Project for the Improvement of
Water Supply, Sewerage and Drainage System
in Yangon City

Final Report

Volume IV
Water Supply System Feasibility Study

Appendix

Appendix

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A RESULT OF WATER QUALITY ANALYSIS

A.1 Sampling Point

No. 1 Small river near Lagunbyin WTP site

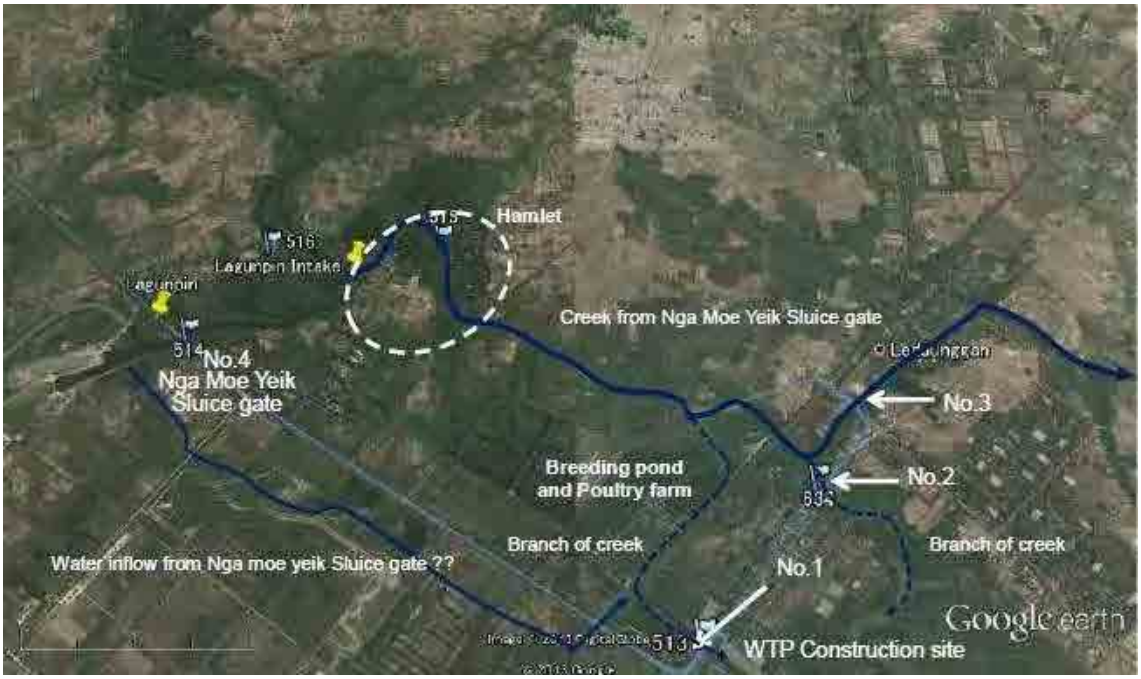
No. 2 Small river near Ledaunggan (1): Tributary river of creek from Ngamoeyeik sluicegate

No. 3 Small river near Ledaunggan (2): Trunk stream of creek from Ngamoeyeik sluicegate

No. 4 Ngamoeyeik sluice gate

Sampling point is shown in figure below.

- Current direction of trunk stream of creek from Ngamoeyeik sluicegate (planned water transmission route to Lagunbyin WTP) passes through point No. 3.
- At point No. 1, dominant water flow is agricultural water from Ngamoeyeik sluice gate.



A.2 Test results

Test Part 1

Sampling: June 25, 2013

Weather of sampling day: Fine

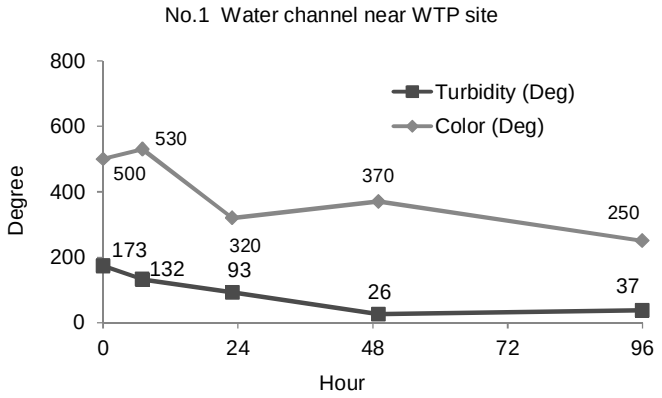
Sampling point

No. 1 Small river near Lagunbyin WTP site

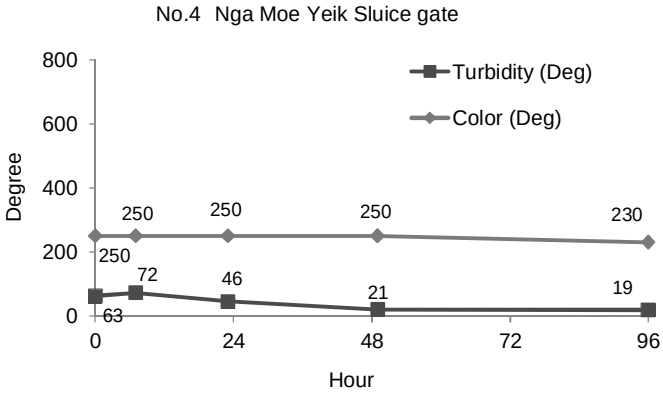
No. 4 Ngamoeyeik sluice gate

Water quality data

Sampling point	pH	EC (μS/cm)	TDS (mg/L)
No. 1	6.57	100	40
No. 4	6.69	140	60



Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)



Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)

- Settling of turbidity was stabilized within 48 hours.
- Color of No. 4 sample was not changed. Possible reason is that color is originated from micro particle or humus.

Test Part 2

Sampling: June 28, 2013

Weather of sampling day: Fine

Remarks: Analysis of BOD and SS were implemented (analysis is in practice)

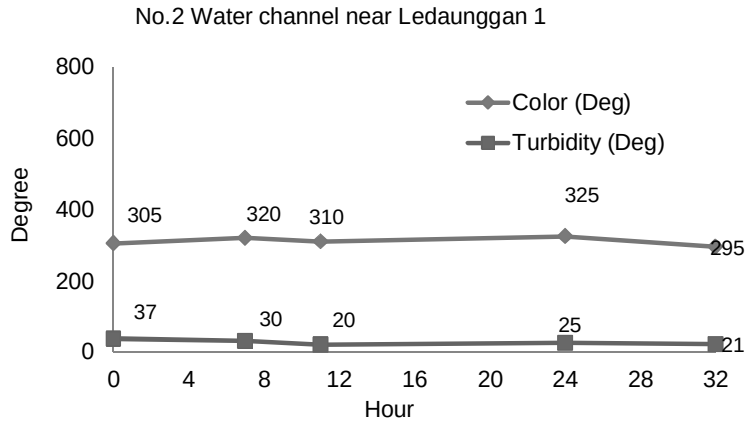
Sampling point

No. 2 Small river near Ledaunggan (1)

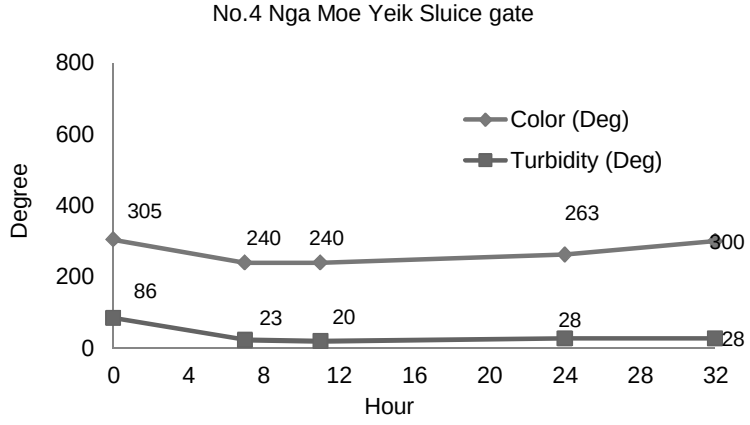
No. 4 Ngamoeyeik sluice gate

Water quality data

Sampling point	pH	EC (μS/cm)	TDS (mg/L)
No. 2	6.44	120	60
No. 4	6.43	30	20



Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)



Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)

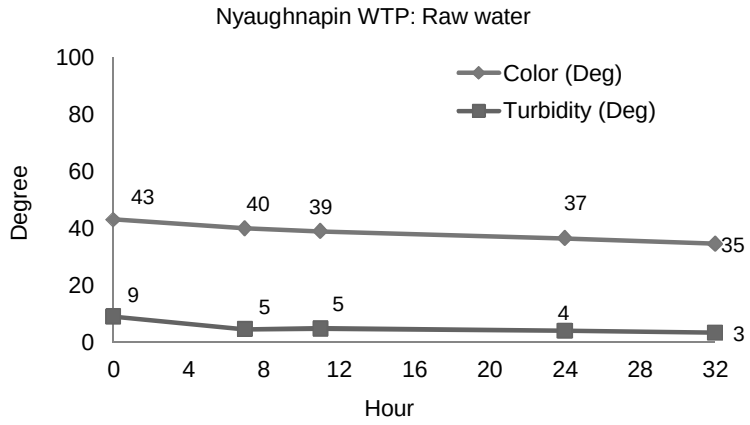
- Settling of turbidity was stabilized within 12 hours.
- Color was not changed (both No. 1 and No. 4)

Reference 1: Settling of turbidity of raw water of Nyaunghnapin WTP

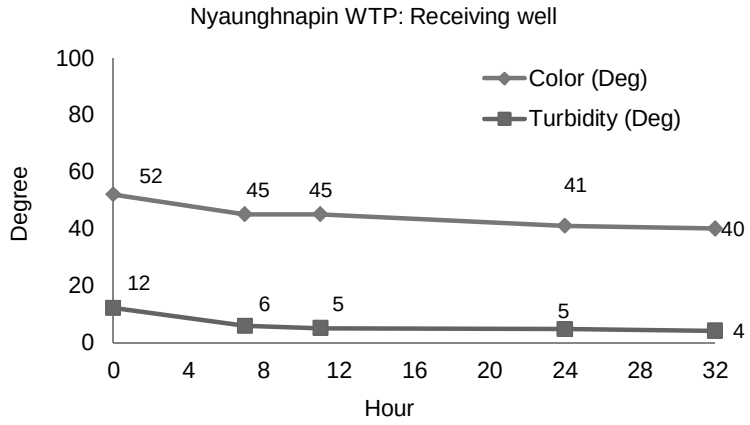
Sampling: June 28, 2013 (same day of Test Part 2)

Water quality data

Sampling point	pH	EC (μS/cm)	TDS (mg/L)
Intake of settling pond (Raw water)	7.23	70	30
Receiving well	7.27	60	30



Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)



Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)

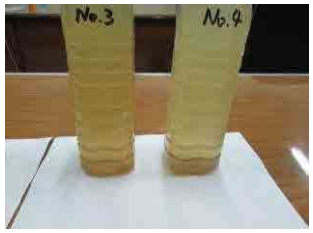
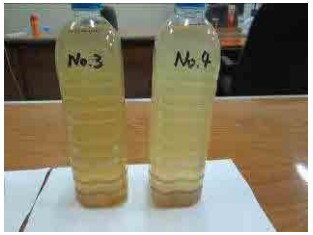
- Initial turbidity and initial color of receiving well was higher than raw water. The reason of this difference is caused by the blow up of deposit of sedimentation pond. However, this result means that maintenance / cleaning of sedimentation pond is insufficient.
- SS of raw water and receiving well is nearly same. This result means that the function of settling pond is decreased.
- Water quality (TDS, turbidity and color) of Nyaunghnapin WTP raw water is better than that of Lagunbyin WTP.

Reference 2: Photo of turbidity settling test

Lagunbyin WTP

Left: Sample No. 2: Small river near Ledaunggan (1)

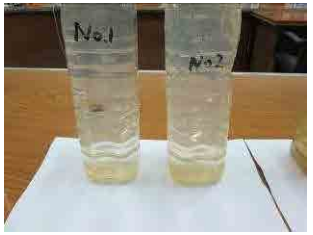
Right: Sample No. 4: Ngamoeyeik sluice gate

				
Start (0 hr)	7hr	11hr	24hr	32hr

Nyaunghnapin WTP

Left: Intake of settling pond (Raw water)

Right: Receiving well

				
Start (0 hr)	7hr	11hr	24hr	32hr

Test Part 3

Sampling: July 3rd, 2013

Weather of sampling day: Rain

Sampling point

No. 1 Small river near Lagunbyin WTP site

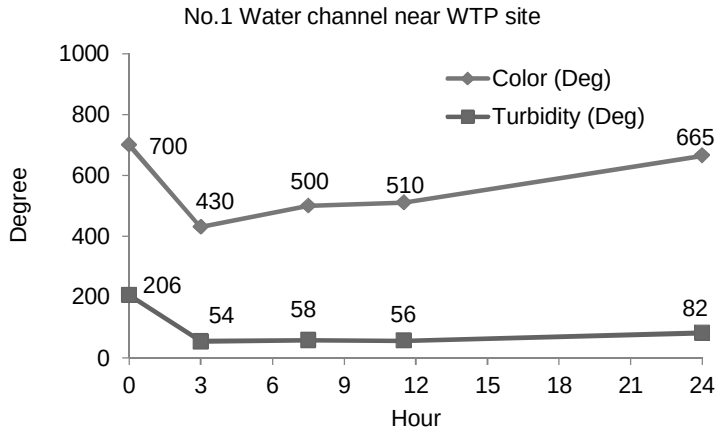
No. 2 Small river near Ledaunggan (1)

No. 3 Small river near Ledaunggan (2)

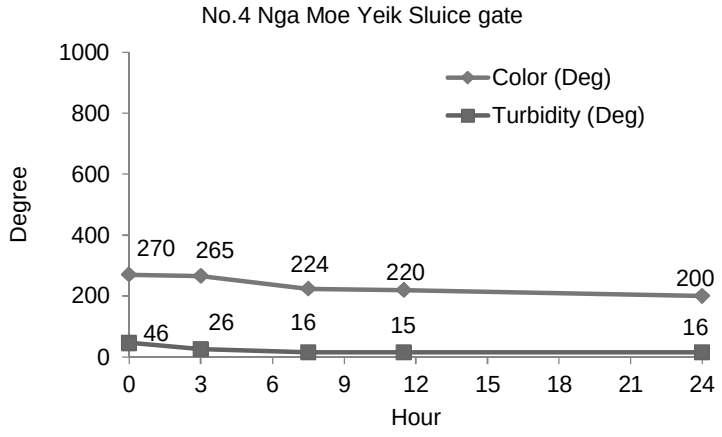
No. 4 Nga Moe Yeik sluice gate

Water quality data

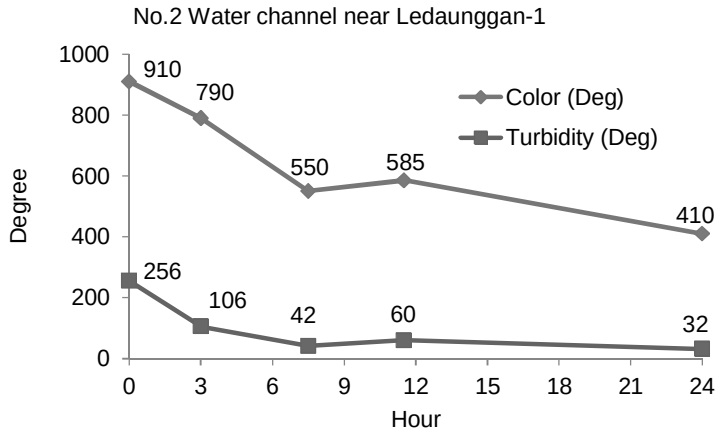
Sampling point	pH	EC (μS/cm)	TDS (mg/L)
No. 1	6.72	110	50
No. 2	6.49	160	80
No. 3	6.43	80	40
No. 4	6.52	50	20



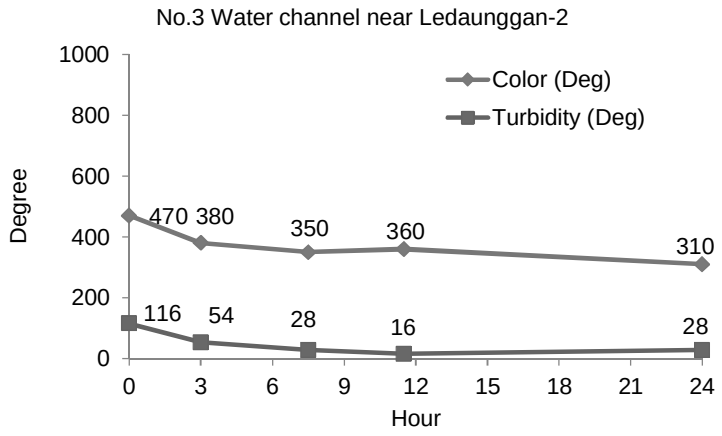
Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)



Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)



Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)



Note: 1 NTU (approx.) = 0.6 × Turbidity (Degree)

- Sampling was done in rainy weather. Therefore, increase of turbidity and color was expected. However, water quality of No. 4 (Nga Moe Yeik sluice gate) was not degraded compared to sample collected on fine / cloudy day.
- On the contrary, turbidity and color of No. 2 increased compared to sample collected on fine/ cloudy day. This increase of turbidity and color is caused by the outflow of pollutant (turbidity or color composition) from hamlet or rice field due to rainfall.
- In rainy condition (i.e. high turbidity and color), turbidity of No. 4 (Nga Moe Yeik sluice gate) decreased and stabilized within 12 hours.

Reference 4: Photo of turbidity settling test

From Left side: No. 1, No. 2, No. 3 and No. 4

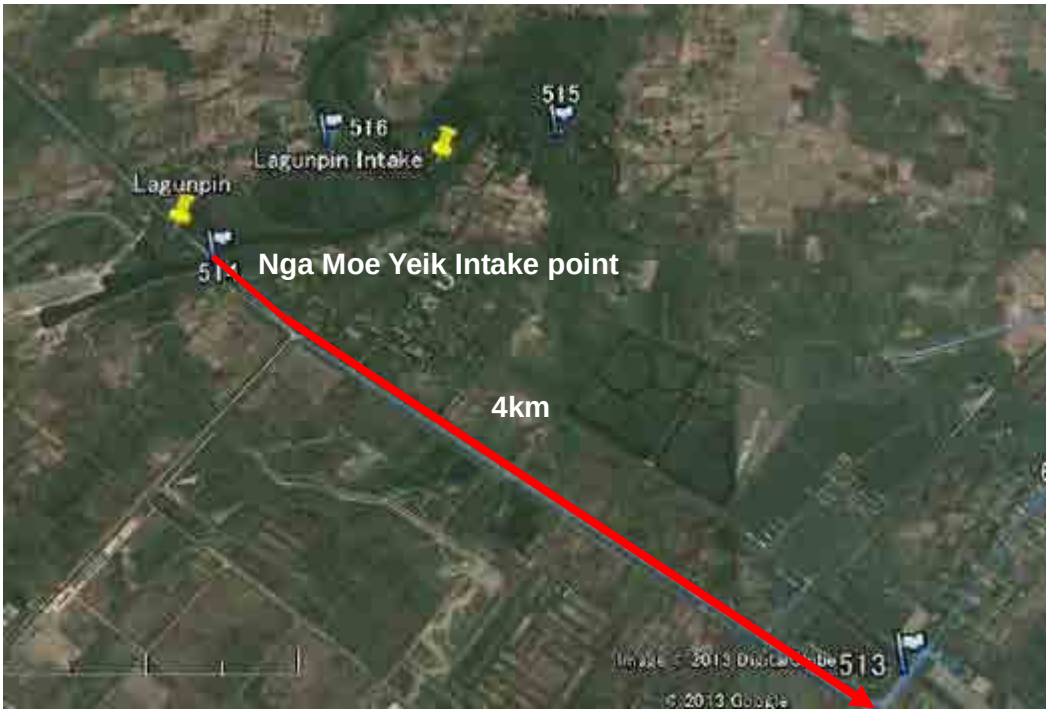
		
Start (0 hr)	7hr	11hr

	
24hr	32hr

A.3 Conclusion

- Except in case of Part 1 test, settling of turbidity was completed within 24 hours (about 12 hours).
- On the contrary, color decreases more slowly than turbidity.
- Turbidity and color of No. 1, No. 2 and No. 3 sample was higher than those of sample No. 4. The reason of this difference is the influence of effluent of hamlet and rice fields in the watershed.
- In addition, water quality data of No. 2 shows that increase of turbidity and color in rainy condition is higher than those of sample No. 4.
- In spite of rainy condition, water quality of No. 4 is stable than other sampling point.
- For raw water, water quality of No. 4 (Nga Moe Yeik sluice gate) is better than other 3 sampling point (No. 1, No. 2 and No. 3).

Considering these results, utilization of existing creek (No.1, No.2 and No.3) is not suitable for raw water transmission because of the degradation of water quality (increase of turbidity and color).
From the view of raw water quality, installation of raw water transmission channel from No.4 (Nga Moe Yeik sluice gate) to Lagunbyin WTP is recommendable option (See below figure).



Distance between Nga Moe Yeik intake point and WTP construction site is about 4km. Because dwelling house is not existence on this route, consideration of relocation is not necessary.

B CAPACITY CALCULATION OF LAGUNBYIN WTP

Lagunpyin Water Treatment Plant **40MGD=181,800m3/d**

Design Basis

1 Design Condition

1.1 Influent water flow rate

5% Loss	QTin=	210,000	m3/d=	8,750	m3/hr
	=	145.83	m3/min=	2.431	m3/sec

1.2 Effluent water flow rate

	QTout=	181,800	m3/d=	7,575	m3/hr
	=	126.25	m3/min=	2.104	m3/sec

1.3 Water quality

Turbidity (Raw W.)	20-200	NTU	Turbidity Data from Ngamoeyeik Creek, Nyaungnapin WTP
Ave.	200	NTU	
Turbidity (Treated W.)	<5	NTU	

2 Specification

2.1 Pre-Sedimentation Pond

Quantity	1	basin					
Type	Gravity flow						
Dimension	Width	40.5	m x Length	879	m x Height	3m	m
Total Volume	118,719	m3					
Retention time	0.6	days (=	13.6	hours)			
Accessories	Baffle walls, Small excavatorm, Sand pumps						

2.2 Intake well

Quantity	2	basin					
Dimension	Width	2	m x Length	7	m x Height	4m	m
Dimension	Width	4	m x Length	6	m x Height	4m	m
Total Volume	304	m3					
Retention time	2.1	min					
Accessories	Gravity flow						

2.3 Intake pump station

1) Intake pump	46.4m3/min x H29.0m x 350kw		
Q'ty	4	sets	(duty 3sets, stand by 1set)
Type	Horizonal Doble Suction Volute		
Accessories			
2) Electrical panel	1	lot	

2.4 Dividing well

Quantity	1	basin					
Type	Rectangular						
Dimension	Dia.	9	m x Height	4	m		
Total Volume	254	m3					
Retention time	1.9	min					
Accessories	Gravity flow						

2.5 Receiving well

Quantity	8	basins					
Dimension	Width	3	m x Length	5	m x Height	5.0m	(Ave.)
Total Volume	600	m3					
Retention time	4.1	min					

2.6 Mixing Tank

Quantity	8	basins					
Type	Horizontal baffle channel						
Dimension	Width	3	m x Length	6.8	m x Height	4.25m	
Total Volume	694	m3					
Retention time	4.7	min					

2.7 Flocculation basin

Quantity	8	basins						
Type	Up-down flow baffle Wall type							
Dimension	Width	1.5	m x Length	63.3	m x Height	5m	m (Ave.)	
Total Volume	3,798	m3						
Retention time	26	min						

2.8 Sedimentation basin

Quantity	8	basins						
Type	Horizontal flow + Tube settler							
Total Dimension	Width	12.5	m x Length	38.6	m x Height	4.2m	(Effective)	
(Tube settler:	Width	15	m x Length	22.5	m x Height	4.2m		
Total Volume	16,212	m3						
Retention time	2.4	hr						
Flow speed	0.3	m/min						
Upward flow speed	65	mm/min						
Surface loading	15.2	mm/min						
Accessories								

2.9 Rpid sand filter

Quantity	4	basins					
Type	Gravity flow rapid sand filter						
Dimension	Width	5.5	m x Length	12.0	m x Height	5m	
Filter layer	Multi-media filter layer		Anthracite	Dep.	0.2	m	
			Silica sand	Dep.	0.5	m	
			Gravel	Dep.	0.2	m	
Filtration rate	150	m/d					
Washing method	Backwashing:	0.7m/min	Self-washing by filtered water				
	Air washing:	0.8m/min	Pressurized filter				
Accessories	Underdrain Equipment						
	Washing Equipment						
	Air-compressor						
	Control Unit						

2.10 Alum Dosing Facility

Liquid PAC		Packing Style	---	kg/bag	
Dissolving Concentration	C=	15	%		
Feed Rate	Ave.	40	ppm as Solid Alum		
Consumption	Ave.	7,272	kg/day as Solid Alum		
		48.5	m3/day as Liquid PAC		
Feed Rate	Max.	100	ppm as Solid Alum		
Consumption	Max.	18,180	kg/day as Solid Alum		
		121.2	m3/day as Liquid PAC		

1) Dissolving/Storage Tank

Quantity	5	tanks					
Type	Rectangular tank		FRP				
Dimension/basin	Diameter	3.6	m x Height	3.8	m(Effect.	2.5m)	
Volume/total	127	m3					
Retention time as average	2.6	days as average/Tanks					
Accessories	Feeding device, Mixer						

2) Alum feed pump

Quantity	3	sets	(2 duty, 1 stand-by)	
Type	Diaphragm pump			
Capacity	Ave.	33.7	L/min x 20m	
			1 Unit Operation 16-50L/min as 20-60ppm	
	Max	84.2	L/min x 20m	
			2 Unit Operation 32-100L/min as 40-100ppm	

2.11 Disinfection Dosing Facility								
Liquid Sodium hypochlorite			Packing Style		---	kg/bag		
Dissolving Concentration	C=		10	% as Sodium hypochlorite				
Feed Rate of Pre&Interm.	Ave.		1	ppm as CL2				
Feed Rate of Post.	Ave.		3	ppm as CL2				
Consumption	Ave.		727	kg/day as CL2				
Consumption	Ave.		7.3	m3/day as Liquid CL2				
1) Dissolving/Storage Tank								
Quantity		3	tanks					
Type	Rectangular tank			FRP				
Dimension/basin	Diameter		3.6	m x Height	3.8	m(Effect.	2.5m)	
Volume/total		76	m3					
Retention time as average		10.5	days as average/Tanks					
Accessories	Feeding device, Mixer							
2) Hypochlorite feed pump	Pre&Intermediate chlorination							
Quantity		8	sets	(2 duty, 1 stand-by)				
Type	Diaphragm pump							
Capacity	Ave.		1.3	L/min x 20m				
				2 Unit Operation 0.6-1.8L/min as 0.5-3ppm				
3) Hypochlorite feed pump	Post-chlorination							
Quantity		2	sets	(2 duty, 1 stand-by)				
Type	Diaphragm pump							
Capacity	Ave.		3.8	L/min x 20m				
				2 Unit Operation 1.9-5.7L/min as 1.5-9ppm				
2.12 Clear Water Reservoir								
Quantity		2	basins					
Dimension	Width		18.8	m x Length	56.4	m x Height	4m (Effective)	
Total Volume		8,000	m3					
Retention time		1.1	hr					
2.13 Trasmission pump station								
1) Trasmission pump	42.2m3/min x H35.0m x 570kw							
Q'ty		4	sets	(duty 3sets, stand by 1set)				
Type	Horizonal Doble Suction Volute							
Accessories								
2) Electrical panel		1	lot					
2.14 Electrical Facility		1	lot					
Transformer								
Incoming Panel								
Water Treatment Panel								
Local Control Panel								
Instrument								
3 Wastewater treatment facility								
3.1 Water quality								
Ave. Turbidity (Intake W.)		200	NTU					
Planned Turbidity		100	NTU	Average turbidity in rainy season is applied.				
3.2 Alum Dosing Facility								
Liquid PAC		40	Packing Style		---	kg/bag		
Dissolving Concentration	C=		15	%				
Feed Rate	Ave.		40	ppm as Solid Alum				
Dry Sludge Amount			20,258	Dry-kg/day				

3.3 Sludge concentration						
Wash water drainage basin	0.5	C: %	5 kg/m3			
Sedimentation Basin	2.0	C: %	20 kg/m3			
Sludge basin	2.0	C: %	20 kg/m3			
Sludge thickener (in)	3.0	C: %	30 kg/m3			
Lagoon (in)	5.0	C: %	50 kg/m3			
3.4 Wash water drainage basin						
Quantity	2	basins				
Dimension	Width		16 m x Length	16 m x Height	3m	(Effective)
Total Volume	1,449	m3				
Wash water Amount	3,780	m3/day				
Retention time	0.2	day (2duty)				
Accessories	Wastewater Trans. Pump (2duty,1Stand-by) 10hours operation					
	Slurry Pump; Capa. 6.6m3/min x 10m x 22KW					
3.5 Sludge basin						
Quantity	4	basins				
Dimension	Width		9.5 m x Length	9.5 m x Height	3m	(Effective)
Total Volume	1,013	m3				
Drainage Amount	271	m3/day	> 3465m3; 1-basin of Sedimentation			
Retention time	1.1	day (4duty)				
Accessories	Wastewater Trans. Pump (2duty,1Stand-by) 10hours operation					
	Slurry Pump; Capa. 1.13m3/min x 20m x 5.5KW					
3.6 Sludge thickener						
Quantity	4	basins				
Dimension	Dia.		12 m x Height	3 m (Effective)		
Total Volume	1,350	m3				
Sludge Amount	675	m3/day				
Retention time	2	day (4duty)				
Accessories	Wastewater Trans. Pump (2duty,1Stand-by) 8hours operation					
	Slurry Pump; Capa. 1.4m3/min x 20m x 11KW					

C CAPACITY ASSESSMENT SHEET

Category		Question	Answer
Large	Small		
Facility Investment [FI] - Expansion (1st: Q3-Q5/ UBC)	Individual house connections	Q21: Does your utility provide direct subsidies to reduce water charges for individual house connections in poor urban areas (excluding cross-subsidies through tariffs)? [1. Yes, 2. No]	2
		Q22-1: Does your utility conduct any poverty mapping or/and poverty assessment, to target areas or households for subsidies? [1. Yes, 2. No]	2
		Q22-2: If 1.Yes, please describe the outline of the poverty mapping or/and household poverty assessment.	
		Q23: Does your utility provide direct subsidies to reduce connection fees for individual house connections and/or installation costs (material and construction, etc.) for poor urban areas (excluding cross-subsidies through tariffs)? [1. Yes, 2. No]	2
		Q24: Does your utility provide any easy-payment system (e.g. spreading payments over multiple periods) for the initial connection fee and/or on-going fees for individual house connections in poor urban areas (excluding cross-subsidies through tariffs)? [1. Yes, 2. No]	2
Capacity Development [CD] -Technical aspects (1st: Q10-Q18/ UBC)	Water meters (1st: Q15-Q16/ UBC)	Q37: Does your utility have its own facility/equipment for testing the accuracy of customer and bulk water meters? [1. No, we do not test water meters, 2. No, but we outsource meter testing, 3. Yes, but not enough, 4. Yes, we have enough]	1
		Q38: How often does your utility exchange customer meters? [1. Only change obviously broken meters, 2. Change meters which are obviously broken or have suspected failure based on monitoring of household water consumption, 3. Exchange them less than every 10 years, 4. Exchange them every 5-10 years but not in the all served areas, 5. Exchange them every 5-10 years in all served areas]	1
		Q39: What is the approximate average error in customer water meters used by your utility? [1. Don't know, 2. More than 10%, 3. Between 6% to 10%, 4. Between 3% to 5%, 5. Less than 3%]	1
		Q40: In which country are the customer meters used by your utility manufactured?	Thailand, China
	Information technology	Q59: How well is office equipment such as computers, printers, photo copiers, etc. maintained? [1. Very inadequately, 2. Inadequately, 3. Could be improved, 4. Well, 5. Very well]	2
		Q60: Are there enough IT specialists or computer-skilled staff at the utility, for example to set local area networks (LAN) with proper security systems? [1. Not nearly enough, 2. Some but not enough, 3. Enough]	1
Capacity Development [CD] -	Financial stability(1st: Q19/ UBC)	Q63: Does your water utility have financial objectives to guide its tariff setting, such as full cost recovery of O&M costs? [Yes or No]	No

Category		Question		Answer	
Large	Small				
Non-technical aspects(1st: Q19-Q24/ UBC)		Q64: How much improvement does your utility need to become financially sustainable (i.e. procurement of funds for facility development and O&M; balancing revenue and expenditure; achieving operational efficiency)? [1. Huge improvement required, 2. Much improvement required, 3. Some improvement required, 4. A little improvement required, 5. Already sustainable]		Public accounting system, financially not independent	
	Procurement of funds	Q65: Have the following sources of finance been used by your utility for capital investment in the last 10 years? [Yes or No]	1) Grants from international agencies (multi or bilateral)	No	
			2) Government transfers to the utility including subsidies (from central or local government)	Yes	
			3) Borrowing from international financial agencies (multi or bilateral)	No	
			4) Government owned banks	No	
			5) Commercial banks or bond holders	No	
		Q67: Does your utility have any local initiatives to attract funding from the private sector, such as from pipe suppliers or international water utility management companies? [Yes or No]		No	
	Accounting (1st: Q19/ UBC)	Q68-1: Is the accounting of your utility part of the general accounting of central or local government? [1. Yes, 2. Yes, but it is also done as independent accounting for analysis, etc., 3. No, the accounting is independent, 4. Other]		1	
			Q68-2: If 4. Other, please describe.		
		Q69-1: Is the accounting system of your utility consistent with internationally accepted double-entry bookkeeping, or is it single-entry bookkeeping? [1. International double-entry bookkeeping, 2. Single-entry bookkeeping, 3. Other]		2	
			Q69-2: If Other, please describe.		
		Q71: Does your utility include the depreciation of all the water supply facilities in its profit-and-loss (P/L) statement? [1. No although those fixed assets belong to the utility, 2. No, because those fixed assets do not belong to the utility, 3. Yes, but the depreciation is partial or underestimated, 4. Yes, the depreciation is fully estimated]		1	
		Q73-1: Approximately how many staff can explain the three most important financial statements (balance sheet, profit and loss statement, and cash flow statement) of your utility are prepared according to appropriate accounting principles? Q73-2: Is this enough capacity to ensure appropriate financial management? [1. Not nearly enough, 2. Not quite enough, 3. Enough]		Some, head of financial division etc.	2
	Tariffs	Q74: Does the unit cost of water increase as the consumption increases, in your utility's tariffs for cross-subsidies? [Yes or No]		No	
		Q75-1: Approximately how many staff can explain the basis/reasoning behind water tariffs and processes for revising them? Q75-2: Is this enough capacity to ensure that customers understand the basis/reasoning behind water tariffs? [1. Not nearly enough, 2. Not quite enough, 3. Enough]		Some	1

Category		Question	Answer	
Large	Small			
	Budgeting	Q76: Is the budgeting process of your utility top-down or bottom-up? [1. Top-down, 2. Neither top-down nor bottom-up, 3.Bottom-up]	2	
		Q77-1: Approximately how many staff can explain the basis/reasoning behind the costs of any outsourced O&M services (e.g. installation of service connections, water quality testing, billing)? Q77-2: Is this enough capacity to avoid over-paying for outsourced O&M services? [1. Not nearly enough, 2. Not quite enough, 3. Enough]	Some	2
		Q78-1: Approximately how many staff can explain the basis/reasoning behind the costs for any consulting services (e.g. facility planning, design, construction supervision) ? Q78-2: Is this enough capacity to avoid over-paying for consulting services? [1. Not nearly enough, 2. Not quite enough, 3. Enough]	Some	2
	Meter reading, billing and collection (1st: Q20/ UBC)	Q80: Are the bill collection and accounting departments or sections separated in your utility, to allow cross-checking and make their responsibilities clear? [1. Yes, they are separated and have a cross-checking function, 2. Yes, they are separated but do not cross-check, 3. No, they are not separated]	2	
		Q81: How well is corruption by meter readers controlled in your utility (for example by separating meter-reading staff from bill collection staff; encouraging customers to report corrupt meter readers, etc.) [1. Not controlled, 2. Not very well controlled, 3. Some improvement required, 4. Well controlled, 5. Very well controlled]	2	
	Control over necessary expenses	Q84: How well distributed is the authority to approve procurement of equipment, construction materials, consumables such as ink cartridges for printers, allowances, etc (i.e. different procurement price caps for different positions)? [1. Not well distributed, 2. Distributed to some extent, 3. Fairly well distributed, 4. Very well distributed]	2	
		Q85: Is enough transportation (car, motorbike, etc.) provided to meter readers, bill collectors, technical staff working in the field, etc.? [1. Not nearly enough, 2. Not quite enough, 3. Enough]	2	
	Organizational function and performance (1st: Q21/ UBC)	Q86: Is your utility's organization structure/chart clearly defined and updated, with each department and section shown? [1. It is not clearly defined or is significantly outdated, 2. It is clearly defined and updated but there are some departments or sections currently not in operation, 3. It is clearly defined and update and all departments shown are currently in operation]	2	
		Q87: How well are group's performance based incentives working in your utility, at organization, department, section, and team/unit level? (e.g. pay raises and bonuses based on group's performance)? [1. Do not exist, 2. Exist but are not working, 3. Working to some extent, 4. Working fairly well, 5. Working very well]	1	
		Q88: Can the salary level of your utility's staff be raised if the cost recovery of your utility improves? [Yes or No]	No	
		Q89: Does your utility understand its current situation/performance based on performance indicators? [1. No, 2. To some extent, 3. Yes]	1	

Category		Question		Answer
Large	Small			
	Employment/ transfer/ turnover	Q92: Does your utility have any staff dedicated to human resources/personnel affairs? [Yes or No]		No
		Q95: How often (at approximately what average interval) are the following categories of staff transferred?	1) Engineers	Few
			2) Technicians	Few
			3) Managers	Few
			4) Administration staff	Few
	Personnel management and incentives(1st: Q22/ UBC)	Q96: How well are duties divided and job descriptions clearly defined for each staff position? (including managers, engineers, technicians, unskilled workers, administration staff of different kinds, etc.)? [1. Not clearly at all, 2. Duties are divided only to some extent and/or job descriptions are not clear, 3. Duties are divided only to some extent, but there are updated job descriptions which are clearly defined, 4. Duties are clearly divided according to updated job descriptions which are clearly defined]		2
		Q97: How well are individual performance based incentives working in your utility (e.g. pay rises, promotions and bonuses based on individual performance)? [1. Do not exist, 2. Exist but not working, 3. Working to some extent, 4. Working fairly well, 5. Working very well]		1
		Q98: Does your utility have a fair evaluation system for individual or unit/team performance? [1. No evaluation system exists, 2. There is an evaluation system but it is not fair, 3. There is a fair evaluation system]		1
		Q99: How clear is the linkage between capacity development of individual staff and improvement of his/her salary or benefits? [1. No linkage, 2. Minimal linkage, 3. Some linkage, 4. Adequate linkage, 5. Strong linkage]		1
		Q100: Is the attendance/working hours of your utility's staff recorded daily, for providing incentives (e.g. overtime payment) or monitoring staff? [1. Not recorded at all, 2. Only recorded partly and it does not provide any control or incentive, 3. Recorded but it does not provide enough control or incentives, 4. Recorded and it provides control but is not used for incentives, 5. Recorded and it provides both control and is used for incentives]		1
		Q101-1: Are there any active criteria for promotion to a management position, such as promotion tests, professional qualification requirements, achievement of target performance level, etc.? [Yes or No]		No
			Q101-2: If Yes, what are the criteria for promotion to a management position?	
		Q102: Does your utility provide a uniform to the staff operating and maintaining facilities? [1. No, 2. Yes, but not fully utilized, 3. Yes, and fully utilized]		3
	Targets and appraisals	Q103: Does your utility have an annual appraisal and target setting system for managers? [Yes or No]		No
		Q104: Does your utility have an annual appraisal and target setting system for all staff? [Yes or No]		No
		Q105: Does your utility have a reward and recognition programme for all staff? [Yes or No]		No
	Communication	Q106: Are the following types of	1) Communication	Yes

Category		Question		Answer
Large	Small			
		communication sufficient (in terms of number of meetings and daily communication) for staff to maximize the effectiveness and efficiency of their work? [Yes or No]	among General Managers and department heads	
		Q107: How accessible/open is the management of your utility to non-management staff, including field staff to discuss issues or make complaints? [1. Not open at all, 2. Open to a limited extent, 3. Open to some extent, 4. Open, 5. Very open]		2
	Planning (1st: Q22/ UBC)	Q108: How well does your utility's human resources development plan meet the current needs of the utility? [1. No plan exists, 2. It exists but does not meet demand at all, 3. It exists and meets demand to some extent, 4. It exists and meets demand fairly well, 5. It exists and meets demand very well]		1
		Q109: Is your utility's budget for human resource development adequate? [1. Not nearly adequate, 2. Less than adequate, 3. Adequate]		1
		Q110: Does your utility have a skills and training strategy for all staff ? [Yes or No]		No
	Training programs (1st: Q22/ UBC)	Q111-1: Does your utility have a training centre for staff ? [Yes or No]		Yes
			Q111-2: If Yes, please name the training centre and provide the name, scale and contents of each training course provided.	- Pipeline installation 3 times/year
		Q112-1: Does the personnel affairs/human resources department of your utility provide any training courses other than those provided by its training centre(s)? [Yes or No]		No
			Q112-2: If Yes, please describe the name, scale and contents of each training course provided.	
		Q113: How much improvement is required in your utility for each of the following aspects of training? [1. Huge improvement required, 2. Much improvement required, 3. Some improvement required, 4. A little improvement required, 5. No improvement required]	1-1) Suitability of training venue or building	2
			1-2) Training facilities, equipment and instruments	2
			2-1) Management capacity for organizing and delivering training programs	1
			2-2) Technical and/or communications skills of trainers	2
			3-1) Recognition by the central government, local government and regulatory bodies of the need for training of water utilities' staff, and support from them	2
			3-2) Recognition of the need for training among the water utilities	3
			4-1) Incentives for the staff working for the training centre (centre managers, trainers, etc.)	2
			4-2) Incentives for participants from water utilities	3
			4-3) Ease of undertaking training for participants (transportation, fee, timing, etc.)	4

Category		Question		Answer
Large	Small			
			5-2) Ensuring that programs and materials meet the needs of technical staff (e.g. engineers, technicians) in water utilities	2
			5-3) Ensuring that programs and materials meet the needs of administration and management staff (e.g. accountants, bill collectors, managers) in water utilities	No training
			5-3) Ensuring programs and materials meeting the needs of managers in your utility	No training
			6-1) Incorporation of external training for management, accounting, languages, IT, etc. including those provided by private companies.	No training
			6-2) Incorporation of international training programs provided by international donors and high-performing international water utilities	3, international donors
		Q114: Do your utility's staff have to take tests after receiving training? [1. Yes - usually, 2. Yes - occasionally, 3. No]		No
		Q115-1: Are there any training programs on construction quality control for small contractors to install service pipes, water meters and/or branch distribution pipes, etc. for reducing leakage from pipes? [Yes or No]		Yes
	On-the-job training	Q116: How well is OJT (on-the-job training) carried out in your utility, in terms of the number of experienced staff who can provide OJT, recognition of the importance of OJT in your utility, an organized approach for OJT, etc? [1. OJT is not carried out, 2. Some OJT is carried out, but in an unorganized way, 3. Some OJT is carried out in an organized way, 4. OJT is a significant part of the organizational culture and it is carried out systematically]		2
		Q117: Does your utility have a culture of knowledge-sharing (senior or experienced staff teach junior or new staff and share all information?) [1. No, 2. Yes - but not active, 3. Yes - it is actively done]		2
	Self-learning	Q118 Does your utility provide a supportive environment for the staff to undertake self-learning (e.g. access to learning materials, equipment, information, communication with other utilities, etc.)? [1. Not supportive at all, 2. Minimal support, 3. Supportive to some extent, 4. Supportive, 5. Very supportive]		2
	Staff retention and motivation	Q119: How serious is the risk of outflow of trained staff from your utility to the private sector, after new training programs are provided without any countermeasure? [1. Very serious, 2. Serious, 3. Not very serious, 4. Not serious at all]		3
		Q122: Please select the answer that most closely describe how your utility pays staff who undergo training: [1. Salary is not paid during training, and training does not increase promotion prospects, 2. Salary is not paid during training, but well-trained staff have good promotion prospects, 3. Salary is paid during training, but training does not increase promotion prospects, 4. Salary is paid during training, and well-trained staff have good promotion prospects]		3

Category		Question		Answer
Large	Small			
	Accountability	Q123: At what level does your utility publicly disclose information from its annual report? [1. No annual report is prepared, 2. Annual report is prepared but no public information disclosure, 3. Some information is selected from the annual report for disclosure through the internet, etc., 4. Complete annual report is disclosed to customers on request, 5. Complete annual report is disclosed proactively through distribution of the report or publication on the internet.]		3
		Q124: How often does your utility publish a public relations newsletter/leaflet? [1. Never, 2. Less than once a year, 3. Once a year, 4. Seasonally, 5. Monthly or more, 6. Project oriented]		4
	Understanding existing and potential customers(1st: Q23/ UBC)	Q126-1: Are there any socio-economic reports or surveys related to the water supply services of your utility? [Yes or No]		No
			Q126-2: If Yes, please provide information on the report(s) such as title of report, year of survey and implementation organization.	
		Q127: Are your utility's decision-making process on strategies for the future open to the public, including existing customers, through public hearings, stakeholder meetings, etc ? [1. Not open at all, 2. Open to a limited extent, 3. Open to some extent, 4. Open, 5. Very open]		2
		Q128: How well-developed is your utility's customer information system? [1. Not at all developed, 2. Paper-based system without computerization, 3. Computerized system, but it is not regularly updated and not linked to mapping system, 4. Computerized system, but it is not regularly updated or not linked to mapping system, 5. Regularly updated computerized database linked to mapping system]		2
		Q129: How serious is illegal use of water for your utility? [1. Very serious, 2. Serious, 3. Not very serious, 4. Not serious, 5. Not serious at all]		2
		Q130: Is there a procedure for dealing with unhappy customers and unserved customers? [1. No, 2. Yes, to some extent, 3. Yes, it is well established]		1
	Existing customer satisfaction and willingness to pay for improvements	Q131: What proportion of the served population are satisfied with the water supply services provided? (if statistical data is not available, please answer this question based on the general perception of your utility) [1. Almost none, 2. Only residents in some areas, 3. About half, 4. The majority, 5. All or almost all]		
		Q132-1: How well does your utility understand your existing and potential customers' willingness-to-pay (WtP) for good water supply services? [1. Has no understanding, 2. Has some understanding but little confidence in data, 3. Has some understanding with some confidence in data, 4. Has some understanding based on results of past socio-economic/WtP surveys, 5. Has some understanding based on results of recent surveys, 6. Good understanding based on results of recent surveys]		2

Category		Question		Answer
Large	Small			
			Q132-2. If other than "1. Has no understanding", how high is the average willingness-to-pay of middle-income-level households for continuous water supply with good water quality? [1. They think water should be free, 2. Less than 1 % of income, 3. Less than 3% of income, 4. Less than 5% of income, 5. More than 5 % of income]	
	Unserved population	Q133: How severely restricted is water consumption for the unserved households in your utility's area of responsibility? [1. Very severe, 2. Severe, 3. Not very severe, 4. Not severe at all, 5. There are no unserved households]		5
		Q134-1: What are the major alternative water sources for the unserved population? [1. Water tanker, 2. Human-powered water carrier (vendor) , 3. Neighbourhood natural water , 4. Other]		2, 3, 4
			Q134-2: If Other, please describe.	bottled water
	Public awareness (1st: Q24/ UBC)	Q136: Does your utility conduct enough public awareness campaigns on the following topics?	1) Encouraging water saving at home, school, etc. [1. Not nearly enough, 2. Not quite enough, 3. Enough]	2
			2) Reducing illegal connections, including intentional damage to water meters [1. Not nearly enough, 2. Not quite enough, 3. Enough]	2
			3) Recognizing the importance of a good quality piped water supply [1. Not nearly enough, 2. Not quite enough, 3. Enough]	1
			4) Reporting visible water leakages [1. Not nearly enough, 2. Not quite enough, 3. Enough]	2
			5) In the case of intermittent water supply, reducing the use of suction pumps to abstract water from the network (which cause uneven water distribution, pressure drop, and contamination) [1. Not nearly enough, 2. Not quite enough, 3. Enough]	2
			6) In the case of continuous water supply, direct connection to the network without using a household receiving tank (to avoid degradation of drinking water quality) [1. Not nearly enough, 2. Not quite enough, 3. Enough]	2
			7) Other, please specify.	
	Water demand management	Q137-1: Is your utility controlling the water demand or water consumption of its customers, other than by raising people's awareness of the limitations and importance of water? [1. Yes, 2. No]		2
			Q137-2: If Yes, how?	
Countermeasures against external influence, and	Governance and political influences	Q138: Is your utility autonomous? [1. Yes, 2. No, 3. In between]		2
		Q139-1: Does your utility have a board of directors or a trust? [Yes or No]		No

Category		Question		Answer
Large	Small			
utilization of existing regulations and guidelines (1st: Q25/ UBC)			Q139-2: If Yes, do external directors have a strong influence? [Yes or No]	
		Q140: How well is the status of the General Manager defined regarding his/her term, conditions of conduct, and authority? [1. not at all, 2. not very well, 3. fairly well, 4. well, 5. very well]		3
		Q141-1: Who has general oversight/control of your utility's minimum service levels and water charge levels? [1. Local, regional or national government department, 2. Independent board of stakeholders, 3. Independent service and price regulator, 4. Your utility, 5. Other]		1
			Q141-2: If "Other", please describe.	
		Q143: If your utility belongs to the central or local government, does the General Manager of your utility have independent authority for O&M of facilities (excluding tariff setting, long-term planning and budgeting)? [1. Not at all, 2. Not very much, 3. Fairly good authority, 4. Good authority and 5. Total authority]		3
		Q144: How strongly do politicians influence your utility's decisions on the amount of water distributed to different areas? [1. Very strongly, 2. Strongly, 3. Interfere but not strongly, 4. Interfere only a little, 5. No or almost no interference]		
		Q145: How much are the following aspects in your utility subject to influence from central or local government, including influence through external members of its board of directors? [1. Strong influence, 2. Some influence, 3 No or almost no influence]	1) Number of staff	2
			2) Staff salaries	1
			3) Tariffs	1
			4) Appointment of staff	1
			5) Appointment of top management	1
			6) Budget for O&M	1
			7) Budget for development	1
			8) Daily operation and management of facilities	3
			9) Disconnection for non-payment	2
	Regulatory bodies	Q146: How well does your utility comply with agreements with regulatory bodies, in terms of service levels (water quality, pressure, etc.), cost recovery, expansion and improvement of facilities, etc ? [1. Not at all, 2. Not well, 3. To some extent, 4. Well, 5. Very Well]		No regulatory body
		Q147: Does your utility submit timely and accurate data to regulatory organizations? [1. No, 2. To a little extent, 3. To some extent, 4. Accurate but not timely, 5. Yes, timely and accurate]		No regulatory body
	Procurement	Q148: How well established are your utility's procurement rules and procedures? [1. Not at all, 2. Not well established, 3. To some extent, 4. Well established, 5. Very well established]		1
		Q150-1: Does your utility follow any regulations for registering qualified construction contractors, consulting companies and manufactures/suppliers? [1. Yes, 2. No]		2

Category		Question		Answer	
Large	Small				
			Q150-2: If Yes, please describe your utility's practice.		
		Q151-1: Does your utility have any specific functions for reducing corruption (such as an ethics committee, or customer information regarding corruption of utility staff)? [1. Yes, 2. No]		2	
			Q151-2: If 1.Yes, please describe these anti-corruption functions.		
	Cooperation with donors, other water utilities, etc.	Q152: Which international donors are significantly contributing to your utility, and what is the role of each of the contributing donors?		JICA	
		Q153-1: Are there any cooperative training programs with other water utilities? [Yes or No]		Yes	
			Q153-2: If Yes, please name the other cooperating utilities, and the contents, scale, target trainees and frequency of the training programs.	Tokyo, Fukuoka	
		Q154-1: Are there any organizations other than water utilities (e.g. water industry associations, universities) that dispatch lecturers/trainers to your water utility? [Yes or No]		No	
			Q154-2: If Yes, please describe the name of the organizations, the expertise of dispatched lectures/trainers, the scale and target trainees for the training programs.		
		Q155-1: Are there any formal or informal agreements of assistance with other utilities in case of water shortages, accidents, etc.? [Yes or No]		No	
			Q155-2: If Yes, please describe these agreements.		
	Regulations(1st: Q25/ UBC)	Q157-1: Are there any laws or regulations on each of following items? [Yes or No]Q157-2: If Yes, does your utility effectively comply with these laws or regulations? [Yes or No]	1) National: Water supply act or its equivalent	No	
			2) Regulations to encourage private sector involvement (Public Private Partnerships (PPP), Public Sector Privatization (PSP), Private Finance Initiatives (PFI), etc.)	No	
			3) Licensing systems for contractors (including small contractors installing service connections), to ensure construction quality control in order to reduce leakage	Yes	
			4) Local: Water supply by-law or ordinance	Yes	Yes
			5) Regulations regarding water intake, including conventional rights to the use of natural water and restrictions on groundwater withdrawal to prevent land subsidence	No	
			6) Vocational qualifications / certification for utility staff (e.g. for construction supervision, operation of purification plant, water quality testing, accounting, computer programs)	Yes	Yes
	Guidelines	Q158-1: Are there any guidelines on each of	1) Water tariff setting	No	
			2) Water quality standards	Yes	Yes
			3) Authorized standards for materials and equipment for water utilities	No	

Category		Question		Answer	
Large	Small				
		following items? [Yes or No] Q158-2: If Yes, does your utility effectively comply with these guidelines? [Yes or No]	4) Design of water supply facilities		
			5) Operation and maintenance of water supply facilities	No	
			6) NRW reduction	No	
			7) Bulk water supply	No	
			8) Governance/management of water utility	No	
			9) Merger/clustering of utilities to improve efficiency (facility integration and/or office administration integration)	No	
			10) Environmental impact assessment	Yes	Yes
	Referencing of Water Supply Services Act	Q159: Does your utility keep copies of updated water industry laws/acts/ordinances well organized for quick referencing? [1. They are scattered over different places, 2. One section keeps the majority of them, but in an unorganized way, 3. One section keeps them all but they are not organized/filed well, 4. They are well-organized in a file or as a book, but recent updates are not included, or the file is not well-utilized, 5. They are well-organized. including all recent updates, and are well-utilized]		1	
Integration with Projects in other sectors (1st: Q26/ UBC)	Water resource allocation	Q162: Does your utility have the potential to threaten rural water supplies by extracting excessively from water sources? [Yes or No]		No	
	Irrigation	Q163: Does your utility have the potential to increase access to water sources, through discussion with the irrigation sector? [Yes or No]		Yes	
	Sanitation	Q164: Does your utility reduce water-borne diseases effectively by optimizing the balance of investment between water supply, sanitation, hygiene education, etc. especially in poor urban areas? [Yes or No]		No	
	Sewerage (1st: Q26/ UBC)	Q165: If your utility's water supply operations have a serious impact on the natural environment due to discharge of untreated wastewater, is it possible to develop sewerage or other types of wastewater treatment facilities along with the development of water supply system especially in cities, slums and areas with tourist value? [Yes or No]		Yes	
		Q166: Do your utility's water sources need to be protected by installing sewerage in the catchment areas? [Yes or No]		Yes	
	Hygiene education	Q167: Is it possible for your utility to conduct hygiene education along with your utility's other public awareness campaigns (e.g. for utilization of piped water supply, importance of water quality, water saving, etc)? [Yes or No]		No, presently no section	
	Roads	Q168: Can your utility coordinate with road management authorities to synchronize the timing of road construction and pipe installations, to avoid extra costs such as re-paving, etc? [Yes or No]		Yes, but not easy	

D COST ESTIMATION

D.1 Cost Estimation

APPROXIMATE COST ESTIMATION FOR THE PRIORITY PROJECTS

(DIRECT CONSTRUCTION COST)

FOR

THE PROJECT FOR THE IMPROVEMENT OF WATER SUPPLY, SEWERAGE AND DRAINAGE SYSTEM

1. Development of Lagunpyin Water Supply System
2. Modernization of Water Supply Zone 1
3. Construction of Chlorination Facilities

1. Development of Lagunpyin Water Supply System

Non-disclosure Information

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2. Modernization of Water Supply Zone 1

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3. Provision of Disinfection Facilities

Non-disclosure Information

Non-disclosure Information

Non-disclosure Information

Non-disclosure Information

Non-disclosure Information

Non-disclosure Information

Non-disclosure Information

Non-disclosure Information

Operation and Maintenance Cost

(1) Operation and Maintenance Cost for Target Facility for F/S

Items	Lagunbyin WTP	Distribution PS for Zone 7&8	Distribution PS for Zone 1	Nyaunghnapin WTP I&II	Hlawga PS	Yegu PS	Total
Salary	69,960	0	0	0	0	0	69,960
Electricity	346,589	405,851	249,616	0	0	0	1,002,056
Maintenance	721,808	147,488	52,912	11,664	5,456	4,784	944,112
Chemical	6,546,293	0	0	1,269,543	666,727	551,314	9,033,878
Other cost	153,693	11,067	6,051	25,624	13,444	11,122	221,000
Total	7,838,344	564,406	308,579	1,306,831	685,627	567,220	11,271,006

(2) Calculation of Operation and Maintenance Cost for Each Facility

1) Lagunbyin WTP

	Ave	Max	
O&M Cost of Lagunpyin WTP	165,300	181,800	m3/day

(USD)

Item	Cost	
Salary	69,960	
Electricity	346,589	
Maintenance(Spare parts)	721,808	
Sludge cake	0	
Chemical	6,546,293	
Sewer	0	
Other cost	153,693	
Total	7,838,344	/year

(USD)

Item	Unit Price
Salary (engineer: month)	209
(technitian:month)	109
(common :month)	95
Electricity (/kWh)	0.041
Sludge Cake (/m3)	5
Choline (/kg)	0.51
Polymer (/kg)	5.1
Coagulant (/kg)	0.5
% of Maitenance	1.60

(1) Salary

	person	unit cost	(USD)
No. of worker (engineer)	8	2,508	= 20,064
No. of worker (technitian)	12	1,308	= 15,696
No. of worker (common)	30	1,140	= 34,200
sum	50		69,960

(2) Electeicity

	kWh	kWh/year		
Amount of kWh	23,160	8,453,400	0.041	= 346,589
sum				346,589

(3) Maintenance(Spare parts)

Non-disclosure Information

(4) Sludge cake

	m3/day	m3/year		
Amount of Sludge Cake		0	5.0	= 0
sum				0

(5) Chemical

	kg/day	kg/year		
Amount of Chlorine	2,755	1,005,575	0.51	= 512,843
Amount of Polymer		0	5.1	= 0
Amount of Coagulant	33,060	12,066,900	0.5	= 6,033,450
sum				6,546,293

Distribution Pumping Station for Zone 7&8

	Ave	Max
O&M Cost of Zone 7 & 8 PS	165,300	181,800

(USD)

Item	Cost
Salary	0
Electricity	405,851
Maintenance(Spare parts)	147,488
Sludge cake	0
Chemical	0
Sewer	0
Other cost	11,067
Total	564,406

(USD)

Item	Unit Price
Salary (engineer: month)	209
(technitian:month)	109
(common :month)	95
Electricity (/kWh)	0.041
Sludge Cake (/m3)	5
Choline (/kg)	1.7
Polymer (/kg)	5.1
Coagulant (/kg)	0.5
% of Maitenance	1.60

(1) Salary

	person	unit cost	(USD)
No. of worker (engineer)		2,508	= 0
No. of worker (technitian)		1,308	= 0
No. of worker (common)		1,140	= 0
sum	0		0

(2) Electeicity

	kWh	kWh/year		
Amount of kWh	27,120	9,898,800	0.041	= 405,851
sum				405,851

(3) Maintenance(Spare parts)

Non-disclosure Information

(4) Sludge cake

	m3/day	m3/year		
Amount of Sludge Cake		0	5.0	= 0
sum				0

(5) Chemical

	kg/day	kg/year		
Amount of Chlorine		0	1.7	= 0
Amount of Polymer		0	5.1	= 0
Amount of Coagulant		0	0.5	= 0
sum				0

Distribution Pumping Station for Zone 1

Ave Max

O&M Cost of Distribution P/S

(USD)

Item	Cost
Salary	0
Electricity	249,616
Maintenance(Spare parts)	52,912
Sludge cake	0
Chemical	0
Sewer	0
Other cost	6,051
Total	308,579

(USD)

Item	Unit Price
Salary (engineer: month)	209
(technitian:month)	109
(common :month)	95
Electricity (/kWh)	0.041
Sludge Cake (/m3)	5
Choline (/kg)	0.51
Polymer (/kg)	5.1
Coagulant (/kg)	0.5
% of Maitenance	1.60

(1) Salary

	person	unit cost	(USD)
No. of worker (engineer)		2,508	= 0
No. of worker (technitian)		1,308	= 0
No. of worker (common)		1,140	= 0
sum	0		0

(2) Electeicity

	kWh	kWh/year		
Amount of kWh	16,680	6,088,200	0.041	= 249,616
sum				249,616

(3) Maintenance(Spare parts)

Non-disclosure Information

(4) Sludge cake

	m3/day	m3/year		
Amount of Sludge Cake		0	5.0	= 0
sum				0

(5) Chemical

	kg/day	kg/year		
Amount of Chlorine		0	0.51	= 0
Amount of Polymer		0	5.1	= 0
Amount of Coagulant		0	0.5	= 0
sum				0

Nyaunghnapin WTP

	Ave	Max	
O&M Cost of NyaunghnapinWTP I & II	372,000	409,200	m3/day

(USD)

Item	Cost
Salary	
Electricity	
Maintenance(Spare parts)	11,664
Sludge cake	
Chemical	1,269,543
Sewer	
Other cost	25,624
Total	1,306,831

(USD)

Item	Unit Price
Salary (engineer: month)	209
(technitian:month)	109
(common :month)	95
Electricity (/kWh)	0.041
Sludge Cake (/m3)	5
Choline (/kg)	0.51
Polymer (/kg)	5.1
Coagulant (/kg)	0.5
% of Maitenance	1.60

(1) Salary

	person	unit cost	(USD)
No. of worker (engineer)		2,508	= 0
No. of worker (technitian)		1,308	= 0
No. of worker (common)		1,140	= 0
sum	0		0

(2) Electeicity

	kWh	kWh/year		
Amount of kWh	103,944	37,939,560	0.041	= 1,555,522
sum				1,555,522

(3) Maintenance(Spare parts)

Non-disclosure Information

(4) Sludge cake

	m3/day	m3/year		
Amount of Sludge Cake		0	5.0	= 0
sum				0

(5) Chemical

	kg/day	kg/year		
Amount of Chlorine	6,820	2,489,300	0.51	= 1,269,543
Amount of Polymer		0	5.1	= 0
Amount of Coagulant		0	0.5	= 0
sum				1,269,543

Hlawga pumping Station

	Ave	Max	
O&M Cost of Hlawga PS	214,900	236,400	m3/d

(USD)

Item	Cost
Salary	0
Electricity	0
Maintenance(Spare parts)	5,456
Sludge cake	0
Chemical	666,727
Sewer	0
Other cost	13,444
Total	685,627

(USD)

Item	Unit Price
Salary (engineer: month)	209
(technitian:month)	109
(common :month)	95
Electricity (/kWh)	0.041
Sludge Cake (/m3)	5
Choline (/kg)	1.7
Polymer (/kg)	5.1
Coagulant (/kg)	0.5
% of Maitenance	1.60

(1) Salary

	person	unit cost	(USD)
No. of worker (engineer)		2,508	= 0
No. of worker (technitian)		1,308	= 0
No. of worker (common)		1,140	= 0
sum	0		0

(2) Electeicity

	kWh	kWh/year		
Amount of kWh		0	0.041	= 0
sum				0

(3) Maintenance(Spare parts)

Non-disclosure Information

(4) Sludge cake

	m3/day	m3/year		
Amount of Sludge Cake		0	5.0	= 0
sum				0

(5) Chemical

	kg/day	kg/year		
Amount of Chlorine	3,582	1,307,308	0.51	= 666,727
Amount of Polymer		0	5.1	= 0
Amount of Coagulant		0	0.5	= 0
sum				666,727

Yegu Pumping Station

	Ave	Max	
O&M Cost of Yegu PS	177,700	195,500	m3/d

(USD)

Item	Cost
Salary	0
Electricity	0
Maintenance(Spare parts)	4,784
Sludge cake	0
Chemical	551,314
Sewer	0
Other cost	11,122
Total	567,220

(USD)

Item	Unit Price
Salary (engineer: month)	209
(technitian:month)	109
(common :month)	95
Electricity (/kWh)	0.041
Sludge Cake (/m3)	5
Choline (/kg)	0.51
Polymer (/kg)	5.1
Coagulant (/kg)	0.5
% of Maitenance	1.60

(1) Salary

	person	unit cost	(USD)
No. of worker (engineer)		2,508	= 0
No. of worker (technitian)		1,308	= 0
No. of worker (common)		1,140	= 0
sum	0		0

(2) Electeicity

	kWh	kWh/year		
Amount of kWh		0	0.041	= 0
sum				0

(3) Maintenance(Spare parts)

Non-disclosure Information

(4) Sludge cake

	m3/day	m3/year		
Amount of Sludge Cake		0	5.0	= 0
sum				0

(5) Chemical

	kg/day	kg/year		
Amount of Chlorine	2,962	1,081,008	0.51	= 551,314
Amount of Polymer		0	5.1	= 0
Amount of Coagulant		0	0.5	= 0
sum				551,314

E ECONOMIC AND FINANCIAL ANALYSIS

E.1 Composition of Alternative Water Sources and Cost

Type of Water Supply	Water uses from alternative sources (%)	Unit cost for water acquisition (Kyat/m^3)
Public Well/Tap	2.2%	406
Neighbors' Well/Tap (Free of Charge)	7.3%	
Rain/ Creek/ Canal/ Pond	18.2%	
Bottled Water	39.2%	3,000
Water Vender	9.7%	
Private Tube Well	23.1%	1,083
None	0.3%	

Source: JICA-HIS

E.2 Saving Effect on Medical Expenditure

A. Estimation of Saving for Medical Treatment (2013)

1. Principal Epidemic Diseases Occurrences in Yangon Region

Disease name	2008	2009	2010	2011	2012	Average occurrence	% in total population
Diarrhea	17,462	13,166	11,851	10,969	15,713	13,832	0.199%
Dysentery	9,489	6,135	6,361	4,436	4,099	6,104	0.088%
Typhoid & Para Typhoid	71	55	98	47	27	60	0.001%
Viral Hepatitis	251	14	271	205	212	191	0.003%
Malaria	5,741	4,605	4,374	2,226	1,539	3,697	0.053%
Population (1,000)	6,944						

Source: Central Statistical Organization, Statistical Year Book 2010,
Regional Department of Health

2. Estimation of Total Number of Patient by Patient Types

Disease name	In-patient Treatment	Out-patient Treatment
Diarrhea	1,383	12,449
Dysentery	427	12,864
Typhoid & Para Typhoid	30	3,052
Viral Hepatitis	126	63
Malaria	1,405	3,784

3. Treatment Cost

	Diarrhea	Dysentery	Typhoid & Para Typhoid[*1]	Viral Hepatitis	Malaria
Average Treatment Day					
In-patient	3	3	5	5	5
Out-patient	1	1	1	1	1
Treatment Cost					
In-patient	6,000	4,000	10,000	7,000	4,000
Out-patient	2,800	1,500	2,000	2,500	1,000
Average Cost of Treatment					
In-patient	18,000	12,000	50,000	35,000	20,000
Out-patient	2,800	1,500	2,000	2,500	1,000

*1 This information is not obtained, so that the treatment cost is estimated

Source: Regional Department of Health

4. Population of the Project beneficiaries in Domestic Users

No. of incremental beneficiaries	30%	decrease percentage in total population

5. Saving through Decrease of Medical Cost

Disease name	Unit	In-patient Treatment	Out-patient Treatment	Total (kyat/year)
Diarrhea	Kyat/ year	18,670,500	26,142,900	87,740,025
Dysentery	Kyat/ year	3,843,000	14,472,000	
Typhoid & Para Typhoid	Kyat/ year	1,125,000	4,578,000	
Viral Hepatitis	Kyat/ year	3,307,500	118,125	
Malaria	Kyat/ year	12,645,000	2,838,000	
Average frequency of infection	Times/ year	2.5		

E.3 Calculation of Willingness to Pay

A. Lagunbyin Water Supply Project

Items		Value	Remarks
(1)	Water Consumption (Median)	75 gallon/HH/day	JICA-HIS
(2)	Willingness-to-pay amount (Drinkable treated water, 24h supply)	1,500 Kyat/HH/month	JICA-HIS
(3)	Willingness-to-pay amount for the Project	76 Kyat/ m^3	(2) / (1)
(4)	Willingness-to-pay amount for the Project	61 Kyat/ m^3	Assumed 80% of (3) will contribute to the Project

B. Non-Revenue Water Reduction Project in Zone 1

Items		Value	Remarks
(1)	Water Consumption (Median)	75 gallon/HH/day	JICA-HIS
(2)	Willingness-to-pay amount (Drinkable treated water, 24h supply)	1,500 Kyat/HH/month	JICA-HIS
(3)	Willingness-to-pay amount for the Project	1,200 Kyat/HH/month	Assumed 80% of (2) will contribute to the Project

* Non-domestic rate is assumed to be 25% up against domestic rate, equivalent to 35 kyat/m^3.

C. Project for Installation of Disinfection facilities

Items		Value	Remarks
(1)	Water Consumption (Median)	75 gallon/HH/day	
(2)	Willingness-to-pay amount (Drinkable treated water, 24h supply)	1,500 Kyat/HH/month	
(3)	Willingness-to-pay amount (Untreated water, 24h supply)	750 Kyat/HH/month	
(4)	Difference (2) – (3)	750 Kyat/HH/month	(2) – (3)
(5)	Modified willingness-to-pay *the Project contributes to improve water quality, but not to ensure 24h	375 kyat/HH/month	Assumed 50% of (4) will contribute to the Project
(6)	Willingness-to-pay for the Project per m^3	37 kyat/m^3	(5) x 12 /(1)

E.4 Standard Conversion Factor

	2000-01	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Import amount	15,073	13,398	11,339	18,419	16,835	18,419	24,874	22,837
Export amount	12,736	14119	16,697	20,647	30,026	35,297	37,028	41,289
Custom duty including import customs revenue &export customs revenue	5,157	4,031	21,131	17,894	29,468	35,568	82,434	45,283

* - Data of the period FY2001-02 is not available

The calculation method is shown as follows:

SCF = 2000 – 2010 import/export total/(2000 – 2010 import/export total + Total customs revenue)
=0.59

E.5 Economic Analysis (Lagunbyin Water Supply Project)

Non-disclosure Information

E.6 Economic Analysis (Zone 1 Non-Revenue Reduction Project)

Non-disclosure Information

E.7 Economic Analysis (Disinfection Project)

Non-disclosure Information

E.8 Financial Analysis (Simulation A)

Non-disclosure Information

E.9 Financial Analysis (Simulation B)

Non-disclosure Information

E.10 Financial Analysis (Simulation C)

Non-disclosure Information

E.11 Financial Analysis (Simulation D)

Non-disclosure Information

F ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

F.1 Framework for Environmental and Social Considerations

F.1.1 Policy, Laws and Administrative Framework

(1) Draft Environmental Impact Assessment Procedure

MOECAF is preparing the Environmental Impact Assessment Procedures with the support from ADB and the draft 16 (dated 6 March 2013) is obtained from JICA. The document consists of eight chapters and definitions, establishment of the environmental impact assessment process, screening, IEE, EIA, environmental consideration in project approval, monitoring, and penalties are described. The procedures are described in the following section.

The law says all Projects undertaken in Myanmar by any ministry, government department, organization, corporation, board, development committee, local government or authority, company, cooperative, institution, enterprise, firm, partnership or individual having the potential to cause significant Adverse Impacts, are required to undertake environmental impact assessment and to obtain an Environmental Compliance Certificate in accordance with this Procedure. The level of environmental impact assessment (IEE, EIA or not required) will be decided by the screening, and the annex (draft) of the law provides guidance on the required level of assessment by type of activities (dated 15 February 2013, 5th draft).

Table 1 Required Assessment Level for Water and Sewerage Facilities

Level	Type of activity	Size
IEE	Water supply schemes	For a population of more than 20,000 and less than 50,000
	Municipal sewerage management system	For a population of 10,000 or more
EIA	Water supply schemes	For a population of 50,000 or more
	Municipal sewerage management - Construction of wastewater treatment facilities in urban areas - Construction of sewerage systems	 125 acres (50 ha) and above Service area 6,250 acres (200ha) and above

(2) Conservation of Water Resources and Rivers Law 2006

The aim of the Law are to conserve and protect the water resources and rivers system for beneficial utilization by the public, to enable smooth and safe waterways navigation along rivers and creeks, to contribute to the development of State economy through improving water resources and river system and to protect environmental from negative impact.

The Law stipulates the duties and powers of the Ministry of Transport and Directorate of Water Resources and Improvement of River System, prohibitions, and penalties. The article 30 of Chapter VII describes that any government department and organization or any person desirous of constructing drainage, utilizing river water intake, constructing bridges spanning rivers, connecting underground

pipe, connecting underground electric power cable, connecting underground telecom cable or digging in rivers and creeks, bank boundary and waterfront boundary, under the requirement of work, shall in order not to adversely affect the water resources and rivers and creeks, carry out relevant activities only after obtaining the approval of the Ministry of Transport.

(3) Forest Law 1992

The Law stipulates the protection and conservation of the forest, biodiversity, establishment of forest protection area.

(4) Protection of wildlife and Wild Plants and Conservation of Natural Areas Law, 1994

The Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, replacing the old Burma Wildlife Protection Act of 1936 was enacted in 1994. The Law highlights habits maintenance and restoration, protection of endangered and rare species of both fauna and flora, establishment of new parks and protected areas, and buffer zone management.

(5) Protection and the Preservation of Cultural Heritage Region Law, 1998

The law briefly highlights the obligation not to carry out any of the following in the cultural heritage region: destroying an ancient monument; willfully altering the original ancient form and structure or original ancient workmanship of an ancient monument; excavating to search for antiques; exploring for petroleum, natural gas, precious stones or minerals.

(6) Prevention and Control of Communicable Diseases Law, 1995 (revised in 2011)

The Law highlights the functions and responsibilities of health personnel and citizens in relation to prevention and control of communicable diseases. It also describes measures to be taken in relation to environmental sanitation, reporting and control of outbreaks of epidemics and penalties for those failing to comply. The law also authorizes the Ministry of Health to issue rules and procedures when necessary with approval of the government.

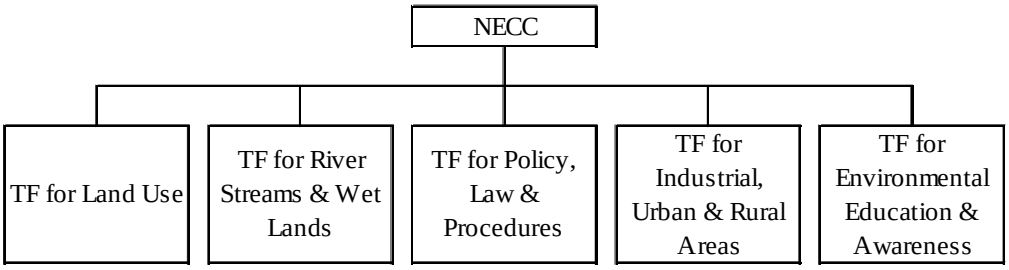
F.1.2 Administrative Framework for Environmental and Social Considerations

(1) Environment Conservation Committee (ECC)

The Environment Conservation Law enumerates that the Union Government shall organize Environment Conservation Committee (ECC), assigning Union Minister for the Ministry of Union as the Chairman of the Committee which shall constitute suitable members. ECC shall hold the following authoritative rights:

- Prepare educative organizing activities and movements on environmental conservation,
- Give advice on making required amendments in school lessons on environmental conservation after making coordination with concerned governmental departments,
- Receive donation funds, cash support, materials and technical assistance and administer these funds, materials and technologies for applying environmental tasks,

- Give appropriate advice on environmental conservation to concerned government departments and organization and exhort them in implementing the task,
- Request proposals and advice on promoting environmental conservation from concerned governmental department and organizations,
- Forbid concerned government departments and organizations that could damage the environment and if necessary, submit the matter to the Union Government requesting its attitude and policy on the condition,
- Adopt Myanmar National Environment Policies and other related policies in conservation of environment with the approval of the Union government.



Source: Presentation materials of Myanmar Cooperation Seminar for the Environment Management Master Plan of Myanmar

Figure 1 Organizational Structure of NECC

(2) Ministry of Environment Conservation and Forestry (MOECAF)

In the Environment Conservation Law 2012, the obligations and authoritative right of MOECAF are stipulated. The ministry has a broad responsibility:

- To implement the policies on environment conservation,
- To plan the environmental management both at the national and regional level,
- To plan, implement and monitor environmental conservation and promotion, and to prevent, control and reduce environmental pollution,
- To pave the way for sustainable development.

In order to do this, the Ministry has the power to create "guidelines for environmental administration, conservation and promotion in different sectors which include ozone layer protection, the conservation of biodiversity, marine coastal conservation, the effort to reduce and balance global warming and climate change, the fight against the increase of desert and waste management". In particular, the Ministry can:

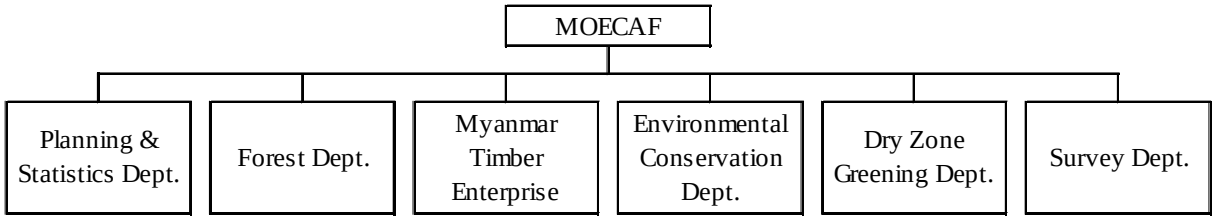
- Set the rules for how much and what type of pollution is allowed, and what businesses and individuals have to do to reduce pollution,
- Set up a system to assess the environmental and social impacts of projects (both those carried out by the government and those done by the private sector),
- Set up a system to monitor pollution from agriculture, industry and mining,
- Decide which types of projects require permission to operate,
- Decide whether to grant the permission to individual projects,
- Require companies to pay for environmental conservation projects to make up for the damage of

the companies cause,

- Oversee the system for judging and punishing environmental damage, and
- Negotiate regional and international environmental agreement.

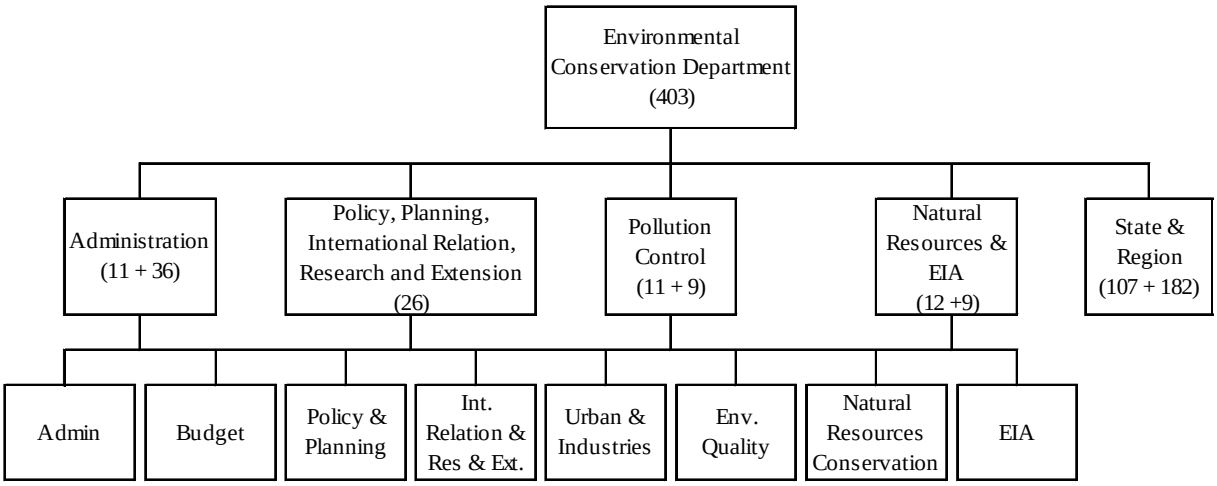
The Ministry, the Committee and the national government share responsibilities for taking action when there is a natural disaster, including warning people about natural disasters.

The MOECAF has six departments as shown in the figure below. The Environmental Conservation Department has the responsibilities on pollution control, natural resources and EIA as described in this section.



Source: Presentation materials of Myanmar Cooperation Seminar for the Environment Management Master Plan of Myanmar

Figure 2 Organization Structure of MOECAF



Source: Presentation materials of Myanmar Cooperation Seminar for the Environment Management Master Plan of Myanmar

Figure 3 Organization Structure of Environmental Conservation Department

<u>Policy, Planning, International Relation, Research and Extension</u>

- To develop planning and its implementation, review and report
- To develop legislation related to rules, regulations, guidelines and procedures in different sectors
- To initiate Green growth and economy strategy for low carbon development
- To develop plan of climate change mitigation and adaptation of combat to desertification and ozone layer protection
- To do national report in relation with international agreements
- To do research and development and extension

- To extend the international cooperation

Pollution Control

- To promote clean development technology
- To develop environmental sound management framework for waste and chemical
- To promote environmental sound technology for waste and chemical management
- To develop the environmental quality standards and guidelines in coordination with relevant agencies
- To develop data based assessment and management system of environmental quality
- To develop monitoring system for the prevention of pollution

Natural Resources Conservation and EIA

- To develop data based assessment and management system of natural resources
- To coordinate the sustainable management of natural resources in terms of ecosystem, nature reserve, biodiversity
- To promote renewable energy and energy efficiency technology and mechanism
- To develop EIA review and monitoring guidelines for the development projects
- To monitor the implementation of environment conservation

F.1.3 Procedures for Environmental and Social Considerations

According to the draft Environmental Impact Assessment Procedures, MOECAF is in charge of the review of IEE/EIA reports. The procedures of environmental and social considerations described in the draft Environmental Impact Assessment Procedures is shown in the figure below.

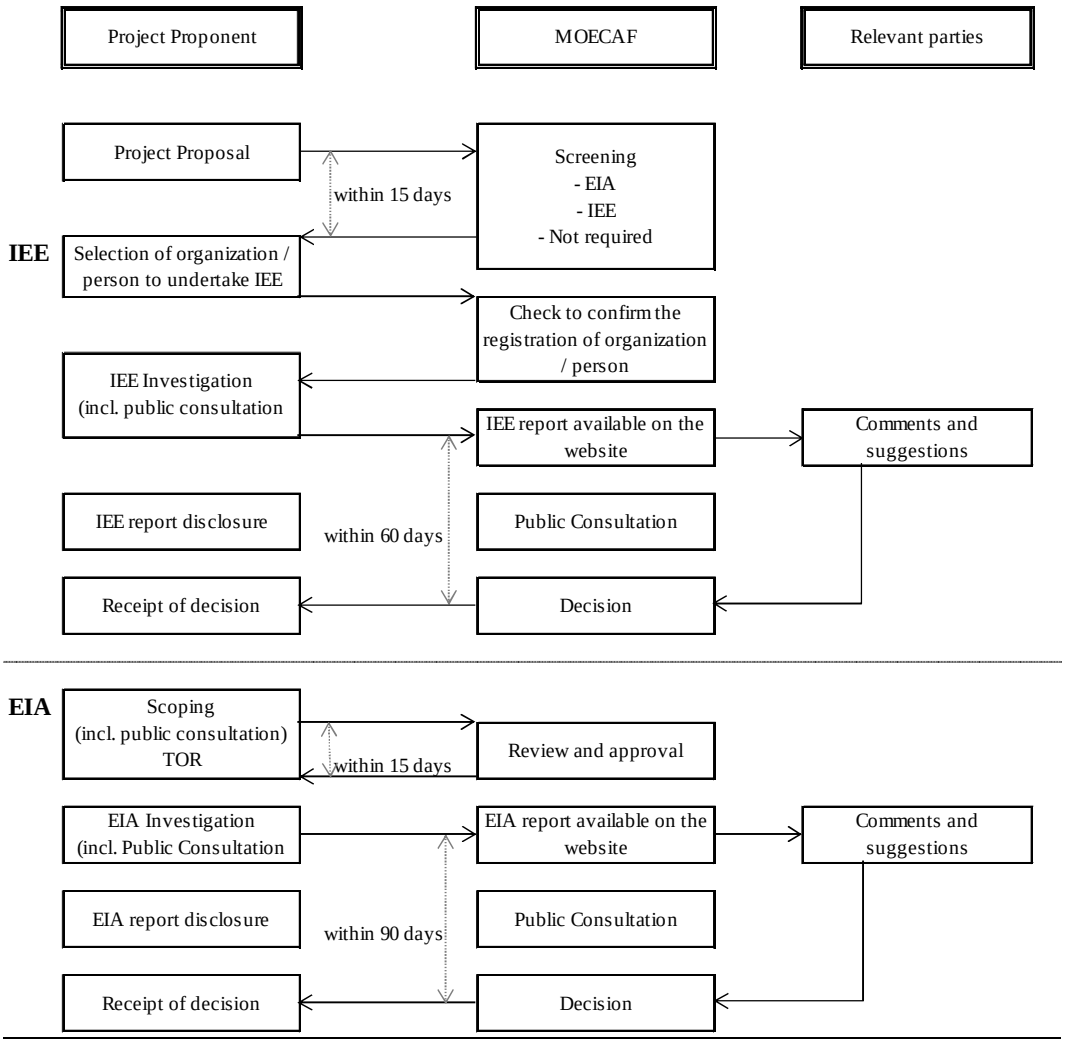


Figure 4 Procedures for Environmental and Social Considerations

(1) Organizations or persons undertaking EIA and IEE

Any organization or person who wishes to prepare an EIA or IEE shall apply to register with the MOECAF, MOECAF review the materials submitted by applicants and decide the registration. The applicant for registration shall be required to make payment of any fees and charges that may be required by the MOECAF in connection with the application submission. No organization or person that is not registered with the MOECAF shall prepare, submit or allow the submission of any IEE/EIA report. No project proponent shall prepare or submit IEE/EIA report to the MOECAF which has not been prepared by an organization or person duly registered with the MOECAF.

(2) Screening

The project proponent shall submit a project proposal completed in accordance with Ministry guidelines to the MOECAF for screening, and MOECAF shall determine whether the project is an EIA type project, or an IEE type project, or not required. In making its determination for a project as to the type of environmental assessment, the factors below shall be considered.

- Protection of cultural or religious norms, and historical or religious heritage

- Conservation and protection of biodiversity
- Introduction of exotic or alien species
- Adoption of new technologies
- National security
- Climate change and
- Other factors as the MOECAF may determine

Within fifteen (15) days of receiving the project proposal, the MOECAF shall determine the type of environmental assessment and inform the project proponent in writing about its determination.

(3) IEE

Prior to commencement of the IEE investigations, the project proponent shall inform to the MOECAF in writing as to the organization and person who has selected to undertake the IEE investigation and reporting and MOECAF will check to confirm that such organization and person has been duly registered. The contents which should be included in IEE report is as followings:

- Project description in reasonable detail together with overview and layout maps indicating all relevant features,
- Identification of the project proponent,
- Identification of the IEE experts including which expert is responsible for which part of the IEE report,
- Description of the surrounding environmental conditions of all relevant physical, biological, social and cultural features,
- Identification and assessment of potential adverse impacts,
- Results of the public consultation / public participation process and the project proponent's written response to comments received during that process,
- The environmental protection measures of the project,
- The conclusion of IEE,
- The EMP and
- The budget needed for implementation of the EMP.

The project proponent should disclose information to the public and civil society through local media and arrange the consultation meeting with local communities, potentially project affected persons (PAPs), local authorities, community based organizations (CBO) and civil society.

(4) Review and approval of IEE

After completing all investigations and public consultation, the project proponent shall submit the IEE report to the MOECAF and disclose the IEE report to civil society, PAPs, local communities and other concerned stakeholders by means of local media, at public meeting places and at the offices of the project proponent. Upon receipt of the IEE report, the MOECAF shall make the IEE report available on the website of the MOECAF, invite comments and suggestions from all relevant parties, arrange

public consultation meetings and make a final decision on approval of the IEE report. If MOECAF determines that the IEE report does not satisfy requirements, the MOECAF demand the project proponent to undertake necessary amendments and to provide supplementary information. Upon completion of its review of the IEE report, the MOECAF shall either (i) approve the IEE report, subject to any conditions as may be prescribed and issue an Environmental Compliance Certificate, or (ii) require that the project undergo EIA and cite the reasons for decision, and inform the project proponent of its decision. The MOECAF shall deliver its final decision within sixty (60) days of receipt of an IEE report. All costs incurred in completing the IEE report disclosure and review, including the public consultation process shall be borne by the project proponent.

(5) EIA

All EIA type projects shall undergo scoping. The project proponent shall be responsible to ensure that the scoping and the preparation of the TOR for the EIA report are undertaken in a professional manner and in accordance with the procedures and any applicable guidelines issued and adopted by the MOECAF. During scoping, the project proponent shall provide an opportunity for consultants, relevant authorities, project developers, interested and affected parties to express their view and concerns regarding the proposal before an EIA proceeds. The contents of scoping report are as follows:

- Executive summary
- Context of the project
- Overview of the policy, legal and institutional framework
- Project description and alternatives
- Description of the environment together with maps indicating all relevant features
- Key potential environmental impacts and mitigation measures
- Public consultation and disclosure
- Conclusions and recommendations

The project proponent shall prepare the TOR for the EIA investigations based on the scoping and submit the scoping report and TOR to MOECAF for review and approval. MOECAF shall within fifteen (15) days of receipt of the scoping report and TOR either approve them with or without conditions, or require the project proponent to revise the scoping report and TOR in accordance with comments. The contents of the EIA report are as follows:

- Executive summary
- Introduction (introduction of the project proponent, environmental and social experts)
- Policy, legal and institutional framework
- Project description and alternative selection
- Description of the surrounding environment
- Impact and risk assessment and mitigation measures
- Cumulative impact assessment
- Environmental management plan
- Public consultation and disclosure

(6) Review and approval of EIA

The process from review to public consultation is same as IEE. The decision will be made within ninety (90) days of the receipt of the EIA report. The decision will be (i) approve the EIA report, subject to any conditions as may be prescribed and issue an Environmental Compliance Certificate, or (ii) reject the EIA report and cite reasons for doing so. The project proponent, person or organization which has submitted an EIA, or government organization or other person or organization potentially affected by any adverse impacts of the project shall have the right to file an appeal to the ECC with respect to a decision by the MOECAF to reject or approve an EIA report within thirty (30) days of the date of decision. The ECC shall within thirty (30) days of its receipt of an appeal consider that appeal and make a decision to (i) uphold the decision of the MOECAF, (ii) instruct the MOECAF to require the project proponent to revise and resubmit the EIA report to the MOECAF, or (iii) instruct the MOECAF to alter, revise or cancel its decision on the EIA report and cite its grounds for such instruction.

(7) Environmental Compliance Certificate

For projects requiring an IEE or EIA, no permit to proceed with implementation of the project shall be issued by MIC (Myanmar Investment Commission), any ministry, or any other competent authority without an Environmental Compliance Certificate issued by the MOECAF. When the MIC or other relevant authority has given approval to a project for which a certificate of environmental clearance has been issued, it shall communicate such approval to the MOECAF.

The Environmental Compliance Certificate issued by the MOECAF shall be valid for a period of two years from the date of issuance. The project proponent shall commence substantial implementation of the project within such two years period, and shall notify the MOECAF in writing of the date of commencement not later than thirty days after such commencement.

(8) Monitoring

The project owner shall, during all phases of the project (pre-construction, construction, operation, decommissioning, closure and post closure), engage in continuous, pro-active and comprehensive self-monitoring of the project and activities related thereto, all adverse impacts, and compliance with applicable laws and standards, the Environmental Compliance Certificate and the EMP. The project owner shall timely submit monitoring reports to the MOECAF in accordance with a schedule in the EMP. The monitoring reports shall include:

- Documentation of compliance with all conditions,
- Progress made to date on implementation of the EMP against the submitted implementation schedule,
- Difficulties encountered in implementing the EMP and recommendations for remedying those difficulties and steps proposed to prevent or avoid similar future difficulties,
- Number and type of non-compliance with the EMP and proposed remedial measures and timelines for completion of remediation,

- Accidents or incidents related to the occupational and community health and safety, and the environment, and
- Monitoring data of environmental parameters and conditions as committed in the EMP or otherwise required.

The project owner shall within ten days of completing a monitoring report make the report publicly available on the project's website, at a designated public office as agreed with the MOECAF and at the project offices. Any organization or person may request a digital copy of a monitoring report and the project shall within ten days of receiving such request, submit a digital copy via email or as may otherwise be agreed upon with the requestor.

F.2 Environmental and Social Baseline Data

F.2.1 Population and Area

The population and area of eighteen townships within the zone 1, 7 and 8 are shown in the table below. The increase of population is expected in zone 7 and 8 but the increase is not expected in the zone 1, especially CBO area.

Table 2 Population and Area of Townships

Township	Area (ha)	Population			Household	Density (pop/ha)
		2011	**2025**	2040		
Latha	0.6	34,125	**34,125**	34,125	5,368	564
Lanmadaw	1.3	43,137	**43,137**	43,137	7,334	329
Pabedan	0.6	37,551	**37,551**	37,551	5,366	607
Kyauktada	0.7	34,797	**34,797**	34,797	6,078	496
Botahtaung	2.6	49,134	**49,134**	49,134	8,148	189
Pazundaung	1.1	53,648	**54,822**	56,647	8,258	503
Ahlone	3.4	65,510	**66,684**	68,509	9,021	194
Kyeemyindaing	4.6	115,841	**128,751**	148,835	20,215	253
Sanchaung	2.4	105,208	**106,382**	108,207	17,242	238
Dagon	4.9	24,492	**33,881**	48,488	3,682	50
Bahan	8.5	100,695	**104,216**	109,693	16,339	119
Tarmwe	5.0	191,114	**193,461**	197,113	32,505	383
Mingalar Taung Nyunt	4.9	155,767	**159,288**	164,765	22,732	315
Seikkan	1.2	2,241	**2,241**	2,241	433	19
North Dagon	24.2	221,200	**247,019**	287,188	36,919	91
South Dagon	37.5	370,403	**440,819**	550,371	58,779	99
East Dagon	170.9	145,505	**551,573**	1,183,320	22,734	9
Dagon Seikkan	42.0	120,161	**229,306**	399,111	21,741	29
Total		1,870,529	**2,517,187**	3,523,232	302,894	-

F.2.2 Existing Infrastructure and Services

The existing infrastructure and services of four townships are shown in the table below. The difference in electricity is less however, in terms of piped water supply, sewerage and telephone, the difference is large among the townships.

Table 3 Infrastructure Services

Township	Electricity		Piped Water Supply		Sewage		Sludge Removal from Septic Tank		Telephone (Fixed)		Solid Waste Collection	
	Yes	No	Yes	No	Yes	No		Yes	No	Yes	No	Yes
Latha	100%	0%	87%	13%	93%	7%	69%	31%	76%	24%	99%	1%
Lanmadaw	99%	1%	91%	9%	86%	14%	59%	41%	72%	28%	97%	3%
Pabedan	100%	0%	86%	14%	91%	9%	70%	30%	71%	29%	95%	5%
Kyauktada	100%	0%	82%	18%	82%	18%	65%	35%	74%	26%	92%	8%
Botahtaung	100%	0%	84%	16%	74%	26%	71%	29%	63%	37%	91%	9%
Pazundaung	100%	0%	89%	11%	82%	18%	79%	21%	73%	27%	94%	6%
Ahlone	100%	0%	67%	33%	74%	26%	92%	8%	62%	38%	93%	7%
Kyee Myin Daing	86%	14%	38%	62%	40%	60%	55%	45%	33%	67%	54%	46%
Sanchaung	100%	0%	65%	35%	78%	22%	89%	11%	50%	50%	94%	6%
Dagon	97%	3%	85%	15%	69%	31%	62%	38%	54%	46%	82%	18%
Bahan	99%	1%	86%	14%	84%	16%	85%	15%	50%	50%	90%	10%
Tarmwe	100%	0%	85%	15%	79%	21%	85%	15%	61%	39%	95%	5%
Mingalar Taung Nyunt	100%	0%	91%	9%	78%	22%	84%	16%	59%	41%	95%	5%
Seikkan	100%	0%	80%	20%	100 %	0%	80%	20%	0%	100 %	100 %	0%
North Dagon	98%	2%	40%	60%	51%	49%	51%	49%	19%	81%	92%	8%
South Dagon	94%	6%	42%	58%	47%	53%	47%	53%	19%	81%	61%	39%
East Dagon	79%	21%	26%	74%	31%	69%	36%	64%	10%	90%	74%	26%
Dagon Seikkan	79%	21%	24%	76%	36%	64%	42%	58%	15%	85%	74%	26%
Average	*88%*	*12%*	*40%*	*60%*	*44%*	*56%*	*49%*	*51%*	*26%*	*74%*	*72%*	*28%*

The access to the toilet facilities is shown in the table below. The piped water supply is the main source within zone 1 and the private tube well is the main for zone 7 and 8.

Table 4 Main Water Source for Other Use

	Piped Water Supply System by YCDC	Public Well/Tap	Private Tube Well	Neighbors' Well/Tap (Free of Charge)	Bottled Water	Water Vender	Rain/ Creek/ Canal/ Pond	None
Latha	93%	3%	3%	0%	0%	1%	0%	0%
Lanmadaw	86%	3%	6%	2%	1%	1%	0%	0%
Pabedan	94%	0%	6%	0%	0%	0%	0%	0%
Kyauktada	96%	0%	4%	0%	0%	0%	0%	0%
Botahtaung	92%	2%	2%	0%	0%	3%	1%	0%
Pazundaung	99%	0%	0%	0%	0%	1%	0%	0%
Ahlone	47%	2%	48%	2%	0%	0%	0%	0%
Kyee Myin Daing	17%	2%	46%	9%	0%	8%	17%	0%
Sanchaung	43%	1%	52%	4%	0%	0%	0%	0%

	Piped Water Supply System by YCDC	Public Well/Tap	Private Tube Well	Neighbors' Well/Tap (Free of Charge)	Bottled Water	Water Vender	Rain/ Creek/ Canal/ Pond	None
Dagon	59%	15%	23%	3%	0%	0%	0%	0%
Bahan	82%	1%	12%	2%	1%	2%	0%	0%
Tarmwe	88%	0%	11%	0%	0%	1%	0%	0%
Mingalar Taung Nyunt	96%	2%	1%	1%	0%	0%	0%	0%
Seikkan	60%	20%	20%	0%	0%	0%	0%	0%
North Dagon	26%	1%	45%	5%	0%	21%	3%	0%
South Dagon	29%	2%	38%	5%	0%	20%	5%	1%
East Dagon	20%	1%	45%	5%	0%	21%	8%	0%
Dagon Seikkan	11%	4%	42%	5%	0%	25%	14%	0%
Yangon	*34%*	*2%*	*37%*	*9%*	*0%*	*9%*	*9%*	*0%*

F.2.3 Socio-Economic Situation

The monthly income distribution by township is shown in the figure below. Compared with the average (red dot line in the figure), CBD and IUR have high income distribution and townships in zone 7 and 8 have low income distribution. The high income level township has high educational level.

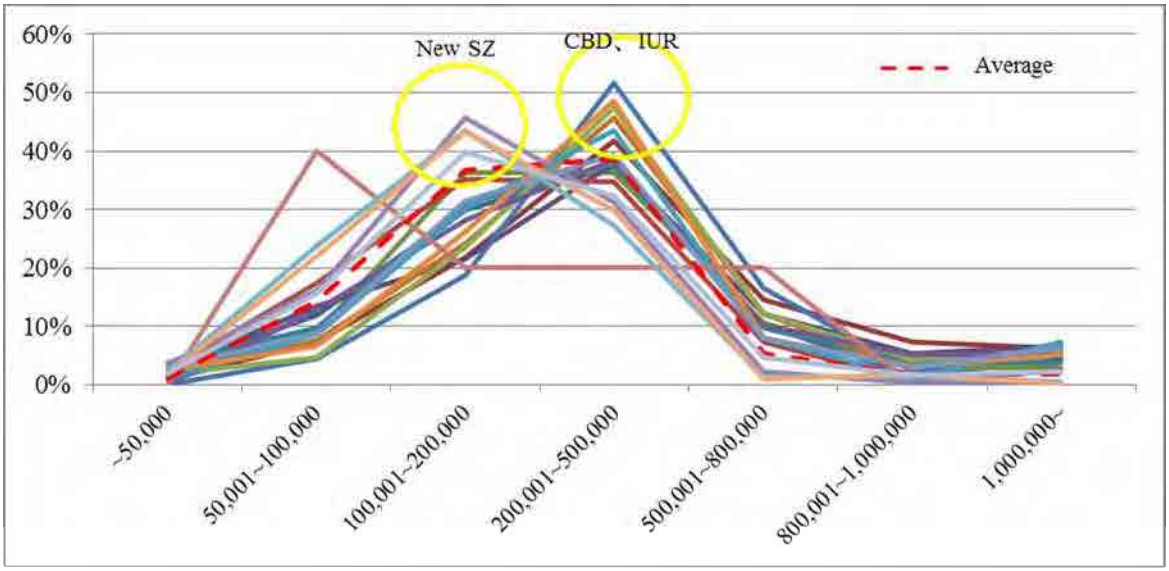


Figure 5 Income Distribution by Township

Table 5 Education Level by Township

	Master Degree/ Doctoral Degree	University	Diploma	High School	Middle School	Primary School	Lower Primary
Latha	9%	39%	2%	18%	17%	5%	11%
Lanmadaw	7%	47%	3%	9%	23%	7%	3%
Pabedan	3%	36%	3%	23%	9%	18%	8%
Kyauktada	0%	32%	4%	24%	27%	5%	7%
Botahtaung	3%	32%	1%	17%	27%	14%	6%
Pazundaung	1%	49%	3%	21%	20%	2%	5%

	Master Degree/ Doctoral Degree	University	Diploma	High School	Middle School	Primary School	Lower Primary
Ahlone	5%	36%	0%	19%	27%	9%	3%
Kyee Myin Daing	1%	25%	0%	8%	28%	22%	16%
Sanchaung	2%	40%	1%	21%	23%	12%	0%
Dagon	0%	46%	0%	18%	15%	10%	10%
Bahan	2%	35%	1%	11%	34%	13%	4%
Tarmwe	2%	33%	1%	19%	31%	9%	5%
Mingalar Taung Nyunt	4%	33%	1%	15%	27%	15%	6%
Seikkan	0%	20%	0%	20%	40%	20%	0%
North Dagon	1%	28%	1%	16%	34%	19%	1%
South Dagon	0%	11%	0%	12%	30%	30%	16%
East Dagon	0%	13%	0%	10%	36%	25%	16%
Dagon Seikkan	0%	12%	0%	8%	30%	31%	18%
Yangon	*1%*	*19%*	*0%*	*12%*	*29%*	*24%*	*15%*

F.2.4 Public Health

The table below shows the number of case and death in case of severe diarrhea by township. In Latha, Lanmadaw, Kyauktada and Dagon, there were no severe diarrhea cases. Many diarrhea cases were reported when the rainy season started, from March to June.

Table 6 Case and Death due to Severe Diarrhea (2012)

Township	Jan		Feb		Mar		Apr		May		Jun		July		Aug		Sep		Oct		Nov		Dec		Total	
	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D
Latha																									0	0
Lanmadaw																									0	0
Pabedan					1																				1	0
Kyauktada																									0	0
Botahtaung	1		3		16		10		9		4		3				1		2		1		2		52	0
Pazundaung	2				3		8		5		3														21	0
Ahlone					2		1		2		5				3		1		3				1		18	0
Kyee Myin Daing	6		1		9		8		17		12		6		6		3								68	0
Sanchaung	1				2		2		7		3				1				1				2		19	0
Dagon																									0	0
Bahan			1		1	1	1		1						1				1						6	1
Tarmwe			2		4		2		4		4				5		1				1				23	0
Mingalar Taung Nyunt	1				3		4		8		4		2		2		3		3		1		2		33	0
Seikkan											1														1	0
North Dagon	5		6		9		14		17		10		11		5		1		2		3		4		87	0
South Dagon	8	1	5		32	1	35		102		60		36		12		8		7		13		9		327	2
East Dagon	1		3		3		10		26		7		6		1		2				2		3		64	0
Dagon Seikkan	4	1			11		60		51		25		5		1		5				2		3		167	1

Source: Yangon Regional Health Department, Ministry of Health
Note: C-no. of case, D-no. of death

The table below shows the cases of dysentery in 2012. The data was collected from the hospitals which are under surveillance. There is no difference among the months.

Table 7 Case of Dysentery (2012)

Township	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total
Latha	2				1	1							4
Lanmadaw													0
Pabedan													0
Kyauktada													0
Botahtaung	1												1
Pazundaung	1		1	1	4			1			2		10
Ahlone	1	2	1	1	5	4	3	4	7	4	4		36
Kyee Myin Daing		1	1	1		1		1	1	1		1	8
Sanchaung													0
Dagon													0
Bahan						4							41
Tarmwe	2	3	2			4		1			3		15
Mingalar Taung Nyunt	4									1			6
Seikkan													0
North Dagon	2	1	5	4		2				2			16
South Dagon	5	10	6	8	7	10	3	7	3	5	9		73
East Dagon	3	11		4	17	11	4	11	8	6	2	5	82
Dagon Seikkan	4	4	3		3	9	6	3	5	2	4	11	54

Source: Yangon Regional Health Department, Ministry of Health

F.2.5 Land Use

The table below shows the land use by township. More than 90 % of the land is already developed in CBD and some townships of IUR. In zone 7 and 8, the land is available for future development.

Table 8 Land Use by Township

Township	Area (km2)	Built-up Area						Urban Development Area	Playground Area	Agricultural Area	Open Spaces	Green Area	Water Surface
		Residential Area	Business Area	Commercial Area	Industrial Area	Public Facilities Area	Built-up Area Total						
Latha	0.60	55 %	0 %	0 %	0 %	45 %	100 %	0 %	0 %	0 %	0 %	0 %	0 %
Lanmadaw	1.31	65 %	10 %	0 %	0 %	25 %	100 %	0 %	0 %	0 %	0 %	0 %	0 %
Pabedan	0.62	76 %	4 %	19 %	0 %	1 %	100 %	0 %	0 %	0 %	0 %	0 %	0 %
Kyauktada	0.70	88 %	11 %	0 %	0 %	0 %	100 %	0 %	0 %	0 %	0 %	0 %	0 %
Botahtaung	2.60	64 %	15 %	0 %	8 %	2 %	88 %	9 %	0 %	1 %	0 %	0 %	0 %
Pazundaung	1.07	78 %	3 %	0 %	8 %	0 %	89 %	10 %	0 %	0 %	0 %	0 %	1 %
Ahlone	3.38	62 %	5 %	0 %	20 %	3 %	90 %	0 %	0 %	0 %	9 %	0 %	1 %
Kyee Myin Daing	4.57	44 %	0 %	0 %	4 %	3 %	51 %	0 %	0 %	45 %	2 %	0 %	1 %
Sanchaung	2.40	92 %	0 %	0 %	0 %	7 %	99 %	0 %	0 %	0 %	1 %	0 %	0 %
Dagon	4.89	48 %	4 %	0 %	0 %	3 %	54 %	0 %	2%	0 %	41 %	3 %	0 %
Bahan	8.47	79 %	1 %	0 %	1 %	1 %	82 %	1 %	0 %	0 %	6 %	5 %	6 %
Tarmwe	4.99	71 %	0 %	0 %	0 %	17 %	88 %	0 %	4 %	1 %	3 %	2 %	1 %

Township	Area (km2)	Built-up Area						Urban Development Area	Playground Area	Agricultural Area	Open Spaces	Green Area	Water Surface
		Residential Area	Business Area	Commercial Area	Industrial Area	Public Facilities Area	Built-up Area Total						
Mingalar Taung Nyunt	4.94	53 %	2 %	1 %	3 %	14 %	83 %	1 5	3 %	0 %	2 %	8 %	3 %
Seikkan	1.17	3 %	9 %	0 %	50 %	0 %	61 %	9 %	0 %	0 %	0 %	0 %	30 %
North Dagon	24.18	56 %	3 %	1 %	0 %	3 %	63 %	17 %	0 %	5 %	10 %	0 %	4 %
South Dagon	37.51	41 %	0 %	0 %	8 %	1 %	51 %	34 %	0 %	7 %	5 %	0 %	2 %
East Dagon	170.87	9 %	0 %	0 %	2 %	1 %	12 %	17 %	0 %	59 %	5 %	2 %	4 %
Dagon Seikkan	42.04	9 %	0 %	0 %	11 %	0 %	20 %	59 %	0 %	11 %	5 %	2 %	1 %

Source: JICA Urban Plan Study, 2012

F.2.6 Air Quality

YCDC is not monitoring the air quality regularly. The existing data of air quality is the results of the measurements of April 2007 and January 2008 by NCEA. The air quality standards are not established yet in Myanmar. Comparing the WHO standards, the values of PM10 and TSP are higher than the standards.

Source: JICA Study Team

Figure 6 Measurement Location of Air Quality

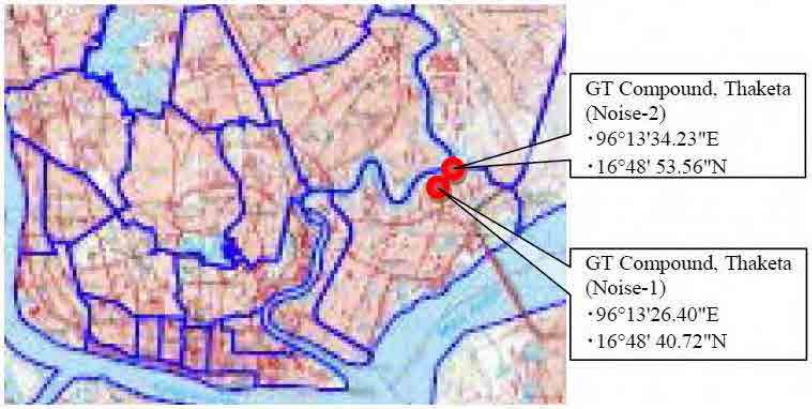
Table 9 Results of Air Quality

Site	Date	TSP (ug/m^3)	PM10 (ug/m^3)	SO2 (ug/m^3)	NO2 (ug/m^3)
1. Commercial site (Traders Hotel)	April, 2007	342.58	177.69	-	-
	Jan, 2008	143.21	71.75	-	-
2. Residential site (IBC)	April, 2007	168.61	68.59	1.14	23.22
	Jan, 2008	118.70	65.30	1.24	22.28
3. Surrounding site near to industrial zone (Forest Department Head Quarter)	April, 2007	127.37	66.95	0.37	28.36
	Jan, 2008	188.66	136.92	0.25	25.42
WHO (2005 updated)		100	50.00	20.00	40.00

Source: DPCC, YCDC

F.2.7 Noise

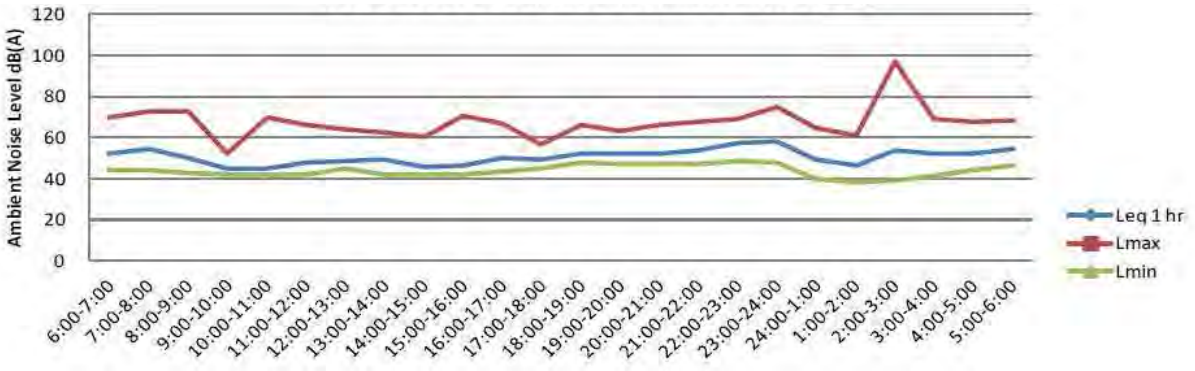
The standards for noise and vibration are not established yet in Myanmar and the measurement has not been conducted. The survey was implemented at two locations in Yangon City by the Project for the Strategic Urban Development Plan of the Greater Yangon shown in the figure below.
The equivalent sound level for one hour was 50 dB (A) and maximum was from 47.7 dB (A) to 96.8 dB (A).



Source: JICA Urban Plan Study, 2012

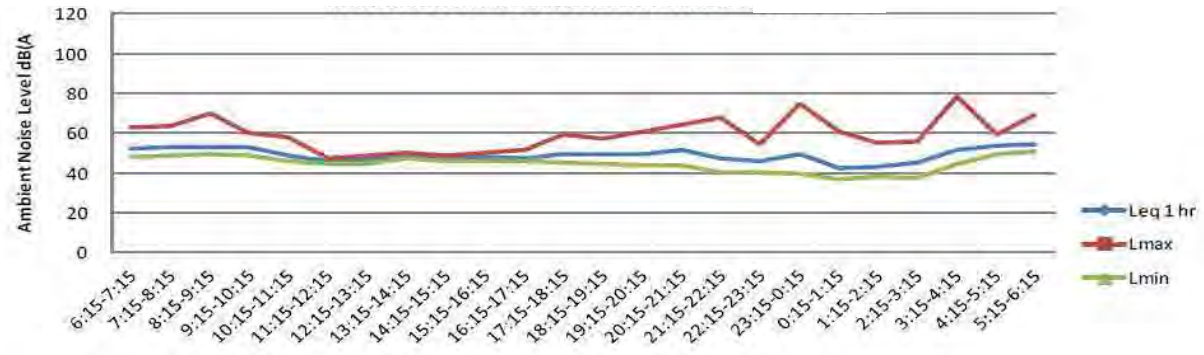
Figure 7 Location of Noise Measurement

The equivalent sound level for one hour varies from 49.25 dB(A) to 50.81 dB(A). At the measurement location 1, the maximum was from 52.4 dB(A) to 96.8 dB(A), and from 47.7 dB(A) to 78.3 dB(A) at location 2. The IFC daytime noise level is 55 dB(A) in the residential/educational area and 70 dB(A) in industrial and commercial area, so that the noise level in two measurement locations are under the IFC standards.



Source: JICA Urban Plan Study, 2012

Figure 8 Noise Level Observation at Thaketa(Noise 1)

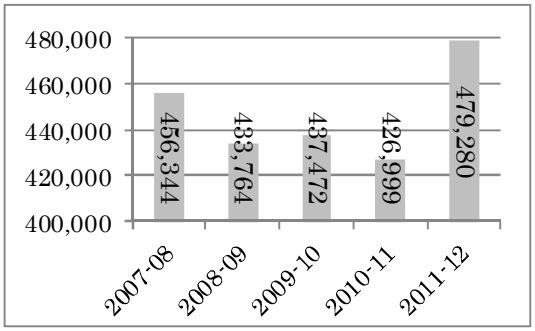


Source: JICA Urban Plan Study, 2012

Figure 9 Noise Level Observation at Thaketa (Noise 2)

F.2.8 Waste

Department of Pollution Control and Cleansing (DPCC) of YCDC is responsible for waste management in Yangon City. DPCC implemented the waste generation survey from 2011 to 2012 and it identified that the waste generation is 0.396 kg per person per day. Among the waste, 76 % is organic, 10% plastic, and 4 % is paper and textile. Waste collected is (1,550 ton per day), around 92 % of total generation. 62 % of collected waste comes from household waste, 35 % from commercial and market waste and 0.1% from the hospital. The amount of disposed waste at the dumping site is 1,250 – 1,400 ton per day in the past 5 years. The amount decreased from 2007 to 2010, but increased from 2010 to 2011. The considerable reasons for decrease are: illegal dumping, recycling activities and capital relocation. The recent increase may be caused by the increase of economic activity and reduction of illegal dumping by control. The amount of waste generation from 2012 to 2013 is 1,690 ton/day.



Source: DPCC, YCDC

Figure 10 Solid Water Amount

There are two main final disposal sites and five temporary sites in Yangon City. These two disposal sites are open and receive waste for 24 hour/day, operated by DPCC. The temporary sites are supervised by DPCC.

Figure 11 Location of Waste Disposal Site

The Htein Bin landfill site is located at 30 km north-west of center of Yangon City. The area is 150 acre (60 ha) and 847 ton /day of solid waste is disposed. The landfill is divided into 16 blocks and one block is 150 m on a side and 3 m depth. The measure to prevent the infiltration to ground is not taken. 10 clocks among 16 blocks are occupied with the solid waste. The Htein Bin landfill accepts the industrial and construction waste and the disposal fee is 5,000 Kyat for first one ton and 2,000 Kyat /ton for the rest of the weight. The medical waste is incinerated at the incinerator located near the Htein Bin landfill. The project is under preparation to generate the electricity and 92% biogas by using the methane gas which will be generated from the solid waste. The construction of the facility may start November 2013 at the earliest.

The Htawe Chaung landfill is located at 26 km north of Yangon City. The area is 150 acre (60 ha) and 612 ton /day of solid waste is disposed. The landfill is open dumping and no measurement to prevent the pollution of soil and groundwater is taken. There is the plan to generate electricity by incinerator.

The recycle activities are implemented by YCDC and the private. The DPCC of YCDC implements the awareness activities to the public and students to enhance the recycle. The amount of recycle waste is 86 ton/day.

Table 10 Recycled Waste

Item	Ton/day
Plastic	5.1
Paper	8.94
Carton	11
Leather	0.1
Iron	0.5
Metal	0.3
Copper	0.3
Lead	0.1
Glass	40.5
Can	5.1

Source: DPCC, YCDC

F.2.9 Cultural Heritage

189 buildings which were constructed before 1950 are registered as cultural heritage buildings by YCDC in 1996. The buildings are located in twenty-one townships and 25 % of the buildings (forty-eight) are located in the Kyauktada and Botahtaung Townships, center of the Yangon City. 49 %

of the heritage buildings are religious buildings such as Pagoda, temple and mosque, and 28 % is used as office buildings.

F.2.10 Fauna, Flora and Biodiversity

The biodiversity inventory has not yet been completed in Myanmar, it is officially stated that there are 153 endangered species. In Greater Yangon, it is recorded that three are threatened animal species and two threatened plant species as shown in the Table below.

Table 11 Endangered Animal Species and Plant

No.	Scientific name	Common name	Family	IUCN, 2011
1	Lissemys punctata 	Indian flap shell turtle	Trionychidae	Endangered (EN) 絶滅危惧IB類
2	Indotestudo elongate 	Yellow tortoise	Testudinidae	Endangered (EN) 絶滅危惧IB類
3	Python molurus divittatus 	Burmese Python	Boidae	Endangered (EN) 絶滅危惧IB類
4	Dipterocarpus alatus 	Kanyin-phyu	Dipterocarpaceae	Endangered (EN) 絶滅危惧IB類
5	Hopea Odorata 	Thin-Gan	Dipterocarpaceae	Vulnerable (VU) 絶滅危惧II類

Source: JICA Urban Plan Study, 2012

F.3 Checklist

F.3.1 Development of Lagunbyin Water Supply System

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) - (b) - (c) - (d) -	(a) The laws and regulations related to EIA are under preparation in Myanmar. Environmental and social considerations were implemented in F/S stage according to JICA Guidelines. (b) - (c) - (d) -
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected in the project design?	(a) Y (b) -	(a) The stakeholder meeting related to the M/P and selection of priority project was implemented in April 2013. The stakeholder meeting to inform the results of IEE study was organized on 17 July 2013. (b) The comments raised by the participants at the first stakeholder meeting were covered by the Study. The questions on the second stakeholders were answered and there are no comments to be reflected to the project design.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) With/Without Project was analyzed. The alternatives for location of WTP and reservoirs were analyzed from land acquisition, involuntary resettlement and land use and the locations were selected.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) Y (b) -	(a) The chlorine storage facility is not included. The chlorine injection facility will be constructed at Lagunbyin WTP and the mitigation measures such as selection of solution which is stable than gas, selection of injection facility which has strong resistance for the acid etc. were proposed. (b) Laws and regulations related to working conditions are not yet established. The safety measures such as protection wears, enough ventilation etc. should be taken followed by the ILO standards.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) -	(a) The effluent standard in Myanmar is not yet established.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) -	(a) There are no standards for disposal of the sludge in Myanmar. The sludge should be disposed at the waste dumping site.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) -	(a) The standards for noise and vibration are not yet established in Myanmar. The standards of IFC (70 dB) shall be applied till the standards will be established. The temporal impact of noise and vibration can be limited under the standards by the proper maintenance of equipment and construction machinery (idling off, installation of mufflers etc.). The construction schedule should be open to the public and the understanding and cooperation from the citizens should be requested.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) -	(a) The extraction of water is not included in the Project.
3 Natural Environment3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a) Protected area does not exist in the Project area.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?(b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?(d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a)N (b)N (c)- (d)-	(a) These are not included in the Project area.(b) These are not included in the Project area.(c) No serious impact is expected.(d) Water will be taken from the Lagunbyin Creek. This is the irrigation canal and aquatic environment may not be affected.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a)N	(a) No intake from groundwater is planned. The water is taken from the Lagunbyin creek but the impact is small as the capacity of the creek is large enough.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a)N (b)- (c)- (d)- (e)- (f)- (g)- (h)- (i)- (j)-	(a) The land for two distribution reservoirs is necessary. The right to use the land belongs to the government (YCDC and Yangon Regional Gov.) and the facilities can be constructed without interruption to the houses nearby so that involuntary resettlement is not expected. (b)- (c)- (d)- (e)- (f)- (g)- (h)- (i)- (j)-
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a)N (b)N	(a) The Project will not adversely affect the living conditions as there is no involuntary resettlement nor land acquisition. The traffic disturbance may be expected to provide impacts on people's daily life and the mitigation measures are described in (1) Impacts during Construction of Category 5 Others.(b) The water intake from the Lagunbyin Creek which is used for irrigation is included in the project, but the permission of intake is obtained from the MOAI and the capacity of the Lagunbyin dam is large enough not to affect the existing water use.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)-	(a) There is no heritage building in zone 7 and 8.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)N	(a) There is no special landscape within the area. The distribution reservoir of Zone 7 will be constructed close to the

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				residential area so that it may disturb the landscape. The height of the building should be lower and the mitigation measures such as tree plantation should be considered.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a)- (b)-	(a) There are no ethnic minorities and indigenous peoples within the Project site and no impact is expected. (b)-
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a)- (b)Y (c)Y (d)Y	(a) Laws and regulations related to working conditions are not yet established. (b) The safety considerations should be prepared by the construction company which should meet the requirement of ILO standards to secure the safety of working conditions. (c) The safety training such as wearing working clothes and work shoes, use of temporary toilet, traffic safety and public health should be provided by the construction company. (d) The education such as behavior and manner of talking to the citizen, the action to the complaint etc. should be provided to the security guard by the construction company.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a)Y (b)- (c)- (d)Y	(a) For the noise, vibration, dust and exhaust gases, the measures such as consideration of construction time, proper maintenance of construction vehicle, idling off and installation of mufflers should be taken. The excavated soil should be disposed of at the existing landfill. (b) No impact is expected. (c) No impact is expected. (d) During construction, the traffic disturbance may be expected. The mitigation measures such as prior notice of construction, provision of proper notice at site and alternative routes should be taken in cooperation with traffic police.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a)Y (b)- (c)Y (d)-	(a) The monitoring system is not yet developed in Myanmar so that the proposed monitoring shall be implemented according to the JICA Guidelines.(b) No items, methods nor frequencies are stipulated. The monitoring of the complaints and actions to the complaint, noise and air quality shall be implemented. (c) The monitoring will be implemented during construction period and the responsible organization is the construction company under the supervision of YCDC. During operation, the monitoring system is proposed and the necessary equipment is included in the project cost.(d) The monitoring system is not yet developed, the report is sent to YCDC only.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a)-	(a)
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)-	(a)
1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.				
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).				
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.				

F.3.2 Modernization of Distribution Zone 1

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host	(a) - (b) - (c) - (d) -	(a) The laws and regulations related to EIA are under preparation in Myanmar. Environmental and social considerations were implemented in F/S stage according to JICA Guidelines. (b) - (c) - (d) -

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		country's government?		
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected in the project design?	(a) Y (b) -	(a) The stakeholder meeting related to the M/P and selection of priority project was implemented in April 2013. The stakeholder meeting to inform the results of IEE study was organized on 17 July 2013. (b) The comments raised by the participants at the first stakeholder meeting were covered by the Study. The questions on the second stakeholders were answered and there are no comments to be reflected in the project design.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) With/Without Project was analyzed. As the component is to rehabilitate the existing reservoirs and replacement of distribution network to improve the water supply service, there are no alternatives.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) N (b) -	(a) It is not included in the component.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) -	(a) There is no effluent from the component.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) -	(a) The operation of the facility will not generate the waste.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) -	(a) The standards for noise and vibration are not yet established in Myanmar. The standards of IFC (70 dB) shall be applied till the standards will be established. The temporal impact of noise and vibration can be limited under the standards by the proper maintenance of equipment and construction machinery (idling off, installation of mufflers etc.). The construction schedule should be open to the public and the understanding and cooperation from the citizens should be requested.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) -	(a) The extraction of water is not included in the Project.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a) Protected area does not exist in the Project area.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a)N (b)N (c)- (d)-	(a) These are not included in the Project area.(b) These are not included in the Project area.(c) No serious impact is expected.(d) Additional water is not used by the component.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a)N	(a) It is not included in the Project.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a)N (b)- (c)- (d)- (e)- (f)- (g)- (h)- (i)- (j)-	(a) There is no involuntary resettlement or land acquisition as the components are the rehabilitation of existing reservoirs and replacement of the distribution network. (b)- (c)- (d)- (e)- (f)- (g)- (h)- (i)- (j)-

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a)N (b)N	(a) The Project will not adversely affect the living conditions as there is no involuntary resettlement nor land acquisition. The traffic disturbance may be expected to provide impacts on people's daily life and the mitigation measures are described in (1) Impacts during Construction of Category 5 Others. (b) Intake of water is not included in the Project.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)N	(a) There are heritage buildings within the project site. The discussion with Building department of YCDC and Yangon Heritage trust (NGO) was held and it was concluded no consideration is required.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)N	(a) The landscape will be worsening due to the dig up of the road, storage of excavated soil and construction materials. To mitigate, the fence to cover the construction site should be considered. The excavated solid should be removed quickly from the site. No impact is expected during operation.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a)- (b)-	(a) There are no ethnic minorities and indigenous peoples within the Project site and no impact is expected. (b)-
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a)- (b)Y (c)Y (d)Y	(a) Laws and regulations related to working conditions are not yet established. (b) The safety considerations should be prepared by the construction company which should meet the requirement of ILO standards to secure the safety of working conditions. (c) The safety training such as wearing working clothes and work shoes, use of temporary toilet, traffic safety and public health should be provided by the construction company. (d) The education such as behavior and manner of talking to the citizen, the action to the complaint etc. should be provided to the security guard by the construction company.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a)Y (b)N (c)N (d)Y	(a) For the noise, vibration, dust and exhaust gases, the measures such as consideration of construction time, proper maintenance of construction vehicle, idling off and installation of mufflers should be taken. The excavated soil should be disposed of at the existing landfill. (b) No impact is expected. (c) No impact is expected. (d) During construction, the traffic disturbance may be expected. The mitigation measures such as prior notice of construction, provision of proper notice at site and alternative routes should be taken in cooperation with traffic police.
5 Others	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a)Y (b)- (c)Y (d)-	(a) The monitoring system is not yet developed in Myanmar so that the proposed monitoring shall be implemented according to the JICA Guidelines. (b) No items, methods nor frequencies are stipulated. The monitoring of the complaints and actions to the complaint, noise and air quality shall be implemented. (c) The monitoring will be implemented during construction period and the responsible organization is the construction company under the supervision of YCDC. During operation, the monitoring system is proposed and the necessary equipment is included in the project cost. (d) The monitoring system is not yet developed, the report is sent to YCDC only.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a)-	(a)
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)-	(a)
1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.				
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).				
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.				

F.3.3 Construction of Chlorination Facility

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) - (b) - (c) - (d) -	(a) The laws and regulations related to EIA are under preparation in Myanmar. Environmental and social considerations were implemented in F/S stage according to JICA Guidelines. (b) - (c) - (d) -
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) -	(a) The stakeholder meeting related to the M/P and selection of priority project was implemented in April 2013. The stakeholder meeting to inform the results of IEE study was organized on 17 July 2013. (b) The comments raised by the participants in the first stakeholder meeting were covered by the Study. The questions on the second stakeholders were answered and there are no comments to be reflected to the project design.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) With/Without Project was analyzed.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) Y (b) -	(a) The chlorine storage facility is not included. The mitigation measures such as selection of solution which is stable than gas, selection of injection facility which has strong resistance for the acid etc. were proposed. (b) Laws and regulations related to working conditions are not yet established. The safety measures such as protection wears, enough ventilation etc. should be taken followed by the ILO standards.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) -	(a) There is no effluent from the component.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) -	(a) The operation of the facility will not generate the waste.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) -	(a) There is no noise and vibration by the operation of the facility.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) The extraction of water is not included in the component.
3 Natural Environment3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a) Protected area does not exist in the Project area.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a)N (b)N (c)- (d)-	(a) These are not included in the Project area.(b) These are not included in the Project area.(c) No serious impact is expected.(d) Additional water is not used by the component.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a)N	(a) It is not included in the component.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a)N (b)- (c)- (d)- (e)- (f)- (g)- (h)- (i)- (j)-	(a) There is no involuntary resettlement or land acquisition as the disinfection facility will be constructed within the existing facility. (b)- (c)- (d)- (e)- (f)- (g)- (h)- (i)- (j)-
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a)N (b)N	(a) There is no adverse impact on living conditions of inhabitants. (b) Intake of water is not included in the Project.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)N	(a) There is no heritage building near around the project site.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)N	(a) The construction will be implemented within the existing site so that no impact on landscape is expected.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a)- (b)-	(a) There are no ethnic minorities and indigenous peoples within the Project site and no impact is expected. (b)-

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a)- (b)Y (c)Y (d)Y	(a) Laws and regulations related to working conditions are not yet established. (b) The safety considerations should be prepared by the construction company which should meet the requirement of ILO standards to secure the safety of working conditions. (c) The safety training such as wearing working clothes and work shoes, use of temporary toilet, traffic safety and public health should be provided by the construction company. (d) The education such as behavior and manner of talking to the citizen, the action to the complaint etc. should be provided to the security guard by the construction company.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a)Y (b)- (c)- (d)-	(a) The construction will be implemented within the existing facility so that the impact can be negligible. As the general measures, consideration of construction time, properly maintenance of construction vehicle, idling off and installation of mufflers will be taken. (b) No impact is expected. (c) No impact is expected. (d) The construction will be implemented within the existing site so that the traffic congestion is not expected.
5 Others	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a)Y (b)- (c)Y (d)-	(a) The monitoring system is not yet developed in Myanmar so that the proposed monitoring shall be implemented according to the JICA Guidelines. (b) No items, methods nor frequencies are stipulated. The monitoring of the complaints and actions to the complaint during construction. The monitoring of residual chlorine and daily check of the injection facility shall be implemented. (c) The monitoring will be implemented during construction period and the responsible organization is the construction company under the supervision of YCDC. During operation, the monitoring system is proposed and the necessary equipment is included in the project cost. (d) The monitoring system is not yet developed, the report is sent to YCDC only.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a)-	(a)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)-	(a)
1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.				
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).				
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.				

F.4 Monitoring Form

F.4.1 Development of Lagunbyin Water Supply System

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

<Construction Phase>

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from YCDC	

2. Pollution

- Noise

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB				70	
Noise level at route of distribution main	dB				70	

* IFC General Health, and Safety (EHS) Guidelines, April 2007

- Air Pollution

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
At WTP construction site						
NO_2	$\mu g/m^3$			-	$40\mu g/m^3$:Annual mean $200\mu g/m^3$ 1-hour mean	
SO_2	$\mu g/m^3$			-	$20\mu g/m^3$:24 hour mean	
PM_{10}	$\mu g/m^3$			-	$50\mu g/m^3$ 24-hour mean	
At distribution main construction site						
NO_2	$\mu g/m^3$			-	$40\mu g/m^3$:Annual mean $200\mu g/m^3$ 1-hour mean	
SO_2	$\mu g/m^3$			-	$20\mu g/m^3$:24 hour mean	
PM10	$\mu g/m^3$			-	$50\mu g/m^3$ 24-hour mean	

***** Air Quality Guidelines Global Update 2005, WHO

<Operation Phase>

- Water Quality of Raw Water at Water Intake Point

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Turbidity	NTU			-	Dry season: 20 – 70 Rainy season: 20 - 250	

* WHO Guidelines for Drinking-water Quality, 4th edition

- Water Quality of Treated Water at WTP

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
pH				-	6.5 – 8.5	
Turbidity	NTU			-	5	
Colour	TCU			-	15	
Taste				-	Acceptable	
Odor				-	Acceptable	
Residual chlorine	mg/l			-	>0.5mg/L	
Total Coliforms	No/100mL			-	0	
Fecal coliforms	No/100mL			-	0	

* WHO Guidelines for Drinking-water Quality, 4th edition

- Water Quality at the end of distribution

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Residual chlorine	mg/l				>0.2 mg/L	

* WHO Guidelines for Drinking-water Quality, 4th edition

- Water Flow

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Water flow at reservoir of zone 7	m^3/min			-	< 81.3m^3/min	
Water flow at reservoir of zone 8	m^3/min			-	< 97.2m^3/min	

* Planned maximum water amount on Feasibility Study

F.4.2 Modernization of Distribution Zone 1

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

<Construction Phase>

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from YCDC	

2. Pollution

- Noise / Vibration

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level at construction site of distribution main	dB				70	

* IFC General Health, and Safety (EHS) Guidelines, April 2007

- Air Pollution

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
At route of distribution main						
NO_2	$\mu g/m^3$				40$\mu g/m^3$:Annual mean 200$\mu g/m^3$ 1-hour mean	
SO_2	$\mu g/m^3$				20$\mu g/m^3$:24 hour mean	
PM_{10}	$\mu g/m^3$				50$\mu g/m^3$ 24-hour mean	

***** Air Quality Guidelines Global Update 2005, WHO

<Operation Phase>

- Water Flow

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Water flow at Kokin reservoir	m^3/min			-	< 100.1m^3/min	
Water flow at Central reservoir	m^3/min			-	< 199.2m^3/min	

* Planned maximum water amount on Feasibility Study

- Water Quality at the end of distribution

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Residual chlorine	mg/l				0.2 mg/L	

* WHO Guidelines for Drinking-water Quality, 4th edition

F.4.3 Construction of Chlorination Facility

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

<Construction Phase>

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from YCDC	

<Operation Phase>

- Water Quality at the end of Distribution

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Residual chlorine	mg/l				0.2 mg/L	

* WHO Guidelines for Drinking-water Quality, 4th edition

- Water Quality at exit of Nyaunghnapin WTP

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Residual chlorine	mg/l				0.5 mg/L	

* Planned Value on Feasibility Study

- Water Quality at exit of Hlawga No.1 PS

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Residual chlorine	mg/l				0.5 mg/L	

* WHO Guidelines for Drinking-water Quality, 4th edition

- Water Quality at exit of Yegu PS

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Residual chlorine	mg/l				0.5 mg/L	

* WHO Guidelines for Drinking-water Quality, 4th edition

- Water Flow

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Water flow at Nyaunghnapin WTP	m^3/day			-	< 409,200m^3/day	
Water flow at Hlawga No.1 PS	m^3/day			-	< 239,000m^3/day	
Water flow at Yegu PS	m^3/day			-	< 187,000m^3/day	

* Planned maximum water amount on Feasibility Study

F.5 Minutes of Public Consultation Seminar

Minutes of Public Consultation Seminar on
The Project for the Improvement of Water Supply,
Sewerage and Drainage System in Yangon City

Venue: Kandawgyi Palace Hotel (Yangon)
Date: 17 July 2013 (Wednesday)
Time: 14:00 am – 16:30 pm
Attendance:
As attached.
Agenda:
1) Opening Session
2) Presentation on the Priority Projects for Water Supply, Sewerage and Drainage System
3) Questions and Answers
4) Closing Session

Minutes:

1. Master announced the opening of the Public Consultation Seminar on the Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City at 14:00 am.
2. Master called for Opening Speech of H. E. U Kyaw Soe, Secretary of Yangon City. U Kyaw Soe gave an opening speech.
3. Master called for Opening Remark of Mr. Akihito Sanjo, Senior Representative of JICA Myanmar Office. Mr. Sanjo gave an opening remark.
4. Master called for the explanation. Mr. Sato of JICA Study Team made a presentation on “Outline of the JICA Project and Components of priority projects for water supply”, with the introduction of seminar agendas and the explanation of study schedule at the beginning.
5. Master called for the explanation and Mr. Miyamoto of JICA Study Team made a presentation on Priority Project for Sewerage System and Improvement of Kandawgyi Lake.
6. Master called for the explanation and Mr. Ohno of JICA Study Team made a presentation on Tariff Setting for Water Supply System.
7. Master called for the explanation and Mr. Nishimaki of JICA Study Team made a presentation on Tariff Setting for Sewerage System.
8. Master called for the explanation and Ms. Yamada of JICA Study Team made a presentation on Environmental and Social Considerations.

9. Master called for questions from audience for agenda 3).
   a) Mr. Than Myint, Myanmar Engineering Society asked the questions:

      ✓ The drainage system was not explained in the presentation though the drainage system is included in the study name. Is it included in the study?
      ✓ The drainage plan was made for whole Yangon City?
      Mr. Miyamoto answered the question that:
      ✓ The drainage system was included in the Master Plan, which was presented in the previous public consultation seminar.
      ✓ The master plan for drainage system covers whole Yangon City.

   b) Prof. Dr. Khin Ni Ni Thein, WRTC Myanmar made a comment to wrap up the seminar and questions.

      ✓ She gave good rating to the presentation as well as the study contents and she appreciated that the questions she made in the previous public consultation seminar (financial analysis, environmental and social considerations etc.) were covered by this presentation.
      ✓ She requested YCDC to follow the suggestions of JICA Study Team related to the tariff setting and environmental and social consideration, and suggest translating the presentation of tariff into Myanmar and announcing to the public.
      ✓ She asked that the transmission pipe from Inya Lake to Kandawgyi Lake costs too much and is not good idea. She suggested that to educate the people not to discharge the waste is better way to improve the water quality.
      Ms. Yamada answered the question that the transmission pipe exists already so there is no need for additional cost. Mr. Momose thanked her suggestions.

   c) Dr. Tha Kyan, Botahtaung Township Development & Support Committee made suggestions as follows:

      ✓ Tariff setting for sewerage system is quite interesting but a little early for the citizens. So let start from hotels, restaurant and industrial.
      Mr. Momose thanked his suggestions.

   d) Ms. Than Than Soe, Director (Rtd), Department of Human Settlement & Housing development, Min. of Construction gave the questions and comments that:

      ✓ Ngamoyeik Plan is considered in the Master plan?
      ✓ The water from Lagunbyin system will be serviced to the Thilawa SEZ?
      Mr. Momose answered that the Ngamoyeik plan is incorporated into the master plan and the water can be distributed to Thilawa SEZ.

10. Master announced the closing of the consultation seminar and the seminar was adjourned at 16:30 pm.

Attachment 1

List of Participants

Name	Title	Organization
U Min Swe	Regional Chief Administrator	Irrigation Department
U Kyi Tin	Director	Department of Development Affairs
U Maung Maung Khin	Advisor	YCDC
Dr. Khin Ni Ni Thein	Chairman	Water Resource Training Centre
U Than Myint	Patron	Myanmar Engineering Society
U Percy Lao	Advisor	Myanmar Engineering Society
Dr. Khin Maung Lwin	Advisor	Asia Development Bank
Daw Than Than Soe	Director (Retired)	Department of Human Settlement and Housing
U Kyaw Soe	Secretary	YCDC
U Soe Si	Committee Member (7)	YCDC
U Myat Thet	Head of Department	Department of City Planning & Land Admin
U Maung Maung Zaw	Head of Department	Department of Engineering (Building)
Dr. Myat Mon Aye	Head of Department	Health Department
U Yi Win	Head of Department	Department of Co-ordination
U Aung San Win	Deputy Head of Dept	Department of Engineering (Water & Sanitation)
U Toe Aung	Deputy Head of Dept	Department of City Planning & Land Admin
U Win Hlaing Htun	Assistant Head of Dept;	Department of City Planning & Land Admin
U Khin Maung Phue	Assistant Head of Dept;	Department of Engineering (Water & Sanitation)
U Aung Khin Zaw	Assistant Head of Dept;	Department of Engineering (Water & Sanitation)
U Myo Thein	Assistant Head of Dept;	Department of Engineering (Water & Sanitation)
U Thein Min	Assistant Head of Dept;	Department of Engineering (Water & Sanitation)
Dr. Myint Than Tun	Head of Sub-Dept;	Department of Engineering (Water & Sanitation)
U Maung Maung Htay	Head of Sub-Dept;	Department of Engineering (Water & Sanitation)
U Htin Lin Kha	Head of Sub-Dept;	Department of Engineering (Water & Sanitation)
Daw Thwet Naing Oo	Head of Sub-Dept;	Department of Engineering (Water & Sanitation)
Daw Wai Wai Myint	Head of Sub-Dept;	Department of Engineering (Water & Sanitation)
Daw Khin Aye Myint	Head of Sub-Dept;	Department of Engineering (Water & Sanitation)
Daw Aye Aye Mar	Assistant Engineer	YCDC Water and Sanitation Dept;
Daw Pyae Pyae Phyoe	Flat	YCDC, Urban Planning Dept;
Daw New Thazin	Sub Assistant Engineer	YCDC, Urban Planning Dept;
Daw Thiri Ko Ko	Flat	YCDC, Urban Planning Dept;
U Khaing Zaw Win	Assistant Chief Engineer	YCDC
U Moe Htein Linn	Assistant Engineer	YCDC
U Myint Win	Sub Assistant Engineer	YCDC
U Than Htay	Assistant Engineer	YCDC
U Zaw Naing Oo	Sub Assistant Engineer	YCDC
U Win Htway	Assistant Engineer	YCDC
U Kyaw Kyaw Oo	Assistant Engineer	YCDC
U Nay Lin	Assistant Engineer	YCDC
Daw Nandar Lin	Assistant Engineer	YCDC
Daw Moe Nilar Aung	Assistant Engineer	YCDC (Road and Bridge Dept;)
Daw Moe Moe	Assistant Engineer	YCDC (Road and Bridge Dept;)
U Lwin Min	Regional Chief administrator	Latha Township Management Department
U Min Aung Lynn	Regional Chief administrator	Latha Township YCDC
U Kyi Win	Chairman	Latha Township Development & Support Committee
U Kyaw Zin	Regional Chief administrator	Lanmadaw Township Management Department
U Khin Maung Gyi	Regional Chief administrator	Lanmadaw Township YCDC
U Htay Aung	Chairman	Lanmadaw Township Development & Support

		Committee
	Regional Chief administrator	Pabedan Township Management Department
U Than Win	Regional Chief administrator	Pabedan Township YCDC
U Ba Than	Chairman	Pabedan Township Development & Support Committee
U Myo Naing	Regional Chief administrator	Kyauktada Township Management Department
U Aung Zaw Moe	Regional Chief administrator	Kyauktada Township YCDC
U Thant Zaw Oo	Regional Chief administrator	Botahtaung Township Management Department
U Yei Myint	Regional Chief administrator	Botahtaung Township YCDC
Dr. Tha Nyan	Chairman	Botahtaung Township Development & Support Committee
U Kyaw Zay Ya	Regional Chief administrator	Pazuntaung Township Management Department
U Zaw Myint	Regional Chief administrator	Pazuntaung Township YCDC
U Nyan Win	Chairman	Pazuntaung Township Development & Support Committee
U Than Naing	Regional Chief administrator	Alone Township Management Department
U Thein Zaw	Regional Chief administrator	Alone Township YCDC
U Own Myint	Chairman	Alone Township Development & Support Committee
U Than Hlaing	Regional Chief administrator	Dagon Township YCDC
U Kyaw Ye Thway	Regional Chief administrator	Kyee Myint Daing Township Management Department
U Nyo Thin Aung	Regional Chief administrator	Kyee Myint Daing Township YCDC
U Kar Si/ U Win Zaw	Chairman	Kyee Myint Daing Township Development & Support Committee
U Tin Oo	Regional Chief administrator	Sanchaung Township YCDC
U Aung Lin	Chairman	Sanchaung Township Development & Support Committee
U Zaw Lwin Aung	Regional Chief administrator	Bahan Township YCDC
U Aung Kyaw Soe	Regional Chief administrator	Tarmwe Township YCDC
U Zaya Own	Regional Chief administrator	Mingalar Taungnyut Township Management Department
U Kyaw Soe	Regional Chief administrator	Mingalar Taungnyut Township YCDC
U Khin Maung Kyway/ U Than Hote	President	Mingalar Taungnyut Township Development & Support Committee
U Tun Win	President	Seitkan Township Development & Support Committee
U Thein Htay	Regional Chief administrator	New-Dagon (East) Township YCDC
U Win Naing/ U Soe Min	President	New-Dagon (East) Township Development & Support Committee
U Hla Thein	Regional Chief administrator	New-Dagon(South) Township YCDC
U Tin Maung Nyein	President	New-Dagon (South) Township Development & Support Committee
U Tin Nyunt	Regional Chief administrator	New-Dagon (North)Township Management Department
U Myat Maw Oo	Regional Chief administrator	New-Dagon(North) Township YCDC
U Ko Ko Lay	President	New-Dagon (North) Township Development & Support Committee
U Myo Soe Moe	Regional Chief administrator	Dagon Seitkan Township Management Department
U Kyaw Sein	Regional Chief administrator	Dagon Seitkan Township YCDC
U Soe Maung	President	Dagon Seitkan Township Development & Support Committee
U Kyaw Aye	Regional Chief administrator	Tharketa Township YCDC
U Aung Ko Zaw	President	Tharketa Township Development & Support Committee
U Myint Wai	Regional Chief administrator	Dawbon Township Management Department
	Regional Chief administrator	Dawbon Township YCDC
U Aung Myint	President	Dawbon Township Development & Support Committee
MRTV	Daw Mar Lwin Oo/ Daw War War Min	MRTV- News
MRTV-4	Daw Ei Theingi Myint	
Skynet	U Zaw Ye Aung	

City News		
MWD	U Soe Min Aung/ U Zin Ko Ko	
Weekly Eleven		
Snap Shot		
Popular News		
Shwe Naing Ngan Thit		
Union Daily		
Myanmar Freedom Daily		
Pe Tin Than Journal		
Myanmar Freedom Daily	Dennis Aung Aung	
The Messenger	Tin Maung Oo	
7 Day News		
The Farmer		
7 Day News	Senior Reporter	Ei Phyu Mar
Myanmar Freedom Daily	Senior Reporter	Soe Sandi Oo
Win Thet Maw	Senior Reporter	Unity
Wai Wai Hnin	Reporter	Flower News
Zayar Myat Khaing	Deputy CE	Monitor News Irr.
Reporter Journal		Moe Lwin Thet
Mr. Park Keon-Soo	1st Secretary	Embassy of the Republic of Korea
Mr. Bae Hyun-Jin	Engineer	K-water
Emilie Röell	Trainee Operations Section	Office of the European Union in Myanmar
Henrice Stöbesand	Research Assistant	German Embassy of Yangon
Ms. Winnie	Central Secretary	International Enterprise of Singapore
Mr. Aung Khine Tun	Senior External Relation Coordinator	CESVI- Myanmar
Dr. Maung Maung		M.Y Associates Co., Ltd.
Mr. Akihito SANJO	Senior Representative	JICA Myanmar Office
Ms. Noriko SAKURAI	Project Formulation Adviser	JICA Myanmar Office
Ms. Myat Thuzar		JICA Myanmar Office
Mr. Masaru MATSUOKA	JICA Expert	JICA Expert
Mr. Kazufumi Momose		JICA Study Team
Mr. Hirotaka Sato		JICA Study Team
Mr. Masafumi Miyamoto		JICA Study Team
Mr. Atsuo Ohno		JICA Study Team
Mr. Hiroshi Nishimaki		JICA Study Team
Mr. Kaoru Kariya		JICA Study Team
Mr. Yasuhiko Morita		JICA Study Team
Ms. Shoko Yamada		JICA Study Team
Ms. Khin Latt Cho		JICA Study Team
Ms. Hsu Mon Win		JICA Study Team
Ms. May The Phyu		JICA Study Team

Attachment 2

Comments from the Participants

1. Prof. Dr. Khin Ni Ni Thein, Founder and President, Water, Research and Training Center (WRTC) Myanmar, IWRM Expert, Sustainable Water Resources Development Standing Committee
   1) Study schedule and area: well organized. Good
   2) Water Supply: very good
   3) Sewerage system: also very good but we still need to consider the appropriate use of treated water before its disposal
   4) Tariff: the definition of non-domestic use need to expand.

   Suggestions: *we need to take drainage study.
   1) YCDC should follow up the recommendations from tariff setting principles. The presentation is "S".
   2) YCDC should translate presentation 3 and 4 into Myanmar language and invite all NGOs and Cos and make public relation event ASAP.
   3) Public consultation to limited invitees only needs to expand to NGOs. To seek public acceptance. Need more stakeholders' participation. Water transfer from Inya Lake to Kandawgyi is going to cause a major problem. We need to seriously reconsider.
   4) Water allocation 30 MGD to Yangon City and 10 MGD to SEZ is reasonable.
   5) Can we get soft-copy of all presentation and calculations behind the last presentation? Result of EIA, SIA and mitigation measures.

2. Dr. Tha Nyan, Botataung Township
   Tariff setting for sewerage system quite interesting. If we start tariff for sewerage we can help to get full cost recovery.
   But it may be a little early for country wise. Shall we start from hotels, restaurant, condominium, industrial zone, etc. as a test case.

3. Dr. Than Than Soe, Director (Rtd), Department of Human Settlement & Housing Development, Ministry of Construction
   - Ngamoyeik Phase 2 has now been operating. By the year 2015, how will YCDC be implemented of plans for transmission main, distribution system to become true for the Master Plan (JICA dream)?
   - Will the Lagunbyin water supply system fully served for Thilawa SEZ. If not, what proposed plans to meet the demand of Thilawa SEZ?
   - For the modernization of water supply zone 1 is JICA ODA will take into account on implementation, by means of financial support?

- My opinion. Master Plan for the improvement of Yangon City is important. Implementation works (short, mid, long term programme) will also important.

4. Dr. Khin Maung Lwin, National Consultant, ADB

Tariff setting is a necessity but it needs a series of public consultation meetings involving every actor/stakeholder/consumer.

People's behavior play critical role in sustainability of the system.

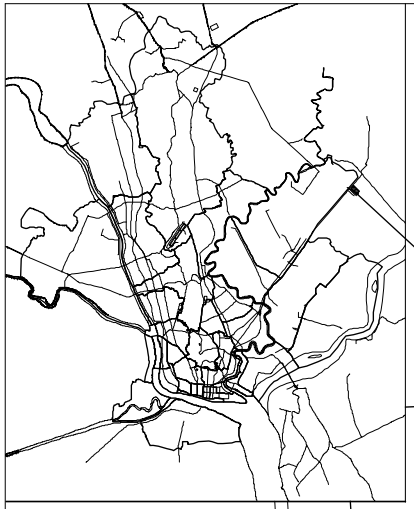
It is very interesting to see the sewerage tariff set in Manila and Singapore. Their experiences need to be shared with YCDC to adopt this innovation by all citizens of Yangon.

G DRAWINGS OF FACILITIES

TABLE OF CONTENTS

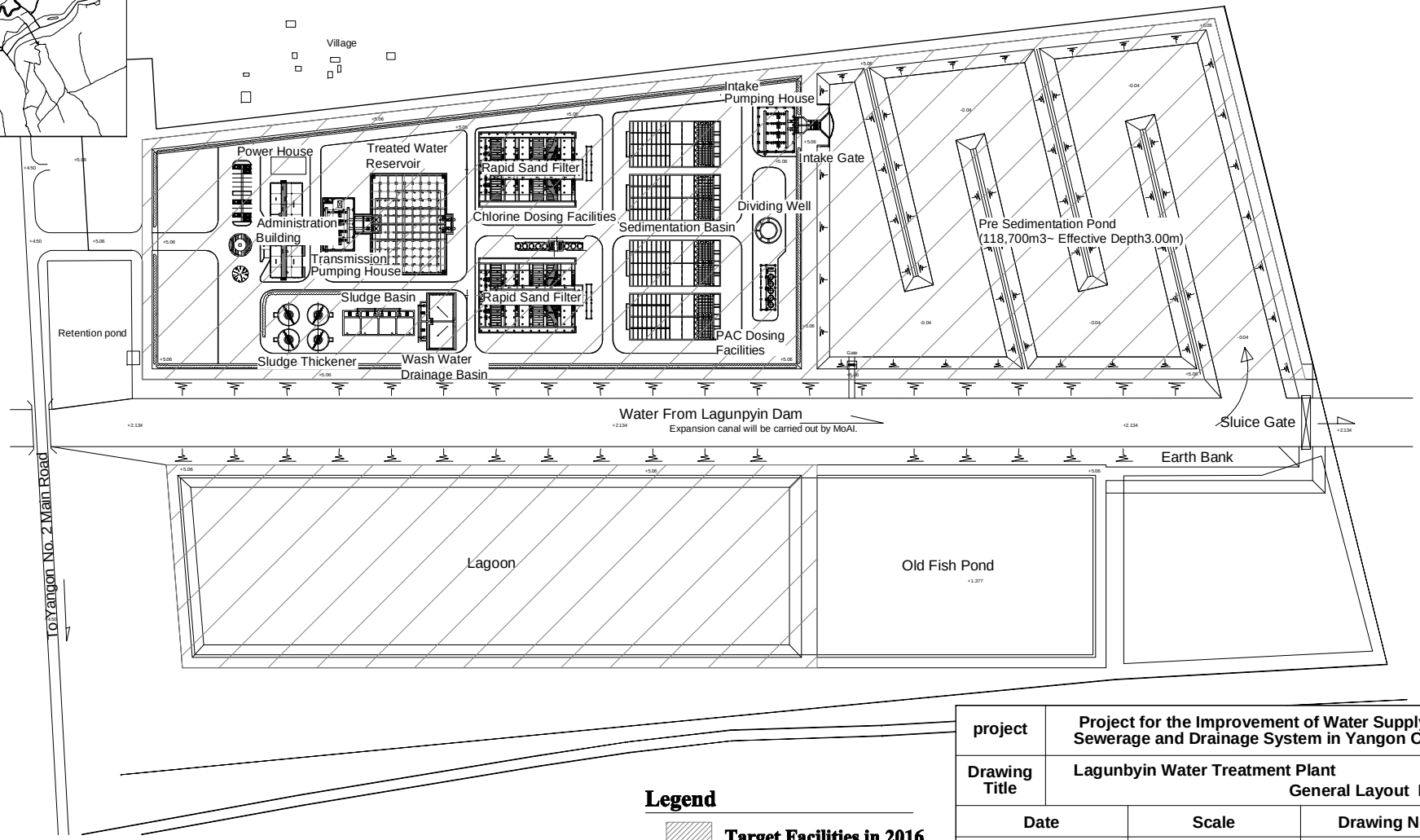
Lagunbyin Water Treatment Plant General Layout Plan

40MGD=181,800m3/day



Lagunpyin WTP

N



Legend

Target Facilities in 2016

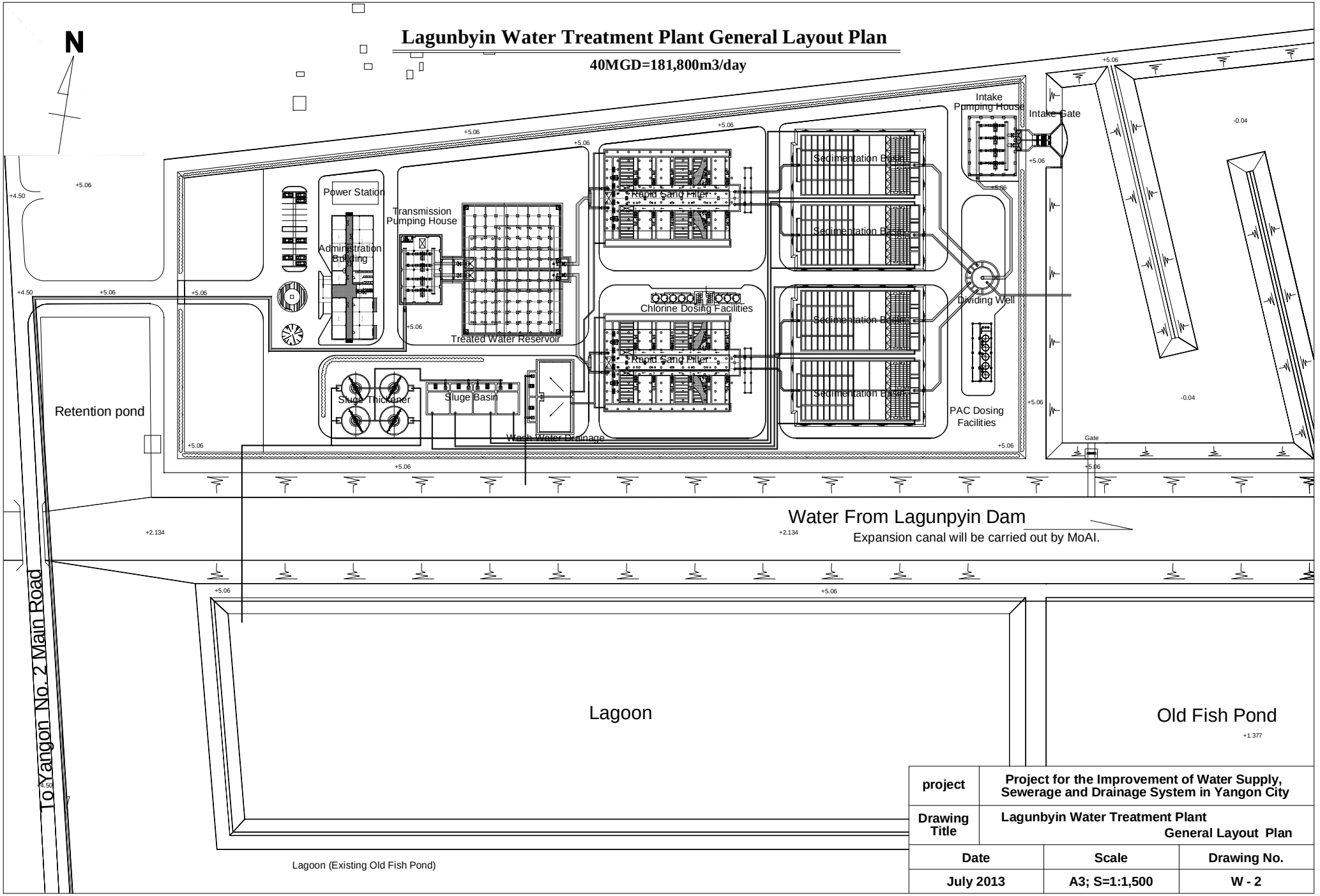
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Lagunbyin Water Treatment Plant General Layout Plan

Date	Scale	Drawing No.
July 2013	A3; S=1:2,500	W - 1

G-3

Lagunbyin Water Treatment Plant General Layout Plan

40MGD=181,800m3/day



project	**Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City**
Drawing Title	**Lagunbyin Water Treatment Plant General Layout Plan**

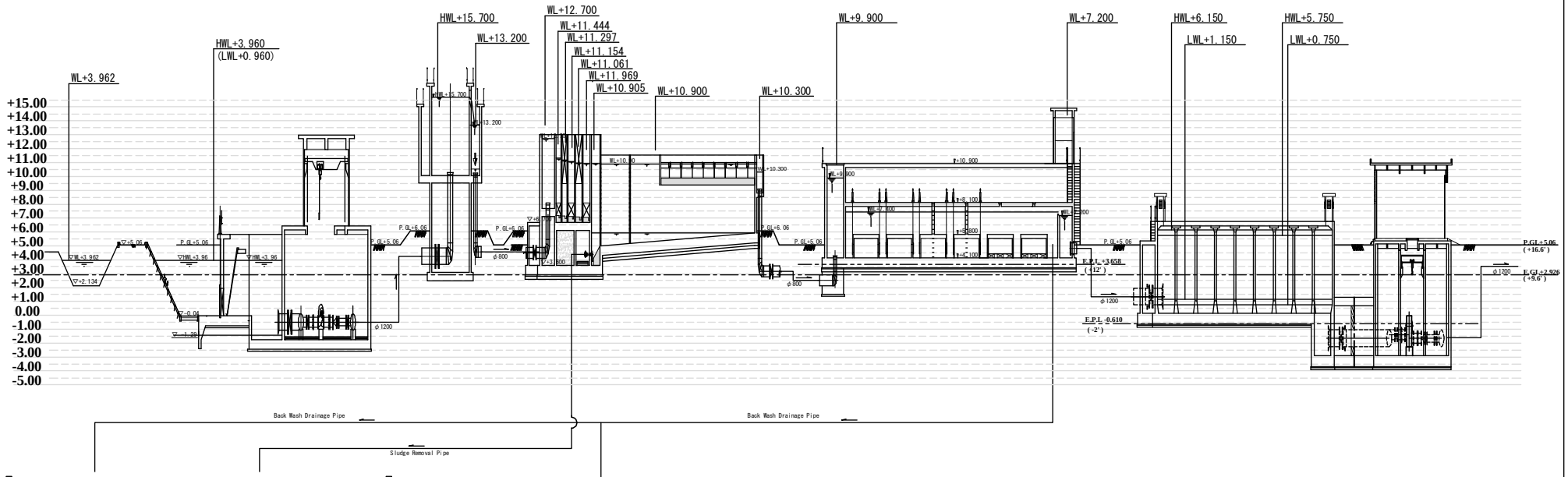
Date	**Scale**	**Drawing No.**
July 2013	**A3; S=1:1,500**	**W - 2**

Lagunbyin WTP Water Level Chart

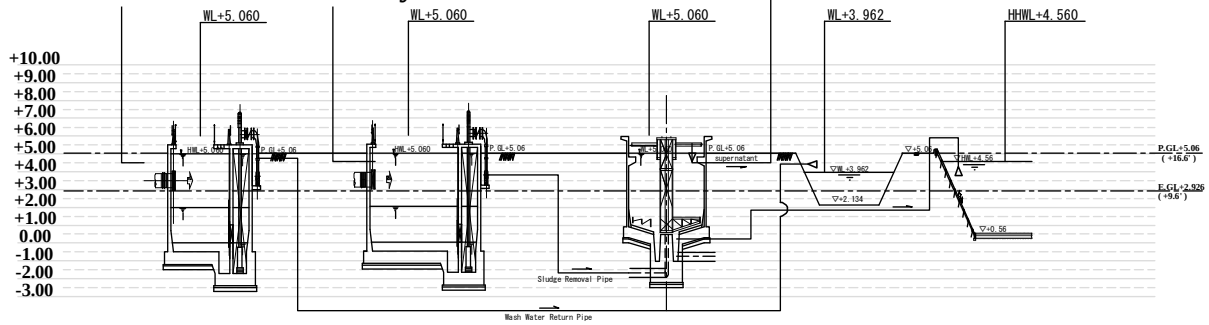
40MGD=181,800m3/day

[Clear Water Treatment System]

Canal	Pre-Sedimentation Pond	Intake Gate and Pumping	Dividing Well	Recieving Well Mixing Tank Flocculation Basin	Sedimentation Basin	Rapid Filter	Post-Chlorine Mixing Basin	Clear Water Reservoir	Water Transmission Pumping Station
	1 Units	4 Units (1 Stand-by)	1 Units	4 Units x 2 Compartments	4 Units x 2 Compartments Tube Settler System	6 Units x 4 Compartments	2 Compartments Horizontal Baffled	2 Compartments	4 Units (1 Stand-by)



[Wastewater Treatment System]

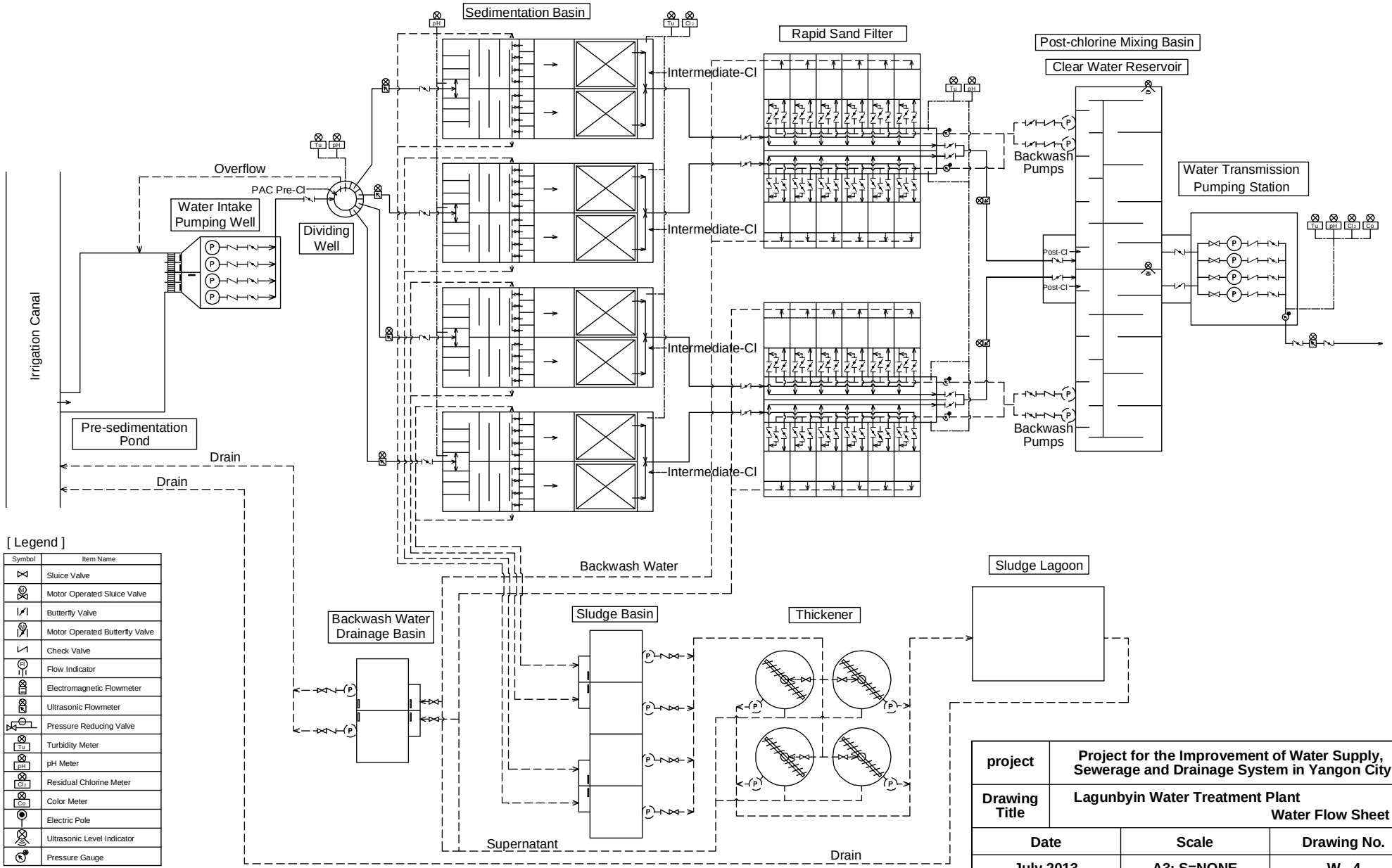


Wash Water Drainage Basin	Sludge Basin	Thickener	Canal Crossing	Lagoon
2 Units	4 Units	4 Units	Pipe Bridge	1 Unit

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Lagunbyin Water Treatment Plant Water Level Chart		
Date		Scale	Drawing No.
July 2013		A3; S=NONE	W - 3

Lagunbyin WTP Water Flow Sheet

40MGD=181,800m3/day



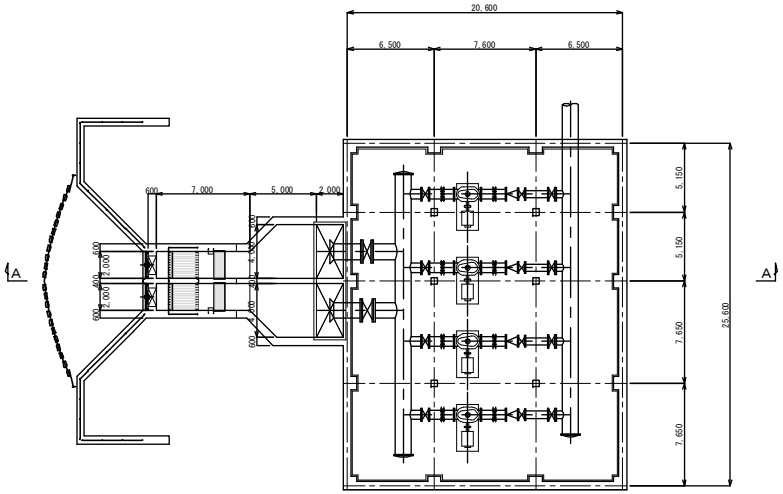
[Legend]

Symbol	Item Name
	Sluice Valve
	Motor Operated Sluice Valve
	Butterfly Valve
	Motor Operated Butterfly Valve
	Check Valve
FI	Flow Indicator
	Electromagnetic Flowmeter
	Ultrasonic Flowmeter
	Pressure Reducing Valve
Tu	Turbidity Meter
pH	pH Meter
Cl_2	Residual Chlorine Meter
Co	Color Meter
	Electric Pole
	Ultrasonic Level Indicator
	Pressure Gauge

project	**Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City**	
Drawing Title	**Lagunbyin Water Treatment Plant Water Flow Sheet**	
Date	**Scale**	**Drawing No.**
July 2013	**A3; S=NONE**	**W - 4**

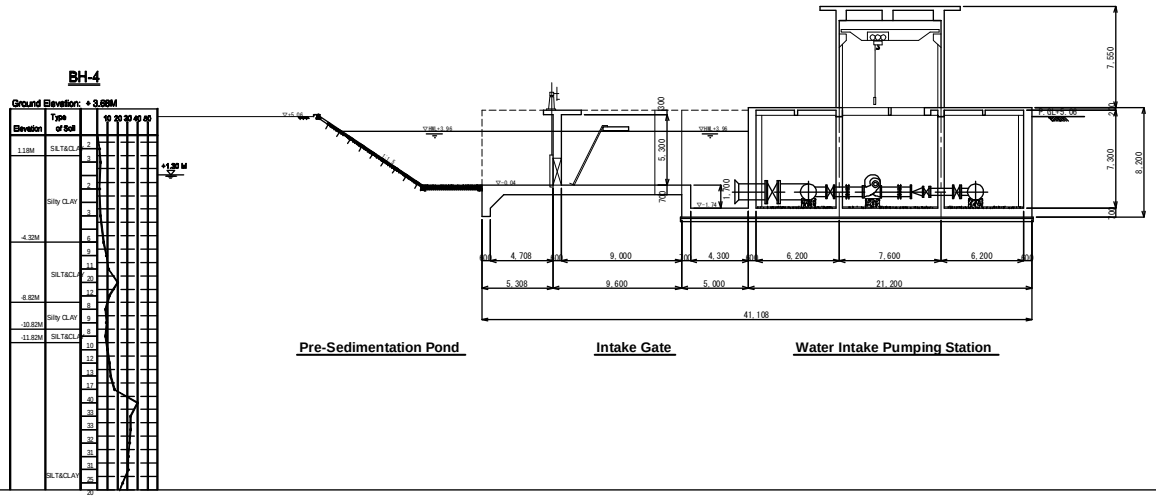
Intake Gate and Pumping Station

PLAN



Pre-Sedimentation Pond Intake Gate Water Intake Pumping Station

SECTION A - A



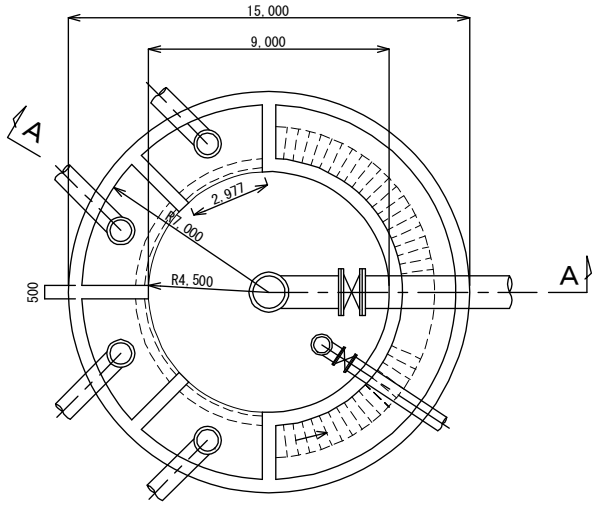
Pre-Sedimentation Pond Intake Gate Water Intake Pumping Station

Note : The values are indicative, and detailed values shall be decided in detailed design.

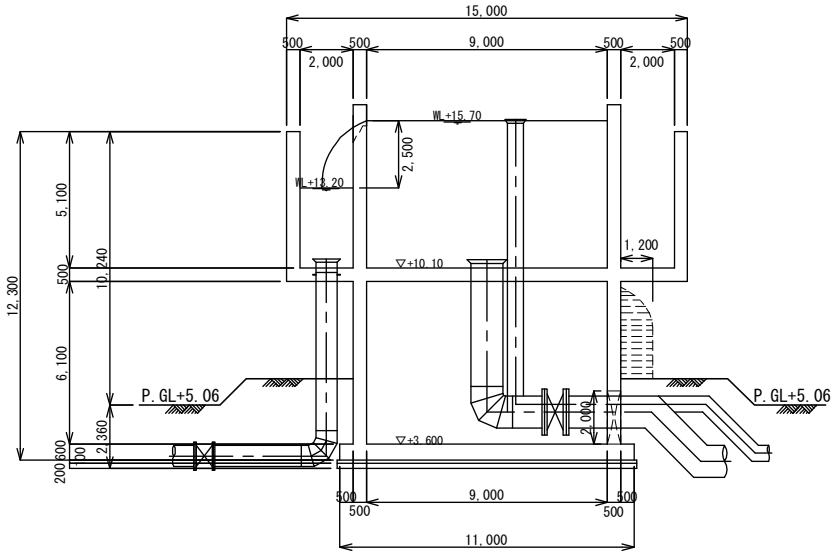
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Lagunbyin Water Treatment Plant Intake Gate & Pumping Station Plan and Section		
Date		Scale	Drawing No.
July 2013		A3; S=1:300	W - 5

Dividing Well

PLAN



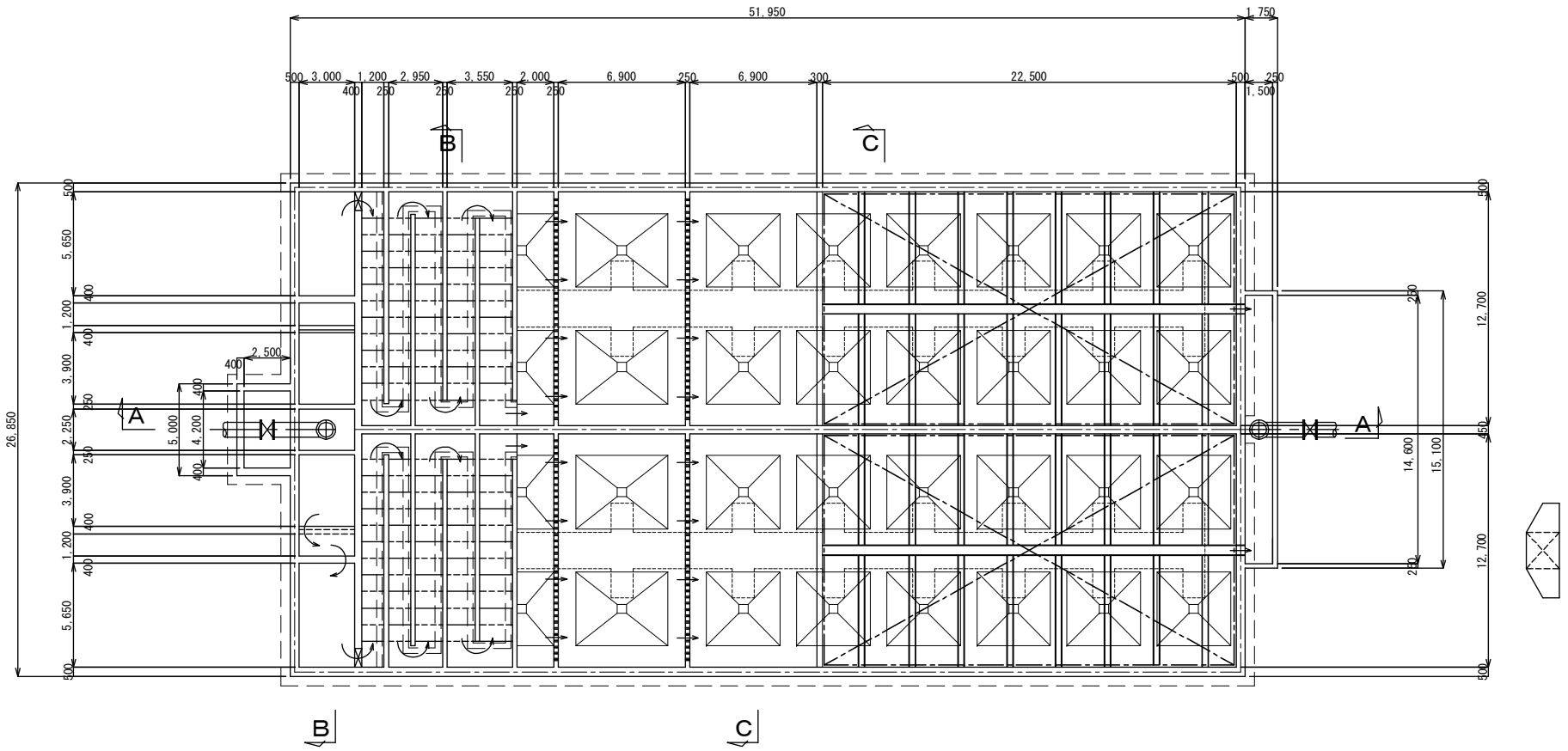
SECTION A - A



Note : The values are indicative, and detailed values shall be decided in detailed design.

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Lagunbyin Water Treatment Plant Dividing Well Plan & Section		
Date		Scale	Drawing No.
July 2013		A3; S=1:200	W - 6

Sedimentation Basin Plan

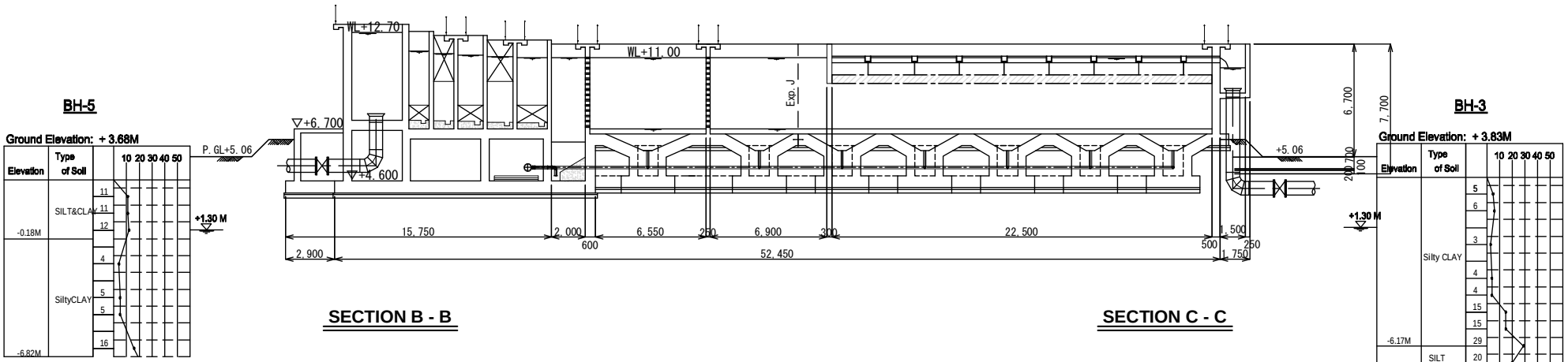


Note : The values are indicative, and detailed values shall be decided in detailed design.

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Lagunbyin Water Treatment Plant Sedimentation Basin Plan		
Date		Scale	Drawing No.
July 2013		A3; S=1:250	W - 7

Sedimentation Basin Cross Section

SECTION A - A



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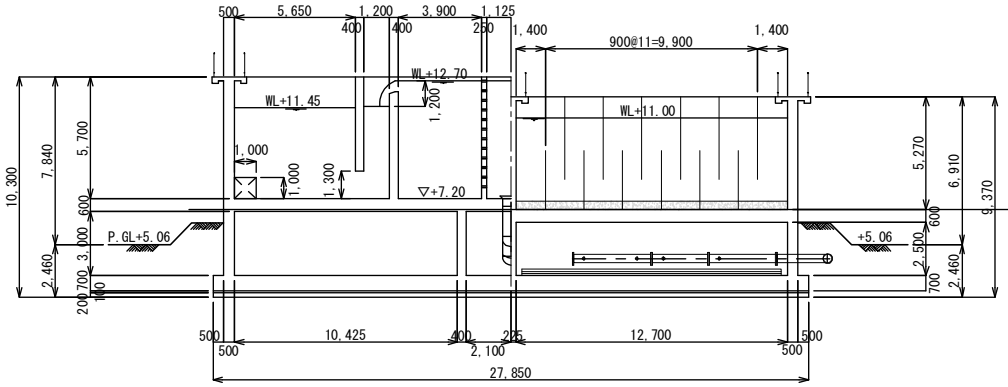
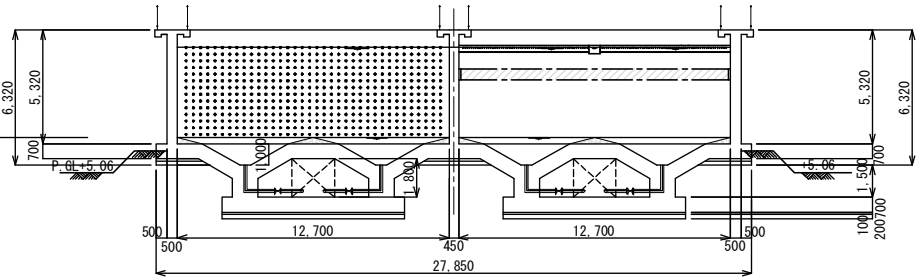


Receiving Well **Flocculation Basin**

SECTION C - C

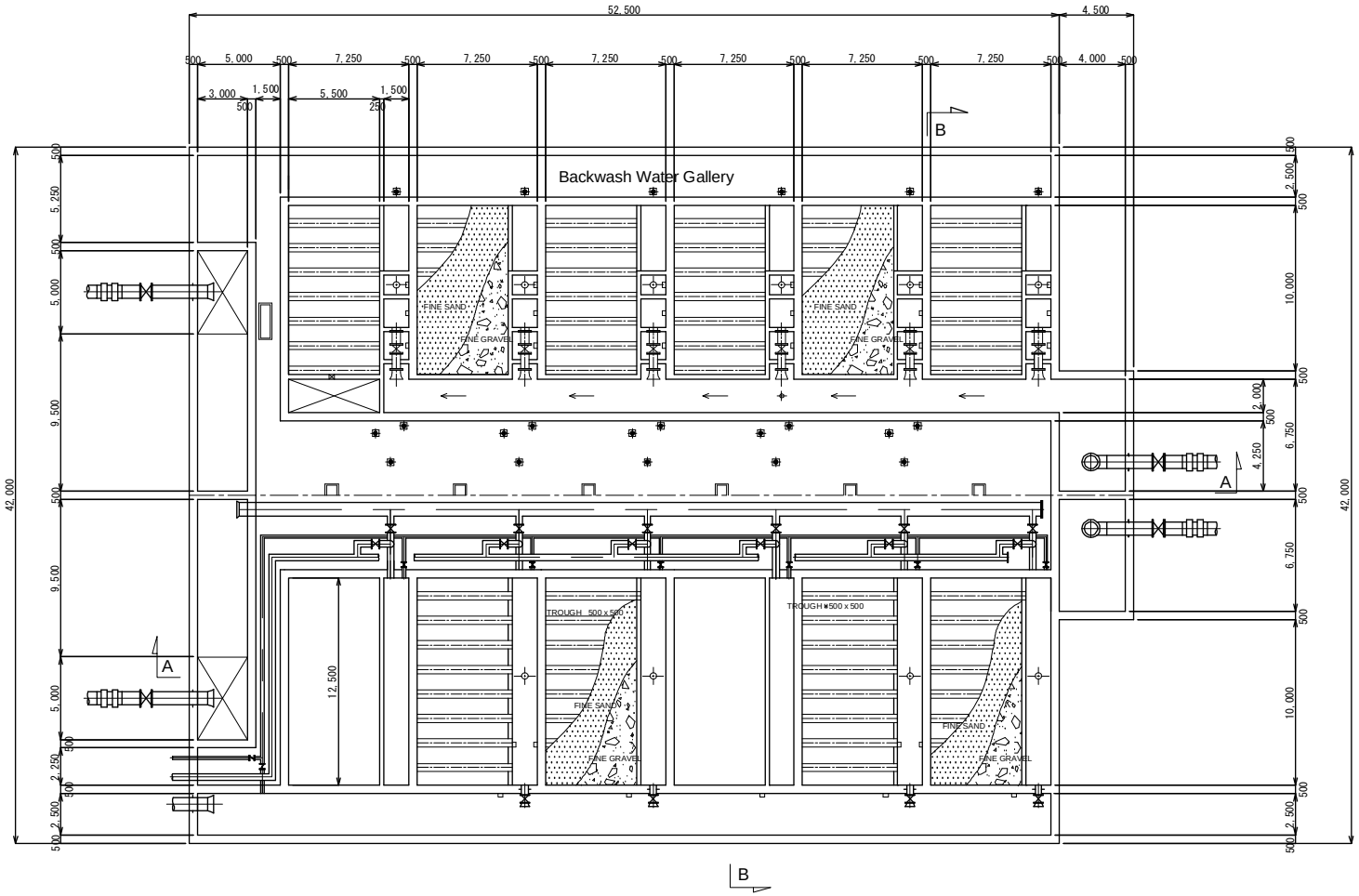


Sedimentation Basin

Note : The values are indicative, and detailed values shall be decided in detailed design.

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Lagunbyin Water Treatment Plant Sedimentation Basin Cross Section		
Date		Scale	Drawing No.
July 2013		A3; S=1:250	W - 8

Rapid Sand Filter Plan



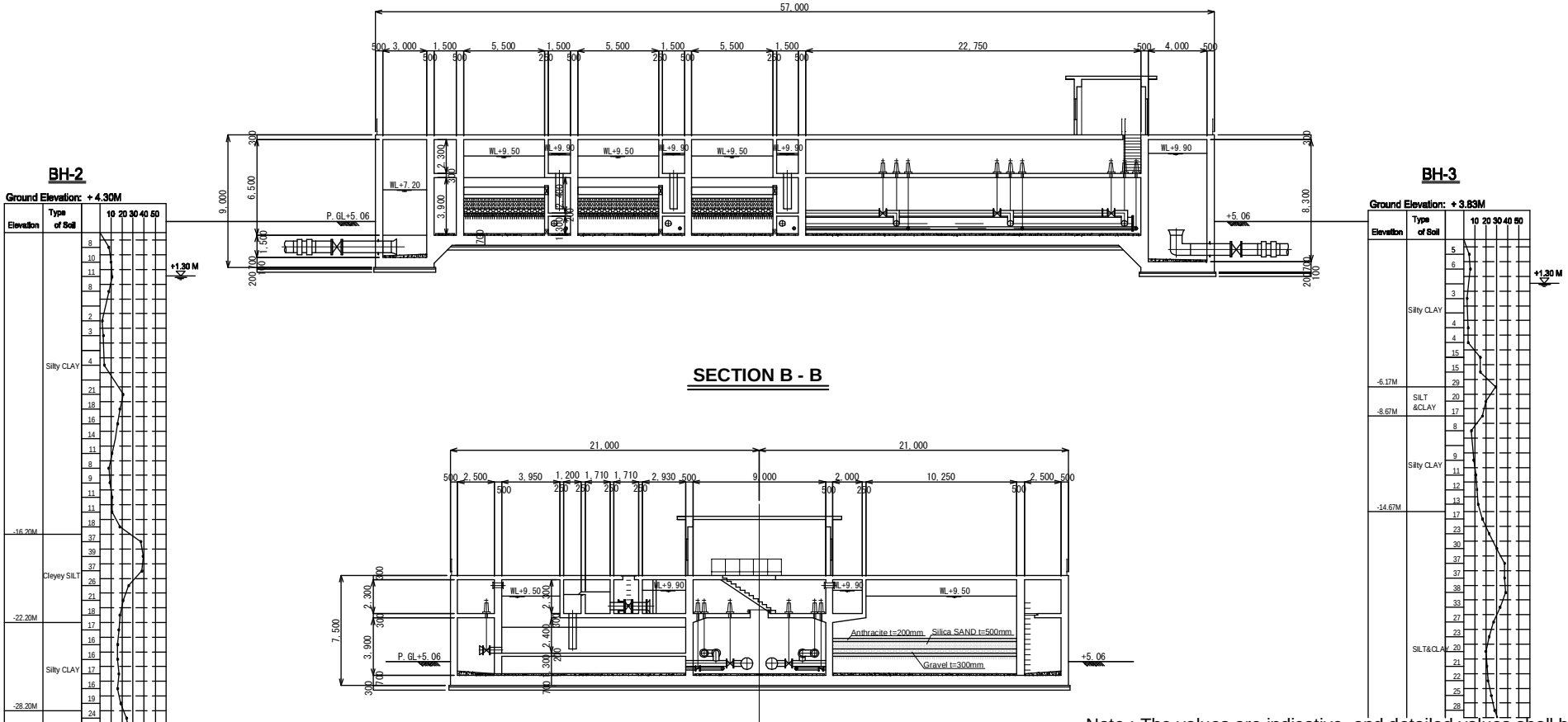
Note : The values are indicative, and detailed values shall be decided in detailed design.

project	**Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City**
Drawing Title	**Lagunbyin Water Treatment Plant Rapid Sand Filter Plan**

Date	**Scale**	**Drawing No.**
July 2013	**A3; S=1:300**	**W - 9**

Rapid Sand Filter Cross Section

SECTION A - A

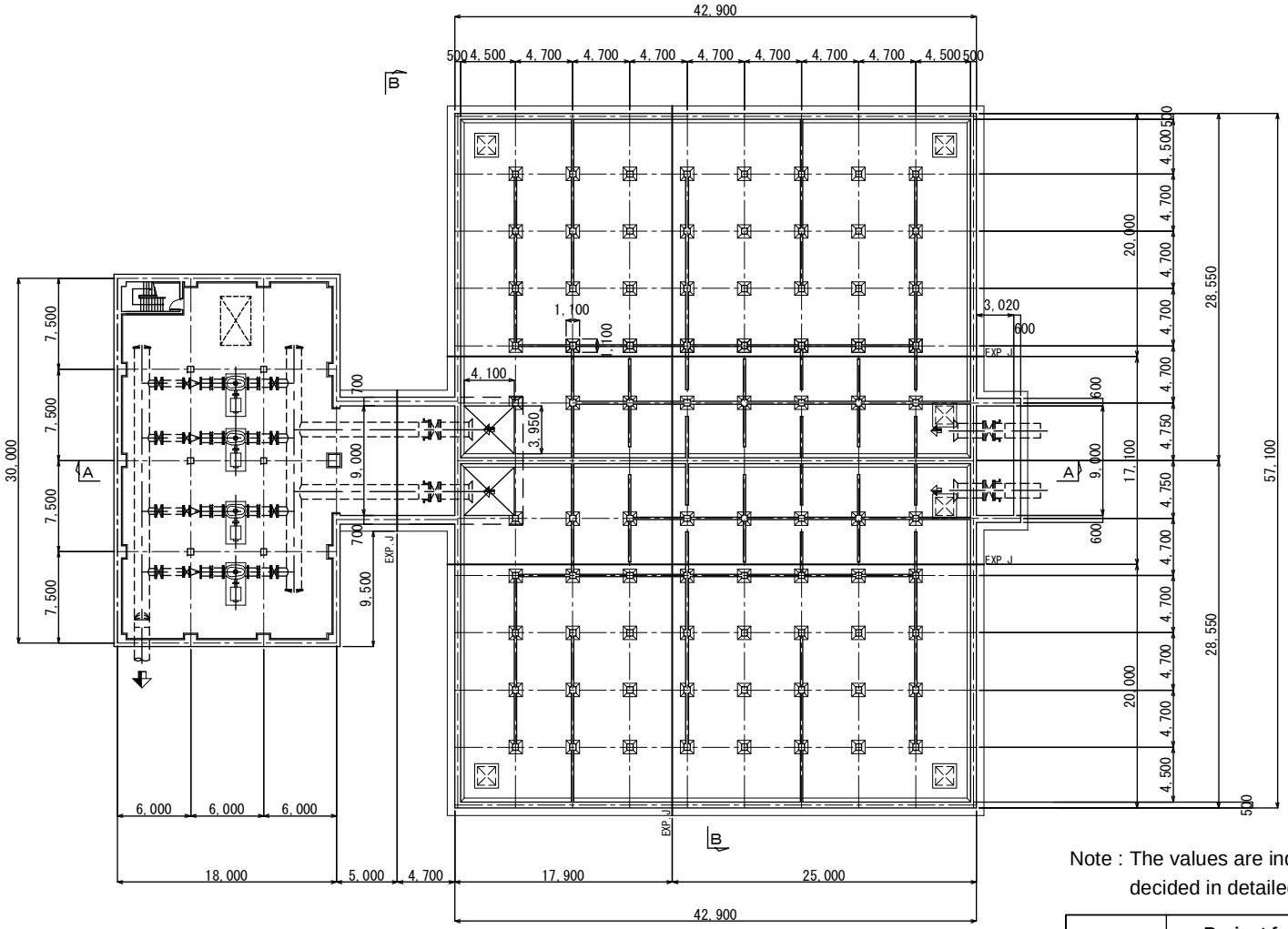


SECTION B - B

Note : The values are indicative, and detailed values shall be decided in detailed design.

project	**Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City**		
Drawing Title	**Lagunbyin Water Treatment Plant Rapid Sand Filter Cross Section**		
Date		**Scale**	**Drawing No.**
July 2013		**A3; S=1:300**	**W - 10**

Clear Water Reservoir Plan

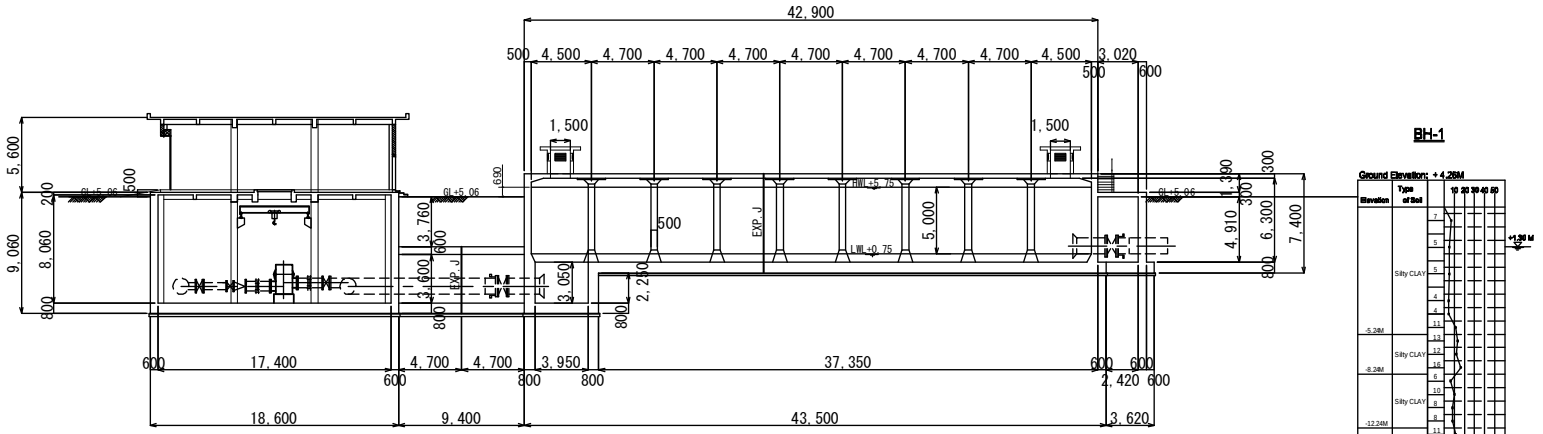


Note : The values are indicative, and detailed values shall be decided in detailed design.

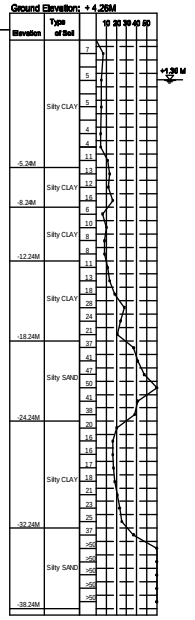
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Lagunbyin Water Treatment Plant Clear Water Reservoir & Transmission Pumping Station, Plan		
Date		Scale	Drawing No.
July 2013		A3; S=1:400	W - 11

Clear Water Reservoir Cross Section

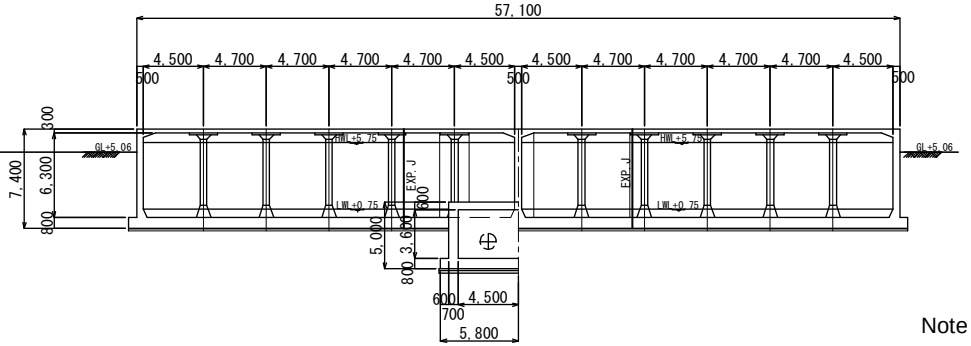
SECTION A - A



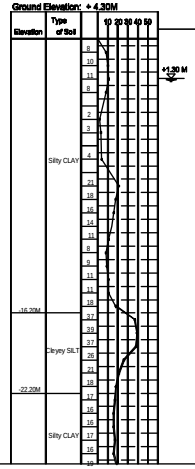
BH-1



SECTION B - B



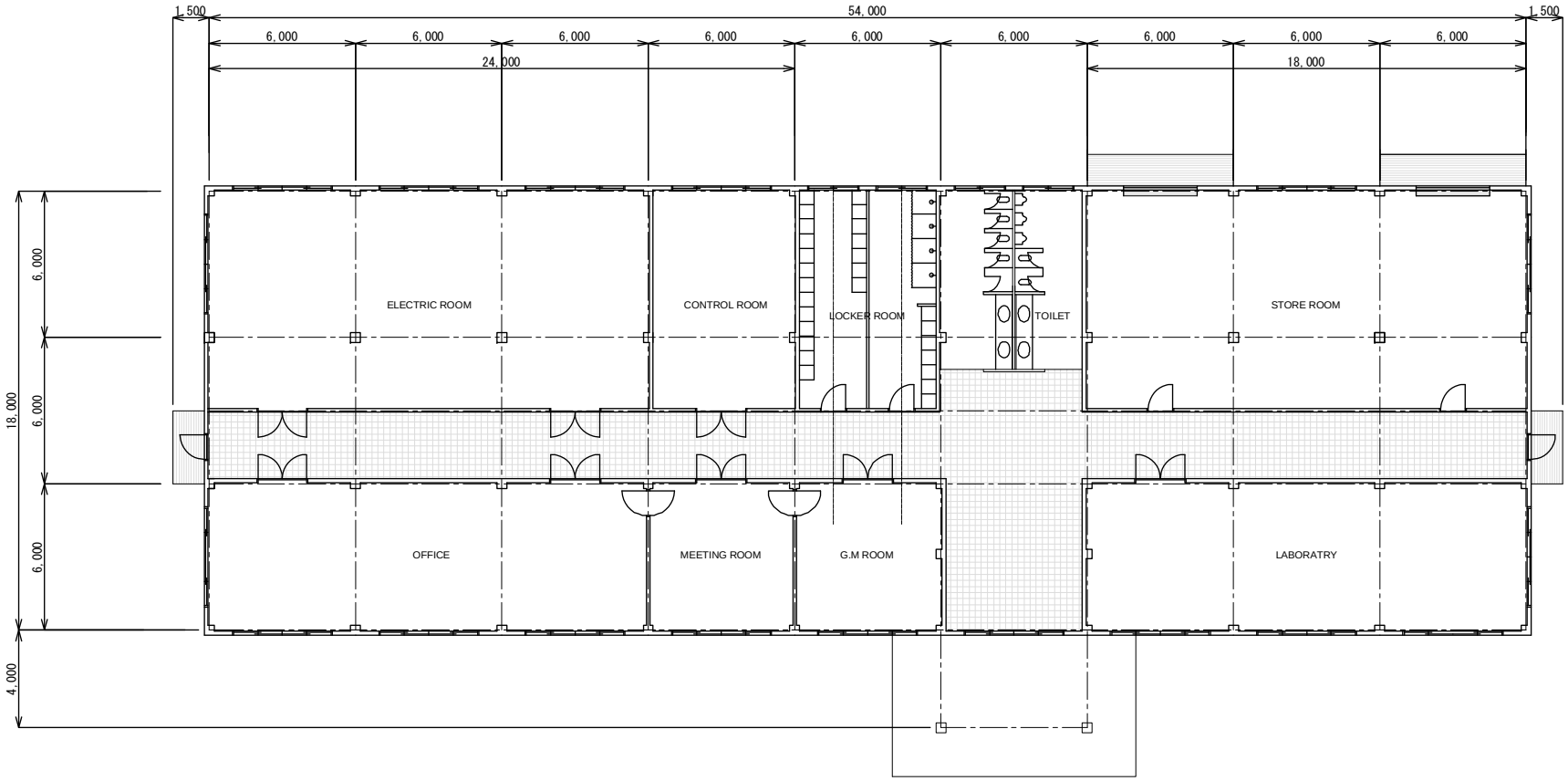
BH-2



Note : The values are indicative, and detailed values shall be decided in detailed design.

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Lagunbyin Water Treatment Plant Clear Water Reservoir & Transmission Pumping Station, Section		
Date		Scale	Drawing No.
July 2013		A3; S=1:400	W - 12

Administration Building Plan

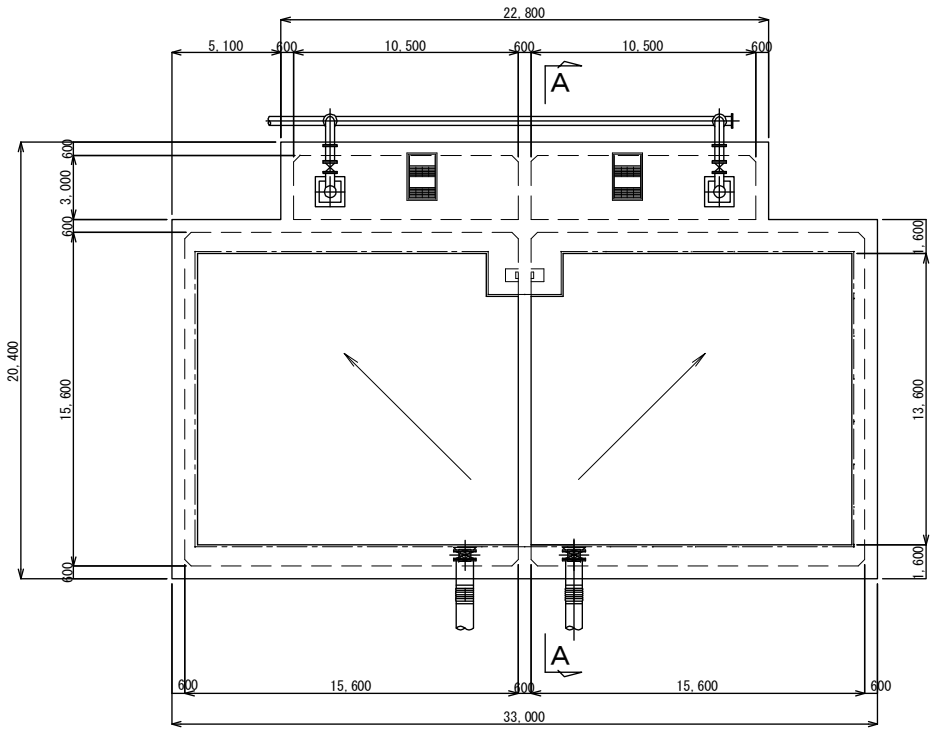


Note : The values are indicative, and detailed values shall be decided in detailed design.

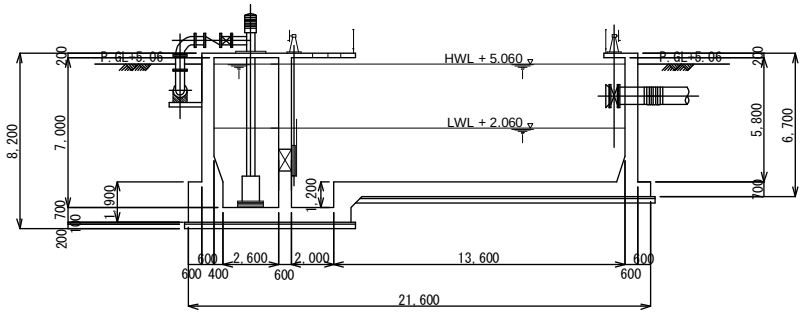
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Lagunbyin Water Treatment Plant Administration Building Plan		
Date		Scale	Drawing No.
July 2013		A3; S=1:200	W - 13

Wash Water Drainage Basin

PLAN



SECTION A - A

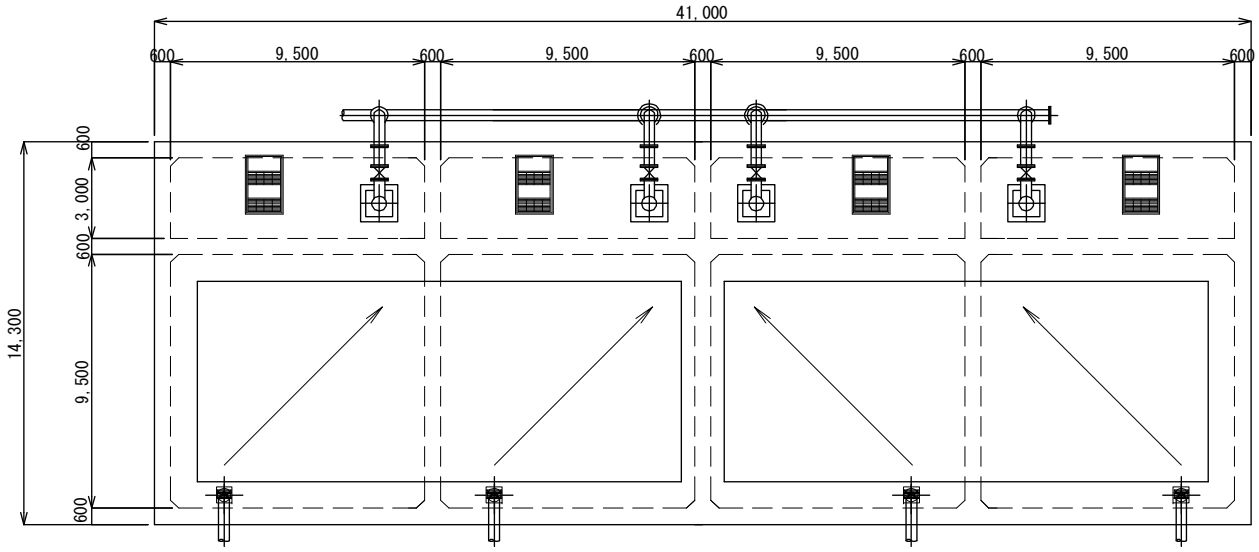


Note : The values are indicative, and detailed values shall be decided in detailed design.

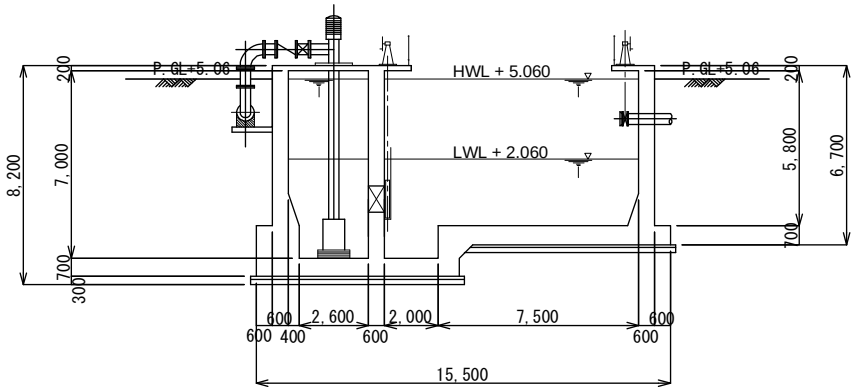
project	**Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City**	
Drawing Title	**Lagunbyin Water Treatment Plant Wash Water Drainage Basin Plan & Cross Section**	
Date	**Scale**	**Drawing No.**
July 2013	**A3; S=1:250**	**W - 14**

Sludge Basin

PLAN



SECTION A - A

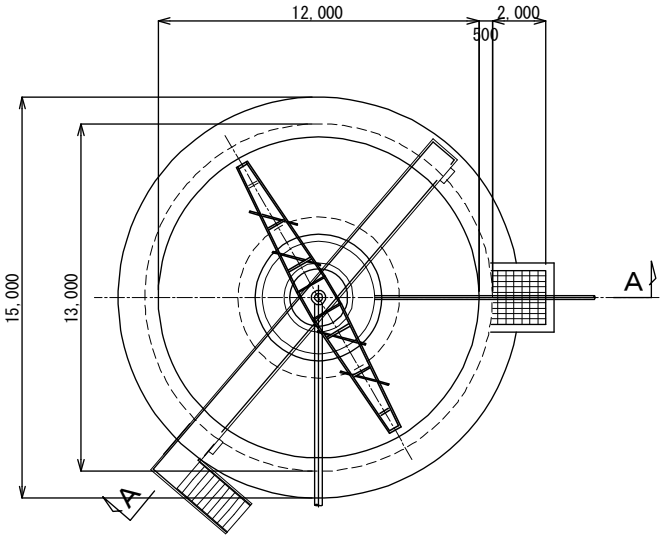


Note : The values are indicative, and detailed values shall be decided in detailed design.

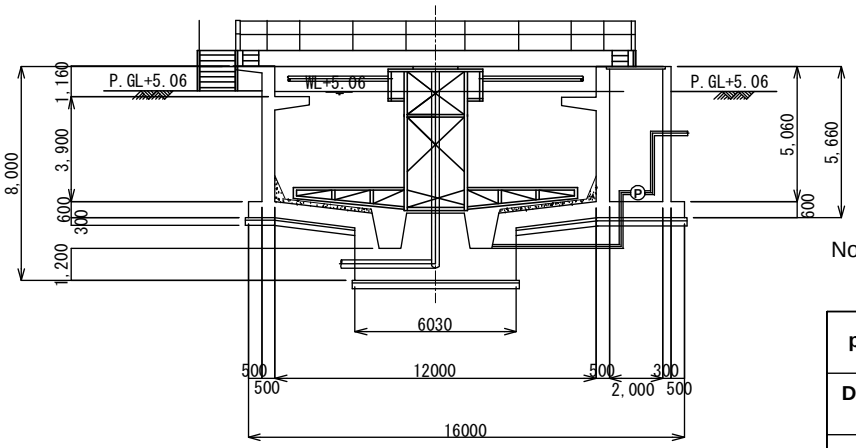
project	**Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City**	
Drawing Title	**Lagunbyin Water Treatment Plant Sludge Basin Plan & Section**	
Date	**Scale**	**Drawing No.**
July 2013	**A3; S=1:200**	**W - 15**

Thickener Plan

PLAN

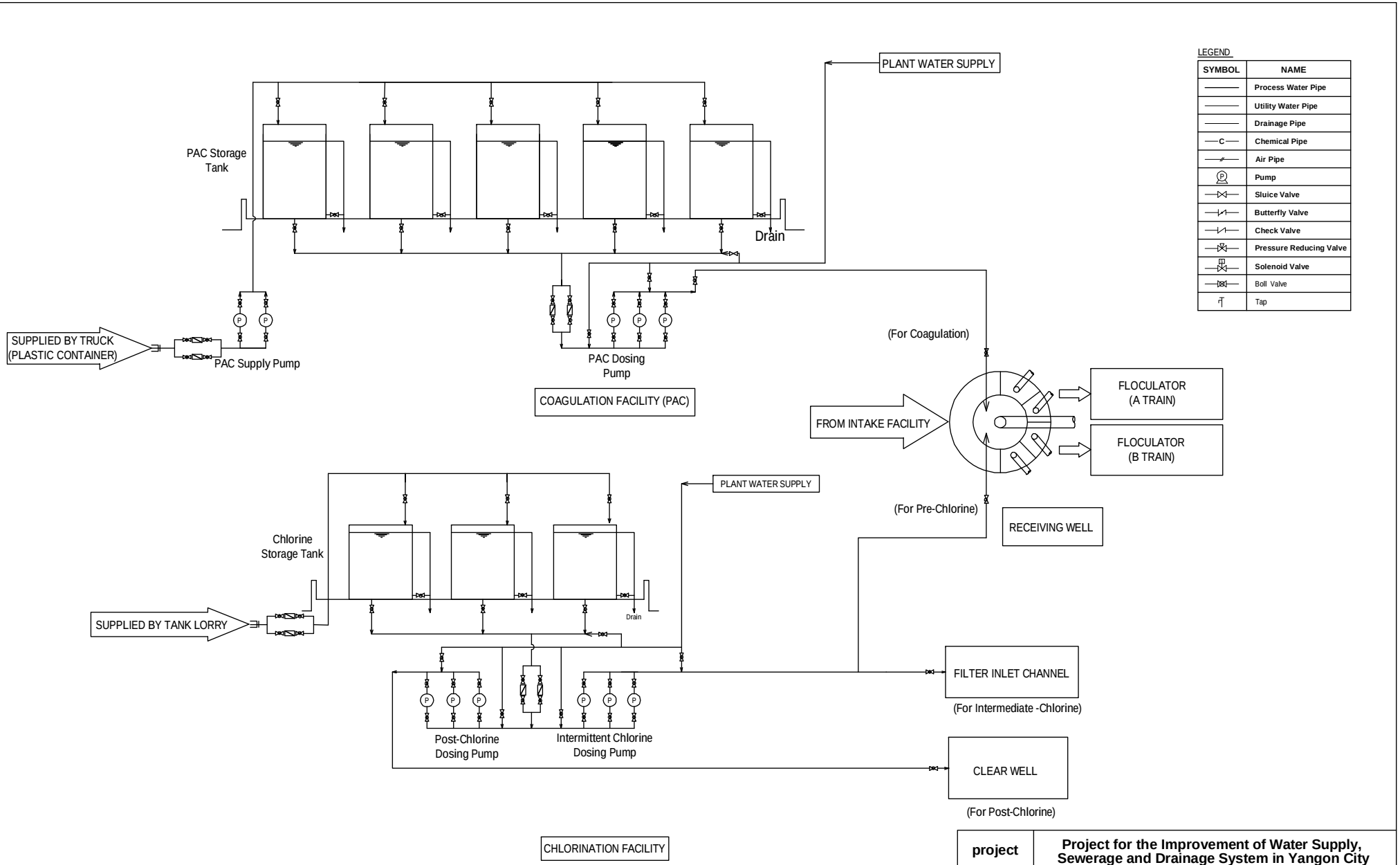


SECTION A - A



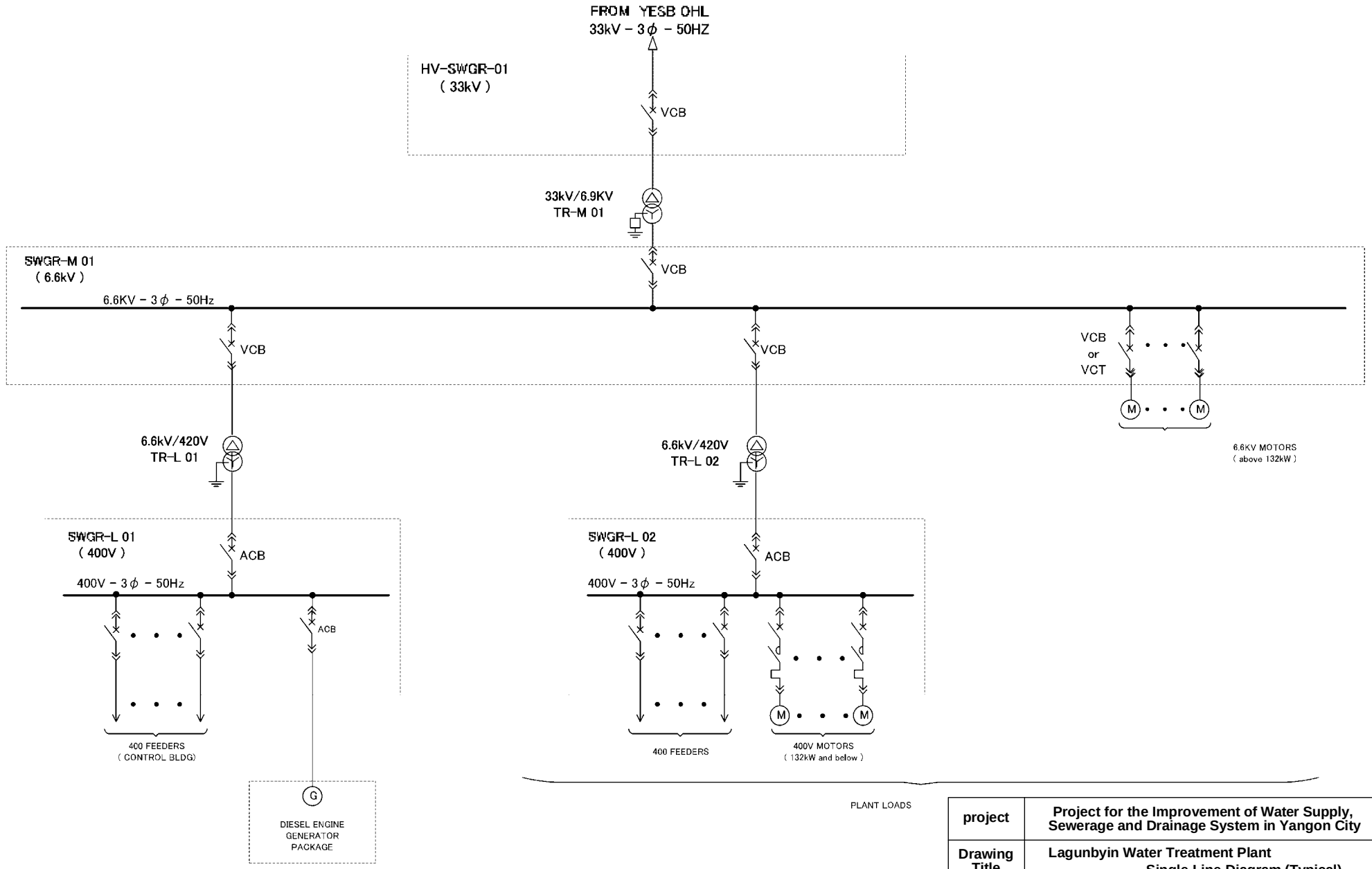
Note : The values are indicative, and detailed values shall be decided in detailed design.

project	**Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City**		
Drawing Title	**Lagunbyin Water Treatment Plant Thickener Plan & Section**		
Date		**Scale**	**Drawing No.**
July 2013		**A3; S=1:200**	**W - 16**



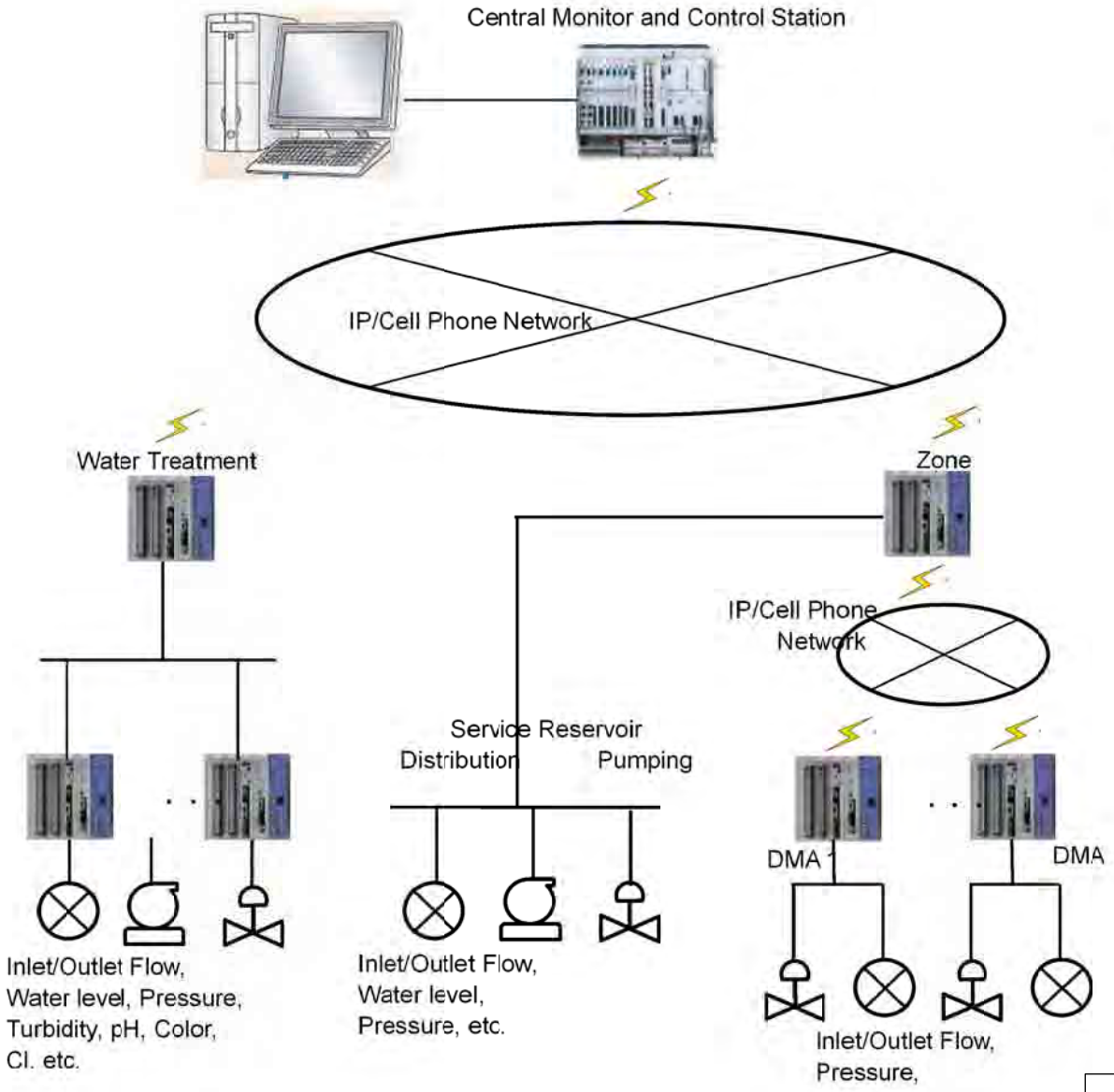
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Lagunbyin Water Treatment Plant Chemical Facility Process Flow Diagram

Date	Scale	Drawing No.
July 2013	None	W - 17



project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Lagunbyin Water Treatment Plant Single Line Diagram (Typical)

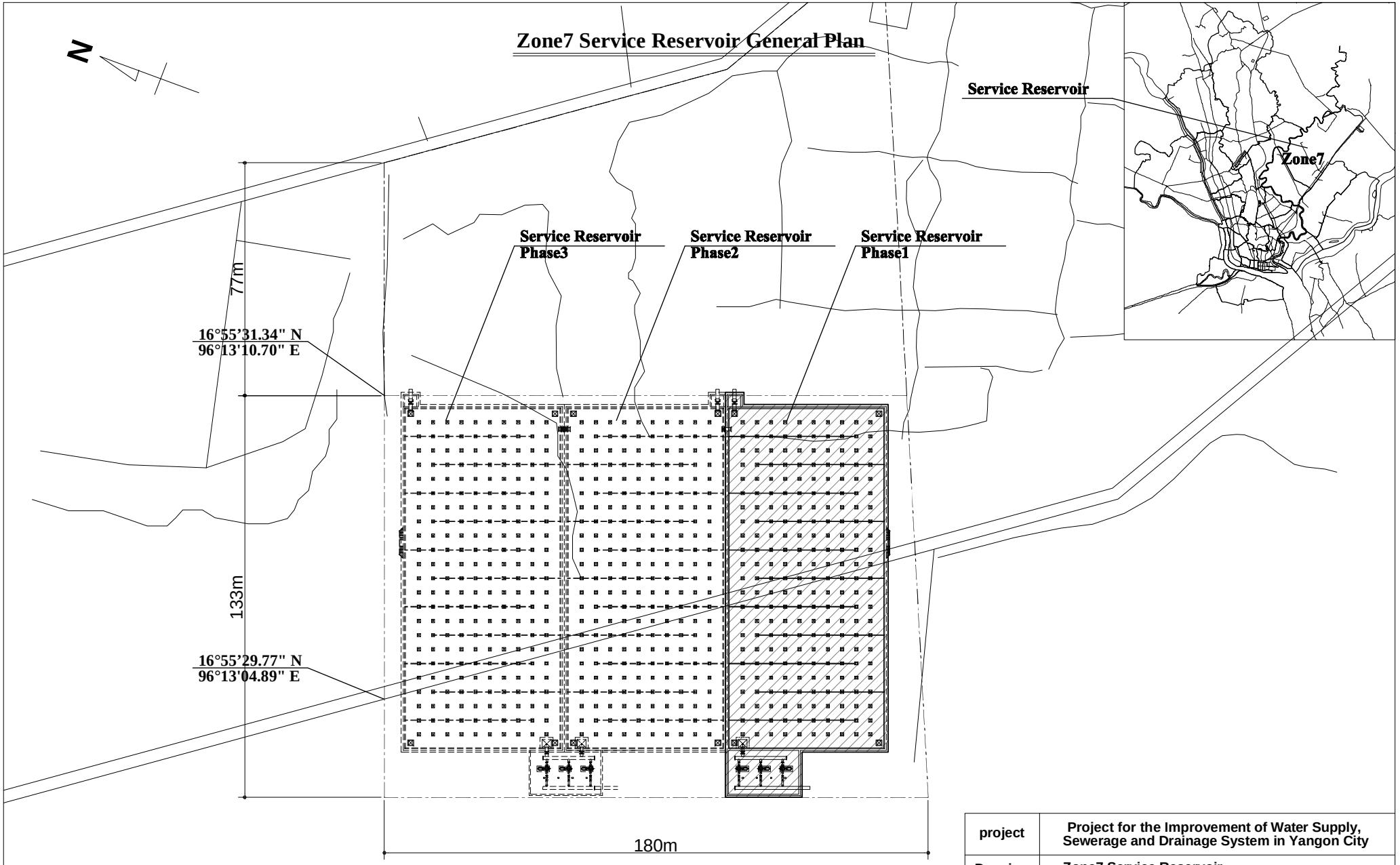
Date	Scale	Drawing No.
July 2013	None	W - 18



project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Lagunbyin Water Treatment Plant Basic SCADA Concept

Date	Scale	Drawing No.
July 2013	None	W - 19

Zone7 Service Reservoir General Plan

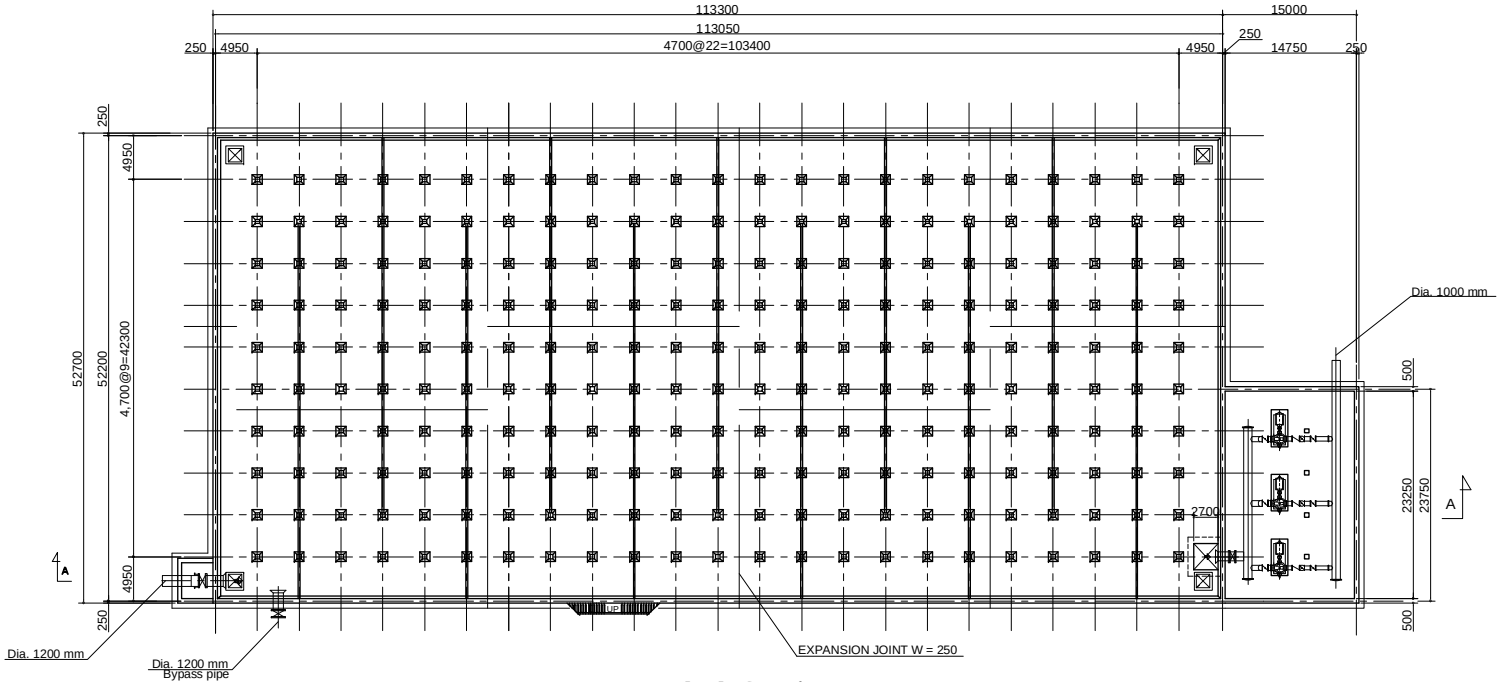


project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Zone7 Service Reservoir General Plan

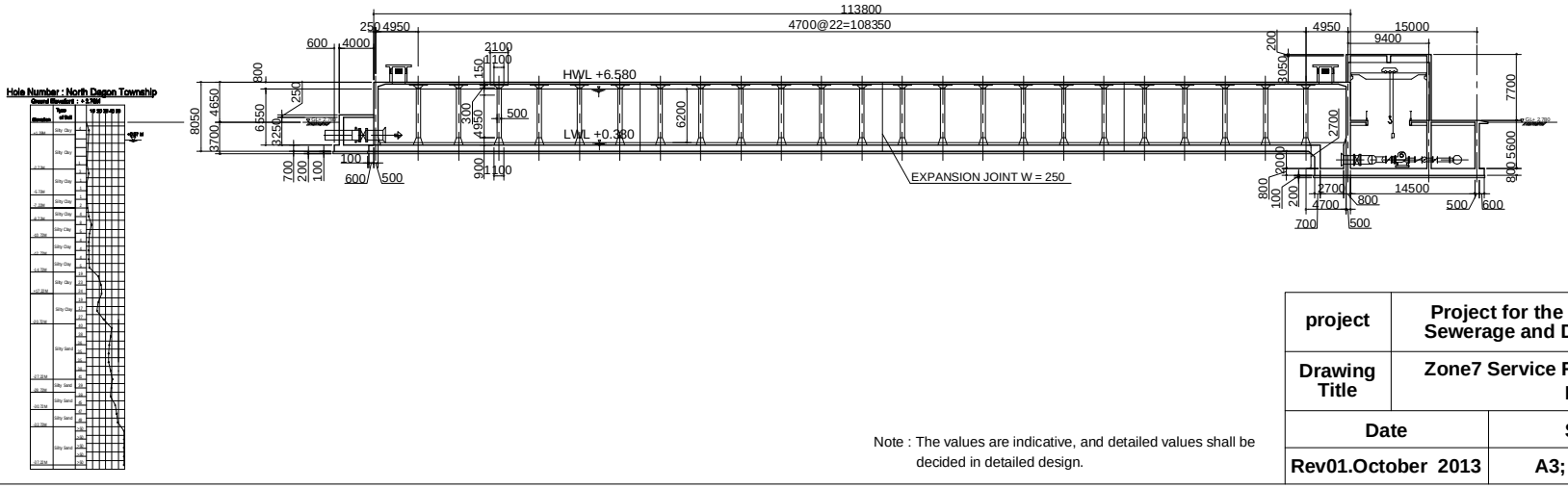
Date	Scale	Drawing No.
Rev01.October 2013	A3; S=1:1200	SR7 - 1

Zone7 Service Reservoir

Plan

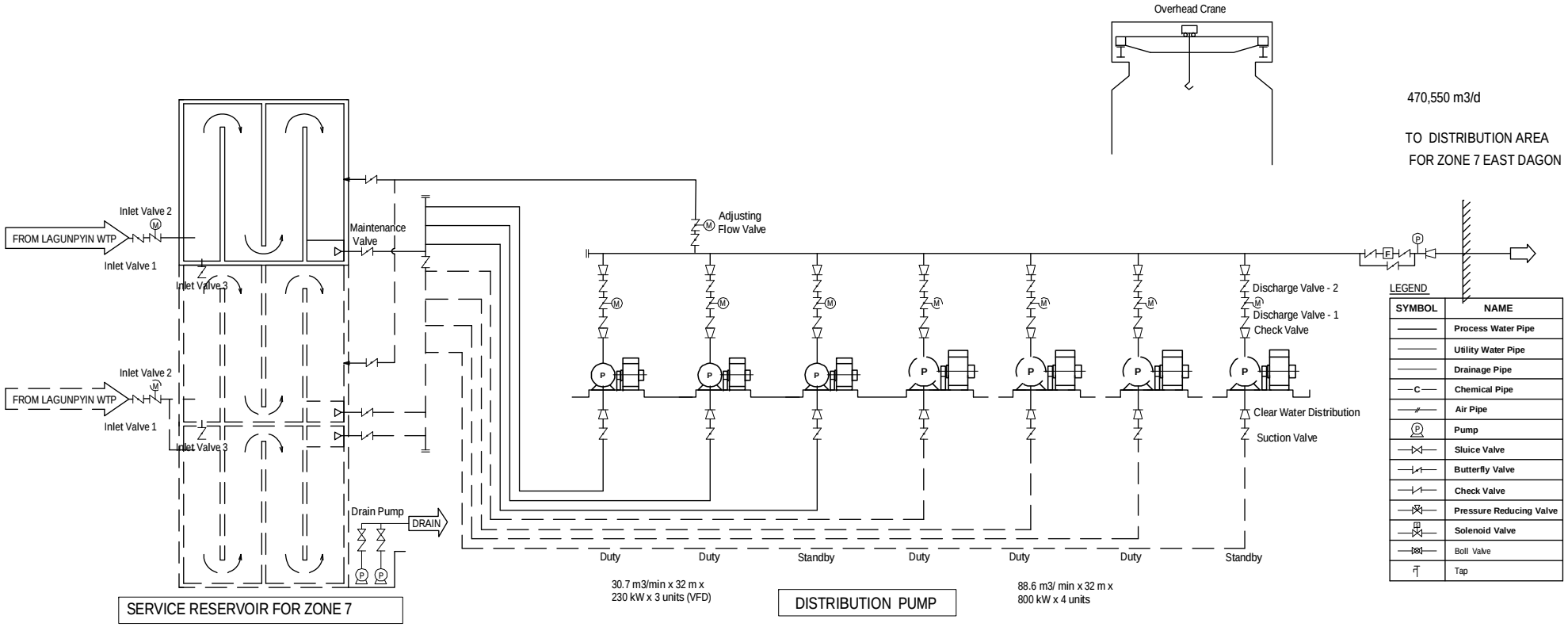


A-A Section



Note : The values are indicative, and detailed values shall be decided in detailed design.

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Zone7 Service Reservoir Plan and Section		
Date		Scale	Drawing No.
Rev01.October 2013		A3; S=1:600	SR7 - 2



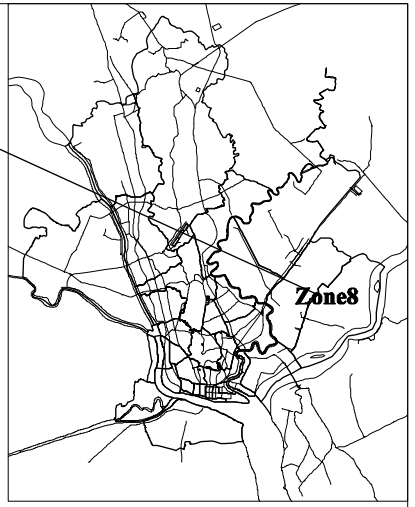
Legend

——— **Target Facilities in 2018**

— — **Target Facilities in the future**

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Service Reservoir Facility for Zone7 **Distribution Pumping Station Process Flow Diagram**		
Date		Scale	Drawing No.
July 2013		None	SR7 - 3

Zone8 Service Reservoir General Plan



16°51'18.00" N
96°15'24.02" E

16°51'12.11" N
96°15'23.11" E

Service Reservoir
Phase1

Service Reservoir
Phase2

Service Reservoir
Phase3

30m

16°51'09.75" N
96°15'24.11" E

GRAPHIC SCALE
(IN METERS)

25 0 12.5 25 50 75 100

Legend

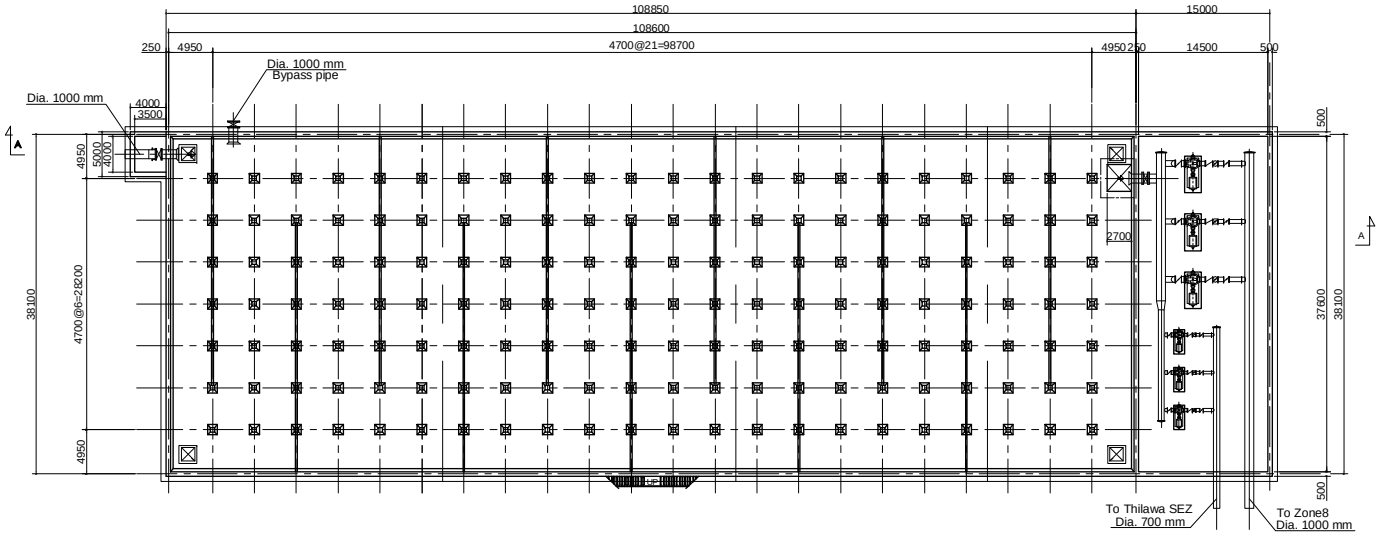
Target Facilities in 2018

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Zone8 Service Reservoir General Plan

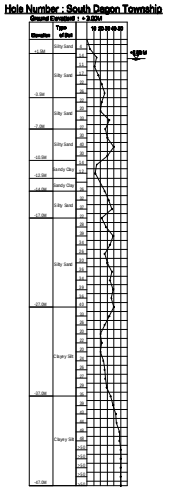
Date	Scale	Drawing No.
Rev03.October 2013	A3; S=1:2500	SR8 - 1

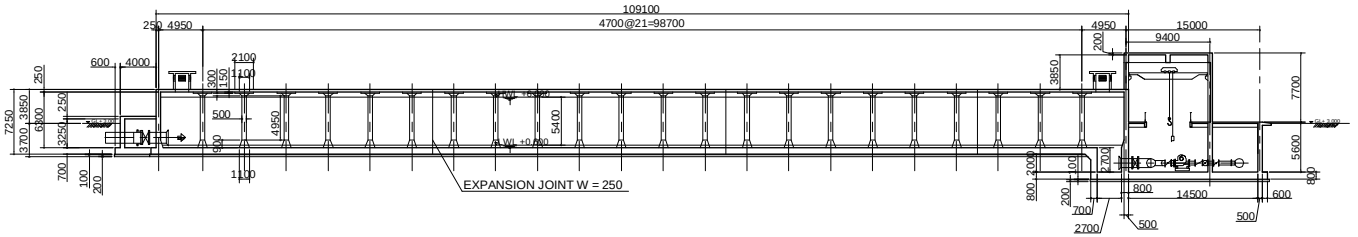
Zone8 Service Reservoir

Plan



Cross Section

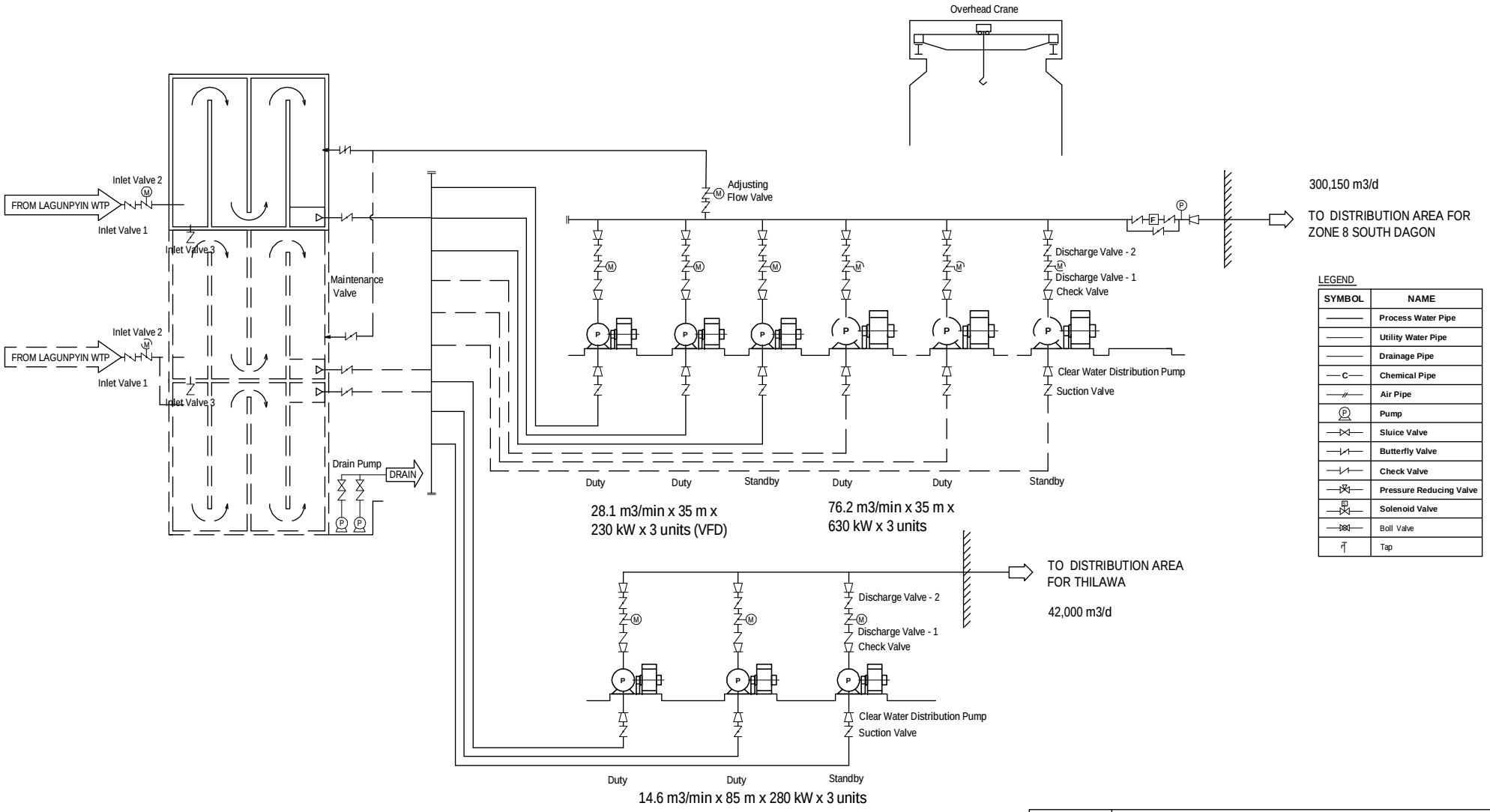




Note : The values are indicative, and detailed values shall be decided in detailed design.

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Zone8 Service Reservoir Plan and Section

Date	Scale	Drawing No.
Rev03.October 2013	A3; S=1:600	SR8 - 2



LEGEND

SYMBOL	NAME
	Process Water Pipe
	Utility Water Pipe
	Drainage Pipe
C	Chemical Pipe
	Air Pipe
P	Pump
	Sluice Valve
	Butterfly Valve
	Check Valve
	Pressure Reducing Valve
	Solenoid Valve
	Boll Valve
	Tap

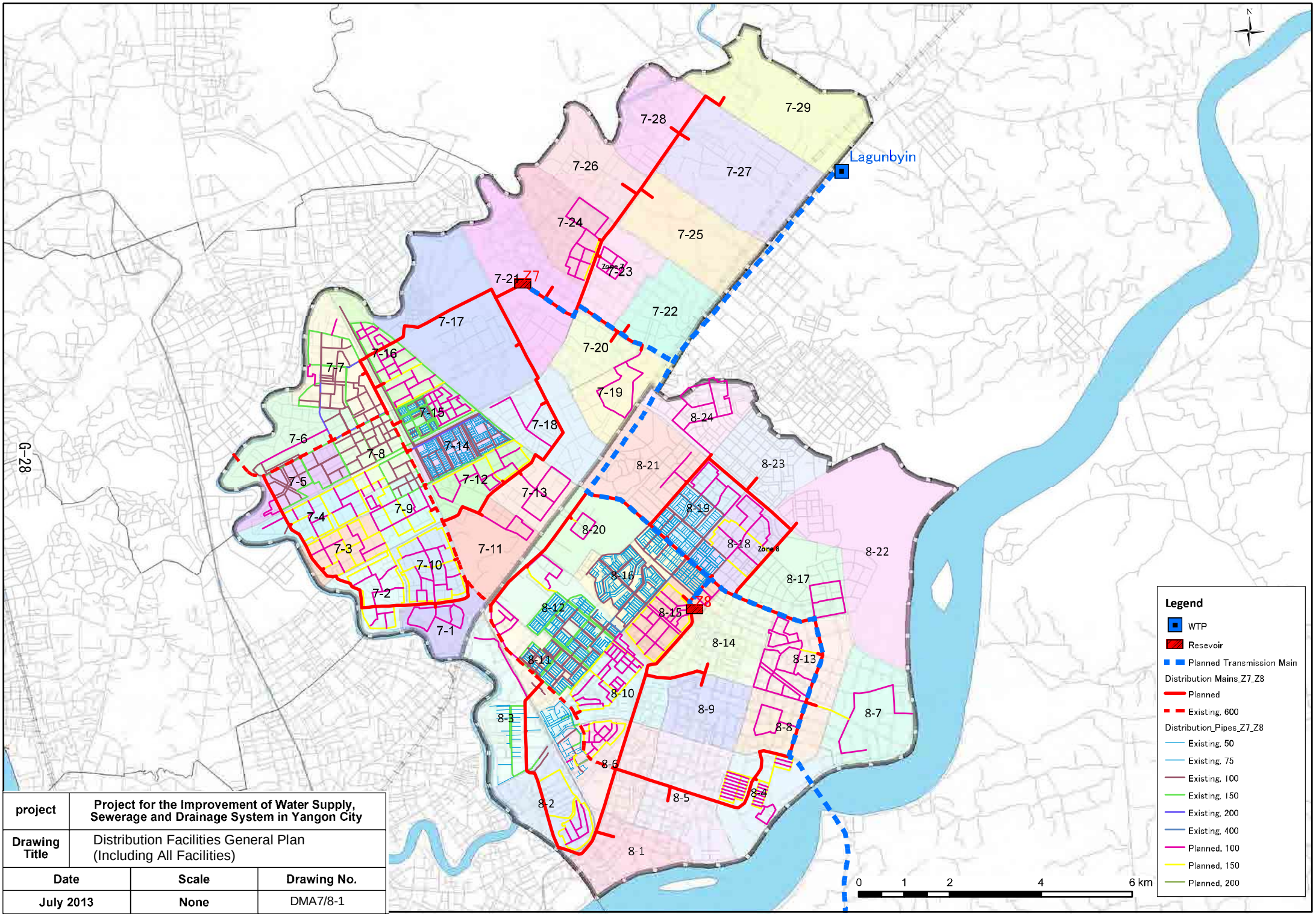
SERVICE RESERVOIR FOR ZONE 8

DISTRIBUTION PUMP

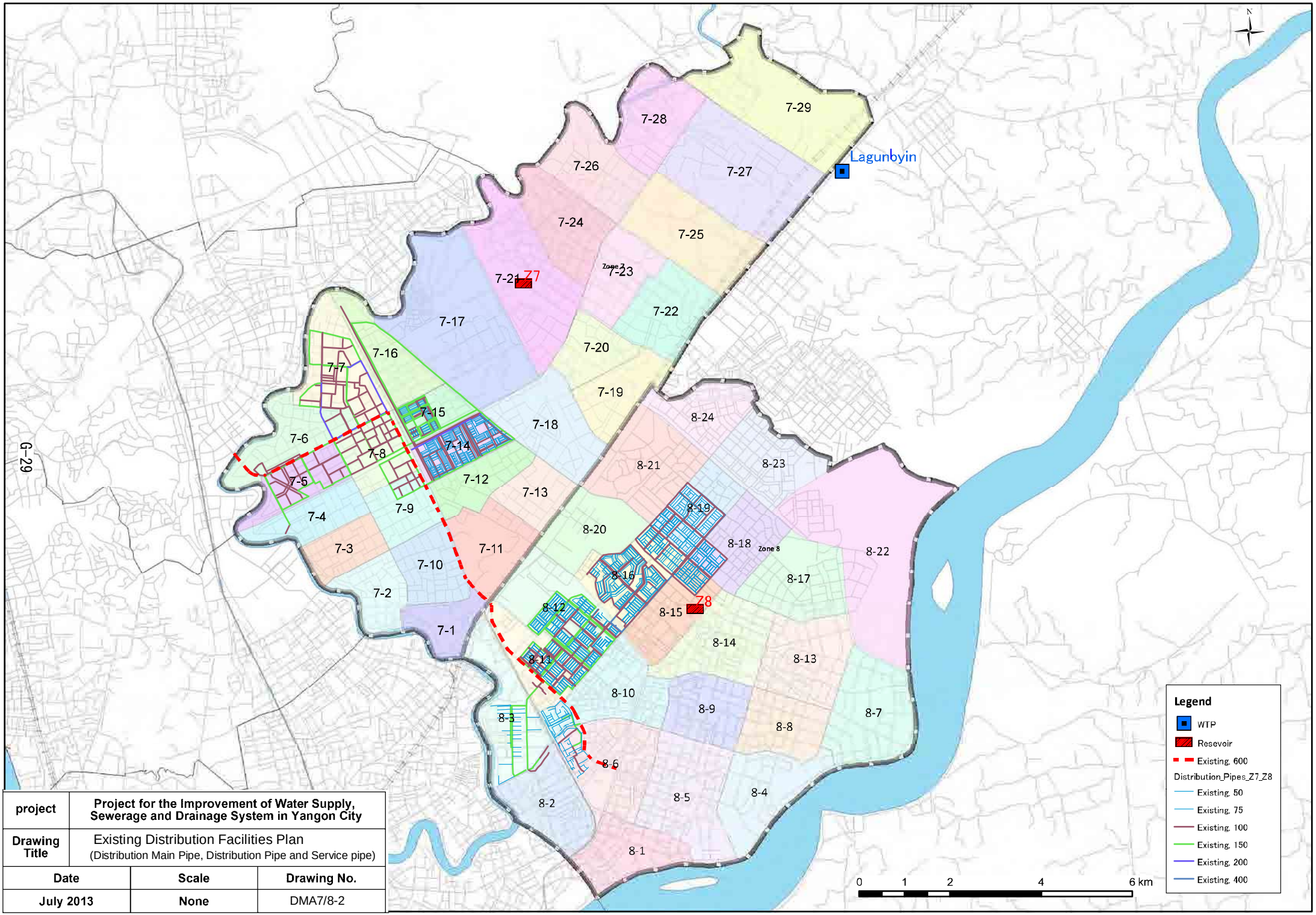
Legend

- **Target Facilities in 2018**
- **Target Facilities in the future**

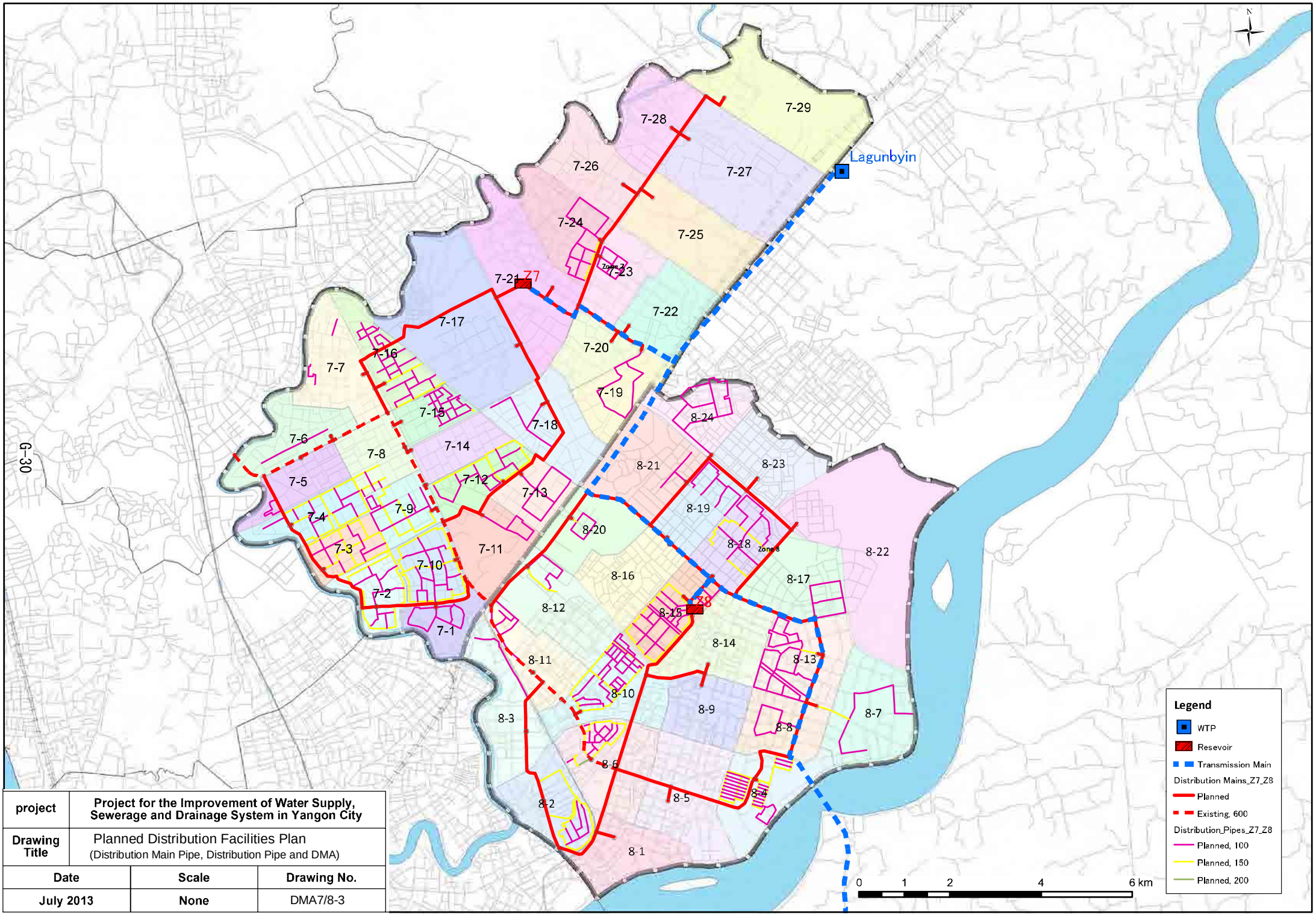
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Service Reservoir Facility for Zone8 **Distribution Pumping Station Process Flow Diagram**		
Date		Scale	Drawing No.
July 2013		None	SR8 - 3



project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City	
Drawing Title	Distribution Facilities General Plan (Including All Facilities)	
Date	Scale	Drawing No.
July 2013	None	DMA7/8-1



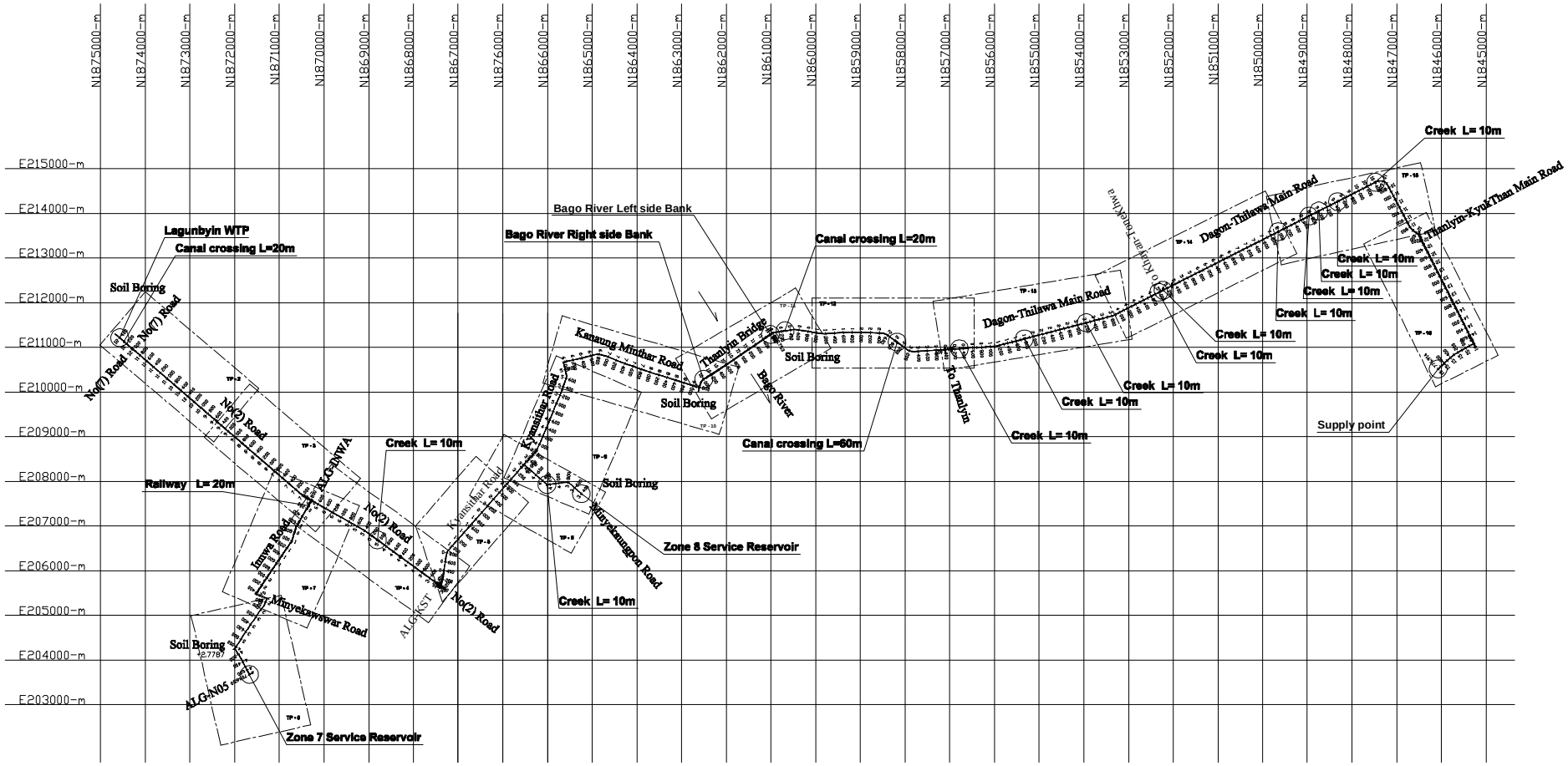
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City	
Drawing Title	Existing Distribution Facilities Plan (Distribution Main Pipe, Distribution Pipe and Service pipe)	
Date	Scale	Drawing No.
July 2013	None	DMA7/8-2



project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Planned Distribution Facilities Plan (Distribution Main Pipe, Distribution Pipe and DMA)

Date	Scale	Drawing No.
July 2013	None	DMA7/8-3

Key Plan of Transmission Pipelines



Legend

- Concrete Road
- Road
- Earth Road
- Center Line Road

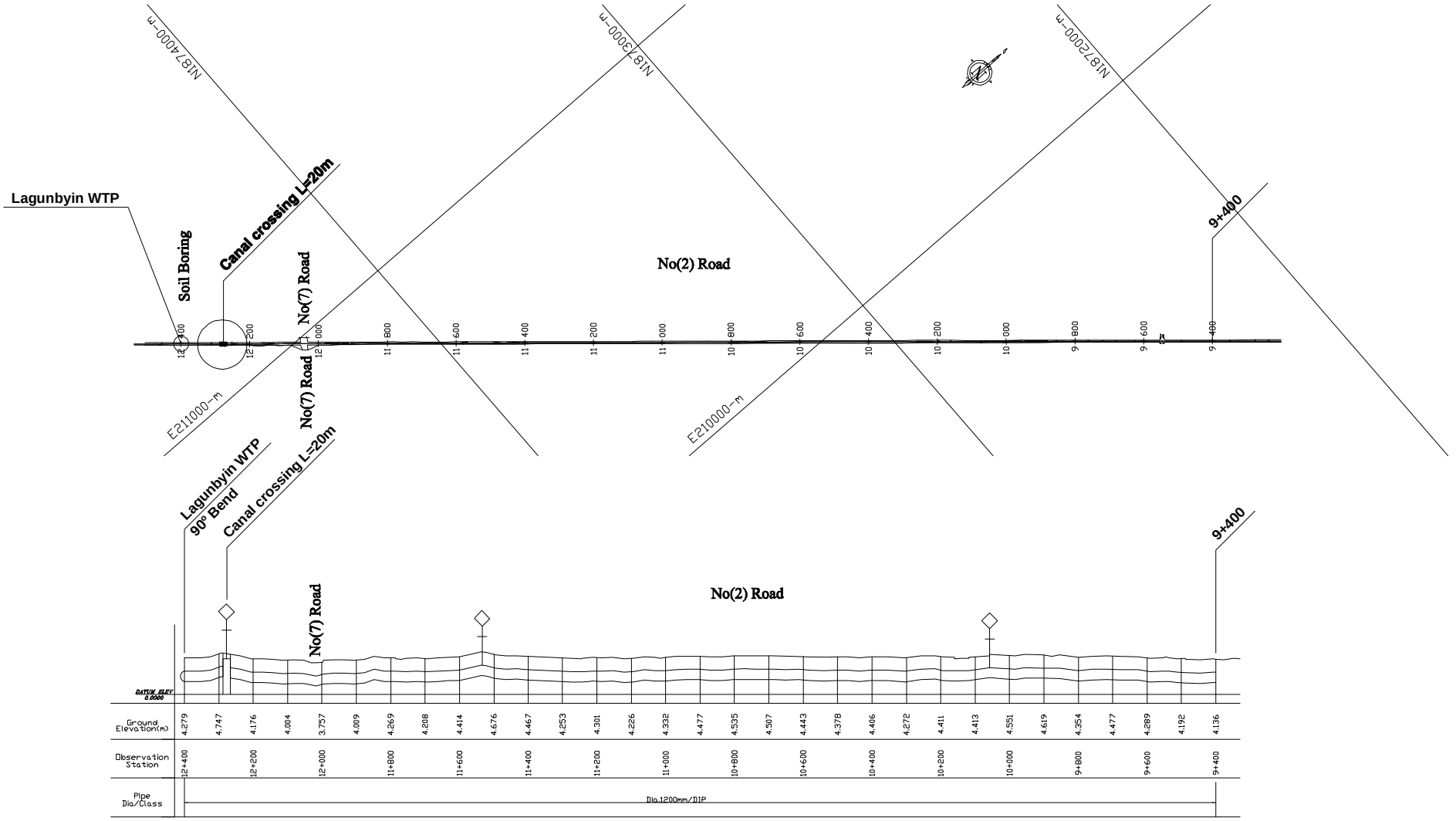
GRAPHIC SCALE
(IN METERS)

1000 0 500 1000 2000 3000 4000 5000

Coordinate System : Myanmar Datum 2000 , UTM 47 N

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Key Plan of Transmission Pipelines		
Date		Scale	Drawing No.
Oct. 2013		A3; S=1:100,000	TP - 1

Transmission Pipe from WTP to Zone8 S/R



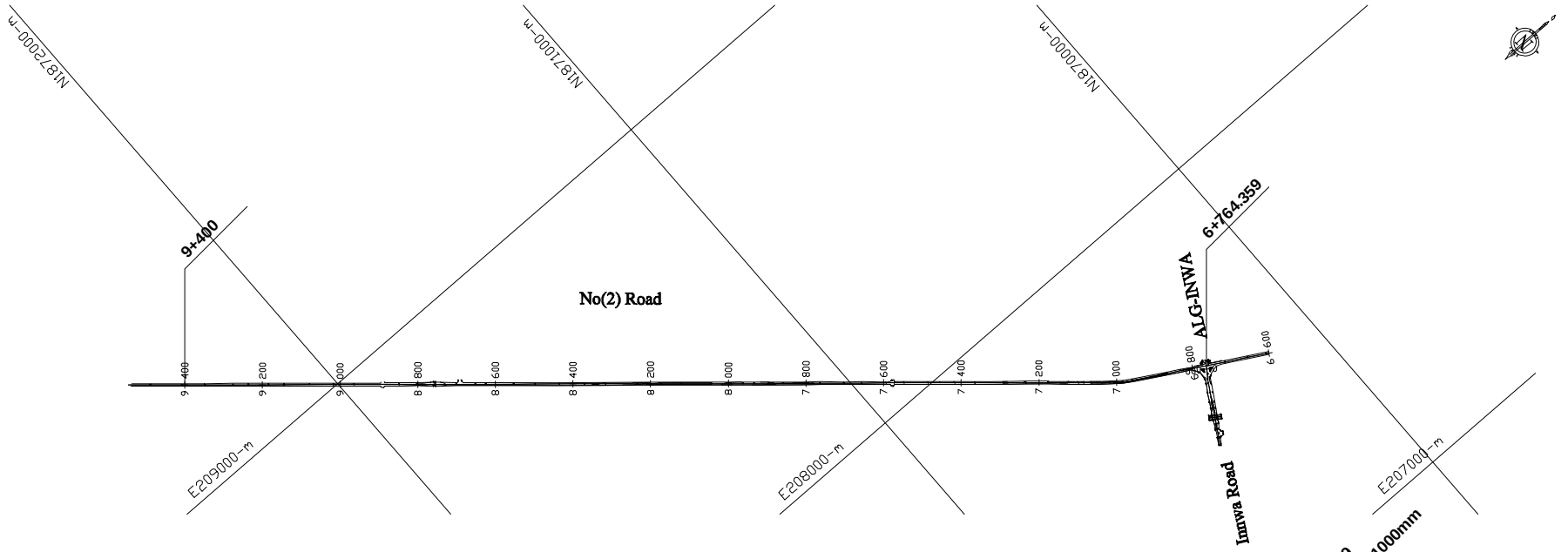
PROFILE

Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from WTP to Zone8 S/R Plan & Longitudinal Section (1/5)		
Date		Scale	Drawing No.
Oct. 2013		A3; H=1:12,000 V=1:1,000	TP - 2

Transmission Pipe from WTP to Zone8 S/R



PROFILE

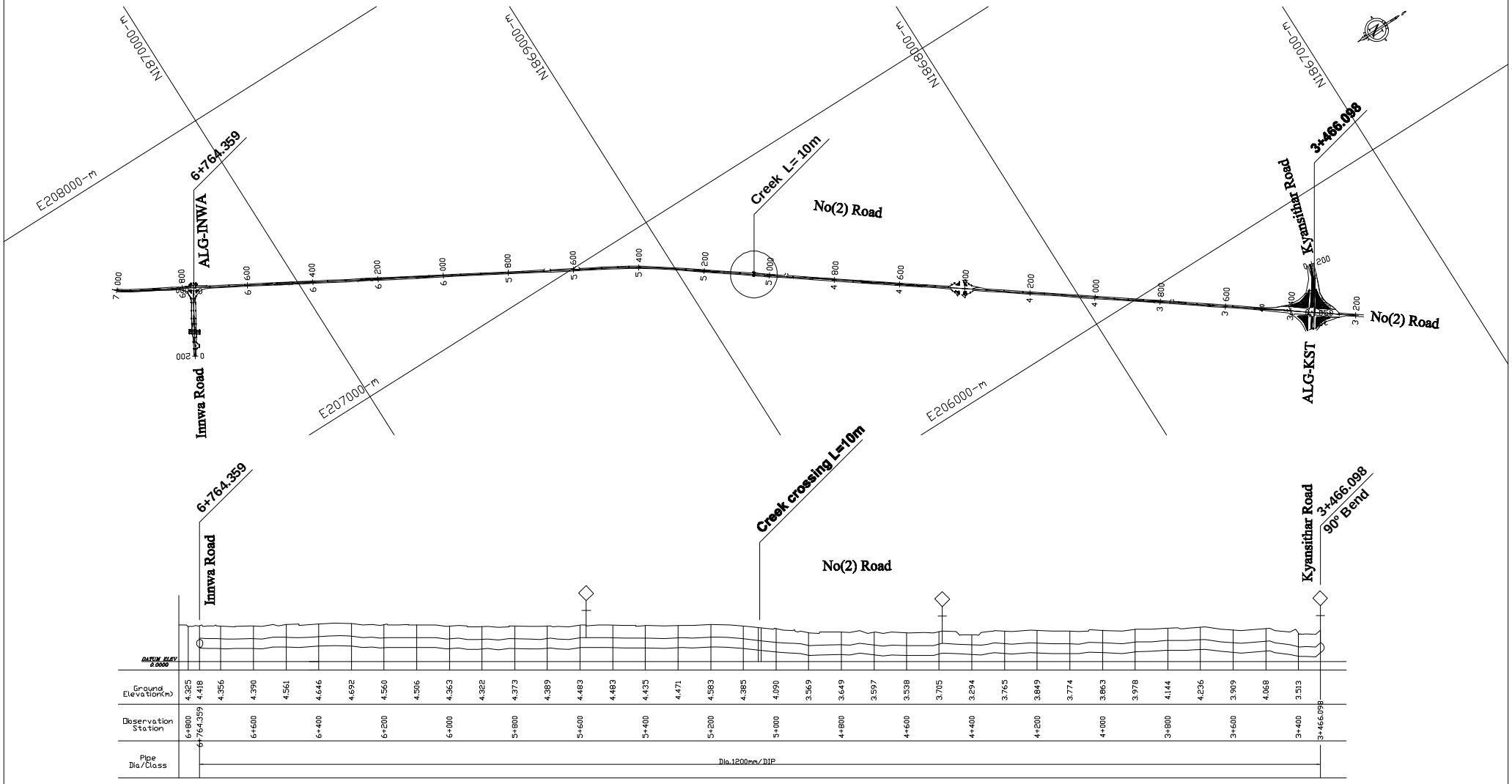
Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Transmission Pipe from WTP to Zone8 S/R Plan & Longitudinal Section (2/5)

Date	Scale	Drawing No.
Oct. 2013	A3; H=1:12,000 V=1:1,000	TP - 3

Transmission Pipe from WTP to Zone8 S/R



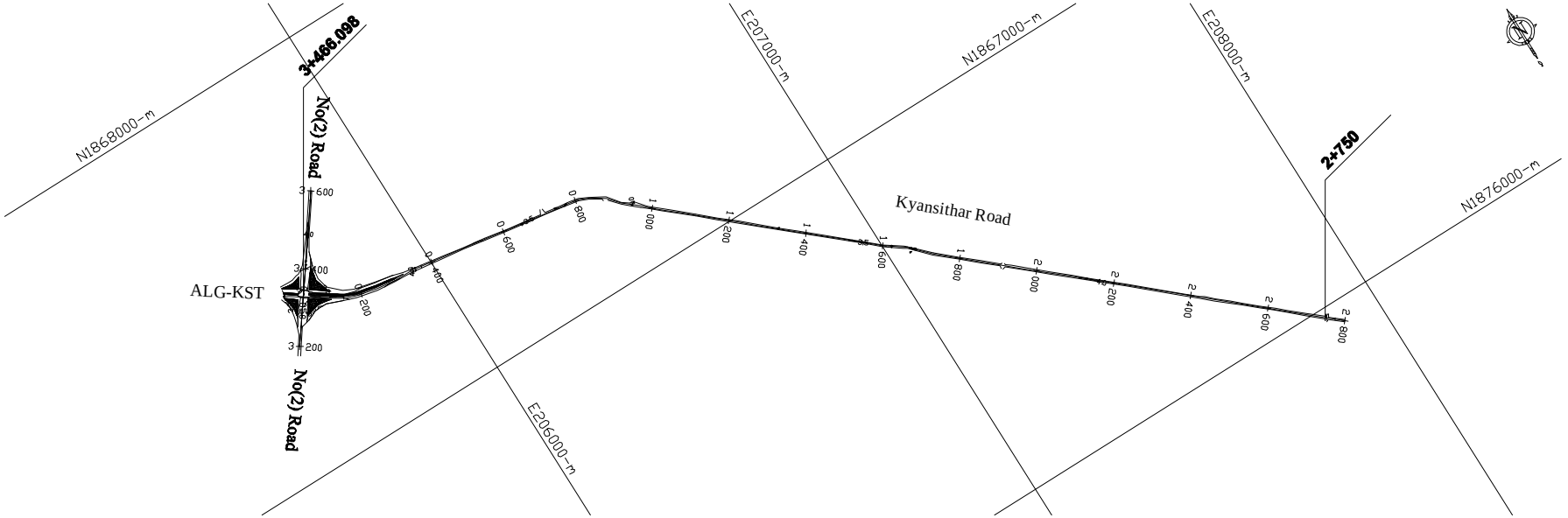
PROFILE

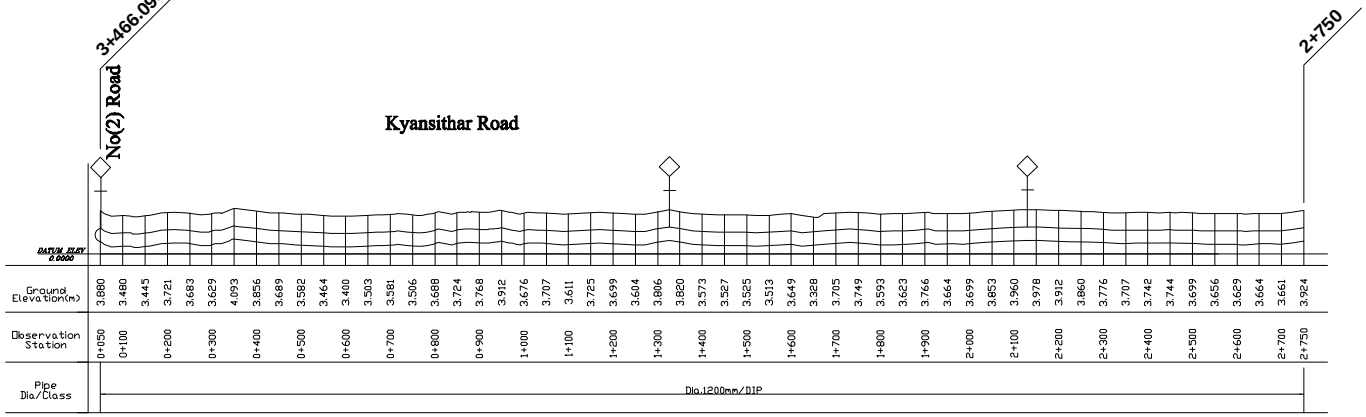
Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from WTP to Zone8 S/R Plan & Longitudinal Section (3/5)		
Date		Scale	Drawing No.
Oct. 2013		A3; H=1:12,000 V=1:1,000	TP - 4

Transmission Pipe from WTP to Zone8 S/R





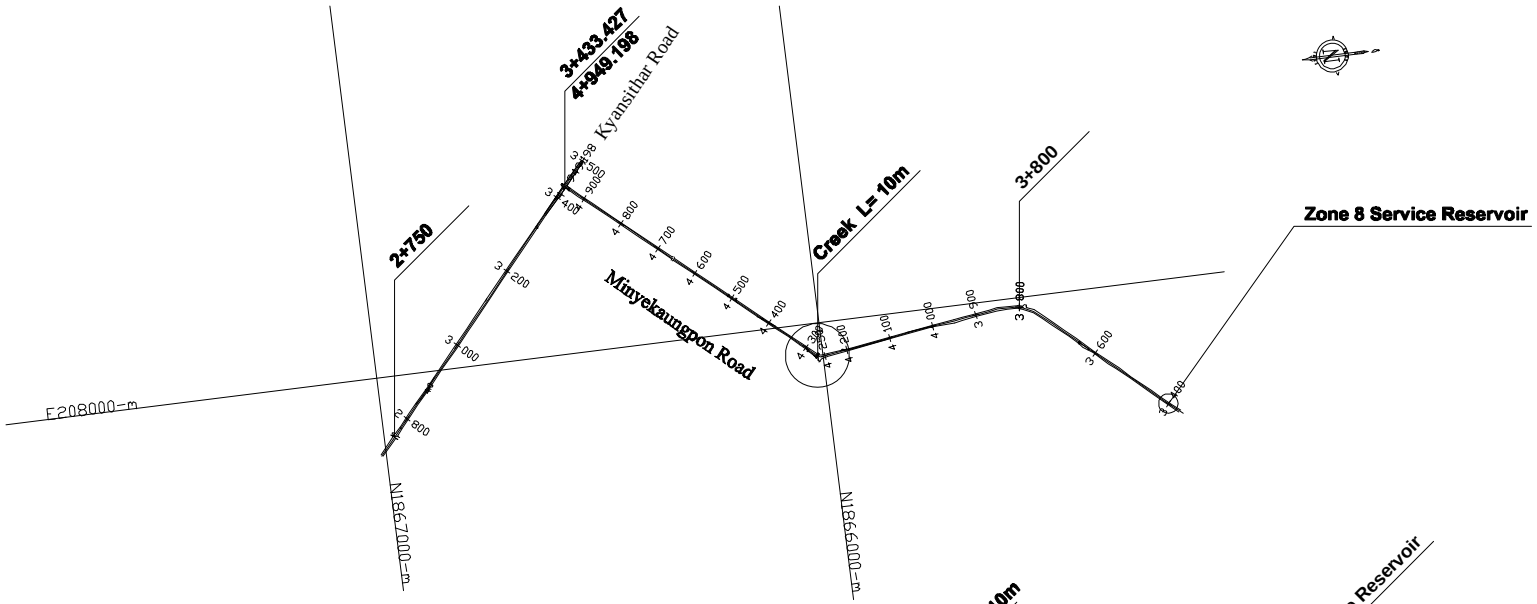
PROFILE

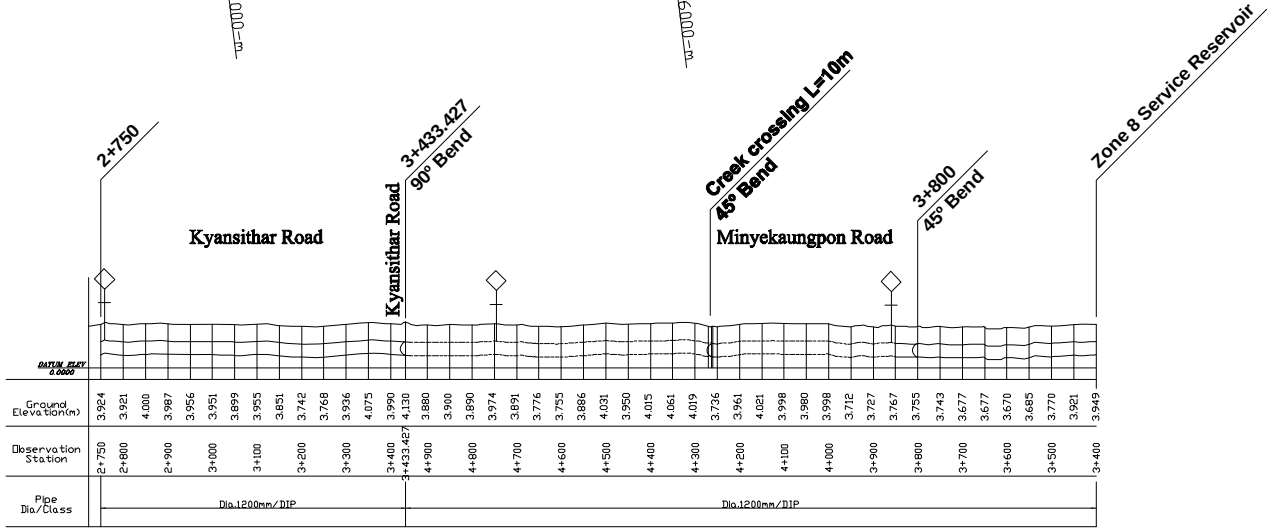
Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from WTP to Zone8 S/R Plan & Longitudinal Section(4/5)		
Date		Scale	Drawing No.
Oct. 2013		A3; H=1:12,000 V=1:1,000	TP - 5

Transmission Pipe from WTP to Zone8 S/R





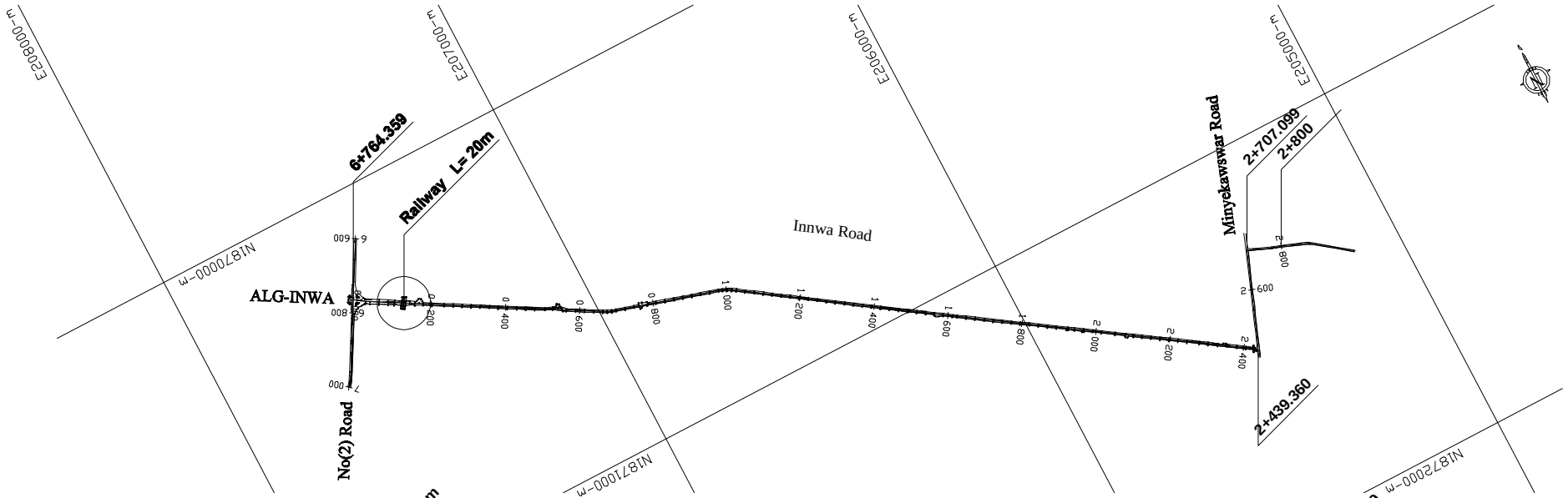
PROFILE

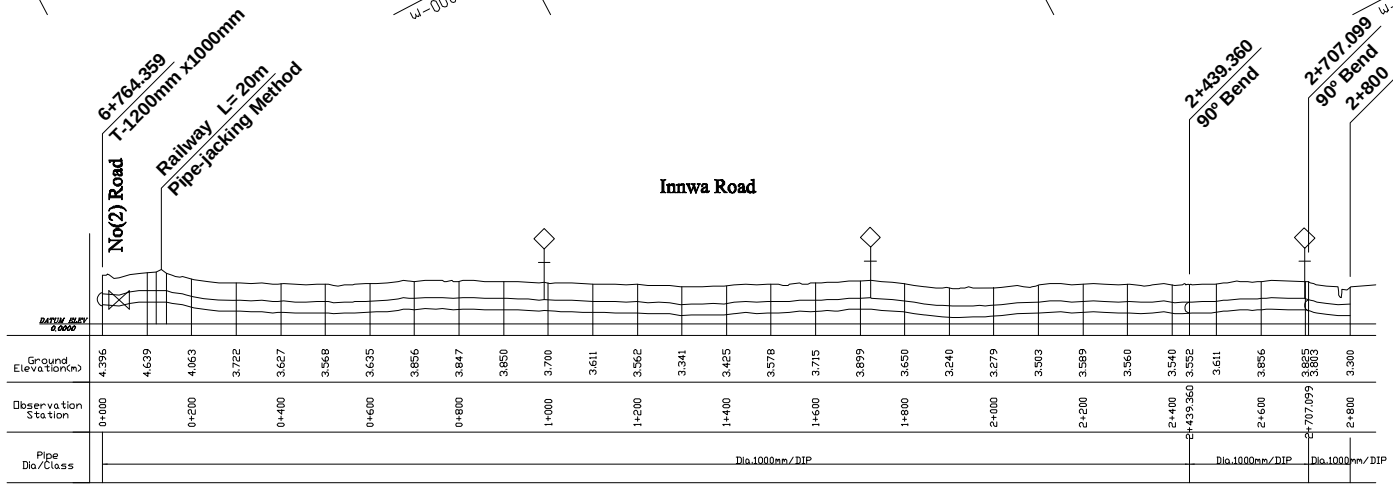
Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from WTP to Zone8 S/R Plan & Longitudinal Section (5/5)		
Date		Scale	Drawing No.
Oct. 2013		A3; H=1:12,000 V=1:1,000	TP - 6

Transmission Pipe from WTP to Zone7 S/R





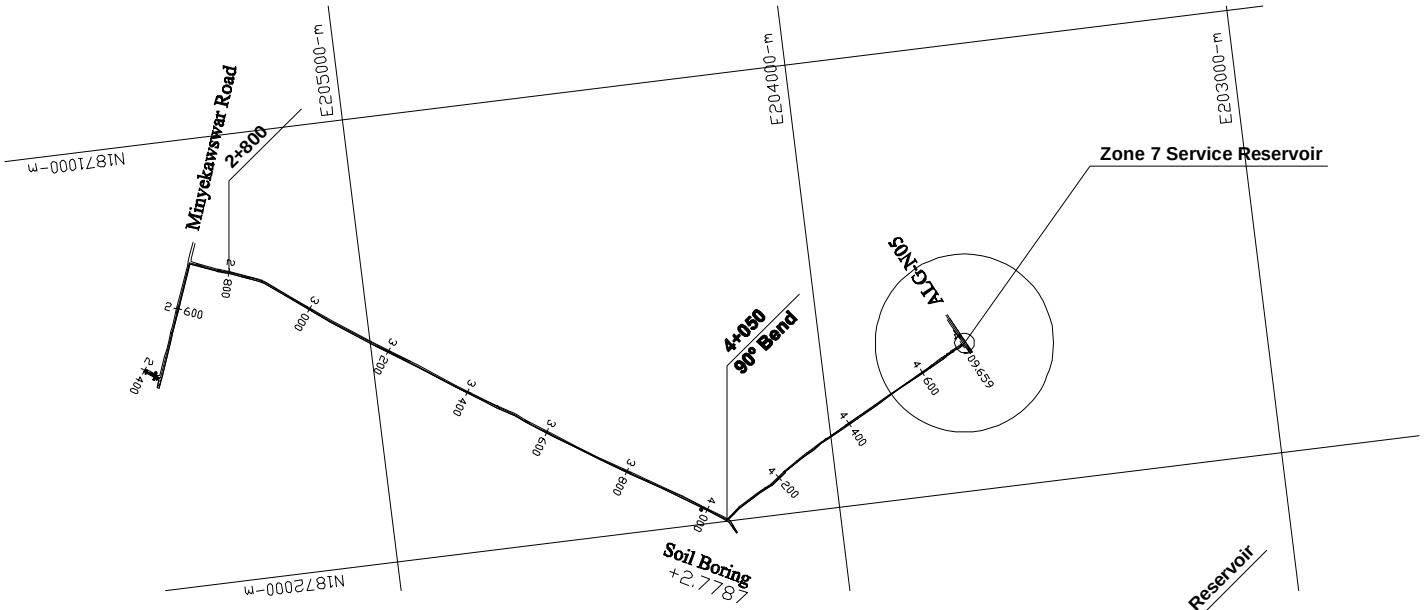
PROFILE

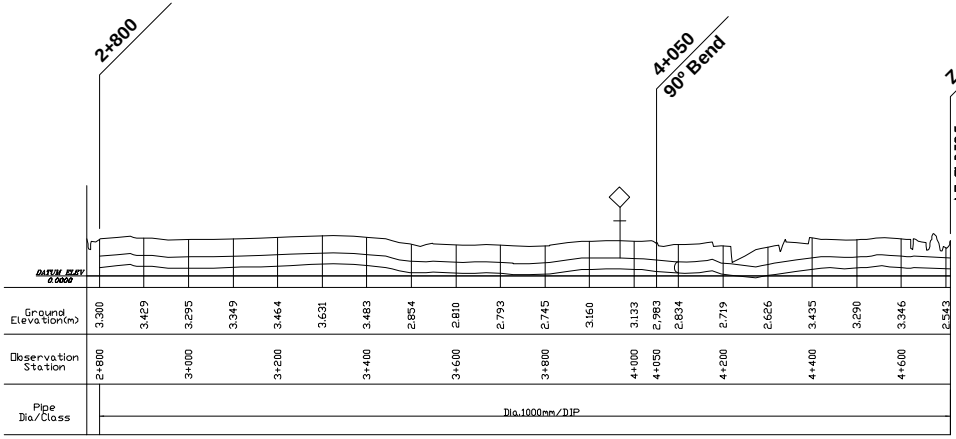
Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from WTP to Zone7 S/R Plan & Longitudinal Section (1/2)		
Date		Scale	Drawing No.
Oct. 2013		A3; H=1:12,000 V=1:1,000	TP - 7

Transmission Pipe from WTP to Zone7 S/R





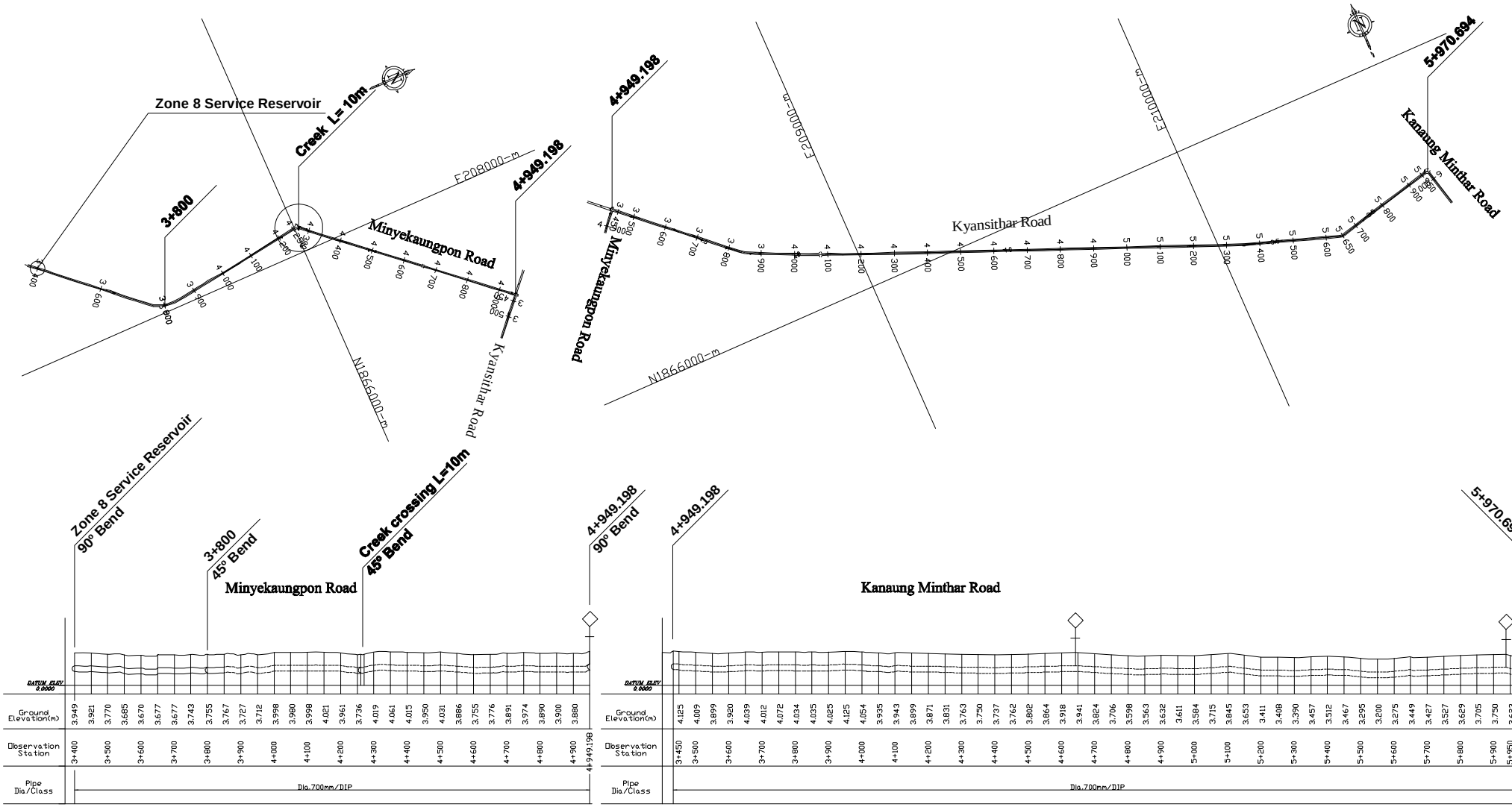
PROFILE

Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from WTP to Zone7 S/R Plan & Longitudinal Section (2/2)		
Date		Scale	Drawing No.
Oct. 2013		A3; H=1:12,000 V=1:1,000	TP - 8

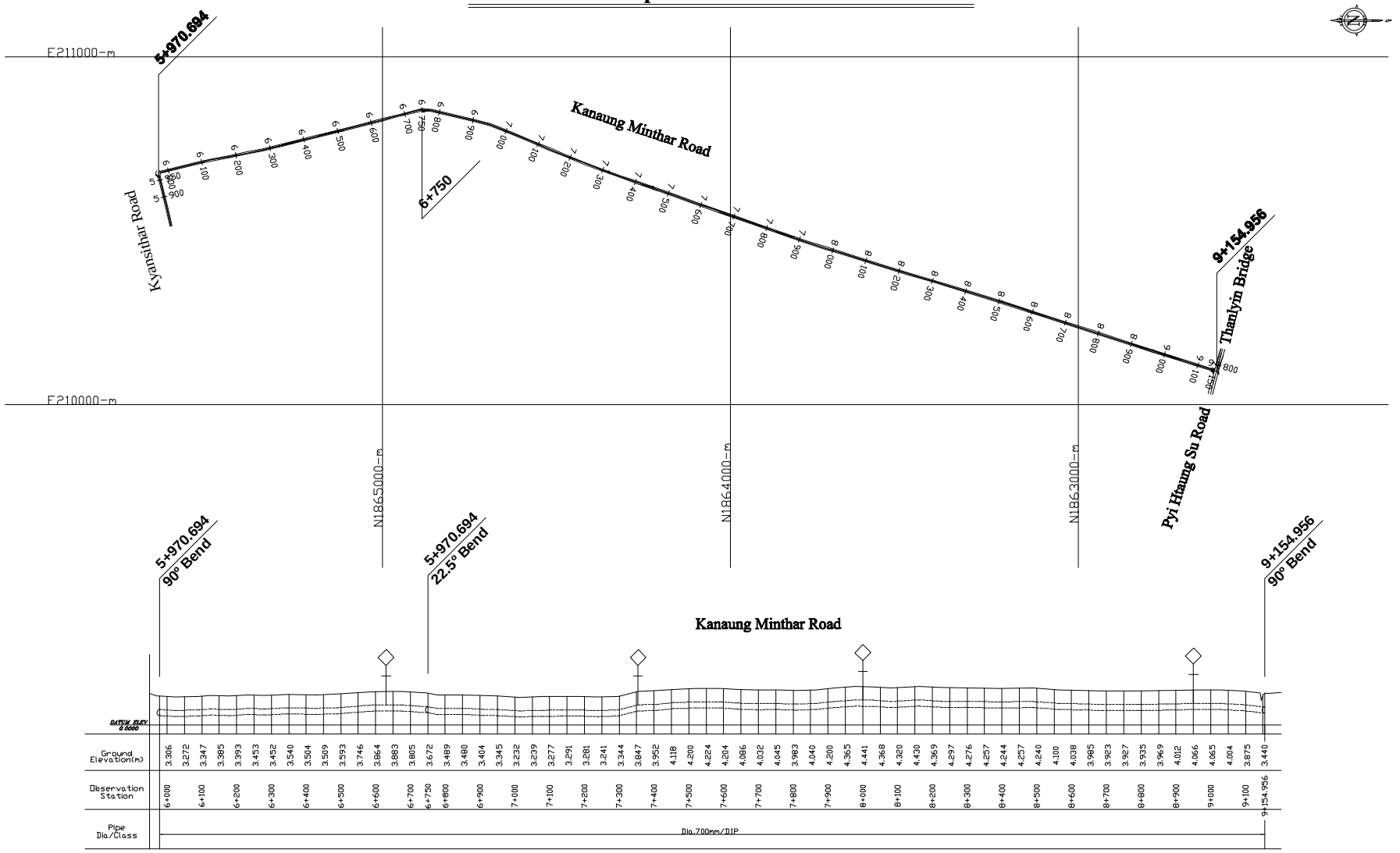
Transmission Pipe from Zone8 S/R to Thilawa



project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Transmission Pipe from Zone8 S/R to Thilawa Plan & Longitudinal Section (1/8)

Date	Scale	Drawing No.
Oct. 2013	A3; H=1:12,000 V=1:1,000	TP - 9

Transmission Pipe from Zone8 S/R to Thilawa



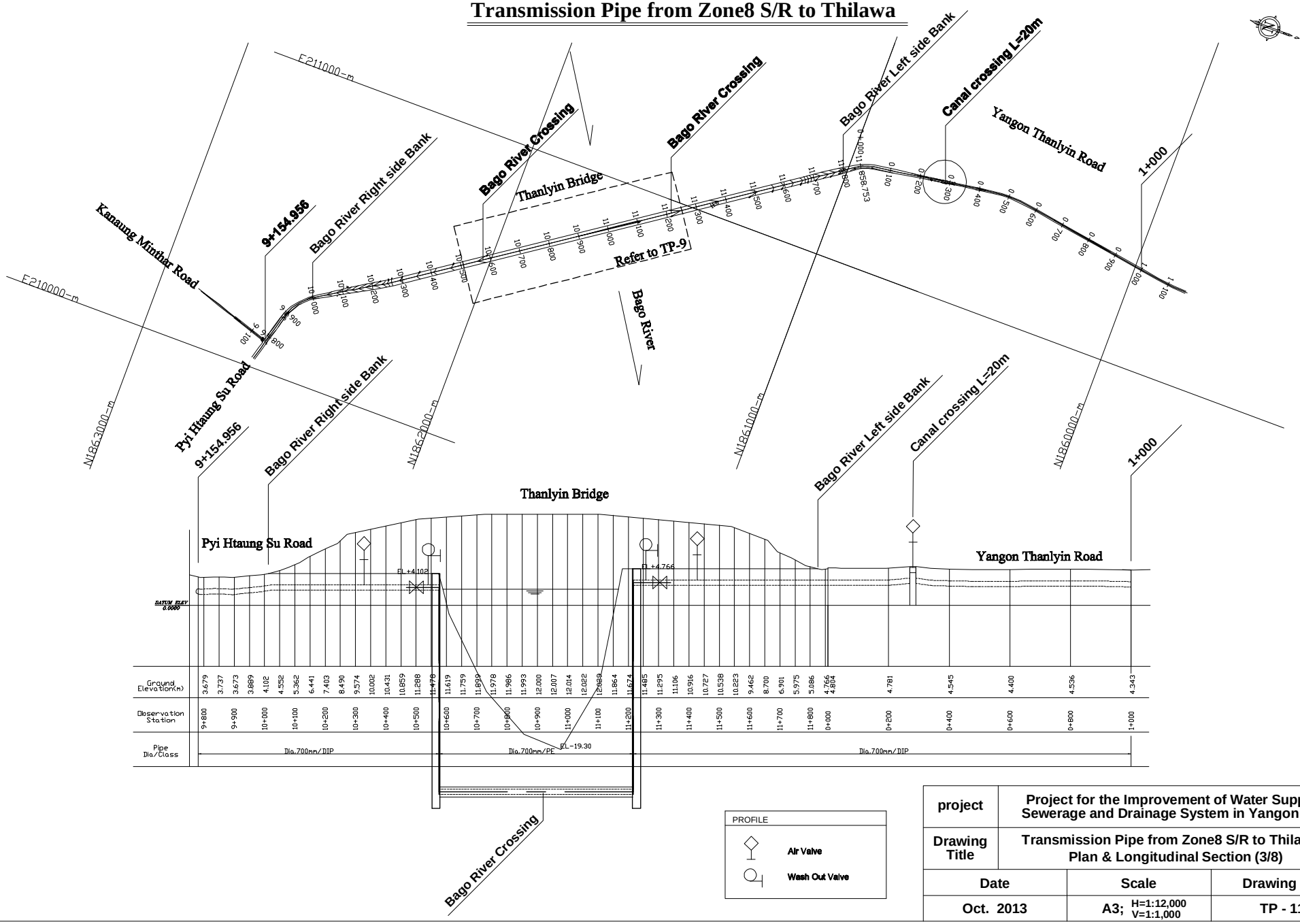
PROFILE

Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from Zone8 S/R to Thilawa Plan & Longitudinal Section (2/8)		
Date		Scale	Drawing No.
Oct. 2013		A3; H=1:12,000 V=1:1,000	TP - 10

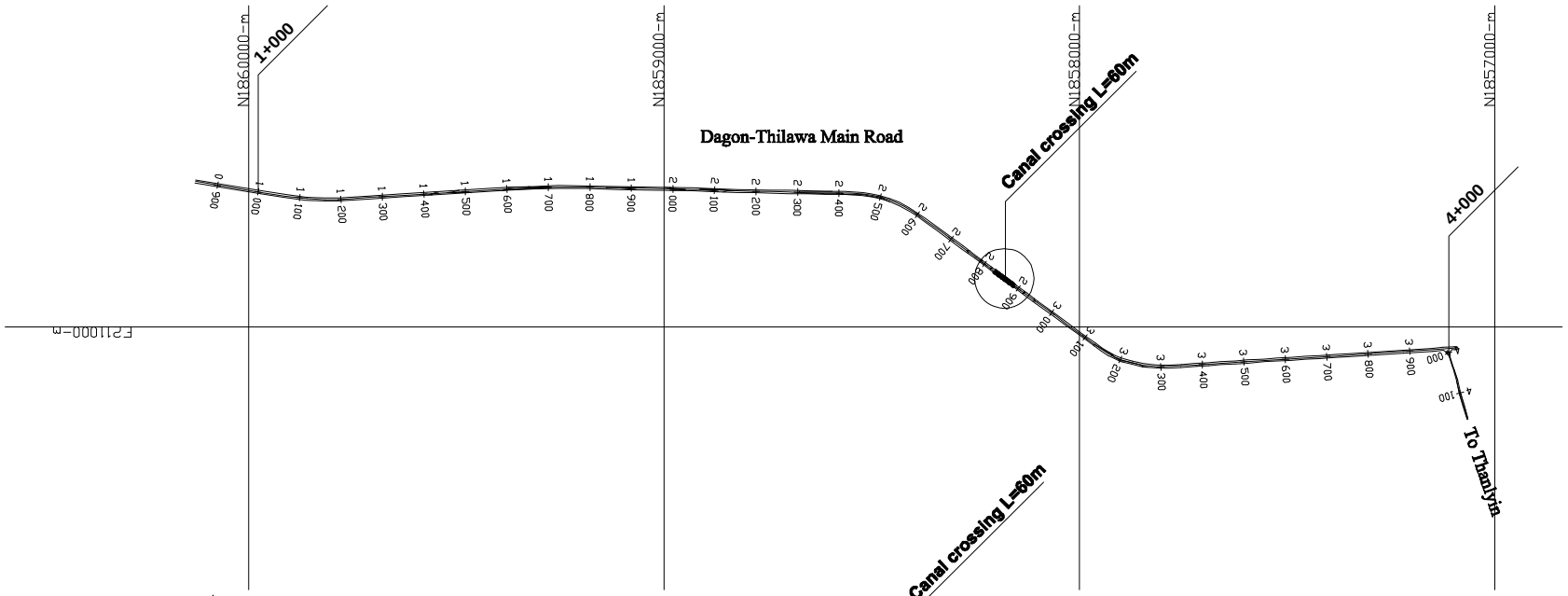
Transmission Pipe from Zone8 S/R to Thilawa

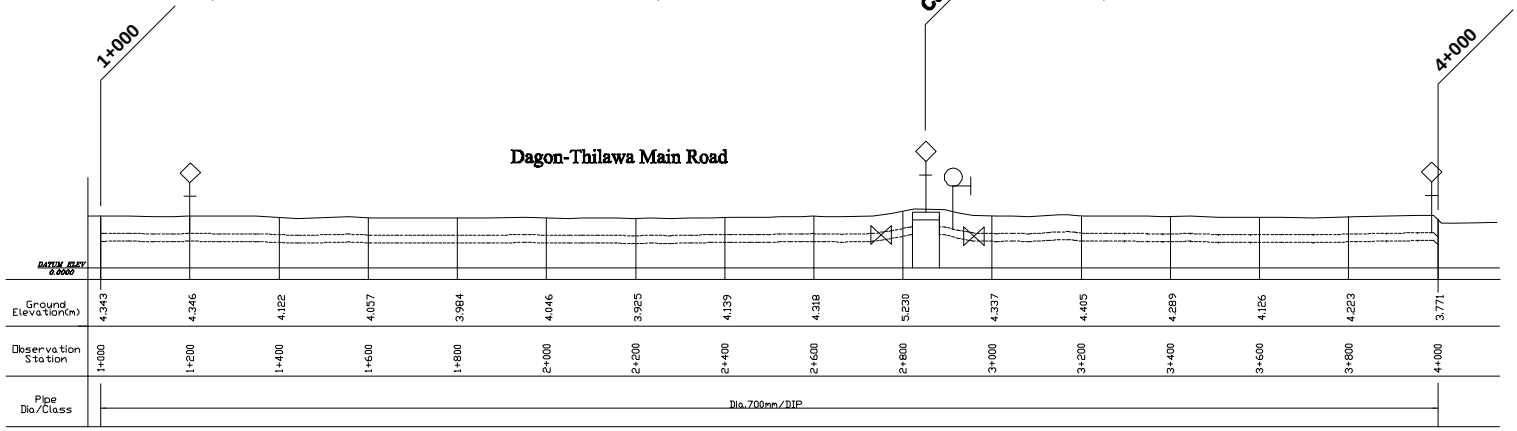


project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Transmission Pipe from Zone8 S/R to Thilawa Plan & Longitudinal Section (3/8)

Date	Scale	Drawing No.
Oct. 2013	A3; H=1:12,000 V=1:1,000	TP - 11

Transmission Pipe from Zone8 S/R to Thilawa





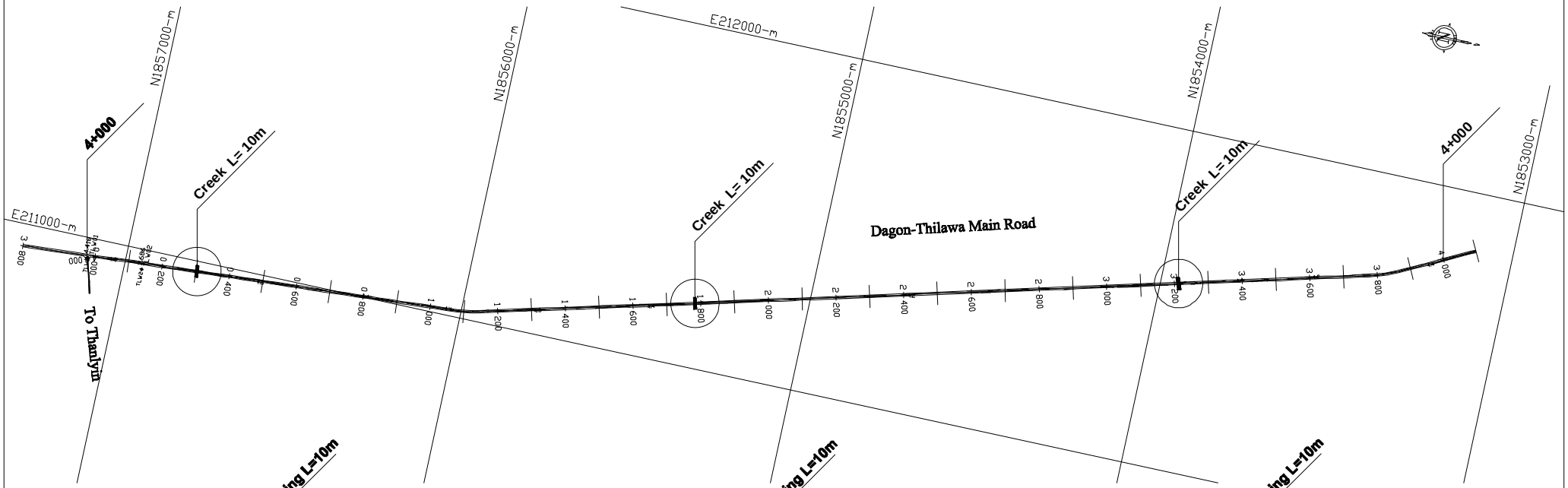
PROFILE

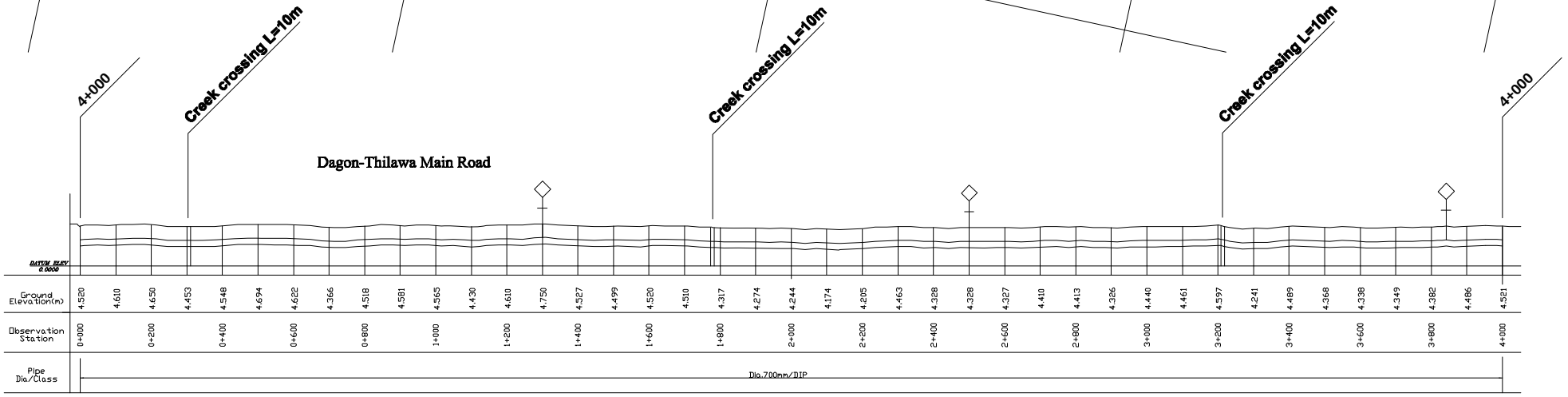
Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from Zone8 S/R to Thilawa Plan & Longitudinal Section (4/8)		
Date		Scale	Drawing No.
Oct. 2013		A3; H=1:12,000 V=1:1,000	TP - 12

Transmission Pipe from Zone8 S/R to Thilawa





PROFILE

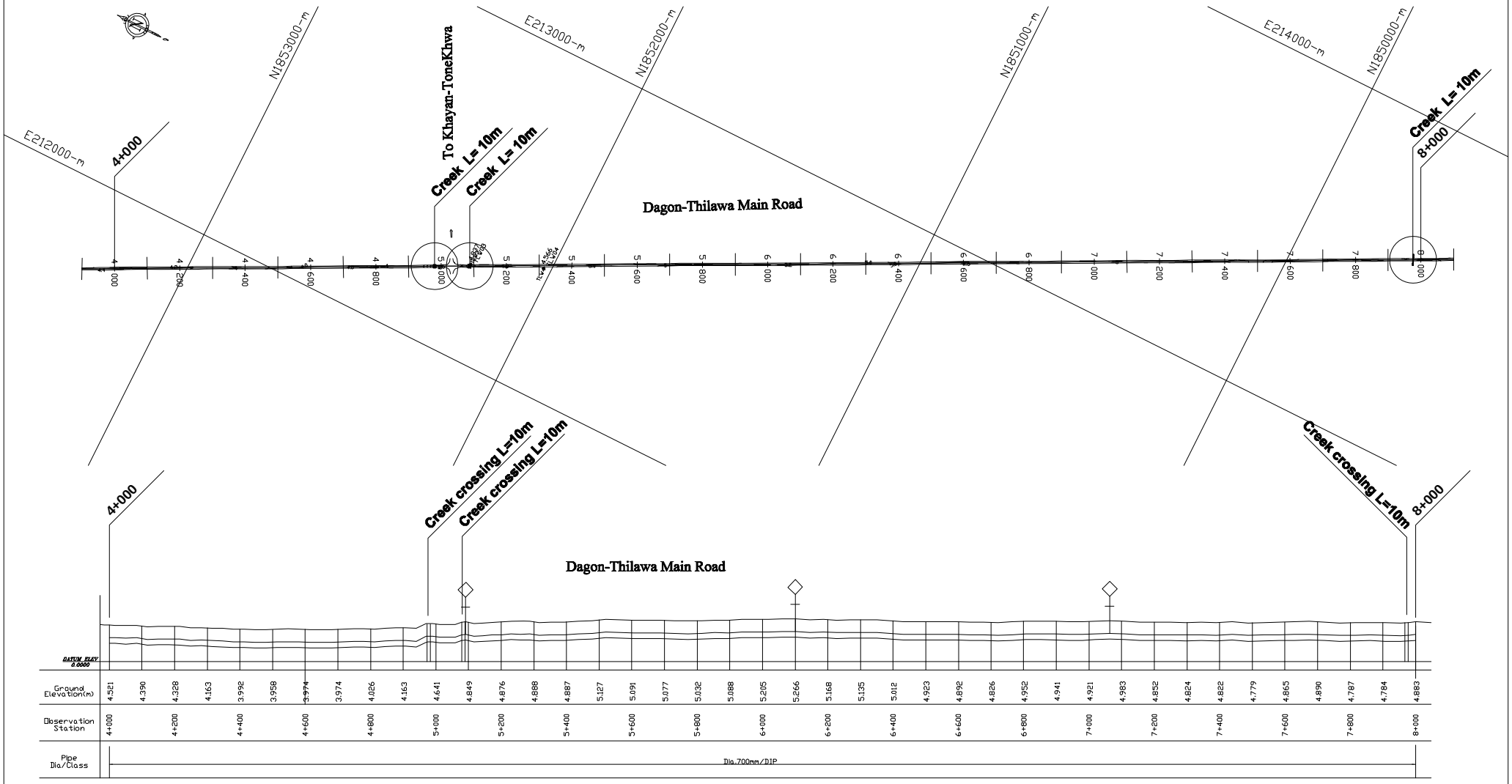
Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Transmission Pipe from Zone8 S/R to Thilawa Plan & Longitudinal Section (5/8)

Date	Scale	Drawing No.
Oct. 2013	A3; H=1:12,000 V=1:1,000	TP - 13

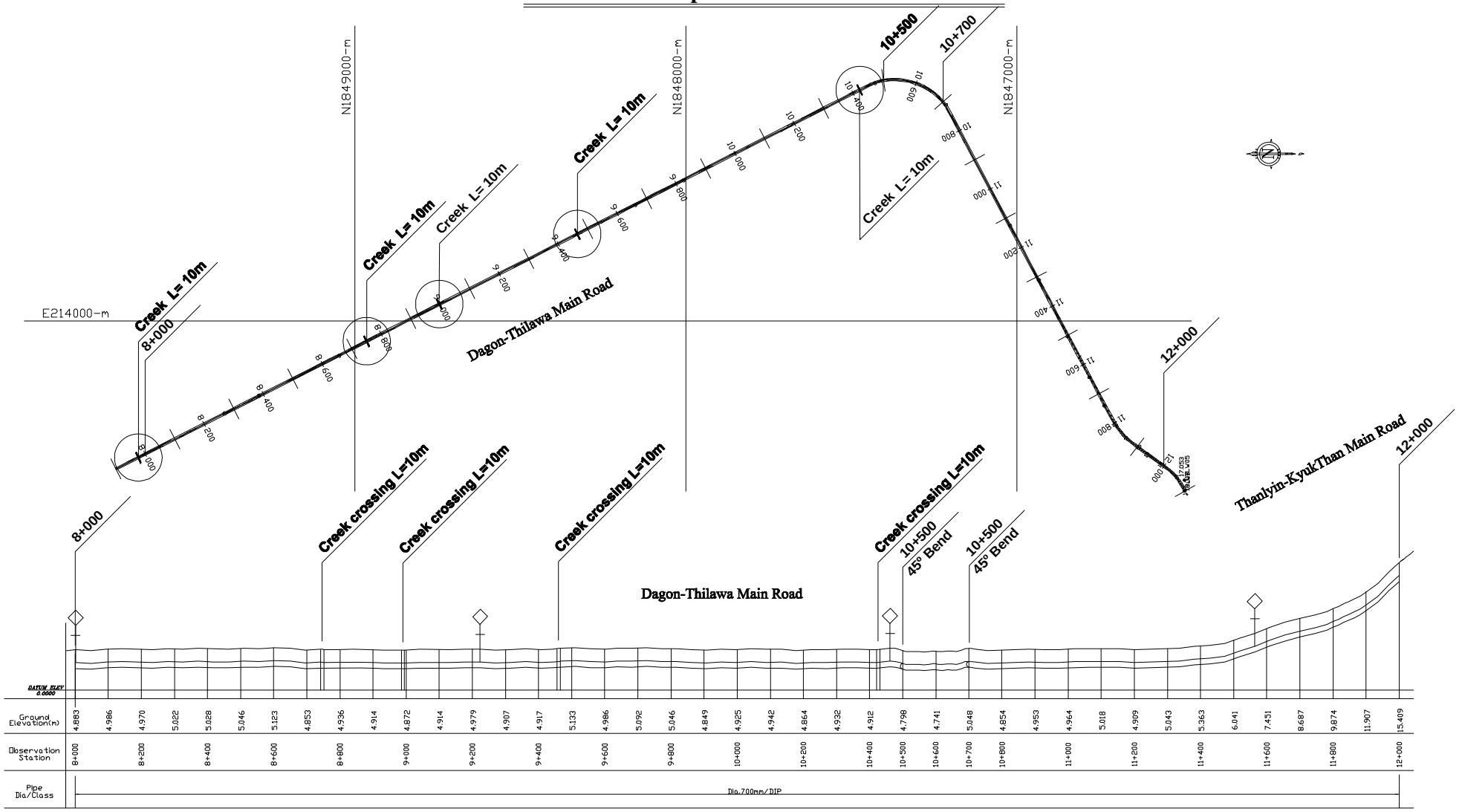
Transmission Pipe from Zone8 S/R to Thilawa



project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Transmission Pipe from Zone8 S/R to Thilawa Plan & Longitudinal Section (6/8)

Date	Scale	Drawing No.
Oct. 2013	A3; H=1:12,000 V=1:1,000	TP - 14

Transmission Pipe from Zone8 S/R to Thilawa



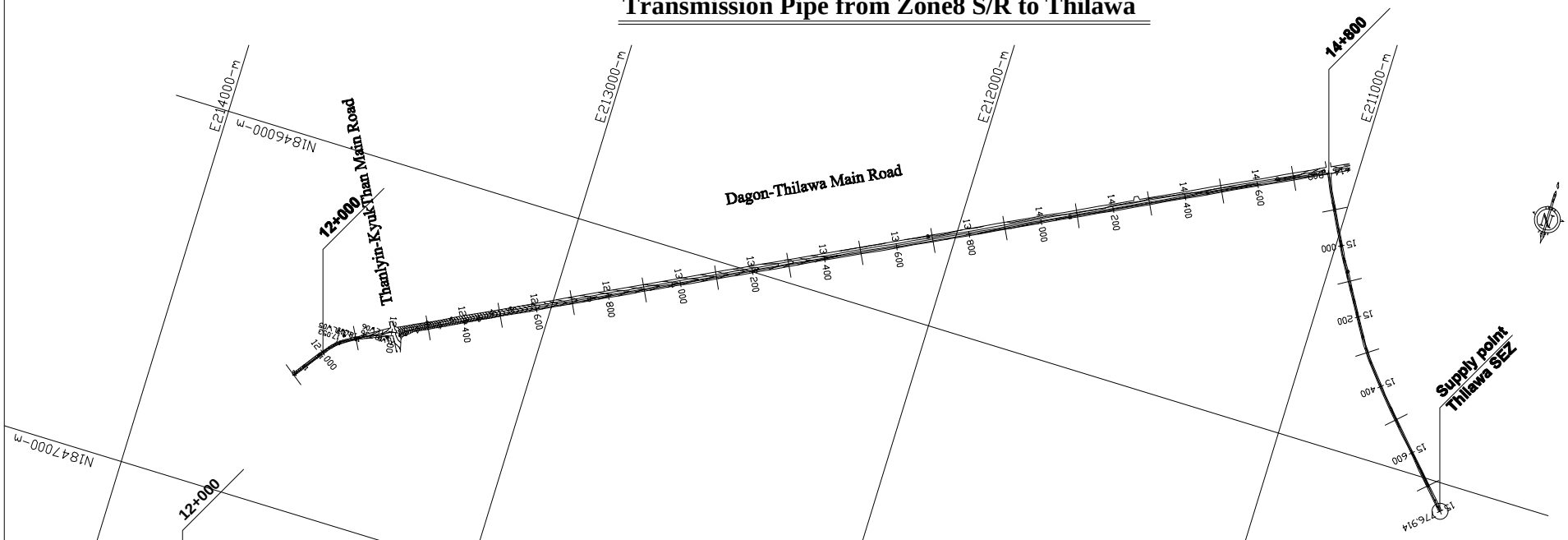
PROFILE

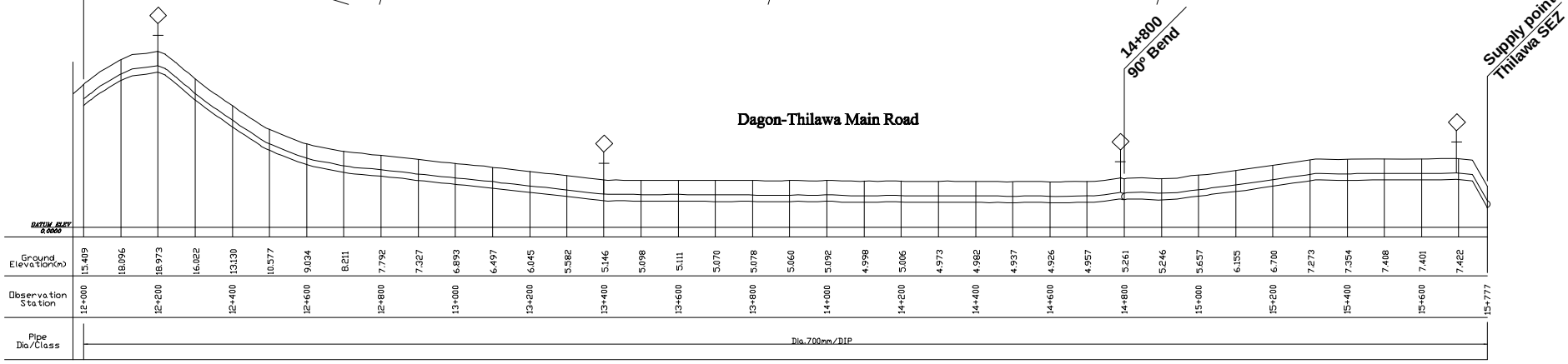
Air Valve

Wash Out Valve

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from Zone8 S/R to Thilawa Plan & Longitudinal Section (7/8)		
Date		Scale	Drawing No.
Oct. 2013		A3; H=1:12,000 V=1:1,000	TP - 15

Transmission Pipe from Zone8 S/R to Thilawa





PROFILE

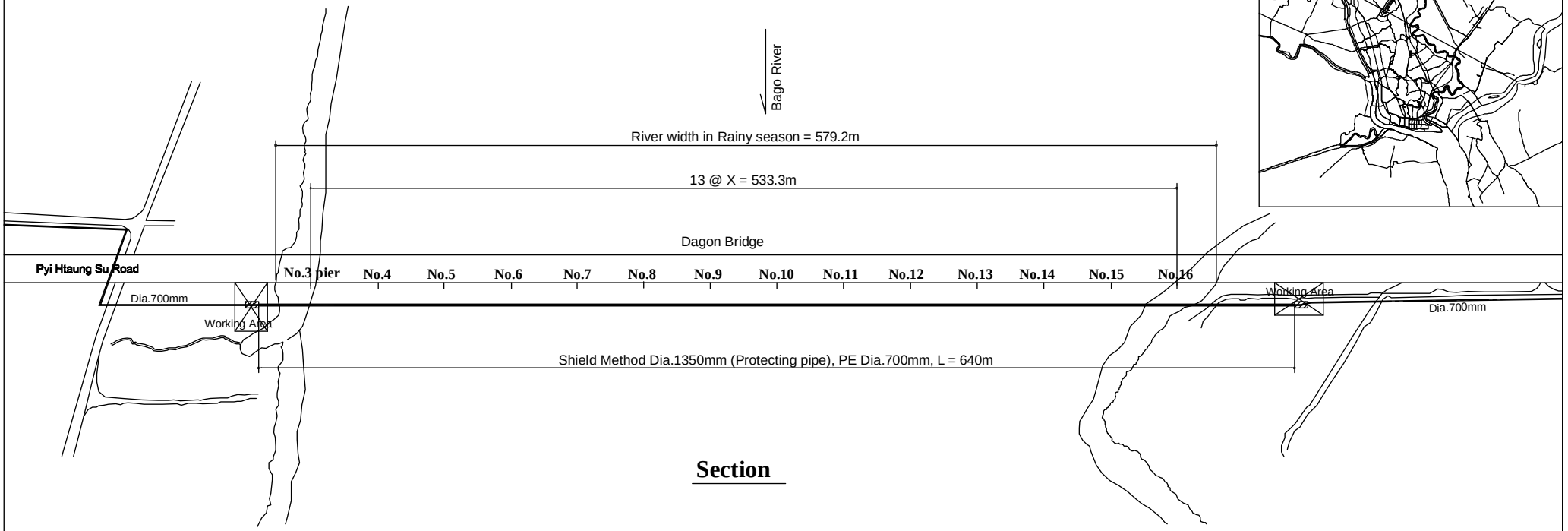
Air Valve

Wash Out Valve

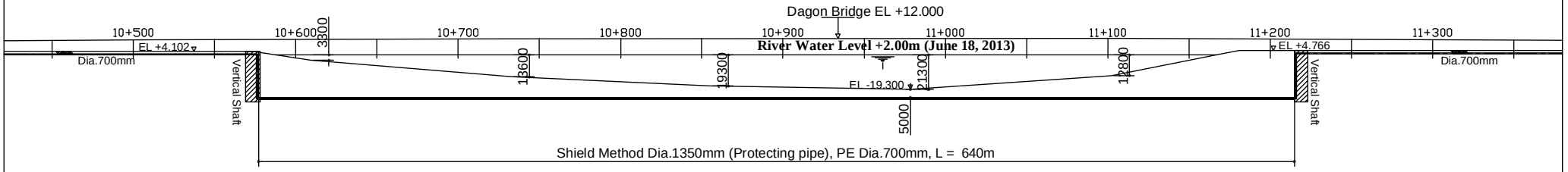
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Transmission Pipe from Zone8 S/R to Thilawa Plan & Longitudinal Section (8/8)		
Date	Scale		Drawing No.
Oct. 2013	A3; H=1:12,000 V=1:1,000		TP - 16

Bago River Crossing

General Plan



Section



GRAPHIC SCALE
(IN METERS)

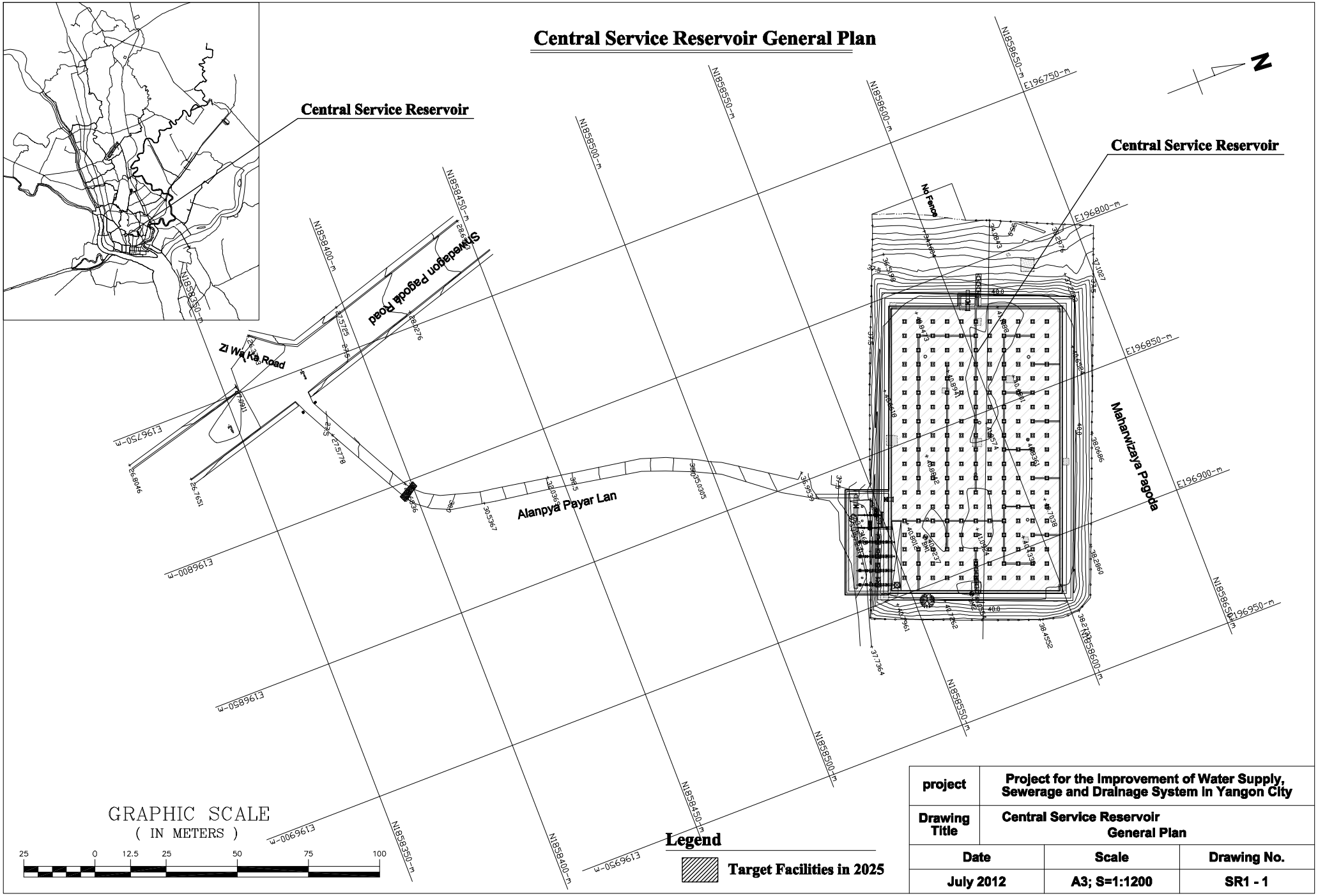
50 0 25 50 100 150 200

Legend

Target Facilities in 2018

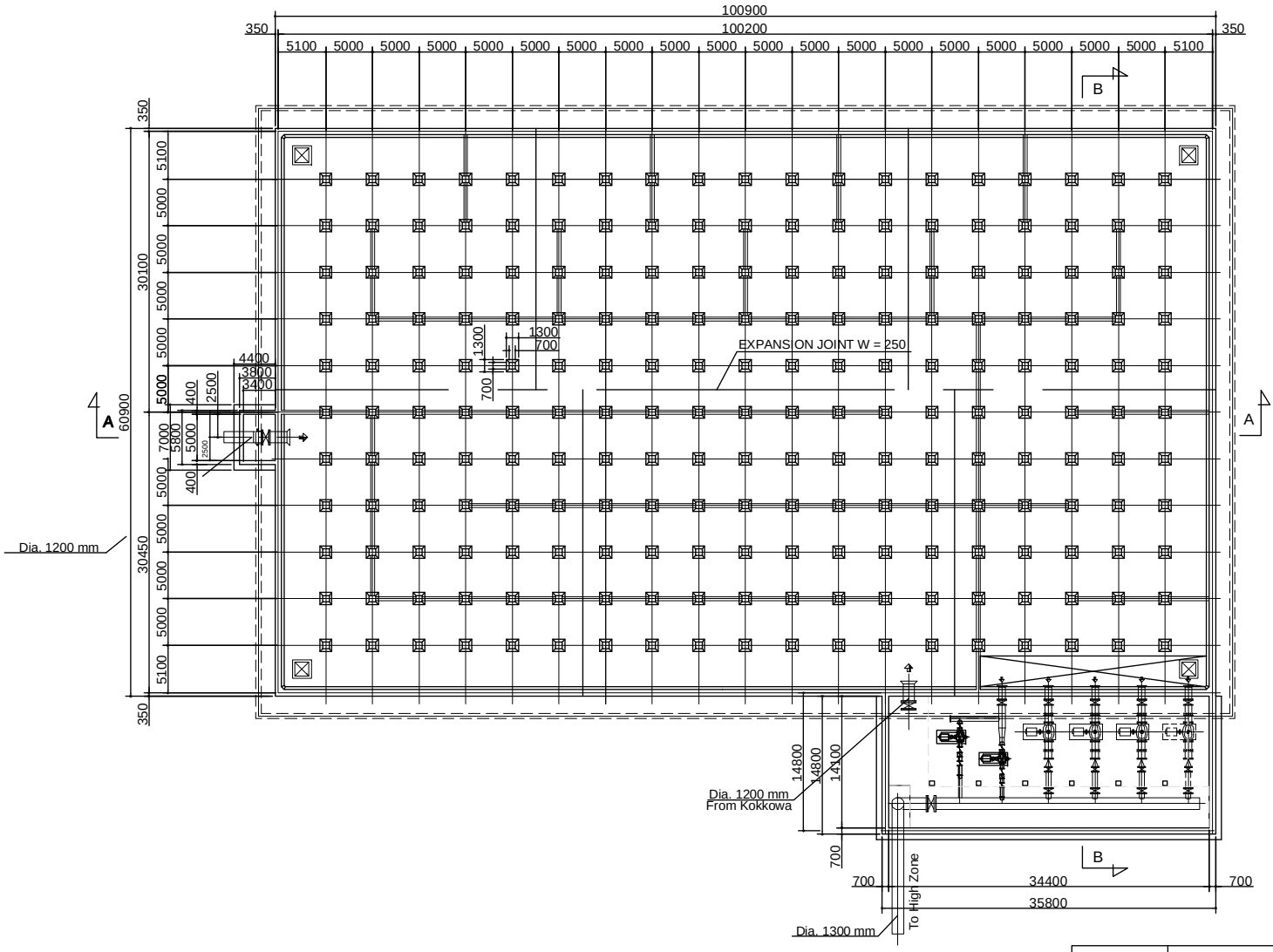
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Transmission Pipe from Zone8 S/R to Thilawa Bago River Crossing General Plan and Section

Date	Scale	Drawing No.
July 2013	A3; S=1:2500	TP-17



project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Central Service Reservoir General Plan		
Date		Scale	Drawing No.
July 2012		A3; S=1:1200	SR1 - 1

Central Service Reservoir Plan

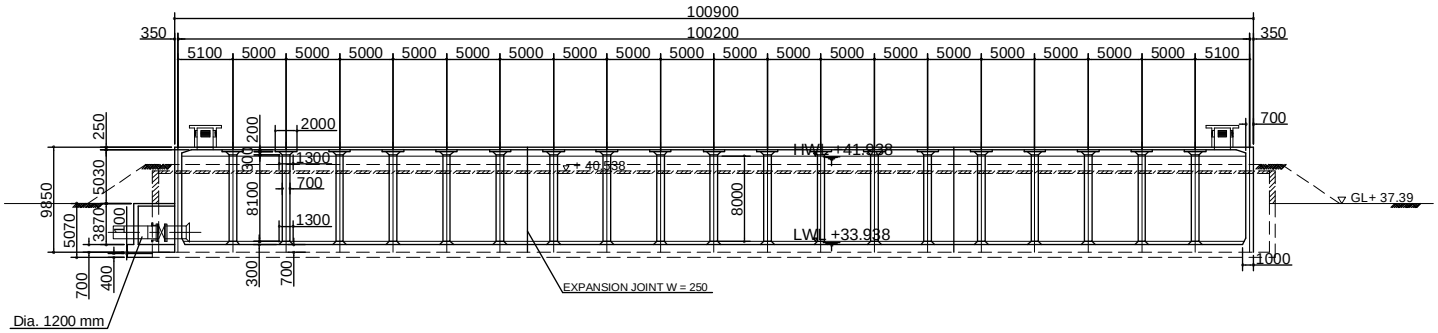


Note : The values are indicative, and detailed values shall be decided in detailed design.

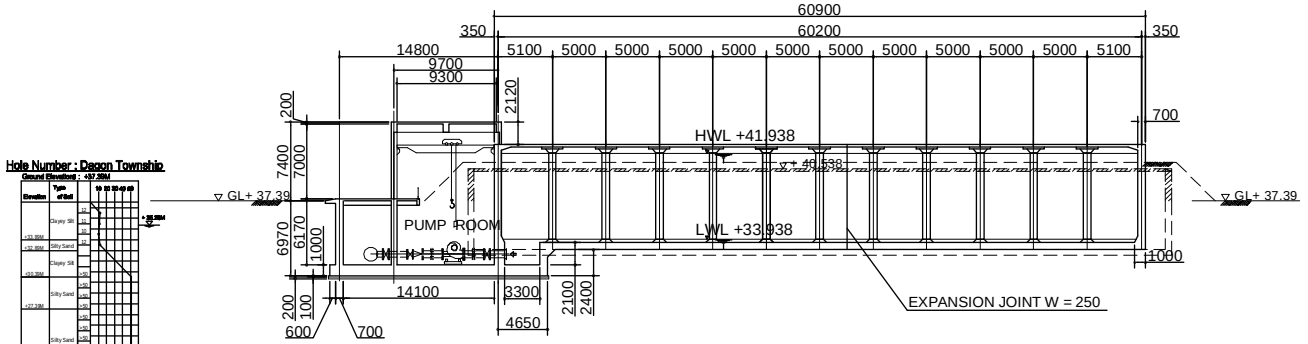
project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Central Service Reservoir Plan		
Date		Scale	Drawing No.
July 2012		A3; S=1:500	SR1 - 2

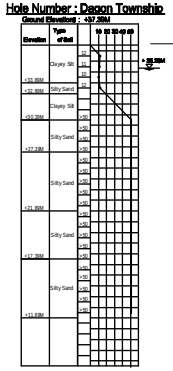
Central Service Reservoir Section

SECTION A - A



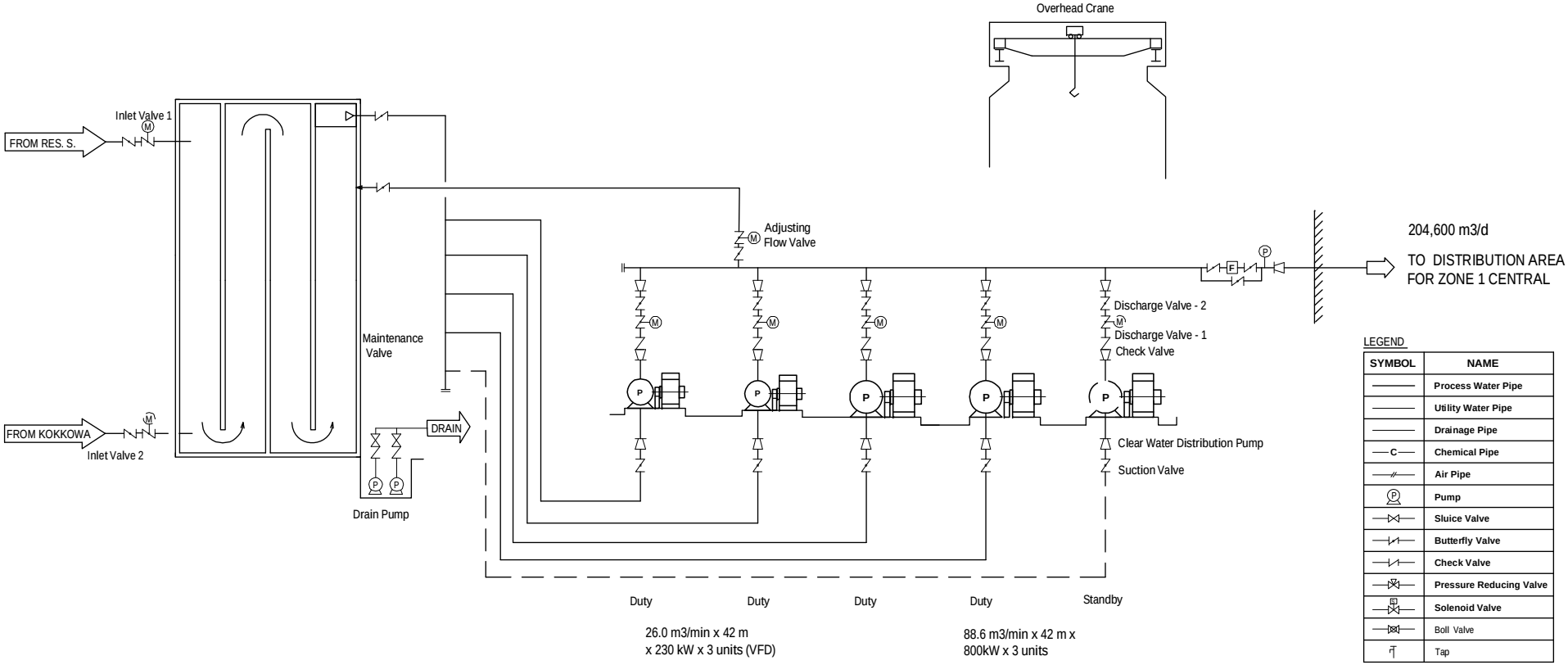
SECTION B - B





Note : The values are indicative, and detailed values shall be decided in detailed design.

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Central Service Reservoir Section		
Date		Scale	Drawing No.
July 2012		A3; S=1:500	SR1 - 3



CENTRAL SERVICE RESERVOIR FOR ZONE 1

DISTRIBUTION PUMP

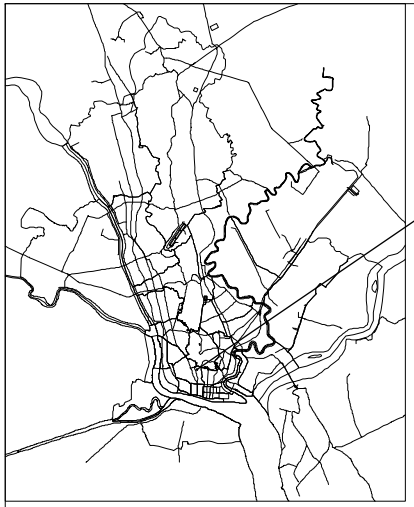
Legend

Target Facilities in 2018

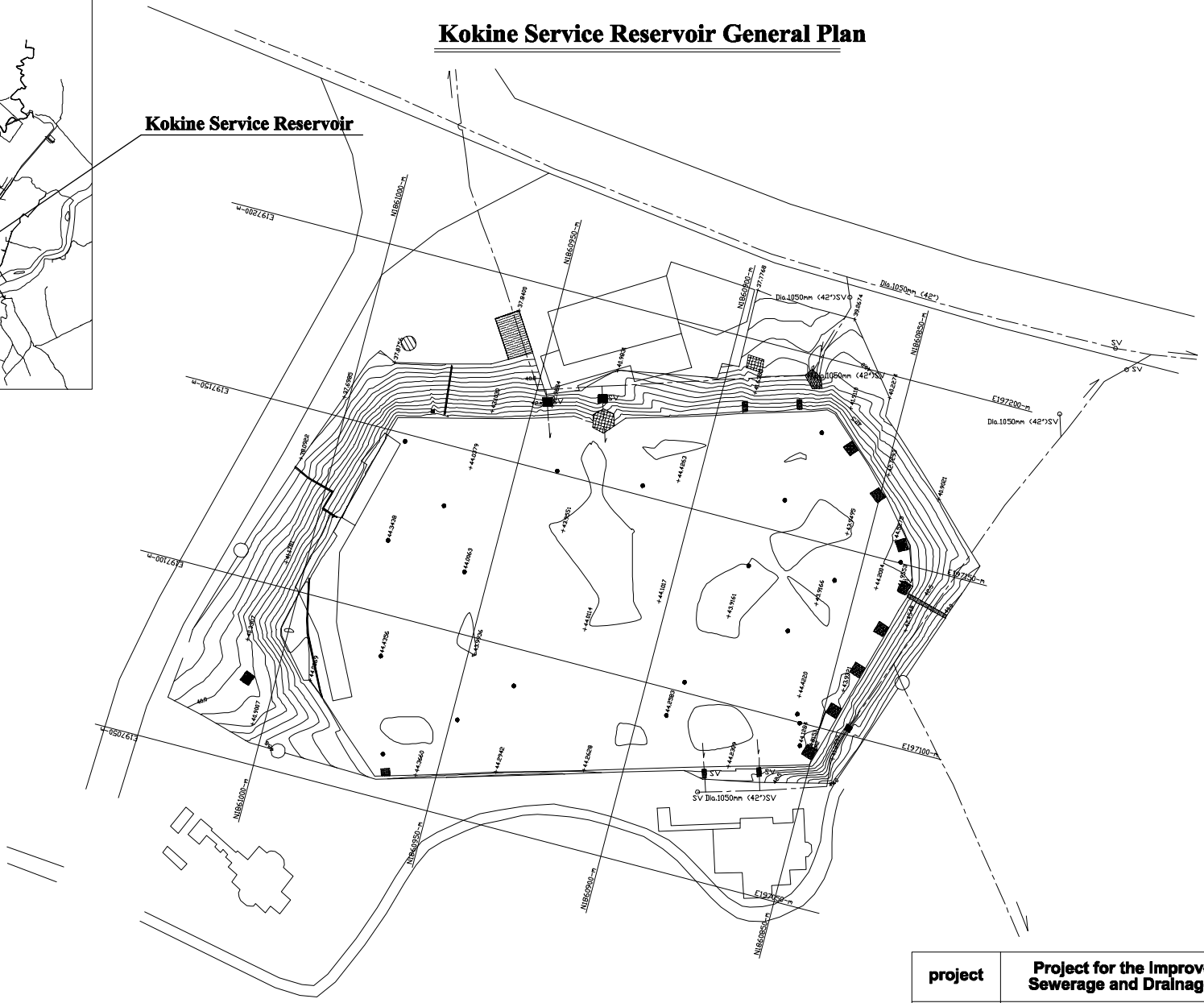
Target Facilities in the future

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Service Reservoir Facility for Zone1 **Distribution Pumping Station Process Flow Diagram**		
Date		Scale	Drawing No.
July 2013		None	SR1 - 4

Kokine Service Reservoir General Plan



Kokine Service Reservoir



GRAPHIC SCALE
(IN METERS)

25 0 12.5 25 50 75 100

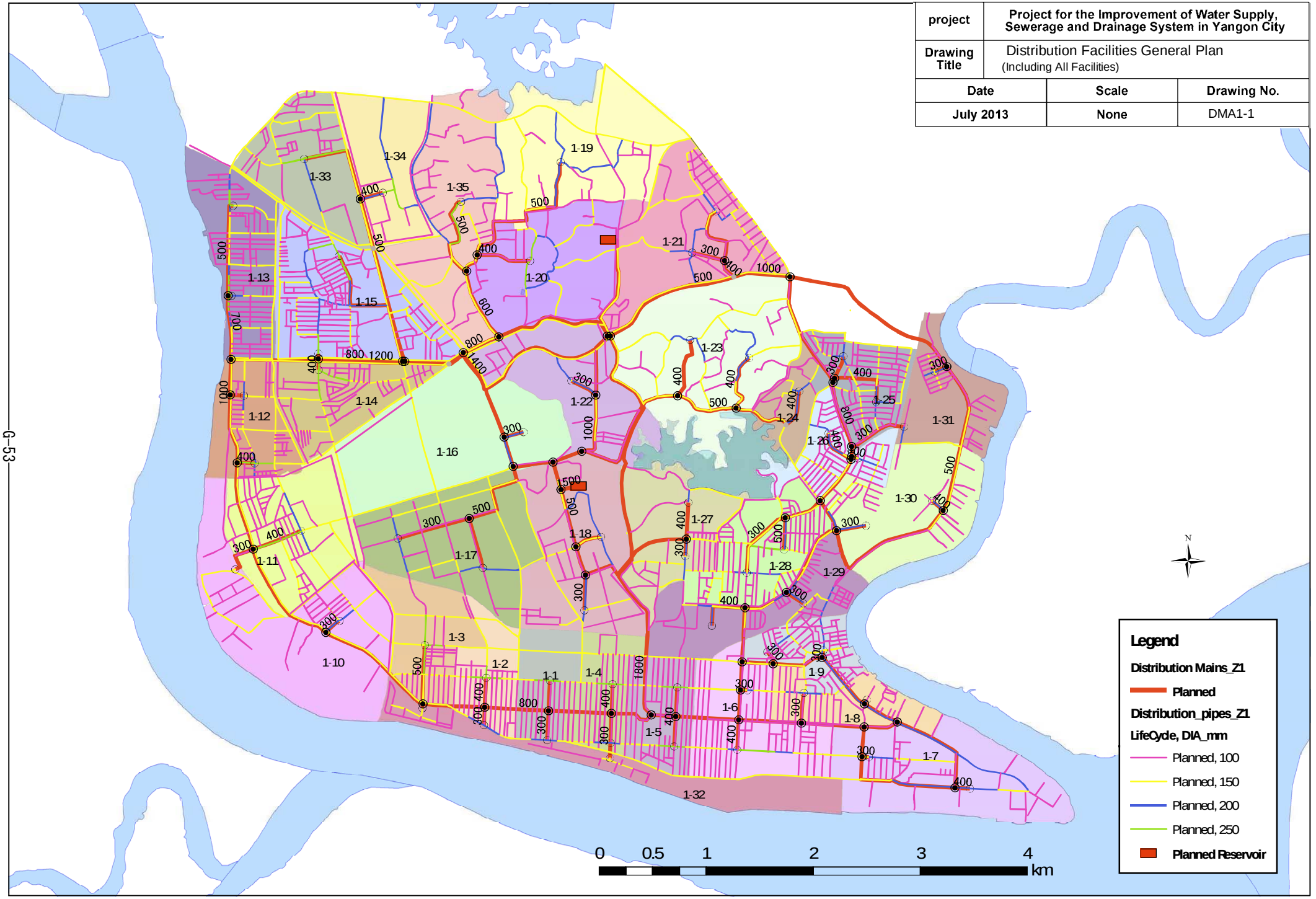
Legend

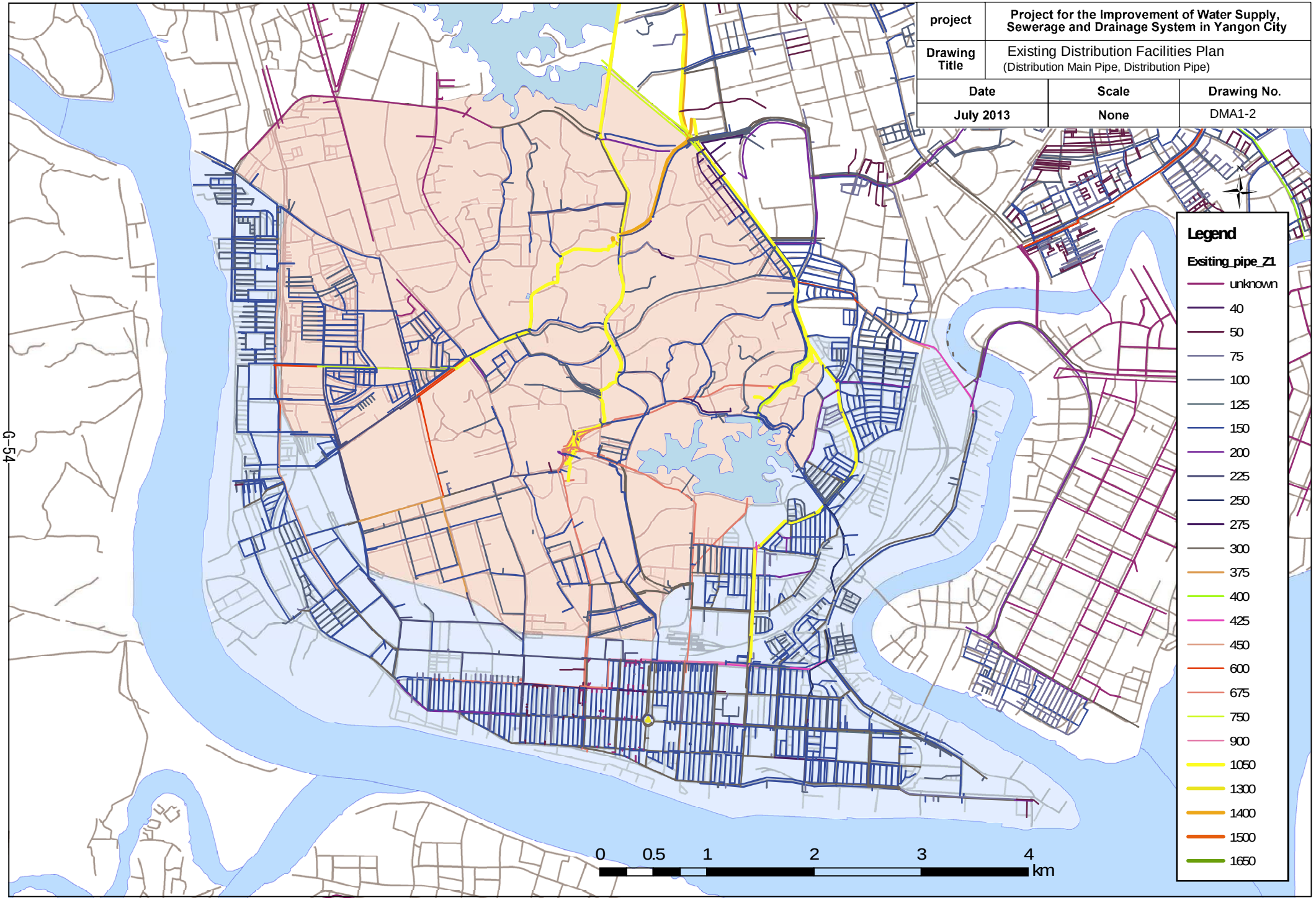
Target Facilities in 2025

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Kokine Service Reservoir General Plan

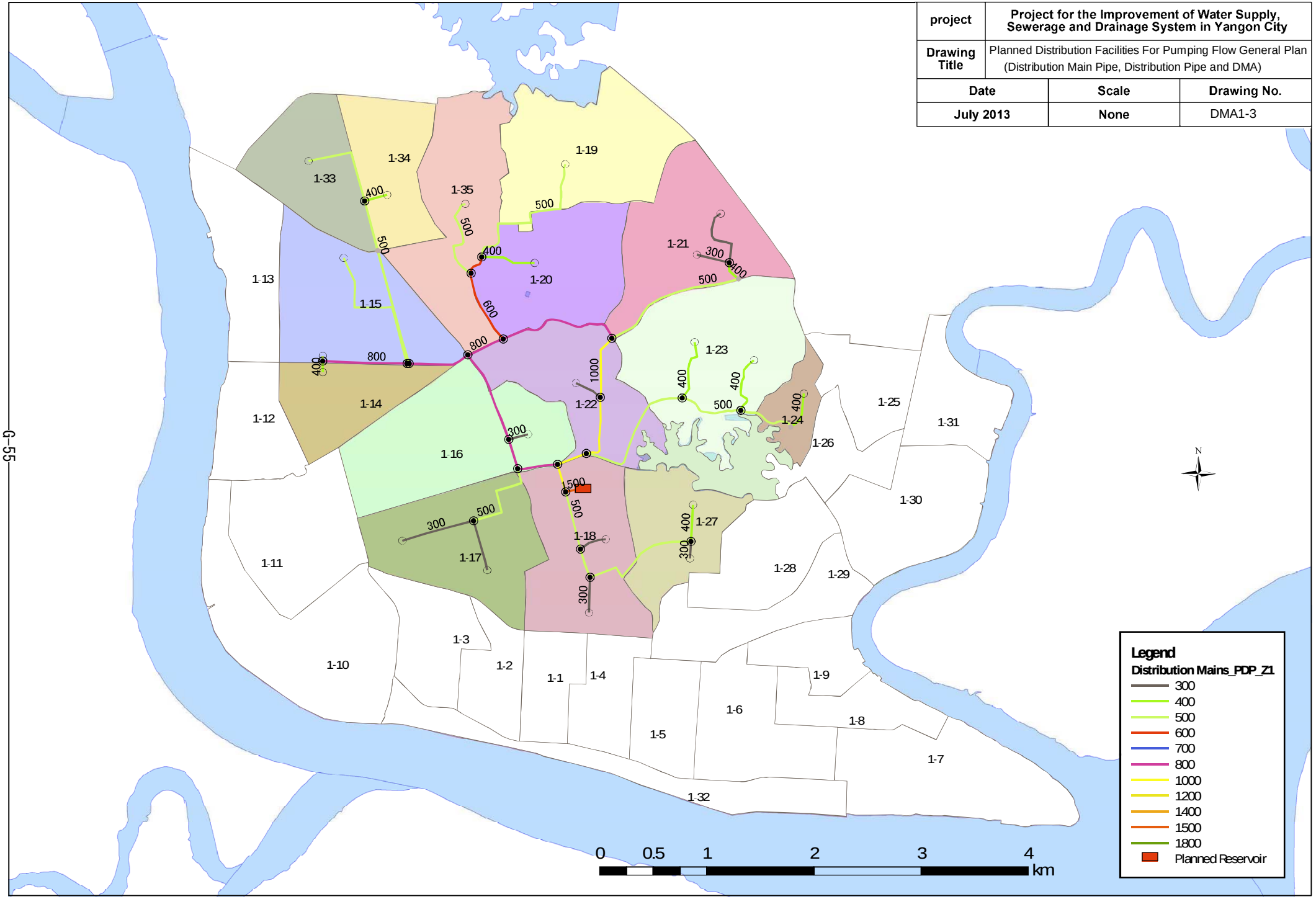
Date	Scale	Drawing No.
July 2012	A3; S=1:1200	SR1 - 5

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Distribution Facilities General Plan (Including All Facilities)		
Date		Scale	Drawing No.
July 2013		None	DMA1-1

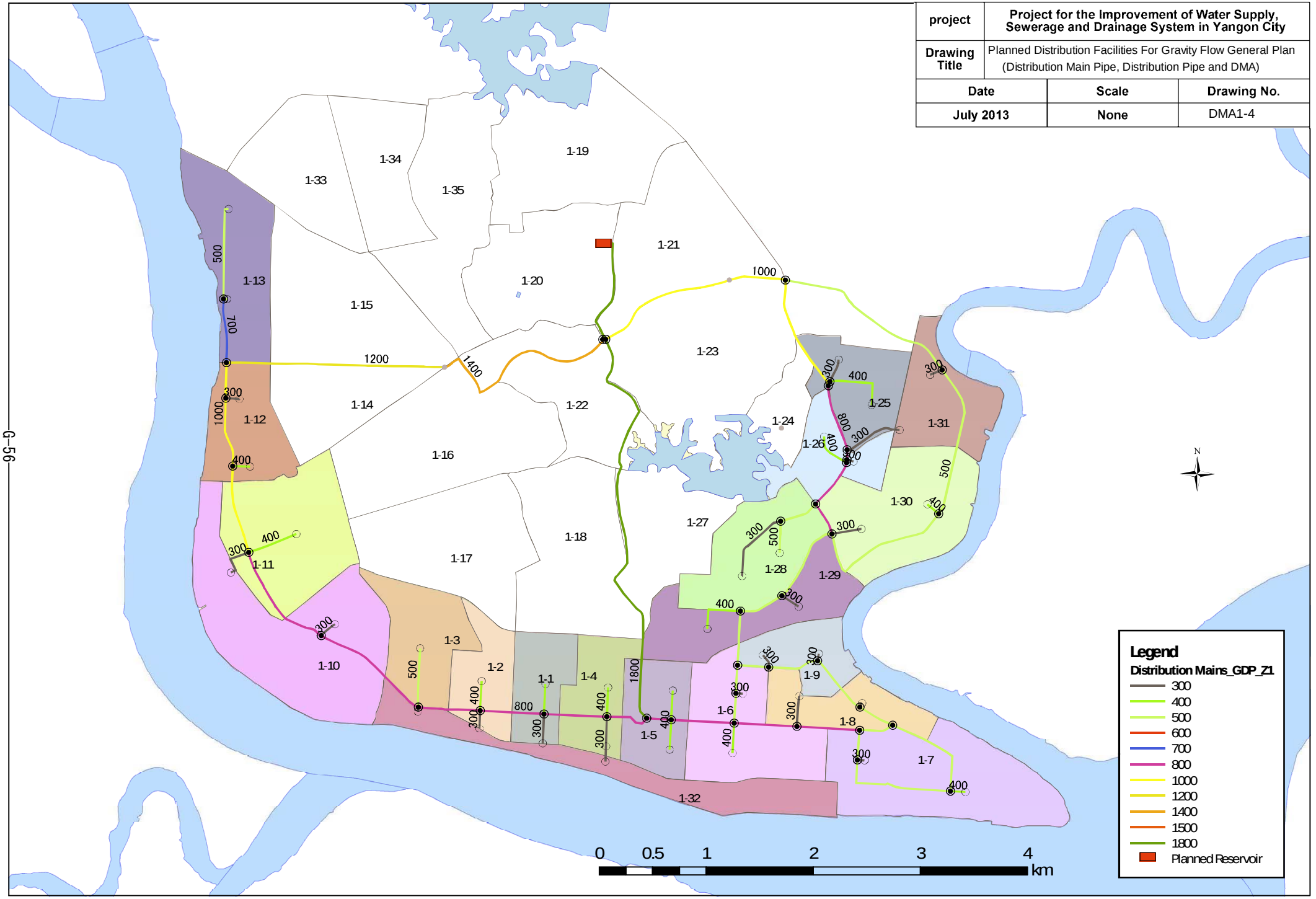


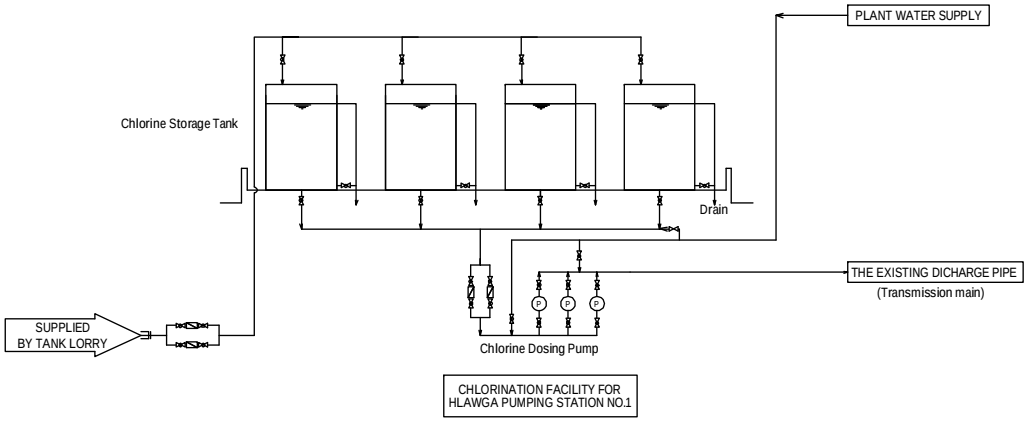

project
Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title
Existing Distribution Facilities Plan
(Distribution Main Pipe, Distribution Pipe)
Date
Scale
Drawing No.
July 2013
None
DMA1-2
Legend
Exsiting_pipe_Z1
unknown
40
50
75
100
125
150
200
225
250
275
300
375
400
425
450
600
675
750
900
1050
1300
1400
1500
1650
0
0.5
1
2
3
4
km

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Planned Distribution Facilities For Pumping Flow General Plan (Distribution Main Pipe, Distribution Pipe and DMA)		
Date		Scale	Drawing No.
July 2013		None	DMA1-3

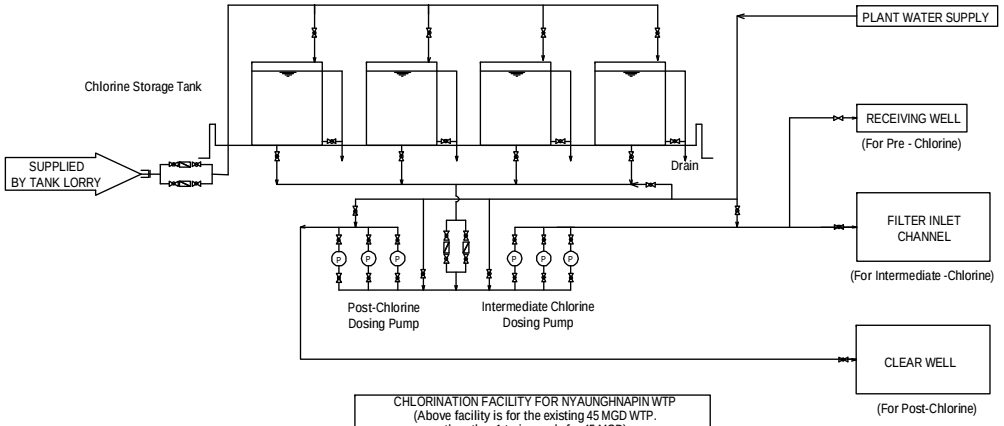


project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Planned Distribution Facilities For Gravity Flow General Plan (Distribution Main Pipe, Distribution Pipe and DMA)		
Date		Scale	Drawing No.
July 2013		None	DMA1-4





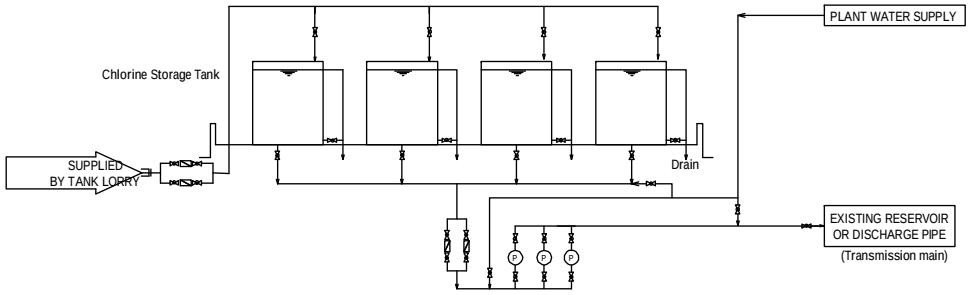
CHLORINATION FACILITY FOR
HLAWGA PUMPING STATION NO.1



CHLORINATION FACILITY FOR NYAUNGHNAPIN WTP
(Above facility is for the existing 45 MGD WTP.
the other 1 train needs for 45 MGD)

LEGEND

SYMBOL	NAME
	Process Water Pipe
	Utility Water Pipe
	Drainage Pipe
C	Chemical Pipe
	Air Pipe
P	Pump
	Sluice Valve
	Butterfly Valve
	Check Valve
	Pressure Reducing Valve
S	Solenoid Valve
	Ball Valve
	Tap



CHLORINATION FACILITY FOR YEGU BOOSTER PUMPING STATION

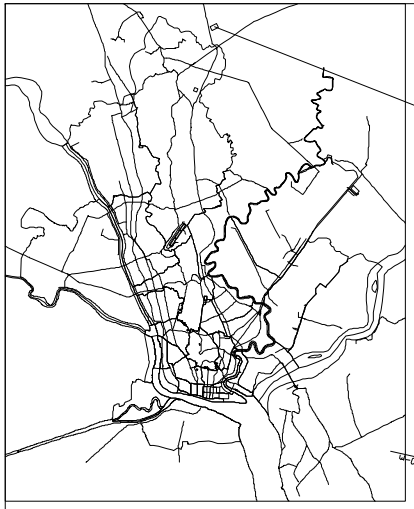
Legend

——— **Target Facilities in 2018**

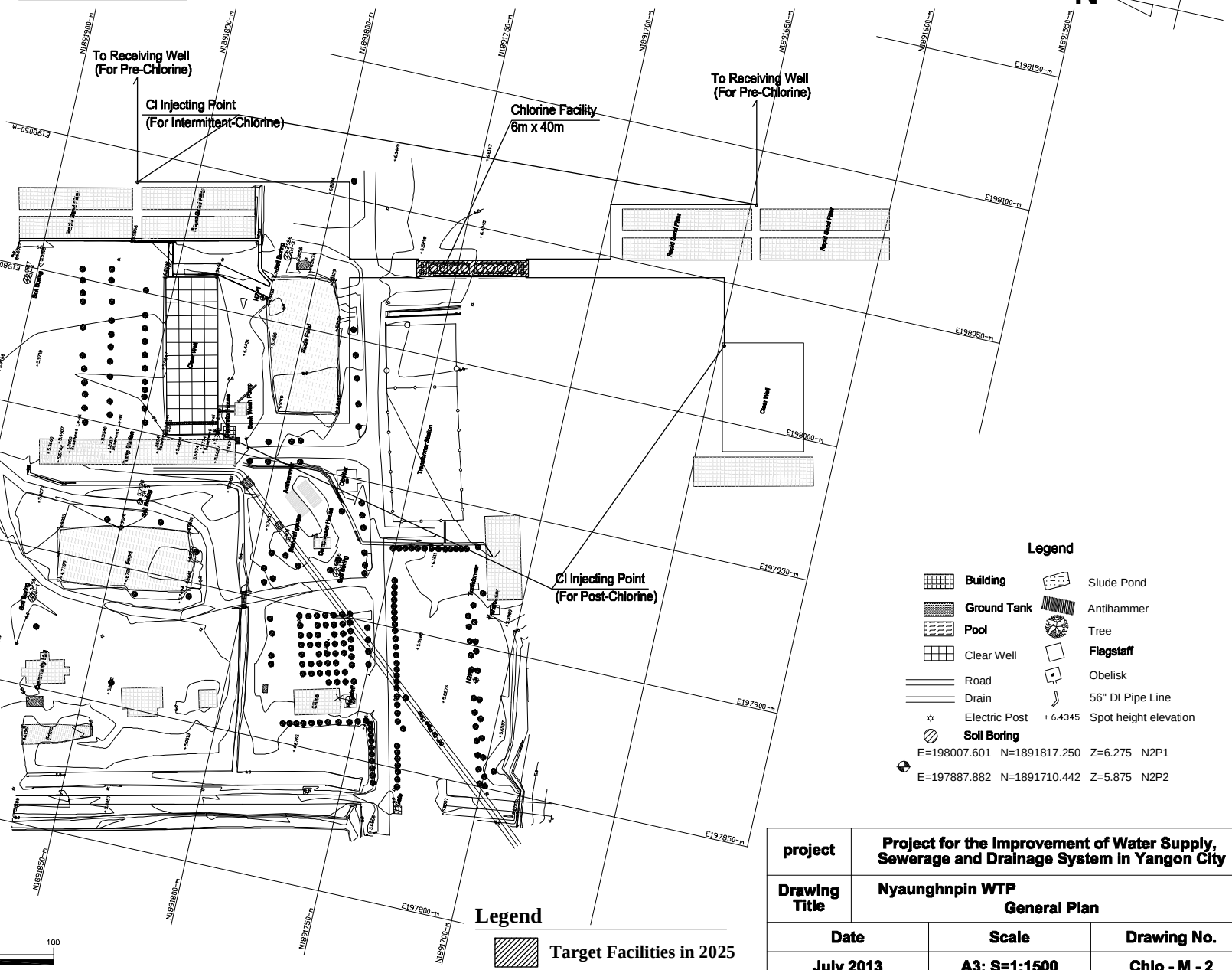
— — **Target Facilities in the future**

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Nyaunghnapin WTP, Hlawga P/S No.1, Yegu Booster P/S Chlorination Facility Process		
Date		Scale	Drawing No.
July 2013		None	Chlo - M - 1

Nyaunghnpin WTP General Plan



Nyaunghnpin WTP



GRAPHIC SCALE
(IN METERS)

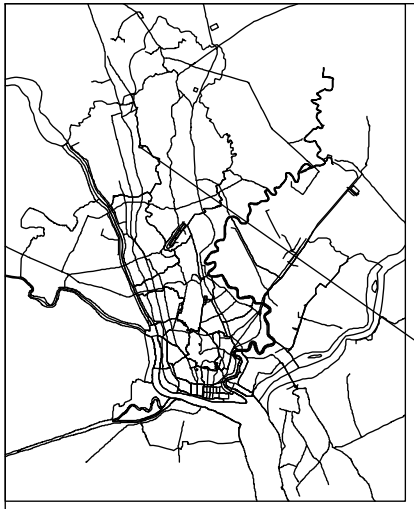
25 0 12.5 25 50 75 100

Legend

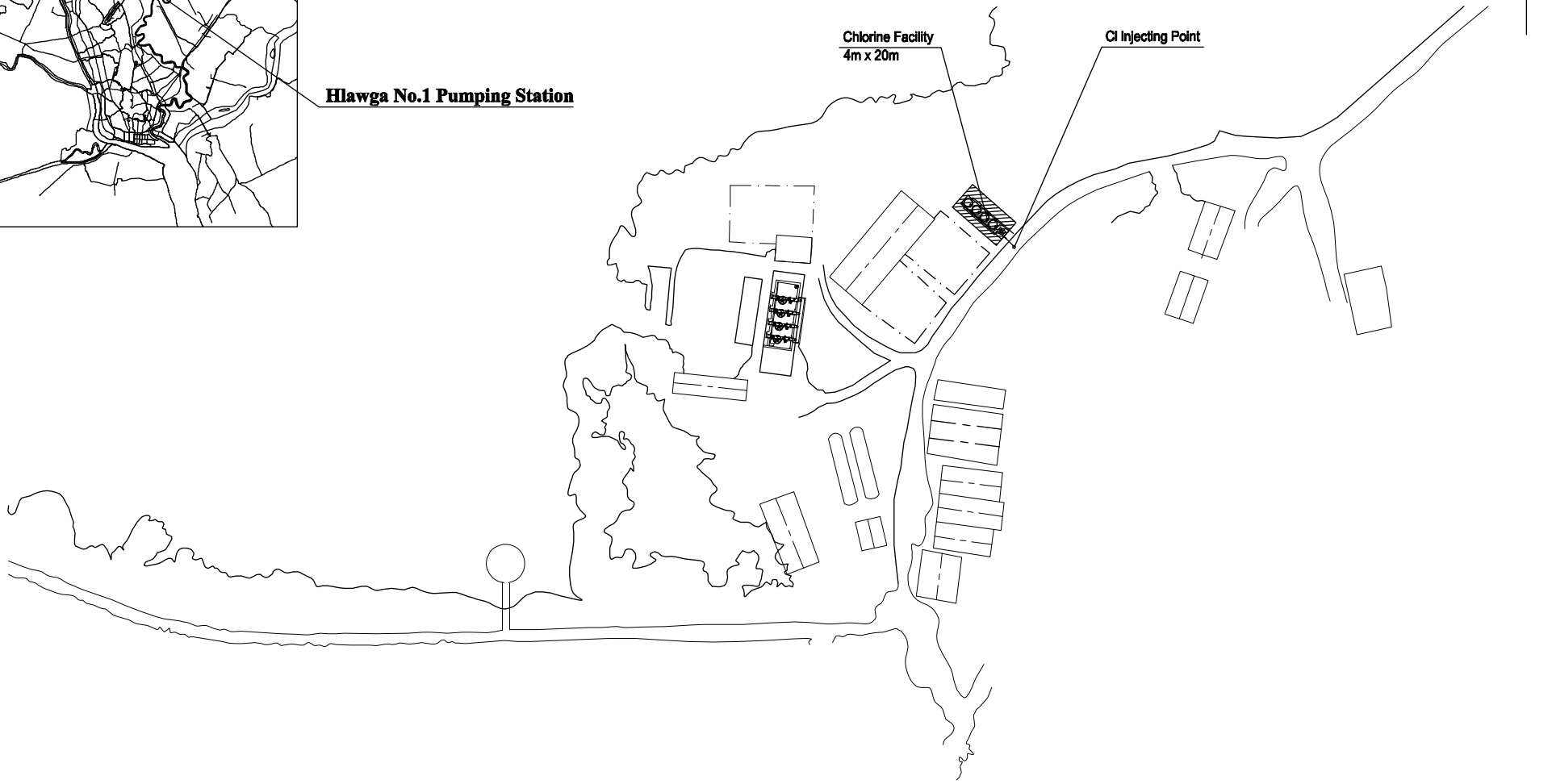
Target Facilities in 2025

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Nyaunghnpin WTP General Plan		
Date		Scale	Drawing No.
July 2013		A3; S=1:1500	Chlo - M - 2

Hlawga No.1 Pumping Station General Plan



Hlawga No.1 Pumping Station



GRAPHIC SCALE
(IN METERS)

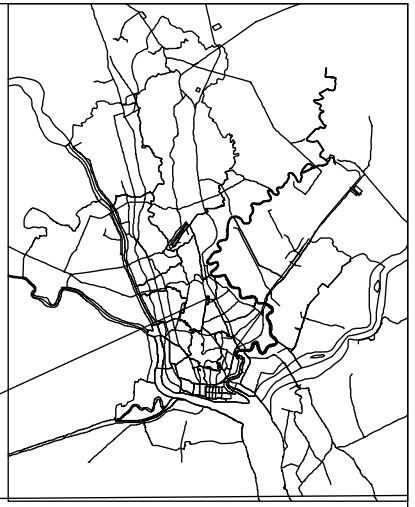
25 0 12.5 25 50 75 100

Legend

Target Facilities in 2025

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City		
Drawing Title	Hlawga No.1 Pumping Station General Plan		
Date		Scale	Drawing No.
July 2013		A3; S=1:1500	Chlo - M - 3

Yegu Pumping Station General Plan



N

56" φ (1,400mm) Gyobyu M.S Pipe
42" φ (1,050mm) Hlawaga C.I Pipe (From No2 P/S Gravity)
66" φ (1,650mm) Hlawaga Concrete Pipe (From No1 P/S)

Butterfly Valve
Opened
Closed
Opened
Closed

36" φ M.S Pipe

Over Flow
1 million gallons Under Ground Tank
New P/S
1-P 2-P 3-P 4-P

Anti Hammer Tank
56" φ Gate Valve
Cl Injection Existing

24" φ
Opened

36" φ
Over Flow

0.7 million gallons Under Ground Tank

Old P/S
P-7 P-6 P-5 P-4 P-3 P-2 P-1

Anti Water Hammer Tank
(Air Vessel x 2 nos.)

Opened
Closed
42" φ Gate Valve

To Kokkine Service Reservoir
To Downtown

Cl Injecting Point

Chlorine Facility
4m x 20m

Supplied by Tank Lorry

GRAPHIC SCALE
(IN METERS)
25 0 12.5 25 50 75 100

Legend

Target Facilities in 2025

project	Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City
Drawing Title	Yegu Pumping Station General Plan

Date	Scale	Drawing No.
July 2012	A3; S=1:1500	Chlo - M - 4