

APPENDIX

Appendix 1 汚水処理による発生汚泥処分に関する調査

APPENDIX1 Study on Disposal for Generated Sludge after Wastewater Treatment

1. Current Situation

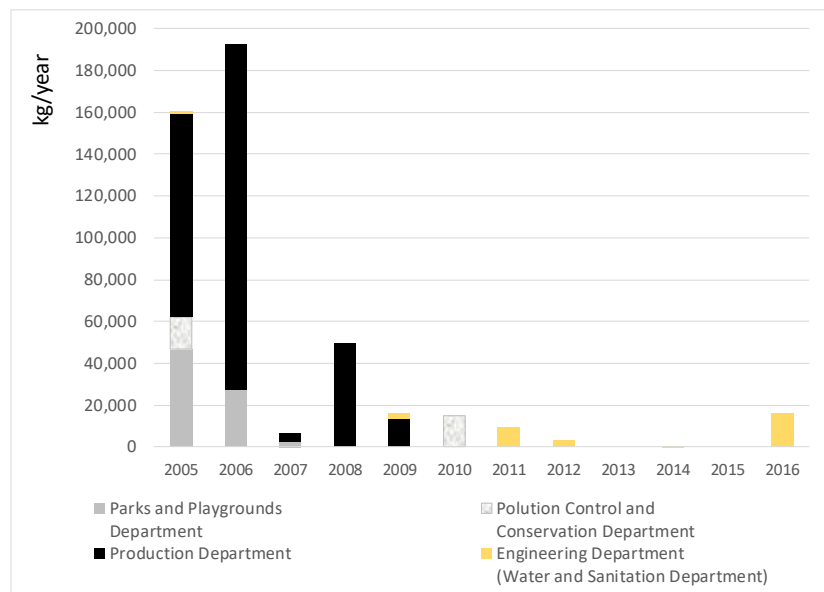
The amount of sludge from the existing wastewater treatment plant (WWTP) has not yet been recorded by the Yangon City Development Committee (YCDC). The amount is not large because the sludge treatment process is not yet operational.

Currently, the sludge is dried in a drying bed, and a portion of the dried sludge is occasionally used for purposes such as a soil conditioner. Accordingly, the dried sludge is not transported and disposed of outside of the WWTP.

2. Demand on the Dried Sludge

(1) Sludge Utilization in the Past Years

According to the records of sludge utilization from the WWTP, four departments of the YCDC, i.e., Engineering Department of Water and Sanitation (EDWS), Pollution Control and Cleaning Department (PCCD), Parks and Playgrounds Department, and Production Department, take the dried sludge from the WWTP as shown in Figure 1. The records indicate that the demand of sludge utilization is not stable and has been in a decreasing trend since 2010. The utilized amounts in 2007 and in 2012 to 2015 are very small compared to other years. EDWS is the only department which utilized the dried sludge after 2011.



Source: EDSW, YCDC

Figure 1: Estimated Amount of Sludge Utilization Based on the Records of the YCDC

(2) Tentative Estimation of Sludge Generation

The future generated amount of dried sludge is estimated as shown in Table 1. Compared to the maximum value in the past records, which is of a high value in 2006, a huge amount of dried sludge will be generated in the new WWTP. Using its value in 2006 as reference, the amount of utilized dried sludge is estimated to increase up to 25 times in 2025 and 63 times in 2035.

Table 1: Estimated Amount of Sludge Utilization

Year	Dried Sludge Amount	Ratio (-)	Reference Value
2025	4,800 (tons/year)	25.3	
2030	7,900 (tons/year)	41.6	
2035	12,000 (tons/year)	63.2	
2006	190 (tons/year)	1.0	Maximum in record

Source: JICA Study Team

(3) Lack of Demand on Sludge Utilization in the YCDC

The Japan International Cooperation Agency (JICA) Study Team and EDWS interviewed concerned departments that might have potential demand on the dried sludge as soil conditioner and for other purposes. The prospective departments are the Parks and Playgrounds Department and the Production Department of the YCDC.

The results of the interview conducted on 22-23 January 2018 are shown in Table 2. It was concluded that these two departments will not use the dried sludge for the same purpose as observed in the past seven years.

Table 2: Result of the Interview with the Departments of YCDC about Sludge Utilization

Department of YCDC	Result of Interview
Parks and Playgrounds Department	<ul style="list-style-type: none"> - The department has not taken any sludge from the WWTP in recent years. - In 2005, they used sludge from the WWTP under the corporation of the Engineering Department (Water and Sanitation) of the YCDC. They tested it in the golf field of the YCDC as land fill and soil conditioner for the grass. However, most of the grass were killed by insects, so they immediately stopped the program. - The Parks and Playgrounds Department does not want to use the sludge from the WWTP. - They are using urea; which consists of 46% of nitrogen, potash for potassium, and chicken/cow manure. Urea is commonly used for grass and trees, although some are damaged in the process. Urea is produced in Thailand and imported to Myanmar. The potash can be easily collected from local whisky factories. - In addition, small amounts of chicken manure is used for rose flower. A small amount of cow manure is also used for some flowers. - They mainly need good quality of soil to fill some shallow parts.
Production Department	<ul style="list-style-type: none"> - The department has approximately 10,000 acres of paddy fields that is rented to farmers who use both organic and inorganic fertilizers. The

	<p>farmers prefer organic fertilizers even though raw materials of organic fertilizers are limited.</p> <ul style="list-style-type: none"> - Based on experience, the sludge from the WWTP is better for rough trees or timber and is not suitable for flowers and soft trees. - Therefore, it is difficult for the department to use the WWTP sludge. - Currently, the department is using half a ton of urea for every 100 acres of timber field at the beginning of plantation every two years. - They think it is better to use the sludge as land fill material instead of soil conditioner. Although they have approximately 40 acres of fish ponds and they need to fill the area, with the current demand, the department cannot wait for the operation of the new WWTP. Besides, such demand is not continuous.
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Source: JICA Study Team Interview

(4) Necessity of a Disposal Facility in the Future

The EDWS envisages that they would, as much as possible, utilize sludge generated from the new WWTP enhanced by the project instead of simply disposing of it as solid waste. The JICA Study Team respects their idea, and EDWS may endeavour to promote the use of dried sludge, while EDWS does not have any promotional plan yet. However, it is probably not possible to utilize all of the sludge from the new WWTP facility considering the estimated generation rate and the possible demand for dried sludge as described above.

Therefore, it is necessary to find and secure a site and/or facility for sludge disposal to prepare for the future generation since the EDWS has not disposed of the sludge of the WWTP to the disposal facility.

3. Alternative Study for Final Disposal

(1) Sites Proposed by the EDWS/YCDC for Sludge Disposal

Upon inquiry by the JICA Study Team about possible locations for a sludge disposal facility last January 2018, the EDWS/YCDC considered and proposed two land areas owned by the YCDC. The locations of the sites are shown in Figure 2.

However, upon comparison in Table 2, both land areas were evaluated as inappropriate by the JICA Study Team because they are surrounded by residential areas. It is probably difficult to make a consensus among stakeholders because they may complain about the development of the disposal facility and the offensive odour from the sludge. Supplemental information is given in the attachment.

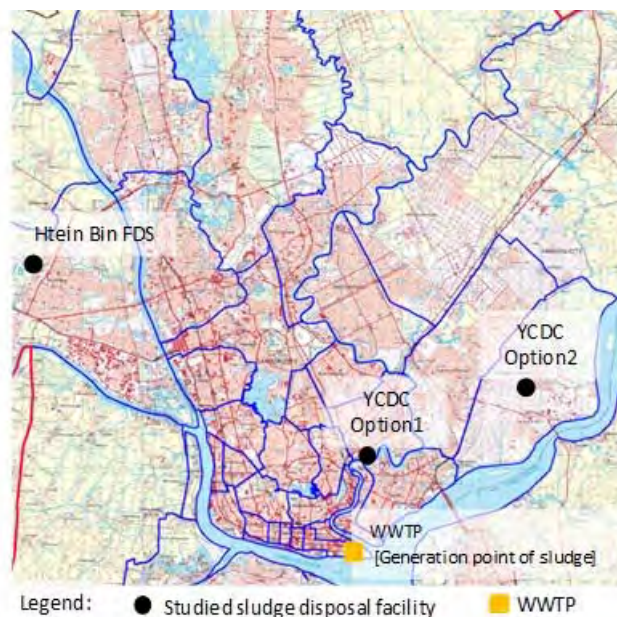


Figure 2: Possible Locations for the Studied Final Disposal Facility of Sludge

Table 3: Comparison of Candidate Sites

	Option 1. [YCDC land 1, future WWTP site]	Option 2. [YCDC land 2]	Option 3. [Solid waste FDS Htain Bin FDS]
Township	East Dagon Myothit	Thingangyun	Htain Tha Yar
Area	86 acres (34 ha)	5 acres (2 ha)	150 acres (60 ha)
Residents	None within the site, several people in the periphery	More than 500 within the site, more people in the periphery	None
Transport distance from WWTP	18 km	5 km	32 km
Necessary arrangements	Agreements/acceptance of residents; Improvement of access road	Resettlement, agreements/acceptance of residents	Coordination with PCCD
Advantage	<ul style="list-style-type: none"> Treatment and disposal are managed by the Water and Sanitation Department. The future WWTP sludge will also need a drying area. 	<ul style="list-style-type: none"> Treatment and disposal are managed by the Water and Sanitation Department. 	<ul style="list-style-type: none"> Serious additional social and environmental impact is not expected. Coordination among departments of YCDC
Disadvantage	<ul style="list-style-type: none"> Impact of odor to residents in the periphery → Detailed confirmation is required according to the JICA environmental and social consideration guideline 	<ul style="list-style-type: none"> Impact brought by resettlement Impact of odor to periphery residents → Detailed confirmation is required according to the JICA environmental and social consideration guideline 	<ul style="list-style-type: none"> Transportation distance is the biggest disadvantage Possible environmental impact due to improper management of FDS
Evaluation	Inappropriate	Inappropriate	Acceptable

Source: JICA Study Team

(2) Final Disposal Site of Solid Waste

The JICA Study Team suggested for EDWS to confirm the possibility of the disposal of the sludge to the final disposal site (FDS) of solid waste managed by the PCCD of YCDC as Option 3 because it is a practice commonly implemented in other countries.

Accordingly, EDWS organized a meeting on 18 January 2018 with PCCD and the JICA Study Team to discuss if the existing FDS would receive the sludge generated from the WWTP.

PCCD stated the following:

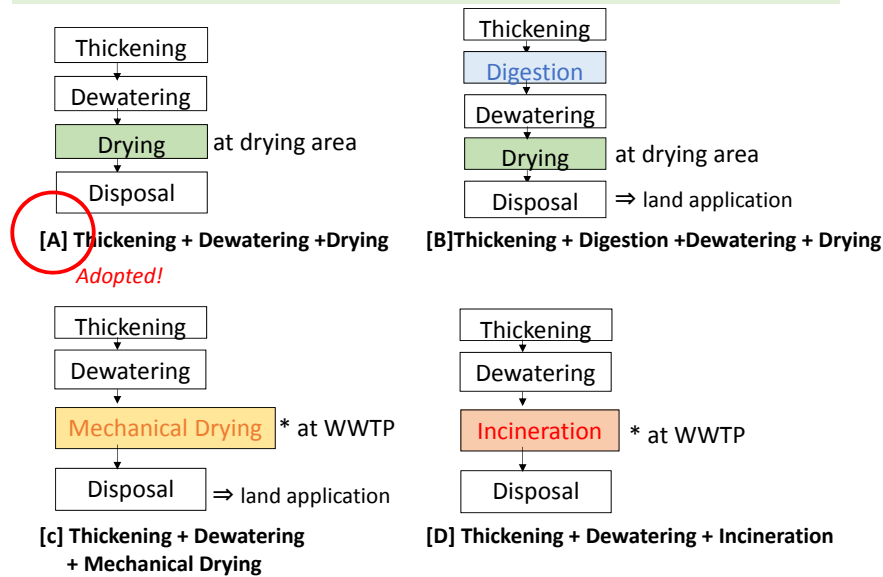
- The sludge disposal issue would be solved through the coordination between EDWS and PCCD.
- Htain Bin FDS can receive the sludge generated from WWTP if the sludge is dried after the dewatering process in the WWTP.

The JICA Study Team considered the option of sludge drying within the FDS because negative social impact that is likely to occur due to the offensive odour from the sludge sun drying process would not be expected. Regarding the JICA Study Team's inquiry about the possibility of installing a sludge drying facility, the YCDC stated the following:

- EDWS must adopt the costlier option within the WWTP area, which is the mechanical drying process instead of sun drying at the FDS, so that the negative impact of odour during transportation of sludge may be avoided and so that special vehicles for odour prevention will not be necessary.
- The PCCD required EDWS to dry the sludge before hauling to the FDS. The PCCD expressed concern in the landfill operation and management in case the dewatered sludge before drying would be disposed of at the solid waste FDS.

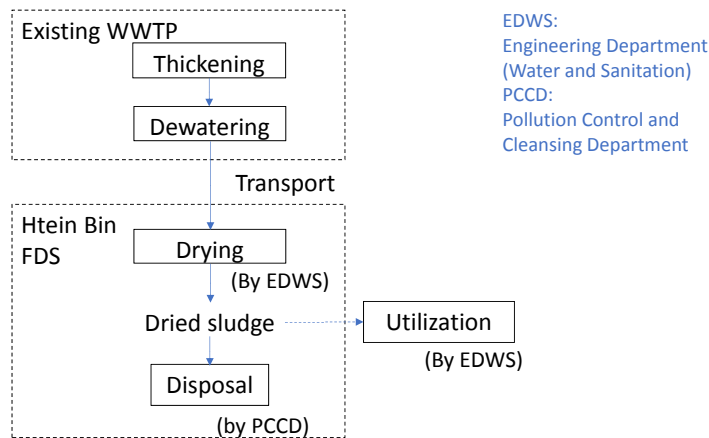
As a result of the series of meetings between relevant officials, including the ones from EDWS and PCCD, the EDWS reported to the JICA Study Team on 27 February 2018 that PCCD agreed that the FDS of solid waste, with Htein Bin FDS considered, would accept only dried sludge as solid waste after wastewater treatment. These agreements were reported in the official letter dated 22 February 2018 from EDWS to the JICA Study Team as well.

Sludge treatment options

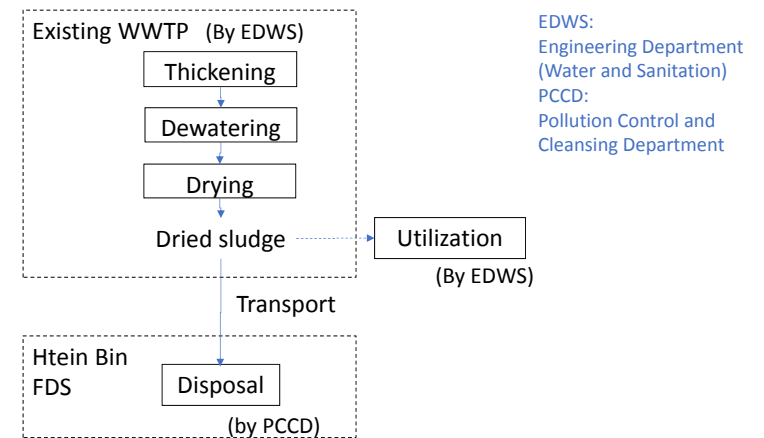


Sludge drying area/facility

- Function: Drying of sludge (Natural [sun drying] or Mechanical)
- Amount of sludge (80% moisture): 120m³/day
- Amount of dried sludge (approx. 30m³/day):

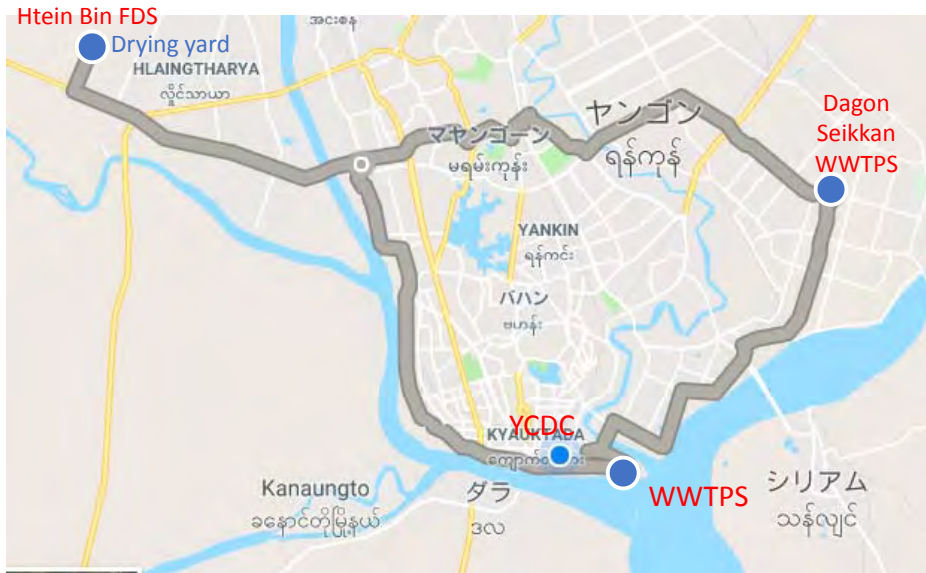


Option: sludge treatment and disposal flow



Option: sludge treatment and disposal flow

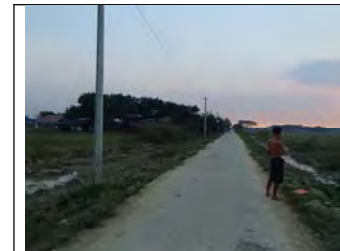
Location of related facilities



Location of candidate places for drying



Option 1
 (Dagon Seikkan WWTPS, owned by YCDC)
 Wider area, surrounded by residential area



Road surrounding the site



Squatter settlement
 (Eastern vicinity of site)



Facility of gas pipeline (North Eastern vicinity of the site)



Sign of gas pipeline facility

Dagon Seikkan WWTPS [Option1, owned by YCDC]



Option 2, (YCDC Land)
inside boundary

Occupied with existing facilities
and residences



Residences of YCDC Families



Residences of YCDC Families



Residences of YCDC Families



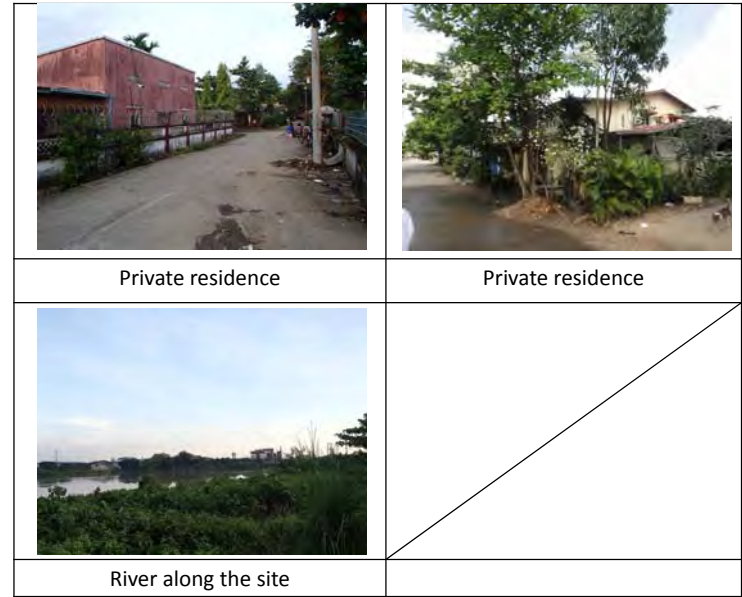
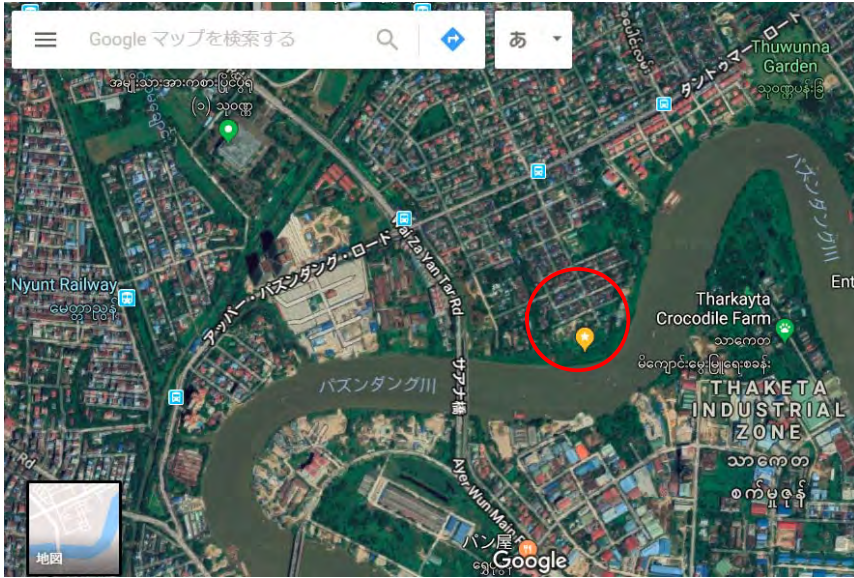
PCCD District office



Option 2 (YCDC Land)
Vicinity

Beside to the private residences

Option 2 (YCDC Land)



Present final disposal site (FDS) of solid waste, Htein Bin FDS [as example]

Htein Bin Final Disposal Site [FDS] managed by PCCD/YCDC



Appendix 2 MBR システムの運営・維持管理
に関する説明資料

APPENDIX2 Presentation About Operation and Maintenance for MBR SYSTEM

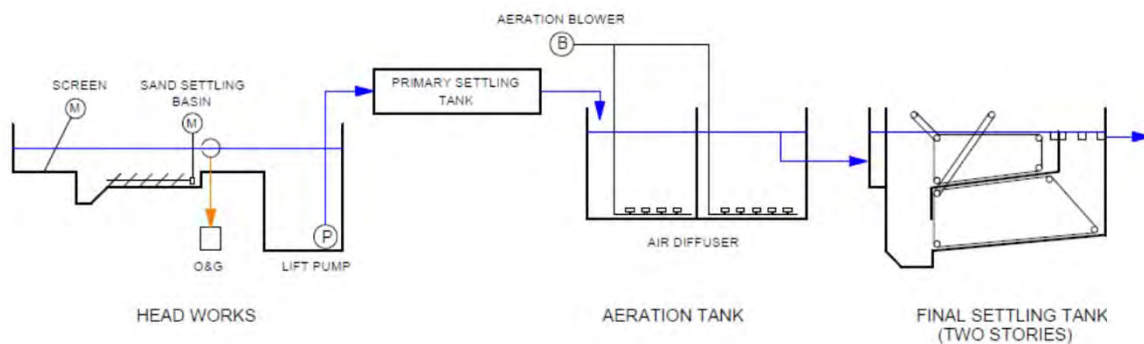
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OPERATION & MAINTENANCE for MBR SYSTEM

FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY

CAS SYSTEM FLOW

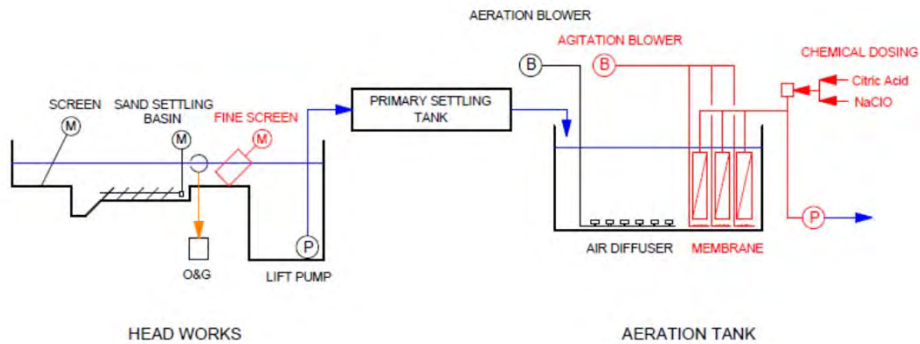
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FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY

MBR FLOW

3



FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY

SYSTEM COMPARISON FOR MBR and CAS SYSTEM

4

DESCRIPTION	MBR	CAS
Overall	Equipment amount is more than CAS System	Less Equipment
Foot Print(*1)	Small (40 ~60)	Large (100)
Power Consumption(*2)	High (130~180)	Low (100)
Chemical Usage	High	Low
Sludge Generation	Slightly Lower (95)	Higher than MBR (100)
Control	Complicated	Simple
Membrane Life Time	8 to 10 years	-

(*1) Foot Print is considered only Aeration Tank and Final Settling Tank.

(*2) Power Consumption depends on MBR Agitation Blower Capacity.

FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY

SAFE OPERATION FOR MEMBRANE (1/2)

5

Prolong **Membrane Life Time** is **key point of** MBR System.

Important points of Operation are as follows: -

Description	Explanation	Method
To Avoid Membrane Fouling	Bacteria, Calcium etc., will adhere on the surface of Membrane and clogged into membrane pores. Long adherence in pores becomes difficult to remove. Thus, Membrane Flux reduces	Periodical Chemical Cleaning Required. Normally, 3 months/time . Using Citric Acid and NaClO.
To Avoid Polymer leak	When polymer for Dewatering Unit overdose, residual polymer will return to aeration Tank. If Polymer adheres on membrane, Flux will reduce	1. Polymer for Dewatering Unit shall be properly adjusted. 2. Never drain un-used polymer solution.

FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY

SAFE OPERATION FOR MEMBRANE (2/2)

6

Description	Explanation	Method
To Avoid No-Flow Agitation	While no filtering, Agitation Air shall stop. If no filtering but still continuous agitate, it will damage Membrane physically. (for Flat type)	MBR shall operate always. Avoid number control operation for Membrane at low flow rate.
Agitation Air Pipe Drain	Diffusers of Agitation Air will be clogged by sludge accumulated at bottom of Membrane Unit. If diffuser clogged and less agitation, Membrane fouling will occur faster.	Diffuser Flushing shall be done manually for daily.
Fine Screen	Membrane required 1 to 2mm opening screen before Aeration Tank. Fine Screen shall not by-pass except emergency.	Proper Maintenance for Fine Screen as well as Coarse Screen
Oil & Grease Removal	If Oil attaches on Membrane surface, it will not be removed easily. Sometime, special cleaning required.	Oil Separator shall operate properly. Separated Oil shall transfer to dumping site.

FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY

MLSS Management (1/2)

7

Membrane Fouling: All of Causes come from MLSS.

TO Check and Adjust MLSS for Avoid rapid Membrane Fouling.

MLSS Concentration

CHECK:

Measure MLSS daily and confirm MLSS is between **8,000 to 12,000 mg/l**

ADJUST:

If MLSS is Lower than 8,000 mg/l, Stop Waste Sludge withdraw.

If MLSS is Higher than 12,000 mg/l, increase Waste Sludge withdraw.

VISCOSITY

CHECK:

Measure MLSS Viscosity daily and confirm Viscosity is **60 mPa · sec or less.**

ADJUST:

Check Oil & Grease or Polymer leak into Aeration Tank and Rectify these problems.

If no leakage of the above, reduce MLSS Concentration but higher than 8,000 mg/l.

FEASIBILITY STUDY FOR SEWERAGE SYSTEM
DEVELOPMENT IN YANGON CITY

MLSS Management (2/2)

8

FILTERABILITY

CHECK:

Measure Filterability and confirm **10 (ml/5min) or more.**

Measurement Method:

Using quantitative filter paper (5C) and measure filtered water amount after 5min.

ADJUST:

Check MLSS Settling Condition (Sludge Volume Index).

If Bulking occurs, rectify case by case.

Or this may be same problem described in Viscosity.

DO

CHECK:

Measure DO in Aeration Tank and confirm 1 mg/l or more.

ADJUST:

Adjust Aeration Blower operation.

FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY

ADDITIONAL BACK-UP

9

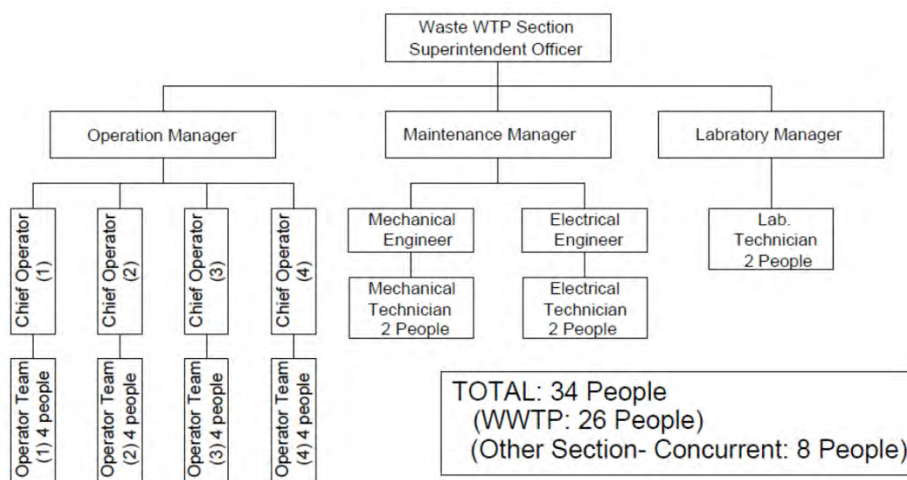
DESCRIPTION	MBR
Training	We recommend Operator's Training for Membrane Treatment by Manufacturer. Example: <ul style="list-style-type: none"> • 2 to 3 months off shore on job in-hand training for Operation Manager and Chief Operators.
Manufacturer's Inspection	We also recommend Manufacture inspection. Example: <ul style="list-style-type: none"> • One year later after commissioning. • Every two Years • Internet data transfer and checked and comment by manufacturer
Instrument Engineer	Instrument Engineer shall join in O&M team. <ul style="list-style-type: none"> • MBR System is operated 90% Automatic. • Programming of operation is in PLC and/or SCADA. • In case circuit board in PLC/SCADA is malfunction, Instrument Engineer shall rectify.

FEASIBILITY STUDY FOR SEWERAGE SYSTEM
 DEVELOPMENT IN YANGON CITY

O&M Recommendation (1/3)

10

Recommended O&M Organization



FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY

O&M Recommendation (2/3)

11

Required Skill for Main Personnel

Position	Required Skill (MBR)	Station
Superintendent Officer	Full Knowledge of Bio Process and trained for membrane Technology (Senior Engineer)	WWTP
Operation Manager	Full Knowledge of Bio Process and trained for membrane Technology as well as basic chemical matter.	WWTP
Maintenance Manager	Knowledge of rotating Machine and Basic knowledge of Electrical and Instrumentation	Other Section
Mechanical Engineer	Knowledge of Mechanical Machines repairing/maintenance and familiarize Membrane Cassettes.	Other Section
Instrumentation/ Electrical Engineer	Knowledge of SCADA, PLC Signal components. Knowledge of Electrical Panel and Machine maintenance.	Other Section
Laboratory Manager	Full Knowledge of Analysis Method.	WWTP

FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY

O&M Recommendation (3/3)

12

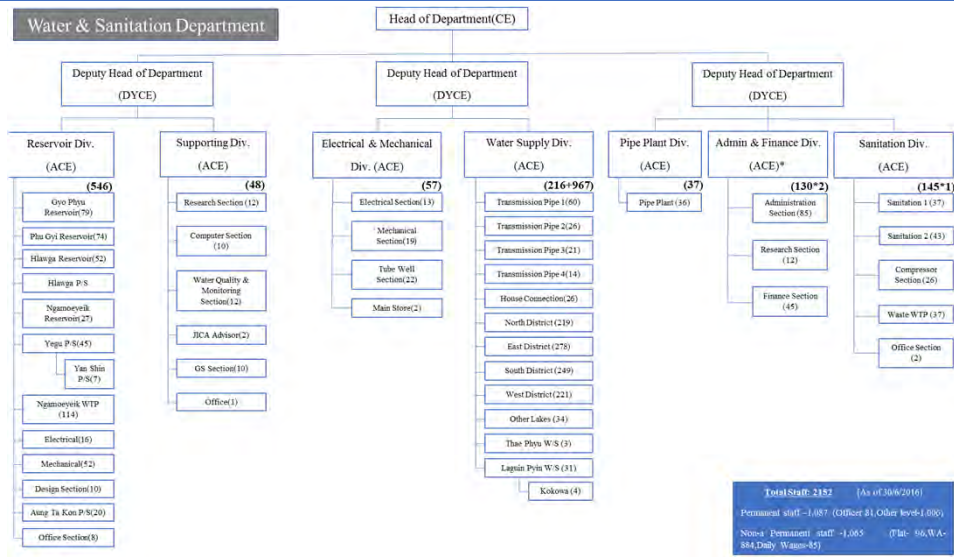
Roles and Tasks for Main Personnel

Position	Roles and Tasks	Report To
Superintendent Officer	<ol style="list-style-type: none"> 1. Full responsible Personnel for WWTP O&M 2. To Organize and lead O&M Team 3. To Organize and lead Emergency System 	Deputy Head of Department
Operation Manager	<ol style="list-style-type: none"> 1. To lead operator team and act as Deputy Superintendent Officer 2. To find problem and inform related team for taking action 3. To adjust machines according to information received from other team. 	Superintendent Officer
Maintenance Manager	<ol style="list-style-type: none"> 1. To lead Maintenance Team 2. Routine maintenance works 3. To receive information from Operation Manager for defective items. 4. To rectify and repair defective items as soon as possible. 	Superintendent Officer & Operation Manager
Laboratory Manager	<ol style="list-style-type: none"> 1. To Lead Laboratory Team 2. To check analysis data and inform Operation Manager 3. To do Jar Test for sludge Dewatering Unit Chemical Feeding rate and inform Operation Manager daily base. 	Superintendent Officer & Operation Manager

NOTE: This Organization is not included for SLUDGE DRYING FACILITY

FEASIBILITY STUDY FOR SEWERAGE SYSTEM DEVELOPMENT IN YANGON CITY




Data (Present Condition)



Appendix 3 下水道管渠敷設の比較

APPENDIX3 COMPARISON OF SEWER LINE ROUTE

Table 1 Comparison of Sewer Line Route

	2 Routes	3 Rotes	5 Routes
Schematic Image of each route			
Construction Cost (MMK/JPY)	MMK 103,607,000,000 (JPY 8,281,890,000)	MMK 92,710,000,000 (JPY 7,410,860,000)	MMK 90,499,000,000 (JPY 7,234,070,000)
Pipe length (m)	Trunk: 15.3 km Branch: 23.3 km Total: 38.6 km	Trunk: 18.1 km Branch: 16.3 km Total: 34.4 km	Trunk: 20 km Branch: 13.4 km Total: 33.4 km
Number of shafts	Total: 261 nos	Total: 233 nos	Total: 230 nos
Workability	<ul style="list-style-type: none"> - The heaviest traffic congestion during construction will be expected because of the longest length and the largest number of shaft. - Construction period might be also the longest. - Difficult to find the large number of shaft locations. 	<ul style="list-style-type: none"> - Total length and number of shaft are bigger than 5 routes. - Length of trunk sewer will be shorter, while branch sewer will be longer than 5 routes. 	<ul style="list-style-type: none"> - The least traffic congestion will be expected because pipe length to be installed is the shortest. - Construction period is also the shortest. - The most simple alignment for pipe jacking method
Compatible with Drainage System	The number of crossing point with drainage lines from north to south in CBD area is the smallest.	The number of crossing point with drainage lines from north to south in CBD area is the less.	The number of crossing point with drainage lines from north to south in CBD area is the biggest.
Evaluation	<ul style="list-style-type: none"> - Trunk sewer will be the shortest, however branch sewer in order to collect sewage by trunk sewer will be the longest. - Less economical due to pipe length and number of shafts than other alternatives. 	<ul style="list-style-type: none"> - Pipe length of smaller and larger diameter pipe is longer than 5 routes - Construction cost is higher than 5 routes - Less crossing with drainage lines 	<ul style="list-style-type: none"> - the lowest construction cost - Largest number of crossing with drainage lines
	Not Recommended	Not Recommended	Recommended

Note: Pipe length and number of shaft was estimated temporary for the comparison purpose only. Construction cost was estimated roughly with unit price in the previous studies.

Appendix 4 汚水処理施設の容量計算

APPENDIX 4

Yangon Sewage

CALCULATION SHEET

(MBR SYSTEM)
56,000 m³/d x 2 TRAIN

1. BASIC CONDITIONS

1-1 BASIC ITEMS

- | | | | | |
|--|---|---------------|----------------------------------|-------|
| (1) Name | : | | Yangon Sewage | |
| (2) Land Area | : | Approximately | 2.5 | ha |
| (3) Ground Level | : | | 4.70 | m |
| (4) Inlet Pipe Invert Level : | | | -13.50 | m |
| | | | | |
| (5) Land Use | : | | Existing Plant | |
| (6) Collection System : | | | Separate Sewer System | |
| (7) Treatment Methc [Sewage Treatment] | | | MBR System | |
| [Sludge Treatment] | | | Thickening + Dewatering + Drying | |
| (8) Effluent Discharge Point : | | | Yangon | River |
| (9) Discharge Point Water Level : | | | 3.95 m | |
| (10) Design Target Year : | | | 2040 | |

1-2 Design Population

Design Population (STP) Proposed Project: PE (Population Equivalent)

2 DESIGN CALCULATION

2- DESIGN CONDITION AND CRITERIA

2-1-1 Design Sewage Flow

1) Ultimate Flow

ITEM	m ³ /day	m ³ /hr	m ³ /min	m ³ /sec
Max Daily Flow (Q ₁)	112,000 (Q _{1-D})	4,667 (Q _{1-H})	77.78 (Q _{1-M})	1.296 (Q _{1-S})
Hourly Maximum (PEAK FLOW)(Q ₂)	168,000 (Q _{2-D})	7,000 (Q _{2-H})	116.67 (Q _{2-M})	1.944 (Q _{2-S})

2) Train 1

ITEM	m ³ /day	m ³ /hr	m ³ /min	m ³ /sec
Max Daily Flow (Q _{n1})	56,000 (Q _{n1-D})	2,333 (Q _{n1-H})	38.89 (Q _{n1-M})	0.648 (Q _{n1-S})
Hourly Maximum (PEAK FLOW)(Q ₂)	84,000 (Q _{n2-D})	3,500 (Q _{n2-H})	58.33 (Q _{n2-M})	0.972 (Q _{n2-S})

3) Train 2

ITEM	m ³ /day	m ³ /hr	m ³ /min	m ³ /sec
Max Daily Flow (Q _{e1})	56,000 (Q _{e1-D})	2,333 (Q _{e1-H})	38.89 (Q _{e1-M})	0.648 (Q _{e1-S})
Hourly Maximum (PEAK FLOW)(Q ₂)	84,000 (Q _{e2-D})	3,500 (Q _{e2-H})	58.33 (Q _{e2-M})	0.972 (Q _{e2-S})

2-1-2 Design Sewage Quality

ITEM	INFLUENT	Primary Treatment		Secondary Treatment		Total Removal
	Sewage (mg/L)	Removal % (%)	Effluent (mg/L)	Removal Ratio (%)	EFFLUENT (mg/L)	
BOD	250	34%	165	87.9%	20	92.0%
SS	250	40%	150	96.7%	5	98.0%
COD	500	-			100	
T-N (No data)	30	16%	25		25	16.7%

2-1-3 Design Criteria

ITEMS	UNIT	Standard Application	Application
Grit Chamber			
(1) Hydraulic Load	m ³ /m ² /day	1800	1800
(2) Maximum Velocity	m/sec	0.3	0.3
(3) Retention Time	min	1.5	1.5
Primary Clarifier			
(1) Surface Load for Daily Average	m ³ /m ² /d	35~75	75
(2) Water Depth	m	4	4
(3) Weir Loading	m ³ /m/d	250	250
(4) Solid Recovery	%	40~50%	40%
(5) Sludge Concentration	%	1%	1%
(6) Settling Time	hr	1.5	1.5
(7) BOD Recovery Rate	%		34%
(8) Organic Contents in Sludge	%	50~85%	85%
Reaction Tank			
(1) BOD-SS Load	kg/kg/day	0.1~0.25	0.2
(2) MLSS Concentration	mg/l	8000~10000	8,000
(3) Return Sludge Ratio	%	-	-
(4) SRT	day	NA	NA
(5) Water Depth	m	-	5
(6) Hydraulic Retention Time (HRT)	hr	Calculation	2.9
(7) Oxygen Requirement	kgO ₂ /kg-substrate	1.5	1.5
(8) BOD Yield	%	30~60%	50%
(9) Dissolved BOD Rate	%	40~50%	40%
(10) SS Sludge Yield	%	90~95%	90%
(11) Sludge self oxidization rate	1/day	0.01~0.07	0.030
(12) Remain Oxygen in Aeration Tank	mg/l	1~2	2.0
MBR (in Aeration Tank)			
(1) Flux	m ³ /m ² /d	-	0.70
(2) Flux at peak flow	m ³ /m ² /d	-	1.40
(3) Water Depth	m		
(4) Sludge Concentration	%	=MLSS	1.0%

ITEMS	UNIT	Standard Application	Application
Disinfection			
(1) Retention Time	min	15	15.0
(2) NaClO Dosing Rate	mg/l	5	5.0
(3) NaClO Concentration	%	12%	10%
(1) Retention Time	sec	5 or more	5
(2) UV Transmission	%	65	NA
Gravity Thickener			
(1) Solid Loading for Daily Average	kg/m ² /d	60~90	90
(2) Water Depth	m	3~4	4.0
(3) Solid Recovery	%	90%	90%
(4) Sludge Concentration	%	2%~4%	4%
Mechanical Thickener			
(1) Loading Capacity	m ³ /h/unit	Manufacturer	120
(2) Sludge Recovery	%	90%	90%
(3) Sludge Conc	%	4~5%	4%
(4) Polymer Dosing rate	%	0.3%	0.3%
(5) Polymer Dilution Rate	%	0.2%	0.2%
-1-3-8 Anaerobic Digester			
Digestion Time	day	20	20
Digestion Ratio for Organic Mat	m ³ /kg	0.5	0
Organic Ratio (Inlet)	%	80%	40%
Organic Ratio (Outlet)	%	66.7	Calculation
Digested Sludge Water Content	%	1.6	Calculation
Sludge Dewatering Unit			
(1) Solid Capacity	kg/hr/unit	-	-
(2) Dewatered Sludge Water Content	%	80%	85%
(3) Sludge Recovery	%	90%	90%
(4) Polymer Dosing rate (per DS)	%		1.5%
(5) Polymer Dilution Rate	%	0.2%	0.2%
(6) Coagulant Dosing Rate	%	20.0%	15.0%
(7) Coagulant Dilution Rate	%	16.0%	16.0%

2-2-1 MASS BALANCE CALCULATION (ULTIMATE)

DESIGN CONDITION

Inlet Quantity (ULTIMATE)	m ³ /d	112,000
Inlet Quantity (Train 1)		56,000
Inlet Quantity (Train 2)		56,000
Inlet SS	mg/l	250
Outlet SS	mg/l	5
Primary Tank Sludge Removal Rat %		40%
Concentration of Primary Sludge %		1.0%
Removal of BOD in Primary Sludg %		34.0%
BOD Yield Coefficient	%	50%
Waste Sludge Solids Content	%	1.0%
MLSS	mg/l	8,000
Recovery Ratio of Gravity Thicker %		90%
Concentration of Gravity thickenec %		4%
Recovery Ratio of Mechanical Thc %		90%
Concentration of Mechanical Thicl %		4%
Recovery Ratio of Dewatering Uni %		90%
Water Contents of Sludge Cake %		85%

Train 1

INLET

Inlet Quantity	m ³ /d	56,000
Inlet SS	kg/d	14,000
Inlet SS Concentration	mg/l	250
Inlet BOD Concentration	mg/l	250
Inlet BOD amount	kg/d	14,000
Inlet Nitrogen Concentration	mg/l	30
Inlet Nitrogen Amount	kg/d	1,680

Primary Clarifier (Sludge)

Primary Sludge Concentration	%	1.0%
Primary Sludge Dry Solid	kg/d	5,600
Primary Sludge Quantity	m ³ /d	560
Primary Sludge BOD Quantity	kg/d	4,760

Reactor inlet

Flow	m ³ /d	55,440
BOD Amount	kg/d	9,240
BOD	mg/l	167
SS Amount	kg/d	8,400
SS	mg/l	152
N Amount	kg/d	27
N Concentration	mg/l	0

Sludge Generation

BOD Sludge Yield		0.40
Sludge from Dissolved BOD	kg/d	1,478
Sludge from SS	kg/d	7,560
Sludge self Oxidization	kg/d	1,608
Sludge Generation	kg/d	7,431

MBR

Sludge Concentration	%	1.00%
Waste Sludge DS	kg/d	7,153
Waste Sludge Quantity	m ³ /d	715

Gravity Thickener (for Primary Sludge)

Thickened Sludge DS	kg/d	5,040
Thckened Sludge Quantity	m ³ /d	126
Supernatant SS	kg/d	560
Supernatant Quantity	m ³ /d	434
Supernatant SS Concentration	mg/l	1,290
Supernatant BOD Quantity	kg/d	476
Supernatant N Concentration	mg/l	30
Supernatant N Quantity	kg/d	13
Supernatant BOD Concentration	mg/l	912

Mechanical Thickener (for Secondary Sludge)

Polymer Dosing Rate	%-DS	0.3%
Polymer Dosing Amount	kg-ss/d	21
Dilution Rate for Polymer make up	%	0.2%
Dilution Water Amount	m ³ /d	11
Thickened Sludge DS	kg/d	6,709
Thckened Sludge Quantity	m ³ /d	168
Supernatant SS	kg/d	466
Supernatant Quantity	m ³ /d	558
Supernatant SS Concentration	mg/l	834
Supernatant BOD Quantity	kg/d	186

Train 2

Inlet Quantity	m ³ /d	56,000
Inlet SS	kg/d	14,000
Inlet SS Concentration	mg/l	250
Inlet BOD Concentration	mg/l	250
Inlet BOD amount	kg/d	14,000
Inlet Nitrogen Concentration	mg/l	30
Inlet Nitrogen Amount	kg/d	1,680

Primary Clarifier (Sludge)

Primary Sludge Concentration	%	1.0%
Primary Sludge Dry Solid	kg/d	8,179
Primary Sludge Quantity	m ³ /d	818
Primary Sludge BOD Quantity	kg/d	5,809

Reactor inlet

Flow	m ³ /d	61,181
BOD Amount	kg/d	11,276
BOD	mg/l	184
SS Amount	kg/d	12,269
SS	mg/l	201
N Amount	kg/d	1,658
N Concentration	mg/l	27

Sludge Generation

BOD Sludge Yield		0.40
Sludge from Dissolved BOD	kg/d	1,804
Sludge from SS	kg/d	11,042
Sludge self Oxidization	kg/d	1,774
Sludge Generation	kg/d	11,072

MBR

Sludge Concentration	%	1.00%
Waste Sludge DS	kg/d	10,766
Waste Sludge Quantity	m ³ /d	1,077

Gravity Thickener (for Primary Sludge)

Thickened Sludge DS	kg/d	7,361
Thckened Sludge Quantity	m ³ /d	184
Supernatant SS	kg/d	818
Supernatant Quantity	m ³ /d	634
Supernatant SS Concentration	mg/l	1,290
Supernatant BOD Quantity	kg/d	581
Supernatant N Concentration	mg/l	50
Supernatant N Quantity	kg/d	32
Supernatant BOD Concentration	mg/l	1,091

Mechanical Thickener (for Secondary Sludge)

Polymer Dosing Rate	%-DS	0.3%
Polymer Dosing Amount	kg-ss/d	32
Dilution Rate for Polymer make up %		0.2%
Dilution Water Amount	m ³ /d	16
Thickened Sludge DS	kg/d	9,721
Thckened Sludge Quantity	m ³ /d	243
Supernatant SS	kg/d	1,077
Supernatant Quantity	m ³ /d	850
Supernatant SS Concentration	mg/l	1,267
Supernatant BOD Quantity	kg/d	431

Thickened Mixed Sludge Tank

Sludge Concentration	%	4.00%
Sludge DS	kg/d	28,832
Waste Sludge Quantity	m ³ /d	721

Dewatering Unit (Estimation)

Polymer Dosing Rate	%-DS	1.50%
Polymer Dosing Amount	kg-ss/d	432
Dilution Rate for Polymer make up	%	0.20%
Dilution Water Amount	m ³ /d	216
PAC Dosing Rate	%-DS	15%
PAC Dosing Amount	kg-ss/d	4,325
PAC Concentration	%	16%
Specific Gravity	-	1.2
PAC Dosing flow	m ³ /d	22.5
Water Content of Cake	%	85%
Cake DS	kg/d	30,230
Cake Quantity	m ³ /d	202
Supernatant SS	kg/d	3,359
Supernatant Quantity	m ³ /d	758
Supernatant SS Concentration	mg/l	4,431
Supernatant BOD Quantity	kg/d	1,344
Supernatant N Concentration	mg/l	30
Supernatant N Amount	kg/d	23
Supernatant BOD Concentration	mg/l	1,772

Other Water

Treated Water Reuse	m ³ /d	4656
City Water Drain	m ³ /d	25

Inlet Condition to Primary Clarifier

Quantity	m ³ /d	63,915
SS	kg/d	20,279
SS Concentration	mg/l	317
BOD Amount	kg/d	17,017
BOD Concentration	mg/l	266

Return from Gravity, Mechanical Thickener and Dewatering Unit

Quantity	m ³ /d	3,234
SS	kg/d	6,279
SS Concentration	mg/l	1,942
BOD Amount	kg/d	3,017
BOD Concentration	mg/l	933

Effluent (Before Disinfection)

Quantity	m ³ /d	114,829
Outlet SS Concentration	mg/l	5
SS	kg/d	574
BOD Concentration	mg/l	20
BOD Amount	kg/d	2,297

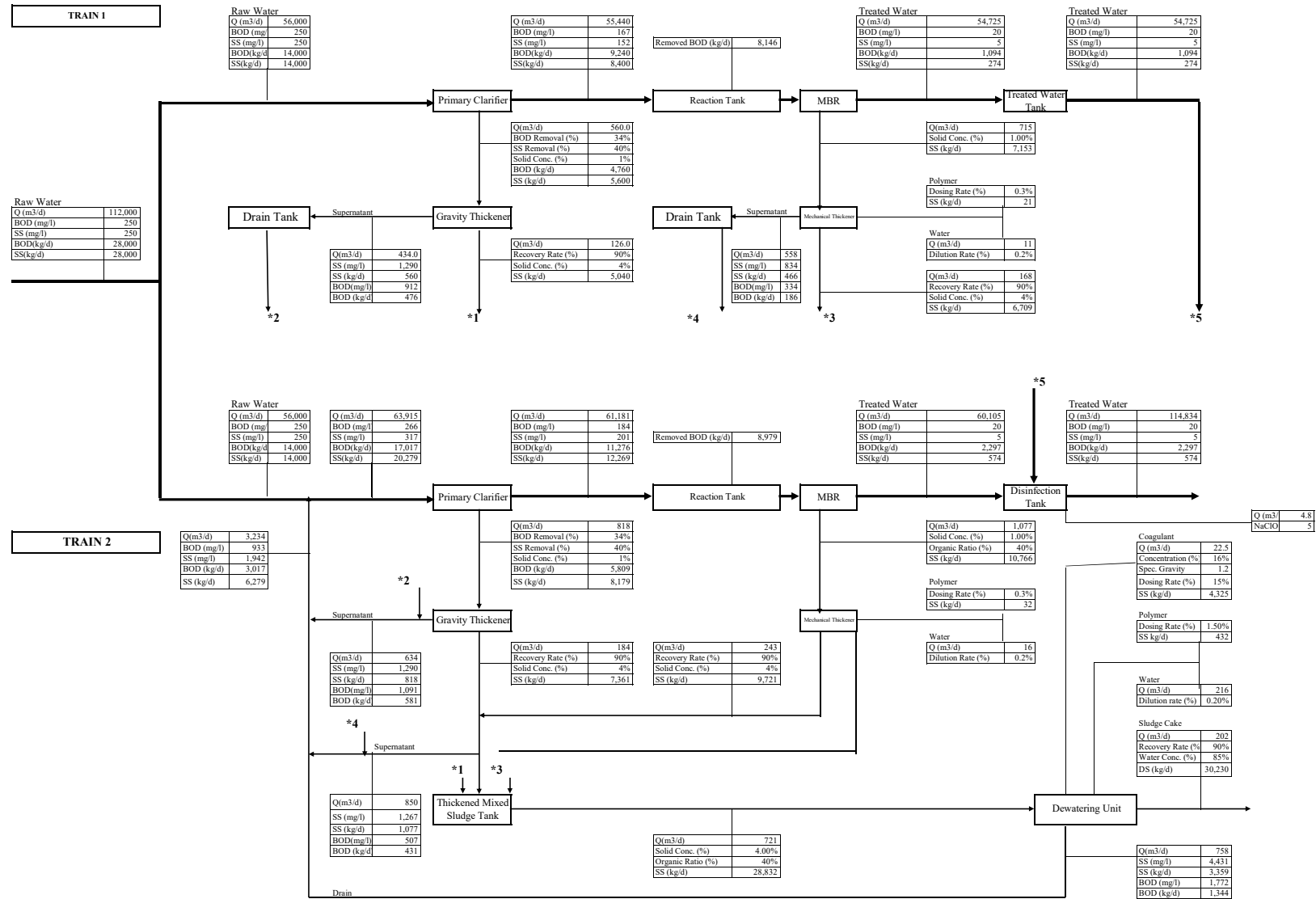
Disinfection Tank

NaClO Dosing Rate	mg/l	5.00
NaClO Concentration	%	12%
NaClO Dosing Amount	kg/d	574
NaClO Doing Flow	m ³ /d	4.8

Effluent (After Disinfection)

Quantity	m ³ /d	114,834
Outlet SS Concentration	mg/l	5
SS	kg/d	574
BOD Concentration	mg/l	20
BOD Amount	kg/d	2,297

MASS BALANCE SHEET (ULTIMATE)



2 Capacity Calculation (Head Works)

ITEM	SYMBOL	DESIGN			
Screen					
1 Hourly Max Flow	Q2-D=	168,000	m3/d		
2 Mimimum Flow Rate	Vscmin=	0.4	m/s		
3 Max Fow Rate	Vscmax=	1	m/s		
4 Target Flow Rate at Peak Flow	Vsc=	0.8	m/s		
5 estimated Water Depth Train	Dsc=	0.5	m		
	Tg=	3			
6 Required Channel width	Wsc=	Q2-D/24/3600/Dsc/Vsc/tg==		1.62037037	
		Say		1.62	m
PUMP PIT					
1 Peak Flow	Q2=	168,000	m3/d		
2 Retention Time	Tp=	5	min		
3 Required Pit Volume	Vrp=	583	m3		
4 Pit Depth	Dpit=	4	m		
5 Required Area	Apit=	146	m2		
Size (half of Shaft)					
Diameter		22	m		
Actual Area		308	m2		
Actual Volume	Vpa=	1,232	m3		
Actual Retention Time	Tpa=	10.6	min		(3 Pits Total)
LIFT PUMP					
1 TRAIN 1					
Flow Rate					
Design	Qe1-D=	56,000	m3/d	38.9	m3/min
Peak	Qe2-D=	84,000	m3/d	58.3	m3/min
2 TRAIN 2					
Flow Rate					
Design	Qn1-D=	56,000	m3/d	38.9	m3/min
Peak	Qn2-D=	84,000	m3/d	58.3	m3/min
3 Selection of Pump					
Flow Control					
Pump Capacity					
70%					
30 m3/min					
Operation method					
Design	Qe1-D=	38.9	m3/min	65%	2 pump Operation
	Qn1-D=	38.9	m3/min	65%	2 pump Operation
Peak	Qe2-D=	58.3	m3/min	97%	2 pump Operation
	Qn2-D=	58.3	m3/min	97%	2 pump Operation
3 Specification					
30 m3/min x 25mH x 4 sets (+2sets common stand-by)					
Dry Pit Submergible Pump					
185 kW/set					

2.4 Capacity Calculation (TRAIN 1)

ITEM	SYMBOL	DESIGN		
Oil Collector				
Channel Quantity	Uc=	1	channels	
Channel Size		W	L	D
		2	4.5	1
Design Flow	Qn1s=	0.648	m3/sec	
Design Max Flow	Qn2s=	0.972	m3/sec	
Max Flow for each Channel	Qmc=	Qn2s/Uc=	0.972	m3/sec
Channel Loss Calculation				
Hydraulic Radius	Rh=	$D*W/(2D+W)=$	0.500	
Flow Velocity	Vf=	$Qmc/(D*W)=$	0.49	m/sec
Rough Coefficient	n=	0.014		
Hydraulic Gradient	I=	$(n*Vf/Rh^{2/3})^2=$		0.000117
Head Loss	Hd=	I*L=	0.0005	m
Pipe Skimmer Specification		300mm dia x opening 100mm		
Oil Separation				
Batch Tank		W	L	D
		1.5	2	1
Floating Scum Collector		Float + Hose		
Waste Oil & Grease Tank		200	lit	
Return Water Pump		0.1 m3/m x 10mH		
Grit Chamber				
1 Hourly Max Flow	Q2-D=	84,000	m3/d	
2 Surface Load	Sfl-G=	1,800	m3/m2/day	
3 Required Surface Area	Sa-G=	Q2-D/Sfl-G=	46.7	m2
4 Tank Width	W=	1.5	m	
5 Tank Length	L=	12	m	
6 Train	Tg=	3	Train	
7 Tank Depth	D=	2.50	m	
8 Actual Surface Area	Saa-G=	W*L*Tg=	54	m2 > 46.7 OK
9 Required Retention Time	Tdist=	1.5	min	
10 Required Volume	Vdist=	Q2-D/24/60*Tdist=	88	m3
11 Required Length	L=	Vdist/W/D/Tg=	7.78	m < 12
12 Tank Design		W 1.5m x L 12 m x D 2.5m (Water level) x 3 train		
Fine Screen				
1 Hourly Max Flow	Q2-D=	84,000	m3/d	
2 Minimum Flow Rate	Vscmin=	0.4	m/s	
3 Max Fow Rate	Vscmax=	1	m/s	
4 Target Flow Rate at Peak Flow	Vsc=	0.8	m/s	
5 Estimated Water Depth	Dsc=	0.5	m	
Train	Tg=	3		
6 Required Channel width	Wsc=	$Q2-D/24/3600/Dsc/Vsc/tg=$		0.810185185
		Say	1.5	m
Distribution Weir				
1 Distribution Weir				
Flow through Distribution Weir	Qdw=	Qn2-D/Udist	10,500	m3/d
		Where		
		Udist: Distribution Points=	8	Places
Allowable Water Level	Hwlp=	0.3	m	
Weir Calculation		$Qdw=1.838*B*Hwlp^{(3/2)}$		
		Where		
		Bdist: Weir Width		
		$Bdist=Qpw/1.838/Hwlp^{(3/2)}$		
Required Weir Width	Bdist=	0.40	m	
		Say	0.6	m

ITEM	SYMBOL	DESIGN
Primary Clarifier		
1 Design Condition		
Design Flow	Qnd=	63,915 m ³ /day (From Mass Balance)
Type		Rectangular Type
Unit Number	UN=	Train Basin/Train Total 4 unit 2 unit 8 unit
2 Design Criteria		
Surface Load	Lh=	75 m ³ /m ² /day
Settling Time	Ts=	1.5 hr
3 Calculation		
Flow Per Unit	Qu=	Qd / UN = 7,989 m ³ /day
Required Area	A=	Qu/Lh = 107 m ² /unit
4 Size		
	W	4.80 m
	L	A/W= 22.2 m Say 23.0
5 Required Depth	Dnp=	Qu/24/W/L= 3.0 m
6 Specification		4.8mW x 13.6 mL x 3.8mD x 2 story with Scraper x 8 x2 sets
7 Weir Calculation		
Weir Load	Lwnp=	250 m ³ /m/d
Required Weir Length	Llwnp=	Qu/Lwnp= 32.0 m total
8 Scum Skimmer		
Pipe Skimmer		300mm dia skimmer x 8 nos.
Scum Pit		1.5m x 2m x 2mD x 2 sets
Scum Pump		0.2 m ³ /min x 10m Submersible pump to Sludge Tank
9 Primary Sludge Pump		
Primary Sludge Amount	Qs=	818 m ³ /d total (from Mass Balance)
Operation Hour	Tpsp=	8 hours/day
Quantity	Upsp=	4 sets/total
Required Flow Rate	Qpsp=	Qs/Tpsp/Upsp= 26 m ³ /h = 0.43 m ³ /min
Specification		End Suction Non Clog Type 0.5 m ³ /min x 10mH x 4sets (+4sets Stand-by)
REACTION TANK		
1. Reaction Tank Size		
Inlet Flow	Qdr	61,181 m ³ /d (from Mass Balance)
Inlet BOD Concentration	BOD in	184 mg/l
Inlet BOD Amount	BOD ia	Qdr*BODin *10 ⁻³ = 11,276 kg/d
BOD SS Load	BSL	0.20
MLSS Concentration	MLSS	8000 mg/l
Required Reaction Tank Volume	Vreact	BODia/BSL/MLSS *1000= 7,047 m ³
Train	Tra	4 Train
Required Volume for each train	Vret	Vreact/Tra= 1,762 m ³
Reaction Tank Size		
Width	Wre	10 m
Length	Lre	28 m
Depth	Dre	6.7 m
Volume	Vreta	1,876 m ³ > 1,762 OK
Total Aeration Volume	Vretat	7,504 m ³ -total

ITEM	SYMBOL	DESIGN			
MBR					
2 Design Condition					
Design Flow	Qdr	61,181	m ³ /day	(From Mass Balance)	
Type		Flat or Hollow Fibre Type Membrane			
Flux	Fln	0.7	m ³ /m ² d	29.2	lmh
Flux at Peak	Flmax	1.05	m ³ /m ² d	43.8	lmh
Membrane Area per Cassettes	Ac	600	m ²		
Cassette quantity					
Required Membrane Area	Arq	Qsec/Fln=	87,402 m ²		
Required Cassette quantity	Ncs	Arq/Ac=	146 nos.		
Actual Cassette quantity	Ncsa		156 nos.		
Actual Membrane Area					
Actual Flux	Flna	Qdr/Arqa=	0.654 m ³ /m ² d	27.24 lmh	
Actual Flux at Peak	Flmaxa	Flna *1.5=	0.980 m ³ /m ² d	40.85 lmh	
Cassette Installtion Area					
Cassette size		W	L	H	
		944.0	2186.0	4213	
Permeate Pump					
1 line Cassettes quantity	U1line=	13			
Required Flow Rate	F1line=	U1line *Ac*Fln=	5,460	m ³ /d	3.79 m ³ /min
		U1line *Ac*Flmax	8,190	m ³ /d	5.69 m ³ /min
			say	4.0 m ³ /min x 5mH x 3 sets	
Agitation Blower					
Air Flow per Cassette	Famu	2 Nm ³ /min/cassettes			
Cassette Quantity	Ncsa	156 nos			
Total Air Flow	Qamt	Famu*Ncsa=	312 Nm ³ /min		
Oxygen Transfer rate for Diffuser	Eam	13%			
SOR calculation for MBR Blower	SORm	Qamt*(Eam*10 ⁻² *ρ*Ow)*60			
		ρ : Air Density=	1.293 kg air/Nm ³		
		Ow: Oxygen Weigh per Air Unit	0.233 kg-O ₂ /kg-air		
	SORm	733 kg-O ₂ /h			
Specification		78 Nm ³ /min x 7mH x 4 (+1 S/B)			
3 Oxygen Requirement(Blower Calculation)					
3.1 Oxygen Demand					
1) Oxygen Demand for Organic Matter					
Oxygen Demand	Db =	(BODin-BODout)*Qin /1000*B			
		Where			
		BODin: BOD Inlet	184 mg/l (Mass Balance)		
		BODout: BOD outlet	20 mg/l (Treated Water)		
		Qin: Flow Inlet	61,181 m ³ /d (Mass Balance)		
		B: Required Oxygen per BOD removal per k ₁	0.45 kg-O ₂ /kg-BOD		
Oxygen Demand Calculation	Db=	4,524 kg-O ₂ /day			
2) Oxygen Demand for Nitrification					
Oxygen Demand	Dn=	C*(Nnin-Nnout)*Qin/1000			
		Where			
		C: Oxygen Requirement for nitrification per l	4.57 kg-O ₂ /kg-N		
		Nnin: inlet Organic Nitrogen	27 mg/l	(Mass Balamce)	
		Nout: Outlet Organic Nitrige	25 mg/l		
Oxygen Demand Calculation	Dn=	586 kg-O ₂ /day			
3) Oxygen Demand for					
For Endogenous Respiration					
Oxygen Deman Calculation	De=	Vreta*MLSS*Tra* η /1000			
		Where			
		Vreta: Reaction Tank Volum	1,876 m ³		
		MLSS: MLSS in Aeration T:	8000 mg/l		
		Tra: Train	4		
		η : Oxygen demand for Endogeneus Respiration per MLVSSkg	0.1 kg-O ₂ /kg-MLVSS		
Oxygen Deman Calculation	De=	6,003 kg-O ₂ /day			

ITEM	SYMBOL	DESIGN
4) Remaining O2 in Reaction Tank	D0=	Ca*Qin/1000 Where Ca: Remaining O2 Concentration 2 mg/l Qin: 61,181 m3/d
Oxygen Deman Calculation	D0=	122 kg/d
5) Total Oxygen Demand	AOR	Db+Dn+De+D0= 11,236 kg/d
3.2 Standard Oxygen Demand	SORa	SORa=(AOR*Csw * r) / (1.024 ^(T-20) * α * (β * Cs * r-C _A))/t Where Csw: Oxygen saturation concentration in clean water at temperature 20°C Csw= 8.84 mg/l T: Temperature of Water T= 26 °C α : Ratio of Oxygen transfer rate in the waste to that in clear water at the same temperature α = 0.7 β : Ratio of Oxygen saturation concentration in the waste to that in clean water β = 0.95 Cs: Oxygen saturation concentration in clean water at Temperature T Cs= 8.11 mg/l C _A : Residual dissolved oxygen concentration in the waste water C _A = 2 mg/l r : Correction of Cs from water depth r=1+(H/2)/10.24= 1.32 H : Water Depth(Average of HWL and LWL) H= 6.5 m t : Aeration time per day t= 24 hr/day
Calculation of SOR	SORa=	829 kg-O2/h 19,894 kg/d
Required SOR for Blower	SOR =	SORa-SORm= 96 kg-O2/h
3.3 Air Requirement	Qair=	SOR/(Ea×10 ⁻² × ρ ×Ow)/60= Where Ea: Diffuser Efficiency at Diffuser Depth= 20% ρ : Air Density= 1.293 kg air/Nm ³ Ow: Oxygen Weigh per Air Unit 0.233 kg-O2/kg-air
Calculation of Qair	Qair=	27 Nm3/min
Actual Air Flow	Qaa=	Qair*(273+T)/273= (T=40°C) 31 m3/min 44,842 m3/day
Equipment		Agitation Blower 78Nm3/min x 7mH x 8sets (total) Aeration Blower 42Nm3/min x 7mH x 4 sets (Total) Common Stand-by 78 Nm3.min x 7mH x 1 set
3.4 Fine Diffuser		
Diffuser Flow	Qdif=	5.00 Nm3/h/pc
Diffuser Quantity	Xdif=	326 pc
4. Waste Sludge Pump		
Waste Sludge Quantity	Qw=	1,077 m3/day (from Mass Balance)
Operation Hour	Tw=	8 hours
Quantity	Uw=	4 sets
Required Flow Rate	Qws=	Qw/Tw/Uw= 33.64 m3/h = 0.56 m3/min
Specification		End Suction Non Clog Type 0.6m3/min x 10mH x 4 sets (+4sets Stand-by)

ITEM	SYMBOL	DESIGN	
CHEMICAL CLAENING			
1 Chemical Feeding			
Flow per cassettes	Vc= Qch=	Volume Feed Rate	1200 x 2 = 2400 lit/cassettes 180~240 240 lit/min
Chemical Concentration	Ccl= Cac=	NaClO Citric Acid	0.25~0.6% 0.50% 0.5~1% 1%
Cleaning cassettes No.	Xclean=	one Permeate Pump :	13 cassettes
Cleaning Solution Volume	Vct=	Vc*Xclean=	31.2 m3
Cleaning Solution Feed Rate	Qcht=	Qch*Xclean=	3.12 m3/min
Chemical Usage per Cleaning			
NaClO	Vclc=	Vct*Ccl*1000=	156 kg/cleaning as 100% NaClO 1,182 lit/cleaning as 12% NaClO
Citric Acid	Vacc=	Vct*Cac*1000=	312 kg/cleaning as 100% Citric Acid 348 lit/cleaning as 70% Citric Acid Density 1.28 kg/lit
Required Chemical Tank Volume			
NaClO	Vtcl=	Vclc*30/1000=	35 m3 as 12% NaClO 1 month retentior : say every day 1 line cleaning (8 days interval)
Citric Acid	Vtac=	Aacc*8/1000=	2.8 m3 as 70% Citrica Acid 1 month retentior : say every month 1 time per 1 line (total 8 lines)
Required Chemical Feed Tank	Vfeed=	Vc/1000=	2.4 m3
Specification			1. NaClO Tank 70 m3 Note: add Disinfection for final 70m3 x 2 sets 2. NaClO Feed Tank 2.4 m3 3. NaClO Transfer Pump 19.7 lit/min 4. NaClO Feed Pump 120 lit/min x 2 sets 5. Citric Acid Tank 5 m3 6. Citric Acid Feed Tank 2.4 m3 7. Citric Acid Transfer Pump 5.80 lit/min 8. Citric Acid Feed Pump 240 lit/min
TREATED WATER TANK			
Required Capacity			
Water Reuse	Qreuse=		2,656 m3/day
Retention Time	Ttrw=		40 min for Water Reuse
Required Capacity	Xtrw=		74 m3
DISINFECTION TANK (Ultimate)			
Required Capacity			
Required Retention Time	Tdis=		15 min (Including pipe Line)
Flow Rate	Qdis=		114,834 m3/d (from Mass Balance)
Require Tank Volume	Vdis=	Qdis/24/60*Tdis=	1196 m3
Pipe Line Volume	Vp=		530 m3 (1.5m dia x 300m)
Actual Required Volume	Vda=	Vdis-Vp=	666 m3
Dimension		3.1mW x41.2mL x 5.37mH=	686 m3
Chlorine Dosing Rate	Ccl=		5 mg/l
Required Chlorine amount	Wcl=	Qdis*Ccl*10^-3=	574 kg/day
Chlorine Concentration	Cconc=		10%
Required NaClO flow rate	Qcl=		5,742 lit/day
Required Dosing Pump Capacity	Qclp=		4.0 lit/min Say 2 lit/min x 2 sets (+1)

3 Capacity Calculation (TRAIN 1)

ITEM	SYMBOL	DESIGN			
Oil Collector					
Channel Quantity	Uc=	1	channels		
Channel Size		W	L	D	
		1	4.5	1	
Design Flow	Qn1s=	0.648	m3/sec		
Design Max Flow	Qn2s=	0.972	m3/sec		
Max Flow for each Channel	Qmc=	Qn2s/Uc=	0.972	m3/sec	
Channel Loss Calculation					
Hydraulic Radius	Rh=	$D*W/(2D+W)=$	0.333		
Flow Velocity	Vf=	$Qmc/(D*W)=$	0.97	m/sec	
Rough Coefficient	n=	0.014			
Hydraulic Gradient	I=	$(n*Vf/Rh^{2/3})^2=$		0.000802	
Head Loss	Hd=	$I*L=$	0.0036	m	
Pipe Skimmer Specification		400mm dia x opening 100mm			
Oil Separation					
Batch Tank		W	L	D	
		1.5	2	1	
Floating Scum Collector		Float + Hose			
Waste Oil & Grease Tank		200	lit		
Return Water Pump		0.1 m3/m x 10mH			
Grit Chamber					
1 Hourly Max Flow	Q2-D=	84,000	m3/d		
2 Surface Load	Sfl-G=	1,800	m3/m2/day		
3 Required Surface Area	Sa-G=	$Q2-D/Sfl-G=$	46.7	m2	
4 Tank Width	W=	2	m		
5 Tank Length	L=	10	m		
6 Train	Tg=	2	Train		
7 Tank Depth	D=	2.50	m		
8 Actual Surface Area	Saa-G	$W*L*Tg=$	40	m2	> ### OK
9 Required Retention Time	Tdist=	1.5	min		
# Required Volume	Vdist=	$Q2-D/24/60*Tdist=$	88	m3	
# Required Length	L=	$Vdist/W/D/Tg=$	8.75	m	< 10
# Tank Design		W 2 m x L 10 m x D 2.0m (Water level) x2 train			
Fine Screen					
1 Hourly Max Flow	Q2-D=	84,000	m3/d		
2 Minimum Flow Rate	Vscmin=	0.4	m/s		
3 Max Flow Rate	Vscmax=	1	m/s		
4 Target Flow Rate at Peak Flow	Vsc=	0.8	m/s		
5 estimated Water Depth	Dsc=	0.5	m		
Train	Tg=	2			
6 Required Channel width	Wsc=	$Q2-D/24/3600/Dsc/Vsc/tg==$	1.215277778		
		Say	1	m	
Distribution Weir					
1 Distribution Weir					
Flow through Distribution Weir	Qdw=	$Qn2-D/Udist$	10,500	m3/d	
		Where			
		Udist: Distribution Points=	8	places	
Allowable Water Level	Hwlp=	0.3	m		
Weir Calculation		$Qpw=1.838*B*Hwlp^{(3/2)}$			
		Where			
		Bdist: Weir Width			
		$Bdist=Qpw/1.838/Hwlp^{(3/2)}$			
Required Weir Width	Bdist=	0.40	m		
		Say	0.4	m	

ITEM	SYMBOL	DESIGN
Primary Clarifier		
1 Design Condition		
Design Flow	Qnd=	56,000 m ³ /day (From Mass Balance)
Type		Rectangular Parallel Flow
Unit Number	UN=	Train Basin/Train Total
		4 unit 2 unit 8 unit
2 Design Criteria		
Surface Load	Lh=	75 m ³ /m ² /day
Settling Time	Ts=	1.5 hr
3 Calculation		
Flow Per Unit	Qu=	Qd / UN = 7,000 m ³ /day
Required Area	A=	Qu/Lh = 93 m ² /unit
4 Size		
	W	4.42 m
	L	A/W= 21.12 m
		Say 20.00 m
5 Depth		
	D=	2.8 m
Settling Time	Tsa=	D*L*W*24/Qu= 0.85
6 Specification		4.42mW x 16mL x 2.8 mD with Scraper x 4 sets
7 Weir Calculation		
Weir Load	Lwnp=	250 m ³ /m/d
Required Weir Length	Llwnp=	Qu/Lwnp= 28.0 m
8 Scum Skimmer		
Pipe Skimmer		400mm dia skimmer x 8 nos.
Scum Pit		1 m ³ x 2 sets
Scum Pump		0.1 m ³ /min x 10m Submersible pump to Sludge Tank
9 Primary Sludge Pump		
Primary Sludge Amount	Qs=	560 m ³ /d total (from Mass Balance)
Operation Hour	Tpsp=	8 hours/day
Quantity	Upsp=	8 sets/total
Required Flow Rate	Qpsp=	Qs/Tpsp/Upsp= 9 m ³ /h = 0.15 m ³ /min
Specification		Submergible pump 0.1 m ³ /min x 10mH x 16sets
REACTION TANK		
1. Reaction Tank Size		
Inlet Flow	Qdr	55,440 m ³ /d (from Mass Balance)
Inlet BOD Concentration	BOD in	167 mg/l
Inlet BOD Amount	BOD ia	Qdr*BODin *10 ⁻³ = 9,240 kg/d
BOD SS Load	BSL	0.20
MLSS Concentration	MLSS	8,000 mg/l
Required Reaction Tank Volume	Vreact	BODia/BSL/MLSS *1000= 5,775 m ³
Train	Tra	4 Train
Required Volume for each train	Vret	Vreact/Tra= 1,444 m ³
Reaction Tank Size		
Width	Wre	9.0 m
Length	Lre	45 m
Depth	Dre	3.3 m
Volume	Vreta	1,337 m ³ > ### OK
Total Aeration Volume	Vretat	5,346 m ³ -total

ITEM	SYMBOL	DESIGN			
MBR					
2 Design Condition					
Design Flow	Qdr	55,440	m ³ /day	(From Mass Balance)	
Type		Flat Type Membrane			
Flux	Fln	0.7	m ³ /m ² d	29.2	lmh
Flux at Peak	Flmax	1.4	m ³ /m ² d	58.3	lmh
Membrane Area per Cassettes	Ac	400	m ²		
Cassette quantity					
Required Membrane Area	Arq	Qsec/Fln=	79,200 m ²		
Required Cassette quantity	Ncs	Arq/Ac=	198 nos.		
Actual Cassette quantity	Ncsa		156 nos.		
Cassette Installtion Area					
Cassette size		W	L	H	
		944.0	2186.0	2923	
Permeate Pump					
1 line Cassettes quantity	U1line=	20			
Required Flow Rate	F1line=	U1line *Ac*Fln=	5,460	m ³ /d	###'min
		U1line *Ac*Flmax	10,920	m ³ /d	m ³ /min
				say	3.6 m ³ /min x 5mH x 3 sets
Air Flow per Cassette	Famu	2 Nm ³ /min/cassettes			
Cassette Quantity	Ncsa	156 nos			
Total Air Flow	Qamt	Famu*Ncsa=	312 Nm ³ /min		
Oxygen Transfer rate for Diffuser	Eam	9%			
SOR calculation for MBR Blower	SORm	Qamt*(Eam*10 ⁻² *ρ*Ow) *60			
		ρ : Air Density=	1.3 kg air/Nm ³		
		Ow: Oxygen Weigh per Air Unit	0.2 kg-O ₂ /kg-air		
	SORm	508 kg-O ₂ /h			
Specification		78 m ³ /min x 4.mH x 4 (+1 S/B)			
3 Oxygen Requirement(Blower Calculation)					
3.1 Oxygen Demand					
1) Oxygen Demand for Organic Matter					
Oxygen Demand	Db =	(BODin-BODout)*Qin /1000*B			
		Where			
		BODin: BOD Inlet	167 mg/l (Mass Balance)		
		BODout: BOD outlet	20 mg/l (Treated Water)		
		Qin: Flow Inlet	55,440 m ³ /d (Mass Balance)		
		B: Required Oxygen per BOD removal per k 0.5 kg-O ₂ /kg-BOD			
Oxygen Demand Calculation	Db=	3,659 kg-O ₂ /day			
2) Oxygen Demand for Nitrification					
Oxygen Demand	Dn=	C*(Nnin-Nnout)*Qin/1000			
		Where			
		C: Oxygen Requirement for nitrification per	4.6 kg-O ₂ /kg-N		
		Nnin: inlet Organic Nitrogen	27 mg/l (Mass Balamce)		
		Nnout: Outlet Organic Nitriger	1 mg/l		
Oxygen Deman Calculation	Dn=	6,650 kg-O ₂ /day			
3) Oxygen Demand for					
For Endogenous Respiration					
	De=	Vreta*MLSS*Tra* η /1000			
		Where			
		Vreta: Reaction Tank Volume	1,337 m ³		
		MLSS: MLSS in Aeration Ta	8000 mg/l		
		Tra: Train	4		
		η : Oxygen demand for Endogeneous Respiration per MLVSSkg	0.1 kg-O ₂ /kg-MLVSS		
Oxygen Deman Calculation	De=	4,277 kg-O ₂ /day			

ITEM	SYMBOL	DESIGN
4) Remaining O2 in Reaction Tank	D0=	Ca*Qin/1000 Where Ca: Remaining O2 Concentration 2 mg/l Qin: 55,440 m3/d
Oxygen Deman Calculation	D0=	111 kg/d
5) Total Oxygen Demand	AOR	Db+Dn+De+D0= 14,697 kg/d
3.2 Standard Oxygen Demand	SORa	SORa=(AOR*Csw * r) / (1.024 ^(T-20) * α * (β * Cs * r-C _A))/t Where Csw: Oxygen saturation concentration in clean water at temperature 20°C Csw= 8.8 mg/l T: Temperature of Water T= 26 °C α : Ratio of Oxygen transfer rate in the waste to that in clear water at the same temperature α = 0.8 β : Ratio of Oxygen saturation concentration in the waste to that in clean water β = ### Cs: Oxygen saturation concentration in clean water at Temperature T Cs= 8.1 mg/l C _A : Residual dissolved oxygen concentration in the waste water C _A = 2 mg/l r : Correction of Cs from water depth r=1+(H/2)/10.24= ### H : Water Depth(Average of HWL and LWL) H= ### m t : Aeration time per day t= 24 hr/day
Calculation of SOR	SORa=	946 kg-O2/h 22,696 kg/d
Required SOR for Blower	SOR =	SORa-SORm= 438 kg-O2/h
3.3 Air Requirement	Qair=	SOR/(Ea×10 ⁻² × ρ ×Ow) /60=
Calculation of Qair	Qair=	121 Nm3/min Where Ea: Diffuser Efficiency at Diffuser Depth= ### ρ : Air Density= 1.3 kg air/Nm ³ Ow: Oxygen Weigh per Air Unit 0.2 kg-O2/kg-air
Actual Air Flow	Qaa=	Qair*(273+T)/273= 133 m3/min (T=26°C) 191,116 m3/day
Specification	Qw=	30 Nm3/min x 4mH x 4 sets (+1 set S/B)
Waste Sludge Quantity	Tw=	715 m3/day (from Mass Balance)
Operation Hour	Uw=	8 hours
Quantity	Qws=	4 sets
Required Flow Rate		Qw/Tw/Uw= 22.35 m3/h = 0.37 m3/min
Specification		End Suction Non Clog Type 0.3m3/min x 10mH x 4 sets (+4sets Stand-by)

ITEM	SYMBOL	DESIGN	
CHEMICAL CLAENING			
1 Chemical Feeding			
Flow per cassettes	Vc= Qch=	Volume Feed Rate	1200 lit/cassettes 240 lit/min 180~240
Chemical Concentration	Ccl= Cac=	NaClO Citric Acid	0.25~0.6% 0.5~1% 0.50% 1%
Cleaning cassettes No.	Xclean=	one Permeate Pump :	19.5 cassettes
Cleaning Solution Volume	Vct=	Vc*Xclean=	23.4 m3
Cleaning Solution Feed Rate	Qcht=	Qch*Xclean=	4.68 m3/min
Chemical Usage per Cleaning			
NaClO	Vclc=	Vct*Ccl*1000=	117 kg/cleaning as 100% NaClO 886 lit/cleaning as 12% NaClO
Citric Acid	Vacc=	Vct*Cac*1000=	234 kg/cleaning as 100% Citric Acid 261 lit/cleaning as 70% Citric Acid Den 1.3 kg/lit
Required Chemical Tank Volume			
NaClO	Vtcl=	Vclc*30/1000=	27 m3 as 12% NaClO say 70 m3
Citric Acid	Vtac=	Aacc*8/1000=	2.1 m3 as 70% Citrica Acid
			1 month retention : say every day 1 line cleaning (8 days interval) 1 month retention : say every month 1 time per 1 line (total 8 lines)
Required Chemical Feed Tank	Vcfeed=	Vc/1000=	1.2 m3
Specification			1. NaClO Tank 70 m3 NOTE: Same size with New Plant 2. NaClO Feed Tank 3. NaClO Transfer Pump 4. NaClO Feed Pump Item 2 to 8, Use New 5. Citric Acid Tank Plant Chemical Feed 6. Citric Acid Feed Tank System as commom 7. Citric Acid Transfer Pump 8. Citric Acid Feed Pump
TREATED WATER TANK			
Required Capacity			
Water Reuse	Qreuse=		2,000 m3/day
Retention Time	Ttrw=		40 min for Water Reuse
Required Capacity	Xtrw=		56 m3

3 Capacity Calculation (Sludge Stream)

ITEM	SYMBOL	DESIGN	
Gravity Thickener for Primary Sludge			
1 Sludge Flow	Qgtn=	818	m3/d (from Mass Balance-New)
	Qgte=	560	m3/d (from Mass Balance-Ex)
Total	Qgt=	1,378	m3/d
2 Solid Loading	Slg=	90	kg/m2/d
3 SS in Sludge	SSgn=	8,179	kg/d (from Mass Balance-New)
	SSge=	5,600	kg/d (from Mass Balance-Ex)
Total	Ssg=	13,779	kg/d
4 Required Area	Arg=	SSg/Slg=	153.1 m2
5 Unit No.	Ugt=	2	Units
6 Required Area for each Unit	Argu=	Arg/Ugt=	76.6 m2
7 Required Diameter	Dgt=	sqrt(Arg*4/pi)=	9.9 m
8 Designed Diameter	Dgta	10	m
9 Water Depth	Hwd=	4	m
10 Total Volume	Vgt=	Pi()*Dgta^2/4*Hwd=	314 m3
11 Retention Time	Trgt=	Vgt/Qgt*24=	9.2 hours
12 Thickener Pump			
Flow for New Plant	Qgsln=	184	
Flow for Existion	Qgsle=	126	
Operation Hour	Tgsl=	8	h/d
Quantity	Ugsl=	2	sets
Required Flow Rate	Qgp=	19.38	m3/h
		0.32	m3/min
Specification		0.4 m3/min x 10mH x 2 sets (+ 2 sets Stand-by)	
Mechanical Thickener for Secondary Sludge			
1 Sludge Flow	Qmtn=	1,077	m3/d (from Mass Balance-New)
	Qmte=	715	m3/d (from Mass Balance-Ex)
Total	Qmt=	1,792	m3/d
2 Loading Capacity	Slmt=	90	m3/h/unit
3 Operation Hour	Homt=	24	h/d
4 Operation day per Week	Tomt=	7	days/week
5 Required Thickening Capacity	Qumt=	Qmt*7/Homt/Tomt=	75 m3/h
2 Required quantity	Umt=	Qumt/Slmt=	0.83 Unit
6 Designed Quantity	Umta=	1	Units
7 Polymer Dosing Rate	Rmtp=	0.30%	per DS
8 Sludge Flow	SSmtn=	10,766	kg/d (from Mass Balance-New)
	Ssmte=	7,153	kg/d (from Mass Balance-Ex)
Total	SSmt=	17,919	kg/d
9 Required Polymer amount (For Dosing Pump selection)	Mpmt=	SSmt*Rmtp=	53.8 kg/d (for Unitility calculation)
10 Sludge Concentration (Inlet)	Cssmt=	SSmt/Qmt=	10.00 kg/m3 ###
11 SS flow per unit	SSmtu=	Slmt*Ccssmt=	900.0 kg/h
12 Required Polymer amount per u	Mpmtu=	Ssmtu*Rmtp=	2.7 kg/h/unit
13 Polymer Dilution Rate	Lpdrp=	0.20%	
14 Required Polymer feed Flow (For Polymer Tank Selection)	Qpmt=	Mpmtu/Lpdrp=	1,350 lit/h/unit
15 Polymer tank retention time	Hmtp=	8	hours
16 Required Tank Volume (total)	Vpmt=	Qpmt*Hmtp*Umta*10^-3=	10.8 m3
17 Tank quantity	Uptmt=	1	unit
18 Tank Capacity	Vpmtu=	Vpmt/Uptmt=	10.8 m3/unit
Equipment		Feed Pump	1.5 m3/min x 10mH x 2 unit
		Mechanical Thickener	90 m3/h/unit x 1 Unit (+ 1 Stand-by)
		Polymer Dosing Pump	1080lit/h x 1 Unit (+ 1 stand-by)
		Auto Polymer Feed Equipment	1.4 m3/h x 1 unit (+1 unit Stand-by)

3 Capacity Calculation (Sludge Stream)

ITEM	SYMBOL	DESIGN
SLUDGE Tank		
Sludge Flow to Mechanical Thickener	Qfm=	896 m ³ /d
Retention time 4 hours	Vslt=	149 m ³
Tank Size	W=	8 m
	L=	5 m
	D=	4 m
		160 m ³
Mixed Sludge Tank		
Sludge Flow to Dewatering Unit		
From Gravity Thickener	Qg=	310.03 m ³ /d
From Mech Thickener	Qm=	411 m ³ /d
Total		720.79 m ³ /d
Retention		4 hours
Required Volume		120.13 m ³
Tank Size	W=	8 m
	L=	4 m
	D=	4 m
		128 m ³
Dewatering Unit		
1 Sludge Flow	Qdwe=	721 m ³ /d
2 Solid Loading Capacity	Ldw=	880 kg/h/unit
3 Dry Solid Flow	SSdw=	28,832 kg/d
4 Operation Hour	Hodw=	24 h/d
5 Operation day per Week	Todw=	7 days/week
6 Required Dewatering Capacity	Ssudw= SSdw*7/Hodw/todw=	1,201 kg-ds/h
4 Required Quantity	Udw= Ssudw/Ldw=	1.37 Unit
5 Design Quantity	Udwa=	2 Unit
Polymer		
Polymer Dosing Rate	Rdwp=	1.5%
Required Polymer amount	Mpdw= SSdw*Rdwp=	432.5 kg/d (for Unitility calculation)
(For Dosing Pump selection)		
SS flow per unit	Ldw=	880 kg/h/unit
Required Polymer amount per unit	Mpdwu= Ldw*Rdwp=	13.2 kg/h
Polymer Dilution Rate	Lpdw=	0.2%
Required Polymer feed Flow	Qpdw= Mpdwu/Lpdw=	6600 lit/h 110.0 lit/min
(For Polymer Tank Selection)		
Polymer tank retention time	Hdwpt=	8 hours
Required Tank Volume (total)	Vptdw= Qpdw*Hdwpt*Udwa*10 ⁻³ =	105.6 m ³
Tank quantity	Uptdw=	5 unit
Tank Capacity	Vpdwu= Vptdw/Uptdw=	21.12 m ³ /unit

3 Capacity Calculation (Sludge Stream)

ITEM	SYMBOL	DESIGN
Coagulant		
Coagulant Dosing Rate	Rdwc=	15%
Required Coagulant amount	Mcdw=	SSdw*Rdwc= 4,325 kg/d (for Unitility calculation)
(For Dosing Pump selection)		
SS flow per unit	Ldw=	880.0 kg/h/unit
Required Coagulant amount per	Mcdwu=	Ldw*Rdwc= 132.0 kg/h
Coagulant Dilution Rate	Lcdw=	16%
Required Coagulant feed Flow	Qcdw=	Medwu/Lcdw= 825.0 lit/h 13.8 lit/min
(For Coagulant Tank Selection)		
Coagulant tank retention time	Hdwct=	8 hours
Required Tank Volume (total)	Vctdw=	Qcdw*Hdwct 6.60 m3
Tank quantity	Uctdw=	2 Units
Tank Capacity	Vcdwu=	Vctdw/Uctdw= 3 m3/unit
Sludge Feed Pump Capacity	Qslf=	Ldw/Ctsl= 22000 lit/h= 0.4 'min Ctsl= 4%
Equipment		Feed Pump x 3 unit 0.36667 m3/min Dewatering Unit x 2 Unit (+1 Stand-by) 880.0 kg/h/unit Polymer Doing Pump x 3 unit 110.0 lit/min Coagulant Dosing Pump x 3unit 13.8 lit/min Auto Polymer Feed Equipment x 2 unit 15 m3/h/unit Coagulant Tank x 2 unit 9 unit

3 Capacity Calculation (Odour Treatment)

ITEM	SYMBOL	DESIGN
BIO TOWER		
Head Works		
Air Exchange	Tair=	6 times/hour
Head Works Room Volume		
	Vhead=	Grid +Pump pit 3,081 m ³ Note: Pump Room and other place shall be normal ventilation Chimney
Odour Flow Rate	QairH=	18,487 m ³ /h= 5.14 m ³ /sec 0.7 m
Linear Velocity	Lvb=	0.3 m/s
Required Area	Aair=	QairH/Lvb 17.1 m ²
S/V	Asv=	200 m ³ /m ³ /h
Required Media Size	Vmedia=	QairH/Asv 92.4 m ³
	W=	2 m
	L0=	8.6 m
Actual L	L=	10.0 m
Media Height	Hmed=	5.40 m
Actual H	H=	8 mH
Sludge Dewatering Room		
Air Exchange	Tair=	6 times/hour
Dewatering Room	Vdew=	2,100 m ³ Chimney
Odour Flow Rate	QairS=	12,600 m ³ /h 0.5 m
Linear Velocity	Lvb=	0.3 m/s
Required Area	Aair=	QairS/Lvb 11.7 m ²
S/V	Asv=	200 m ³ /m ³ /h
Required Media Size	Vmedia=	QairS/Asv 63.0 m ³
	W=	3.00 m
	L0=	3.9 m
Actual L	L=	9.5 m
Media Height	Hmed=	5.40 m
Actual H	H=	8 mH

	Description	Flow Rate (m ³ /d) Max	Velocity (m/sec)	Required Size (m)	Pipe Size (mm)
1	Feed Pipe				
1.1	From Pump to WTF 1	105,000	1.5	1.015657	1100
1.2	From Pump to WTF 2	63,000	1.5	0.786725	800
2	Overflow pipe				
1.1	After WTF 1 Settling Tank	105,000	1.50	1.015657	1100
1.2	After WTF 2 Settling Tank	63,000	1.00	0.963537	1000
3	Before Disinfection Tank	168,000	1.00	1.57345	1500

Facility	Purpose of Use	Total Number of Unit	①	②	③	④	⑤	⑥	⑦	system		Remarks
			Number of Duty Operation unit	Number of Simultaneous Operation unit	Water Supply Amount per unit	Water Supply Hours	Maximum Instantaneous Water Supply L/min	Hourly Maximum Water Supply m ³ /h	Daily Water Supply Amount m ³ /d	Filtered Water		
	(Reuse Water)											
	Reaction Tank	160	160	160	15	24	2,400	144.0	3456.0			Scum Removal Water (nozzles)
	Dewatering Unit	8	8	8	100	24	800	48.0	1152.0			
	Floor Washing	1	1	1	20	8	100	6.0	48.0			
	Sub-Total						3,300	198	4,656			

Appendix 5 既存汚水処理施設の容量計算

APPENDIX 5

Temporary Facility (Existng WTF)

CALCULATION SHEET

(Conventional Activated Slude Method)

1. BASIC CONDITIONS

1-1 BASIC ITEMS

- (1) Name :
- (2) Land Area : Approximately ha
- (3) Ground Level : 30.60 m
- (4) Inlet Pipe Diameter and Invert Level :

- (5) Land Use : Existing
- (6) Collection System : Separate Sewer System
- (7) Treatment Method [**Sewage Treatment**] Standard Activated Sludge Method
[**Sludge Treatment**]
- (8) Effluent Discharge Point : River
- (9) Discharge Point Water Level : _____ m
- (10) Design Target Year :

1-2 Design Population

Design Population (STP) Proposed Project: PE (Population Equivalent)

2 DESIGN CALCULATION

2-1 DESIGN CONDITION AND CRITERIA

2-1-1 Design Sewage Flow

1) Proposed Project

ITEM	m ³ /day	m ³ /hr	m ³ /min	m ³ /sec
Daily Average (Q ₁)	2,000 (Q _{1-D})	83 (Q _{1-H})	1.39 (Q _{1-M})	0.023 (Q _{1-S})
Hourly Maximum (PEAK FLOW)(Q ₂)	2,000 (Q _{2-D})	83 (Q _{2-H})	1.39 (Q _{2-M})	0.023 (Q _{2-S})

2-1-2 Design Sewage Quality

ITEM	INFLUENT	Primary Treatment		Secondary Treatment		Total Removal
	Sewage (mg/L)	Removal % (%)	Effluent (mg/L)	Removal Ratio (%)	EFFLUENT (mg/L)	
BOD	600	32%	408	95.1%	20	96.7%
SS	600	40%	360	94.4%	20	96.7%
COD	500	-			60	
T-N	-					
AMN	-				-	
Nitrate N	-				-	
T-P	-				-	
Oil & Grease	-				2	

2-1-3 Design Criteria

ITEMS	UNIT	Standard Application	Application
Reaction Tank			
(1) BOD-SS Load	kg/kg/day	0.1~0.25	0.2
(2) MLSS Concentration	mg/l	3,000	3,000
(3) Return Sludge Ratio	%	100	100
(4) SRT	day	NA	NA
(5) Water Depth	m	4	4.2
(6) Hydraulic Retention Time (HRT)	hr	Calculation	
(7) Oxygen Requirement	kgO ₂ /kg-substrate	1.5	1.5
(8) BOD Yield	%	50%	50%
(9) Organic Ratio in SS	%	50%~85%	80%
(10) Sludge self oxidization rate	1/day	0.01~0.07	0.05
(11) Remain Oxygen in Aeration Tank	mg/l	1~2	2.0
Secondary Clarifier			
(1) Surface Load for Daily Average	m ³ /m ² /d	20	20
(2) Water Depth	m	3.5	3.5
(3) Weir Loading	m ³ /m/d	150	150
(4) Sludge Concentration	%	0.80%	0.8%
(5) Settling Time	hr	4	4.0

2.3 Capacity Calculation (Liquid Stream)

ITEM	SYMBOL	DESIGN	
REACTION TANK			
1. Reaction Tank Size			
Inlet Flow	Qdr	2,000 m3/d	
Inlet BOD Concentration	BOD in	600 mg/l	
Inlet BOD Amount	BOD ia	$Qdr * BODin * 10^{-3} =$	1,200 kg/d
BOD SS Load	BSL	0.2	
MLSS Concentration	MLSS	3000 mg/l	
Required Reaction Tank Volume	Vreact	$BODia / BSL / MLSS * 1000 =$	2,000 m3
Train	Tra	1 Train	
Required Volume for each train	Vret	$Vreact / Tra =$	2,000 m3
Reaction Tank Size			
Width	Wre	18 m	
Length	Lre	50 m	
Depth	Dre	4 m	
Volume	Vreta	3,780 m3	> 2,000 OK
Total Aeration Volume	Vretat	3,780 m3-total	
2 Oxygen Requirement(Surface Aerator Calculation)			
2.1 Oxygen Demand			
1) Oxygen Demand for Organic Matter			
Oxygen Demand	Db =	$(BODin - BODout) * Qin / 1000 * B$	
	Where		
	BODin: BOD Inlet	600 mg/l	
	BODout: BOD outlet	20 mg/l (Treated Water)	
	Qin: Flow Inlet	2,000 m3/d	
	B: Required Oxygen per BOD removal per kg	0.45 kg-O2/kg-BOD	
Oxygen Demand Calculation	Db =	522 kg-O2/day	
2) Oxygen Demand for Nitrification			
Oxygen Demand	Dn =	$C * (Nnin - Nnout) * Qin / 1000$	
	Where		
	C: Oxygen Requirement for nitrification per kg	4.57 kg-O2/kg-N	
	Nnin: inlet Organic Nitrogen :	0 mg/l (Mass Balance)	
	Nnout: Outlet Organic Nitrogen	0 mg/l	
Oxygen Deman Calculation	Dn =	0 kg-O2/day	
3) Oxygen Demand for For Endogenous Respiration			
Oxygen Deman Calculation	De =	$Vreta * MLSS * Tra * \eta / 1000$	
	Where		
	Vreta: Reaction Tank Volume =	3,780 m3	
	MLSS: MLSS in Aeration Tank	3000 mg/l	
	Tra: Train	1	
	η : Oxygen demand for Endogeneous Respiration per MLVSSkg	0.1 kg-O2/kg-MLVSS	
Oxygen Deman Calculation	De =	1,134 kg-O2/day	
4) Remaining O2 in Reaction Tank			
Oxygen Deman Calculation	D0 =	$Ca * Qin / 1000$	
	Where		
	Ca: Remaining O2 Concentration	2 mg/l	
	Qin:	2,000 m3/d	
Oxygen Deman Calculation	D0 =	4 kg/d	
5) Total Oxygen Demand			
AOR =	Db + Dn + De + D0 =	1,660 kg/d	
6) Surface Aerator Oxygen Transfer			
Ox =	1.5 kg-O2/kWh		
7) Standard Surface Aerator Oxygen Transfer			
Oxs =	$Ox * (A * Cs - C) / Cs * 1.024^{(t-20)} * B =$	1.073 kg-O2/kWH	
	Where:		
	A: Coefficient for Saturated Oxygen Concentration:	0.95	
	Cs: Average Saturated Oxygen Concentration:	9.88 mg/l	
	C: Reaminig DO Concentration	2 mg/l	
	t: temperature	25 °C	
	B: Power Efficiency	85%	
8) Required Aerator kW			
Kwr =	$AOR / 24 / Oxs =$	64.46101274 kW	
9) Equipment			
	37kW x 3 sets =	111kW OK	

ITEM	SYMBOL	DESIGN
SECONDARY SETTLING TANK		
1. Design Condition		
Design Flow	Qsec	2,000 m ³ /day (From Mass Balance)
Type		Squire Settling Tank
Unit Number	Tsec	Train Basin/Train Total 1 unit 1 unit 1 unit
2. Design Criteria		
Surface Load	Lsec	10 m ³ /m ² /day
Settling Time	Ts	4.0 hr
3. Calculation		
Flow Per Unit	Qusec	Qsec / Usec = 2,000 m ³ /day
Required Area	Afs	Qusec/Lsec = 200 m ² /unit
Tank Width	Dfsa	18.0 m
Required Area	Lfsa	Afs/Dfsa = 11.1 m ² /unit
Actual Length	La	24.0 m
Actual Area	Aa	Dfsa*La = 432.0 m ²
Actual Surface Load	Lseca	Qusec/Aa = 4.6 m ³ /m ² /d < 10 OK
Weir Loading	Lw	150.0 m ³ /m/d
Required Weir Length	Lew	Qusec/Lw = 13.3 m Say 18.0 m
2. Specification		
Square Settling Tank 18m x 24m x 1 sets		
3. Return Sludge Pump		
MLSS	MLSS=	3,000 mg/l
Secondary Sludge Concentration	Sc=	8,000 mg/l
Required Return Sludge Rate	Rr=	MLSS/(Sc-MLSS) = 0.60 -
Required Return Sludge Flow	Qrr=	Qusec*Rr = 1,200 m ³ /d
Return Sludge Flow (more than Rr)	Qr=	1,200 m ³ /d (50% Return)
Operation Hour	Tr=	24 hours/day
Quantity	Ur=	1 sets
Required Flow Rate	Qrs=	Qr/Tr/Ur = 50 m ³ /h = 0.8 m ³ /min
Specification		Submergible Pump 0.1m ³ /min x 5mH x 8 sets
4. Waste Sludge Pump		
Waste Sludge Quantity	Mw=	1,200 kg/d
Concentration	Csl=	0.6 %
Waste Sludge Flow	Qw=	2.0 m ³ /d
Operation Hour	Tw=	6 hours
Quantity	Uw=	1 sets
Required Flow Rate	Qws=	Qw/Tw/Uw = 0.33 m ³ /h = 0.01 m ³ /min
Specification		Submergible Pump 0.01m ³ /min x 10mH x 1 sets (+1sets Stand-by)

Appendix 6 流量計算表 (CBD)

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer							Remark	(Total Vol.) / (Discharge) - (Total Vol.)				
		Partial	Accumulation	Partial	Accumulation	Unit Vol.	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.	Invert level (bottom)	Invert level			Earth Covering	Man-hole, head		
							Partial	Accumulation															Up	Up
		ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		m ³ /sec	mm	%	m/sec	m ³ /sec	m	m			m	m	m	
ED1	Lt1	150.00	150.00			0.0071	0.1227	0.123					0.123	600	2.20	1.019	0.288	8.550	4.870	5.550	3.00			2.347
Lt1	Pb2	7.16	7.16	209.0	209.0	0.0163	0.0135	0.136					0.136	600	2.20	1.019	0.288	12.492	4.870	5.550	3.00			2.115
Pb2	Pb3	3.18	45.34	309.0	2161.0	0.0208	0.0077	0.355					0.355	800	1.90	1.147	0.577	9.719	2.933	3.813	5.91			1.626
Pb3	Ky1	2.92	48.26	286.0	2447.0	0.0208	0.007	0.362					0.362	800	1.90	1.147	0.577	7.491	2.346	3.226	4.27			1.595
Pb1	Ky1	2.92	2.92	201.0	201.0	0.0208	0.007	0.007					0.007	200	10.00	1.044	0.033	12.102	8.842	9.102	3.00			4.714
Ky1	Ky2	0.00	60.26	312.0	2759.0	0.0167	0.000	0.369					0.369	800	1.90	1.147	0.577	8.107	1.802	2.682	5.42			1.565
Ky2	Bo2	1.89	62.15	294.0	3053.0	0.0167	0.0037	0.373					0.373	800	1.90	1.147	0.577	8.056	1.209	2.089	5.97			1.549
Bo2	Bo3	5.90	156.78	292.0	3345.0	0.0069	0.0047	0.377					0.377	800	1.90	1.147	0.577	5.436	0.651	1.531	3.91			1.530
Bo1	Bo3	5.52	201.29	231.0	231.0	0.0069	0.004	0.004					0.004	250	5.00	0.857	0.042	8.004	4.694	5.004	3.00			9.545
Bo3	Bo5	10.32	211.61	294.0	3639.0	0.0069	0.008	0.390					0.390	900	1.70	1.173	0.746	4.536	-0.004	0.986	3.55			1.914
Pz1	Pz4	4.58	4.58	160.0	160.0	0.0177	0.009	0.009					0.009	200	7.00	0.873	0.027	7.200	3.940	4.200	3.00			2.872
Pz5	Pz4	4.01	4.01	241.0	241.0	0.0177	0.008	0.008					0.008	200	7.00	0.873	0.027	6.600	3.340	3.600	3.00			3.293
Pz4	Pz6	0.00	8.59	57.8	298.8	0.0177	0.000	0.018					0.018	250	5.00	0.857	0.042	6.800	1.603	1.913	4.89			2.386
Pz6	Bo5	7.27	15.86	253.0	551.8	0.0177	0.015	0.033					0.033	300	4.50	0.918	0.065	5.800	1.264	1.624	4.18			2.000
Pz9	Bo5	0.00	19.80	286.0	286.0	0.0177	0.000	0.000					0.000	200	6.50	0.842	0.026	4.933	1.673	1.933	3.00			#DIV/0!
Bo5	Pz14	0.00	303.63	263.0	3902.0	0.0069	0.000	0.422					0.422	900	1.70	1.173	0.746	4.452	-0.886	0.104	4.35			1.767

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer					Remark	(Total Vol.) / (Discharge) - (Total Vol.)								
		Partial	Accumulation	Partial	Accumulation	Unit Vol.	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.			Invert level (bottom)	Invert level	Earth Covering	Man-hole, head				
							Partial	Accumulation								Up			Up	Up	Up	M				
																Dw			Dw	Dw	Dw	H				
ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	mm	%	m/sec	m ³ /sec	m	m	m	m	m								
Line2																										
Ld2	Ld6	3.56	3.56	275.0	275.0	0.0143	0.006	0.006					0.006	200	5.00	0.738	0.023	15.920	12.660	12.920	3.00			3.898		
																									0.017	
Ld5	Ld6	1.49	1.49	167.0	167.0	0.0143	0.003	0.003					0.003	200	5.00	0.738	0.023	14.800	11.540	11.800	3.00			9.200		
																									0.021	
Ld6	Ld14	2.36	2.36	134.0	409.0	0.0143	0.004	0.012					0.012	250	5.00	0.857	0.042	14.717	11.235	11.545	3.17			3.415		
																									0.030	
Ld8	Ld14	7.52	7.52	287.0	287.0	0.0143	0.012	0.012					0.012	200	6.50	0.842	0.026	14.310	11.050	11.310	3.00			2.097		
																										0.014
Ld9	Ld14	1.21	1.21	163.0	163.0	0.0143	0.002	0.002					0.002	200	6.50	0.842	0.026	14.199	10.939	11.199	3.00			13.000		
																										0.024
Ld14	Ld18	3.65	3.65	268.0	677.0	0.0143	0.006	0.033					0.033	300	5.00	0.967	0.068	13.665	10.215	10.575	3.09			2.080		
																										0.035
Ld19	Ld18	2.60	2.60	162.0	839.0	0.0143	0.004	0.004					0.004	250	5.00	0.857	0.042	12.954	9.644	9.954	3.00			9.767		
																										0.038
Ld18	Ld13	4.00	4.00	292.0	1131.0	0.0143	0.007	0.044					0.044	400	3.00	0.908	0.114	11.744	8.275	8.738	3.01			2.615		
																										0.070
Ld1	Ld13	5.26	5.26	549.0	549.0	0.0143	0.009	0.009					0.009	200	6.50	0.842	0.026	17.265	14.005	14.265	3.00			2.989		
																										0.017
Ld13	Ld22	2.00	2.00	270.0	819.0	0.0143	0.003	0.056					0.056	400	3.00	0.908	0.114	14.310	10.237	10.700	3.61			2.050		
																										0.058
Ld22	Ld27	2.30	2.30	295.0	1114.0	0.0143	0.004	0.059					0.059	400	3.00	0.908	0.114	7.215	3.727	4.190	3.03		5.70	1.919		
																										0.055
Ld27	Ld29	2.33	2.33	313.0	1427.0	0.0143	0.004	0.063					0.063	500	2.40	0.942	0.185	4.975	1.342	1.912	3.06		1.40	2.923		
																										0.122

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer							Remark	(Total Vol.) / (Discharge) - (Total Vol.)		
		Partial	Accumulation	Partial	Accumulation	Unit Vol.	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.	Invert level (bottom)	Invert level			Earth Covering	Man-hole, head
							Partial	Accumulation								Up	Up	Up			Up	M
		ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		m ³ /sec	mm	%	m/sec	m ³ /sec	m	m			m	m
Ld28	Ld23	2.10	2.10	293.0	293.0	0.0143	0.004	0.004			0.004	200	6.00	0.809	0.025	7.200	3.940	4.200	3.00			7.143
																5.500	2.182	2.442	3.06			0.022
Ld23	Ld29	2.99	2.99	276.0	276.0	0.0143	0.005	0.008			0.008	200	6.00	0.809	0.025	11.744	8.484	8.744	3.00			2.976
																4.571	1.228	1.488	3.08	5.60		0.017
Ld29	Ld31	2.20	2.20	294.0	1997.0	0.0143	0.004	0.075			0.075	500	2.40	0.942	0.185	4.571	0.590	1.160	3.41			2.457
																4.868	-0.115	0.455	4.41			0.110
Ld24	Ld31	1.94	1.94	277.0	277.0	0.0143	0.003	0.003			0.003	200	7.00	0.873	0.027	12.772	9.512	9.772	3.00			8.438
																4.868	1.573	1.833	3.04	6.00		0.024
Ld31	Ld33	2.20	2.20	288.0	2285.0	0.0143	0.004	0.082			0.082	600	2.20	1.019	0.288	4.868	-0.215	0.465	4.40			3.508
																5.053	-0.849	-0.169	5.22			0.206
Ld30	Ld25	1.92	1.92	293.0	293.0	0.0143	0.003	0.003			0.003	200	6.00	0.809	0.025	8.000	4.740	5.000	3.00			7.813
																7.000	2.982	3.242	3.76			0.022
Ld25	Ld33	1.93	1.93	278.0	278.0	0.0143	0.003	0.006			0.006	200	6.50	0.842	0.026	11.052	7.792	8.052	3.00			4.063
																5.053	1.785	2.045	3.01	4.20		0.020
Ld33	Lt4	2.21	2.21	294.0	2579.0	0.0143	0.004	0.092			0.092	600	2.20	1.019	0.288	5.053	-0.849	-0.169	5.22			3.124
								0.000								6.212	-1.496	-0.816	7.03			0.196
Ld32	Ld26	1.90	1.90	290.0	290.0	0.0143	0.003	0.003			0.003	200	6.00	0.809	0.025	6.600	3.340	3.600	3.00			8.065
																7.000	1.600	1.860	5.14			0.022
Ld26	Lt4	3.25	3.25	279.0	279.0	0.0143	0.005	0.009			0.009	200	6.50	0.842	0.026	9.143	5.883	6.143	3.00			3.059
																6.212	0.770	1.030	5.18	3.30		0.018
Lt4	Pb6	6.50	6.50	592.0	3171.0	0.0163	0.012	0.113			0.113	700	2.00	1.076	0.414	6.212	-1.596	-0.806	7.02			3.664
																6.039	-2.780	-1.990	8.03			0.301
Lt3	Pb6	2.00	2.00	269.0	269.0	0.0163	0.004	0.004			0.004	200	6.50	0.842	0.026	9.719	6.459	6.719	3.00			6.842
																6.039	2.711	2.971	3.07	2.00		0.022
Pb6	Pb7	7.64	7.64	290.0	3461.0	0.0208	0.018	0.135			0.135	700	2.00	1.076	0.414	6.039	-2.780	-1.990	8.03			3.062
																5.516	-3.360	-2.570	8.09			0.279
Pb7	Ky5	8.29	8.29	307.0	3768.0	0.0208	0.020	0.155			0.155	800	1.90	1.147	0.577	5.516	-3.460	-2.580	8.10			3.718
																6.070	-4.043	-3.163	9.23			0.422
Ky5	Ky6	8.60	8.60	315.0	4083.0	0.0167	0.017	0.172			0.172	800	1.90	1.147	0.577	6.070	-4.043	-3.163	9.23			3.359
																7.469	-4.642	-3.762	11.23			0.405

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer					Remark	(Total Vol.) / (Discharge) - (Total Vol.)							
		Partial	Accumulation	Partial	Accumulation	Unit Vol.	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.			Invert level (bottom)	Invert level	Earth Covering	Man-hole, head			
							Partial	Accumulation								Up			Up	Up	Up	M			
		ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		m ³ /sec	mm	%	m/sec	m ³ /sec			m	m	m	m	H		
Ky6	Bo6	8.10	8.10	289.0	4372.0	0.0167	0.016	0.188			0.188	800	1.90	1.147	0.577	7.469	-4.642	-3.762	11.23					3.077	
																4.800	-5.191	-4.311	9.11					0.390	
Bo6	Bo7	7.96	7.96	292.0	4664.0	0.0069	0.006	0.194			0.194	800	1.90	1.147	0.577	4.800	-5.191	-4.311	9.11					2.977	
																4.229	-5.745	-4.865	9.09					0.383	
Bo7	Pz14	7.86	7.86	291.0	4955.0	0.0069	0.006	0.200			0.200	800	1.90	1.147	0.577	4.229	-5.745	-4.865	9.09					2.884	
																4.369	-6.298	-5.418	9.79					0.377	
Line1⇒																									
Pz14	Pz16	7.81	7.81	291.0	5246.0	0.0177	0.016	0.638			0.638	1,200	1.40	1.290	1.459	4.369	-6.698	-5.383	9.75					2.285	
																4.481	-7.106	-5.791	10.27					0.821	
Pz8	Pz10	3.46	3.46	201.0	201.0	0.0177	0.007	0.007			0.007	200	6.50	0.842	0.026	5.758	2.498	2.758	3.00					3.662	
																4.933	1.192	1.452	3.48					0.019	
Pz10	Pz16	2.46	2.46	263.0	464.0	0.0177	0.005	0.012			0.012	250	5.00	0.857	0.042	4.933	1.142	1.452	3.48					3.443	
																4.469	-0.174	0.137	4.33					0.030	
Pz15	Pz16	3.20	3.20	294.0	294.0	0.0177	0.007	0.007			0.007	200	6.50	0.842	0.026	4.473	1.213	1.473	3.00					3.939	
																4.481	-0.698	-0.438	4.92					0.019	
Pz16	Bo13	0.00	0.00	277.0	5523.0	0.0177	0.000	0.657			0.657	1,200	1.40	1.29	1.459	4.481	-7.106	-5.791	10.27					2.220	
																4.223	-7.494	-6.179	10.40					0.802	
⇒Line3																									

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol. m ³ /sec	Sewer							Remark	(Total Vol.) / (Discharge) - (Total Vol.)				
		Partial	Accumulation	Partial	Accumulation	Unit Vol. m ³ /m ² /d	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.	Invert level (bottom)	Invert level			Earth Covering	Man-hole, head		
							Partial	Accumulation															Up	Up
		ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		m	%	m/sec	m ³ /sec	m	m	m			m	m		
Line3																								
Ld34	Ld39	5.13	5.13	435.0	435.0	0.0143	0.009	0.009			0.009				4.975	1.665	1.975	3.00						3.882
															4.312	0.360	0.670	3.64						0.025
Ld39	Ld40	8.50	8.50	297.0	732.0	0.0143	0.014	0.023			0.023				4.312	0.310	0.670	3.64						2.345
															4.204	-0.581	-0.221	4.43						0.030
Ld40	Ld41	10.62	10.62	286.0	1018.0	0.0143	0.018	0.040			0.040				4.204	-0.781	-0.211	4.42						4.403
															4.381	-1.410	-0.840	5.22						0.137
Ld41	Lt7	8.74	8.74	288.0	1306.0	0.0143	0.015	0.055			0.055				4.381	-1.430	-0.860	5.24						3.236
															4.482	-2.064	-1.494	5.98						0.122
Lt7	Lt8	8.34	8.34	293.0	1599.0	0.0163	0.016	0.070			0.070				4.482	-2.064	-1.494	5.98						2.514
															4.365	-2.708	-2.138	6.50						0.107
Lt8	Pb10	8.18	8.18	298.0	1897.0	0.0163	0.015	0.086			0.086				4.365	-2.808	-2.128	6.49						3.205
															5.605	-3.404	-2.724	8.33						0.189
Pb10	Pb11	8.23	8.23	286.0	2183.0	0.0208	0.020	0.106			0.106				5.605	-3.404	-2.724	8.33						2.602
															4.927	-3.976	-3.296	8.22						0.169
Pb11	Ky9	8.81	8.81	313.0	2496.0	0.0208	0.021	0.127			0.127				4.927	-3.976	-3.296	8.22						2.165
															4.758	-4.602	-3.922	8.68						0.148
Ky9	Ky10	15.72	15.72	302.0	2798.0	0.0167	0.030	0.157			0.157				4.927	-4.702	-3.912	8.84						2.497
															5.651	-5.246	-4.456	10.11						0.236
Ky10	Bo10	16.31	16.31	294.0	3092.0	0.0167	0.032	0.189			0.189				5.651	-5.246	-4.456	10.11						2.080
															4.552	-5.775	-4.985	9.54						0.204
Bo10	Bo11	13.45	13.45	292.0	3384.0	0.0069	0.011	0.200			0.200				4.552	-5.775	-4.985	9.54						1.969
															4.273	-6.301	-5.511	9.78						0.193
Bo11	Bo12	16.39	16.39	294.0	3678.0	0.0069	0.013	0.213			0.213				4.273	-6.401	-5.521	9.79						2.488
															4.201	-6.871	-5.991	10.19						0.316
Bo12	Bo13	29.45	29.45	294.0	3972.0	0.0069	0.023	0.236			0.236				4.201	-6.871	-5.991	10.19						2.242
															4.223	-7.342	-6.462	10.68						0.293
Line2⇒																								
Bo13	Bo19	16.60	16.60	293.0	4265.0	0.0069	0.013	0.906			0.906				4.223	-7.742	-6.427	10.65						1.610
															4.219	-8.152	-6.837	11.06						0.553
Pz3	Pz7	6.45	6.45	176.0	176.0	0.0177	0.013	0.013			0.013				6.212	2.952	3.212	3.00						2.045
															5.468	1.720	1.980	3.49						0.014
Pz7	Pz11	2.81	2.81	103.0	279.0	0.0177	0.006	0.019			0.019				5.468	1.670	1.980	3.49						2.211
															5.758	1.155	1.465	4.29						0.023
Pz11	Pz12	10.40	10.40	343.0	622.0	0.0177	0.021	0.040			0.040				5.758	1.055	1.465	4.29						2.129
															4.816	-0.146	0.264	4.55						0.046

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer							Remark	(Total Vol.) / (Discharge) (Discharge) - (Total Vol.)						
		Partial	Accumulation	Partial	Accumulation	Unit Vol.	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.	Invert level (bottom)	Invert level			Earth Covering	Man-hole, head				
							Partial	Accumulation															Up	Up	Up	Up
		ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		m ³ /sec	mm	%	m/sec	m ³ /sec	m	m			m	m	m	H		
Pz18	Pz12	5.25	5.25	270.0	270.0	0.0177	0.011	0.011					0.011	250	5.00	0.857	0.042	4.825 4.816	1.515 0.165	1.825 0.475	3.00 4.34			3.889 0.031		
Pz12	Pz13	3.43	3.43	75.7	697.7	0.0177	0.007	0.058					0.058	400	3.20	0.937	0.118	4.816 4.657	-0.196 -0.438	0.267 0.025	4.55 4.63			2.027 0.060		
Pz20	Pz13	1.55	1.55	305.0	305.0	0.0177	0.003	0.003					0.003	250	5.00	0.857	0.042	4.700 4.657	1.390 -0.135	1.700 0.175	3.00 4.48			13.125 0.039		
Pz13	Pz17	0.00	0.00	59.3	757.0	0.0177	0.000	0.061					0.061	450	2.60	0.914	0.145	4.657 4.473	-0.488 -0.642	0.029 -0.125	4.63 4.60			2.362 0.084		
Pz17	Bo19	2.37	2.37	283.0	1040.0	0.0177	0.005	0.066					0.066	450	2.60	0.914	0.145	4.473 4.219	-0.642 -1.378	-0.125 -0.861	4.60 5.08			2.187 0.079		
Pz19	Bo14	1.59	1.59	210.0	210.0	0.0177	0.003	0.003					0.003	200	6.50	0.842	0.026	4.825 4.434	1.565 0.200	1.825 0.460	3.00 3.97			7.879 0.023		
Bo15	Bo14	8.08	8.08	315.0	315.0	0.0069	0.006	0.006					0.006	200	6.50	0.842	0.026	4.537 4.443	1.277 -0.771	1.537 -0.511	3.00 4.95			4.063 0.020		
Bo20	Bo14	4.20	4.20	283.0	283.0	0.0069	0.003	0.003					0.003	200	6.50	0.842	0.026	4.851 4.443	1.591 -0.249	1.851 0.011	3.00 4.43			7.879 0.023		
Bo14	Bo19	7.32	7.32	298.0	613.0	0.0069	0.006	0.019					0.019	250	5.00	0.857	0.042	4.443 4.219	-0.821 -2.311	-0.511 -2.001	4.95 6.22			2.234 0.023		
Bo19	Bo26	2.10	2.10	283.0	4548.0	0.0069	0.002	0.993					0.993	1,350	1.30	1.344	1.924	4.219 4.718	-8.302 -8.670	-6.827 -7.195	11.05 11.91			1.937 0.931		
⇒Line4																										

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer							Remark	(Total Vol.) / (Discharge) - (Total Vol.)			
		Partial	Accumulation	Partial	Accumulation	Unit Vol.	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.	Invert level (bottom)	Invert level			Earth Covering	Man-hole, head	
							Partial	Accumulation															m
		Up	Up	Up	Up	M																	
ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	mm	%	m/sec	m ³ /sec	m	m	m	m	m					
Line4																							
Ld44	Lt11	6.10	6.10	319.0	319.0	0.0143	0.010	0.010				0.010	250	3.00	0.664	0.033	4.239	0.929	1.239	3.00		3.267	
																	4.199	-0.028	0.282	3.92		0.023	
Lt11	Lt12	8.40	8.40	298.0	617.0	0.0163	0.016	0.026				0.026	450	2.40	0.878	0.14	4.199	-0.228	0.289	3.91		5.405	
																	3.978	-0.943	-0.426	4.40		0.114	
Lt12	Pb14	8.43	8.43	297.0	914.0	0.0163	0.016	0.042				0.042	450	2.40	0.878	0.14	3.978	-0.943	-0.426	4.40		3.349	
																	4.161	-1.656	-1.139	5.30		0.098	
Pb14	Pb15	9.57	9.57	288.0	1202.0	0.0208	0.023	0.065				0.065	450	2.40	0.878	0.14	4.161	-1.656	-1.139	5.30		2.157	
																	4.489	-2.347	-1.830	6.32		0.075	
Pb15	Ky13	12.03	12.03	304.0	1506.0	0.0208	0.029	0.094				0.094	600	2.00	0.971	0.275	4.489	-2.497	-1.817	6.31		2.929	
																	4.687	-3.105	-2.425	7.11		0.181	
Ky13	Ky14	1.43	1.43	308.0	1814.0	0.0167	0.003	0.097				0.097	600	2.00	0.971	0.275	4.687	-3.105	-2.425	7.11		2.844	
																	5.993	-3.721	-3.041	9.03		0.178	
Ky14	Bo22	0.00	0.00	293.0	2107.0	0.0167	0.000	0.097				0.097	600	2.00	0.971	0.275	5.993	-3.721	-3.041	9.03		2.844	
																	7.733	-4.307	-3.627	11.36		0.178	
Bo22	Bo23	10.89	10.89	290.0	2397.0	0.0069	0.009	0.105				0.105	600	2.00	0.971	0.275	7.733	-4.307	-3.627	11.36		2.609	
																	4.685	-4.887	-4.207	8.89		0.170	
Bo28	Bo23	1.62	1.62	273.0	273.0	0.0069	0.001	0.001				0.001	200	6.50	0.842	0.026	4.765	1.505	1.765	3.00		20.000	
																	4.685	-0.270	-0.010	4.69		0.025	
Bo23	Bo24	5.65	5.65	295.0	2692.0	0.0069	0.005	0.111				0.111	600	2.00	0.971	0.275	4.685	-4.887	-4.207	8.89		2.473	
																	4.448	-5.477	-4.797	9.25		0.164	
Bo24	Bo25	0.00	0.00	293.0	2985.0	0.0069	0.000	0.111				0.111	600	2.00	0.971	0.275	4.448	-5.477	-4.797	9.25		2.473	
																	4.458	-6.063	-5.383	9.84		0.164	
Bo29	Bo25	0.96	0.96	217.0	217.0	0.0069	0.001	0.001				0.001	200	6.50	0.842	0.026	4.552	1.292	1.552	3.00		32.500	
																	4.458	-0.119	0.141	4.32		0.025	
Bo25	Bo26	6.48	6.48	293.0	3278.0	0.0069	0.005	0.117				0.117	600	2.00	0.971	0.275	4.458	-6.063	-5.383	9.84		2.346	
																	4.718	-6.649	-5.969	10.69		0.158	
Bo30	Bo26	1.68	1.68	224.0	224.0	0.0069	0.001	0.001				0.001	200	6.50	0.842	0.026	4.842	1.582	1.842	3.00		20.000	
																	4.718	0.126	0.386	4.33		0.025	

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer							Remark	(Total Vol.) / (Discharge) - (Total Vol.)				
		Partial	Accumulation	Partial	Accumulation	Unit Vol.	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.	Invert level (bottom)	Invert level			Earth Covering	Man-hole, head		
							Partial	Accumulation								Up	Up	Up			Up	M		
		ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		m ³ /sec	mm	%	m/sec	m ³ /sec	Dw	Dw			Dw	Dw	H	
Line3⇒																								
Bo26	Bo27	3.67	3.67	294.0	3572.0	0.0069	0.003	1.115				1.115	1,350	1.30	1.344	1.924	4.718	-8.670	-7.195	11.91				1.726
																	4.851	-9.052	-7.577	12.43				0.809
Bo27	Bo32	3.55	3.55	286.0	3858.0	0.0069	0.003	1.117				1.117	1,350	1.30	1.344	1.924	4.851	-9.052	-7.577	12.43				1.722
																	4.766	-9.424	-7.949	12.71				0.807
Bo21	Bo32	2.10	2.10	343.0	343.0	0.0069	0.002	0.002				0.002	200	6.50	0.842	0.026	4.537	1.277	1.537	3.00				15.294
																	4.766	-0.953	-0.693	5.46				0.024
Bo32	Bo40	9.14	9.14	210.0	4068.0	0.0069	0.007	1.126				1.126	1,350	1.30	1.344	1.924	4.766	-9.424	-7.949	12.71				1.708
																	4.534	-9.697	-8.222	12.76				0.798
⇒Line5																								

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer							Remark	(Total Vol.) / (Discharge) - (Total Vol.)						
		Partial	Accumulation	Partial	Accumulation	Unit Vol.	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.	Invert level (bottom)	Invert level			Earth Covering	Man-hole, head				
							Partial	Accumulation															Up	Up	Up	Up
		ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		m ³ /sec	mm	%	m/sec	m ³ /sec	m	m			m	m	m			
Line5																										
Ky17	Ky18	6.89	6.89	332.0	332.0	0.0167	0.013	0.013				0.013	250	5.00	0.857	0.042	4.510	1.200	1.510	3.00					3.158	
																	5.224	-0.460	-0.150	5.37					0.029	
Ky18	Bo33	8.28	8.28	296.0	628.0	0.0167	0.016	0.029				0.029	300	4.00	0.865	0.061	5.224	-0.510	-0.150	5.37					2.082	
																	6.803	-1.694	-1.334	8.14					0.032	
Bo33	Bo34	0.00	0.00	289.0	917.0	0.0069	0.000	0.029				0.029	350	3.50	0.897	0.086	6.803	-1.744	-1.334	8.14					2.935	
																	4.765	-2.756	-2.346	7.11					0.057	
Bo34	Bo35	17.95	17.95	592.0	1509.0	0.0069	0.014	0.044				0.044	400	2.00	0.741	0.093	4.765	-2.806	-2.343	7.11					2.133	
																	4.552	-3.990	-3.527	8.08					0.049	
Bo35	Bo36	7.13	7.13	291.0	1800.0	0.0069	0.006	0.049				0.049	400	3.00	0.908	0.114	4.552	-3.990	-3.527	8.08					2.312	
																	4.842	-4.863	-4.400	9.24					0.065	
Bo36	Bo37	9.03	9.03	292.0	2092.0	0.0069	0.007	0.057				0.057	450	2.40	0.878	0.14	4.842	-4.913	-4.396	9.24					2.478	
																	4.793	-5.613	-5.096	9.89					0.084	
Bo31	Bo37	3.35	3.35	225.0	225.0	0.0069	0.003	0.003				0.003	200	6.50	0.842	0.026	4.851	1.591	1.851	3.00					9.630	
																	4.793	0.129	0.389	4.40					0.023	
Bo37	Bo40	10.26	10.26	297.0	2389.0	0.0069	0.008	0.067				0.067	450	2.60	0.914	0.145	4.793	-5.613	-5.096	9.89					2.151	
																	4.534	-6.386	-5.869	10.40					0.078	
Line4⇒																										
Bo40	Bo43	21.87	21.87	589.0	814.0	0.0069	0.017	1.211				1.211	1,350	1.30	1.344	1.924	4.534	-9.697	-8.222	12.76					1.589	
																	4.247	-10.462	-8.987	13.23					0.713	
Bo41	Bo39	9.79	9.79	287.0	287.0	0.0069	0.008	0.008				0.008	200	6.50	0.842	0.026	4.295	1.035	1.295	3.00					3.333	
																	4.181	-0.831	-0.571	4.75					0.018	
Pz21	Bo38	10.00	10.00	327.0	327.0	0.0177	0.021	0.021				0.021	250	5.00	0.857	0.042	4.825	1.515	1.825	3.00					2.049	
																	4.734	-0.120	0.190	4.54					0.022	
Bo38	Bo39	44.56	44.56	627.0	954.0	0.0069	0.036	0.056				0.056	400	3.00	0.908	0.114	4.734	-0.270	0.193	4.54					2.036	
																	4.181	-2.151	-1.688	5.87					0.058	
Bo39	Bo43	7.18	7.18	325.0	1279.0	0.0069	0.006	0.070				0.070	450	2.60	0.914	0.145	4.181	-2.201	-1.684	5.87					2.086	
																	4.247	-3.046	-2.529	6.78					0.076	

APPEDIX6 Flow Calculation (CBD)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer						Remark	(Total Vol.) / (Discharge) - (Total Vol.)			
		Partial	Accumulation	Partial	Accumulation	Unit Vol.	Black water vol.		Partial	Accumulation		Diameter	Slope	Velocity	Discharge	G. L.	Invert level (bottom)			Invert level	Earth Covering	Man-hole, head
							Partial	Accumulation								Up	Up			Up	Up	M
ha	ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	mm	%	m/sec	m ³ /sec	m	m	m	m	m				
Bo42	Bo45	17.04	17.04	572.0	572.0	0.0069	0.014	0.014			0.014		250	5.00	0.857	0.042	4.295	0.985	1.295	3.00		3.088
																						0.028
Bo44	Bo45	11.29	11.29	376.0	376.0	0.0069	0.009	0.009			0.009		200	6.50	0.842	0.026	3.762	0.502	0.762	3.00		2.889
																						0.017
Bo45	Bo43	0.00	0.00	270.0	842.0	0.0069	0.000	0.023			0.023		300	4.00	0.865	0.061	3.762	-2.042	-1.682	5.44		2.699
																						0.038
Bo43	WWTP	23.21	23.21	414.0	414.0	0.0069	0.019	1.322			1.322		1,500	1.20	1.386	2.449	4.247	-10.612	-8.972	13.22		1.853
																						1.127

Appendix 7 流量計算表 (Dagon)

APPENDIX7 Flow Calculation (Dagon)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol. m³/sec	Sewer								Remark	(Total Vol.) / (Discharge) - (Total Vol.)		
		Partial	Partial	Accumulation	Unit Vol. m³/m²/d	Black Water Vol.		Partial	Accumulation	Diameter mm		Slope %	Velocity m/sec	Discharge m³/sec	G.L.	Invert Level (bottom)	Invert Level	Earth Covering	Manhole, Haed				
						Partial	Accumulation								Up	Up	Up	Up					
															Down	Down	Down	Down					
ha	m	m	m³/m²/d	m³/sec	m³/sec	m³/sec	m³/sec	m	%	m/sec	m³/sec	m	m	m	m	m							
Dagon-West																							
1	2	1.50	339.0	339.0	0.007	0.0012	0.001				0.001	200	5.00	0.738	0.023	18.544	15.284	15.544	3.00			19.167	
																17.067	13.589	13.849	3.22			0.022	
2	19	0.63	109.0	109.0	0.007	0.0005	0.002				0.002	200	5.00	0.738	0.023	17.067	13.589	13.849	3.22			13.529	
																17.504	13.044	13.304	4.20			0.021	
12	19	4.22	342.0	451.0	0.007	0.0035	0.004				0.004	200	5.00	0.738	0.023	17.567	14.307	14.567	0:00			6.571	
																17.504	12.597	12.857	4.65			0.020	
11	17	0.32	107.0	107.0	0.007	0.0003	0.000				0.000	200	5.00	0.738	0.023	18.544	15.284	15.544	3.00			76.667	
																17.567	14.249	14.509	3.06	0.50		0.023	
17	18	1.02	208.0	315.0	0.007	0.0008	0.001				0.001	200	5.00	0.738	0.023	17.567	14.249	14.509	3.06			20.909	
																16.688	13.209	13.469	3.22			0.022	
27	18	2.44	148.0	148.0	0.007	0.002	0.002				0.002	200	5.00	0.738	0.023	17.434	14.174	14.434	3.00			11.500	
																16.688	13.434	13.694	2.99			0.021	
18	29	5.43	346.0	494.0	0.007	0.0044	0.008				0.008	200	5.00	0.738	0.023	16.688	13.209	13.469	3.22			3.067	
																17.191	11.479	11.739	5.45			0.016	
19	29	1.94	201.0	695.0	0.007	0.0016	0.007				0.007	200	5.00	0.738	0.023	17.504	12.597	12.857	4.65			3.382	
																17.191	11.592	11.852	5.34			0.016	
29	32	2.66	182.0	877.0	0.007	0.0022	0.017				0.017	250	5.00	0.857	0.042	17.071	11.429	11.739	5.33			2.545	
																16.390	10.519	10.829	5.56			0.026	
32	33	3.16	155.0	1032.0	0.007	0.0026	0.019				0.019	250	5.00	0.857	0.042	16.390	10.519	10.829	5.56			2.199	
																16.314	9.744	10.054	6.26			0.023	
33	35	3.71	228.0	1260.0	0.007	0.003	0.022				0.022	300	4.00	0.865	0.061	16.314	9.694	10.054	6.26			2.760	
																16.712	8.782	9.142	7.57			0.039	
3	4	0.97	224.0	224.0	0.007	0.0008	0.001				0.001	200	5.00	0.738	0.023	17.067	13.807	14.067	3.00			28.750	
																16.467	12.687	12.947	3.52			0.022	
4	21	0.61	106.0	330.0	0.007	0.0005	0.001				0.001	200	5.00	0.738	0.023	16.467	12.687	12.947	3.52			17.692	
																16.306	12.157	12.417	3.89			0.022	
13	21	2.08	232.0	232.0	0.007	0.0017	0.002				0.002	200	5.00	0.738	0.023	17.504	14.244	14.504	3.00			13.529	
																16.306	13.084	13.344	2.96			0.021	
21	31A	2.30	195.0	427.0	0.007	0.0019	0.005				0.005	200	5.00	0.738	0.023	16.306	12.157	12.417	3.89			4.694	
																17.418	11.182	11.442	5.98			0.018	

APPENDIX7 Flow Calculation (Dagon)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol. m ³ /sec	Sewer								Remark	(Total Vol.) / (Discharge) - (Total Vol.)
		Partial	Partial	Accumulation	Unit Vol. m ³ /m ² /d	Black Water Vol.		Partial	Accumulation	Diameter mm		Slope ‰	Velocity m/sec	Discharge m ³ /sec	G.L. Up	Invert Level (bottom) Up	Invert Level Down	Earth Covering Up	Manhole, Haed m		
						Partial	Accumulation														
		ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		mm	%	m/sec	m ³ /sec	m	m	m	m		
20	31A	2.26	229.0	229.0	0.007	0.0018	0.002			0.002	200	5.00	0.738	0.023	17.191	13.931	14.191	3.00		12.778	
															17.418	12.786	13.046	4.37		0.021	
31A	31B	0.82	99.0	328.0	0.007	0.0007	0.007			0.007	200	5.00	0.738	0.023	17.418	11.182	11.442	5.98		3.108	
															17.222	10.687	10.947	6.28		0.016	
31B	34	0.91	90.0	418.0	0.007	0.0007	0.008			0.008	200	5.00	0.738	0.023	17.222	10.687	10.947	6.28		2.840	
															17.019	10.237	10.497	6.52		0.015	
30	34	2.37	230.0	230.0	0.007	0.0019	0.002			0.002	200	5.00	0.738	0.023	16.390	13.130	13.390	3.00		12.105	
															17.019	11.980	12.240	4.78	0.00	0.021	
34	35	1.51	150.0	380.0	0.007	0.0012	0.011			0.011	200	5.00	0.738	0.023	17.019	10.237	10.497	6.52		2.054	
															16.712	9.187	9.447	7.27	0.30	0.012	
35	41	2.35	236.0	616.0	0.007	0.0019	0.035			0.035	350	3.50	0.897	0.086	16.712	8.732	9.142	7.57		2.443	
															17.272	7.906	8.316	8.96		0.051	
5	6	1.00	230.0	230.0	0.007	0.0008	0.001			0.001	200	5.00	0.738	0.023	16.467	13.207	13.467	3.00		28.750	
															18.804	12.057	12.317	6.49		0.022	
7	6	2.36	497.0	497.0	0.007	0.0019	0.002			0.002	200	5.00	0.738	0.023	25.262	22.002	22.262	3.00		12.105	
															18.804	15.517	15.777	3.03	4.00	0.021	
6	23	0.59	108.0	605.0	0.007	0.0005	0.007			0.007	200	5.00	0.738	0.023	18.804	12.057	12.317	6.49		3.260	
															18.312	11.517	11.777	6.54		0.016	
14	23	2.20	235.0	235.0	0.007	0.0018	0.002			0.002	200	5.00	0.738	0.023	16.306	13.046	13.306	3.00		12.778	
															18.312	11.871	12.131	6.18		0.021	
15	23	6.64	494.0	494.0	0.007	0.0054	0.005			0.005	200	5.00	0.738	0.023	24.357	21.097	21.357	3.00		4.259	
															18.312	15.027	15.287	3.03	3.60	0.018	
23	36A	2.41	203.0	697.0	0.007	0.002	0.016			0.016	250	5.00	0.857	0.042	18.312	11.467	11.777	6.54		2.584	
															18.241	10.452	10.762	7.48		0.026	
22	36A	2.27	235.0	235.0	0.007	0.0019	0.002			0.002	200	5.00	0.738	0.023	17.418	14.158	14.418	3.00		12.105	
															18.129	12.983	13.243	4.89	0.00	0.021	
24	36A	7.74	496.0	496.0	0.007	0.0063	0.006			0.006	200	5.00	0.738	0.023	22.064	18.804	19.064	3.00		3.651	
															18.241	14.924	15.184	3.06	1.40	0.017	
36A	36B	0.88	102.0	598.0	0.007	0.0007	0.025			0.025	300	4.00	0.865	0.061	18.241	10.402	10.762	7.48		2.425	
															18.200	9.994	10.354	7.85		0.036	
54	36B	2.36	235.0	235.0	0.007	0.0019	0.002			0.002	200	5.00	0.738	0.023	17.222	13.962	14.222	3.00		12.105	
															18.200	12.787	13.047	5.15	0.00	0.021	
36B	41	3.99	229.0	464.0	0.007	0.0033	0.030			0.030	300	4.00	0.865	0.061	18.200	9.994	10.354	7.85		2.010	
															17.272	9.078	9.438	7.83	0.00	0.031	
41	43	0.98	114.0	578.0	0.007	0.0008	0.066			0.066	450	2.60	0.914	0.145	17.272	7.806	8.323	8.95		2.185	
															17.095	7.510	8.027	9.07		0.079	

APPENDIX7 Flow Calculation (Dagon)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer						Remark	(Total Vol.) / (Discharge) - (Total Vol.)		
		Partial	Partial	Accumulation	Unit Vol.	Black Water Vol.		Partial	Accumulation	Diameter		Slope	Velocity	Discharge	G.L.	Invert Level (bottom)	Invert Level			Earth Covering	Manhole, Haed
						Partial	Accumulation								Up	Up	Up			Up	
		ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		mm	%	m/sec	m ³ /sec	m	m			m	m
39	40	0.34	108.0	108.0	0.007	0.0003	0.000			0.000	200	5.00	0.738	0.023	16.712	13.452	13.712	3.00			
															15.923	12.612	12.872	3.05	0.30		
40	43	2.90	234.0	342.0	0.007	0.0024	0.003			0.003	200	5.00	0.738	0.023	15.923	12.612	12.872	3.05			
															17.095	11.442	11.702	5.39	0.00		
55	43	4.06	209.0	551.0	0.007	0.0033	0.003			0.003	200	5.00	0.738	0.023	17.100	13.840	14.100	3.00			
															17.095	12.795	13.055	4.04	0.00		
43	45	2.41	223.0	565.0	0.007	0.002	0.074			0.074	500	2.40	0.942	0.185	17.095	7.460	8.030	9.07			
															16.900	6.924	7.494	9.41			
44	45	9.41	455.0	455.0	0.007	0.0077	0.008			0.008	200	5.00	0.738	0.023	19.800	16.540	16.800	3.00			
															16.900	13.565	13.825	3.08	0.70		
47	45	5.58	344.0	344.0	0.007	0.0046	0.005			0.005	200	5.00	0.738	0.023	17.529	14.269	14.529	3.00			
															16.900	12.549	12.809	4.09	0.00		
45	50	7.40	523.0	867.0	0.007	0.0061	0.093			0.093	600	2.20	1.019	0.288	16.900	6.824	7.504	9.40			
															12.765	5.674	6.354	6.41			
50	49B	3.33	239.0	1106.0	0.007	0.0027	0.095			0.095	600	2.20	1.019	0.288	12.765	5.674	6.354	6.41			
															13.617	5.148	5.828	7.79			
9	8	0.88	194.0	194.0	0.007	0.0007	0.001			0.001	200	5.00	0.738	0.023	26.664	23.404	23.664	3.00			
															25.262	20.934	21.194	4.07	1.50		
8	25	0.69	115.0	309.0	0.007	0.0006	0.001			0.001	200	5.00	0.738	0.023	25.262	20.934	21.194	4.07			
															24.357	20.359	20.619	3.74			
16	25	3.55	264.0	264.0	0.007	0.0029	0.003			0.003	200	5.00	0.738	0.023	24.672	21.412	21.672	3.00			
															24.357	20.092	20.352	4.01	0.00		
25	46	4.94	208.0	472.0	0.007	0.004	0.008			0.008	200	5.00	0.738	0.023	24.357	20.092	20.352	4.01			
															22.064	18.752	19.012	3.05	0.30		
46	48	10.29	297.0	769.0	0.007	0.0084	0.017			0.017	250	5.00	0.857	0.042	22.064	18.702	19.012	3.05			
															19.100	15.717	16.027	3.07	1.50		
48	49A	9.23	285.0	1054.0	0.007	0.0076	0.024			0.024	300	4.00	0.865	0.061	19.100	15.667	16.027	3.07			
															17.529	14.127	14.487	3.04	0.40		
49A	49B	9.82	372.0	1426.0	0.007	0.008	0.032			0.032	350	3.50	0.897	0.086	17.529	14.077	14.487	3.04			
															13.617	10.175	10.585	3.03	2.60		
49B	Cross Point	7.30	187.0	187.0	0.007	0.006	0.134			0.134	600	2.20	1.019	0.288	13.617	5.148	5.828	7.79			
															9.400	4.737	5.417	3.98			
			11591.00																		

APPENDIX7 Flow Calculation (Dagon)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol.	Sewer							Remark	(Total Vol.) / (Discharge) (Discharge) - (Total Vol.)			
		Partial	Partial	Accumulation	Unit Vol.	Black Water Vol.		Partial	Accumulation	Diameter		Slope	Velocity	Discharge	G.L.	Invert Level (bottom)	Invert Level	Earth Covering			Manhole, Haed		
						Partial	Accumulation								Up	Up	Up	Up					
		ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec		mm	‰	m/sec	m ³ /sec	m	m	m			m	m	
Dagon-East																							
1	34	3.19	383.0	383.000	0.007	0.0026	0.003			0.003	200	5.00	0.738	0.023	32.131	28.871	29.131	3.00				8.846	
															26.852	23.556	23.816	3.04	3.40			0.020	
34	36	8.24	631.0	1014.000	0.007	0.0067	0.009			0.009	250	5.00	0.857	0.042	26.852	23.506	23.816	3.04				4.516	
															21.344	17.951	18.261	3.08	2.40			0.033	
3	36	6.23	367.0	367.000	0.007	0.0051	0.005			0.005	200	5.00	0.738	0.023	27.400	24.140	24.400	3.00				4.510	
															21.344	17.805	18.065	3.28	4.50			0.018	
36	11	1.53	240.0	1621.000	0.007	0.0012	0.016			0.016	250	5.00	0.857	0.042	21.344	17.755	18.065	3.28				2.692	
															20.076	16.555	16.865	3.21				0.026	
9	11	4.89	306.0	306.000	0.007	0.004	0.004			0.004	200	5.00	0.738	0.023	22.863	19.603	19.863	3.00				5.750	
															20.076	16.773	17.033	3.04	1.30			0.019	
11	20	5.57	259.0	2186.000	0.007	0.0046	0.024			0.024	300	4.00	0.865	0.061	20.076	16.505	16.865	3.21				2.521	
															15.983	12.569	12.929	3.05	2.90			0.037	
14	20	4.08	260.0	260.000	0.007	0.0033	0.003			0.003	200	5.00	0.738	0.023	16.601	13.341	13.601	3.00				6.970	
															15.983	12.041	12.301	3.68				0.020	
20	28	11.17	456.0	2902.000	0.007	0.0091	0.037			0.037	350	3.50	0.897	0.086	15.983	11.891	12.301	3.68				2.350	
															11.665	8.195	8.605	3.06	2.10			0.049	
2	8	17.10	431.0	431.000	0.007	0.014	0.014			0.014	250	5.00	0.857	0.042	32.131	28.821	29.131	3.00				3.000	
															27.400	24.066	24.376	3.02	2.60			0.028	
8	16	10.33	349.0	780.000	0.007	0.0085	0.023			0.023	300	4.00	0.865	0.061	27.400	24.016	24.376	3.02				2.711	
															22.863	19.420	19.780	3.08	3.20			0.039	
16	21	8.50	298.0	1078.000	0.007	0.007	0.030			0.030	400	3.00	0.908	0.114	22.863	19.320	19.783	3.08				3.864	
															16.601	13.126	13.589	3.01	5.30			0.085	
19	21	0.94	158.0	158.000	0.007	0.0008	0.001			0.001	200	5.00	0.738	0.023	15.400	12.140	12.400	3.00				28.750	
															16.601	11.350	11.610	4.99				0.022	

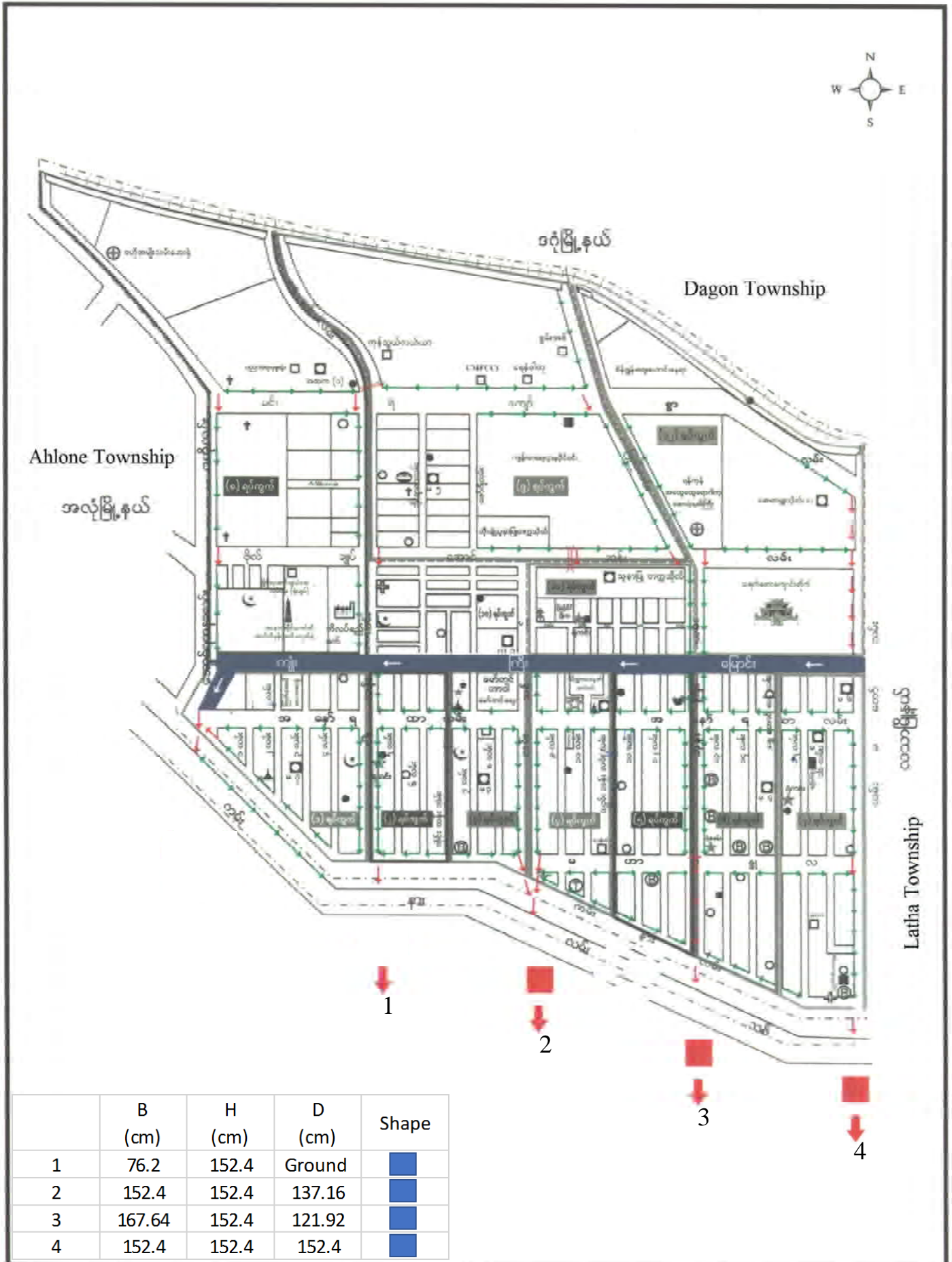
APPENDIX7 Flow Calculation (Dagon)

Section	Section (downstream)	Area		Length		Discharge Volume			Other		Total Vol. m ³ /sec	Sewer								Remark	(Total Vol.) / (Discharge) - (Total Vol.)	
		Partial	Partial	Accumulation	Unit Vol. m ³ /m ² /d	Black Water Vol.		Partial	Accumulation	Diameter mm		Slope %	Velocity m/sec	Discharge m ³ /sec	G.L.		Invert Level (bottom) m	Invert Level m	Earth Covering m			Manhole, Haed m
						Partial	Accumulation								Up	Down						
		ha	m	m	m ³ /m ² /d	m ³ /sec	m ³ /sec	m ³ /sec	m ³ /sec	mm		%	m/sec	m ³ /sec	m	m	m	m				
21	27	3.29	324.0	1560.000	0.007	0.0027	0.033			0.033	450	2.60	0.914	0.145	16.601	11.100	11.617	4.98				
															12.099	8.558	9.075	3.02	1.70			
25	26	30.55	242.0	242.000	0.007	0.025	0.025			0.025	300	4.00	0.865	0.061	19.128	12.768	13.128	6.00				
															17.148	11.800	12.160	4.99				
26	23	2.00	248.0	490.000	0.007	0.0016	0.027			0.027	300	4.00	0.865	0.061	17.148	11.800	12.160	4.99				
															14.828	10.808	11.168	3.66				
22	23	4.76	331.0	331.000	0.007	0.0039	0.004			0.004	200	5.00	0.738	0.023	15.400	12.140	12.400	3.00				
															14.828	10.485	10.745	4.08				
23	27	2.43	240.0	1061.000	0.007	0.002	0.033			0.033	350	3.50	0.897	0.086	14.828	10.335	10.745	4.08				
															12.099	7.995	8.405	3.69	1.50			
27	28	0.76	111.0	2732.000	0.007	0.0006	0.066			0.066	450	2.60	0.914	0.145	12.099	7.895	8.412	3.69				
															11.665	7.606	8.123	3.54				
28	29	0.53	51.7	5685.700	0.007	0.0004	0.103			0.103	600	2.20	1.019	0.288	11.665	7.456	8.136	3.53				
															12.769	4.943	5.623	7.15	2.40			
33	32	1.39	185.0	185.000	0.007	0.0011	0.001			0.001	200	5.00	0.738	0.023	17.148	13.888	14.148	3.00				
															15.410	12.063	12.323	3.09	0.90			
32	30	6.20	329.0	514.000	0.007	0.0051	0.006			0.006	200	5.00	0.738	0.023	15.410	12.063	12.323	3.09				
															14.056	10.418	10.678	3.38				
31	30	1.45	159.0	159.000	0.007	0.0012	0.001			0.001	200	5.00	0.738	0.023	14.828	11.568	11.828	3.00				
															14.056	10.773	11.033	3.02				
30	29	3.55	286.0	959.000	0.007	0.0029	0.010			0.010	200	5.00	0.738	0.023	14.056	10.418	10.678	3.38				
															12.769	8.988	9.248	3.52				
29	Cross Point	0.44	27.0	6671.700	0.007	0.0004	0.114			0.114	600	2.20	1.019	0.288	12.769	4.943	5.623	7.15				
															8.600	4.883	5.563	3.04	0.00			
			6671.7																			

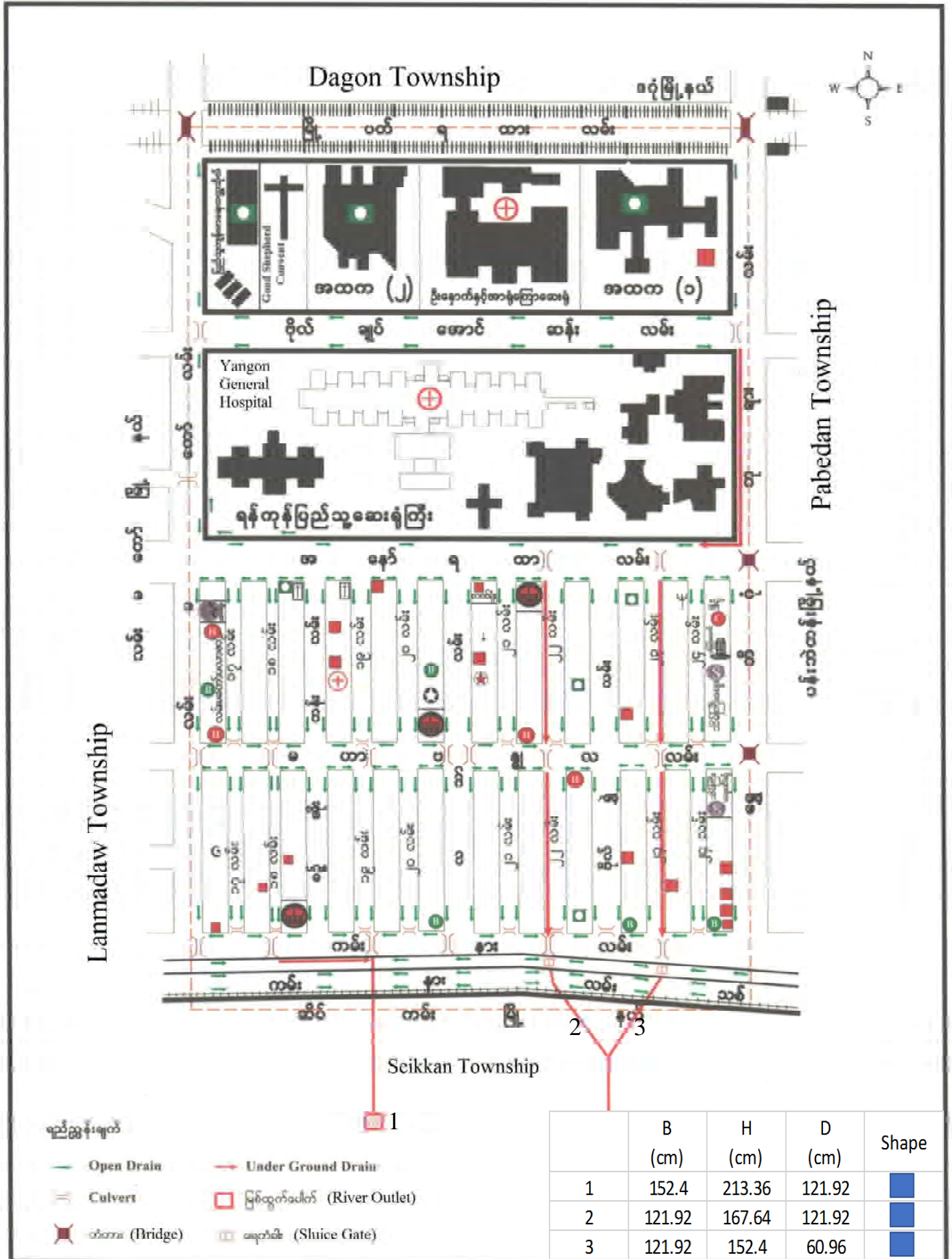
Appendix 8 既存排水路の位置と寸法

APPENDIX8 Layout Plan of Existing Drainage Channels

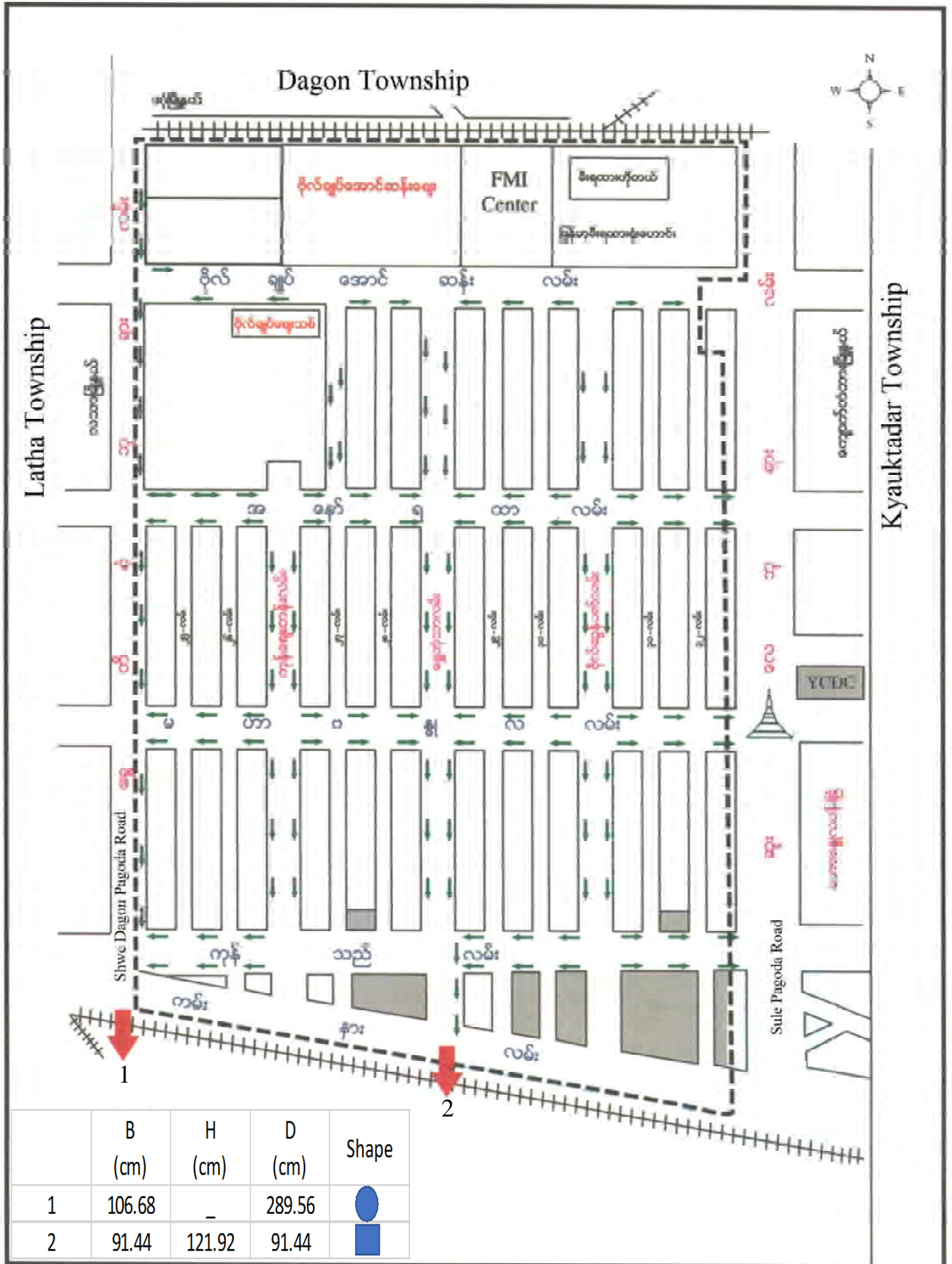
Drainage and Channel Map in Lanmadaw Township



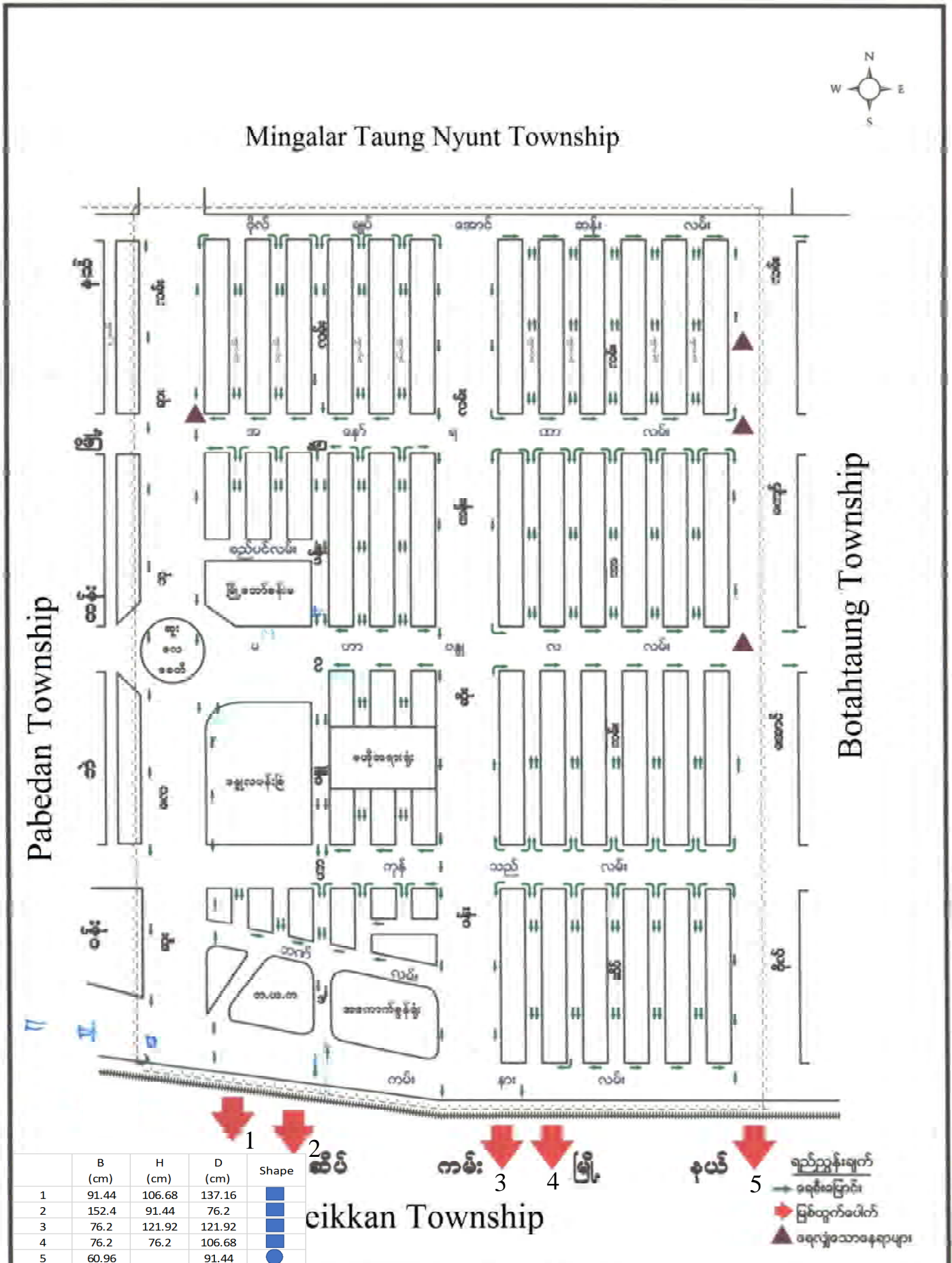
Drainage and Channel Map in Latha Township



Drainage and Channel Map in Pabedan Township



Drainage and Channel Map in Kyauktadar Township



Botahtaung Township Map

Dawbon Township

ミャンマー国
ヤンゴン市下水道分野情報収集・確認調査
ファイナルレポート

- မြေအောက်ရေကြော
- မြေအောက်ရေကြော
- မြေအောက်ရေကြော
- +++++ လမ်း
- မြေအောက်ရေကြော
- ငါး
- မြေအောက်ရေကြော
- △ မြေအောက်ရေကြော
- မြေအောက်ရေကြော
- ⊕ မြေအောက်ရေကြော
- ⊗ မြေအောက်ရေကြော
- ⊙ မြေအောက်ရေကြော
- ⊚ မြေအောက်ရေကြော
- ⊛ မြေအောက်ရေကြော
- ⊜ မြေအောက်ရေကြော

Pazundaung Creek

Yangon River

	B (cm)	H (cm)	D (cm)	Shape
1	182.88	121.92	304.8	■
2	243.84	243.84	182.88	■
3	60.96	—	304.8	●
4	137.16	182.88	60.96	■

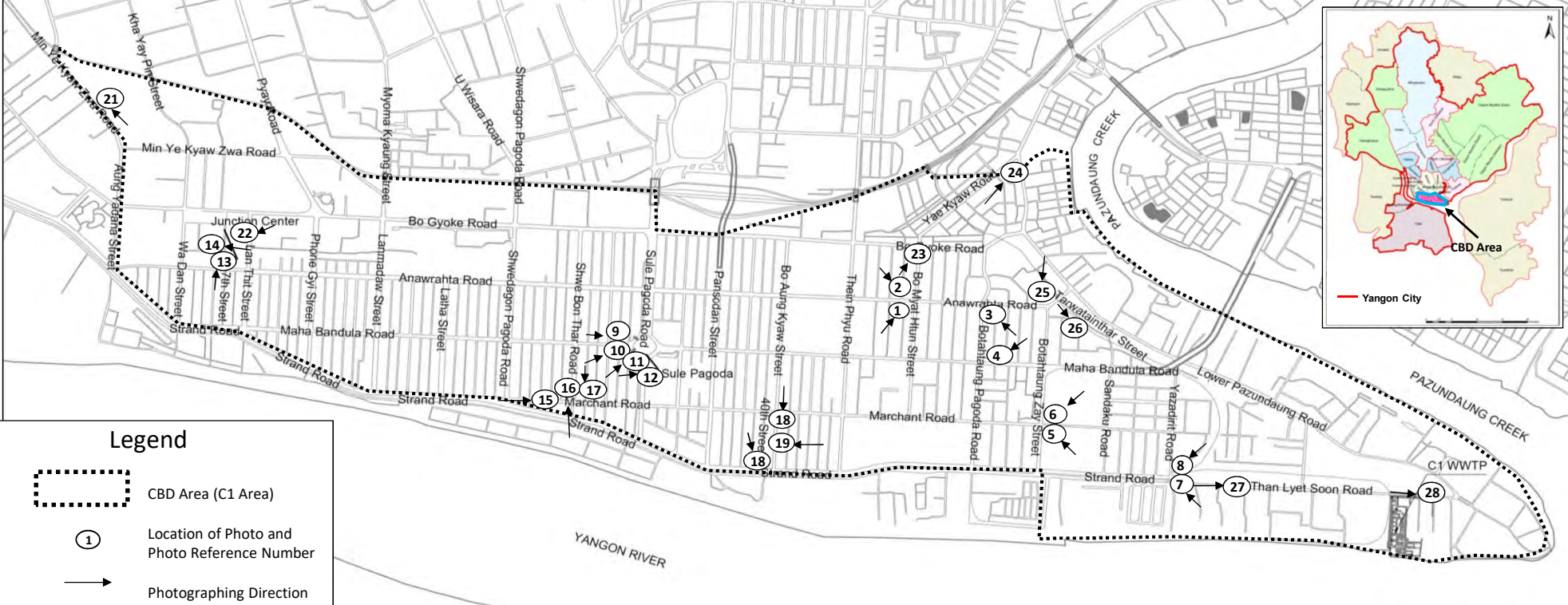
Appendix 9 現場写真台帳

APPENDIX 9 Site Photo List

Table : Site Photo List

No.	Item
A	CBD Area (C1 Area)
B	Dagon Area (Part of W1 Area)
C	Back Drainage Space (BDS)
D	Ejector System
E	C1 Wastewater Treatment Plant
F	Htein Bin Final Disposal Site
G	Meeting with YCDC
H	Thida Substation

Map A : CBD Area (C1 Area)





No.	A - 1
Location	Crossing of
	Anawrahta Rd.
	and
	Bo Myat Htun St.
Remark	



No.	A - 4
Location	Crossing of
	Maha Bandula Rd.
	and
	Botahtaung Pagoda St.
Remark	



No.	A - 2
Location	Crossing of
	Anawrahta Rd.
	and
	Bo Myat Htun St.
Remark	



No.	A - 5
Location	Crossing of
	Merchant Rd.
	and
	Botahtaung Zay St.
Remark	



No.	A - 3
Location	Crossing of
	Maha Bandula Rd.
	and
	Botahtaung Pagoda St.
Remark	



No.	A - 6
Location	Crossing of
	Merchant Rd.
	and
	Botahtaung Zay St.
Remark	



No.	A - 7
Location	Crossing of
	Strand Rd.
	and
	Yazadirit Rd.
Remark	



No.	A - 10
Location	Maha Bandula Rd.
Remark	West side of Sule Pagoda



No.	A - 8
Location	Crossing of
	Strand Rd.
	and
	Yazadirit Rd.
Remark	



No.	A - 11
Location	Maha Bandula Rd.
Remark	Southwest side of Sule Pagoda



No.	A - 9
Location	Maha Bandula Rd.
Remark	West Side of Sule Pagoda



No.	A - 12
Location	Maha Bandula Rd.
Remark	Left side: Sule Pagoda
	Front side: City Hall



No.	A - 13
Location	7th St. in Lanmadaw
Remark	Building around 7th St.



No.	A - 16
Location	Merchant Rd.
Remark	There was the drainage under the sidewalk.



No.	A - 14
Location	7th St. in Lanmadaw
Remark	Building around 7th St.



No.	A - 17
Location	Shwe Bon Thar Rd.
Remark	There was the drainage under the sideway.



No.	A - 15
Location	Merchant Rd.
Remark	Sidewalk of Merchant Rd There was the drainage under the sidewalk.



No.	A - 18
Location	40th St.
Remark	South Direction



No.	A - 19
Location	40th St.
Remark	Storage Pump beside the 40th St.



No.	A - 22
Location	Behind Junction Center
Remark	No.10 Creek



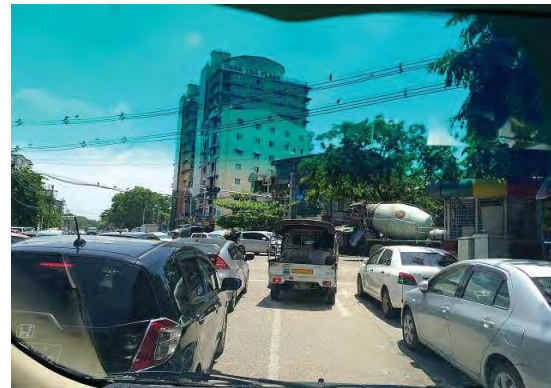
No.	A - 20
Location	40th St.
Remark	North Direction



No.	A - 23
Location	Yae Kyaw Rd.
Remark	



No.	A - 21
Location	Min Ye Kyaw Zwa Rd.
Remark	



No.	A - 24
Location	Yae Kyaw Rd.
Remark	



No.	A - 25
Location	Anawratha Rd.
Remark	



No.	A - 28
Location	Than Lyet Soon Rd.
Remark	End of Than Lyet Soon Rd.



No.	A - 26
Location	Tarwataintha St.
Remark	



No.	A - 27
Location	Than Lyet Soon Rd.
Remark	



No.	B - - 1
Location	Pyidaungzu Yeiktha St.
Remark	



No.	B - - 4
Location	Myoma Kyaung St.
Remark	North Direction



No.	B - - 2
Location	Padonmar St.
Remark	



No.	B - - 5
Location	Ma New Hari St.
Remark	



No.	B - - 3
Location	Myoma Kyaung St.
Remark	South Direction The Traffic to CBD Area



No.	B - - 6
Location	Zagawar St.
Remark	This site was dropped from pipe laying area because of redevelopment area.



No.	B - 7
Location	Than Ta Man St.
Remark	



No.	B - 10
Location	Padonmar St.
Remark	Residential Section along the Padonmar St.



No.	B - 8
Location	Zagawar St.
Remark	Unpaved Walkway



No.	B - 11
Location	Padonmar St.
Remark	Embassy of Russia along the Padonmar St



No.	B - 9
Location	Taw Win Rd.
Remark	



No.	B - 12
Location	Crossing of Padonmar St. and Samone St.
Remark	



No.	B - 13
Location	Baho Rd.
Remark	



No.	B - 16
Location	Lanmadaw Railway
Remark	Connected to "Main Sewer Line1 in CBD Area" by pipe jacking



No.	B - 14
Location	Ahlon Rd.
Remark	Traffic to the East side



No.	B - 17
Location	Lanmadaw Railway
Remark	



No.	B - 15
Location	Ahlon Rd.
Remark	



No.	B - 18
Location	Lanmadaw Railway
Remark	Water Channel beside the Lanmadaw Station (West Side)



No.	B - 19
Location	Lanmadaw Railway
Remark	Water Channel beside the Lanmadaw Station (West Side)



No.	B - 22
Location	Bo Yar Nyunt Rd.
Remark	Traffic volume is low.



No.	B - 20
Location	Phaya Lan Railway
Remark	Connected to "Main Sewer Line1 in CBD Area" by pipe jacking



No.	B - 23
Location	Shwedagon Pagoda Rd.
Remark	Northwest side of the Phaya Lan Station North Direction



No.	B - 21
Location	Crossing of Bo Yar Nyunt Rd. and Pan Tra St.
Remark	Over side of the gate was a military facility



No.	B - 24
Location	Yaw Min Gyi St.
Remark	



No.	B - 25
Location	Dorgah Of Second Bahadur Shah
	Zi Wa Ka St.
Remark	



No.	B - 28
Location	U Wisara Rd.
Remark	West side of Maha Wizaya Pagoda



No.	B - 26
Location	Bo Yar Nyunt Rd.
Remark	A lot of Street Parking



No.	B - 29
Location	U Wisara Rd.
Remark	East side of Military Hospital



No.	B - 27
Location	Alan Pya Pagoda St.
Remark	This site was used as the parking area.



No.	B - 30
Location	U Wisara Rd.
Remark	



No.	B - 31
Location	Crossing of
	U Wisara Rd.
	and
	Shwedagon Pagoda Rd.
Remark	



No.	B - 34
Location	Alan Pya Pagoda St.
Remark	Left side: Elementary School



No.	B - 32
Location	Alan Pya Pagoda St
Remark	Over side of the gate was a military facility.



No.	B - 35
Location	Alan Pya Pagoda St.
Remark	



No.	B - 33
Location	Yaw Min Gyi St.
Remark	



No.	B - 36
Location	Nawaday St.
Remark	



No.	B - 37
Location	Nawaday St.
Remark	



No.	B - 40
Location	Kha Yay Pin St.
Remark	



No.	B - 38
Location	Shwedagon Pagoda Rd.
Remark	



No.	B - 41
Location	Kha Yay Pin St.
Remark	

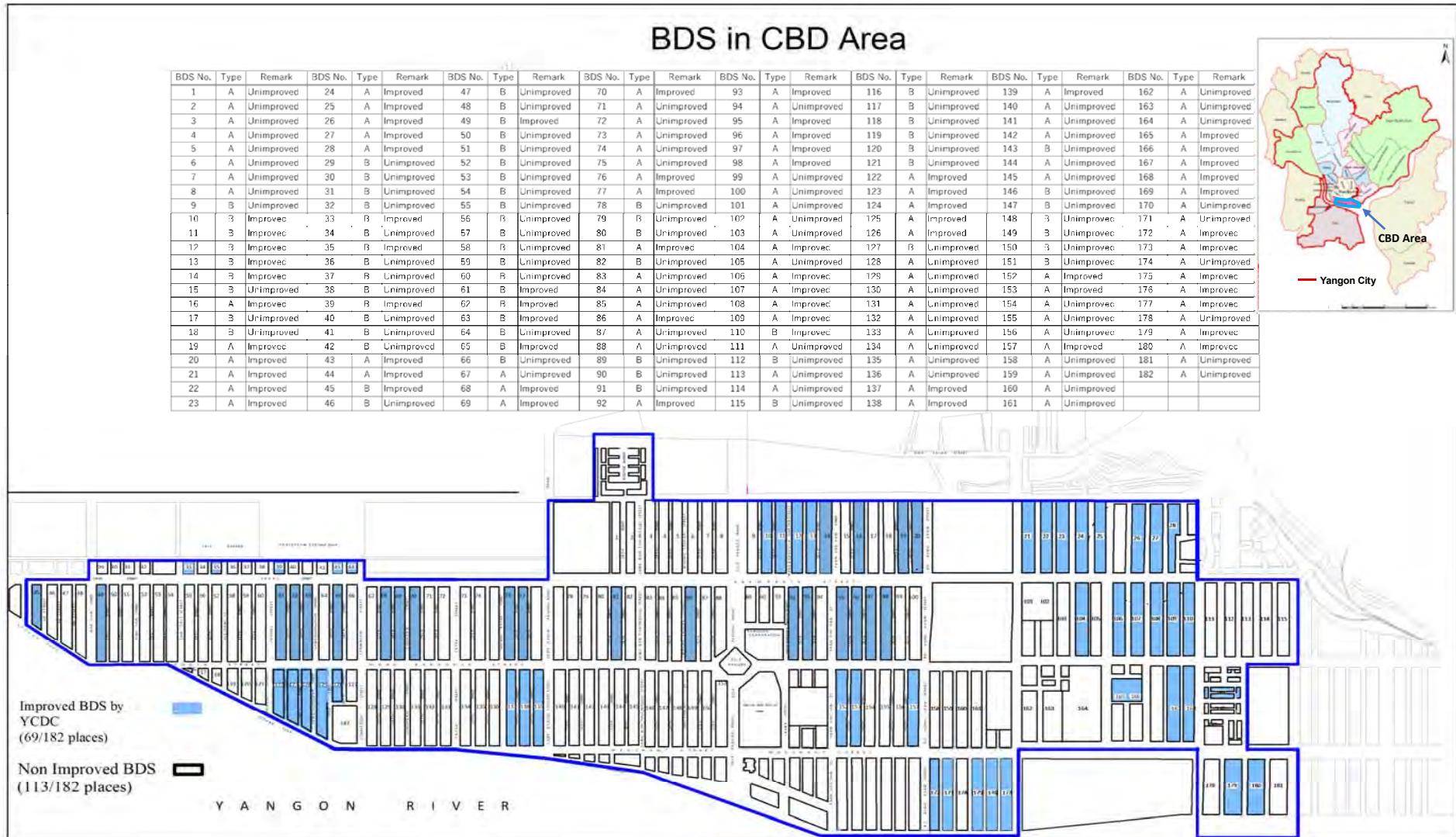


No.	B - 39
Location	U Wisara Rd.
Remark	



No.	B - 42
Location	Zagawar St.
Remark	West Direction

Map C : BDS in CBD Area





No.	C - - 1
Location	No.22
Remark	Type A (Improved)



No.	C - - 4
Location	No.22
Remark	Inside of Chamber Type A (Improved)



No.	C - - 2
Location	No.22
Remark	Storm water pipe from roof to drainage Type A (Improved)



No.	C - - 5
Location	No.23
Remark	Type A (Improved)



No.	C - - 3
Location	No.22
Remark	Chamber Type A (Improved)



No.	C - - 6
Location	No.23
Remark	Type A (Improved)



No.	C - 7
Location	No.23
Remark	Type A (Improved)



No.	C - 10
Location	No.50
Remark	Type B (Not Improved)



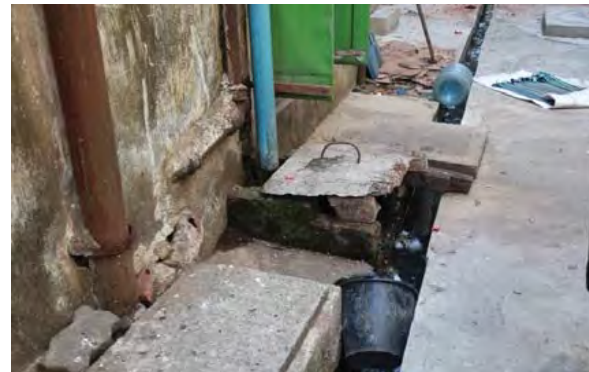
No.	C - 8
Location	No.23
Remark	Inside of Chamber Type A (Improved)



No.	C - 11
Location	No.50
Remark	Type B (Not Improved)



No.	C - 9
Location	No.23
Remark	Storm water pipe from roof to drainage. Type A (Improved)



No.	C - 12
Location	No.50
Remark	Type B (Not Improved)



No.	C - 13
Location	No.50
Remark	
	Type B (Not Improved)



No.	C - 16
Location	No.81
Remark	Workers confirmed clogging
	Type A (Improved)



No.	C - 14
Location	No.81
Remark	
	Type A (Improved)



No.	C - 17
Location	No.81
Remark	Inside of Chamber
	Type A (Improved)



No.	C - 15
Location	No.81
Remark	
	Type A (Improved)



No.	C - 18
Location	No.143
Remark	Residents threw away garbage to BDS. It was difficult to discover the cause of pipe clogging because of much amount of garbage.
	Type B (Not Improved)



No.	C - 19
Location	No.143
Remark	Type B (Not Improved)



No.	C - 22
Location	No.178
Remark	Type A (Not Improved)



No.	C - 20
Location	No.143
Remark	Inside of Chamber Type B (Not Improved)



No.	C - 23
Location	No.178
Remark	Type A (Not Improved)



No.	C - 21
Location	No.178
Remark	Residents threw away garbage to BDS. Building was constructed on drainage of BDS. Type A (Not Improved)



No.	C - 24
Location	No.178
Remark	Type A (Not Improved)



No.	C - 25
Location	No.178
Remark	Pipe was clogged
	Type A (Not Improved)



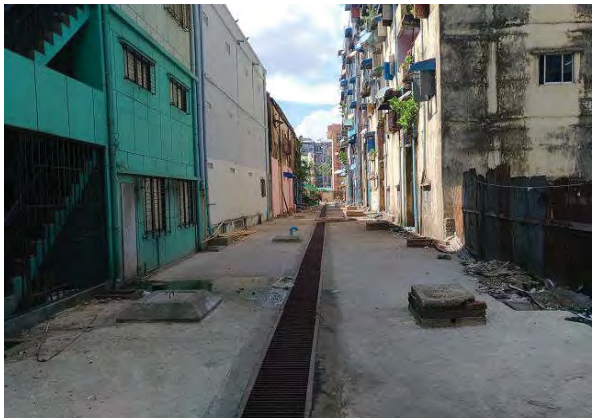
No.	C - 28
Location	No.179
Remark	This surrounding place was dirty because the pipes were broken.
	Type A (Improved)



No.	C - 26
Location	No.178
Remark	Residents discharged black water into drainage due to pipe clogging.
	Type A (Not Improved)



No.	C - 29
Location	No.179
Remark	
	Type A (Improved)



No.	C - 27
Location	No.179
Remark	
	Type A (Improved)



No.	C - 30
Location	No.179
Remark	Pipe was clogged
	Type A (Improved)



No.	C - 31
Location	No.179
Remark	Inside of Chamber
	Type A (Improved)



No.	C - 34
Location	No.180
Remark	Type A (Not Improved)



No.	C - 32
Location	No.179
Remark	Inside of Chamber
	Pipe was not clogged.
	Type A (Improved)



No.	C - 35
Location	No.180
Remark	Type A (Not Improved)



No.	C - 33
Location	No.180
Remark	Residents extended to their living space to BDS.
	Type A (Not Improved)



No.	C - 36
Location	No.180
Remark	Storm water & grey water were collected by same pipe
	Type A (Not Improved)



No.	C - 37
Location	No.180
Remark	Inside of Expanded Space on the drainage
	Type A (Not Improved)



No.	C - 40
Location	No.180
Remark	Pipe was not clogged.
	Type A (Not Improved)

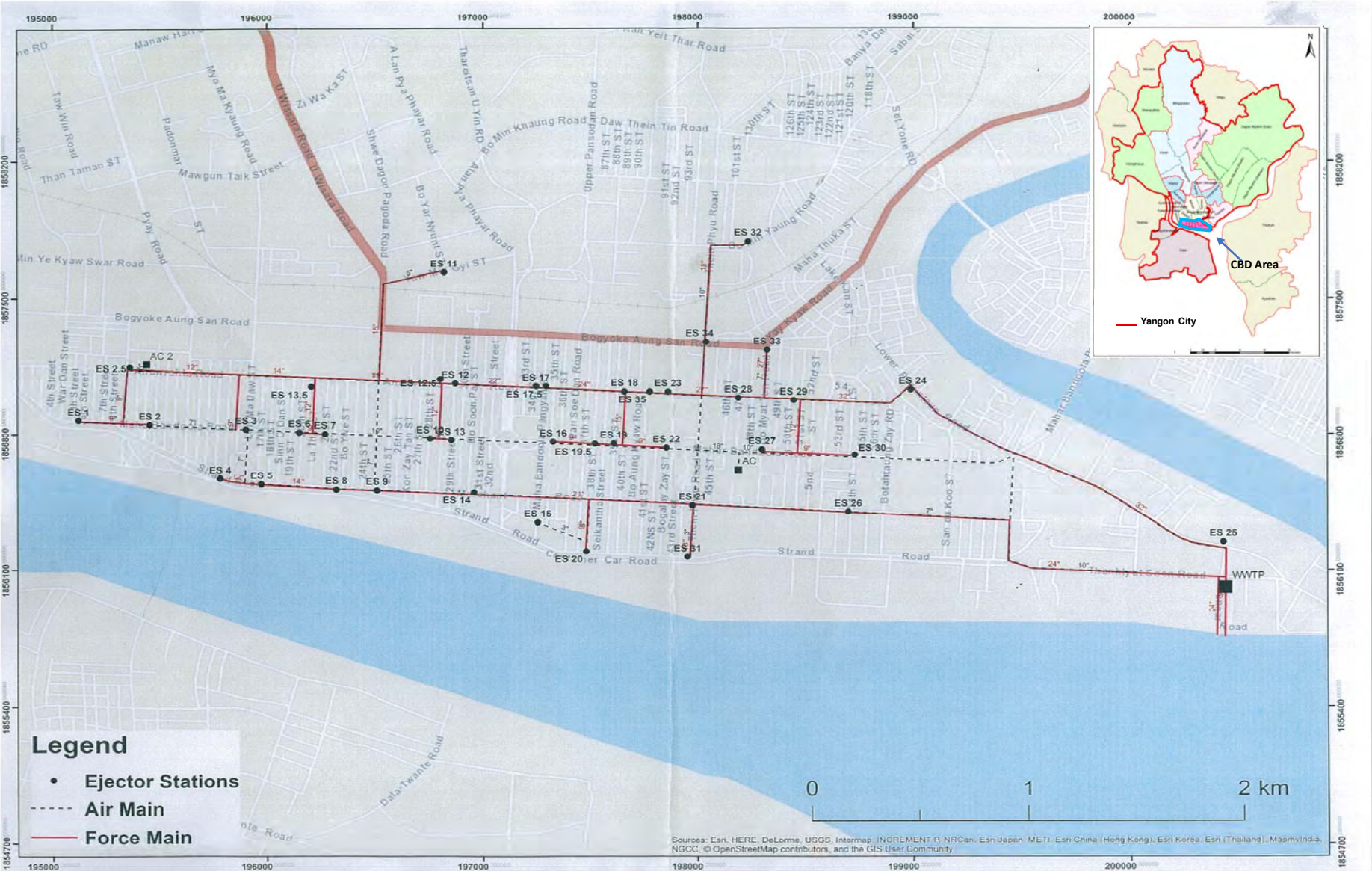


No.	C - 38
Location	No.180
Remark	Roof was constructed by bamboo, wood, plastic and plate.
	Type A (Not Improved)



No.	C - 39
Location	No.180
Remark	BDS was used as material storage.
	Type A (Not Improved)

Map D : Ejector Station





No.	D - - 1
Location	ES 21
Remark	Entrance to Ejector Station



No.	D - - 4
Location	ES 21
Remark	



No.	D - - 2
Location	ES 21
Remark	Inside of Ejector Station



No.	D - - 5
Location	ES 21
Remark	



No.	D - - 3
Location	ES 21
Remark	Inside of Ejector Station (Air Pressure Pump)



No.	D - - 6
Location	ES 21
Remark	Sewage Pressure Feed Pipe



No.	D - 7
Location	ES 21
Remark	Bottom part of Air Pressure Pump



No.	D - 10
Location	Air Compressor (near YCDC Office)
Remark	Air Compressor



No.	D - 8
Location	ES 21
Remark	Air Compressor for ES21



No.	D - 11
Location	Air Compressor (near YCDC Office)
Remark	

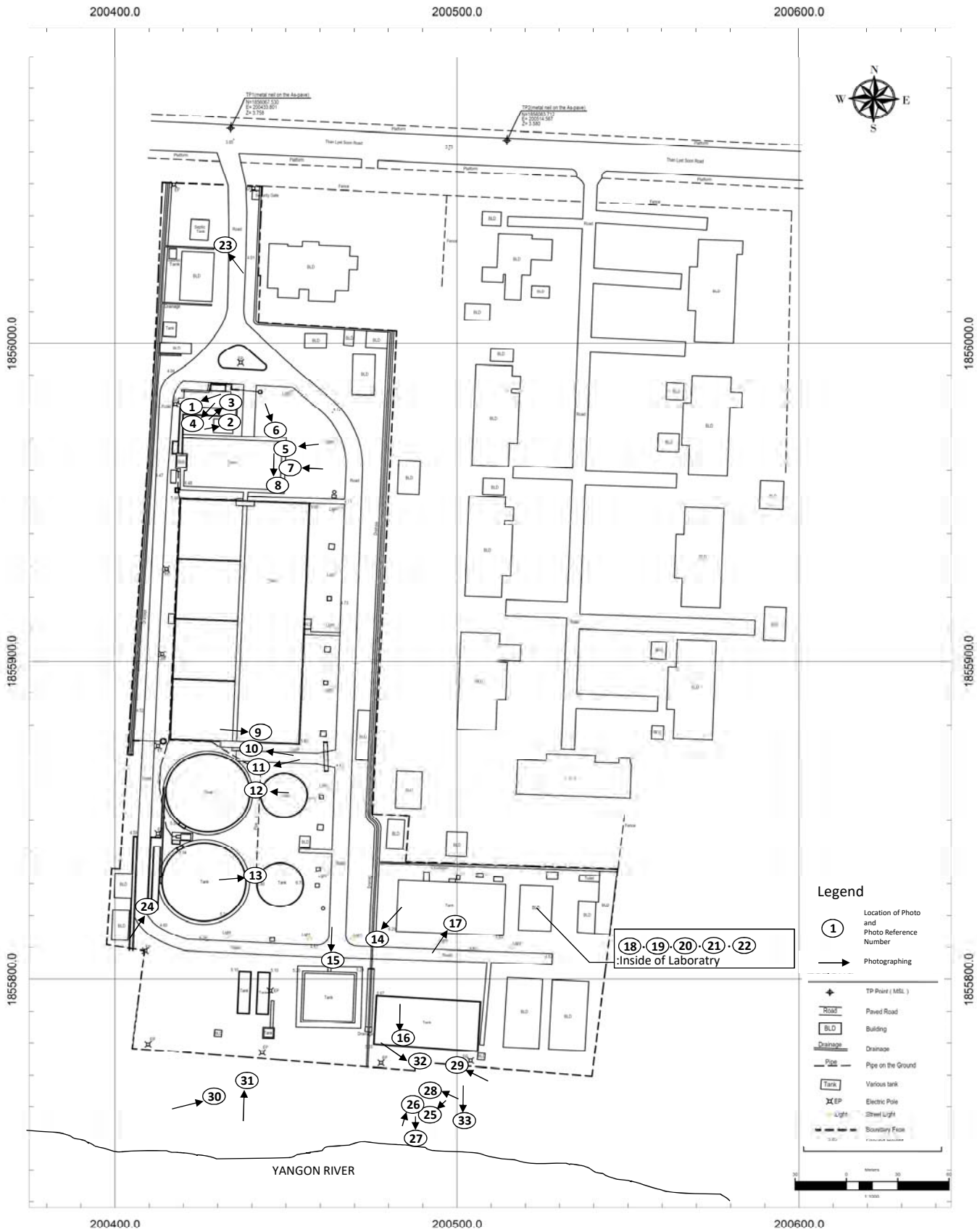


No.	D - 9
Location	Air Compressor (near YCDC Office)
Remark	Drawing about Ejector System Main air compressor having air-blow performance to 35 Ejector Stations



No.	D - 12
Location	Air Compressor (near YCDC Office)
Remark	

Map E : C1 Wastewater Treatment Plant





No.	E - 1
Location	C1 Wastewater Treatment Plant
Remark	Channel to Grit Chamber & Auto Bar Screen Pump Sump



No.	E - 4
Location	C1 Wastewater Treatment Plant
Remark	Primary Sedimentation Tank



No.	E - 2
Location	C1 Wastewater Treatment Plant
Remark	Grit Chamber & Auto Bar Screen Pump Sump



No.	E - 5
Location	C1 Wastewater Treatment Plant
Remark	Primary Sedimentation Tank



No.	E - 3
Location	C1 Wastewater Treatment Plant
Remark	Grit Chamber & Auto Bar Screen Pump Sump



No.	E - 6
Location	C1 Wastewater Treatment Plant
Remark	Primary Sedimentation Tank



No.	E - - 7
Location	C1 Wastewater Treatment Plant
Remark	Primary Sedimentation Tank



No.	E - - 10
Location	C1 Wastewater Treatment Plant
Remark	Equipment of Aeration Tank



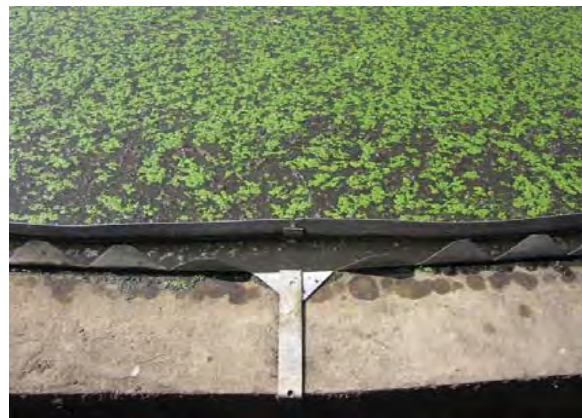
No.	E - - 8
Location	C1 Wastewater Treatment Plant
Remark	Aeration Tank
	Surface Aeration Method



No.	E - - 11
Location	C1 Wastewater Treatment Plant
Remark	Secondary Sedimentation Tank



No.	E - - 9
Location	C1 Wastewater Treatment Plant
Remark	Overflow Weir of Aeration Tank



No.	E - - 12
Location	C1 Wastewater Treatment Plant
Remark	Suspended Sludge on the Tank Surface



No.	E - 13
Location	C1 Wastewater Treatment Plant
Remark	Sludge Thickener



No.	E - 16
Location	C1 Wastewater Treatment Plant
Remark	Yangon River beside the WWTP site



No.	E - 14
Location	C1 Wastewater Treatment Plant
Remark	Sun Dried Tank



No.	E - 17
Location	C1 Wastewater Treatment Plant
Remark	Inside of Sludge Digesters



No.	E - 15
Location	C1 Wastewater Treatment Plant
Remark	Dried Sludge in the Sun Dried Tank



No.	E - 18
Location	C1 Wastewater Treatment Plant
Remark	Inside of Laboratory



No.	E - 19
Location	C1 Wastewater Treatment Plant
Remark	Inside of Laboratory



No.	E - 22
Location	C1 Wastewater Treatment Plant
Remark	Laboratory Instrument



No.	E - 20
Location	C1 Wastewater Treatment Plant
Remark	Table related to Standards for Discharge of Effluent



No.	E - 23
Location	C1 Wastewater Treatment Plant
Remark	Workers were pulling out sewage from the septic tank truck .



No.	E - 21
Location	C1 Wastewater Treatment Plant
Remark	Laboratory Instrument



No.	E - 24
Location	C1 Wastewater Treatment Plant
Remark	Outlet of Secondary Sedimentation Tank



No.	E - 25
Location	C1 Wastewater Treatment Plant
Remark	Outlet to Yangon River
	•24-inch
	•36-inch



No.	E - 28
Location	C1 Wastewater Treatment Plant
Remark	Outlet to Yangon River
	There was a hole on the pipe.



No.	E - 26
Location	C1 Wastewater Treatment Plant
Remark	Outlet to Yangon River
	(North Side)



No.	E - 29
Location	C1 Wastewater Treatment Plant
Remark	Yangon River beside the WWTP site



No.	E - 27
Location	C1 Wastewater Treatment Plant
Remark	Outlet to Yangon River
	(South Side)



No.	E - 30
Location	C1 Wastewater Treatment Plant
Remark	The revetment was considerably decrepit.



No.	E - 31
Location	C1 Wastewater Treatment Plant
Remark	Surface of the revetment

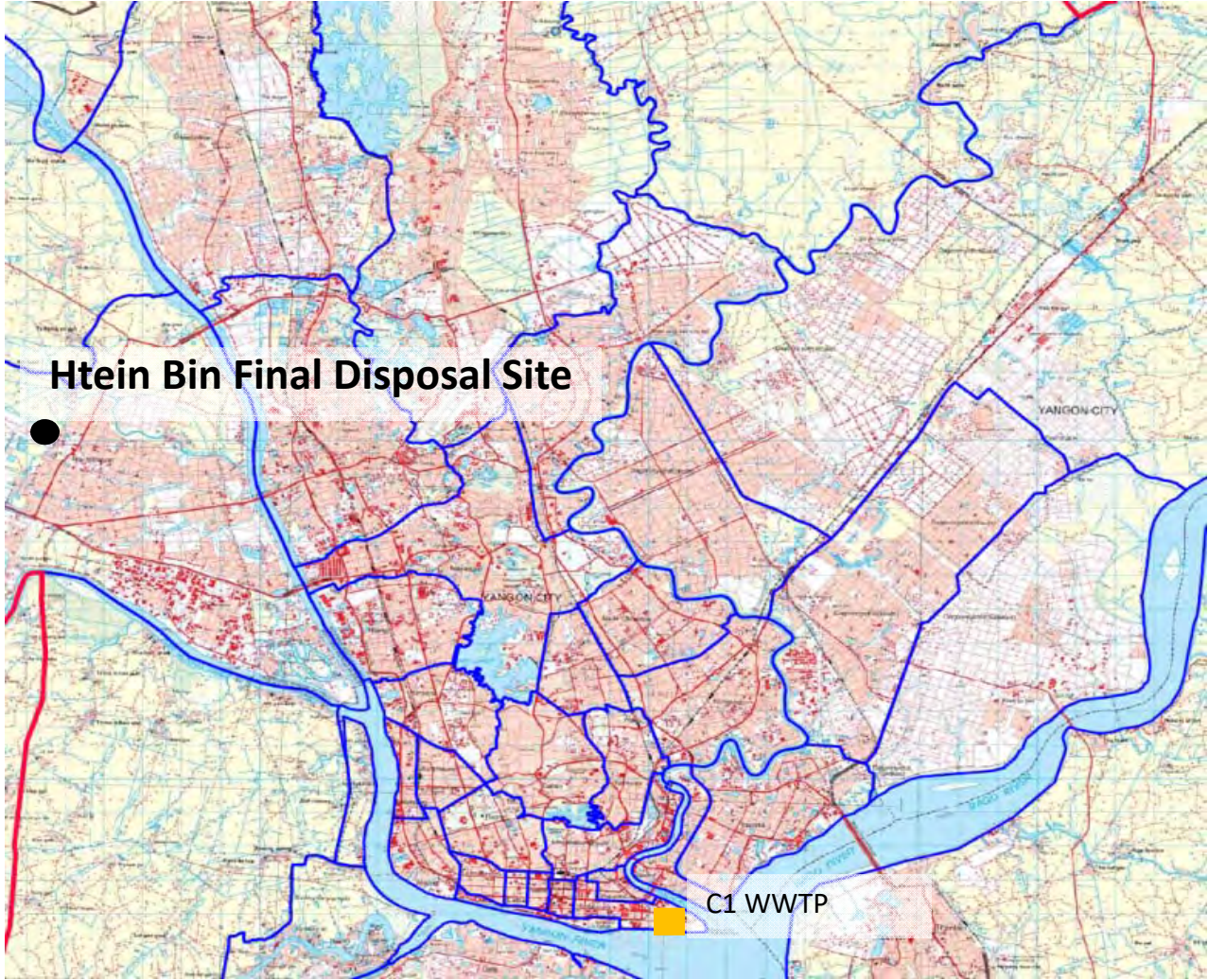


No.	E - 32
Location	C1 Wastewater Treatment Plant
Remark	Pier leading from WWTP to the side of Yangon River



No.	E - 33
Location	C1 Wastewater Treatment Plant
Remark	On the pier
	(South Direction)

Map F : Htein Bin Final Disposal Site



Legend: ● Sludge Disposal Facility ■ C1 WWTP



No.	F - 1
Location	Site for Sludge Disposal
	(Htain Bin Final Disposal Site)
Remark	Inside of Final Disposal Site



No.	F - 4
Location	Site for Sludge Disposal
	(Htain Bin Final Disposal Site)
Remark	Leachate in the Stream beside the Site



No.	F - 2
Location	Site for Sludge Disposal
	(Htain Bin Final Disposal Site)
Remark	Inside of Final Disposal Site



No.	F - 5
Location	Site for Sludge Disposal
	(Htain Bin Final Disposal Site)
Remark	Surrounding Area and Stream beside the Site

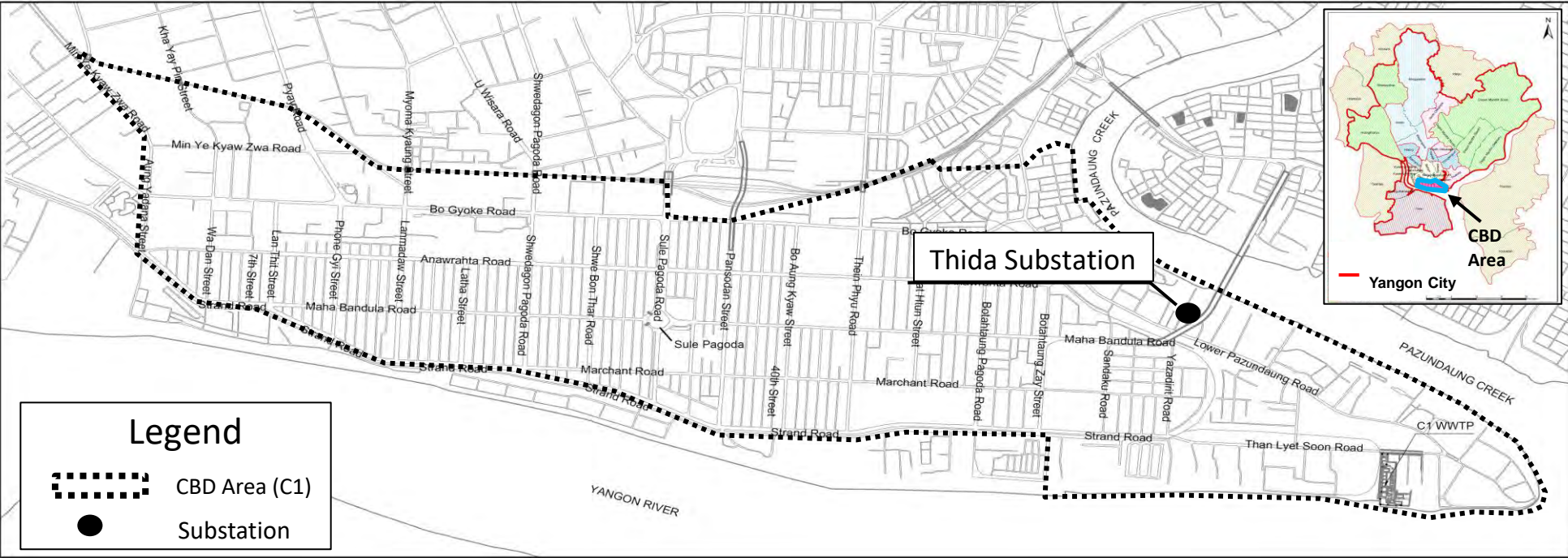


No.	F - 3
Location	Site for Sludge Disposal
	(Htain Bin Final Disposal Site)
Remark	Disposal Solid Waste



No.	F - 6
Location	Site for Sludge Disposal
	(Htain Bin Final Disposal Site)
Remark	Landfill equipment (Excavator)

Map G : Thida Substation





No.	G - 1
Location	Thida Substation
Remark	Under jurisdiction of Yangon Electricity Supply Cooperation



No.	G - 4
Location	Thida Substation
Remark	Administration Building



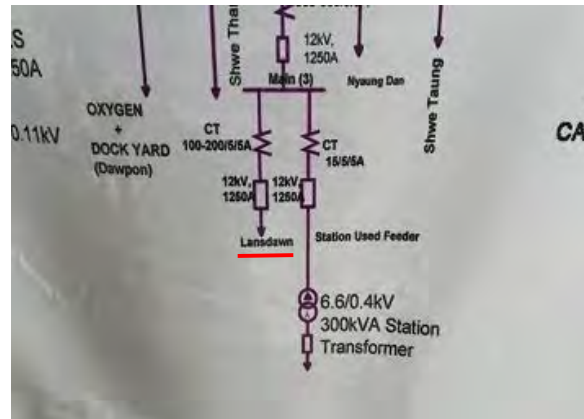
No.	G - 2
Location	Thida Substation
Remark	Equipment made in China, Vietnam and Japan was installed.



No.	G - 5
Location	Thida Substation
Remark	



No.	G - 3
Location	Thida Substation
Remark	



No.	G - 6
Location	Thida Substation
Remark	Lansdown: The Surrounding Area with C1 WWTP This substation supplied electricity to Lansdown Area.

Appendix 10 測量調査

APPENDIX 10 Topographic Survey

Procurement of satellite Image

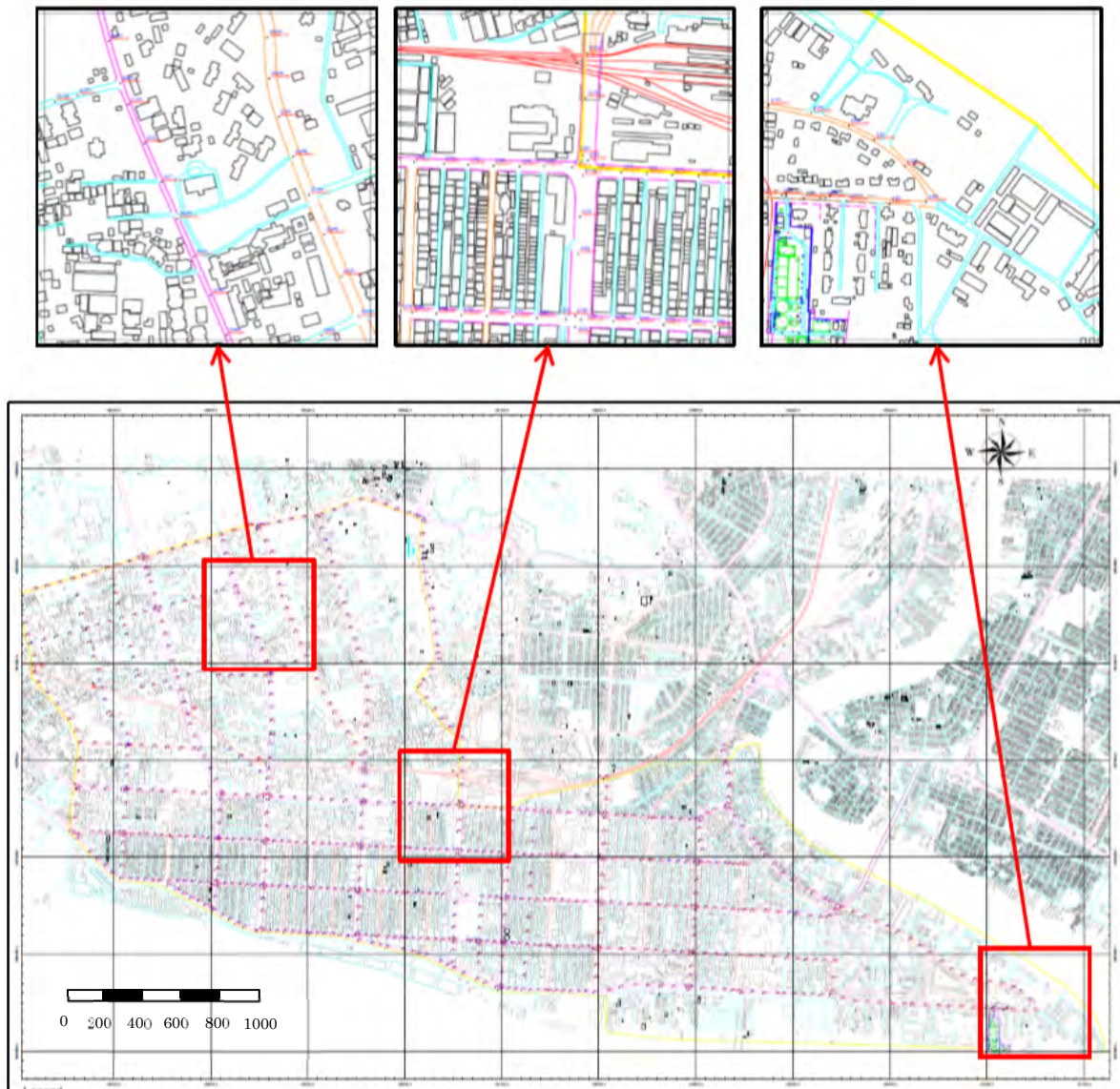
Satellite name	Digital Globe World View 2
Resolution	Standard: 0.5m, Max: 0.55m
Area	96.13124443554632, 16.798499286525825 96.13095916097352, 16.76597798523054 96.19913978386454, 16.763838425934797 96.19971033301007, 16.79721555094838
Observed date	16 th December, 2017
Image Type	Ortho ready Standard, 4 Band (Pan-Sharpen)
Cloud Cover	0.0%
Area Off Nadir	24.7 degree
Sun Elevation	47.0 degree
Format	Geo Tiff



Source: JICA Study Team

0 200 400 600 800 1000

Whole data of feature mapping and its part



Source: JICA Study Team

Drawing by the plane table survey

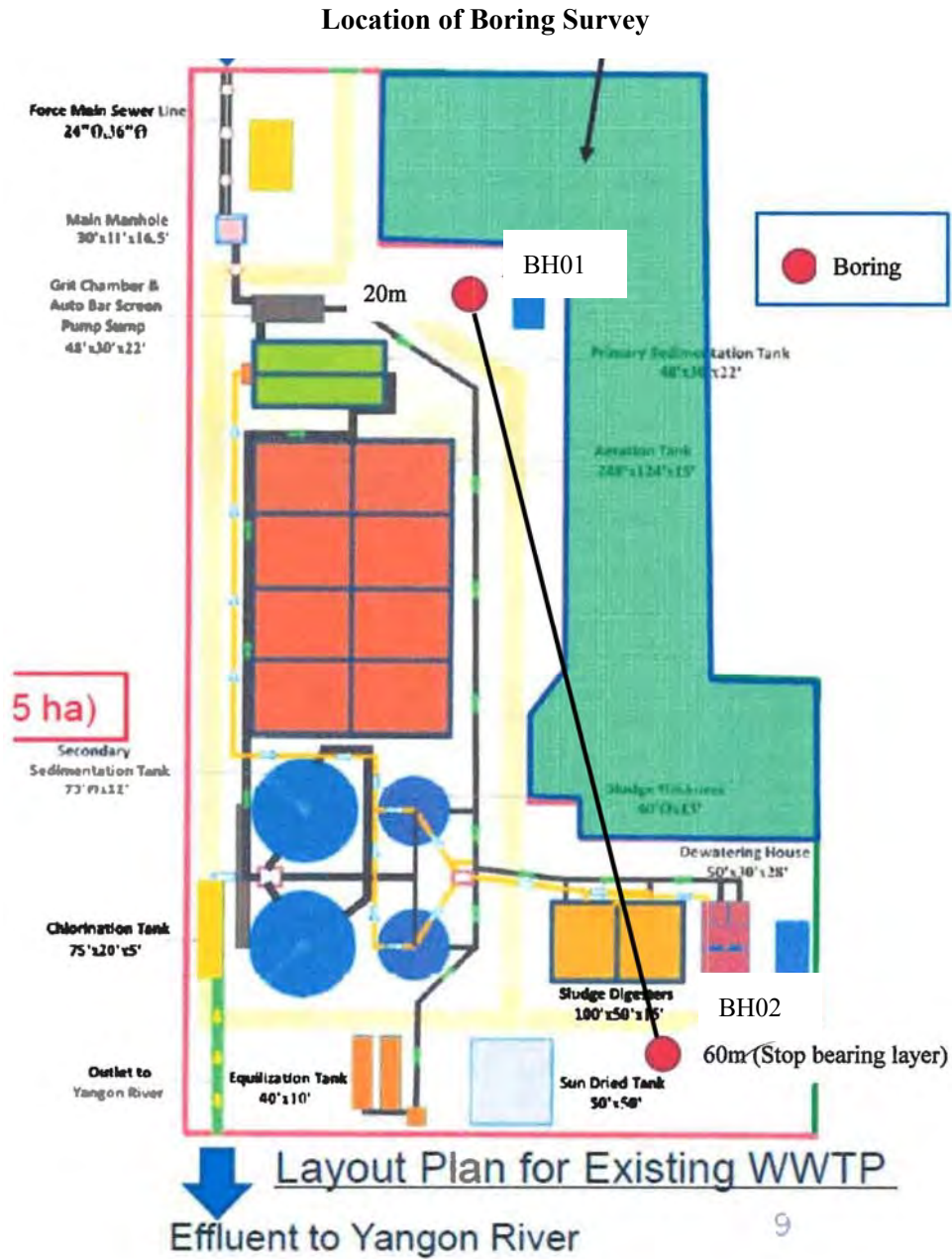
WASTE WATER TREATMENT PLANT



Source: JICA Study Team

Appendix 11 地質調査

APPENDIX11 GEOTECHNICAL SURVEY



Source: JICA Study Team

Result of 20m Boring Survey

BORE HOLE No. BH-01		BORING LOG										Job No. <small>FKYB-2017-040</small>											
												Sheet No. <small>1 OF 3</small>											
PROJECT NAME : Geotechnical Survey for Existing Wastewater Treatment Plant Project				BORING EQUIPMENT : TOHO "D1"				DATE : 03.01.2018 - 04.01.2018															
LOCATION : Botataung Township, Yangon Region, Myanmar				BORING METHOD : Rotary Direct Circulation				CLIENT															
GROUND LEVEL : 9.78m				ORIENTATION : Vertical				NIPPON KOEI															
COORDINATE : E 200460.000 ; N 1855990.000 DEPTH : 20.00m				GROUND WATER LEVEL : 4.10m																			
SCALE (m)	ELEVATION (m)	DEPTH (m)	THICKNESS (m)	DIAGRAM	COLOR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING DEPTH (m) & DIAMETER (mm)	WATER DEPTH (m)	STANDARD PENETRATION TEST TEST METHOD (ASTM)					SAMPLING			SCALE (m)			
												DEPTH (m)	N-Value (Blows/30cm)	CURVE OF BLOW	SAMPLE (Type & No)	DEPTH (m)	TCR (%)	SCR (%)	ROD (%)				
					brownish gray	Very soft to soft	CLAY	Very soft, brownish gray, wet, high plasticity. CLAY	2.00	Ø112													
					brownish gray	Soft to firm	Sandy CLAY	Soft to firm, brownish gray, moist, medium plasticity, fine grained, Sandy CLAY	3.01, 3.18, 6.00														
					brownish gray	Soft to firm	Sandy CLAY	Soft to firm, brownish gray, moist, medium plasticity, fine grained, Silty SAND	4.01, 18.00, 20.00														
								This borehole is terminated at that depth, according to the termination criteria.															

NOTES				Sample key		Plunger diameter		Discontinuities	
Relative density description	SPT N-Value (max)	Consistency description	SPT N-Value (max)	PHF	Pneum. Fract. Test	Term	Spacing (mm)	Term	Spacing (mm)
Very loose	0 - 4	Very soft	under 2	VS	Vane Shear Test	Very thick	> 2000	Very widely spaced	> 2000
Loose	4 - 10	Soft	2 - 4	PMT	Pressuremeter Test	Thick	600 - 2000	Widely spaced	600 - 2000
Medium dense	10 - 30	Firm	5 - 8			Medium	200 - 600	Medium spaced	200 - 600
Dense	30 - 50	Stiff	9 - 15			Thin	60 - 200	Closely spaced	60 - 200
Very dense	over 50	Very stiff	16 - 30			Very thin	20 - 60	Very closely spaced	20 - 60
		Hard	over 30			Thickly laminated	6 - 20	Extremely closely spaced	< 20
						Thinly laminated	< 6		

<p>Relative density description</p> <p>Very loose: 0 - 4</p> <p>Loose: 4 - 10</p> <p>Medium dense: 10 - 30</p> <p>Dense: 30 - 50</p> <p>Very dense: over 50</p>	<p>Consistency description</p> <p>Very soft: under 2</p> <p>Soft: 2 - 4</p> <p>Firm: 5 - 8</p> <p>Stiff: 9 - 15</p> <p>Very stiff: 16 - 30</p> <p>Hard: over 30</p>
--	--

<p>Plunger diameter</p> <p>Very thick: > 2000</p> <p>Thick: 600 - 2000</p> <p>Medium: 200 - 600</p> <p>Thin: 60 - 200</p> <p>Very thin: 20 - 60</p> <p>Thickly laminated: 6 - 20</p> <p>Thinly laminated: < 6</p>	<p>Discontinuities</p> <p>Very widely spaced: > 2000</p> <p>Widely spaced: 600 - 2000</p> <p>Medium spaced: 200 - 600</p> <p>Closely spaced: 60 - 200</p> <p>Very closely spaced: 20 - 60</p> <p>Extremely closely spaced: < 20</p>
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<p>Notes</p> <p>○: Disturbed sample (SPT sample)</p> <p>□: Undisturbed sample (Pluton sample)</p> <p>□: Undisturbed sample (Debris sample)</p> <p>■: Rock core sample (Single core tube)</p> <p>■: Rock core sample (Double core tube)</p> <p>■: Rock core sample (Core Loss)</p> <p>■: Water sample</p>	<p>Terminology</p> <p>PHF: Penetration Fracture Test</p> <p>VS: Vane Shear Test</p> <p>PMT: Pressuremeter Test</p> <p>RQD (%): Rock Quality Designation</p> <p>0 - 25: Very poor</p> <p>25 - 50: Poor</p> <p>50 - 75: Fair</p> <p>75 - 90: Good</p> <p>90 - 100: Excellent</p>
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<p>Company Information</p> <p>FUKKEN CO., LTD. Consulting Engineers (Yangon Branch) FCSE www.fukken.co.jp</p>	<p>Revision</p> <p>Rev: 01 Revision Date: 15.02.2018</p>
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Source: JICA Study Team

BORE HOLE No. BH-02		BORING LOG				Job No.	FKYB-2017-040																					
						Sheet No.	2 OF 3																					
PROJECT NAME : Geotechnical Survey for Existing Wastewater Treatment Plant Project				BORING EQUIPMENT : TOHO "D1"		DATE : 29.12.2017 ~ 02.01.2018																						
LOCATION : Botahtung Township, Yangon Region, Myanmar				BORING METHOD : Rotary Direct Circulation		CLIENT NIPPON KOGEI																						
GROUND LEVEL : 9.97m				ORIENTATION : Vertical																								
COORDINATE : E 20604.000, N 1855802.000, DEPTH : 65.00m				GROUND WATER LEVEL : 1.50m																								
SCALE (m)	ELEVATION (m)	DEPTH (GL - (m))	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (G/CONSISTENCY)	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)	STANDARD PENETRATION TEST METHOD (ASTM)					SAMPLING											
												DEPTH (GL - (m))	N-Value (Blows / 30cm)	CURVE OF BLOW				SAMPLE (Type & No.)	DEPTH (GL - (m))	RETR (%)	SCR (%)	ROD (%)	SCALE (m)					
							Silty SAND	Medium dense to dense, brownish gray, moist, fine to medium grained. Silty SAND					0	10	20	30	40	50	P-24	31.00								
							Silty SAND	GL(41.00-41.45m, Medium dense, gray, moist, fine to medium grained, low plastic Clayey SAND layer is observed as intercalated layer at that depth	30.12.17 36.00				31.00	37.30					P-25	31.45								
							Silty SAND	Medium dense to dense, yellowish brown, moist to wet, medium to coarse grained. Silty SAND	31.12.17 51.00				32.00	22.30					P-26	32.00								
							Silty SAND						33.00	24.30					P-27	32.45								
							Silty SAND						34.00	30.30					P-28	33.00								
							Silty SAND						35.00	32.30					P-29	33.45								
							Silty SAND						36.00	8.30					P-30	34.00								
							Silty SAND						37.00	8.30					P-31	34.45								
							Silty SAND						38.00	18.30					P-32	35.00								
							Silty SAND						39.00	19.30					P-33	35.45								
							Silty SAND						40.00	28.30					P-34	36.00								
							Silty SAND						41.00	22.30					P-35	36.45								
							Silty SAND						42.00	12.30					P-36	37.00								
							Silty SAND						43.00	21.30					P-37	37.45								
							Silty SAND						44.00	23.30					P-38	38.00								
							Silty SAND						45.00	31.30					P-39	38.45								
							Silty SAND						46.00	50.29					P-40	39.00								
							Silty SAND						47.00	48.30					P-41	39.45								
							Silty SAND						48.00	47.30					P-42	40.00								
							Silty SAND						49.00	50.18					P-43	40.45								
							Silty SAND						50.00	47.30					P-44	41.00								
							Silty SAND						51.00	50.18					P-45	41.45								
							Silty SAND						52.00	40.30					P-46	42.00								
							Silty SAND						53.00	50.29					P-47	42.45								
							Silty SAND						54.00	36.30					P-48	43.00								
							Silty SAND						55.00	35.30					P-49	43.45								
							Silty SAND						56.00	50.16					P-50	44.00								
							Silty SAND						57.00	50.27					P-51	44.45								
							Silty SAND						58.00	50.27					P-52	45.00								
							Silty SAND						59.00	27.30					P-53	45.45								
							Silty SAND						60.00	50.23						46.00								
							Silty SAND						61.00	50.23						46.44								
Continue to next sheet																												

NOTES

Relative density description	SPT N-Value (max)	Consistency description	SPT N-Value (max)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key		Permeability Test	
●	Disturbed sample (SPT sample)	PBT	Permeability Test
□	Undisturbed sample (Piston sampler)	VS	Vane Shear Test
□	Undisturbed sample (Division sampler)	PMT	Pressuremeter Test
■	Rock core sample (Single core tube)		
■	Rock core sample (Double core tube)		
■	Rock core sample (Core Line)		
■	Water sample		

Planes & spacings		Discontinuity	
Very thick	> 2000	Very widely spaced	> 2000
Thick	600 - 2000	Widely spaced	600 - 2000
Medium	200 - 600	Medium spaced	200 - 600
Thin	60 - 200	Closely spaced	60 - 200
Very thin	20 - 60	Very closely spaced	20 - 60
Thickly laminated	6 - 20	Extremely closely spaced	< 20
Thinly laminated	< 6		

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Revision No. Rev: 01
Revision Date 15.02.2018

Source: JICA Study Team

BORE HOLE No. BH-02		BORING LOG				Job No.	FKYB-2017-040	
						Sheet No.	3 OF 3	
PROJECT NAME : Geotechnical Survey for Existing Wastewater Treatment Plant Project			BORING EQUIPMENT : TOHO "D1"			DATE : 29.12.2017 - 02.01.2018		
LOCATION : Botahtung Township, Yangon Region, Myanmar			BORING METHOD : Rotary Direct Circulation			CLIENT NIPPON KOEI		
GROUND LEVEL : 9.97m			ORIENTATION : Vertical					
COORDINATE : E 200504.000 ; N 185802.000			DEPTH : 65.00m			GROUND WATER LEVEL : 1.50m		

SCALE (m)	ELEVATION (m)	DEPTH G.L. (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (%) / CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING DEPTH (m) & DIAMETER (mm)	WATER DEPTH (m)	STANDARD PENETRATION TEST METHOD (ASIM)					SAMPLING				SCALE (m)				
												DEPTH G.L. (m)	N-Value (Blows / 30cm)	CURVE OF BLOW				SAMPLE TYPE & No.	DEPTH G.L. (m)	RECOVER (%)		SCR (%)	ROD (%)		
														0	10	20	30							40	50
61.00							Silty SAND	Medium dense to dense, yellowish brown, moist to wet, medium to coarse grained. Silty SAND	20118			61.00	50/25					P-54	61.00					61	
62.00												62.00	50/22					P-55	62.00					62	
63.00												63.00	50/28					P-56	63.00					63	
64.00												64.00	30/30					P-57	64.00					64	
65.00												65.00	50/17					P-58	65.00					65	
66.00								This borehole is terminated at that depth, according to the termination criteria.	65.00															66	
67.00																									67
68.00																									68
69.00																									69
70.00																									70
71.00																									71
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87.00																									87
88.00																									88
89.00																									89
90.00																									90
91.00																									91

NOTES				Sample key				Plunger & Spoon				Discontinuity			
Relative density description		Consistency description		PBT Permeability Test		VS Vane Shear Test		Term		Spacing (mm)		Term		Spacing (mm)	
Relative density	SPT N-Value (blows)	Consistency	SPT N-Value (blows)	VS	VS	Very thick	> 2000	Very widely spaced	> 2000						
Very loose	0 - 4	Very soft	under 2	PMT	PMT	Thick	600 - 2000	Widely spaced	600 - 2000						
Loose	4 - 10	Sft	2 - 4			Medium	200 - 600	Medium spaced	200 - 600						
Medium dense	10 - 30	Firm	5 - 8			Thin	60 - 200	Closely spaced	60 - 200						
Dense	30 - 50	Stiff	9 - 15			Very thin	20 - 60	Very closely spaced	20 - 60						
Very dense	over 50	Very stiff	16 - 30			Thickly laminated	6 - 20	Extremely closely spaced	< 20						
		Hard	over 30			Thinly laminated	< 6								
						Good	75 - 90								
						Excellent	90 - 100								

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Revision Date	15.02.2018

Source: JICA Study Team

Appendix 12 既存施設インベントリー調査

APPENDIX 12 Inventory Survey

EXISTING WASTEWATER TREATMENT PLANT

EQUIPMENT LIST

Mechanical Equipment List

M-1 (Grit Removal and Pumping Station)					
NO.	Equipment Name	Quantity	Motor kW	Specification	Manufacturere
1.1	Screen Facility				
a.	Auto Bar Screen	1	2.2 kW	Opening: 15mm	INOX
1.2	Grit Removal Facility				
a.	Grit Collector	1		Concrete Tank	
b.	Grit Separator	1	0.55 kW	Flow: 54 m3/h, Grit: 2m3/h	INOX
c.	Grit Pump	1+(1)=2	1.7 kW	15 m3/h x 12 mH (Submersible)	ABS
1.3	Raw Waste Water Pump Facility				
a-1	Raw Waste Water Pump	1	22 kW	Submersible Pump	ABS
a-2	Raw Waste Water Pump	1+(1)=2	24 kW	500 m3/min x 10mH (Submersible)	ABS
b.	Hoist	1		Hoist Beam only	

M-2 (Primary Settling Tank Facility)					
NO.	Equipment Name	Quantity	Motor kW	Specification	Manufacturere
2.1	Clarifier	2	0.75 kW	7.2m W x 27m L x 3.45m WD	MCON
2.2	Primary Sludge Pump	2	1.2 kW	13.5m3/min x 8mH (Submersible)	ABS

M-3 (Aeration Tank Facility)					
NO.	Equipment Name	Quantity	Motor kW	Specification	Manufacturere
3.1	Floataion Surface Aerator	8	37 kW	1.5kg-O2/kWH, 58rpm	Aquastar

M-4 (Secondary Settling Tank Facility)					
NO.	Equipment Name	Quantity	Motor kW	Specification	Manufacturere
4.1	Clarifier	2	0.75 kW	22.5m dia. x 3.9mD	MCON
4.2	Return Sludge Pump	2	18.5 kW	460 m3/h x 10mH (Submersible)	ABS
4.3	Excess Sludge Pump	2	1.2 kW	19 m3/h x 10mH (Submersible)	ABS
4.4	Scum Pump	2	0.47 kW	6.99 m3/h x 7 mH (Submersible)	ABS

M-5 (Disinfection Tank Facility)					
NO.	Equipment Name	Quantity	Motor kW	Specification	Manufacturere
5.1	Chlorine Dosing System	1+(1)=2	0.2 kW	NaOCl 155 lith, with 3 m3 Tank x 2	OBI

M-6 (Sludge Thickener Facility)					
NO.	Equipment Name	Quantity	Motor kW	Specification	Manufacturere
6.1	Center Drive Clarifier	2	0.75 kW	12m dia. x 3.9mD, 0.007 rpm	MCON
6.2	Thickened Sludge Pump	2	1.5 kW	0.1m3/min x 30mH (Mono)	MONO

M-7 (Aerobic Digester Facility)					
NO.	Equipment Name	Quantity	Motor kW	Specification	Manufacturere
7.1	Submersible Aerator	8	6 kW	10kg-O2/h at 4mD	ABS
7.2	Digested Sludge Pump	2	1.5 kW	0.1m3/min x 30mH (Mono)	MONO

M-8 (Sludge Dewatering Facility)					
NO.	Equipment Name	Quantity	Motor kW	Specification	Manufacturere
8.1	Dewatering Unit	2	0.75 kW	Belt Press 1mW, 180kg-ds/h	INOX
8.2	Belt Washing Water Pump	1	4 kW	12 m3/h x 50mH	
8.3	Air Compressor	1	1.1 kW	220 lit/min x 8 bar	
8.4	Polymer Dosing System	1+(1)=2	0.2 kW	101 lith with 3 m3 Tank x 2	OBI

Electrical Panel List

E-1 (Transformer Room)				
NO.	Panel Name	Incoming	Load	
1	Incoming Panel	6.6kV	630 kVA	
2	Capacitor Bank (20Kvar x 5)			
3	Transformer (315kVA x 2 sets)	6.6kV/440V		
4	Main Distribution Panel (1)	440V		
	Main MCB		800A	
	Outgoing 1		400A	
	Outgoing 2		250A	
	Outgoing 3		200A	
	Outgoing 4		60A	
	Outgoing 5		60A	
5	Main Distribution Panel (2)	440V		
	Main MCB		800A	
	Outgoing 6		400A	
	Outgoing 7		250A	

E-2 (Pump Control Room)				
NO.	Panel Name	Incoming	Load	
6	Raw Waste Water Pump Panel	400V		
	Raw Waste Water Pump A		22 kW	
	Raw Waste Water Pump B		24 kW	
	Raw Waste Water Pump C		24 kW	
7	Grit Pump	400V	1.7 kW	
8	Grit Separator	400V	2.2 kW	

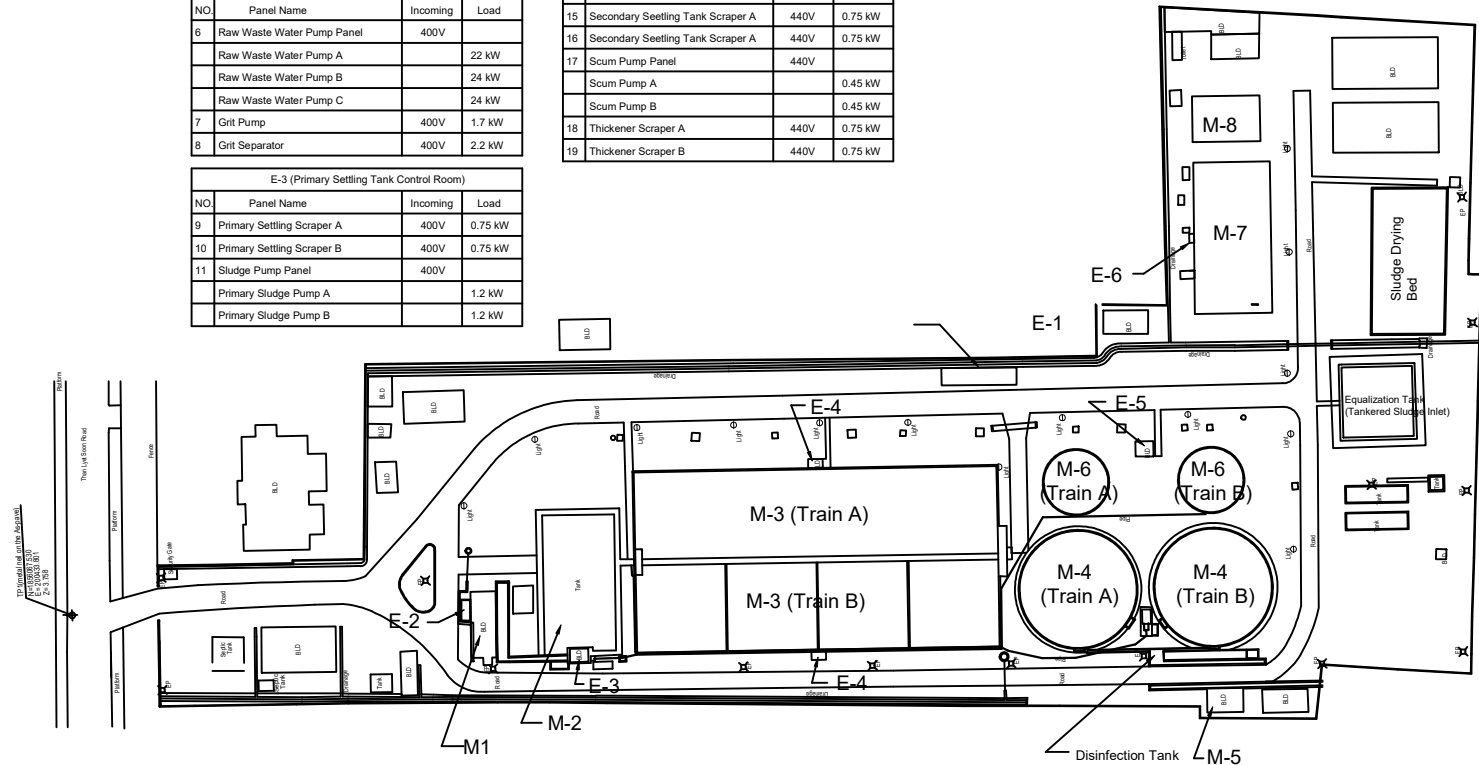
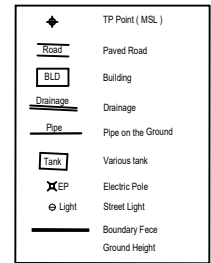
E-3 (Primary Settling Tank Control Room)				
NO.	Panel Name	Incoming	Load	
9	Primary Settling Scraper A	400V	0.75 kW	
10	Primary Settling Scraper B	400V	0.75 kW	
	Sludge Pump Panel	400V		
	Primary Sludge Pump A		1.2 kW	
	Primary Sludge Pump B		1.2 kW	

E-4 (Aerator Control Room A & B)				
NO.	Panel Name	Incoming	Load	
12	Aerator Panel A	400 V		
	Surface Aerator A-1		37 kW	
	Surface Aerator A-2		37 kW	
	Surface Aerator A-3		37 kW	
	Surface Aerator A-4		37 kW	
13	Aerator Panel B	440V		
	Surface Aerator B-1		37 kW	
	Surface Aerator B-2		37 kW	
	Surface Aerator B-3		37 kW	
	Surface Aerator B-4		37 kW	

E-5 (Secondary Settling Tank Control Room)				
NO.	Panel Name	Incoming	Load	
14	Return Sludge Pump Panel	400 V		
	Return Sludge Pump A		18.5 kW	
	Return Sludge Pump B		18.5 kW	
15	Secondary Settling Tank Scraper A	440V	0.75 kW	
16	Secondary Settling Tank Scraper A	440V	0.75 kW	
17	Scum Pump Panel	440V		
	Scum Pump A		0.45 kW	
	Scum Pump B		0.45 kW	
18	Thickener Scraper A	440V	0.75 kW	
19	Thickener Scraper B	440V	0.75 kW	

E-6 (Digester Control Room)				
NO.	Panel Name	Incoming	Load	
20	Digester Aerator Panel A	400 V		
	Digester Aerator A-1		5.9 kW	
	Digester Aerator A-2		5.9 kW	
	Digester Aerator A-3		5.9 kW	
	Digester Aerator A-4		5.9 kW	
13	Digester Aerator Panel B	440V		
	Digester Aerator B-1		5.9 kW	
	Digester Aerator B-2		5.9 kW	
	Digester Aerator B-3		5.9 kW	
	Digester Aerator B-4		5.9 kW	

Legend



**Yangon Existing Sewage Treatment Plant
Mechanical Equipment Survey Data**

Present Condition : ☉ ; good condition , ○ ; Able to operate but maintenance required,
△; Better Renewal, X; to be consider different system/equipment

No.	Description	Specification	Manufacturer/ Type	kW	Quantity			Present Condition	C/O	Year of Installation	Photps	Remarks
					OP	S/B	Total					
1 Grit Removal and Pumping Station (Head Works)												
1.1 Screen Facility												
a	Auto Bar Screen	Automatic Bar Screen Opening 15mm	INOX (France) Assmbl Thailand	2.2	1		1	△	Thailand	2005	Mechanical No. 1, 2 & 3	
b	Screenings Bin	No Bin						X				
1.2 Grit Removal Facility												
a	Grit Collector							X				
b	Grit Separator	Mixing Wash Type with Screw Conveyor 54m ³ /h Grit 2m ³ /h	INOX (France) Assmbl Thailand	0.55	1		1	○	Thailand	2005	Mechanical No. 5	
c	Grit Pump	Submersible Pump 15m ³ /h x 12mH	ABS	1.7	1	1	2	△	Ireland	2005		
1.3 Pumping Facility												
a	Raw Waste Water Pump (First Installation)	Non-Clog Type Submersible pump with Quick Discharge Connection 460 m ³ /min x 10mH	ABS	18.5	2	1	3	Replaced	Ireland	2005	Mechanical No. 4	
	Raw Waste Water Pump (Second Installation)	Non-Clog Type Submersible pump with Quick Discharge Connection ? m ³ /min x 10mH	ABS	22	1			○	Ireland			
	Raw Waste Water Pump (Present Installation)	Non-Clog Type Submersible pump with Quick Discharge Connection 500 m ³ /min x 10mH	ABS	24	1	1	2	○	Ireland	2017		
b	Hoist	Beam + Chain Hoist (Hoist not find)	?					X				No Chain Hoist
c	Valve/Pipe/Support Condition	Check Valve						○				

No.	Description	Specification	Manufacturer/ Type	kW	Quantity			Present Condition	C/O	Year of Installation	Photos	Remarks
					OP	S/B	Total					
2 Primary Settling Tank Facility												
2.1	Clarifier (w/Scum Skimmer)	7.2mW x 27mL x 3.45mD (24' x 90' x 11.5'D) Travelling Bridge Type with Scum Skimmer Speed 1.5m/min	MCON (USA) Assmbl. Thailand	0.75	2		2	△	Thailand	2005	Mechanical No. 6 & 7	
2.2	Primary Sludge Pump	Non-Clog Type Submersible pump with Quick Discharge Connection 13.5m ³ /min x 8mH	ABS	1.2	2		2	△	Ireland	2005		
3 Aeration Tank Facility												
3.1	Surface Aerator	Floatation Surface Aerator	Aquastar 57.3~62.9kg O ₂ /h 1.5kg O ₂ /kWh 58rpm	37kW		8	8	○ 4 Units Operation	Australia	2005	Mechanical No. 8	
4 Final Settling Tank facility												
4.1	Clarifier (w/Scum Skimmer)	Peripheral Drive Circular Clarifier (Travelling Bridge with Scum Scraper) 22.5 m dia. X 3.9m D (75' x 13'D) 0.013rpm	MCON (USA) Assmbl. Thailand	0.75	2		2	△	Thailand	2005	Mechanical No. 9	
4.2	Return Sludge Pump	Submersible Pump 460m ³ /h x 10m	ABS	18.5	1 (2)	1 (0)	2	△	Ireland	2005	Mechanical No. 10	
4.3	Excess Sludge Pump	Submersible Pump 19 m ³ /h x 10m	ABS	1.2	2		2	△	Ireland	2005		
4.4	Scum Pump	Submersible Pump 6.99 m ³ /h x 7 m	ABS	0.47	2		2	△	Ireland	2005		
5 Disinfection Tank												
5.1	Chlorine Dosing System	NaOCl 155lit/h with 3m ³ Tank x 2	OBI	0.2	1	1	2	X	Italy	2005	Mechanical No. 11	
6 Sludge Thickener Facility												
6.1	Thickener	Center Drive Circular Clarifier 12m dia. X 3.9mD) (40' x 13'D) 0.007rpm	MCON (USA) Assmbl. Thailand	0.75	2		2	X	Thailand	2005		
6.2	Thickened Sludge Pump	Mono Pump 100 l/m x 30 m	Mono	1.5	2		2	X	Australia	2005		

No.	Description	Specification	Manufacturer/ Type	kW	Quantity			Present Condition	C/O	Year of Installation	Photps	Remarks
					OP	S/B	Total					
7	Aerobic Digester Facility											
7.1	Submersible Aerator	Natural aspiration Submersible Aerator 10kgO ₂ /h at 4m D	ABS	6	8		8	X	Germany	2005	Mechanical No. 15	
7.2	Digested Sludge Pump	Mono Pump 100 l/m x 30 m	Mono	1.5	2		2	X	Australia	2005		
8	Sludge Dewatering Facility											
8.1	Dewatering Unit	Belt Press Belt Width 1m 180kg-DS/h	INOX (France) Assmbl. In Thailand	0.55	2		2	X	Thailand	2005	Mechanical No. 13	
8.2	Belt Washing Water Pump	12m ³ /h x 5 bar	Part of Dewatering Unit	4	1		1	X		2005		
8.3	Air Compressor	220lit/min x 8 bar	Part of Dewatering Unit	1.1	1		1	X		2005		
8.4	Polymer Dosing System	101 lit/h with 3m ³ Tank x 2	OBI	0.2	1	1	2	X	Italy	2005	Mechanical No 14	
9	Sludge Drying Bed											
9.1	Drying Bed Condition	-						△			Mechanical No 12	
9.2	Filtered Water Return Pump							△				

Memo (Problem/Improvement Idea)

(Problems) Treatment condition is not good as plant ability. Improvement for treatment condition shall be depending on Operation and maintenance condition.

(Operation) Aerators shall operate for 24 hours/day. Present condition in Aeration Tank is not enough for Oxygen feed. SVI shall be measured daily base so as to find optimal operation condition.

Excess Sludge pump shall be installed and operate according to SVI measurement result.

(Maintenance) Inlet Screen shall be clean by water manually. Pump pit may be clean periodically so that pump life time can be prolonged.

**Yangon Existing Sewage Treatment Plant
Electrical Panel Survey Data**

Present Condition : ◎ ; good condition , ○ ; able to operate but maintenance required,
△; Better Renewal, X; Bad Condition

No.	Panel Name	Incoming	Load List		Place	Panel Condition	Components Condition	Photpo No.	Remarks
			Name	A					
1	Incoming Panel	6.6kV			Transformer Room	X	X	Electrical -No.1	
2	Capacitor Bank				Transformer Room	X	△	Electrical -No.2	20Kvar x 5
3	Transformer	6.6kV x 400V			Transformer Room	X	○	Electrical -No.3	315kVA x 2 sets
4	Main Distribution Panel (1)	400V	Main	800 A	Transformer Room	X	△	Electrical -No.4	
			Outgoing 1	400 A		X	△		
			Outgoing 2	250A		X	△		
			Outgoing 3	200A		X	△		
			Outgoing 14	60A		X	△		
			Outgoing 5	60A		X	△		
5	Main Distribution Panel (2)	400V	Main	800 A	Transformer Room	X	△	Electrical -No.5	
			point 6	400 A		X	△		
			point 7	250A		X	△		
6	Raw Water Pump	400V	Raw Water Pump A	22kW	Pump Control Room	△	△	Electrical -No.11	
			Raw Water Pump B	24kW		△	△		
			Raw Water Pump C	24kW		△	△		
7	Grit Pump	400V	Grit Pump	1.7kW	Pump Control Room	△	△	Electrical -No.12	
8	Grit Separator	400V	Grit Separator	2.2kW	Pump Control Room	△	△	Electrical -No.12	
9	Primary Settling Tank	400V	Primary Settling Scraper A	0.75kW	Primary Settling	△	△		
10	Primary Settling Tank		Primary Settling Scraper B	0.75kW	Tank Control Room	△	△		
11	Sludge Pump	400V	Primary Sludge Pump A	1.2kW	Primary Settling	△	△		
			Primary Sludge Pump B	1.2kW	Tank Control Room	△	△		
12	Surface Aerator A	400V	Surface Aerator A-1	37kW	Aerator Control Room	△	△	Electrical -No.10	
			Surface Aerator A-2	37kW		△	△		
			Surface Aerator A-3	37kW		△	△		
			Surface Aerator A-4	37kW		△	△		
13	Surface Aerator B	400V	Surface Aerator B-1	37kW	Aerator Control Room	△	△		
			Surface Aerator B-2	37kW		△	△		
			Surface Aerator B-3	37kW		△	△		
			Surface Aerator B-4	37kW		△	△		

No.	Panel Name	Incoming	Load List		Place	Panel Condition	Components Condition	Photpo No.	Remarks
			Name	A					
14	Return Sludge Pump	400V	Return Sludge Pump A	18.5kW	Secondary Settling	X	△	Electrical -No.8	
			Return Sludge Pump B	18.5kW	Tank Control Room	X	△		
15	Secondary Settling Tank A	400V	Scraper A	0.75kW	Secondary Settling	X	△	Electrical -No.7	
16	Secondary Settling Tank B	400V	Scraper B	0.75kW	Tank Control Room	X	△	Electrical -No.7	
17	Scum Pump	400V	Scum Pump A	0.45kW	Secondary Settling	X	△	Electrical -No.9	
			Scum Pump B	0.45kW	Tank Control Room	X	△		
18	Thickener A	400V	Scraper A	0.75kW	Secondary Settling	X	△	Electrical -No.7	
19	Thickener B	400V	Scraper B	0.75kW	Tank Control Room	X	△	Electrical -No.7	
20	Aerobic Digester	400V	No.1 Aerobic Digester	5.9kW	Digester Room	X	△	Electrical -No.6	
			No.2 Aerobic Digester	5.9kW		X	△		
			No.3 Aerobic Digester	5.9kW		X	△		
			No.4 Aerobic Digester	5.9kW		X	△		
21	Aerobic Digester	400V	No.5 Aerobic Digester	5.9kW	Digester Room	X	△		
			No.6 Aerobic Digester	5.9kW		X	△		
			No.7 Aerobic Digester	5.9kW		X	△		
			No.8 Aerobic Digester	5.9kW		X	△		

Note: Local Control Panels are not included such as Dewatering Unit, Polymer Dosing Panel and NaOCl Dosing Panel

Yangon Existing WWTP
Mechanical Equipment Photos

Photo took on 17th Jan 2017

No	Description
1	Auto Bar Screen (Side View)
2	Auto Bar Screen (Front View)
3	Auto Bar Screen (Drive Side)
4	Pump Pit (Raw Water Pit)
5	Grit Separator
6	Primary Settling Tank (Scraper)
7	Primary Settling Tank (Overflow Trough)
8	Aeration Tank (Surface Aerator)
9	Secondary Settling Tank
10	Return Sludge Pump Pit
11	Disinfection Tank
12	Sludge Drying Bed
13	Sludge Dewatering Unit (Belt Press 1mW)
14	Sludge Dewatering Unit (Polymer Dosing Unit)
15	Aerobic Digester (Submersible Aerator)



No.1 Auto Bar Screen (Side View)



No.3 Auto Bar Screen (Drive Side)



No.2 Auto Bar Screen (Front View)



No.4 Pump Pit (Raw Water Pit)



No.5 Grit Separator



No.7 Primary Settling Tank (Overflow Trough)



No.6 Primary Settling Tank (Scraper)



No.8 Aeration Tank (Surface Aerator)



No.9 Secondary Settling Tank



No. 11 Disinfection Tank



No.10 Return Sludge Pump Pit



No. 12 Sludge Drying Bed



No. 13 Sludge Dewatering Unit (Belt Press 1mW)



No. 15 Aerobic Digester (Submersible Aerator)



No. 14 Sludge Dewatering Unit (Polymer Dosing Unit)

Yangon Existing WWTP
Electrical Panel Photos

Photo took on 17th Jan 2017

No.	Description
1	Incoming Panel
2	Capacitor Bank
3	Transformer
4	Distribution Panel (1)
5	Distribution Panel (2)
6	Aerobic Digester Control Panel
7	Secondary Settling Tank Scrapers & Thickener Scrapers
8	Return Sludge Pump Panel
9	Scum Pump Panel
10	Surface Aerator Panel
11	Raw Waste Water Pump Panel
12	Grit Separator & Grit Pump



No.1 Incoming Panel



No.3 Transformer



No.2 Capacitor Bank



No.4 Distribution Panel (1)



No.5 Distribution Panel (2)



No.7 Secondary Settling Tank Scrapers & Thickener Scrapers



No.6 Aerobic Digester Control Panel



No.8 Return Sludge Pump Panel



No.9 Scum Pump Panel



No.11 Raw Waste Water Pump Panel



No.10 Surface Aerator Panel



No.12 Grit Separator & Grit Pump

Appendix 13 構造調査

APPENDIX 13: Structural Survey

1. Visual Inspection (Reactor of C1 WWTP)



Photo 1: Concrete Surface of Reactor in C1 WWTP

The operation of the C1 Wastewater Treatment Plant (WWTP) started on 2005, which means that 13 years have passed since the start of operations at the time of the survey in 2018. Since both storm water and wastewater are retained inside the facilities, visual inspection was conducted on the external wall of the semi-underground structure (upper part 15%-20%) for a reactor which is potentially reusable.

Cracks associated with deformation caused by foundation settlement were not found. However, cold joints and coarse concrete surface due to rough finishing works were observed. In addition, dirt and moss were observed on top of the wall.

Because the facility was painted originally, small cracks were not observed. It was concluded that the facility can be reused by repairing the surface finishing.

2. Concrete Chipping Survey (Reactor of C1 WWTP)



Photo 2: Concrete Chipping Survey (Reactor of C1 WWTP)

To examine re-utilization of the existing facility (reactor), a concrete chipping survey was conducted at one location approved by the Yangon City Development Committee (YCDC). The chipping work was done by the YCDC.

It was confirmed that the concrete covering depth is 70 mm, and corrosion was not observed according to the result of the neutralization test conducted separately, which is explained below.

3. Non-Destructive Concrete Strength Test (Reactor of C1 WWTP)



Photo 3: Concrete Chipping Survey (Reactor of C1 WWTP) Figure 1: Schmidt Hammer

As a simple method to measure compressive strength of concrete, the Schmidt hammer test was used to evaluate that of the existing concrete. To do this, a mesh of 20 3 cm x 3 cm squares was measured for each location, and the compression strength was estimated from the average of the rebound numbers at each location. The test was conducted at seven locations.

Regarding location No. 1, the surface was polished because it was rough due to the low accuracy of the mold construction. As a result, since the repulsion degree varied greatly, the test results considered were only from locations No. 2 to No. 7, excluding No.1.

Based on the measurement results of locations No. 2 to No. 7, a strength of approximately 45 to 50 N/mm² could be confirmed. It seems that the structure can be reused as a permanent structure after rehabilitation.

In the detailed design stage, a detailed survey, such as the core-completion test, is recommended to be conducted again.

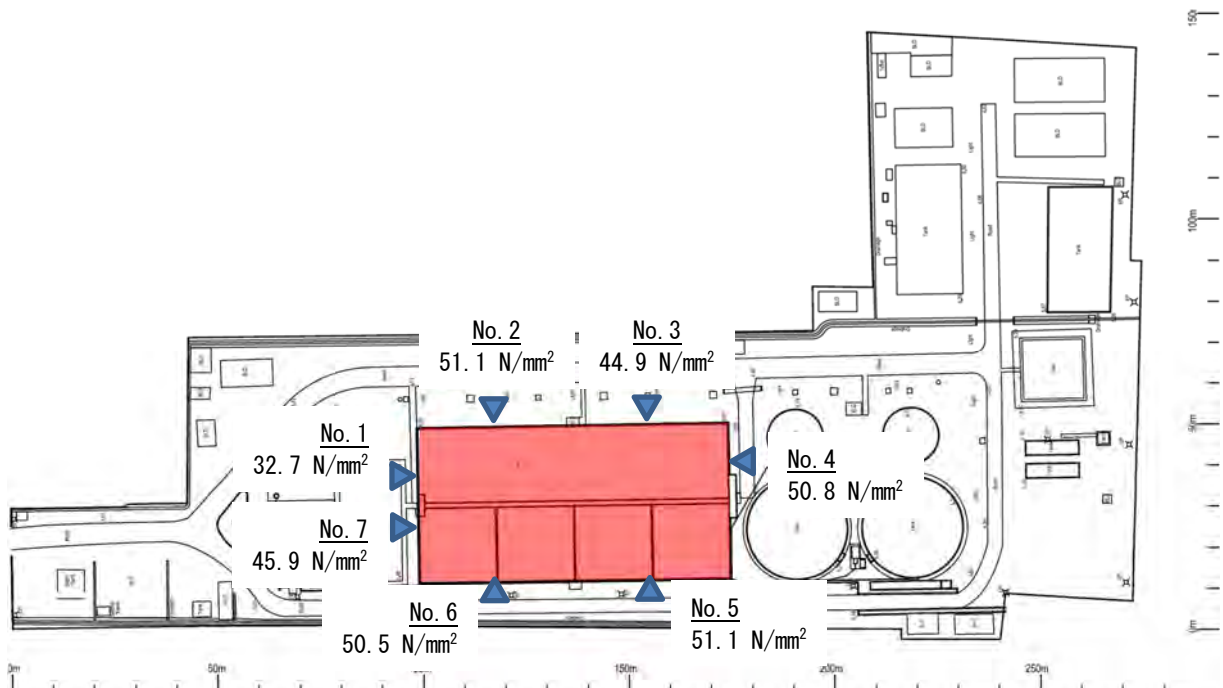


Figure 2: Test Result (Target Facility: Reactor)

4. Neutralization Test (Reactor of C1 WWTP)

At the location of the concrete chipping survey (chipping work was done by the YCDC), a neutralization test was conducted.

The result indicated that the neutralization depth was 10 mm. The neutralization rate coefficient was calculated using the formula below to predict the future status.

According to the prediction, it is estimated that the durable years of the structure is considerably long. Although the design compression strength was not obtained, a non-destructive concrete strength test using the Schmidt hammer test showed that the concrete compression strength was high enough. Therefore, there is a possibility that high-strength concrete was used. In this state, the concrete surface solidity is high, and the neutralization is less likely to progress from the concrete surface.

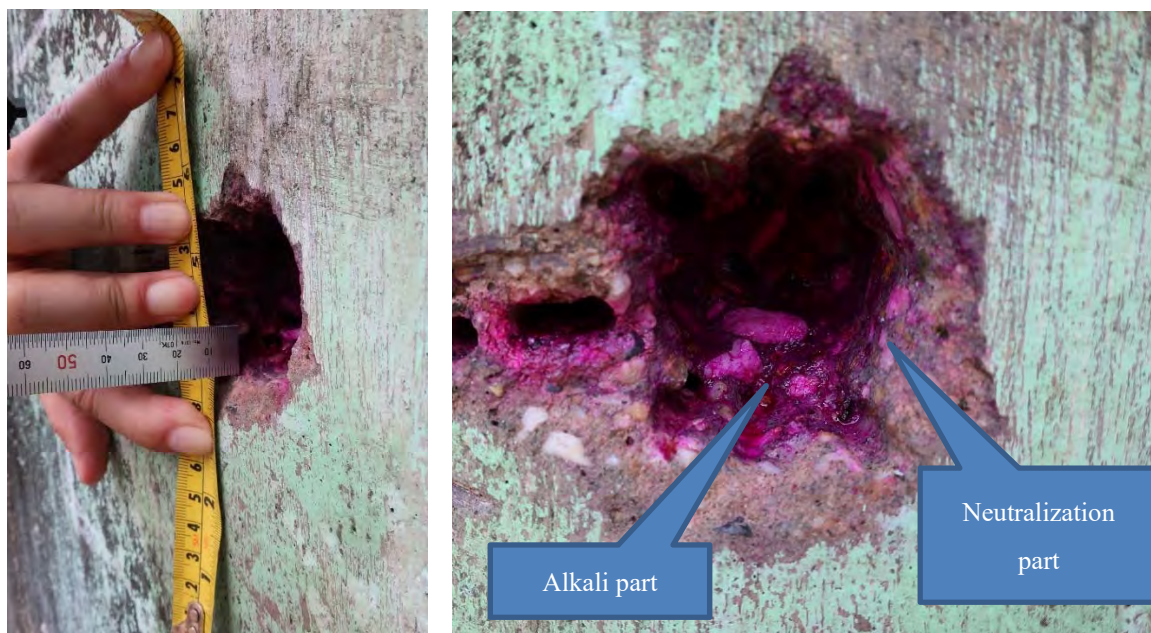


Photo 3: Neutralization Test

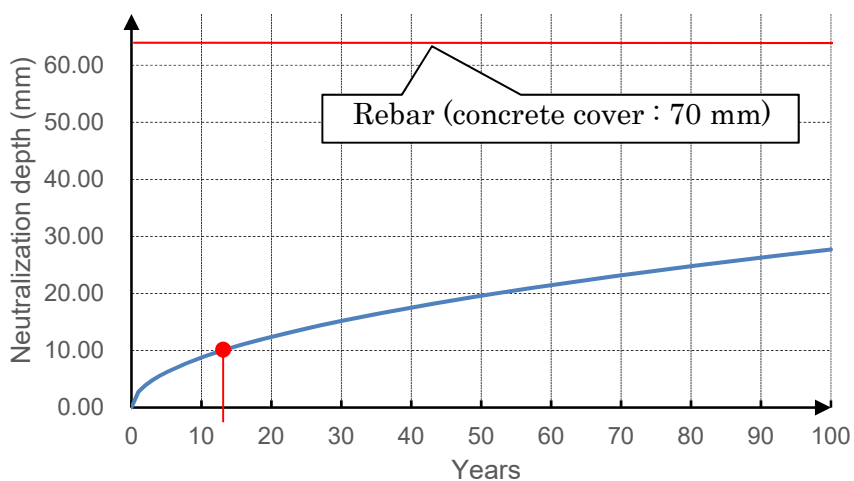
Formula for calculation of concrete neutralization depth:

$$X = A x \sqrt{t}$$

X: neutralization depth (mm), A: neutralization rate coefficient,





t: passed years (year)

The following chart shows the calculated neutralization rate coefficient when it will be 10 mm after 13 years.



<Photos>

<p>Schmidt Hammer Usage Explanation</p>	<p>Chipping Work on Reactor Wall (done by YCDC)</p>
<p>Schmidt Hammer Test Location (No.1)</p>	<p>Schmidt Hammer Test Location (No.2)</p>
<p>Schmidt Hammer Test Location (No.3)</p>	<p>Schmidt Hammer Test Location (No.4)</p>

	
Schmidt Hammer Test Location (No.5)	Schmidt Hammer Test Location (No.6)
	
Schmidt Hammer Test Location (No.7)	Phenolphthalein Reaction after Chipping Survey

Source: JICA Study Team

Appendix 14 高層建築物品質管理委員会
(CQHP)におけるガイドライン
(水供給・衛生)

APPENDIX14



REPUBLIC OF THE UNION OF MYANMAR
COMMITTEE FOR QUALITY CONTROL OF
HIGH-RISE BUILDING CONSTRUCTION PROJECTS

**GUIDELINES FOR HIGH-RISE BUILDING
CONSTRUCTION PROJECTS
(WATER SUPPLY AND SANITATION)**

23rd February, 2017

COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING
CONSTRUCTION PROJECTS
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GUIDELINES FOR HIGH - RISE BUILDING
CONSTRUCTION PROJECTS
(SANITAY)

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**COMMITTEE FOR QUALITY CONTROL OF HIGH-RISE BUILDING
 CONSTRUCTION PROJECTS
 GUIDELINE IV
 SANITATION**

Sanitation

1. Spent Water (R)

- 1-1 Spent water contribution should be based on water demand as given in para. 1-1, Guideline III. It is recommended that at least 90% of the water consumed will be discharged as spent water.
 - 1-1-1 Spent water consists of soil and waste water. Table 1, Appendix (R)
 - 1-1-1-1 Soil water is the spent water from WCs and urinals.
 - 1-1-1-2 Waste water is the spent water from basins, kitchen sinks, showers and bath tubs.

2. Soil Water Treatment and Disposal (M)

- 2-1 Soil water shall be treated before being discharged into a water course or public drain or municipal sewer.
- 2-1-1 The effluent quality of the treated soil water shall conform to the following:

Items of Analysis		Sewer	Watercourse	Controlled Water course
		Units in milligram per litre or otherwise stated		
1	BOD (5 days at 20°C)	300	50	20
2	COD	450	100	60
3	Total Suspended Solids	300	50	30

Note: BOD value refers to 5-day incubation period at 20°C.

- 2-1-2 Any sewage treatment system meeting the requirement shown in para 2-1-1 can be used.
- 2-1-3 Soil and waste water may be treated separately before final disposal.
- 2-2 Soil water discharged into YCDC sewer, if allowed shall conform to the normal range generally specified for domestic soil water. (para 2-1-1)
- 2-3 A permit shall be obtained from authority concerned for the discharge of treated soil water.
- 2-4 Effluent of treated soil water shall be disinfected with chlorine or by any other approved method where required.
- 2-5 Where effluent is chlorinated, residual chlorine shall be between 0.1 and 0.2 mg/l.

3. Waste Water Disposal

- 3-1 Waste water from residences may be discharged directly after undergoing appropriate treatment followed by disinfection into public drain. (R)
- 3-2 However, waste water from kitchen sinks shall first be discharged into a grease trap before its disposal into public drain (M). Undergoing the same treatment as mentioned in para 3-1.
- 3-3 Waste water is prohibited from being discharged into YCDC sewer. However, if allowed the effluent quality shall conform to the normal range generally specified for domestic waste water. (para 2-1-1)
- 3-4 A permit shall be obtained from authority concerned before waste water is disposed into public drain. (M)
- 3-5 Recycling of grey water may be used for purposes other than domestic such as drinking, cooking, washing, bathing etc.....

4. Combined Soil and Waste Water Treatment and Disposal (M)

- 4-1 Combined soil and waste water shall be treated before being discharged into a water course or public drain.
- 4-2 The effluent quality shall conform to that given in para 2-1-1 and disinfected as given in para (2-4, 2-5).
- 4-3 The effluent of the combined treated soil and waste water is prohibited from being discharged into town sewer.
- 4-4 A permit shall be obtained from authority concerned, YCDC, for the discharged of the treated combined soil and waste water.

5. Soil and Waste Water Collection (M)

- 5-1 Horizontal collecting pipes placed in ceiling shall be securely supported by hangers and given a slope with self-cleansing velocity of 3.0 ft/sec.
- 5-2 Sewer laid in ground shall be placed in proper bedding and given a slope with self-cleansing velocity of 3.0 ft/sec.
- 5-3 Sewer shall be laid in straight line.
- 5-4 However, manholes shall be placed where there is either a change of direction or gradient of sewer.
- 5-5 Provision of ducts with adequate space.

6. Sewage Pumps (M)

- 6-1 Pumps used for pumping soil and waste water shall meet the designer's requirement.
- 6-2 At least one stand-by pump shall be provided for duty pump/ pumps installed.
- 6-3 Characteristic curves for the sewage pumps installed showing the relationships between head, discharged, horse power and efficiency shall be provided by the designer in the desing calculation.

7. Soil, Waste and Vent Pipe System (M)

- 7-1 Fully ventilated system shall be used. See also guide line VII para 2-1.

8. Fittings (M)

- 8-1 Pipes and fittings used shall be of the same material.

9. Sanitary Appliances (M)

- 9-1 All sanitary appliances used shall be of approved make.

10. Specifications

- 10-1 Specifications for the following should conform to any internationally recognized standard or approved make: (R)
 - 10-1-1 Cast iron pipes and fittings for soil, waste and vent piping system.
 - 10-1-2 PVC or uPVC pipes and fittings for soil, waste and vent piping system.
 - 10-1-3 Any other materials other than those given in para 10-1-1 and 10-1-2.
 - 10-1-4 Soil/Waste Water tank shall be water-proof both on the inside and outside of the tank.

11. Installation (R)

- 11-1 Installation of soil, waste and vent pipes shall referred to SINGAPORE CODE OF PRACTICE ON SANITARY PLUMBING AND DRAINAGE SYSTEM (1976 or any up dated version) or any other recognized code of practices.

12. Rain Water Collection and Disposal

- 12-1 Neither soil nor waste water shall be discharged into rain water down pipes. (M)
- 12-2 Rain water shall therefore be collected and disposed of in a separate system. (M)
- 12-3 Rain water can be directly discharged into road side drain. (S)
- 12-4 Rain water gutter shall have the capacity of collecting rain water runoff from roof area. (M)
- 12-5 Rain water gutter outlets shall be designed to ensure free discharge into down pipes. (M)
- 12-6 Rain water gutter outlets pipe shall have the capacity of conveying rain water runoff from the gutter through the gutter outlet to the roadside drain. (M)
- 12-7 Materials for rain water down pipe should be of C.I, D.I, G.I, PVC or uPVC ,or of any approved material. Fabrication with M.S or G.I sheet should not be used. (R)
- 12-8 An external perimeter drain, shall consist of the volume of rainwater, effluent of soil and waste water from treatment system. The minimum velocity used shall be 0.7m/s .

Appendix 15 下水処理場からの発生汚泥の焼却

APPENDIX 15: Incineration of the Sludge from the Wastewater Treatment Plant (WWTP)

In the master plan conducted in 2014 by the Japan International Cooperation Agency (JICA), six wastewater treatment plants (WWTP) have been planned in Yangon City (core area) as shown in Figure 1.



Figure 1: Sewerage Zones in Yangon City

Excess sludge will be generated after wastewater treatment. However, the available area for sludge disposal sites in Yangon City are quite limited; thus, the sludge, especially from the WWTP in the area near the city center, must be transported to a site outside the city center.

In general, the generated sludge is treated through a drying process in the WWTP and disposed of at the disposal site. However, due to the reason mentioned above, the Yangon City Development Committee (YCDC) would like to minimize the volume of sludge generated as much as possible by using an incinerator.

Basically, the incineration process is planned to be installed in several wastewater treatment facilities. The initial and operation costs are quite high compared to simply disposing of the dried sludge at a disposal site even if the sludge volume is greatly reduced by incineration. Some skilled operational staff and maintenance staff are also necessary.

In addition, a certain amount of calories is required for the operation of an incinerator. These calories of the sewage sludge, however, are normally low; thus, the fuel necessary for incineration

and co-incineration of the dewatered sewage sludge with solid waste is also considered in that case.

Also, there is a tendency that construction of an incineration facility is not acceptable to residents because of environmental issues.

Thus, an incineration facility should be planned by integrating and covering multiple zones instead of only one facility in one sewerage zone.

As mentioned in the background, YCDC is considering to plan for the installation of an incineration facility in the future by conducting a master plan of integrated sewage sludge management for the entire area of Yangon City.

Appendix 16 JICA ガイドラインにおけるプロ
ジェクトカテゴリー及び IEE レベ
ルの検討

APPENDIX 16 Project Category and IEE level Study in the JICA Guidelines

Project Category in the JICA Guidelines

Category	Description
A	Proposed projects are classified as “Category A” if they are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as “Category A”. These impacts may affect an area broader than the sites or facilities subject to physical construction. “Category A”, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas.
B	Proposed projects are classified as “Category B” if their potential adverse impacts on the environment and society are less adverse than those of “Category A” projects. Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily.
C	Proposed projects are classified as “Category C” if they are likely to have minimal or little adverse impact on the environment and society.

Source: JICA Guidelines for Environmental and Social Considerations (April 2010)

IEE level study defined by the JICA Guidelines

Item	Definition
IEE	“Initial Environmental Examination (IEE) level study” is a study that includes an analysis of alternative plans, a prediction and assessment of environmental impacts, and a preparation of mitigation measures, and monitoring plans based on easily available information including existing data and simple field surveys.

Source: JICA Guidelines for Environmental and Social Considerations (April 2010)

Appendix 17 アセスメント目的のための下水道
事業の分類

APPENDIX 17 Categorization for Sewerage Projects for Assessment Purposes of Myanmar

No.	Type of Economic Activity	Initial Environmental Examination (IEE)	Environmental Impact Assessment (EIA)
Waste Management			
103.	Non-Hazardous Waste Disposal Facilities	Landfills < 10 t/d and total capacity < 25,000 t Others < 50 t/d	Landfills ≥ 10 t/d or total capacity ≥ 25,000 t Others ≥ 50 t/d
104.	Non-Hazardous Waste Incinerators	< 3 t/h	≥ 3 t/h
105.	Non-Hazardous Waste Recycling, Recovery or Reuse Facilities	< 50 t/d	≥ 50 t/d
106.	Hazardous Waste Disposal Facilities	-	All sizes
107.	Hazardous Waste Recycling, Recovery or Reuse Facilities	< 10 t/d	≥ 10 t/d
108.	Wastewater Treatment Plants (centralized systems)	-	All sizes
109.	Wastewater and Storm Water Collection Systems	Length ≥ 1 km but < 10 km	≥ 10 km

Source: Notification (No. 616 / 2015) Annex "Categorization of Economic Activities for Assessment Purposes"

Appendix 18 ヤンゴン地域の動植物種別

APPENDIX18 Flora and Fauna Species in Yangon Area

1. List of Mammal Species recorded in Yangon

No.	Scientific Name	Family Name	Common Name	IUCN/Status
1	<i>Herpestes javanicus</i>	Herpestidae	Small Asian Mongoose (or) Javan Mongoose	LC
2	<i>Herpestes urva</i>	Herpestidae	Crab eating Mongoose	LC
3	<i>Callosciurus phayrei</i>	Sciuridae	Phayre's Squirrel	LC
4	<i>Viverricula indica</i>	Viverridae	Small Indian Civet	LC
5	<i>Callosciurus erythraeus</i>	Sciuridae	Pallas's Squirrel	LC
6	<i>Mus musculus</i>	Muridae	Asian House Mouse	LC
7	<i>Paradoxurus hermaphroditus</i>	Viverridae	Common Palm Civet	LC
8	<i>Rattus rattus</i>	Muridae	House Rat	LC
9	<i>Bandicota indica</i>	Muridae	Greater Bandicoot Rat	LC
10	<i>Tupaia belangeri</i>	Tupaiaidae	Northern Tree shrew	LC
11	<i>Lepus peguensis</i>	Leporidae	Burmese Hare	LC
12	<i>Pteropus giganteus</i>	Pteropodidae	Indian Flying Fox	LC

LC = Least Concerned

Source: Field recorded data by Resource and Environment Myanmar Co., Ltd. (2017)

2. List of Bird Species recorded in Yangon

No.	Scientific Name	Family Name	Common Name	IUCN Status
1	<i>Garrulax leucolophus</i>	Leiothrichidae	White-crested Laughingthrush	LC
2	<i>Orthotomus atrogularis</i>	Sylviidae	Dark-necked Tailorbird	LC
3	<i>Prinia rufescens</i>	Cisticolidae	Rufescent prinia	LC
4	<i>Accipiter badius</i>	Accipitridae	Shikra	LC
5	<i>Acridotheres grandis</i>	Sturidae	White-Vented Myna	LC
6	<i>Acridotheres javanicus</i>	Sturidae	Jungle Myna	LC
7	<i>Acridotheres tristis</i>	Sturidae	Common Myna	LC
8	<i>Acrocephalus bistrigiceps</i>	Acrocephalidae	Black-browed reed-warbler	LC
9	<i>Acrocephalus orientalis</i>	Acrocephalidae	Oriental reed-warbler	LC
10	<i>Actitis hypoleucos</i>	Scolopacidae	Common Sandpiper	LC
11	<i>Ageithina tiphia</i>	Aegithinidae	Common Iora	LC
12	<i>Anas zonorhyncha</i>	Anatinae	Chinese spot-billed duck	LC
13	<i>Anastomus oscitans</i>	Ciconiidae	Asian Openbill	LC
14	<i>Anhinga melanogaster</i>	Anhingidae	Oriental Darter	LC
15	<i>Anthreptes malacensis</i>	Nectariniidae	Brown-throated sunbird	LC
16	<i>Anthus hodgsoni</i>	Motacillidae	Olive-backed Pipit	LC
17	<i>Apus nipalensis</i>	Apodidae	House Swift	LC
18	<i>Arachnothera longirostra</i>	Nectariniidae	Little Spiderhunter	LC
19	<i>Arachnothera magna</i>	Nectariniidae	Streaked Spiderhunter	LC
20	<i>Ardea alba</i>	Ardeidae	Great Egret	LC
21	<i>Ardea cinerea</i>	Ardeidae	Grey Heron	LC
22	<i>Ardeola bacchus</i>	Ardeidae	Chinese Pond Heron	LC
23	<i>Ardeola grayii</i>	Ardeidae	Indian Pond Heron	LC
24	<i>Ardeola grayii</i>	Ardeidae	Purple Heron	LC
25	<i>Artamus fuscus</i>	Artimidae	Ashy Woodswallow	LC
26	<i>Athene brama</i>	Strigidae	Spotted Owlet	LC
27	<i>Athys rufulus</i>	Motacillidae	Paddy field Pipit	LC
28	<i>Bubulcus coromandus</i>	Ardeidae	Eastern Cattle Egret	LC
29	<i>Butorides striata</i>	Ardeidae	Little heron	LC
30	<i>Cacomantis sepulcralis</i>	Cuculidae	Plaintive Cuckoo	NE
31	<i>Centropus sinensis</i>	Cuculidae	Greater Coucal	LC
32	<i>Ceropis daurica</i>	Hirundinidae	Red-rumped swallow	LC
33	<i>Chalcoparia singalensis</i>	Nectariniidae	Ruby-cheeked Sunbird	LC
34	<i>Charadrius placidus</i>	Charadriidae	Little winged Plover	NE
35	<i>Chlidonias leucopterus</i>	Sternidae	White wing Tern	LC
36	<i>Chloropsis aurifrons</i>	Eurylaimidae	Golden-fronted Leafbird	LC
37	<i>Chloropsis hardwickii</i>	Chloropseidae	Orange-bellied Leafbird	LC
38	<i>Chroicocephalus ridibundus</i>	Laridae	Black-headed Gull	LC
39	<i>Chrysococcyx xanthorhynchus</i>	Cuculidae	Violet Cuckoo	LC
40	<i>Chrysomma sinense</i>	Pachycephalidae	Yellow-eye Babler	LC
41	<i>Cinnyris jugularis</i>	Nectariniidae	Olive-Backed Sunbird	LC
42	<i>Circus macrourus</i>	Accipitridae	Pied Harrier	NT
43	<i>Cisticola juncidis</i>	Cisticolidae	Zitting Cisticola	LC
44	<i>Clamator coromandus</i>	Cuculidae	Chestnut-winged Cuckoo	LC
45	<i>Columba livia</i>	Columbidae	Rock Pigeon	LC
46	<i>Copsychus malabaricus</i>	Muscicapidae	White-rumped Shama	LC
47	<i>Copsychus saularis</i>	Muscicapidae	Oriental Magpie Robin	LC
48	<i>Coracias benghalensis</i>	Coraciidae	Indian Roller	LC
49	<i>Coracias benghalensis</i>	Meropidae	Little-green-bee-Eater	LC
50	<i>Coracina melaschistos</i>	Campephagidae	Black-winged Cuckoo Shrike	LC
51	<i>Corvus macrorhynchos</i>	Corvidae	Large-billed Crow	LC
52	<i>Corvus splendens</i>	Corvidae	House Crow	LC
53	<i>Crypsirina temia</i>	Corvidae	Racket-tailed Treepie	LC
54	<i>Culicicapa ceylonensis</i>	Stenostiridae	Grey-headed canary flycatcher	LC
55	<i>Cypsiurus balasiensis</i>	Apodidae	Asian Palm Swift	LC
56	<i>Cypsiurus balasiensis</i>	Apodidae	Asian Palm-Swift	LC

No.	Scientific Name	Family Name	Common Name	IUCN Status
57	<i>Dendrocitta vagabunda</i>	Corvidae	Rufous Treepie	LC
58	<i>Dendrocygna javanica</i>	Anatidae	Lesser Whistling Duck	LC
59	<i>Dicaeum cruentatum</i>	Dicaeidae	Scarlet-backed Flowerpecker	LC
60	<i>Dicaeum ignipectus</i>	Dicaeidae	Fire-breasted Flowerpecker	LC
61	<i>Dicrurus aeneus</i>	Dicruridae	Bronzed Drongo	LC
62	<i>Dicrurus hottentottus</i>	Dicruridae	Hair-crested Drongo	LC
63	<i>Dicrurus leucophaeus</i>	Dicruridae	Ashy Drongo	LC
64	<i>Dicrurus macrocercus</i>	Dicruridae	Black Drongo	LC
65	<i>Dicrurus paradiseus</i>	Dicruridae	Greater Racket-tailed Drongo	LC
66	<i>Dicrurus remifer</i>	Dicruridae	Lesser Racket-tailed Drongo	LC
67	<i>Egretta garzetta</i>	Ardeidae	Little Egret	LC
68	<i>Elanus axillaris</i>	Accipitridae	Black-Shoulder kite	LC
69	<i>Eudynamis scolopaceus</i>	Cuculidae	Asian Koel	LC
70	<i>Eumyias thalassinus</i>	Muscicapidae	Verditer flycatcher	LC
71	<i>Ficedula parva albicilla</i>	Muscicapidae	Taiga flycatcher	LC
72	<i>Gallinago gallinago</i>	Scolopacidae	Common Snipe	LC
73	<i>Gallus gallus</i>	Phasianidae	Red junglefowl	LC
74	<i>Garrulax chinensis</i>	Leiothrichidae	Black-throated laughingthrush	LC
75	<i>Garrulax pectoralis</i>	Leiothrichidae	Greater Necklaced Laughingthrush	LC
76	<i>Geokichla citrina</i>	Turdidae	Orange-headed thrush	LC
77	<i>Glaucidium cuculoides</i>	Strigidae	Asian Barred Owlet	LC
78	<i>Gracupica contra</i>	Sturnidae	Asian pied Starling	LC
79	<i>Gracupica nigricollis</i>	Sturnidae	Black-collared starling	LC
80	<i>Halcyon pileata</i>	Alcedinidae	White-throated Kingfisher	LC
81	<i>Hirundo rustica</i>	Hirundinidae	Barn Swallow	LC
82	<i>Hirundo rustica</i>	Hirundinidae	House Swallow	LC
83	<i>Hydrophasianus chirurgus</i>	Jacaniidae	Pheasant-tailed Jacana	LC
84	<i>Hypothymis azurea</i>	Monaarchidae	Black-naped monarch	LC
85	<i>Ixobrychus cinnamomeus</i>	Ardeidae	Cinnamon Bittern	LC
86	<i>Jynx torquilla</i>	Picidae	Eurasian Wryneck	LC
87	<i>Lanius collurio</i>	Laniidae	Burmese Shrike	LC
88	<i>Lanius cristatus</i>	Laniidae	Brown shrike	LC
89	<i>Lanius schach</i>	Campephagidae	Long-tail shrike	LC
90	<i>Leptocoma brasiliana</i>	Nectariniidae	Van Hasselt's Sunbird	LC
91	<i>Lonchura atricapilla</i>	Estrildidae	Chestnut Munia	LC
92	<i>Lonchura punctulata</i>	Estrildidae	Scally-breasted Munia	LC
93	<i>Lonchura striata</i>	Estrildidae	White-rump Munia	LC
94	<i>Malacocincla abbotti</i>	Pellorneidae	Abbott's Babbler	LC
95	<i>Megalaima australis</i>	Capitonidae	Coppersmith Barbet	NE
96	<i>Megalaima lineata</i>	Ramphastidae	Lined Barbet	LC
97	<i>Merops ieschenaulti</i>	Meropidae	Chestnut-headed Bee-eater	LC
98	<i>Merops orientalis</i>	Meropidae	Little green bee-eater	LC
99	<i>Merops orientalis</i>	Meropidae	Green-Bee-Eater	LC
100	<i>Mesophoxys intermedia</i>	Ardeidae	Intermediate Egret	LC
101	<i>Metapidius indicus</i>	Jacaniidae	Bronze-winged jacana	LC
102	<i>Microhierax caerulescens</i>	Falconidae	Collared falconet	LC
103	<i>Milvus lineatus</i>	Accipitridae	Black-eared Kite	LC
104	<i>Milvus migrans</i>	Accipitridae	Black Kite	LC
105	<i>Monticola solitarius</i>	Muscicapidae	Blue rock-thrush	LC
106	<i>Motacilla alba</i>	Motacillidae	White Wagtail	LC
107	<i>Motacilla cinerea</i>	Motacillidae	Grey Wagtail	LC
108	<i>Muscicapa dauurica</i>	Muscicapidae	Asian brown Flycatcher	LC
109	<i>Neptapus coromandelianus</i>	Anatidae	Cotton-pygmy Goose	LC
110	<i>Nycticorax nycticorax</i>	Ardeidae	Black-crowned night-heron	LC
111	<i>Oriolus cruentus</i>	Oriolidae	Black-naped Oriole	LC
112	<i>Oriolus xanthornus</i>	Oriolidae	Black-hooded Oriole	LC
113	<i>Orthotomus atrogularis</i>	Sylviidae	Dark-necked Tailorbird	LC
114	<i>Orthotomus ruficeps</i>	Cisticolidae	Common Tailorbird	LC
115	<i>Passer domesticus</i>	Passeridae	House Sparrow	LC
116	<i>Passer flaveolus</i>	Passeridae	Plain-backed Sparrow	LC
117	<i>Passer montanus</i>	Passeridae	Eurasian tree Sparrow	LC
118	<i>Pellorneum ruficeps</i>	Pellorneidae	Puff-throated Babbler	LC
119	<i>Pericrocotus roseus</i>	Campephagidae	Rosy Minivet	LC
120	<i>Phaenicophaeus tristis</i>	Cuculidae	Green-billed Malkoha	LC
121	<i>Phalacrocorax niger</i>	Phalacrocoracidae	Little Cormorant	LC
122	<i>Phalacrocorax niger</i>	Phalacrocoracidae	Little-Cormorant	LC
123	<i>Phylloscopus fuscatus</i>	Phylloscopus	Dusky warbler	LC
124	<i>Pitta moluccensis</i>	Pittidae	Blue-winged pitta	LC
125	<i>Pitta sordida</i>	Pittidae	Hooded Pitta	LC
126	<i>Ploceus hypoxanthus</i>	Ploceidae	Asia Golden Weaver	NT
127	<i>Ploceus hypoxanthus</i>	Ploceidae	Asian golden weaver	NT
128	<i>Ploceus manyar</i>	Ploceidae	Streaked weaver	LC
129	<i>Ploceus phili</i>	Ploceidae	Baya weaver	LC
130	<i>Pluvialis fulva</i>	Charadriidae	Pacific Golden Plover	NE
131	<i>Prinia flaviventris</i>	Cisticolidae	YellowBellied Prinia	LC
132	<i>Prinia inornata</i>	Cisticolidae	Grey-breasted prinia	LC
133	<i>Prinia inornata</i>	Cisticolidae	Plain Prinia	LC
134	<i>Psittacula alexandri</i>	Psittacidae	Red-breasted Parakeet	NT
135	<i>Psittacula finschii</i>	Psittacidae	Grey-headed Parakeet	NT
136	<i>Pycnonotus cafer</i>	Campephagidae	Red-vented Bulbul	LC

No.	Scientific Name	Family Name	Common Name	IUCN Status
137	<i>Pycnonotus atriceps</i>	Pycnonotidae	Black-headed Bulbul	LC
138	<i>Pycnonotus finlaysoni</i>	Pycnonotidae	Stripe-throated Bul Bul	LC
139	<i>Pycnonotus melanicterus</i>	Pycnonotidae	Black-crested Bulbul	LC
140	<i>Pycnonotus blanfordi</i>	Pycnonotidae	Streak-eared Bul Bul	LC
141	<i>Pycnonotus jocosus</i>	Pycnonotidae	Red-Whiskered Bul Bul	LC
142	<i>Saxicola caprata</i>	Muscicapidae	Pied Bushchat	LC
143	<i>Saxicola maura</i>	Muscicapidae	Eurasian Stonechat	NE
144	<i>Saxicola maurus</i>	Muscicapidae	Siberian stonechat	NE
145	<i>Streptopelia chinensis</i>	Columbidae	Spotted Dove	NE
146	<i>Streptopelia orientalis</i>	Columbidae	Oriental Turtle Dove	LC
147	<i>Streptopelia tranquebarica</i>	Columbidae	Red Collared Dove	LC
148	<i>Streptopelia tranquebarica</i>	Columbidae	Red-collared Dove	LC
149	<i>Sturnia malabarica</i>	Sturnidae	Chestnut-tailed Starling	LC
150	<i>Surniculus dicruroides</i>	Cuculidae	Drongo Cuckoo	LC
151	<i>Tachybaptus ruficollis</i>	Podicipedidae	Little grebe	LC
152	<i>Terpsiphone paradisi</i>	Monaarchidae	Asian paradise-flycatcher	LC
153	<i>Tinialia pileata</i>	Timalidae	Chestnut-Capped Babbler	LC
154	<i>Tringa ochropus</i>	Scolopacidae	Green Sandpiper	LC
155	<i>Turdoides gularis</i>	Ianiidae	White-throated Babbler	LC (endemic)
156	<i>Tyto alba</i>	Tytonidae	Barn Owl	LC
157	<i>Vanellus cinereus</i>	Charadriidae	Grey-headed Lapwing	NE
158	<i>Vanellus indicus</i>	Charadriidae	Red-wattled Lapwing	NE
159	<i>Yungipicus canicapillus</i>	Picidae	Grey-capped pygmy Woodpecker	LC
160	<i>Yungipicus moluccensis</i>	Picidae	Sunda pygmy Woodpecker	LC
161	<i>Zosterops palpebrosus</i>	Zosteropidae	Oriental white-eye	LC

NE = Not Evaluated, LC = Least Concerned, NT = Near Threatened

Source: Field recorded data by Resource and Environment Myanmar Co., Ltd. (2017)

3. List of Reptile Species recorded in Yangon

No	Scientific Name	Family Name	Common Name	IUCN/Status
1	<i>Calotes versicolor</i>	Agamidae	Garden Lizard	NE
2	<i>Calotes mystaceus</i>	Agamidae	Blue Forest Lizard	NE
3	<i>Calotes irawadi</i>	Agamidae	Ayeyarwady Forest Lizard	NE
4	<i>Eutropis quadricarinata</i>	Scincidae	Common Sun Skink	NE
5	<i>Hemidactylus frenatus</i>	Gekkonidae	Asian House Gecko	NE
6	<i>Ptyas mucosa</i>	Colubridae	Indian Rat Snake	NE
7	<i>Gekko gekko</i>	Gekkonidae	Tokay Gecko	NE
8	<i>Lycodon aulicus</i>	Colubridae	Dusky Wolf Snake	LC
9	<i>Xenochrophis piscator</i>	Colubridae	Chequered Keelback Water Snake	NE
10	<i>Dendrelaphis caudolineatus</i>	Colubridae	Stripe-tailed Bronze back Tree Snake	NE
11	<i>Daboia russelii</i>	Viperidae	Russel's Viper	NE
12	<i>Bungarus flaviceps</i>	Elapidae	Banded Krait	LC
13	<i>Xenopeltis unicolor</i>	Xenopeltidae	Sunbeam Snake	NE
14	<i>Lissemys punctata</i>	Trionychidae	Indian flapshell turtle	LC
15	<i>Indotestudo elongate</i>	Testudinidae	Yellow headed-tortoise	EN
16	<i>Python bivittatus</i>	Pythonidae	Burmese Python	VU

NE = Not Evaluated, LC = Least Concerned, EN = Endangered, VU = Vulnerable

Source: Field recorded data by Resource and Environment Myanmar Co., Ltd. (2017)

4. List of Amphibian Species recorded in Yangon

No.	Scientific Name	Family Name	Common Name	IUCN/Status
1	<i>Kaloula pulchra</i>	Microhylidae	Banded Bullfrog (or) Malaysian Narrow mouth Toad	LC
2	<i>Hylarana erythraea</i>	Ranidae	Common Green Frog	LC
3	<i>Microhyla heymonsi</i>	Microhylidae	Arcuate-spotted Pygmy Frog	LC
4	<i>Fejervarya limnocharis</i>	Dicroglossidae	Asian Grass Frog	LC
5	<i>Leptophryne borbonica</i>	Bufonidae	Hourglass Toad	LC
6	<i>Duttaphrynus melanostictus</i>	Bufonidae	Black-Spectacled Toad or Asian Toad	LC

LC = Least Concerned

Source: Field recorded data by Resource and Environment Myanmar Co., Ltd. (2017)

5. List of Fish Species recorded in Yangon

No	Scientific Name	Family	Common Name	IUCN Status
1	<i>Notopterus notopterus</i>	Notopteridae	Grey featherback	LC
2	<i>Puntius spp</i>	Cyprinidae	Barb	LC
3	<i>Amblypharyngodon mola</i>	Cyprinidae	Mola carplet	LC
4	<i>Labeo rohita</i>	Cyprinidae	Rohu	LC
5	<i>Labeo angra</i>	Cyprinidae	Angra Labeo	LC
6	<i>Labeo stoliczkae</i>	Cyprinidae	Cráp	NE
7	<i>Labeo calbasu</i>	Cyprinidae	Karnataka labeo	LC
8	<i>Cirrhinus mrigala</i>	Cyprinidae	Mrigal	LC
9	<i>Salmophasia sardinella</i>	Cyprinidae	Sardinella razorbelly minnow	LC
10	<i>Raiamas guttatus</i>	Cyprinidae	Burmese trout	LC
11	<i>Amblypharyngodon atkinsonii</i>	Cyprinidae	Burmese carplet	LC
12	<i>Osteobrama belangeri</i>	Cyprinidae	Manipur Osteobrama	NT
13	<i>Osteobrama cotio</i>	Cyprinidae	Cunma osteobrama	LC
14	<i>Puntius chola</i>	Cyprinidae	Chola barb	LC
15	<i>Puntius gonionotus</i>	Cyprinidae	Silver barb	LC

No	Scientific Name	Family	Common Name	IUCN Status
16	<i>Puntius sarana</i>	Cyprinidae	Olive barb	LC
17	<i>Catla catla</i>	Cyprinidae	Catla	LC
18	<i>Hilsa ilisha</i>	Clupeidae	Hilsa	NE
19	<i>Gudusia variegata</i>	Clupeidae	Burmese River Shad	LC
20	<i>Claris batrachus</i>	Clariidae	Walking Catfish	NE
21	<i>Lepidocephalichthys berdmorei</i>	Cobitidae	Burmese loach	LC
22	<i>Gagata cenia</i>	Sisoridae	Indian gagata	LC
23	<i>Bagarius bagarius</i>	Sisoridae	Gangetic goonch	NT
24	<i>Bagarius yarrellii</i>	Sisoridae	Goonch	NE
25	<i>Heteropneustes fossilis</i>	Heteropneustidae	Stinging catfish	LC
26	<i>Anabas testudineus</i>	Anabantidae	Climbing perch	DD
27	<i>Late calcarifer</i>	Centropomidae	Giant sea perch	NE
28	<i>Mystus montanus</i>	Bagridae	Wynaad mystus	LC
29	<i>Mystus vittatus</i>	Bagridae	Catfish	LC
30	<i>Mystus beekeri</i>	Bagridae	Day's mystus	LC
31	<i>Mystus leucophasis</i>	Bagridae	Catfish	NE
32	<i>Mystus cavasius</i>	Bagridae	Genetic mystus	LC
33	<i>Mystus pulcher</i>	Bagridae	Striped dwarf catfish	LC
34	<i>Hemibagrus menoda</i>	Bagridae	Menoda catfish	LC
35	<i>Neotropius acutirostris</i>	Schilbeidae	Dwarf cat-fish	NE
36	<i>Clupisoma prateri</i>	Schilbeidae	Brumese garua	LC
37	<i>Eutropiichthys vacha</i>	Schilbeidae	Batchwa vacha	LC
38	<i>Clupisoma macrophthalmus</i>	Schilbeidae	Burmes taakree	NE
39	<i>Ompok bimaculatus</i>	Siluridae	Indian butter catfish	NT
40	<i>Ompok pabo</i>	Siluridae	Pabo catfish	NT
41	<i>Wallago attu</i>	Siluridae	Boal	NT
42	<i>Macrogathus aral</i>	Mastacembelidae	Spiny eel	LC
43	<i>Macrogathus zebrius</i>	Mastacembelidae	Burmese spiny eel	LC
44	<i>Mastacembelus armatus</i>	Mastacembelidae	Spiny-eel	LC
45	<i>Monopterus albus</i>	Synbranchidae	Rice swampeeel	LC
46	<i>Monopterusuchia</i>	Synbranchidae	Gangetic mudeel	LC
47	<i>Oreochromis spp</i>	Cichlidae	Mozambic cichlid	NE
48	<i>Claris batrachus</i>	Clariidae	Walking Catfish	NE
49	<i>Arius acutirostris</i>	Ariidae	Salween catfish	LC
50	<i>Rhinomugil corsula</i>	Mugilidae	Corsula	LC
51	<i>Xenentodon cancila</i>	Belontiidae	freshwater garfish	LC
52	<i>Boleophthalmus boddarti</i>	Gobiidae	Boddart's goddle eye goby	LC
53	<i>Glossogobius giuris</i>	Gobiidae	Bareye Goby	LC
54	<i>Polynemus paradiseus</i>	Polynemidae	Mangoes fish	NE
55	<i>Cynoglossus lingua</i>	Cynoglossidae	Long tonguesole	NE

NE = Not Evaluated, LC = Least Concerned, NT = Near Threatened, DD = Data Deficient
Source: Field recorded data by Resource and Environment Myanmar Co., Ltd. (2017)

6. List of Butterfly Species recorded in Yangon

No.	Scientific Name	Family Name	Common Name	IUCN Status
1	<i>Papilio demoleus</i>	Papilionidae	Lime Butterfly	NE
2	<i>Papilio polytes</i>	Papilionidae	Common Mormon	NE
3	<i>Papilio memnon</i>	Papilionidae	Great Mormon	NE
4	<i>Papilio iswara</i>	Papilionidae	Great Helen	NE
5	<i>Papilio mahadeva</i>	Papilionidae	Burmese raven	NE
6	<i>Chilasa clytia</i>	Papilionidae	Common mime	NE
7	<i>Graphium sarpedon</i>	Papilionidae	Lime butterfly	NE
8	<i>Catopsilia pomona</i>	Pieridae	Lemon Emigrant	NE
9	<i>Catopsilia pyranthe</i>	Pieridae	Mottled Emigrant	NE
10	<i>Catopsilia scylla</i>	Pieridae	Orange Emigrant	NE
11	<i>Catopsilia florella</i>	Pieridae	Common vagrant	NE
12	<i>Hebomoia glaucippe</i>	Pieridae	Great Orange -tip	NE
13	<i>Ixias pyrene</i>	Pieridae	Yellow Orange-tip	NE
14	<i>Delias agostina</i>	Pieridae	Yellow Jezebel	NE
15	<i>Delias eucharis</i>	Pieridae	Common Jezebel	NE
16	<i>Delias hyparete</i>	Pieridae	Painted Jezebel	NE
17	<i>Pieris canidia</i>	Pieridae	Indian cabbage white	NE
18	<i>Appias libythea</i>	Pieridae	Striped Albatross	NE
19	<i>Appias nero</i>	Pieridae	Orange albatross	NE
20	<i>Appias lalage</i>	Pieridae	Spot puffin	NE
21	<i>Appias lycida</i>	Pieridae	Chocolate albatross	NE
22	<i>Leptosis nina</i>	Pieridae	Psyche	NE
23	<i>Gandaca harina</i>	Pieridae	Tree Yellow	NE
24	<i>Cepora nerissa</i>	Pieridae	Common gull	NE
25	<i>Dercas lycorias</i>	Pieridae	Plain sulphur	NE
26	<i>Eurema hecabe</i>	Pieridae	Common Grass Yellow	NE
27	<i>Eurema ada</i>	Pieridae	-	NE
28	<i>Eurema sari</i>	Pieridae	Chocolate Grass Yellow	NE
29	<i>Eurema blanda</i>	Pieridae	Three spot grass yellow	NE
30	<i>Eurema simulatrix</i>	Pieridae	Hill grass yellow	NE
31	<i>Danaus affinis</i>	Nymphalidae	Mangrove Tiger	NE
32	<i>Danaus chrysippus</i>	Nymphalidae	Plain Tiger	NE
33	<i>Danaus genutia</i>	Nymphalidae	Common Tiger	NE
34	<i>Tirumala limniace</i>	Nymphalidae	Blue Tiger	NE

No.	Scientific Name	Family Name	Common Name	IUCN Status
35	<i>Parantica agleoides</i>	Nymphalidae	Dark Glassy Tiger	NE
36	<i>Elymnias hypermnestra</i>	Nymphalidae	Common palmfly	NE
37	<i>Cethosia biblis</i>	Nymphalidae	Red lacewing	NE
38	<i>Cethosia penthesilea</i>	Nymphalidae	Orange lacewing	NE
39	<i>Cethosia cyane</i>	Nymphalidae	Leopard lacewing	NE
40	<i>Euthalia monina</i>	Nymphalidae	Malay Baron	NE
41	<i>Euthalia phemiis</i>	Nymphalidae	White edged blue baron	NE
42	<i>Euploea core</i>	Nymphalidae	Crow	NE
43	<i>Euploea sylvestris</i>	Nymphalidae	Double-banded Crow	NE
44	<i>Athyma perius</i>	Nymphalidae	Common Sergeant	NE
45	<i>Ariadne ariadne</i>	Nymphalidae	Angled castor	NE
46	<i>Hypolimnas misippus</i>	Nymphalidae	Danaid Eggfly	NE
47	<i>Hypolimnas bolina</i>	Nymphalidae	Great Eggfly	NE
48	<i>Neptis soma</i>	Nymphalidae	Sullied sailer	NE
49	<i>Neptis hylax</i>	Nymphalidae	Common sailer	NE
50	<i>Neptis jumbah</i>	Nymphalidae	Chestnut-streaked sailer	NE
51	<i>Acraea violae</i>	Nymphalidae	Tawny Coster	NE
52	<i>Junonia lemonias</i>	Nymphalidae	Lemon Pansy	LC
53	<i>Junonia hierta</i>	Nymphalidae	Yellow Pansy	NE
54	<i>Junonia atlites</i>	Nymphalidae	Grey Pansy	NE
55	<i>Junonia almana</i>	Nymphalidae	Peacock Pansy	LC
56	<i>Mycalasis perseus</i>	Nymphalidae	Dingy bush brown	NE
57	<i>Melanitis leda</i>	Nymphalidae	Common Evening brown	NE
58	<i>Melanitis phedima</i>	Nymphalidae	Dark Evening brown	NE
59	<i>Zizula hylax</i>	Lycaenidae	Pygmy Grass blue	NE
60	<i>Una usta</i>	Lycaenidae	Pale four-line blue	NE
61	<i>Nacaduba beroe</i>	Lycaenidae	Opaque six-line blue	NE
62	<i>Castalius rosimon</i>	Lycaenidae	Common Pierrot	NE
63	<i>Udara rona</i>	Lycaenidae	-	NE
64	<i>Anthene lycaenina</i>	Lycaenidae	Pointed ciliate blue	NE
65	<i>Megisba malaya</i>	Lycaenidae	Malayan	NE
66	<i>Jamides camilda</i>	Lycaenidae	Jamides	NE
67	<i>Zizeeria maha</i>	Lycaenidae	Pale Grass Blue	NE
68	<i>Lambrix stellifer</i>	Hesperiidae	Starry Bab	NE
69	<i>Borbo cinnara</i>	Hesperiidae	Formosan Swift	NE
70	<i>Parnara ganga</i>	Hesperiidae	Continental Swift	NE

NE = Not Evaluated, LC = Least Concerned

Source: Field recorded data by Resource and Environment Myanmar Co., Ltd. (2017)

7. List of Plant Species recorded in Yangon

No.	Scientific Name	Family Name	Common Name	Habitat	IUCN Status
1	<i>Fuirena ciliaris</i>	Cyperaceae	-	Grass	LC
2	<i>Annona squamosa</i>	Annonaceae	Awza	Small Tree	NE
3	<i>Caraya arborea</i>	Lecythidaceae	Bambwe	Tree	NE
4	<i>Terminalia catappa</i>	Combretaceae	Banda	Tree	NE
5	<i>Physalis minima</i>	Solanaceae	Bauk-pin	Herb	NE
6	<i>Ficus religiosa</i>	Moraceae	Bawdi-nyaung	Tree	NE
7	<i>Monochoria vaginalis</i>	Pontederiaceae	Beda	Aquatic	LC
8	<i>Piper betle</i>	Piperaceae	Betle	Climber/Creepers	NE
9	<i>Mimosa rubicaulis</i>	Mimosaceae	Biat-hti-ka-yone	Herb	NE
10	<i>Duranta repens</i>	Vrebenaceae	Bo-kadaw-myet-hkone	Shrub	NE
11	<i>Lagenaria siceraria</i>	Cucurbitaceae	Bu	Climber/Creepers	NE
12	<i>Canna indica</i>	Cannaceae	Budatharana	Herb	NE
13	<i>Gnaphalium indium</i>	Asteraceae	Byaing-che	Herb	NE
14	<i>Theobroma cacao</i>	Malvaceae	Cacao	Small Tree	NE
15	<i>Flueggea virosa</i>	Euphorbiaceae	Chin ya	Small tree	NE
16	<i>Hibiscus cannabinus</i>	Malvaceae	Chin-baung	Shrub	NE
17	<i>Flueggea leucopyrus</i>	Euphorbiaceae	Chinya-phyu	Shrub	NE
18	<i>Lawsonia alba</i>	Lythraceae	Dan	Shrub	NE
19	<i>Moringa oleifera</i>	Moringaceae	Dan-da-lun	Tree	NE
20	<i>Cassia occidentalis</i>	Caesalpiniceae	Dangwe	Shrub	NE
21	<i>Lawsonia alba</i>	Lythraceae	Dan-gyi	Shrub	NE
22	<i>Cassia bicapsularis</i>	Caesalpiniceae	Dan-kywe	Shrub	LC
23	<i>Moringa aleifera</i>	Moringaceae	Dantalon	Tree	NE
24	<i>Archidendron jiringa</i>	Mimosaceae	Danyin	Tree	NE
25	<i>Scoparia dulcis</i>	Scrophulariaceae	Darna-thu-kha	Herb	NE
26	<i>Lumitzera racemosa</i>	Combretaceae	Dawei-hmaing	Small Tree	NE
27	<i>Millingtonia hortensis</i>	Bignoniaceae	Egayit	Tree	NE
28	<i>Eucalyptus camaldulensis</i>	Myrtaceae	Eucalypt	Tree	NE
29	<i>Helicodiceras muscivorus</i>	Araceae	Gamone-gwin-doe	Herb	NE
30	<i>Mesua ferrea</i>	Hypericaceae	Gangaw	Tree	NE
31	<i>Crocus sativus</i>	Iridaceae	Gon-ga-man	Herb	NE
32	<i>Spondias malayana</i>	Anacardiaceae	Gwe	Tree	NE
33	<i>Bhesa robusta</i>	Cleastraceae	Gwedauk	Tree	NE
34	<i>Dregea volubilis</i>	Asclepiadaceae	Gwe-dauk-nwe	Climber/Creepers	NE
35	<i>Oldenlandia corymbosa</i>	Rubiaceae	Hingalar	Herb	NE
36	<i>Amaranthus bitoides</i>	Amaranthaceae	Hin-nu-new	Herb	NE
37	<i>Amaranthus spinosus</i>	Amaranthaceae	Hin-nu-new-subak	Herb	NE
38	<i>Ceiba pentandra</i>	Bombacaceae	Hmo-bin	Tree	LC

No.	Scientific Name	Family Name	Common Name	Habitat	IUCN Status
39	<i>Tridax procumbens</i>	Asteraceae	Hmwezok-ne-gya	Herb	NE
40	<i>Dendrocalamus strictus</i>	Poaceae	Hmyin-wa	Bamboo	NE
41	<i>Rosa damascena</i>	Rosaceae	Hninsi	Shrub	NE
42	<i>Costus speciosus</i>	Costaceae	Htamasok	Herb	NE
43	<i>Glochidion fagifolium</i>	Euphorbiaceae	Htamasok gyi	Small Tree	NE
44	<i>Borassus flabellifer</i> L.	Areaceae	Htan	Tree	NE
45	<i>Tabernaemontana divaricata</i>	Apocynaceae	Htein	Shrub/Climber	NE
46	<i>Mimosa pudica</i>	Mimosaceae	Hti-ka-yone	Herb	LC
47	<i>Pinus insularis</i>	Pinaceae	Htinyu	Tree	NE
48	<i>Thyrsostachys siamensis</i>	Poaceae	Htiyo-wa	Bamboo	NE
49	<i>Crateva magna</i>	Capparaceae	Kadet	Tree	NE
50	<i>Diospyros discolor</i>	Ebenaceae	Kadiba	Tree	NE
51	<i>Hyptis suaveolens</i>	Lamiaceae	Kala pin sein	Herb	NE
52	<i>Lantana aculeata</i>	Verbenaceae	Kala-pan	Herb	NE
53	<i>Ficus palmata</i>	Moraceae	Kala-thapan	Tree	NE
54	<i>Alternanthera nodiflora</i>	Amaranthaceae	Kanaphaw	Herb	LC
55	<i>Dipterocarpus alatus</i>	Dipterocarpaceae	Kanyin-phyu	Tree	VU
56	<i>Clerodendrum villosum</i>	Verbenaceae	Ka-on	Herb	NE
57	<i>Erythrina arborescens</i>	Fabaceae	Kathis	Tree	NE
58	<i>Urena lobata</i>	Malvaceae	Katsene	Shrub	NE
59	<i>Ipomoea aquatica</i>	Convolvulaceae	Kazun-ywet	Climber/Creepers	LC
60	<i>Hibiscus-rosa-sinensis</i>	Malvaceae	Khaung-yan	Shrub	NE
61	<i>Luffa acutangula</i>	Cucurbitaceae	Kha-we	Climber/Creepers	NE
62	<i>Luffa acutangula</i>	Cucurbitaceae	Kha-we-yaing	Climber/Creepers	NE
63	<i>Acanthus illicifolius</i>	Acanthaceae	Khaya	Shrub	NE
64	<i>Solanum melongena</i>	Solanaceae	Khayan	Shrub	NE
65	<i>Solanum indicum</i> L.	Solanaceae	Khayan-kazaw	Shrub	NE
66	<i>Manikara hexandra</i>	Sapotaceae	Khayay	Tree	NE
67	<i>Mucuna pruriens</i>	Fabaceae	Khwela-ya	Climber	NE
68	<i>Ixora coccinea</i>	Rubiaceae	Kinmon	Shrub	NE
69	<i>Acacia concinna</i>	Mimosaceae	Kinmun-gyin	Shrub	NE
70	<i>Euphorbia milii</i>	Euphorbiaceae	Kiss-me-quick	Shrub	DD
71	<i>Albizia lebbek</i>	Mimosaceae	Kokko	Tree	NE
72	<i>Areca catechu</i>	Areaceae	Kunthi-pin	Small Tree	NE
73	<i>Operculina turpethum</i>	Convolvulaceae	Kyahin-bin	Climber/Creepers	NE
74	<i>Bambusa bambos</i>	Poaceae	Kyakat-wa	Bamboo	NE
75	<i>Saccharum sinense</i>	Poaceae	Kyan	Grass	NE
76	<i>Benincasa hispida</i>	Cucurbitaceae	Kyauk-pha-yon	Climber/Creepers	NE
77	<i>Acalypha indica</i>	Euphorbiaceae	Kyaung-se-pin	Shrub	NE
78	<i>Oroxylum indicum</i>	Bignoniaceae	Kyaung-sha	Tree	NE
79	<i>Coix lacryma-jobi</i>	Poaceae	Kyeik	Grass	NE
80	<i>Eclipta alba</i>	Asteraceae	Kyeik-hman	Herb	DD
81	<i>Ficus rumphii</i>	Moraceae	Kyein	Tree	NE
82	<i>Momordica charantia</i>	Cucurbitaceae	Kyet-hin-khar	Climber/Creepers	NE
83	<i>Amaranthus caudatus</i>	Amaranthaceae	Kyet-mauk	Herb	NE
84	<i>Achyranthes aspera</i>	Amaranthaceae	Kyet-mauk-sue-pyan	Herb	NE
85	<i>Ricinus communis</i>	Euphorbiaceae	Kyet-su	Small tree	NE
86	<i>Butea frondosa</i>	Fabaceae	Kyi-ah	Tree	NE
87	<i>Phragmites vallisneria</i>	Poaceae	Kyu	Grass	NE
88	<i>Tectona grandis</i>	Verbenaceae	Kyun	Tree	NE
89	<i>Glochidion fagifolium</i>	Euphorbiaceae	Kywe-hna-kaung-gyeik	Small Tree	NE
90	<i>Capparis spinosa</i>	Capparaceae	Kywel-na-khaung	Shrub	NE
91	<i>Combretum squamosum</i>	Combretaceae	Kywet-nwe	Shrub	NE
92	<i>Arytera littoralis</i>	Sapindaceae	Lamu	Small Tree	LR/LC
93	<i>Syzygium aromaticum</i>	Myrtaceae	Lay-hnyin	Small Tree	NE
94	<i>Hippeastrum reticulatum</i>	Amaryllidaceae	Lay-kunn-khatta	Herb	NE
95	<i>Bombax ceiba</i>	Bombacaceae	Let-pan	Tree	NE
96	<i>Tamarindus indica</i>	Caesalpiniaceae	Magyi	Tree	NE
97	<i>Gardenia sessiliflora</i>	Rubiaceae	Magyi-bauk	Small Tree	NE
98	<i>Markhamia stipitata</i>	Bignoniaceae	Ma-hlwa	Tree	NE
99	<i>Psidium guajava</i>	Myrtaceae	Malaka	Small Tree	NE
100	<i>Acacia auriculiformis</i>	Mimosaceae	Malaysia-padauk	Small Tree	LC
101	<i>Senna siamea</i>	Caesalpiniaceae	Mazali	Tree	NE
102	<i>Hygrophila phlomisoides</i>	Acanthaceae	Migyaung-kunbat	Herb	NE
103	<i>Caryota mitis</i>	Areaceae	Minbaw	Tree	NE
104	<i>Scaphium scaphigerum</i>	Steruliaceae	Mohbin	Tree	NE
105	<i>Raphanus sativus</i>	Brassicaceae	Monla-u	Herb	NE
106	<i>Brassica campestris</i>	Brassicaceae	Mon-nyin	Herb	NE
107	<i>Sphaeranthus indicus</i>	Asteraceae	Mwe-sok	Herb	LC
108	<i>Commelina diffusa</i>	Commelinaceae	Myat kyut	Herb	LC
109	<i>Oreocnide frutescens</i>	Urticaceae	Myauk u	Small Tree	NE
110	<i>Themeda triandra</i>	Poaceae	Myauk-mi	Grass	NE
111	<i>Microcos paniculata</i>	Tiliaceae	Mya-yar	Small Tree	NE
112	<i>Cynodon dactylon</i>	Poaceae	Mye-sa	Grass	NE
113	<i>Ziziphus oenoplia</i>	Rhamnaceae	Myesa-myet	Shrub, Climber	NE
114	<i>Dichanthium caricosum</i>	Poaceae	Myet-kha	Grass	NE
115	<i>Phyllanthus urinaria</i>	Euphorbiaceae	Mye-zi-phyu	Herb	NE
116	<i>Lansea coromandelica</i>	Anacardiaceae	Nabe	Tree	NE
117	<i>Ananas comosus</i>	Bromeliaceae	Nanat	Herb	NE
118	<i>Aeschynomene indica</i>	Fabaceae	Nan-bin	Herb	LC

No.	Scientific Name	Family Name	Common Name	Habitat	IUCN Status
119	<i>Justica decussata</i>	Acanthaceae	Nat-pan	Shrub	NE
120	<i>Clerodendrum natans</i>	Verbenaceae	Ngayan-padu	Shrub	NE
121	<i>Capsicum annuum</i>	Solanaceae	Ngayok	Shrub	NE
122	<i>Musa sapientum</i>	Musaceae	Nget-pyaw	Herb	NE
123	<i>Cassia fistula</i>	Caesalpinaceae	Ngu	Tree	NE
124	<i>Sesbania bispinosa</i>	Fabaceae	Nyan	Shrub	LC
125	<i>Ficus rumphii</i>	Moraceae	Nyaung	Tree	NE
126	<i>Ficus obtusifolia</i>	Moraceae	Nyaung-gyat	Tree	NE
127	<i>Oreocnide frutescens</i>	Urticaceae	Obok	Small Tree	NE
128	<i>Streblus asper</i>	Moraceae	Okhne	Small Tree	NE
129	<i>Aerva javanica</i>	Amaranthaceae	On-hnye	Herb	NE
130	<i>Pterocarpus macrocarpus</i>	Fabaceae	Padauk	Tree	NE
131	<i>Hedychium gracile</i>	Zingiberaceae	Pade-gaw	Herb	NE
132	<i>Athaea rosea</i>	Malvaceae	Pan-chinbaung	Shrub	NE
133	<i>Melia azedarach</i>	Meliaceae	Pan-tama	Small Tree	NE
134	<i>Butea frondosa</i>	Fabaceae	Pauk	Tree	NE
135	<i>Sesbania grandiflora</i>	Fabaceae	Paukpan-byu	Small Tree	NE
136	<i>Cinnamomum camphora</i>	Lauraceae	Payok	Tree	NE
137	<i>Alternanthera sessilis</i>	Amaranthaceae	Pazun-sar	Herb	LC
138	<i>Desmodium triflorum</i>	Fabaceae	Pe yaing	Herb	LC
139	<i>Vigna catjang</i>	Fabaceae	Pedaung-she	Climber/Creep	NE
140	<i>Colocasia esculenta</i>	Araceae	Pein	Herb	LC
141	<i>Artocarpus heterophyllus</i>	Moraceae	Peinne	Tree	NE
142	<i>Costus speciosus</i>	Costaceae	Phalan taung hmwe	Herb	NE
143	<i>Casuarina equisetifolia</i>	Casuarinaceae	Pinle-kabwe	Tree	NE
144	<i>Ixora arborea</i>	Rubiaceae	Ponna-yeik	Small Tree	NE
145	<i>Calophyllum inophyllum</i>	Hypericaceae	Pon-nyet	Tree	LR/LC
146	<i>Eucalyptus torrelliana</i>	Myrtaceae	Pyi-lon-chantha	Tree	NE
147	<i>Murraya koenigii</i>	Rutaceae	Pyindaw-thein	Small Tree	NE
148	<i>Lagerstroemia speciosa</i>	Lythraceae	Pynma	Tree	NE
149	<i>Ficus benghalensis</i>	Moraceae	Pyi-nyaung	Tree	NE
150	<i>Cymbopogon citratus</i>	Poaceae	Sabalin	Grass	NE
151	<i>Jasminum arborescens</i>	Oleaceae	Sabe	Shrub/Climber	NE
152	<i>Lactuca sativa</i>	Asteraceae	Salat-ywet	Herb	NE
153	<i>Cratogeomys pruniflorum</i>	Hypericaceae	Sa-thange-ohnauk	Tree	NE
154	<i>Delonix rigia</i>	Caesalpinaceae	Sein-ban	Tree	NE
155	<i>Delonix rigia</i>	Caesalpinaceae	Sein-ban gyi	Tree	NE
156	<i>Caesalpinia pulcherrima</i>	Caesalpinaceae	Seinban-gale	Small Tree	NE
157	<i>Tecoma stans</i>	Bignoniaceae	Sein-ta-kyu	Shrub	NE
158	<i>Bougainvillea spectabilis</i>	Nyctaginaceae	Sekku-pan	Climber/Creep	NE
159	<i>Acacia inopinata</i>	Mimosaceae	Sha-ha-naung	Tree	NE
160	<i>Eryngium foetidum</i>	Apiaceae	Shan-nan-nan	Herb	NE
161	<i>Citrus medica</i>	Rutaceae	Shauk	Shrub/Small Tree	NE
162	<i>Bambusa vulgaris</i>	Poaceae	Shwe-wa	Bamboo	NE
163	<i>Stemona tuberosa</i>	Stemonaceae	Simi-tauk	Herb	NE
164	<i>Heliotropium indium</i>	Boraginaceae	Sin-hna-maung	Herb	NE
165	<i>Eleusine indica</i>	Poaceae	Sin-ngo-myet	Grass	LC
166	<i>Ochna jabotapita</i>	Ochnaceae	Si-nwe	Shrub	NE
167	<i>Elaeis guineensis</i>	Arecaceae	Si-ohn	Tree	NE
168	<i>Albizia procera</i>	Mimosaceae	Sit	Tree	NE
169	<i>Acacia megaladena</i>	Mimosaceae	Subok	Small Tree	NE
170	<i>Acacia pennata</i>	Mimosaceae	Suboke-gyi	Climber/Creep	NE
171	<i>Capparis sepiaria</i>	Capparaceae	Sugauk	Shrub	NE
172	<i>Ziziphus oenoplia</i>	Rhamnaceae	Supauk-pin	Shrub, Climber	NE
173	<i>Acacia pennata</i>	Mimosaceae	Suyit	Climber/Creep	LC
174	<i>Bauhinia acuminata</i>	Caesalpinaceae	Swe-daw	Small Tree	LC
175	<i>Azadirachta indica</i>	Meliaceae	Tama	Tree	NE
176	<i>Dichanthium caricosum</i>	Poaceae	Ta-myet-si	Grass	NE
177	<i>Zingiber squarrosus</i>	Zingiberaceae	Taukta	Herb	NE
178	<i>Coldenia procumbens</i>	Boraginaceae	Taukte-letwa	Herb	NE
179	<i>Garcinia cowa</i>	Hypericaceae	Taung-thale	Tree	NE
180	<i>Eleusine indica</i>	Poaceae	Taw pyindawthein	Grass	LC
181	<i>Pueraria sp.</i>	Fabaceae	Taw-pe	Climber/Creep	NE
182	<i>Crotalaria retusa</i>	Fabaceae	Taw-peiksan	Shrub	NE
183	<i>Malvastrum coromandelianum</i>	Malvaceae	Taw-pilaw	Herb	NE
184	<i>Leucas aspera</i>	Lamiaceae	Taw-pin-sein	Shrub	NE
185	<i>Chionanthus macrocarpus</i>	Oleaceae	Taw-sabe	Shrub	NE
186	<i>Syzygium fruticosum</i>	Myrtaceae	Taw-thabye	Tree	NE
187	<i>Hibiscus panduriformis</i>	Malvaceae	Taw-yone-padi	Shrub	NE
188	<i>Tabernaemontana divaricata</i>	Apocynaceae	Taw-zalat	Shrub/Climber	NE
189	<i>Plumeria obtusa</i>	Apocynaceae	Tayok-saga	Small Tree	NE
190	<i>Euphorbia nerifolia</i>	Euphorbiaceae	Ta-zaung	Small tree	NE
191	<i>Diospyros burmanica</i>	Ebenaceae	Te	Tree	NE
192	<i>Polyalthia simiarum</i>	Annonaceae	Thabut	Tree	NE
193	<i>Luffa aegyptiaca</i>	Cucurbitaceae	Thabut nwe	Climber/Creep	NE
194	<i>Eugenia bracteolata</i>	Myrtaceae	Tha-bye	Tree	NE
195	<i>Syzygium grande</i>	Myrtaceae	Thabye gyi	Tree	NE
196	<i>Eugenia oblata</i>	Myrtaceae	Thabye-ni	Tree	NE
197	<i>Achras zapota</i>	Sapotaceae	Thagya	Tree	NE
198	<i>Aglai odoratissima</i>	Meliaceae	Thanakha	Tree	NE

No.	Scientific Name	Family Name	Common Name	Habitat	IUCN Status
199	<i>Indigofera linifolia</i>	Fabaceae	Than-manaing-kyauk-manaing	Shrub	LC
200	<i>Mangifera indica</i>	Anacardiaceae	Tha-yet	Tree	DD
201	<i>Croton oblongifolius</i>	Euphorbiaceae	Thetyin-gyi	Shrub	NE
202	<i>Limonia acidissima</i>	Rutaceae	Thi	Tree	NE
203	<i>Anacardium occidentale</i>	Anacardiaceae	Thiho	Tree	NE
204	<i>Carica papaya</i>	Caricaceae	Thinbaw	Small Tree	DD
205	<i>Albizia falcata</i>	Mimosaceae	Thinbaw-magyi	Tree	NE
206	<i>Catharanthus roseus</i>	Apocynaceae	Thinbaw-ma-hnyo	Shrub	NE
207	<i>Peltophorum pterocarpum</i>	Caesalpiniaceae	Thinbaw-mezali	Tree	NE
208	<i>Hopea odorata</i>	Dipterocarpaceae	Thin-gan	Tree	VU
209	<i>Millettia pendula</i>	Febaceae	Thinwin	Tree	NE
210	<i>Sandoricum koetijabe</i>	Meliaceae	Thitto	Tree	NE
211	<i>Eucalyptus camaldulensis</i>	Myrtaceae	U-ca-lit	Tree	NE
212	<i>Dendrocalamus brandisii</i>	Poaceae	Wabo	Bamboo	NE
213	<i>Oxytenanthera albociliata</i>	Poaceae	Wa-gauk	Bamboo	NE
214	<i>Gossypium arboreum</i>	Malvaceae	Wah	Shrub	NE
215	<i>Bambusa wamin</i>	Poaceae	Wamin	Bamboo	NE
216	<i>Gigantochloa wanet</i>	Poaceae	Wa-net	Bamboo	NE
217	<i>Bambusa burmanica</i>	Poaceae	Waya	Bamboo	NE
218	<i>Sida acuta</i>	Malvaceae	Wet-chay-pan	Herb	NE
219	<i>Urena lobata</i>	Malvaceae	Wetchi-pane	Shrub	NE
220	<i>Murdannia crocea</i>	Commelinaceae	Wet-kyut	Herb	NE
221	<i>Ipomoea aquatica</i>	Convolvulaceae	Ye-kazun	Climber/Creepier	NE
222	<i>Cedrela febrifuga</i>	Meliaceae	Ye-tama	Tree	NE
223	<i>Ficus glomerata</i>	Moraceae	Ye-thapan	Tree	NE
224	<i>Morinda angustifolia</i>	Rubiaceae	Yeyo	Small Tree	NE
225	<i>Chukrasia velutina</i>	Meliaceae	Yinma	Tree	NE
226	<i>Abelmoschus esculentus</i>	Malvaceae	Yonbade	Shrub	NE
227	<i>Codiaeum variegatum</i>	Euphorbiaceae	Ywet-hla	Shrub	NE
228	<i>Kalanchoe pinnata</i>	Crassulaceae	Ywet-kye-pin-pauk	Herb	NE
229	<i>Pavetta indica</i>	Rubiaceae	Za-gwe-pan	Shrub	NE
230	<i>Cerbera manghas</i>	Apocynaceae	Zalat	Small tree	NE
231	<i>Averrhoa carambola</i>	Oxalidaceae	Zaung-yar	Small Tree	NE
232	<i>Dracaena fragrans</i>	Dracaenaceae	Zawgi taunghway	Shrub	NE
233	<i>Ziziphus jujuba</i>	Rhamnaceae	Zi	Tree	LC
234	<i>Gardenia jasminoides</i>	Rubiaceae	Zizawa	Shrub	NE

NE = Not Evaluated, LR/LC = Lower Risk/Least Concerned, VU = Vulnerable, DD = Data Deficient
Source: Field recorded data by Resource and Environment Myanmar Co., Ltd. (2017)

Appendix 19 EIA 予算案

ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ
၁.၁၀.၂၀၁၈ မှ ၃၀.၉.၂၀၁၉ ထိ ငွေလုံးငွေရင်းအသုံးစရိတ်မှ သုံးစွဲမည့်လုပ်ငန်းများစာရင်း

(ကျပ်သန်း)

စဉ်	ဆောင်ရွက်မည့်လုပ်ငန်းများ	မူလခန့်မှန်းခြေ	
		သင့်ငွေ	စုစုပေါင်း
၆။	ဗိုလ်တထောင်မြို့နယ်၊ ရေဆိုးသန့်စင်စက်ရုံ နှင့် Johkasou ဓာတ်ခွဲခန်းသုံးပစ္စည်းများ၊ ဓါတ်ခွဲခန်းသုံးတိုင်းတာရေးပစ္စည်းများနှင့် ဆက်စပ်ပစ္စည်းများဝယ်ယူခြင်း။	၁၂၀.၀၀၀	
၇။	လမ်းမတော်မြို့နယ် ၁၀-လမ်းလေမှုတ်စက်ရုံရှိ ၂၀၀HP လျှပ်စစ်လေမှုတ်စက်(၁)လုံး အကြီးစားပြုပြင်ခြင်း။	၁၀.၀၀၀	
၈။	ဗိုလ်တထောင်မြို့နယ် ပင်မလေမှုတ်စက်ရုံအတွက် ၁၈"Ø Air gate valve (၄)လုံးဝယ်ယူခြင်း။	၁၀.၀၀၀	
၉။	လမ်းမတော်မြို့နယ် (၁၀)လမ်း ပင်မလေမှုတ်စက်ရုံအတွက် ၁၈"Ø Air gate valve (၃)လုံး ဝယ်ယူခြင်း။	၇.၅၀၀	
၁၀။	ဗိုလ်တထောင်မြို့နယ် ပင်မလေမှုတ်စက်ရုံ နှင့် လမ်းမတော်မြို့နယ် (၁၀)လမ်း လေမှုတ်စက်ကြီးများအတွက် Section and delivery valve (၄၄)လုံးဝယ်ယူခြင်း။	၉.၇၀၀	
၁၁။	အင်းစိန်မြို့နယ်အောင်ဇေယျာတံတားအနီးရေဆိုးသန့်စင်စက်ရုံတည်ဆောက်ခြင်း။	၁၅၀၀.၀၀၀	✓(၆၈-၁၉)
၁၂။	လမ်းမတော်မြို့နယ်မိလ္လာတွန်းစက်အမှတ်(၁)ဧရိယာနောက်ဖေးလမ်းကြား(၃)ခုမိလ္လာပိုက်လိုင်း၊ Manhole များအသစ်လဲလှယ်ခြင်း။	၇၅၀.၀၀၀	
၁၃။	ဗိုလ်တထောင်မြို့နယ်မိလ္လာတွန်းစက်အမှတ်(၂)ဧရိယာနောက်ဖေးလမ်းကြား(၃)ခုမိလ္လာပိုက်လိုင်း၊ Manhole များအသစ်လဲလှယ်ခြင်း။	၇၅၀.၀၀၀	
၁၄။	ဗိုလ်တထောင်မြို့နယ် ရေဆိုးသန့်စင်စက်ရုံ Aeration Tank နှင့် Submersible Aerator အသစ်တပ်ဆင်ခြင်း။	၅၀.၀၀၀	
၁၅။	ဗိုလ်တထောင်မြို့နယ် ရေဆိုးသန့်စင်စက်ရုံ "C1" တိုးချဲ့ခြင်းလုပ်ငန်းအတွက် ESIA (Environment Social Impact Access) ပြုလုပ်ခြင်း။	၅၀.၀၀၀	
၁၆။	ဗိုလ်တထောင်မြို့နယ် ပင်မလေမှုတ်စက်ရုံ 200HP လျှပ်စစ် လေမှုတ်စက် (၂)လုံးအကြီးစားပြုပြင်ခြင်း။	၁၈.၀၀၀	
၁၇။	မြို့တွင်း(၆)မြို့နယ်ရှိမိလ္လာတွန်းစက်(၂၀)လုံးအားလိုအပ်သောစက်အစိတ်အပိုင်းများအစားထိုးလဲလှယ်အဆင့်မြှင့်တင်ခြင်းနှင့် level control system နှင့် level control & compressor system အား လျှပ်စစ်စက်ပစ္စည်းများအစားထိုးလဲလှယ်တပ်ဆင်ခြင်း။	၂၀၇.၆၀၀	
၁၈။	မြို့တွင်း(၆)မြို့နယ်ရှိ နောက်ဖေးလမ်းကြားများတွင် မိလ္လာကန်အဖုံးတပ်ဆင်ခြင်း၊ ပျက်စီးသည့်အပိုင်းများအသစ်အစားထိုးတည်ဆောက်ခြင်း။	၆၀.၀၀၀	
၁၉။	မိလ္လာစွန့်ပစ်ခြင်းလုပ်ငန်းအတွက်လိုအပ်သောပစ္စည်းများဝယ်ယူခြင်း။	၅၀.၀၀၀	
၂၀။	၁.၁.၁၀.၁ မြို့တွင်းရေဖူလုံရေး	၆၈၁၅.၀၆၀	
၂၁။	တောင်ဥက္ကလာပမြို့နယ် ၁၂ရပ်ကွက် ၁၁ရပ်ကွက် (၁၊ ၂၊ ၃)လမ်းတွင် တီထွေးရှင်းရန်အတွက် 110mmØ HDPE ပိုက်(၈၀၀)ပေနှင့် 90mmØ HDPE ပိုက်(၆၀၀)ပေ ဆက်သွယ်ခြင်း။	၅၀.၀၀၀	
၂၂။	တောင်ဥက္ကလာပမြို့နယ် ၁၃ရပ်ကွက်အတွင်းတီထွေးရှင်းရန်နှင့် Recycle Pipe များလဲလှယ်ရန်အတွက် 110mmØ HDPE ပိုက်(၃၀၀၀)ပေနှင့် 90mmØ HDPE ပိုက်(၂၈၇၀၀)ပေ ဆက်သွယ်ခြင်း။	၂၁၅.၆၀၀	

D:\1 year (laster) 12.1.2018Last (8-1-2018)

Yangon City Development Committee
List of Proposed Projects within an interval of 1.10.2018 – 30.9.2019

Sr	Proposed Projects	Estimated amount (Million Kyats)
	Implementation of ESIA (Environmental Social Impact Assessment) for WWTP Improvement inside C ₁	50

Appendix 20 発生汚水量の算定根拠

将来人口 (TS毎)

単位：人

	2014	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
Latha	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057
Lanmadaw	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160	47,160
Pabedan	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336
Kyauktada	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853
Botahaung	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995
Pazundaung	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455
Dagon	25,082	28,222	29,148	30,074	30,999	32,064	33,130	34,195	35,260	36,325	37,390	38,455	39,520	40,585	41,651	45,201	48,751
Total	249,938	253,078	254,004	254,930	255,855	256,920	257,986	259,051	260,116	261,181	262,246	263,311	264,376	265,441	266,507	270,057	273,607

Source: Data Collection Survey for the Project for Updating the Strategic Urban Development Plan of the Greater Yangon, 2017, JICA

給水率 (各TS)

単位：%

	2014	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
Latha	85%	91%	93%	95%	97%	98%	98%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%
Lanmadaw	70%	76%	78%	80%	82%	84%	86%	88%	90%	92%	94%	96%	98%	100%	100%	100%	100%
Pabedan	88%	94%	96%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Kyauktada	96%	98%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Botahaung	98%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pazundaung	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Dagon	47%	53%	55%	57%	59%	61%	63%	65%	67%	69%	71%	73%	75%	77%	79%	89%	100%

Source: -Data 2014, 2020, 2025, 2030, 2035, 2040: Preparatory Survey for Greater Yangon Water Supply Improvement Project (Phase II), JICA, 2017

-Other data: 上記データから線形補完で内挿

給水人口 (各タウンシップ)

単位：人

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
Latha	22,802	23,303	23,804	24,305	24,456	24,606	24,756	24,907	25,057	25,057	25,057	25,057	25,057	25,057	25,057	25,057
Lanmadaw	35,842	36,785	37,728	38,671	39,614	40,558	41,501	42,444	43,387	44,330	45,274	46,217	47,160	47,160	47,160	47,160
Pabedan	31,336	32,003	32,669	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336	33,336
Kyauktada	29,256	29,455	29,654	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853	29,853
Botahaung	40,585	40,722	40,858	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995	40,995
Pazundaung	48,213	48,293	48,374	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455	48,455
Dagon	14,958	16,031	17,142	18,290	19,559	20,872	22,227	23,624	25,064	26,547	28,072	29,640	31,251	32,904	40,229	48,751
Total	222,991	226,592	230,230	233,905	236,268	238,674	241,123	243,614	246,147	248,573	251,042	253,553	256,107	257,760	265,085	273,607

*給水人口 (各TS) = (将来人口 (TS毎)) x (給水率 (各TS))

給水原単位

単位：lpcd

	2014	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
Domestic	111	122	125	129	132	136	139	143	146	150	153	157	160	163	167	183	200
Commercial	74	81	83	86	88	90	93	95	98	100	102	104	107	109	111	122	133
Total	185	203	208	214	220	226	232	238	244	250	256	261	267	272	278	306	333

Source: -Data 2014, 2020, 2025, 2030, 2035, 2040: Preparatory Survey for Greater Yangon Water Supply Improvement Project (Phase II), JICA, 2017

-Other data: 上記データから線形補完で内挿

浸水量 (各TS)

単位：m³/d

	面積 (ha)	単位水量 (m ³ /ha/d)	計
Latha	60	10	605
Lanmadaw	131	10	1,311
Pabedan	62	10	619
Kyauktada	70	10	702
Botahaung	260	10	2,602
Pazundaung	107	10	1,067
Dagon	299	10	2,994
Total	990		9,900

Peak Factor= 1.1

Peak Factor= 1.5

BDSあり面積 381 ha 3,810 m³/d

BDSなし面積 310 ha 3,096 m³/d

浸水量

*浸水量 = (面積 (各TS)) x (単位水量 (10m³/ha/d))

発生汚水量 (日最大)

単位：m³/d

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
Latha	5,744	6,006	6,273	6,547	6,745	6,945	7,146	7,350	7,556	7,709	7,862	8,015	8,168	8,322	9,087	9,853
Lanmadaw	9,425	9,871	10,330	10,800	11,290	11,792	12,307	12,834	13,373	13,903	14,445	14,999	15,563	15,852	17,293	18,734
Pabedan	7,661	8,015	8,377	8,748	8,968	9,188	9,408	9,628	9,848	10,052	10,256	10,459	10,663	10,867	11,885	12,904
Kyauktada	7,289	7,522	7,758	7,996	8,194	8,391	8,588	8,785	8,982	9,164	9,347	9,529	9,711	9,894	10,806	11,718
Botahaung	11,902	12,194	12,488	12,783	13,053	13,324	13,595	13,866	14,136	14,386	14,637	14,887	15,138	15,388	16,641	17,894
Pazundaung	11,914	12,242	12,570	12,900	13,220	13,540	13,860	14,180	14,499	14,795	15,092	15,388	15,684	15,980	17,461	18,941
Dagon	6,626	6,968	7,332	7,720	8,156	8,620	9,113	9,635	10,186	10,756	11,357	11,988	12,652	13,348	16,815	21,169
Total	60,561	62,817	65,128	67,495	69,626	71,800	74,016	76,276	78,581	80,767	82,995	85,266	87,580	89,650	99,988	111,213

*発生汚水量 (日最大) = ((給水人口) x (給水原単位) + (浸水量)) x (Peak factor: 1.1)

発生汚水量 (時間最大)

単位：m³/d

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
Latha	8,617	9,008	9,410	9,821	10,117	10,417	10,720	11,025	11,334	11,564	11,793	12,023	12,253	12,482	13,631	14,779
Lanmadaw	14,138	14,807	15,495	16,200	16,935	17,688	18,460	19,250	20,060	20,855	21,668	22,498	23,345	23,777	25,939	28,100
Pabedan	11,491	12,022	12,566	13,122	13,452	13,782	14,112	14,442	14,772	15,078	15,384	15,689	15,995	16,300	17,828	19,356
Kyauktada	10,933	11,283	11,637	11,995	12,290	12,586	12,881	13,177	13,472	13,746	14,020	14,293	14,567	14,841	16,209	17,577
Botahaung	17,854	18,291	18,731	19,174	19,580	19,986	20,392	20,798	21,204	21,579	21,955	22,331	22,707	23,083	24,961	26,840
Pazundaung	17,870	18,362	18,856	19,351	19,830	20,310	20,790	21,269	21,749	22,193	22,637	23,082	23,526	23,970	26,191	28,412
Dagon	9,938	10,451	10,998	11,580	12,234	12,930	13,669	14,452	15,280	16,135	17,035	17,982	18,978	20,022	25,223	31,754
Total	90,842	94,226	97,692	101,243	104,439	107,699	111,024	114,414	117,871	121,150	124,492	127,898	131,370	134,475	149,982	166,819

*発生汚水量 (時間最大) = ((給水人口) x (給水原単位) + (浸水量)) x (Peak factor: 1.1) x (Peak factor: 1.5)

下水道整備率

単位：%

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	
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人口密度

単位：人/ha

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
Latha	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414
Laanmadaw	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360
Pabedan	539	539	539	539	539	539	539	539	539	539	539	539	539	539	539	539
Kyauktada	425	425	425	425	425	425	425	425	425	425	425	425	425	425	425	425
Botahaung	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158
Pazundaung	454	454	454	454	454	454	454	454	454	454	454	454	454	454	454	454
Dagon	94	97	100	104	107	111	114	118	121	125	128	132	136	139	151	163
Total	2,444	2,447	2,450	2,453	2,457	2,460	2,464	2,467	2,471	2,474	2,478	2,482	2,485	2,489	2,500	2,512

*人口密度 = (将来人口) / (面積)

将来人口 (パッケージ毎)

単位：人

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
CBD(BDS)	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436
CBD(NonBDS)	110,420	110,420	110,420	110,420	110,420	110,420	110,420	110,420	110,420	110,420	110,420	110,420	110,420	110,420	110,420	110,420
Dagon	28,222	29,148	30,074	30,999	32,064	33,130	34,195	35,260	36,325	37,390	38,455	39,520	40,585	41,651	45,201	48,751
Total	253,078	254,004	254,930	255,855	256,920	257,986	259,051	260,116	261,181	262,246	263,311	264,376	265,441	266,507	270,057	273,607

*CBD (BDS) = (人口密度) x (CBD(BDS)の面積) ※次頁参照

CBD (Non BDS) = (将来人口(Latha, Lanmadaw, Pabedan, Kyauktada, Botahaung 及び Pazundaungの合計)) - (将来人口(CBD (BDS)))

Dagon = Dagonタウンシップの将来人口

給水率 (パッケージ毎)

単位：%

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
CBD(BDS)	93%	94%	95%	97%	97%	97%	98%	98%	99%	99%	99%	100%	100%	100%	100%	100%
CBD(NonBDS)	93%	94%	95%	97%	97%	97%	98%	98%	99%	99%	99%	100%	100%	100%	100%	100%
Dagon	53%	56%	57%	59%	61%	63%	65%	67%	69%	71%	73%	75%	77%	79%	89%	100%

*各パッケージの給水率はタウンシップの平均

各戸接続-工事進捗率

単位：%

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
CBD(BDS)	0%	0%	0%	0%	17%	50%	83%	100%	100%	100%	100%	100%	100%	100%	100%	100%
CBD(NonBDS)	0%	0%	0%	0%	0%	0%	0%	0%	25%	75%	100%	100%	100%	100%	100%	100%
Dagon	0%	0%	0%	0%	0%	0%	0%	33%	67%	100%	100%	100%	100%	100%	100%	100%

*CBD(BDS)は下水道渠整備率に基づき設定。CBD(NonBDS)は下水道渠整備後2年の各戸接続、Dagonは3年の各戸接続期間を設定。その後は、給水率増加に伴って各戸接続を継続的に実施する。

各戸接続率

単位：%

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
CBD(BDS)	93%	94%	95%	97%	97%	97%	98%	98%	99%	99%	99%	100%	100%	100%	100%	100%
CBD(NonBDS)	0%	0%	0%	0%	0%	0%	0%	0%	25%	74%	99%	100%	100%	100%	100%	100%
Dagon	0%	0%	0%	0%	0%	0%	0%	22%	46%	71%	73%	75%	77%	79%	89%	100%

*各戸接続率 = (給水率) x (各戸接続-工事進捗率)

*CBD(BDS)では、2023年までは既存下水道システムが使用され、給水率が各戸接続率となる

接続人口

単位：人

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
CBD(BDS)	106,330	107,697	109,064	110,431	110,927	111,423	111,918	112,414	112,910	113,292	113,673	114,055	114,436	114,436	114,436	114,436
CBD(NonBDS)	0	0	0	0	0	0	0	0	27,237	81,987	109,684	110,052	110,420	110,420	110,420	110,420
Dagon	0	0	0	0	0	0	0	7,875	16,709	26,547	28,072	29,640	31,251	32,904	40,229	48,751
Total	106,330	107,697	109,064	110,431	110,927	111,423	111,918	120,289	156,857	221,825	251,429	253,747	256,107	257,760	265,085	273,607

*接続人口 = (将来人口) x (各戸接続率)

下水道普及率

単位：%

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
CBD(BDS)	93%	94%	95%	97%	97%	97%	98%	98%	99%	99%	99%	100%	100%	100%	100%	100%
CBD(NonBDS)	0%	0%	0%	0%	0%	0%	0%	0%	25%	74%	99%	100%	100%	100%	100%	100%
Dagon	0%	0%	0%	0%	0%	0%	0%	22%	46%	71%	73%	75%	77%	79%	89%	100%
Total	42%	42%	43%	43%	43%	43%	43%	46%	60%	85%	95%	96%	96%	97%	98%	100%

*下水道普及率 = (接続人口) / (将来人口)

汚水収分量(日最大)

単位：m3/d

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2035	2040
CBD(BDS)	630	630	630	630	630	630	630	34,289	35,185	35,997	36,812	37,633	38,458	39,158	42,654	46,151
CBD(NonBDS)	0	0	0	0	0	0	0	0	8,330	25,576	34,887	35,676	36,470	37,145	40,519	43,893
Dagon	0	0	0	0	0	0	0	2,849	6,110	9,801	10,467	11,165	11,894	12,656	16,453	21,169
Total	630	630	630	630	630	630	630	37,138	49,626	71,374	82,167	84,474	86,823	88,959	99,626	111,213

*汚水収分量 (日最大) = (接続人口) x (給水原単位) x (Peak factor: 1.1) + (浸入水量) x (各戸接続率) x (Peak factor: 1.1)

*CBD(BDS)の2017から2023年の汚水収分量は実績値であり、バキュームカーによる搬入量を含む

Line	Type	Pipe No.	Area ha	Year											
				2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2040
Line1	Trunk	Pb2	3.180	1,713	1,713	1,713	1,713	1,713	1,713	1,713	1,713	1,713	1,713	1,713	1,713
Line1	Trunk	Pb3	2.920	1,573	1,573	1,573	1,573	1,573	1,573	1,573	1,573	1,573	1,573	1,573	1,573
Line1	Trunk	Ky1	0.000	0	0	0	0	0	0	0	0	0	0	0	0
Line1	Trunk	Ky2	1.890	804	804	804	804	804	804	804	804	804	804	804	804
Line1	Trunk	Bo2	5.900	930	930	930	930	930	930	930	930	930	930	930	930
Line1	Trunk	Bo3	10.320	1,626	1,626	1,626	1,626	1,626	1,626	1,626	1,626	1,626	1,626	1,626	1,626
Line1	Trunk	Bo5	0.000	0	0	0	0	0	0	0	0	0	0	0	0
Line2	Trunk	Ld29	2.200	792	792	792	792	792	792	792	792	792	792	792	792
Line2	Trunk	Ld31	2.200	792	792	792	792	792	792	792	792	792	792	792	792
Line2	Trunk	Ld33	2.210	795	795	795	795	795	795	795	795	795	795	795	795
Line2	Trunk	Lt4	6.500	2,693	2,693	2,693	2,693	2,693	2,693	2,693	2,693	2,693	2,693	2,693	2,693
Line2	Trunk	Pb6	7.640	4,115	4,115	4,115	4,115	4,115	4,115	4,115	4,115	4,115	4,115	4,115	4,115
Line2	Trunk	Pb7	8.290	4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465	4,465
Line2	Trunk	Ky5	8.600	3,658	3,658	3,658	3,658	3,658	3,658	3,658	3,658	3,658	3,658	3,658	3,658
Line2	Trunk	Ky6	8.100	3,445	3,445	3,445	3,445	3,445	3,445	3,445	3,445	3,445	3,445	3,445	3,445
Line2	Trunk	Bo6	7.960	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254
Line2	Trunk	Bo7	7.860	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238
Line2	Trunk	Pz14	7.810	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545	3,545
Line2	Trunk	Pz16	0.000	0	0	0	0	0	0	0	0	0	0	0	0
Line3	Trunk	Ld39	8.500	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059	3,059
Line3	Trunk	Ld40	10.620	3,822	3,822	3,822	3,822	3,822	3,822	3,822	3,822	3,822	3,822	3,822	3,822
Line3	Trunk	Ld41	8.740	3,145	3,145	3,145	3,145	3,145	3,145	3,145	3,145	3,145	3,145	3,145	3,145
Line3	Trunk	Lt7	8.340	3,455	3,455	3,455	3,455	3,455	3,455	3,455	3,455	3,455	3,455	3,455	3,455
Line3	Trunk	Lt8	8.180	3,389	3,389	3,389	3,389	3,389	3,389	3,389	3,389	3,389	3,389	3,389	3,389
Line3	Trunk	Pb10	8.230	4,432	4,432	4,432	4,432	4,432	4,432	4,432	4,432	4,432	4,432	4,432	4,432
Line3	Trunk	Pb11	8.810	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745	4,745
Line3	Trunk	Ky9	15.720	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686	6,686
Line3	Trunk	Ky10	16.310	6,937	6,937	6,937	6,937	6,937	6,937	6,937	6,937	6,937	6,937	6,937	6,937
Line3	Trunk	Bo10	13.450	2,119	2,119	2,119	2,119	2,119	2,119	2,119	2,119	2,119	2,119	2,119	2,119
Line3	Trunk	Bo11	16.390	2,582	2,582	2,582	2,582	2,582	2,582	2,582	2,582	2,582	2,582	2,582	2,582
Line3	Trunk	Bo12	29.452	4,640	4,640	4,640	4,640	4,640	4,640	4,640	4,640	4,640	4,640	4,640	4,640
Line3	Trunk	Bo13	16.600	2,615	2,615	2,615	2,615	2,615	2,615	2,615	2,615	2,615	2,615	2,615	2,615
Line3	Trunk	Bo19	2.100	331	331	331	331	331	331	331	331	331	331	331	331
Line4	Trunk	Lt12	8.430	3,493	3,493	3,493	3,493	3,493	3,493	3,493	3,493	3,493	3,493	3,493	3,493
Line4	Trunk	Pb14	9.570	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154	5,154
Line4	Trunk	Pb15	12.030	6,479	6,479	6,479	6,479	6,479	6,479	6,479	6,479	6,479	6,479	6,479	6,479
Line4	Trunk	Ky13	1.430	608	608	608	608	608	608	608	608	608	608	608	608
Line4	Trunk	Ky14	0.000	0	0	0	0	0	0	0	0	0	0	0	0
Line4	Trunk	Bo22	10.890	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716	1,716
Line4	Trunk	Bo23	5.650	890	890	890	890	890	890	890	890	890	890	890	890
Line4	Trunk	Bo24	0.000	0	0	0	0	0	0	0	0	0	0	0	0
Line4	Trunk	Bo25	6.480	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021
Line4	Trunk	Bo26	3.670	578	578	578	578	578	578	578	578	578	578	578	578
Line4	Trunk	Bo27	3.550	559	559	559	559	559	559	559	559	559	559	559	559
Line4	Trunk	Bo32	9.140	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440
Line5	Trunk	Bo40	21.870	3,446	3,446	3,446	3,446	3,446	3,446	3,446	3,446	3,446	3,446	3,446	3,446
Line5	Trunk	Bo43	23.210	3,657	3,657	3,657	3,657	3,657	3,657	3,657	3,657	3,657	3,657	3,657	3,657
Total			380.9	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436	114,436

Appendix 21 運用・効果指標

APPENDIX 21 運用・効果指標

以下に本事業の運用・効果指標及びその定義について示す。

表 1 運用・効果指標

	指標名	基準値 (2017 年実績)	目標値 (2029 年)
(1)	事業対象地域における 汚水処理人口	106,330 人 ^{*1}	256,107 人 ^{*1}
(2)	事業対象地域における 汚水処理量	630 m ³ /日	86,823 m ³ /日 ^{*1}
(3)	下水処理能力	15,000 m ³ /日	112,000 m ³ /日
(4)	放流水 BOD 濃度	98 mg/L	20 mg/L
(5)	事業対象地域における 下水道普及率	42% ^{*1}	96% ^{*1}

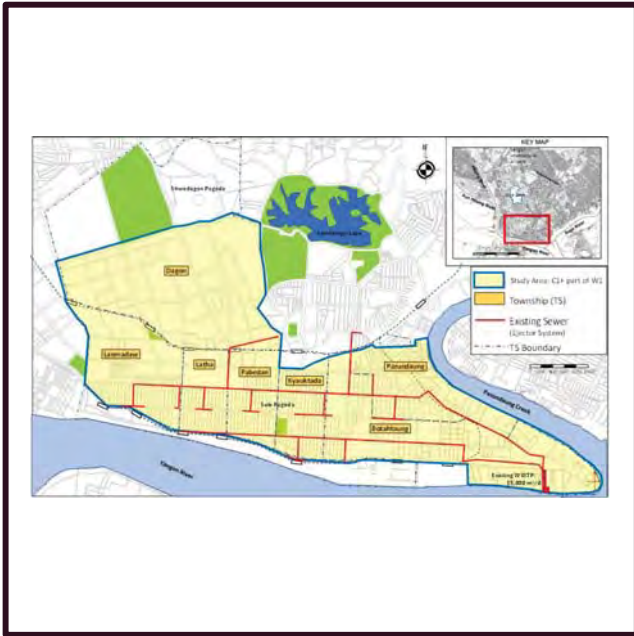
*1: Appendix 20 参照

出典：国際協力機構 評価部「資金協力事業 開発課題別の指標例」2018 年 10 月の指標例
(下水道) を参考に調査団が作成

- (1) 「下水処理場につながる路地裏排水管に接続している家屋の人口」と「新規敷設する
下水管に接続した家屋の人口」との合計
- (2) 下水処理場における一日間の流入水量の年間最大値 (降雨の影響がないとき)
- (3) 下水処理場における下水処理能力 (日最大)
- (4) 下水処理場放流水の生物化学的酸素要求量の測定値 (最大値)
- (5) 「事業対象地域における汚水処理人口」を「事業対象地域内にある家屋の人口」で除
したもの

Appendix 22 家計調査

OVERVIEW OF THE RESEARCH



【Objective】

This scope of works will be applied to household surveys to be conducted for the data collection survey for sewerage system development in Yangon City

【Term】

From January 31st 2018 to February 12th, 2018

【Data Collection】

Interview to 7 Township (Dagon, Lanmadaw, Latha, Kyauktada, Pazundaung, Pabedan, Botahtaung)

【Research Professionals】

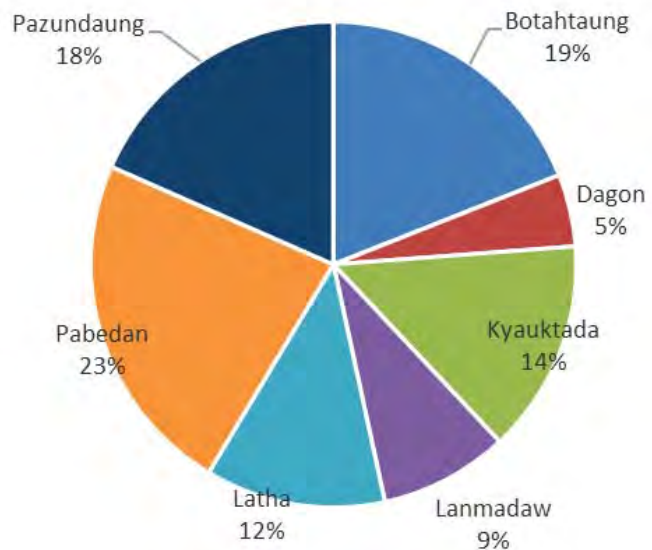
12 researchers and 2 team leaders of Trust Venture Partners (2 extra members)



TOWNSHIP

n = 500

Township	Count
Botahtaung	95
Dagon	24
Kyauktada	71
Lanmadaw	43
Latha	60
Pabedan	115
Pazundaung	92
Total	500



SEC CLASSIFICATION

n = 500

SEC	Income range	Count
E	below 200,000	32
D	200,001 - 400,000	141
C	400,001 - 700,000	190
B	700,001 - 1,000,000	74
A	1000001 and above	60
-	No Answer	3

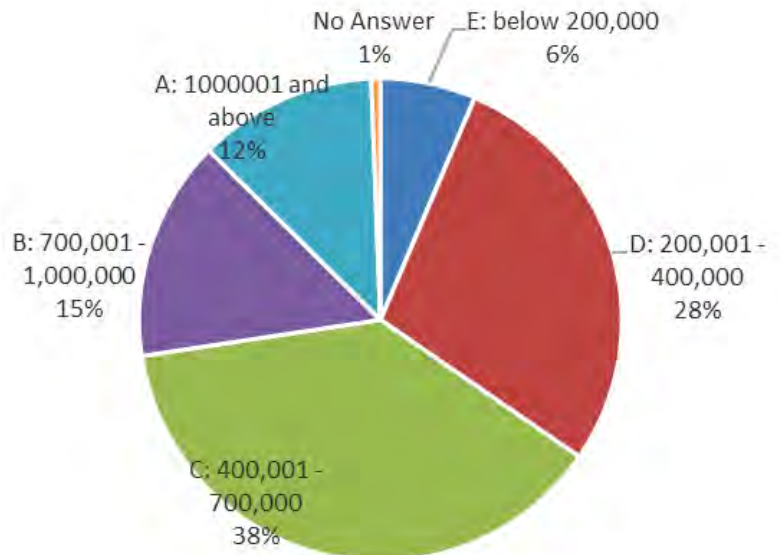
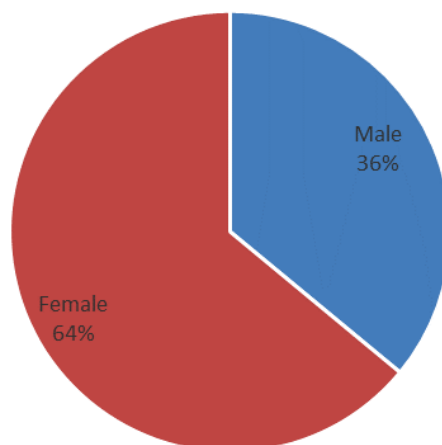


TABLE : @ 001
Q1A : GENDER
BASE : ALL RESPONDENTS

n = 500

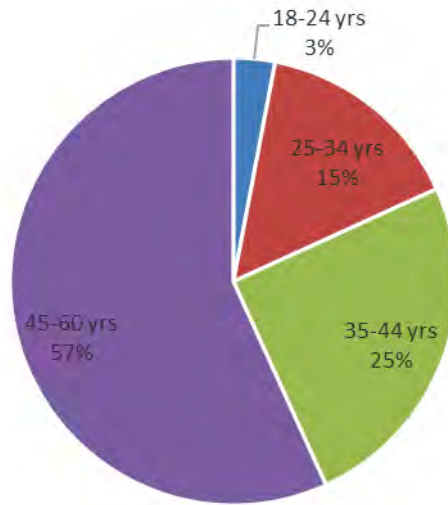


	Total	Gender		Age				SEC						
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	No answer	
Q1a. Gender	Total	500	180	320	15	76	125	284	60	74	190	141	32	3
	Male	180	180	0	5	28	36	111	28	32	69	41	9	1
	Female	320	0	320	10	48	89	173	32	42	121	100	23	2



TABLE : @ 002
 Q1B : AGE GROUP
 BASE : ALL RESPONDENTS

n = 500

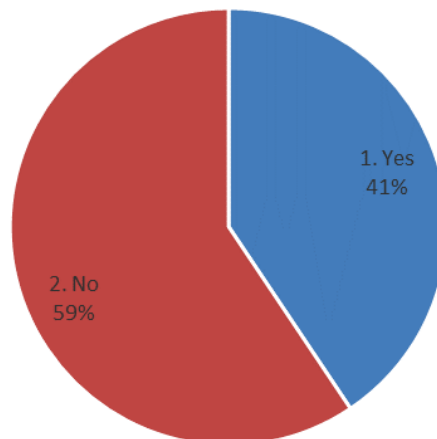


	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Q1b. Age	500	180	320	15	76	125	284	60	74	190	141	32	3
18-24 yrs	15	5	10	15	0	0	0	0	1	7	5	2	0
25-34 yrs	76	28	48	0	76	0	0	16	12	25	15	8	0
35-44 yrs	125	36	89	0	0	125	0	12	18	48	39	7	1
45-60 yrs	284	111	173	0	0	0	284	32	43	110	82	15	2



TABLE : @ 003
 Q1C : ARE YOU HEAD OF HOUSEHOLD?
 BASE : ALL RESPONDENTS

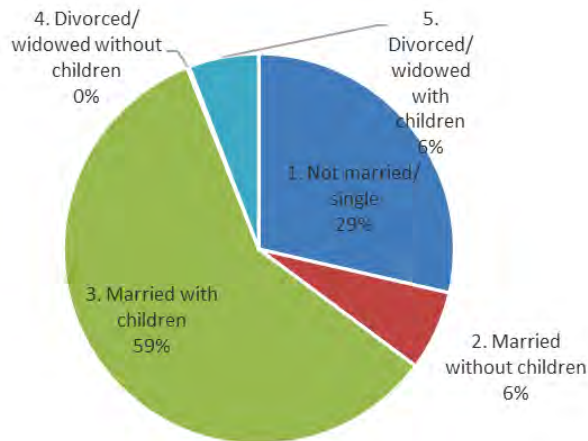
n = 500



	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Q1c. Head of household	500	180	320	15	76	125	284	60	74	190	141	32	3
1. Yes	203	121	82	2	15	36	150	30	29	73	54	15	2
2. No	297	59	238	13	61	89	134	30	45	117	87	17	1



TABLE : @ 004
Q1D : MARITAL STATUS
BASE : ALL RESPONDENTS

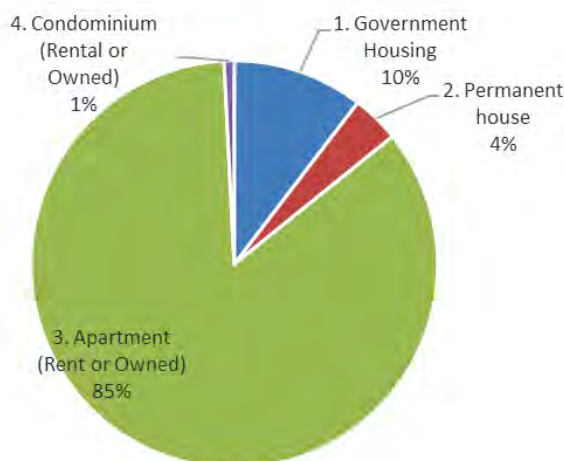


n = 500

	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Total	500	180	320	15	76	125	284	60	74	190	141	32	3
1. Not married/ single	143	51	92	10	24	47	62	15	13	53	45	16	1
2. Married without children	33	14	19	1	10	7	15	2	4	15	11	1	0
3. Married with children	294	113	181	4	41	70	179	42	53	109	76	12	2
4. Divorced/ widowed without children	1	0	1	0	0	0	1	0	1	0	0	0	0
5. Divorced/ widowed with children	29	2	27	0	1	1	27	1	3	13	9	3	0



TABLE : @ 005
Q2 : TYPE OF HOUSE
BASE : ALL RESPONDENTS



n = 500

	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Total	500	180	320	15	76	125	284	60	74	190	141	32	3
1. Government Housing	52	14	38	2	11	14	25	2	5	19	23	3	0
2. Permanent house	19	9	10	0	1	1	17	0	1	12	4	2	0
3. Apartment (Rent or Owned)	425	156	269	13	64	109	239	55	67	159	114	27	3
4. Condominium (Rental or Owned)	4	1	3	0	0	1	3	3	1	0	0	0	0



TABLE : @ 006
A1,A2,A3 : HOW MANY PEOPLE LIVE IN THE HOUSE?
BASE : ALL RESPONDENTS

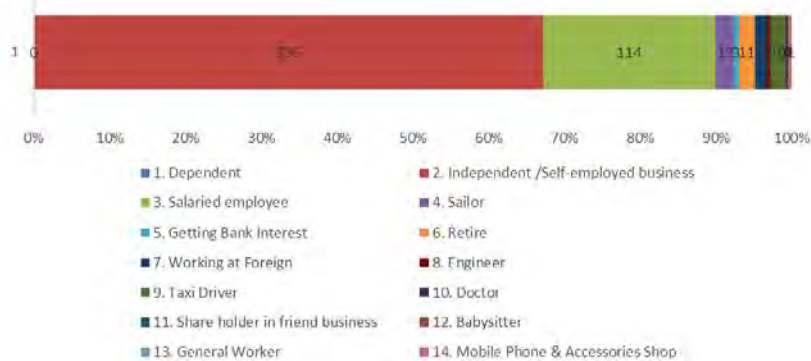
n = 500

		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
A1. Number of adult (Male)	Count	430	180	250	14	63	108	245	55	66	168	116	23	2
	Average	1.85	1.84	1.86	1.50	2.00	1.74	1.88	2.16	2.08	1.79	1.71	1.61	2.00
A1. Number of adult (Female)	Count	480	160	320	14	74	118	274	57	73	182	135	30	3
	Average	2.16	2.14	2.18	2.36	2.27	2.13	2.14	2.67	2.16	2.26	1.93	1.70	1.33
A2. Number of senior citizens (Male)	Count	102	35	67	2	20	30	50	14	12	39	32	5	0
	Average	1.07	1.09	1.06	1.50	1.10	1.03	1.06	1.14	1.00	1.13	1.00	1.00	
A2. Number of senior citizens (Female)	Count	163	68	95	5	27	57	74	26	24	59	45	8	1
	Average	1.18	1.13	1.21	1.00	1.15	1.09	1.27	1.27	1.13	1.14	1.20	1.25	1.00
A3. Number of children (Male)	Count	135	39	96	7	28	54	46	19	26	47	36	6	1
	Average	1.35	1.44	1.31	1.14	1.39	1.50	1.17	1.16	1.38	1.30	1.42	1.83	1.00
A3. Number of children (Female)	Count	135	41	94	5	38	49	43	24	27	49	29	5	1
	Average	1.33	1.32	1.33	1.20	1.42	1.37	1.21	1.67	1.22	1.24	1.34	1.00	1.00



TABLE : @ 007
A4 : WHAT KIND OF OCCUPATION FOR THE MAJOR INCOME SOURCE OF YOUR HOUSEHOLD?
BASE : ALL RESPONDENTS

n = 500

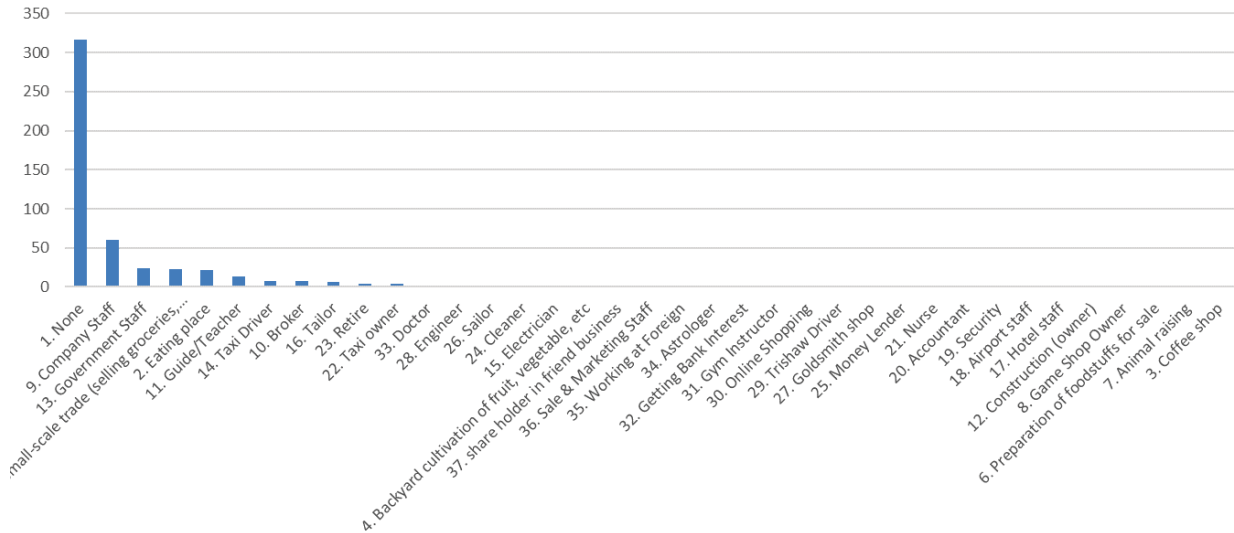


		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
A4. Occupation	Total	500	180	320	15	76	125	284	60	74	190	141	32	3
	1. Dependent	0	0	0	0	0	0	0	0	0	0	0	0	0
	2. Independent /Self-employed business	336	131	205	10	49	91	186	40	58	134	84	18	2
	3. Salaried employee	114	34	80	3	21	23	67	9	14	44	41	6	0
	4. Sailor	12	4	8	0	1	2	9	7	1	4	0	0	0
	5. Getting Bank Interest	3	1	2	0	0	1	2	1	1	1	0	0	0
	6. Retire	11	5	6	0	2	1	8	0	0	3	3	4	1
	7. Working at Foreign	7	1	6	1	1	1	4	0	0	1	3	3	0
	8. Engineer	3	0	3	0	1	1	1	2	0	0	1	0	0
	9. Taxi Driver	10	3	7	0	1	4	5	0	0	3	7	0	0
	10. Doctor	1	1	0	1	0	0	0	0	0	0	0	1	0
	11. Share holder in friend business	0	0	0	0	0	0	0	0	0	0	0	0	0
	12. Babysitter	1	0	1	0	0	0	1	0	0	0	1	0	0
	13. General Worker	1	0	1	0	0	0	1	0	0	0	1	0	0
	14. Mobile Phone & Accessories Shop	1	0	1	0	0	1	0	1	0	0	0	0	0



TABLE : @ 008
A5 : DOES ANY MEMBER OF THE HOUSEHOLD CARRY OUT ANY INCOME GENERATING ACTIVITIES HERE IN YOUR HOME?
BASE : ALL RESPONDENTS

n = 500

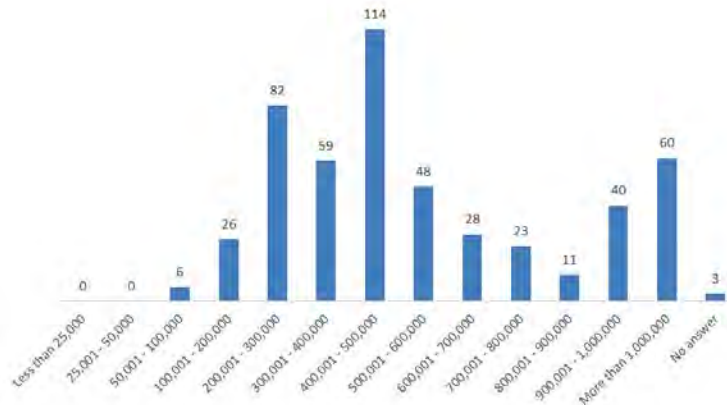


	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Total	500	180	320	15	76	125	284	60	74	190	141	32	3
1. None	317	116	201	9	41	85	182	35	42	115	93	30	2
9. Company Staff	60	17	43	2	9	17	32	10	10	28	12	0	0
13. Government Staff	24	11	13	2	7	7	8	1	5	9	9	0	0
5. Small-scale trade (selling groceries, cigarettes, fruit etc from house)	23	9	14	0	4	7	12	3	6	11	3	0	0
2. Eating place	22	4	18	0	7	5	10	5	5	9	3	0	0
11. Guide/Teacher	13	4	9	0	1	1	11	2	2	6	3	0	0
14. Taxi Driver	8	1	7	0	4	0	4	0	0	5	3	0	0
10. Broker	7	4	3	2	0	1	4	0	1	4	2	0	0
16. Tailor	6	3	3	0	0	2	4	0	1	2	3	0	0
23. Retire	4	1	3	0	0	0	4	1	1	0	2	0	0
22. Taxi owner	4	3	1	0	1	1	2	2	1	1	0	0	0
33. Doctor	2	1	1	0	0	0	2	1	0	1	0	0	0
28. Engineer	2	2	0	0	1	0	1	0	0	1	0	1	0
26. Sailor	2	1	1	0	0	0	2	1	0	0	1	0	0
24. Cleaner	2	1	1	0	1	0	1	0	0	1	1	0	0
15. Electrician	2	2	0	0	1	0	1	0	0	0	1	1	0
4. Backyard cultivation of fruit, vegetable, etc	2	1	1	0	0	1	1	0	1	0	1	0	0
37. share holder in friend business	1	0	1	0	0	0	1	1	0	0	0	0	0
36. Sale & Marketing Staff	1	0	1	0	1	0	0	0	0	0	1	0	0
35. Working at Foreign	1	0	1	0	0	0	1	0	1	0	0	0	0
34. Astrologer	1	0	1	0	0	0	1	0	1	0	0	0	0
32. Getting Bank Interest	1	0	1	0	0	0	1	0	0	0	0	0	1
31. Gym Instructor	1	1	0	1	0	0	0	0	0	1	0	0	0
30. Online Shopping	1	0	1	0	1	0	0	0	1	0	0	0	0
29. Trishaw Driver	1	0	1	0	0	0	1	0	0	0	1	0	0
27. Goldsmith shop	1	1	0	0	0	0	1	0	0	0	1	0	0
25. Money Lender	1	0	1	0	0	0	1	0	0	0	1	0	0
21. Nurse	1	1	0	0	0	0	1	0	0	0	1	0	0
20. Accountant	1	0	1	0	1	0	0	1	0	0	0	0	0
19. Security	1	0	1	0	1	0	0	0	0	1	0	0	0
18. Airport staff	1	0	1	0	0	0	1	0	0	0	1	0	0
17. Hotel staff	1	0	1	0	0	1	0	0	1	0	0	0	0
12. Construction (owner)	1	0	1	0	0	0	1	1	0	0	0	0	0
8. Game Shop Owner	1	1	0	0	0	0	1	0	0	0	1	0	0
6. Preparation of foodstuffs for sale	1	1	0	0	1	0	0	1	0	0	0	0	0
7. Animal raising	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Coffee shop	0	0	0	0	0	0	0	0	0	0	0	0	0



TABLE : @ 009
A6 : WHAT IS THE TOTAL MONTHLY INCOME OF YOUR HOUSEHOLD?
BASE : ALL RESPONDENTS

n = 500



	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
A6. Monthly household income	500	180	320	15	76	125	284	60	74	190	141	32	3
Less than 25,000	0	0	0	0	0	0	0	0	0	0	0	0	0
25,001 - 50,000	0	0	0	0	0	0	0	0	0	0	0	0	0
50,001 - 100,000	6	2	4	1	0	2	3	0	0	0	0	6	0
100,001 - 200,000	26	7	19	1	8	5	12	0	0	0	0	26	0
200,001 - 300,000	82	20	62	4	8	22	48	0	0	0	82	0	0
300,001 - 400,000	59	21	38	1	7	17	34	0	0	0	59	0	0
400,001 - 500,000	114	46	68	6	18	31	59	0	0	114	0	0	0
500,001 - 600,000	48	15	33	1	5	8	34	0	0	48	0	0	0
600,001 - 700,000	28	8	20	0	2	9	17	0	0	28	0	0	0
700,001 - 800,000	23	7	16	0	0	4	19	0	23	0	0	0	0
800,001 - 900,000	11	6	5	0	3	1	7	0	11	0	0	0	0
900,001 - 1,000,000	40	19	21	1	9	13	17	0	40	0	0	0	0
More than 1,000,000	60	28	32	0	16	12	32	60	0	0	0	0	0
No answer	3	1	2	0	0	1	2	0	0	0	0	0	3

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TABLE : @ 010
A7 : HOW MUCH IS YOUR AVERAGE MONTHLY EXPENDITURE?
BASE : ALL RESPONDENTS

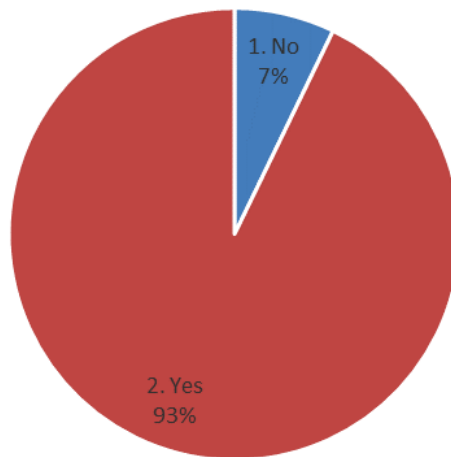
n = 500

		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
A7-1. Food	Count	500	180	320	15	76	125	284	60	74	190	141	32	3
A7-1. Food	Average	240,282.0	249,611.1	235,034.4	185,333.3	236,644.7	239,360.0	244,563.4	435,000.0	308,648.7	234,315.8	161,283.7	91,875.0	333,333.3
A7-2. Clothing	Count	407	153	254	12	67	93	235	56	66	159	107	16	3
A7-2. Clothing	Average	26,371.0	27,483.7	25,700.8	145,000.0	34,074.6	26,268.8	24,821.3	55,750.0	35,984.9	21,679.3	14,803.7	7,187.5	30,000.0
A7-3. Health	Count	390	136	254	11	59	98	222	51	58	158	103	18	2
A7-3. Health	Average	62,088.5	70,772.1	57,439.0	29,545.5	46,627.1	72,285.7	63,308.6	127,274.5	68,784.5	61,873.4	35,941.8	13,111.1	10,000.0
A7-4. Education	Count	261	90	171	5	34	76	146	47	48	102	59	4	1
A7-4. Education	Average	146,053.0	161,003.7	138,184.2	57,000.0	135,955.9	143,144.7	152,968.0	349,361.7	156,291.7	95,686.3	70,980.2	37,500.0	100,000.0
A7-5. Water (YCDC)	Count	453	165	288	13	65	114	261	58	70	175	119	28	3
A7-5. Water (YCDC)	Average	2,162.5	2,170.3	2,158.0	1,792.3	2,132.9	2,196.8	2,173.3	2,823.1	2,188.6	2,087.1	2,028.8	1,871.8	1,200.0
A7-6. Water (Other)	Count	399	155	244	14	65	104	216	51	67	156	103	20	2
A7-6. Water (Other)	Average	10,372.1	10,248.4	10,450.6	8,564.3	10,786.2	10,295.2	10,401.6	15,715.7	11,209.0	10,686.2	7,539.8	6,365.0	7,500.0
A7-7. Electricity	Count	499	180	319	15	76	124	284	60	74	189	141	32	3
A7-7. Electricity	Average	17,753.6	19,194.4	16,940.6	16,366.7	19,247.4	18,575.0	17,068.5	29,496.7	22,333.1	16,851.9	13,401.4	10,218.8	11,666.7
A7-8. Communication	Count	499	180	319	15	76	125	283	60	74	190	140	32	3
A7-8. Communication	Average	28,096.8	30,793.3	26,575.2	29,200.0	32,052.6	25,516.0	28,115.9	61,466.7	36,878.4	26,286.8	15,548.6	11,843.8	17,666.7
A7-9. Gas, fuel, firewood (for cooking)	Count	152	55	97	5	18	43	86	24	24	60	36	7	1
A7-9. Gas, fuel, firewood (for cooking)	Average	12,616.3	11,621.8	13,180.2	12,680.0	14,849.1	14,848.8	11,029.1	15,437.5	20,145.8	12,723.3	6,632.9	7,785.7	7,000.0
A7-10. Transport	Count	454	169	285	13	69	113	259	57	69	176	125	24	3
A7-10. Transport	Average	31501.10	40949.70	25898.25	15923.08	35695.65	27115.04	33079.15	83543.86	42942.03	23982.95	16956.00	6500.00	26666.67
A7-11. House rental	Count	58	23	35	2	21	18	17	12	12	18	15	1	0
A7-11. House rental	Average	182,251.7	239,678.3	144,514.3	157,500.0	233,238.1	157,222.2	148,682.4	347,500.0	174,166.7	178,777.8	56,173.3	250,000.0	
A7-12. Loan payment	Count	14	7	7	0	3	6	5	2	3	7	2	0	0
A7-12. Loan payment	Average	66,500.0	66,000.0	67,000.0	40,000.0	73,833.3	73,600.0	49,000.0	114,666.7	62,714.3	25,000.0			
A7-13. Donation/ Social Activities	Count	49	14	35	0	7	11	31	9	11	17	11	1	0
A7-13. Donation/ Social Activities	Average	43,591.8	26,785.7	50,314.3	25,000.0	105,272.7	25,903.2	147,777.8	38,000.0	15,529.4	10,818.2	5,000.0		
A7-14. Bank Deposit	Count	4	3	1	0	0	1	3	0	2	2	0	0	0
A7-14. Bank Deposit	Average	68,750.0	25,000.0	200,000.0	50,000.0	75,000.0			105,000.0	32,500.0				
A7-15. Business Interests	Count	1	0	1	0	0	0	1	0	1	0	0	0	0
A7-15. Business Interests	Average	600,000.0		600,000.0			600,000.0		600,000.0					

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TABLE : @ 011
 B1 : ARE YOU CONNECTED TO YCDC PIPED WATER?
 BASE : ALL RESPONDENTS

n = 500

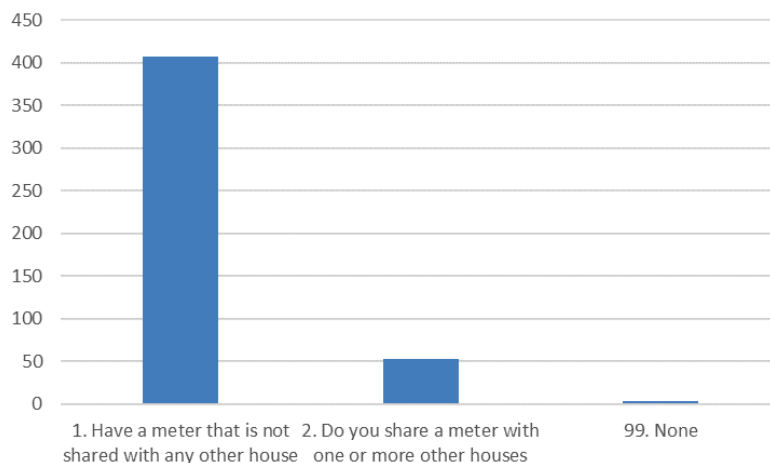


	Total	Gender		Age				SEC					No answer	
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E		
B1. Connected to YCDC piped water	Total	500	180	320	15	76	125	284	60	74	190	141	32	3
	1. No	36	12	24	1	9	10	16	2	4	14	13	3	0
	2. Yes	464	168	296	14	67	115	268	58	70	176	128	29	3



TABLE : @ 012
 B2 : OWN OR SHARE METER IF CONNECTED TO YCDC PIPED WATER
 BASE : RESPONDENTS THOSE WHO CONNECTED TO YCDC PIPED WATER

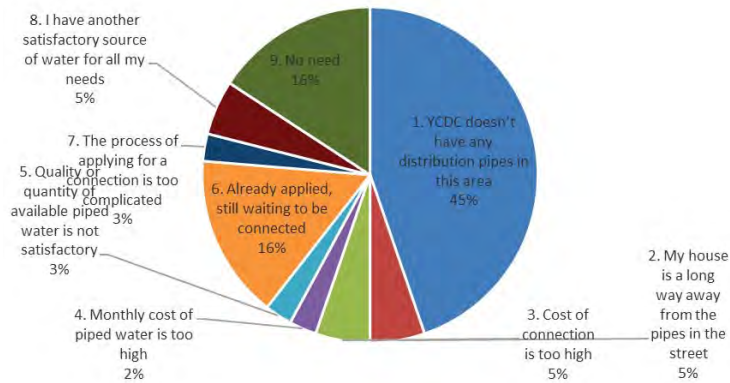
n = 464



	Total	Gender		Age				SEC					No answer	
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E		
B2. Own or share meter	Total	464	168	296	14	67	115	268	58	70	176	128	29	3
	1. Have a meter that is not shared with any other house	407	151	256	12	59	101	235	54	62	153	111	24	3
	2. Do you share a meter with one or more other houses	53	16	37	2	8	14	29	4	6	22	16	5	0
	99. None	4	1	3	0	0	0	4	0	2	1	1	0	0



TABLE : @ 013
 B3 : WHAT ARE YOUR REASONS FOR NOT CONNECTING TO THE PIPED WATER SUPPLY?
 BASE : RESPONDENTS THOSE WHO DID NOT CONNECT TO YCDC PIPED WATER



n = 36

	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
B3. Reasons	36	12	24	1	9	10	16	2	4	14	13	3	0
1. YCDC doesn't have any distribution pipes in this area	17	7	10	0	4	6	7	1	4	7	3	2	0
2. My house is a long way away from the pipes in the street	2	2	0	0	0	1	1	0	1	1	0	0	0
3. Cost of connection is too high	2	0	2	0	0	0	2	0	0	1	1	0	0
4. Monthly cost of piped water is too high	1	1	0	0	1	0	0	0	0	1	0	0	0
5. Quality or quantity of available piped water is not satisfactory	1	0	1	1	0	0	0	0	0	1	0	0	0
6. Already applied, still waiting to be connected	6	2	4	0	1	1	4	1	0	1	4	0	0
7. The process of applying for a connection is too complicated	1	1	0	0	0	0	1	1	0	0	0	0	0
8. I have another satisfactory source of water for all my needs	2	0	2	0	1	1	0	0	0	0	1	1	0
9. No need	6	1	5	0	2	2	2	0	0	2	4	0	0

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TABLE : @ 014
 C1 : ON AVERAGE, HOW MUCH WATER DOES YOUR HOUSEHOLD USE FROM DIFFERENT SOURCES EACH MONTH (IN UNIT)?
 BASE : ALL RESPONDENTS

n = 500

	Total	Gender		Age				SEC					No answer	
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E		
Total	Count	500	180	320	15	76	125	284	60	74	190	141	32	3
C1-1. YCDC piped water (own or shared)	Count	450	164	286	13	64	114	259	58	69	175	119	26	3
	Average	24.25	24.45	24.13	19.15	24.81	24.07	24.44	33.10	24.83	23.11	22.65	19.77	8.33
C1-2. Tanker	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
C1-3. Your own or neighbour's well	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
C1-4. A communal well/tap stand	Count	1	1	0	0	1	0	0	0	0	0	1	0	0
	Average	22.00	22.00		22.00						22.00			
C1-5. Bottled water	Count	9	5	4	1	2	3	3	2	3	2	1	1	0
	Average	19.00	18.60	19.50	30.00	11.50	21.67	17.67	20.00	12.67	25.00	13.00	30.00	
C1-6. River/canal/pond/stream	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
C1-7. Rain water	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
No Answer	Count	48												

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TABLE : @ 015
C1 : ON AVERAGE, HOW MUCH WATER DOES YOUR HOUSEHOLD USE FROM DIFFERENT SOURCES EACH MONTH (IN KYAT)?
BASE : ALL RESPONDENTS

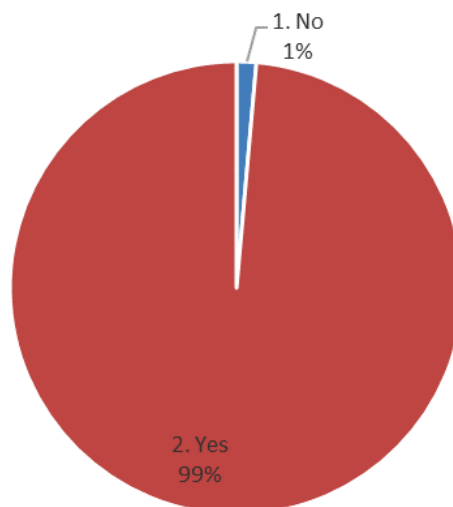
n = 500

		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Total	Count	500	180	320	15	76	125	284	60	74	190	141	32	3
C1-1. YCDC piped water (own or shared)	Count	453	165	288	13	65	114	261	58	70	175	119	28	3
	Average	2,162.50	2,170.32	2,158.03	1,792.31	2,132.92	2,196.81	2,173.33	2,823.10	2,188.57	2,087.10	2,028.76	1,871.79	1,200.00
C1-2. Tanker	Count	5	1	4	0	1	1	3	0	0	1	4	0	0
	Average	2,000.00	2,000.00	2,000.00	0	2,000.00	2,000.00	2,000.00			2,000.00	2,000.00		
C1-3. Your own or neighbour's well	Count	16	4	12	1	4	4	7	1	1	5	8	1	0
	Average	5,800.00	10,875.00	4,108.33	1,800.00	5,125.00	1,500.00	9,214.29	30,000.00	1,500.00	5,860.00	3,375.00	5,000.00	
C1-4. A communal well/tap stand	Count	9	6	3	0	3	2	4	1	2	4	2	0	0
	Average	3,600.00	4,366.67	2,066.67	0	2,000.00	2,600.00	5,300.00	4,000.00	2,600.00	4,800.00	2,000.00		
C1-5. Bottled water	Count	390	150	240	13	64	100	213	51	65	153	99	20	2
	Average	10,277.56	10,112.00	10,381.04	9,084.62	10,587.50	10,575.00	10,117.61	15,049.02	11,450.77	10,598.37	7,450.51	6,115.00	7,500.00
C1-6. River/canal/pond/stream	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
C1-7. Rain water	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
No Answer		7												



TABLE : @ 016
C2 : DO YOU PAY FOR ANY OF THE WATER YOU USE (NOT INCLUDING COST OF CONSTRUCTING, OPERATING WELLS ETC)?
BASE : ALL RESPONDENTS

n = 500



		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
C2. Pay for using any water	Total	500	180	320	15	76	125	284	60	74	190	141	32	3
	1. No	7	2	5	0	1	1	5	0	0	0	5	2	0
	2. Yes	493	178	315	15	75	124	279	60	74	190	136	30	3



TABLE : @ 017
 C3 : HOW MUCH DO YOU PAY FOR WATER PER MONTH FOR?
 BASE : RESPONDENTS WHO PAY FOR USING ANY WATER

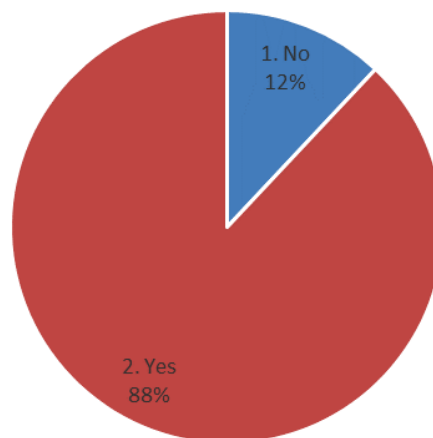
n = 500

		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
C3-1. YCDC piped water (own or shared meter)	Count	453	165	288	13	65	114	261	58	70	175	119	28	3
	Average	2,162.50	2,170.32	2,158.03	1,792.31	2,132.92	2,196.81	2,173.33	2,823.10	2,188.57	2,087.10	2,028.76	1,871.79	1,200.00
C3-2. Water piped to your house by a private business	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
C3-3. Tanker	Count	5	1	4	0	1	1	3	0	0	1	4	0	0
	Average	2,000.00	2,000.00	2,000.00		2,000.00	2,000.00	2,000.00			2,000.00	2,000.00		
C3-4. Operation and maintenance of your own well	Count	6	3	3	1	0	2	3	1	0	2	3	0	0
	Average	6,550.00	11,500.00	1,600.00	1,800.00		1,500.00	11,500.00	30,000.00		1,900.00	1,833.33		
C3-5. Water from your neighbour's well	Count	10	1	9	0	4	2	4	0	1	3	5	1	0
	Average	5,350.00	9,000.00	4,944.44		5,125.00	1,500.00	7,500.00		1,500.00	8,500.00	4,300.00	5,000.00	
C3-6. Use of a communal well/tap	Count	9	6	3	0	3	2	4	1	2	4	2	0	0
	Average	3,600.00	4,366.67	2,066.67		2,000.00	2,600.00	5,300.00	4,000.00	2,600.00	4,800.00	2,000.00		
C3-7. Bottled water	Count	390	150	240	13	64	100	213	51	65	153	99	20	2
	Average	10,277.56	10,112.00	10,381.04	9,084.62	10,587.50	10,575.00	10,117.61	15,049.02	11,450.77	105,98.37	7,450.51	6,115.00	7,500.00
No Answer		7												



TABLE : @ 018
 D1 : ARE YOU CONNECTED TO YCDC SEWER?
 BASE : ALL RESPONDENTS

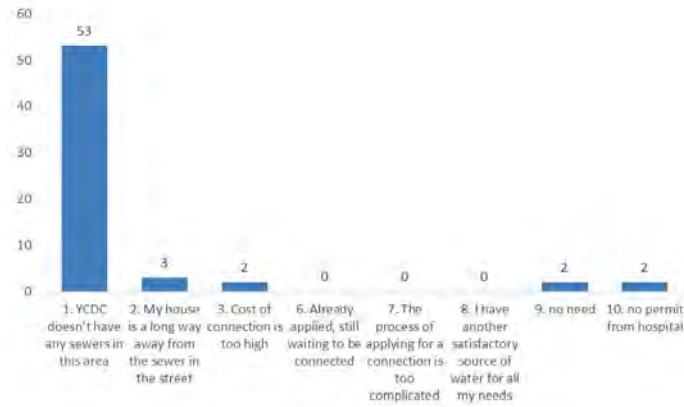
n = 500



		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
D1. Connected to YCDC Sewer	Total	500	180	320	15	76	125	284	60	74	190	141	32	3
	1. No	60	19	41	3	11	17	29	1	7	29	18	5	0
	2. Yes	440	161	279	12	65	108	255	59	67	161	123	27	3



TABLE : @ 019
D2 : WHAT ARE YOUR REASONS FOR NOT CONNECTING TO THE YCDC SEWER?
BASE : RESPONDENTS THOSE WHO DID NOT CONNECT TO YCDC SEWER



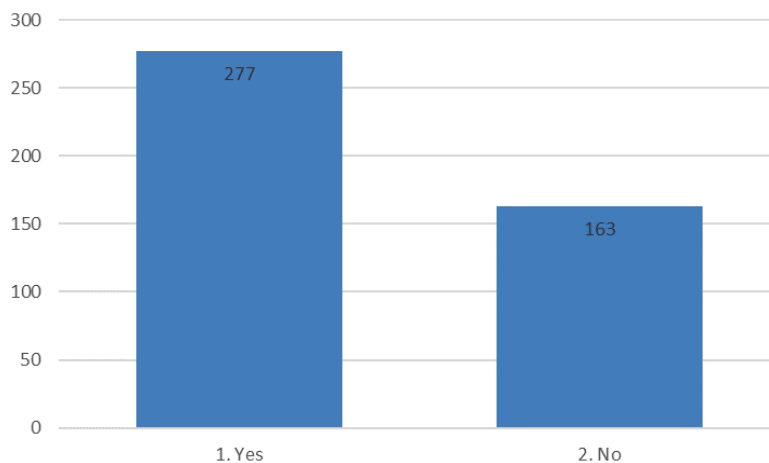
n = 60

D2. Reasons	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Total	60	19	41	3	11	17	29	1	7	29	18	5	0
1. YCDC doesn't have any sewers in this area	53	16	37	2	10	15	26	1	7	24	16	5	0
2. My house is a long way from the sewer in the street	3	1	2	0	2	1	0	0	0	3	0	0	0
3. Cost of connection is too high	2	1	1	1	0	0	1	0	0	2	0	0	0
6. Already applied, still waiting to be connected	0	0	0	0	0	0	0	0	0	0	0	0	0
7. The process of applying for a connection is too complicated	0	0	0	0	0	0	0	0	0	0	0	0	0
8. I have another satisfactory source of water for all my needs	0	0	0	0	0	0	0	0	0	0	0	0	0
9. no need	2	0	2	0	0	1	1	0	0	0	2	0	0
10. no permit from hospital	2	1	1	0	0	0	2	0	0	2	0	0	0



venture partners

TABLE : @ 020
E1 : ARE YOU SATISFIED WITH YCDC WASTEWATER SERVICE?
BASE : RESPONDENTS THOSE WHO CONNECT TO YCDC SEWER

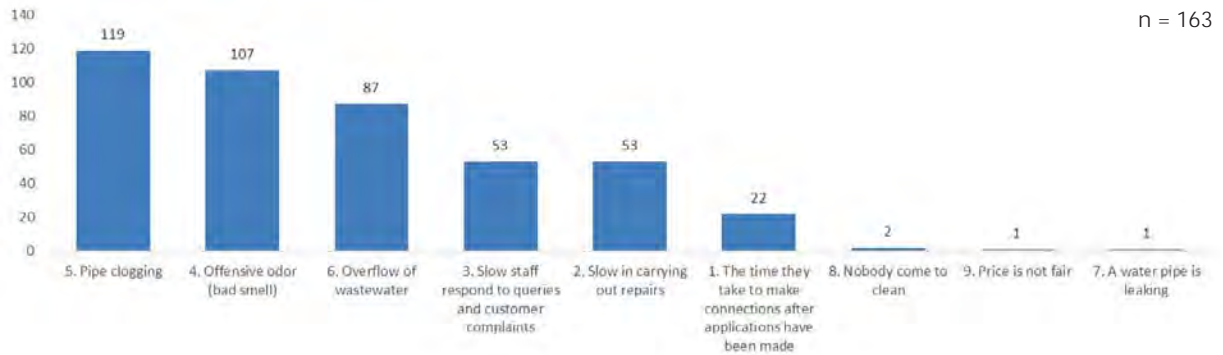


n = 440

E1. Satisfaction on YCDC Wastewater Service	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Total	440	161	279	12	65	108	255	59	67	161	123	27	3
1. Yes	277	95	182	11	50	71	145	37	39	108	70	20	3
2. No	163	66	97	1	15	37	110	22	28	53	53	7	0



TABLE : @ 021
 E1.1 : UNSATISFIED REASONS
 BASE : RESPONDENTS THOSE WHO DO NOT SATISFIED ON YCDC WASTEWATER SERVICE

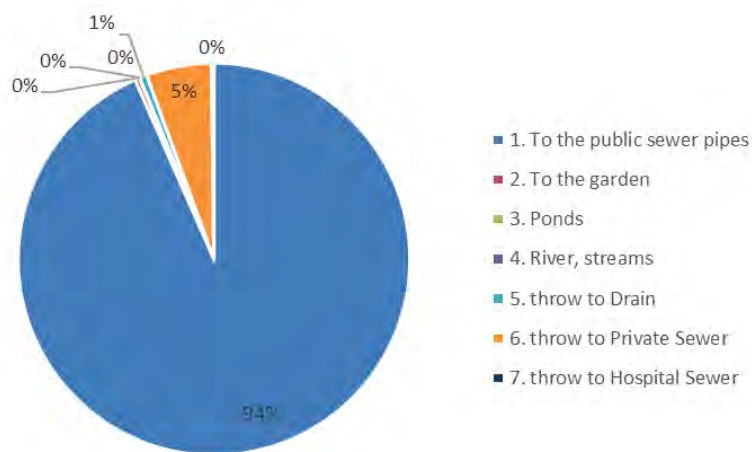


n = 163

	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Total	163	66	97	1	15	37	110	22	28	53	53	7	0
5. Pipe clogging	119	52	67	0	13	27	79	18	23	38	33	7	0
4. Offensive odor (bad smell)	107	37	70	0	11	27	69	18	18	34	32	5	0
6. Overflow of wastewater	87	37	50	0	11	15	61	14	16	26	28	3	0
3. Slow staff respond to queries and customer complaints	53	23	30	0	5	14	34	10	14	10	17	2	0
2. Slow in carrying out repairs	53	25	28	1	3	10	39	7	12	13	20	1	0
1. The time they take to make connections after applications have been made	22	14	8	0	3	3	16	4	8	5	4	1	0
8. Nobody come to clean	2	1	1	0	0	0	2	0	0	0	2	0	0
9. Price is not fair	1	0	1	0	0	1	0	0	0	0	1	0	0
7. A water pipe is leaking	1	1	0	0	0	0	1	0	0	1	0	0	0

26

TABLE : @ 022
 E2 : HOW DO YOU DISCHARGE WASTEWATER FROM YOUR HOUSE?
 BASE : ALL RESPONDENTS



n = 500

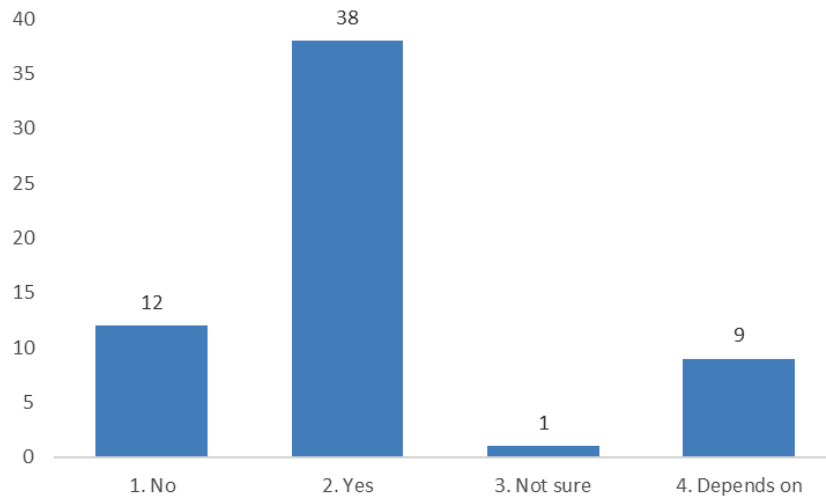
	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Total	500	180	320	15	76	125	284	60	74	190	141	32	3
1. To the public sewer pipes	467	171	296	14	71	118	264	59	71	175	130	29	3
2. To the garden	2	1	1	0	1	1	0	0	0	0	2	0	0
3. Ponds	0	0	0	0	0	0	0	0	0	0	0	0	0
4. River, streams	0	0	0	0	0	0	0	0	0	0	0	0	0
5. throw to Drain	3	1	2	0	0	1	2	0	0	1	2	0	0
6. throw to Private Sewer	27	6	21	1	4	5	17	1	3	13	7	3	0
7. throw to Hospital Sewer	1	1	0	0	0	0	1	0	0	1	0	0	0

27

TABLE : @ 023

G1 : IF THE YCDC PROVIDES GOOD QUALITY FOR WASTEWATER SERVICE, WILL YOU CONNECT?

BASE : RESPONDENTS THOSE WHO DID NOT CONNECT TO YCDC SEWER



	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
G1. Connect on wastewater service	60	19	41	3	11	17	29	1	7	29	18	5	0
1. No	12	2	10	1	2	2	7	0	1	2	6	3	0
2. Yes	38	13	25	2	8	10	18	1	4	19	12	2	0
3. Not sure	1	0	1	0	0	0	1	0	0	1	0	0	0
4. Depends on	9	4	5	0	1	5	3	0	2	7	0	0	0



TABLE : @ 024

G2 : HOW MUCH WOULD YOUR HOUSEHOLD BE WILLING AND ABLE TO PAY IN ORDER TO CONNECT?

BASE : RESPONDENTS THOSE WHO ANSWER YES/NOT SURE CONNECT ON WASTEWATER SERVICE

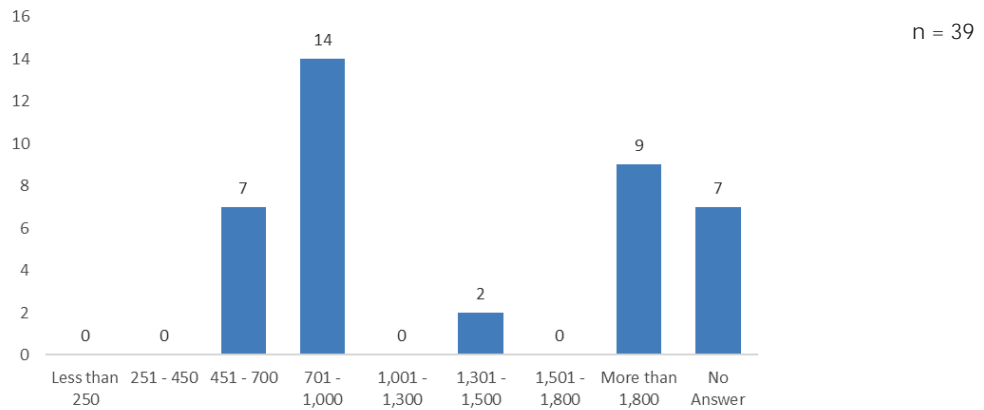
n = 39

	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
G2. Amount willing to pay in order to connect	39	13	26	2	8	10	19	1	4	20	12	2	0
Average	15,562.50	12,394.23	17,146.63	12,500.00	11,140.63	20,556.25	15,118.42	20,000.00	12,500.00	17,084.38	15,437.50	5,000.00	



TABLE : @ 025

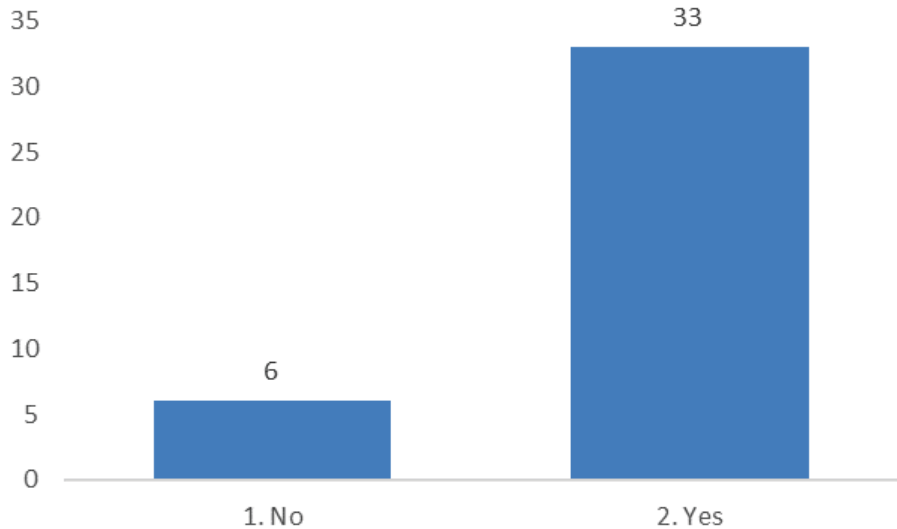
G3 : HOW MUCH IN MAXIMUM IS YOUR HOUSEHOLD WILLING TO PAY PER MONTH?
 BASE : RESPONDENTS THOSE WHO ANSWER YES/NOT SURE CONNECT ON WASTEWATER SERVICE



	Total	Gender		Age				SEC					No answer	
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E		
G3. Maximum amount willing to pay per month	39	13	26	2	8	10	19	1	4	20	12	2	0	
Less than 250	0	0	0	0	0	0	0	0	0	0	0	0	0	
251 - 450	0	0	0	0	0	0	0	0	0	0	0	0	0	
451 - 700	7	3	4	0	0	1	6	0	0	4	2	1	0	
701 - 1,000	14	5	9	0	3	3	8	1	2	7	3	1	0	
1,001 - 1,300	0	0	0	0	0	0	0	0	0	0	0	0	0	
1,301 - 1,500	2	1	1	2	0	0	0	0	0	2	0	0	0	
1,501 - 1,800	0	0	0	0	0	0	0	0	0	0	0	0	0	
More than 1,800	9	2	7	0	3	5	1	0	2	4	3	0	0	
No Answer	7	2	5	0	2	1	4	0	0	3	4	0	0	
G3. Maximum amount willing to pay per month	Count	39	13	26	2	8	10	19	1	4	20	12	2	0
	Average	1631.25	1466.35	1713.70	1450.00	2032.81	2213.13	1175.00	1000.00	1750.00	1579.69	1877.08	750.00	

30

n = 39



	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
G4. Pay for the construction fee	39	13	26	2	8	10	19	1	4	20	12	2	0
1. No	6	1	5	0	2	1	3	0	0	2	4	0	0
2. Yes	33	12	21	2	6	9	16	1	4	18	8	2	0

31



TABLE : @ 027

G5 : WHEN YOU CONSIDER CONNECTING TO YCDC SEWER, WHAT ARE THE MOST IMPORTANT ISSUES FOR YOU?

BASE : RESPONDENTS THOSE WHO WILLING TO PAY THE CONSTRUCTION FEE

n = 33

	Total	Gender		Age				SEC					No answer	
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E		
G5. Price	Total	33	12	21	2	6	9	16	1	4	18	8	2	0
	First rank	5	0	5	0	0	3	2	0	1	1	2	1	0
	Second rank	13	9	4	0	3	3	7	1	2	6	3	1	0
	Third rank	15	3	12	2	3	3	7	0	1	11	3	0	0
G5. Environmental condition	Total	33	12	21	2	6	9	16	1	4	18	8	2	0
	First rank	17	7	10	2	4	2	9	0	2	12	3	0	0
	Second rank	7	1	6	0	1	3	3	0	1	4	2	0	0
	Third rank	9	4	5	0	1	4	4	1	1	2	3	2	0
G5. Reliability of service	Total	33	12	21	2	6	9	16	1	4	18	8	2	0
	First rank	11	5	6	0	2	4	5	1	1	5	3	1	0
	Second rank	13	2	11	2	2	3	6	0	1	8	3	1	0
	Third rank	9	5	4	0	2	2	5	0	2	5	2	0	0

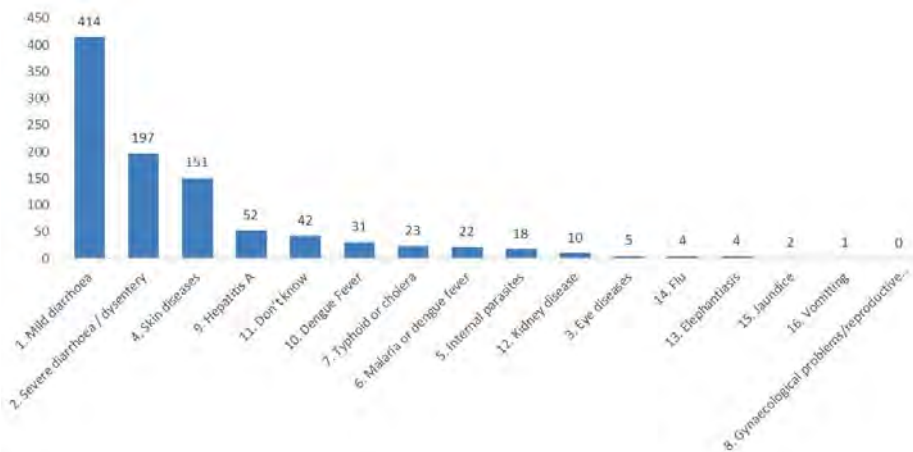


TABLE : @ 028

H1 : WHAT HEALTH PROBLEMS DO YOU BELIEVE CAN BE INFLUENCED BY THE WATER USED?

BASE : ALL RESPONDENTS

n = 500

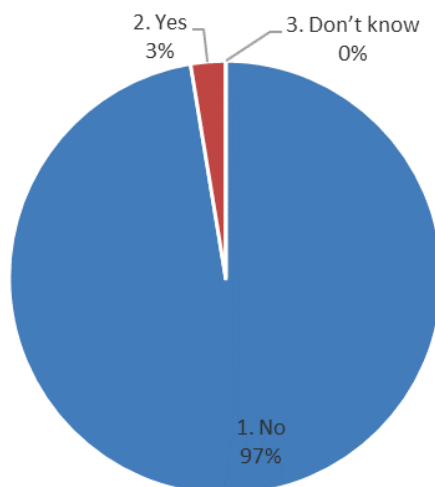


	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
Total	500	180	320	15	76	125	284	60	74	190	141	32	3
1. Mild diarrhoea	414	148	266	15	60	106	233	48	60	159	119	25	3
2. Severe diarrhoea / dysentery	197	79	118	10	28	50	109	21	27	77	55	15	2
4. Skin diseases	151	48	103	2	18	38	93	24	26	57	40	3	1
9. Hepatitis A	52	19	33	1	2	16	33	6	13	15	16	2	0
11. Don't know	42	18	24	0	7	8	27	5	6	17	10	4	0
10. Dengue Fever	31	14	17	2	3	6	20	4	5	11	9	2	0
7. Typhoid or cholera	23	8	15	2	4	4	13	4	3	8	6	2	0
6. Malaria or dengue fever	22	7	15	1	3	3	15	5	1	8	4	4	0
5. Internal parasites	18	6	12	0	2	3	13	2	3	7	5	1	0
12. Kidney disease	10	5	5	1	2	2	5	0	3	5	2	0	0
3. Eye diseases	5	3	2	0	0	2	3	2	2	0	1	0	0
14. Flu	4	3	1	1	0	2	1	1	0	2	1	0	0
13. Elephantiasis	4	1	3	0	2	1	1	1	0	1	0	2	0
15. Jaundice	2	0	2	0	0	1	1	0	0	0	1	1	0
16. Vomiting	1	0	1	0	0	0	1	0	0	1	0	0	0
8. Gynaecological problems/reproductive tract infection	0	0	0	0	0	0	0	0	0	0	0	0	0



TABLE : @ 029
H2 : DO YOU THINK BAD WATER QUALITY HAS CAUSED ANY ILLNESS IN YOUR FAMILY IN THE PAST TWELVE MONTHS?
BASE : ALL RESPONDENTS

n = 500



	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
H2. Have caused any illness	500	180	320	15	76	125	284	60	74	190	141	32	3
1. No	487	176	311	13	76	122	276	58	73	183	139	31	3
2. Yes	13	4	9	2	0	3	8	2	1	7	2	1	0
3. Don't know	0	0	0	0	0	0	0	0	0	0	0	0	0

34



TABLE : @ 030.1
H3 : NUMBER OF ADULT HAS AFFECTED BY ILLNESS IN THE LAST TWELVE MONTHS
BASE : RESPONDENTS THOSE WHO HAVE CAUSED ANY ILLNESS IN FAMILY IN THE PAST TWELVE MONTHS BECAUSE OF BAD WATER QUALITY

n = 13

		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
H3-1 Mild diarrhoea	Count	8	3	5	2	0	2	4	1	1	4	2	0	0
	Average	2.00	1.00	2.60	1.00		1.50	2.75	4.00	2.00	1.00	3.00		
H3-2. Severe diarrhoea	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-3. Eye diseases	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-4. Skin diseases	Count	3	1	2	0	0	0	3	1	0	2	0	0	0
	Average	1.00	1.00	1.00				1.00	1.00		1.00			
H3-5. Internal parasites	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-6. Malaria or dengue fever	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-7. Typhoid or cholera	Count	1	1	0	0	0	0	1	0	0	1	0	0	0
	Average	1.00	1.00					1.00			1.00			
H3-8. Gynaecological problems/reproductive tract infection	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-9. Hepatitis A	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-10. Dengue Fever	Count	1	0	1	0	0	0	1	0	0	0	0	1	0
	Average	1.00		1.00				1.00					1.00	

35



TABLE : @ 030.2

H3 : NUMBER OF CHILD HAS AFFECTED BY ILLNESS IN THE LAST TWELVE MONTHS
 BASE : RESPONDENTS THOSE WHO HAVE CAUSED ANY ILLNESS IN FAMILY IN THE PAST TWELVE MONTHS BECAUSE OF BAD WATER QUALITY

n = 13

		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
H3-1. Mild diarrhoea	Count	3	0	3	0	0	1	2	1	1	0	1	0	0
	Average	1.33		1.33			2.00	1.00	1.00	2.00		1.00		
H3-2. Severe diarrhoea	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-3. Eye diseases	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-4. Skin diseases	Count	1	0	1	0	0	1	0	0	0	1	0	0	0
	Average	1.00		1.00			1.00				1.00			
H3-5. Internal parasites	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-6. Malaria or dengue fever	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-7. Typhoid or cholera	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-8. Gynaecological problems/reproductive tract infection	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-9. Hepatitis A	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													
H3-10. Dengue Fever	Count	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average													

36



TABLE : @ 030.3

H3 : TOTAL NUMBER IN HOUSEHOLD WHO SOUGHT TREATMENT FROM A HEALTH CARE PROVIDER FOR THIS ILLNESS
 BASE : RESPONDENTS THOSE WHO HAVE CAUSED ANY ILLNESS IN FAMILY IN THE PAST TWELVE MONTHS BECAUSE OF BAD WATER QUALITY

n = 13

		Total	Gender		Age				SEC					No answer
			Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
H3-1. Mild diarrhoea	Total	8	3	5	2	0	2	4	1	1	4	2	0	0
	0	7	2	5	2	0	2	3	1	1	4	1	0	0
	100	1	1	0	0	0	0	1	0	0	0	1	0	0
H3-4. Skin diseases	Total	4	1	3	0	0	1	3	1	0	3	0	0	0
	0	4	1	3	0	0	1	3	1	0	3	0	0	0
	100	1	1	0	0	0	0	1	0	0	1	0	0	0
H3-7. Typhoid or cholera	Total	1	1	0	0	0	0	1	0	0	1	0	0	0
	0	1	1	0	0	0	0	1	0	0	1	0	0	0
	100	1	0	1	0	0	0	1	0	0	0	1	0	0
H3-10. Dengue Fever	Total	1	0	1	0	0	0	1	0	0	0	0	1	0
	0	1	0	1	0	0	0	1	0	0	0	0	1	0
	100	1	0	1	0	0	0	1	0	0	0	0	1	0

37



TABLE : @ 031

H4 : WHAT WAS THE TOTAL AMOUNT OF MONEY THE HOUSEHOLD PAID FOR MEDICAL CARE FOR ALL MEMBERS WITH THE ILLNESSES DURING THE LAST 12 MONTHS?
 BASE : RESPONDENTS THOSE WHO HAVE CAUSED ANY ILLNESS IN FAMILY IN THE PAST TWELVE

n = 13

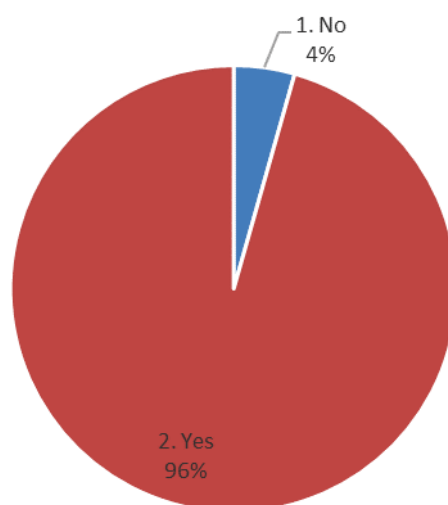
	Total	Gender		Age				SEC					No answer	
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E		
H4. Amount of money pay for medical care	Count	13	4	9	2	0	3	8	2	1	7	2	1	0
	Average	26,422.22	11,055.56	33,251.85	12,500.00		22,140.74	31,508.33	25,900.00	5,000.00	31,263.49	20,711.11	26,422.22	



TABLE : @ 032

H5 : DOES THIS HOUSEHOLD HAVE ITS OWN TOILET?
 BASE : ALL RESPONDENTS

n = 500

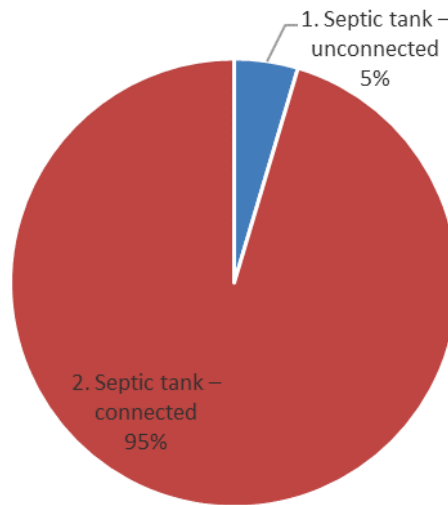


	Total	Gender		Age				SEC					No answer	
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E		
H5. Have own toilet	Total	500	180	320	15	76	125	284	60	74	190	141	32	3
	1. No	22	5	17	1	4	6	11	0	3	10	8	1	0
	2. Yes	478	175	303	14	72	119	273	60	71	180	133	31	3



TABLE : @ 033
H6 : WHICH OF THE FOLLOWING BEST DESCRIBES THE TOILET?
BASE : RESPONDENTS THOSE WHO HAVE OWN TOILET

n = 478

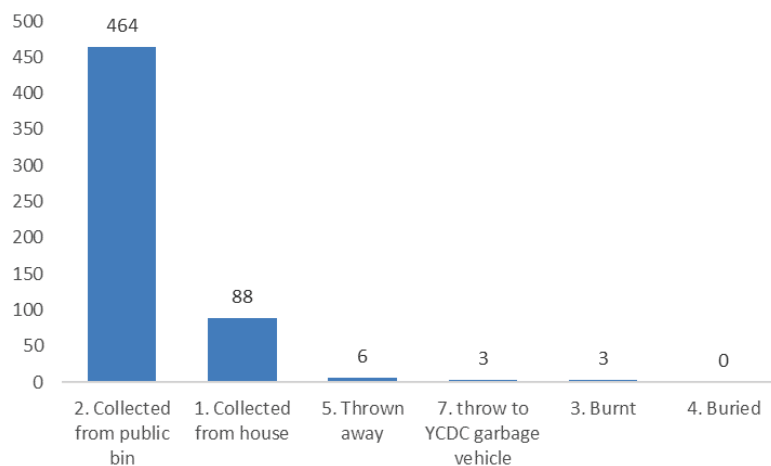


	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
H6. Unconnect or connect septic tank	478	175	303	14	72	119	273	60	71	180	133	31	3
1. Septic tank – unconnected	22	5	17	1	2	6	13	1	2	9	7	3	0
2. Septic tank – connected	456	170	286	13	70	113	260	59	69	171	126	28	3



TABLE : @ 034
H8 : HOW DO YOU DISPOSE OF YOUR HOUSEHOLD GARBAGE?
BASE : ALL RESPONDENTS

n = 500

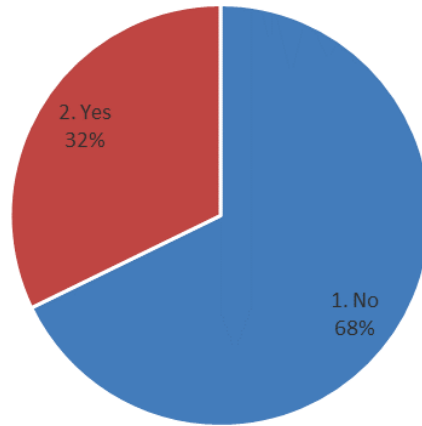


	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
H8. Dispose of household garbage	500	180	320	15	76	125	284	60	74	190	141	32	3
2. Collected from public bin	464	167	297	13	69	120	262	55	69	177	129	31	3
1. Collected from house	88	34	54	4	14	18	52	12	13	33	27	3	0
5. Thrown away	6	1	5	0	0	2	4	0	1	2	2	0	1
7. throw to YCDC garbage vehicle	3	3	0	0	0	0	3	0	1	2	0	0	0
3. Burnt	3	0	3	0	0	2	1	0	0	0	2	1	0
4. Buried	0	0	0	0	0	0	0	0	0	0	0	0	0



TABLE : @ 035
 I1 : HAVE YOU EXPERIENCED ANY WATER-RELATED HAZARDS IN THE PAST 5 YEARS (FLOOD, ETC)?
 BASE : ALL RESPONDENTS

n = 500



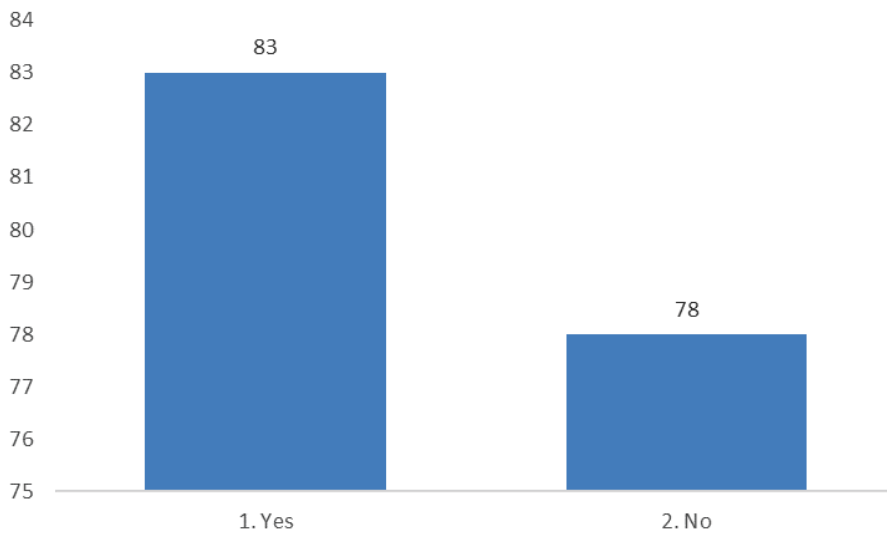
	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
I1. Water-related hazards	500	180	320	15	76	125	284	60	74	190	141	32	3
1. No	339	125	214	9	55	89	186	41	52	128	95	22	1
2. Yes	161	55	106	6	21	36	98	19	22	62	46	10	2

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TABLE : @ 036
 I2.2 : WHAT WAS AFFECTED TO YOUR LIVING CONDITION?
 BASE : RESPONDENTS THOSE WHO HAVE EXPERIENCED ANY WATER-RELATED HAZARDS IN THE PAST 5 YEARS

n = 161



	Total	Gender		Age				SEC					No answer
		Male	Female	18-24 yrs	25-34 yrs	35-44 yrs	45-60 yrs	SEC A	SEC B	SEC C	SEC D	SEC E	
I22. Affected to living condition	161	55	106	6	21	36	98	19	22	62	46	10	2
1. Yes	83	27	56	3	8	23	49	5	10	33	27	6	2
2. No	78	28	50	3	13	13	49	14	12	29	19	4	0

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