Republic of the Union of Myanmar
Foreign Economic Relations Department, Ministry of Planning and Finance
Planning Department, Ministry of Planning and Finance
Department of Highways, Ministry of Construction
Department of Bridges, Ministry of Construction
Electricity Supply Enterprise, Ministry of Electricity and Energy
Mandalay Electricity Supply Corporation, Ministry of Electricity and Energy
Department of Rural Development, Ministry of Agriculture, Livestock and Irrigation

Preparatory Survey for Regional Development for Poverty Reduction Phase II Final Report(Summary)

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1. Background of Survey

1.1 Background

The Republic of the Union of Myanmar (hereinafter referred to as "Myanmar") has been actively promoting democratic reform since the establishment of former political administration in 2011. The reform covers a broad range of political and economic areas, such as expansion of international trades and investments, democratization, peace agreement and others. In this context, the National League for Democracy (NLD), led by Aung San Suu Kyi, won the general elections in November 2015 and the new administration was put in place in March 2016, and the reform process is expected to accelerate even faster in the near future. The economic situation of Myanmar may also continue to perform well, with the economic growth rate in the financial year 2015 estimated to reach 7.2%, according to the Asian Development Bank analysis.

On the other hand, Myanmar is still considered as a "developing" country in both social and economic state. Besides, poverty rate was 26% in 2010 according to the UNDP data, although there has been slight improvement in the last few years. Since the previous military administration had concentrated on development in urban areas for major infrastructure installations, countryside or regional areas could not receive much of the investment for development. Thus, infrastructure development in countryside and regional areas faced major delay for a long time, and this has caused serious disparity in poverty rate between regions in the country.

Under such circumstances, a Yen-loan agreement was signed in June 2013 for the Regional Development Project for Poverty Reduction (Phase-I). This Phase-I project aims to bring national development in a more balanced manner, responding to a high and increasing demand for comprehensive regional development projects. At present, the Phase-I project is considered to be addressing poverty reduction effectively across the areas in Myanmar. Following the positive impact brought by the Phase-I project, the government of Myanmar has been expecting the continuous assistance from the Japanese government and requested for the Regional Development Project for Poverty Reduction (Phase-II) implementation. Thus, the Japanese government has agreed on the implementation of a preparatory survey for the yen-loan project in March, 2015 in order to assist Myanmar government to accomplish sustainable economic development goals based on the human resource development envisioned in the National Comprehensive Development Plan.

The NLD's new administration has announced twelve major economic development policies in July, 2016. Among the policies, the top prioritized policy notes "balancing of sustainable resource mobilization and allocation across States and Regions." This policy corresponds well with the National Comprehensive Development Plan, and the Phase-II Project is in line with the NLD's new administration policy.

1.2 Objectives

The main objective of the Phase-II Preparatory Survey is to select sub-projects which are expected to contribute to poverty reduction of the country in all seven Regions and seven States. Following the basic strategies of the Phase-I project, these sub-projects will involve the establishment of new, or the rehabilitation of existing basic social infrastructure (roads, bridges, power supply and water supply facilities) that are expected to benefit the poor and are considered to be the immediate needs.

The main elements of this survey that should also be utilized for the JICA appraisal process are as follows: background, purpose and scope of sub-projects, target areas of each sub-project, project needs, structure of project implementation agencies, organization of operation and maintenance bodies, environmental and social considerations, and coordination among other concerned entities.

1.3 Significant Effects of Yen-loan Project Implementation

Significant effects of Yen-loan Project implementation can be summarized as follows.

- It is highly capable to correspond to a large financial demand, or of implementing large-scale packaged infrastructure development in all over Myanmar to meet urgent and high needs.
- Receiving development funds or financing through market/private investment is difficult and limited and not always an option for Myanmar government due to the weak and underdeveloped market, and the potential risks are often deemed to be high for the cautious private investors. In this context, Japanese Yen-loan is the best viable option as its terms and conditions are so concessional that the loan could be utilized for implementing such projects.
- Also, the Japanese Yen-loan can provide technical assistance and transfer conducted by highly experienced consultants. Therefore, the capacity of the government officials and engineers for the

implementation, operation and management can be practically improved during the course of the Project.

- Since methodologies to evaluate the projects are established, projects with high efficiency in poverty reduction and positive economic impact can be properly selected.

1.4 Highlight of Phase-II Project

The Project Team has made particular survey to collect local people's needs on infrastructure development in the survey areas in order to identify highly effective projects for poverty reduction. The result of the hearings indicates the selected Sub-Projects for implementation are matching with the priority infrastructure needs of the expected beneficiaries.

According to the infrastructure development ratio of each State and Region, Weighting Coefficient for each sector is set in order to achieve effective Sub-Project selection corresponding to the current infrastructure development level of each State and Region so that the demand of infrastructure development is quantitatively evaluated at the Sub-Project selection stage.

2. Poverty Status of Myanmar and Strategy of Phase-II Project

2.1 Current Status under Poverty Reduction Perspective and Possibility of Improvement

2.1.1. Poverty Population and Status of Basic Infrastructure Development

According to several data collected and analyzed by the Team as shown in the following table 2-1, current poverty population is approximately 12 million in Myanmar. Especially Magway, Mandalay, Rakhine, Shan and Ayeyarwady, the poverty population is exceeding one million.

These States and Regions from infrastructure development rate point of view have much lower preparedness comparing to the national average, such as access to electricity and water supplies in Magway and Rakhine, and road development and water supply in Ayeyarwady. Therefore, it is expected that such States and Regions should be selected for the development of concerned Sub-Project sectors.

Table 2-1 Infrastructure Preparedness and Poverty Population in each State and Region

State and Region	Number of population (person) (2014)	Number of population (person) (2010)	Rural Poverty Population (person) (2010)	States' and Regions' Poverty population (person) (2010)	Poverty Rate (%) (2010)	Ratio of Paved Road (%) (2014)	Ratio of Access to Electricity (%) (2014)	Ratio of Piped Water Supply Coverage (%) (2014)
Kachin	1,642,841	98,478	312,544	412,479	28.6	25.7	30.3	5.2
Kayah	286,627	2,020	30,903	31,627	11.4	57.5	48.6	23.0
Kayin	1,504,326	39,090	209,877	249,164	17.4	49.7	26.9	4.5
Chin	478,801	43,265	314,355	348,898	73.3	29.4	15.4	68.2
Sagaing	5,325,347	123,912	637,571	774,941	15.1	51.4	24.2	7.5
Tanintharyi	1,408,401	57,438	383,072	445,142	32.6	62.9	8.0	11.0
Bago	4,867,373	155,388	733,528	887,222	18.3	80.5	27.7	1.9
Magway	3,917,055	94,821	985,104	1,105,220	27.0	80.2	22.7	7.8
Mandalay	6,165,723	234,599	1,294,126	1,531,936	26.6	97.1	39.4	11.2
Mon	2,054,393	86,806	260,405	344,779	16.3	84.8	35.7	7.6
Rakhine	2,098,807	111,684	1,334,098	1,401,771	43.5	56.9	12.8	4.9
Yangon	7,360,703	476,439	562,023	959,875	16.1	95.5	69.3	13.3
Shan	5,824,432	147,443	1,351,464	1,487,285	33.1	53.9	33.4	20.0
Ayeyarwady	6,184,829	178,010	1,880,227	2,034,074	32.2	25.7	30.3	5.2
Nay Pyi Taw	1,160,242							
Union	51,486,253	1,849,395	10,289,297	12,014,411	25.6	59.7	32.4	9.0

Source: Poverty population was calculated based on the 2010 population and poverty rate by Preparatory Survey Team utilizing data listed below.

- Number of population (2014): Myanmar Population and Housing Census / Ministry of Immigration and Population
- Base population data for Poverty Population calculation (2010) : Township Health Profile 2011 (Health Planning Department, Ministry of Health)
- Poverty Rate (2010): Integrated Household Living Conditions Survey in Myanmar (2009-2010) Poverty Profile / 2011/ IHLCA PROJECT TECHNICAL UNIT (UNDP etc.)
- Ratio of Paved Road: Ministry of Construction
- Ration of Access to Electricity (On-Grid only) : Myanmar Population and Housing Census/ 2014 (Department of Population, Former Ministry of Border Affair and Population)
- Ratio of Piped Water Supply Coverage : Myanmar Population and Housing Census/ 2014 (Department of Population, Former Ministry of Border Affair and Population)

Note1: 2014 national total population figure (51,486,253) is inclusive of population in autonomous self-governing regions, and it is different from the total population of State and Regions.

Note2: Poverty population is calculated by adding together Urban and Rural poverty population.

2.1.2. Poverty Population and Status of Economy

Together with the previous section 2.1.1, States and Regions with higher poverty population namely Magway, Mandalay, Rakhine, Shan and Ayeyarwady are comparably analysed with household income and unemployment rate.

Rakhine indicates its household income per month lower than the national average as well as its highest annual unemployment rate in the country. Magway and Ayeyarwady show their household income per month lower than the national average. Such States and Regions are expected to be selected for power and water supply projects to improve such infrastructure supply environment, and household tasks, such as water fetching and preparing firewood for cooking, will be reduced so that the time currently used for household tasks and works could be utilized for other income generating work or studies that possibly contributing for job opportunity.

Table 2-2 Poverty Population, household Income and Unemployment Rate of States and Regions

State and Region	Number of population (person) (2014)	Number of population (person) (2010)	Rural Poverty Population (person) (2010)	States' and Regions' Poverty population (person) (2010)	Poverty Rate (%) (2010)	Household Monthly Income (Kyats) (2012)	Unemployment Rate (15 Years Old and Above) (%) (2014)
Kachin	1,642,841	98,478	312,544	412,479	28.6	304,708	3.7
Kayah	286,627	2,020	30,903	31,627	11.4	237,956	2.7
Kayin	1,504,326	39,090	209,877	249,164	17.4	322,517	7.5
Chin	478,801	43,265	314,355	348,898	73.3	150,844	5.4
Sagaing	5,325,347	123,912	637,571	774,941	15.1	223,166	3.6
Tanintharyi	1,408,401	57,438	383,072	445,142	32.6	326,536	4.6
Bago	4,867,373	155,388	733,528	887,222	18.3	222,970	5.1
Magway	3,917,055	94,821	985,104	1,105,220	27.0	205,385	3.3
Mandalay	6,165,723	234,599	1,294,126	1,531,936	26.6	318,133	3.1
Mon	2,054,393	86,806	260,405	344,779	16.3	298,088	6.2
Rakhine	2,098,807	111,684	1,334,098	1,401,771	43.5	198,651	10.4
Yangon	7,360,703	476,439	562,023	959,875	16.1	328,603	4.1
Shan	5,824,432	147,443	1,351,464	1,487,285	33.1	282,450	2.0
Ayeyarwady	6,184,829	178,010	1,880,227	2,034,074	32.2	206,114	3.4
Nay Pyi Taw	1,160,242						
Union	51,486,253	1,849,395	10,289,297	12,014,411	25.6	258,061	4.0

Source:

・Household Monthly Income :Household Income and Expenditure Survey (1997 and 2012)
/ Central Statistical Organization, Ministry of Planning and Finance

・Unemployment Rate (15 Years Old and Above): Population and Housing Census of Myanmar 2014
/ Ministry of Immigration and Population

2.2 Current Status in view of Operation of Yen-loan Project and Improvement Strategy

It is important to learn from the Phase-I Project experiences in order to smoothly implement the Phase-II Project. The following five aspects regarding the Yen-loan project implementation have been carefully studied for the Phase-II implementation and management through the issues and problems identified during Phase-I: Preparation Stage, Operation and Maintenance, Consulting Services, Executing Organization and Sector based Implementation and maintenance.

One of the largest differences between Phase-I and Phase-II Projects is the task and position of FERD (Foreign Economic Relations Department, Ministry of Planning and Finance) takes a role of coordination rather than executing role. It is necessary to have strong and effective coordination structure of PSC (Project Steering Committee) and PMU (Project Management Unit) to manage three different development sectors into one whole integrated project. Though, FERD remain in the same position as Phase-I for coordination to organize PMU and PSC meetings. Particulars on the project execution and management learned from the Phase-I Project are described in table 2-3 hereafter.

Table 2-3 Lessons and Approach for Implementation Structure

Item	Current Situation / Lessons learned in Phase-I	Proposed Approach for Phase-II (※See 9.3 of chapter 9)
Cross-sector Management	・ Implementation structure to manage and coordinate all three sub-sectors was not effectively formulated. Finance, bidding packages, contracts, construction schedule as well as project formation and achievement of targets of each sub-project are all managed among sectors. ・ All Executing Agencies are sharing burdens of overall management cost, but there are no clear rules about how they are shared among sectors.	・ FERD is going to be a Coordination Agency, while FERD was an executing agency for the Phase-I. Therefore, FERD shall be responsible for any coordination of PMU and PSC when these are held same as the Phase-I. On the other hand, the executing agency(s) being responsible on the following matters that have been taken by FERD for Phase-I has not been selected yet. (※Continued discussion with C/P after the preparatory survey.) - Necessary Process Management for Consulting Service Agreement - Submission Management of RFD (Request of Disbursement Form) document of Consulting Service. - RSP Submission Management Accounting Management, etc.
Role of PMU (Project Monitoring Unit)	・ Coordination among and control of the line ministries' activities were not effectively made. ・ Basic roles of PMU are the following (1) Overall project management; (2) Project Coordination/Management with consultants; (3) Monitoring and Evaluation of sub-projects; (4) Financial and Disbursement Management; (5) Environmental and Social Consideration; (6) Management of the PSC (7) Coordination with and reporting to JICA including submission of quarterly progress report and project completion report; and (8) Coordination with Union Auditor-General's Office regarding the project-specific auditing.	・ Permanent administrative staff with controlling power from the beginning of the implementation work is placed. ・ Basic roles of PMU follow the Phase-I. However, the "(1) Overall project management" is made more specific so that it is clearer. The following items, for example, are specified; • Consensus building over addition and cancellation of sub-projects, etc.) • Holding PMU meetings monthly • Management of secretariat and overall management fee
PMU Secretariat	・ FERD's Director is in charge of general administration of PMU, but not a full-time responsibility. Deputy Director and assistant help the administration work.	・ Set up PMU secretariat and designate permanent staff are mandatory for proper functioning.
Frequency of PMU meeting	・ PMU is held monthly ・ Meetings at earlier stage were not held on time or effectively.	・ Frequency is the same as Phase-I ・ PMU meeting schedule are fixed for year based duration and all PMU members are responsible for attending accordingly.
PMU Agreement Process	・ PMU agreement is made every three month on Project Status Report, which is submitted to JICA from FERD. ・ It is difficult to deal with urgent issues due to its low frequency ・ Decision making by all PMU members often delayed due to the difficulty in ministry-level approvals.	・ Agreement is made once a month at PMU meeting held monthly to deal with issues timely ・ Give stronger leadership to FERD in the control of Executing Agencies' approval process.
Role of PSC (Project Steering Committee)	・ Some tasks and roles of PSC are not clearly defined and decision by PSC should be made timely.	・ Basic structure and roles of PSC in Phase-I are succeeded in Phase-II but with clearer definition.
PSC Secretariat	・ FERD's Director is in charge of general administration of PMU, but not a full-time responsibility. Deputy Director and assistant help the administration work. ・ Only the Japan Desk in FERD take a role between PSC and PMU, but it is limited in terms of manpower and time.	・ Permanent secretariat and official(s) are appointed for continuous and smooth project implementation and coordination between PSC and PMU. ・ Information regarding a sudden need of PSC call is also managed at the secretariat.

Item	Current Situation / Lessons learned in Phase-I	Proposed Approach for Phase-II (※See 9.3 of chapter 9)
Frequency of PSC meeting	・ PSC with attendees from local governments is held biannually, and this cannot respond to emergency situations. ・ It is requested that JICA is included as attendees of PSC.	・ Rules for emergency PSC call are established and approved for implementation for Phase-II newly.
PSC Approval Process	・ PSC approval is made every six months at PSC meetings held biannually. ・ The scope of PSC approval is unclear, causing a major delay of failure of project implementation.	・ Scope and items of PSC approval in the Phase-I are restudied for better procedure and control – including change or addition of sub-projects and components. ・ Rules for emergency actions taken by PSC are set for better.

Source: The Preparatory Survey Team

3. Shortlist of Phase-II Project

3.1 Longlist Provided by the Project Counterparts

The sector-based longlist of Sub-Projects was originally submitted by Myanmar counterparts in September, 2015. However, the original longlist was revised because the counterparts have requested cancellation and addition of some Sub-Projects between December, 2015 and May, 2016. The latest longlist as of the end of May, 2016 is shown in Table 3-1 below.

Table 3-1 Number of Sub-Projects listed on the latest Longlist (as of May, 2016)

State / Region	Road & Bridge	Power Supply			Water Supply
		On-Grid	Off-Grid		
			Solar Home System	Mini-Hydro System	
Kachin	1	2			
Kayah	2	2			
Kayin	1	4			6
Chin	1	2	41 (45)	5(12)	
Sagaing	1	27	14 (137)		
Tanintharyi		2		1(36)	3
Bago	1	6	17 (299)		3
Magway	1	3	6 (171)		9
Mandalay	3	7	10 (109)		2
Mon	2	2	4 (108)		4
Rakhain	3	2			1
Yangon	2		2 (17)		
Shan	2	9		6(12)	11
Ayeyarwady	1	5			10
Nay Pyi Taw	1		4 (70)		
Total	22	73	98(956)	12(60)	49

Source: Prepared by Preparatory Survey Team based on the longlist provided by the counterpart agencies.

Note: Numbers in parentheses of off-Grid Sector indicate village number.

Note: The numbers indicated in the table specifies the Sub-Project quantities excluding canceled sub-projects by the counterpart.

Note: Numbers of Off-grid power supply indicate the number of Townships, and those noted in (brackets) are the numbers of Villages. The above table only indicates total numbers of Sub-Projects excluding sub-projects canceled by the counterpart agencies.

3.2 Evaluation Perspectives

In the Phase-II project, there are four (4) main perspectives for the Sub-Project evaluation: ①Needs/Urgency, ②Purposiveness, ③Cost-benefit performance and ④Feasibility.

Table 3-2 Perspective for Evaluation

Perspective	Description
Needs / Urgency	Taking into account the poverty dynamics in each State and Region, Sub-Projects with higher needs and urgency are evaluated in the light of poverty reduction[1] and satisfying basic human needs. It is expected to address the improvement of livelihood of people who are at the poverty line.
Purposiveness	Sub-Projects that are consistent with National Plans or development policy of Myanmar government are evaluated.
Cost-Benefit Performance	Sub-Projects with high cost performance (project economic effectiveness) and economic appropriateness are evaluated highly.
Feasibility	Sub-Projects that could be achievable, well maintained and managed under the Japanese-Yen-loan scheme are evaluated.

Source: The Preparatory Survey Team

3.3 Shortlisting Procedure

3.3.1. Shortlisting Steps

The procedure of shortlisting is divided into the following three steps (from STEP 1 to STEP 3)

STEP 1: Screening of Sub-Projects

Any Sub-Projects falls into the set condition[2] should be excluded from the Shortlist.

STEP 2: Screening of Sub-Projects

First of all, evaluation index set in the above table 3-4 is used for scoring of each Sub-Project. Next, each of the obtained score is multiplied by the Weighting Coefficient of each State and Region by sector, so that higher weight is given to sector(s) that have low level of infrastructure development (Table 3-5). All candidate sub-projects are ranked based on their final score: highest at the top rank.

STEP 3: Selection of Sub-Projects

In STEP 3, Sub-Projects are selected from the top of the above-described ranking with reference to "Referential Distribution of JICA Loan for each State and Region" (Table 3-3) until the total cost reaches the 15 billion JPY budget line[3].

In the first round of selection, the sub-projects are selected from the top with the "Referential Distribution" amount as the upper limit for each State and Region (when the total cost for each State or Region exceeds this limit by selecting a certain sub-project, the sub-project will not be selected and the sub-project ranked next is prioritized). After reaching the bottom in this way, then in the second round, the rest of sub-projects are selected from the top with the maximum at 2 billion JPY for each State and Region.

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[1] As described in JICA's "Thematic Guideline on Poverty Reduction", poverty is not simply a lack of income. Instead, the concept of poverty incorporates any deprivation of people's opportunity to lead a basic human life or exclusion from society and development process, which includes gender discrimination, etc. In this context, gender inequality is considered as one of the critical aspects of poverty reduction for the Phase-II project. Therefore, the possibility of gender integration during the Project implementation is explored

[2] Set condition for screening of Sub-Projects
- Already funded or possibly funded by other sources
- Located in the areas with security concern
- Categorized as "A" by the JICA Environmental Guideline
- Existing facilities or equipment satisfy the current demand (of water and power) and therefore there is no need for proposed sub-project to be implemented
- Inconsistent with each sector's Upper Plan
- Project size is too small for Yen-loan project (total construction cost is under 10 million JPY)
- It is difficult to acquire land necessary for proposed sub-project
- Necessary information for the preparation of Yen-loan (Feasibility Study Report, etc.) have not been provided or obtained.
- Standard design and project cost are not appropriate considering the purpose of this Project (spec or cost is too high)
- Economic benefit is not expected

[3] However, the cost only includes actual construction cost, but consulting service fees, contingency and other miscellaneous costs are not included

Phase-II Project aims disparity reduction in terms of poverty among States and Regions. The ranking and shortlisting process have been made with consideration of the balanced Sub-Project selection among States and Regions based on the poverty population in order for proper share of Yen-loan amount.

3.3.2. Referential Distribution of JICA Loan based on the Poverty Population

The Yen-loan budget distribution proportion for each State and Region is calculated as reference based on the poverty population, as described in the Section 3.2.2.1 "Shortlisting Steps" and shown in the following Table 3-3.

Table 3-3 Distribution[4] of JICA Loan for each State and Region based on the Poverty Population - referential (Total Project Cost: 15 billion Japanese Yen)

State/ Region	Population ※1	Poverty Rate※2	Poverty Population ※3	Poverty Population Deviation Value	Poverty Population Coefficient
	A	B	A×B	C	D
Kachin	1,642,841	28.6%	469,853	43.4	0.06204
Kayah	286,627	11.4%	32,675	36.4	0.05204
Kayin	1,504,326	17.4%	261,753	40.1	0.05728
Chin	478,801	73.3%	350,961	41.5	0.05932
Sagaing	5,325,347	15.1%	804,127	48.8	0.06969
Tanintharyi	1,408,401	32.6%	459,139	43.3	0.0618
Bago	4,867,373	18.3%	890,729	50.2	0.07168
Magway	3,917,055	27.0%	1,057,605	52.8	0.07549
Mandalay	6,165,723	26.6%	1,640,082	62.2	0.08882
Mon	2,054,393	16.3%	334,866	41.3	0.05895
Rakhine	2,098,807	43.5%	912,981	50.5	0.07218
Yangon	7,360,703	16.1%	1,185,073	54.9	0.07841
Shan	5,824,432	33.1%	1,927,887	66.8	0.09541
Ayeyarwady	6,184,829	32.2%	1,991,515	67.8	0.09687
Total	50,279,900	25.6%	12,616,269	750.0	1.00000

※1 Source: 2014 Myanmar Population and Housing Census

※2 Integrated Household Living Conditions Survey in Myanmar (2009-2010) Poverty Profile / 2011/ IHLCA PROJECT TECHNICAL UNIT (UNDP etc.)

※3 Poverty Population is calculated through multiplying Poverty Rate by Population.

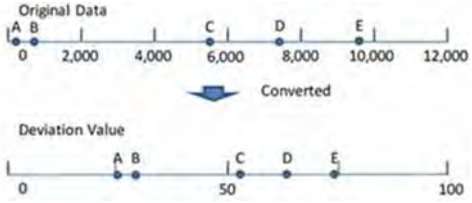
※4 Naypyitaw is not included as the necessary data could not be obtained.

[4] The referential amount of distribution for each State and Region is calculated in the following manner. First, poverty population of each State and Region is converted into deviation values (deviation value here indicates the amount by which a single measurement differs from a mean value). Then, the total cost of 15 billion Japanese Yen is allocated based on the coefficient calculated from the obtained deviation value.

The calculation applies Deviation Value instead of Absolute Value, because the gap between the largest and smallest budget for each State and Region would become too much (as the largest budget becomes 60 times as large as the lowest) when the Absolute Value is used. The calculation formula of deviation value is illustrated below.

Deviation Value (DVi) = ((x - xbar) / S)×10+50
where: DVi; Deviation Value of i State/Region
x; Poverty Population of i State/Region in 2010 shown in IHLCA Survey.
xbar; Average Poverty Population of States/Regions
S; Standard deviation of data

Deviation value shows the extent of original value from the average. In case of poverty population is large, the value becomes somewhere between 50 and 100, and in case of small, the value becomes between 0 and 50 according to the original value. The deviation values are normalized between 0 to 1 in this Project. The deviation value method has a merit to compare different indices each other.



3.3.2.1 Selection Criteria

Four sets of evaluation criteria, reflecting the four evaluation perspectives explained (①Needs/Urgency, ② Purposiveness, ③Cost-Benefit Performance and ④Feasibility) are shown in Table 3-4. These criteria are used to evaluate sub-projects of all sectors. Among the four, ①"Needs / Urgency" is valued most because it directly addresses poverty reduction and Basic Human Needs, which are the ultimate goals of this Project, more than the other three. Therefore, the Weighting of the criterion ①"Needs / Urgency" is the highest.

Table 3-4 Sub-Project Selection Criteria/Indices

	Selection Criteria			Score	Weight
Needs / Urgency	Poverty Population	Sub-Projects located in States or Regions with larger poverty population are evaluated.		Normalized into Continuous Value of 0～1.0	40%
Purposiveness	Integrity with National Policy And C/P's Priority	Sub-Projects consistent with National Plans, State/Regional Development Plans (5-Year Plans, etc.) or development policy of Myanmar government are evaluated. Sub-Projects prioritized by the counterparts agencies are also evaluated.			
		National Policy	- Sub-Projects that are (a) identified in 5-Year Plans (2016-2021), or (b) planned to be implemented within the period of 2016-2021, or (c) listed in the related superior plans.[5]	1.0	20% National Policy 50% C/P Needs 50%
			- Sub-Projects which have high possibility to be included in 5-Year Plans (2016-2021) or to be implemented within the period of 2016-2021	0.5	
			- Sub-Projects not falling into any of the above-described.	0.0	
		C/P's Priority	- Sub-Projects regarded as high priority by MoC based on the request from Local Government	1.0 or 0.0	
			- Sub-Projects regarded as high priority by ESE based on the request from Local Government	1.0 or 0.0	
			- Sub-Projects regarded as high priority by SDC or RDC and TDC based on the request from the local Government.	Normalized into Continuous Value of 0～1.0 (Based on the ranking)	
Cost-Benefit Performance	Economic Benefit/Economic Development Effectiveness	Sub-Projects expected to have higher economic cost-benefit performance or higher EIRR upon implementation are evaluated. ※Benefit of Road&Bridge sub-project is calculated based on the reduction of travel time/expense[6], while that of Power and Water Supply sector is based on "Willingness to pay[7]"		Normalized into Continuous Value of 0～1.0	20%

[5]The MoC is under the process of evaluating projects to be listed in the 5-Year Plan. However, it does not set up a short-term development plan for Roads/Bridges. Instead, it currently sets annual project package based on the requests from local governments and implements projects with actual budgets allocated including donor funds. On the other hand, as for regional trunk roads or high-standard roads have been listed in the MoC's 30-Year Plan (superior plan), which are to be implemented one by one. The all 22 Sub-Projects listed in the longlist are all projected for implementation in 2016.

[6]Benefit from a reduction of travel time and expense, which is used as economic benefit indicator of Road & Bridge sector, is calculated based on the International Roughness Index (IRI). It presupposes that Road Sub-Project would make an improvement from category RI10 to IRI3 of this Index. The index is also adopted by the ADB project in Myanmar (Mqubin-Phyapon Road Rehabilitation Project).

[7] The Preparatory Survey Team has conducted household survey targeting at 120 households in Shan and Kayah States and Bago Region during the third field survey. The resulting Willingness to Pay for Power Supply and Water Supply sectors by the local people are shown below.

・Willingness to Pay for Power Supply: 5,000 Kyat/month.HH
・Willingness to Pay for Water Supply: 758 Kyat/month.person (Median Value)

	Selection Criteria			Score	Weight
Feasibility	Healthy Implementation and O&M	From the implementation point of view, sub-projects which can be smoothly implemented are evaluated, taking into technical difficulties and capacity of Implementation Agencies. From the O&M point of view, sub-projects with little or no technical difficulties (Road & Bridge) or which enable the repayment of JICA loan are evaluated through the collection of fee (Power Supply and Water Supply).			
		Road and Bridge	・ Sub-Projects without any problem with technical matters or capacity of Implementation Agencies during implementation. ・ Sub-Projects involving some technical difficulty in implementation (e.g. construction work during rainy seasons or construction technologies.)	1.0 or 0.5	20% Implementation 50% O&M 50%
		Road and Bridge	・ Sub-Projects without any problem with technical matters or capacity of Implementation Agencies during O&M. ・ Sub-Projects involving some technical difficulty in O&M (e.g. procurement of equipment and installation during rainy season, etc.)	1.0 or 0.5	
		Power and Water Supply	Sub-Projects implemented by Implementation Agencies which have experience of smooth implementation of similar project.	ESE1.0 or TDC0.9[8]	
		Power and Water Supply	Sub-Projects whose financial condition is expected to be stable after the implementation, or with which ESE/TDC will have sufficient capacity to repay JICA loan (household income, electricity charge and water tariff, subsidies and so on.)	FIRR(%) Normalized into Continuous Value of 0～1.0	

Source: The Preparatory Survey Team

3.3.2.2 Scoring Method

The actual scoring method of "STEP2: Scoring and Ranking" mentioned in the Section 3.3.2.2 is described hereafter.

(1) Scoring by Four Evaluation Criteria

The scoring of sub-project involves the following steps;

① Sub-Project data obtained for evaluation is either discrete or continuous values (Figure 3-1). In order to enable cross-comparison among different items of data, the continuous values among them are normalized in the range of zero (0) to one (1), using the formula below (Figure 3-2).

$$\textbf{Continuous Value} = \{X - \text{Min}(X_1, X_2 \cdots X_n)\} \;/\; \{\text{Max}(X_1, X_2 \cdots X_n) - \text{Min}(X_1, X_2 \cdots X_n)\}$$

②Next, all the values for the common evaluation, as well as all those for sub-sector evaluation are added up respectively and then divided proportionally by n (the number of numbers added together to get the total) respectively. As a result of this, two values (one for common evaluation and the other for sub-sector evaluation) are calculated.

③Lastly, in the same way, the above described two values are also added up and divided by two. For the sake of easy comparison, figures/values used in this scoring process are multiplied by 100 – leading to the total score of each sub-project.

[8] In Phase-I, the implementation of two water supply pilot projects under TDC has delayed under TDC, taking additional 10% of the expected schedule. Therefore, the score of TDC is set at 0.9.

Reference Number	Project Code	State/Region	Name of Subproject	Evaluation(Original)							
				① Purposiveness				② Cost-Benefit	③ Needs / Urgency	④ Feasibility	
				National Policy	C/P Needs				Poverty Population	Implementation	Management
112	ESE-1201	Ayeyarwady	Pathein	1.00	1.00		1.00	112.6%	2,400,510	1.0	98.2%
117	ESE-1206	Ayeyarwady	Einme	1.00	0.00		0.00	102.5%	2,400,510	1.0	90.9%
168	TDC-28	Ayeyarwady	Pathein	0.5	1.00	1.00	1.00	5.8%	2,400,510	0.9	11.5%
165	TDC-25	Ayeyarwady	Wakema	0.5	0.89	1.00	0.94	4.0%	2,400,510	0.9	4.0%
169	TDC-29	Ayeyarwady	Myaungmya	0.5	0.78	1.00	0.89	8.9%	2,400,510	0.9	5.5%
160	TDC-20	Ayeyarwady	Bogale	0.5	0.67	1.00	0.83	10.1%	2,400,510	0.9	2.4%
161	TDC-21	Ayeyarwady	Kyaiklat	0.5	0.44	1.00	0.72	7.5%	2,400,510	0.9	16.0%
18	MoC-18	Ayeyarwady	NgaThine Chaung - Gwa Road	1.00	1.00		1.00	-6.5%	2,400,510	1.0	1.0
114	ESE-1203	Ayeyarwady	Myaungmya (Pyin Village)	0.00	1.00		1.00	-11.0%	2,400,510	1.0	-15.3%
163	TDC-23	Ayeyarwady	Nyaungdon	0.5	0.11	1.00	0.56	-2.3%	2,400,510	0.9	6.8%
162	TDC-22	Ayeyarwady	Dedaye	0.5	0.00	1.00	0.50	-5.2%	2,400,510	0.9	3.0%
17	MoC-17	Shan	Tangoo - LeikTho - YaDo - Hopone Road	1.00	1.00		1.00	-5.5%	1,728,813	0.5	1.0
135	ESE-1317	Mandalay	PyinOoLwin T/S (Ahne Sakhan-Myomia, Myomia S/S)	1.00	1.00		1.00	77.5%	2,013,886	1.0	65.8%

Figure 3-1 Original Data obtained in Discrete Value and Continuous Value

Source: The Preparatory Survey Team

Reference Number	Project Code	State/Region	Name of Subproject	Evaluation(Norm)							
				① Purposiveness			② Cost-Benefit	③ Needs / Urgency		④ Feasibility	
				National Policy	C/P Needs			Poverty Populatio	Implementation	Management	
112	ESE-1201	Ayeyarwady	Pathein	1.00	1.00	1.00	0.62	1.00	1.00	0.56	0.78
117	ESE-1206	Ayeyarwady	Einme	1.00	0.00	0.50	0.58	1.00	1.00	0.53	0.76
168	TDC-28	Ayeyarwady	Pathein	0.5	1.00	0.75	0.16	1.00	0.90	0.18	0.54
165	TDC-25	Ayeyarwady	Wakema	0.5	0.94	0.72	0.15	1.00	0.90	0.15	0.52
169	TDC-29	Ayeyarwady	Myaungmya	0.5	0.89	0.69	0.17	1.00	0.90	0.15	0.53
160	TDC-20	Ayeyarwady	Bogale	0.5	0.83	0.67	0.17	1.00	0.90	0.14	0.52
161	TDC-21	Ayeyarwady	Kyaiklat	0.5	0.72	0.61	0.16	1.00	0.90	0.20	0.55
18	MoC-18	Ayeyarwady	NgaThine Chaung - Gwa Road	1.00	1.00	1.00	0.10	1.00	1.00	1.00	1.00
114	ESE-1203	Ayeyarwady	Myaungmya (Pyin Village)	0.00	1.00	0.50	0.08	1.00	1.00	0.06	0.53
163	TDC-23	Ayeyarwady	Nyaungdon	0.5	0.56	0.53	0.12	1.00	0.90	0.16	0.53
162	TDC-22	Ayeyarwady	Dedaye	0.5	0.50	0.50	0.11	1.00	0.90	0.14	0.52
17	MoC-17	Shan	Tangoo - LeikTho - YaDo - Hopone Road	1.00	1.00	1.00	0.11	0.72	0.50	1.00	0.75

Figure 3-2 Normalization into Continuous Value between Zero to One (highlighted in red boxes)

Source: The Preparatory Survey Team

(2) Setting up Weighting Coefficient of Each State and Region by Sector

Each State and Region has different priority of infrastructure development among Road and Bridge, Power Supply and Water Supply. Therefore, the weighting coefficient among these sub-sectors is set for each State and Region based on the current level of infrastructure development. Rate of unpaved road (Road and Bridge), rate of non-access to electricity (Power Supply) and rate of non-access to safe water (Water Supply) are used to set up the coefficient in order to quantitatively evaluate infrastructure needs of each State and Region. The set weighting coefficient is shown in Table 3-5.

Each of the obtained score from the four sets of evaluation criteria, as described in (1), is multiplied by the weighting coefficient and the total score is drawn.

Table 3-5 Weighting Coefficient for Each State and Region by Sector

State/Region	Road		Power Supply		Water Supply	
	Rate of Unpaved Road (%)※1	Coefficient (Ave. Dev. Value)	Rate of Non Access to Electricity (%)※2	Coefficient (Ave. Dev. Value)	Rate of Non Access to Safe Water (%)※3	Coefficient (Ave. Dev. Value)
Kachin	74%	67.878	70%	49.766	96%	58.033
Kayah	43%	52.898	51%	38.072	80%	48.857
Kayin	50%	56.573	73%	51.938	93%	56.275
Chin	71%	66.135	85%	59.287	20%	15.999
Sagaing	49%	55.772	76%	53.664	83%	50.835
Tanintharyi	37%	50.355	92%	64.016	83%	50.725
Bago	20%	42.064	72%	51.427	96%	57.649
Magway	20%	42.206	77%	54.622	73%	44.956
Mandalay	3%	34.245	61%	43.951	74%	45.780
Mon	15%	40.039	64%	46.315	89%	54.132
Rakhine	43%	53.181	87%	60.948	81%	49.736
Yangon	5%	34.999	31%	24.844	82%	50.286
Shan	46%	54.594	67%	47.785	86%	52.044
Ayeyarwady	30%	47.199	88%	61.460	98%	59.132
Nay Pyi Taw	40% ※4	51.862	57%	41.906	92%	55.561

Weighti=DVi/ΣDVi

DVi: Deviation Value of i sector

Source: Public Works (※1), Population and Housing Census (※2), IHLCA survey 2009-2010 (※3),
Note ※4 The Union rate is shown as the rate of road pavement in Naypyitaw is not obtained.

3.4 Summary of shortlisted Sub-Projects

3.4.1. Total Result of the Number of Sub-Projects shortlisted

The summary of shortlisted Sub-Projects in quantity is shown in table 3-6.

Table 3-6 Total result of the number of Sub-Projects shortlisted

State / Region	Road and Bridge	Power Supply (On-Grid)	Water Supply	Total of each State and Region
Kachin		1		1
Kayah				
Kayin	1	1	2	4
Chin		1		1
Sagaing	1	6		7
Tanintharyi		2	2	4
Bago	1	6	2	9
Magway	1	2	5	8
Mandalay		7	2	9
Mon		1	2	3
Rakhine		2	1	3
Yangon				
Shan	2	1	3	6
Ayeyarwady	1	2	3	6
Nay Pyi Taw				
Total of each sector	7	32	22	61

Source: The Preparatory Survey Team

3.4.2. Summary of shortlisted Sub-Projects

General description of shortlisted Sub-Projects are illustrated in Tables 3-7, 3-8 and 3-9.

3.4.2.1 Road and Bridge Sector（7）

Table 3-7 Summary of Sub-Projects of Road and Bridge Sector

Project No	State Region	Sub-Project Name ※1	Items	Quantitative Effect ※2 ① Annual Average Daily Traffic (AADT) ② Number of Passers (one direction) (Nos.) /③ Travel Time (min.) / ④ Average Velocity (km/hour)/⑤Annual Traffic Im-passability Dates (day)	
				Before（2015）	After（2023）
MOC-03	Kayin	Taungoo - Leik Tho - Yar Do - Loikaw - Ho Pone Roa（78.0km）	Civil rehabilitation work:55nos / Road construction:16.0km RC bridge construction:64.0m / Box culvert construction : 1nos / Retaining wall and Drainage : 11.6km Guard rail: 31.2km	① 40 ② 2,911 ③ 200 ④ 24 ⑤ 2	① 150 ② N/A ③ 120 ④ 40 ⑤ 0
MOC-05	Sagaing	Mandalay-Dagaung-Myit Kyina Road (Mya Taung- Tharya Gone Section)（56.2km）	Road construction:53.0km Road rehabilitation:3.2m RC bridge construction:54.9m	① 100 ② 1,763 ③ 99 ④ 34 ⑤ 5	① 380 ② N/A ③ 67 ④ 50 ⑤ 0
MOC-06	Bago	◎Taungoo - LeikTho - YaDo - Loikaw - Hopone Road（16.8km）	Civil widening work:16.8km Road construction:16.8km	① 40 ② 2,911 ③ 30 ④ 34 ⑤ 0	① 150 ② N/A ③ 25 ④ 40 ⑤ N/A
MOC-07	Magway	Gan Gaw-Aika Road（14.8km）	Civil widening work:6.4km / Road construction:14.8km RC bridge construction:6.1m Box culvert construction(1.52m1.52m×12.19m) : 7nos Box culvert construction(1.52m1.52m×8.53m): 2nos Drainage: 0.475km	① 30 ② 252 ③ 29 ④ 31 ⑤ 0	① 110 ② N/A ③ 22 ④ 40 ⑤ N/A
MOC-17	Shan	Taungoo - Leik Tho - Yar Do - Loikaw - Ho Pone Road（39.4km）	Civil rehabilitation work:15nos Road construction:39.4km / RC bridge construction:22.9m Box culvert construction: 34nos / Retaining wall and Drainage: 9.6km / Guard rail: 8.0km	① 40 ② 2,911 ③ 105 ④ 23 ⑤ 0	① 150 ② N/A ③ 60 ④ 40 ⑤ N/A
MOC-18	Ayeyar-wady	◎Nga Thine Chaung - Gwa Road（32.4km）	Civil widening work:19.8km / Civil rehabilitation work:17nos Road construction:32.4km / Box culvert construction(1.52m×1.52m×15.24m) : 15nos / Box culvert construction(1.52m×1.52m×6.1m) : 2nos / Retaining wall and Drainage : 32.4km / Guard rail : 10.6km	① 180 ② 964 ③ 54 ④ 36 ⑤ 0	① 680 ② N/A ③ 49 ④ 40 ⑤ N/A
MOC-22	Shan	Han - Myintmo - Myo Gyi - Ywar Ngan - Aung Pan Road（14.6km）	Civil widening work:11.8km Road construction:14.6km Box culvert construction : 13nos Retaining wall: 11.8km / Guard rail: 4.8km	① 370 ② 651 ③ 25 ④ 35 ⑤ 0	① 1,390 ② N/A ③ 22 ④ 40 ⑤ N/A

Source: The Preparatory Survey Team

3.4.2.2 Power Supply Sector (On-grid)（32）

Table 3-8 Summary of Sub-Projects of Power Supply Sector(On-Grid)

Project No	State Region	Sub-Project Name ※1	Items	Quantitative Effect ※2 ①Electrified Households by grid ②Sale Volume (MWh)	
				Before（2015）	After（2023）
ESE-0101	Kachin	Waing maw	66/33kV substation(10MVA) :1Nos Switch Bay (33KV): 3Nos	① 13,047 ② 4,566	① 17,102 ② 17,102
ESE-0303	Kayin	Pinekyon	33/11kV substation(5MVA) :1Nos 33kV Single Pole with Earthing Wire :19mile	① 122 ② 43	① 7,799 ② 7,799
ESE-0401	Chin	Teetain	Transformer(100kVA) :8Nos / 11/0.4kV Pole-mounted Transformer(50kVA) :1Nos 11kV ACSR: 8.8miles / 0.4kV ABC :5mile	① 0 ② 0	① 850 ② 850
ESE-0501	Mon	Saung Naing Gyi (Kyaikhto)	33/11kV substation(5MVA) :1Nos 33kV Single Pole with Earthing Wire :15mile	① 13,019 ② 4,557	① 32,423 ② 32,423
ESE-0601	Rakhine	Ann(kazukain)	33/11kV substation(5MVA) :1Nos 33kV Single Pole with Earthing Wire :7mile	① 0 ② 0	① 3,850 ② 3,850
ESE-0602	Rakhine	Thandwe (Kyaunkgyi)	66/11kV substation(10MVA): 1Nos Switch Bay (66KV):1Nos / 66kV H-pole: 22mile 11/0.4kV Pole-mounted Transformer(100kVA) :19Nos 11/0.4kV Pole-mounted Transformer(50kVA) :25Nos 11kV ACSR: 35.6miles / 0.4kV ABC :16.3mile	① 5,855 ② 2,049	① 10,353 ② 10,353
ESE-0703	Shan	◎Kalow（Heho）	66/11kV substation(10MVA): 1Nos 66kV H-pole: 15mile	① 3,593 ② 1,257	① 8,899 ② 8,899

Project No	State Region	Sub-Project Name ※1	Items	Quantitative Effect ※2 ①Electrified Households by grid ②Sale Volume (MWh)	
				Before（2015）	After（2023）
ESE-0802	Sagaing	Ohmtaw-Myinmu	33kV Single Pole with Earthing Wire :25.44mile	① 9,887 ② 3,460	① 10,876 ② 10,876
ESE-0805	Sagaing	Watlat(Sinnaingkwe)	33/11kV substation(5MVA) :1Nos / 33kV Single Pole with Earthing Wire :0.2mile / 11kV ACSR: 7.5miles	① 1,705 ② 597	① 11,452 ② 11,452
ESE-0808	Sagaing	Khin Oo (Chay Myint Kyin)	33/11kV substation(5MVA) :1Nos / 33kV Single Pole with Earthing Wire :4.5mile / 11kV ACSR: 15miles	① 0 ② 0	① 6,610 ② 6,610
ESE-0809	Sagaing	Depayin (Myae)	33/11kV substation(5MVA) :1Nos / 33kV Single Pole with Earthing Wire :23mile / 11kV ACSR: 6miles	① 358 ② 125	① 6,282 ② 6,282
ESE-0812	Sagaing	Kani	66/11kV substation(10MVA) :1Nos 66kV H-pole :1mile / 11kV ACSR: 2miles	① 500 ② 175	① 10,836 ② 10,836
ESE-0813	Sagaing	Batalin (MaungTaung)	33/11kV substation(5MVA) :1Nos / 33kV Single Pole with Earthing Wire :8mile / 11kV ACSR :16miles	① 0 ② 0	① 5,147 ② 5,147
ESE-0901	Tanintharyi	Launglon(Zalot village)	33/11kV substation(10MVA) :1Nos 33kV Single Pole with Earthing Wire :20mile	① 0 ② 0	① 3,850 ② 3,850
ESE-0902	Tanintharyi	Thayetchaung(Mindut)	33/11kV substation(10MVA) :1Nos 33kV Single Pole with Earthing Wire :20mile	① 0 ② 0	① 3,850 ② 3,850
ESE-1006	Bago	Tharyarwad	33/11kV substation(5MVA) :1Nos 33kV Single Pole with Earthing Wire :0.8mile	① 4,529 ② 1,585	① 15,389 ② 15,389
ESE-1008	Bago	Bago(N0-4(Oakthar))	33/11kV substation(10MVA) :1Nos 33kV Single Pole with Earthing Wire :4mile	① 0 ② 0	① 1,100 ② 14,240
ESE-1011	Bago	Htantabin (Zayatgyi)	33/11kV substation(5MVA) :1Nos / 33kV Single Pole with Earthing Wire :12mile / 11kV ACSR: 6miles	① 5,056 ② 1,770	① 7,425 ② 7,425
ESE-1013	Bago	Yedashe(Myohla)	33/11kV substation(5MVA) :1Nos / 33kV Single Pole with Earthing Wire :1.0mile / 11kV ACSR: 0.5miles	① 1,975 ② 681	① 4,928 ② 4,928
ESE-1014	Bago	Sinmeeswe	33/11kV substation(5MVA) :1Nos 33kV Single Pole with Earthing Wire :0.8mile	① 2,160 ② 756	① 4,246 ② 4,246
ESE-1016	Bago	Othegon	33/11kV substation(5MVA) :1Nos 33kV Single Pole with Earthing Wire: 6mile	① 1,924 ② 673	① 5,246 ② 5,246
ESE-1101	Magway	◎Chauk (GwePin Village)	66/11kV substation(10MVA) :1Nos 66kV H-pole :5miles	① 0 ② 0	① 6,153 ② 6,153
ESE-1102	Magway	Taungdwingyi (Satthwa Village)	66/11kV substation(10MVA) :1Nos 66kV H-pole :1.5miles	① 1,201 ② 420	① 8,809 ② 8,809
ESE-1201	Ayeyarwady	Pathein	33/11kV substation(10MVA) :1Nos 33kV Si P,O/HEM :1mile	① 33,220 ② 11,627	① 60,500 ② 60,500
ESE-1206	Ayeyarwady	Einme	33/11kV substation(10MVA) :1Nos	① 3,555 ② 1,244	① 41,812 ② 41,812
ESE-1305	Mandalay	Taungthar T/S	66/33kV substation(30MVA) :1Nos Switch Bay(66kV) :1Nos / Switch Bay(33kV) :6Nos 33kV Single Pole with Earthing Wire :14mile	① 11,000 ② 3,850	① 28,050 ② 28,050
ESE-1309	Mandalay	◎Nyungoo T/S	66/11kV substation(10MVA) :1Nos Switch Bay(66kV) :1Nos	① 0 ② 0	① 4,400 ② 4,400
ESE-1317	Mandalay	PyinOoLwin T/S	Switch Bay(33kV) :1Nos 33kV Single Pole with Earthing Wire :10mile	① 20,125 ② 7,044	① 28,090 ② 28,090
ESE-1318	Mandalay	McikHtilar T/S	33/11kV substation(5MVA) :1Nos Switch Bay(33kV) :1Nos	① 1,772 ② 620	① 6,475 ② 6,475
ESE-1319	Mandalay	TharSi T/S	33/11kV substation(5MVA) :1Nos / 33kV Single Pole with Earthing Wire :10mile / 11kV ACSR: 24miles	① 0 ② 0	① 3,550 ② 3,550
ESE-1321	Mandalay	Kyauk Pa Taung T/S	66/11kV substation(10MVA) :1Nos Switch Bay(66kV) :1Nos	① 291 ② 102	① 11,768 ② 11,768
ESE-1322	Mandalay	TharSi T/S	33/11kV substation(10MVA) :1Nos	① 0 ② 0	① 15,166 ② 15,166

Source: The Preparatory Survey Team

3.4.2.3 Water Supply Sector（22）

Table 3-9 Summary of Sub-Projects of Water Supply Sector

Project No	State Region	Sub-Project Name※1	Items	Quantitative Effect ※2 ①Percentage of Population Served (%)②Water Supply per Capita (litter/c/day)③Turbidity in NTU ④Residual Chlorine (mg/L)⑤Measurement Frequency ⑥O&M Cost (mil. Kyat/year)	
				Before（2015）	After（2023）
TDC-01	Rakhine	◎Sittwe	Expansion	①54②91(20G/c/day)③Unknown④0 ⑤N/A⑥70	①71②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥137
TDC-04	Magway	Chauk	Expansion	①80②91(20G/c/day)③700mg/L in SS ④0⑤N/A⑥171	①100②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥480
TDC-05	Magway	Taungdwingyi	Expansion	①86②41(9G/c/day)③Unknown④0 ⑤N/A⑥50	①100②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥147
TDC-06	Magway	Minbu	Expansion	①80②91(20G/c/day)③Unknown④0 ⑤0⑥110	①100②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥59
TDC-08	Magway	Thayet	Expansion	①21②36(8G/c/day)③Unknown④0 ⑤N/A⑥40	①100②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥85

Project No	State Region	Sub-Project Name※1	Items	Quantitative Effect ※2 ①Percentage of Population Served (%)②Water Supply per Capita (litter/c/day)③Turbidity in NTU ④Residual Chlorine (mg/L)⑤Measurement Frequency ⑥O&M Cost (mil. Kyat/year)	
				Before（2015）	After（2023）
TDC-11	Magway	Pakokku	Expansion	①36②91(20G/c/day)③Unknown④0 ⑤N/A⑥108	①50②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥148
TDC-13	Mandalay	Myingyan	Expansion	①25②91(20G/c/day)③Unknown④0 ⑤N/A⑥16	①85②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥180
TDC-16	Kayin	Than Daung Gyi	Expansion	①19②68(15G/c/day)③Unknown④0 ⑤N/A⑥24	①90②68(15G/c/day)③≦5④0.1～1 ⑤Once per day⑥60
TDC-18	Kayin	Kyainseikgyi	New	① 4 ② 0 ③ Unknown ④ 0 ⑤ N/A ⑥ 0	①100②114(25G/c/day)③≦5④0.1～1 ⑤Once per day⑥72
TDC-25	Ayeyarwady	Wakema	New	①0②0③Unknown④0⑤N/A⑥0	①78②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥85
TDC-28	Ayeyarwady	◎Pathein	New	①0②0③80④0⑤N/A⑥0	①90②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥656
TDC-29	Ayeyarwady	Myaungmya	New	①0②0③140④0⑤N/A⑥0	①85②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥215
TDC-30	Bago	Bago	Expansion	①11②114(25G/c/day)③0.5④0 ⑤Unknown⑥28	①33②114(25G/c/day)③≦5④0.1～1 ⑤Once per day⑥1,068
TDC-32	Bago	Gyobingauk	Expansion	①8②68(15G/c/day)③Unknown④0 ⑤N/A⑥9	①35②68(15G/c/day)③≦5④0.1～1 ⑤Once per day⑥60
TDC-34	Tanintharyi	Launglon	Expansion	① 0 ② 0 ③ Unknown ④ 0 ⑤ N/A ⑥ 0	①65②114(25G/c/day)③≦5④0.1～1 ⑤Once per day⑥38
TDC-36	Tanintharyi	Bokpyin	Expansion	① 0 ② 0 ③ Unknown ④ 0 ⑤ N/A ⑥ 0	①91②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥21
TDC-37	Shan	Taunggyi	Expansion	①35②91(20G/c/day)③Unknown④0 ⑤N/A⑥75	①60②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥313
TDC-38	Shan	Aungpan	Expansion	①52②91(20G/c/day)③＜5④0⑤N/A ⑥96	①100②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥160
TDC-44	Shan	Lashio	Expansion	①36②91(20G/c/day)③Unknown④0 ⑤N/A⑥167	①86②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥338
TDC-54	Mon	Thanbyuzayat	Expansion	①2②45(10G/c/day)③Unknown④0 ⑤N/A⑥10	①60②55(12G/c/day)③≦5④0.1～1 ⑤Once per day⑥130
TDC-57	Mandalay	◎Meiktila	Expansion	①52②91(20G/c/day)③Unknown④0 ⑤N/A⑥226	①100②91(20G/c/day)③≦5④0.1～1 ⑤Once per day⑥333
TDC-58	Mon	Mawlamyine	Expansion	①29②114(25G/c/day)③Unknown④0 ⑤N/A⑥348	①52②114(250G/c/day)③≦5④0.1～1 ⑤Once per day⑥480

Source: The Preparatory Survey Team

※Note1：Sub-Project Names with "◎" symbol are proposed for Priority Projects.

※Note2："Quantitative Effect" means direct effect only. Tables 8-2-5, 8-3-5 and 8-4-5 of Chapter-8 indicate indirect effect as well.

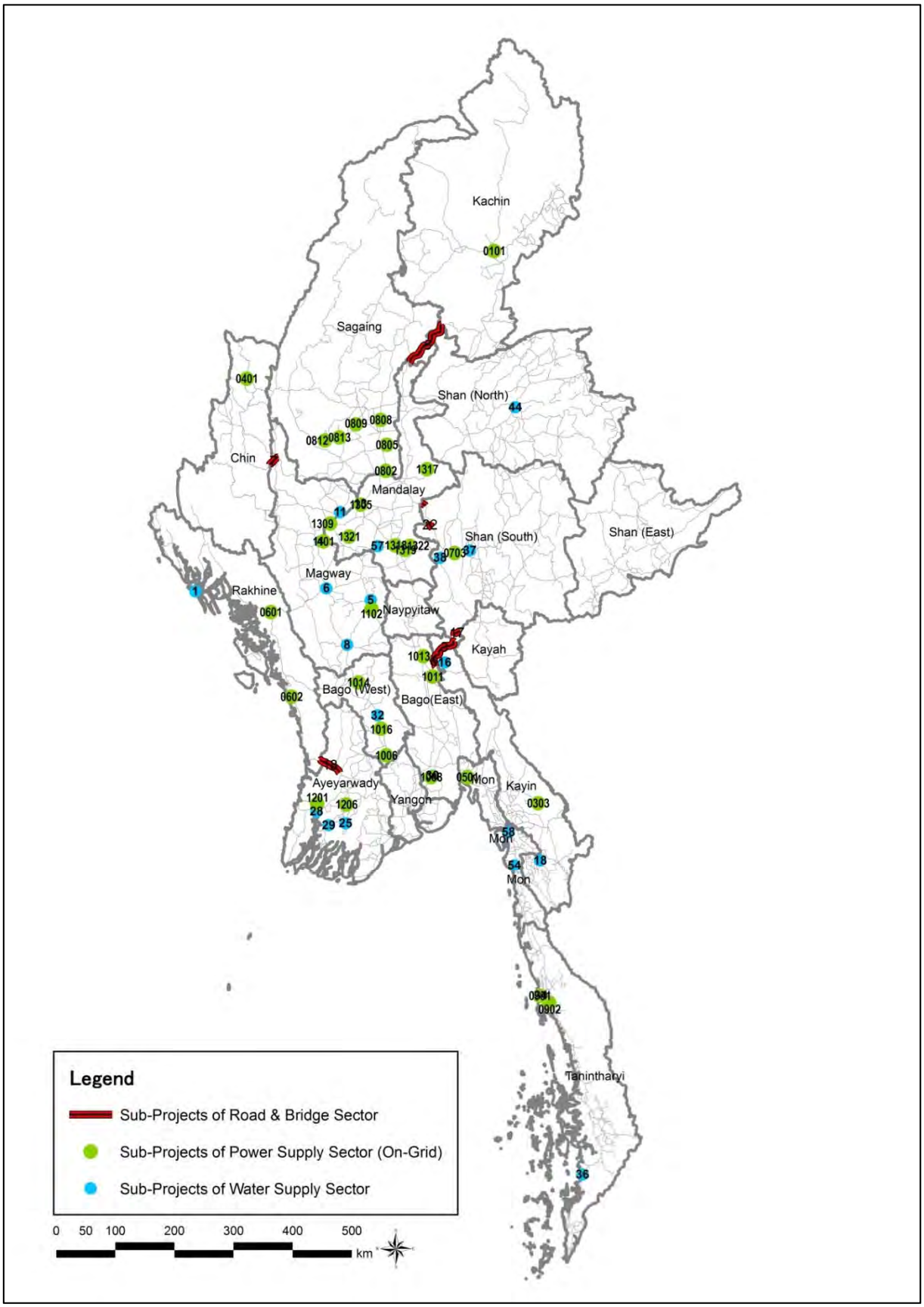


Figure 3-3 Integrated Sub-Project Location Map (Final Version)

Source: JICA Preparatory Survey Team

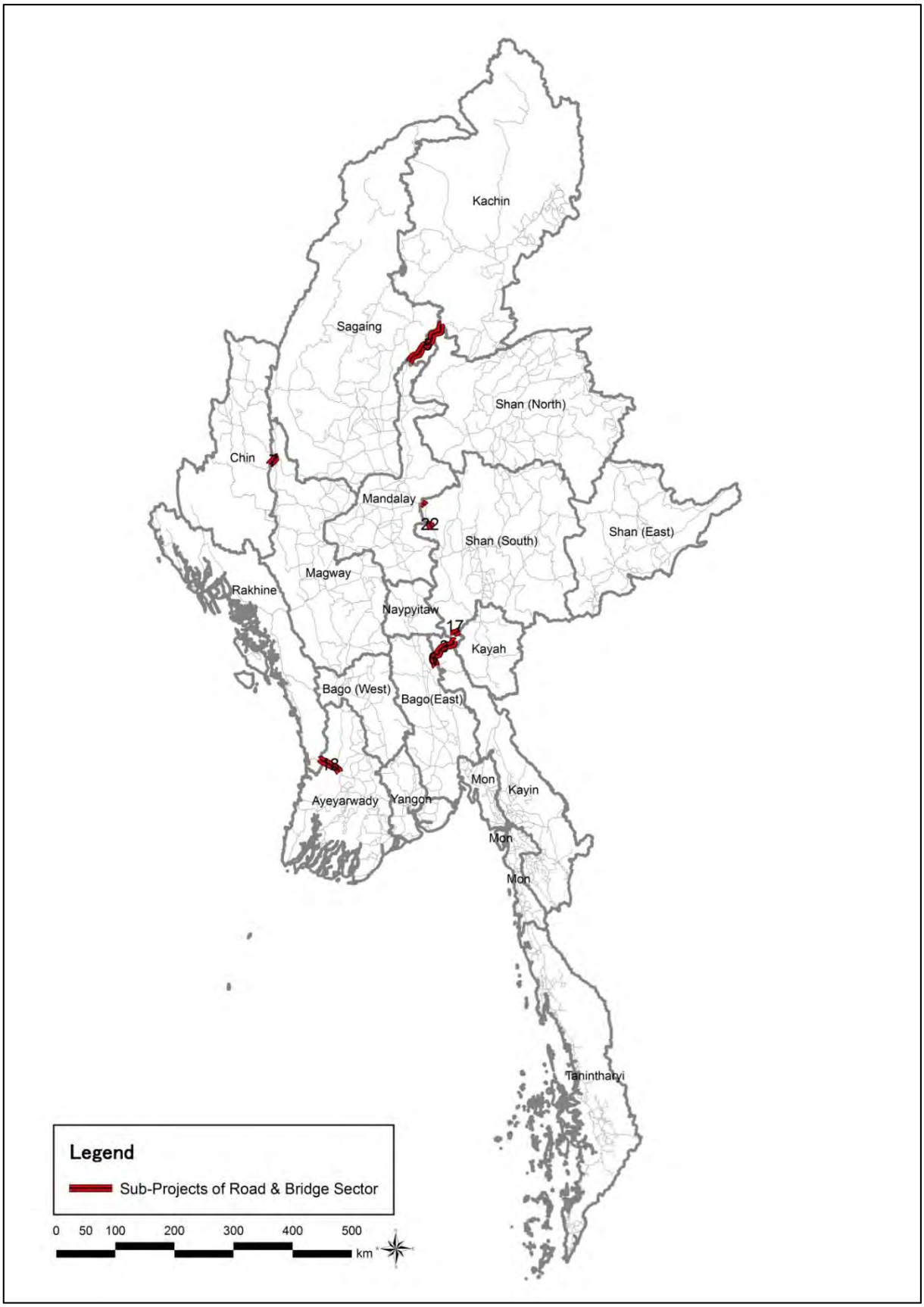


Figure 3-4 Road and Bridge Sub-Project Location Map (Final Version)

Source: JICA Preparatory Survey Team

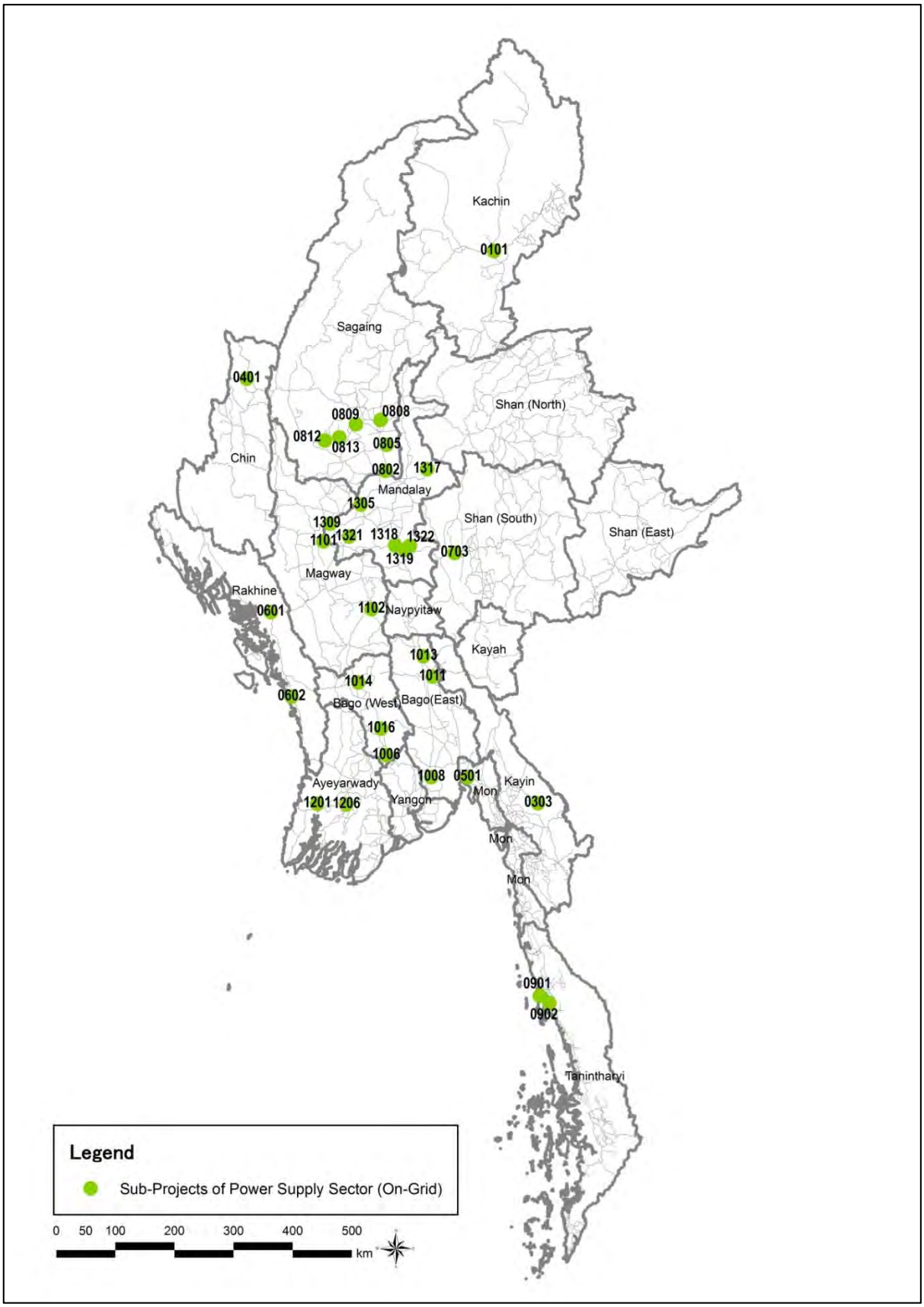


Figure 3-5 On-Grid Sub-Project Location Map (Final Version)

Source: JICA Preparatory Survey Team

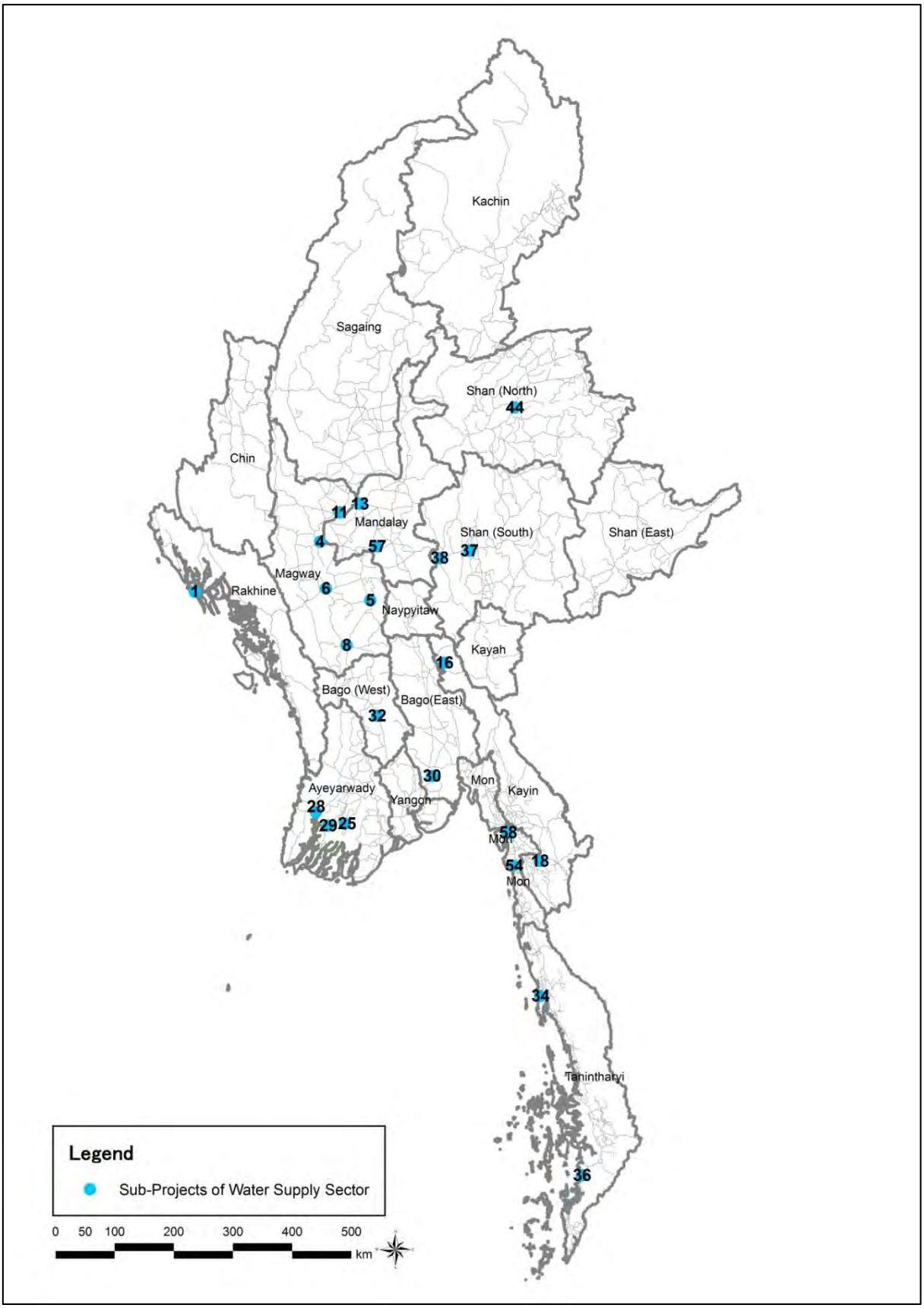


Figure 3-6 Water Supply Sub-Project Location Map (Final Version)

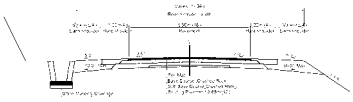
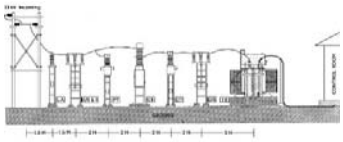
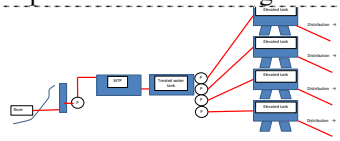
Source: JICA Preparatory Survey Team

4. Sector based Sub-Project Summary

4.1 Sector based Sub-Project Summary

The following table 4-1 illustrates Sub-Project Summary of the three sectors.

Table 4-1 Sector Sub-Project Summary

	ROAD AND BRIDGE SECTOR	POWER SUPPLY (ON-GRID) SECTOR	WATER SUPPLY SECTOR
Executing Agency	Department of Highways, Ministry of Construction	Electricity Supply Enterprise and Mandalay Electricity Supply Corporation, Ministry of Electricity and Energy	Department of Rural Development, Ministry of Agriculture, Livestock and Irrigation
Projects ※Refer to the ANNEX	Civil rehabilitation work, Civil widening work / Road rehabilitation, Road construction / Box culvert construction / RC bridge construction/Drainage/ Retaining wall/ Guard rail	66kV/33kV and 66kV/11kV substations/ 33kV/11kV substations/ 66kV transmission lines/ 33kV transmission lines / 11kV distribution lines / 0.4kV distribution lines/ Distribution transformer	Water Source Facilities/Water Conveyance Facilities/Water Treatment Facilities/Water Transmission Facilities/Water Reserve Facilities/Water Distribution Facilities/Electric Power Receiving Facilities/Equipment for Operation & Monitoring
Standard Design	 Figure: Bituminous Road Overlaying: 5.5m	 Figure: 33kV/11kV substations	 Figure: Type 4 : Surface Water WTP + Gravity Distribution
Schedule ※Numbers in the brackets indicate unit of "month."	MOC3,17,18: about 3 years (Design : 6 / Procurement : 6 / Construction:24) MOC5: about 2 years and 9 months (Design : 3 / Procurement : 6 / Construction:24) MOC6: about 2 years and 3 months (Design : 3 / Procurement : 6 / Constrution:18) MOC7: about 1 year and 9 months (Design : 3 / Procurement : 6 / Construction:12) MOC22: about 2.5 years (Design : 3 / Procurement : 6 / Construction:21)	About 2 years and 3 months for all the projects (Basic Design Review・Detailed Design : 5 / Tender Notice and Preparation : 3 / Proposal Evaluation・Negotiation・Contract : 7 / Construction : 12)	TDC28: about 3 years (Design : 5 / Design Firm and Contractor Procurement : 11 / Construction:20) About 2 years for other projects (Design : 5 / Design Firm and Contractor Procurement : 11/ Construction:12)
Contract (Terms of payment)	To be finalized before the Project implementation (Survey Team proposed B/Q Procurement) ※Design to be handled by DoH ※Contractor to be selected for construction.	Lump Sum Procurement (Turn-Key Contract planned ※Design to be handled by ESE ※Contractor to be selected for construction	Lump Sum Procurement B/Q Procurement only for Water well construction ※Works of design and construction to be separately procured.
Executing Organization Structure -Above: Executing Body -Lower Consultant Services	• Organization and management of PSC / PMU • Detailed Design (including natural condition survey) / Bid Document Preparation • Contractor Procurement / Contract (Contractor and Consultant) • Construction Supervision • Discussions and Coordination with concerned agencies	• Organization and management of PSC / PMU • Detailed Design (including natural condition survey) / Bid Document Preparation • Contractor Procurement / Contract (Contractor and Consultant) • Construction Supervision • Discussions and Coordination with concerned agencies	≪Tasks of DRD≫ • Organization and management of PSC / PMU • Management of budget and contract • Procurement of contractor and consultants • Technical advice to State/ Region as well as TDC ≪Tasks of TDC≫

	ROAD AND BRIDGE SECTOR	POWER SUPPLY (ON-GRID) SECTOR	WATER SUPPLY SECTOR
	• Environmental Approval and conducting Public Consultations	• Environmental Approval and conducting Public Consultations • Custom clearance of imported equipment, Payment control, Coordination and Support with other related entities.	• Outsourced Design Work Supervision • Construction Supervision • Environmental Approval and conducting Public Consultations • Periodical reporting to State / Regional Development Committee and TC
	• Technical assistance work on the above noted tasks and works • Technology transfer regarding asset management	• Technical assistance work on the above noted tasks and works • Commissioning and testing / Inspection during the warranty period	• Technical assistance work on the above noted tasks and works • Commissioning and testing / Inspection during the warranty period
Operation and Maintenance ※Refer to the ANNEX	• Operation and Maintenance Plan formulation and decision making on O&M Plan • Budget management for O&M and proper distribution of budget to the operating offices • Procurement of O&M equipment and materials • Implementation of O&M	• Operation and Maintenance Plan formulation and decision making on O&M Plan • Control of project budget and proper distribution of budget to the operating offices • Procurement of materials and equipment of power supply, transformer and other related parts • Transportation of equipment and materials to the development sites • Implementation of O&M	• Operation and Maintenance Plan formulation and decision making on O&M Plan • Control and management of O&M budget and executing officials • Necessary reporting to the State and Region development committee regarding O&M • Procurement of materials and equipment • Implementation of water supply projects (testing/ O&M /Water charge and fee collection, etc.)

Source: The Preparatory Survey Team

4.2 Status of Priority Sub-Project Preparation

4.2.1. Road and Bridge Sector

4.2.1.1 Selected Priority Sub-Projects

As shown in Table 4-2, two sub-projects were selected as priority sub-projects in the work shop held on 6 July 2016. MOC-06 was selected because it is the highly prioritized sub-project by MOC and the work components are only widening of the existing embankment and pavement which is a kind of simple civil works. MOC-18 was also selected taking into account the strong request of urgent implementation by MOC because it is adjacent to the road section in Rakhine State, which will be improved by an aid of World Bank.

Table 4-2 Priority Sub-Project for Regional Road and Bridge Sector

Project No	State / Region	Sub-Project Name	Length(km)
MOC-6	Bago	Taungoo - LeikTho - YaDo - Loikaw - Hopone Road	16.8
MOC-18	Ayeyarwaddy	Nga Thine Chaung - Gwa Road	32.4

Source: Prepared by the Preparatory Survey Team based on the Interview with MoC

4.2.1.2 Preparation Status of the Priority Projects and Points to be Concerned

(1) Preparation Status

The current status on preparation for the implementation of the Priority Sub-Projects such as detail design, procurement, construction, operation and maintenance and so on are shown in Table 4-3.

Table 4-3 Status of preparation of Priority Sub-Projects in Road and Bridge Sector

	MoC-6	MoC-18
Detailed Design	• Geometric design is unnecessary since the sub-project component is only widening of the existing embankment and pavement. In pavement design, pavement type should be changed to "Double Bituminous Surface Treatment (DBST) " from "Penetration Macadam" at F/S, but the modification has not completed yet by MOC • Design drawings for small bridges and box culverts are not prepared but typical design drawings in past projects can be utilized for construction since foundation piles are expected to be unnecessary in the project site. • 24 feet pavement width will be applied to the possible section on MoC-06 and the adjacent section. About one month is required to identify the possible road section to be applied with 24 feet pavement and cost estimation.	• Geometric design should be conducted for the improvement of road alignment since the conventional manuscript design drawings prepared by MOC are insufficient to prepare the bidding document. JST is therefore requesting MOC to product 3 D topographic data by a topographic survey, however it has not conducted yet by MOC (3D topographic data is necessary to prepare efficiently the design drawings in order to identify the necessary quantities for earth work and construction of small bridges, retaining walls and box culverts).
Procurement	• Local Competitive Bid Method will be applied for procurement of contractors in this project. MOC has a certain level of the experiences in Phase-I project. • Bill of Quantity Method will be introduced to this project so that the implementing agency should prepare General Specification to clarify the quantity estimation method for each BQ item. General Specification (Draft) was delivered to the representatives from DOH in Phase-I project and the expected representatives from MOC in Phase-II project and the main contents were explained at the technical training seminar held in Nay Pyi Taw on 24 August 2016 by Japanese experts in Phase-I project.	
Construction Schedule	• In Phase-I project, the construction period was planned to be approximately one year based on the past MOC's practices. However the necessary construction period for Sub-Projects in Phase-II project should be appropriately secured in accordance with the work component for each project. The technical assistance for implementation of MOC-18 is expected to hand over from the Consultant for implementation of the Priority Sub-Projects to the Loan Consultant since improvement of road alignment is included in MOC-18 and construction period is supposed to be beyond one year.	
Construction, Operation and Maintenance	• Fundamental guidance in quality control and maintenance was already introduced to the (expected) representatives from DOH in Phase-I and Phase-II project as mentioned above. • The public consultation is expected to be completed before bid announcement as Phase-I project.	

Source : Prepared by the Preparatory Survey Team based on the Interview with MoC

(2) Points to be Concerned

In Phase-I Project, the construction period has been set based on the past practices in direct construction by MOC since MOC didn't have experience in outsourcing of road and bridge construction. JST recommends for MOC that the contracted construction period should be planned in consideration of the general capacity of private contractors in Myanmar because it was very difficult even for the major local contractors to follow the contracted period in Phase-I project. It is also advised that the reasonable construction period, which can be quantitatively estimated by the availability of construction machines, possible daily construction progress by local contractors, critical path for construction etc., should be carefully considered in preparation of bid documents so as to enhance/secure fairness and competitiveness of bids.

4.2.1.3 Publication

Road and bridge construction is one of the large-scaled public works and opening/completion ceremonies are often held being watched by the publics. The Phase-II Project should be positively promoted through TV and newspapers to the public.

Moreover, it is desirable for smooth implementation of the Priority Sub-Project to formulate public consensus through the announcement to the representatives of local government and the related private companies as well as the stakeholders before commencement of construction.

4.2.2. Power Supply Sector (On-Grid)

4.2.2.1 Selected Priority Sub-Projects

These three sub-projects are selected as the Priority sub-projects because of more urgent than others caused by the rapid increase of forecasted demand. All Sub-Projects are to construct a 66/11kV substation in order to increase supply capacity in the area. These Sub-projects allow ESE/MESC to extend each electrified area by the distribution line expansion in time with commencement date of the substation.

And ESE-0703 and ESE-1309 are located near sightseeing areas where many hotels and restaurants recently opened. In addition, ESE-1101 is close to oil wells and factories.

Table 4-4 Priority Sub-Projects in Power Supply (On-Grid) Sector

Project No	State / Region	Sub-Project Name	Items
ESE-0703	Shan	Kalow (Heho)	66/11kV substation(10MVA) :1Nos 66kV H-pole :1.5miles
ESE-1101	Magway	Chauk (GwePin Village)	66/11kV substation(10MVA) :1Nos 66kV H-pole :5miles
ESE-1309	Mandalay	Nyungoo T/S(Wetgyinn)	66/11kV substation(10MVA) :1Nos Switch Bay(66kV) :1Nos

Source: Prepared by the Preparatory Survey Team based on the Interview with ESE and MESC

4.2.2.2 Preparation Status of the Priority Sub-Projects and Points of Concern

(1) Status of Preparation

Status of preparation for the implementation of the Priority sub-projects such as detail design, procurement, construction, operation and maintenance and so on are shown in Table 4-5.

Table 4-5 Status of preparation of Priority Sub-Projects in Power Supply (On-Grid) Sector

	ESE-0703 / ESE-1101 / ESE-1309
Detail Design	Each ESE/MESC district engineer is preparing the necessary document for bidding such as specification s, lay-out plan, single-line diagram, etc.
Procurement	The bidding scheme for procurement is LCB (Local Competitive Bid) as the same as Phase I.
Schedule	All sub-projects will be completed within one year.
Construction Operation and Maintenance	Construction shall be done by the selected company by the bidding process. Operation and Maintenance will be done by the District Offices of ESE and MESC.

Source: Prepared by the Preparatory Survey Team based on the Interview with ESE and MESC

(2) Points of Concern

ESE submitted the letter No. 225/MD/2016 "Necessity of Consultant and Support for "Pilot Projects" under Preparatory Survey for Regional Development Project for Poverty Reduction Phase II" to the Preparatory Survey Team on 11th May, 2016. According to the letter, ESE requested JICA to continue to support the implementation team which consists of ESE and JICA consultants. The reason why ESE requested JICA's support is to implement the Priority Project faster, more reliably and effectively.

4.2.2.3 Publication

In the Phase I project, there is an example to set the signboard for advertising Japanese ODA project at the substation and so on. Therefore, ESE and MESC are planning to put the signboards and to put forward this project in the target electrified areas.

4.2.3. Water Supply Sector

4.2.3.1 Selected Priority Sub-Projects

There are three (3) priority Sub-Projects selected in the Water Supply sector, and these are selected from different water sources.

The Sub-Project in Sittwe (TDC-1) with well water source is the only one selected project in Rakhine State, and it is also included in Phase-I Project. There is a very high demand of water supply project in this State Capital, thus it was selected as priority sub-project. The Sub-Project in Pathein (TDC-28) with river water sourc is selected as priority sub-project in order to implement sooner because of urgency of the Region's Capital of Ayeyarwady. The Sub-Project in Meiktila (TDC-57) with lake water source has been nominated in both Phase-I and Phase-II project in Mandalay Region, and it has higher demand by the Regional government so that the project was selected as priority sub-project. The three Sub-Projects listed in the following table 4-6 are the final selected priority Sub-Projects.

Table 4-6 Status of preparation of Priority Sub-Projects in Water Supply Sector

Project No	State / Region	Sub-Project Name
TDC-1	Rakhine	Sittwe Water Supply Development
TDC-28	Ayeyarwady	Pathein Water Supply Development
TDC-57	Mandalay	Meiktila Wate Supply Development

Source: Prepared by the Preparatory Survey Team based on the Interview with DRD and TDC

4.2.3.2 Preparation Status of the Priority Sub-Projects and Points of Concern

Currently several supporting works for contractor procurement, the detailed design development assistance for the projects, such as preparation of bid documents for tenders and technical advices for detail design development for local design firms which shall be working together with TDCs, and others that should be completed before the actual Phase-II Yen-loan Project implementation are awaited for execution.

These three priority Sub-Projects have been confirmed that there is no change in plans, designs and cost estimates upon the hearings to the TDCs. These priority Sub-Projects should be implemented at the earliest possible so that the necessary advices for land acquisition and preparation of project sites as well as preparation of agreement for the Sub-Project implementation are given, and the assurance of the project lands for facility development has been confirmed with the Project concerned TDCs through the hearings.

In this context TDCs are the facility owners and have responsibility of loan repayment, while DRD is responsible of overall budget and payment management over 22 TDCs taking into account of contracts, payment to the contractors and repayment to JICA.

4.2.3.3 Publication

The following activities are projected as Public Relations Activities.

- Hold public consultations prior to the Project implementation,
- Place JICA Project sign board at each construction site as to inform communities of ODA Project, and
- Inform the Project completion publicly through ceremony or public media

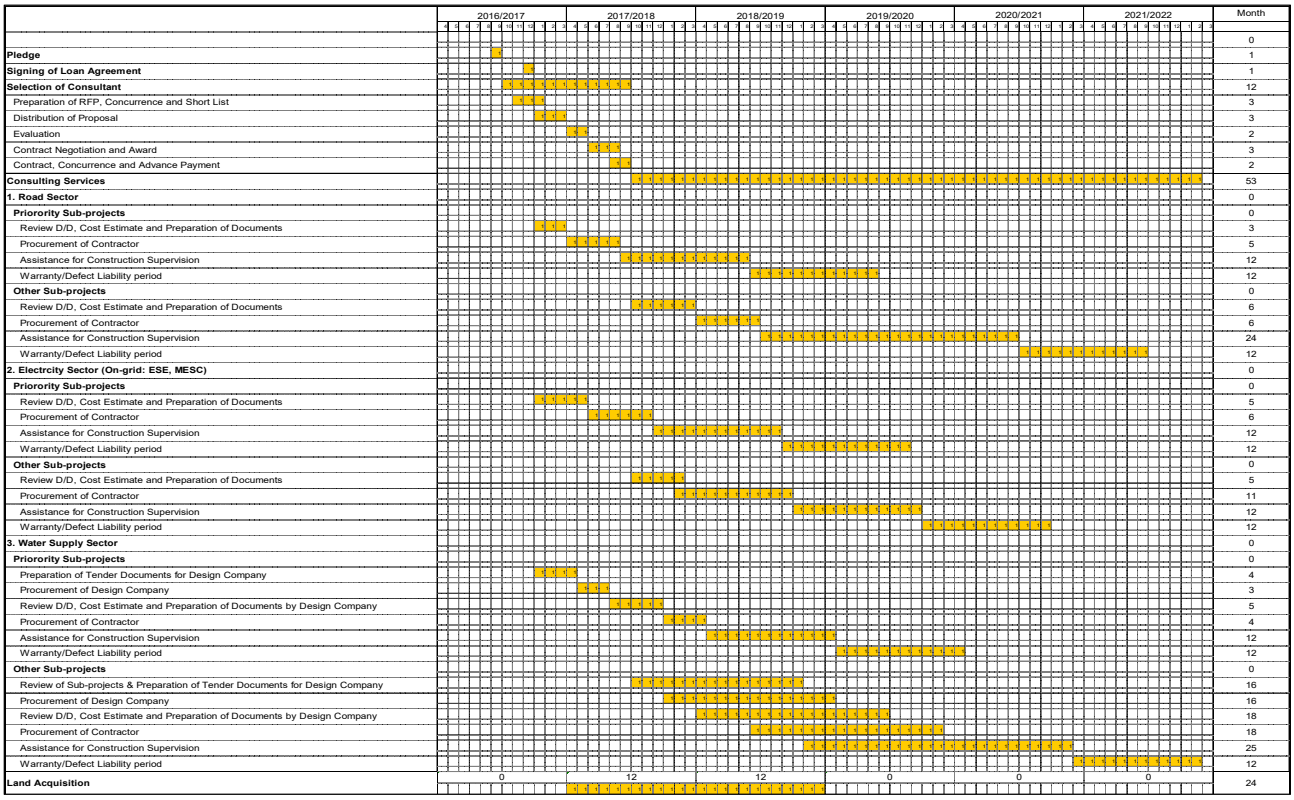
5. IMPLEMENTATION PLAN OF PROJECT

5.1 Implementation Schedule

- Pledge of Loan: September, 2016
- Loan Agreement: December, 2016 (expected tentatively)
- Period for Consultant Selection: 12 months after the signing of Loan Agreement

Total required period from the signing of Loan Agreement to the completion of the Project except defect liability period is 54 months. Considering defect liability period and possibility of the extension of the Project, eight (8) years of loan period is recommended. The schedule shown in table 5-1 considers that the loan agreement will be expectedly signed in December, 2016.

Table 5-1 Implementation Schedule



Notes：

*1)Review of designs made by DRD, MoALI

*2)Review of detailed design under the Design-Build contract

Source: The Preparatory Survey Team

5.2 Implementing Agencies

5.2.1. Executing Agency

- The Executing Agencies consists of four ministries, Ministry of Construction (MoC) represented by Department of Highways (DoH), Ministry of Electricity and Energy represented by Electricity Supply Enterprise (ESE) and Mandalay Electric Supply Company (MESC), and Ministry of Livelihood, Fisheries and Rural Development represented by Department of Rural Development (DRD).

  TDC is the operation and maintenance body for water supply sub-projects.
- FERD of Ministry of Planning and Finance is the coordination and organizing agency of all concerned executing agencies, and is responsible on coordinating and communicating among the Project implementation bodies.
- Above the Project coordinating agency, PMU (Project management Unit) is positioned to make decisions and O&M as well as PSC (Project Steering Committee)

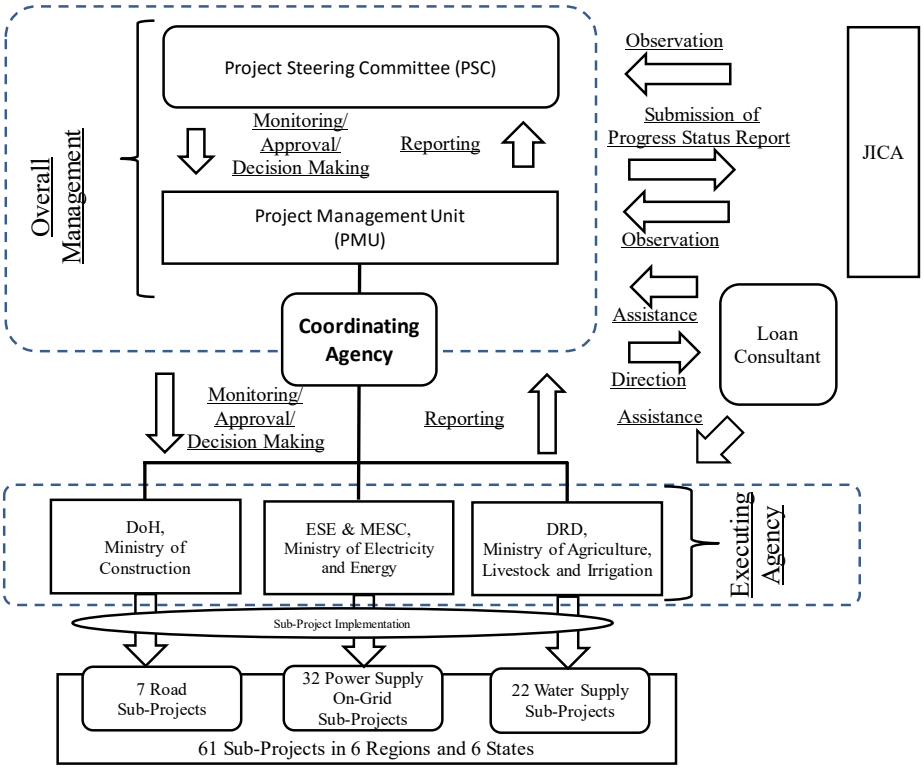


Figure 5-1 Implementation Structure

Source : The Preparatory Survey Team

5.2.2 O&M Structures

O& M structures for 3 executing agencies namely Department of Highway (DoH), Electricity Supply Enterprise (ESE), Mandalay Electric Supply Company (MESC) and Department of Rural Development (DRD) are as shown in Figure 5-2 to 5-5, respectively. For each executing agency, coordination among headquarters, region/state offices and district/township offices are organized. However, there are some issues/problems such as communication among the offices, insufficient equipment, capacity of staff and so on. It is recommended to improve O & M system by the following measures for instance.

- To establish O&M budgeting system by means of preparation of standard operation procedure (SOP) for short-midterm O&M activities and inventory survey on facilities belonging to offices
- To establish several O&M centers in each region/state as warehouse of equipment and materials and training center
- To examine outsourcing to private sector in future

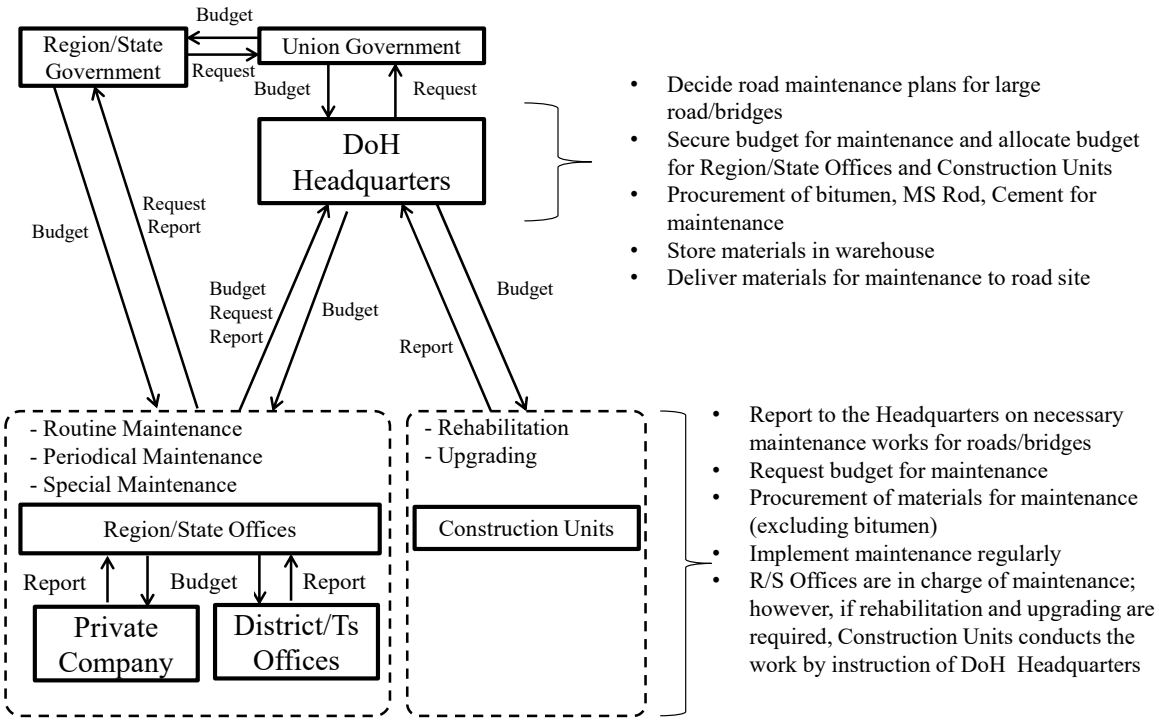


Figure 5-2 O&M Structure of Department of Highway (DoH)

Source : The Preparatory Survey Team

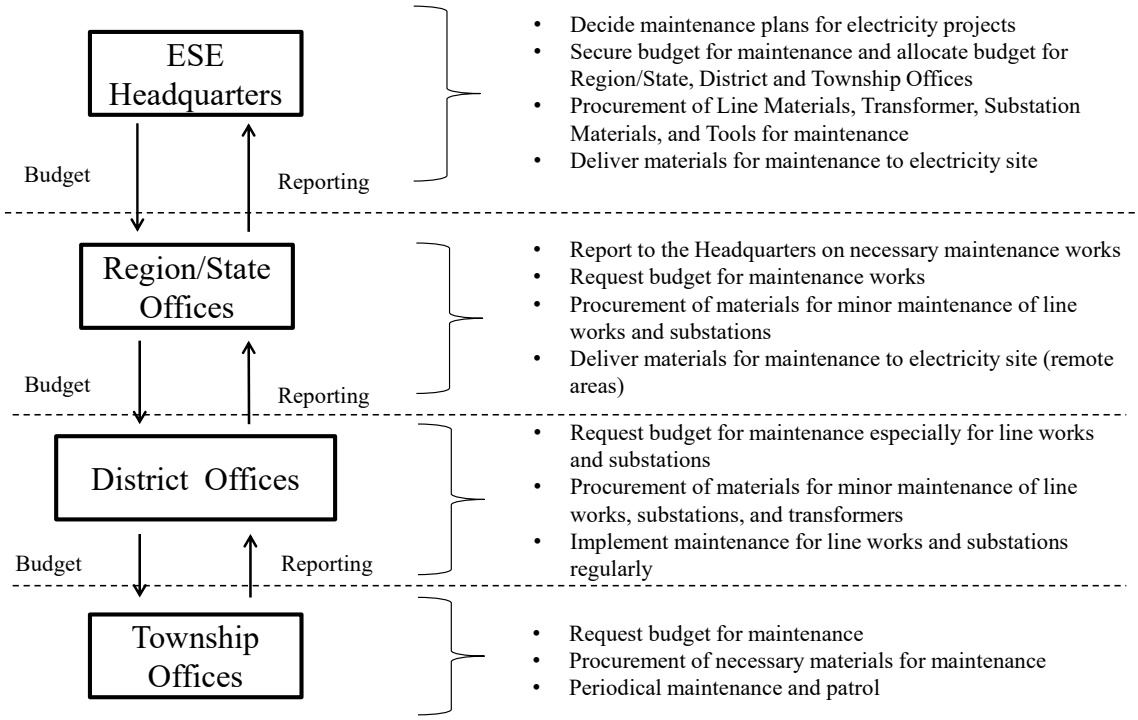


Figure 5-3 O&M Structure of Electricity Supply Enterprise (ESE)

Source : The Preparatory Survey Team

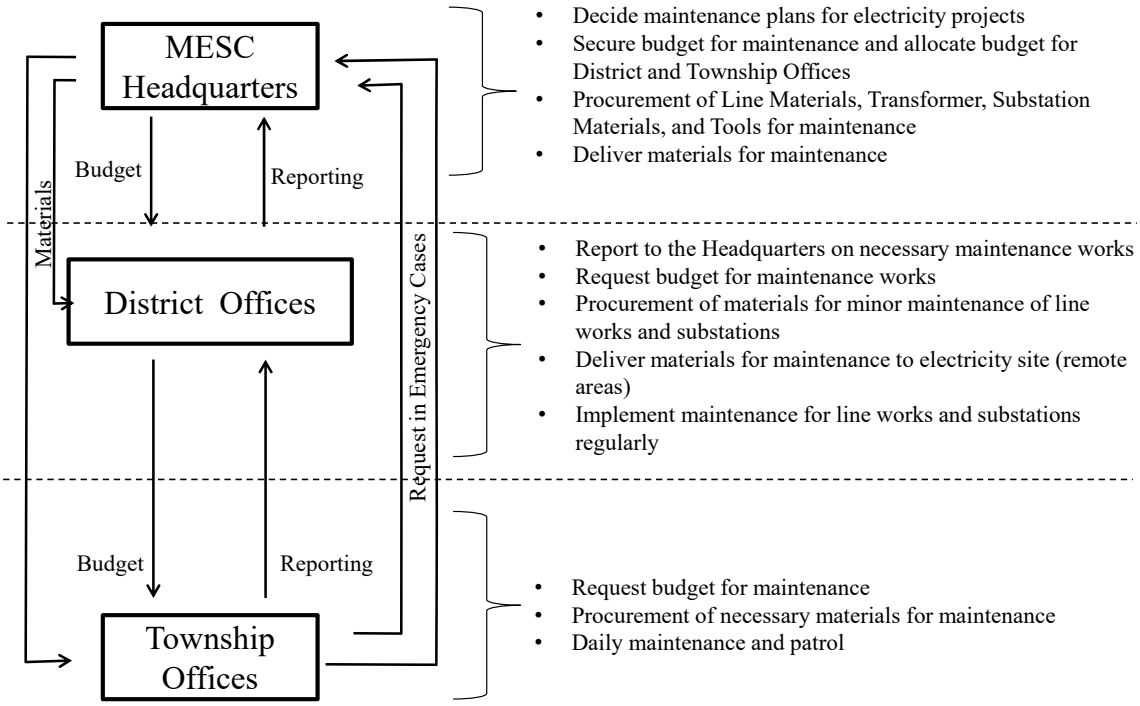


Figure 5-4 O&M Mandalay Electric Supply Company (MESC)

Source : The Preparatory Survey Team

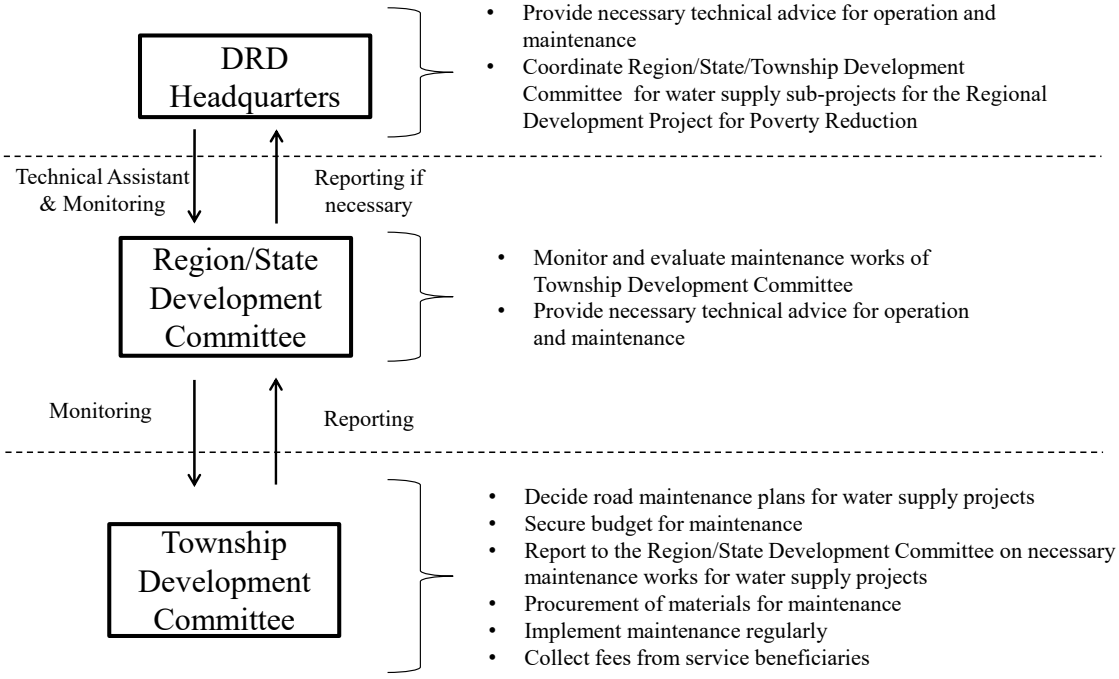


Figure 5-5 O&M Structure of Department of Rural Development (DRD)

Source : The Preparatory Survey Team

5.2.3. PMU and PSC

Table 5-2 Tasks and Members of Project Steering Committee (PSC) and Project Management Unit (PMU)

	PSC	PMU
Tasks	• Overall responsible body for Project implementation • Coordination of stakeholders • Monitoring progress status of sub-projects • Resolving impediments/issues at national policy level in implementing sub-projects • Approval or decision making for measures against cost overrun which proposed by PMU • Semi-annual PSC meeting	• Overall project management • Project Coordination/Management with consultants • Monitoring and Evaluation of sub-projects • Financial and Disbursement Management • Monitoring on Environmental and Social Consideration • Examination of Change of sub-projects • Evaluation of Rational of Utilization of Contingency • Arrangement of PMU Meeting • Coordination with and reporting to JICA including submission of quarterly progress report and project completion report • Coordination with Union Auditor-General's Office regarding the project-specific auditing
Members	• Deputy Minister, MoNPED (Chairman) • Director General, Budget Department, MoNPED • Representatives of Region and State • Managing Director, ESE • Managing Director, MESC • Deputy Chief Engineer, DRD • Managing Director, DoH • Director General, FERD	• Directorate General, FERD (Chairman) • Director, FERD • Deputy Director, Planning Department, MoNPED • Deputy Director, Project Appraisal and Progress Reporting Department, MoNPED • Deputy Director, ESE • Deputy Director, MESC • Deputy Director, DRD • Chief Engineer, DoH
Observer	Representative of JICA	Representative of JICA
Assistant	Consultant	Consultant

Source: The Preparatory Survey Team (All names of the government entities are listed based on the NLD's political administration after the restructuring of ministries

5.2.4. Change of Sub-Projects

(1) Principles

1. At the commencement of the consulting services, review of short-listed Sub-Project shall be conducted. Result of review shall be discussed and agreed by PMU, PSC and JICA.
2. New candidate Sub-Projects for replacement or addition shall be evaluated and be scored using same scoring method applied for the Preparatory Survey.
3. Substitute Sub-Project for cancellation shall be selected from same state/region and same sector with referring the long list.
4. In case that certain sub-projects are strongly requested by the line ministries such as post disaster project, such sub-projects may be selected with careful examination of its necessity and urgency by PMU, PSC and JICA.
5. MoC, ESE, MESC and DRD (hereinafter referred to as "the line ministries" as collective term) can manage solely change of Sub-Projects as long as the total cost does not exceed the originally allocated loan amount. In case the cost exceeds the allocated loan amount to each executing agency, it shall be discussed in PMU and PSC before process of reallocation of proceeds of loan.

   Note: Transferring parliament's final decision making authority to PSC for more effective and faster Project implementation and proceedings.

(2) Sub-Project Change Procedure

1. The line ministries review the short-listed sub-projects.
2. The line ministries, PMU and JICA confirm and agree on cancellation of sub-projects.

3. The Consultant reviews design and cost estimate of remaining short-listed sub-projects. Cost minimization or value engineering shall be examined in the design review.
4. PMU shall calculate overall project cost for each sector based on the estimated costs of finalized Sub-Projects for implementation under the assistance provided by the Consultant.
5. The Consultant shall simultaneously review all new sub-project candidates proposed by the executing agencies for design quality, cost, economic and financial validity, environmental and social consideration, and project rationality aspects.
6. The Consultant evaluates the new candidate sub-projects and add them to the long list.
7. In case the estimated cost of each sector underruns the allocated loan amount, the line ministries can add new/substitute sub-projects up to the total cost meets the allocated loan amount. Contingency shall be kept for additional works and/or price escalation of contracted sub-projects.
8. When the final cost of on-going sub-project can be seen, remaining amount including contingency can be used for another additional sub-projects.

Note: In case the estimated cost of each sector overruns the allocated loan amount, contingency is allocated to the sector with prior consensus of PMU and PSC. If consensus cannot be obtained, some sub-project shall be cancelled or implemented by other fund sources.

5.3 Procurement

5.3.1. Selection of Consultant

- Since the Project is financed as Japanese Yen-loan, international consultant shall be selected properly and promptly in accordance with the consultant procurement guideline of JICA.
- For the selection, international experience, technical experience and qualification and total capability shall be fairly evaluated.
- Since Myanmar Government and executing agencies have very limited experiences of contractor selection under Japanese Yen-loan scheme, it is recommended to employ a consultant for special assistance for the procurement management facilitation.

5.3.2. Procurement of Contractor

- Pre-qualification is not conducted and qualification of bidder is evaluated as a part of technical evaluation in bidding.
- Evaluation committee is organized for each procurement. As for Department of Highways, Ministry of Construction (DoH) and Department of Rural Development, Ministry of Agriculture, Livestock and Irrigation(DRD), representative of related state or region shall be a member of the evaluation committee.
- Comprehensive evaluation method by two envelop - one stage is applied.
- Minimum price system[9] is applied.

6. Environmental and Social Considerations

Under the survey IEE level environmental and social assessment was made in accordance with the JICA Environmental Guidelines. Although land acquisition and resettlement are expected with the Project development, total number of project affected people accounts less than 200 so that abbreviated resettlement action plan (ARAP) is prepared.

Myanmar EIA Procedure (2016) is also adopted for Environmental Management Plan (EMP) formulation on all Sub-Projects to submit to executing agencies. Furthermore, IEE level assessment report for the Sub-Project listed in the following table are prepared in accordance with the EIA Procedure and basis, and submitted to DoH and TDC.

[9] The minimum price system controls the quality of bid process and selection of proper contractor and disqualifies any company's bidding unnecessarily low prices below planned price (generally 70 to 75% in Japan) in order to prevent deterioration of quality due to excessive damping.

Table 6-1 Expected PAPs and Affected Units (PAUs) and the Land Sizes

Sectors	Affected HHs	Project Affected Persons	PAUs					
			No. of Buildings	No. of land plots	Total Land Area (m2)	No. of Tube wells	No. of Dug wells	No. of Valuable Trees
Road & Bridge	15	57	17	-	388	-	-	-
Power Supply	9	35	-	8	44,951	-	-	-
Water Supply	2	8	1	2	4,067	1	1	15

Source: The Preparatory Survey Team

Table 6-2 Sub-Project List concerned about IEE under the Myanmar EIA Procedure

Sector	Number	Sub-Projects
Road and Bridge	2	MOC-5 / MOC-3,6,17
Water Supply	6	TDC-01 / TDC-5 / TDC-11 / TDC-13 / TDC-16 / TDC-34

Source: The Preparatory Survey Team

7. Standard Design and Operation & Maintenance Plan of each Sector 【ANNEX】

7.1 Road and Bridge Sector

7.1.1. Standard Design

7.1.1.1 Typical Cross Section

As for the pavement type, DBST is applied in all the shortlisted sub-projects. For the pavement width, most of the sub-project applies 18 feet basically but MoC-18 applies 24 feet for the whole length of the road. Also, MoC-03, MoC-06 and MoC-17 would apply 24 feet for some of the parts where possible.

The following figures 7-1 through 7-5 illustrate typical cross sections of road design.

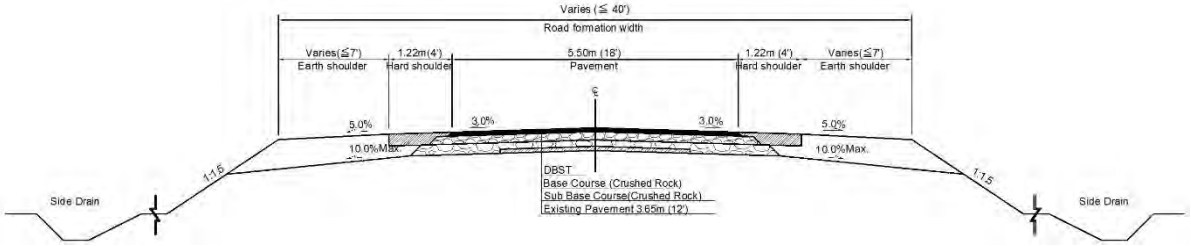


Figure 7-1 Typical Cross Section in Flat Region (MOC-05 / Bituminous Road (DBST): 5.5m)

Source: The Preparatory Survey Team

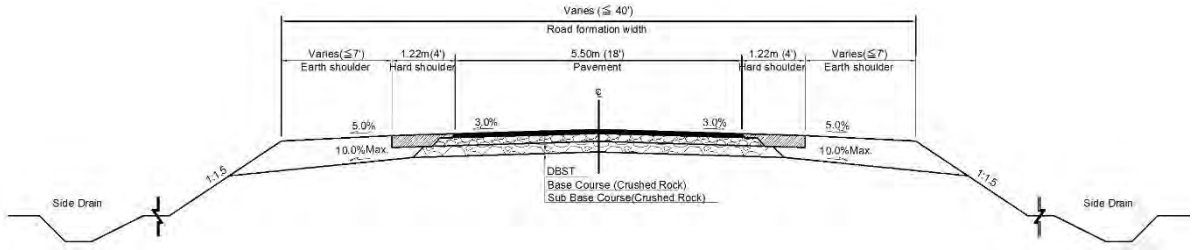


Figure 7-2 Typical Cross Section in Flat Region (MOC-07 / Bituminous Road (DBST) Overlaying: 5.5m)

Source: The Preparatory Survey Team

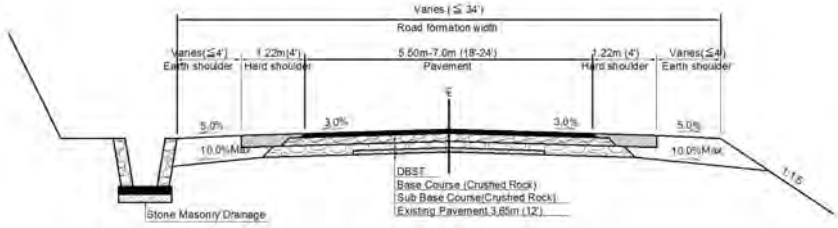


Figure 7-3 Typical Cross Section in Mountain Region (MOC-03,06,17 / Bituminous Road (DBST)Overlaying: 5.5-7.0m)

Source: The Preparatory Survey Team

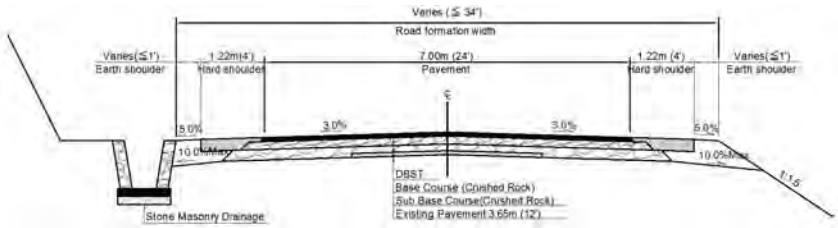


Figure 7-4 Typical Cross Section in Mountain Region (MOC-18 / Bituminous Road (DBST) Overlaying: 7.0m)

Source: The Preparatory Survey Team

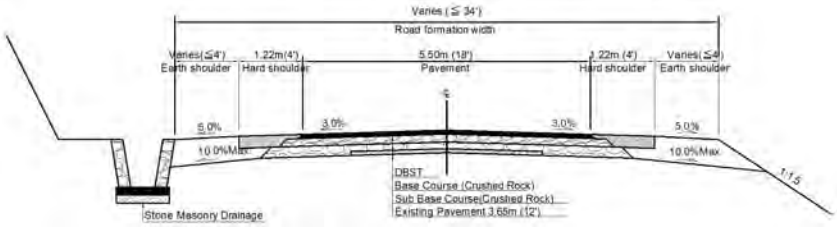


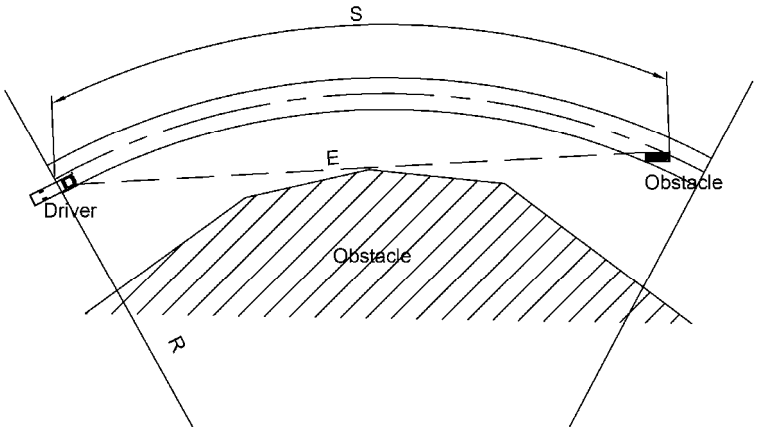
Figure 7-5 Typical Cross Section in Mountain Region (MOC-22 / Bituminous Road (DBST) Overlaying: 5.5m)

Source: The Preparatory Survey Team

7.1.1.2 Recommendation for Further Design Stage

(1) Sight Distance

The sight distance is important for safe and comfortable driving. Especially, sight distance is highly required on curve sections of road ahead. Sight distance can be ensured by leaving clear the inter part of the curve to a distance equal to the setback distance as shown in Figure 7-6.



Desirable Sight Distance (m)	
Design Speed (km/h)	Sight Distance (m)
120	210
100	160
80	110
60	75
50	55
40	40
30	30
20	20

$$E = \frac{S^2}{8\,R}$$

S = Sight Distance (m)
R = Curve Radius (m)
E = Setback Distance(m)

Figure 7-6 Basic Concept of Sight Distance at Curve Section

Source: Japanese Road Structure Ordinance

(2) Slope Protection and Drainage

Slope protection and drainage should be installed on necessary sections especially in mountainous terrain areas in order to secure road safety and slope stability. Stone masonry retaining wall and drainage are planned to be installed on 15% of the total road length in mountain region based on the Phase-I practice, in consideration of the practices in Myanmar and the capacity of local contractors.

Typical cross section is shown in Figure 7-7.

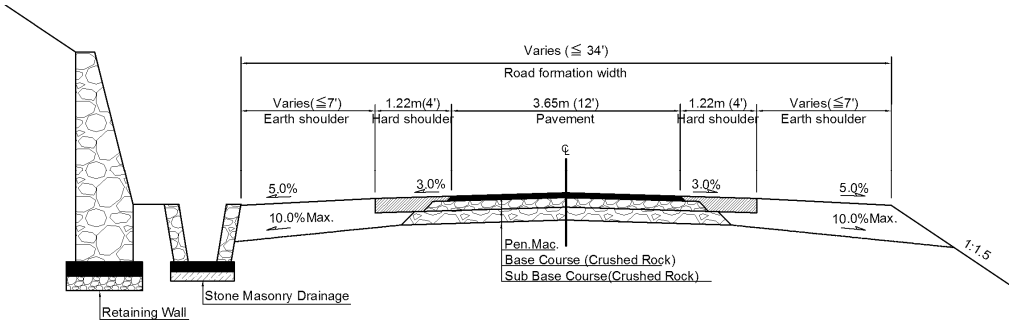


Figure 7-7 Typical Cross Section with Stone Masonry Retaining Wall and Drainage

Source: Prepared by the Preparatory Survey Team

7.1.2. Operation and Maintenance (O&M) Plan

7.1.2.1 General

Penetration macadam pavement (low-cost pavement) has been applied to the project roads. since the traffic volume of the project roads are currently less than 1,000 vehicles per day, and the policy stipulates to use this type of pavement where the traffic volume is small. And the low-cost pavement is quite reasonable for actualizing the longest distance and a larger number of paved roads within the limited budget. On the other hand, appropriate Operation and Maintenance (O&M) is highly required for the low-cost pavement in order to secure an appropriate service level. In addition, efficient and effective O&M is necessary for the sustained service level, considering the expected drastic increase in the future traffic volume and the number of road infrastructures along with economic growth in Myanmar.

In this project, it is proposed to apply "Asset Management Method" for O&M and to enhance the capacity of the Implementing Agency.

7.1.2.2 Asset Management

Asset management is a method to understand conditions of road assets, to predict future deterioration based on the conditions of road assets, to plan repair/upgrading before appearance of critical damage and to sustain the required service level on road assets.

The flow chart for asset management is shown in Figure 7-8.

(1) Inspection

Accurate understanding of the soundness of road assets by inspections is the first step in asset management. As described in Table 7-1, inspection works are categorized into (1) Routine inspection, (2) Periodic inspection and (3) Emergency inspection. Continuous updates of the database on the basis of inspection results are quite important for improvement of deterioration prediction and for the optimization of O&M plan.

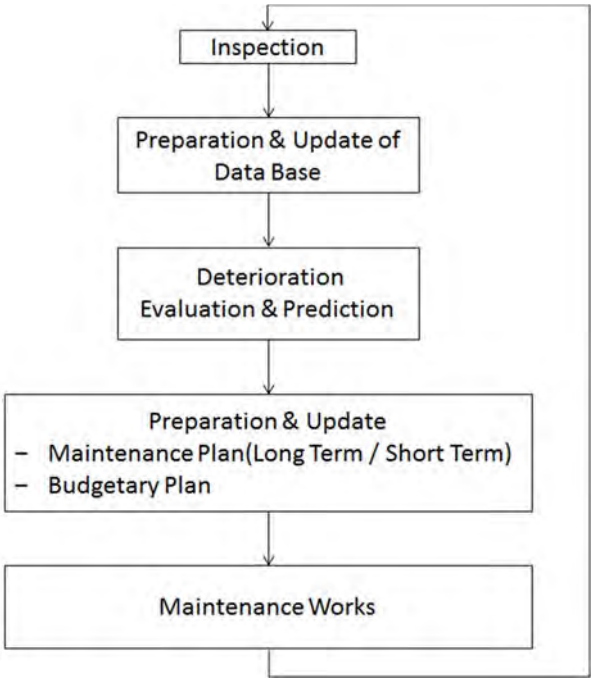


Figure 7-8 Flow Chart of Asset Management

Source: The Preparatory Survey Team

Table 7-1 Proposed Classification of Inspection Work

Inspection Type			Major objects	Purpose	Methods
Routine	Daily	Once or twice	Road surface	Road safety	Visual inspection from vehicle
		Morning & evening	Doors/hatches of girder	Security	Visual and physical inspection on foot
Periodic	Yearly		All components	Damage and Safety	Visual inspection by min. equipment (crack scale, hand tape, etc.)
	Every 5 years		All components	Damage and Safety	• Visual inspection (using equipment) • Testing (using equipment)
Non-periodic	Emergency (at the time of accident/disaster)		All damaged components	Damage and Safety	Visual inspection by equipment
	Special (as required)		Defective portions Discovered by above inspections	• to grasp detailed behavior of defects/ actions needed • to monitor progress of damage • to investigate cause of damage	• Visual inspection • Inspection (using equipment) • Testing (using equipment)

Source: The Preparatory Survey Team

① Routine Inspection

In order to find out the current condition of the roads and structures, routine inspections are undertaken visually from road patrol on the shoulder or left-most lane. Accordingly, items for inspection are limited to those which can be observed from moving vehicles. The items include the following:

- Pavement condition
- Water-logging (drainage)
- Embankment/cut slope
- Auxiliary facilities (guard rail, traffic information board, etc.)

② Periodic Inspection

In order to understand the overall status of the structure, visual inspection should be undertaken by equipment, if required. Furthermore, prior to initiating inspection work, several field works such as traffic control, preparation and arrangement of transportation are required.

③ Emergency Inspection

Beyond routine or periodic inspections, additional inspections are necessary for structural damage caused by accidents/disasters. The purpose of emergency inspections is to check the soundness of roads and bridges. In the case that serious damage is observed on a major component, further detailed inspection may be necessary.

(2) Preparation and Update of Database

Although MoC has developed the road network of more than 40,000 km in total length in Myanmar, the lack of appropriate inventory data makes it difficult to identify the required maintenance works as well as to establish proper future development plans. Accordingly, it is considered that technical assistance is necessary to DOH to establish and manage the road inventory database. In the implementation stage of the project, involvement of asset management specialist is proposed to support DOH on the establishment of inventory database. Necessary information on database is summarized as below:

- Basic Information: Road Asset No. / Road Name/ Completion Date / Management Office / Location / Road Classification
- Basic Features: Design Conditions / Road Formation / Pavement Type / Length / CBR / Max Vertical Gradient / Structure Data
- Others: Crossing Condition / Record of Repair, Rehabilitation and Upgrading Works / Record of Damage/Record of Inspection / Traffic Volume

(3) Deterioration Evaluation and Prediction

Reliable deterioration prediction is necessary to optimize maintenance and budgetary plan. To this end, establishment of the reliable road inventory database is quite important and the database should be regularly updated because prediction accuracy depends on the amount of technical information obtained from the actual road assets by inspections. In this project, pavement shall be focused in technical knowledge transfer on prediction and evaluation of deterioration to the Implementing Agency because rehabilitation cost of pavement is one of the main items constituting the maintenance cost.

(4) Preparation and Update of Maintenance Plan and Budgetary Plan

In this sage, future maintenance and budgetary plan shall be prepared based on the prediction and evaluation of future deterioration. The initial plan should be continuously updated depending on inspection results. Main maintenance items are summarized in the next section. The Implementing Agency shall prepare and improve the O&M plan, which will be prepared in the Phase-I project, with the assistance of the Consultant in the implementation stage of Phase-II.

(5) Maintenance Works

Usually, road maintenance works are categorized into three types: (1) Routine maintenance, (2) Periodic maintenance, and (3) Emergency maintenance.

① Routine Maintenance

Routine maintenance includes road cleaning: removal of trash, debris, soil, stone, etc. including mowing of slopes and cleaning of drainage facilities. The frequency may vary from once a day to once a year, according to necessity. Localized repairs of pavement and shoulder damage, such as pothole patching, reshaping of side drains, repairing and cleaning of culverts and retaining wall are included. Also, repainting of road markings, repairing and replacing of road signs, lighting and guardrails should be undertaken.

② Periodic Maintenance

Periodical maintenance differs from routine maintenance chiefly due to its

- longer interval of implementation, the length of which is influenced by the traffic volume, especially that of heavy vehicles; and
- relatively large scale, requiring closure of lane(s).

Periodic maintenance includes full-width resurfacing or treatment of the existing pavement or roadway to maintain surface features and structural integrity for continued serviceability. Specific activities to be performed after 10 years of operation include the removal/replacement of damaged surface course, as well as localized reconstruction of considerably damaged base course.

③ Emergency Maintenance

Emergency maintenance mainly refers to the urgent repair of the road structure damaged by natural disasters or large-scale accidents. There are various forms of such damage and it is very difficult to anticipate what will happen. Some examples of such damage include the failure of embankment/cut slope during or after heavy rain and damage due to earthquakes (bridge/viaduct, cut/embankment slope, retaining wall, pavement, etc.).

To minimize traffic disturbance, such repair work is often implemented at two stages:

- urgent temporary repair to ensure smooth traffic flow, and
- full-scale repair including strengthening measures to prevent recurrence in the future.
- Maintenance work items are summarized in the table 7-2 below.

Table 7-2 Maintenance Items

Maintenance Type		Purpose	Maintenance Work
Routine	Daily	Road cleaning	Removal of trash, debris, soil, stones, etc.
	Every 3 months	Mowing on slopes	Mowing grass on slopes; frequency depends on weather conditions
		Drainage facilities cleaning	Removal of trash and sediments in side ditches, culverts etc.
	Every year	Repair of minor defects on pavement	Patching potholes, sealing cracks etc.
		Soundness of road facility/device	Repair/changing parts of lighting, road signs, lane markings etc.
Periodic	Every 10 years	Rehabilitation of pavement	Removal/replacement of damaged surface course
Emergency	At the time of accident/disaster	Repair of the damaged portions	Repair of pavement, structure, slope, etc.

Source: The Preparatory Survey Team

7.1.1.3 Operation and Maintenance (O&M) Cost

Operation and maintenance of the project roads is classified into routine maintenance at every year or periodic maintenance at every 10 years as mentioned in 4.10.2. O&M cost should be revised and optimized based on the actual asset management, therefore, several assumptions are set up for estimation of O&M as below;

- Up to 10years ; Routine maintenance cost
- After 10 years ; Routine maintenance and Periodical maintenance cost (Overlay on 20% of the total length for each road)

7.2 Power Supply Sector (On-Grid)

7.2.1. Standard Design

7.2.1.1 Standards of Design and Specifications

The outlines of standards of design and specifications for the facilities of sub-projects are described as follows. The descriptions are based on the existing ESE specifications and design in order to suit existing facilities.

(1) 66kV/33kV and 66kV/11kV substations

There are two types of 66kV substation in the ESE, which are 66kV/33kV and 66kV/11kV. The standard type of 66kV substations is an air-insulated substation. Basically, the MEPE (Myanmar Electric Power Enterprise) constructs 66kV substations while the ESE operates and maintains them. However, small-scale 66kV substations are constructed by the ESE.

(2) 33kV/11kV substations

Figure 7-9 shows the standard design of 33kV/11kV substation. A 33kV/11kV substation has one incoming transmission line, one set of switch bay and one transformer. Air insulated switchgears are applied for 33kV circuits and named Switch Bay. 11kV switchgear panels are installed in the control room, and a 33kV remote control panel for transformers, meters, relays are also installed.

There are some Sub-Projects, where ESE installed a small-capacity transformer (such as 5MVA), become overloaded due to load increase, and these are replaced and upgraded by a large-capacity one. In this case, the removed transformer is diverted to other substations.

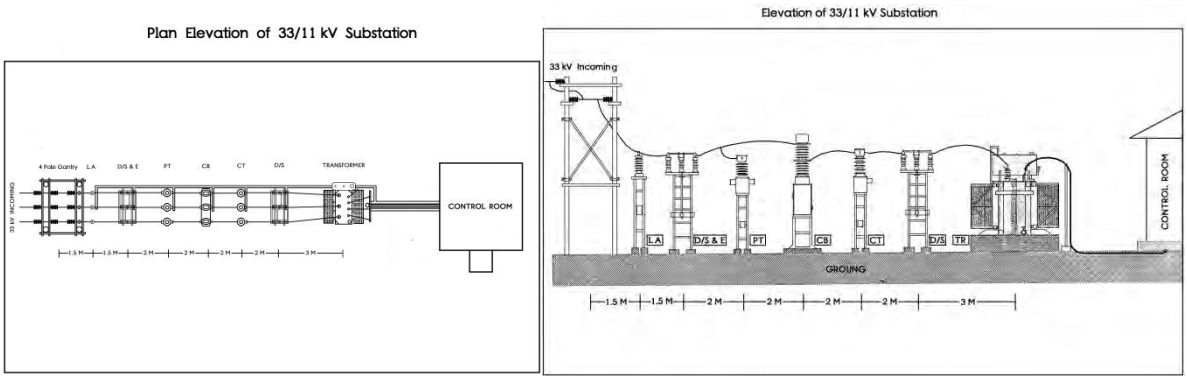


Figure 7-9 33/11kV substation Standard Layout

Source: ESE

(3) 66kV transmission lines

66kV transmission lines are overhead lines and consist of Aluminum Conductor Steel Reinforced (ACSR) for conductors and concrete poles for supporting structure. The ACSR 185 mm^2 conductors and 15 meter concrete poles are commonly used as the ESE standard.

(4) 33kV transmission lines

33kV transmission lines are overhead lines and consisted of ACSR for conductors and concrete poles for supporting structure. The ACSR 150 mm^2 conductors and 12 meter concrete poles are commonly used as the ESE standard. Figure 7-10 shows the examples of the standard 33kV overhead line.

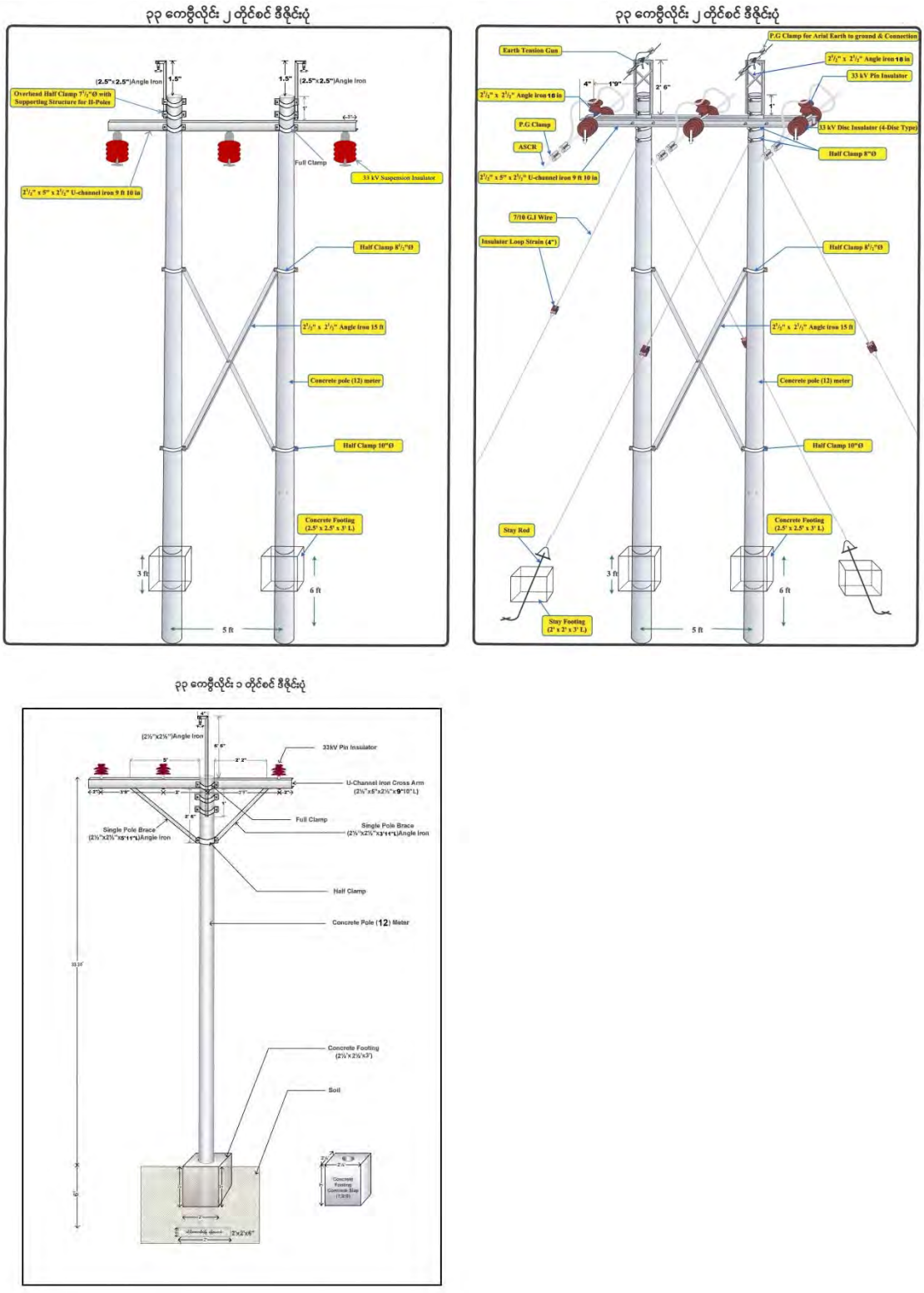


Figure 7-10 Examples of pole design for 33kV transmission lines

Source: ESE

(5) 11kV distribution lines

11kV distribution lines are overhead lines and consisted of ACSR for conductors and concrete poles for supporting structure. The ACSR 95 mm^2 conductors and 10 meter concrete poles are applied for the ESE standard. Figure 7-11 shows examples of the standard 11kV overhead line.

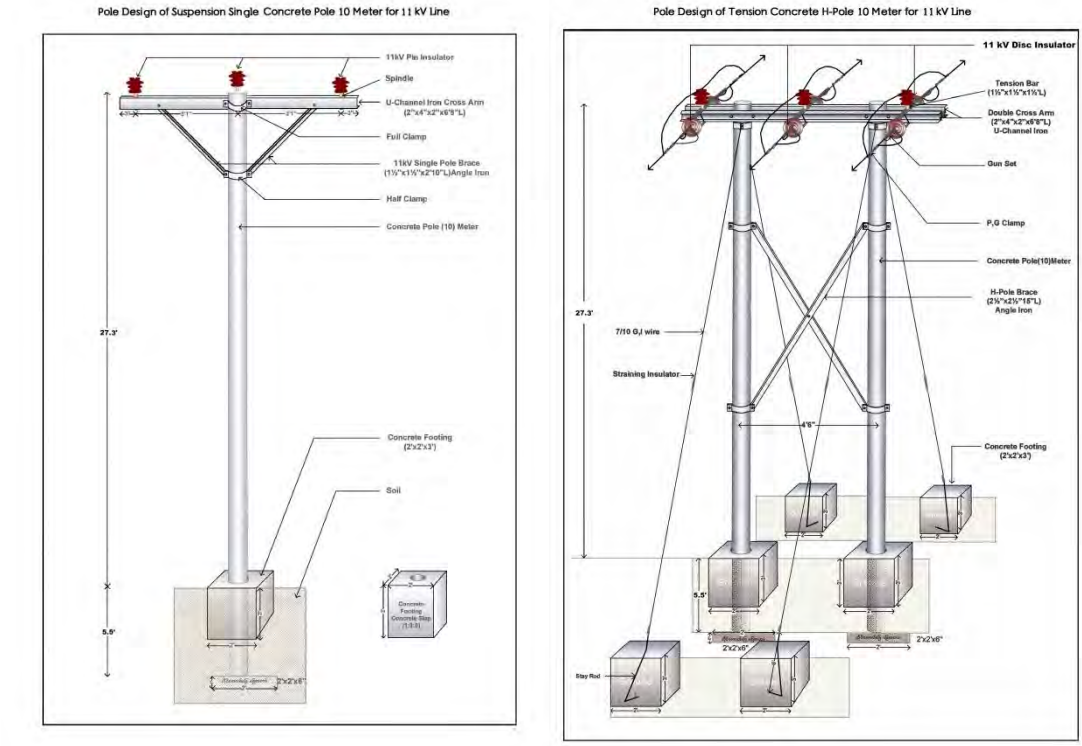


Figure 7-11 Examples of pole design for 11kV distribution line

Source: ESE

(6) 0.4kV distribution lines

Although Hard Drawn Bare Copper (HDBC) wire had been used for 400/230V distribution lines in the past, Aerial Bundled Cable (ABC) is widely used currently. The latter is a covered wire and compared to the HDBC, it has considerable advantages such as safety, less fault and reduction of non-technical loss. Figure 7-12 shows examples of the standard of low voltage line.

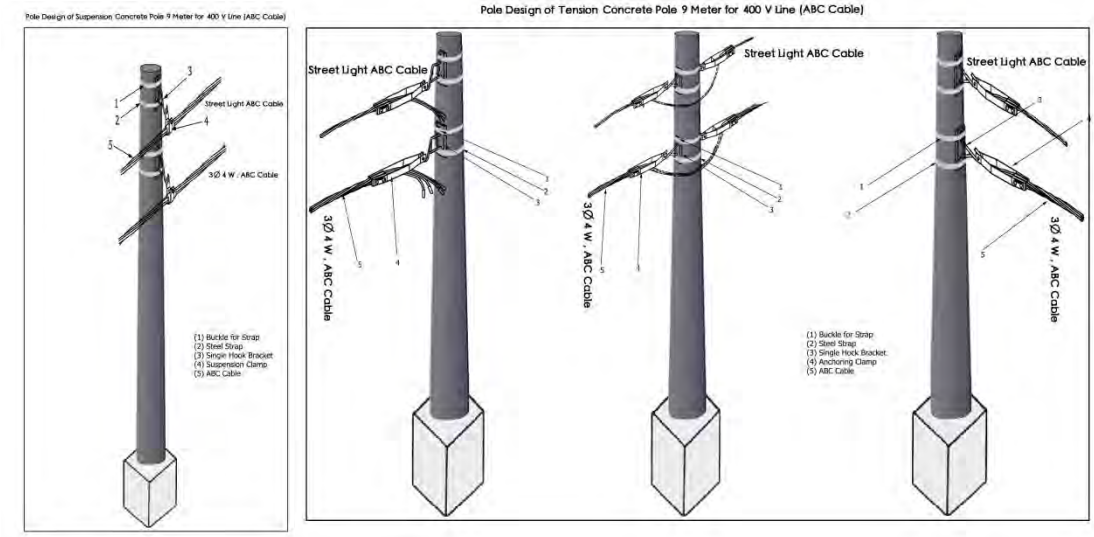
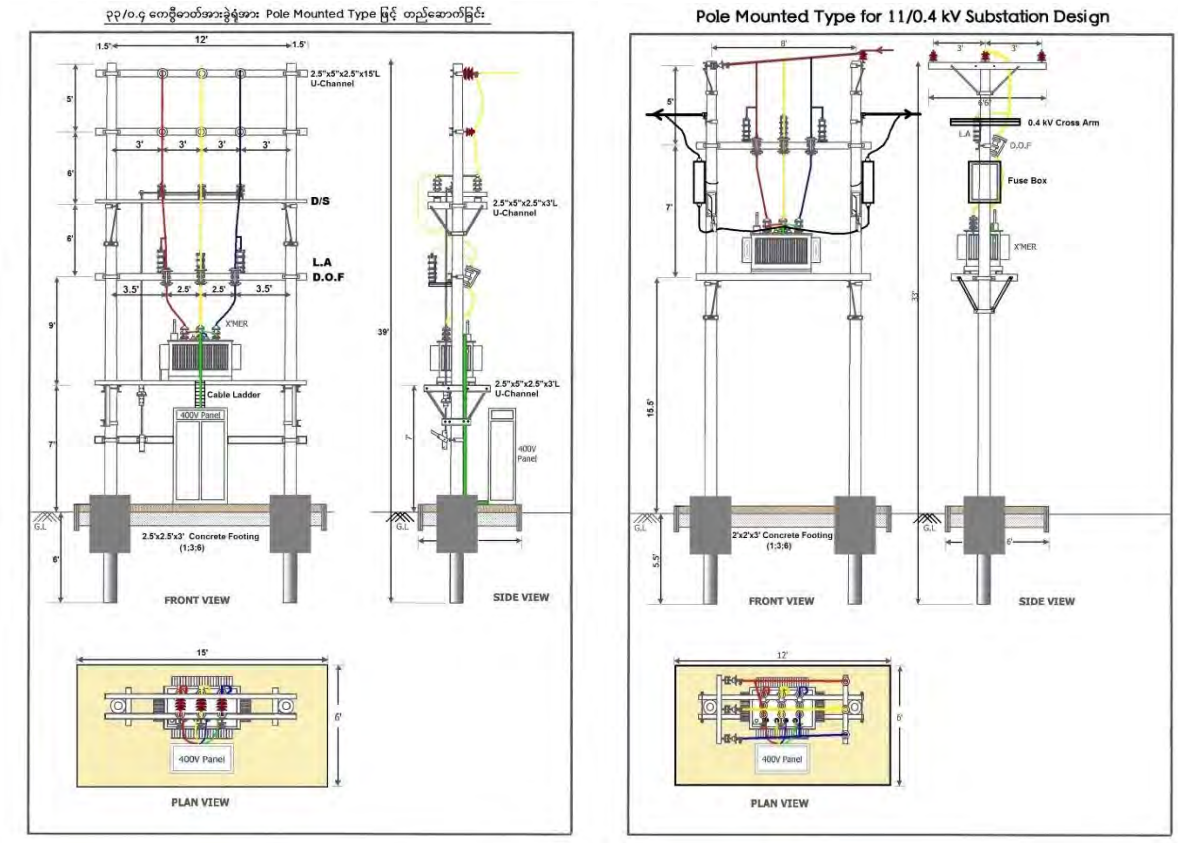


Figure 7-12 Examples of pole design for 0.4kV distribution line

Source: ESE

(7) Distribution transformer

The ESE has 33kV/0.4kV distribution transformers and 11kV/0.4kV distribution transformers. Standard pole installation designs of pole-mounted transformer (for both 33kV/0.4kV and 11kV/0.4kV) are shown in Figure 7-13.



(33kV/0.4kV) (11kV/0.4kV)

Figure 7-13 Examples of pole design for pole-mounted distribution transformers

Source: ESE

7.2.1.2 Applicable Codes and Standards

With regard to the Project design, relevant international standards such as IEC, ISO and other relevant standards are applied to the major functions of equipment and facilities in conformity with the existing electrical equipment and facilities in Myanmar. As for the system of units, the International System of Units (SI) is applied in principle. The standards applied are listed hereafter.

- International Standardization Organization (ISO): Applied to performance evaluation of industrial products in general
- International Electro-technical Commission (IEC): Applied to major functions of electrical products in general
- Relevant Technical Standards on Electrical Installation: Applied to electrical work in general

7.2.1.3 Conditions and Specifications of Basic Electrical Design

Basic conditions and specifications for designing the electrical equipment and materials are shown in Table 7-3 and Table 7-4.

Table 7-3 Basic Electrical Design Conditions

Item	High Voltage			Low Voltage		DC
	66kV	33kV	11kV	MESC [10]& ESE	Independent Power Producer	
Nominal voltage	66kV	33kV	11kV	400/230V	400/230V	110V
Maximum voltage	72kV	36kV	12kV	440/242V	440/242V	116V
Wiring System	3 phase 3 wire			3 phase 4 wire		2 wire
Frequency	50 Hz					-
Power Factor	0.8 to 0.9 lagging					-
Grounding method	Direct grounding			Resistance grounding / ZPT / ZCT	Direct grounding	-

Source: ESE

Table 7-4 Basic Specifications

Item	Design Conditions
Main Transformer	Mechanical strength: Withstand max. instant short circuit current x k where k shall be referred to IEC 60076 or equivalent standard Thermal strength: Withstand short circuit current 2 second 11kV, 33kV, 66kV direct grounding system
Circuit Breaker (CB)	Mechanical strength: Rated breaking current x 2.5 Thermal strength: 2 second of Rated breaking current
Short time max. current rating	CB 11kV---- 25kA, 40kA, 50kA, 80kA
Grounding resistance	Under condition with no rain for more than 12 hours Less than 10 Ω For substation, it shall be not more than 2 Ω.
Pole	400V: 9m (4.55ft underground) 11kV: 10m (5ft underground) 33kV: 12m (6ft underground) 66kV: 15m (6.5ft underground) >66kV and Road crossing: 18m (7ft underground) Product: Reinforced concrete pole with certified strength and quality
Overhead grounding wire	Supporting wire system: Double, Triple, 4 pole system
Lightning Arrester	IEC 60099 or equivalent standard: 5kA, 10kA
Protection	1) Transformer (main) Differential relay, grounding relay, overcurrent relay, under voltage relay, thermal relay 2) Distribution line Grounding relay, overcurrent relay, over voltage grounding relay, over current grounding relay
Monitoring	Parameters to be monitored shall be Wh, W, Power Factor, Voltage, three phase current voltage meter
Safety regulation	Safety distance from high voltage and low voltage dielectric devices
Protection and insulation	Distribution system including substation should be coordinated Protection and insulation with each line devices

Source: ESE

[10] Mandalay Electricity Supply Corporation

7.2.2. Operation and Maintenance (O&M) Plan

It is expected that the each Township Engineering Office of the ESE and the MESC will be responsible for the operation and maintenance of newly constructed facilities.

At the moment, all substations are manned and engineers and linemen are engaged in 24-hour operation of distribution facilities by rotation. These facilities are checked by daily patrol. And shutdown maintenance in order to check transformers, CT, VT, GCB, DS and ES in detail is being implemented once in three months.

However, since the facility data management is currently paper-based and lacking a common format, it is difficult to manage facilities properly and to prevent faults. Maintenance should duly be planned according to daily patrol record, periodical inspection history, etc. in the management database. The computer-based facility database would increase the efficiency and performance of the maintenance work and makes it easier to access to the facility data. Furthermore, it can be a foundation to plan the future development. ESE and MESC recognize that this matter should be considered later.

Also, technology transfer including capacity building at site can be recommended at the construction stage. This kind of training will be conducted by the Consultant at construction stage. Sharing skills and experience with the ESE and the MESC staff members in both the headquarters and local offices would similarly be desirable and thus should further be considered in order to improve life-cycle cost and reduce faults.

And the electricity tariff, which is financed for ESE and MESC operation, is calculated according to the stated unit rate and collected by the invoice every month. Basically, the payment has to be done by 25th day from the invoice date and there are possibilities to stop sending the electricity to the user if the payment is delinquent.

7.3 Water Supply Sector

7.3.1. Standard Design

Necessary components for the sub-projects are classified basically as shown in Figure 7-14 to 7-17. In deciding the mentioned components, original plans of TDCs were respected, but necessary modifications were provided during the Preparatory Survey. Although there was no plan to construct Water Treatment Plant (WTP) by TDCs for groundwater distribution, it should be constructed. The characteristics of the typical 4 systems are summarized in Table 7-5.

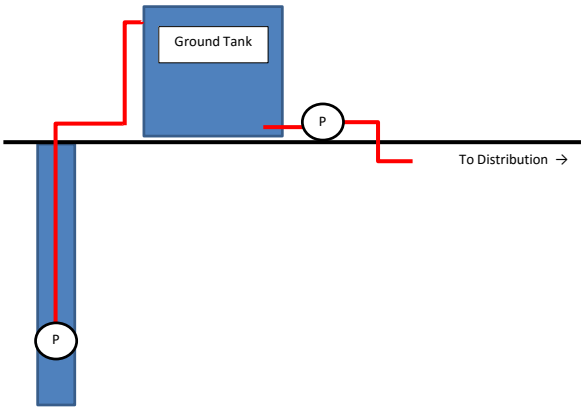


Figure 7-14 Type 1
Groundwater Tube Well + Pump Distribution
Source: The Preparatory Survey Team

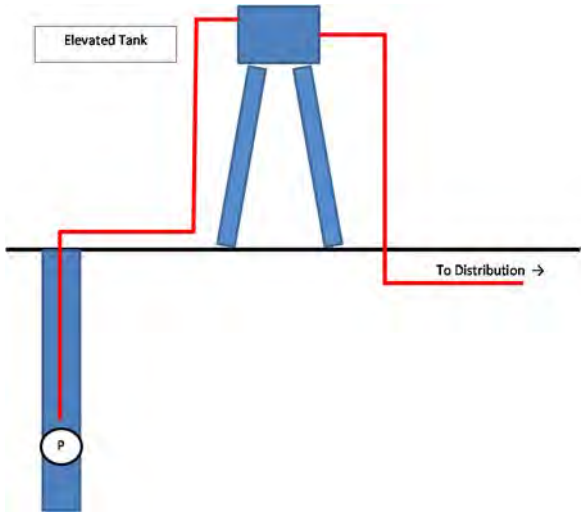


Figure 7-15 Type 2
Groundwater Tube Well + Gravity Distribution
Source: The Preparatory Survey Team

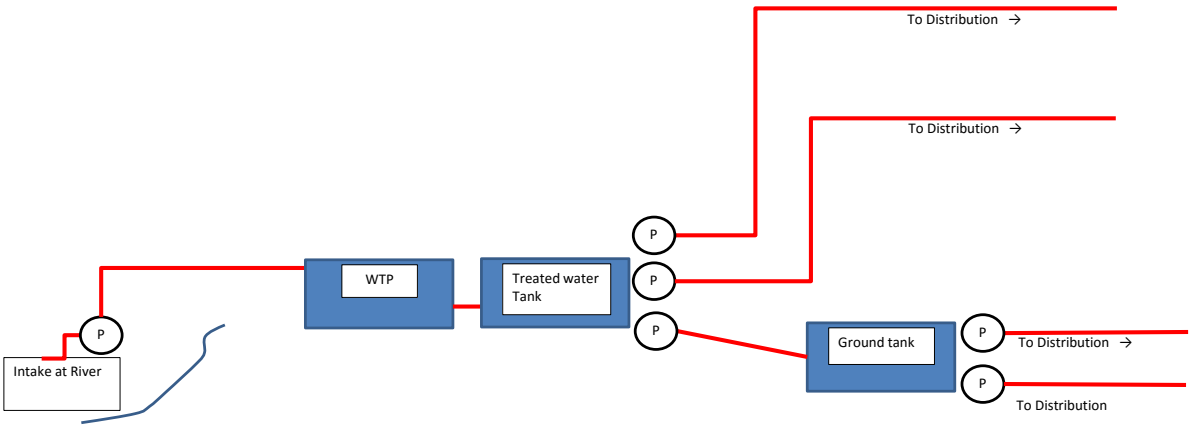


Figure 7-16 Type 3 : Surface Water WTP + Pump Distribution

Source: The Preparatory Survey Team

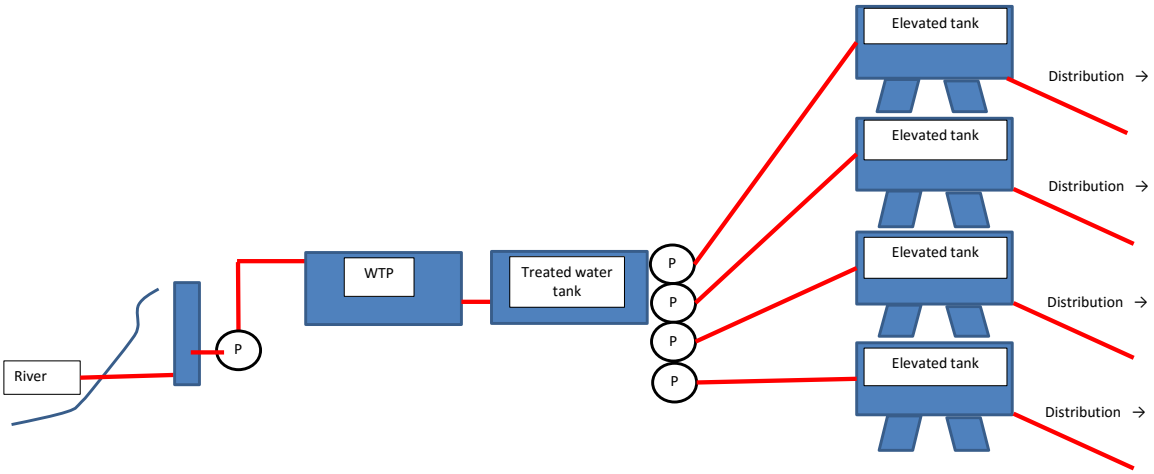


Figure 7-17 Type 4 : Surface Water WTP + Gravity Distribution

Source: The Preparatory Survey Team

Table 7-5 Characteristics of Typical System

Type	Characteristics
Type 1	System to distribute groundwater. To store the water in a ground tank and to distribute it by pump. Distribution pressure can be provided by pump. Chlorination is provided at a ground tank in general.
Type 2	The other system to distribute groundwater. To store the water in an elevated tank and to distribute it by gravity. Distribution pressure is provided by the height of the elevated tank. Since TDCs want to avoid a tank placed higher than around 15m (low water level), it is difficult to secure the distribution pressure for 0.15MPa or more. Chlorination is provided at an elevated tank in general.
Type 3	System to distribute surface water such as river, rainwater pond, etc. To treat in-taken water by a WTP, including the chlorination. To store the water in a ground tank and to distribute it by pump. Distribution pressure can be provided by pump.
Type 4	The other system to distribute the surface water. To distribute the water from elevated tanks. It is easier to keep a certain distribution pressure by gravity. Distribution pressure is provided by the height of the elevated tank. Since the TDCs want to avoid a tank placed higher than around 15m (low water level), it is difficult to secure the distribution pressure for 0.15MPa or more.

Source: The Preparatory Survey Team

7.3.1.1 Treatment System for Surface Water

All the surface water should be filtered before distribution. Two methods are proposed for the filtration as shown in Table 7-6.

Table 7-6 Water Filtration Methods

Items	Method 1: Rapid sand filtration	Method 2: Slow sand filtration
Basis Component	Coagulant mixing, Flocculation, Sedimentation, Rapid sand filter	Slow sand filter (pre-treatment is necessary according to raw water quality)
Advantage	Possible to treat turbid water like river water. Large area is necessary for sedimentation, but smaller space for filtration.	Required only slow sand filter (no pre-treatment), in general, if 10 NTU or less in raw water turbidity. Simple operation for the filter. Less frequency for filter washing.
Disadvantage	Sophisticated operation and daily back-wash works are necessary for filters.	Large space is necessary for filters. Pre-treatment is necessary if around 10 NTU or more in raw water turbidity.
Filtration velocity	120 - 150 m/day in general	4.0 - 5.0 m/day in general

Source: Prepared by the Preparatory Survey Team

During the Preparatory Survey, the filtration methods have been discussed among TDCs and the Preparatory Survey Team. The slow sand filtration (Method 2) is recommended for the following reasons:

- TDCs consider higher importance with easier operation and maintenance (O&M) than the size of land.
- In case of spring and rainwater pond, a simple slow sand filter system may be adoptable since the raw water turbidity is around 10 NTU or less.
- For river water, pre-treatment systems are acceptable by TDCs.
- In Phase-I, the slow sand filtration is adopted and its operation results may be acquired before or during the detail design stage. The treatment system can be verified and modified at this stage.

As for pre-treatment, roughing filter system is basically adopted. To correspond to the high turbidity of river water in rainy seasons, it is recommended to install a coagulation dosing facility for the pre-treatment. Phaan, Kayin State have the experience of using this system. Figure 7-18 illustrates the conceptual system of the WTP (slow sand filtration with pre-treatment).

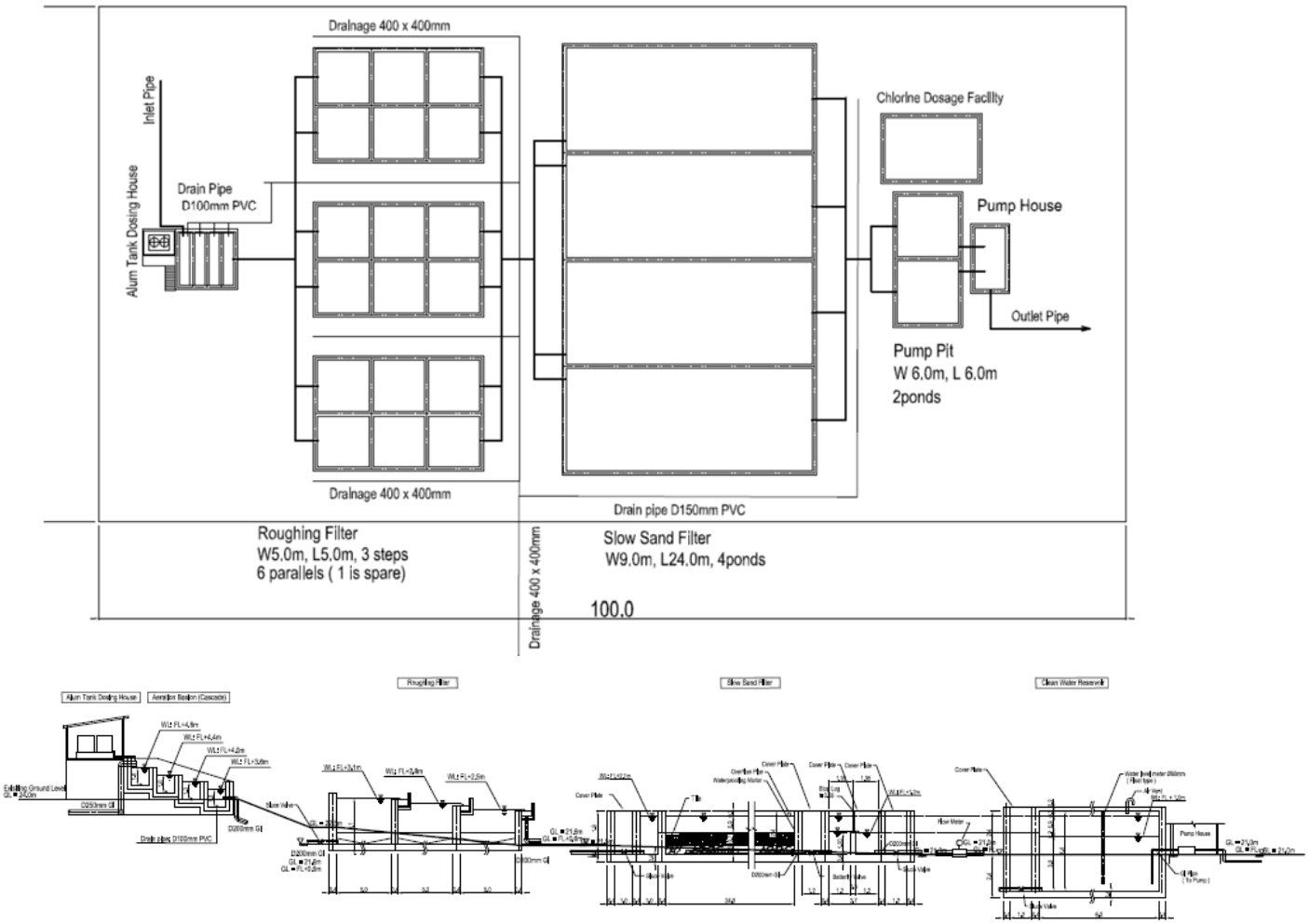


Figure 7-18 Sample Drawings of Water Treatment Plant

Source: Phase-I (MY-P1) Project

7.3.1.2 Recommendation for Further Design Stage

(1) Water Treatment Process

The present quality analysis of raw water is not available for all TDCs. Even though it is available, the data are not sufficient to evaluate the seasonal fluctuation. The treatment process should be further examined on the following points:

- Conditions of operation and efficiency of facilities constructed in Phase-I, as well as water quality
- Conditions of operation and efficiency of facilities constructed by other projects than Phase-I
- Further data for raw water quality.

(2) Availability of Groundwater and Depth/Diameter of Tube Well

At present, no data are available for groundwater availability. The water availability and groundwater table should be examined by the electromagnetic exploration and test extraction. Accordingly, design of tube wells (depth, diameter, etc.) and pumping capacity should be finalized.

(3) Groundwater Quality and Appropriateness of Well

Analysis data of groundwater quality are presently insufficient. TDCs should undertake the water quality analysis. It is recommended to conduct analysis seasonally to grasp the seasonal fluctuation. If inappropriateness is found in water quality, design modification should be undertaken. The groundwater of TDCs which are planning to utilize dug wells should be carefully examined.

7.3.2. Operation and Maintenance (O&M) Plan

7.3.2.1 Technology and Organization for O&M

TDCs have little experience in water supply business as well as water treatment. In construction stage, basic training on usage of facility and equipment should be provided by the Consultant and/or the Contractors. Besides the experience and knowledge, the number of organization and staff members is insufficient. TDCs, therefore, are advised to establish an organization exclusively for water supply and to newly employ necessary staff members. To establish the new organization, 24-hour service should be considered in team formation. As a reference, five staff members per 1,000 connections are the average scale of organization.

7.3.2.2 Finance

TDCs have no exclusive finance system for water supply. Since the income sources are limited for TDCs activities (road construction, local electricity distribution, public building construction, etc.), TDCs sometimes collect the necessary amount of finance as water tariff. To ensure the accountability for finance, the establishment of an independent financial system is recommended.

As for the tariff system, many of TDCs presently collect tariffs at fixed monthly rate and not based on metering system. As the system of fixed monthly rate causes over-usage of water, it is supposed to be inefficient. Installation of meters and introduction of metering system are recommended for the Project.