection and selling method

After the discussion with C/P and the pilot schools, the separation, collection and selling method for each school was decided as follows.

Table 3-6. Outline of the School Recycling PP in LPB

	Santiphab Secondary School	Pongkham Secondary School
Target waste	PET bottles	
Methods	The students store PET bottles in the class rooms. On a designated day of the week, the responsible students of each class bring the PET bottles to a certain place and hand over them to a responsible teacher. The PET bottles are then stored in a storage facility and when the facility is full, a buyer will be called.	Wheeled bins are located in the middle of school buildings. The students put PET bottles every day after they finish the classes. Responsible teachers bring the PET bottles to a storage facility. When the facility is full, a buyer will be called.
Payment rate	<ul style="list-style-type: none"> • At the handing over of PET bottles from classes: 1000kip/kg to be saved as a class fund. • At the sale to the collector: 1800kip/kg, the balance to be saved for school 	<ul style="list-style-type: none"> • At the handing over from the students to the teachers: No payment. • At the sale to the collector: 1800kip/kg in expectation.

c. Procurement of equipment

In August 2014, SJET procured the following equipment.

- Santiphab Secondary School
4 storages for recyclable wastes (with net capacity of 8m3)
- Pongkham Secondary School
2 storages for recyclable wastes (with net capacity of 8m3)
8 wheeled garbage bins (120L)

d. Preparation of education tools

In August 2014, SJET made a poster for explaining the separation and collection methods of recyclable waste for each school and delivered it to the classes.

4. Implementation

a. Delivery of equipment and instruction of method

On September 16, 2014, handing over ceremony of the storages and the garbage bins was held at Santiphab Secondary School with the attendance of people concerned of both pilot schools. Instructions of the PET bottle's separation and collection methods were given to the teachers and students together with the delivery of the posters.

b. Monitoring and awareness raising

After the delivery of the equipment, DONRE and UDAA have conducted monitoring regularly.

At the request of the pilot schools, lessons of the recyclable waste separation and awareness raising education of general waste problems were given at Pongkham School on February 2, 2015 and at Santiphap School on February 3, 2015.

A handbook for explaining the general waste problems was procured so that the teachers could continue to educate students after the completion of the project. A video which explains the objectives and the contents of the school recycling activity was also made for further dissemination by C/P.

5. Evaluation and Achievements

Achievement status of the PP is shown in the chart below.

Indicator	Means of Verification	Achievement Status
Indicator 2.1. 3Rs are promoted.		
1. The school recycling activities continue at the two pilot project schools.	1. LPPE Progress Report	Achieved. As of June 2015, both pilot schools still continue the project.
Indicator 3.2. The residents participate the 3Rs activities.		
1. The cooperation rate of the school recycling at the PP schools is more than 50% of total numbers of classes.	1. Information from the schools	Achieved. As of June 2015, 100% of the classes cooperates the project.

In addition to the achievements above, Pongkham School started to collect papers and cardboards besides PET bottles. In conclusion, the project purpose was achieved.

6. Suggestion for the Post-Project Activities

a. Plus factor for the successful implementation of the PP

The reasons why this PP successfully implemented are considered as follows:

1. School was chosen as a pilot site.
2. The project didn't make students to bring their recyclable wastes from home.

Since there are informal collectors who push a cart to collect recyclable wastes from house to house, people tend to separate their recyclable wastes at home and sell them to the collectors in order to get small amounts of money. If the project ignored this current recycling system and tried to disturb it by forcing the students to bring their recyclable wastes from home, this PP might not continue. Though some donors or international organizations had built Waste Bank at village offices or schools in the past, in order to promote community based recycling, none of those activities is still active, as far as SJET knows. School seems to be an ideal place for this recycling project because the money generated through the project would be easily managed; the money can be used for buying school's equipment or for school's activities.

b. Criteria for the selection of new school

For further dissemination of the project, new pilot school should be selected in accordance with the criteria as follows:

1. Is there enough recyclable wastes generated at the school? Some schools especially in the rural area don't generate a large amount of recyclable waste.
2. Is there any collection company come to the school to buy the recyclable wastes?
3. Is there any teacher who is active for the environmental beautification activity? Careful instructions and leadership of the teacher are needed at the beginning of the project.

c. Cooperation with CSR activity of private company

Some schools don't have place for storing recyclable waste or budget for the construction of the storage, even though they would like to implement the recycling activity. With regards to the budget for storage construction, not only donors but private companies who are interested in CSR activities also have high opportunity to support the budget. Therefore, it is recommended to ask those companies for the budget by using the dissemination video.

d. Importance of teaching "Reduce"

This PP was realized by the current situation that students consume a large amount of PET bottles at the schools. However, it is important to teach the students not only recycling but also reducing. Unlike in Japan, students cannot drink tap water in the schools, so it would be difficult for students to refuse the PET bottles totally. However, behavior toward reducing the amount of waste in the daily life needs to be taught to the students.

1.1.3 a. Avoidance of the use of excess packages such as plastic shopping bags (Eco-basket)

1. Project Purpose and Summary

The purpose of this project is to encourage households and stalls in LPB to refuse unnecessary use of plastic bags in order to reduce the number of plastic bags discharged as waste.

Two villages were selected as a pilot village. Project delivered eco-baskets to every household in the two villages. The objectives of the PP and instructions on the use of the baskets were explained to the households. The eco-baskets were also delivered to some of the shoppers and sellers in the pilot market. Awareness raising activity was also given in order to facilitate the attention of the basket users on reducing the use of excess plastic bags.

2. General Concept

DONRE and UDAA were selected as a main counterpart and had discussions with SJET to design the project plan. Since the main actor of promotion and expansion of eco-basket PP should be transferred from SJET to C/P transitionally, project's phase was decided to be divided into two; Phase I, which is mainly managed by SJET with a purpose of OJT to C/P and Phase II, which is mainly managed by C/P.

Table 3-7. Outline of the Plan for Eco-basket PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, SJET	■				
	Set up concept	DONRE, UDAA, SJET	■				
Planning of PP	Study and selection of pilot area	DONRE, UDAA, SJET	■■■■				
	Procurement of equipment	SJET		■			
	Preparation of education tools	DONRE, UDAA, SJET		■			
Implementation of PP	Delivery of equipment and instruction of use	DONRE, UDAA, SJET		■■■■■			

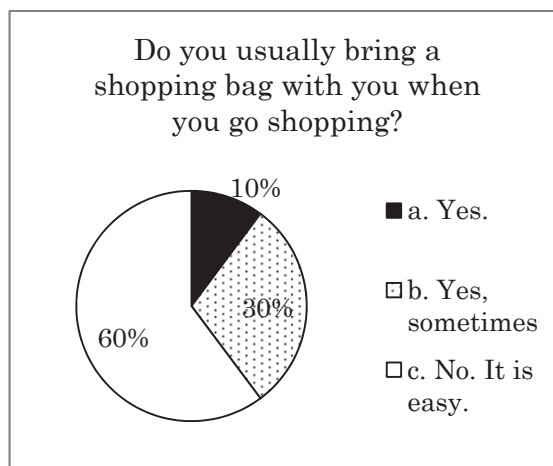
Monitoring and awareness raising	DONRE, UDAA, SJET						
Evaluation of the PP	DONRE, UDAA, SJET						
Suggestion for dissemination by C/P	SJET						

3. Planning

a. Study and selection of pilot area

a.1 Study of current situation of plastic shopping bag

According to the Public Opinion Survey (POS) conducted before the implementation of the PP, in May 2013, 15% of interviewees answered “Yes, often” to the question of “Have you ever refused plastic shopping bags at shops?”, and 10 % of interviewees answered “Yes” to the question of “Do you usually bring a shopping bag with you when you go shopping?”. The details are shown in the chart below.



a.2 Selection of pilot area

In the three pilot villages of the “PP for Reduction of kitchen waste and garden waste at households”, two villages namely Vatthaat village and Pakham village were selected as a pilot village because those villages are located in the center of the town. As for the pilot market, criteria for the selection were as follows:

1. Market which is located near the two pilot villages
2. Market whose size is comparatively big.
3. Market’s owner is cooperative for the reduction of plastic bag use.

After the consideration, Taheua Market was selected to be a pilot market as it met the criteria above.

b. Procurement of equipment

SJET was supposed to promote eco-bags as a substitution of plastic shopping bags, but “eco-baskets” instead of eco-bags were chosen as a tool for reducing plastic bags, because most of the participants preferred eco-baskets rather than eco-bags for its convenience to put wetty fresh foods.

In May 2013, SJET delivered 1,482 eco-baskets. Each basket was tagged with logos of LPPE and JICA.

c. Preparation of education tools

In May 2013, SJET made a leaflet for explaining the objectives and the methods of plastic bag reduction.

4. Implementation

a. Delivery of equipment and instruction of use

In May 2013, opening ceremony for the awareness-raising signboard at the pilot market was held. The eco-baskets and leaflets were delivered to some of the shoppers and the sellers in the market at the same time. Instruction and awareness raising activity for plastic bag reduction were also given in the two pilot villages. The eco-baskets and leaflets were delivered to every household.

As for Phase II, a total of 800 eco-baskets were delivered at 10 new places by C/P. C/P also gave instructions and carried out awareness raising activities to the participants.

b. Monitoring and awareness raising

Since the delivery of equipment, DONRE together with UDAA had conducted monitoring regularly. As a tool for raising awareness, publicizing stickers were produced and script for broadcasting through the market's public-address system was prepared.

5. Evaluation and Achievements

Achievement status of the PP is shown in the chart below.

Indicator	Means of Verification	Achievement Status
Indicator 2.1. 3Rs are promoted.		
1. Plastic shopping bag reduction activities are started at one or more new places under the instruction of the C/P.	1. LPPE Progress Report	Achieved. C/P delivered eco-baskets at 10 new places with giving instructions and raising awareness.
Indicator 3.2. The residents participate the 3Rs activities.		
1. The rate of the households that refuse plastic bags as many as possible to all the households in all the pilot villages: 30%	1. MONRE Monitoring Report and Information from the chief of the village	Achieved. As of March 2015, 55% of the households try to refuse plastic bags.
2. The rate of the stalls that cooperate plastic bag reduction to all the stalls in all the pilot markets: 30%	2. Information from the stalls	Achieved. As of March 2015, 81% of the stalls cooperate plastic bag reduction.

In conclusion, the project purpose was achieved.

6. Suggestion for the Post-Project Activities

a. Importance of raising stalls' awareness

According to an informal interview with the participants, it was found that some stalls automatically put their goods into plastic bags before the participants refuse, even though the participants bring their eco-baskets. It shows that the reduction of plastic bag will not succeed if there is no cooperation not only from the shoppers but also from the sellers. Therefore, it is important to raise stall's awareness enough to enable the shoppers to avoid using unnecessary plastic bags.

b. Continuous awareness raising

The participants who said “I rarely use the eco-basket” explained their reasons as follows:

- I always forget to take the eco-basket when I go shopping.
- I usually go to market directly from my office after I finish work, but I don’t take the eco-basket to my office when I go to work in the morning.

Though they don’t use their eco-baskets, they replied that they understand the importance of the plastic bag reduction. It shows that many people “understand but do not make action”. Since changing people’s behavior would take time, it is important for C/P to raise people’s awareness continuously.

c. Priority stores for post-project activities

During the planning of the PP, SJET introduced some examples of plastic bag reduction in Japan: Shops charge their customer for the plastic bags, shoppers can get some rewards or discounts from the store when they refuse plastic bags, etc. However, the owner of the pilot market refused to make those trials because he said it would be very difficult to control stalls as the market is made up of more than 80 of the stalls and the turnover of the stalls is quite high. Therefore, this PP only carried out awareness-raising activities for the shoppers and the sellers. If C/P would like to attempt the new approach rather than simple awareness raising, it might be effective to start from the shops of imported goods and foods or souvenir shops, because foreign customers are relatively many and they tend to be environmentally conscious.

If the new method for reducing the plastic bags is successfully established at the stores aforementioned, it can be applied to other shops.

1.1.3 b. Avoidance of the use of excess packages such as plastic shopping bags (Eco-bag)

1. Objectives and Project Summary

The objective of this project is to encourage tourists in LPB to refuse unnecessary plastic bags in order to reduce the amount of plastic bags discharged as a waste.

The project procured Eco-bags to the pilot hotels and guesthouses in LPB. The pilot hotels and guesthouses encouraged their guests to borrow the eco-bags in order to reduce the use of unnecessary plastic bag.

2. General Concept

DONRE and UDAA were selected as a main C/P and had discussions with SJET in order to design the project plan. C/P asked Luang Prabang Hotel, Guesthouse and Restaurant Association to publicize the project in order to increase the number of hotels and restaurants to join.

This PP and the PP on “the promotion of recycling at off-site by composting” to be described next together formed an “Eco-Stay Project”.

Since the delivery of equipment, DONRE together with UDAA had conducted monitoring regularly. As a tool for publication, general information and the participant list of the PP were posted at the website of the Ministry of Information Culture and Tourism. The implementation of the PP was also reported and aired by Lao National TV. Eco-stay Project Promotion Seminar was held twice in order to increase the membership of the PP.

5. Evaluation and Achievements

Achievement status of the PP is shown in the chart below.

Indicator	Means of Verification	Achievement Status
Indicator 2.1. 3Rs are promoted.		
1. More than 30 hotels/guesthouses participate in the plastic shopping bag reduction project.	1. LPPE Progress Report	Achieved. 21 hotels and 9 guesthouses joined the eco-bag PP.

In addition to the achievement above, Maison Suvannaphoum hotel, one of the PP members, started to provide the eco-bag service for guests by using the hotel's own eco-bags that were prepared by its own budget.

In conclusion, the project purpose was achieved.

6. Suggestion for the Post-Project Activities

a. Management system of the eco-bags

At the beginning of the implementation of the PP, some staffs of the hotels/guesthouses who didn't understand the objectives of the PP took the eco-bags for their own use or gave them to the guests without any consultation. Though these happened in limited cases, it is necessary for the responsible person to inform every staff about the objectives of the eco-bags.

There are two ways to let the guests use the eco-bags as follows:

1. The hotels keep the eco-bags at the reception and guests can borrow there.
2. The hotels put the eco-bags inside the guest room as a hotel's equipment and let the guest borrow it freely.

Hotels or guesthouses chose one of the ways which is suitable for their situation. In the case of keeping the eco-bags at the reception, the bags are seldom taken away because the staff can easily manage. On the other hand, in the case where the bags are set inside the guest room, it often happens that some bags are taken away in spite of instructions given in the guest room. In order to prevent those losses of the bags, some of the hotels taught house-keeping staff to check whether or not the bag is inside the room when guest check out. It would be important for the members to make that kind of eco-bag management system before the implementation of the PP.

b. Collaboration with CSR activity of private company

Unlike Maison Suvannaphoum hotel aforementioned, most of the hotels/guesthouses don't have enough budget for the activities that would not directly lead to profit. Therefore, if all of the eco-bags were lost, PP would be stopped because the limited budget of the hotels/guesthouses doesn't allow them to buy additional bags. However, private companies who are interested in CSR activities for example, might be able to utilize the eco-bags in order to appeal that they are environmentally conscious. They can also use the bags as a publicizing tool by printing their logos or characters with the bags. It is recommended to find such active companies to ask for the

budget.

1.1.4 Reduction of kitchen waste from hotels and restaurants

1. Project Purpose and Project Summary

The purpose of this project is to reduce the final disposal amount of kitchen waste from hotels and restaurants by composting.

Pilot hotels and restaurants separately discharged their kitchen wastes, and UDAA collected them to make compost at the landfill.

2. General Concept

DONRE and UDAA were selected as a main C/P and had discussions with SJET in order to design the project plan.

C/P asked the Lunag Prabang Hotel, Guesthouse and Restaurant Association to publicize the project in order to increase the number of the hotels and restaurants join.

This PP and the PP on “the promotion of eco-bags” described previously together formed an “Eco-Stay Project”.

Table 3-9. Outline of the Plan for the Off-site composting PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	UDAA, DONRE, SJET	■				
	Set up concept	UDAA, DONRE, SJET	■				
Planning of PP	Study and selection of pilot area	UDAA, DONRE, SJET	■				
	Study of composting method	SJET		■			
	Facility design and procurement of equipment	SJET		■			
	Preparation of education tools	UDAA, DONRE, SJET		■	■		
Implementation of PP	Civil works, delivery of equipment and instruction of method	UDAA, DONRE, SJET		■	■		
	Contents analysis of the compost	SJET			■		
	Monitoring	UDAA, DONRE, SJET			■	■	■
	Evaluation of the PP	UDAA, DONRE, SJET				■	
	Suggestion for dissemination by C/P	SJET				■	

3. Planning

a. Study and selection of pilot area

According to the SJET’s interview to the hotels and restaurants in LPB, most of the hotels and restaurants did not separate the kitchen waste and discharged them together with other waste.

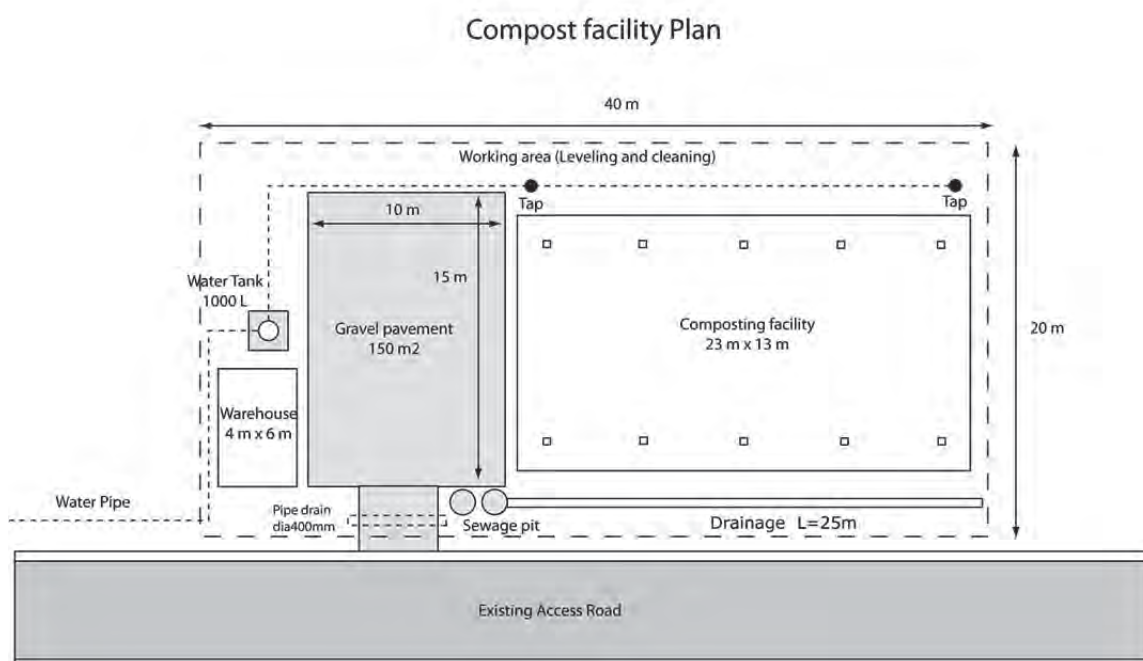
One of the hotels used to attempt composting, but they stopped because of the smell and insanitary conditions. Some of the hotels have farm or garden. Herbs or vegetables that were planted at the farm or garden are served to the guests at their restaurant. Needs of the compost seemed to be high because the hotels would like to use compost rather than chemical fertilizer so that the guests would feel safe and satisfied.

b. Study of composting method

Taking account of the project sustainability and estimated waste amount to be received, the windrow composting method not employing machinery but using manpower was selected.

c. Facility design and procurement of equipment

SJET designed an off-site composting facility along the access road of the KM8 disposal site as shown below.



Also, SJET procured a pick-up truck for collection and transportation of the kitchen waste which is also used for the collection of healthcare waste. 120 Barrels for storage of the kitchen waste were procured.

Moreover, a chopping machine was additionally procured after compost production started in order to produce homogeneous compost with high quality. The chopping machine does not cut soft foreign materials such as plastics into pieces. This later turned out to be very effective in the sieving process.

d. Preparation of education tools

In August 2013, SJET made a leaflet which explains the objectives of the PP including the participants list of the member.

In December 2013, SJET made a poster which instructs the way of kitchen waste separation, and delivered it to the members.

4. Implementation

a. Civil works, delivery of equipment and instruction of method

The construction of the off-site composting facility was completed in July 2013.

In November 2013, the barrels, leaflets and posters were delivered to the member's hotels/restaurants. C/P gave instructions and delivered the equipment whenever hotels/restaurants newly joined the PP.

The off-site compost operation procedure was instructed to UDAA by SJET as below.

- i) Every Tuesday and Friday, UDAA's new pickup truck goes to the participating hotels and restaurants, collects the waste barrels with food scrap and leaves empty barrels for the next waste storage.
- ii) The truck brings the barrels to the composting plant. The workers empty the barrels of food waste onto part of platform, which has a gentle slope so that water contained in waste can be drained.
- iii) On the next collection day, the windrow piles should be turned over in an order of age. The waste which was delivered on the previous collection day is finally piled.
- iv) The composting process has primary fermentation for 20-30 days and secondary fermentation for 30-60 days. During those periods, the windrow piles should be turned over once or twice a week.
- v) After fermentation, the compost undergoes the processes of chopping and sifting through a 6 mm mesh sieve. Further sifting through a 6 mm mesh sieve is needed when the customer demands fine compost.

b. Monitoring and awareness raising

DONRE and UDAA conducted the monitoring regularly. As a publicizing activity, general information and the participants of the PP were posted at the website of the Ministry of Information, Culture and Tourism. The contents of the PP and the interview to the members were also aired by Lao National TV. Eco-stay Project Promotion Seminar was held twice in order to recruit new member.

As a tool of dissemination, a off-site composting video which explains the objectives of the PP and the procedures of composting was procured.

5. Evaluation and Achievements

Achievement status of the PP is shown in the chart below.

Indicator	Means of Verification	Achievement Status
Indicator 2.1. 3Rs are promoted.		
1. More than 30 hotels/restaurants participate in the off-site compost project.	1. LPPE Progress Report	Achieved. 8 restaurants and 22hotels participated in the off-site composing project.
2. Compost is produced at the off-site compost plant.	2. LPPE Progress Report	Achieved.

6.5 ton of waste was received in April 2015, which was the end of the high season of tourism in Luang Prabang, as the rainy season would start soon. The outbreak of MERS also affected the number of Korean tourists. As a result, the waste amount received dropped to 3.55 ton in May, 1.5 ton in June and 1.0 ton in July.

In addition to the achievement above, some analyses were carried out to know its quality

including toxic substances analysis by the National University of Lao, nutrients analysis by Plant Protection Center (Ministry of Agriculture and Forestry, Department of Agriculture) and field application test by Clean Agricultural Development Center (Ministry of Agriculture and Forestry, Department of Agriculture). As a result, the product was validated to have sufficient quality to be compost.

UDAA used to apply the compost product for its own tree planting works, but started to explore its market to make a profit from compost. At the time of reporting, UDAA reached agreement of compost sale with one hotel and is negotiating with several member hotels and schools.

In conclusion, the project purpose was achieved.

6. Suggestion for the Post-Project Activities

Since the turning over of the compost piles is very hard work, UDAA is recommended to get enough budgets to increase the number of the staff who works at the compost plant.

Strategy 2. Waste collection system is improved.

Approach 2.1: Improvement of existing collection and discharge system

2.1.1/2.1.2 Primary collection system

1. Project Purpose and Summary

This PP aims to improve a discharge and collection system for general waste which generates from households in LPB.

The PP, after selecting 6 pilot villages, introduced a primary collection system, using wheeled waste bins, to households who live on inaccessible streets for waste collection vehicle, so that it could lead 1) To make waste collection service more efficient, 2) To make a waste discharge rule more convenient for people, and 3) To keep the collection points clean.

Also the project aimed to promote the separation of recyclables so that they were diverted from the waste collection system as much as possible.

2. General Concept

Even though the collection service has been provided in the central area of the city, UDAA had been concerned about inconvenience and inefficiency found along the narrow alleys, which are inaccessible for collection vehicles.

In such a situation, 10 villages which seemed to be facing such problems were invited to a meeting. As a result of the discussion, 3 villages were selected as the pilot sites for Phase I.

The implementation was planned to be conducted in 2 phases considering technical transfer. As for Phase I, pilot project was implemented by SJET's initiative in the 3 villages. As for Phase II, the implementation was conducted by UDAA's initiative in other 3 villages which were selected by UDAA based on the experience of Phase I.

Table 3-10 Outline of the Plan for Introduction of Primary Collection System PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule			
			2012	2013	2014	2015
Project Planning	Set up project management system	SJET, UDAA, DONRE	■			
	Set up concept	SJET, UDAA, DONRE		■		
Planning and Preparation PP	Study and selection of pilot area	SJET, UDAA, DONRE		■		
	Collection system determination	SJET, UDAA, DONRE		■		
	Procurement of equipment	SJET		■		
	Preparation of education tools	SJET, UDAA, DONRE		■		
Implementation of PP	Delivery of equipment and instruction of method	UDAA, DONRE, SJET		■		
	Monitoring and awareness raising	UDAA, DONRE, SJET			■	■
	Pre-dissemination by C/P	UDAA, DONRE			■	
	Evaluation of the PP	UDAA, DONRE, SJET				■
	Suggestion for dissemination by C/P	SJET				■

3. Planning

a. Baseline Survey

In connection with the PP on waste collection service planning to be described later, the PP decided to carry out a baseline survey and to take an overview of all the 117 villages in LPB district to gain a hint for a direction of improvement. This contributed to show how to select pilot villages and figure out the form of pilot project.

As a result of the baseline survey, the overview of 117 villages in LPB district is summarized as follows. The primary collection PP is supposed to be effective in [1] to [3] in the table below.

Table 3-11 Overview for waste collection improvement in LPB

		Class	Villages Served	Total villages	Problems	Proposal for improvement on existing collection system
Urban	World heritage area	[1] Central Urban	15	15	Some residents who live along with inaccessible alleys for vehicles are forced to carry their garbage to collection points when the vehicles come close. Therefore some people think the collection service is inconvenient.	To make residents manage and discharge wastes on duty giving communities hand-cart due to that there is few space to put container.

	[2] Urban	7	7	It is not beautiful scenery since garbage in plastic bags is put on throughout the street. It is not so efficient because almost they collect from house to house so that vehicles make move and stop in short interval.	Although they have relatively less problem compared to other classes, it is possible to install containers at some area to follow currently several containers is installed, or to specify some collection point on trial to avoid house-to house collection.
	[3] Sub urban	29	29	Some residents who live along with inaccessible alleys for vehicles are forced to carry their garbage to collection point while the vehicle closely came. Therefore some people think the collection service is inconvenient. And also a part of residents has no service itself due to the difficulty of access for vehicles	It is possible to install container at the area which has space. Or to make residents manage and discharge wastes on duty giving communities hand-cart.
Rural	Accessible [4] Close to main road	12	42	Although distance depends (about from 10 km to 30km) basically they are far from central area so that it takes long time and high cost for collection service. The farthest village among those already served is 13km away from central area. Also It is not so efficient because almost they collect from house to house.	For the place where is away more than 10km from central, it should be shifted to container collection which require low collection frequency rather than house-to-house collection. And also for within 10km area, to specify some collection point on trial to avoid house-to house collection.
	Difficult to access [5] Remote	0	24	Currently there is no remarkable problem since any collection service is not provided to this area. Though necessity of service seems to be low if they expand service up to here it can be thought low accessibility will be quite obstacle.	Collection service itself is not performed.

b. Determination of waste collection method

Waste bins with wheels will be provided to the groups of residents who live along streets inaccessible to the waste collection vehicles and managed by them on a rotating basis. The household on duty during a particular period will collect waste from other households of the group and bring it to the nearest waste discharge point on the collection day. This will establish a primary waste collection system, whereby the convenience and efficiency of waste collection will be improved.

c. Selection of pilot area

The problem should exist in [1]Central Urban (15 villages) and [3]Sub urban (29 villages). It means that 44 villages potentially have this type of problem. From the viewpoint of practicability,

the C/P initially selected 10 villages as candidates as below.

Table 3-12 Villages first selected

Category	Name of village group	Name of village	Number of household	Current service provider
Central Urban	Wat Thad	Hua Xieng	67	UDAA
	Wat Thad	Wat Thad	59	UDAA
	Vi Soun	Meun Na	98	UDAA
	Vi Soun	A Phay	63	UDAA
Urban	Wat Thad	Thad Luang	168	UDAA
Sub Urban	Wat Thad	Say Lom	136	SaynamKhan co
	Vi Soun	Thad Bosoth	112	SaynamKhan co
	Meuang Nga	Phon Saad	169	UDAA
	Meuang Nga	Had Hien	316	UDAA
	Pha Korm	Sarng Korng	95	UDAA

The representatives of these villages gathered at a workshop, where the content of the pilot project was explained and group discussion was facilitated by UDAA. As a result, the following three villages were finally selected.

Table 3-13. Pilot 3 villages in Phase I

Category	Name of village group	Name of village	Number of household	Current service provider
Central Urban	Wat Thad	Hua Xieng	67	UDAA
	Wat Thad	Wat Thad	59	UDAA
Sub Urban	Vi Soun	Thad Bosoth	112	SaynamKhan co

As for Phase II, UDAA would initiatively decide the villages after certain progress of phase I in a proper period.

d. Preparation and implementation survey

After target area being selected, preparation and a fact finding survey were conducted prior to the actual improvement. The procedure is outlined in following table.

Table 3-14. Procedure for preparation and implementation survey

---Prerequisite		Completed/ Year 2013
1	To re-explain outline of the pilot project/What is Community base Primary collection/	February
2	To ask the village chives to nominate the person responsible for the project on voluntary base in order to educate households	February
3	To ask village chives to provide the village map	Skipped
---On-site survey, interview		
4	To take GPS data	April
5	To ask general information such as current collection schedule, point and system.	April
6	To determine the unit boundary on the map	April
7	To ask filling out household list to be participated in the project	April
8	To divide into "Group" based on above information	April

Through this procedure, it was found that there was no necessity to improve Wat Thad. Apay

village was selected as pilot village instead of Wat Thad village.

Table 3-15. Pilot 3 villages and groups in Phase I (Confirmed)

Village	Total / People/	Number of Households	Number of Groups
Huaxieng	141	30	6
Thadbosoth	452	70	16
Apay	201	37	11
Total	794	137	33

e. Procurement of material

80 wheeled waste bins with 240L capacity were procured for being used in primary collection based on the fact finding survey.

f. Leaflet for discharging rule

The residents are divided into groups and one group is basically composed of about 5 households. Every group must manage their wheeled garbage bin of 240L distributed by the PP. The groups decide how to manage garbage bins based on the discussion among the group. For instance, each household of a group manages the bin by a weekly rotation; divide the group into two sub-groups to manage the bin alternatively; or, in case where a proper place is available, the group can place the bin there. Each group has to bring the bin to the collection point by specified time on twice-a-week collection days in a manner of separation and discharge described in a leaflet.

The rules and manner of separation and discharge applied in the PP are listed as below.

Table 3-16 Discharging rule described in leaflet which is distributed for primary collection

Collected	1.	General Waste	To be discharged at specified collection point on the collection date being put in the garbage bin provided by the project
	2.	Green Waste	Large trees must be cut into separate pieces and be tied up to discharge at specified collection point on the collection date
	3.	Fragment of Glass or Ceramic	To be discharged at specified collection point on the collection date being put in a plastic bag
Not collected	4.	Recyclables (Glass-Bottle, Can or Pet-bottle)	To be stored for certain period at home to sell it to recycling dealers who periodically visit around villages.
	5.	Construction Waste (Brick or Block)	Not collected by the ordinary waste collection service. They must be discarded with extra service charge or be individually carried to the disposal site.

* Garbage of #1. to #3. is be collected in the same schedule, and #4. and #5. are basically not collected.

Table 3-17 Primary items described in leaflet

1.	Name of group leader	4.	Waste collection point
2.	Contact number of the leader	5.	List of group member
3.	Location and method for managing the garbage bin	6.	How to separate and discharge the waste

As shown above, UDAA showed its policy not to collect the recyclables and to encourage the households to sell them to the dealers. It aims to raise the public awareness of 3Rs.

4. Implementation

a. Dissemination of the rule, public meeting

In June 2013, after the public meetings for each target household, wheeled waste bins and leaflet were distributed to commence the primary collection from August.

b. Monitoring

After the introduction of primary collection, monitoring by MONRE and the third parties such as a project evaluation team and the PP workshop members was carried out. Particularly MONRE monitored the progress in regular monitoring tour every three months.

The monitoring in Feb 2014 revealed some problems as follows;

It appeared in Villages Apay and Huaxieng among three that (i) the residents are not adequately aware of the activity and do not cooperate sufficiently, (ii) the village chiefs were changed and project visibility becomes low, (iii) tourists often mistake the containers for public dust bins and put waste into the containers which were left on the street after the primary collection, and (iv) the containers may be broken as the waste collection workers handle them so roughly. In the other village, Thadbosoth, the primary collection is going well.

MONRE and UDAA discussed the necessary actions to be taken, and concluded that the following should be conducted.

- 1) UDAA will directly talk with village chiefs.
- 2) Community meetings will be held to raise the awareness of the residents.
- 3) The waste collection workers will be properly instructed.

Actually, MONRE in cooperation with UDAA held an awareness raising meeting in March.

c. Result of implementation

During the planning period, only 3 pilot villages of phase I were selected. Considering the progress in Phase I, UDAA selected new 3 villages as pilot following the implementation procedure of phase I, and introduced primary collection. Below table illustrates the result of implementation of each phase.

Table 3-18 : The status of introduction of primary collection in LPB

	Village	Alley street	Total HH living in alley street	Population	Number of groups	Number of garbage bins provided
Phase I	Huaxieng	3	30	141	6	6
	Thadbosoth	4	70	452	16	16
	Apay	3	36 + 1 temple	201	11	11
Phase II	Viengmay	6	82	436	23	23
	Naviengkham	3	31	145	7	7
	Viengsay	2	13	75	5	5
	Thadbosoth				9	9
Total		21	262 + 1 temple	1450	77	77

5. Evaluation and Achievements

Table 3-19. Evaluation and Achievements of PP for Introduction of Primary Collection

System in LPB

Indicator	Means of verification	Achievement status
Indicator 2.2. The solid waste collection system is improved.		
1. The activities of the existing collection improvement and the promotion of recyclables discharge PP are implemented in one or more new villages under the instruction of the UDAA and DONRE.	1. LPPE Progress Report	Achieved. UDAA has already introduced primary collection service in the new 3 villages.
Indicator 3.2. The residents participate the 3Rs activities.		
1. The rate of the cooperating households to all the households covered by the existing primary collection system project is more than 70%	1. MONRE Monitoring Report and Information from the chief of the village	Achieved. It was 89%.
Indicator 3.3. The residents cooperate with the waste collection system.		
1. Waste management groups are established in the pilot villages of the primary collection system project.	1. Group member list	Achieved. Primary collection share groups have been established in the former 3 villages and the new 3 villages respectively.
2. The rate of the cooperating households to all the households covered by the existing primary collection system project is more than 70%	2. MONRE Monitoring Report and Information from the chief of the village	Achieved. It was 90%.

In addition to the abovementioned achievement of PP indicators, PP implementation resulted in following outcomes.

- There is no more garbage littered around the collecting points. This improvement contributes to keep favorable landscape in the central area, as a world heritage site. Therefore, the effect of this improvement is recognized by people.

6. Suggestion for the Post-Project Activities

Although the primary collection is an effective way to increase the waste collection contract, it necessitates initial investment as it requires waste containers.

However, those who discharge waste in the central area are responsible for preventing garbage from being littered and keeping favorable landscape as LPB is the world heritage site. Therefore it is important to emphasize the effect and importance of the primary collection which were recognized through the pilot project. By doing so, it is expected that the village leaders and/or the residents would be willing to buy the waste bins.

Approach 2.2: Expansion of waste collection service area

2.2.1 Waste collection service planning

1. Project Purpose and Summary

This PP aims to formulate a waste collection service plan in LPB district in order to expand the waste collection service area.

The plan is formulated based on the situation in 2013 for whole LPB with around 117 villages toward target year 2020.

2. General Concept

UDAA had been concerned about the villages not covered by collection service in LPB, and intended to expand waste collection service to improve it in future. While it is indispensable to formulate a plan from a long-term point of view, it was difficult to do so since information was not organized quantitatively and visually.

Therefore, firstly the situation of collection service in 2013 was studied. This information was visualized by using GIS application. Based on the situation in 2013 and visualized data, UDAA set the target figure about coverage of collection service in 2020. This was also visualized by GIS.

Table 3-20. Outline of Waste Collection Service Planning

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Baseline Survey	The first determination of present waste stream flow-chart	SJET, UDAA, DONRE	■				
	Detailed survey	SJET, UDAA, DONRE	■				
Drafting the Plan	Sharing the survey result among stake holders	SJET, UDAA, DONRE		■			
	Discussion and consideration internally by the local authority	UDAA		■			
	Drafting the plan in rough scale	SJET, UDAA, DONRE		■			
Review and Updating the Plan	Monitoring and watching the progress concerned about solid waste management	UDAA			■	■	
	Reviewing and detail planning comparing between the draft and latest situation	UDAA					■

3. Current situation survey

a. Calculation and prediction of population and household

Since proper statistical population data of 2013 was not available, population up to 2020 was estimated based on existing information of 2009 population and the annual population growth rate at 1.80% which is figured out from Socio-economic Development Plan (2009-2015).

It was assumed that the ratio of population in each village would not change even though population increased. This means that the population of each village would increase in

proportion to total population increase. The value of year 2010 from “Table of statistics poverty assessment 2011” was applied as basic information for population ratio of each village.

As for the number of household, for the information of average size of household was obtained from census 2006. It was also assumed not to change until 2020.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Population	80808	82263	83743	85251	86785	88347	89938	91557	93205	94883	96591	98330

Source: Socio-economic Development Plan (2009-2015)

Table 3-21. Population predict of each year

	Number of village	2009	2013	2020
[1] Central Urban	15	5746	6171	6993
[2] Urban	7	5968	6409	7262
[3] Sub-urban	29	34263	36794	41688
[4] Close to main roads	42	25787	27696	31382
[5] Remote	24	9044	9715	11005
Total	117	80808	86785	98330

b. Situation of waste collection service coverage in 2013

SJET and UDAA cooperated to summarize the situation in 2013 into the table below.

Table 3-22. Waste Collection Coverage Status in 2013, LPB (the number of villages and households by service providers)

Number of village	Number of Villages				Number of Households			
	UDAA	Private	No Service	Total	UDAA	Private	No Service	Total
[1] Central Urban	15			15	1,104			1,104
[2] Urban	7			7	1,113			1,113
[3] Sub-urban	16	13		29	3,803	2,852		6,656
[4] Close to main roads		12	30	42		2,058	3,165	5,224
[5] Remote			24	24			1,833	1,833
Total	38	25	54	117	6,020	4,911	4,999	15,930

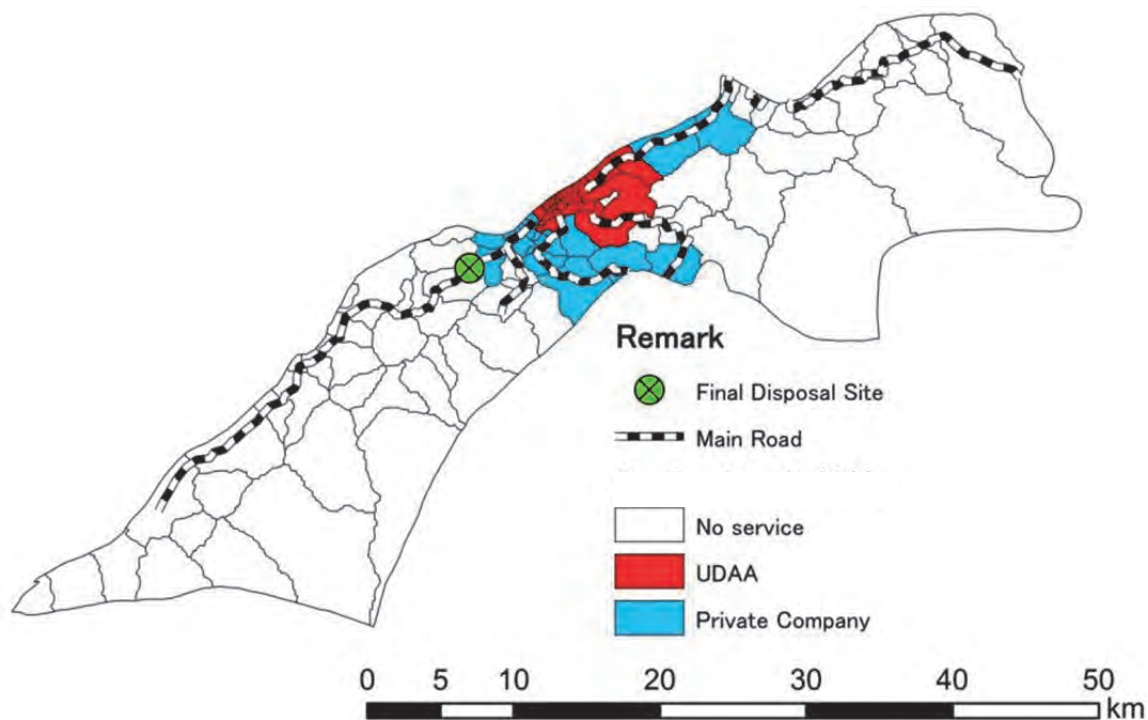


Figure 3-1 Waste Collection Coverage Status Map in 2013

4. Implementation (Determination of waste collection service plan)

a. Target of waste collection coverage in 2020

Table 3-23. Target of Waste Collection Coverage in 2020, LPB (the number of villages and households by service providers)

Number of village	Number of Villages				Number of Households			
	UDAA	Private	No Service	Total	UDAA	Private	No Service	Total
[1] Central Urban	15			15	1,251			1,251
[2] Urban	7			7	1,262			1,262
[3] Sub-urban	16	13		29	4,309	3,232		7,541
[4] Close to main roads	10	12	20	42	1,361	2,332	2,226	5,919
[5] Remote	8		16	24	716		1,361	2,077
Total	56	25	36	117	8,898	5,564	3,587	18,049

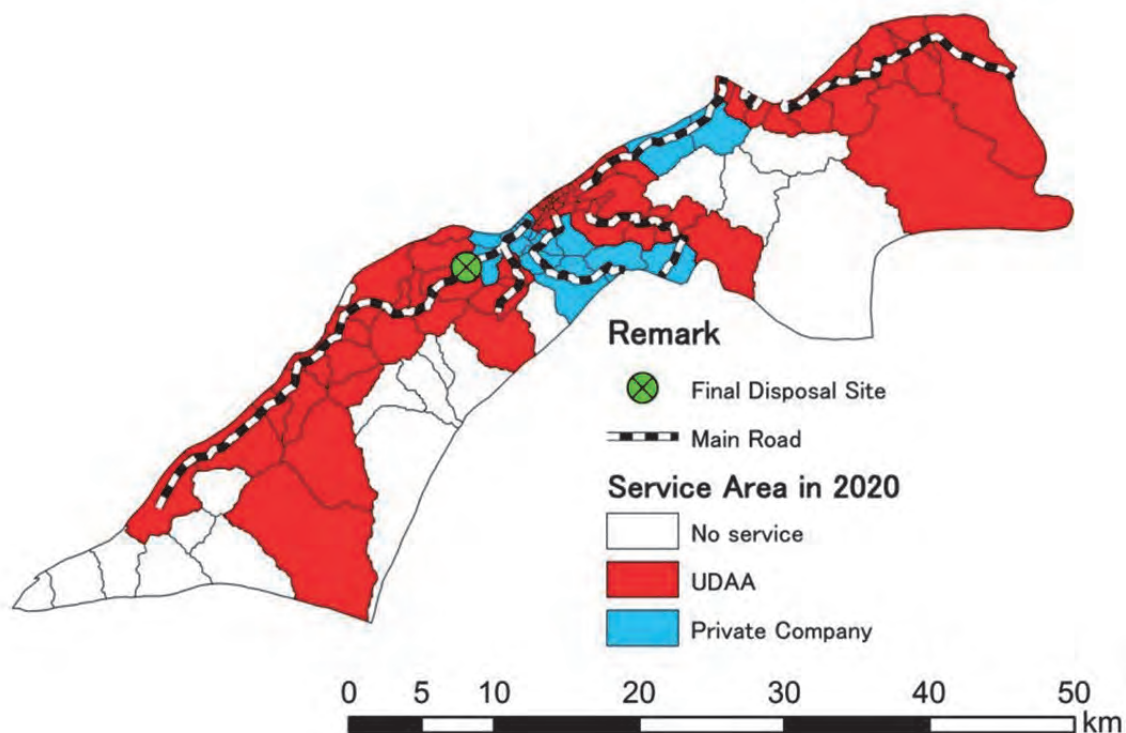


Figure 3-2 Map indicating objective for waste collection coverage in 2020

b. Situation in 2015

The latest information taken as of the end of Jul 2015 is summarized in following table. The number of villages, which are covered by waste collection service by UDAA, changed from 38 in 2013 to 24 villages, which indicates reduction instead of increase towards 56 villages for target year 2020. On the contrary, the number of villages which the private company provides collection service reached 41, which means it has exceeded 25 villages, the target for 2020. Although UDAA had been depending on the private service provider for collection coverage expansion since their own collection vehicles are limited, UDAA intends to achieve the 2020 target value using collection vehicles to be provided by the grant aid project.

Table 3-24. Number of village which is covered or not covered with collection service

		2013	2015	2020
UDAA	Central Urban	15	15	15
	Urban	7	7	7
	Sub-urban	16	2	16
	Close to main roads	0	0	10
	Remote	0	0	8
UDAA total		38	24	56
Private	Sub-urban	13	27	13
	Close to main roads	12	14	12
Private total		25	41	25
No Service	Close to main roads	30	28	20
	Remote	24	24	16
No Service Total		54	52	36
Service Total		63	65	81

Total		117	117	117
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* 2013 and 2015 are actual figure, planned value for 2020

5. Evaluation and Achievements

Table 3-25 Evaluation and Achievements of Waste Collection Service Planning in LPB

Indicator	Means of verification	Achievement status
Indicator 2.2. The solid waste collection system is improved.		
1. A waste collection and transportation plan is formulated.	1. Waste collection and transportation plan	Achieved. The plan for waste collection was formulated in March 2014

In addition to the abovementioned achievement of PP indicator, PP implementation resulted in following outcomes.

- The draft future plan proposed in this project was used as basic data in the grant aid project to make a plan for provision of equipment for waste collection.

6. Suggestion for the Post-Project Activities

Basically, collection service is well provided in the central area while it is not provided enough in the remote area. The service distribution is determined by a lot of factors such as accessibility, population density, waste discharge amount and so on. Considering those factors, the methods and frequency of waste collection must be planned properly. For instance, dump trucks can be used for the general waste collection. In areas where dump truck can't access, 5 m³ containers might be applicable.

The review in 2015 shown above tells that the private company already exceeded the target for 2020 while UDAA should additionally provide 32 villages with collection service. In order to accomplish the plan, UDAA is expected to widely mobilize waste collection vehicles of grand aid and employ the capability of collection service using 5m³ containers which is acquired through the PP.

2.2.2 Waste collection using 5m³ containers

1. Project Purpose and Summary

This PP aims to improve UDAA's waste collection service capability using 5m³ containers in order to expand the waste collection service area.

Placing a container to an area without collection service will directly contribute to extend the collection service. Placing a container to an area with dump truck collection service will indirectly contribute to extend the collection service, because the dump truck, which used to serve this area, can be used in other area without collection service.

The project strengthens the UDAA's capability for making containers which is applicable for its skip loader and for maintenance through practical operation. The pilot containers are also installed at places of each customer, and transported for waste collection.

2. General Concept

UDAA has recognized the importance of waste container collection since a couple of years ago. It particularly focuses on: 1) securing the revenue source from generation sources of large volume of waste, and 2) extending waste collection service for general waste in remote villages.

The PP implementation was decided in order to develop a comprehensive system in UDAA including container manufacturing, collection and maintenance so as to make the container collection system sustainable.

Table 3-26. Outline of Waste collection using 5m³ container PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule			
			2012	2013	2014	2015
Project Planning	Set up project management system	SJET, UDAA, DONRE	■			
	Set up concept	SJET, UDAA, DONRE		■		
Planning and Preparation PP	Procurement of equipment	SJET		■		
	Construction the facility	SJET		■		
	Study and training of assembling	SJET		■		
	Drafting the container placement plan	SJET, UDAA, DONRE		■		
Implementation of PP	Assembling the 10 containers	UDAA		■		
	Negotiation and contract with the customers	UDAA			■	■

3. Planning

a. Context

There mainly are two types of waste dischargers; one is small such as ordinary households, another is larger such as markets, hotels, schools and so on. Currently two types of collection methods have been taken in LPB; collection by ordinary dump trucks and another using a skip loader and 5m³ containers. Those conditions are summarized in the following table.

Table 3-27. Features of each waste collection method

	Small dischargers (Households)	Large dischargers	UDAA's status
Dump truck collection	xxx Very suitable.	xx Applicable.	Fully operated and not available.
Container collection	x Depending on situation; applicable when households are closely located in the village center or in other situation.	xxx Very suitable.	Without enough number of containers, the skip loader is not fully used. UDAA's capability for procurement of new containers is not sufficient while containers are easily corroded by acid from garbage.

Considering the current status of LPB and resources available from LPPE, it is decided to expand the waste collection service by strengthening the capability of container collection.

In practice, the PP firstly assisted UDAA to manufacture 5m³ containers by itself. The next step will be negotiation and agreement concerned about waste collection manner and service charge between UDAA and potential container users prior to container installation. Finally the proper operation of waste collection service will follow. These make one cycle of procedure. The PP intends to develop the capacity of UDAA to independently expand waste collection service in the area applied with 5m³ containers even after the project finishes.

b. Content of planning

- SJET procures equipment and tools, and constructs the workshop.
- UDAA produces containers after the engineers were trained by VUDAA in Vientiane.
- The draft of a placement plan of containers produced is prepared, and UDAA implements waste collection using the containers as per the plan.

Table 3-28. Role and Responsibility for Relevant Organization

	SJET	C/P(DONRE/UDAA)
Making Container	✓ To provide materials equivalent of 10 containers	✓ To perform making 10 containers
Running waste collection service with container	✓ To make container placement plan in cooperation with DONRE/UDAA	<ul style="list-style-type: none"> ✓ To make container placement plan in cooperation with JET ✓ To negotiate and agree with 10 container users such as villagers , hospitals, hotels and so on according to the plan; in terms of that service fee and waste collection system ✓ To perform properly waste collection service

c. 5m³ Container Placement Plan

Table 3-29. 5m³ Container Placement Plan

No.	Name	Frequency of Collection expected (times/week)	Location
1	New China Hospital	2	Donemai village
2	Ministry Hospital	2	Phasouk village
3	New airport	3	Phasouk village
4	Law school	2	Nongsai Village
5	Sipsongphanna Hotel	2	Phonpeng Village
6	China Hospital	2	Xangkhong Village
7	Vanhsana Hotel	2	Phonpeng Village
8	Donekheo Village	2	Donekheo Village
9	Noonsavart Village	2	Noonsavart Village
10	Medicine school	2	Thatluang Village

d. Procurement and Construction

d.1 Procurement of equipment:

- A welding machine, an iron cutting machine, an electric sander, different gas tanks, a hanging crane and so on

d.2 Procurement of material:

- Steel plate, steel square bar, hinge, oxygen and acetylene gas, welding rod, paint, anti-rust

d.3 Construction of facility:

- Workshop for producing containers; 1 (in the premise of existing KM9 waste disposal site)

4. Implementation

a. Technical training

In Mar 2013, two engineers of UDAA visited KM7 workshop of VUDAA in VTE to be technically trained in making 5m³ containers for 3 days.

b. Producing containers

In Mar 2014, it was observed that UDAA engineers had finished producing 10 units of 5m³ containers.

c. Result of implementation

Table 3-30 : Installation status of 5m³ containers in LPB

	Place	Number of Container installed	Location (village)	Collection Frequency (Monthly)	Income of container fee (Million kip/month)
1	Military hospital	1	B. Phasouk	8	2.0
2	New airport	2	B. Phasouk	24	6.0
3	Phouvao hotel	1	B. Naviengkham	8	2.0
4	Medical college	1	B. Done	8	2.0
5	Teachers training school	1	B. Nasangveuy	8	2.0
6	Financial college	1	B. Phosy	8	2.0
7	Dara market	1	B. Kamyong	3	0.6
8	Provincial hospital	2	B. Phoumok	8	2.0
	Total	10		75	18.6

※"Collection Frequency" and "Income of Container fee" are based on actual performance in July 2015.

5. Evaluation and Achievements

Table 3-31. Evaluation and Achievements of PP for Waste collection using 5m³ container in LPB

Indicator	Means of verification	Achievement status
Indicator 2.2. The solid waste collection system is improved.		
1. 10 units of 5m ³ waste containers are assembled and they are placed in accordance with the container placement plan.	1. LPPE Progress Report, 10 units of public containers (5m ³) and container placement plan	Mostly achieved. UDAA has already completed the production of 10 containers. Two of them were planned to be placed in remote villages, but in the end, all of them were

		<p>placed at the large volume generators. When a skip trailer is provided from grant aid project at the end of 2015, UDAA intends to start container collection for remote villages using two new containers.</p>
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In addition to the abovementioned achievement of PP indicator, PP implementation resulted in following outcomes.

- UDAA’s own workshop was constructed. Thus, in addition to producing and repairing the 5m³ containers, they can carry out various mechanical works for the urban maintenance, which is UDAA’s important duty, e.g. welding repair of dump truck body or bucket of excavator.
- It was decided to collect health care waste incineration ash generated at the provincial hospital at the same time of the container collection for general waste. The skip loader must be modified for this purpose, and the modification work is supposed to be done by UDAA in the workshop.

6. Suggestion for the Post-Project Activities

All the 5m³ containers provided by the PP are under regular operation in each generation source. The next challenge within the a coming couple of years will be how to manufacture new containers with UDAA's own budget to get new customers while properly maintaining and repairing the existing containers. Therefore, UDAA should simulate the balance of income based on the information acquired through the PP implementation, including the cost of production and maintenance of 5m³ containers, transportation cost, and actual income from customers. Based on the simulation result, C/P should consider the actions such as the adjustment of container production price (e.g. saving unnecessary cost by using cheaper material) or the revision of the container collection fee.

In villages which generate small amount of waste in remote area, container collection is desirable because it is inefficient to allocate a dump-truck to villages in such a distance, although its effectiveness was not examined in this PP. However, the remote villages may not afford container collection service because of their low population density. UDAA must find out proper place considering and balancing those two elements contradicting each other.

Strategy 3. Final disposal system is improved.

Approach 3.1: The final disposal site is managed to dispose of waste properly.

3.1.1 Proper management of existing final disposal site

1. Project Purpose

The purpose of this PP is to improve the final disposal site, to dispose of waste properly and to mitigate adverse impacts on the surrounding area.

2. Concept

The proper operation and maintenance of KM8 existing final disposal site is conducted in

accordance with the formulated operation plan of final disposal site by deputy director and staff of UDAA to improve the existing final disposal site. The implementation schedule is shown as follows;

Table 3-1. Implementation schedule of Proper management of existing final disposal site PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	UDAA, SJET,	■				
	Set up concept	UDAA, SJET,	■				
Planning of PP	Identify and study the pilot area at KM8 existing final disposal site	UDAA, SJET,	■				
	Formulation of improvement plan of infrastructure at KM8 existing final disposal site	UDAA, SJET,	■				
	Formulation of draft operation plan at KM8 existing final disposal site	UDAA, SJET,		■			
	Formulation of operation plan reflecting the Grant aid project	UDAA, SJET,			■	■	
Implementation of PP	Improvement of KM8 existing final disposal site and procurement of heavy machinery	SJET		■			
	Proper operation of KM8 existing final disposal site	UDAA, SJET			■	■	■
	Monitoring	DONRE, SJET	▲	▲	▲	▲	
	Evaluation of the PP	SJET				■	
	Suggestion for continuation by C/P	SJET				■	

3. Plan

a. Identify and study the pilot area

A topographic survey was conducted to identify the boundary of pilot area at KM8 existing final disposal site.

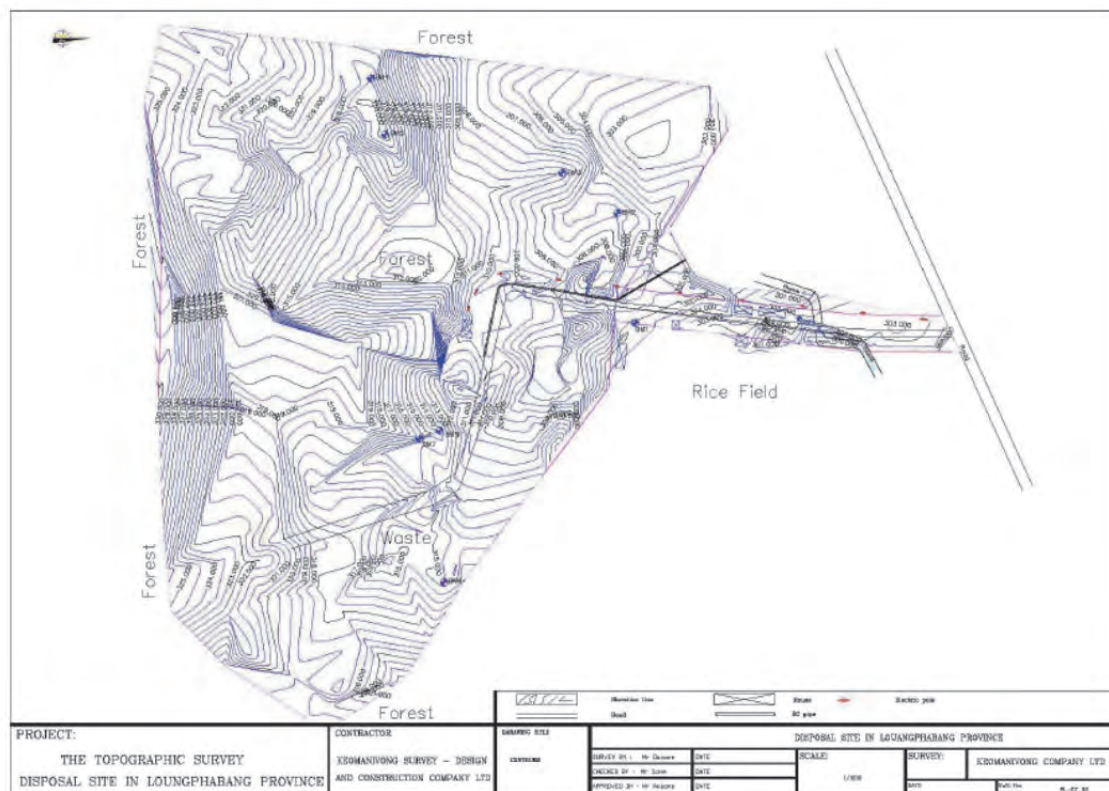


Figure 3-3. The boundary of pilot area at KM8 existing final disposal site

b. Formulation of improvement plan

The improvement plan of infrastructure at KM8 existing final disposal site was formulated in the boundary of project site as shown in the following table and figure.

Table 3-32. Improvement plan of infrastructure at KM8 existing final disposal site

No.	Items	Qty.	Unit
1	Access road	800.0	m
2	Earth drain	470.0	m
3	Embankment	400.0	m
4	Pipe drain (dai600mm L=10.0m)	3	Place
5	Weight bridge	1	Place
6	Gate	1	Place
7	Leachate collection pipe	100	m
8	Re-circulated pump and flexible pipe	150	m
9	Workshop	1	Place
10	Concrete Plate	130	no.

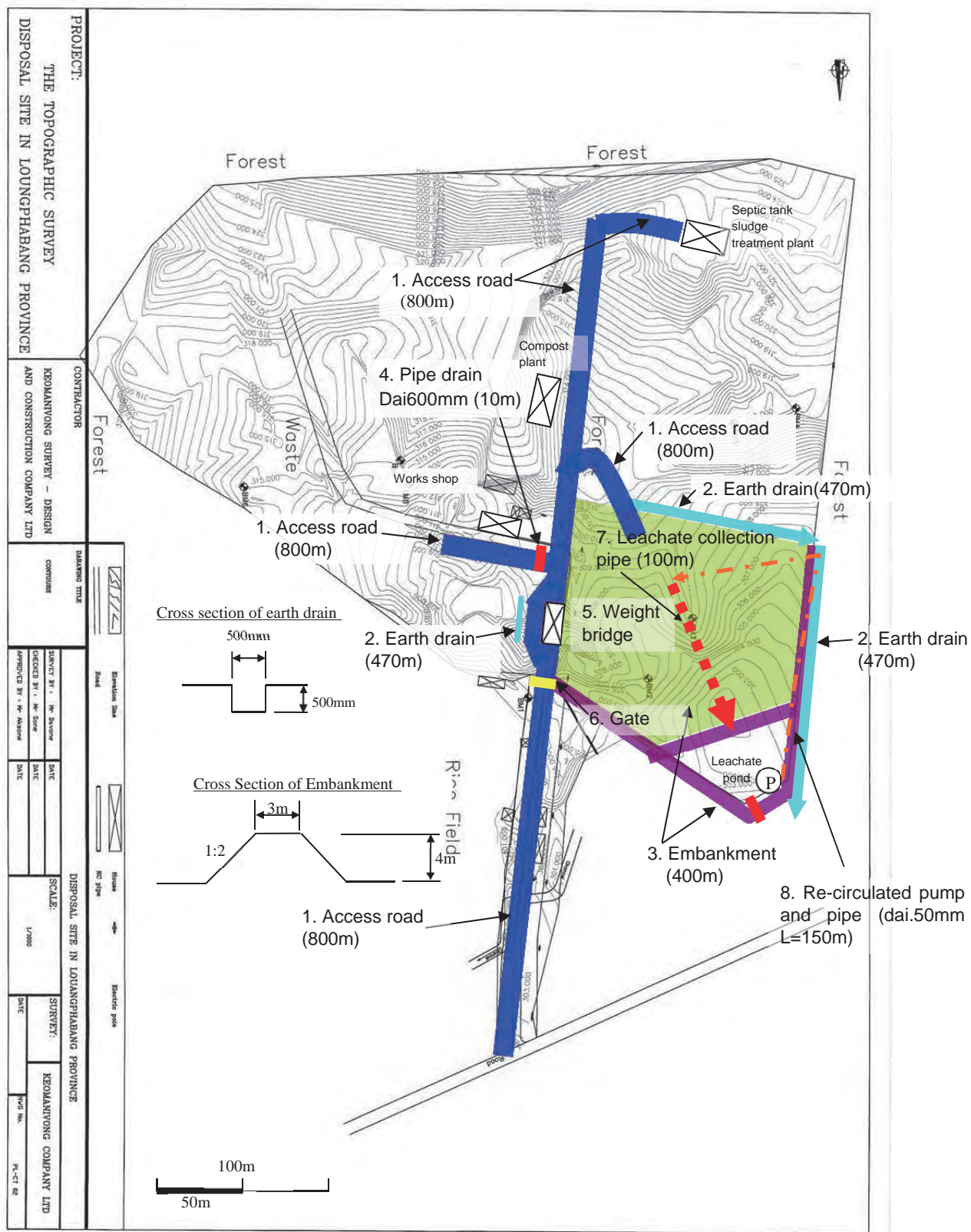
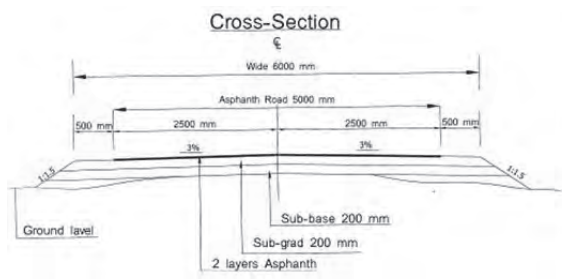


Figure 3-4. Improvement plan of infrastructure at KM8 existing final disposal site

b.1 Access road

The function of the access road is to allow waste trucks to access to active cells from the main road for waste discharging. The structure of the access road consists of two layers asphalt (w=5,000mm), sub-grad (t=200mm) and sub-base (t=200mm) and leveling. The length of access road improvement is 800m.

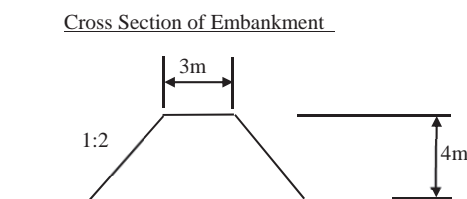


b.2 Earth drain

The function of the earth drain is to divert rain water. The structure of the earth drain is width 500mm and depth 500mm. The length of earth drain improvement is 470m.

b.3 Embankment

The function of the embankment is to establish the cell for waste discharge. The size of the embankment is 4m high, 3 m wide at the top and 1:2 slope. The length of embankment improvement is 400m.



b.4 Pipe drain

The function of the pipe drain is to divert rain water. Structure of pipe drain is diameter 600mm and length 10m concrete pipe.

b.5 Weight bridge

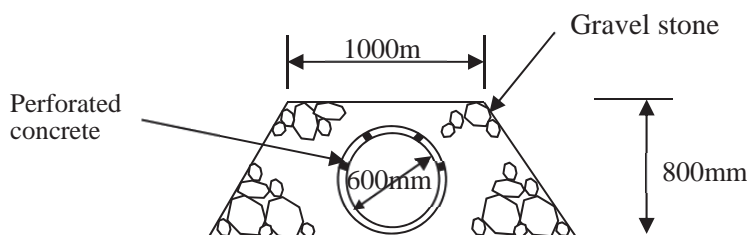
The function of the weight bridge is to measure the weight of collection vehicle. The structure of the weight bridge consists of platform weigh bridge, control house (W3mxB3mxH2.3m) and electricity.

b.6 Gate

The function of the gate is to control the entering of collection vehicle without permission and security reason.

b.7 Leachate collection pipe

The function of leachate collection pipe is to collect and treat the leachate. The structure of leachate collection pipe consists of perforated concrete pipe and gravel and the length is 100m.



b.8 Re-circulation pump and a flexible pipe

The function of re-circulation pump and flexible pipe is to circulate the leachate from the leachate pond to the leachate collection pipe to treat leachate. The structure of the re-circulating pump is a submerged pump in the perforated oil barrel and a flexible pipe (dai.50mm, L=150m).

b.9 Workshop

The function of the workshop is to assemble the 5m³ containers for waste collection service. The workshop consists of a building, electricity, a gate type crane and so on

b.10 Concrete plates

The concrete plates are used on a muddy access road in order to allow the waste trucks to run in the rainy season. The size of a concrete plate is 2,000mm (length) x 1,000mm (width) x 200mm (height). 130 plates are used.

c. Formulation of draft operation plan

The collected waste is disposed of at the designated disposal area in the improved KM8 final disposal site. The collection vehicles can approach to the designated disposal area on the concrete plate in the rainy season although the access road becomes muddy.

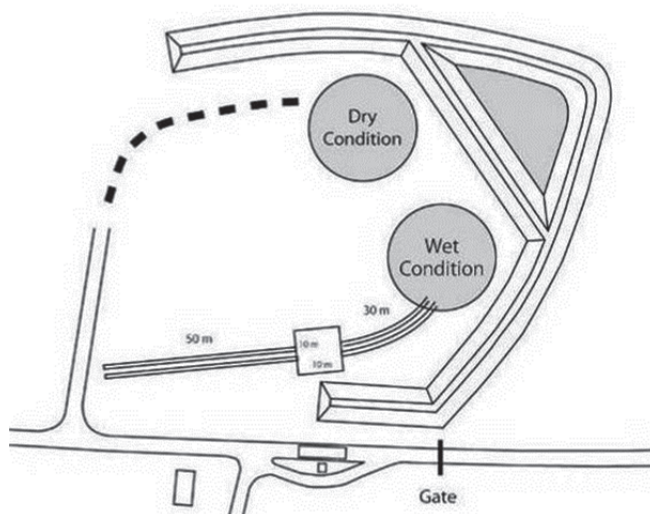


Figure 3-5. The operation plan at KM8 existing final disposal site

d. Formulation of operation plan reflecting the grant aid project

The draft operation plan was continuously implemented and examined at the improved KM8 final disposal site since 2012. And the operation plan was finalized in August 2015 by UDAA and SJET. Operation plan reflecting the grant aid project by the Japanese Government is described in Appendix 4

4. Implementation

a. Procured equipment and implementation of improved work

a.1 Procured equipment

An excavator was procured in May 2012 to move the disposed waste.

a.2 Implementation of Improved work at existing KM8 disposal site

SJET supported JICA to put out the tender for improvement work at existing KM8 disposal site in November 2013. The improvement work started in November 2013, completion inspection was conducted on 5 March and operation started on 9 April 2013.

Table 3-2. Improvement work at existing KM8 disposal site

No.	Items	Qty.	Unit
1	Access road	800.0	m
2	Earth drain	470.0	m
3	Embankment	400.0	m
4	Pipe drain (dai600mm L=10.0m)	3	Place
5	Weight bridge	1	Place
6	Gate	1	Place
7	Leachate collection pipe	100	m
8	Re-circulated pump and flexible pipe	150	m
9	Workshop	1	Place
10	Concrete Plate	130	no.



Figure 3-6. Layout of existing disposal site after improvement

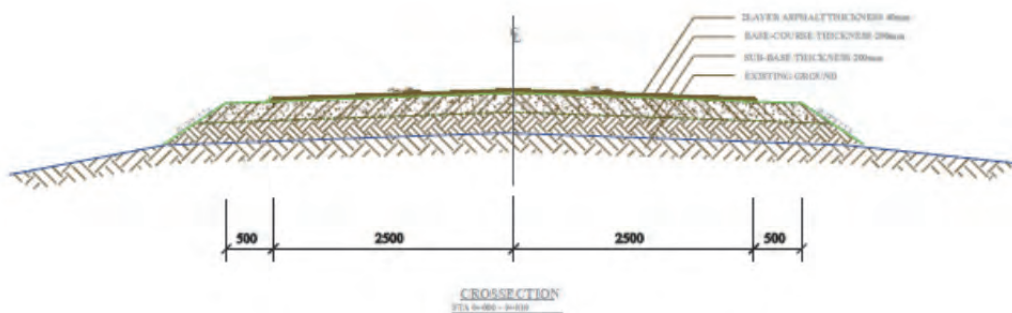


Figure 3-7. As built drawing of access road section

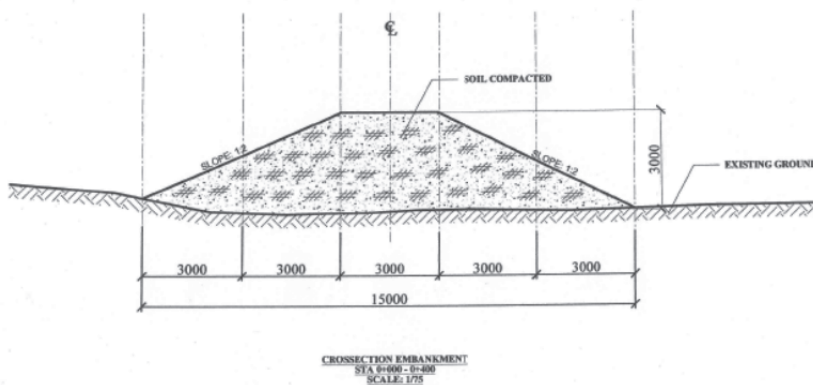


Figure 3-8. As built drawing of embankment section

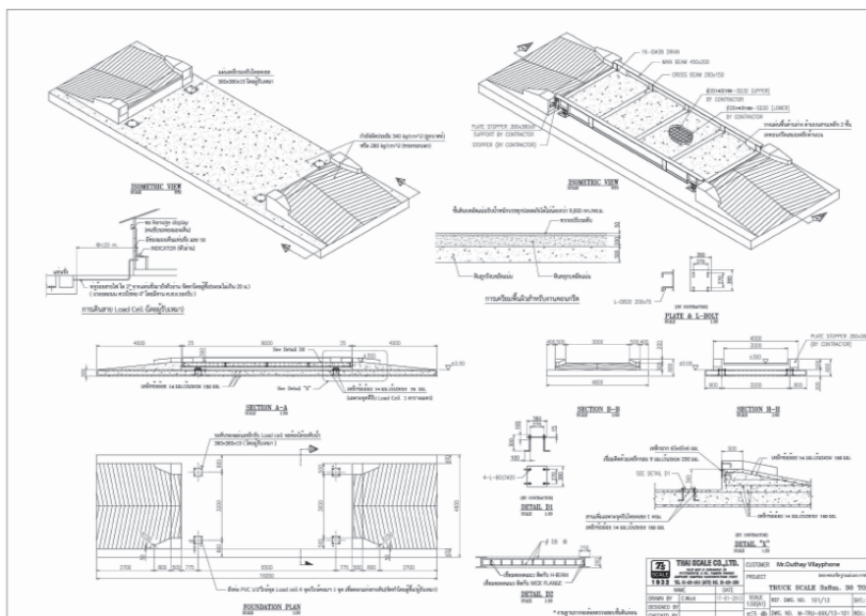


Figure 3-9. As built drawing of weight bridge

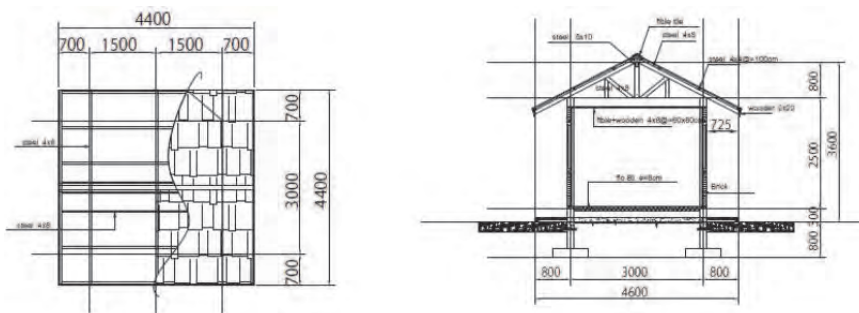


Figure 3-10. As built drawing of control house of weight bridge

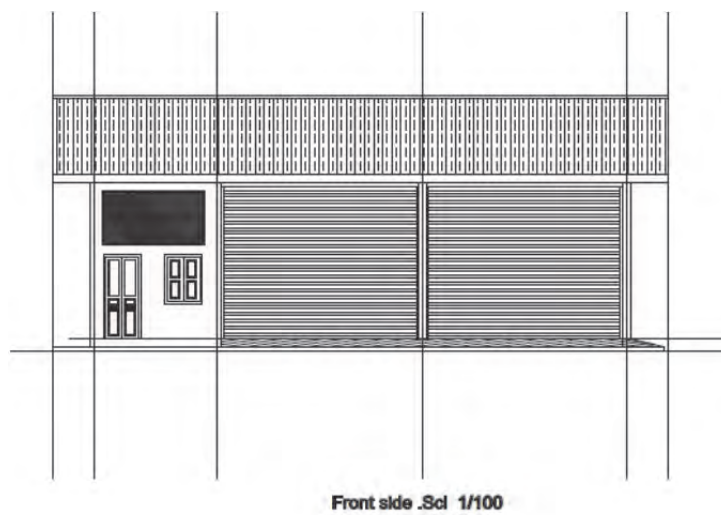


Figure 3-11. As built drawing of workshop building

- b. Operation after the improvement work
- b.1 Incoming waste data

The proper operation of KM8 existing final disposal site stated on 9 April 2013. The incoming amount of collected waste was measured at the weight bridge and is shown below.

Table 3-3. Incoming amount of collected waste

Month	2013	2014	2015
	ton/month	ton/month	ton/month
1	-	1,565	1,695
2	-	1,448	1,503
3	-	1,569	1,631
4	1,583	1,685	1,817
5	1,644	1,728	1,793
6	1,469	1,678	1,819
7	1,684	1,896	1,778
8	1,714	1,797	
9	1,558	1,787	
10	1,612	1,676	
11	1,435	1,542	
12	1,403	1,602	
Total	14,102 ton	19,973 ton/year	12,036 ton/year

b.2 Waste dumping

UDAA had been dumping waste in the designated disposal area (Area A in the figure below) utilizing the procured excavator. The waste spreading and pressing works could not be done sufficiently without a bulldozer, but nevertheless, UDAA made its effort to efficiently use the disposal area.

In spite of this, the disposal area became almost full in the middle of 2014, which made the disposal work difficult. UDAA started to use Area C shown below, which was a previous disposal area before the PP, in around June 2015.

UDAA considers that after the reception of a bulldozer by Japan's grant aid, it will continue to use Area A referring to the operation plan that reflects the grant aid.

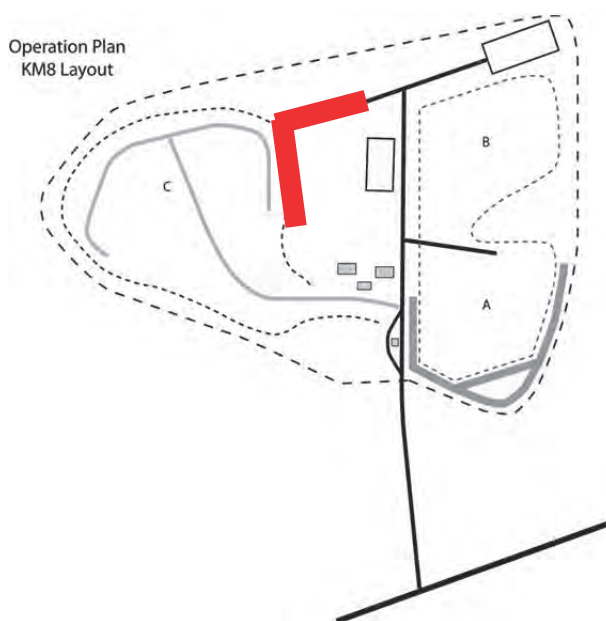


Figure 3-12. Waste cells in KM8

b.3 Access road

Before this PP, the access by the truck to the disposal area was so difficult in the rainy season that waste was even dumped nearby the entrance of the disposal site. After the improvement work of the PP, the concrete plates were used in the disposal area and the access of the trucks has been maintained.

When UDAA change the disposal area from A to C as mentioned in the former section, UDAA acquired an additional budget from the provincial government and developed a gravel-paved access road to Area C, which is shown by a red bold line in the figure above.

b.4 Leachate management

The leachate generated at the final disposal site is flowed to the leachate pond through leachate collection pipe. In case that the surface level of leachate at the leachate pond is high and expected to over flow, the leachate is recirculated to the final disposal site and treated by recirculation pump.

b.5 Coil coverage

UDAA has conducted soil coverage to prevent problems of fire, smoke, offensive odor and waste scattering mainly at former landfill site (C of Figure 3-12). When Area B is developed into a new disposal site, the excavated soil in Area B is used as the covering soil material for Area B.

c. Monitoring

After the commencement of the pilot project, on-site monitoring was carried out approximately once a year. The number of participants and date of monitoring were 45 persons in May 2012, 24 persons in July 2013, 12 persons in August 2015 and 40 persons in June 2015. The participants were those from governmental agencies at the national, provincial and district levels, village officers, social organizations (Labor Union, Women’s Union and Youth Union), schools and World Heritage Office. The participants were given a lecture about the facility and operation of the disposal site, observed the facility operation and answered prepared questionnaires.

The questionnaire had a structure and questions shown below. The questions of Category A were asked every time of the monitoring, while the questions of Category B were asked at the 2nd monitoring and onwards as they were related to the operation of facility developed by the civil works in 2013.

Category A (regarding environmental aspects)	Category B (regarding facility operation)
<ul style="list-style-type: none"> • Offensive odor • Fire and smoke • Waste scattering • Vermin (flies and other small animals) • Wastewater stagnation, etc. 	<ul style="list-style-type: none"> • Access road • Drainage system • Landfill operation • Septage treatment facility • Healthcare waste management, etc.
Three answer options: acceptable, medium, not acceptable	Three answer options: functioning medium, not functioning

The answers were compiled according to the year of monitoring and questions. The results across the years were shown below.

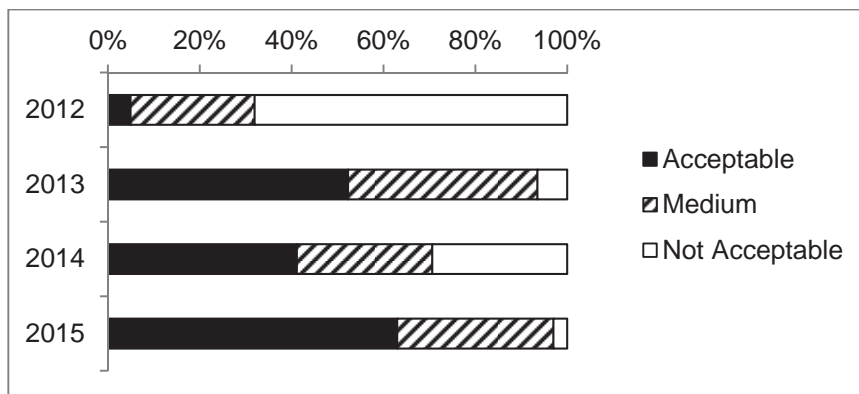


Figure 3-13. Results of Category A

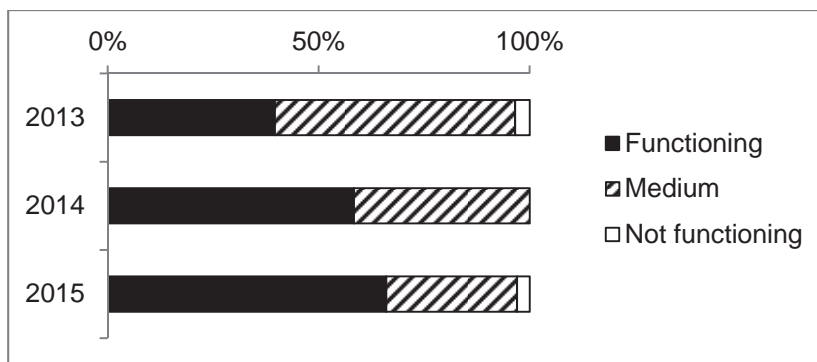


Figure 3-14. Results of Category B

Both categories generally have a trend of improvement. The improvement works completed in the previous month of the monitoring in 2013, whereby overall landscape was particularly upgraded and the occurrence of flies, smoke and fire were drastically lowered. This will explain the steep increase of the answer of “Acceptable” from 2012 to 2013. The effort of UDAA after the improvement works in spite of financial constraint should have resulted in the steady improvement shown in Category B.

5. Evaluation and output

The status of the indicators is as shown below and the project purpose is achieved.

Table 3-4. Evaluation of Proper management of existing final disposal site

Objectively verifiable Indicator	Means of verification	Achievement
Indicator 2.3. The operation of the final disposal site is improved		
1. An operation plan of the final disposal site is formulated.	1. Final disposal operation plan	Achieved. An operation plan of the final disposal site was formulated after discussion between UDAA and SJET.
2. The final disposal site is operated in accordance with the operation plan.	2. Final disposal operation record	Achieved. The final disposal site is operated in accordance with the operation plan and the waste amount of incoming waste was properly recorded.
3. The final disposal site is monitored by the final disposal site monitoring committee once a year.	3. The monitoring report of the committee	Achieved. The final disposal site is monitored by the final disposal site monitoring committee once a year.

6. Recommendation

Necessary budget should be secured every year for the adequate operation and maintenance of the final disposal site. After the reception of a bulldozer procured by the grant assistance of the Japanese Government in 2015, the cost for operation and maintenance including the use of the bulldozer is estimated at 321,182 thousand kip per year.

The capacity of the present disposal site will be full by 2024. UDAA is required to have acquired a land, prepared an engineering design and constructed the landfill by then.

As for the daily operation, the main issue is to keep the site operational and to keep allowing the access of waste trucks in the rainy season by applying the concrete plates. As the concrete plates, however, will be deteriorated with age, UDAA should produce new concrete plates using

formwork provided by the LPPE.

3.1.2 Proper management of waste pickers and improvement of their working conditions

1. Project Purpose

The purpose of this PP is to manage the waste pickers properly and to improve their working conditions.

2. Concept

The proper management of waste picker is formulated and conducted to improve their working conditions by UDAA and SJET. The management of waste pickers is monitored by waste pickers meeting.

Table 3-5. Implementation schedule of Proper management of waste pickers and improvement of their working conditions PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	UDAA, SJET,	■				
	Set up concept	UDAA, SJET,	■				
Planning of PP	Identify the waste pickers	UDAA, SJET,	■				
	Formulation of management and improvement plan	UDAA, SJET,	■				
Implementation of PP	Management of Waste Pickers and Improvement of their Working Conditions	UDAA, SJET		■			
	Waste pickers meeting	UDAA, DONRE, SJET	▲	▲		▲	
	Evaluation of the PP	SJET				■	
	Suggestion for continuation by C/P	SJET				■	

3. Plan

a. Identify the waste pickers

The ID cards of waste pickers are issued to identify and organize the waste pickers.

b. Formulation of management and improvement plan

In order to regulate and control the activities of waste pickers, UDAA established and issued “302/UDAA OFF22/01/2013:Announcement on Prohibition to Outsider for Entering KM8 Disposal Site” in January 2013. Furthermore, in order to facilitate control of waste pickers, UDAA in cooperation with SJET stated the control of waste pickers in the KM8 disposal site operation plan finalized in August 2015 as follows.

- The regular discussion between the waste pickers and UDAA staff are held.
- Waste pickers are required to be registered for working at the disposal site.
- Waste pickers are required to bring the issued ID cards while working.

- Waste pickers are required to put on safety jackets, gloves, masks and long boots.
- Waste pickers are required to have preventive injection for infection disease supported.
- Waste pickers are required not to work at the active disposal area to avoid any accident.

4. Implementation

a. Management of Waste Pickers and Improvement of their Working Conditions

In order to facilitate control of waste pickers UDAA in cooperation with SJET has conducted the following activities:

- (1) ID cards were issued to organize the waste pickers
- (2) The following equipment was provided to the waste pickers.
 - Preventive injection for infection disease (25 persons)
 - Gloves (25persons)
 - Long boots (25persons)
 - Safety Jacket (25 persons)

UDAA instructed the waste pickers to put on the gloves, boots and safety jackets when they work on waste picking and warned anybody not following this.

The implementation of the KM8 disposal site operation plan contributes the improvement of working condition, such as the prevention of infectious disease, accidents caused by heavy machinery and disputes among waste pickers and so on.

b. Waste picker meeting

The 1st waste picker meeting was held in January 2013 and the above mentioned management plan was instructed to them. Meanwhile, “302/UDAA OFF 22/01/2013: Announcement on Prohibition to Outsider for Entering KM8 Disposal Site” was issued. The meetings were held once a year.

5. Evaluation and output

The status of the indicators is as shown below and the project purpose is achieved.

Table 3-6. Evaluation of Proper management of waste pickers and improvement of their working conditions PP

Objectively verifiable Indicator	Means of verification	Achievement
Indicator 2.3. The operation of the final disposal site is improved		
1. A management plan of waste picker is formulated.	1. Final disposal operation plan	Achieved. A management plan of waste pickers was formulated.
2. The waste pickers working conditions is improved in accordance with the management plan.	2. Progress report	Achieved. The waste pickers' working conditions was improved in accordance with the management plan.
3. The management of waste pickers is monitored by waste pickers meeting	3. Progress report	Achieved. The management of waste pickers is monitored by the waste picker meeting.

6. Recommendation

The regular discussion is recommended to manage the waste pickers.

After the reception of a bulldozer by the grant aid of the Japanese Government in November

2015, the operation method of the final disposal will be changed. For example, the frequency of waste movement and soil coverage will increase and the waste disposal work and waste picking work can have conflicts. The waste picker management rule will need a revision and all the waste pickers understand it.

Approach 3.2: Sludge from septic tanks is treated properly to mitigate impacts to surrounding aquatic environment.

3.2.1 Development and management of the treatment facility for the sludge from septic tanks

1. Project Purpose

The purpose of this PP is to properly manage the treatment facility for the sludge from septic tanks and to mitigate impacts to the surrounding aquatic environment.

2. Concept

The proper operation and maintenance of the treatment facility for sludge from septic tanks is conducted in accordance with the formulated operation plan. its operation is regularly monitored after improvement.

Table 3-7. Implementation schedule of Development and management of the treatment facility for the sludge from septic tanks PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	UDAA, SJET,	■				
	Set up concept	UDAA, SJET,	■				
Planning of PP	Identify and study the pilot area at KM8 existing final disposal site	UDAA, SJET,	■				
	Formulation of improvement plan of infrastructure	UDAA, SJET,	■				
	Formulation of draft operation plan of treatment facility for the sludge from septic tanks	UDAA, SJET,		■			
	Finalization of operation plan	UDAA, SJET,			■	■	
Implementation of PP	Establishment of treatment facility for the sludge from septic tanks	SJET		■			
	Proper operation of treatment facility for septic tank sludge	UDAA, SJET			■	■	
	Monitoring	UDAA, DONRE, SJET	▲	▲	▲	▲	
	Evaluation of the PP	SJET				■	
	Suggestion for continuation by C/P	SJET				■	

3. Plan

a. Identify and study the pilot area

The topographic survey was conducted to identify the boundary of the pilot area at KM8 existing final disposal site.

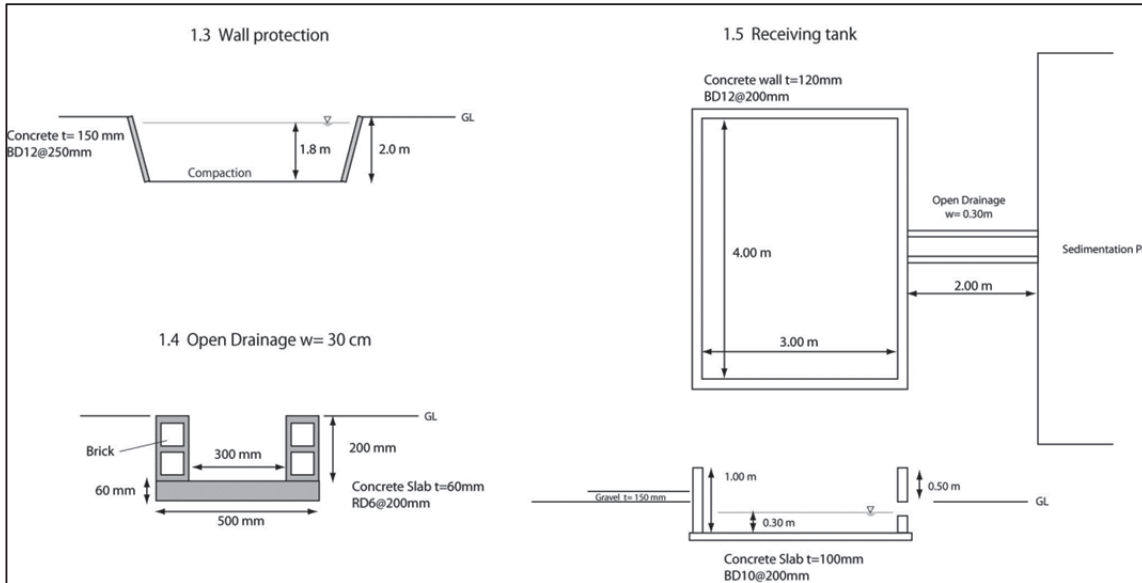


Figure 3-17. Typical section of the treatment facility for the sludge from septic tanks

c. Formulation of draft operation plan of treatment facility for the sludge from septic tanks

The constructed treatment facility for the sludge from septic tanks requires not only proper operation but also proper maintenance. The draft operation plan included following maintenance procedure.

The Use of Septic Sludge Treatment Facility

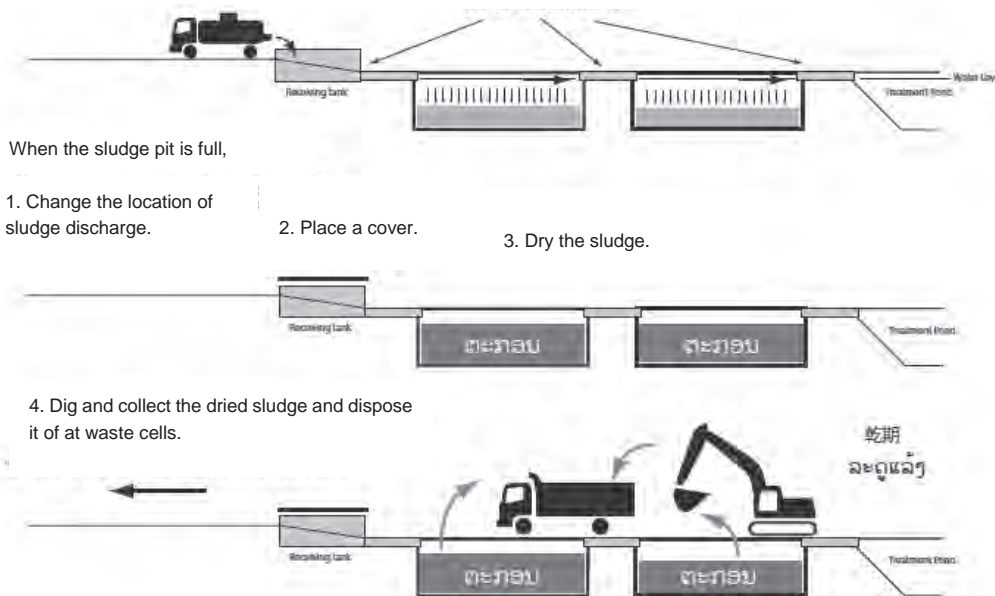


Figure 3-18. Procedure of operation and maintenance of treatment facility for the sludge from septic tanks

d. Finalization of operation plan

The finalized operation and maintenance plan of treatment facility for the sludge from septic tanks is described in Appendix 5.

4. Implementation

a. Implementation of construction of treatment facility for the sludge from septic tanks

The construction started in March 2013 and completed in June 2013. The operation of treatment facility for the sludge from septic tanks started in July 2013.

Table 3-8. Construction of treatment facility for the sludge from septic tanks

	Items	Qty	unit
1	Site clearing	2,100	m ²
2	Excavation of Sedimentation Pit & Treatment Pond	736	m ³
3	Wall protection (Concrete t= 150mm)	192	m ²
4	Open Drainage w= 30 cm	26	m
5	Receiving tank 3 x 4 m	2	place
6	Gate w= 4.0m	1	place
7	Fence H= 1.8m (RC pole & Wire mesh)	196	m
8	Gravel pavement t= 150 mm	250	m ²
9	Concrete pavement w=5.0 m	25	M

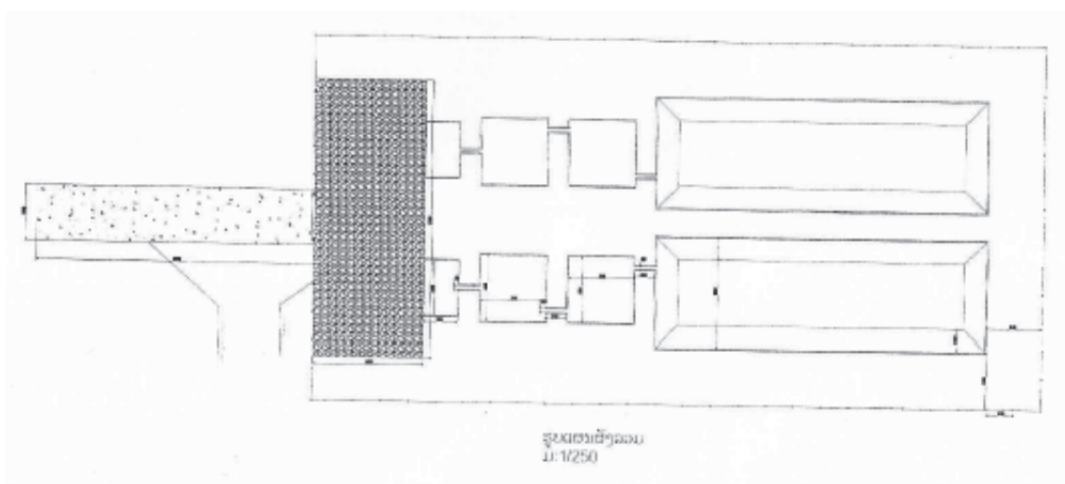


Figure 3-19. As built drawing of treatment facility for the sludge from septic tanks

b. Operation of treatment facility for the sludge from septic tanks

The treatment facility for the sludge from septic tanks has operated since July 2013. The incoming amount of collected sludge was measured at the weight bridge and is shown in the following table.

Table 3-9. The incoming amount of collected sludge

Month	2013 m ³ /month	2014 m ³ /month	2015 m ³ /month
1	-	896	684
2	-	588	720
3	-	588	528
4	-	552	500
5	-	404	700
6	-	412	500
7	636	566	516
8	660	512	
9	512	511	
10	840	513	

11	608	642	
12	688	709	
Total	3,944	6,893	4,148

c. Monitoring

The treatment facility for the sludge from septic tank was monitored by the monitoring committee once a year in the monitoring committee for the proper management of final disposal site. According to the monitoring results from 2013 to 2015, it was evaluated by most of the monitoring participants that the septic tank sludge treatment facility was operating at an acceptable level or a medium level.

5. Evaluation and output

The status of the indicators is as shown below and the project purpose is achieved.

Table 3-10. Evaluation of treatment facility for the sludge from septic tanks PP

Objectively verifiable Indicator	Means of verification	Achievement
Indicator 2.3. The operation of the final disposal site is improved		
1. An operation plan of the treatment facility for the sludge from septic tanks is formulated.	Final disposal operation plan	Achieved. An operation plan of the treatment facility for the sludge from septic tanks was formulated.
2. The treatment facility for the sludge from septic tanks is operated in accordance with the operation plan.	Final disposal operation record	Achieved. The treatment facility for the sludge from septic tank was operated in accordance with the operation plan.
3. The treatment facility for the sludge from septic tanks is monitored by the final disposal site monitoring committee once a year.	The monitoring report of the committee	Achieved. The treatment facility for the sludge from septic tank was monitored by the final disposal site monitoring committee once a year.

6. Recommendation

So far, VUDAA removed the sludge sediment approximately every six months and the facility keeps functioning well. UDAA should continue sludge removal at the same frequency as present.

In case that daily receiving amount of septic tank sludge in a moth reaches more than 90% (32.4m³) of capacity of treatment pond, the new treatment pond is recommended to design.

Strategy 4. Healthcare waste management (HCW) is improved.

Approach 4.1: HCW is collected properly.

4.1.1 HCW collection system establishment

Approach 4.2: HCW is disposed of properly.

4.2.1 HCW treatment and disposal system establishment

Due to the close linkage of these two PPs, they are described below together.

1. Project Purpose and Summary

The PP for HCW Collection System Establishment aims to establish a separate collection and transportation system for HCW generated in main hospitals in LPB and its monitoring system.

The PP for HCW Treatment and Disposal System Establishment aims to establish a treatment and disposal system for the separately collected HCW generated from main hospitals in LPB and its monitoring system.

Through these projects, infectious HCW discharged from four main hospitals in LPB is separately collected and incinerated.

2. General Concept

To establish the project concept, the PP implementation body, which was chaired by deputy director general of DONRE and consisted of members of UDAA and DOH, was organized in the beginning of year 2012. SJET in cooperation with the implementation body made the outline and schedule of overall PP as shown in the table below.

The PP implementation body was formally established as the Provincial Committee of HCWM (HCW management) by the LPB Provincial Governor's Decree No 27 /LPB.Pro.Gov. The decree stipulated the roles of waste generators, UDAA and other organizations in regard to the separate collection, incineration and final disposal of HCW.

Table 3-33. Outline of the Plan for HCW Collection System Establishment PP and HCW Treatment and Disposal System Establishment PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Concept Planning	Set up project management system	DONRE, UDAA, DOH, SJET	■				
	Set up concept	SJET, DONRE, DOH, UDAA,	■				
Planning of PP	Study and selection of pilot hospitals	DONRE, SJET, DOH, UDAA,	■				
	Preparation of treatment and disposal PP plan	SJET, UDAA, DOH, DONRE	■				
Implementation of PP	Construction of a HCW incinerator	SJET	■				
	Instruction of the incinerator operation	SJET, Provincial Hospital (PH), UDAA	■				
	Implementation of HCW incineration	PH, UDAA, DOH, DONRE, SJET		■	■	■	■
	Procurement of a HCW collection vehicle	SJET		■			
	Preparation of education tools	SJET, DOH, DONRE, UDAA		■	■		
	Implementation of separated HCW collection	UDAA, DOH, DONRE, SJET			■	■	■
	Monitoring and awareness rising	DOH, DONRE, UDAA, SJET			■	■	
	Evaluation of the PP	SJET, DOH, UDAA, DONRE				■	
	Formulation of HCWM plan	SJET, UDAA, DOH, DONRE			■	■	
	Suggestion for expansion	SJET, UDAA,				■	

	by C/P	DOH, DONRE					
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3. Planning

a. Study and Selection of Pilot Hospitals

a.1 Study on Current HCWM

After literature search until April 2012, an interview survey was carried out in May at LPB provincial hospital and LPB military regional hospital to know their waste generation, separation, collection, treatment and disposal practices. The findings are shown below regarding HCW generation in the two hospitals.

Table 3-34. HCW Generation in the Two Hospitals in LPB (2012)

Name of Hospital	Nos of beds	Occupation rate	Total staff	Out-patients/day	In-patients/day	Waste Total (hearing survey)	Infectious + Sharps (hearing survey)	Infectious+ Sharps (Weighing)
		rate	Persons	person	person	kg/d	kg/d	kg/d
LPB Provincial	150	50%	250	100	26	150	20	34.1
Military Regional	150	80%	270	70	50	45	2	14.5
Total	300		520	170	76	195	22	48.6

HCW collection practices for the two hospitals in May 2012 are shown in the table below.

	A	B	C	D
No	Name of Hospitals	Fee for General Waste (kip/month)	Fee for Infectious Waste (kip/month)	Separate Collection
1	LPB provincial	1,500,000	LS	No
2	Military Regional	400,000	LS	No

LS: lump sum (fee for general waste collection covers infectious waste collection)

As in Column D, both hospitals do not use separate collection service. The LPB provincial hospital discharge all the waste into the waste container, which is transferred to the final disposal site. The LPB military regional hospital places the waste into the storage, from which all the waste is collected as part of collection service for general waste from households. There is no additional fee for the collection of infectious waste.

a.2 Selection of Pilot Hospitals

Based on the results of the current HCWM study the target hospitals of PP were selected as follow. Also, two project targets were set.

Target hospitals: 4 Main hospitals of LPB, namely Provincial Hospital, Military Hospital, Chinese Hospital, International Chinese Hospital

Indicator:

1. A healthcare waste collection, treatment and disposal plan for the target hospitals is formulated.
2. Healthcare waste from the target hospitals is collected, treated and disposed of in accordance with the aforementioned plan.

b. Preparation of Collection, Transportation, Treatment and Disposal PP Plan

SJET made a plan to procure a pickup truck and containers dedicated for infectious HCW in order to separately collect it from the target hospitals.

Futhermore, infectious HCW separately collected from the target hospitals shall be treated by the HCW incinerator and the ashes remaining after incineration shall be disposed of at the HCW pit in the KM8 disposal site. The UDAA and the Provincial Hospital made an agreement that the HCW incinerator should be installed at the Provincial Hospital based on the following reasons:

- There was no proper place at the KM8 disposal site. It is also difficult for UDAA to newly employ and train operation staffs for the incinerator.
- On the contrary, the Provincial Hospital installed several incinerators and experienced their operation in the past. The hospital has necessary staffs for its operation.

Based on the agreement to install the HCW incinerator at the Provincial Hospital, UDAA and the hospital agreed to bear the following roles each other:

- UDAA conducts separate collection of infectious HCW discharged by 3 main hospitals except for the Provincial Hospital.
- The Provincial Hospital incinerates infectious HCW separately collected from the three main hospitals and its own infectious HCW.
- UDAA conducts separate collection of incineration ash and its final disposal at the designated pit at the KM8 disposal site.

4. Implementation

a. Procurement of Equipment and Construction of Facility

a.1 Procurement of Collection Equipment

In August 2013, SJET procured a new pickup truck for HCW collection and transportation and 10 dedicated plastic containers. In September 2013, the pickup was refurbished in order for UDAA to collect HCW from hospitals. As the results, the separate collection system became ready to serve for the target hospitals except for the Provincial Hospital.

a.2 Construction of Facility for Infectious HCW Incineration

a.2.1 Facility for Infectious HCW Incineration

In May 2012 SJET constructed a facility for infectious HCW incineration and installed an infectious HCW incinerator made in Vietnam, i.e. manufactured by VAST (Vietnamese Academy of Science) and with a capacity of 10 kg/hr). After installation VAST provided an operation training to the operation staffs of the Provincial Hospital. Following the training a test operation was conducted and necessary cost for operation was understood. Based on the test operation results, UDAA and the Provincial Hospital set up infectious HCWM fee (collection, transportation and incineration fee) at 15,000 kips/kg and asked the Provincial Committee for HCWM legislation. The fee was prescribed by the LPB District Governor's Decree No 575 /LPB.Dis.Gov issued on July 30th, 2013.

The incinerator had a breakdown in mid-January 2014, but started operation again after repair. Meanwhile, the incinerator in VTE had a trouble in the middle of July 2014 and some spare parts needed to be purchased. Spare parts for the incinerator of LPB were also ordered together to ensure continuous operation. Those are listed in the table below

Table 3-35: List of Spare Parts for the Incinerator

	Spare-parts	Unit	Quantity	Note
1	Photoelectric eyes	Piece	1	Common to the burners
2	Ignition electrode	Piece	1	Common to the burners
3	Temperature sensor	Piece	1	Common to No.1 and 2 chambers
4	Nozzle	Piece	2	One for each burner

a.2.2 Infectious HCW Pit

UDAA in cooperation with SJET constructed an infectious HCW pit at KM8 disposal site in January 2015. UDAA uses the pit for the disposal of ashes after incineration and infectious HCW disposal in an emergency of a breakdown of the incinerator.

b. Implementation of Separate Collection and Incineration of Infectious HCW

Performance of the incinerator operation from May 2012 when the incinerator was installed at the Provincial Hospital to August 2015 is presented in the table below.

Table 3-36. Operational Performance of HCW Incinerator in LPB

Period	Operation Time (Hours)	Fuel Consumption (ltrs)	Total Incineration		Incinerated Amount of HCW Other than Provincial Hos.	
			kg	kg/month	kg	kg/month
May 2012 ~ Dec 2012	18	90	125	15.6	0	0
Jan 2013 ~ Dec 2013	53	275	543	45.3	0	0
Jan 2014 ~ June 2014	70	700	1,066.8	177.8	5.8	0.97
July 2014 ~ Dec 2014	80	800	1,272.7	212.1	29.6	4.93
Jan 2015 ~ Apr 2015	84	840	1,340.8	335.2	246.3	61.58
May 2015 ~ July 2015	56	560	950	316.7	392.0	130.67
Total	-	-	5,298.3	-	673.7	-

On March 31st 2014 UDAA made a contract with Chinese Hospital (Sang Khong Village), which is one of the 3 main hospitals in LPB, on the separate collection and incineration of infectious HCW. On May 2nd 2014 the separate collection and incineration of infectious HCW commenced. This is the first case for UDAA to carry out the separate collection of infectious HCW

Furthermore on January 1st 2015 UDAA made a contract with Military Hospital on the separate collection and incineration of infectious HCW and started to execute the contract from January 2015. The separate collection and incinerated amount of HCW from hospitals other than Provincial Hospital has increased a lot.

From May 2012, when the incinerator installed, to Dec 2013, infectious HCW incinerated was only from the Provincial Hospital and its average daily amount was less than 1.5kg, which is far below its capacity, 10 kg/hr. From January 2014 the amount of incinerated infectious HCW from the Provincial Hospital is steadily increasing.

The reason of the increase of incineration is the issuance of the Order of LPB/DOH No.159. This order requires all the medical institutions in LPB to segregate infectious waste and general waste and to manage infectious waste from the point of collection to the final disposal by using a manifest form.

From May to July 2015 the incineration amount of HCW from hospitals other than Provincial Hospital has increased a lot. The reason would be the amount of infectious HCW entrusted by the Military Hospital increased a lot.

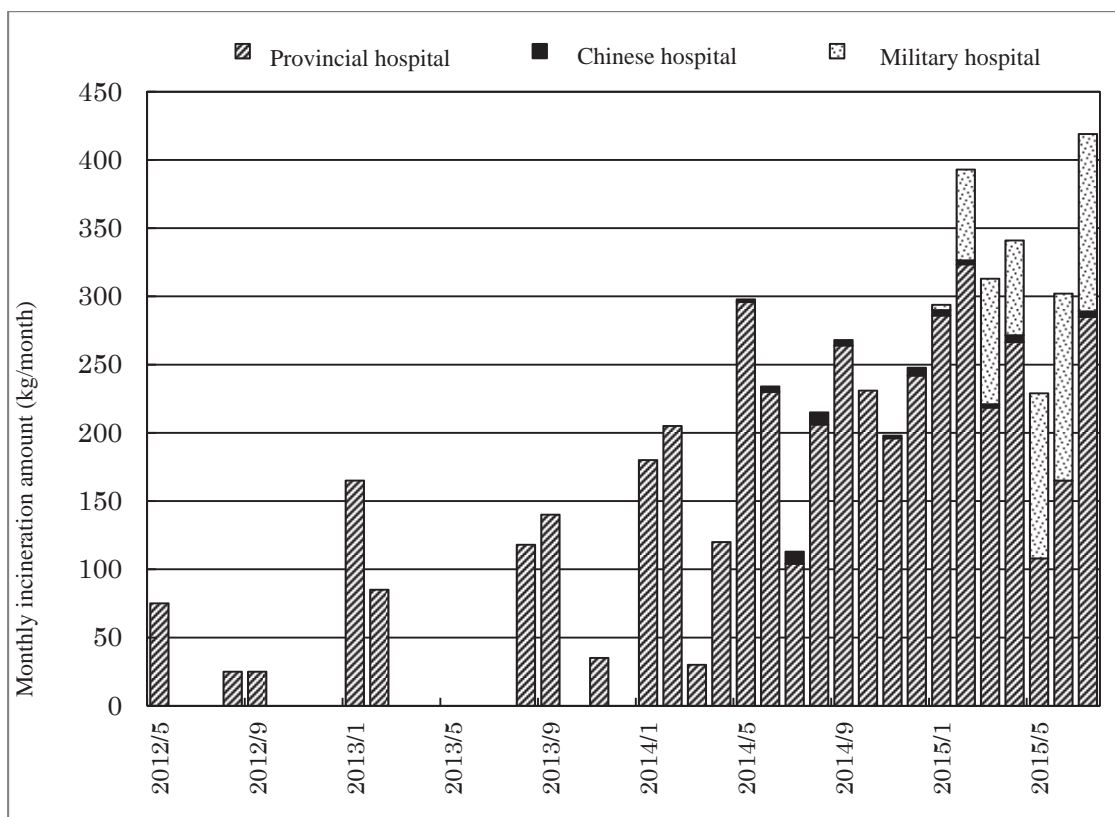


Figure 3-20: Monthly Incineration Amount (Kg/Month)

Average daily possible incineration amount is estimated at 38 kg/day based on the calculation below. From the above table, the maximum daily incineration amount is found less than 12 kg/day. This means the incinerator has still enough capacity to receive infectious HCW by three times more.

1. Capacity: 10 kg/hour
2. Required operation hours for one batch: 2hours 20 minutes (Two hours operation + 20 minutes cool down)
3. Maximum numbers of batch operation: 3 times/day
4. Maximum incineration amount: 60 kg/day (10 kg/hour x 2 hours x 3 batch)
5. Monthly possible operation days: 21.4 days (30 days x 5/7)
6. Monthly maintenance days: 2 days
7. Yearly maintenance days: 5 days
8. Yearly operation days: 232 days ((365 x 5/7) – (2 x 12) – 5)
9. Yearly incineration amount: 13,920 kg/year (60 kg/day x 232 days)
10. Average daily possible incineration amount: 38 kg/day (13,920kg/365 days)

c. Education, Monitoring and Awareness Raising Activities

As described above, the incinerated amount from May 2012 to December 2013 was very limited and far below its capacity. In addition the separate collection and incineration of infectious HCW from hospitals other than Provincial Hospital was conducted during that period. In order to solve these situations SJET in cooperation with the Provincial Committee of HCWM and MOH, DOH conducted the following education, monitoring and awareness raising activities. As a result, the separate collection and incineration of infectious HCW from hospitals other than Provincial

Hospital started to be carried out.

Table 3-37. Major Education, Monitoring and Awareness Raising Activities to Improve HCWM in LPB

Date	Activities
January 5, 2014	Order of LPB/DOH No.159 was issued. This order requires all the medical institutions in LPB to segregate infectious waste and general waste and to manage infectious waste from the point of collection to the final disposal by using a manifest form.
February 20, 2014	Provincial Committee of HCWM hold a meeting to explain the DOH Order NO.159 to the major hospitals in LPB.
March 14, 2014	Training seminar was held in cooperation with the Provincial Hospital regarding the internal separation, discharge, collection, treatment and disposal of HCW.
March 31, 2014	Chinese Hospital (Sang Khong Village), one of the three major medical institutions, signed a contract with UDAA for the separate collection and incineration treatment of infectious HCW.
Middle of April, 2014	A training video was made using the video shooting of the seminar on March 14. Since then, the Provincial Committee on HCWM has provided the video to other hospitals on demand to urge appropriate HCW management.
May 2, 2014	On May 2, Chinese Hospital (Sang Khong Village) entrusted the collection and treatment of infectious HCW to UDAA according to the contract. This is the first event where infectious waste not from the Provincial Hospital was incinerated.
September 24 and 25, 2014	In order to facilitate the separate collection incineration MONRE/PCD and SJET, in cooperation with MOH/DHHP (Department of Hygiene and Health Promotion), carried out a monitoring study and gave instructions.
October to December 2014	With a support of MOH/DHHP, Provincial Committee of HCWM in cooperation with DOH, continued to promote the contract agreement regarding infectious waste separate collection and incineration.
January 1 st , 2015	UDAA and Military Hospital signed a contract and the actual treatment started in January.

d. Formulation of HCWM Plan

A HCWM Plan (draft) was formulated and reviewed several times through the discussion with the C/P before finalization. The finalized HCW flows are shown in the figures below.

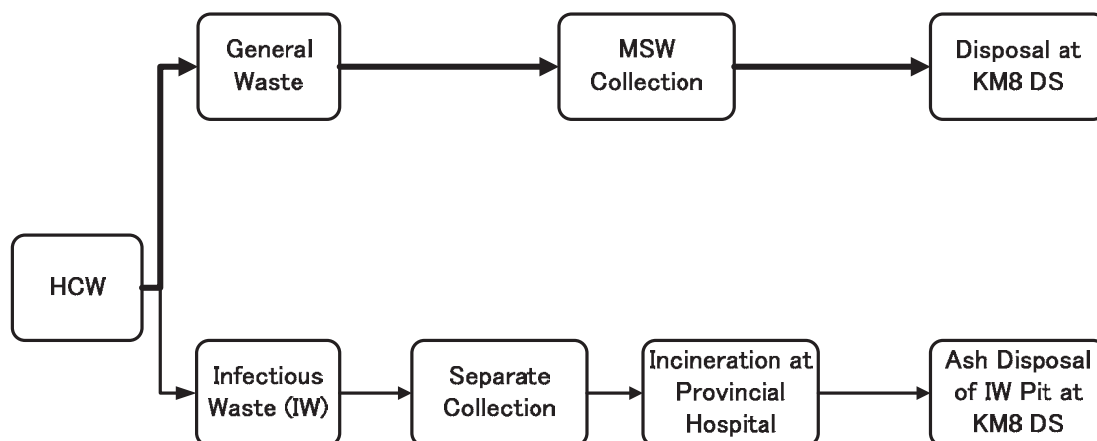


Figure 3-21. HCWM Flow in 2015

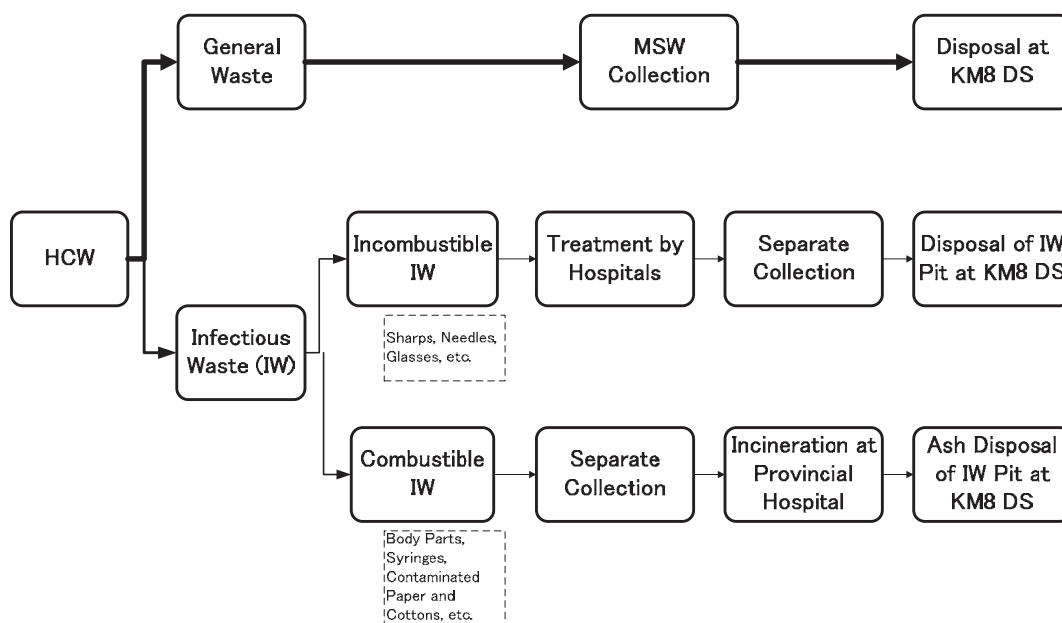


Figure 3-22. HCWM Flow in 2020

The details of the Plan is shown in the Appendix 6, Supplement 2.

5. Evaluation and Achievements

Achievement of the PP indicators is as follows:

- HCWM Plan (draft) was formulated. Based on the results of the discussions with C/Ps, the plan was reviewed and finalized. The indicator (target 1), therefore, has been achieved.
- As for separate collection, treatment and disposal of infectious HCW, the target is achieved only partly. Separate collection, incineration and disposal has not yet been conducted for the infectious HCW from the International Chinese Hospital.

Table 3-38. Evaluation of HCWM Improvement PP

Objectively Verifiable Indicators	Means of Verification	Achievement Status
Indicator 2.4. Healthcare waste management is improved.		
1. A healthcare waste collection, treatment and disposal plan for the target hospitals is formulated.	1. The healthcare waste collection, treatment and disposal plan	Achieved. HCWM Plan was formulated, reviewed and finalized.
2. Healthcare waste from the target hospitals is collected, treated and disposed of in accordance with the aforementioned plan.	2. The record of healthcare waste collection, treatment and disposal.	Partly achieved. Separate collection, incineration and disposal is not conducted for the infectious HCW from the International Chinese Hospital.

In addition to the above-mentioned indicators, the following outputs were produced through the implementation of the PP:

- Provincial Committee of HCWM has been established to improve HCWM in LPB.

- Legal tools necessary for the improvement of HCWM in LPB have been established with a lead of the committee.
- Furthermore, a coordination and cooperation system among relevant organizations for the enforcement of legal tools has established.

6. Suggestion for the Post-Project Activities

Although the service does not cover all the target hospitals, the base for a system of separate collection, incineration and final disposal was established. The target set by the HCWM Plan for the year 2020 is to separately collect, incinerate and dispose of all the infectious waste in LPB district. UDAA in cooperation with DOH is recommended to take the following improvement measures by continuing and expanding the PP:

1. UDAA should make a contract with the International Chinese Hospital on the separate collection, incineration and disposal service of infectious HCW and put it into force as soon as possible.
2. A reliable list of medical institutions in LPB district should be prepared and the HCWM plan should be reviewed and modified when necessary using the list.
3. In the review of the HCWM plan, UDAA should examine the demand of incineration of the incombustible infectious HCW from the medical institutions that do not have its treatment facility for a purpose of intermediate treatment.
4. The operation and maintenance of the incinerator should follow the manual shown in Appendix 7.
5. At present the incinerator has enough capability to receive more infectious HCW. UDAA, therefore, in cooperation with DOH, should conduct necessary enforcement, education and public relation to incinerate all of the infectious HCW generated in LPB district based on the revised HCWM plan.

Strategy 5. Institutional system to support the above improvements be established.

Approach 5.1: The responsibilities that the relevant stakeholders should bear to achieve a goal of solid waste management are clarified.

5.1.1 Consensus building among stakeholders

1. Project Purpose and Summary

To improve SWM in LPB District a lot of pilot projects (PPs) have been conducted based on the strategies of the A/P, i.e. Promotion of 3Rs, Improvement of Collection System, Improvement of Final Disposal System and Improvement of Healthcare Waste Management. The purpose of this PP is to codify the responsibilities of each stakeholder regarding PPs for SWM improvement conducted in LPB and build consensus among them.

The PP has clarified the responsibilities of each stakeholder necessary for the implementation of PPs and built consensus among them through mutual discussions. When consensus was made, the PP tried to codify the contents of the consensus as much as possible. The products of codification varied from legal documents to leaflets distributed among the stakeholders according to the nature of the PPs.

2. General Concept

To establish the project concept the PPs implementation body, which is chaired by deputy director general of DONRE and consists of members of UDAA and DOH, was organized in the beginning of year 2012. SJET in cooperation with the implementation body made the outline and schedule of overall PP as shown in the table below.

The HCWM PP implementation body was formally established as the Provincial Committee of HCWM by the LPB Provincial Governor's Decree No 27 /LPB.Pro.Gov.

As for the PPs for Promotion of 3Rs, Improvement of Collection System, Improvement of Final Disposal System, DONRE and UDAA formulated the PP execution bodies in consideration of their roles and duties.

Table 3-39. Outline of the Plan for Consensus Building among Stakeholders PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, DOH, SJET	■				
	Set up concept	SJET, UDAA, DONRE, DOH	■				
Planning of PP	Study on the needs of consensus building for PPs	SJET, UDAA, DONRE, DOH	■	■	■		
	Preparation of draft consensus building plan	SJET, UDAA, DONRE, DOH		■	■	■	
Implementation of PP	Implementation of PPs	UDAA, DONRE, DOH, SJET		■	■	■	■
	Monitoring and awareness rising	DONRE, UDAA, DOH, SJET			■	■	
	Evaluation of the PP	SJET, UDAA, DONRE, DOH				■	
	Suggestion for expansion	SJET, UDAA, DOH, DONRE				■	

3. Planning

The purpose of this PP is to codify the responsibilities of each stakeholder regarding PPs for SWM improvement conducted in LPB District and build consensus among them. The activities and indicator of the project is shown below.

Target Area: LPB District

Activities: The clarification of roles and responsibilities of the stakeholders of the PPs for SWM improvement conducted based on the 4 strategies of the A/P, i.e. Promotion of 3Rs, Improvement of Collection System, Improvement of Final Disposal System and Improvement of Healthcare Waste Management.

Indicator: Regulation on the responsibilities of stakeholders for improved SWM is prepared and/or drafted.

4. Implementation

a. Situation before the PP

Situation before the PP is shown in the reports of each PP in this Appendix.

b. Implementation

The PPs for SWM improvement have been conducted in order to implement 4 strategies of the A/P, i.e. Promotion of 3Rs, Improvement of Collection System, Improvement of Final Disposal System and Improvement of Healthcare Waste Management. The roles and responsibilities of the stakeholders of the PPs are codified as shown in the table below. The officially issued regulations are shown in underlined and bold letters.

Table 3-40: Roles and Responsibilities of Stakeholders of SWM Improvement PPs in LPB

Pilot Project	Stakeholder	Roles and Responsibilities	Method of Codification
Strategy 1: 3Rs Promotion			
1.1.1. Reduction of kitchen waste and garden waste at households (On-site Composting)	DONRE, UDAA	Planning, Public education, awareness raising and instruction, Monitoring, Dissemination	<ul style="list-style-type: none"> On-site composting leaflet Worm composting dissemination video
	Village Resident	Public education, awareness raising and instruction Implementation	
	MONRE	Dissemination and Expansion	
1.1.2.a. Recyclable waste separation project at household	DONRE, UDAA	Planning, Public education, awareness raising and instruction, Monitoring, Dissemination	<ul style="list-style-type: none"> Primary collection leaflet
	Village Resident	Public education, awareness raising and instruction Implementation	
	MONRE	Dissemination and Expansion	
1.1.2. b. School recycling project	DONRE, UDAA	Planning, Monitoring, Dissemination	<ul style="list-style-type: none"> School recycling leaflet School recycling dissemination video
	School, Teacher	Planning, Education, awareness raising and instruction to students, Management of recyclable materials	
	Student MONRE	Implementation Dissemination and Expansion	
1.1.3.a Avoidance of the use of excess packages, Eco-basket project	DONRE, UDAA	Planning, Public education, awareness raising and instruction, Monitoring, Dissemination	<ul style="list-style-type: none"> Eco-basket leaflet
	Village Resident, Stalls of the market	Public education, awareness raising and instruction Implementation	
	MONRE	Dissemination and Expansion	
1.1.3.b Avoidance of the use of excess packages, Eco-bag project	DONRE, UDAA	Planning, Preparation of awareness raising tools, Monitoring, Dissemination	<ul style="list-style-type: none"> Eco-bag leaflet
	Hotel association	Information and awareness raising of Hotel & Guesthouse	
	Hotel & Guesthouse MONRE	Implementation Dissemination and Expansion	
1.2.1. Reduction of kitchen waste from hotels and restaurants	UDAA, DONRE	Planning, Preparation of awareness raising tools, Monitoring, Dissemination	<ul style="list-style-type: none"> Off-site composting education leaflet Off-site composting dissemination video
	Hotels and restaurants	Separate discharge of kitchen waste	
	UDAA	Separate collection and composting	

	MONRE	Dissemination and Expansion	
Strategy 2: Collection System Improvement			
2.1.1&2 Improvement of exiting collection and discharge system, Primary collection system project	UDAA, DONRE	Planning, Preparation of awareness raising tools, Monitoring, Dissemination	<ul style="list-style-type: none"> • Primary collection education leaflet
	Village Resident	Public education, awareness raising and instruction Implementation	
	MONRE	Dissemination and Expansion	
2.2.2 Waste collection service expansion by using 5m ³ containers	UDAA,	Planning, construction of 5m ³ containers, Contract negotiation with large discharger, Dissemination	<ul style="list-style-type: none"> • Contract agreement of collection service
	Large discharger	Contract negotiation with UDAA, Education and instruction in the discharger	
	MONRE	Dissemination and Expansion	
Strategy 3: Final Disposal System Improvement			
3.1.2. Proper management of waste pickers and improvement of their working conditions	UDAA	Establishment of the rule, Education, awareness raising and instruction to Waste Picker	<ul style="list-style-type: none"> • <u>302/UDAA OFF 22/01/2013: Rules of KM8 disposal site</u>
	KM8 disposal site	Enforcement and instruction of the rule, Improvement of working condition of Waste Picker	
	Waste Picker	Compliance of rules	
	MONRE	Dissemination and Expansion	
Strategy 4: HCWM Improvement			
4.1.1. HCW collection system establishment	Provincial Committee of HCWM MOH, DOH	Preparation of the Governor's agreement Public education, awareness raising and instruction to MIs	<ul style="list-style-type: none"> • <u>LPB Provincial Governor's Agreement: No 27/LPB.Pro.Gov 17/01/2013</u> • <u>Regulation of LPB District Governor: No 575 /LPB.Dis.Gov 30/07/2013</u> • <u>Regulation of LPB/DOH: No.159/DOH.LPB 05/01/2014</u> • Contract agreement of separate collection service with MIs
	UDAA Medical institution (MIs)	Separate collection of infectious HCW Separate discharge of infectious HCW and payment for service	
4.2.1. HCW treatment and disposal system establishment	Provincial Committee of HCWM MOH, DOH	Preparation of the Governor's agreement Public education, awareness raising and instruction to MIs	
	UDAA Provincial Hospital	Separate disposal of infectious HCW Incineration of infectious HCW	
	Medical institution	Separate discharge of infectious HCW and payment for service	

5. Evaluation and Achievements

Achievement of the PP indicator (Regulation on the responsibilities of stakeholders for improved SWM is prepared and/or drafted.) is as follows:

Strategy 3: Final Disposal System Improvement :

1. **302/UDAA OFF 22/01/2013: Announcement on Prohibition to Outsider for Entering KM8 Disposal Site:**

- To control KM 8 disposal site operation and the activities of waste pickers the Announcement establishes rules of the site and penalty of the violator.

Strategy 4: HCWM Improvement :

1. **No 27/LPB.Pro.Gov 17/01/2013: Luang Prabang Province Governor’s Agreement on Committees and Secretary Nomination regarding task and roles for implementation of Health Care Waste Incinerator:**

- Provincial Committee of HCWM is established with DONRE, UDAA, DOH and Provincial Hospital for appropriate HCWM in LPB to implement proper HCWM.
- Clarification of the responsibilities of UDAA and other organization in regard to HCW separate collection, incineration and final disposal.

2. **No 575 /LPB.Dis.Gov 30/07/2013: Regulation of the Governor of Luang Prabang District on Transportation fee and Disposal fee for Infectious Waste from Hospital and Public Health Places in Luang Prabang District:**

- Review of the fee of HCWM including infectious HCW separate collection and incineration
- Establishment of the fee for infectious HCW collection and incineration at 15,000 kip/kg.

3. **No.159/DOH.LPB 05/01/2014: Regulation on HCWM from Healthcare Facilities in LPB District:**

- This regulates that all the medical institutions must discharge infectious HCW separately from general waste, use a manifest format, and strictly manage from collection to final disposal.

As mentioned above, 4 legal documents considered as “regulation” were established for two strategies. For the other strategies of 3Rs Promotion and Improvement of Collection System, the PP activities were carried out in villages and the codification of the responsibilities did not correspond to regulation. Nevertheless, the codification of responsibilities and consensus building, which were the purpose of the PP, were completed and the codified documents could serve for the future regulations at the district or provincial level. Accordingly, the purpose of the PP was achieved.

Table 3-41: Evaluation of Consensus Building among Stakeholders PP

Objectively Verifiable Indicators	Means of Verification	Achievement Status
Indicator 2.5. The following documents are prepared.		
1. Regulation on the responsibilities of stakeholders for improved SWM is prepared and/or drafted.	1.1 UDAA’s regulation on waste discharge, collection and final disposal. 1.2 Draft amendment of LPB District’s regulation on SWM or additional implementation rules.	Achieved. 4 legal documents, or regulations, were established in the PPs and other documents could serve for the future regulations. ,

In addition to the above-mentioned targets, the following outputs have been achieved through the implementation of the PP:

- The roles and responsibilities of stakeholders on improvement of SWM became clear through the implementation of various PPs.
- Through the implementation of various PPs coordination system among MONRE, MOH and MPWT of central government and Province, District and Village of local government, and Residents have been established.
- The Provincial Committee of HCWM has been established to promote proper HCWM in LPB Province.
- The coordination system among relevant organizations was established to enforce the regulations on the improvement of HCWM.

6. Suggestion for the Post-Project Activities

Although the implementation of various PPs clarified roles and responsibilities of stakeholders for the improvement of SWM, the number of regulations formulated was limited. In order to promote further legislation, relevant organizations are recommended to conduct the following measures:

- “Basic Laws on SWM” should be established as soon as possible by the lead of MONRE.
- Following the “Basic Laws on SWM”, LPB Province in cooperation with LPB District should establish “Regulation on SWM in LPB” according to the situation of LPB District.
- If “Basic Laws on SWM” of national level delays, LPB Province may need to establish “Regulation on SWM in LPB” with the cooperation of MONRE.
- For the establishment of “Regulation on SWM in LPB” LPB Province and District should utilize the experiences of the PPs.

Approach 5.2: Financial system necessary for proper SWM is improved.

5.2.1 Financial System Improvement

1. Project Purpose and Summary

To improve SWM in LPB District a lot of pilot projects (PPs) have been conducted based on the strategies of the A/P, i.e. Promotion of 3Rs, Improvement of Collection System, Improvement of Final Disposal System and Improvement of Healthcare Waste Management. The purpose of this PP is to improve the financial system for r SWM improvement through the implementation of the above-mentioned PPs.

The financial system to be improved by the PP includes the following.

1. Financial system necessary for the implementation of the PPs for SWM improvement; and
2. Financial system necessary for the continuation, dissemination and expansion of the PPs to be implemented by the Laotian C/Ps after the termination of LPPE.

As for the former system, most of the proposals were regarding the operation and maintenance (O&M) cost shouldered by the Laotian side since the basic investment was born by the Japanese

side of LPPE. In addition, most of the proposals were actually implemented because of the necessity of implementation of the PPs for SWM improvement.

As for the latter system, simple proposals are prepared for both O&M cost and investment.

2. General Concept

To establish the project concept the PPs implementation body, which was chaired by deputy director general of DONRE and consisted of members of UDAA and DOH, was organized in the beginning of year 2012. SJET in cooperation with the implementation body made the outline and schedule of overall PP as shown in the table below.

The HCWM PP implementation body was formally established as the Provincial Committee of HCWM by the LPB Provincial Governor's Decree No 27 /LPB.Pro.Gov.

As for the PPs for Promotion of 3Rs, Improvement of Collection System, Improvement of Final Disposal System, DONRE and UDAA formulated the PP execution bodies in consideration of their roles and duties.

Table 3-42. Outline of the Plan for Financial System Improvement PP

Activities	Detailed Activities	Allocation of Roles	Time Schedule				
			2012	2013	2014	2015	2020
Project Planning	Set up project management system	DONRE, UDAA, DOH, SJET	■				
	Set up concept	SJET, UDAA, DONRE DOH	■				
Planning of PP	Study on the needs of financial system improvement	SJET, UDAA, DONRE, DOH	■	■	■		
	Preparation of draft financial system improvement plan	SJET, UDAA, DONRE, DOH		■	■	■	
Implementation of PP	Implementation of PPs	UDAA, DONRE, DOH, SJET		■	■	■	■
	Monitoring and awareness raising	DONRE, UDAA, DOH, SJET			■	■	
	Evaluation of the PP	SJET, UDAA, DONRE, DOH				■	
	Suggestion for expansion	SJET, UDAA, DOH, DONRE				■	

3. Planning

The purpose of this PP is to improve the financial system necessary for SWM improvement through the implementation of the PPs conducted in LPB District. The activities and targets of the project are shown below.

Target Area: LPB District

Activities: To prepare financial system improvement proposals necessary for SWM improvement through the implementation of the PPs based on the 4 strategies of the A/P.

Indicator: Proposal for financial system improvement necessary for SWM improvement is prepared.

4. Implementation

a. Situation before the PP

Situation before the PP is shown in the reports of each PP in this Appendix.

b. Implementation

The PPs for SWM improvement were carried out in order to implement 4 strategies of the A/P, i.e. Promotion of 3Rs, Improvement of Collection System, Improvement of Final Disposal System and Improvement of Healthcare Waste Management. The financial systems to be improved are divided into “the financial system necessary for the implementation of the PPs for SWM improvement” that were planned and implemented for the implementation of the PPs, and “the financial system necessary for the continuation, dissemination and expansion of the PPs to be implemented by the Laotian C/Ps after termination of LPPE” as shown in the table below.

Table 3-43: Results of Financial Burdens for PP Implementation in LPB District and Proposal of Financial Burdens for Continuation, Dissemination and Expansion of PPs

Projects	Implementation of PP		Continuation, Dissemination and Expansion of PP	
	Items of Financial Burden	Organization Bore Burden	Items of Financial Burden	Proposed Organization to Bear Burden
Strategy 1: 3Rs Promotion				
1.1.1. Reduction of kitchen waste and garden waste at households (On-site Composting)	Study and planning	SJET	Study and planning	DONRE, UDAA
	Procurement of equipment	SJET	Procurement of equipment	Resident
	Implementation	Resident	Implementation	Resident
	Awareness raising, education and monitoring	SJET, DONRE, UDAA, Ban, MONRE	Awareness raising, education and monitoring	DONRE, Ban, UDAA
1.1.2.a. Recyclable waste separation project at household	Study and planning	SJET	Study and planning	DONRE, UDAA
	Procurement of container for separation	Resident	Procurement of container for separation	Resident
	Implementation	Resident	Implementation	Resident
	Awareness raising, education and monitoring	SJET, DONRE, UDAA, Ban, MONRE	Awareness raising, education and monitoring	DONRE, Ban, UDAA
1.1.2. b. School recycling project	Study and planning	SJET, DONRE, UDAA, School	Study and planning	DONRE, School, UDAA
	Construction of store facility	SJET	Construction of store facility	Acquisition of subsidies and support from donors and CSR by MONRE/DONRE
	Implementation	School, Students	Implementation	School, Students
	Awareness raising, education and monitoring	SJET, DONRE, UDAA, School, MONRE	Awareness raising, education and monitoring	DONRE, UDAA, School
1.1.3.a Avoidance of the use of excess packages, Eco-basket project	Study and planning	SJET	Study and planning	DONRE, UDAA
	Procurement of Eco-basket	SJET	Procurement of Eco-basket	Resident, Acquisition of subsidies and support from donors and CSR by MONRE/DONRE
	Implementation	Resident, Stalls of market	Implementation	Resident
	Awareness raising, education and monitoring	SJET, DONRE, UDAA, Ban, MONRE	Awareness raising, education and monitoring	DONRE, Ban, UDAA
1.1.3.b Avoidance of the use of excess packages, Eco-bag project	Study and planning	SJET	Study and planning	DONRE, UDAA
	Procurement of Eco-bag	SJET	Procurement of Eco-bag	Hotel and Guesthouse
	Implementation	Hotel and Guesthouse	Implementation	Hotel and Guesthouse

	Awareness raising, education and monitoring	SJET, Hotel and Guesthouse, DONRE, UDAA, MONRE	Awareness raising, education and monitoring	Hotel and Guesthouse, DONRE, UDAA
1.2.1. Reduction of kitchen waste from hotels and restaurants	Study and planning	SJET	Study and planning	UDAA, DONRE
	Procurement of equipment and Construction of facility	SJET	Additional procurement of equipment and Expansion of facility	UDAA, Hotel and restaurant
	Implementation	UDAA, Hotel and restaurant	Implementation	UDAA, Hotel and restaurant
	Awareness raising, education and monitoring	SJET, UDAA, Hotel and restaurant, DONRE, MONRE	Awareness raising, education and monitoring	UDAA, Hotel and restaurant, DONRE
Strategy 2: Collection System Improvement				
2.1.1&2 Improvement of exiting collection and discharge system, Primary collection system project	Study and planning	SJET	Study and planning	UDAA, Ban
	Procurement of container for primary collection	SJET	Procurement of container for primary collection	Part of collection fee collected from resident by UDAA and Collection company
	Implementation	Resident	Implementation	Resident
	Awareness raising, education and monitoring	SJET, UDAA, DONRE, Ban, MONRE	Awareness raising, education and monitoring	UDAA, DONRE, Ban, Collection company
2.2.2 Waste collection service expansion by using 5m ³ containers	Study and planning	SJET	Study and planning	UDAA
	Construction of 5m ³ containers	SJET, UDAA	Construction of 5m ³ containers	Part of collection fee collected from users by UDAA
	Implementation	Users of 5m ³ containers	Implementation	Collection fee from large waste generator, and Ban and its resident
	Awareness raising, education and monitoring	SJET, UDAA, DONRE, MONRE	Awareness raising, education and monitoring	UDAA
Strategy 3: Final Disposal System Improvement				
3.1.1 Proper management of existing final disposal site	Study and planning	SJET	Study and planning	UDAA
	Procurement of equipment and Construction of facility	SJET	Procurement of equipment and Construction of facility	Part of tipping fee collected from users by UDAA, Donor and subsidies from Province
	Implementation	UDAA	Implementation	Tipping fee from UDAA and users other than UDAA
	Awareness raising, education and monitoring	UDAA, DONRE, MONRE	Awareness raising, education and monitoring	UDAA, DONRE

3.1.2. Proper management of waste pickers and improvement of their working conditions	Study and planning	SJET	Study and planning	UDAA
	Procurement of equipment	SJET	Procurement of equipment and Construction of facility	UDAA, Waste Picker
	Implementation	SJET, UDAA	Implementation	UDAA, Waste Picker
	Awareness raising, education and monitoring	SJET, UDAA, DONRE, MONRE	Awareness raising, education and monitoring	UDAA, DONRE
3.2.1. Development and management of the treatment facility for the sludge from septic tanks	Study and planning	SJET	Study and planning	UDAA
	Construction of facility	SJET	Maintenance of facility	UDAA
	Implementation	Users of facility, UDAA	Implementation	Treatment fee from users of facility, UDAA
	Awareness raising, education and monitoring	UDAA, DONRE, MONRE	Awareness raising, education and monitoring	UDAA, DONRE
Strategy 4: HCWM Improvement				
4.1.1. HCW collection system establishment	Study and planning	SJET	Study and planning	UDAA, DOH
	Procurement of equipment	SJET	Procurement of equipment	Part of separate collection fee collected from users by UDAA
	Implementation	Separate collection fee from medical institutions	Implementation	Separate collection fee from medical institutions
	Awareness raising, education and monitoring	SJET, DOH, MOH, UDAA, DONRE, MONRE	Awareness raising, education and monitoring	DOH, UDAA
4.2.1. HCW treatment and disposal system establishment	Study and planning	SJET	Study and planning	UDAA, DOH
	Construction of incinerator	SJET	Construction of facility	Part of incineration fee collected from users by Provincial Hospital
	Implementation	Incineration treatment fee from medical institutions	Implementation	Incineration treatment fee from medical institutions
	Awareness raising, education and monitoring	SJET, DOH, MOH, UDAA, DONRE, MONRE	Awareness raising, education and monitoring	DOH, UDAA

5. Evaluation and Achievements

a. Financial system necessary for PP implementation

As for the proposals necessary for the implementation of the PPs for SWM improvement, the following documents were prepared and officially issued:

Strategy 2: Collection System Improvement :

1. **No 101/LPB.Pro.Gov 18/02/2014: Luang Prabang Province Governor’s Agreement on Acknowledgement of Waste Collection Service Improvement Fee in Luang Prabang City Area:**
 - Waste collection fee of LPB District is revised according to the current situation.

Strategy 3: Final Disposal System Improvement :

2. **No 101/LPB.Pro.Gov 18/02/2014: The same as the above**
 - Tipping fee of KM8 disposal site is stipulated for the waste collection company with collection business license and without it.

Strategy 4: HCWM Improvement :

3. **No 575 /LPB.Dis.Gov 30/07/2013: Regulation of the Governor of Luang Prabang District on Transportation fee and Disposal fee for Infectious Waste from Hospital and Public Health Places in Luang Prabang District :**
 - Review of the fee of HCWM including infectious HCW separate collection and incineration
 - Establishment of the fee for infectious HCW collection and incineration at 15,000 kip/kg.
4. **No 282 UDAA/Chinese Hospital 31/03/2014 and No 001 UDAA/Military Hospital 01/01/2015: Contract for Infectious HCW Collection, Incineration and Disposal Service :**
 - Contract agreement between UDAA and Chinese Hospital/Military Hospital on infectious HCW separate collection, incineration and incinerated ash disposal.

As mentioned above, 3 proposals considered as “legal documents” were established for three strategies. For the 3Rs Promotion, the implementation of PPs did not need financial proposals for the implementation of the PPs.

b. Financial system necessary for the continuation, dissemination and expansion of the PPs

The financial proposals for the continuation, dissemination and expansion of the PPs were prepared as shown in the Table 3-43.

As a conclusion the PP indicator was satisfied and the PP purpose was achieved.

Table 3-44: Evaluation of Financial System Improvement PP

Objectively Verifiable Indicators	Means of Verification	Achievement Status
Indicator 2.5. The following documents are prepared.		
1. Proposal for financial system improvement necessary for SWM improvement is prepared.	1. Proposal for financial system improvement necessary for SWM improvement.	Achieved. 3 proposals were established as legal documents in the PPs and other documents could serve for the future regulations. ,

In addition to the above-mentioned targets, the following outputs have been achieved through the

implementation of the PP:

- Through the implementation of various PPs, the needs of a financial system improvement plan with fair financial burden among stakeholders became clear.
- In order to prepare and implement the financial system improvement plan, the coordination system have been established among MONRE, MOH and MPWT of central government, local governments at the Province, District and Village levels and residents through the implementation of various PPs.

6. Suggestion for the Post-Project Activities

Although the implementation of various PPs clarified the needs of a financial system improvement plan and fair financial burden of each stakeholder for the improvement of SWM, the number of legal documents formulated was limited. In order to promote further legal documentation of the financial proposals, relevant organizations are recommended to conduct the following measures:

- The financial capacity on SWM improvement of the local governments is very limited. It is, therefore, recommended to examine O&M cost for SWM improvement based on the beneficiaries-bear principle.
- As for the investment, it is also recommended to apply the beneficiaries-bear principle in general. It is, however, very difficult to manage the large investment cost for the equipment procurement and facility construction with only fees from beneficiaries. It is, therefore, recommended to ask budget from the Central and Provincial governments and financial cooperation of donors and enterprises that promote CSR (cooperate social responsibility).
- As for the preparation of financial proposals it is recommended to utilize the experiences of various PPs as much as possible. Especially for the financial system improvement plan for the continuation of the PPs, and dissemination and expansion of them, it is recommended to utilize Table 3-43: Results of Financial Burdens for PP Implementation in LPB District and Proposal of Financial Burdens for Continuation, Dissemination and Expansion of PPs.

Appendix 4

OPERATION PLAN FOR KM 8 DIPOSAL SITE IN LPB

LPP-Environment

In cooperation with JICA Experts Team

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1. Operation of Landfill Site

1.1 Required Landfill Volume

1.1.1 MSW Flow in 2011

Based on the municipal solid waste management (MSWM) study conducted by LPPE in 2011, MSW flow in LPB in 2011 has been prepared as shown in the figure below.

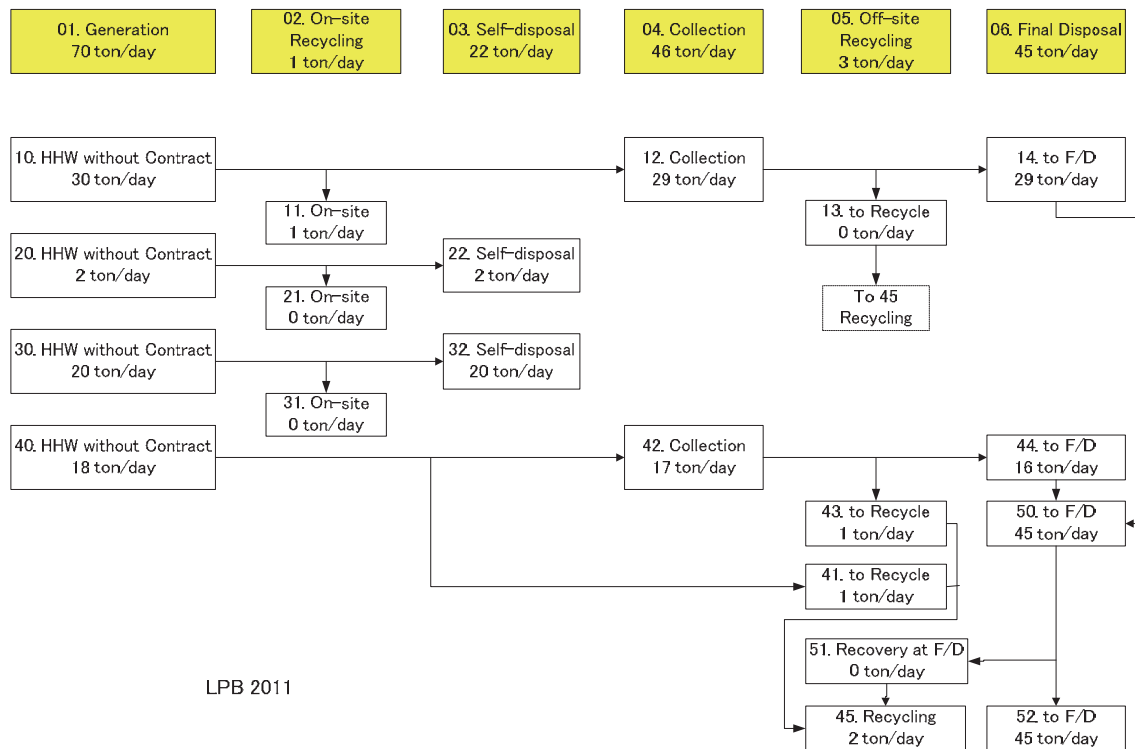


Figure 1: MSW Flow in 2011

1.1.2 Estimation of MSW Disposal Amount

Based on the above-mentioned MSW flow in 2011 the following basic data and assumptions are established for estimation of disposal amount:

- d.1. Population: 77,829 in 2010, Population growth rate 1.80 % from Socio-economic Development Plan (2009 – 2015)
- d.2. Population in 20xx (Pxx): $77,829 \times (1 + 0.018)^{(20xx-2010)}$
- d.3. GRDP Growth Rate: 7.5 % from “The Project for Urban Development Master Plan Study in Vientiane Capital”
- d.4. Household waste generation rate in 2011: 654 g/person/day from LPPE waste amount and composition survey in 2011
- d.5. Household waste generation rate in 20xx (HWGRxx):
 $HWGR_{xx} = 654 \times (0.55 \times (1 + 0.075)^{(20xx - 2011)})$
 Note: 0.55 is the coefficient obtained from statistic data in Japan
- d.6. Household waste generation amount in 20xx (HWGAxx):
 $HWGA_{xx} = HWGR_{xx} \times P_{xx}$

- d.7. MSW generation in 20xx: Estimated by considering MSW flow in 2011 and d.2, d.5 and d.6.
d.8. MSW collection coverage rate in 2020: 79% in 2020 according to the Japanese grant aid project.

Based on the above data and assumptions the disposal amount of KM8 disposal site (KM8DS) is estimated as shown in the table below.

Table 1: MSW Disposal in KM8DS by 2020

Items	Unit	2016	2017	2018	2019	2020
Population	person	86,623	88,182	89,769	91,385	93,030
Household waste generation rate	g/person/day	799	832	866	902	939
Household waste generation amount	ton/day	69	73	78	82	87
MSW generation	ton/day	93	99	105	111	117
MSW collection coverage rate	%	70	72	73	76	79
MSW collection amount	ton/day	65	71	77	84	92
MSW disposal amount	ton/day	63	70	76	83	91

(Note) Difference of collection amount and disposal amount is due to recycling activities observed in the waste stream survey conducted in 2011.

1.1.3 Required Landfill Volume

Required landfill volume is calculated by the formula below:

$$YRLV_{xx} = ((YFD_{xx}/UWWL) * (1 + CSR))$$

- YRLV_{xx}: Yearly Required Landfill Volume in 20xx (m³/year)
- DD_{xx}: Daily Disposal Amount in 20xx (ton/day)
- YD_{xx}: Yearly Disposal Amount in 20xx (ton/year)
- UWWL: Unit Weight of MSW at the Landfill (ton/m³)
- CSR: Cover Soil Rate to Landfilled Waste
- ARLV: Accumulated Required Landfill Volume (m³)

Considering the current waste composition and future landfill operation the following assumptions is set for the required landfill volume calculation:

- DD_{xx}: Up to the year 2020 the figure of “MSW disposal amount” in the Table 1 applied. After 2021 it will increase 5% every year.
- UWWL: 1.2 ton/m³
- CSR: 5% of landfill MSW volume. Although it is not enough for sanitary landfill operation (more than 10%), minimum soil cover will be conducted.

Table 2: Required Landfill Volume until 2030

Year	DDAxx (ton/day)	YDAxx (ton/year)	YRLVxx (m3/year)	ARLV (m3)
2016	63.0	22,995	20,121	20,121
2017	70.0	25,550	22,356	42,477
2018	76.0	27,740	24,273	66,749
2019	83.0	30,295	26,508	93,258
2020	91.0	33,215	29,063	122,321
2021	95.6	34,876	30,516	152,837
2022	100.3	36,620	32,042	184,879
2023	105.3	38,451	33,644	218,523
2024	110.6	40,373	35,326	253,850
2025	116.1	42,392	37,093	290,942
2026	121.9	44,511	38,947	329,890
2027	128.0	46,737	40,895	370,784
2028	134.4	49,074	42,939	413,724
2029	141.2	51,527	45,086	458,810
2030	148.2	54,104	47,341	506,151

1.2 Landfill Plan

1.2.1 Possible Landfill Operation Area

1.2.1.1 Possible Landfill Area Operation Plan

Possible landfill area of KM8DS is divided into the three areas as shown in the figure below.

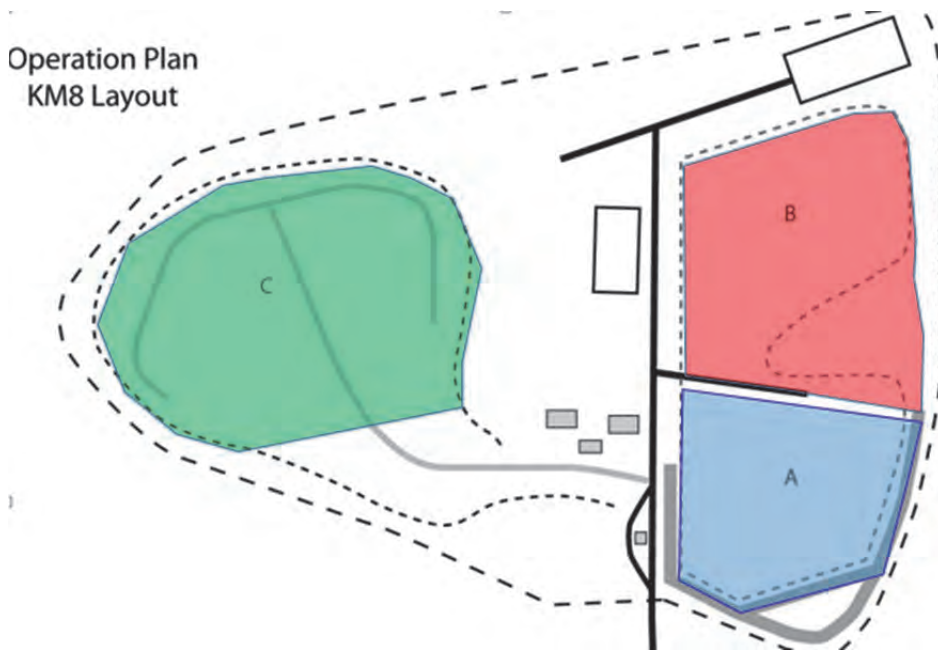


Figure 2: Possible Landfill Area of KM8DS

Landfill operation plan is made Area A & B and C respectively as shown in the Figure below.

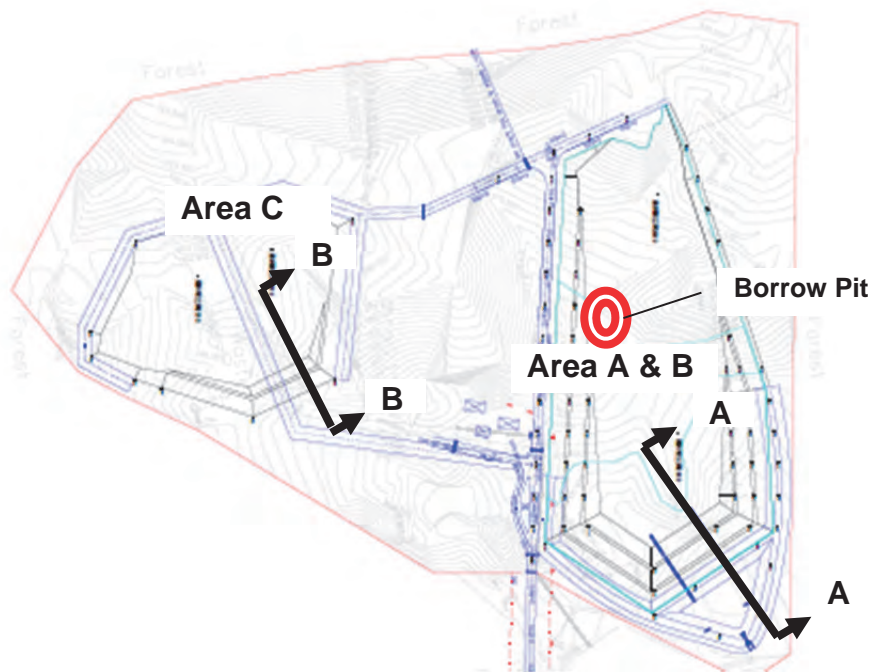


Figure 3: Landfill Area Operation Plan

1.2.1.2 Area A & B

As shown the figure Area A & B will be landfilled by the three steps as shown in the Figure below. The first step landfill operation is conducted until the dumped waste height comes EL 313m. The dumped waste height becomes EL 318m by the second step landfill operation. The final and completed landfill height will be EL 323m by the third step. As of June 30 in 2015 the dumped waste height of Area A is estimated as EL 314.5 m.

Cross Section A-A



1.2.1.3 Area C

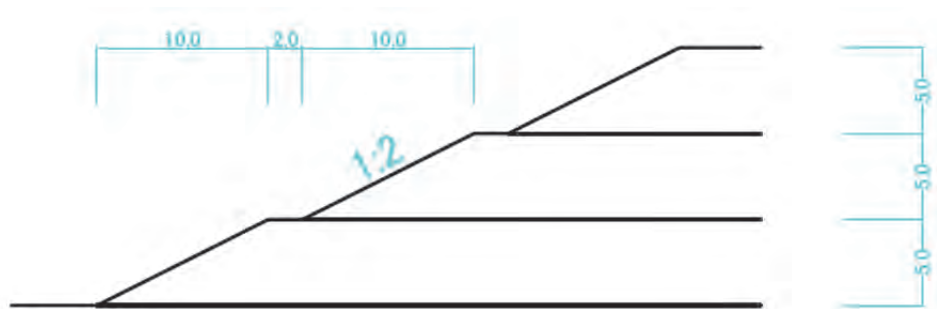
As for the Area C the landfill operation will be conducted by the two steps as shown in the Figure below. The first step landfill operation is conducted until the dumped waste height comes EL 318m. The final and completed landfill height will be EL 322m by the second step.

Cross Section B - B



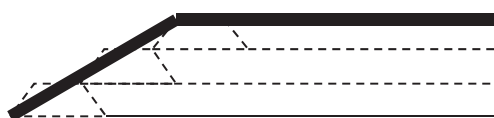
1.2.1.4 Slope Structure and Grade

As shown in the Figure below the grade of landfilled waste slope shall be gentler than 1 (Height) to 2 (Length) in order for the bulldozer to compact the landfilled waste and cover soil on the slope. As indicated in the Figure maximum height of the slope shall be 5m. If the height is 5m the length shall be more than 10m and 2m of step shall be made before the commencement of next slope in order to avoid slope slide.



1.2.1.5 Enclosing Bank

In order to dispose waste of at designated place enclosing bank shall be constructed at the edge of the landfill. It is preferred to construct the bank by excavated soil. Considering very limited landfill budget, however, the bank could be constructed by using dumped waste. As indicate in the Figure below 1 to 2 m height of small bank (as shown in the dot line) will be constructed by using dumped waste. After filled up inside the bank and height of the landfilled area becomes about 5m, about 5m slope will be shaped as instructed in the above and cover soil on the slope.



1.2.1.6 Borrow Pit of Soil

As indicated in the Figure 3 proposed borrow pit of soil for covering slope and construction of access road will be Area B. It is advantage that in accordance with the excavation of soil the landfill capacity of Area B will increase.

1.2.2 Order of Landfill Area Operation

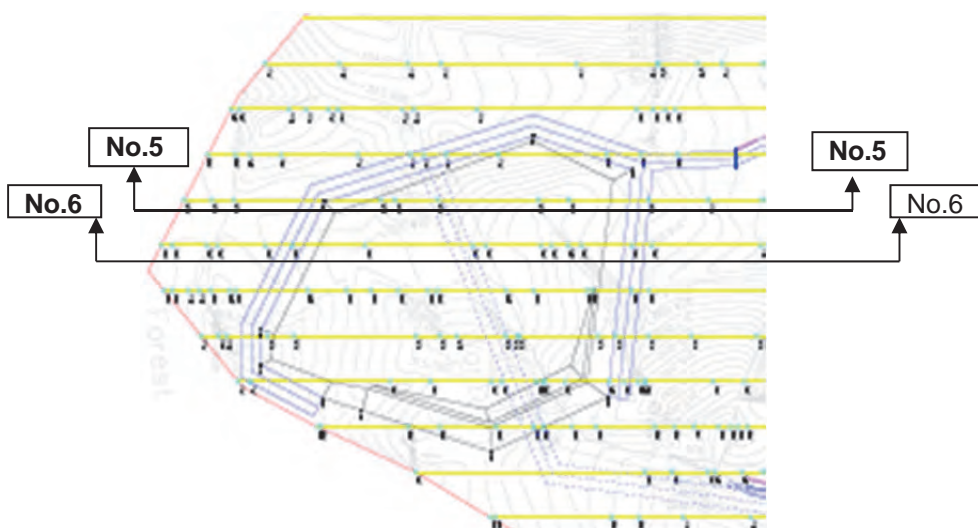
Since available landfill equipment until November 2015 is only one excavator and Area A operation became very difficult. Then landfill operation area has been shifted from Area A to Area C. In order to smoothly conduct landfill operation in the Area C, in June 2015 UDAA constructed a new access road to Area C by connecting asphalt paved road. Consequently proposed order of landfill area operation is as follows:

- Phase 1. Landfill Area C up to EL 322m
- Phase 2. Landfill Area A&B up to EL 323m
- Phase 3. Previous Private Landfill Operation Area Next to the Landfill Area C up to EL 322m

1.2.3 Duration of Landfill Area Operation

1.2.3.1 Possible Landfill Volume Calculation

As shown in the Figure 3: Landfill Area Operation Plan, landfill area operation plan is made by the CAD (computer aided design). Based on the CAD plan cross-section plans are prepared and possible landfill **area** of each cross-section (LACSx) is calculated by CAD system. The possible landfill **volume** of Area C is calculated by multiplying average area with width as shown in the table below.



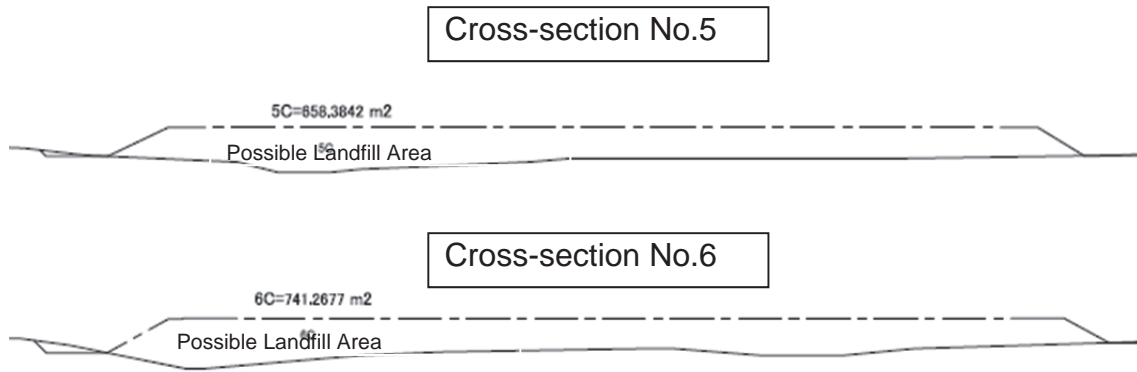
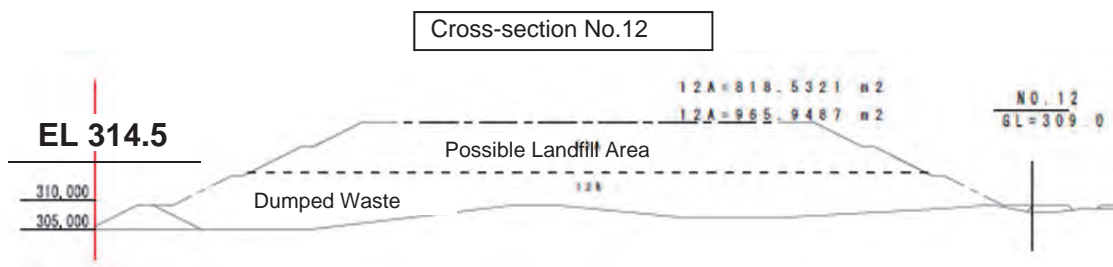


Table 3: Possible Landfill Volume of Area C

Section No.	Width Between Section (m)	Landfill Area (m ²)	Average Landfill Area (m ²)	Landfill Volume (m ³)
No.2+12	0	0	0	0
No.3	8	60	30	244
No.4	20	424	242	4,840
No.5	20	658	541	10,825
No.6	20	741	700	13,997
No.7	20	798	770	15,397
No.8	20	731	765	15,299
No.9	20	121	426	8,523
No.9+11	20	0	60	665
Total				69,790

As for the Area A &B MSW has been disposed of at Area A. The average height of the dumped waste is assumed as EL 314.5m as shown in the Figure below.



With the same calculation method the possible landfill volume of Area A&B is calculated as shown in the table below.

Table 4: Possible Landfill Volume of Area A&B

Section No.	Width Between Section (m)	Waste Dumped Area (m ²)	Average Waste Dumped Area (m ²)	Dumped Waste Volume (m ³)	Possible Landfill Area (m ²)	Average Possible Landfill Area (m ²)	Possible Landfill Volume (m ³)	Total Landfill Volume (m ³)
No.0	0	0	0	0	0	0	0	0
No.1	20	0	0	0	67	33	665	665
No.2		0	0	0	323	195	3,899	3,899
No.3		0	0	0	507	415	8,302	8,302
No.4		0	0	0	679	593	11,859	11,859
No.5		0	0	0	707	693	13,860	13,860
No.6		0	0	0	689	698	13,962	13,962
No.7		0	0	0	1,027	858	17,167	17,167
No.8		0	0	0	1,322	1,175	23,496	23,496
No.9		625	312	6,248	887	1,105	22,094	28,343
No.10		767	696	13,916	887	887	17,747	31,663
No.11		873	820	16,395	840	864	17,279	33,674
No.12		966	919	18,387	819	829	16,589	34,976
No.13		1,141	1,053	21,068	798	808	16,167	37,235
No.14		717	929	18,574	147	472	9,447	28,021
No.15		256	486	9,724	0	73	1,465	11,189
No.16		0	128	2,558	0	0	0	2,558
Total				106,871			193,998	300,869

1.2.3.2 Duration of Landfill Area Operation

Based on the possible landfill volume of Area C and A&B, and the required landfill volume shown in the Table 2, the duration of landfill operation of each phase is estimated as follows:

Phase 1. Landfill Area C up to EL 322m

Possible Landfill Volume of Area C: about 70,000m³

Possible Duration of Area C Operation: **Until the beginning of 2019**, because the required landfill volume up to the end of 2018 is 66,749 m³ according to the Table 2.

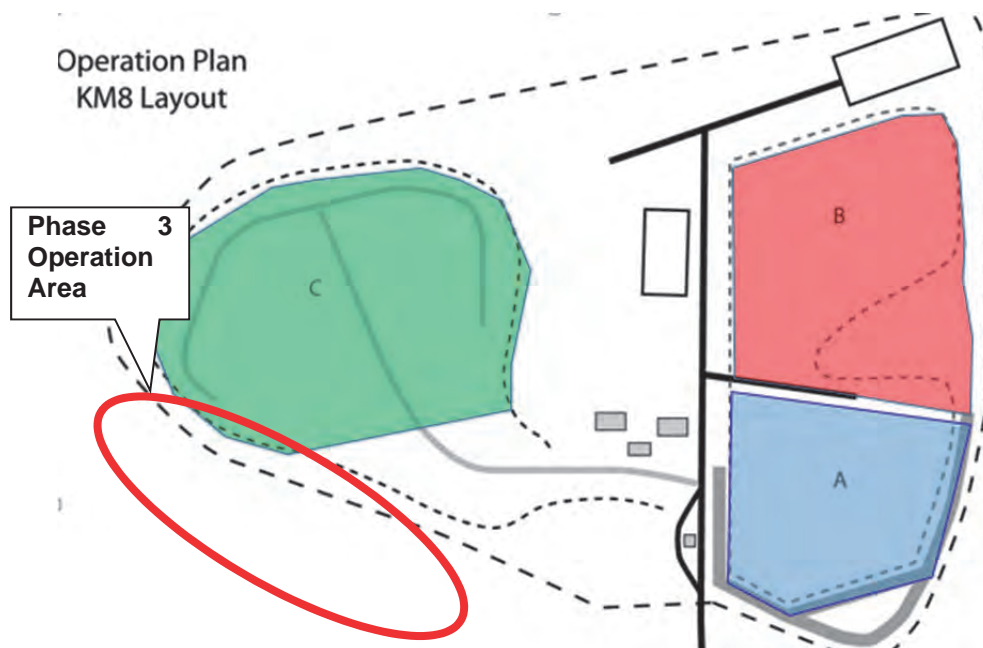
Phase 2. Landfill Area A&B up to EL 323m

Possible Landfill Volume of Area A&B: about 194,000m³

Possible Duration of Area A&B Operation: **Until the beginning of 2025**, because the required landfill volume up to the end of 2024 is 253,850 m³ according to the Table 2 and total possible landfill volume of Area C + Area A&B is about 264,000 m³.

Phase 3. Previous Private Landfill Operation Area Next to the Landfill Area C up to EL 322m

Since after year 2024 KM8DS will not have space for landfill operation, UDAA needs to construct a new landfill by the end of 2024. In case UDAA intends to continuously use the KM8DS, UDAA will use the Previous Private Landfill Operation Area Next to the Landfill Area C up to EL 322m as shown in the Figure below.



1.3 Infrastructure Development Plan

In order to use three possible landfill area the following infrastructures shall be developed:

- Access road to the landfill operation area
- Drainage system

1.3.1 Access Road

The first priority of the landfill operation shall be given to secure the access road for collection vehicle to dump its waste onto the designated place of the landfill.

Phase 1. For Operation of Landfill Area C

As for the operation of Area C, UDAA has constructed gravel paved access road the east side of the Area C in June 2015. It is proposed that UDAA will further extend access road to the west side of the Area C by improving the existing unpaved road as shown in the Figure below.

Phase 2. For Operation of Landfill Area A&B

As for the operation of Area A&B, it is proposed that UDAA will construct an access road from the septic sludge facility to the existing dumped area as shown in the Figure below.

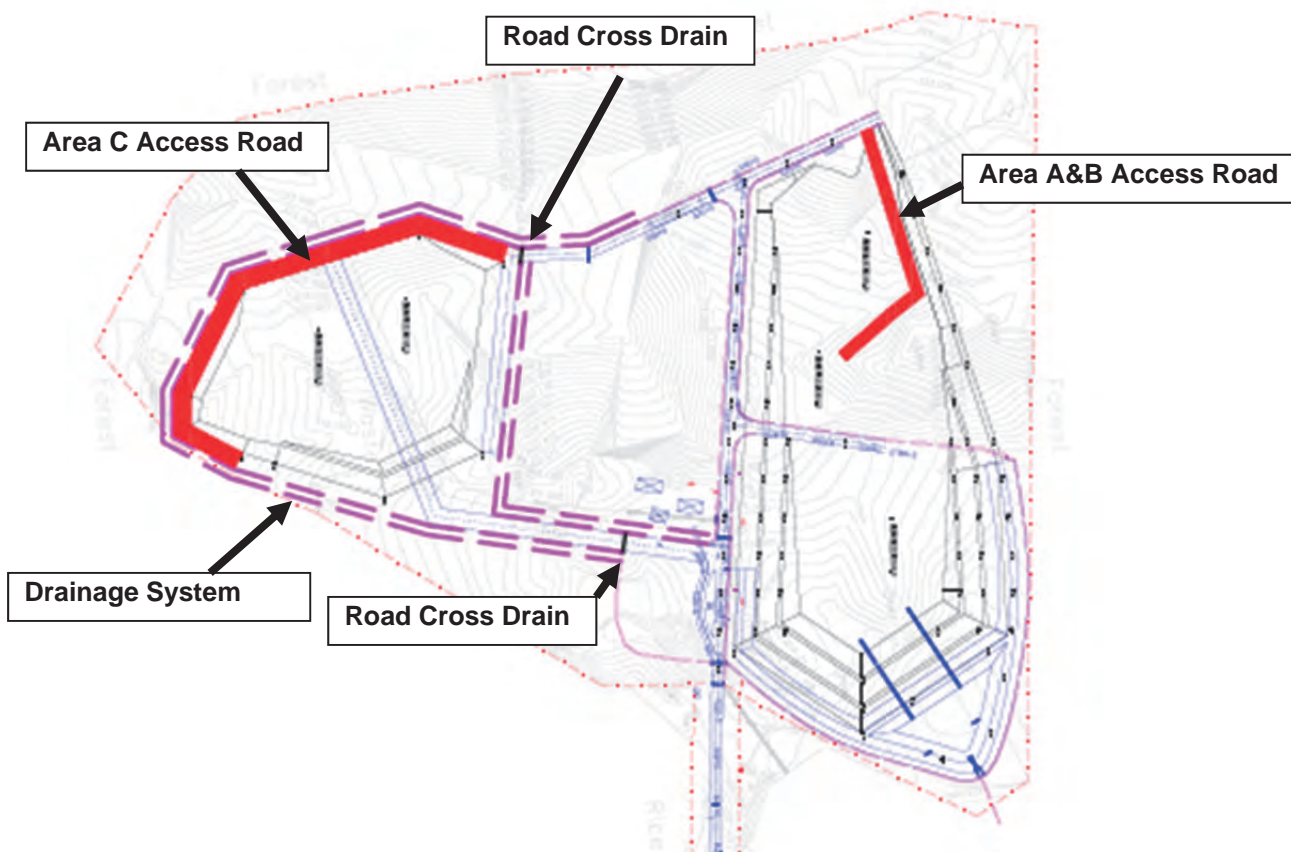


Figure 4: Infrastructure Development Plan

1.3.2 Drainage System

In order to maintain the access road drainage system shall be provided along the proposed access road. Otherwise the access road will be damaged and become unpassable in rainy season as often happened before the LPPE improvement.

Phase 1. For Operation of Landfill Area C

As for the operation of Area C, UDAA has constructed gravel paved access road the east side of the Area C in June 2015 and UDAA will further extend access road to the west side of the Area C by improving the existing unpaved road as shown in the Figure above. Along the constructed road drainage system with two road cross drain shall be constructed as shown in the Figure above.

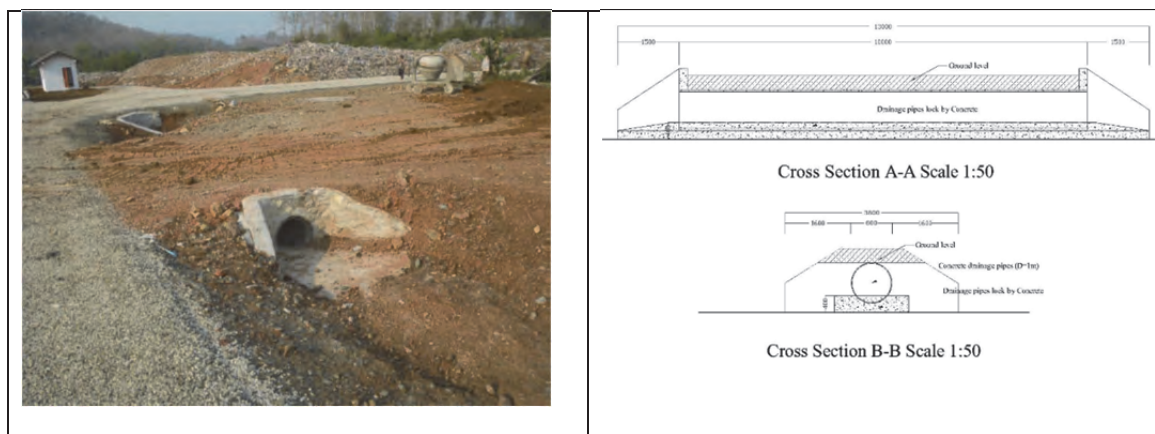


Figure 5: Photo and Design Drawing of Road Cross Drain

1.3.3 Investment

The above infrastructure development is summarized as shown in the table below. The cost of the investment will be estimated by UDAA.

Table 5: Summary of Infrastructure Development

Phase	Access Road (m)	Drainage System (m)	Road Cross Drain (Number)
Phase 1	270	810	2
Phase 2	140	0	0

1.4 Operation Cost Estimation

Monthly operation cost of the landfill is calculated based on the Table below.

Table 6: Monthly Landfill Operation Cost

Items	Quantity	Monthly Cost (1,000 kip)	Remarks
1. Landfill Equipment			
1.1 Bulldozer (10ton)	1		(12ltr/hour x 5hour x 30day) x 7,200kip
1.2 Excavator (Bucket 1m ³)	1		(?? litr/month by UDAA) x 7,200kip
1.3 Dump trunk for covering soil (10ton)	1		(?? litr/month by UDAA) x 7,200kip
2. Staff for operation of landfill site			
2.1 Manager	1		
2.2 Bulldozer operator	1		
2.3 Excavator operator	1		
2.4 Dump truck driver for covering soil	1		
2.5 Foreman	1		
2.6 Weigh bridge operator	1		
2.7 Worker for Composting	2		
2.8 Mechanics	1		
Total			

1.5 Other Important Issues for Proper Landfill Operation

For proper landfill operation the following issues shall be cleared:

- Clear instruction and control of dumping area to the landfill user, i.e. incoming vehicle. If an incoming vehicle does not follow the instruction, the vehicle shall be penalized.
- Provide the incoming vehicle smooth access to the dumping area. Therefore conduct frequent maintenance of access road. For the access road from paved road to the dumping area, concrete plate will be installed.
- Establish fare tipping fee system by using weighbridge data. Then revise tipping fee in order to conduct sanitary operation as much as possible, i.e. frequent cover soil, etc.
- Clear instruction and control of waste pickers not to work at the place where landfill equipment working.

2. Management of waste pickers

2.1 Identify the waste pickers

The ID cards of waste pickers are issued to identify and organize the waste pickers.

2.2 Rules and measures for the control of waste pickers in the KM 8 Disposal Site

In order to regulate and control the activities of waste pickers, UDAA established and issued “Announcement on Prohibition to Outsider for Entering KM8 Disposal Site” in January 2013. Furthermore, in order to facilitate control of waste pickers, UDAA in cooperation with SJET states the control of waste pickers in the KM8 disposal site as follows.

- Waste pickers are required to be registered for working at the disposal site.
- Waste pickers are required to bring the issued ID cards when they work at the disposal site.
- Waste pickers are required to put on safety jackets, gloves, masks and long boots.
- Waste pickers are required to have Preventive injection for infection disease
- Waste pickers are required not to work at the active disposal area to avoid any accident.

UDAA instructs the waste pickers to put on the gloves, boots and safety jackets when they work on waste picking and warned anybody.

2.3 Waste picker meeting

The regular waste picker meeting shall be held to manage the waste pickers.

2.4 Other Important Issues for Proper Waste Picker Management

After the reception of a bulldozer by the grant aid of the Japanese Government in November 2015, the operation method of the final disposal will be changed. For example, the frequency of waste movement and soil coverage will increase and the waste disposal work and waste picking work can have conflicts. The waste picker management rule will need a revision and all the waste pickers should understand it.

3. Monitoring

The on-site monitoring shall be carried out approximately once a year. It is recommended that the member of monitoring be from governmental agencies at the national, capital and district levels, social organizations (Labor Union, Women’s Union and Youth Union).

The member of monitoring are given a lecture about the facility and operation of the disposal site, observed the facility operation and answered prepared questionnaires.

The questionnaire had a structure and questions shown below. The questions of Category A and B are asked every time of the monitoring. The result of monitoring shall be submitted to DONRE and UDAA and feedback to develop the operation of landfill site.

Check List for Monitoring Committee for the Landfill Site					Date:	
					Time:	
Category A: Environmental effect (Before and after construction)						
No	Items	Acceptable	Medium	Terrible	Score	Notes
A1.	Fire & Smoke	0	1	2		
A2.	Offensive odour	0	1	2		
A3.	Waste water (Leachate)	0	1	2		
A4.	Withering of trees caused by discharged waste	0	1	2		
A5.	Waste scattering	0	1	2		
A6.	Animals (dogs, monkeys, birds etc.)	0	1	2		
A7.	Vermin (Flies, etc.)	0	1	2		
A8.	View	0	1	2		
A9.	Working condition of waste pickers	0	-	2		
Total of Category A						
Category B: Function of Facilities (After construction)						
No	Items	Functioning	Medium	Not functioning	Score	Notes
B1.	Covering soil at new discharge area	0	1	2		
B2.	Rain water drainage system	0	1	2		
B3.	Access road	0	1	2		
B4.	Treatment facility of sludge from septic tanks					
	Fence	0	1	2		
	Sedimentation pond	0	1	2		
	Treatment pond	0	1	2		
Total of Category B						
<u>Comment:</u>						
<u>Name & Signature</u>						

Appendix 5.

OPERATION AND MAINTENANCE MANUAL FOR THE SEPTIC TANK SLUDGE TREATMENT POND AT LPB KM 8 (2015)



LPP-Environment-Component

In cooperation with JICA Experts Team

This is the Operation and Maintenance Manual for the septic tank sludge treatment pond established at KM8 final disposal site in Luang Prabang District.

1. Outline of the septic tank sludge treatment ponds

The objective of the septic tank sludge treatment ponds is to remove the suspended solid (SS) of septic tank sludge collected in the Luang Prabang District. The septic tank sludge treatment ponds contribute to reduce the suspended solid (SS) load in the treatment pond. The septic tank sludge treatment ponds consist of two parallel lines of a receiving tank and two sedimentation pits and following treatment ponds. The layout of receiving tank, sedimentation pits and treatment ponds is shown in the following figure.

- The functions of the receiving tank is to screen the large particle matter of discharged septic tank sludge and to avoid the turbulence at the sedimentation pit due to high velocity of influent from receiving tank.
- The function of the 1st and the 2nd sedimentation pits is to removes the suspended solid (SS) of septic tank sludge.
- The effluent of the 2nd sedimentation pit is flowing to the treatment pond to remove BOD₅.
- The effluent of the treatment ponds flows to the drain along the site.

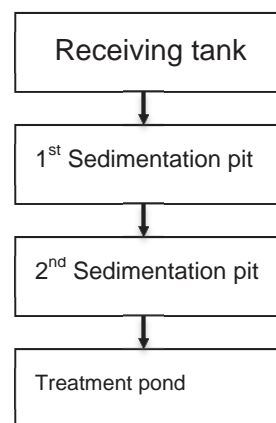


Fig: The layout of receiving tank, sedimentation pits and treatment pond

2. Specification the septic tank sludge treatment ponds

(1) Designed treatment capacity: 18m³/day x 2 lines

(2) Volume capacity of tank and pit

- receiving tank : 24m³ x 2 lines
- the 1st sedimentation pit : 36m³ x 2 lines
- the 2nd sedimentation pit : 36m³ x 2 lines
- treatment pond : 500m³ x 2lines (600m³/1.2=500m³)

(3) Retention time

- the 1st sedimentation pit : 2days (=36m³ / 18m³/day)
- the 2nd sedimentation pit : 2days (=36m³ / 18m³/day)
- treatment pond : 28days (=500m³/18m³=27.7days)

3. Operation principles of the septic tank sludge treatment ponds

There are following four principals of operation of the septic tank sludge treatment ponds.

- (1) Target of treatment is the septic tank sludge
- (2) Usually one line of the septic tank sludge treatment ponds is operated.
- (3) In case that the amount of discharged septic tank sludge is quite large and one line is not enough, two lines of the septic tank sludge treatment ponds are operated.
- (4) Sedimentation settled out and scum floating in the receiving tank and the sedimentation ponds is regularly removed to avoid blocking of drains and decreasing of retention time.

4. Work procedure of the collection vehicle of septic tank sludge and administration office at KM8 final disposal site

- (1) The collection vehicle of septic tank sludge shall be designated at the administration office at KM8 final disposal site beforehand.
- (2) The driver of collection vehicle of septic tank sludge shall report the amount and collection area of septic tank sludge to the administration office at KM8 final disposal site before approaching the septic tank sludge treatment ponds.
- (3) The administration office shall record the reported information and instruct the location of the septic tank sludge treatment ponds where septic tank sludge should be discharged.
- (4) The driver of collection vehicle of septic tank sludge shall properly discharge sludge to the receiving tank instructed by administration office.
- (5) The driver of collection vehicle of septic tank sludge shall clean the surrounding of receiving tank after discharging the sludge.



Photo: Removal of sedimentation by excavator
(VTE KM32)



Photo: Removal of sedimentation by excavator
(VTE KM32)

5. Maintenance of the septic tank sludge treatment ponds

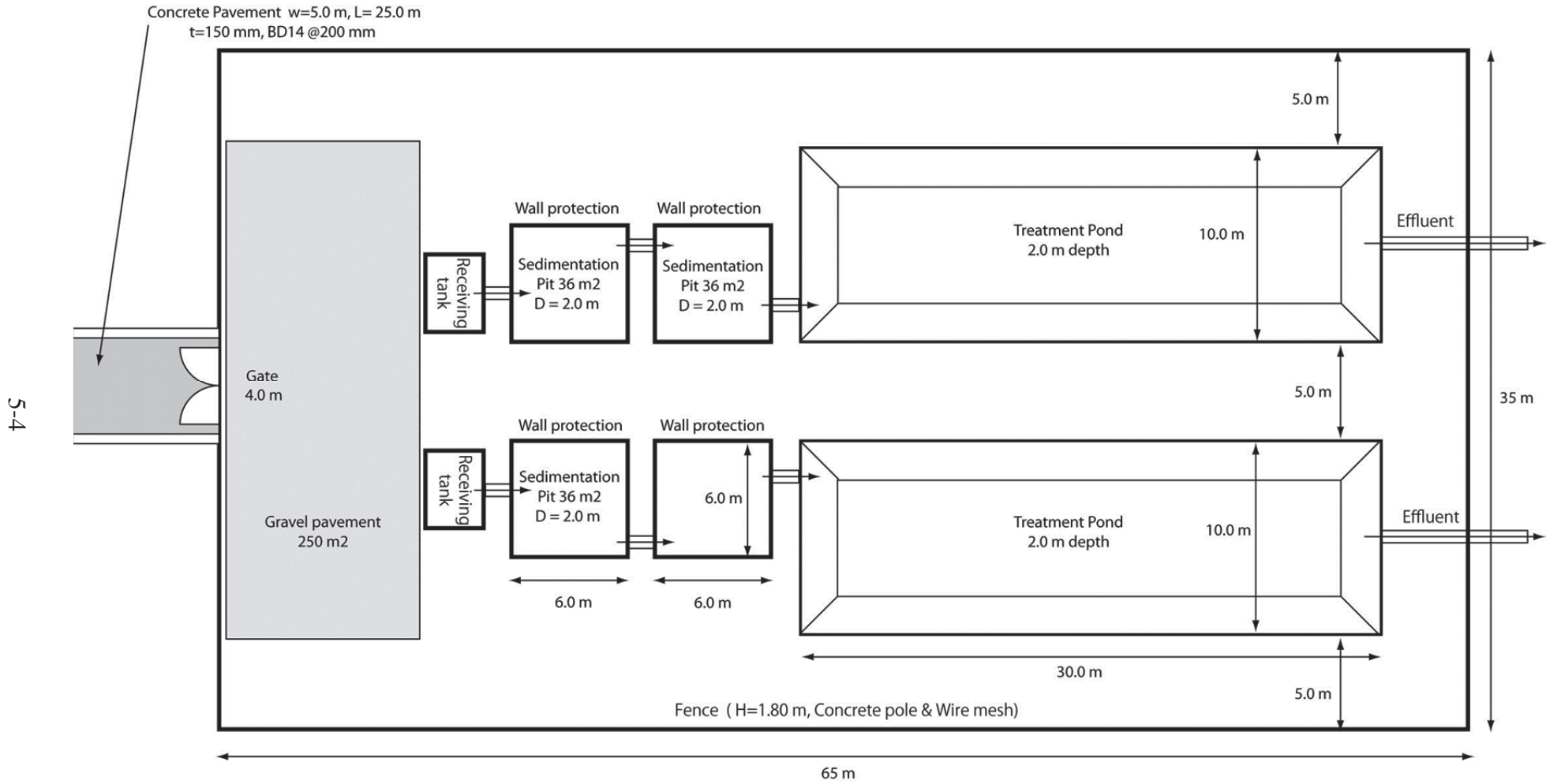
- (1) Receiving tank, sedimentation pits and drains shall regularly be inspected and the clog shall be cleared, such as scum in the drains.
- (2) The sedimentation settled out in the receiving tank and sedimentation pit shall be removed more than two times in a year; beginning and end of dry season.
- (3) In case that the receiving tank and sedimentation do not function well due to the too much sedimentation, the sedimentation shall be removed more frequently.
- (4) The area between two lines can be used as the access road for the operation of heavy machinery and dump truck..

6. Methodology of removing sedimentation

- (1) The sedimentation in the receiving tank shall be removed by manual.
- (2) The wastewater in the sedimentation pit shall be sucked by collection vehicle of septic tank sludge before removing the sedimentation and scum in the pit. The volume of wastewater sucked is estimated 18 m³ and three loading of 6m³ collection vehicle of septic tank sludge are required.
- (3) The sedimentation settled out in the sedimentation pit shall be removed by the excavator and load it to the dump truck. The volume of removed sedimentation is estimated approximately 18m³ from one line.
- (4) The removed sedimentation shall be discharged at the designated place in the final disposal site.
- (5) Maintenance of oxidation pond is not implemented for a while.

7. Annex

(1) Plan of septic tank sludge treatment facility

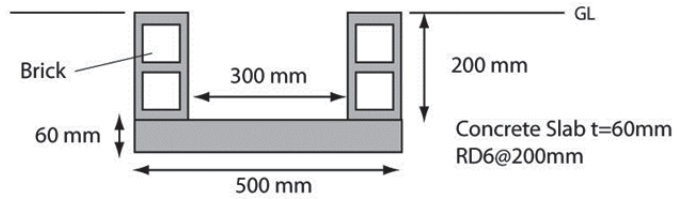


(2) Detail of facilities

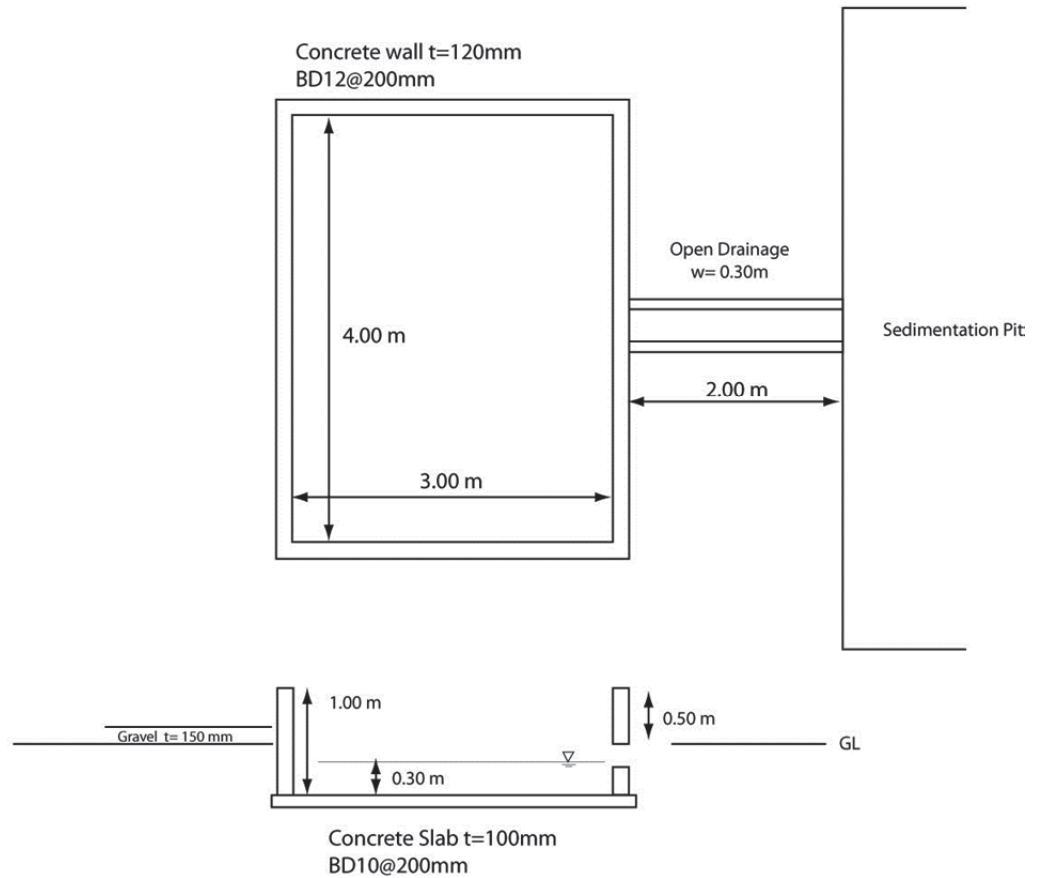
1.3 Wall protection



1.4 Open Drainage $w=30\text{ cm}$

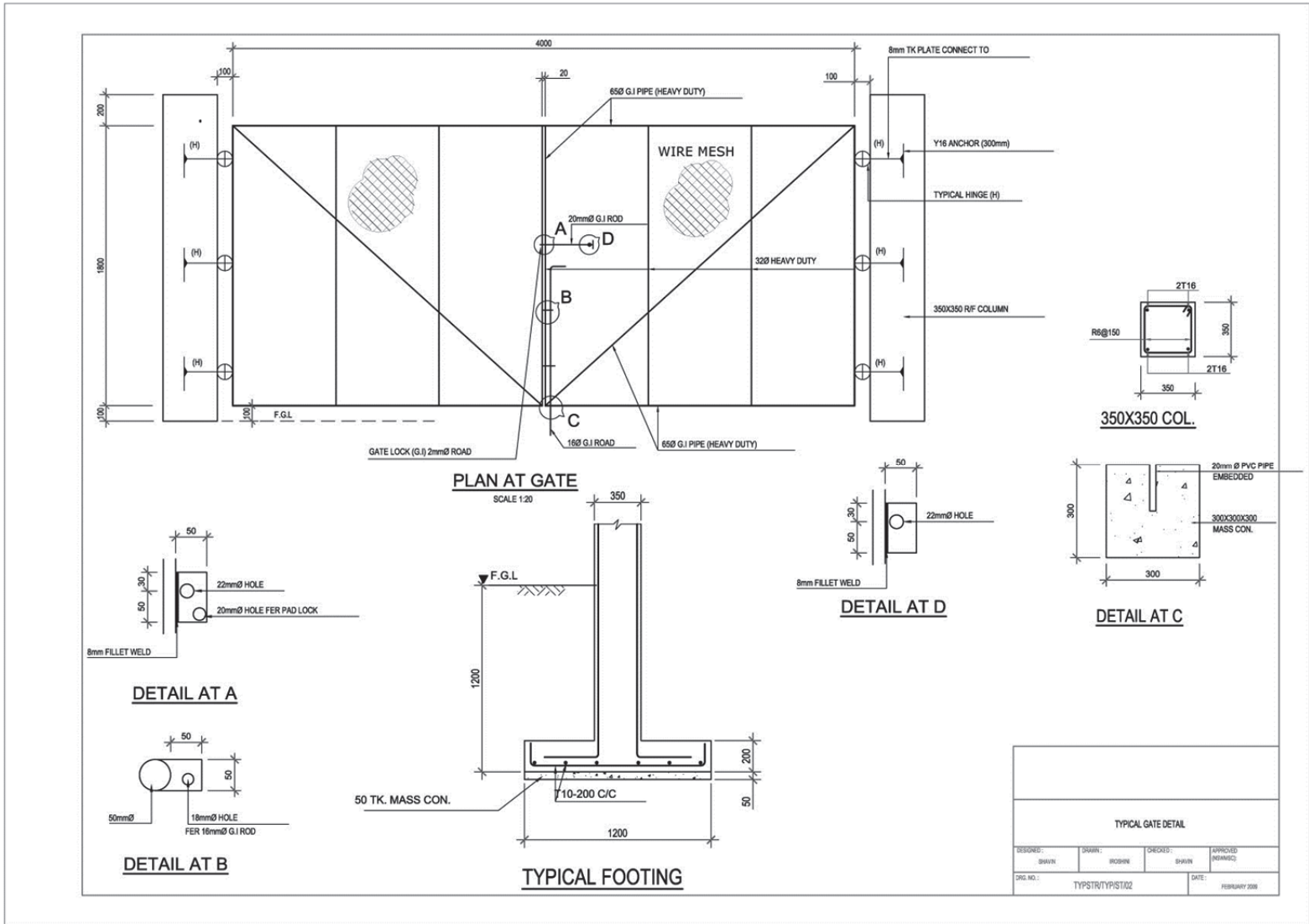


1.5 Receiving tank



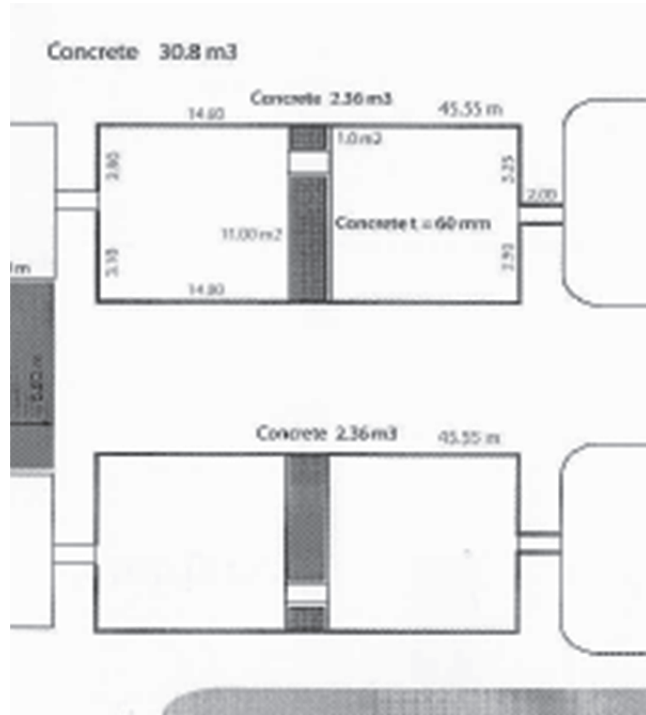
(3) Gate

5-5

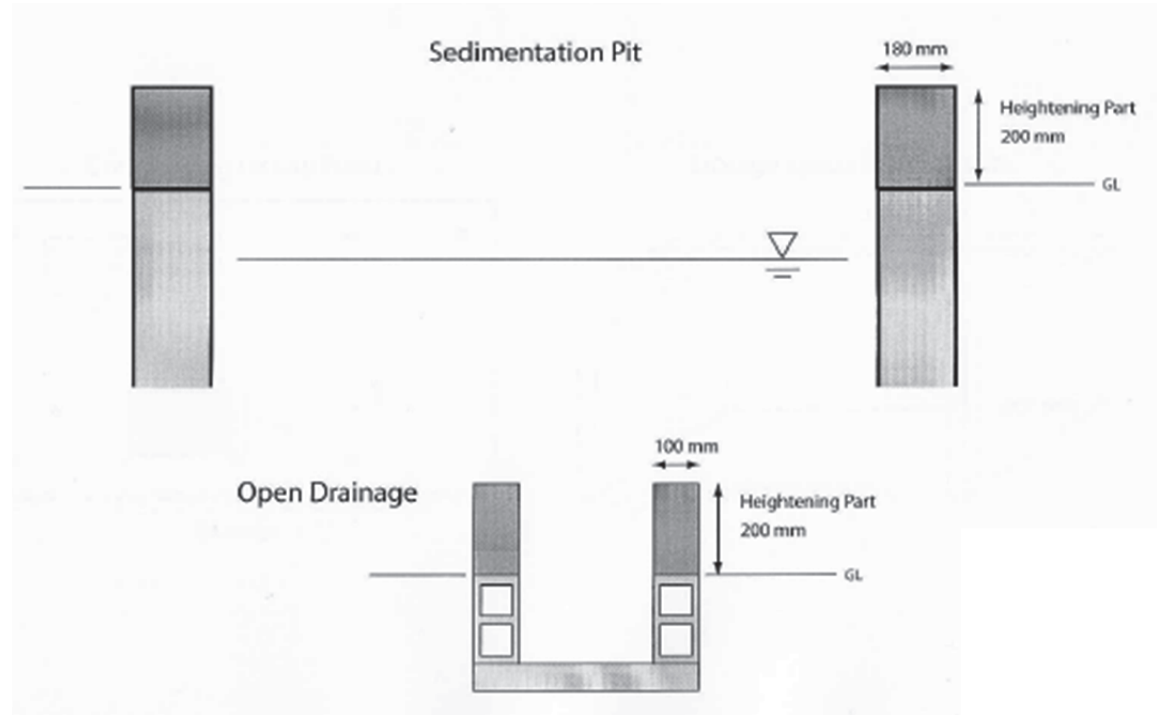


TYPICAL GATE DETAIL			
DESIGNED: SHAWN	DRAWN: ROSHNE	CHECKED: SHAWN	APPROVED (SIGNATURE)
Dwg. NO.: TYPSTR/TYPST02		DATE: FEBRUARY 2008	

(4) Improvement work for Facilities at Disposal Site



Sewage facility



Heighten Side Wall

Appendix 6. Plan for Healthcare Waste Management (HCWM)

1 HCWM in May 2012

1.1 HCWM in LPB

1.1.1 HCWM in the Two Main Hospitals

In May 2012, an interview survey was carried out at LPB provincial hospital and LPB military regional hospital to know their waste separation practices. Both have been considered to be the target hospitals of the incinerator.

As observed at hospitals in VTE, the two hospitals in LPB refer to the MOH's Decree No.1706 and separate waste into infectious waste, sharps and general wastes. The LPB provincial hospital uses yellow bags for infectious waste and sharps and black bags for general waste. All the waste bags are, however, put into a 5m³ waste container together for collection. The LPB military regional hospital uses only black bags (and blue bags occasionally) although they separate waste into three, and store the waste in a storage. This storage with a rainproof structure is considered as an ideal place to store healthcare waste.

1.1.2 Collection Service for the Two Main Hospitals

The waste collection service provided to the two hospitals in May 2012 is shown below.

Table 1: Waste Collection Service for the Two Main Hospitals in LPB District

	A	B	C	D
No	Name of Hospitals	Fee for General Waste (kip/month)	Fee for Infectious Waste (kip/month)	Separate Collection
1	LPB provincial	1,500,000	LS	No
2	Military Regional	400,000	LS	No

LS: lump sum (fee for general waste collection covers infectious waste collection)

As in Column D, both hospitals do not use separate collection service. As already mentioned, the LPB provincial hospital discharge all the waste into the waste container, which is transferred to the final disposal site. The LPB military regional hospital places the waste into the storage, from which all the waste is collected as part of collection service for general waste from households. There is no additional fee for the collection of infectious waste.

1.1.3 HCW Generation

In May 2012, a one-week waste weighing survey was carried out at the two hospitals by the hospital staff using a scale to know the amount of waste generated and all the data were collected by July. The result is shown below. The total number of beds are 250, total waste amount is 195 kg/day and total infectious (including sharps) is 48.6 kg/day for the two hospitals. Based on the survey, generation rate of infectious waste is obtained as 0.1944 kg/bed/day, or approximately **0.2 kg/bed/day**.

Table 2: Results of Weighing Survey (LPB)

Name of Hospital	Nos of beds	Occupation rate	Total staff	Out-patients/day	In-patients/day	Waste Total (hearing survey)	Infectious + Sharps (hearing survey)	Infectious + Sharps (Weighing)
		rate	Persons	person	person	kg/d	kg/d	kg/d
LPB Provincial	150	50%	250	100	26	150	20	34.1
Military Regional	100	80%	270	70	50	45	2	14.5
Total	250		520	170	76	195	22	48.6

1.2 Medical Institutions (MIs) in LPB

According to the information from the LPB Province Health Department, the following medical institutions (MIs) are located in LPB district. Based on the above-mentioned weighing survey infectious waste generation amount from each institution is estimated as shown in the table below.

Table 3: Medical Institutions (MIs) in LPB and Infectious Waste Generation Amount

Name of Medical Institution (MI)	Nos of MI	Nos of bed	Occupancy Rate (%)	Infectious Waste Amount (incl. Sharp Waste) (kg/day)	Waste Collection Service Provider
Provincial Hospital	1	150	50	34 (*1)	UDAA
Military Hospital	1	100	80	15 (*1)	UDAA
District Hospital	1	10		2 (*2)	UDAA
Chinese Hospital	2	120		24 (*2)	UDAA
Clinics	29	-		8 (*3)	About 50 % by UDAA
Total	34	380		83	

Source: LPB Province Health Department

(*1) Data obtained by weighing for a week, with the average of 0.2kg/bed/day without regard for bed occupancy rate.

(*2) 0.2 multiplied by the number of beds.

(*3) The infectious waste generation amount from 29 clinics is assumed 10% of total generation amount from all hospitals, i.e. 8kg/day.

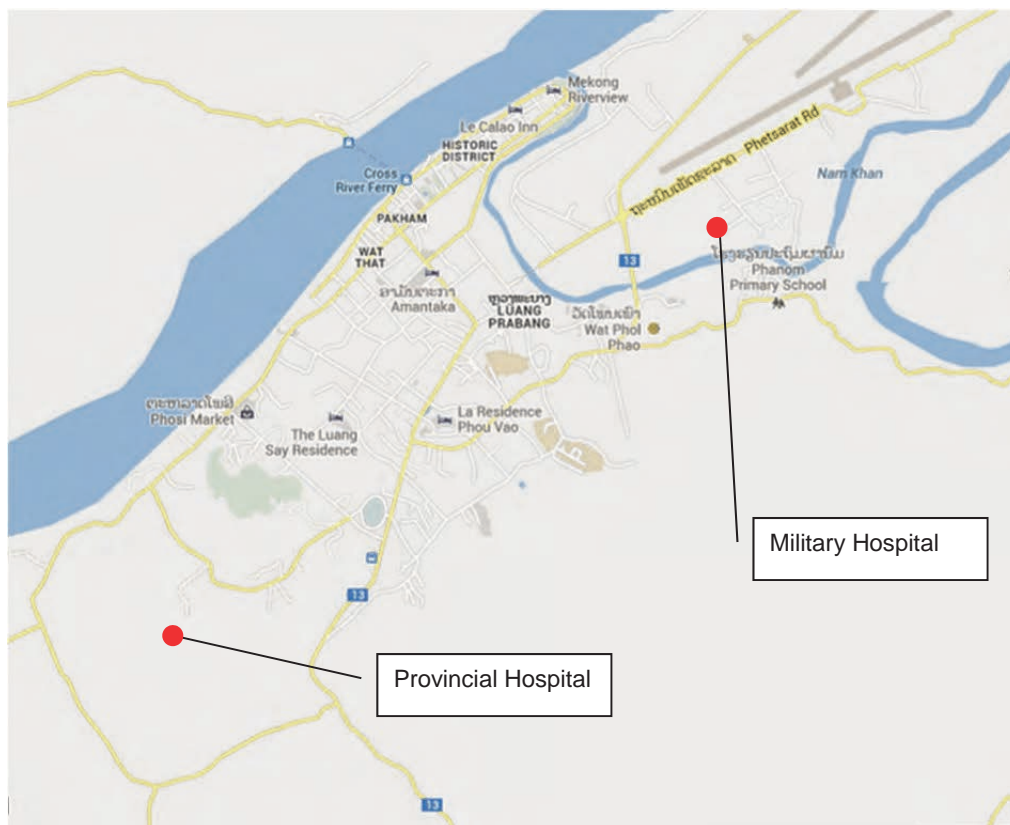


Figure 1: Location of the Two Main Hospitals in LPB District

2 HCWM Plan in LPB District

2.1 Goal of the HCWM in LPB District

In order to improve HCWM in LPB District, SJET and the C/P (UDAA and DONRE) established the target year as 2020 and the following goals.

Table 4: Goal of the HCWM in LPB District in the Year 2020

Name of Medical Institution (MI)	Nos of MI	Nos of bed	Waste Collected by	Treatment & Disposal Method
Provincial Hospital	1	150	UDAA	Separate collection, Incineration, Separate disposal of ash by 2015
Military Hospital	1	100	UDAA	Separate collection, Incineration, Separate disposal of ash by 2015
District Hospital	1	10	UDAA	Separate collection, Incineration, Separate disposal of ash by 2020
Chinese Hospital International	1	80	UDAA	Separate collection, Incineration, Separate disposal of ash by 2015
Chinese Hospital (Sang Khong Village)	1	40	UDAA	Separate collection, Incineration, Separate disposal of ash by 2015
Clinics	29	-	UDAA	Separate collection, Incineration, Separate disposal of ash by 2020
Total	34	380		

2.2 HCWM Plan in LPB District

2.2.1 Basic Conditions

HCWM plan in LPB district is formulated based on the following conditions:

- HCW is divided into **i. General waste** (non-infectious waste) and **ii. Infectious waste**.
- Infectious waste is divided into **ii-1. Combustible infectious waste** (subjected waste for incineration) and **ii-2. Incombustible infectious waste** (needles, sharps, etc.).
- Since general waste (non-infectious waste) is collected, treated and disposed of by the municipal collection service, HCWM plan focuses on the infectious waste.

2.2.2 Basic HCWM Flow in 2020

Basic HCWM Flow in 2020 is made based on the following assumptions:

1. All the HCW generated in LPB should be separated into i. **General waste** and ii. **Infectious waste**.
2. General waste shall be collected by municipal solid waste (MSW) collection service and disposed of at KM8 DS together with MSW.
3. Infectious waste shall be separated into ii-1. **Combustible infectious waste** (Contaminated cottons, etc.) and ii-2. **Incombustible infectious waste**.
4. The **incombustible infectious waste** shall be treated by the generation source if treatment facility like an autoclave is available, and separately collected and disposed of at the infectious waste (IW) pit at KM8 DS.
5. The **combustible infectious waste** shall be separately collected and transported to the incinerator at the Provincial Hospital. Then it shall be incinerated and ash from incineration shall be disposed of at the IW pit at KM8 DS..

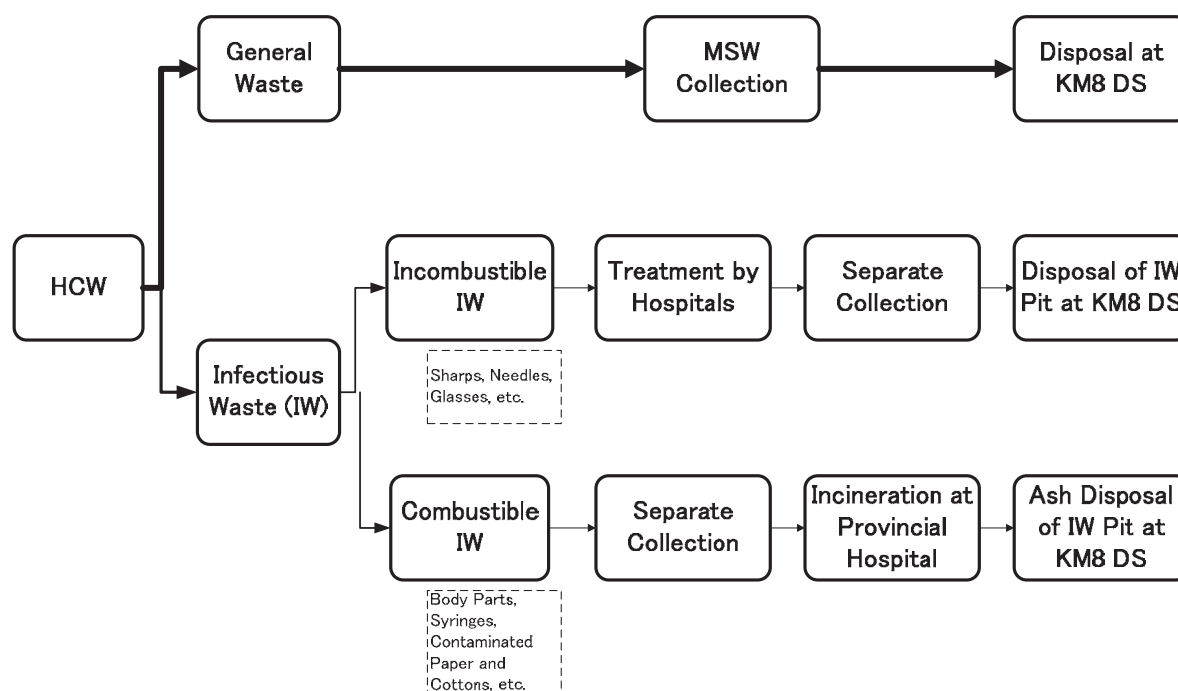


Figure 2: Basic HCWM Flow in 2020

2.2.3 Estimation of the Infectious Waste Generation

Future infectious waste generation is estimated by setting the following conditions:

- Infectious waste generation amount in 2012 is based on the survey results as shown in the Table 3.
- The infectious waste generation amount from 29 clinics in the Table 3 is assumed 10% of total generation amount from all hospitals in the table, i.e. 8kg/day.
- Then total infectious waste generation amount in 2012 in LPB District is 83 kg/day.
- The infectious waste generation amount is assumed to increase in accordance with the population growth, 2.2%¹. Consequently infectious waste generation amounts in 2014, 2015 and 2020 is calculated as 87, 89 and 99 kg/day respectively.
- According to the incineration record, the combustible infectious waste generated in the Provincial Hospital is calculated as 8.8 kg/day in September 2014. Since infectious waste generation amount in the Provincial Hospital in 2014 is calculated as 35.5 kg/day, the rate of combustible and incombustible infectious waste is assumed as 1:3.

Based on the above-mentioned assumption, infectious waste generation amount is estimated as shown in the table below

Table 5: Estimation of Infectious Waste Generation Amount

Unit: kg/day

HCW	2012	2015	2020
ii-1. Combustible Infectious Waste	20.8	22.3	24.8
ii-2. Incombustible Infectious Waste	62.2	66.7	74.2
ii. Infectious Waste	83	89	99

2.2.4 Discharge, Collection and Transportation

In order to achieve the goal and realize the HCWM flow in 2020, improvement of discharge, collection and transportation system will be implemented as described below.

1. By 2015, the path forwards 2020 must be clear. Therefore, the large HCW generators should be obligated to separate their HCW and to discard infectious waste separately using designated bags and/or container.
2. Separate collection of infectious waste will be commenced from the large generator, i.e. the Chinese Hospitals.
3. A collection vehicle for infectious waste collection shall be procured before the

¹ National population growth rate in 2009 is 2.2% according to the “Statistical Year Book 2009, Ministry of Planning and Investment, Lao PDR”.

commencement of separate collection of infectious waste.

4. Necessary legal documents should be prepared by the commencement of separate collection service.
5. Financial management system shall be established in order to support the separate collection service.

2.2.5 Treatment and Final Disposal

In order to achieve the goal improvement of treatment and disposal system will be implemented as described below.

1. In 2012 an incinerator shall be constructed at the Provincial Hospital and conduct test operation.
2. By the beginning of 2013 the incinerator shall be commenced full operation for the combustible infectious waste generated in the Provincial Hospital.
3. After the procurement of the infectious waste collection vehicle, the incinerator shall receive the combustible infectious waste from other medical institutions (MIs) than the Provincial Hospital.
4. By February 2015 an infectious waste (IW) pit shall be constructed at the KM8 DS.
5. By December 2015 the infectious waste separately collected from the target generators, i.e. Chinese and Military hospitals. The combustible infectious waste should be treated at the incinerator and the incombustible infectious waste together with ash from the incinerator shall be disposed of at the IW pit of KM8 DS
6. By 2020, all infectious waste generated in LPB district should be separately collected, treated and disposed as described above.
7. Necessary legal documents should be prepared by the commencement of infectious waste disposal of at the isolated pit.
8. Financial management system shall be established in order to support the infectious waste disposal of at the isolated pit.

Based on the above-mentioned assumption, infectious waste management in 2012, 2015 and 2020 is described as shown in the table below.

Table 6: Targets of Infectious Waste Management

Unit: kg/day

HCW	2012	2015	2020
Infectious Waste Generation	83	89 (36.3)	99 (40.5)
Combustible Infectious Waste Generation	20.8	22.3 (9.1)	24.8 (10.1)
Incombustible Infectious Waste Generation	62.2	66.7 (27.2)	74.2 (30.4)
Separate Collection	0	69.2 ^{*1}	88.9 ^{*2}
Incineration	0	19.6 ^{*3}	24.8
Disposal at the Isolated Pit of KM8 DS	0	52.1 ^{*4}	79.2 ^{*5}

Note: Figure in parenthesis in infectious waste generation in the Provincial Hospital.

$$*1 = 89 - 9.1 - ((2+8) \times (1.022)^{^3})$$

$$*2 = 99 - 10.1$$

$$*3 = 22.3 - ((2+8) \times (1.022)^{^3})/4$$

$$*4 = 66.7 - ((2+8) \times (1.022)^{^3}) + (19.6 \times 0.2)$$

$$*5 = 74.2 + (24.8 \times 0.2)$$

3 Implementation of HCWM Plan

3.1 Implementation of HCWM Plan

3.1.1 Before the Implementation of HCWM Plan

Separate collection and disposal of IW has not been conducted in LPB District. The HCWM study in the two main hospitals conducted in May 2012 found out as follows:

- The Provincial hospital discharged all the waste into the waste container, which was transferred to the final disposal site. The Military hospital placed the waste into the storage, from which all the waste is collected as part of collection service for general waste from households.
- Consequently infectious HCW was disposed of at the KM8 disposal site together with general HCW and other municipal waste.

3.1.2 Implementation of HCWM Plan

a. Modification of HCWM flow

As of August 2015 the HCWM has been conducted according to the plan mentioned in the sections 2.2.4 and 2.2.5. However the following differences are observed between the plan and implementation:

- Since the treatment facilities of the incombustible IW at the generation (hospitals) are

not well-functioned at each hospital, incombustible IW is separately collected and incinerated. UDAA/DONRE/DOH have temporarily modified the Basic HCWM Flow in 2020 as shown in the figure below.

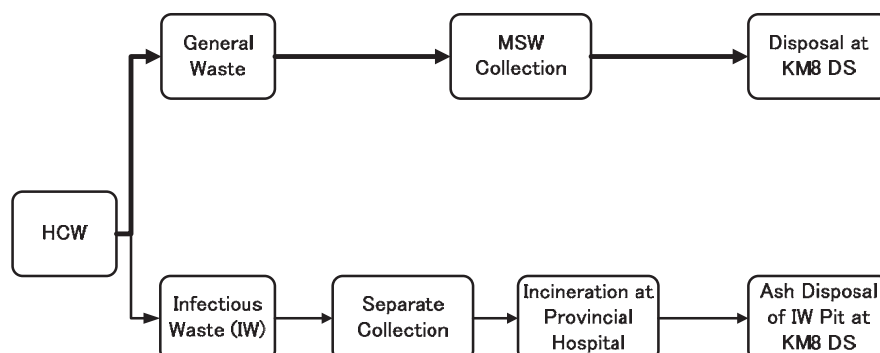


Figure 3: HCWM Flow in 2015

UDAA/DONRE/DOH will make best efforts to achieve the Basic HCWM Flow in 2020.

b. Separate collection, treatment and disposal of infectious HCW

As for separate collection, treatment and disposal of infectious HCW, the target of HCWM pilot project is not achieved because separate collection, incineration and disposal is not conducted for the infectious HCW from the International Chinese Hospital.

c. Separate collection and treatment by incineration

As for the separate collection and incineration, the incineration amount recorded in the Provincial Hospital from May 2012 to July 2015 is shown in the table below.

Table 7: Incineration Amount from May 2012 to July 2015

Duration	Total Incineration		Incineration Amount of Provincial Hospital		Incineration Amount of Other Hospitals	
	kg	kg/day	kg	kg/day	kg	kg/day
May 2012 to Dec 2012	125	0.52	125	0	0	0
Jan 2013 to Dec 2013	543	1.51	543	0	0	0
Jan 2014 to June 2014	1,066.8	5.93	1,061.0	5.90	5.8	0.03
July 2014 to Dec 2014	1,272.7	7.07	1,243.1	6.91	29.6	0.16
Jan 2015 to Apr 2015	1,340.8	11.17	1,094.5	9.12	246.3	2.05
May 2015 to July 2015	816.0	8.87	424.0	4.61	392.0	4.26
Total	5,164.3	-	4,490.6	-	673.7	-

The table shows a rapid increase in the amount of waste incinerated. Its background is as follows.

- On March 31st 2014 UDAA made a contract with Chinese Hospital (Sang Khong Village), which is one of the 3 main hospitals in LPB, on the separate collection and incineration of infectious HCW. On May 2nd 2014 the separate collection and incineration of infectious HCW commenced. This is the first case for UDAA to carry out the separate collection of infectious HCW
- Furthermore on January 1st 2015 UDAA made a contract with Military Hospital on the separate collection and incineration of infectious HCW and started to execute the contract from January 2015. The separate collection and incinerated amount of HCW from hospitals other than Provincial Hospital has increased a lot.
- From May 2012, when the incinerator installed, to Dec 2013, infectious HCW incinerated was only from the Provincial Hospital and its average daily amount was less than 1.5kg, which is far below its capacity, 10 kg/hr. From January 2014 the amount of incinerated infectious HCW from the Provincial Hospital is steadily increasing.
- The reason of the increase of incineration is due to the issuance of the Order of LPB/DOH No.159. This order requires all the medical institutions in LPB to segregate infectious waste and general waste and to manage infectious waste from the point of collection to the final disposal by using a manifest form.
- From May to July 2015 average monthly incineration amount has decreased as shown in the Figure below. But the incineration amount of HCW from hospitals other than Provincial Hospital has increased a lot. The reason would be strict separation of infectious HCW by staffs in the Provincial Hospital.

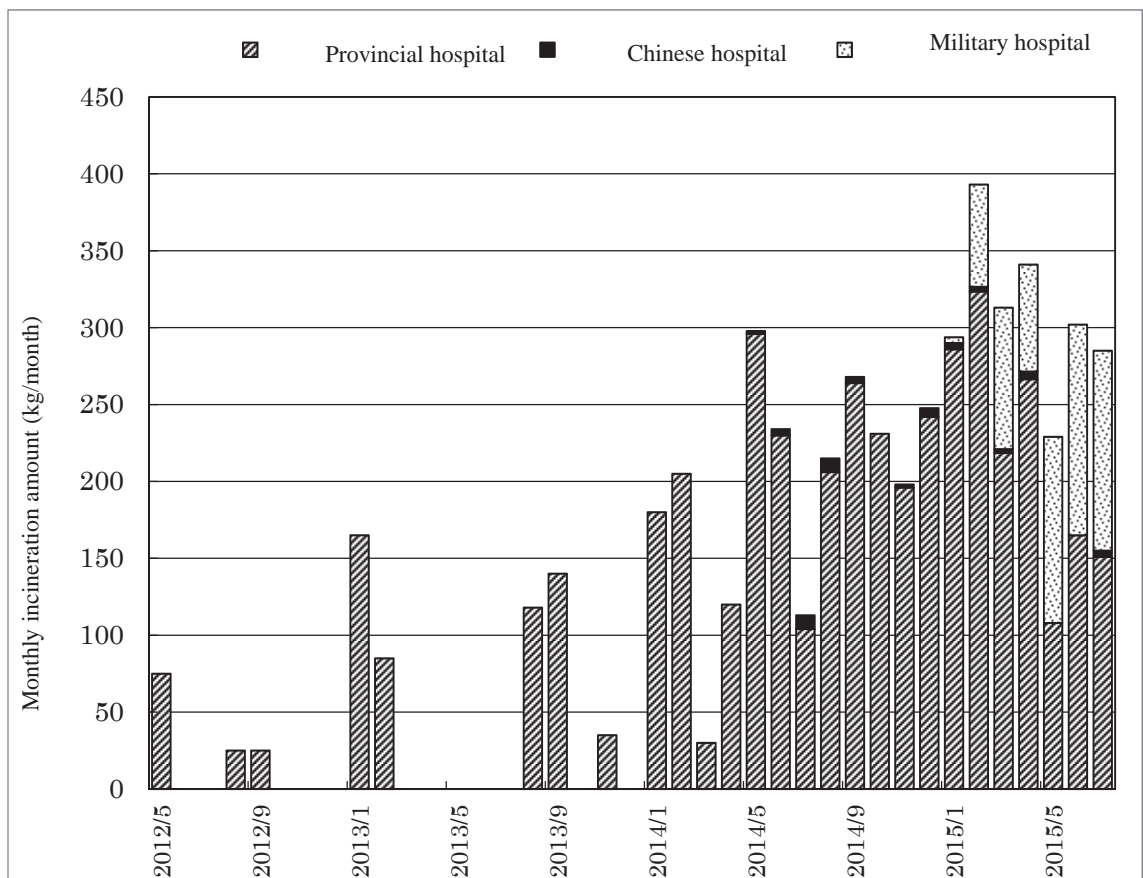


Figure 3-4: Monthly Incineration Amount (Kg/Month)

- Average possible daily possible incineration amount is estimated as 38 kg/day based on the calculation below. According to the above table maximum daily incineration amount calculated less than 12 kg/day. This means the incinerator has still enough capacity to receive infectious HCW.
- According to the table above although the incineration amount is increasing steadily, the incinerator still has enough capacity to receive infectious HCW from other hospitals than the Provincial comparing with the average incineration capacity (38 kg/day) as shown below.

1. Capacity:	10 kg/hour
2. Required operation hours for one batch:	2hours 20 minutes (Two hours operation + 20 minutes cool down)
3. Maximum numbers of batch operation:	3 times/day
4. Maximum incineration amount:	60 kg/day (10 kg/hour x 2 hours x 3 batch)
5. Monthly possible operation days:	21.4 days (30 days x 5/7)
6. Monthly maintenance days:	2 days
7. Yearly maintenance days:	5 days
8. Yearly operation days:	232 days ((365 x 5/7) – (2 x 12) – 5)
9. Yearly incineration amount:	13,920 kg/year (60 kg/day x 232 days)
10. Daily incineration amount:	38 kg/day (13,920kg/365 days)

3.2 Recommendation of Improvement Measures

Since separate collection, incineration and disposal is not conducted for the infectious HCW from the International Chinese Hospital as described above, the target of HCWM PP is not achieved. UDAA, however, has been conducting separate collection, incineration and disposal of the infectious HCW from the Military Hospital in addition to the Chinese Hospital from January 2015 by making contract with the hospital. In order to achieve the target in 2020 of the HCWM plan, all infectious HCW in LPB district will be separately collected, treated and disposed, UDAA in cooperation with DOH is recommended to take the following improvement measures by continuing and expanding the PP:

1. UDAA shall make contract with the International Chinese Hospital on the separate collection, incineration and disposal service of infectious HCW and conduct it as soon as possible.
2. Review and modify the HCWM plan by making reliable list of MIs in LPB district and using data of the list.
3. For the review of the HCWM plan, UDAA shall examine the demand of incineration of the incombustible infectious HCW from the medical institutions that do not have its treatment facility.
4. At present the incinerator has enough capability to receive more infectious HCW. UDAA, therefore, in cooperation with DOH shall conduct necessary enforcement, education and public relation to incinerate all of infectious HCW generated in LPB district based on the revised HCWM plan.

Appendix 7.

OPERATION AND MAINTENANCE MANUAL FOR HEALTH CARE WASTE INCINERATOR AT LPB PROVINCIAL HOSPITAL (2015)



LPP-Environment component

In cooperation with JICA Experts Team

This is an operation and maintenance manual for the incinerator for health-care waste (HCW) installed at Provincial hospital in LPB.

1. Outline of the incinerator for health-care waste
 - (1) Model name: Medical solid waste VHI-18B-10
 - (2) Manufacturer: Vietnam Academy of Science and Technology Institute of Environmental Technology
 - (3) Specification of the incinerator for health-care waste VHI-18B-10

Items	Unit	Capacity
Capacity	kg/h	10
Operation time	Per batch	2hours 20 minutes
Daily maximum capacity	kg/day	60 (3 batch)
Target medical waste	-	Combustible infectious waste
Total weight of incinerator	kg	3,500
Dimensions: length x wide x height	m	1.1 x 1.1 x 2.4
Temperature of primary combustion chamber	°C	500 – 800
Temperature of secondary combustion chamber	°C	1,050 – 1,200
Retention time in the secondary chamber	sec	1.5 – 2
Operation cost : Electricity consumption	kw/h	1.5
Operation cost : Diesel oil consumption	liter/h	5 – 8

【Daily incineration amount】

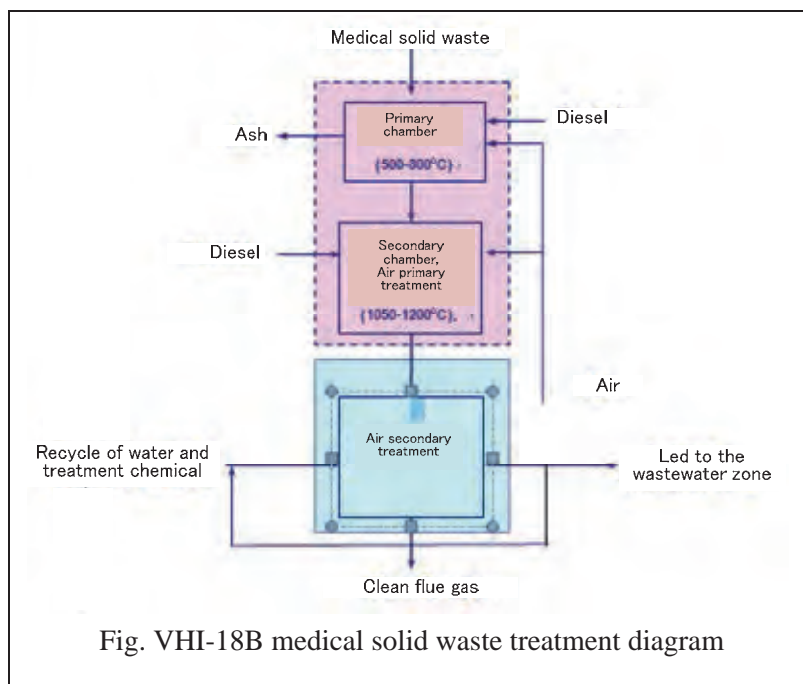
1. Capacity: 10 kg/hour
2. Required operation hours for one batch: 2hours 20 minutes (Two hours operation + 20 minutes cool down)
3. Maximum numbers of batch operation: 3 times/day
4. Maximum incineration amount: 60 kg/day (10 kg/hour x 2 hours x 3 batch)
5. Monthly possible operation days: 21.4 days (30 days x 5/7)
6. Monthly maintenance days: 2 days
7. Yearly maintenance days: 5 days
8. Yearly operation days: 232 days ((365 x 5/7) – (2 x 12) – 5)
9. Yearly incineration capacity: 13,920 kg/year (60 kg/day x 232 days)
10. Daily incineration capacity: 38 kg/day (13,920kg/365 days)

2. Operation principles

Incinerator VHI-18B-10 is designed based on the multi-zone combustion technology that has been widely used in developed countries.

Waste is fed into the primary combustion chamber, which is maintained at a temperature of 800 °C. Air is continuously supplied to the combustion process. Smoke exhausted from the primary chamber (product of incomplete combustion which contains dusts and toxic matters) is mixed with air and then exhausted to the post combustion chamber.

In the secondary chamber, the incomplete combustive products (containing dioxins and furan) will be continuously broken down and combusted at high temperature (1,050 °C – 1,200 °C) with a good enough retention time of 1.5 – 2 seconds. Smoke from the secondary chamber will be exhausted to the flue gases treatment system for removing dust, heavy metals and other environmental pollutants: NO_x, SO_x, HCl, HF, etc.



3. Operation manual

Part 1: General regulations on using incinerators

A. Regulations on labor safety

- (1) Workers have to use protective wear: clothing, head protection (hat or helmet), shoes, gloves and glasses.
- (2) Check the electricity system (automatic and circuit-breakers) to ensure there are no possible causes of electrical fires or leakages.
- (3) Check the fuel supplying system (diesel oil) to ensure there is adequate oil and no leaks.
- (4) The operating house for medical solid waste incinerator VHI-18B has to be clean, obstruction-free, and has windows and doors wide open.
- (5) The operating house always stores type 03 fire extinguishers.

B. Regulations on using incinerators

- (1) This incinerator is only used to burn medical solid waste, so it is necessary to sort out waste in accordance with regulations before putting it into the furnace.
- (2) There must be an incinerator log (recording specific volume, time and dates of operation and finishing of a batch, incidents, etc.)
- (3) While the incinerator is in operation, there must be an operator present.
- (4) In case of an incident that cannot be remedied, a record identifying the cause must be made, and this must be reported to the installation unit.

Part 2: Process of operation of Medical Solid Waste Incinerator VHI-18B

A. Operating instructions

- (1) Clean the combustion chamber (scrape all the glass, ashes and so on through the discharge

opening at the back).

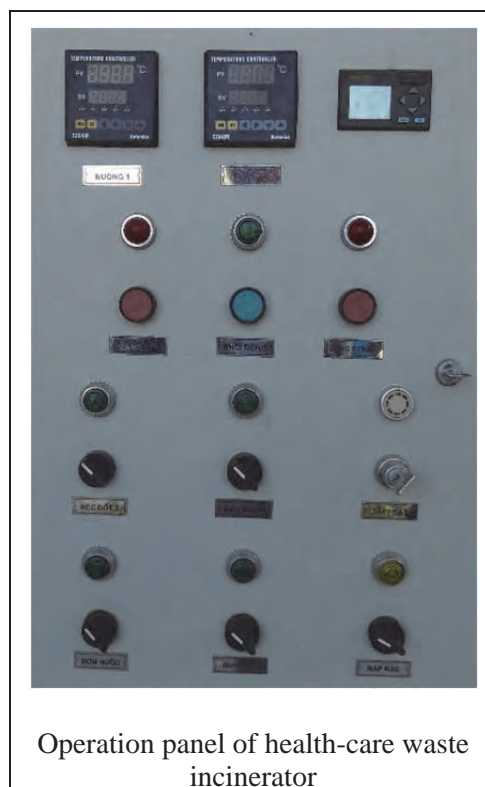
- (2) The grate and the ash pit in the combustion chamber have to be cleared.
- (3) Load about 20kg of medical solid waste (i.e. one batch) into the No.1 combustion chamber (primary). Basically, incinerating one batch of health-care waste (HCW) takes two hours.
- (4) Check the diesel oil level and open the oil charge valve for the burner.
- (5) Check the water pump and pit under the waste cyclone for cooling water system.
- (6) Add alkaline solution such as sodium hydroxide (NaOH) or Ca (OH)₂ (residue-free lime water) into the tank and stir.

(note: the cooling water system is designed to pump and circulate. Besides cooling the water, it has a very important role of absorbing and neutralizing acid gases such as: NO_x, SO_x, CO ... and cyclone dust. Hence the cooling water must satisfy the following conditions:

- + *Maintain temperatures below 30°C*
- + *Maintain pH level between 8 and 10*
- + *Add water regularly*
- + *Clean the tank every 3 months to remove sediment*

- (7) Switch the power switches to general automatic (including the one in the control box).
- (8) Turn OFF both switches on the control box (to the left)
- (9) Lock the air-charging valve into the furnace.

- (10) Press the START button.
- (11) Turn ON the switches "WATER PUMP", "EJECTOR FAN", "BURNER 1", "BURNER 2"(to the right) in tum to start the water pump, ejector fan, and burner.
- (12) The system will then start working automatically. Observe the corresponding signals on the control cabinet and check the operation of the devices.
- (13) At this time the burner No.2 will operate first. When the temperatures of the secondary chamber (chamber No.2) reach 500°C, the automatic control program will power on burner No.1 to waste.
- (14) When the temperature of the primary chamber (chamber No.1) reaches 350°C the automatic control program will power off burner No.1 as the waste is now self-combustible. At this time the air-charging valve into the furnace should be open to maintain the burning (note: the valve must be opened slowly and the airflow regulated appropriately)



Operation panel of health-care waste incinerator

B. Actions to suspend the operation of the system.

- (1) The burner No.2 must be manually switched off after two (2) hours of operation.
- (2) After a further 20 minutes, turn OFF the "EJECTOR FAN" and "WATER PUMP" (to the left).
- (3) Press the stop button and turn off automatic on the control box.
- (4) Shut the incoming circuit breaker and half-open the discharge opening at the back.
- (5) In case that the amount of health-care waste cannot be incinerated in the first batch process, two or more batches of incineration must be conducted in a day. When the temperature of chamber No.1 cools down to 350°C at the end of the batch processing, the next batch processing can be started by conducting the same procedures as the first batch. The operator and workers should be aware of the high temperature of the incinerator.

Note: During the whole working process of the incinerator, it is possible to perform an emergency stop at any time by pressing the "EMERGENCY STOP" button. However, we should only press it in case of an incident or when the incineration process is complete to stop the system.

C. Incidents and solutions.

- (1) When the incinerator is not working properly according to the set mode (no light, or the wrong light is on) press the "EMERGENCY STOP" button and then press the "START" button to "RESET" the system. To restart the system, press "START", then turn on the switches as desired.
- (2) If the light of one of the burners is still ON without the burner operating, press the "RESET" button(s) on the burner(s).
- (3) In case of oil shortage in the burners, after fully charging, press the "RESET" button on the burner(s). In case the light is still ON without performing burner operation on which the "RESET" button was pressed, check if the burner is clogged and if the light sensor (magic eye) is stained by black smoke or distorted by heat (note: periodically maintain the burner by cleaning the magic eye, oil filters, air atomizer, igniters and unclog oil injectors inside the burners)
- (4) If the temperature gauge on the control box does not display the temperature in the furnace, check if the temperature sensor (the temperature gauge plugged into the furnace) is open-circuited.
- (5) If a lot of black smoke appears on top of the chimney, it is necessary to reduce the charging air from the blower into the furnace through the valve behind. In case of an emergency, burner No.1 can be shut down temporarily.
- (6) If all such incidents are excluded and the system still does not operate, some function (if the equipment does not work and indicates that no lights are ON in the control box, check the fuses on the control box; if the light of a fuse is ON, this indicates that the fuse is open-circuited and needs replacing (cut-off value of the fuses in the box is 10A)

D. Countermeasure for black smoke exhausted from chimney

【Causes of black smoke】

- (1) The burner No.1 is not working well and the burning process is not complete (oil is not completely burned)
- (2) There is insufficient supply of air

- (3) The composition of the input waste contains high humidity or too much rubber and plastic

【Countermeasures for black smoke】

- (1) Clean the second burners: clean the nozzles, flame rods, diffusers, oil filters and oil tank
- (2) Adjust supply air appropriately (when the incinerator starts working, close the air valve. When the temperature of burner No. 1 reaches 350 °C, slowly open the air valve and if the black smoke is discharged at the top of the stack, reduce the supply of air)
- (3) Strictly control waste separation stage. This incinerator was designed for solid waste only, not for high humid waste. In a batch, do not burn waste containing too much rubber and plastic.

4. Maintenance

- (1) List of spare parts

The spare parts to properly operate the incinerator of HCW are shown in the following table.

No.	Spare-parts	Unit	Proposed quantity	Remark
1	Photoelectric eyes	Piece	1	Model OM-1N/OM-0N
2	Ignition electrode	Piece	1	Model OM-1N/OM-0N
3	High-voltage cable	Piece	1	Model OM-1N/OM-0N
4	Control relay	Piece	1	Model OM-1N/OM-0N
5	Temperature sensor	Piece	1	Model OM-1N/OM-0N
6	Nozzle	Piece	2	Model OM-1N/OM-0N

- (2) Supplier of spare parts

- Name of supplier: Vietnam academy of science and technology (VAST), Institute of environmental technology (IET)
- Address. : 18 Hoang Quoc Viet Road Cau Glay District, Hanoi, Vietnam

(3) Procedure of HCW incinerator operation at LPB

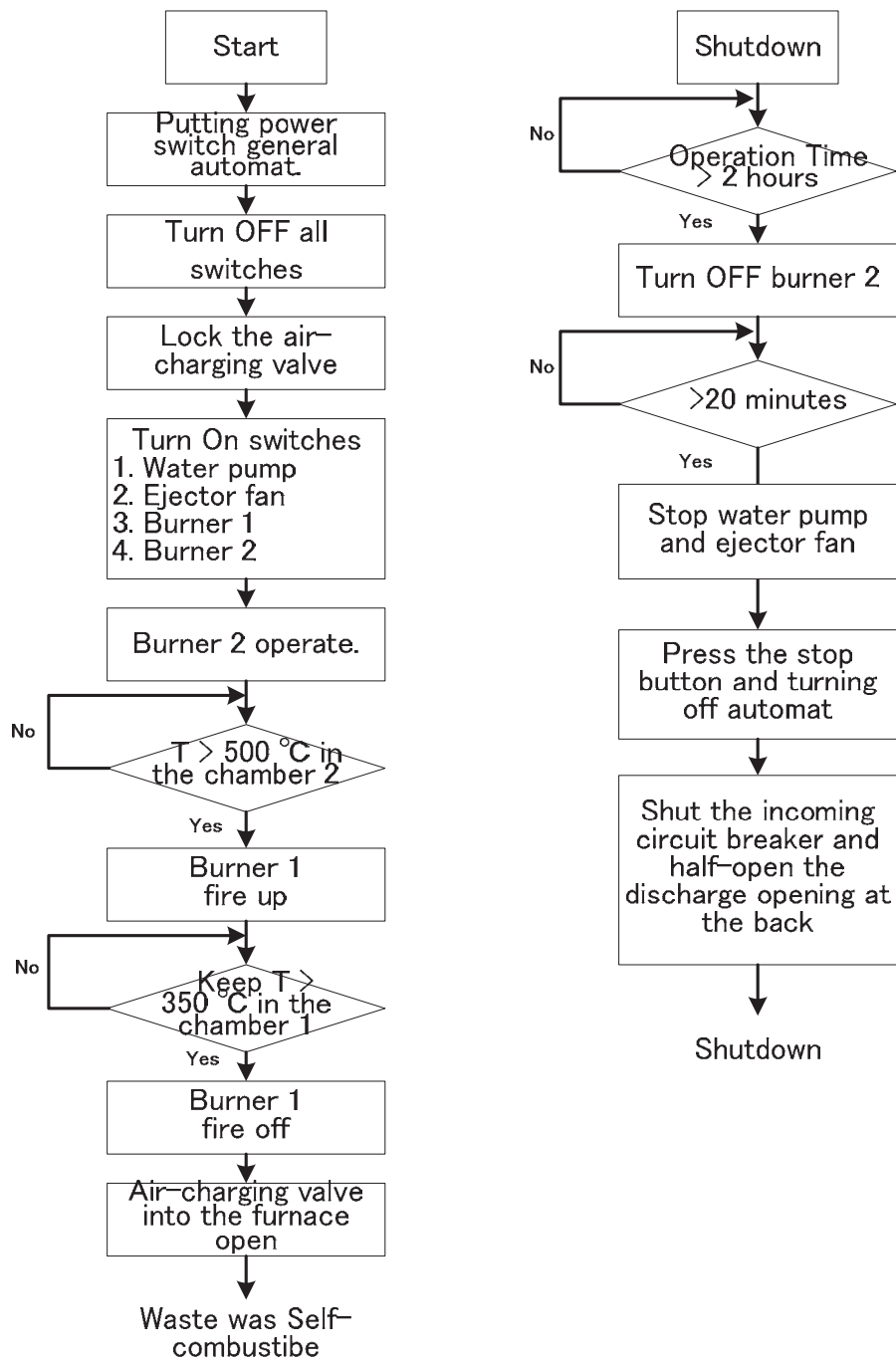


Fig. Procedure of medical solid waste incineration at LPB

(4) Comparison of operation time, temperature and total consumption of oil amount

Comparison of operation time, temperature and total consumption of oil amount between chamber No.1 and chamber No2. are shown in following figure.

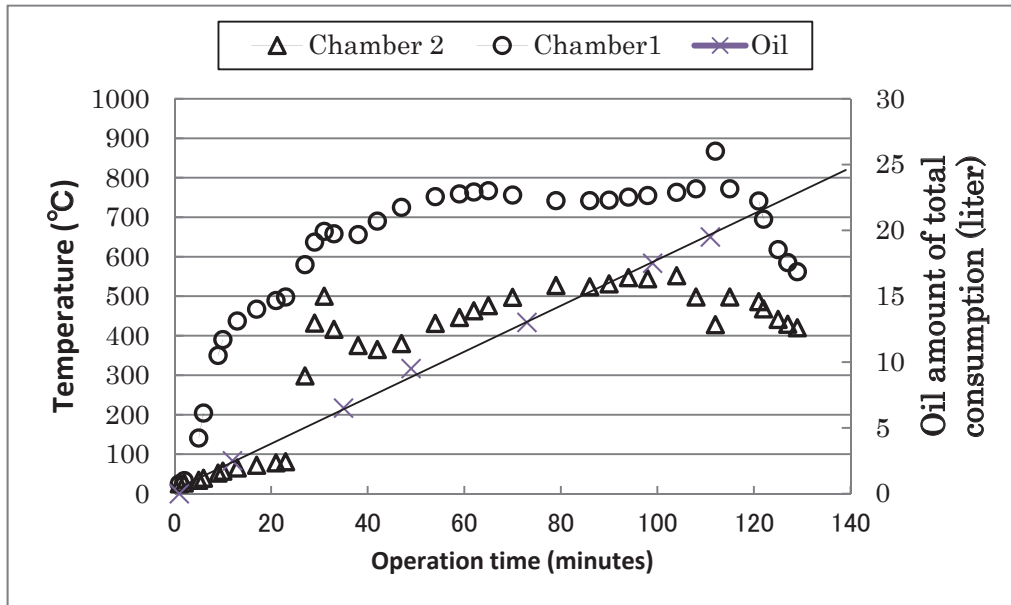


Fig. Operation data (24 June 2014)

Appendix 8.

OPERATION AND MAINTENANCE MANUAL FOR THE OFF-SITE COMPOST FACILITY AT LPB KM 8 (2015)



LPP-Environment

In cooperation with JICA Experts Team

This is an operation and maintenance manual for the off-site compost facility installed at KM8 disposal site in LPB.

1. Outline of off-site compost activity

UDAA of LPB makes compost by collecting kitchen waste (food waste) generated at hotels and restaurants in the city in order to reduce the amount of kitchen waste discharged at KM8 final disposal site.

Composting of food waste is performed at off-site compost facility installed at KM8. The composting system of this facility is windrow type with manual turning in consideration of sustainable operation and the amount of collected food waste. In this facility, dewatering area was installed for draining the water of food waste out. Since the amount of moisture of collected food waste is high, this dewatering facility was installed as pre-treatment.

The treatment capacity of this facility is 6 ton/month (= 500 kg/day x 3 day/week x 4 week/month). However, if the amount of collected kitchen waste exceeds this capacity constantly, UDAA should increase the number of operation worker, expand the composting area (including the dewatering area), and use machine such as small type of backhoe for turning of the windrow piles.

2. Definition of Terms

- **Raw material:** the material to be used for the off-site compost facility. Separated organic waste (food waste) from the hotels and restaurants are designated as the raw material.
- **Composting:** the controlled biological decomposition of organic materials under aerobic conditions. The product of this process is defined as **raw compost**.
- **Composting period (primary fermentation):** the period of decomposition of the raw material. This preliminary period is assumed to be **20-40 days**.
- **Turning:** action of mixing the windrow piles in order to maintain aerobic conditions inside the windrow.
- **Curing:** time for stabilization of raw compost. The product of this process is defined as **mature compost**.
- **Curing Period (secondary fermentation period)** is defined as the maturation period. This curing period is assumed to be **40-60 days**.
- **Screening:** the process of removing large-size particles and non-compostables (e.g., plastic, glass, can, metal, etc.) and not-yet-decomposed materials (e.g., paper and wood). Mature compost is passed through a sieve with removing the large particles.
- **Compost Product:** the final product resulting from the composting, curing, and screening processes.

3. Fundamental Issues

This O & M manual is designed for the off-site compost plant installed at KM8 disposal site in LPB. It covers the process from waste reception to final product storage.

(1) Working Hours

This off-site compost plant is open the following hours.

- Mondays - Fridays 9:00 - 12:00 (3 hour/day).
- Saturdays, Sundays and National Holidays Closed.

(2) Type of Solid Waste

The off-site compost facility receives the compostable food waste separated at hotels and restaurants.

(3) Process flow of the off-site compost plant

The next figure shows the process flow of the off-site compost plant.

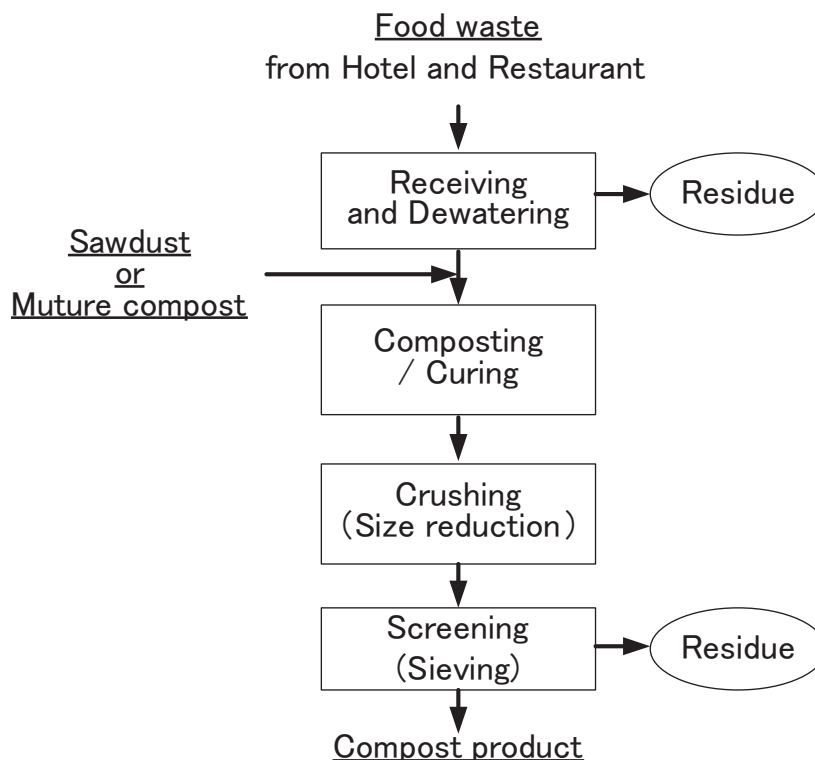


Figure 1: Process flow of the off-site compost plant

(4) Weighbridge

The off-site compost facility and the landfill site shares one weighbridge.

(5) Staff

The number of workers at this facility is 2-3 persons; they work for all process, such as collection/hauling, composting, curing, and screening.

4. Collection/Hauling

(1) Collection/Hauling

UDAA was procured a pick-up truck for the collection of food waste. At present, since the amount of the kitchen waste is small, UDAA collects the waste on Tuesday and Friday only. However, if the number of the target hotels and restaurants increase, UDAA should increase the collection day and/or the number of collection times per day. The applicable collection route will be



Collection vehicle and collection barrels

planned in accordance with the actual conditions.

(2) Collection barrel

UDAA collects the barrels (capacity around 80 litre) filled with food waste, and gives the empty barrels for exchange. Therefore, if the number of target hotels and restaurants increase, UDAA should buy new collection barrels.

5. Product compost

5.1 From receiving food waste to producing mature compost

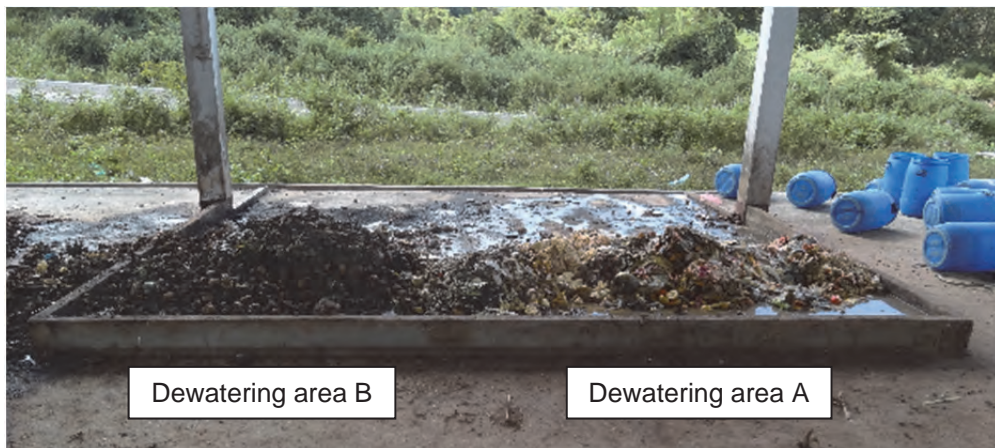
(1) Preparation for receiving food waste

The preparations to receive the food waste are as follows.

- a. Food waste in the dewatering area B is moved to composting area (concrete floor), and a windrow pile is formed.
- b. Food waste of dewatering area A which was carried last time is moved to the dewatering area B. A windrow pile is formed by adding sawdust or mature compost as bulky material.
- c. The empty dewatering area A is used for receiving new food waste.



Formed windrow pile moved from the dewatering area B



Dewatering area

(2) Waste reception

Raw materials (food wastes) delivered by the collection vehicle is unloaded onto the dewatering area A, and the water in the food wastes is removed. The food wastes should be piled flat, because it would be easy for the worker to remove non-compostable matters (e.g., plastic, glass, can, metal, etc.). The bottom of the dewatering area is sloping so that the water in the food wastes can be easily drained out.

(3) Make windrow pile

Food waste at the dewatering area B is moved to the compost area (concrete floor), and formed in the shape of windrow pile.

(4) Turning

Formed pile is turned by human power. The turning is performed on all the formed piles in rotation. This turning is the operation for providing required air inside the piles in order to promote aerobic fermentation. The internal temperature of the pile which carries out the aerobic fermentation well rises around 50 to 60 degrees Celsius.



Turning

The turning is carried out 2 times per week for the primary fermentation period (20-40 day) and 1 time per week for the secondary fermentation (40-60 days). Even during the primary fermentation period, if the temperature of the pile is low, frequency of the turning should be decreased in order to prevent a drop in temperature inside the pile.

(5) Combine piles

Although the amount of collected food waste is 300-500 kg, the volume of the pile decreases because of the following reasons: 1) water of the food waste is removed, 2) organic material of the food waste is decomposed, 3) evaporation of water caused by high temperature inside the pile. The pile of one-time collected waste is too small to keep the temperature of the pile high enough. Therefore, as the composting process progresses, the pile should be combined with other piles in order to maintain the size of windrow pile. The matured windrow pile is made of about 4,000kg (6-10 times of receiving) of the kitchen waste at the weight of carrying in.



Combining Piles

(6) Measure temperature of windrow pile

The maturing of windrow pile is managed by measuring the pile's temperature. In the primary fermentation period (20-40 days), temperature inside the pile rises at 50 to 60 degrees Celsius after the pile formed. In the secondary fermentation period, the pile temperature drops below 40 degrees. The frequency of the turning should be decreased when it becomes 40 degrees or less.



Measure temperature of windrow pile

(7) Measure apparent specific gravity (ASG) of windrow pile

ASG of pile is deeply related to the water content of the pile. In other words, if the water content of the pile is high, ASG becomes high, on the other hand, if the water content of the pile is low, ASG becomes small. ASG of pile (i.e. water content of pile) is related to the permeability of the pile. By managing the permeability appropriately, fermentation condition can be kept good.

In this off-site compost facility, it is managed that the ASG of compost become the range of 0.45-0.50 ton/m².

- When ASG is higher than the range, it is not necessary to supply water but only performs the turning.
- When ASG is smaller than the range, water has to be supplied so that the fermentation of the compost becomes active.

The method to manage the permeability by measuring pile's ASG was chosen as following reasons.

- There is correlativity between ASG and permeability.
- It is difficult to measure pile's water content at the site, and even if the water content can be measured, it takes long time to obtain the result.

The management method of pile by simple measurement of the windrow pile ASG

<Measuring procedure>

1. Put compost into the plastic bucket as it reaches the limit of its capacity.
2. Measure the whole weight and get the compost's weight.
3. Calculate ASG from the bucket capacity and the compost's weight.

<Control>

1. If ASG is high, windrow pile should be turned without supplying water.
2. If ASG is low, windrow pile should be turned with supplying water.



(8) Curing (Maturing)

The compost whose primary fermentation period finishes shall be matured by the secondary fermentation period (40-60 days). Managing of the pile by ASG is also done in this period, and the turning is carried out if necessary.

(9) Cleaning of the collection barrels

The barrels used for the collection of food waste should be washed with water at the appointed place at KM8 in order to be prepared for the next food waste collection.

5.2 Purification of raw compost

The following procedures perform the purification of raw compost.

(1) Preparation

- a. Check the crusher kept in the warehouse.
 - Outward of the electric motor and the connection of the power cable.
 - Flexure of the belt
 - Inside of the crusher, etc.
- b. Workers should wear gloves and boots. Eye protector should be also applied in order to prevent damage of the eyes by crushed fragments.
- c. Cover the floor with plastic sheet.
- d. Check the direction of the crusher's edge by idling of the engine. Also, check whether or not there is any unusual sound generated.
- e. Sieve should be installed in the compost product storage area in order to screen the crushed compost.



Crusher



Preparation of plastic sheet



Screening

(2) Crushing process

- a. Supply mature compost to the crusher chute little by little after operating the crusher. The workers should be careful not to insert their hands into the crusher. In addition, the workers sort the impurities in the mature compost such as metals, cans or glass bottles out by hands in advance.
- b. Install a plastic sheet and/or a carton box at the crush chute in order to reduce scattering of the crushed matters.

(3) Screening process

There are two stages of screening: primary screening for raw compost and final screening for mature compost.



Feeding maturated compost

a. Primary screening for raw compost

The crushed mature compost is screened with the sieve of 10mm screen size for making product compost. The compost which passes screen is moved to the designated stock yard. The large size of impurities is returned to the dewatering area B, and is mixed with the carrying in food waste as bulky material. If the impurities are generated a lot, they should be discharged at the disposal site properly.

b. Final screening for mature compost

The primary-screened compost is screened again by the 6 mm-size sieve depending on the demand of users (farmhouse, restaurant, etc.). This product compost is called “fine compost”.

(4) Storage process

- a. Keep the product compost in the storage place or a warehouse in the off-site compost facility.
- b. Although the product compost is stored by pile, it is possible to pack in container such as plastic bag for sending.

6. Application of product compost

(1) Application criteria

The application criteria of the LPB compost were shown in the following table. Agriculture Division of LPB made these criteria based on the component analysis of the LPB product.compost.

1.	It can be mixed with soil for vegetable cultivation at the rate of 0.1 kg/m ² .
2.	It can be mixed with soil for flower and garden tree at the rate of 0.2 kg/m ² .
3.	It can be mixed with soil for fruit tree at the rate of 0.3 kg/tree.
4.	It can be used for spreading the in-season rice field and double-crop field at the rate of 10-15 ton/ha.

For reference, the application criteria of the food waste compost in Nagano Prefecture in Japan are shown in the following table.

(unit : kg/ m²)

Fertilization object	Application standard for compost
Paddy, Wheat, Soybean, Millet, Fruit	0.2 - 0.5
Vegetable, Flower	0.2 - 1.0

Source : 2010 The guideline for organic matter materials proper application (Nagano Prefecture in Japan)

This table is a general application criteria and changes according to the difference of maturity of the compost and kinds of the soil etc. Application amount is also considered in accordance with the effect of fertilizer, such as nitrogen, phosphoric acid, and potassium. The criteria show the annual quantity on condition of successive application.

(2) Application method (Source : Web site of Kita-Kyusyu city in Japan)

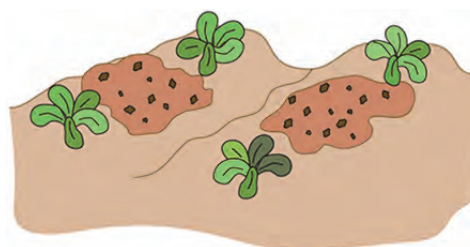
a. Overall application (mix the compost into soil)

After the compost is sprinkled over soil, the soil is cultivated about 20cm depth. It is effective for improving the surface of the soil, and the whole part of the soil becomes soft.



b. Mulching-compost (application method for plant)

The compost is put on the surface of the soil after crops were planted (mulching). Decomposition of the compost is promoted and the effect appears gradually.



c. Annular-compost

The compost is put in the trench which was dug around a tree (in the direction of which the root extends).



(3) Example of the compost application

a. LPB's flower bed

Application of LPB compost was carried out to the flower bed on the road of LPB.



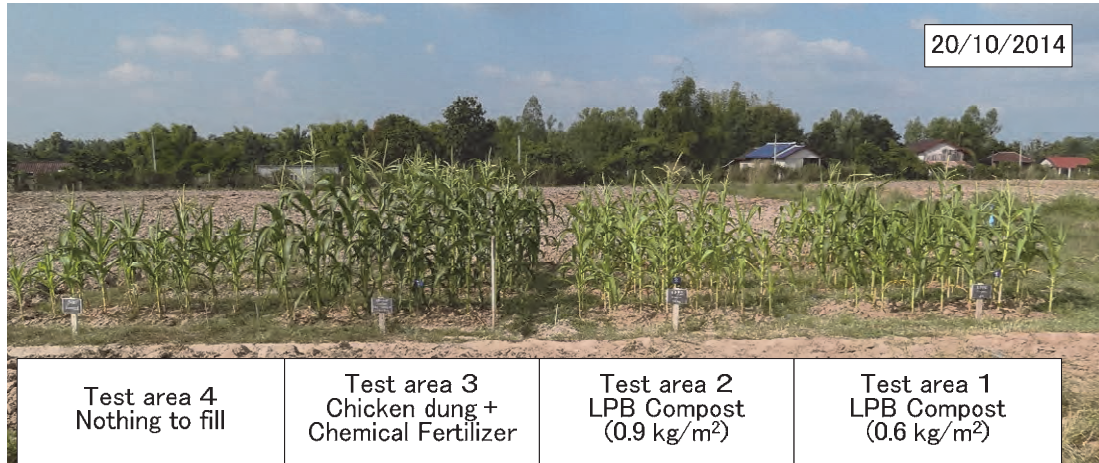
b. Application test using sweet corn in GAP's farm of LPPA

By using LPB Compost (product compost made in the LPB KM8 disposal Off-site compost plant), LPPE team carried out an application test using sweet corn. This test

was conducted by the collaboration of LPPA and LPPE in GAP's farm¹ of LPPA in VTE during 13/8/2014 to 13/11/2014.

The team conducted comparative tests with sweet corn by applying LPB compost, chemical fertilizer, and nothing.

As a result, the effectiveness of the LPB compost can be recognized sufficiently though the height, weight, and yield of the sweet corns obtained in LPB compost area are lower than that of GAP method area (test area 3).



¹ GAP section is under Clean Agricultural Development Center, supported by LPPA's project (JICA Laos) : GAP's farm, Samsaard village, Xaythani district, Vientiane Capital

7. References

1. Measurement of product compost
 - (1) Component measurement results of LPB compost



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PEACE INDEPENDENCE DEMOCRACY UNITY PROSPERITY

ກະຊວງ ກະສິກໍາ ແລະ ປ່າໄມ້
MINISTRY OF AGRICULTURE AND FORESTRY
ກົມປູກຝັງ
DEPARTMENT OF AGRICULTURE
ສູນປ້ອງກັນພືດ
PLANT PROTECTION CENTER

ເລກທີ: 0327-ຊ
No.: /PPC
ນະຄອນຫຼວງວຽງຈັນ, ວັນທີ: 15 JUL 2014
Vientiane, Date:



ໃບຢັ້ງຢືນ ຜົນການວິໄຈຜຸນ CERTIFICATE OF FERTILIZER ANALYSIS

ຊະນິດຕົວຢ່າງ Kind of Sample :	Compost	ຜູ້ນຳເຂົ້າ Importer:	KoKua Saikodyo Company
ຊື່ການຄ້າ Trade Name :		ຊື່ນາມສະກຸນ Name and Family name:	
ລະຫັດຕົວຢ່າງ ID of Samples:	No:079 F/2014	ທີ່ຢູ່ Address:	Louangprabang Province
ເຄື່ອງໝາຍການຄ້າ Trade mark:		ໂທລ/ແຟັກ Tel/Fax:	

No.	ລາຍການວິໄຈ Analyzed Items	ຜົນການວິໄຈ Results	ຜູ້ວິໄຈ Examiner
1	ທາດໂນໂຕຼເຈນລວມ (% Total N)	1.89	ວິໄລຊາ ແລະ ຈັນທະສອນ
2	ທາດ ພຶດສະຟໍລິດລວມ (% P ₂ O ₅)	0.63	ວິໄລຊາ ແລະ ຈັນທະສອນ
3	ທາດ ໂປຼຕິດຊຽມ ລວມ (% K ₂ O)	0.43	ວິໄລຊາ ແລະ ຈັນທະສອນ
4	ອິນຊີວັດໆ (% Total OM)	36.91	ວິໄລຊາ ແລະ ຈັນທະສອນ
5	ຄວາມເປັນກົດເປັນຕ່າງ (pH)	9.78	ວິໄລຊາ ແລະ ຈັນທະສອນ
6	ຄວາມຜຸ່ມ (% Moisturo)	15.2	ວິໄລຊາ ແລະ ຈັນທະສອນ

ໝາຍເຫດ:
Remark:

5
ຮັບຮູ້ໂດຍຫົວໜ້າສູນປ້ອງກັນພືດ
Certified by Director of PPC

ໜ່ວຍງານ ຍາປາບສັດຕູພືດແລະອາຫານພືດ
Pesticide and Plant nutrient Unit

ຜູ້ວິໄຈ
Examiner

ຕຽງຄຳ ວົງສາບຸດ

ວິໄລຊາ ທາລິບຸດ

(2) Hazardous substances measurement results of LPB compost



ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນາຖາວອນ



ກະຊວງສຶກສາທິການ ແລະ ກິລາ
ມະຫາວິທະຍາໄລແຫ່ງຊາດ
ຄະນະວິທະຍາສາດທຳມະຊາດ
ສາທາລິຊາດມີສາດ

ເລກທີ...251.../ກມ.ຄວທ
ນະຄອນຫຼວງວຽງຈັນ, ວັນທີ...20.../3.../2015.....

ຜົນການວິເຄາະທາດໄລຫະໜັກ ແລະທາດຢູ່ໃນຝຸ່ນອົງຄະທາດ

ລ/ດ No.	ລາຍການ Items	ຜົນການວິໄຈ Results	ໝາຍເຫດ
1	ວິໄຈ ທາດອາຊູນິກ As (mg/Kg)	0.07	EPA 3050b/ Borohydride AA
2	ວິໄຈ ທາດບາຫຼອດ Hg (mg/Kg)	0.13	EPA 3050b/Cold vapor AA
3	ວິໄຈ ທາດທອງ Cu (mg/Kg)	50.41	EPA 3050b/ FLAA
4	ວິໄຈ ທາດສິງກະສີ Zn (mg/Kg)	65.15	EPA 3050b/ FLAA
5	ວິໄຈທາດແກັດມຽມ Cd (mg/Kg)	0.94	EPA 3050b/ FLAA
6	ວິໄຈທາດນິຕີ N (%)	2.31	Kjeldahl Nitrogen, titration
7	ວິໄຈທາດຄາບອນ Organic carbon (%)	41.2	K ₂ Cr ₂ O ₇ / H ₂ SO ₄ , UV-Vis spectrophotometer 590 nm
8	ວິໄຈຂີ້ເຫີ້ Ash (% weight of ash to sample)	28.4	600°C, 2h
9	ວິໄຈຄວາມຊຸ່ມ water content (%)	11.6	105°C, 2h

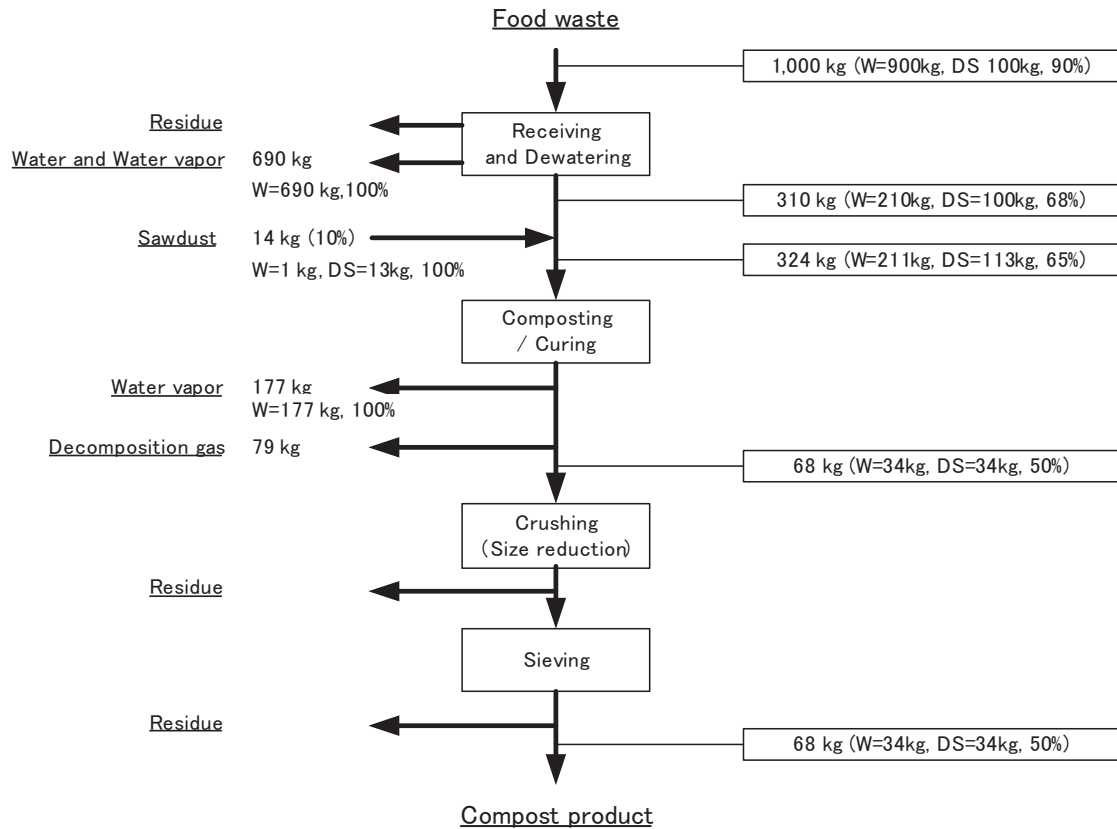


ສສ.ດອ.ບຸນຜັນ ຜຶ້ນແພງ

ຄະນະສາທາລິຊາ
ສຶກສາທາລາດ ຫຼວງສີສຸວັນ

ຜູ້ວິໄຈ
ສສ. ແພງໃຊ ຄຳວິໄຈ

2. Waste balance of LPB's off-site compost facility (Calculation condition: Food waste 1,000kg, Moisture content 90%)



3. Layout plan of LPB's off-site compost facility

Compost facility Plan

