4. 討議議事録（M／D）

討議議事録 (M/D) の写しを次頁以降に示す。

(1) Minutes of Discussions on the Preparatory Survey for the Project for Explanation of Water Supply System in Svay Rieng in the Kingdom of Cambodia （2019 年 9 月 3 日署名）

(2) Minutes of Discussions on the Preparatory Survey for the Project for Explanation of Water Supply System in Svay Rieng in the Kingdom of Cambodia （2020 年 2 月 13 日署名）

(3) Minutes of Discussions on the Preparatory Survey for the Project for Explanation of Water Supply System in Svay Rieng in the Kingdom of Cambodia （2021 年 4 月 12 日署名）

(4) Minutes of Discussions on the Preparatory Survey for the Project for Explanation of Water Supply System in Svay Rieng in the Kingdom of Cambodia （2021 年 12 月 15 日署名）

Minutes of Discussions
on the Preparatory Survey for the Project for
Expansion of Water Supply System in Svay Rieng in the Kingdom of Cambodia

With reference to the minutes of discussions signed between Ministry of Industry & Handicraft (hereinafter referred to as "MIH") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 24th August, 2017 and in response to the request from the Government of Kingdom of Cambodia (hereinafter referred to as "Cambodia") dated on 26th June, 2017, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Expansion of Water Supply System in Svay Rieng (hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Phnom Penh, September 03, 2019

Mr. Makoto Iwase	H.E. Oum Sotha
Leader	Secretary of State
Preparatory Survey Team	Ministry of Industry & Handicraft
Japan International Cooperation Agency	Kingdom of Cambodia

ATTACHMENT

1. Water Sources

   In the Minutes of Discussions dated on 24th August, 2017, both sides agreed to change water source to be studied in the Preparatory Survey from Vay Kor Lake due to the concern about the structure of existing Vay Kor Dam. However, the Japan Water Agency investigated the soundness of the dam in detail based on expert knowledge in 2018, and concluded that the dam was deteriorated but could be used by repair reinforcement. Based on this results, both sides confirmed the Preparatory Survey for Svay Rieng project will survey the possibility to utilize the Vay Kor Lake as water sources. In this connection, the Team strongly request MIH to facilitate Ministry of Water Reousrces and Meteorology to implement necessary repairs and reinforcement for the Vay Kor Dam according to Annex which had been recommended by the Japan Water Agency.

2. Scope of the Project

   Both side agreed to consider the scope of the project will cover the urban area under the coverage area of Svay Rieng waterworks and increase water supply capacity of Svay Rieng waterworks to respond to the government target in 2025.

3. Timeline for the Preparatory Survey for the Svay Rieng Project

   The Team explained to the Cambodian side that the expected timeline for the project implementation is as follows:

   - Field Survey from October 2019 to March 2020
   - Domestic Analytical Work from April 2020 to August 2020
   - Explanation on Draft Preparatory Survey Report in August 2020

Annex: Result of Survey by the Japan Water Agency on the Vay Kor Lake

Survey results: Soundness of spillway

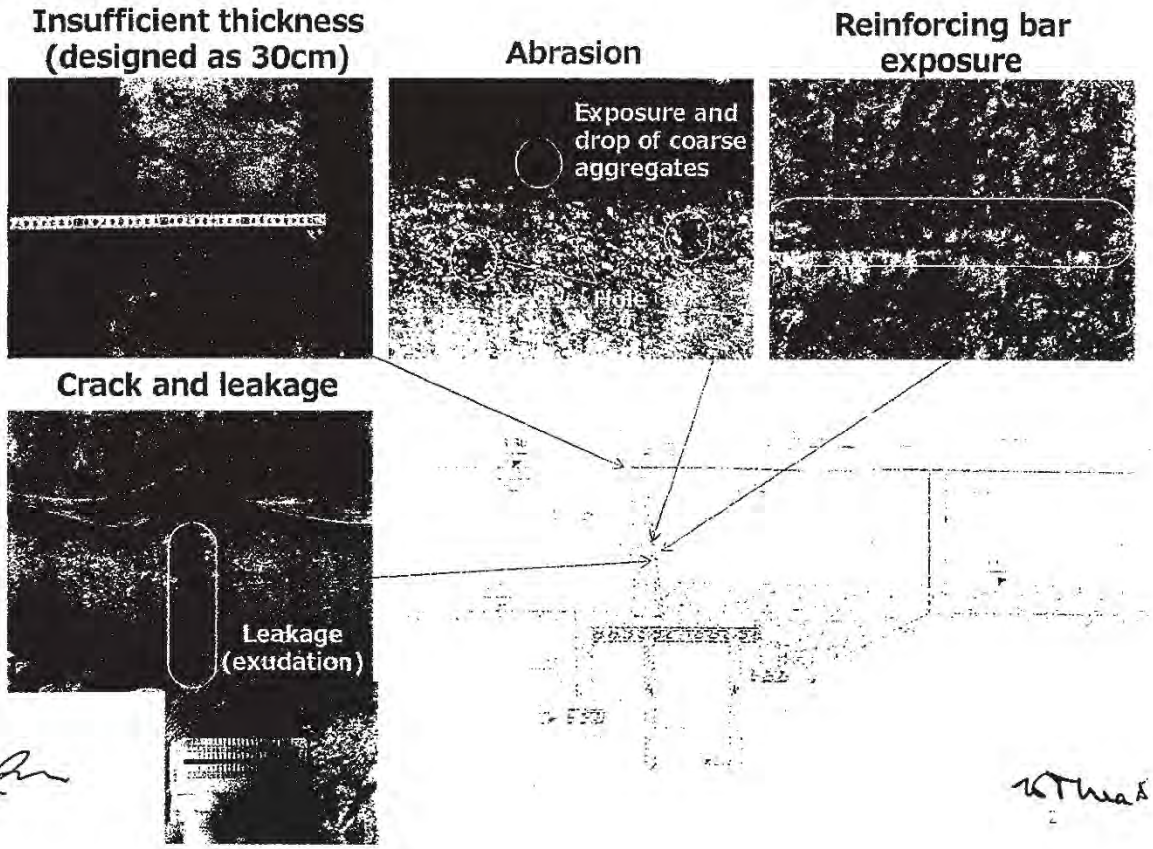
Reinforcement and repair are recommended.

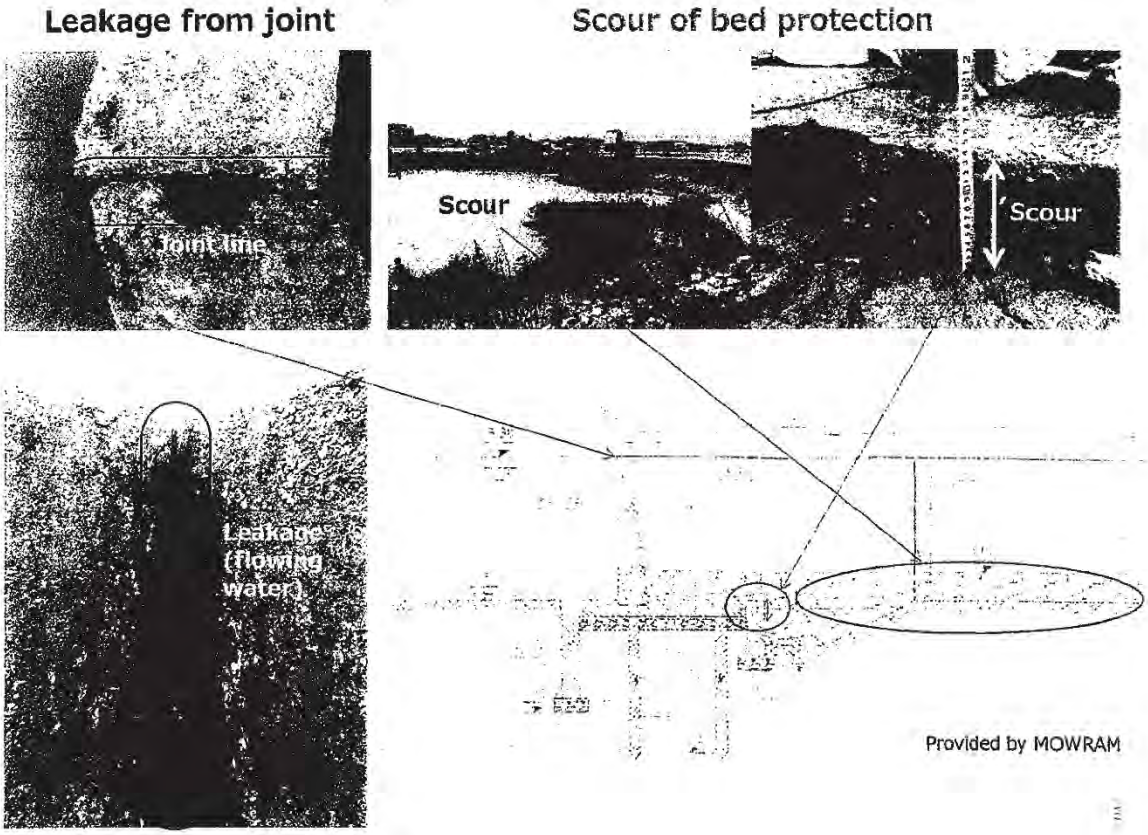
Soundness rank: S-2 "Noticeable deterioration" (based on Japanese evaluation tool for irrigation facilities)

S-2	**Status of facility:** Recognize deformation affected on structural stability of the facility Status capable of countermeasure work with reinforcement	**Typical example of actual status:** ① Partial deficiency in cross-sectional area of concrete and/or reinforcing bar ② Obvious deformation of concrete structure due to ground deformation or increase of earth pressure	**Action:** Reinforcement or repair

Reference: Ministry of Agriculture, Forestry and Fisheries of Japan

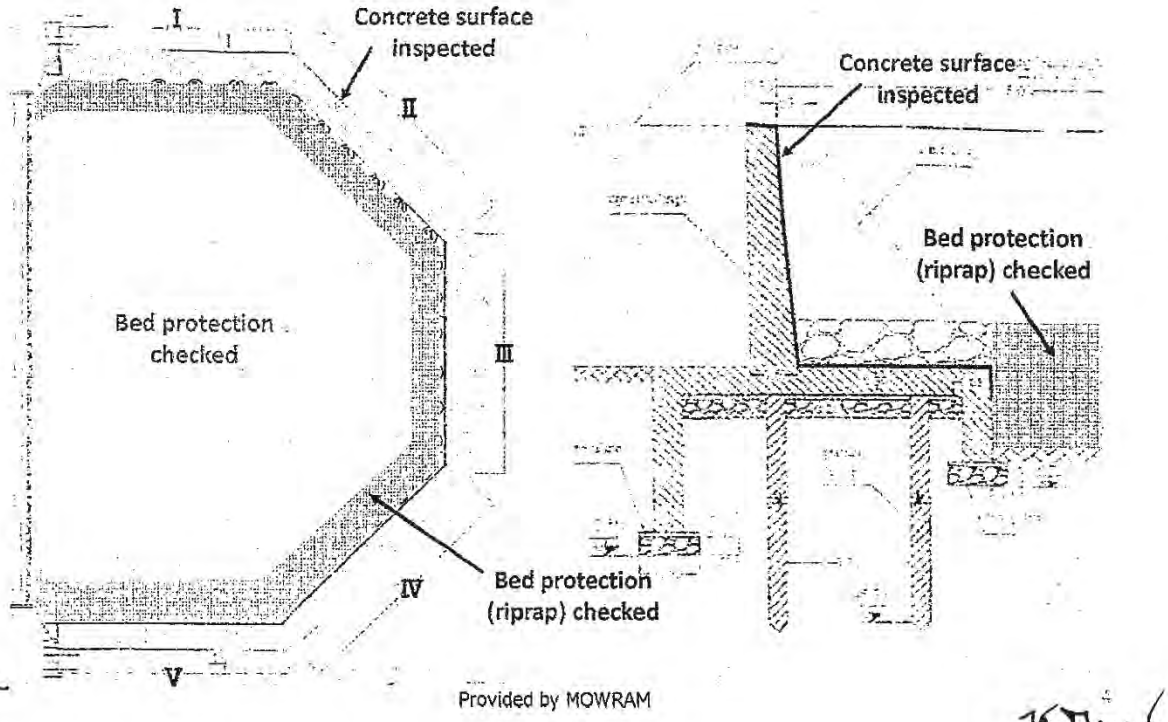
- **Deterioration covers whole of dam structure.**
- **Bed protection is also severely damaged.**
- **Repairs of concrete surface and body are required to maintain dam stability.**
- **Damaged bed protection requires to recover the function by structural reinforcement.**



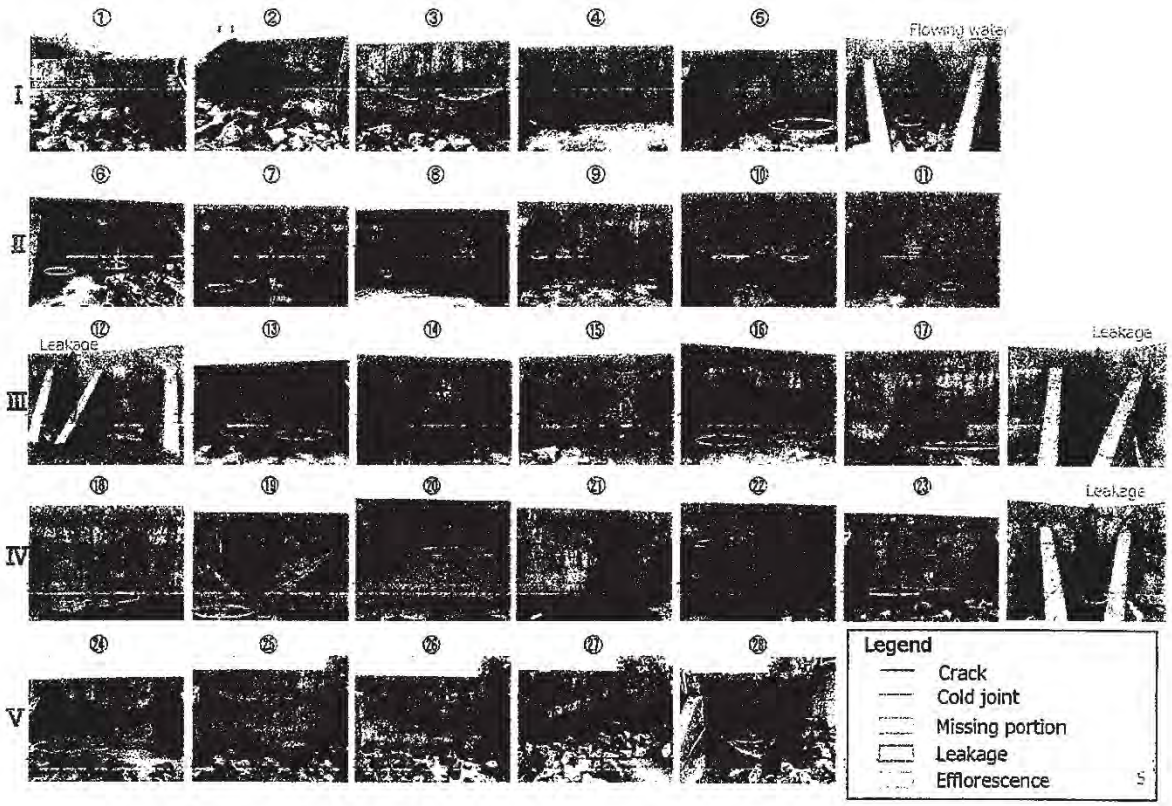


Inspection record of Vaico Dam

Structure and layout design



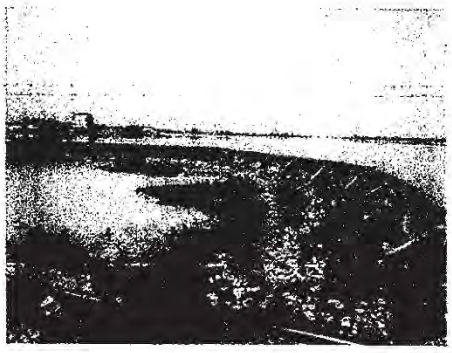
Status of deterioration for each segment



Repair and reinforcement of Vaico Dam

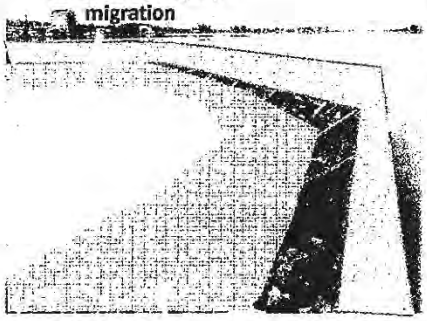
Technical options for repair and reinforcement

- Concrete surface coating and section repair
  - ✓ Removal and repair of deteriorated portion (crack, abrasion, fall-off, etc.)
- Bed protection improvement (preventing from scouring)
  - ✓ Relocation of flushed riprap or refilling new riprap
  - ✓ Replacement by larger-sized riprap
  - ✓ Caged riprap
  - ✓ Inverted filter (riprap and gravel layer formation)
- Expansion of dam structure
  - ✓ Concrete structure thickness increasing



Repair and reinforcement of Vaico Dam

Prevention of riprap migration



Riprap rearrangement

Concrete surface coting and section repair

Appropriate material and method depending on the cause and condition are selected.

Materials:

- ✓ Cement, Resin (epoxy, etc.), Polymer cement

Methods:

- ✓ Grouting, pre-packed, plastering, etc.

Bed protection improvement

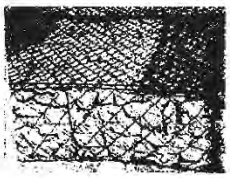
Regular maintenance of riprap arrangement

- ✓ Relocation of flushed riprap
- ✓ Filling new riprap
- ✓ Replacing to larger riprap

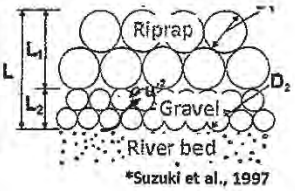
Prevention of riprap migration and bed scouring

- ✓ Caged riprap
- ✓ Inverted filter (riprap and gravel layer formation)

Caged riprap



Inverted filter



*Suzuki et al., 1997

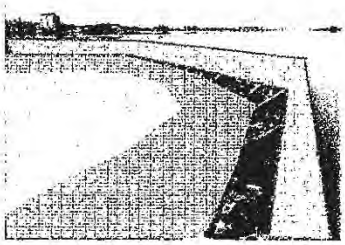
Repair and reinforcement of Vaico Dam

[Reference case]: Makara 7 Dam in Kandal Stueng

Bed protection

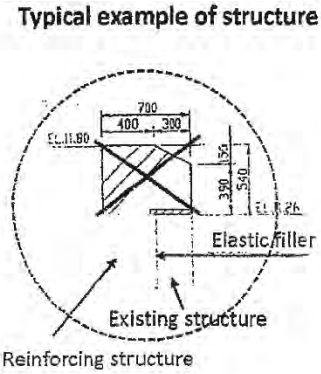
Riprap design:

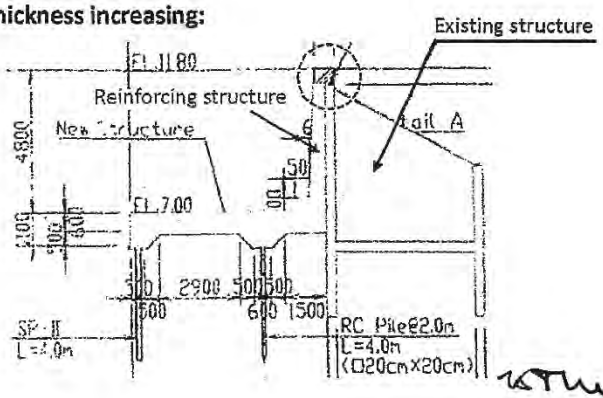
- Use riprap large enough not to be flushed
- Put riprap to cover whole area of spillway downstream
- Relocate flushed riprap in every dry season



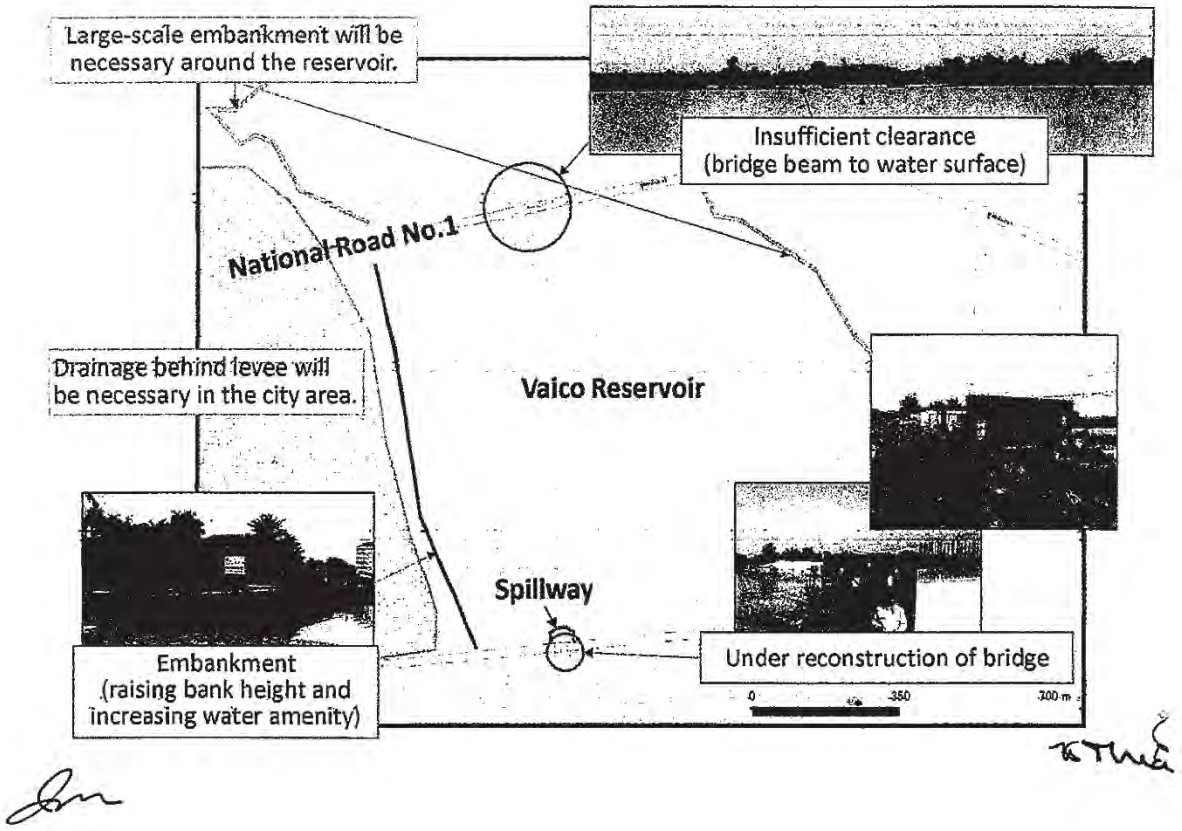
Expansion of structure

Typical example of structure thickness increasing:





Raising spillway height



Minutes of Discussions
on the Preparatory Survey for the Project for
Expansion of Water Supply System in Svay Rieng in the Kingdom of Cambodia

With reference to the minutes of discussions signed between Ministry of Industry & Handicraft (hereinafter referred to as "MIH") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 24th August, 2017, 28th June, 2018, and 3rd September 2019, and in response to the request from the Government of Kingdom of Cambodia (hereinafter referred to as "Cambodia") dated on 26th June, 2017, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the Project for Expansion of Water Supply System in Svay Rieng (hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Phnom Penh, February 13, 2020

Mr. Makoto Iwase	H.E. Oum Sotha
Leader	Secretary of State
Preparatory Survey Team	Ministry of Industry & Handicraft
Japan International Cooperation Agency	Kingdom of Cambodia

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve the access to safe water in the city of Svay Rieng through the expansion of water supply system.

2. Title of the Preparatory Survey

Accoring to the minutes sighed on 28th June, 2018, both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Expansion of Water Supply System in Svay Rieng".

3. Project site

Both sides confirmed that the site of the Project is in Svay Rieng, which is shown in Annex 1.

4. Responsible authority for the Project

Both sides confirmed the authorities responsible for the Project are as follows:

4-1. The Ministry of Industry and handicraft will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be managed by relevant authorities properly and on time.

5. Basis for Project Design

5-1. Both sides discussed and confirmed that the basis for project design are the high investment efficiency and alignment of the following development policies in Cambodia.

<u>Development policies for urban water supply in Cambodia</u>

- To provide the population in urban area access to water supply service 100% in 2025, 90% to be covered by tap water and 10% to be covered by other sources, which in one of the targets of "National Strategic Development Plan from 2019 to 2023" of the Cambodian government.
- Goal 6 of SDGs, to provide safe water to all by 2030.

5-2. Both sides confirmed that target year of the Project is the Year 2027.

5-3. The both sides confirmed that the scope of the Project will mainly consist of the following works;

- new intake and transmission facilities,

- water treatment facilities,
- distribution facilites.

5-4. The both sides agreed that the Project scope covered by Japanese Grant Project will be determined based on the preparatory survey results at the explanation on the draft preparatory survey report. The final decision of the Project scope will be, however, made by the Government of Japan.

6. Procedures and Basic Principles of Japanese Grant

6-1. The Cambodian side agreed that the procedures and basic principles and basic principles of Japanese Grant (hereinafter referred to as "the Grant") as described in Annex 2 shall be applied to the Project.

As for the monitoring of the implementation of the Project, JICA requires Cambodian side to submit the Project Monitoring Report, the form of which is attached as Annex 3.

6-2. The Cambodian side agreed to take the necessary measures, as described in Annex 4, for smooth implementation of the Project. The contents of the Annex 4 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report.

The contents of Annex 4 will be updated as the Preparatory Survey progresses, and eventually, will be used as an attachment to the Grant Agreement.

7. Tentative Schedule of the Survey

7-1. JICA will prepare a draft Preparatory Survey Report in English and Khmer and dispatch a mission to Cambodia in order to explain its contents around September-December, 2020.

7-2. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. The Cambodian side confirmed to give due environmental and social considerations before and during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8-2. The Project is categorized as "B" from the following considerations:

The Cambodian side confirmed that the project is not located in a sensitive area, nor has sensitive characteristics, nor falls into sensitive sectors under the JICA guidelines for environmental and social considerations (April 2010), and its

potential adverse impacts on the environment are not likely to be significant.

The Cambodian side confirmed to prepare Environmental Protection Contract (EPC) and make EPC on the Project between MIH and Ministry of Environment(MOE) according to the procedure of MOE.

8-3. Both sides confirmed that the Project is not expected to occur any resettlement. The Cambodian side confirmed that, in case of the Project would result in involuntary resettlement, the Cambodian side would prepare a Resettlement Action Plan (RAP)/Abbreviated Resettlement Action Plan (ARAP) and make it available to the public. In addition, the Cambodian side confirmed to provide the affected people with sufficient compensation and/or support in accordance with RAP/ARAP, which is consistent with JICA Guidelines for Environmental and Social Considerations (April, 2010), in a timely manner.

9. Other Relevant Issues

9-1. Assurance of Sustinability of Vay Kor Dam

The Team requested and MIH agreed to obtain the confirmation letter from Ministry of Water Resources and Meteorology before the explanation on the draft preparatory survey report for keeping the water level of the Vay Kor dam to intake enough water and for prompt recovery of the water level in case of accident. Both sides confirmed that the confirmation letter above mentioned would be refered on the minuites at the explanation on the draft preparatory survey report.

9-2. House Connection for New Supply Area

MIH agreed to arrange the smooth connection of service pipes in new water supply area which would be expanded by the Project and the details will be discussed at the explanation on the draft preparatory survey report.

9-3. Recruit of the New Staff

MIH agreed to secure and recruit necessary numbers of staff and the details will be discussed at the explanation on the draft preparatory survey report.

9-4. Land Preparation for the Project

MIH agreed to implement following land preparation for the Project.

- UXO survey for water treatment plant, intake site and temporary yard
- Land preparation for temporary yard and dump site
- Land elevation Work at WTP site

- Land acquisition for intake facility

Annex 1 Project Site
Annex 2 Japanese Grant
Annex 3 Project Monitoring Report (template)
Annex 4 Major Undertakings to be taken by the Government of Kingdom of Cambodia

Annex 1 Project Site

Annex 2

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

1

The aim of the Survey is to provide basic documents necessary for the appraisal of the the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the Recipient necessary for the implementation of the Project.
- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the Recipient to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project are used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

5

Attachment 1

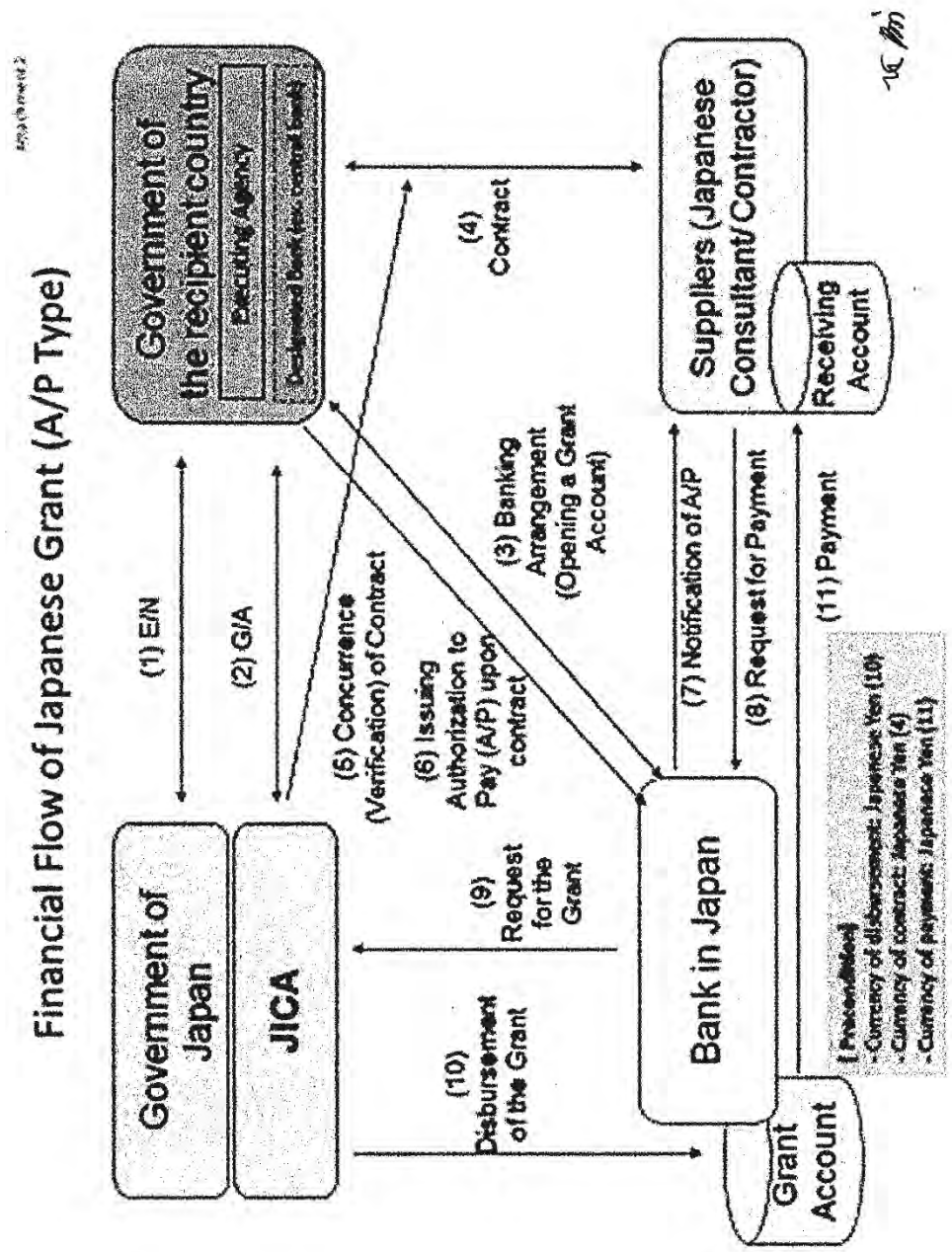
PROCEDURES OF JAPANESE GRANT

Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

notes:

1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.
2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.

6


Financial Flow of Japanese Grant (A/P Type)
Government of Japan
JICA
Government of the recipient country
Executing Agency
Designated Bank (an Authorized Bank)
Suppliers (Japanese Consultant/Contractor)
Receiving Account
Bank in Japan
Grant Account
(1) E/N
(2) G/A
(3) Banking Arrangement (Opening a Grant Account)
(4) Contract
(5) Concurrence (Verification) of Contract
(6) Issuing Authorization to Pay (A/P) upon contract
(7) Notification of A/P
(8) Request for Payment
(9) Request for the Grant
(10) Disbursement of the Grant
(11) Payment
[Presentation]
- Currency of disbursement: Japanese Yen (10)
- Currency of contract: Japanese Yen (4)
- Currency of payment: Japanese Yen (11)

7

Annex 3
G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Project Monitoring Report
on
Project Name
Chapter 1. *Grant Agreement No. XXXXXXX*

20XX, Month

Organizational Information

1) Signer of the G/A (Recipient)	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Executing Agency	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Line Ministry	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant (Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any*	Original[1),2)] *(proposed in*	Actual

		modification)	*the outline design)*	
	1.			

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*
Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):

3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

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Attachment 6

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

		Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost		(A/D%)	(B/D%)	(C/D%)	
	Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
	others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost		(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost		(A/D%)	(B/D%)	(C/D%)	
Total		(A/D%)	(B/D%)	(C/D%)	

Annex 4

Major Undertakings to be taken by the Government of Kingdom of Cambodia

1. Specific obligations of the Government of Kingdom of Cambodia which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open bank account (B/A)	within 1 month after the signing of the G/A	MEF		
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract(s)	MIH		
3	To make a Environmental Protection Contract and secure the necessary budget for implementation	within 1 month after the signing of the G/A	MIH		
4	To contract land lease in order to secure the temporary yard	before notice of the bidding document(s)	MIH		
5	To obtain the planning, zoning, building permit	before notice of the bidding document(s)	MIH		
6	To clear, level and reclaim the following sites 1) Embankment at proposed water treatment plant site and intake pump station site 2) To explore landmines and UXO at construction site and temporary yard	before notice of the bidding document(s)	 MIH MIH		
7	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding document(s)	MIH		

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	MIH		
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	MIH		
	2) Payment commission for A/P	every payment	MEF		
3	To ensure prompt unloading and customs clearance at ports of disembarkation in Cambodia and to assist the Supplier(s) with internal transportation therein	during the Project	MIH		
4	To accord Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into Cambodia and stay therein for the performance of their work	during the Project	MEF		
5	To ensure that customs duties, VAT, internal taxes and other fiscal levies which may be imposed in Cambodia with respect to the	during the Project	MEF		

NO	Items	Deadline	In charge	Estimated Cost	Ref.
	purchase of the products and/or the services be exempted by its designated authority without using the Grant;				
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project			
7	1) To submit Project Monitoring Report	every month	MIH		
	2) To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	MIH		
8	To submit a report concerning completion of the Project	within six months after completion of the Project	MIH		
9	To get permit for construction of temporary access bridges for laying water pipes and lease necessary land for approach road to the temporary access bridges (if necessary)	1 month before the start of the construction	Local Communities, MIH		
10	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)				
	1) Electricity The distributing line to the site	before start of the construction	MIH		
	2) Information System Contracting process of broadband LAN connection for the distribution information system	2 months before completion of the construction	MIH		
11	To take necessary measure for safety construction - traffic control - rope off	during the construction	MIH		
12	To implement EMP and EMoP	during the construction	MIH		
13	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	MIH		
14	To obtain permission for occupancy of roads for the pipe laying work	before start of the construction for conveyance, transmission and distribution pipes	MIH (PWW[1])		
15	To obtain all permissions required for the project implementation such as construction permission for intake facility and water treatment facility	before start of the construction	MIH (PWW)		
16	To recruit new staff members who are necessary for the operation of new system	up to the end of 202X	MIH (PWW)		
17	To establish the construction scheme for the new service pipe connections, including hiring temporary work force. To carry out	up to the end of 202X	MIH (PWW)		

[1] PWW: Provincial Waterworks

NO	Items	Deadline	In charge	Estimated Cost	Ref.
	the technical guidance, budgeting, planning and publicity for enhancing new connections.				
18	To identify poor household (Provisional)	up to the end of 202X	MIH (PWW)		

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To implement EMP and EMoP	for a period based on EMP and EMoP	MIH		
2	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between MIH and JICA.	for 3 years after the Project	MIH		
3	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	after completion of the construction	MIH		
4	To work for service pipe connection 1) Establishment of construction scheme including hiring temporary staff for service connection work, providing guidance, budgeting, planning and publicity for enhancing new connections 2) Connection for the poor level 1 household (Provisional) - Connection work is under responsibility of Cambodian side.	up to the end of 202X	MIH (PWW)		
5	To sustain the enough water level of Vay Kor dam for intake the water.		MOWRAM		

Minutes of Discussions
on the Preparatory Survey for the Project for
Expansion of Water Supply System in Svay Rieng in the Kingdom of Cambodia

With reference to the minutes of discussions signed between Ministry of Industry, Science, Technology & Innovation (hereinafter referred to as "MISTI") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 24th August, 2017, 28th June, 2018, 3rd September 2019, and 13th February 2020, and in response to the request from the Government of Kingdom of Cambodia (hereinafter referred to as "Cambodia") dated on 26th June, 2017, JICA Preparatory Survey Team (hereinafter referred to as "the Team") and MISTI have a series of discussions for the Project for Expansion of Water Supply System in Svay Rieng (hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

April 12, 2021

Mr. Yoichi INOUE	H.E. Oum Sotha
Leader	Secretary of State
Preparatory Survey Team	Ministry of Industry, Science, Technology & Innovation
Japan International Cooperation Agency	Kingdom of Cambodia

ATTACHMENT

1. New Water Treatment Plant (WTP) funded by ADB in Svay Rieng

1-1. Outline of ADB's project

MISTI explained that following outline of ADB's project in Svay Rieng and that there is no duplication of service area among Japanese grant project, bulk water supply by Chinese firm, and ADB's new scheme.

[Purpose of ADB's Project]

New WTP funded by ADB will be utilized to distribute safe water to additional 4 communes such as Por Reach, Svay Chrum, Ta Sous and Kampong Chamlorng and to replace existing WTP which has the treatment capacity of 4,560m^3/day.

[Specification]

Intake Facility: 11,000 m^3/day at Vay Kor dam
Conveyance Pipe: Length 63 m
Water Treatment Capacity: 9,000 m^3/day
Distribution Main Pipe: Length 30.6 km

[Service Area]

Service area of ADB's project is existing service area, which is the area surrounded by blue line, and 4 communes composed of the commune "Por Reach", "Svay Chrum", "Ta Sous", and "Kampong Chamlorng" on the attached map.

[Schedule]

The construction of WTP will be completed by the middle of 2022. Installation of distribution pipe will be finished by the end of 2021.

[Usage of Existing WTP]

The existing WTP will be utilized as stand-by facility for an emergency.

1-2. Expansion of distribution network and Operational Priority of WTP

MISTI promised to install distribution pipe network in additional 4 communes of ADB's Project area as soon as possible with the best effort and to put a priority on maximizing operational ratio of the WTP to be granted by Japan rather than ADB's one to provide water to the Project site described in 2-2.

2. Project Outline

2-1. Basis for the Project

Both sides reconfirmed that target year of the Project is the Year 2027 (2 year after the completion of the facilities) and the basis for project design are the high investment efficiency and alignment of the following development policies in Cambodia.

Development policies for urban water supply in Cambodia

- To provide the population in urban area access to water supply service 100% in 2025, 90% to be covered by tap water and 10% to be covered other sources, which in one of the targets of "National Strategic Development Plan from 2019 to 2023" of the Cambodian government.
- Goal 6 of SDGs, to provide safe water to all by 2030.

2-2. Tentative Project Scope

Both side confirmed the assumed Project scope as described below and the project site is shown in attachment. According to the tentative scope, the Team will proceed for the outline design and coordinating with relevant authorities. Both sides reconfirmed that the Project scope covered by Japanese Grant Project will be determined based on the preparatory survey results at the explanation on the draft preparatory survey report. The final decision of the Project scope will be, however, made by the Government of Japan.

Intake Facility: 7,480m^3/day, Intake Pump Station
Intake Pump: 2 inverter pump to save electric consumption (1duty, 1 stand-by)
Conveyance pipe: Length 2.9km
Water Treatment Plant: 6,800m^3/day
Clear Water Reserovoir: 2,200m^3
Distribution Pipe Length: Length: 124 km
Procurement equipment such as laboratory equipment, service pipe material for poor house holds 375 sets and etc..

3. Others

3-1. Intake Water Right

Both sides confirmed that MISTI had already requested Ministry of Water Resources and Meteorology (MOWRAM) to obtain additional water right for taking water from Vay Kor dam because of ADB's project, and that approval would be obtained from

MOWRAM before the explanation on the draft preparatory survey report.

3-2. Assurance of Sustainability of Vay Kor Dam

Both sides reconfirmed that MISTI would obtain the guarantee letter from MOWRAM before the explanation on the draft preparatory survey report for keeping the water level of the Vay Kor dam to intake enough water and for prompt recovery of the water level in case of accident. Both sides confirmed that the guarantee letter above mentioned would be refered on the minuites at the explanation on the draft preparatory survey report.

3-3. Financial Soundness and Appropriate Water Tariff

Since the Team had confirmed there were discrepancies on financial statements of public water supply utility in Svay Rieng, the Team requested to MISTI to submit acculate financial statements for last 3 years.

The Team emphasized the importance of financial soundness in water utility for sustainable development and both sides agreed the necessity of setting appropriate water tariff for both of financial soundness and low income household.

3-4. Recruitment of New Staff for the Project and ADB's Project

The Team expressed the concern on the shortage of staff due to two additional WTPs to be provided by Japanese grant and ADB's project, and requested to MISTI to hire enough number and capable staff for appropriate maintenance for WTPs.

3-5. Environmental Protection Contract

MISTI obtained the agreement on Environmental Protection Contract (EPC) by the Ministry of Environment on 30th March, 2021. Cambodian side agreed to take initiative in following the EPC in the implementation of the Project.

3-6. Administrative Permission for Construction Works for the Project

MISTI agreed to obtain necessary administrative permission for construction works.

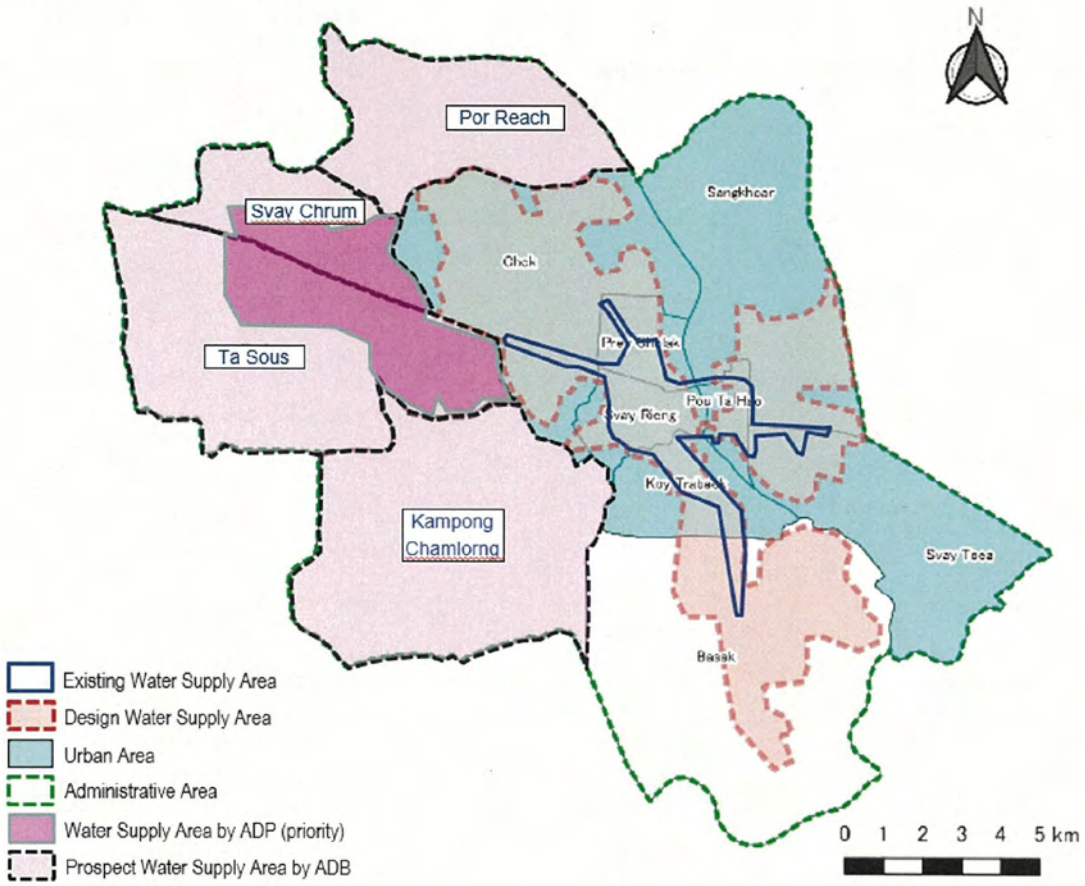
3-7. Land Elevation Works at Treatment Facility Site including access road

MISTI agreed to implement land elevation works for the Treatment Facility Site as well as access road.

3-8. Expansion of National Road No.1

MISTI explained Ministry of Public Works and Transport has a plan for expansion of the national road No.1 and the construction works will start in the year 2022. MISTI will update the detail information and coordinate with the Team.

Attachment:



Water Supply Area

Minutes of Discussions
on the Preparatory Survey for the Project for
Expansion of Water Supply System in Svay Rieng
(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Ministry of Industry, Science, Technology & Innovation (hereinafter refferd to as "MISTI") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 24th August, 2017, 28th June, 2018, 3rd September, 2019, 13th February, 2020, and 12th April, 2021, and in response to the request from the Government of Kingdom of Cambodia (hereinafter refferd to as "Cambodia") dated on 26th June, 2017, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Expansion of Water Supply System in Svay Rieng (hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Phnom Penh, 15th December, 2021

Mr. Yoichi Inoue
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

H.E. Oum Sotha
Secretary of State
Ministry of Industry, Science, Technology & Innovation
Kingdom of Cambodia

ATTACHEMENT

1. Contents of the Draft Report

After the explanation of the contents of the Draft Report by the Team, the Cambodian side agreed to its contents. JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Cambodian side around April, 2022.

2. Cost estimate

Both sides confirmed that the cost estimate including the contingency explained by the Team is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

3. Confidentiality of the cost estimate and technical specifications

Both sides confirmed that the cost estimate and technical specifications of the Project should never be disclosed to any third parties until all the contracts under the Project are concluded.

4. Timeline for the project implementation

The Team explained to the Cambodian side that the expected timeline for the project implementation is as attached in Annex 3.

5. Expected outcomes and indicators

Both sides agreed that key indicators for expected outcomes are as follows. The Cambodian side will be responsible for the achievement of agreed key indicators targeted in year 2027 and shall monitor the progress for Ex-Post Evaluation based on those indicators.

[Quantitative indicators]

No.	Indicator	Baseline (Measured in 2019)	Target (in 2027) [Two years after completion]
1	Daily average water supply amount (m^3/day)	4,627	10,009
2	Population served (persons)	23,545	55,964
3	Water supply ratio (Urban area) (%)	48.9	86.7
4	Water pipe connection to poor households (Poor levels 1 and 2)	53	1,254

[Qualitative indicators]

Improvement of the living environment of the population (improvement of the sanitary environment and convenience of the population without water supply connection before)

6. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability). The result of the evaluation will be publicized. The Cambodian side is required to provide necessary support for the data collection.

7. Technical assistance ("Soft Component" of the Project)

Considering the sustainable operation and maintenance of the products and services granted through the Project, following technical assistance is planned under the Project. The Cambodian side confirmed to deploy necessary number of counterparts who are appropriate and competent in terms of its purpose of the technical assistance as described in the Draft Report.

8. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 4. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in (2) - 5 of Annex 4, both sides confirmed that such customs duties, internal taxes and other fiscal levies, which shall be clarified in the bid documents by MISTI during the implementation stage of the Project.

The Cambodian side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that the Annex 4 will be used as an attachment of G/A.

9. Monitoring during the implementation

The Project will be monitored by the Executing Agency (hereinafter referred to as MISTI) and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 5. The timing of submission of the PMR is described in Annex 4.

10. Project completion

Both sides confirmed that the project completes when all the facilities constructed and equipment procured by the Grant are in operation. The completion of the Project will be reported to JICA promptly by the Executing Agency, but in any event not later than six months after completion of the Project.

11. Environmental and Social Considerations

11-1 General Issues

11-1-1 Environmental Guidelines and Environmental Category

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as "B" because the project is not located in a sensitive area, nor has sensitive characteristics, nor falls into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant

11-1-2 Environmental Checklist

The environmental and social considerations including major impacts and mitigation measures for the Project are summarized in the Environmental Checklist attached as Annex 6. Both sides confirmed that in case of major modification of the content of the Environmental Checklist, the Cambodian side shall submit the modified version to JICA in a timely manner.

11-2 Environmental Issues

11-2-1 Initial Environmental Impact Assessment (IEIA)

Both sides confirmed the IEIA report has been submitted to the Ministry of Environment (MOE) and Environmental Protection Contract (EPC) necessary for the Project has been signed between MISTI and MOE on 31st March, 2021.

11-2-2 Environmental Management Plan and Environmental Monitoring Plan

Both sides confirmed Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) of the Project is as Annex 7, respectively. Both sides agreed that environmental mitigation measures and monitoring shall be conducted based on the EMP and EMoP, which may be updated during the detailed design stage.

11-3 Environmental and Social Monitoring

11-3-1 Environmental Monitoring

Both sides agreed that the Cambodian side will submit results of environmental monitoring to JICA with PMR by using the monitoring form attached as Annex 8. The timing of submission of the monitoring form is described in Annex 4.

11-3-2 Information Disclosure of Monitoring Results

Both sides confirmed that the Cambodian side will disclose results of environmental and social monitoring to local stakeholders through their website / in their field offices.

The Cambodian side agreed JICA will disclose results of environmental and social monitoring submitted by the Cambodian side as the monitoring forms attached as Annex 8 on its website.

12. Other Relevant Issues

12-1. Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

12-2. Expansion of Distribution Network and Operational Priority of WTP

Both sides reconfirmed that MISTI will put a priority on maximizing operational ratio or run in full capacity of the WTP to be granted by Japan to provide water to the Project site. Also, MISTI promised to install distribution pipe network in addtional 4 communes as soon as possible with the best effort. The existing pipes are already included in the calculation of design under JICA project, therefore MISTI explained that any existing pipes would not be utilized for the other projects, and those projects would install additional pipes seperately.

12-3. Intake Water Rights

Both sides confirmed that MISTI obtained additonal water right for taking water from Vay Kor dam, from Ministry of Water Resources and Meteorology (MOWRAM), under the approval letter dated 12th July 2021.

12-4. Assuarance of Sustainability of Vay Kor Dam

Both sides understand that water source management and balancing including dam development and maintenance are the responsibility of MOWRAM. Therefore, both sides reconfirmed that MISTI would closely work with MOWRAM to maintain the water level of the Vay Kor Dam for keeping sufficient water source for the water intake and to take necessary actions for prompt recovery of the water level in case of any incident. In addition, MISTI explained to the team that approval of water right from MOWRAM as per 12-3 means that MOWRAM assures MISTI(applicant) that MOWRAM will keep the water level of Vay Kor Dam enough for water intake.

12-5. Financial Soundness and Appropriate Water Tariff

The Team strongly recommended to revise the water tariff from the current 1,200 Riel/m3 to 1,580 Riel/m3 in order to ensure the financial soundness of the SWWs while maintaining the operation and maintenance of the facilities, in order to realize sustaibnable water supply services. The Cambodian side understood the importance of the tariff revision, and confirmed to take necessary procedure by 2024. Notwithstanding the importance of the tariff revision, in the unlikely event that the revision cannot be implemented on schedule, MISTI will take responsibility for supplementing the budget required to operate the facility.

12-6. Increasing the number of water service connections

Cambodian side will be expected to complete seven thousand three hundred seventy eight (7,378) service connections including poor household, under the Project. Both sides confirmed that it is important to carry out the connections as planned, to maximize the benefit for the people from the Project. In order to ensure smooth implementation, Cambodian side agreed to mobilize temporary construction team for the service connections from 2022 to 2027. Expected number of connection for each year is 500 households (HHs) in 2022, 500 HHs in 2023, 500 HHs in 2024, 1,878 HHs in 2025, 2,000 HHs in 2026, 2000 HHs in 2027. Both sides also confirmed that facilitating connections also means increasing revenue for the water utility, which is important for sound management of the water utility. MISTI will report annuarly to JICA Cambodia Office the progress of the connection increase, using the template in Annex 5.

12-7. Official permission for land use of intake

To acquire land use permit at the intake point, the SWWs should apply to the Provincial Government via Department of Industry, Science, Technology and Innovation (DISTI), so that approval can be obtained.

The Cambodian side agreed to proceed the above process by August 2022.

12-8. Official permission for the construction of WTP and the intake facility

The SWWs should apply to the Provincial Government via Department of Industry, Science, Technology and Innovation (DISTI), so that the approval on the construction of the WTP and intake facility can be obtained.

The Cambodian side agreed to proceed the above process by August 2022.

12-9. Land Acquisition for WTP, Ground Leveling for WTP and Intake Facility

Land for the WTP was acquired in December 2017. The intake pump station will be installed in public land along National Highway No. 1, which crosses the lake. The land on which the WTP and water intake facility will be built need to be leveled before starting the construction. The Cambodian side agreed to implement necessary ground levelling by August 2022.

12-10. Recruitment of new staff

Considering the sustainable operation and maintenance of the provided new facility, Cambodian side is requested to recruit twenty-two (22) new staff by 2027. Break down of the new staffs is described in the Annex 2.

Cambodian side agreed to secure enough staff and budget for appropriate operation and maintenance of the facilities.

12-11. Additional licence for SUMS

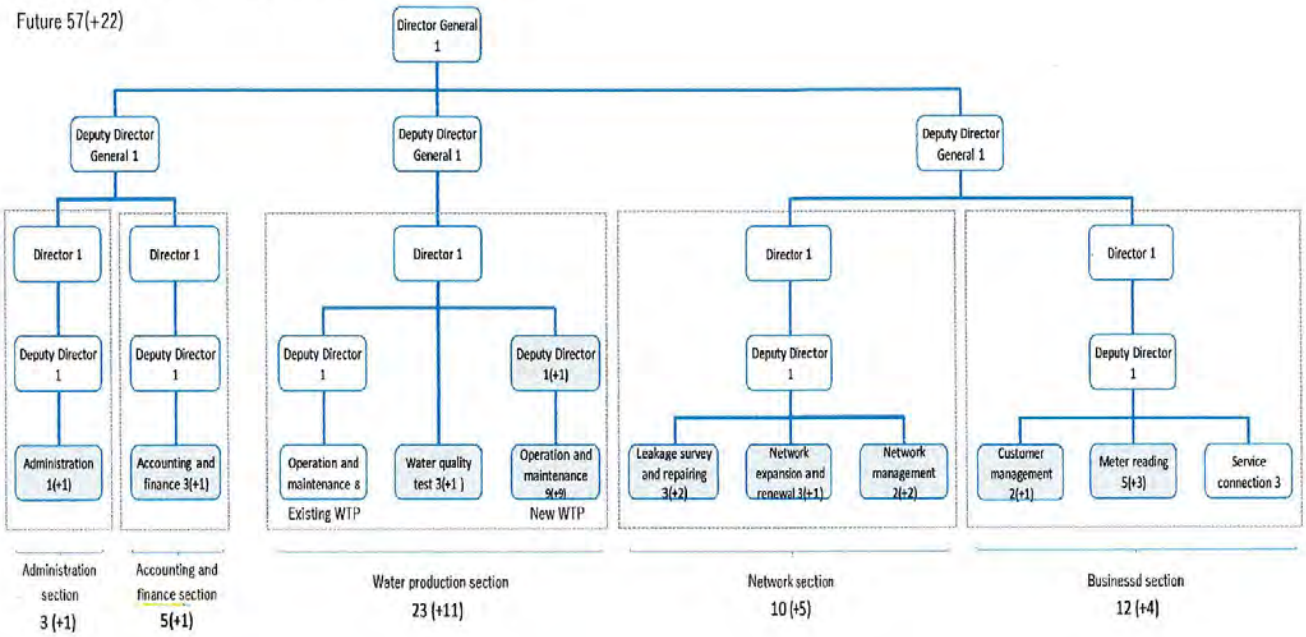
As the number of water service connections increases by the Project, the amount of work involved in issuing invoices and processing payments will increase, thus additional software licenses for Synergistic Utilities Management System (SUMS) will be procured under the Project. The Cambodian side agreed to be responsible for renewing the licenses.

END

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Project Implementation Schedule
Annex 4 Major Undertakings to be taken by the Government of Cambodia
Annex 5 Project Monitoring Report (template)
Annex 6 Environmental Check List
Annex 7 Environmental Management Plan/Environmental Monitoring Plan
Annex 8 Environmental and Social Monitoring Form

【Annex1 Project Site】

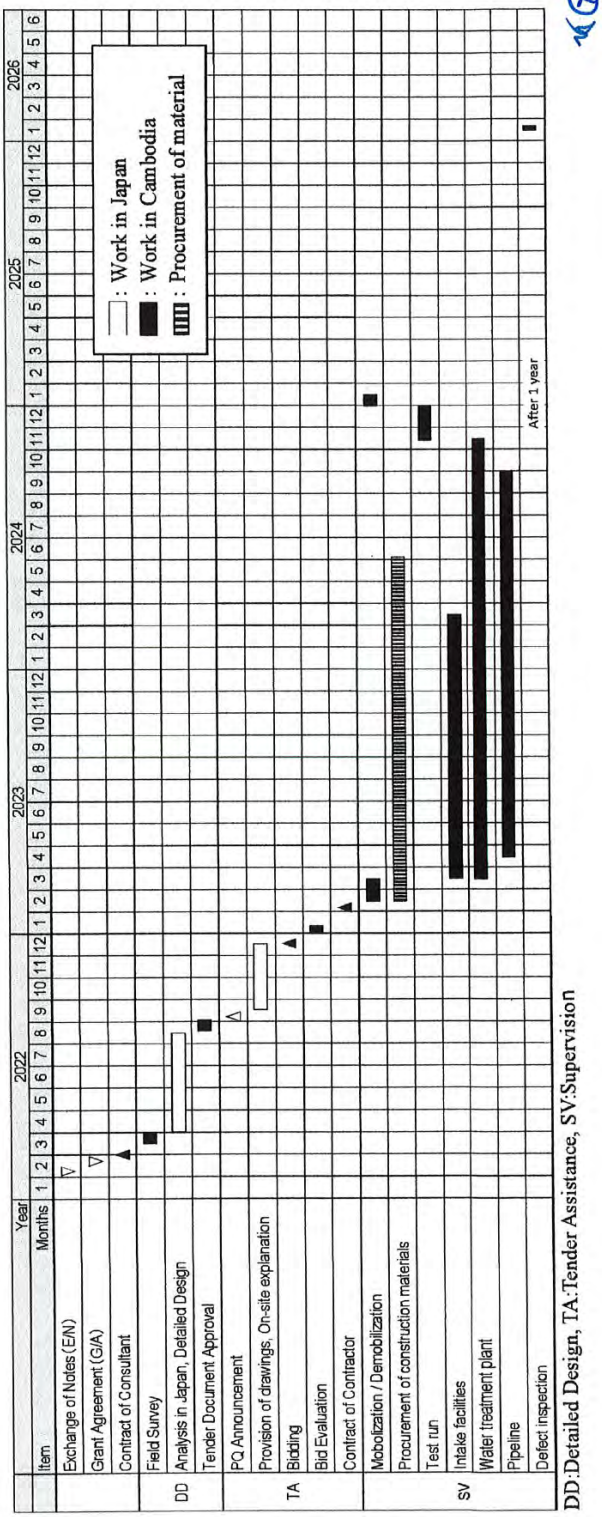
【Annex 2 Organization Chart】



* Highlighted sections/positions are expected to increase the number of staff.

* Proposed increased number of staff is noted in brackets.

【Annex 3 Project Implementation Schedule】



DD:Detailed Design, TA:Tender Assistance, SV:Supervision

3

【Annex 4 Major Undertakings to be taken by the Government of Cambodia】

1. Specific Obligations of the Government of Cambodia which will not be funded with the Grant

(1) Before the Tender

No	Items	Deadline	In charge	Estimated Cost
1	To open bank account (B/A) *1)	within 1 month after the signing of the G/A*5)	MEF*6)	$4,421
2	To issue A/P*2) to a bank in Japan (the Agent Bank) for the payment to the Consultant	within 1 month after the signing of the contract(s)	MISTI*7)	
3	To contract land lease in order to secure the temporary yard	before notice of the bidding document(s)	MISTI	$50,000
4	To obtain the planning, zoning, building permit	before notice of the bidding document(s)	MISTI	
5	To clear, level and reclaim the following sites. Embankment at proposed WTP*3) site and intake pump station site.	before notice of the bidding document(s)	MISTI	$496,340
6	To explore landmines and UXO*4) at construction site and temporary yard.	before notice of the bidding document(s)	MISTI	$22,104
7	To submit Project Monitoring Report (with the result of Detail Design)	before notice of the bidding document(s)	MISTI	

Note : *1) B/A : Banking Arrangement, *2) A/P : Authorization to Pay, *3) WTP : Water Treatment Plant, *4) UXO : Unexploded Ordnance, *5) G/A : Grant Agreement, *6) MEF: Ministry of Economic and Finance, *7) MISTI: Ministry of Industry, Science, Technology & Innovation

(2) During the Project Implementation

No	Items	Deadline	In charge	Estimated Cost
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	MISTI	$4,421
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A			
	(1) Advising commission of A/P	within 1 month after the signing of the contract(s)	MISTI	
	(2) Payment commission for A/P	every payment	MEF	$13,262
3	To ensure prompt unloading and customs clearance at ports of disembarkation in the country of the Recipient and to assist the Supplier(s) with internal transportation therein	during the Project	MISTI	
4	To accord the Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services as may be necessary, for their entry into the country of the Recipient and stay therein for the performance of their work	during the Project	MISTI	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted.	during the Project	MISTI	
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	MISTI	

No	Items	Deadline	In charge	Estimated Cost
7	To submit Project Monitoring Report	every month	MISTI	
	To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	MISTI	
8	To submit a report concerning completion of the Project	within six months after completion of the Project	MISTI	
9	To get permit for construction of temporary access roads for laying water pipes and lease necessary land for approach roads	1 month before the start of the construction	Local Communities, MISTI	
10	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project to the site(s)		MISTI	
	(1) Electricity The distributing line to the main road near the proposed facility	before start of the construction		$38,424
	(2)Electricity The distributing line from the main road to the site of proposed facility	2 months before the commissioning test		
	(3) Information System Contract of Internet line and GPRS[*1)] line for the remote monitoring and control system for intake facility and distribution monitoring system	2 months before completion of the construction		$4,421
11	To take necessary measures for safety construction - traffic control - rope off	during the construction	MISTI	
12	To implement EMP[*2)] and EMOP[*3)]	during the construction	MISTI	
13	To ensure the safety of persons engaged in the implementation of the Project	during the Project	MISTI	
14	To submit results of environmental monitoring to JICA[*4)], by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	MISTI	
15	To obtain permission for occupancy of roads for the pipe laying work	before start of the construction for conveyance, transmission, and distribution pipes	MISTI (WWs)[*5)]	
16	To obtain all permissions required for the project implementation such as construction permission for intake facility and the WTP	before start of the construction	MISTI (WWs)	
17	To conduct service pipe connection work during the project implementation	during the construction	MISTI (WWs)	$4,439
18	To recruit new staff members who are necessary for the operation of new system	up to the end of 2027 Since it is difficult to hire the necessary personnel at once, it is desirable to hire them in stages from 2022.	MISTI (WWs)	
19	To establish the construction scheme for the new service pipe connections, including hiring temporary work force. To carry out the technical guidance, budgeting, planning and publicity for	up to the end of 2027	MISTI (WWs)	

No	Items	Deadline	In charge	Estimated Cost
	enhancing new connections.			
20	To identify poor household	up to the end of 2027	MISTI (WWs)	

Note : *1) GPRS : General Packet Radio Service, *2) EMP : Environmental Management Plan, *3) EMOP : Environmental Monitoring Plan, *4) JICA : Japan International Cooperation Agency, *5) WWs: Waterworks,

(3) After Project Completion

No	Items	Deadline	In charge	Estimated Cost
1	To implement EMP and EMOP	for a period based on EMP and EMOP	MISTI	$8,842
2	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between MISTI and JICA	for three years after the Project	MISTI	
3	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid (1) Allocation of maintenance cost (2) Operation and maintenance structure (3) Routine check/Periodic inspection	After completion of the construction	MISTI	
4	To conduct service pipe connection work after the project completion continuously	up to the end of 2027	MISTI (WWs)	$21,555
	(1) Establishment of construction scheme including hiring temporary staff for service connection work, providing guidance, budgeting, planning and publicity for enhancing new connections.			
	(2) Connection for poor household - Material is procured by Japanese side, connection work is conducted by Cambodian side.			
	(3) Connection for household without poverty group - Material and connection work is under responsibility of Cambodian side.			
	(4) To report the results of service pipe connection work to JICA every year			

2. Other obligations of the Government of Cambodia funded with the Grant

No	Items	Deadline	Amount (Million Japanese Yen)*
1	1) To conduct the following transportation a) Marine(Air) transportation of the products from Japan to the country of the Recipient b) Internal transportation from the port of disembarkation to the project site 2) To construct pavement of in-plant road 3) To construct the temporary building 4) To provide facilities for the distribution of electricity, drainage and other incidental facilities 5) To provide facilities for water supply a) New intake facility - Inlet channel with gate - Pump station building - Administration building - Installation of two (2) intake pumps (including one backup pump) - Electrical facility b) Conveyance pipe laying c) New water treatment plant - Rapid stirring basin - Flocculation basin - Rectangular sedimentation basins - Rapid filtration basins - Distribution reservoir - Distribution pumps with flow control devices - Electric facility, administration building for chemical liquid injection, chlorine injection building, lagoons d) Laying distribution pipes Water reservoir e) Procurement of Equipment - Water quality analysis equipment - Machinery equipment - Accounting system equipment - Equipment and materials for house connection f) Soft components - Operation and maintenance of water treatment facilities - Maintenance of distribution facilities - Production management	project completion	
2	To implement detailed design, bidding support and construction supervision (Consulting Service)		
3	Contingencies		

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【Annex 5 Project Monitoring Report (template)】

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Organizational Information

1) Signer of the G/A (Recipient)	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Executing Agency	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Line Ministry	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant (Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with

Schedule 4 of the Grant Agreement).

- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).

- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*
Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low

	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials
(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)
-
-
-

A-77

Attachment 6

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

【Annex 6 Environmental Check List】

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
1 Approvals, explanations	(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) Y (b) Y (c) N (d) Y	(a) (b) MISTI submitted the report pursuant to the requirement to MOE. MOE inspected and approved the report, and the EPC was agreed on March 30, 2021. (c) No conditions. (d) MISTI will obtain official permission letter of water extraction from Vay Kor Lake by MOWRAM by December 2021, and permission letter of construction of water intake by Provincial Hall.
	(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) Y	(a) All related departments of the development project understood the project purpose and contents, and they agreed on the implementation. At the public hearing, the villagers welcomed the project. They wished the early project start. There is no particular objection. (b) The design of the intake facility is considered for the suitable appearance to meet the lake environment with comments from Provincial Hall. The water intake is designed with the consideration to prevent fish invasion by the request from the DOE.
	(3) Examination of Alternatives	(a) Have multiple alternative plans for the Project been analyzed? (Including analysis of items related to the environment/society.)	(a) Y	(a) Alternatives have been examined for the water source, site selection of intake and WTP, and extent of the supply area.
2 Pollution Measures	(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) Y	(a) The Project plans to use breaching power for disinfection. This reagent is stable, and occurrence of air pollution is considered less. The exhaust fan will be situated at the facilities of disinfection. (b) The above measures serve to keep appropriate working condition.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the	(a) N/A	Discharge generated at the treatment process will be recycled, and sludge will be dried. Therefore, any effluent from

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
		country's effluent standards?		treatment process will not be generated. Sewage will be treated by septic tanks and clear upper portion will be infiltrated into ground. Therefore, the discharge water is not generated.
	(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) Y	(a) Sludge will be treated and dried at dry-bed, then dry sludge will be disposed at an appropriate site with the permission of the landowner. MISTI is responsible for the arrangement.
	(4) Noise and vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a)Y	(a) The pump will be installed at basement made by the RC with the noise reducing walls. The noise will be controlled within the limit of GOC requirement. So, the noise and vibration will be controlled in permissible limit by the above measures.
	(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 Project does not use groundwater.
3 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) Y	(a) The Vay Kor Lake is divided in two parts by the national road No.1. The intake will be constructed at the upper side but the lower side is designated as protected area for the protection of fishery resources. The measures will be taken to prevent the occurrence of turbid water during construction. In addition, education and training will be provided to the workers not to do the fishing activities. In the design of the water intake, a bar screen will be installed, and the maximum inflow speed is set to 0.1 m / s or less, which is extremely slow, to prevent fish from entering. With the above measures, the impact of project implementation can be avoided.
	(2) Ecosystems	(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	(a) N (b) N (c) N (d) N	(a) The site does not contain any virgin forests, tropical old-growth forests, or important ecological habitats. (b) No habitats for any rare species are present in the site. (c) No major concerns.

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
		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?		(d) No major concerns
	(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) Impact on groundwater is not expected. The amount of water taken from the lake is small compared to the amount of the capacity, and the effect on surface water is limited.
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) Are the compensations going to be paid prior to the resettlement? (e) Are 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	(a)N (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) SWW purchased about 1ha of land for the WTP from the landowner. The land was agricultural land and there were no authorized/unauthorized residents, and there is no relocation of residents. (b) Land sales were conducted in the presence of the village chief and sufficient explanations were given. (c) The sale price of land is about 1.2 times the price of the surrounding land and is considered to be the replacement price. (d) SWW already paid the full amount. (e) Conducted as a general land sale. (F) The landowner is a farmer, and his family (wife only) participated the contract process and agreed to the sales contract. (g) No relocation occurred. (h) DISTI and the village chief were involved, and land sales were carried out appropriately. (i) The full contract amount has already been paid and no monitoring is performed. (j) If there is a complaint, it will be

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
		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?		communicated to DISTI or MISTI via the village chief, but no complaint has occurred in this sale.
	(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 has positive impact to improve basic human needs. There is no particular negative impact. (b) The Svay Rieng River has enough discharge capacity and the intake of water supply does not affect significantly.
	(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) No anthropological, historical, cultural, religiously important heritages or historical remains have been identified in 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 intake will be constructed at the roadside, and it will be designed to be harmonized with the environment to meet the request of the stakeholders.
	(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) N/A (b) N/A	(a)(b) There are no ethnic minorities or indigenous peoples living near the project site.
	(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) Y (b) Y (c) Y (d) Y	(a) Adherence to laws concerning working conditions will be made explicit in contracts with contractors and managed. (b) Countermeasures such as installation of safety handrail are taken. (c) It will be achieved to set as an obligation of contractor in contract document. (d) Security guards will be included in target members of worker training. .

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
		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?		
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) Y (d)Y	(a) Mitigation measures will be taken under EPM for managing all noise, vibration, turbid water, dust, gas emissions, and waste discharged from the work site. (b)Particular negative impact is not expected. (c) Temporary traffic disturbance will occur. The negative effect will be minimized by the measures such as setting of detours, assignment of traffic guide, installation of signboard, appropriate information sharing. (d) Since the water intake facility will be constructed along the national highway crossing the lake, the temporary reduction of the number of lanes will be required, and it may cause traffic congestion. The measures to be taken are as described above.
	(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) Y (c) Y (d) Y	(a) MISTI is responsible for the monitoring as in previous similar project which they are experienced. (b) It will be determined in EMoP. (c) Monitoring by proponent is a part of usual operation activities. The training will be given as a part of soft component. (d) It is stipulated in the EMP.

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
6 Focal points	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a) N/A	(a) The intake amount is not much, and the intake structure is small scale at the upper flow of existing headwork. Therefore, it is not necessary to refer the checklist of Dam and River Projects
	Precautions when using the 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) N	(a) None

【Annex 7 Environmental Management Plan/Environmental Monitoring Plan】

Impact	Parameter	Monitoring Method	Monitoring Point	Frequency	Responsibility	Cost
Construction						
Air Pollution	Dust	Visual observation	Vicinity of construction site	Daily	Contractor	Construction cost
	Exhaust gas	Inspection of registered vehicle	Construction Office	Monthly	Contractor	Construction cost
Noise and vibration	Working time	Working record	Construction site	Daily during construction	Contractor	Construction cost
	Management of vehicles	Inspection of registered vehicles	Construction Office	Monthly	Contractor	Construction cost
	Guidance to operator	Training record	Construction Office	Once during construction	Contractor	Construction cost
Water Pollution and sediment	Turbidity, oil	Visual inspection	Inlet of discharge	Weekly but daily during construction of foundation	Contractor	Construction cost
	Water quality	pH, EC, COD, turbidity, oil	Outlet of discharge	When abnormal incident is observed	Contractor	Construction cost
Solid Waste (domestic)	Proper management	Visual inspection	Domestic waste	Weekly	Contractor	Construction cost
Solid Waste (Construction)	Proper dumping	Visual inspection	Temporary damping yard	At the time of damping	Contractor	Construction cost
	Preparation of dumping site	Contract document	Dumping site for soil waste	At the time of contract	SWWs, MISTI	No charge
Ecosystem	Ban of hunting and fishing	Training record	Construction Office	Monthly	Contractor	Construction cost
Hydrology	Construction schedule in rainy season	Monthly construction report	Construction Office	Monthly during rainy season	Contractor	Construction cost
Land and local resource usage	Lease of land	Contract document	Construction Office	At the time of contract of lease	SWWs, MISTI	About 300 USD/month
Existing social infrastructure and services	Mitigation measures to prevent traffic disturbance	Monthly construction report	Construction Office	Monthly	Contractor	Construction cost

HIV/AIDS and other infectious disease	Management of occupational safety and hygiene	Monthly construction report	Construction Office	Monthly	Contractor	Construction cost
Working condition	Management of occupational safety and hygiene	Monthly construction report	Construction Office	Monthly	Contractor	Construction cost
Accident	Traffic plan of construction vehicle	Plan	Construction Office	At planning	Contractor	Construction cost
	Safety training	Monthly construction report	Construction Office	Monthly	Contractor	Construction cost
Miscellaneous	Complaint management	Analysis of complaint	Construction Office	Monthly	Contractor	Construction cost
Operation						
Waste	Appropriate treatment of sludge	Monitoring record	WTP	Every three months	SWWs	O&M cost
	Preparation of dumping site for sludge	Contract document	SWWs	At the time of contract	SWWs	No charge
Noise and vibration	Monitoring with standard operating procedure (SOP)	SOP and monitoring record	Pumping station	Every three months	SWWs	O&M cost
	Guidance for operators	Training record	Pumping station	Every three months	SWWs	O&M cost

【Annex 8 Environmental and Social Monitoring Form】

Monitoring Form (Construction)

Construction site (Daily monitoring)

Monitoring Item		Procedure	Result	Measures to be taken	Reference standard		Frequency
Dust		Visual inspection			Acceptable or not		Daily
Noise		Sensory inspection			Acceptable or not		Daily
		Operation time check			Stated operation time in EMP		Daily
Water Quality (turbidity, oil)		Visual inspection			Acceptable or not		Daily (during foundation work)
Water Quality	pH	Laboratory test			6 - 8	Determined by the monitoring result	In case of abnormal observation of turbidity or oil
	EC				80		
	COD				10		
	Turbidity				500		

Construction site (Weekly monitoring)

Monitoring Item	Procedure	Result	Measures to be taken	Reference standard	Frequency
Waste (Domestic)	Patrol			Acceptable or not	Weekly

Construction site (Monthly monitoring)

Monitoring Item	Procedure	Result	Measures to be taken	Reference standard	Frequency
Condition of construction machinery and vehicles	Maintenance record check			Acceptable or not (Exhaust gas, noise, vibration, and usual safety check)	
Traffic management	Patrol			Stated procedure in EMP	Monthly
Accident	Patrol			Acceptable or not	Monthly
Training and educational meetings to worker	Report check			Stated procedure in EMP (frequency, contents, target, etc.)	
Claim and comment	Report check			Acceptable or not	Monthly

Others

Monitoring Item	Procedure	Result	Measures to be taken	Reference standard	Frequency
Land for waste dumping Land for temporary use	Lease condition			Appropriate or not (Size, location, permission (if necessary))	Contract of lease
Plan of safety transportation	Plan check			Acceptable or not	At planning

Monitoring Form (Operation)

Monitoring Item	Procedure	Result	Measures to be taken	Reference standard	Frequency
Waste (treatment sludge)	Patrol			Appropriate or not	Monthly
Land for waste dumping	Procedure check			Appropriate or not (Size, location, permission (if necessary))	At contract agreement
Noise and vibration*	Patrol and maintenance			Normal condition or not	Daily

*Noise and vibration of pump shall be checked in an operation record every day.

カンボジア国
スバイリエン上水道拡張計画

ソフトコンポーネント計画書

2021 年 12 月

カンボジア国
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目　　次

1　ソフトコンポーネントを計画する背景

「スバイリエン上水道拡張計画」（以下「本プロジェクト」という。）は、カンボジア国スバイリエン州の州都であるスバイリエン市に浄水能力 6,800 m^3/日の浄水場と約 112km の配水管網を新たに整備するものである。

本プロジェクトにより同市の水道施設は大幅に増強されることから、同市の水道を所管するスバイリエン水道局は、新しい施設の適切な運用・運転維持管理に見合うだけの組織体制を整備することが求められる。組織体制の整備には新規職員の採用や外部人材の活用が必要となるが、同水道局はこれらの人材を指導する現職職員の技術力向上や現在抱えている課題の克服などに取り組んでいかなければならない。

1-1　スバイリエン水道局の現状

現在のスバイリエン水道局は、浄水能力 4,560 m^3/日の既存浄水場と 2020 年 4 月に中国企業との BOT 事業により既存浄水場内で運用を開始した膜処理施設 2,000 m^3/日を合わせ、6,560 m^3/日の浄水能力と約 65km の配水管網を有している。BOT 事業での運転維持管理は、20 年間中国企業が行うことになっている。

このほか、本プロジェクトに先行して、ADB の支援による 9,000 m^3/日の浄水場建設と約 30km の配水管網の整備が予定されている。

水道局の運営は、局長を含めた 34 名（現在、配水課長が欠員のため定数は 35 名）の職員で行っている。この職員数には、2020 年以降に ADB プロジェクトのために増員された 4 名を含んでいる。

既存の浄水場では、主に浄水課職員が交替制で 24 時間運転業務を行っており、おおむね良好な運転維持管理が行われている。しかし、この交替制の運転業務は職員の長時間拘束を前提としており、人員が充分とは言い難い。配水施設については、配水課の職員が漏水調査・修繕、管網管理、管路拡張・更新などの維持管理業務を実施しているが、人員に余裕はなく、外部人材も活用しながら業務を遂行している。また、営業課などその他の部署においても職員が余剰しているわけではない。本プロジェクトによる施設拡張に向けた組織体制の整備が不可欠である。

1-2　技術水準

スバイリエン水道局は、カンボジア水道事業人材育成プロジェクト・フェーズ 2（2007～2012 年）及びフェーズ 3（2012～2018 年）の対象事業体である。2007 年から 2012 年にかけての 5 年間は、浄水場の運転維持管理、水質試験、配水施設維持管理等に係る技術移転、2012 年からは経営改善に係る技術移転が実施されてきた。

既存浄水場は地下水を原水として利用しており、鉄やマンガンを多く含むため、塩素を注入後に砂の層を通過させて処理している。本プロジェクトで採用を予定している浄水処理方式は急速ろ過方式で、既存浄水場の処理方式と異なるため、現職員は凝集沈殿、急速ろ過についての知識・経験を持っていない。

既存の浄水施設の点検整備は計画的に実施され、人材育成プロジェクトで導入したチェックシートや標準作業手順書（Standard Operating Procedure：SOP）が活用されている。施設を定められた手順で適切に運転、維持管理することはできるものの設備が故障した場合に故障箇所を特定できないなど、維持管理についての技術は不足している。

水質試験については、通常測定している濁度、pH、残留塩素の測定などは適切に実施できている。しかし、既存浄水場で実施することがないジャーテストについては技術がなく、急速ろ過方式の浄水場において必須となる凝集剤の注入量を決定することはできない。生物試験についても、装置はあるが職員は試験、分析を実施したことがない。

配水施設の維持管理においては、これまでの人材育成プロジェクトで移転された漏水調査や工事記録作成等の技術が活用されている。一方で、本プロジェクトで採用を予定している配水監視システムは既存浄水場に導入されていないため、現在は浄水場内のメータを読み、総配水流量の記録だけを続けている。従って、本プロジェクトを通じて整備される新たなシステムを活用しながら、配水流量監視、流量データの分析及びそれに基づく配水施設の維持管理を行っていく必要がある。

給水接続工事については、掘削は手掘り、給水装置の配管材料はポリエチレン製で、接続にはカップリング継ぎ手を用いているため、接続に特別な器具を必要としない。職員は作業に慣れてはいるが、チェックリストなどを活用した施工の品質管理は行われておらず、今後急増する給水接続工事の品質を確保するためには改善されることが望ましい。

全体的にみると、既存施設の運転維持管理について改善すべき点があるものの、概ね計画的かつ良好に実施され業務記録も整理されている。一方、職員のうち工学系の高等教育を修了した者はわずかであり、各職員が必ずしも自分の職務に関する高度な専門的知識を有しているわけではない。

1-3　運転・維持管理上の課題

本プロジェクトによる新規施設の建設後は従来の施設に加え、新たな施設を運転・維持管理していくこととなる。スバイリエン水道局が持つ技術水準を考慮し、現時点で考えられる運転・維持管理上の課題は以下のとおり。

(1)　新しい施設の運転維持管理

施設建設・機材調達業務の中で行われる初期操作指導は、マニュアルに沿った基本的な機器の基本操作や取扱説明、機器単体の点検方法など単純条件下における説明が主体となるが、それだけでは新しい水道施設を適切に運転維持管理することはできない。

水道施設は多くの機器が組み合わさって構成され、その機能を発揮する。設計図書、各種マニュアルを十分に理解し、日々の水質や水需要の変動に応じながら運転維持管理を実施しなければならない。

また、本プロジェクトで採用される急速ろ過方式は、既存浄水場の浄水処理に比べ運転や維持管理における設備のメンテナンスなどが複雑になる。原水濁度が急上昇した場合などには水質変動に対応する技術力も必要となる。特に、既存浄水場と異なる部分として、凝集剤の適正な注入管理が必要となること、フロックの形成状態の監視、定期的な排泥と池内の洗浄作業が増大することが挙げられる。

運転維持管理手順の立案は、これらの基礎知識を十分に習得したうえで、実際に施設を稼働することでしかわからない操作の要点やリスクを整理して行わなければならない。また、立案された手順を担当者が速やかに習得するためには、実施設を使用した OJT が不可欠である。これらには確かな専門知識と豊富な経験に基づく水道技術や考察力が求められるため、現在のスバイリエン水道局の技術水準では水道局の職員が単独で行うことは難しい。

(2)　配水監視と配水流量分析に基づいた施設の維持管理

スバイリエン水道局の料金徴収率はほぼ 100%であり、近年は盗水も発見されていないため、無収水の多くを漏水が占めていると考えられる。漏水の原因は老朽管の破裂や給水装置の施工不良、他工事による破損など様々な原因が考えられるが、漏水は修繕しても時間が経つと新たな漏水が発生するという復元現象が起きる。

2018 年時点での比較的良好な無収水率（8.9%）を今後も維持していくためには、目に見えない地下漏水や復元する漏水を見つけ出して修繕するなど、積極的な維持管理が必要である。

配水施設は、浄水施設などと異なりそのほとんどが地中に埋設されるため、目視による保守点検は実施することができない。本プロジェクトで拡大する配水管網において、闇雲に漏水調査を実施したり、手当たり次第に老朽管を更新するのは非効率であり、客観的なデータに基づいて漏水調査の対象区域を選定したり、老朽管更新の優先順位を決定するなど、効率的な配水施設の維持管理が求められる。

配水流量監視は、配水区域別に配水流量や夜間最少流量を監視、記録し、得られたデータを整理、分析することで、各配水施設の状態把握、異常検知及び異常原因を推定するために必要な情報を与えるものである。本プロジェクトの実施により、スバイリエン水道局には配水監視システムが新たに導入され、配水管網が 4 つの配水ブロックに分割されることにより、各ブロックの流量と水圧が監視できるようになる。配水流量監視に係る技術については、配水監視システムの操作や維持管理等を含め、基本的な部分から習得する必要がある。

(3) 給水装置の品質確保

現在、給水装置の接続工事については営業課の担当職員と外部人材によって実施している。担当者は作業に慣れてはいるものの、特に品質確保に向けた取り組みが実施されているわけではない。

一般に漏水発生件数の大半を給水装置からの漏水が占めることから、給水接続の品質向上は無収水量を削減する上で重要である。

今後、本プロジェクトの実施により給水接続工事が急増することが見込まれる。給水装置からの漏水を予防するためには、施工手順の改善や担当者の施工管理能力向上による品質確保が必要である。

(4) 給水接続申し込みの促進

本プロジェクトの実施により、給水戸数は 2019 年時点の約 4,700 戸から目標年次である 2027 年には約 12,100 戸まで増加することを想定している。このうち、本プロジェクトでは 375 世帯の貧困世帯に対して給水管接続のための機材調達を行う予定である（工事は先方負担）。

給水戸数が想定を下回った場合、給水収益が伸び悩み水道事業経営にも影響する。そのため、新たな給水区域における給水接続の申し込みを促進することは経営上の重要な課題である。

現在、スバイリエン水道局では営業課の職員が各戸を訪問し、住民の水道に関する理解促進のために啓発活動を行っているが、本プロジェクトの目標とする給水戸数の達成に向けては、幅広い世代の多くの住民に水道について認知し興味を持ってもらわなければならない。イベントを行うなど、より効果的に給水接続の申し込みを促進していく必要がある。

(5) 生産管理

スバイリエン水道局は、本プロジェクトの終了後には、これまで経験のない複数の浄水場を運用していくことになる。浄水場の運用にあたっては、各種原単位（浄水単価、給水

原価、供給単価など)、浄水コスト、配水区域の状況を十分に理解した上で、日給水量の少ない期間は配水区域を変更して給水コストの低減を図ったり、各浄水場の薬品の在庫管理を確実に行うなど、これまでよりも高度な生産管理が求められる。また、汚泥処理計画の策定と実施手順の立案についても、既存の浄水場が汚泥処理施設を有しないため、新しい施設のために新たに必要となる。

(6) SOP の改訂・作成

本プロジェクトの成果が持続するためには、新しい施設や機材の運転維持管理の手順や運用のルール、操作の要点や注意事項などが SOP としてとりまとめられ、必要に応じていつでも参照できるようになっていることが重要である。以下に既存の SOP の状況を述べる。

既存の浄水施設については、人材育成プロジェクトにおいて、浄水場の運転業務、施設の維持管理業務に係る基礎知識や作業手順、安全上の留意点などが SOP として取りまとめられている。しかし、それらはあくまでも既存施設の使用を前提としている。新しい浄水施設は、既存施設と異なる急速ろ過方式を採用するため、新規施設の処理方式や設備に合わせた SOP を準備する必要がある。

水質試験についても、人材育成プロジェクトにおいて、重要な水質項目に対する試験方法や水質計器の操作及び校正の方法、ジャーテストの方法など浄水処理の過程や水道水として管理していく必要がある水質項目について、必要な情報が SOP としてまとめられている。ただし、これらの SOP は、既存の水質計器を使用することを前提として作成されたものである。本プロジェクトでは、新しい水質計器が導入されることとなるため、既存の SOP の内容を確認し、必要に応じて修正を加え、新しい機器を使用した水質試験に関する SOP を準備しなければならない。

配水流量監視については、本プロジェクトで新たに導入される配水監視システムを用いた SOP を新規に作成する必要がある。配水監視システムを実際に運用し配水流量を監視していくために必要な情報の解釈や流量データの分析などを内容に盛り込んでいく。

また、スバイリエン水道局全体として複数の浄水施設を稼働しての運用管理や新しい浄水場の汚泥処理などに関するものは、生産管理に係る SOP として新たに作成しなければならない。

これら SOP の改訂、作成には、運転維持管理手順の立案と同様に専門的な知識と経験が必要となるため、現在のスバイリエン水道局の技術水準でこれを単独で行うのは難しい。

1-4　ソフトコンポーネント導入の必要性

本プロジェクトが円滑に立ち上がり、協力の成果が最低限持続するためには、下記の要件を満たす必要がある。

(1) 運用開始までに施設の運転操作と維持管理方法を最低限度理解すること
(2) 運転維持管理に係る手順やルールが文書として整理されていること
(3) 現職員のうち、新しい施設を十分に理解し、他の職員を指導できる者が育成されること

本プロジェクトによる施設建設が完成した後、スバイリエン水道局は直ちに新しい水道施設を運用していかなければならない。しかし、現在のスバイリエン水道局の技術水準では単独で短期間のうちにこれらの要件を満たすことは難しく、専門的技術を有する経験豊富な技術者のサポートが必要である。このため、ソフトコンポーネントとしてスバイリエン水道局に対し、新しい水道施設の運用・運転維持管理に係る技術移転を実施するものとする。

なお、本プロジェクト実施に伴う新しい組織において、浄水課は現職の課長の下に副課長をリーダーとする新たなチームを設け、新規浄水場の運転維持管理を 9 名に、水質試験を 1 名に担当させる予定であり、11 名の増員を予定している。

配水課は、現職の副課長の下、漏水調査・修繕、管路拡張・更新及び配水管理で 5 名の増員を予定している。

営業課は、現職の課長の下、顧客情報及び検針で 4 名の増員を予定している。また、総務課及び経理・財務課においても 1 名ずつの増員を予定している。

図 1-1 及び図 1-2 にスバイリエン水道局の現在と将来の組織体制を示す。

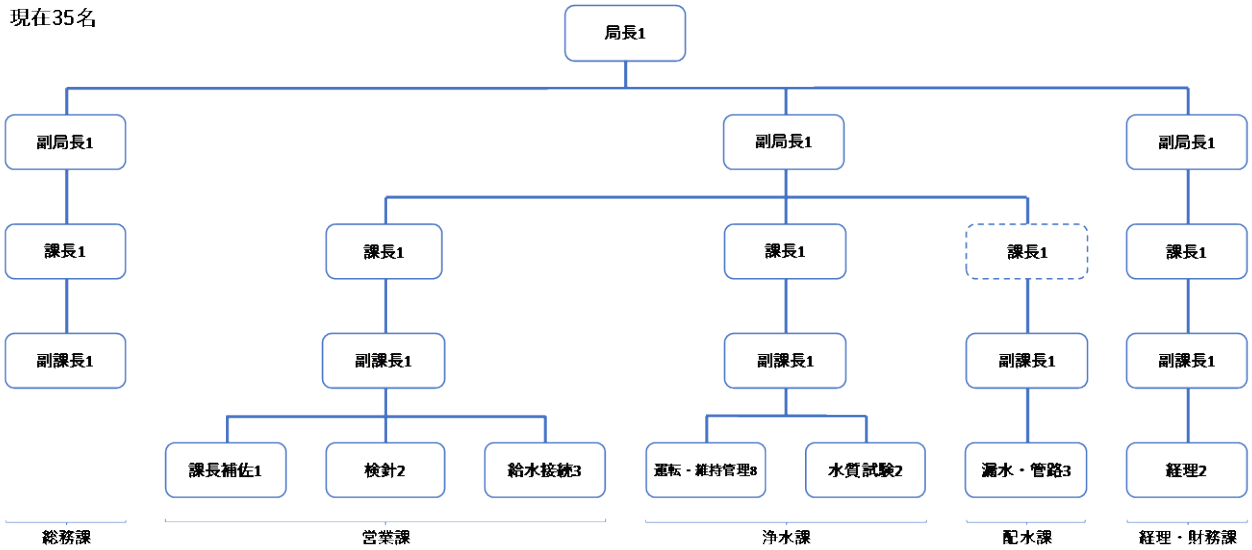


図 1-1　スバイリエン水道局の組織（現在）

出典：スバイリエン水道局

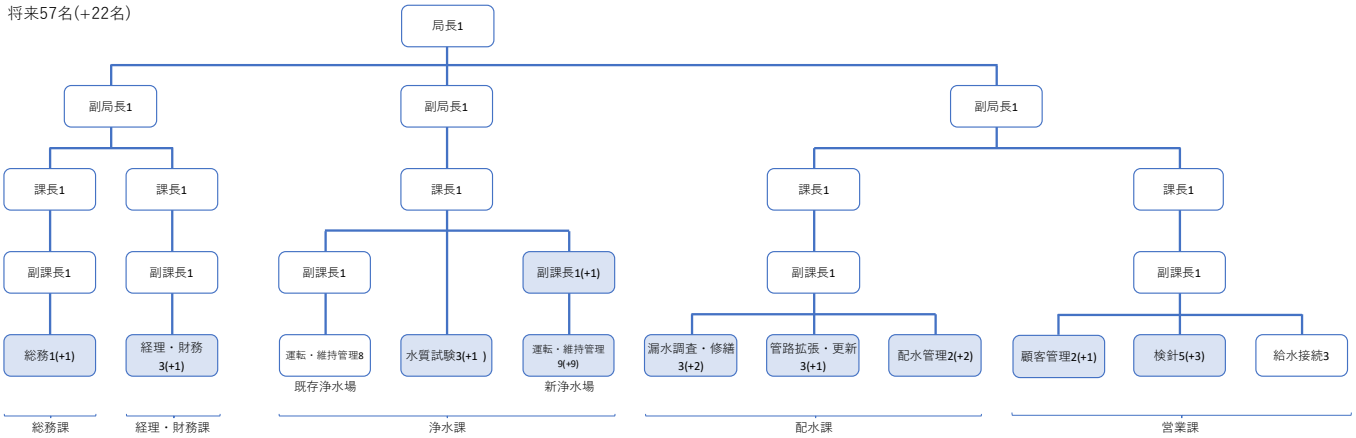


図 1-2　スバイリエン水道局の組織（将来）

出典：JICA 調査団

2　ソフトコンポーネントの目標

本ソフトコンポーネントは、「スバイリエン水道局が、新しい水道施設の運転・維持管理を適切に行い、既存の施設も有効に活用しながら、水質基準を満たす水を安定的に供給すること」を目標とする。

3　ソフトコンポーネントの成果

1-3 運転・維持管理上の課題を踏まえ、本ソフトコンポーネントの成果を下記のとおり設定し、その現状を述べる。

(1)　新しい浄水施設の運転維持管理手順が習得される

既存の浄水施設の運転維持管理は概ね適切に実施されているが、新しい浄水施設の運転維持管理の手順は、専門家の支援の下で新たに立案されなければならない。また、現職員と新規職員が運転維持管理を習得するために、専門的な知識を学ぶ基礎研修と必要な技術を身につける OJT が必要である。本プロジェクトと同規模の拡張をした地方公営水道局の施設を用いての研修を取り入れるなど、効果的に実施する。

(2)　新しい機器を用いた水質試験の手順が習得される

既存の機器を用いた水質試験は概ね適切に実施されているが、本プロジェクトで導入される新しい機器を用いた水質試験の手順は、専門家の支援の下で必要な水質項目について再検討されなければならない。また、新規職員が水質試験の手順を習得するためと現職員の知識を向上させるために、基礎研修と OJT が必要である。

(3)　配水流量監視に係る能力が習得される

スバイリエン水道局には配水監視システムが導入されていないため、配水監視に関する技術力は乏しい。そのため、配水監視システムを活用した配水流量監視や分析に係る技術の基礎的な研修、配水監視システムの運用手順の立案と OJT については、専門家及び今回導入する配水監視システムの運用経験がある現地の技術者を活用しながら実施する必要がある。

(4)　給水接続工事の施工管理体制が強化される

給水接続工事は問題なく実施されているが、本プロジェクトの実施により目標年次まで工事件数が急増することになる。漏水を予防する観点からも給水接続工事の施工品質を向上させるためには、専門家と現地技術者の指導の下、施工手順の再確認と OJT、施工管理体制の強化が必要である。

(5)　給水接続の申し込み促進に係る活動が実施される

本プロジェクトの目標とする給水戸数の達成に向けて、効果的な啓発資料の作成や啓発活動の企画立案に係る支援が必要である。

(6)　生産管理能力が向上する

スバイリエン水道局は複数の浄水場を運用した経験を有しないことから、水道局全体として効率的な運用の方法について検討、立案、理解されなければならない。

また、既存の浄水場は汚泥処理施設を有しないため、汚泥処理計画の策定と実施手順の立案、OJT が必要である。

(7) SOP が改訂・作成される

既存施設の使用を前提とした SOP はあるが、新しい施設の運転維持管理が理解され定着していくためには、新しい施設や機材を使用した運転維持管理の手順や運用のルール、操作の要点や注意事項が分かり易くとりまとめられ、必要に応じていつでも参照できるようになっていなければならない。

既存施設と異なる新しい施設の運転維持管理として、浄水施設運転維持管理では急速ろ過方式での薬品注入管理と沈殿池・ろ過池の運用や洗浄方法など、配水施設運転維持管理では配水監視システムを活用した配水流量監視などが挙げられる。また、生産管理においても、複数の浄水場を運用しての効率的な施設運用、天日乾燥床を利用した汚泥処理がある。これらの新しい施設に係る項目については新規 SOP の作成、その他は既存 SOP の改訂が必要である。

4 成果達成度の確認方法

本ソフトコンポーネントの成果毎の達成度確認方法について、表 4-1 に示す。

表 4-1 ソフトコンポーネント各分野・成果毎の達成度の確認方法

成果	達成度の確認項目	達成度の確認方法
(1) 新しい浄水施設の運転維持管理手順が習得される	① 浄水場の運転、浄水処理工程の管理が適切に実施される。 ② 浄水濁度がカンボジアの水道水質基準 5NTU 以下を満足する。 ③ 給水栓における残留塩素がカンボジアの水道水質基準 0.1～1.0 mg/L を満足する。 ④ 施設の保守点検が計画的に行われる。	① 運転日誌や薬品注入記録、実作業で確認。 ② 水質記録で確認。 ③ 水質記録で確認。 ④ 実作業、保守点検記録、点検計画で確認。
(2) 新しい機器を用いた水質試験の手順が習得される	① 水質試験が適切に実施される。 ② 水質試験の結果が定められた頻度で記録される。	① 水質試験記録や実作業で確認 ② 水質試験記録を確認。

成果	達成度の確認項目	達成度の確認方法
(3) 配水流量監視に係る能力が習得される	① 配水流量監視が適切に行われ、記録が整理される。 ② 配水流量の分析が行われる。 ③ 配水流量の分析結果に基づいた配水施設の状態把握（漏水等）について理解される。	① 配水流量監視記録で確認。 ② 配水流量の分析結果で確認。 ③ 小テストで確認。
(4) 給水接続工事の施工管理体制が強化される	① 給水接続工事の手順が再検討され必要に応じて改善される。 ② 給水接続工事の施工管理の方法が検討され、実施される。	① SOP で確認。 ② 給水接続の施工管理記録で確認。
(5) 給水接続の申し込み促進に係る活動が実施される	① 住民啓発に係る資料が作成される。 ② 給水接続の促進活動が実施される。	① 住民啓発資料で確認。 ② 実際の活動や記録で確認。
(6) 生産管理能力が向上する	① 水道局全体の効率的な運用が理解される。 ② 薬品の在庫管理が適切に実施される。 ③ 汚泥処理が適切に実施される。	① 小テストで確認。 ② 在庫管理記録で確認。 ③ 汚泥処理記録、実際の状況で確認。
(7) SOP が改訂・作成される	① 浄水施設運転維持管理（運転維持管理、水質試験）に関する SOP が整理される。 ② 配水施設運転維持管理（配水流量監視、給水接続工事）に関する SOP が整理される。 ③ 生産管理（効率的な施設の運用、汚泥処理）に関する SOP が作成される。	① SOP で確認。 ② SOP で確認。 ③ SOP で確認。

出典：JICA 調査団

5　ソフトコンポーネントの活動（投入計画）

5-1　投入方針

本ソフトコンポーネントにおいての投入は、3 ステップで実施する。

第 1 回の投入は水道施設の完成前に、基礎知識の習得を目的として研修を実施する。併せて、SOP の改訂及び作成の支援などを実施する。

第 2 回の投入は、施設建設、機材調達業務による試運転調整と並行して OJT 研修を行う。また、第 1 回に引続き SOP の改訂及び作成の支援などを実施する。

第 3 回の投入は、実際に運用を開始して 3 カ月程度経過したタイミングで、フォローアップを目的として研修を実施する。運用実績のレビュー、課題の洗い出しとその対策に係る支援及び SOP の見直しなどを行う。

想定するソフトコンポーネントの投入時期を図 5-1 に示す。

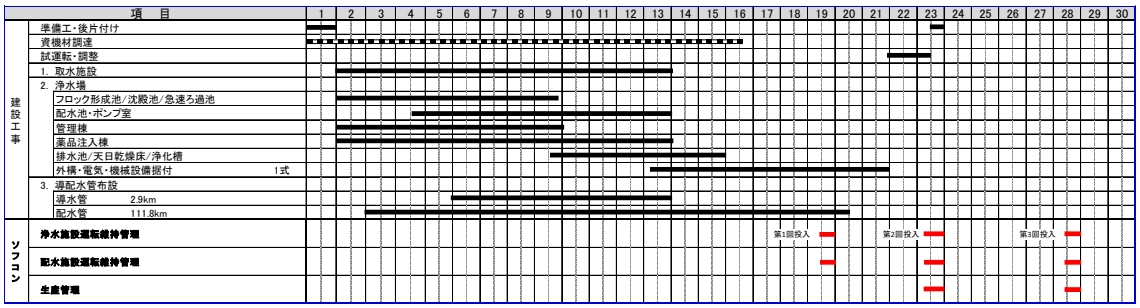


図 5-1　ソフトコンポーネントの投入時期

出典：JICA 調査団

5-2　投入計画

新しい施設の運転維持管理手順の立案や研修、SOP の改訂・作成支援など、確かな専門知識と豊富な経験に基づく水道技術や理論的な考察力を必要とする業務は日本人専門家による直接支援型とし、一部、人材育成プロジェクトで育った人材を活用し現地技術者ならではの技術移転を実施するものとする。

投入要素は、日本人専門家、現地技術者、現地スタッフとし、業務区分は概ね下記のとおりとする。

(1)　日本人専門家

各分野の総括、新規施設運営に必要な業務内容及び業務量分析、研修コース管理、運転維持管理手順の立案、基礎研修、OJT、SOP の改訂・作成支援、研修資料作成、成果達成度の評価

(2)　現地技術者

カンボジアでの経験に基づく研修、スバイリエン水道局以外での研修、クメール語研修資料作成

(3)　現地スタッフ

資料整理、クメール語研修資料作成、カウンターパートとの連絡調整、日本人専門家活動時の通訳、資料翻訳

なお、本ソフトコンポーネントの実施にあたっては、水道事業の経験を有する日本の水道専門家の投入を予定しているが、一般的に日本の水道事業体においては、浄水施設の運転維持管理は電気・機械などの設備系職員、配水施設の維持管理は土木系の職員が充てられる。

このため、本ソフトコンポーネントでは、新しい施設の運転維持管理手順の立案や基礎研修、OJT、SOP 改訂・作成に係る支援については、水質試験を含む浄水施設運転維持管理分野と、配水流量監視を中心とする配水施設維持管理分野に分けて実施するものとし、それぞれ設備系と土木系の専門家を投入するものとする。また、支援内容と業務量を考慮し、生産管理分野に係る専門家をそれらとは別に投入するものとする。

本ソフトコンポーネントの活動（投入計画）を表 5-1 に示す。

表 5-1　ソフトコンポーネントの活動（投入計画）

分野	成果	活動内容	対象者	必要な投入量
浄水施設運転維持管理	(1) 新しい浄水施設の運転維持管理手順が習得される	1. 運転維持管理手順の立案 2. 運転維持管理基礎研修 3. 運転維持管理 OJT ➢ 浄水処理 ➢ 運転記録 ➢ 薬品注入 ➢ ろ過池洗浄 ➢ ポンプなど運転操作 ➢ 保守点検 ➢ 事故・故障対応体制	浄水課 23 名	日本人専門家 1 名×2.03 P/M（61 日） 第 1 回（0.60 P/M：18 日） 運転維持管理基礎研修 水質試験基礎研修 SOP 改訂指導 第 2 回（0.80 P/M：24 日） 運転維持管理研修 水質試験研修 SOP 改訂指導 第 3 回（0.63 P/M：19 日）

分野	成果	活動内容	対象者	必要な投入量
	(2) 新しい機器を用いた水質試験の手順が習得される	1. 水質試験手順の立案 2. 水質試験基礎研修 3. 水質試験 OJT ➢ 水質試験 ➢ 分析記録		レビュー フォローアップ研修 SOP 改訂指導 現地技術者 1 名×0.17 P/M（5 日） 現地スタッフ 1 名×1.79 P/M（54 日）
	(7) SOP が改訂・作成される	1. SOP 改訂・作成支援 ➢ 浄水施設運転維持管理 ➢ 水質試験		
配水施設運転維持管理	(3) 配水流量監視に係る能力が習得される	1. 配水流量監視手順の立案 2. 配水流量監視基礎研修 3. 配水流量監視 OJT ➢ 配水流量監視・記録 ➢ 夜間最少流量分析 ➢ 配水監視システム操作 ➢ 配水流量分析 ➢ 配水施設維持管理（漏水調査）	配水課 10 名	日本人専門家 1 名×2.03 P/M（61 日） 第 1 回（0.60 P/M：18 日） 配水流量監視基礎研修 給水接続工事基礎研修 SOP 改訂指導 第 2 回（0.80 P/M：24 日） 配水流量監視研修 給水接続工事研修 SOP 改訂指導 第 3 回（0.63 P/M：19 日） レビュー フォローアップ研修 SOP 改訂指導 現地技術者 1 名×0.17 P/M（5 日） 現地スタッフ 1 名×1.79 P/M（54 日）
	(4) 給水接続工事の施工管理体制が強化される	1. 施工管理体制の検討 2. 給水接続工事手順の検討 3. 給水接続工事 OJT ➢ 給水接続工事 ➢ 施工管理	営業課 5 名 (課長、副課長、給水接続担当 3 名)	
	(7) SOP が改訂・作成される	1. SOP 改訂・作成支援 ➢ 配水流量監視 ➢ 給水接続工事	配水課 10 名 営業課 5 名 (課長、副課長、給水接続担当 3 名)	

分野	成果	活動内容	対象者	必要な投入量
生産管理	(5) 生産管理に係る能力が向上する	1. 効率的な施設の運用方法の立案 2. 汚泥処理計画の作成 3. 生産管理 OJT ➢ 原単位計算 ➢ 給水収益・コスト ➢ 浄水場運用 ➢ 在庫管理 ➢ 汚泥処理 ➢ 全体的な SOP 運用	9 名 (局長、副局長、各課長) 汚泥処理は浄水課 23 名	日本人専門家 1 名×1.43 P/M（43 日） 第 2 回（0.80 P/M：24 日） 浄水場運用研修 汚泥処理研修 給水接続促進研修 SOP 作成指導 第 3 回（0.63 P/M：19 日） レビュー フォローアップ研修 SOP 作成指導 現地スタッフ 浄水施設運転維持管理と配水施設運転維持管理と共同で投入
	(6) 給水接続の申し込み促進に係る活動が実施される	1. 啓発資料作成に係る支援 2. 啓発活動に係る支援		
	(7) SOP が改訂・作成される	1. SOP 作成支援 ➢ 効率的な施設の運用 ➢ 汚泥処理		

出典：JICA 調査団

表 5-1 に記載した活動に係る各分野の具体的な研修内容、投入日数などの業務計画（案）について、表 5-2 に示す。

表 5-2　業務計画（案）

分野		研修内容	準備/準備	1 Sun	2 Mon	3 Tue	4 Wed	5 Thu	6 Fri	7 Sat	8 Sun	9 Mon	10 Tue	11 Wed	12 Thu	13 Fri	14 Sat	15 Sun	16 Mon	17 Tue	18 Wed	19 Thu	20 Fri	21 Sat	22 Sun	23 Mon	24 Tue	合計 P/D	合計 P/M
浄水施設運転維持管理	第1回	渡航（日本⇔カンボジア）																										
		協議、研修資料作成、報告書作成、国内移動など																										
		運転維持管理基礎研修（講義） 浄水処理システム全体 沈殿池の基礎、役割 ろ過池の基礎、役割 薬注の基礎、役割 単位換算、濃度計算、薬品注入量・注入率 機械・電気設備の基礎、役割 機械・電気設備の保守点検方法																										
		水質試験基礎研修（講義） 水質試験項目全体 ジャーテストの方法																										
		リソース 日本人専門家																									18	0.60
		リソース 現地技術者																									0	0.00
		リソース 現地スタッフ	1日																								16	0.53

分野		研修内容	事前準備	1 Sun	2 Mon	3 Tue	4 Wed	5 Thu	6 Fri	7 Sat	8 Sun	9 Mon	10 Tue	11 Wed	12 Thu	13 Fri	14 Sat	15 Sun	16 Mon	17 Tue	18 Wed	19 Thu	20 Fri	21 Sat	22 Sun	23 Mon	24 Tue	合計 P/D	合計 P/M
浄水施設運転維持管理	第2回	渡航（日本⇔カンボジア）																											
		協議、研修資料作成、報告書作成、国内移動など																											
		第1回の復習（講義）																											
		運転維持管理																											
		水質試験																											
		運転維持管理研修（OJT）																											
		沈殿池・ろ過池の運用、洗浄																											
		薬品の溶解、保管方法																											
		機械・電気設備の保守点検																											
		機械・電気設備の点検計画																											
		水質試験研修（OJT）																											
		水質試験、ジャーテスト																											
		現地技術者を活用した研修																											
		浄水処理（沈殿池、ろ過池、薬注など）																											
		機械・電気設備保守点検（ポンプなど）																											
		水質試験、ジャーテスト																											
		SOP改訂・作成指導																											
		浄水施設運転維持管理、水質試験																											
		リソース 日本人専門家																										24	0.80
		リソース 現地技術者																										5	0.17
		リソース 現地スタッフ	1日																									22	0.73
	第3回	渡航（日本⇔カンボジア）																											
		協議、研修資料作成、報告書作成、国内移動など																											
		運用レビュー																											
		運転維持管理																											
		水質試験																											
		運転維持管理フォローアップ研修																											
		ろ過池維持管理（砂層厚測定、性能検査）																											
		浄水処理に関する課題抽出と対策																											
		機械・電気設備の故障対応																											
		水質試験フォローアップ研修																											
		水質試験の課題抽出と対策																											
		SOP改訂・作成指導																											
		浄水施設運転維持管理、水質試験																											
		リソース 日本人専門家																										19	0.63
		リソース 現地技術者																										0	0.00
		リソース 現地スタッフ																										16	0.53
配水施設運転維持管理	第1回	渡航（日本⇔カンボジア）																											
		協議、研修資料作成、報告書作成、国内移動など																											
		配水流量監視基礎研修（講義）																											
		配水システム全体																											
		流量・水圧データの記録、分析方法																											
		配水監視システム（構成、機能など）																											
		給水接続工事基礎研修																											
		現在の工事の確認（施工、記録など）																											
		現地技術者を活用した研修																											
		配水ポンプの運転維持管理																											
		配水監視システム操作、維持管理																											
		流量分析																											
		漏水防止																											
		リソース 日本人専門家																										18	0.60
		リソース 現地技術者																										5	0.17
		リソース 現地スタッフ	1日																									16	0.53
	第2回	渡航（日本⇔カンボジア）																											
		協議、研修資料作成、報告書作成、国内移動など																											
		第1回の復習（講義）																											
		配水流量監視																											
		給水接続工事																											
		配水流量監視研修（OJT）																											
		運転維持管理（ポンプ、管路など）、点検計画																											
		流量・水圧監視、記録、分析																											
		配水監視システム操作、維持管理																											
		給水接続工事研修（OJT）																											
		工事手順																											
		施工管理																											
		SOP改訂・作成指導																											
		配水流量監視、給水接続工事																											
		リソース 日本人専門家																										24	0.80
		リソース 現地技術者																										0	0.00
		リソース 現地スタッフ	1日																									22	0.73
	第3回	渡航（日本⇔カンボジア）																											
		協議、研修資料作成、報告書作成、国内移動など																											
		運用レビュー																											
		配水流量監視																											
		給水接続工事																											
		配水流量監視フォローアップ研修																											
		運転維持管理に関する課題抽出と対策																											
		流量・水圧監視、記録、分析の課題抽出と対策																											
		配水監視システムに関する課題抽出と対策																											
		給水接続工事フォローアップ研修																											
		工事手順・施工管理の課題抽出と対策																											
		SOP改訂・作成指導																											
		配水流量監視、給水接続工事																											
		リソース 日本人専門家																										19	0.63
		リソース 現地技術者																										0	0.00
		リソース 現地スタッフ																										16	0.53

分野	研修内容		事前準備	1 Sun	2 Mon	3 Tue	4 Wed	5 Thu	6 Fri	7 Sat	8 Sun	9 Mon	10 Tue	11 Wed	12 Thu	13 Fri	14 Sat	15 Sun	16 Mon	17 Tue	18 Wed	19 Thu	20 Fri	21 Sat	22 Sun	23 Mon	24 Tue	合計 P/D	合計 P/M
生産管理	第2回	渡航（日本⇔カンボジア）																										
		協議、研修資料作成、報告書作成、国内移動など																										
		浄水場運用研修（講義、OJT）																										
		複数の浄水場の運用（取水～配水）																										
		原単位計算																										
		薬品在庫管理の重要性、役割																										
		薬品リスト、発注方法の確認																										
		事故・異常時における対策																										
		汚泥処理（講義、OJT）																										
		汚泥処理システム全体																										
		天日乾燥床の基礎、役割																										
		汚泥処理・搬出計画																										
		給水接続促進研修（講義、OJT）																										
		啓発活動の資料作成支援																										
		啓発活動の企画																										
		SOP改訂・作成指導																										
		効率的な施設運用、汚泥処理																										
		リソース 日本人専門家																									24	0.80
		リソース 現地技術者																									0	0.00
		リソース 現地スタッフ	浄水施設運転維持管理と配水施設運転維持管理と共同で投入する																								0	0.00
	第3回	渡航（日本⇔カンボジア）																										
		協議、研修資料作成、報告書作成、国内移動など																										
		運用レビュー																										
		生産管理																										
		給水接続の申し込みの促進																										
		浄水場運用フォローアップ研修																										
		効率的な施設運用に関する課題抽出と対策																										
		SOPの運用と管理																										
		汚泥処理フォローアップ研修																										
		汚泥処理の課題抽出と対策																										
		給水接続促進フォローアップ研修																										
		啓発活動の支援																										
		SOP改訂・作成指導																										
		効率的な施設運用、汚泥処理																										
		リソース 日本人専門家																									19	0.63
		リソース 現地技術者																									0	0.00
		リソース 現地スタッフ	浄水施設運転維持管理と配水施設運転維持管理と共同で投入する																								0	0.00

6　ソフトコンポーネントの実施リソースの調達方法

本ソフトコンポーネント実施にあたり、配置が想定される実施リソースを以下に示す。

(1)　日本人専門家

浄水施設運転維持管理、配水施設運転維持管理、生産管理のそれぞれに、水道事業運営や水道施設の運転維持管理に精通している日本の水道事業体の専門家を投入するものとする。

(2)　現地技術者

プノンペン水道公社（Phnom Penh Water Supply Authority：PPWSA）は、浄水場の運転維持管理においてカンボジアでも特に豊富な経験を有している。配水施設の維持管理においても、直送式の送水ポンプを使用していることに加え、配水流量監視システムを活用した無収水対策を実施しており、これまでも多くのプロジェクトで技術者を他都市に派遣してきた。その他の地方公営水道局も PPWSA と同様、人材育成プロジェクトで育成された人材をその他の都市に専門家として派遣するなどしていることから、本ソフトコンポーネントにおいても、PPWSA や地方公営水道局の職員を現地技術者として活用する。その他、工業科学技術革新省（Ministry of Industry, Science, Technology and Innovation : MISTI）の協力を仰ぎ、本プロジェクトと同規模の地方公営水道局の浄水場視察等を行うことを検討する。

また、給水接続の促進に関しては、他都市での実績を確認し、活用可能なローカルリソースがあれば活用するものとする。

7　ソフトコンポーネントの実施工程案

本ソフトコンポーネントの実施工程案を図 7-1 に示す。

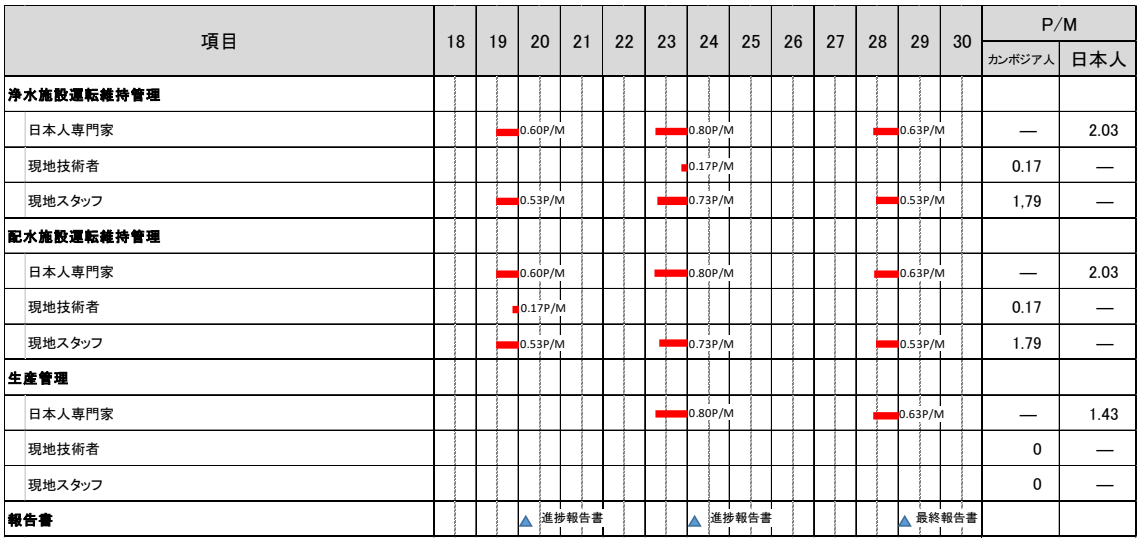


図 7-1　実施工程案

出典：JICA 調査団

8　ソフトコンポーネントの成果品

本ソフトコンポーネントの成果品は、表 8-1 に示す。

表 8-1　ソフトコンポーネント成果品

提出時期	成果品
第 1 回投入 完了時（21 延月）	ソフトコンポーネント進捗状況報告書 研修資料（実施分） その他活動と関連する資料
第 2 回投入 完了時（25 延月）	ソフトコンポーネント進捗状況報告書 研修資料（実施分） その他活動と関連する資料
第 3 回投入 完了時（30 延月）	ソフトコンポーネント完了報告書 研修資料 各種 SOP（浄水施設・配水施設・生産管理） 各種記録フォーマット（運転記録簿） 成果の達成度・評価（モニタリングシート）

出典：JICA 調査団

報告書の記載要領は「ソフトコンポーネントガイドライン（第 4 版）」（2020 年 11 月）に準じるものとする。

また、成果物は「水安全計画策定ガイドライン・厚生労働省健康局水道課」（2008 年 5 月）の趣旨に沿い、取水から給水装置に至る統合的な管理に資するよう取りまとめるものとする。

9　ソフトコンポーネントの概略事業費

本ソフトコンポーネントの投入は、各分野において必要な研修期間を集計した結果、浄水施設運転維持管理専門家 2.03P/M、配水施設運転維持管理専門家 2.03P/M、生産管理専門家 1.43P/M の合計 5.49P/M、現地技術者の活用は 2 名合計 0.34P/M、通訳/支援の現地スタッフは合計 3.58P/M となった。

概略事業費は表 9-1 に示すとおりである。

表 9-1　ソフトコンポーネント概略事業費

項目	日本円（千円）	現地貨		第三国		合計（千円）
		現地貨 (USD)	円換算（千円）	第三国 (USD)	円換算（千円）	
直接人件費	4,458	0	0	0	0	4,458
直接経費	3,476	11,237	1,236	0	0	4,712
間接費	9,272	0	0	0	0	9,272
合計	17,206	11,237	1,236	0	0	18,442

出典：JICA 調査団

10　相手国側実施機関の責務

本ソフトコンポーネントは、スバイリエン水道局が新しい施設を速やかに、適切に運用していくために必要な技術指導を行うものであり、実際の運用に必要な人員の確保と適切な職員配置はカンボジア国側で実施されるべき事項である。表１０－１に必要と考える要員計画を示す。2021 年時点の職員数は 35 名であり、2027 年までに順次増員する計画とする。特にソフトコンポーネントの対象となる浄水課、配水課、営業課の職員配置は、新規職員に対する水道局による職員教育も含めて、ソフトコンポーネント実施前までに完了していることが必要である。それまでに新規職員の配置が難しい場合は、新しい浄水場の運転に携わる現職員を対象としたソフトコンポーネントを実施することとし、新規職員が配置された時点で、現職員より研修を実施することとする。

表 10-1　要員計画

	2019	2020	2021	2022	2023	2024	2025	2026	2027
浄水課	9	9	12	15	18	23	23	23	23
配水課	4	4	5	5	7	10	10	10	10
営業課	7	8	8	8	9	11	11	11	12
経理・財務課	4	4	4	4	4	5	5	5	5
総務課	2	2	2	2	2	3	3	3	3
局長・副局長	4	4	4	4	4	4	4	4	4
合計	30	31	35	38	44	56	56	56	57

※暦年は建設工事における試運転・調整が 2025 年 5 月に完了する場合を想定。

出典：JICA 調査団

11　技術協力プロジェクトとの連携・成果の活用

2007 年から実施されているカンボジア国水道事業人材育成プロジェクト（フェーズ 2 及び 3）において、浄水処理、水質管理、電気設備、機械設備、配水施設に係る SOP が作成されており、スバイリエン水道局でも運用されている。本プロジェクトによるソフトコンポーネントでは、既存の SOP を活用し、新しい施設に合わせた形で改訂・作成するものとする。現地技術者については、同人材育成プロジェクトで育成した人材から相応しい人材を選定し活用するものとする。

また、本ソフトコンポーネントの実施に当たっては、2018 年から開始されている MISTI の水道総局を対象とするカンボジア国水道行政管理能力向上プロジェクトと本ソフトコンポーネント計画書を共有し、双方の活動が重複しないよう配慮するものとする。

6. 参考資料（収集資料リスト）

番号	資料	形態 図書・ビデオ 地図・写真	オリジナル・コピー	発行機関または入手元	発行年
1	National Institute of Statistics 1998	ハードコピー	コピー	MOP	1999
2	National Institute of Statistics 2008	ハードコピー	コピー	MOP	2009
3	National Institute of Statistics 2013	ハードコピー	コピー	MOP	2014
4	スバイリエン人口（ビレッジ単位）	Excel	コピー	スバイリエン水道局	2010-2019
5	PROVINCIAL TOWNS IMPROVEMENT PROJECT, PART B CONTRACT NO. ICB/PTIP/AB/002 FOR CONSTRUCTION OF WATER SUPPLY SYSTEMS IN BATTAMBANG, PURSAT, KOMPONG CHAM, KOMPONG THOM, KAMPOT AND SVAY RIENG	ハードコピー	コピー	MISTI	2007
6	スバイリエン処理能力増強工事資料	ハードコピー	コピー	スバイリエン水道局	2017
7	スバイリエン水道局配水量データ	エクセル	コピー	スバイリエン水道局	2010-2019
8	スバイリエン水道局水質データ	エクセル	コピー	スバイリエン水道局	2010-2019
9	給水関連資材予算	ハードコピー	コピー	スバイリエン水道局	2016-2019
10	標準管路布設位置図	ハードコピー	コピー	スバイリエン DPWT	不明
11	標準舗装等構成図	ハードコピー	コピー	スバイリエン DPWT	不明
12	スバイリエン既存管網図	ハードコピー及び CAD	コピー	スバイリエン水道局	不明
13	配水圧測定データ	ハードコピー	コピー	スバイリエン水道局	2019
14	時間別ポンプ運転マニュアル	ハードコピー	コピー	スバイリエン水道局	2019
15	プルサット水道局 組織図/職務規定	ハードコピー	コピー	スバイリエン水道局	2019
16	各種作業報告書	ハードコピー	コピー	スバイリエン水道局	2019
17	スバイリエン水道局 資産データ	Excel	コピー	スバイリエン水道局	2016-2019
18	スバイリエン水道局バランスシート	Excel	コピー	スバイリエン水道局	2016-2019
19	Sub Decree-MoE-07-on Biodiversity Conservation Corridor of Natural Protected Area	ハードコピー	コピー	MOE	2017
20	Water Resources Management Sector Development Program ADB Loan 2673- CAM and TA7610-CAM CAMBODIAN RESOURCES PROFILE	ハードコピー	コピー	ADB	2014
21	TA6456-REG: Preparing The Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project, Irrigation Engineer report	ハードコピー	コピー	ADB	2012

番号	資料	形態 図書・ビデオ 地図・写真	オリジナル・ コピー	発行機関または入手元	発行年
22	降水量データ	ハードコピー	コピー	MOWRAM	2000-2019
23	河川水位データ	ハードコピー	コピー	MOWRAM	2000-2019
24	カンボジア労働法	Word	コピー	MLVC	1997

7. その他資料・情報

7-1 テクニカルノート

テクニカルノート協議の写しを次頁以降に示す。

(1) Minutes of Discussions on the Preparatory Survey for the Project for Explanation of Water Supply System in Svay Rieng in the Kingdom of Cambodia （2019 年 12 月 18 日署名）

TECHNICAL NOTES
ON
THE PREPARATORY SURVEY ON THE PROJECT
FOR EXPANSION OF WATER SUPPLY SYSTEM
IN PURSAT AND SVAY RIENG
IN THE KINGDOM OF CAMBODIA

Based on the Minutes of Discussions (hereinafter referred to as "M/D") on the Preparatory Survey on the Project For Expansion of Water Supply System in Pursat and Svay Rieng in the Kingdom of Cambodia (hereinafter referred to as "the Project") signed on August 24th, 2017 between Japan International Cooperation Agency (hereinafter referred to as "JICA") and Ministry of Industry and Handicraft (hereinafter referred to as "MIH"), of the Government of Cambodia, the consultant members of the JICA Preparatory Survey Team (hereinafter referred to as "the Team") had a series of discussions and conducted field surveys from November 5th and will continue until December 22th, 2019.

As a result of the discussions and the surveys, both sides (MIH and the Team) confirmed the technical conditions described in the attached sheets of this note.

It should be noted that this technical note does not mean the commitment of the project scope, project implementation, design and method to be implemented. The final project scope, project implementation, designs, etc. will be decided by the Government of Japan.

Phnom Penh, December 18th, 2019

H.E. Mr. YEA Bunna	Mr. Hideki KONNO
Director General	Chief Consultant
General Department of Potable Water Supply	Preparatory Survey Team
Ministry of Industry and Handicraft (MIH)	Japan International Cooperation Agency (JICA)

ATTACHMENT

Both sides agreed upon and confirmed the following items.

1. Intake Site in the Vay Kor Lake

The Team explained the candidate intake sites in the Vay Kor Lake (refer to **Figure A1-1**). As the result of discussion on technical note meeting in 17th July 2017, the most recommendable intake site is at the north side of the road dike of National Road No.1 (NR1) beside the existing bridge in the Vay Kor Lake (Site No.2). The main reasons are 1) Close distance to water surface, and 2) Enough depth during the dry season under proper management of surface water resources of the Lake.

The other candidate sites are not suitable as the intake site because of shallow water depth or located in environmental protection area.

MIH, Svay Rieng Waterworks and the Team agreed to have the meeting with Svay Rieng Provincial Hall to explain the details of the Project including intake facility.

2. Site for New Water Treatment Plant (WTP) for Svay Rieng

Regarding the selection of new WTP site in Svay Rieng, the Team made an evaluation from three candidate sites, proposed by the Cambodian Side (refer to **Figure A2-1**).

As a result of discussion among the MIH, Svay Rieng provincial waterworks and the Team, site No.01 was selected as a candidate location for new WTP. The reason of selection of site No.01 is 1) the area is enough space to plan the proposed scale of new WTP, 2) the location is within the proposed water supply area, and 3) the land acquisition contract with the landowner has been completed.

3. Intake Facilities

The Team recommended to adopt horizontal end suction pump because of easier maintenance and less consumable parts comparing to vertical mixed flow pump. MIH requested the Team to adopt horizontal pump type as intake pumps.

With reference to the method of abstracting water from Vay Kor Lake, the Team recommended the suction pipe type as shown on the **Figure A3-1** because it is easy to clean out the sediment in the intake suction pit by the submersible sand pumps and it is possible to take the suspended matter by bar screen installed at inlet. The garbage on the screen is collected manually. The outline specification for intake facility is shown in **Table A3-1**.

Cambodian side requested to the Team that the design of intake facility should be aesthetic to fit the environment because the location is promoted as photo tourism.

4. Layout of WTP

The land for new WTP was prepared by the Cambodian Side (MIH, Svay Rieng DIH and Svay Rieng Waterworks) (refer to **Figure A4-1**). MIH, Svay Rieng Waterworks and the Team discussed about layout and design condition of new WTP (refer to **Figure A4-2** and **Table A4-1**).

The Team explained that the embankment of new WTP site to + 5.2m shall be conducted by Cambodian

side. The planed ground level is set with the consideration of flood level which is +4.4m near Vay Kor Lake. Since existing ground level of new WTP site is around +4.4m, the amount of earth filling is about 0.8m height. And in case the surface soil is soft and that does not have enough strength by the result of the geological survey, certain thickness soil shall be replaced with required quality soil. In addition, the Team requested that the trees in the new WTP site shall be cut down before the embankment work.

Svay Rieng Waterworks requested to the Team to consider the layout, 1) Drying bed should be placed far from main entrance, 2) To have two entrance gates for main gate and back side, 3) To place the location of chemical building near administrative building. Therefore, Cambodian side requested to the team to re-study and consider the layout again to ensure the land using efficiency.

5. Supply Area and Distribution System

The Team explained about alternatives of water supply area shown in **Figure A5-1**. MIH and the Team agreed on the future supply area shown in **Figure A5-1, Alternative Case 4** with the WTP capacity of 6,600m^3. The water supply area will cover 41 Villages, 8 Communes in 2 Districts. In addition, MIH strongly requested to the Team to consider maximize the capacity of WTP within the Project budget.

The supply area was comprehensively decided in terms of the piped water supply service ratios in the area, especially in the urban area, investment efficiency and sustainability of water supply operation, based on the results of the preliminary studies including case setting of the study area, estimation of increased served population and increased maximum daily supply in the area, preliminary design of whole water supply facilities, cost estimation for initial construction, renewal, operation and maintenance.

The Team explained the design policy (draft) as shown in **Annex-6** to Cambodian side (MIH, Svay Rieng DIH and Svay Rieng provincial waterworks), and Cambodian side agreed the design policy. The Team explained the alternative concept of the distribution system in Svay Rieng as shown in **Table A6-4**.

- Alternative (A) : Distribution pumps with flow control directly distribute water to the service area.
- Alternative (B) : Distribution pumps directly distribute water to the service area and also send water to elevated tank to regulate the distribution flow or control water pressure in the service area.

Cambodian side agreed on Alternative (A).

6. Demand Projection

MIH and the Team agreed to set the target year of the Project in 2026, which is 3 years after the expected completion of the Project. The Team explained that the design service ratio on this Project will be about 86.7% for urban area (for the Pursat Project is 86.1%). The definition of urban area is based on the "Reclassification of Urban Areas in Cambodia, 2011 by National Institute of Statistics, Ministry of Planning".

The Team explained other factors for the demand projection as below;

- Future population is based on the following information.
  - Village Population data between 2010 to 2019 from Svay Rieng Waterworks.
  - Village Population data from the study result of JICA technical assistance project "The Project on Capacity Building for Water Supply System Phase 3 in Cambodia"

- Water supply areas of Svay Rieng in the target year are 8 communes in 2 districts shall be set as proposed water supply area.
- Per Capita Consumption per day in the target year is set as 135L in existing supply area and 115L in new supply area based on the record from Svay Rieng Waterworks during 2010 to 2019.
- Percentage of domestic water consumption is set to 80% based on the record from 2015 to 2019.
- Non-revenue water ratio is set to 15% based on the ministerial ordinance of the MIH. Leakage ratio is set to 11.3% which is 75% of non-revenue water ratio based on past experience of similar projects.
- Daily maximum water supply is set as 1.33 based on the record of load factor from 2016 to 2019.
- Based on the demand projection, required daily maximum water supply amount in the target year 2026 is calculated as approx. 13,160m^3/day. On the other hand, the capacity of existing WTP is 4,560 m^3/day. Therefore, the lack of water treatment capacity in the target year is estimated as approx. 8,600 m^3/day. The Team explained that the WTP capacity is supposed to be about 6,600m^3/day that is same scale as the Pursat Project. MIH agreed that the remaining capacity shall be borne by Cambodian side. MIH requested to the Team to provide the new WTP whose capacity will cover the above lack of capacity of existing WTP as much as possible.

7. Social and Environmental Considerations

MIH agreed to play the main role of conducting Initial Environmental Impacts Assessment (IEIA) and Public Hearing. Both sides (MIH and the Team) agreed that the IEIA report should be prepared by the firm which has the license of Ministry of Environment. Both sides confirmed that the resettlement would not occur in the project implementation. Both sides agreed that the temporally land for construction and permanent land for sludge damping would be prepared by Svay Rieng Waterworks.

8. Measures for UXO

Cambodian side (MIH, Svay Rieng DIH and Svay Rieng Waterworks) promises to enhance the process of landmine and UXO survey at the proposed site for intake and WTP.

9. Land Acquisition by Cambodian Side

Cambodian side (MIH, Svay Rieng Provincial Hall and Svay Rieng Waterworks) promises to facilitate to acquire the permission for the land of intake facility.

10. Securing of Water Intake Permission

The intake permission has already got from Ministry of Water Resources and Meteorology (MOWRAM) in 30th August 2017.

11. Soft Component

Regarding the operation and maintenance management and production management of the WTP, the treatment system is different from the existing WTP because the new WTP is a rapid filtration system. Regarding distribution facility operation and maintenance, a water distribution management system will be newly introduced, and it will be possible to monitor the amount of water and pressure at the WTP. These

points need to be educated and trained regardless of the current staff and the newly hired staff.
Cambodian side (MIH) requested to the Team that the training material shall be easy for all staff and also conduct TOT (Training of Trainers) for sustainable operation.

12. Confirmation of the Request

Cambodian side (MIH, Svay Rieng DIH and Svay Rieng Waterworks) requested the following items to be procured under this Project.
Both sides agreed that the equipment of water quality should be minimized quantity because there is already one equipment set in existing WTP, the equipment which can be shared in both WTP dose not need to be procured in this Project.

Item		Contents
Equipment	Water quality analyzer	Distillation apparatus, Microscope, Reagents, Glassware, pH meter, Turbidity meter, UPS, Jar Tester, Residual Chlorine meter, Conductivity meter, Spectrophotometer, Refrigerator (for reagent)
	Maintenance tools of Electrical and Mechanical	Power tester, Vibration checker, Torque Wrench, Handy Flow Meter, Filtration Sand Tester
	Accounting system	SUMS System
	Distribution management tools	Pipe laying (socket fusion)

13. Schedule of the Project

The project schedule for expansion of water supply system in Svay Rieng is as follows:

Item	2019			2020									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Preparation in Japan														
Field Survey in Cambodia														
Analysis in Japan														
Briefing Outline Design to Cambodian Side														
Submission of Preparatory Survey Report														Δ
Key Meetings with Cambodian Side		Δ Inception	Δ Technical Note								Δ Draft F/R			

14. Others

- The Team explained major undertakings to be taken by the Recipient Government such as securing permission from related ministries for construction of facilities, connection of water service pipe and meters, securing of access road for construction, drawing of electricity line, proper operation and maintenance of facilities and various tax exemption to purchase of the products and/or the services.
- As for the individual house connection for poor households, necessity of provision of the materials such as water meters, fittings and pipes in the Project will be examined in consideration of similar

projects. MIH and the Team confirmed that MIH will bear the cost for installation works.

- The team asked MIH to obtain a letter indicating that MoWRAM will perform reliable maintenance of Vay Kor Dam to ensure the water level required for stable water intake. MIH agreed to consult with MOWRAM on this issue and will confirm the team.
- Svay Rieng Waterworks proposed temporary yard in Svay Rieng for the Project as shown in **Figure A7-1**. If the site is not available during the construction stage of the Project, the Cambodian side should prepare alternative sites which are at least same size of proposed site.
- Svay Rieng Waterworks proposed disposal area in Svay Rieng for the Project as shown in **Figure A7-1**. However, it is too small as disposal area. Therefore, the Cambodian side should prepare alternative site which is at least 1 ha or more. Cambodian side took this issue into consideration and will confirm the team.
- Svay Rieng Waterworks shall lease a land during construction stage for temporary construction road next to new WTP site as shown in **Figure A7-2**. Cambodian side took note on this issue; however, Cambodian side and the team will go to the site to check whether a better alternative access road to new WTP exists or not. Location of temporary yards and dump sites in Svay Rieng is shown in **Annex-7**.

No	Purpose of use	Size	Area
1	Temporary Yard	80m x 200m	1.6ha
2	Dump Site	50m x 20m	0.1ha

- The items to be processed by Cambodian Side before tender stage is shown in below table.

Items to be processed by Cambodian Side for Svay Rieng Project (before tender stage)

No.	Contents	Timeline	
		Pursat	Svay Rieng
1	Information as for Future plan of Vay Kor Dam		**Mid of January, 2020**
2	UXO survey in OD stage	Complete in October, 2017	**Mid of January, 2020**
3	Acquisition of letter from MoWRAM for reliable O&M of Vay Kor Dam		Mid of August, 2020
4	Approval of IEIA	**Late of January, 2020**	Late of January, 2021
5	Land acquisition for temporary yard and dump site	End of June 2020	End of June 2021
6	Construction permission from related agencies	End of June 2020	End of June 2021
7	Land acquisition for construction site	End of June 2020	End of June 2021
8	UXO survey in DD stage	End of June 2020	End of June 2021
9	Preparation of Project Monitoring Report	End of June 2020	End of June 2021

*Note: The items of **bold letter** need to be processed within 3 months.*

Annex-1 Intake and WTP Site in Svay Rieng

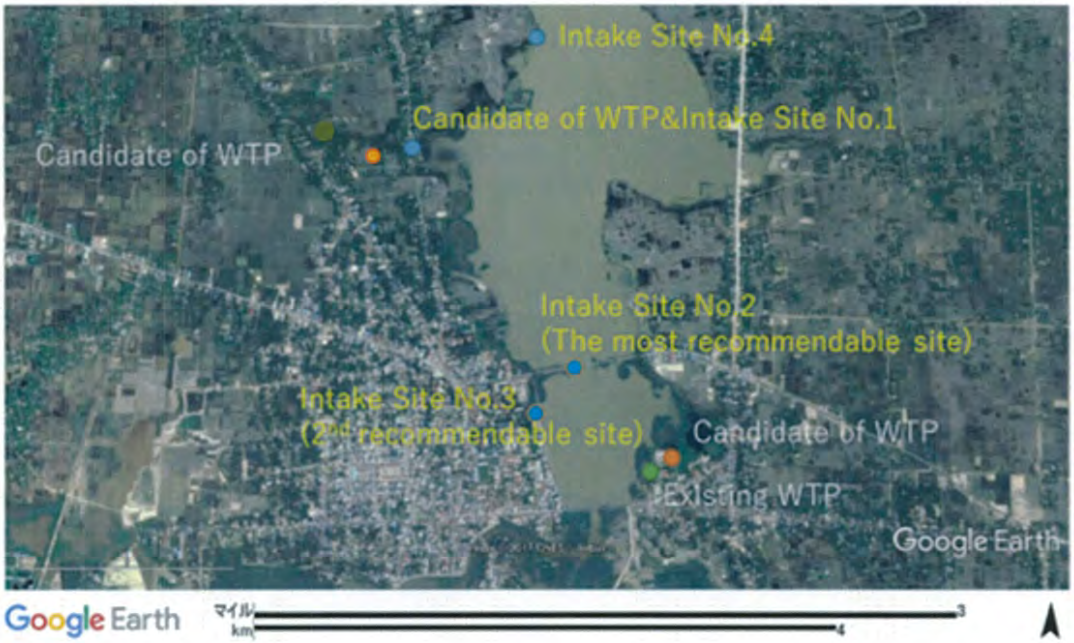


Figure A1-1 Candidate Intake Site in Svay Rieng

Table A1-1 Assessment of the Candidate Intake Sites for Svay Rieng

Site No.	Km upstream from Vay Kor Dam	Water Surface from Bank in Dry Season	Water Depth	Inundation Floods	Environmental Protection Area	Site Suitability for Intake
No.1	About 2.6km at right bank	Long distance with about 300 to 400m from the bank	Shallow	Bank is almost equal to the max. WL of 2011 Flood	N/A	Not suitable
No.2	1.0km at right bank and upstream side beside the NR1 Bridge	Near within about 10 to 20m from the road dike of NR1	Enough	No inundation. Max. WL during 2011 Flood was about 0.5m below the shoulder of the road cum dike.	N/A	Suitable and the most recommendable site with facing bigger lake area in northern side.
No.3	760m at right bank along the road cum dike between Vay Kor Dam and NR1	Near within about 20 to 30m from the bank	Enough	No inundation. Max. WL during 2011 Flood was about 0.1 to 0.3m below the shoulder of the road cum dike.	Applicable	Not suitable
No.4	About 3.5km at right bank	Long distance with about 100m from the bank. Only small access road, which car cannot enter. No electricity lines.	Shallow	Bank is almost equal to the max. WL of 2011 Flood	N/A	Not suitable

Annex-2 Candidate Site for New WTP

Three candidate sites for a new WTP in Svay Rieng were proposed by the Cambodian Side as shown in Figure A2-1.

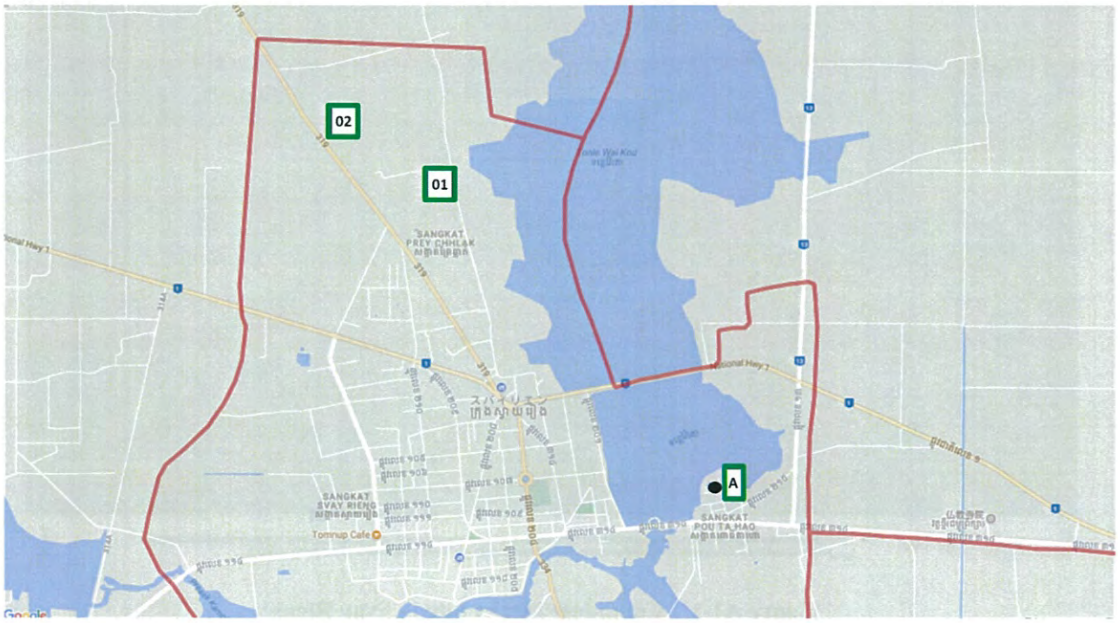


Figure A2-1 Candidate Site for New WTP in Svay Rieng

Annex-3 Intake Facility

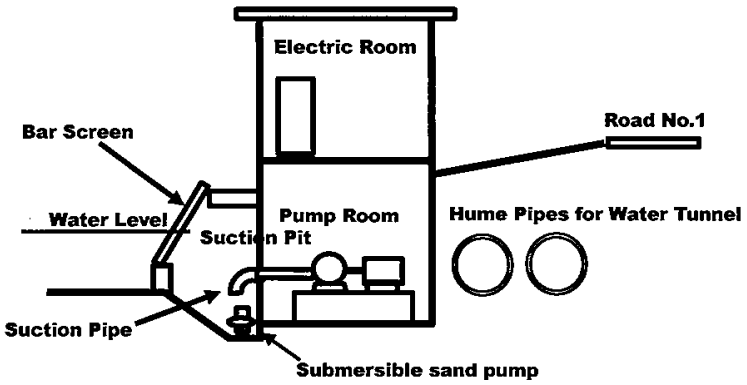


Figure A3-1 Intake Pump Station

Table A3-1 Outline Specification for Intake Facility

No.	Item	Specification
Mechanical		
1	Standards	ISO, IEC, JIS, JEC
2	Pump type	Horizontal, end suction volute pump
3	Number of pumps	2-duty pump +1-standby
4	Pump discharge capacity	7260m3/D, @3630m3/D (2.52m3/min)
5	Pump head and motor kW	18.5m, 18.5kW
6	Flow control system	Pump number control by manual from WTP and local
7	Intake type	Suction pipe type (Figure A3-1)
8	Counter measure of water hammer	Flywheel type
9	Discharge method of sand in pit	By submersible sand pump
10	Crane type	Manual type, overhead crane
11	Intake screen	Steel bar screen, 16mm clear space
12	Sand discharge	To Vay Kor lake
Electrical		
1	Standards	ISO, IEC, JIS, JEC
2	Monitoring items transmitted to WTP	- Integrate trouble - River side and pump pit water levels - ON/OFF of each pump - Grid/DG power source
3	Control item from WTP	- Start/Stop of each pump
4	Signal transmission method	IP leased line
5	Substation	22/0.38kV from EDC power line Received on site of pump station
6	Level meters	4-20mA signal, installed river and pump pit
7	Emergency diesel generator	- 100% capacity for all lords in intake pump station - Fuel tank capacity for 10 hours
8	Power factor	Improved to 0.95

Annex-4 Location and Layout of New WTP in Svay Rieng

Figure A4-1 Location of New WTP

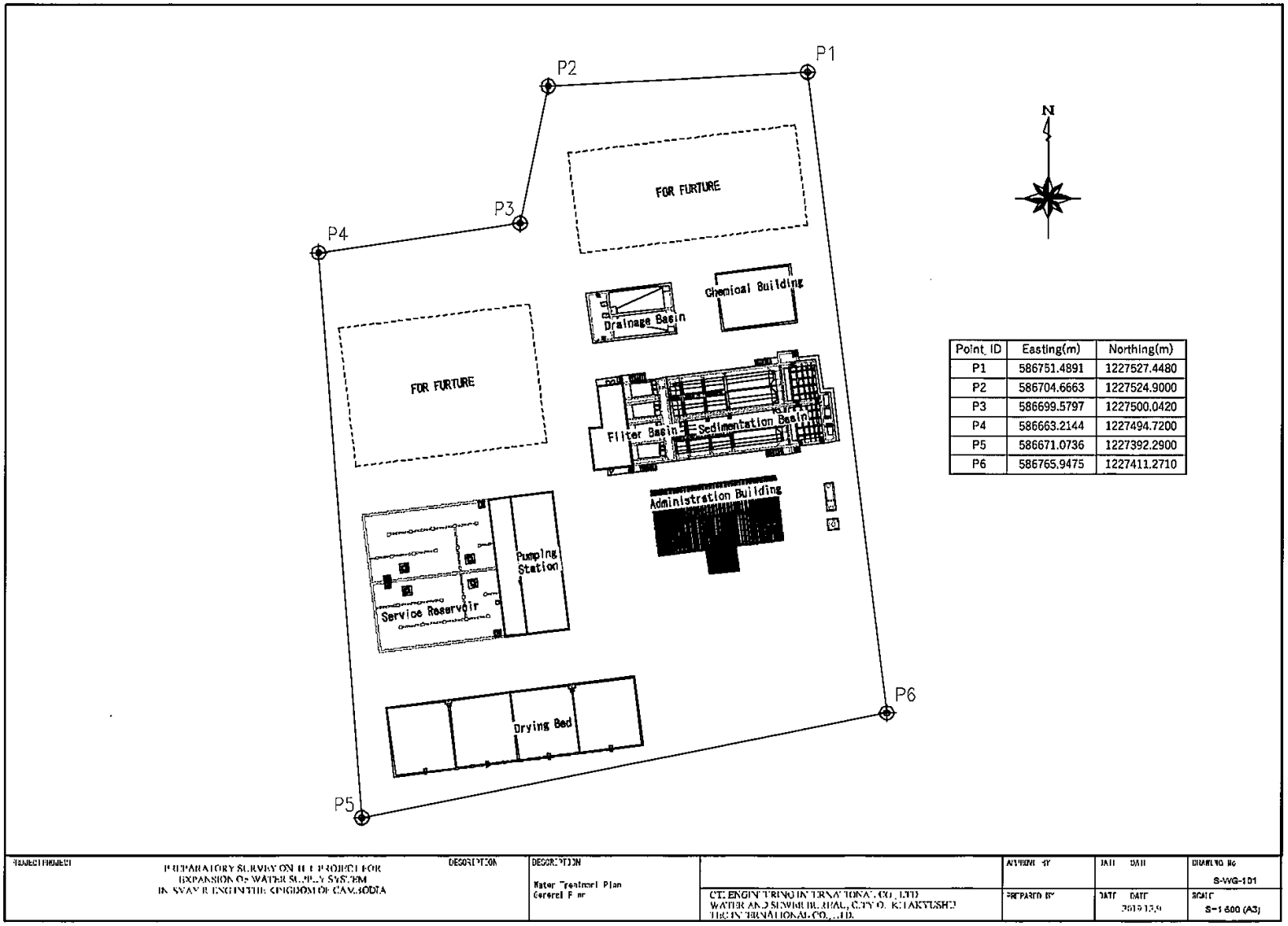


Figure A4-2 Layout of New WTP (one of the alternative layouts)

Table A4-1 Design Condition of New WTP

Name of Equipment & Facilities, etc.	Design criteria applied to the project			Reference		
				Japanese Design Criteria	Example of similar projects in Cambodia	Request
Civil Architectural Mechanical Electrical						
Raw Water			Vay Kor Laker	Well, River, Lake, Pond	River	River
Selection of water treatment methods and water treatment facilities	Selection of water treatment methods and water treatment facilities	Selection of water treatment methods	Rapid sand filtration method	>Disinfection only >Slow sand filtration method >Rapid sand filtration method >Membrane filtration method >Advanced treatment method >Other treatment method	Rapid sand filtration method	
	Wastewater treatment	Sludge treatment type (Sludge of Sedimentation Basin)	Drying bed>>To carry out the dried sludge cake and dispose of it.	>Drying bed >Machine dehydrator >Dehydrating thermal dry	Drying bed >>To carry out the dried sludge cake and its dispose.	
		Wastewater treatment type (backwashing water of filter)	Returning from the wastewater basin to the receiving well.		Returning from the wastewater basin to the receiving well.	
Receiving well	Structure and volume		The one basin has two divisions with a perforated baffle.	Two divisions. Drainage facilities and overflow facilities	The one basin has two divisions with a perforated baffle.	
			More than 1.5min (Target value: about 3min)	More than 1.5min	Retention time about 3min	
Feeding facility of coagulants	Coagulants	Coagulant type	PAC (Polyaluminium chloride)	>Aluminum sulfate >Polyaluminum chloride >Ferric chloride >Polysilicic iron	Aluminum sulfate	PAC (Polyaluminium chloride)
	Acid and alkali agents		Lime	>Lime >Sodium carbonate >Sodium hydrate	Lime	Lime
Mixing basin	Structure and type		Methods to utilize the energy of water flow itself (Weir type)	>Methods to give mechanical energy from outside >Methods to utilize the energy of water flow itself (Weir type、partial flume type、water jump type)	Methods to utilize the energy of water flow itself (Weir type)	
	Retention time		> 1-5 min (Target value : about 1.5 min)	1 - 5 min	1 - 2 min	

Name of Equipment & Facilities, etc.	Design criteria applied to the project			Reference		
				Japanese Design Criteria	Example of similar projects in Cambodia	Request
Flocculation basins	Structure and type		Methods to utilize the energy of water flow itself		Methods to utilize the energy of water flow itself	
	The number of basins		2 basins		2-4 basins	
	Shape		Roundabout flow type	>Mechanical stirring method > Roundabout flow type > Horizontal zigzag flow type	Roundabout flow type	
	Retention time		Retention time 20 - 40min	20 - 40 min	Retention time 26.4 - 60.9 min (Dray season)	
Chemical sedimentation basin	Composition and structure	Type	Intermediate takeout type sedimentation basin	>Horizontal flow type sedimentation basins >Sloping-plate (tube) type sedimentation basin (Horizontal flow) >Sloping-plate (tube) type sedimentation basin (Upward flow) >Suspended solid contact clarifier	Intermediate takeout type sedimentation basin	
		Number of basins	2 basins	Over two basins principally.	2 - 4 basins	
		Effective depth	3 – 4m	3 - 4m	3.5 - 4.12m	
	Horizontal flow sedimentation basin	Overflow rate	Standard range 15 - 30mm/min (Target value: about 20mm/min)	>Single-floored type: Standard range 15 - 30mm/min >Multi-story type: Standard range 15 - 25mm/min	Surface Load: Q/A=19-20.0mm/min	
	Desludging facilities		Desludging valves (Cleaning the inside of sedimentation basin every two month)	Apply a proper method. Close at power outage.	Desludging valves (Cleaning the inside of sedimentation basin every two month)	

Name of Equipment & Facilities, etc.	Design criteria applied to the project			Reference		
				Japanese Design Criteria	Example of similar projects in Cambodia	Request
Rapid sand filters	Structure and type		Gravity type	Gravity filtration (Standard)	Gravity type	
	Filter bed area, number of filter units and shape	Filter units	4 basins	Over two basins	6 basins	
		Standby filter units	Nothing	One basin per ten basins	Nothing	
		Filter bed area	Less than 150m^2 per one basin	The filter bed area per filter shall be less than 150 m2.	17.5m2 (From the drawings)	
		Shape	Rectangle	Rectangle	Rectangle	
	Filtration rate controller		Upstream flow control method (self-balancing)	A device to control the flow of filtration shall be installed.	Downstream flow control method	
	Filtration rate		120 - 150m/d (Target Value: About. 120m/d)	120 - 150m/d	120m/d(about.)	
	Filter sand and its depth	Effective diameter	Effective diameter 1.0mm	0.45 - 0.75 mm (for surface washing) Don't describe for Airwash		For Backwash + Air wash
		Uniformity coefficient	Uniformity coefficient less than 1.7	Less than 1.7		
		Depth of sand	Depth of sand 100cm	60 - 70cm	Depth of sand: 100cm	For Backwash + Air wash
	Underdrain system		Only nozzle block type	>(Perforated) block type >Strainer(nozzle) type >Perforated pipe type	Porous plate type block type	
	Type of washing		Backwash +Air wash (Backwash storage tank)	>Backwash+Surface wash >Backwash +Air wash	Backwash +Air wash	
Disinfection facilities	Types of chlorine agents, dosage and points of dosage	Type of chlorine agents	Powder (Calcium hypochlorite)	>Sodium hypochlorite >Liquid Chlorine >Calcium hypochlorite	Liquid Chlorine	Powder (Calcium hypochlorite)
		Points of dosage	Mixing basin Outlet of sand filter	>Receiving well >Chlorine mixing chamber >The entrance to the clear water	Mixing basin Outlet of sand filter	
Drainage basin	Number of basins Water Depth		2 basins 2 - 4m	More than two basins 2 - 4m	2 basins Internal dimensions of one basin	
Drying bed	Number of beds Water Depth		4 beds More than 1m	More than two beds More than 1m	4beds	

Name of Equipment & Facilities, etc.	Design criteria applied to the project			Reference		
				Japanese Design Criteria	Example of similar projects in Cambodia	Request
Administration Building			One story >Administration office, Laboratory, Control room, Meeting room, Entrance Hall, Toilet		One story >Administration office, Laboratory, Control room, Meeting room, Entrance Hall, Toilet	Svay Rieng WWs request to prepare the storage space of pipe material.
Chemical building			Three-story >Chemical feeding room (PAC, Lime, Powder Chlorine), Chemical storage room (PAC, Lime, Powder Chlorine), Work space / Equipment storage space (pipe material), Generator room, Toilet		Three-story >Chemical feeding room (PAC, Lime, Powder Chlorine), Chemical storage room (PAC, Lime, Powder Chlorine), Work space / Equipment storage space (pipe material), Generator room, Toilet	Chlorine agents : Powder chlorine (Not chlorine gas)
Pump Station			Pumps, Panels,		Pumps, Panels,	Svay Rieng WWs requires the generator to be changed to be installed elsewhere. The Team propose it to be installed Pump Station.
Electrical Standard			ISO, IEC, JIS, JEC, JEM		ISO, IEC, JIS, JEC, JEM	
Substation			22/0.4kV from EDC power line, received in WTP	Depend on EDC (Electricity of Cambodia)	22/0.4kV from EDC power line, received in WTP	
Emergency diesel generator			100% capacity for all lords Fuel tank capacity for 10 hours		100% capacity for all lords	
Load Power Factor			More Than 95%		More Than 95%	
Motor Rated Voltage			380V		380V	
Motor for Distribution Pump			Variable Speed Motor		Variable Speed Motor	
Method of Speed control			Discharge Pressure control		Discharge Pressure control	
Filter Control			Automatic Control		Automatic Control	
Control and Monitoring of WTP			Self- Standing Graphic Panel Control Item: Intake Pump Distribution Pump Raw water valve		Self- Standing Graphic Panel	

Name of Equipment & Facilities, etc.	Design criteria applied to the project			Reference		
				Japanese Design Criteria	Example of similar projects in Cambodia	Request
Monitoring system of Distribution Network			Flow rate & Pressure Monitoring Center: PC at WTP Local Station: each measuring point of Distribution Network		Flow rate & Pressure Monitoring Center: PC at WTP Local Station: each measuring point at Distribution Network	
Transmission method for Intake Pump Station and Monitoring System of Distribution Network			Between WTP – Intake Pump Station :Internet line Between WTP – Local Monitoring Station : Mobile Network		Between WTP – Intake Pump Station :Internet line Between WTP – Local Monitoring Station : Mobile Network	

Annex-5 Proposed Design Water Supply Area

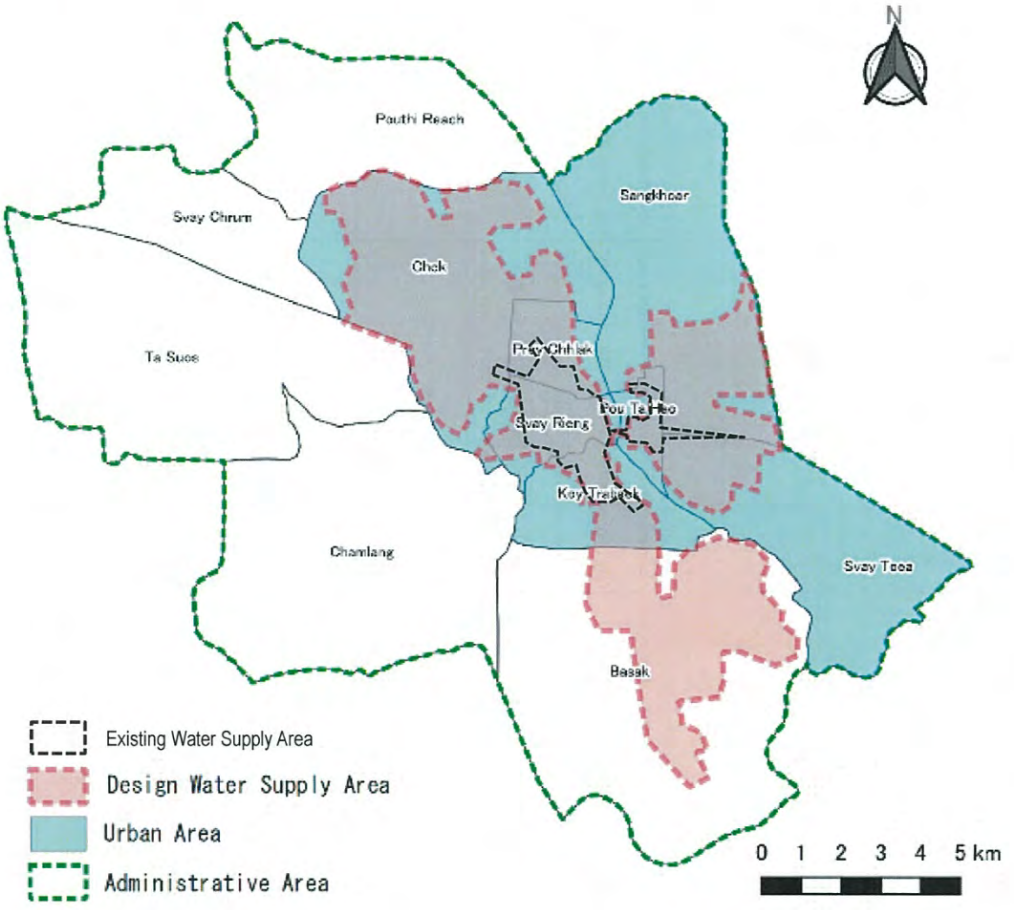


Figure A5-1 Proposed Design Water Supply Area

Table A5-1 Comparison of design water supply area

Item	Case 1	Case 2	Case 3	Case 4
Design service area				
Concept of water supply area setting	Expand to all urban areas and the most hight priority villages set by Svay Rieng WWs (Village Priority: 1, 4 – 12, 14, 15, 23, 24, 25, 26)	Expand to higher priority villages set by Svay Rieng WWs (Village Priority: 1 - 13)	Expand to higher priority villages set by Svay Rieng WWs In Addition, select a village with a large water supply per 100m of distribution pipe (Village Priority: 1 - 7, 9 - 14, 16)	Expand to higher priority villages set by Svay Rieng WWs, but secure over 85% population served in urban area (Village Priority: 1 - 12, 14)
Design population served in 2026 (Design year) (Increased population served since 2019)	56,460 (42,045)	55,630 (41,215)	57,448 (43,033)	55,477 (41,062)
Existing area	33,140 (18,725)	31,938 (17,523)	33,140 (18,725)	33,140 (18,725)
Extended area	23,320 (23,320)	23,692 (23,692)	24,308 (24,308)	22,337 (22,337)
Design number of households served in 2026 (Design year) (Increased number of households served since 2019)	11,292 (6,583)	11,126 (6,417)	11,490 (6,781)	11,095 (4,709)
Population served as % of population in the administrative area	53.4	52.6	54.3	52.5
Population served as % of population in urban area	**100**	80.1	80.7	**86.7**
Maximum daily water supply (m^3 / day)	13,367	13,145	13,578	13,156

Item	Case 1	Case 2	Case 3	Case 4
Required water supply capacity(m^3/day)	13,367	13,145	13,578	13,156
Existing WTP	4,560	4,560	4,560	4,560
New WTP	6,807	6,585	7,018	6,596
Others	2,000	2,000	2,000	2,000
Existing distribution pipe extension (km) (ϕ20 or more)	64.9	64.9	64.9	64.9
Required distribution pipe extension (km) (ϕ50 or more)	149.2	121.0	126.2	127.8
Ratio of water pipe laying construction cost to case1	1	0.83	0.83	**0.81**
Ratio of required distribution pipe laying cost per 1m^3 to case1	1	0.84	**0.80**	0.84
Ratio of initial construction cost to case1	1	0.94	0.96	**0.93**
Ratio of operation and maintenance cost to case1	1	0.99	1.01	**0.99**
Evaluation				Appropriate from a comprehensive perspective
Advantage	· Service ratio is over 90% of population in urban area, which is a government goal.	· Water is supplied to higher priority villages. · Water pipe laying construction cost is relatively low.	· Ratio of required distribution pipe laying cost per 1m3 is most low and efficient.	· Service ratio is close to 90% of population in urban area, which is a government goal. · Water is supplied to higher priority villages. · Water pipe laying construction cost is most low. · Initial construction cost, and also Operation and maintenance cost is most low.
Disadvantage	· Water is not supplied to higher priority villages. · Water pipe laying construction cost is most costly. · Initial construction cost, and also Operation and maintenance cost is most costly.	· Service ratio is nearly 80% of population in urban area, but it is far of the government goal. ·	· Service ratio is nearly 80% of population in urban area, but it is far of the government goal. · Water is not supplied to parts of higher priority villages.	· Ratio of required distribution pipe laying cost per 1m3 is a little higher than case 3.

Annex-6 Draft Facility Planning and Design Policy for Water Supply Facilities: Raw Water Transmission and Distribution System

■ Design Policy on Raw Water Transmission and Distribution System

The selection of suitable routes of laying of transmission mains and distribution mains, the durability, prevention of water pollution in the transmission mains, the ease of maintenance, economic benefits, energy efficiency.

■ Design Criteria

Table A6-1 Design criteria related to Water Supply Facilities: Raw Water Transmission and Distribution System

Facilities	Design criteria applied to the project			Reference	
				Japanese guideline	Example of similar projects in Cambodia
Raw water transmission	Design flow of raw water transmission		The design flow of raw water transmission facilities shall be based on the design flow of raw water intake.	The design flow of raw water transmission facilities shall be based on the design flow of raw water intake.	
	Type of raw water transmission		Pumping type, pipe conduit	Pumping type, pipe conduit	
	Raw water transmission mains	Pipe diameter	The pipe diameter shall be determined in consideration of the correlation between the pipe diameter and the annual cost.	The pipe diameter shall be determined in consideration of the correlation between the pipe diameter and the annual cost.	Pursat: Diameter 350mm
		Flow velocity	The flow velocity shall be the most economic velocity	The flow velocity shall be the most economic velocity	
		Pipe material	In case of the diameter 300 mm or more, the pipe shall be DIP and the ISO standard (push-on joint excellent in workability even in narrow excavation width) shall be adopted. In case of diameter 250 mm or less, it shall be HDPE pipe of PN 10 class.		Pursat: DIP
Service reservoir	Structure and type		RC	RC, PC, SS, SUS	Pursat: RC, Rectangle Kampong Cham: RC, Rectangle Battambang: RC, Rectangle Kampot: RC, Rectangle

Facilities	Design criteria applied to the project			Reference	
				Japanese guideline	Example of similar projects in Cambodia
	Capacity		The capacity of the service reservoir shall be 8 hours equivalent of the maximum daily supply of the service area. The firefighting water to be added to the above capacity (if necessary)	The capacity of the service reservoir shall be 12 hours equivalent of the maximum daily supply of the service area. The firefighting water to be added to the above capacity.	Pursat: 7.8 hours Kampong Cham: 5.2 hours Battambang: 6.5 hours Kampot: 3.5 hours
	Water depth	water depth	3 - 6m	3 – 6m	Pursat:5.5m Kampong Cham:3.8m Battambang:4.3m
	Distribution pump		Based on pipe network analysis H-W equation C=110	Based on pipe network analysis H-W equation C=110	Pursat: RC, Rectangle Kampong Cham: RC, Rectangle Battambang: RC, Rectangle Kampot: RC, Rectangle
Distribution mains	Design distribution flow		The design maximum hourly distribution flow in the service area	The design maximum hourly distribution flow in the service area	
			The ratio (K) of the design maximum hourly distribution flow to the average hourly flow shall be determined with reference to the experiences or the condition in the region with similar characteristics. K=1.3	The ratio (K) of the design maximum hourly distribution flow to the average hourly flows hall is determined with reference to the experiences or the condition in the region with similar characteristics. K=1.5-2.0	Pursat: 1.3
	Water pressure	The minimum dynamic water pressure	More than 50- 100 kPa (0.05 0.10 MPa)	More than 100-150 kPa (0.10-0.15 Mpa)	
		The maximum static water pressure	Less than 740 kPa (0.74 MPa)	Less than 740 kPa (0.74 MPa)	
	Pipe diameter		Based on pipe network analysis H-W equation C=110 C=130 in case computing the head loss for the straight sections only	Based on pipe network analysis H-W equation C=110 C=130 in case computing the head loss for the straight sections only	

Facilities	Design criteria applied to the project			Reference	
				Japanese guideline	Example of similar projects in Cambodia
	Pipe material		In case of the diameter 300 mm or more, the pipe shall be DIP and the ISO standard (push-on joint excellent in workability even in narrow excavation width) shall be adopted. In case of diameter 250 mm or less, it shall be HDPE pipe of PN 10 class. In case of the river crossing sections, the materials for the distribution mains shall be SP with corrosion prevention.		

■ Outline Design

1. Conveyance Pipe

(1) Basic Condition

1) Design Flow of Conveyance Pipe: 7,260 m^3/ day (6,600 m^3/day x 1.1)

2) Type of Conveyance Pipe: pumping type, the conveyance pipe to be laid under public roads

3) Route of Conveyance Pipe: the shortest distance between water intake facility and the WTP

Length of conveyance pipe main: Approximately 2.9 km north-west from the water intake to the WTP, Status of road pavement: Surrounding roads of the intake and the WTP are unpaved, others are asphalt or concrete pavements, No crossing for river etc.

Source: JICA Survey Team

Figure A6-1 Proposed Route of Conveyance pipe

4) Pipe Material: Ductile Cast Iron Pipe (DIP)

5) Pipe Diameter: 350mm

Table A6-2 Hydraulic Calculation Results of Each Pipe Diameter

Q: flow rate (m3/d)	L: length (m)	D: inside diameter (m)	I: Hydraulic gradient (‰)	H: friction head loss (m)	V: Flow Velocity (m/s)	Evaluation
7,260	2,946	250	15.62	46.01	1.71	Large loss head
7,260	2,946	300	6.43	25.93	1.19	Large loss head
7,260	**2,946**	**350**	**3.03**	**15.94**	**0.87**	**Recommendable**
7,260	2,946	400	1.58	4.66	0.67	Uneconomical

Hazen-Williams formula

$I = 10.666 \cdot C^{-1.85} \cdot D^{-4.87} \cdot Q^{1.85}$, C: velocity coefficient (110)

$H = I \cdot L$

$V = Q/A = Q/(\pi D^2/4)$

Source: JICA Survey Team

6) Proposed Specifications of Conveyance Pipe

Table A6-3 Proposed Specifications of Conveyance Pipe

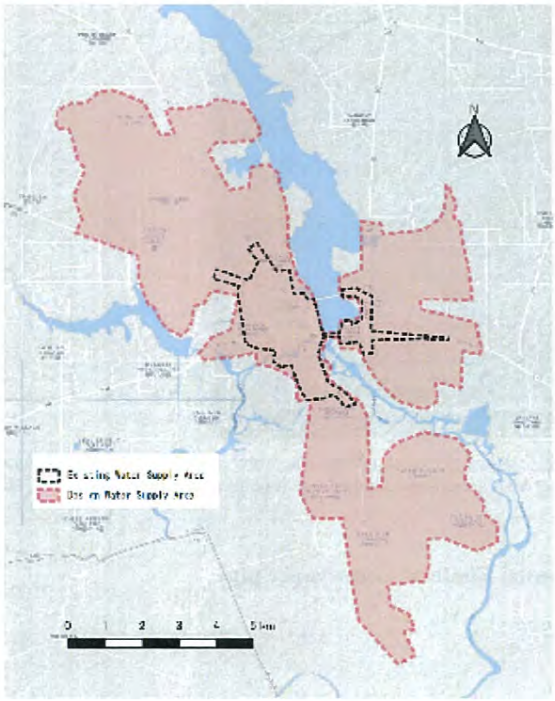
Facility	Type and Structure	Length
Conveyance Pipe	DIP, Diameter 350mm	2.9 km

Source: JICA Survey Team

2. Distribution Facilities

(1) Basic Condition:

1) Design Service Area: shown in **Figure A6-2**



District	Commune	Number of Village
Krong Svay Rieng	Svay Rieng	7
	Prey Chhlak	5
	Koy Trabaek	2
	Pou Ta Hao	4
	Chek	10
	Svay Toea	3
	Sangkhoar	5
Svay Chrum	Basak	5

Source: JICA Survey Team

Figure A6-2 Design Service Area

2) Design Distribution Flow

- Design maximum hourly distribution flow for design service area to be distributed from new water treatment: 357.5 m^3/hr (= 6,600 m^3/day x 1.3)
- Design maximum hourly distribution flow for design service area to be distributed from existing water treatment: 355.3 m^3/hr (= 4,560 + 2,000 = 6,560 m^3/day x 1.3)

Note) 2,000 m^3/day is considered as the existing capacity

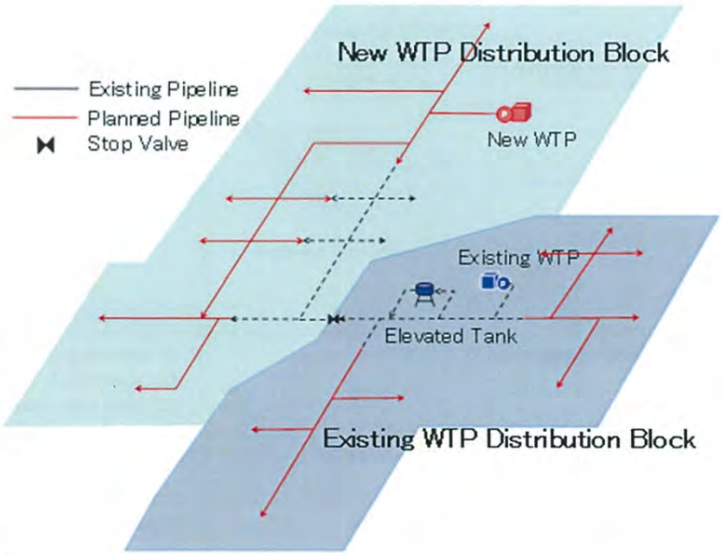
(2) Water Distribution System:

1) Reorganization of the Water Distribution System: See **Figure A6-3**

- To separate the design service area into two distribution areas such that the water demand there are corresponding to the capacities of the existing facility, and the new facility, and that water will be supplied by the shortest routes from each facility to save energy.

- To minimize duplication of pipe installation on the same route, and not to replace the existing water mains.
- To facilitate easier operation and maintenance, the boundary of each water distribution area is blocked by the isolation valves so as not to interfere with each other. In case of emergency it enables to cover mutually by opening the above-mentioned valves.
- To monitor and use the distribution flow rate and water pressure for planning and operation of water distribution and large leakage detection by dividing the distribution area of the new WTP into two DMAs and the distribution area of the existing WTP into two DMAs.

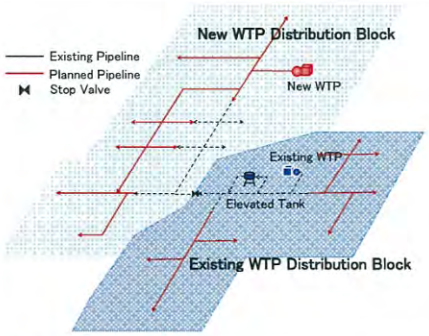
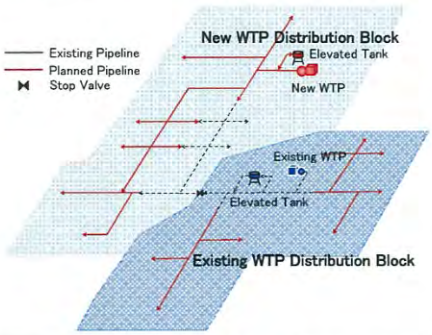
2) Type of Water Distribution: Water shall be supplied by pumps with the inverter control in the new WTP.



Source: JICA Survey Team

Figure A6-3 Illustrated Concept of Reorganization of Distribution System

Table A6-4 Comparison of Water Distribution Type

Item	**Alternative (A):** Pumping (inverter control) type from the WTP	**Alternative (B):** Combined type (pumping from the WTP and gravity flow from elevated tank)
Description	· Distribution pumps in new WTP directly distribute water to the service area. · The existing distribution pumps in the existing WTP directly distribute water to the modified service area having water demand amount corresponding to the capacity of those pumps /WTP.	· Distribution pumps in new WTP directly distribute water to the service area and send water to elevated tank to regulate the distribution flow or control water pressure in the service area. · The existing distribution pumps in the existing WTP directly distribute water to the modified service area having water demand amount corresponding to the capacity of those pumps /WTP.
Schematic illustration		
The ease of operation and maintenance	· Easy compared to B	· A service reservoir is separately provided in the new WPT, and the distribution pressure is regulated by means of controlling pumps or inlet valves in relation to the water depth in the elevated reservoir. · A little difficult compared to A.
Construction cost	· Slightly cheaper compared to B · Construction cost includes a service reservoir, distribution pumps, and distribution mains.	· More expensive compared to B · Construction cost includes a service reservoir; distribution pumps distribution mains and an elevated tank.
Energy efficiency	· Total head of distribution pumps are comparable with B and energy saving can be expected by the inverter installation.	· Total head of distribution pumps are comparable with A, but energy saving can be not expected due to unit control compared to A.
Evaluation	Recommendable	

Source: JICA Survey Team

(3) Distribution Pump:

1) Type of Control:

Water shall be directly supplied to the service area by distribution pumps with inverter control that enables smooth control and high efficiency operation against constantly changing water demand to reduce power consumption cost and simplify pump operation.

2) Specification of Distribution Pump:

Table A6-5 Specification of Distribution Pump (tentative)

Item	Specification
Type	Horizontal, end suction volute pump
Quantity	3sets (Including one set of standby)
Capacity of pump	4950m^3/day (3.44m^3/min)
Total head	55m
Output of motor	75kW
Diameter	200mm x 100mm
Speed	SS1500min-1
Accessory equipment	Flywheel GD2=200kgm^2

Note: Existing distribution pump specification: 150m^3/hr, H=50m x 2 units, 340m^3/hr x 1 unit. While approximately 360 m^3/hr of total pump capacity assumed to be required, increasing of pump capacity is needed because the existing pump capacity is lack and no standby.

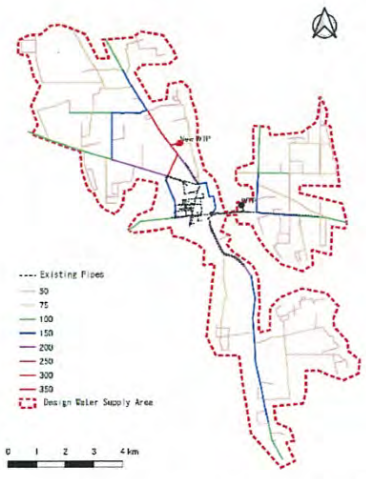
Source: JICA Survey Team

(4) Capacity of Service Reservoir:

In order to achieve stable water supply during normal times and emergency, the capacity of the service reservoir shall be 8 hours volume equivalent of the maximum daily supply of the service area;

2,200 m^3 (6,600 m^3 × 8/24)

(5) Plan for Distribution Mains:

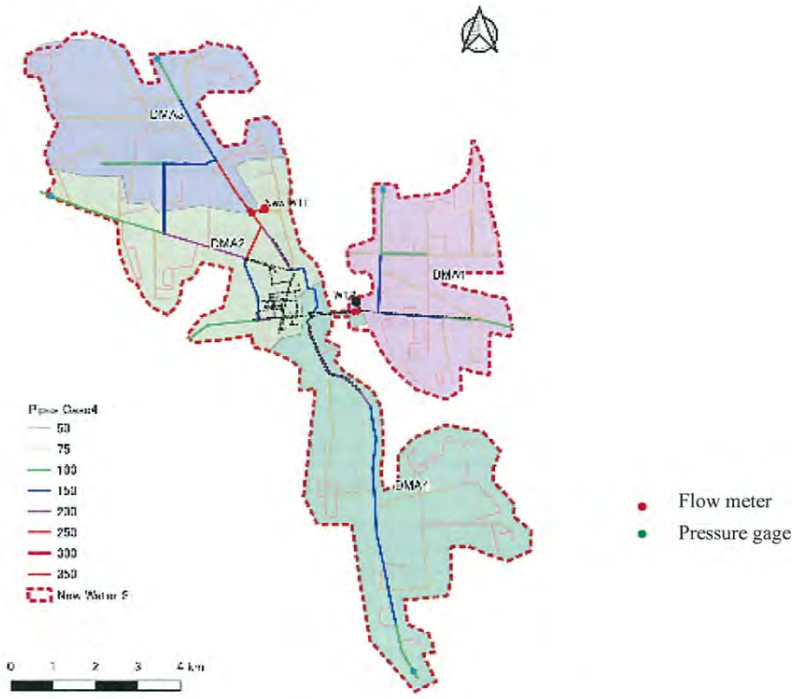


Source: JICA Survey Team

Figure A6-4 Plan for Distribution Mains

(6) Monitoring System for Water Distribution:

The monitoring system for water distribution shall be introduced, aiming at collection of the water distribution flow and centralized data management, efficient operation, leakage reduction, and smooth response to emergency such as an accident of pipelines.



Source: JICA Survey Team

Figure A6-5 Monitoring Plan for Distribution Flow and Water Pressure

(7) Design Criteria for Distribution Mains:

Table A6-6 Design Criteria for Distribution Mains

Classification		Design Criteria
Location of pipe laying		· The pipes shall be laid under the road shoulder. · The route of pipe laying shall not move to the left or right side on the road at short intervals to facilitate management.
Earth covering		· National road: H=1.2m, Other roads: for ϕ400, H=1.0m, for ϕ350 or less H=0.8m
Excavation / Backfilling		· For the upper surface of the pipe, 0.2m of sand shall be backfilled to protect the pipe. · When there are many cobble stones and there is irregularity between the pipe material and the ground, the bottom layer of the pipe shall be backfilled with sand of 0.1 m or more. · If the excavation depth is deeper than 1.5m, lightweight steel sheet pile (Type III) shall be constructed.
Ancillary facilities	Closure valves	· Closure valves shall be installed at locations, such as start points, end points, branches, inverted siphons, bridge-piggybacked water mains, water main bridges and others. · The Gate valve and the round valve box shall be adopted.
	Air valves	· The air valves shall be installed at locations, such as ridge-piggybacked water mains and water main bridges.

Classification		Design Criteria
		· For ϕ200 or more, the air valves shall be installed at locations, such as topographical convex parts, inverted siphons and others.
	Drainage facilities	· The drainage facilities shall be installed at pipe concave sections and/or near rivers and irrigation canal etc.
	Protection of special fittings	· The anti-escapement fixture shall be adopted. This is a countermeasure to suppress the damage of the pipe due to the imbalanced forces generated by the bent parts, the branch parts, the gate valves and others. · The protection by concrete blocks as another method requires curing period of concrete. · Therefore, it shall not be adopted considering the workability based on road conditions.
	Hydrants	· The hydrant (ground type) shall be installed on the distribution mains, considering request by Department of firefighting.

Source: JICA Survey Team

(8) Plan for Distribution Facilities:

Table A6-7 Specification for Distribution Facilities (tentative)

<table>
<tr><th>Facility</th><th>Type and Structure</th><th>Quantity</th></tr>
<tr><td>Service Reservoir (inside the new WTP)</td><td>Reinforced concrete (RC) Structure, Rectangle, two reservoirs
Effective Capacity: V=1,100 m3×2
Effective depth: H=3.80 m</td><td>1 set</td></tr>
<tr><td>Distribution Pump Facilities (inside new WTP)</td><td>Horizontal Volute Pump 3.5m3/min H=55m 75kW Inverter Equipment</td><td>3 Pumps (including 1 standby pump)</td></tr>
<tr><td>Distribution Mains</td><td><table><tr><th>Pipe inside diameter(mm)</th><th>Pipe material</th><th>Length(km)</th></tr><tr><td>50</td><td>HDPE</td><td>52.4</td></tr><tr><td>75</td><td>HDPE</td><td>37.2</td></tr><tr><td>100</td><td>HDPE</td><td>13.3</td></tr><tr><td>150</td><td>HDPE</td><td>15.8</td></tr><tr><td>200</td><td>HDPE</td><td>6.2</td></tr><tr><td>250</td><td>HDPE</td><td>2.3</td></tr><tr><td>300</td><td>DCIP</td><td>0.4</td></tr><tr><td>350</td><td>DCIP</td><td>0.5</td></tr><tr><td>Total</td><td>DCIP</td><td>128</td></tr></table></td><td></td></tr>
<tr><td>Monitoring equipment of water distribution</td><td>Central monitoring station: data receiver, data transmitter, monitoring computer, printer & ancillary equipment Monitoring station (inside WTP) : data receiver, monitoring computer, printer & ancillary equipment, Street monitoring station: 4 sites flow meters, data transmitter & ancillary equipment / 4 water pressure meters, data transmitter & ancillary equipment)</td><td>1 LS</td></tr>
</table>

Source: JICA Survey Team

Annex-7 Location of Temporary Yards and Dump Sites in Svay Rieng

Figure A7-1 Location of Temporary Yard and Disposal Area in Svay Rieng

Figure A7-2 Location of Temporary Construction Road in Svay Rieng

7-2 概略設計図

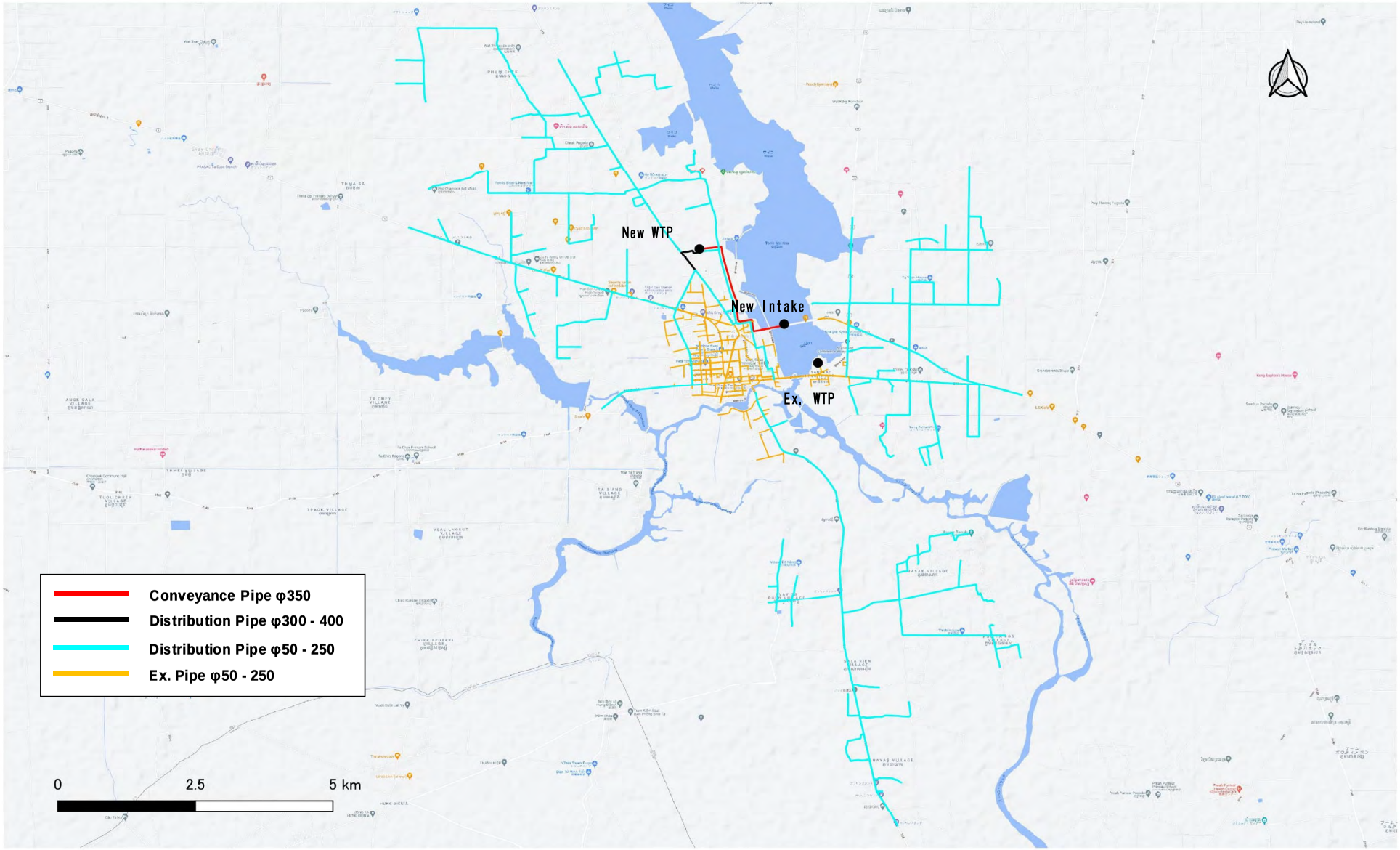
概略設計図の目次を以下に示す。

表 7-1 概略設計図面リスト

No.	FACILITY CLASIFICATION	Description	DRAWING No
1.	General (G)	General Layout of Svay Rieng	G1
2.	Intake Facility (I)	Intake Facilities (1)	PI-1
		Intake Facilities (2)	PI-2
		Intake Facilities (3)	PI-3
		Intake Facilities (4)	PI-4
		Intake Facilities (5)	PI-5
		Pump House Plan	PI-6
		Pump House Section	PI-7
3.	Raw Water Transmission Facility (R)	Conveyance Pipeline Plan	SR-1
4.	Treatment Facility (T)	Water Treatment Plant General Plan	ST-1
		Hydraulic Profile of Svay Rieng Water Treatment Plant	ST-2
		Water Treatment Facilities Structure (1)	ST-3
		Water Treatment Facilities Structure (2)	ST-4
		Water Treatment Facilities Structure (3)	ST-5
		Water Treatment Facilities Structure (4)	ST-6
		Water Treatment Facilities Structure (5)	ST-7
		Water Treatment Facilities Structure (6)	ST-8
		Water Treatment Facilities Structure (7)	ST-9
		Water Treatment Facilities Structure (8)	ST-10
		Water Treatment Facilities Structure (9)	ST-11
		Service Reservoir and Pumping Station Structure (1)	ST-12
		Service Reservoir and Pumping Station Structure (2)	ST-13
		Service Reservoir and Pumping Station Structure (3)	ST-14
		Drainage Basin Structure	ST-15
		Drying Bed Structure	ST-16
5.	Distribution Facility (D)	Location Map for Distribution Pipeline	SD-1
		Distribution Pipe Plan (1)	SD-2
		Distribution Pipe Plan (2)	SD-3
		Distribution Pipe Plan (3)	SD-4
		Distribution Pipe Plan (4)	SD-5
		Distribution Pipe Plan (5)	SD-6
		Distribution Pipe Plan (6)	SD-7
		Distribution Pipe Plan (7)	SD-8
		Distribution Pipe Plan (8)	SD-9
		Distribution Pipe Plan (9)	SD-10
		Distribution Pipe Plan (10)	SD-11
		Distribution Pipe Plan (11)	SD-12
		Distribution Pipe Plan (12)	SD-13

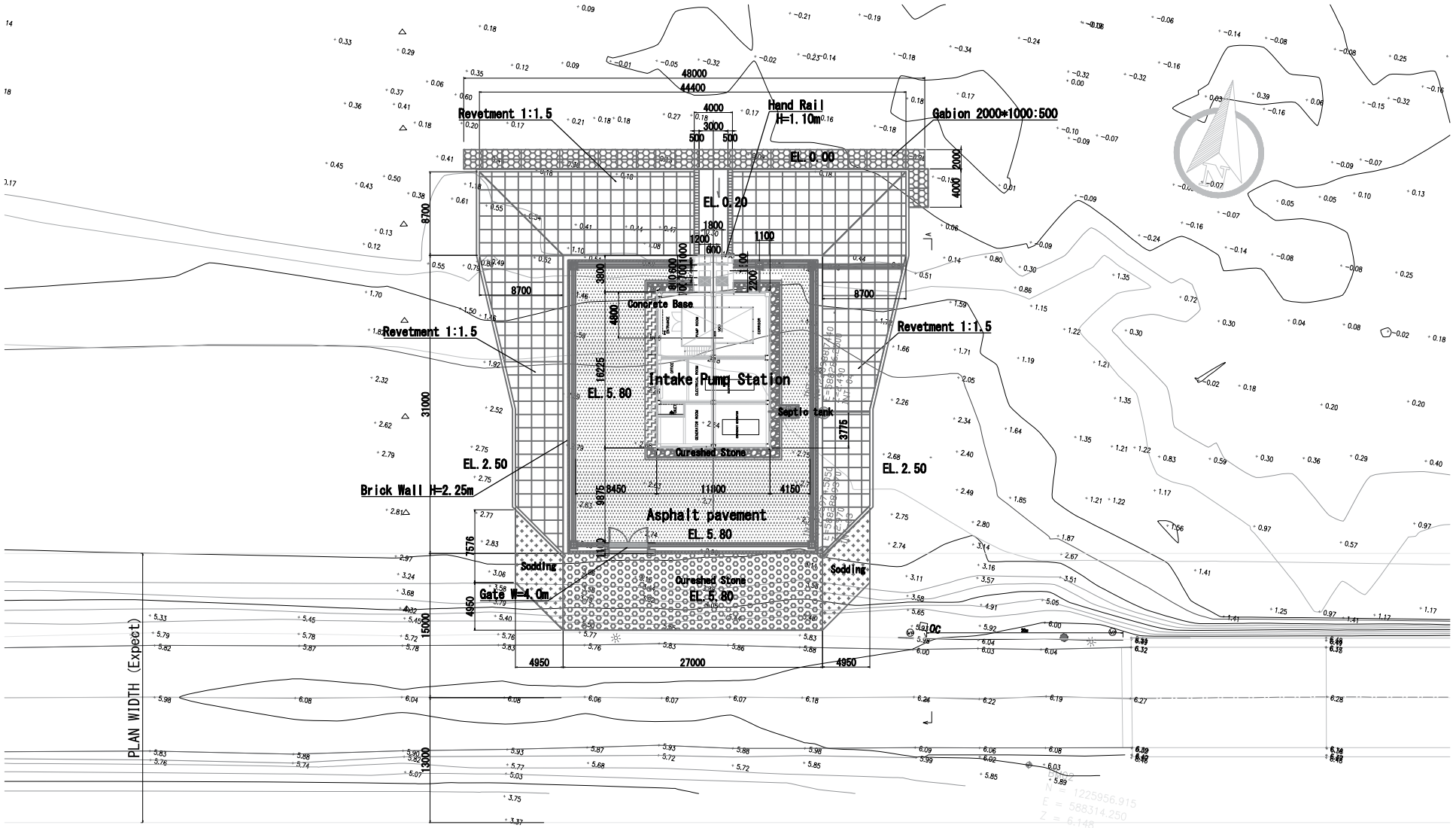
No.	FACILITY CLASIFICATION	Description	DRAWING No
		Distribution Pipe Plan (13)	SD-14
		Distribution Pipe Plan (14)	SD-15
		Distribution Pipe Plan (15)	SD-16
		Distribution Pipe Plan (16)	SD-17
		Distribution Pipe Plan (17)	SD-18
		Distribution Pipe Plan (18)	SD-19
		Distribution Pipe Plan (19)	SD-20
		Distribution Pipe Plan (20)	SD-21
		Distribution Pipe Plan (21)	SD-22
		Typical Drawing for Pipe Laying (1)	TYP-1
		Typical Drawing for Pipe Laying (2)	TYP-2
		Typical Drawing for Pipe Laying (3)	TYP-3
		Typical Drawing for Pipe Laying (4)	TYP-4
		Typical Drawing for Pipe Laying (5)	TYP-5
		General Earth Work for Pipe Laying	TYP-6
		Typical Drawing for Sluice Valve	TYP-7
		Typical Drawing for Installation of Air Valve and Washout	TYP-8

出典: JICA 調査団

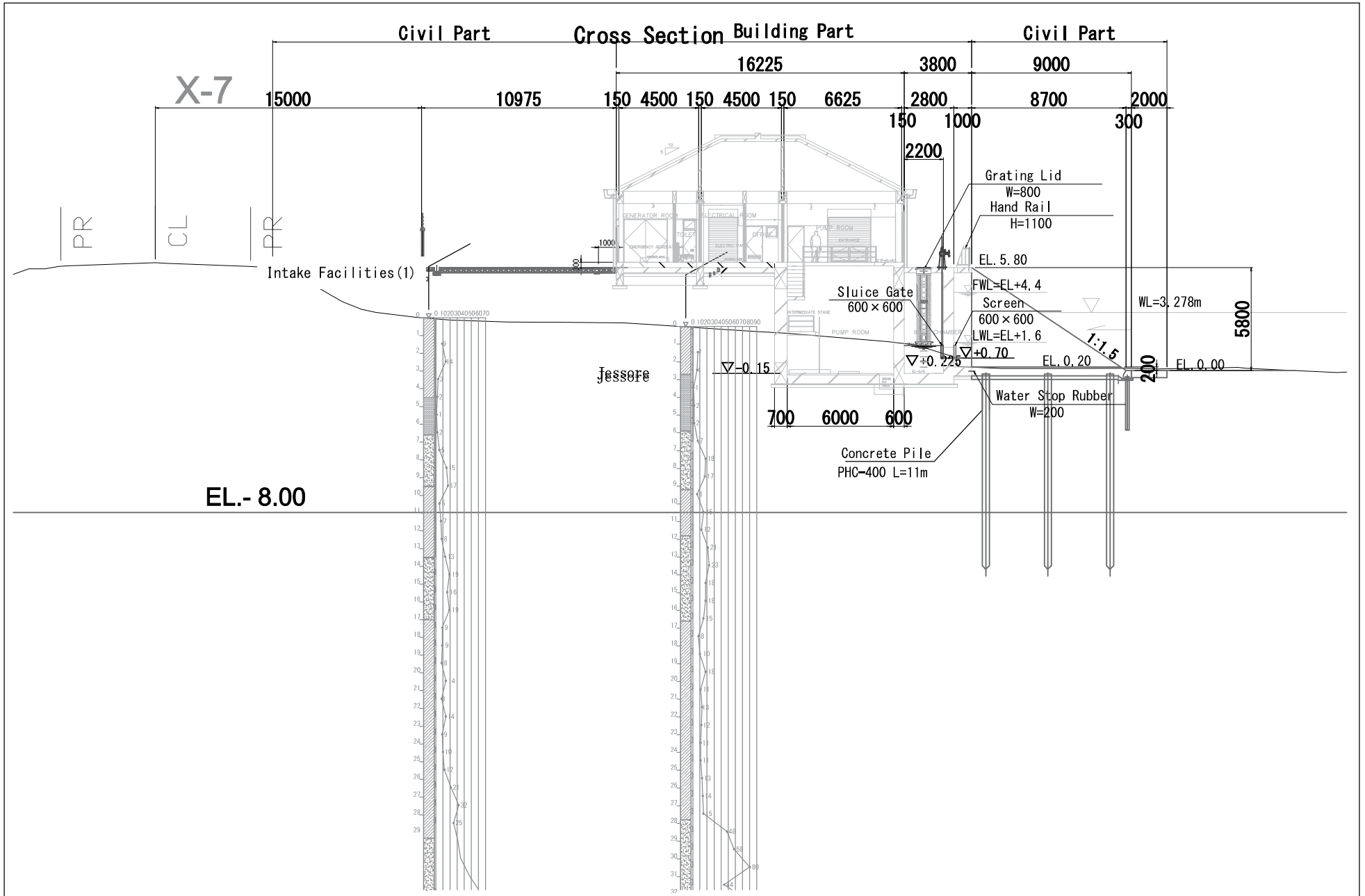


Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale:	Description: General Map
			Chief Consultant: Hideki KONNO		Date:	Drawing Number: G1

Plain View



Project:	CLIENT:	CONSULTANT:	Design:	Approval:	Scale:	Description:	Drawing Number:
The Project for Expansion of Water Supply System in Svay Rieng	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	the Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Chief Consultant: Hideki KONNO		1 : 400 Date: ***. 2021	Intake Facilities (1)	PI-1



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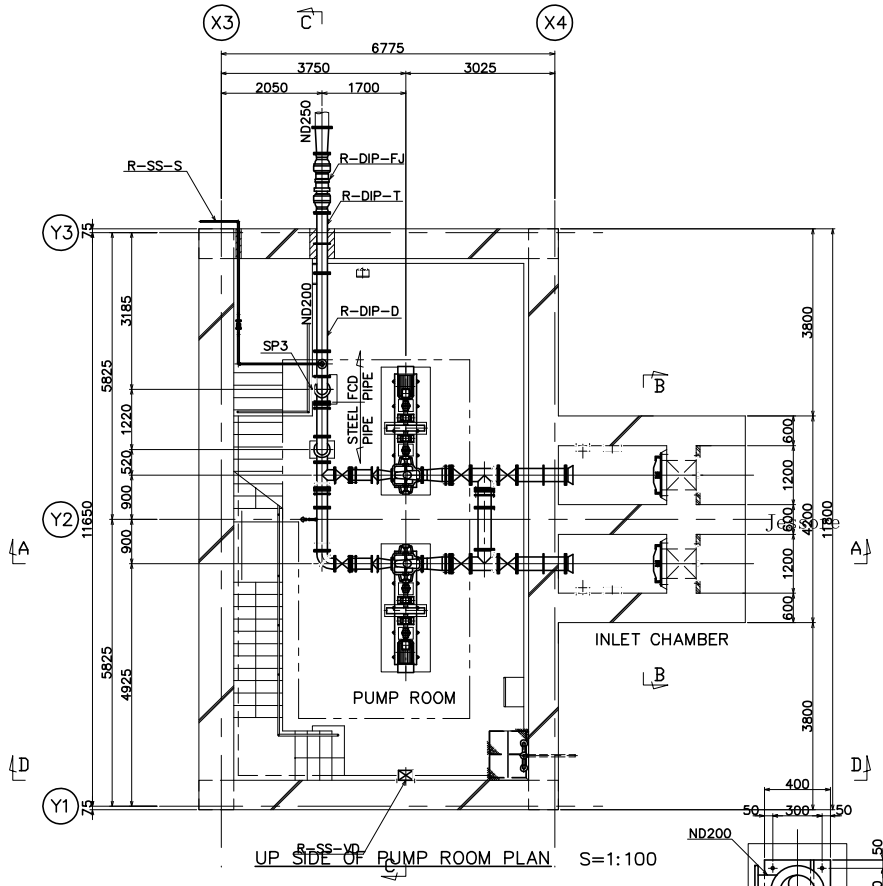
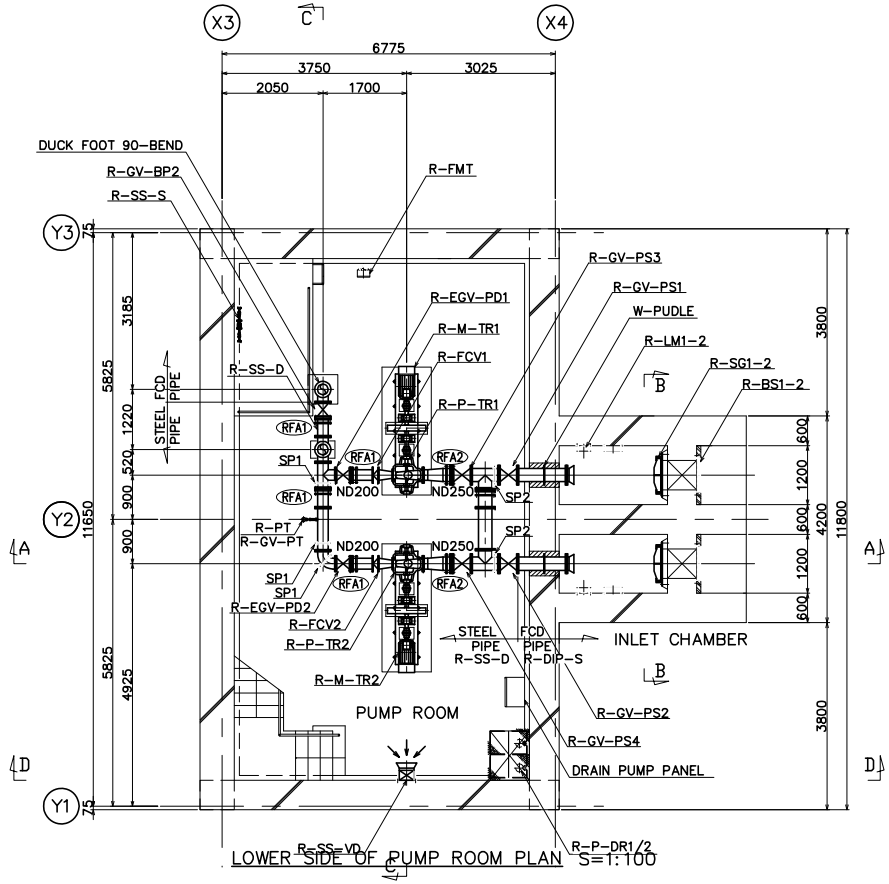
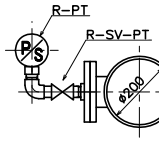
			Chief Consultant: Hideki KONNO		Date: ***. 2021		



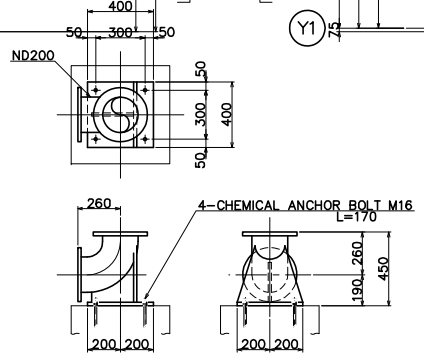
UP SIDE OF PUMP ROOM PLAN S=1:100



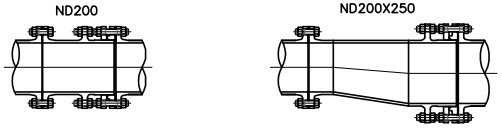
LOWER SIDE OF PUMP ROOM PLAN S=1:100



PRESSURE TRANSMITTER INSTALLATION S=1:15

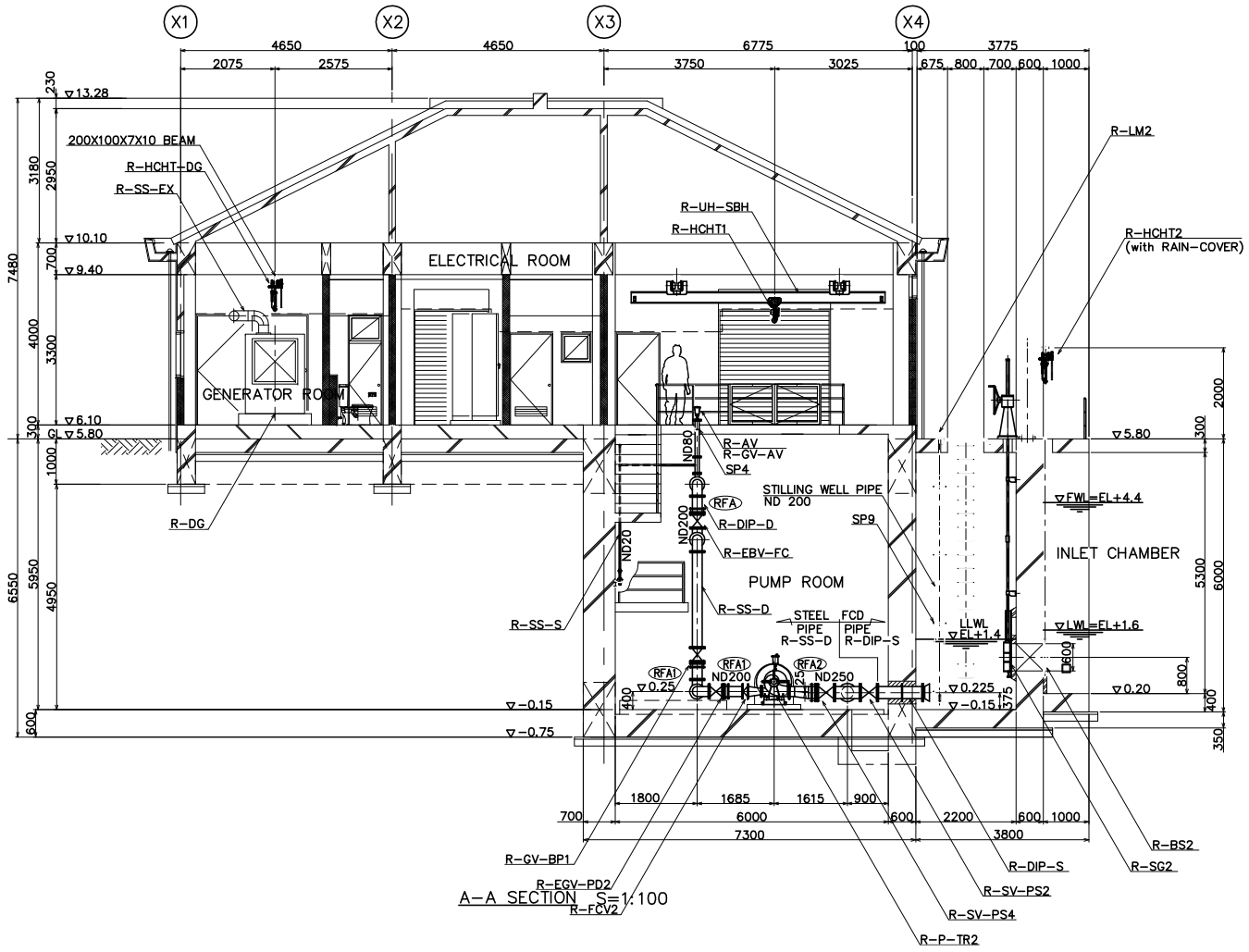


DETAIL OF DUCKFOOT 90-BEND S=1:30

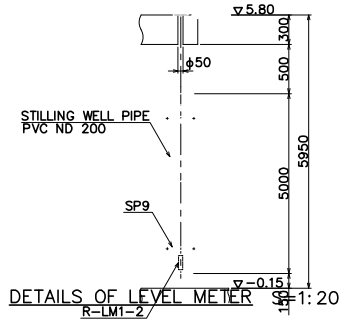


DETAIL OF RESTRAINED FLANGE ADAPTORS S=1:20

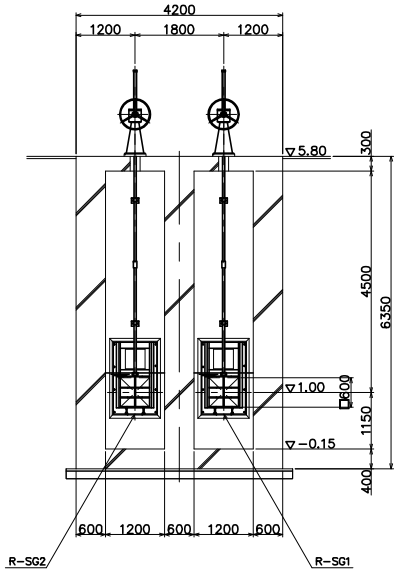
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: the Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approval:	Scale: 1:100,30, 20,15 / Date: ***. 2021	Description: Intake Facilities (3)	Drawing Number: PI-3



A-A SECTION S=1:100

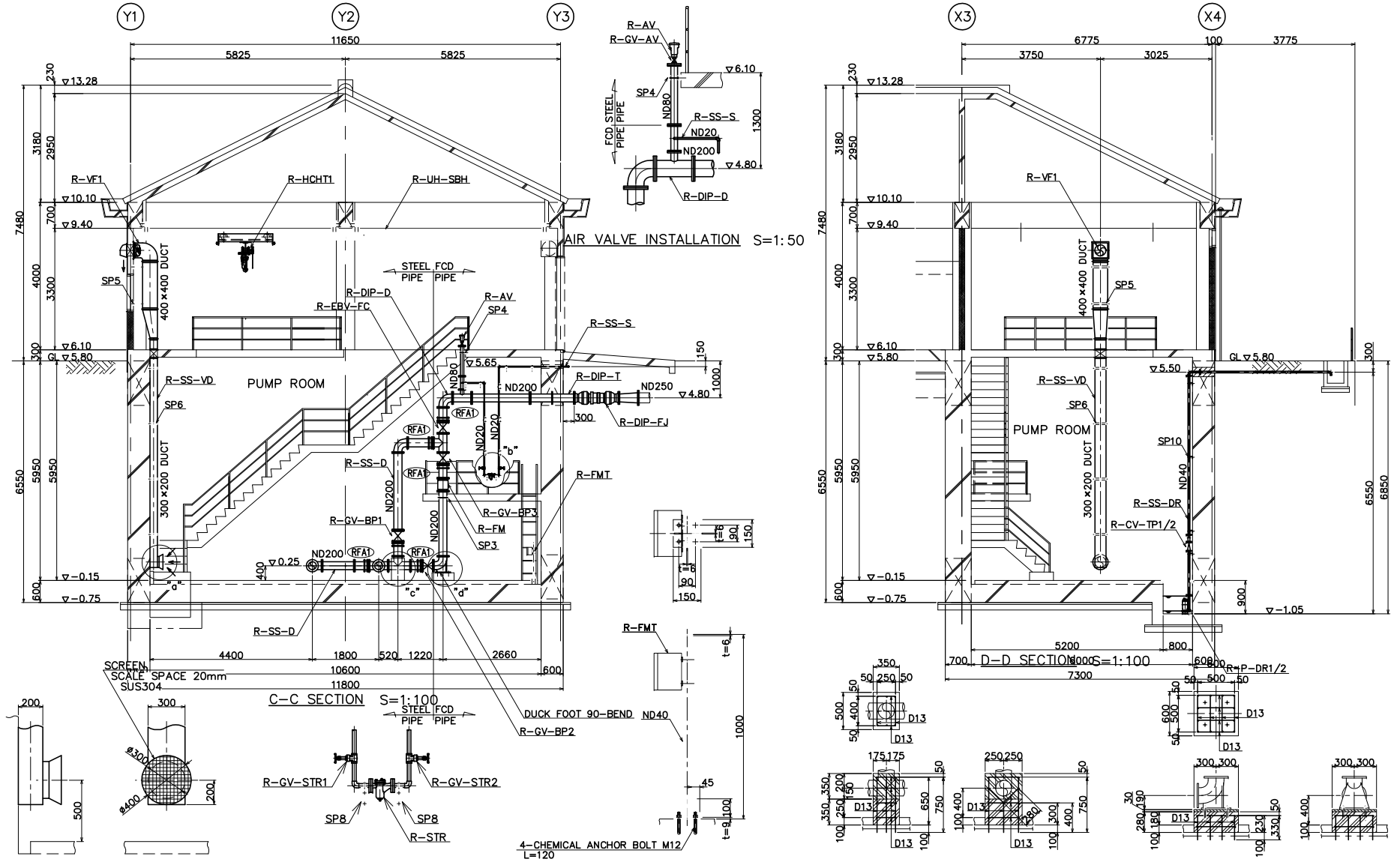


DETAILS OF LEVEL METER S=1:20

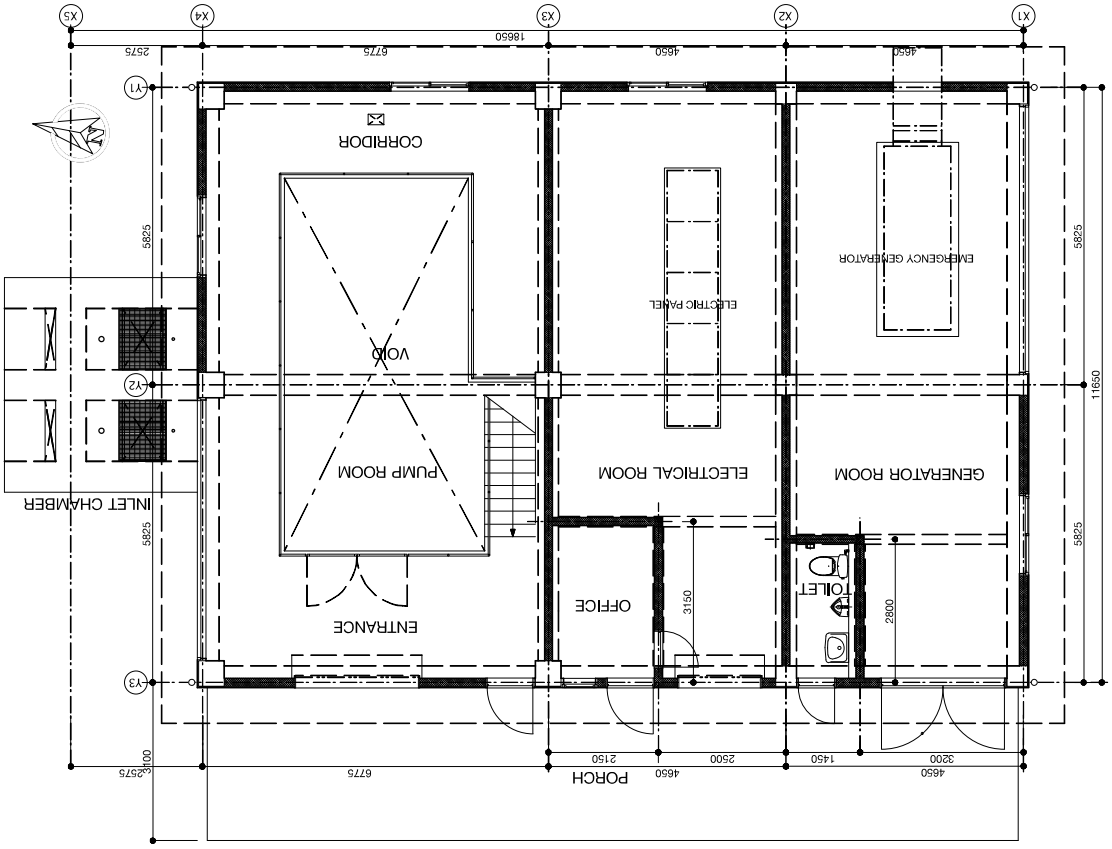


B-B SECTION S=1:100

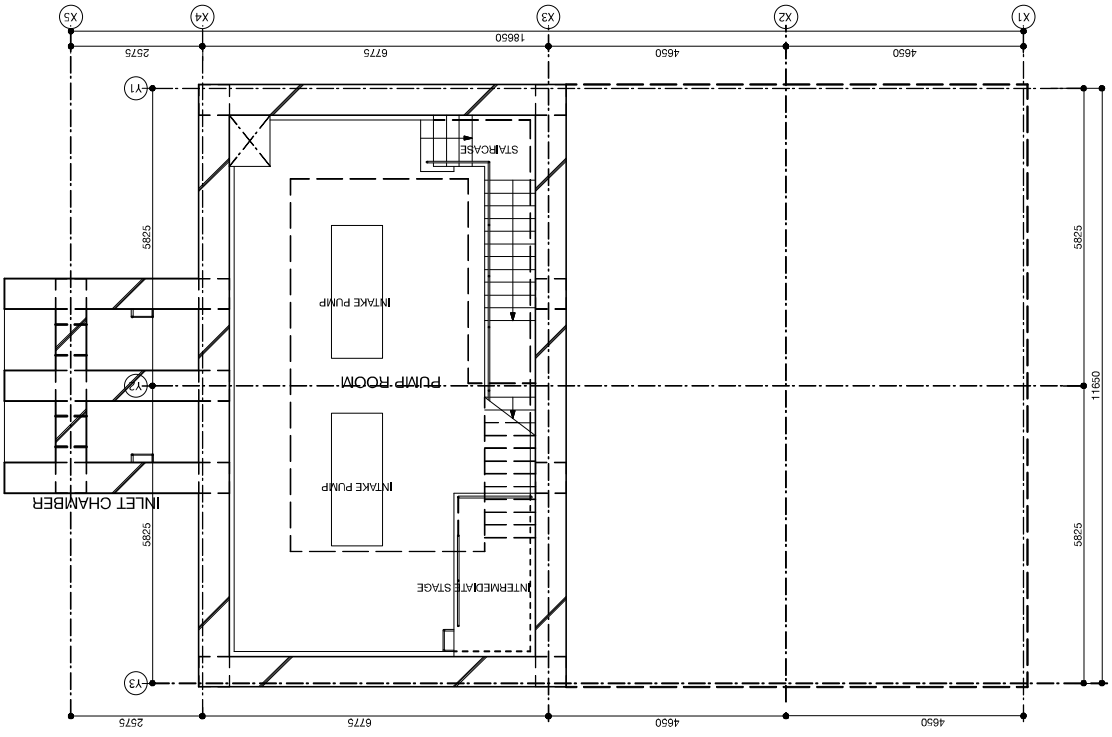
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: the Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approval:	Scale: 1:100 / Date: ***. 2021	Description: Intake Facilities (4)	Drawing Number: PI-4



Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: the Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approval:	Scale: 1:100,30 / Date: ***. 2021	Description: Intake Facilities (5)	Drawing Number: PI-5



FIRST FLOOR PLAN 1:100



BASEMENT FLOOR PLAN 1:100

Project: The Project for Expansion of Water Supply System in Svay Rieng

CLIENT: Ministry of Industry, Science, Technology & Innovation, the Kingdom of Cambodia

CONSULTANT: the Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.

Design: Chief Consultant: Hideki KONNO

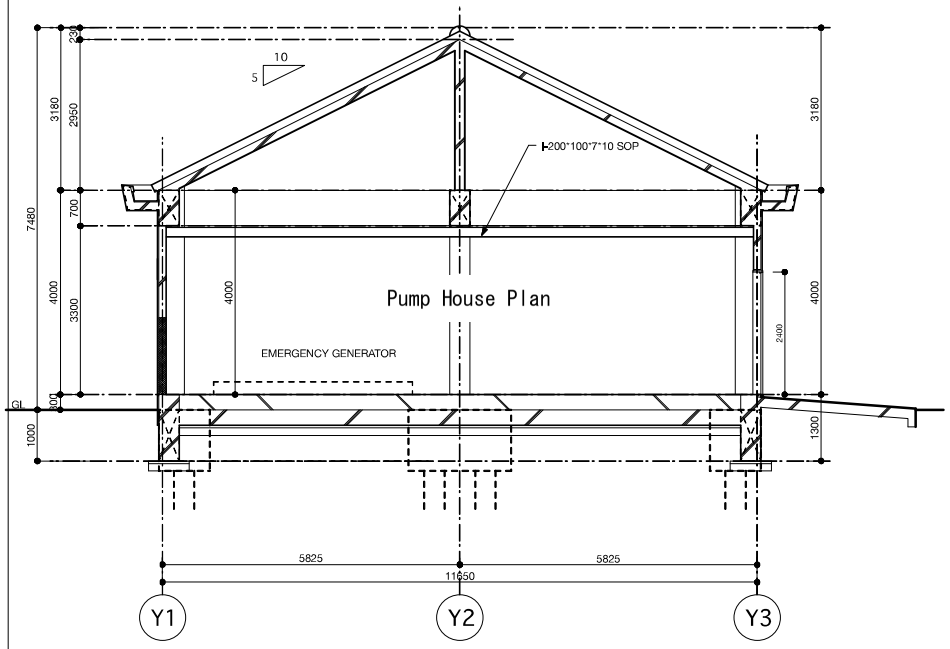
Approval:

Scale: 1:100

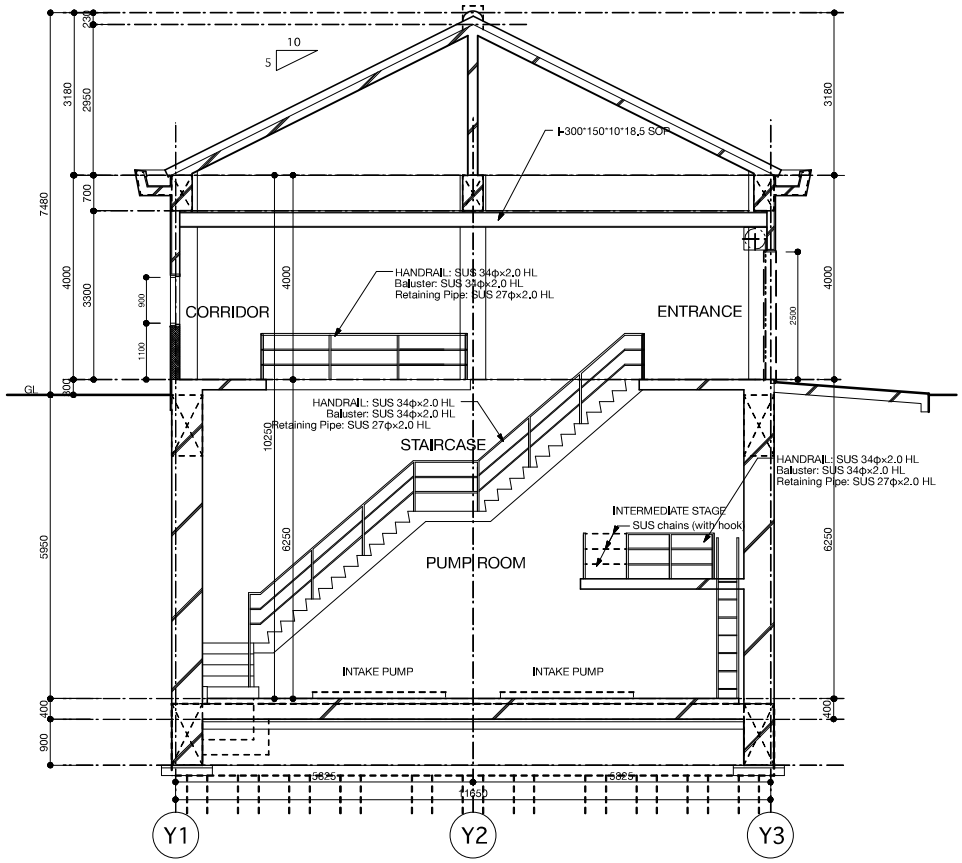
Date:

Description: Pump House Plan

Drawing Number: PI-6

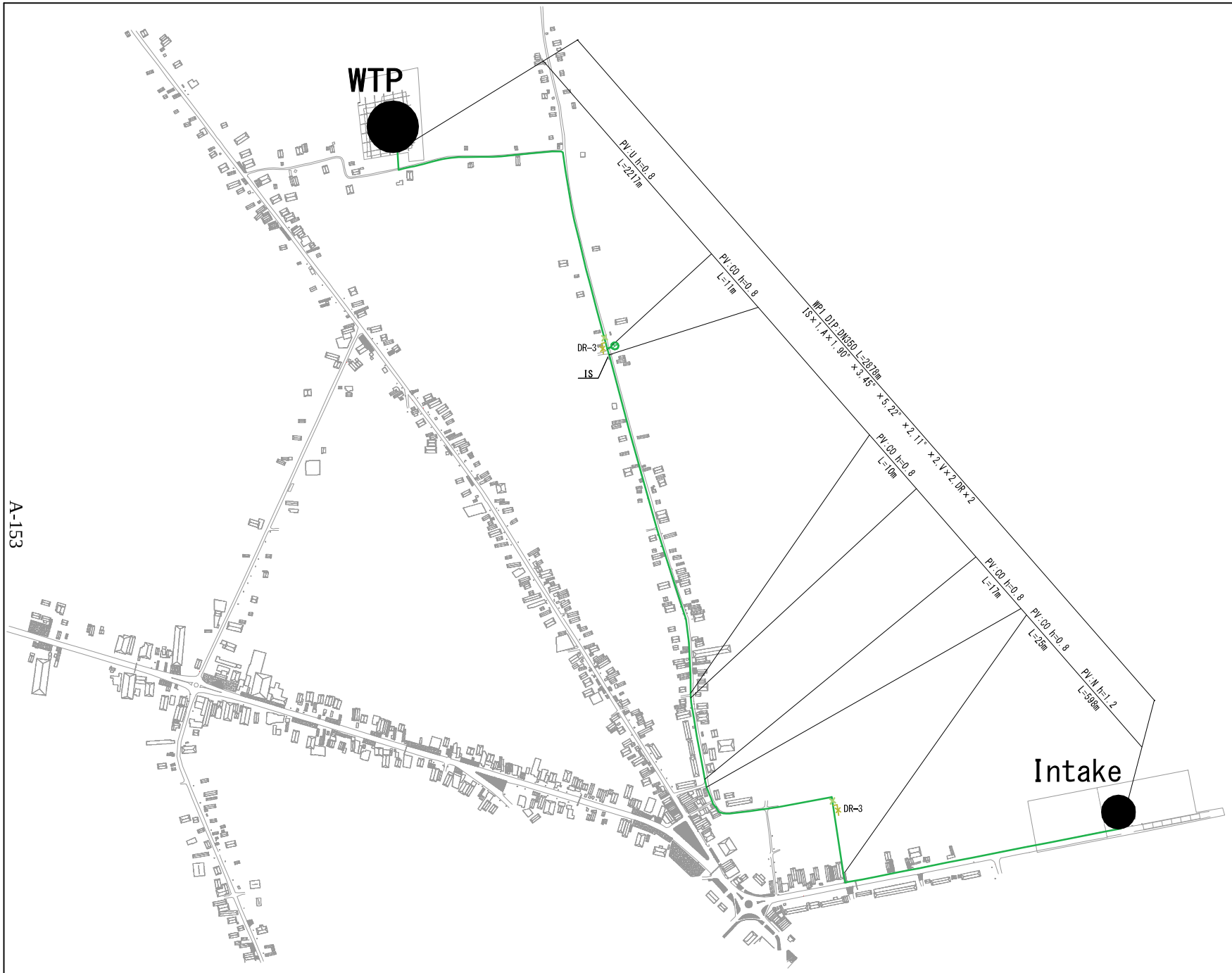


B-B SECTION 1:100

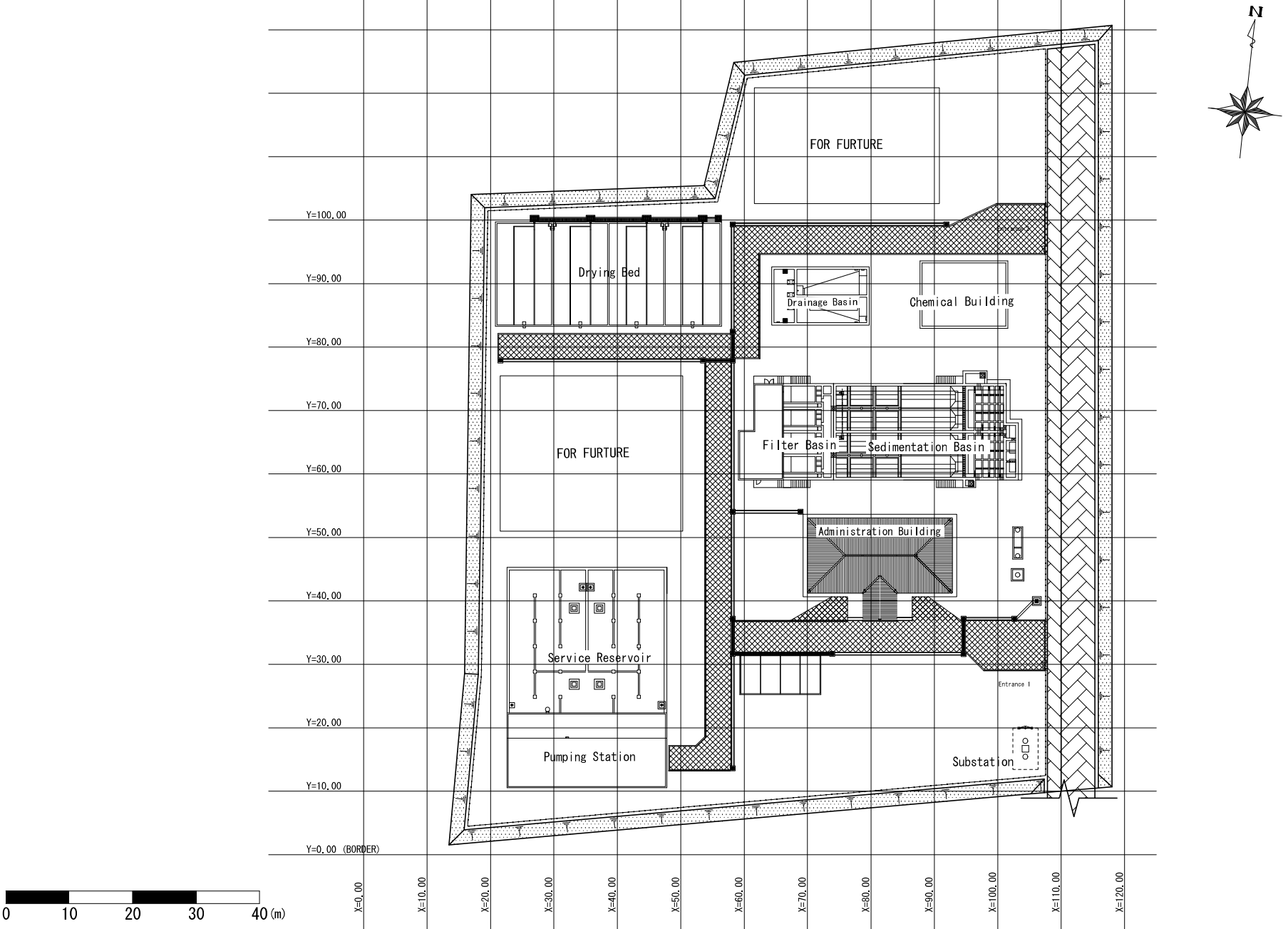


A-A SECTION 1:100

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: the Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:100	Description: Pump House Section	Drawing Number: PI-7
			Chief Consultant: Hideki KONNO		Date:		

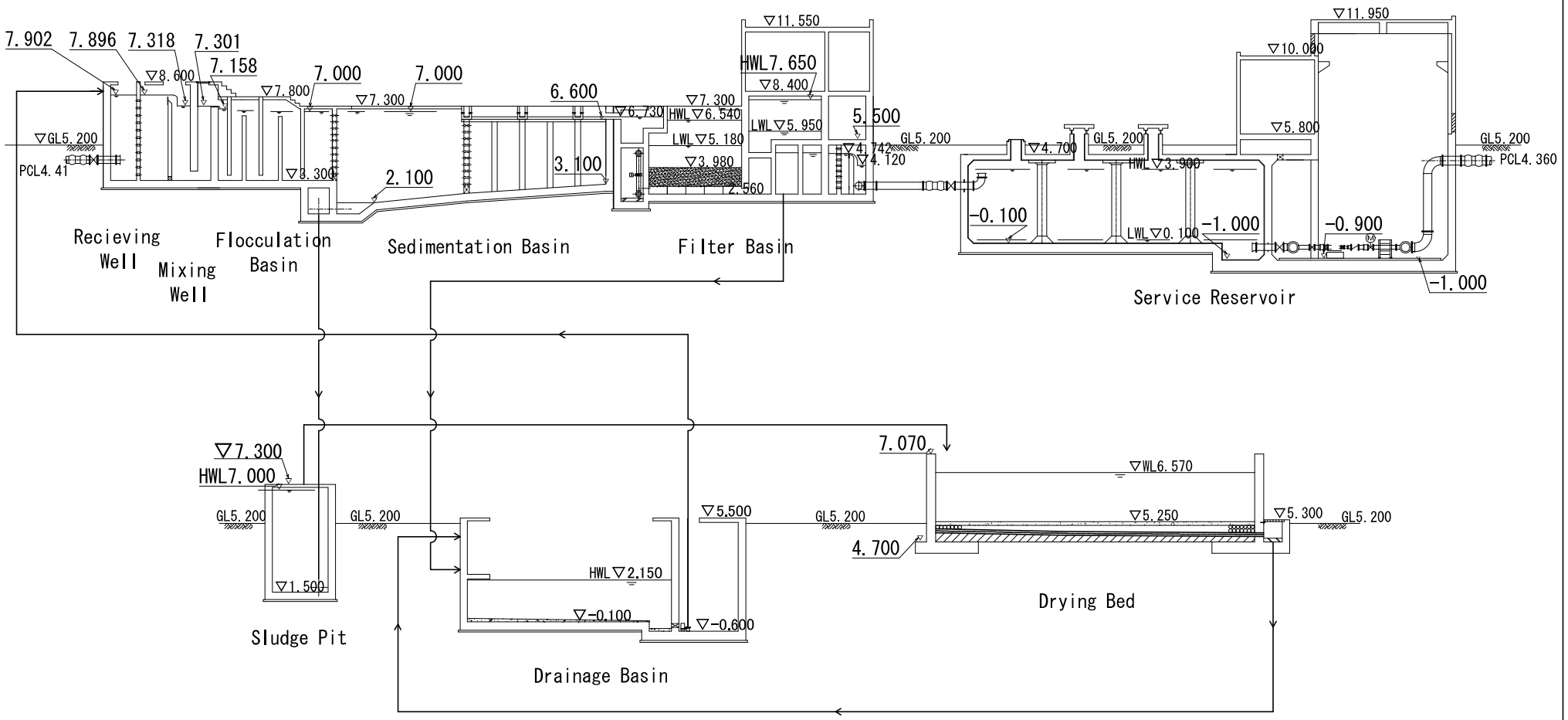


Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale:	Description: Conveyance Pipeline Plan	Drawing Number: SR-1
			Chief Consultant: Hideki KONNO		Date:		

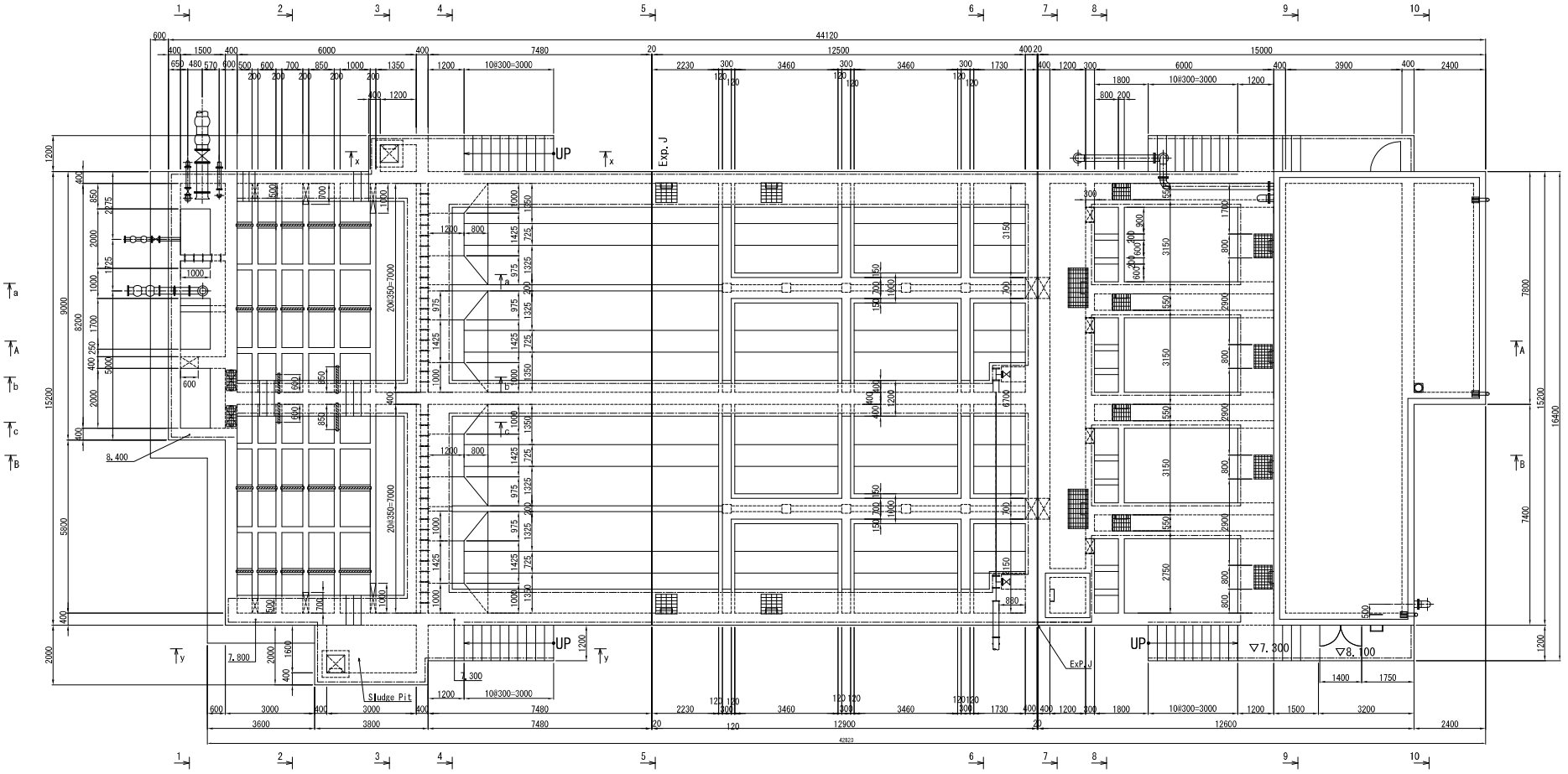


Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approved:	Scale: S=1:600 / Date:	Description: Water Treatment Plant General Plan	Drawing Number: ST-1

FLOW DIAGRAM SVAY RIENG WATER TREATMENT PLANT



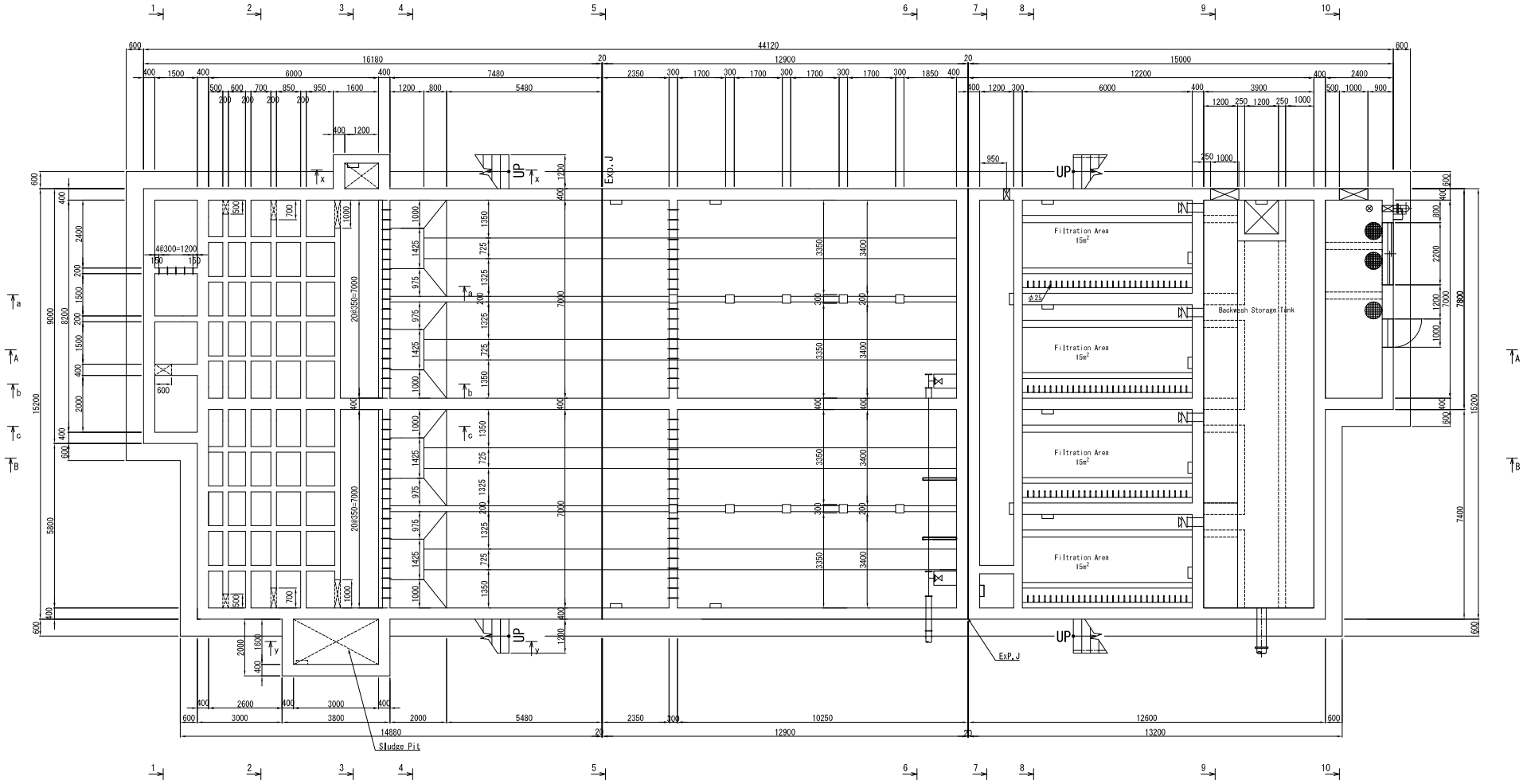
Project	CLIENT	CONSULTANT	Design	Approval	Scale	Description	Drawing Number
The Project for Expansion of Water Supply System in Svay Rieng	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Chief Consultant: Hideki KONNO		NONE Date:	Hydraulic Profile of Svay Rieng Water Treatment Plant	ST-2



Receiving Well & Mxing Well | Flocculation Basin | Sedimentation Basin | Filter Basin

Treatment Facilities PLAN1 (EL 12.200)

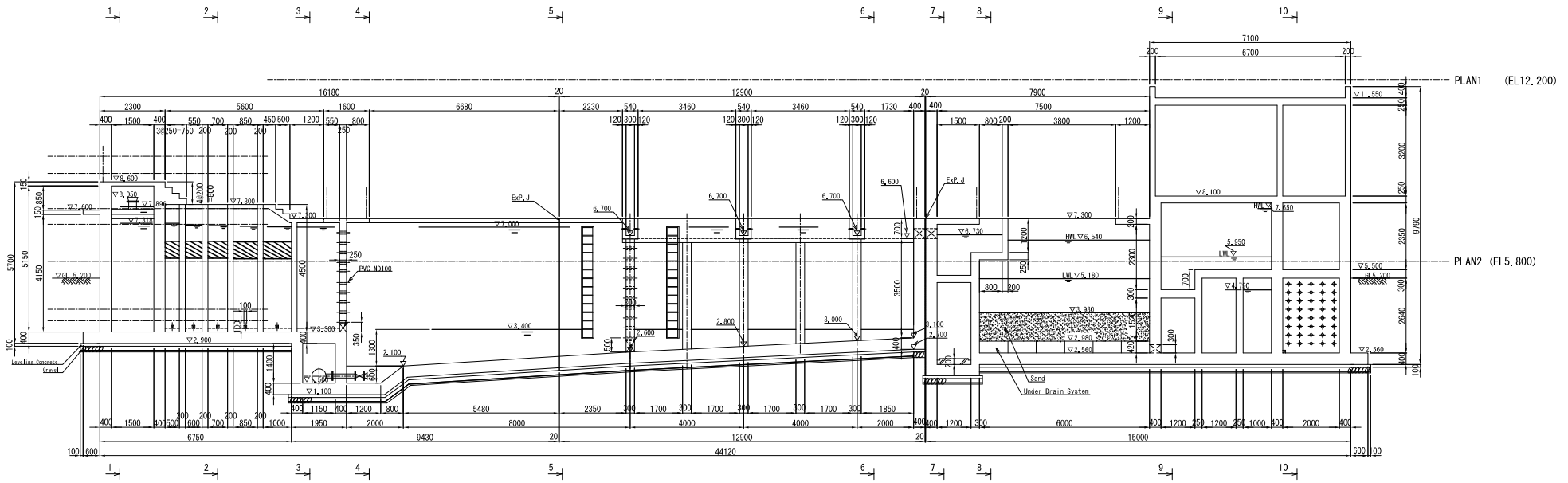
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approval:	Scale: S=1:150 (A3) / Date:	Description: Water Treatment Facilities Structure (1)	Drawing Number: ST-3



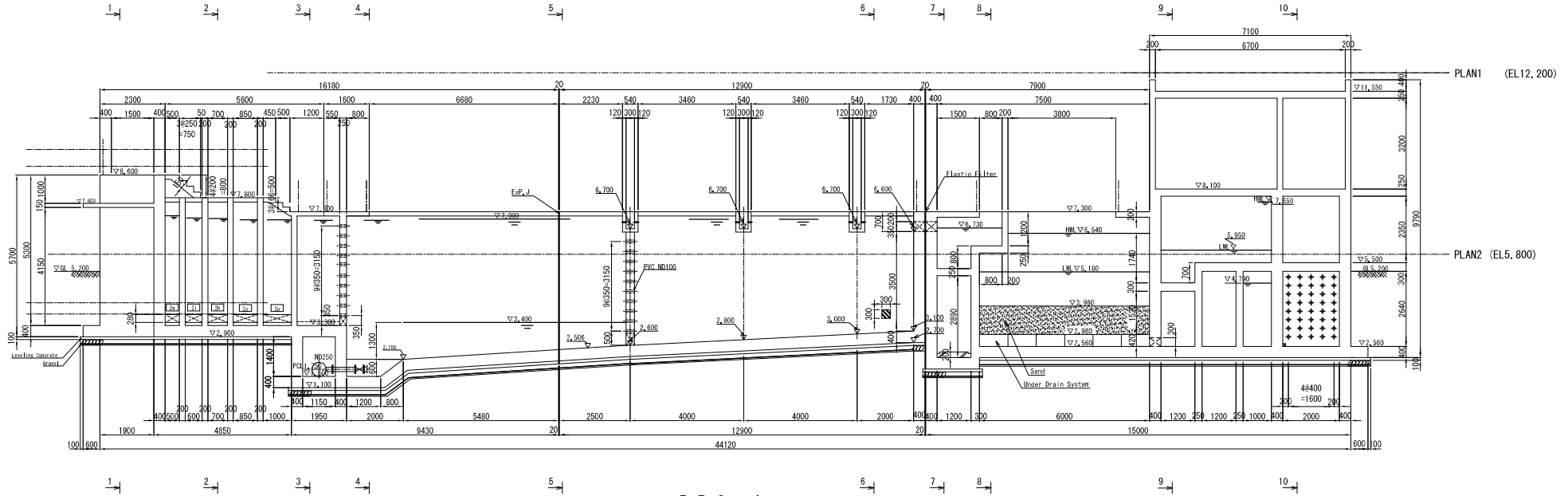
Recieving Well & Flocculation Basin　　Sedimentation Basin　　Filter Basin

Treatment Facilities PLAN2 (EL 5.800)

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approved:	Scale: S=1:150 (A3) / Date:	Description: Water Treatment Facilities Structure (2)	Drawing Number: ST-4

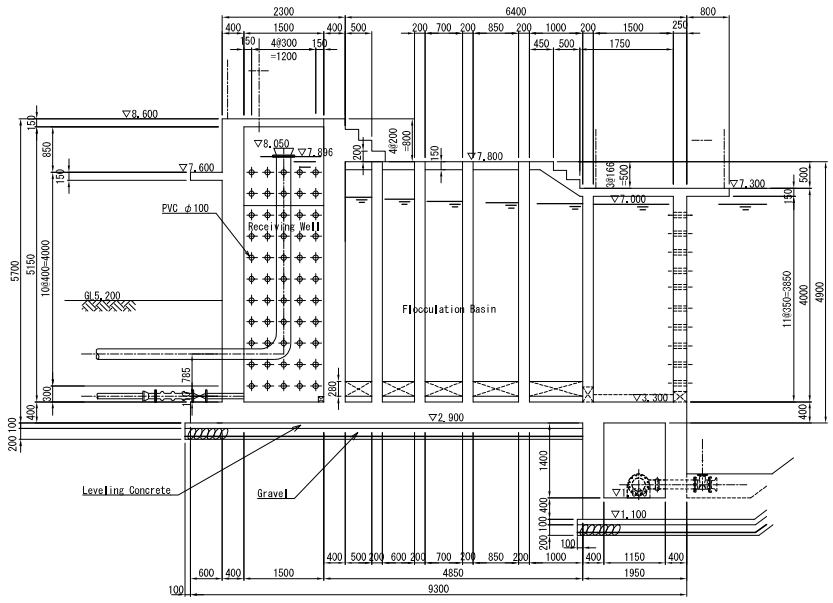


A-A Section

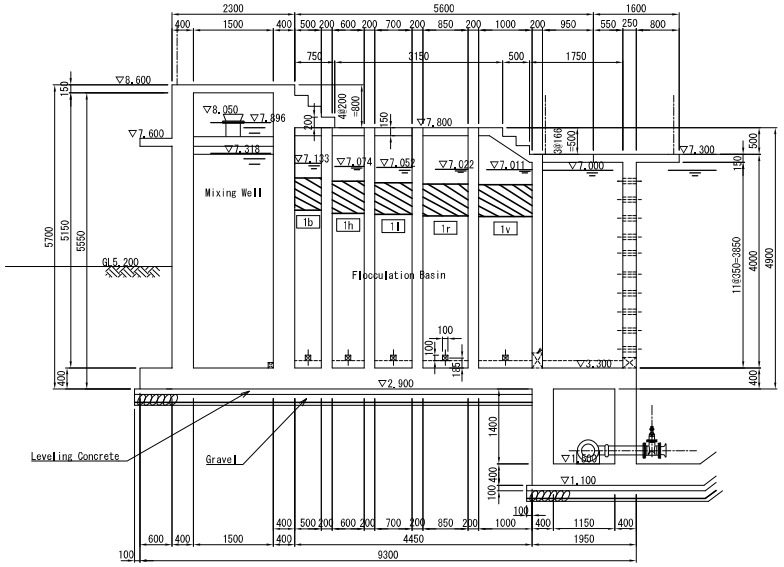


B-B Section

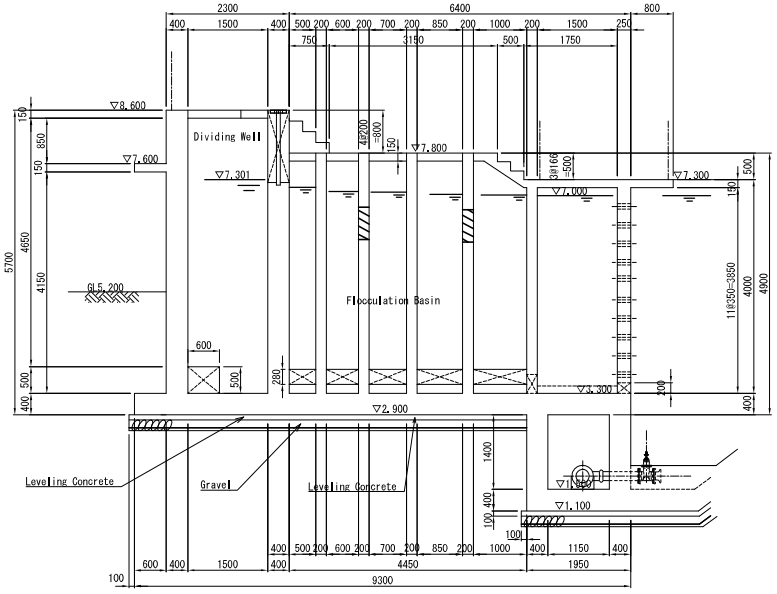
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approved:	Scale: S=1:150 (A3) / Date:	Description: Water Treatment Facilities Structure (3)	Drawing Number: ST-5



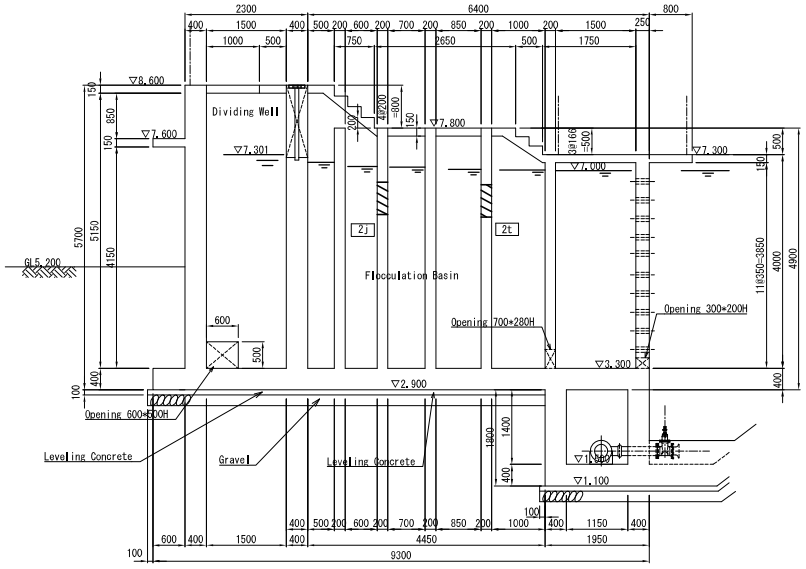
a-a Section



A-A Section

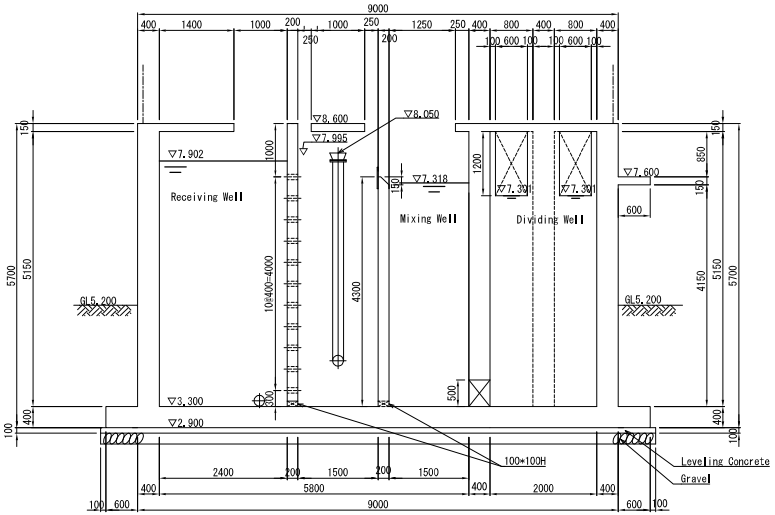


b-b Section

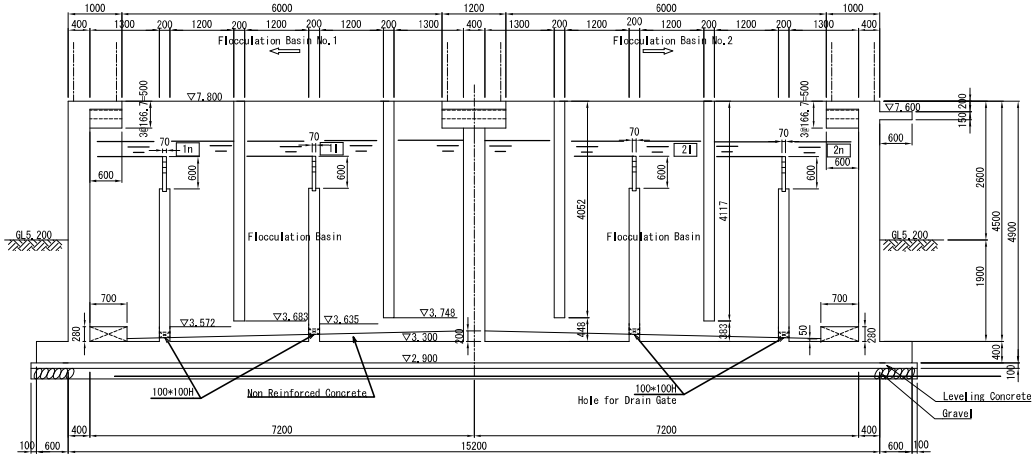


c-c Section

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approved:	Scale: S=1:100 (A3)	Description: Water Treatment Facilities Structure (4)
			Chief Consultant: Hideki KONNO		Date:	Drawing Number: ST-6

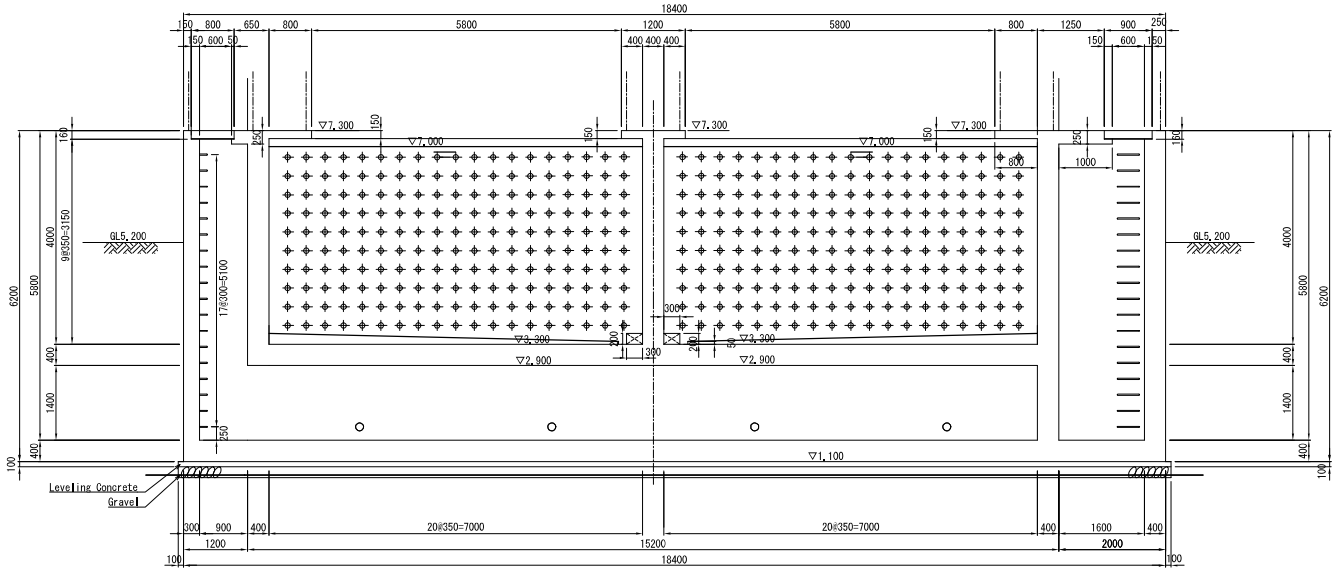


1-1 Section

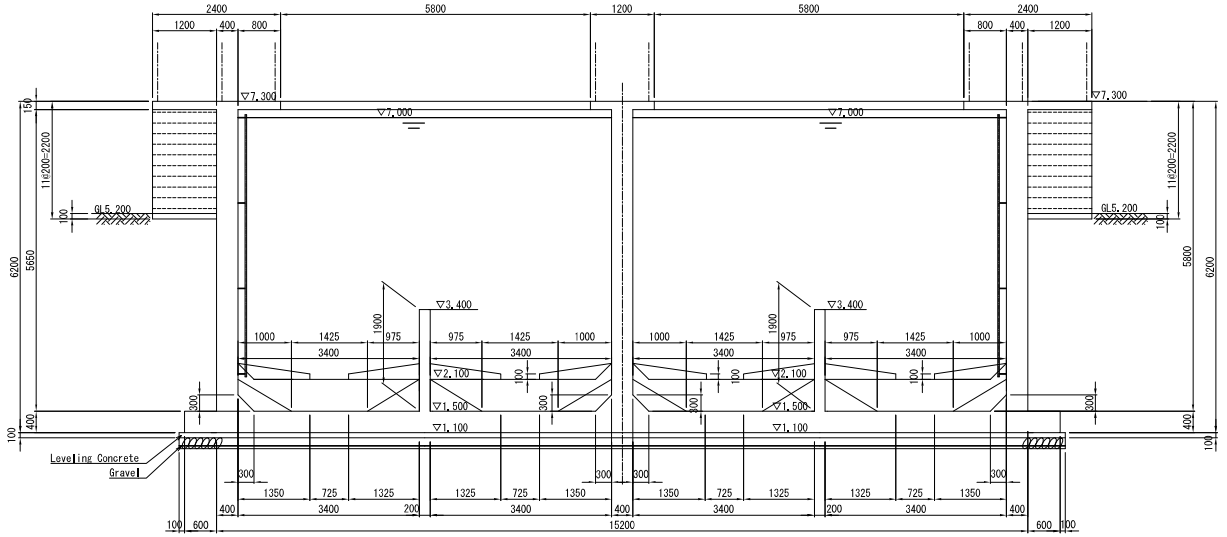


2-2 Section

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: S=1:100 (A3)	Description: Water Treatment Facilities Structure (5)	Drawing Number: ST-7
			Chief Consultant: Hideki KONNO		Date: 13.10.2020		

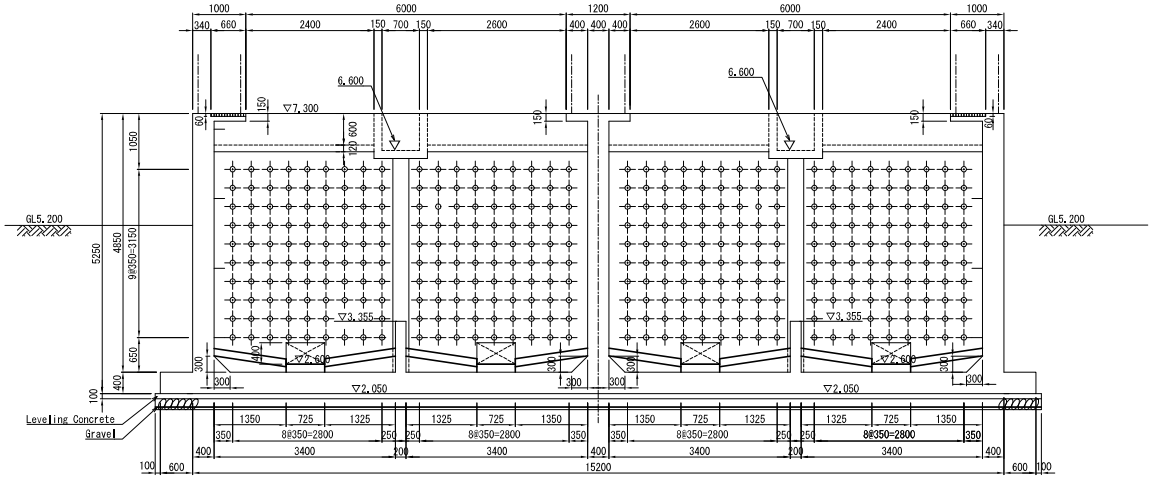


3-3 Section

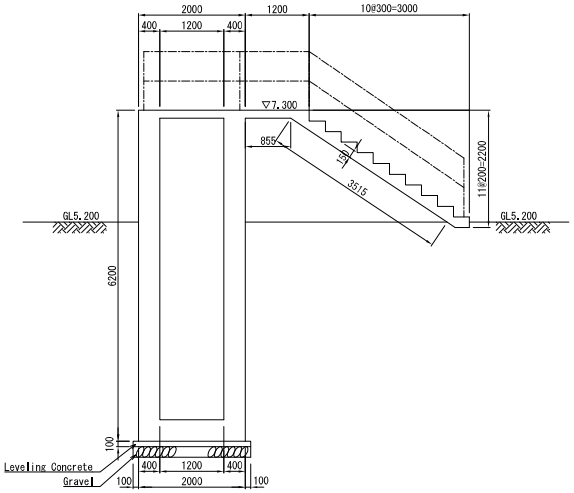


4-4 Section

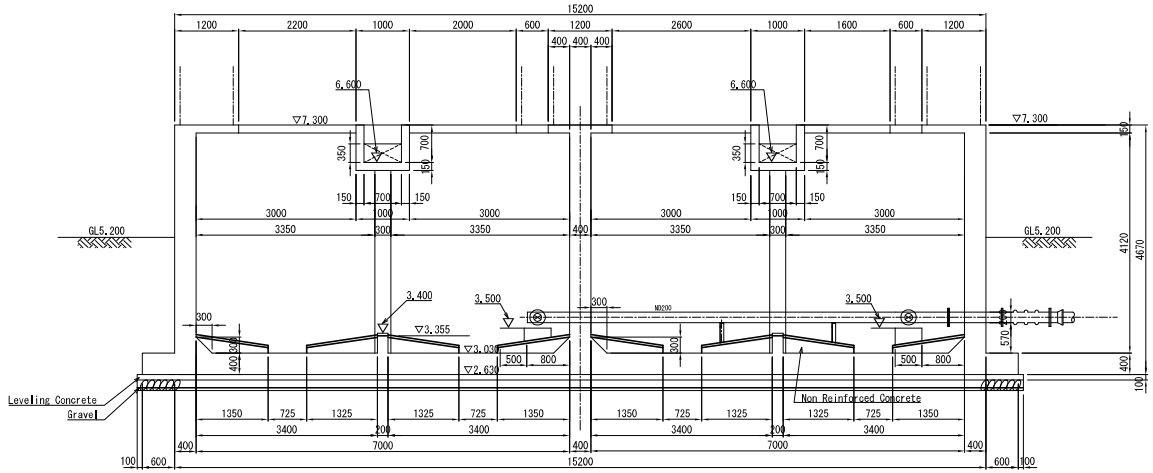
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approved:	Scale: S=1:100 (A3) / Date:	Description: Water Treatment Facilities Structure (6)	Drawing Number: ST-8



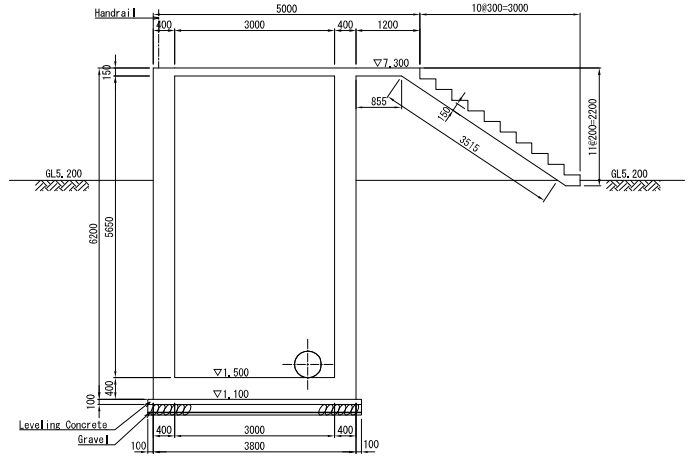
5-5 Section



x-x Section

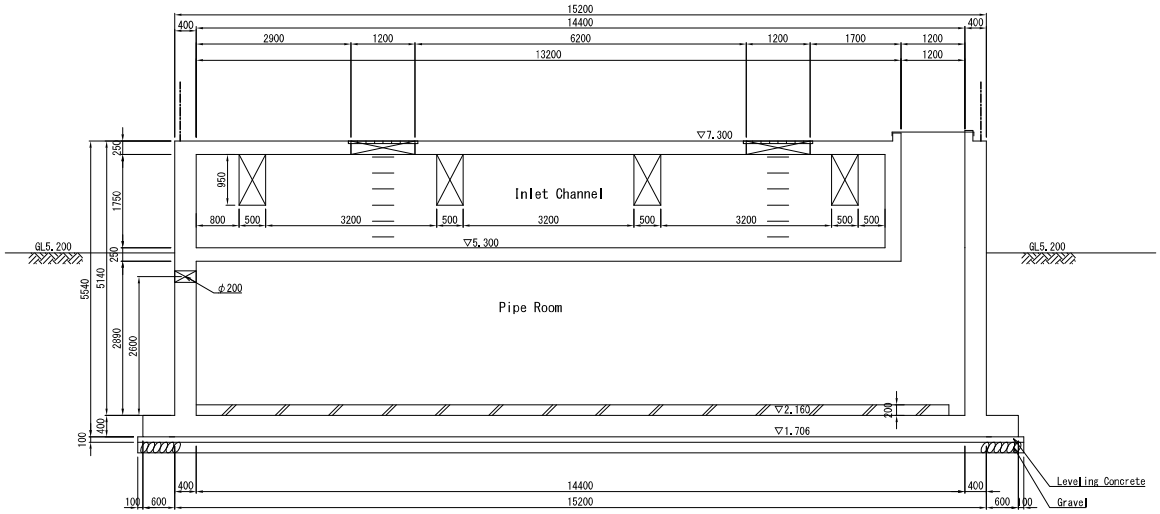


6-6 Section

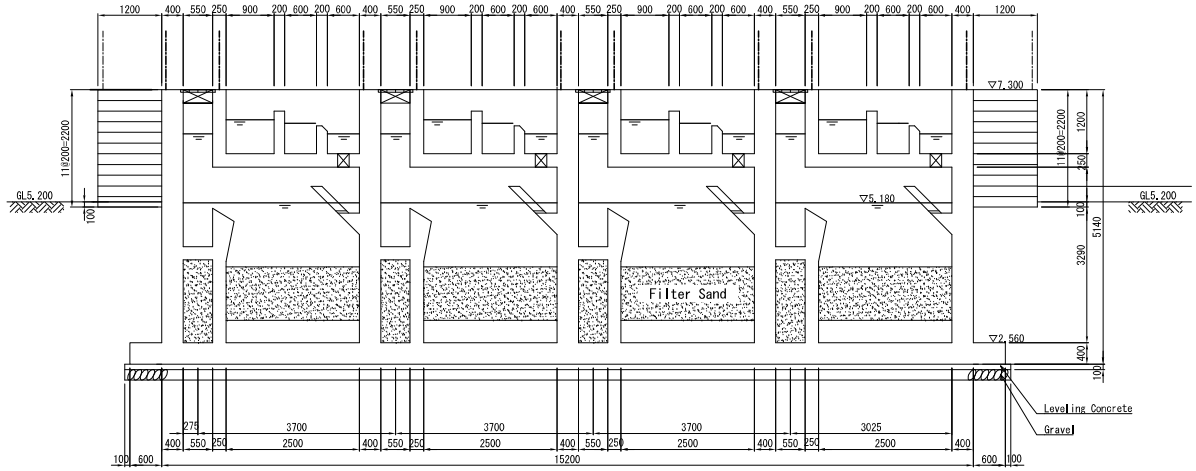


y-y Section

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approved:	Scale: S=1:100 (A3) / Date:	Description: Water Treatment Facilities Structure (7)	Drawing Number: ST-9

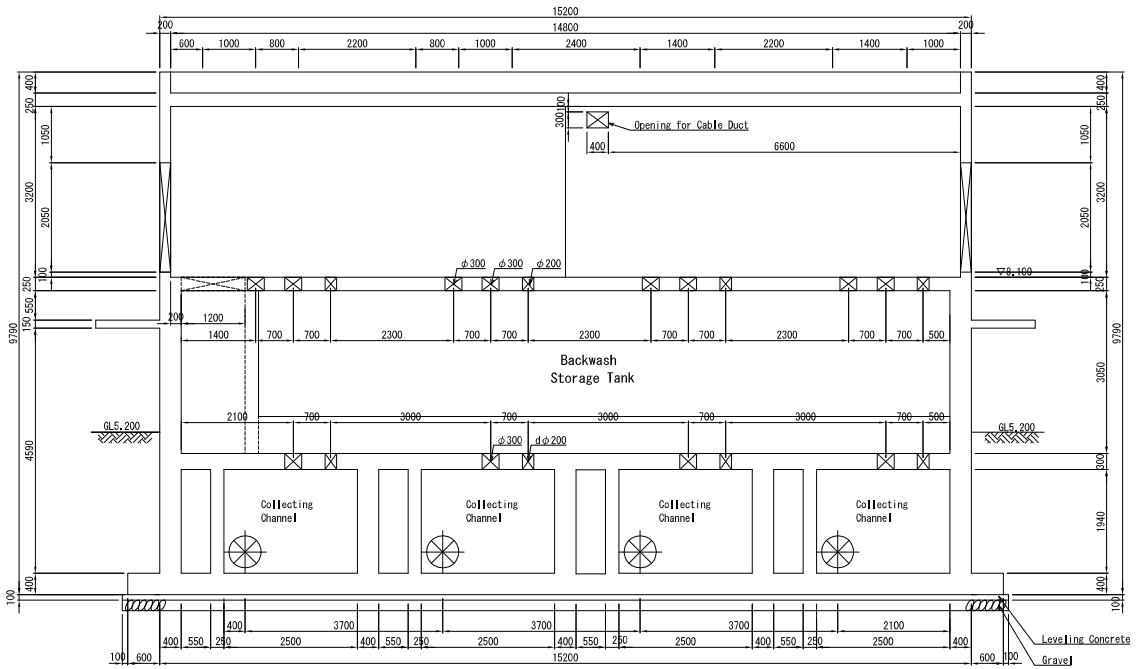


7-7 Section

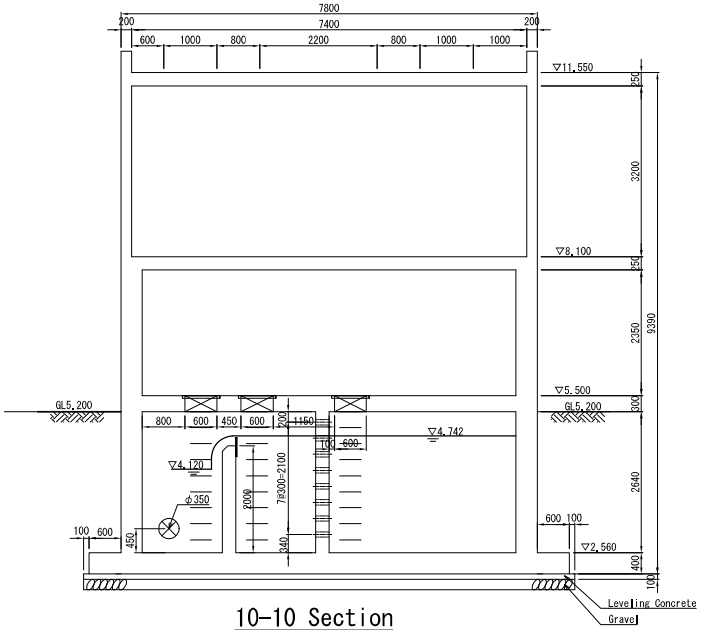


8-8 Section

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approved:	Scale: S=1:100 (A3)	Description: Water Treatment Facilities Structure (8)	Drawing Number: ST-10
			Chief Consultant: Hideki KONNO		Date:		

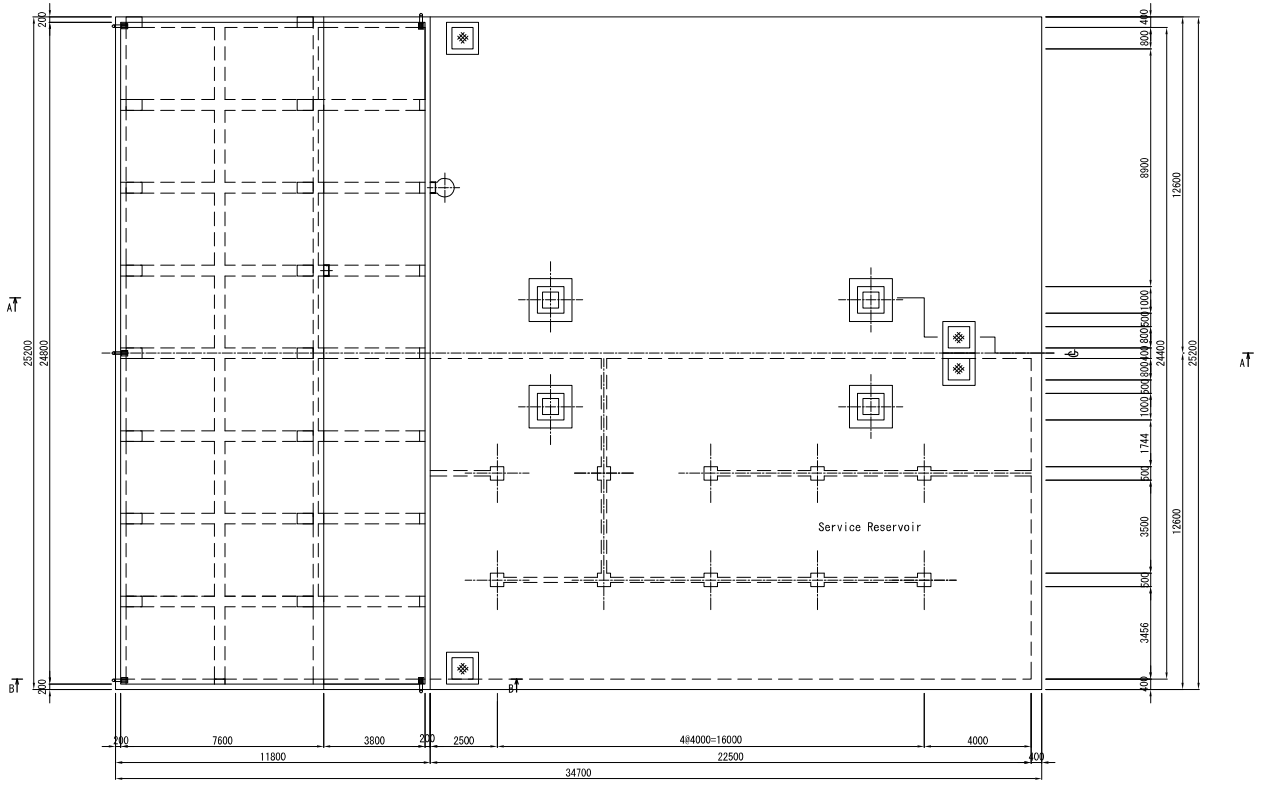


9-9 Section

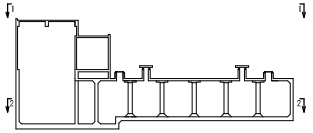


10-10 Section

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approved:	Scale: S=1:100 (A3) / Date:	Description: Water Treatment Facilities Structure (9)	Drawing Number: ST-11

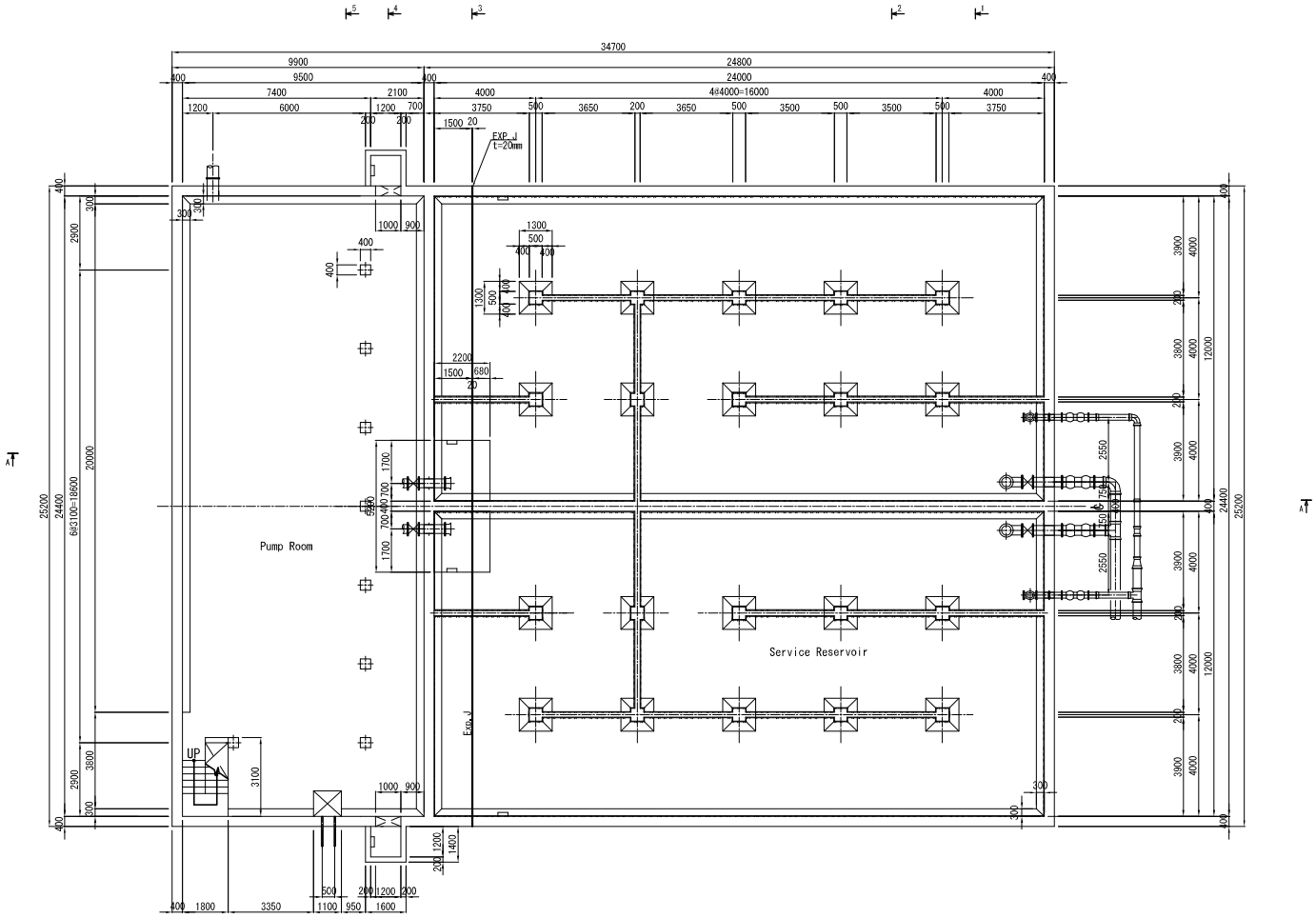


PLAN 1 (EL12.200)

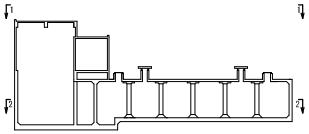


Key Plan

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approved:	Scale: S=1:200 (A3) / Date:	Description: Service Reservoir and Pumping Station Structure (1)	Drawing Number: ST-12

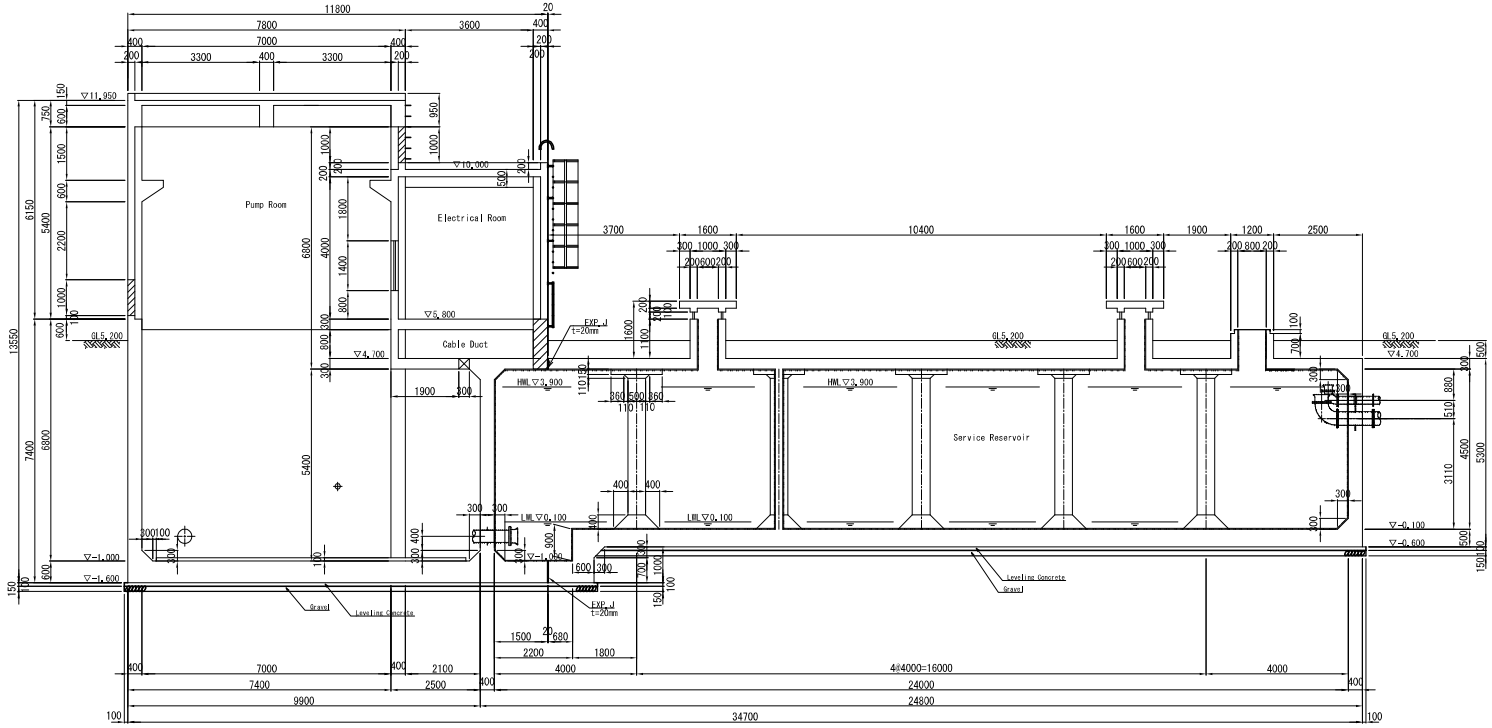


PLAN 2 (EL0. 700)



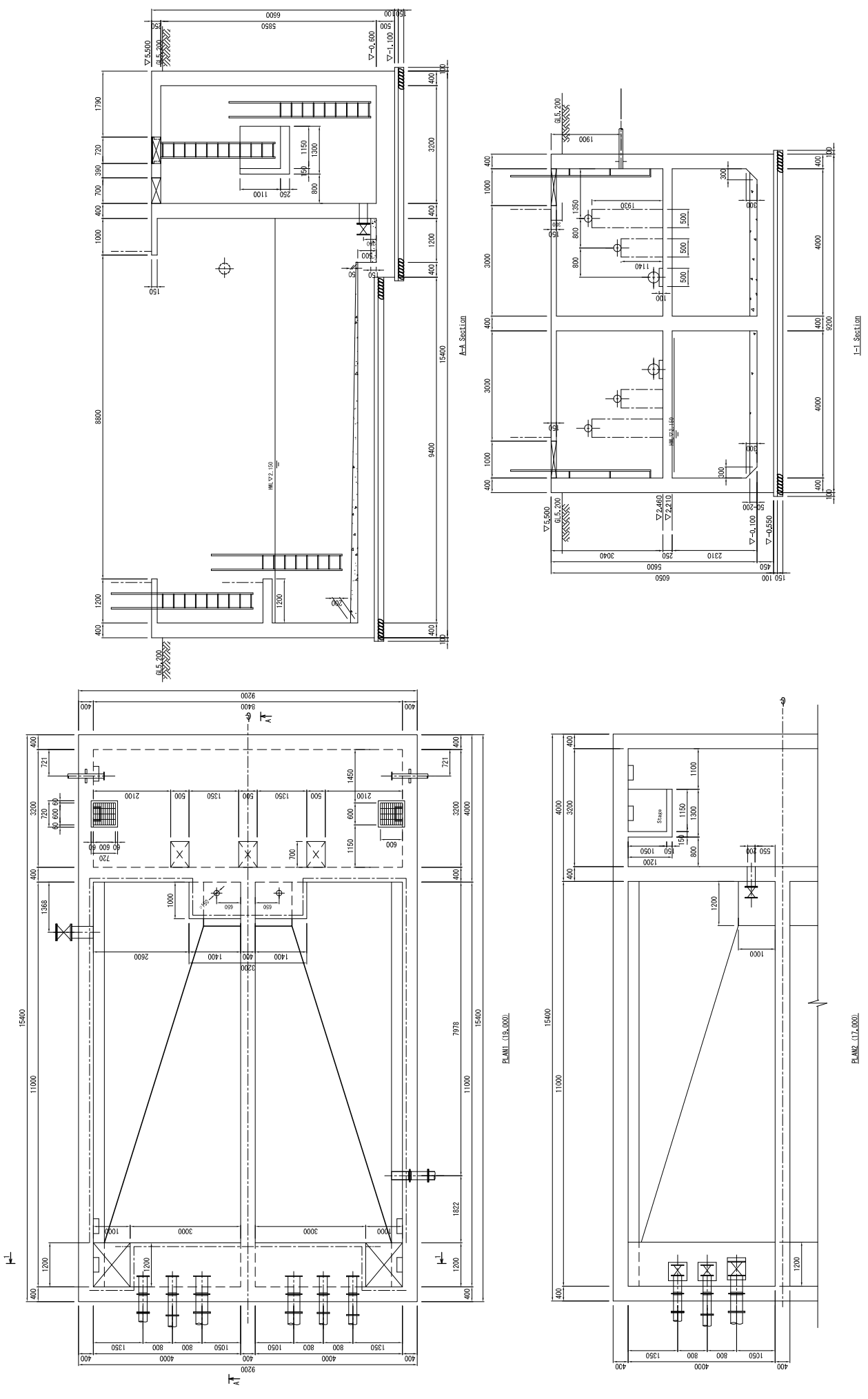
Key Plan

Project:	CLIENT:	CONSULTANT:	Design:	Approval:	Scale:	Description:	Drawing Number:
The Project for Expansion of Water Supply System in Svay Rieng	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Chief Consultant: Hideki KONNO		S=1:200 (A3) Date:	Service Reservoir and Pumping Station Structure (2)	ST-13



A-A Section

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewerage Bureau, City of Kitakyushu and Pacific Consultants International Co., Ltd.	Design:	Approved:	Scale: S=1:150 (A3)	Description: Service Reservoir and Pumping Station Structure (3)	Drawing Number: ST-14
			Chief Consultant: Hideki KONNO		Date:		



Project: The Project for Expansion of Water Supply System in Svay Rieng

Client: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia

Consultant: The Joint Venture of CTI Engineering International Co., Ltd. Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.

Design: Chief Consultant: Hideki KONNO

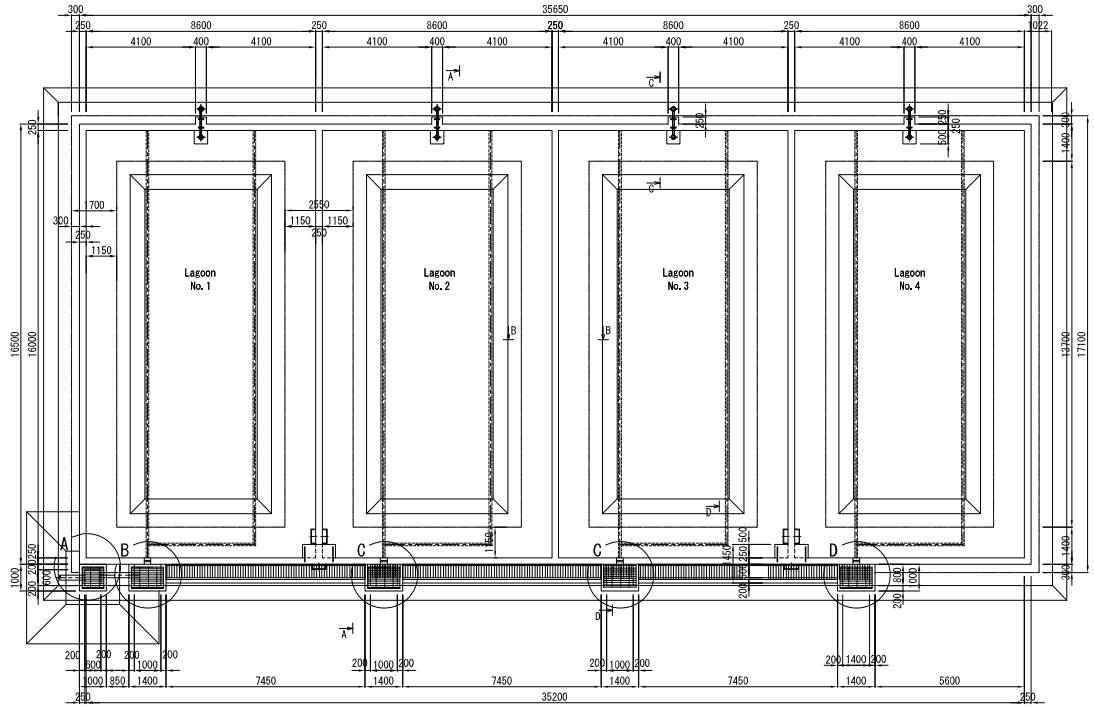
Approved:

Scale: S=1:100 (A3)

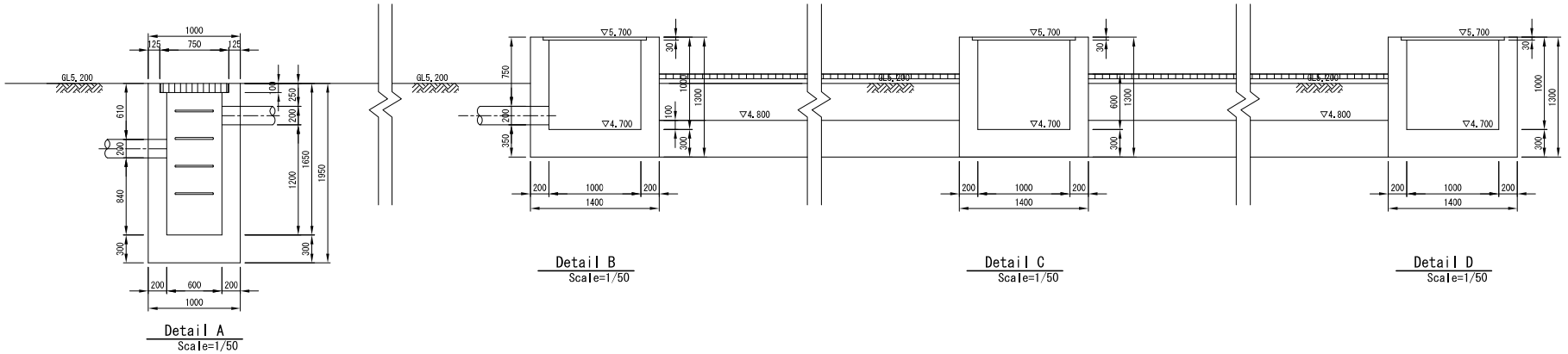
Date:

Description: Drainage Basin Structure

Drawing Number: ST-15



PLAN
Scale=1/200



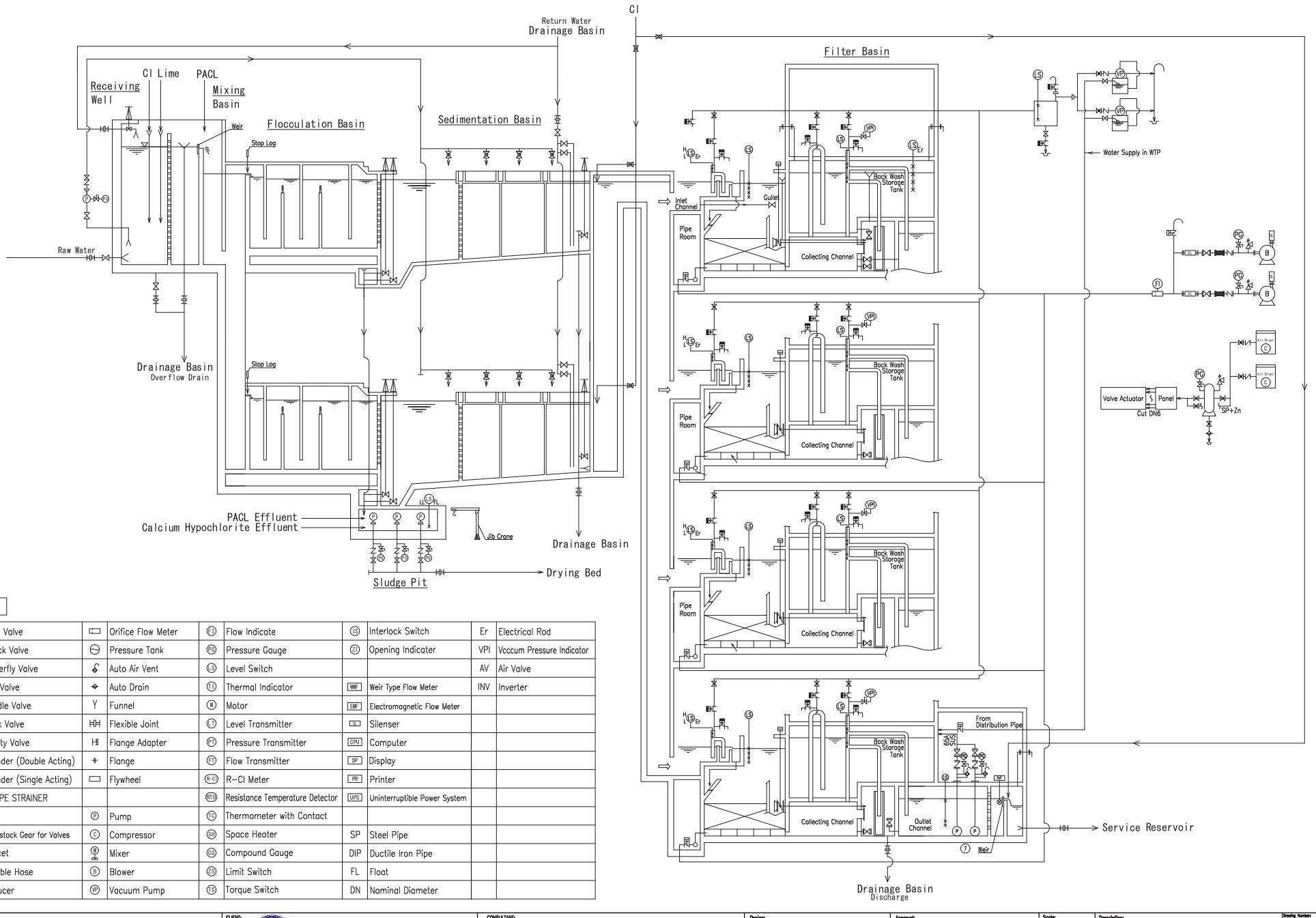
Detail A
Scale=1/50

Detail B
Scale=1/50

Detail C
Scale=1/50

Detail D
Scale=1/50

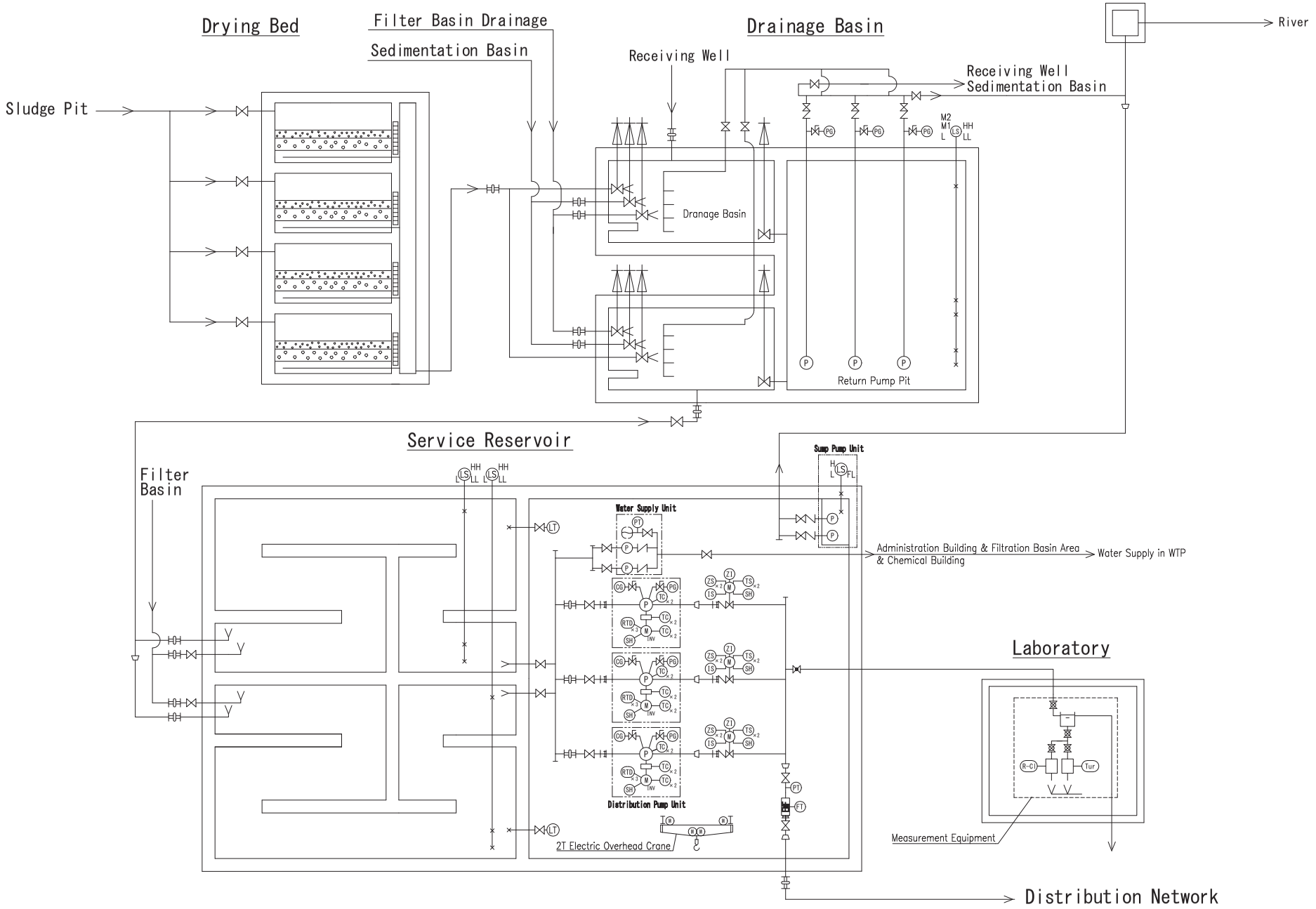
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approved:	Scale: S=1:200, 1:50 (A3)	Description: Drying Bed Structure	Drawing Number: ST-16
			Chief Consultant: Hideki KONNO		Date:		



LEGEND

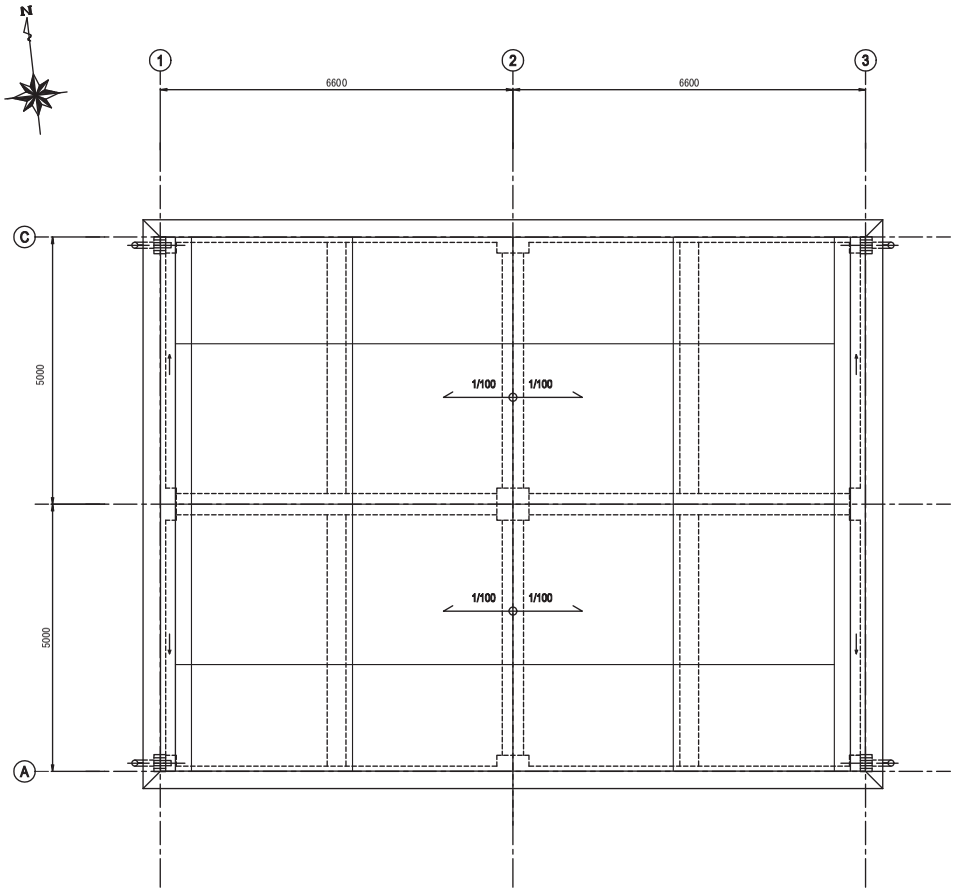
	Gate Valve		Orifice Flow Meter	FI	Flow Indicate	LS	Interlock Switch	Er	Electrical Rod
	Check Valve		Pressure Tank	PG	Pressure Gauge	ZI	Opening Indicator	VPI	Vcccum Pressure Indicator
	Butterfly Valve		Auto Air Vent	LS	Level Switch			AV	Air Valve
	Ball Valve		Auto Drain	TI	Thermal Indicator	WMF	Weir Type Flow Meter	INV	Inverter
	Needle Valve		Funnel	M	Motor	EMF	Electromagnetic Flow Meter		
	Cock Valve		Flexible Joint	LT	Level Transmitter	SL	Silenser		
	Safety Valve		Flange Adapter	PT	Pressure Transmitter	CPU	Computer		
	Cylinder (Double Acting)		Flange	FT	Flow Transmitter	DP	Display		
	Cylinder (Single Acting)		Flywheel	R-Cl	R-Cl Meter	PR	Printer		
	Y TYPE STRAINER			RTD	Resistance Temperature Detector	UPS	Uninterruptible Power System		
	Gate	P	Pump	TC	Thermometer with Contact				
	Headstock Gear for Valves	C	Compressor	SH	Space Heater	SP	Steel Pipe		
	Faucet	M	Mixer	CG	Compound Gauge	DIP	Ductile Iron Pipe		
	Flexible Hose	B	Blower	LS	Limit Switch	FL	Float		
	Reducer	VP	Vacuum Pump	TS	Torque Switch	DN	Nominal Diameter		

Project: The Project for Expansion of Water Supply System in Pursat	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approval:	Scale: NONE / Date:	Description: Water Treatment Plant Process Flow Diagram (1) / Drawing Number: ST-17

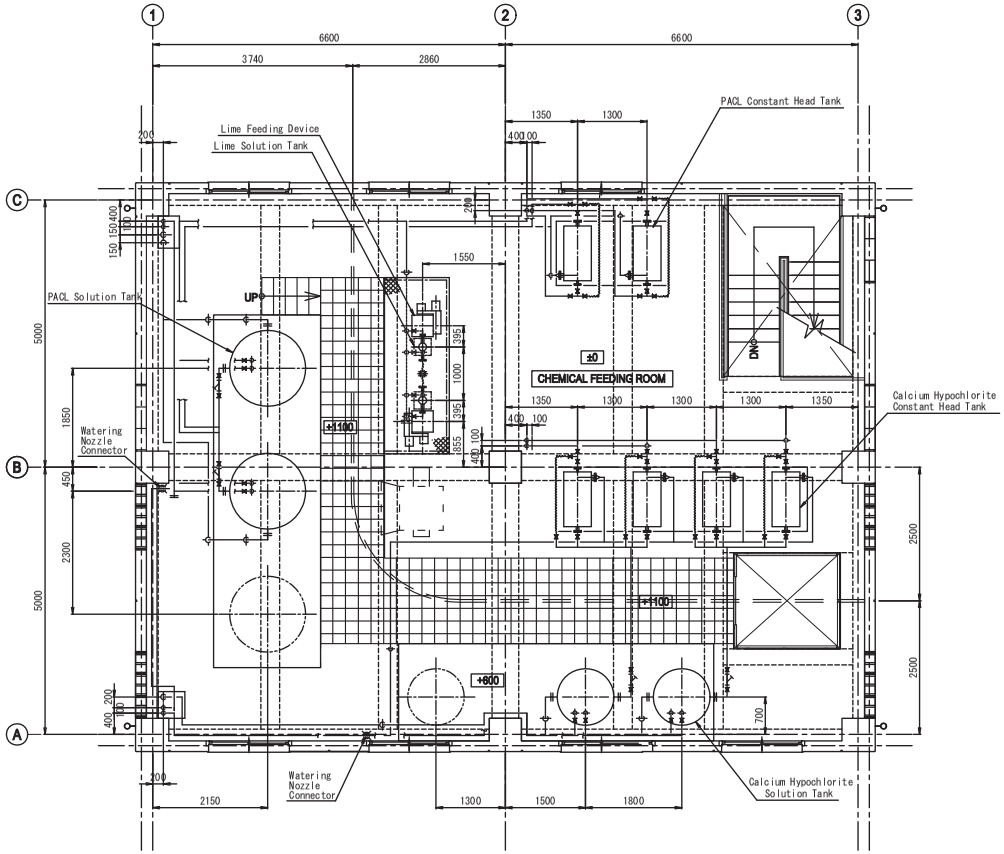


A-171

Project: The Project for Expansion of Water Supply System in Pursat	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Designe: Chief Consultant: Hideki KONNO	Approval:	Scale: NONE Date:	Description: Water Treatment Plant Process Flow Diagram (2)	Drawing Number: ST-18

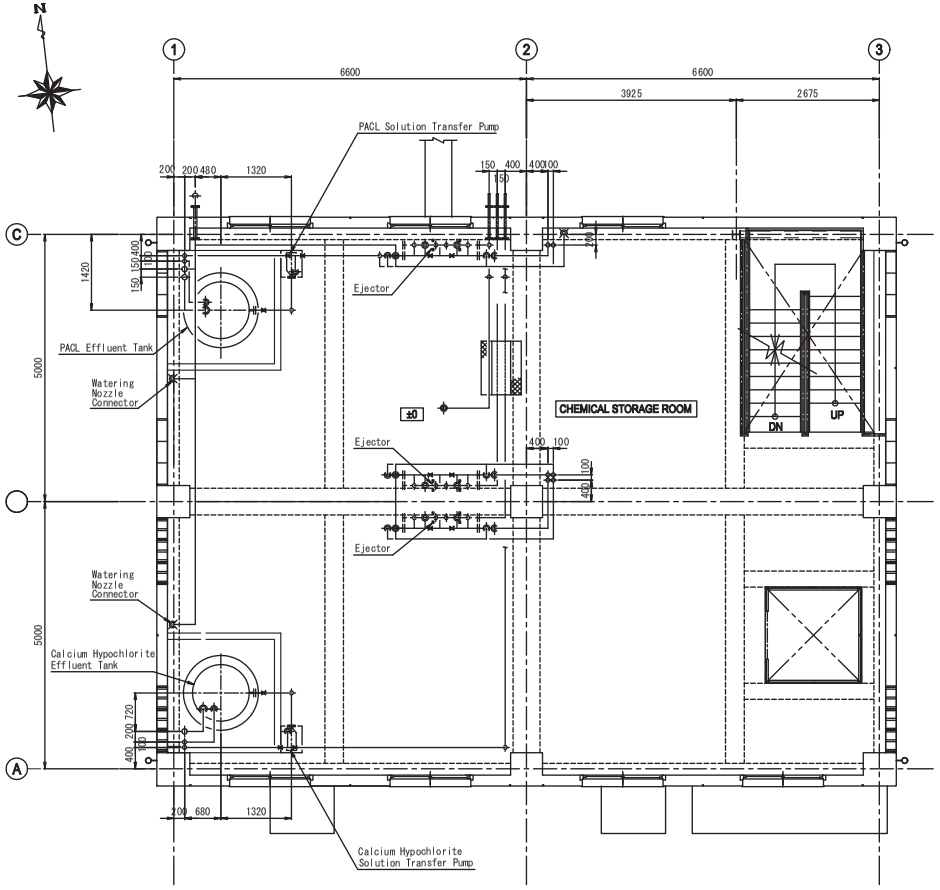


PLAN (GL+11350)

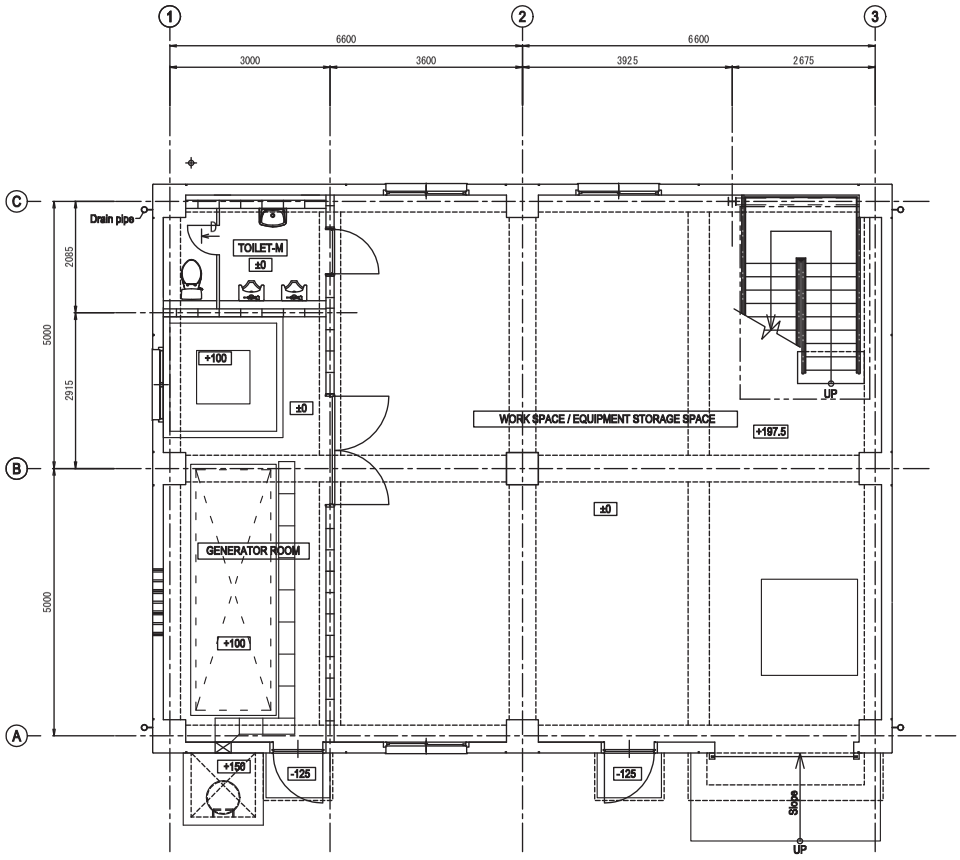


PLAN (GL+7200)

Project: The Project for Expansion of Water Supply System in Pursat	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Designr: Chief Consultant: Hideki KONNO	Approval:	Scale: S=1:100 (A3) Date:	Description: Chemical Feeding Facility Plan (1)	Drawing Number: ST-19

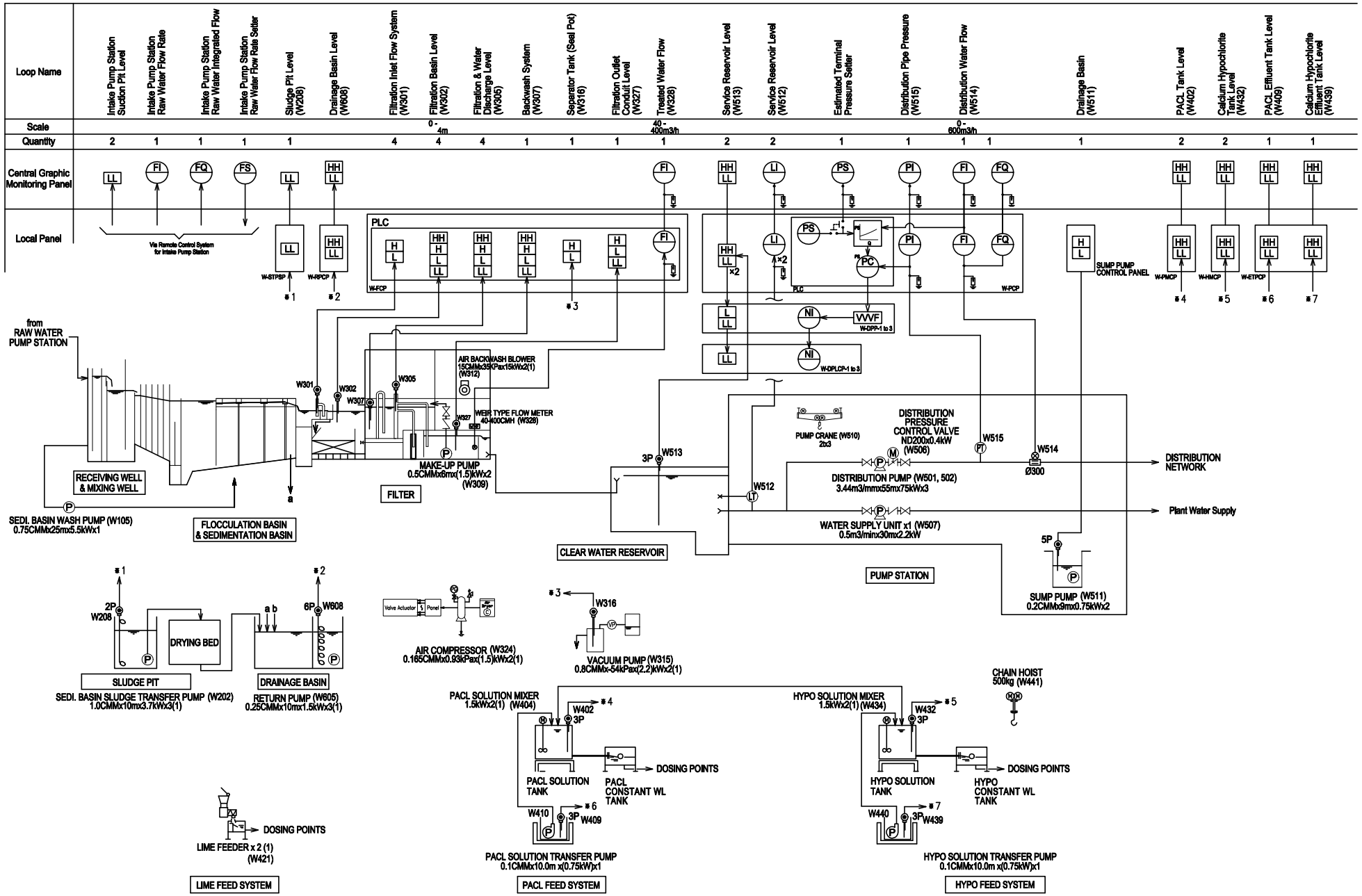


PLAN (GL+4200)

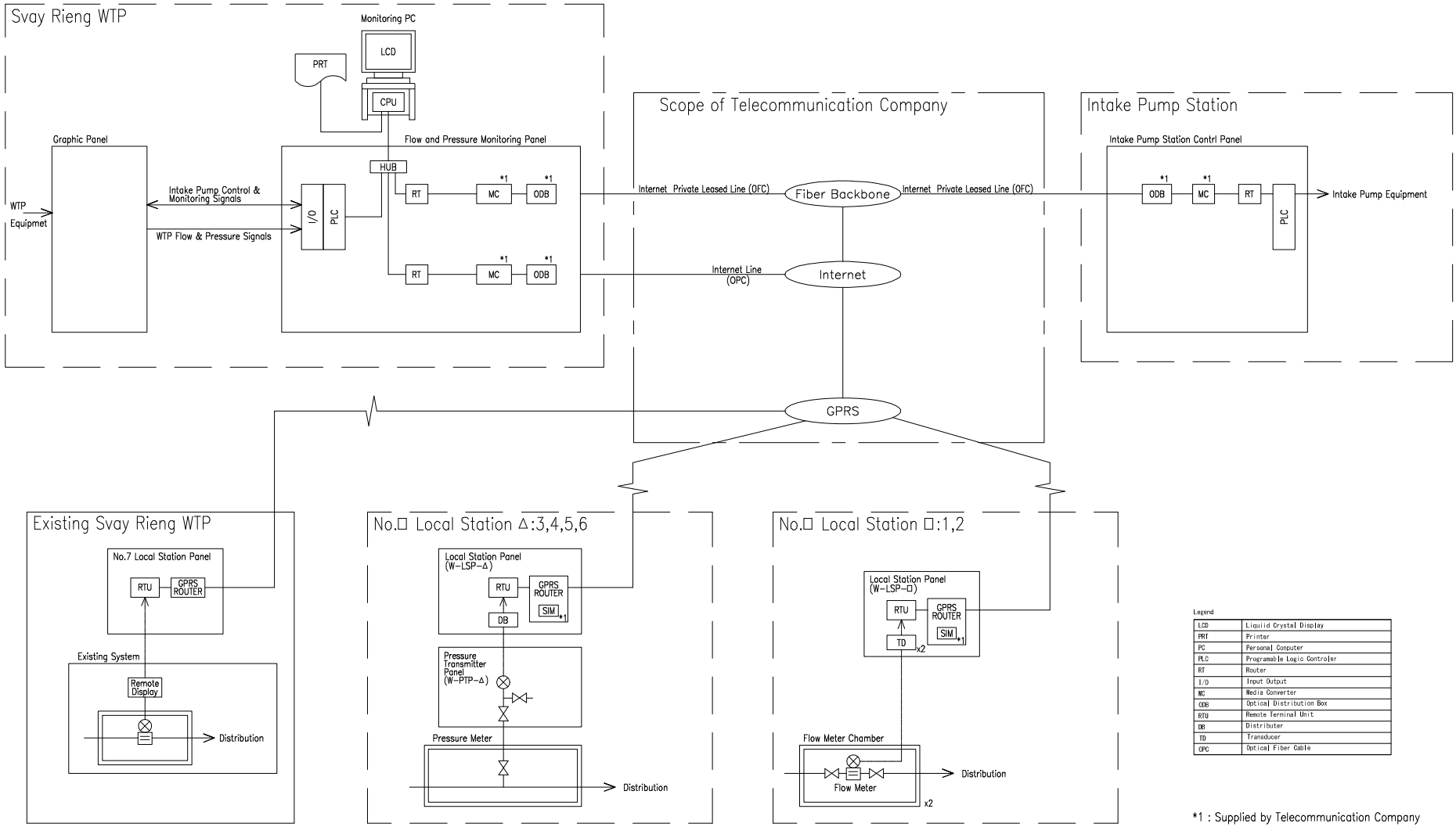


PLAN (GL+250)

Project:	CLIENT:	CONSULTANT:	Design:	Approval:	Scale:	Description:	Drawing Number:
The Project for Expansion of Water Supply System in Pursat	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Chief Consultant: Hideki KONNO		S=1:100 (A3) Date:	Chemical Feeding Facility Plan (2)	ST-20



Project: The Project for Expansion of Water Supply System in SVR	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: Chief Consultant: Hideki KONNO	Approved:	Scale: NONE Date:	Description: Instrument & Control Flow Diagram	Drawing Number: ST-21

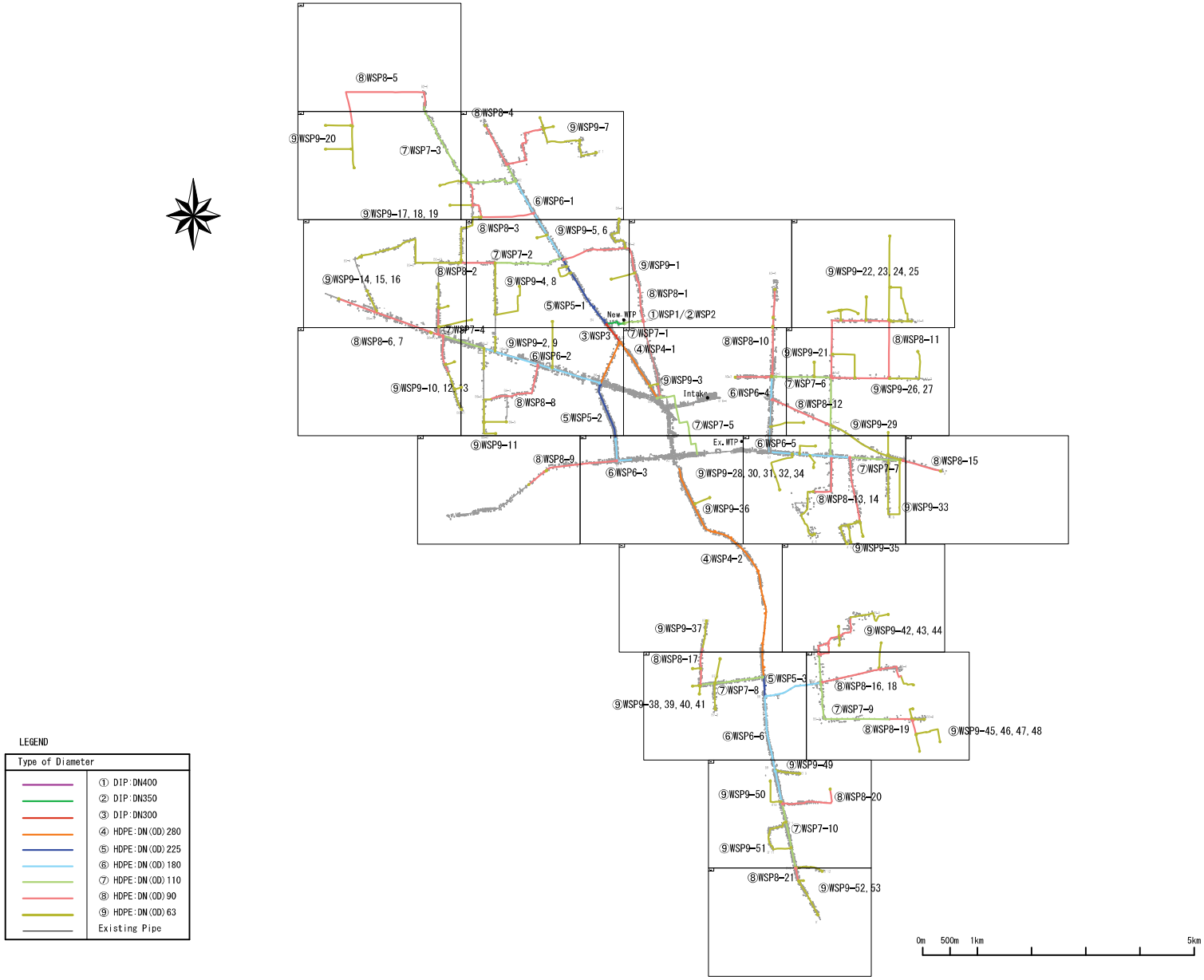


Legend

LCD	Liquiid Crystal Display
PRT	Printer
PC	Personal Computer
PLC	Programable Logic Controler
RT	Router
I/O	Input Output
MC	Media Converter
ODB	Optical Distribution Box
RTU	Remote Terminal Unit
DB	Distributer
TD	Transducer
OPC	Optical Fiber Cable

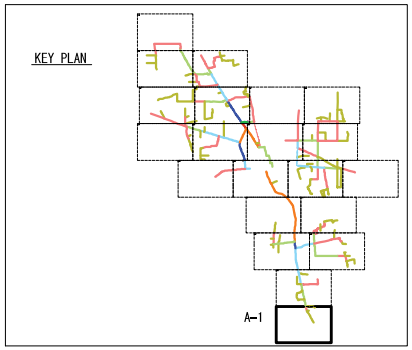
*1 : Supplied by Telecommunication Company

Project: The Project for Expansion of Water Supply System in SVR	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: Chief Consultant: Hideki KONNO	Approval:	Scale: NONE Date:	Description: Intake PS Monitoring System & Distribution Monitoring System Diagram	Drawing Number: ST-22

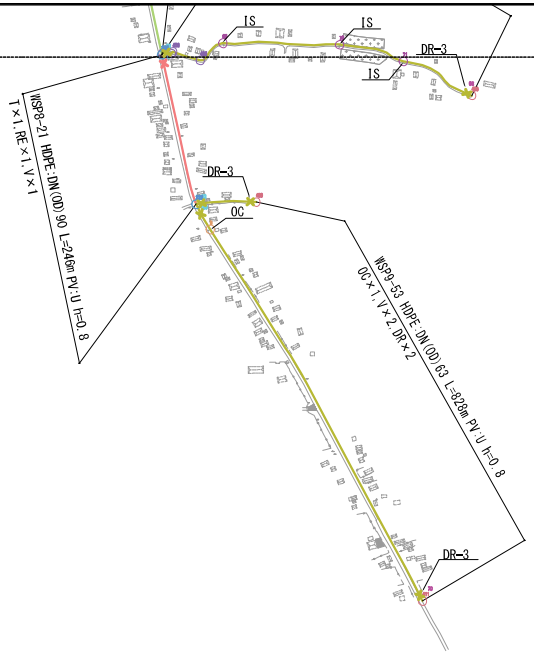


Project:	CLIENT:	CONSULTANT:	Design:	Approval:	Scale:	Description:	Drawing Number:
The Project for Expansion of Water Supply System in Svay Rieng	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Chief Consultant: Hideki KONNO		Date:	Location Map for Distribution Pipeline	SD-1

A-1

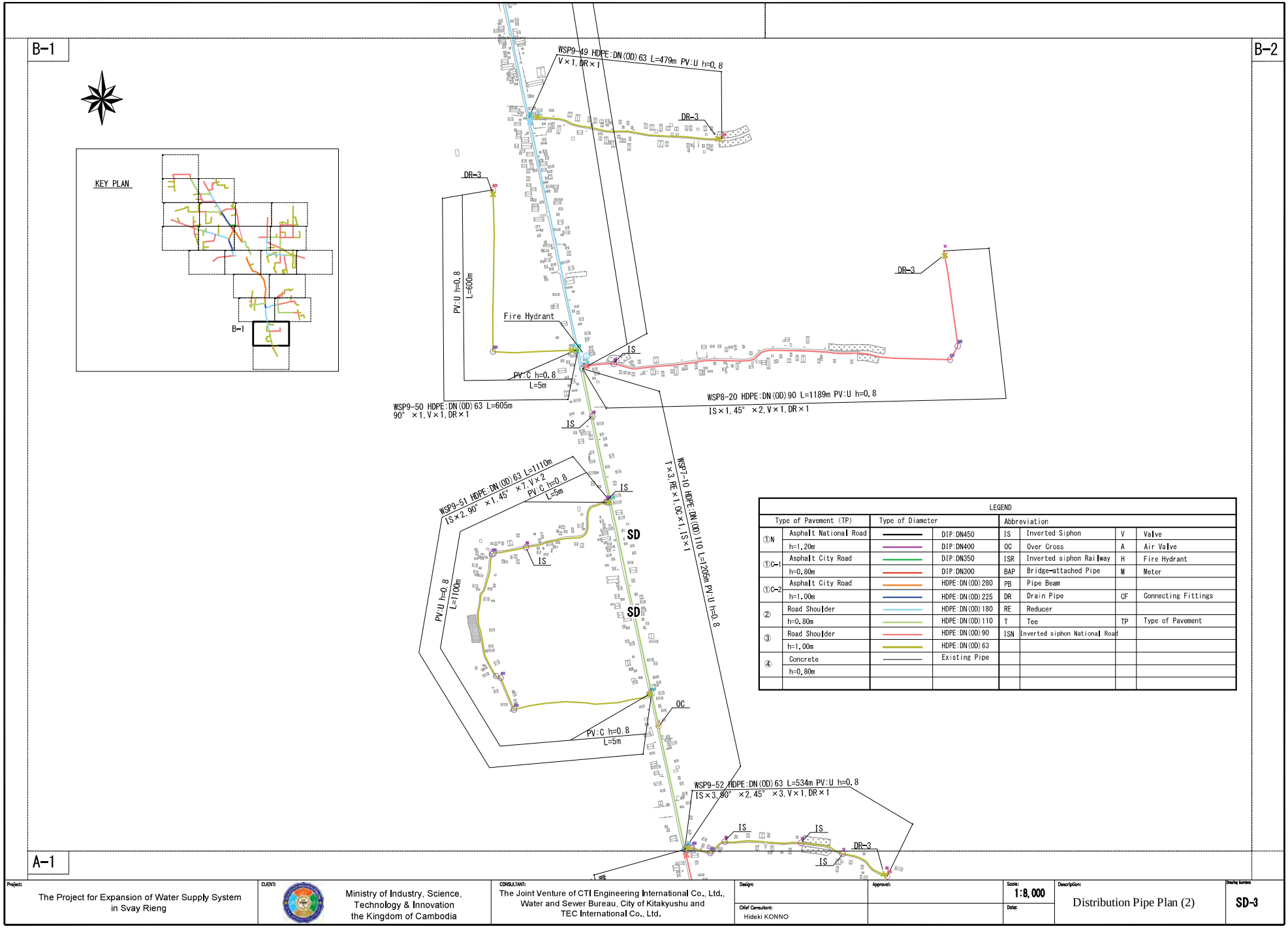


Location Map for
Distribution Pipeline



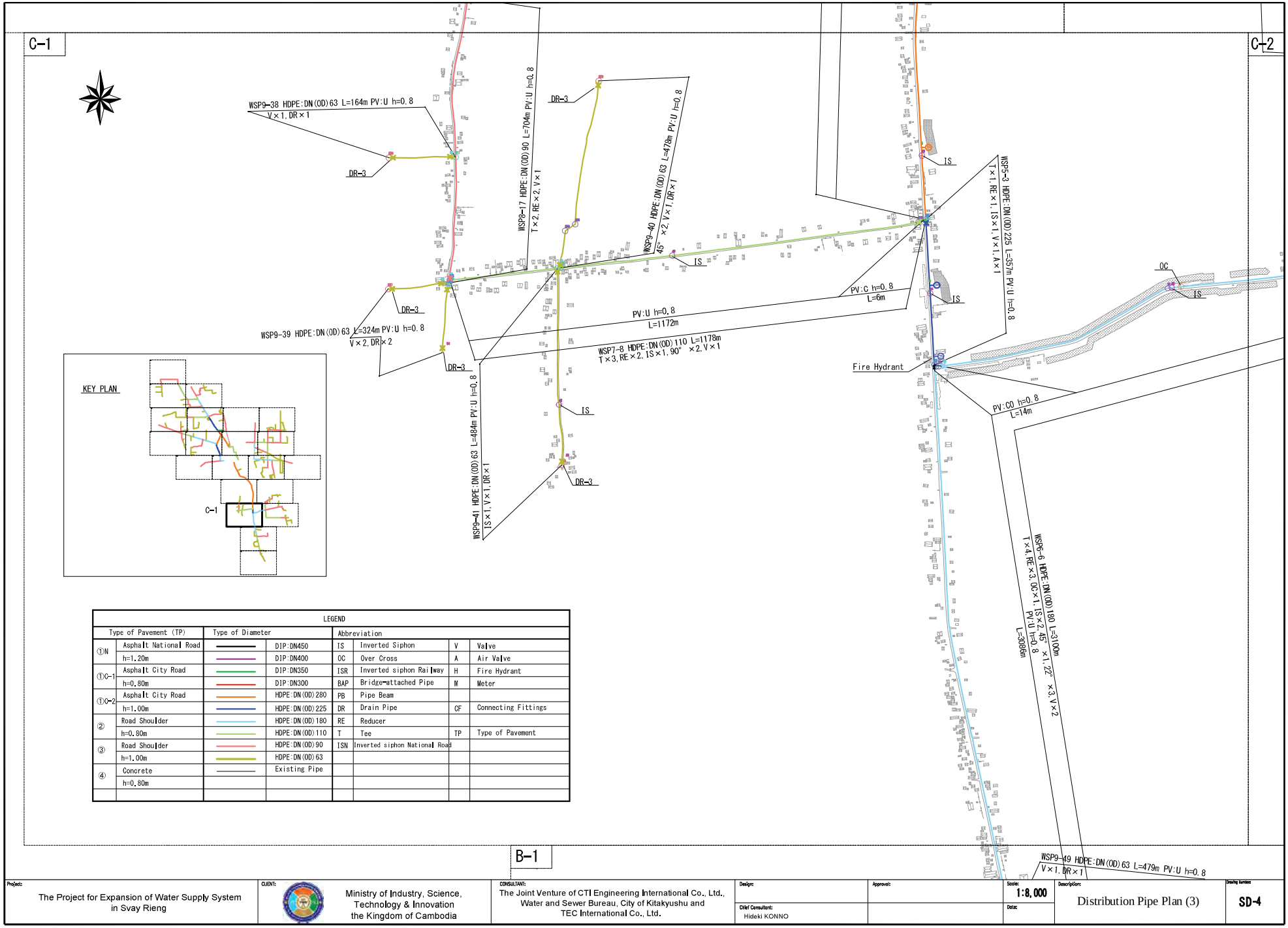
LEGEND								
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer		
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m		HDPE:DN(OD)63				
④	Concrete		Existing Pipe				
	h=0.80m						

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approved:	Scale: 1:8,000	Description: Distribution Pipe Plan (1)	Drawing Number: SD-2
			Chief Consultant: Hideki KONNO		Date:		



A-178

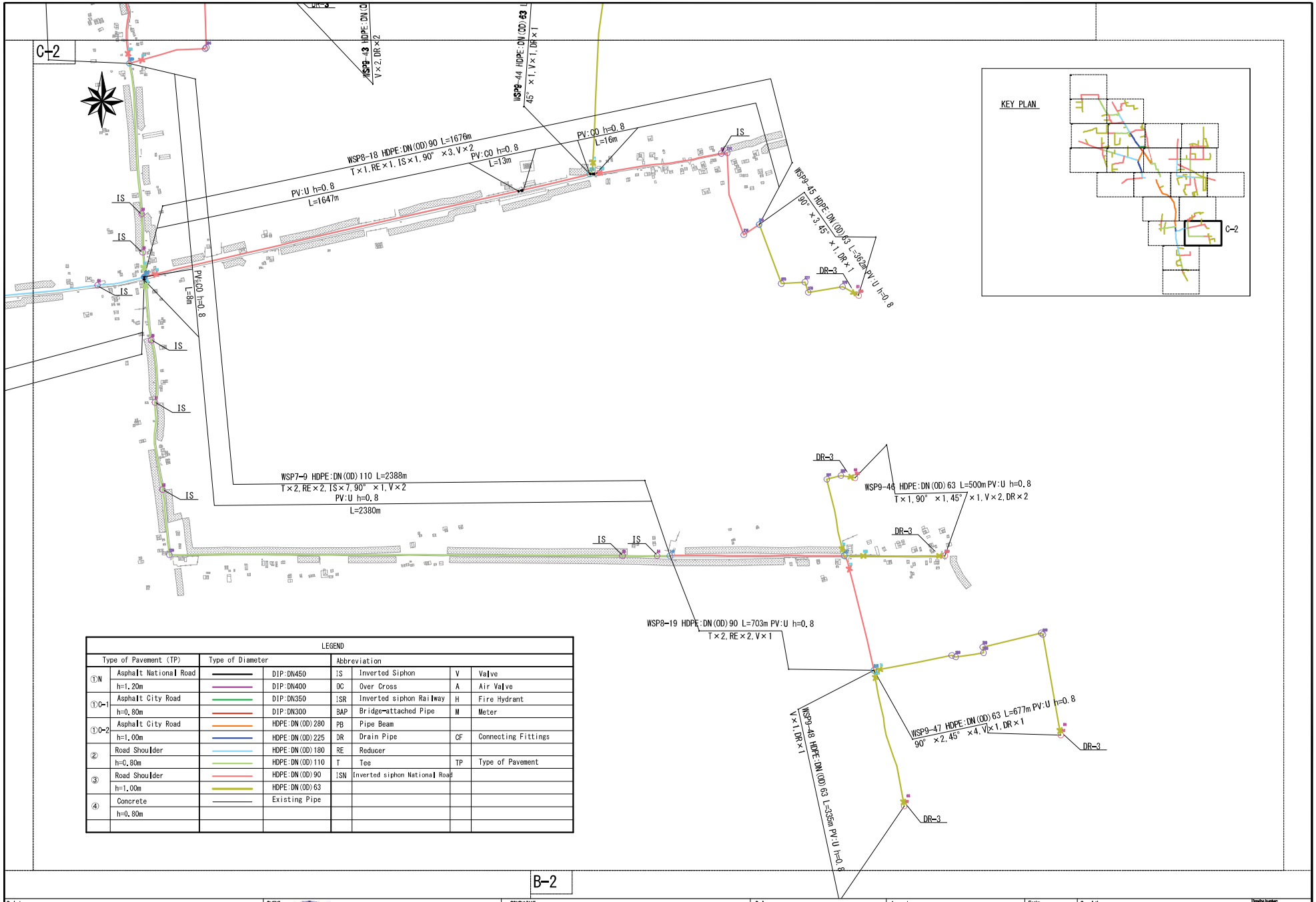
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (2)	Drawing Number: SD-3
			Chief Consultant: Hideki KONNO		Date:		



LEGEND

Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer		
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m		HDPE:DN(OD)63				
④	Concrete		Existing Pipe				
	h=0.80m						

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Designr: / Chief Consultant: Hideki KONNO	Approval:	Scale: 1:8,000 / Date:	Description: Distribution Pipe Plan (3) / Drawing Number: SD-4



LEGEND

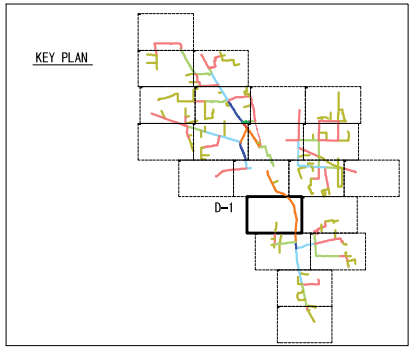
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road	DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m	DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road	DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m	DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road	HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m	HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder	HDPE:DN(OD)180	RE	Reducer		
	h=0.80m	HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder	HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m	HDPE:DN(OD)63				
④	Concrete	Existing Pipe				
	h=0.80m					

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (4)
			Chief Consultant: Hideki KONNO		Date:	Drawing Number: SD-5

D-1

D-2

C-1



WSP4-4 HDPE:DN(OD)280 L=4473m
T×2, RE×1, IS×5, 90°×1, IT×4, V×1, A×5, CF×2

PV:U h=0.8
L=4457m

IS

Fire Hydrant

IS

LAKE

IS

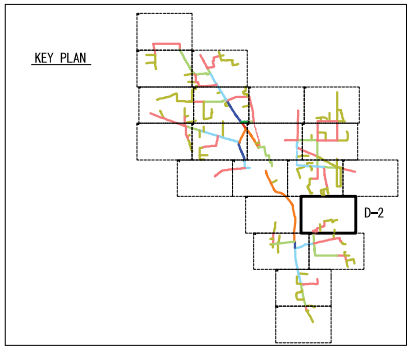
WSP9-37 HDPE:DN(OD)63 L=503m PV:U h=0.8
DR×1

DR-3

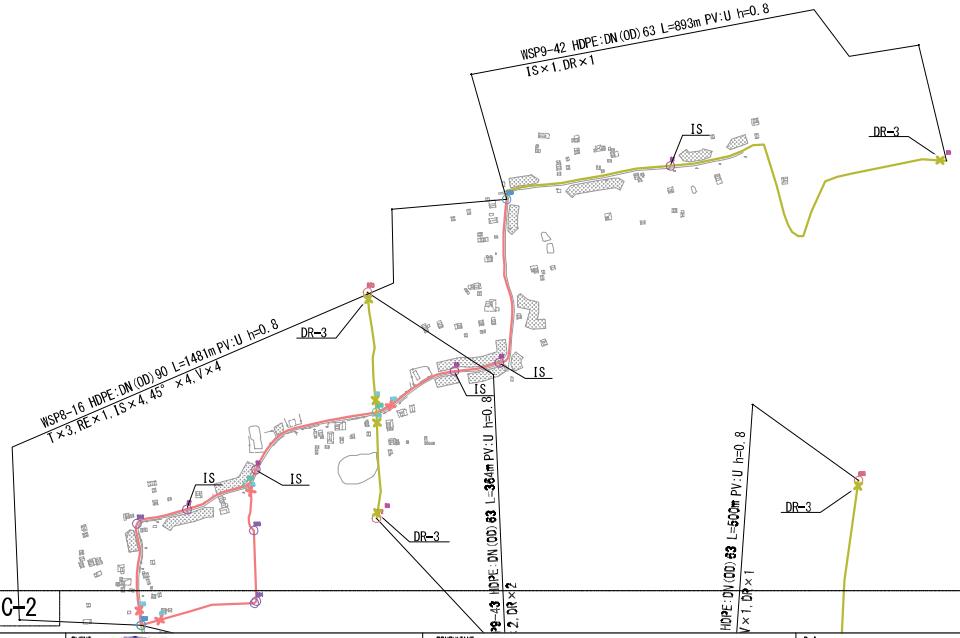
LEGEND							
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer		
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m		HDPE:DN(OD)63				
④	Concrete		Existing Pipe				
	h=0.80m						

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (5)	Drawing Number: SD-6
			Chief Consultant: Hideki KONNO		Date:		

D-2



LEGEND							
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer		
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m		HDPE:DN(OD)63				
④	Concrete		Existing Pipe				
	h=0.80m						

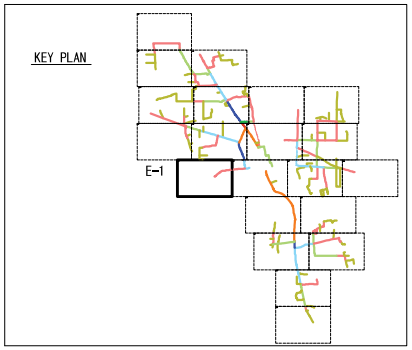


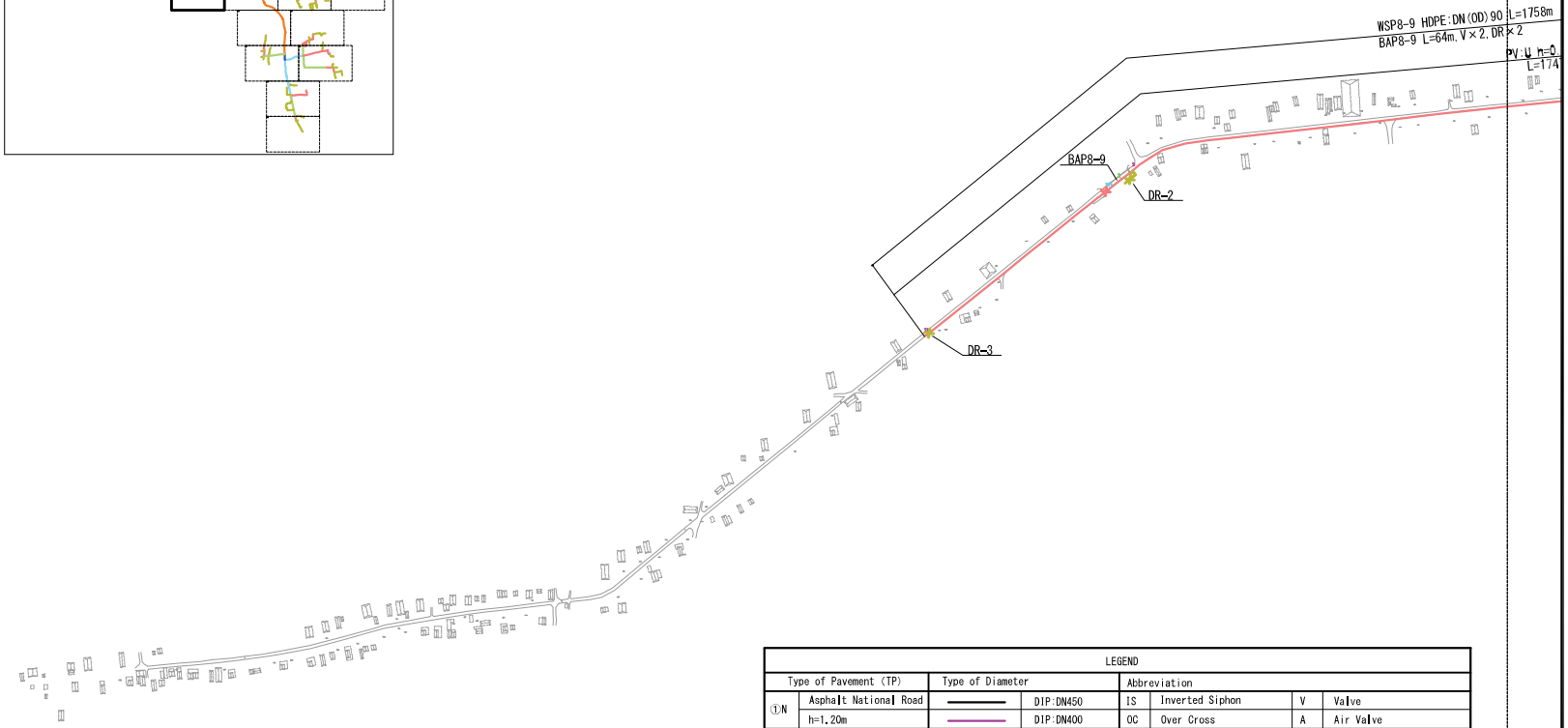
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (6)	Drawing Number: SD-7
			Chief Consultant: Hideki KONNO		Date:		

E-1

E-2

KEY PLAN

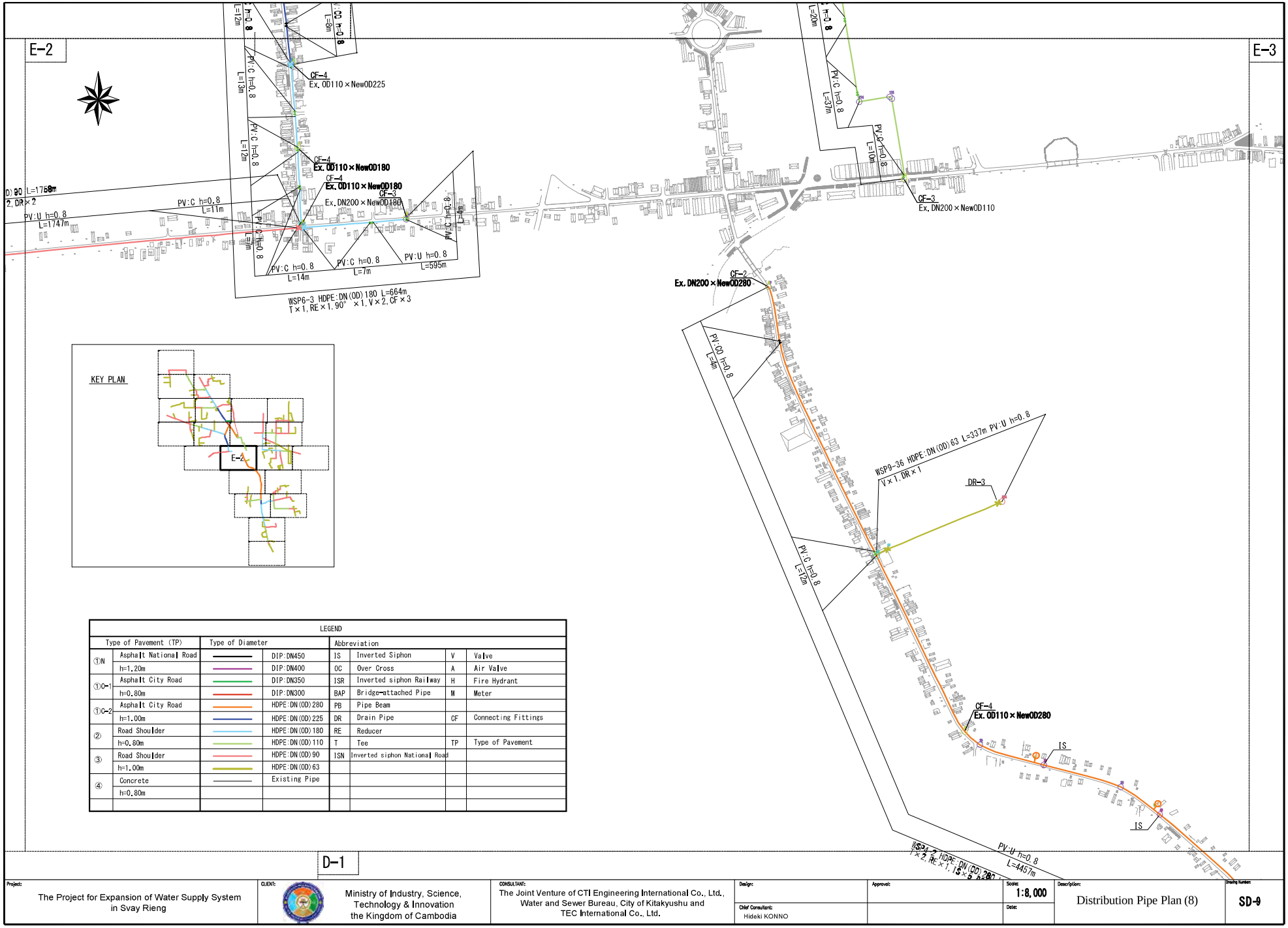




LEGEND

Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road	DIP:DN450		IS	Inverted Siphon	V	Valve
	h=1.20m	DIP:DN400		OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road	DIP:DN350		ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m	DIP:DN300		BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road	HDPE:DN(OD)280		PB	Pipe Beam		
	h=1.00m	HDPE:DN(OD)225		DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder	HDPE:DN(OD)180		RE	Reducer		
	h=0.80m	HDPE:DN(OD)110		T	Tee	TP	Type of Pavement
③	Road Shoulder	HDPE:DN(OD)90		ISN	Inverted siphon National Road		
	h=1.00m	HDPE:DN(OD)63					
④	Concrete	Existing Pipe					
	h=0.80m						

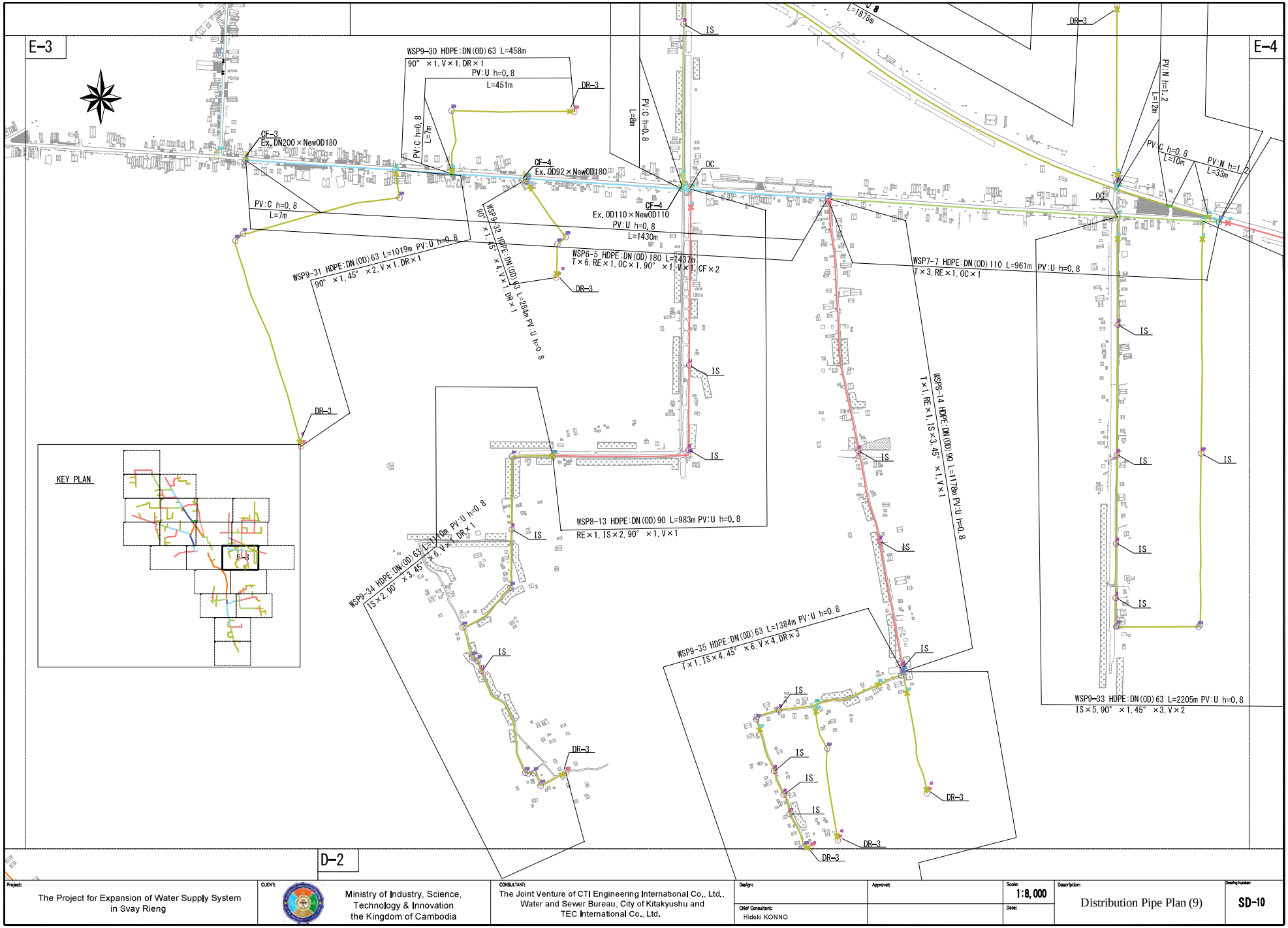
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (7)	Drawing Number: SD-8
			Chief Consultant: Hideki KONNO		Date:		



LEGEND

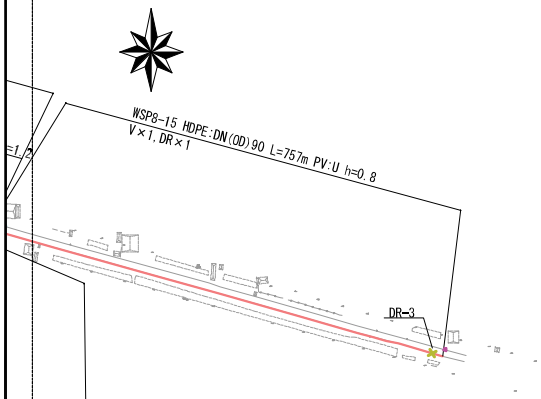
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road	DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m	DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road	DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m	DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road	HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m	HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder	HDPE:DN(OD)180	RE	Reducer		
	h=0.80m	HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder	HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m	HDPE:DN(OD)63				
④	Concrete	Existing Pipe				
	h=0.80m					

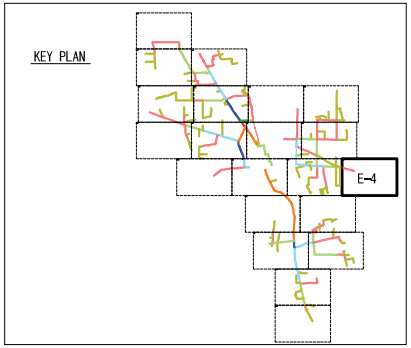
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approval: / Date:	Scale: 1:8,000
Description: Distribution Pipe Plan (8)	Drawing Number: SD-9				



Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (9)	Drawing Number: SD-10
			Chief Consultant: Hideki KONNO		Date:		

E-4

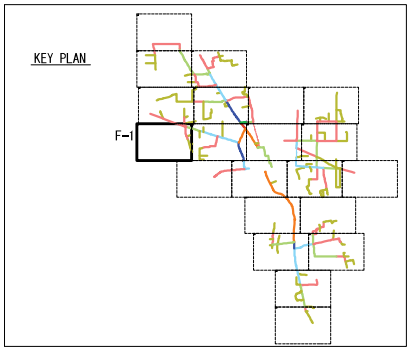


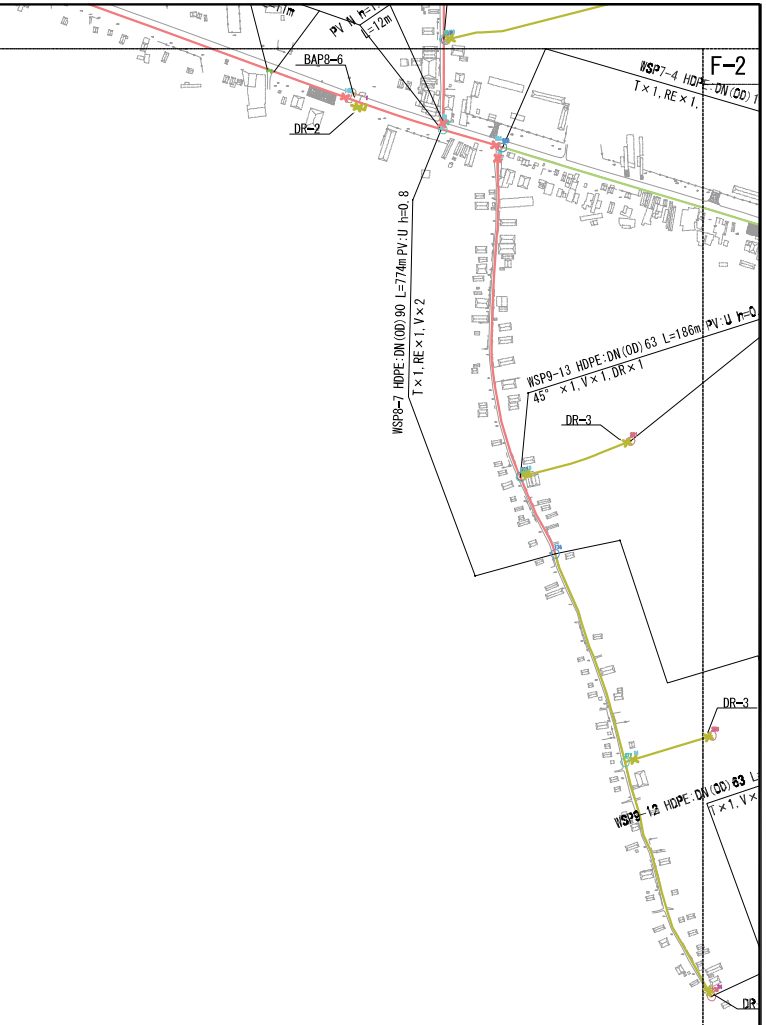


LEGEND								
Type of Pavement (TP)		Type of Diameter		Abbreviation				
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve	
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve	
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant	
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter	
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam			
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings	
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer			
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement	
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road			
	h=1.00m		HDPE:DN(OD)63					
④	Concrete		Existing Pipe					
	h=0.80m							

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approval: / Date:	Scale: 1:8,000	Description: Distribution Pipe Plan (10) / Drawing Number: SD-11

F-1



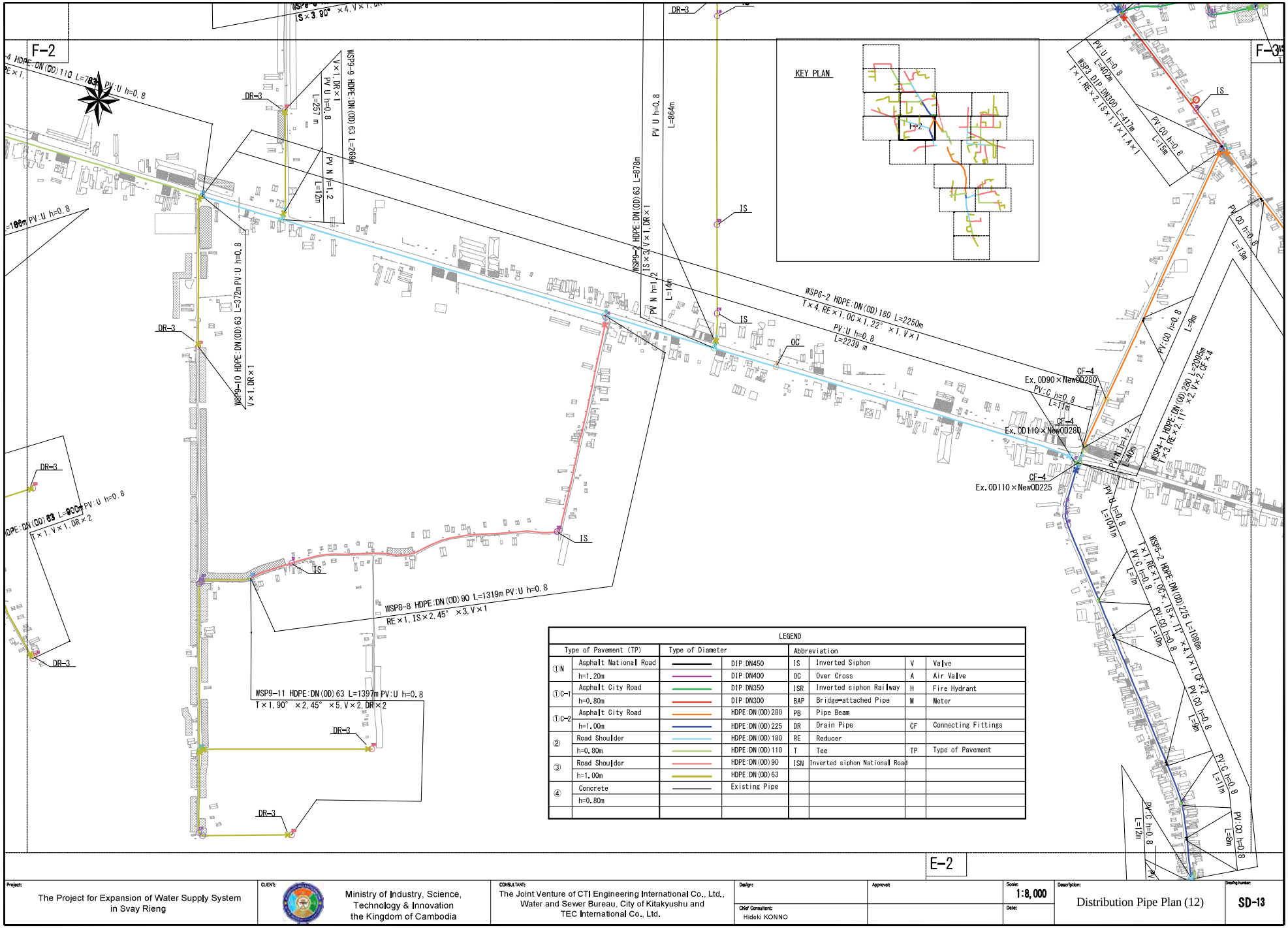


LEGEND

Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer		
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m		HDPE:DN(OD)63				
④	Concrete		Existing Pipe				
	h=0.80m						

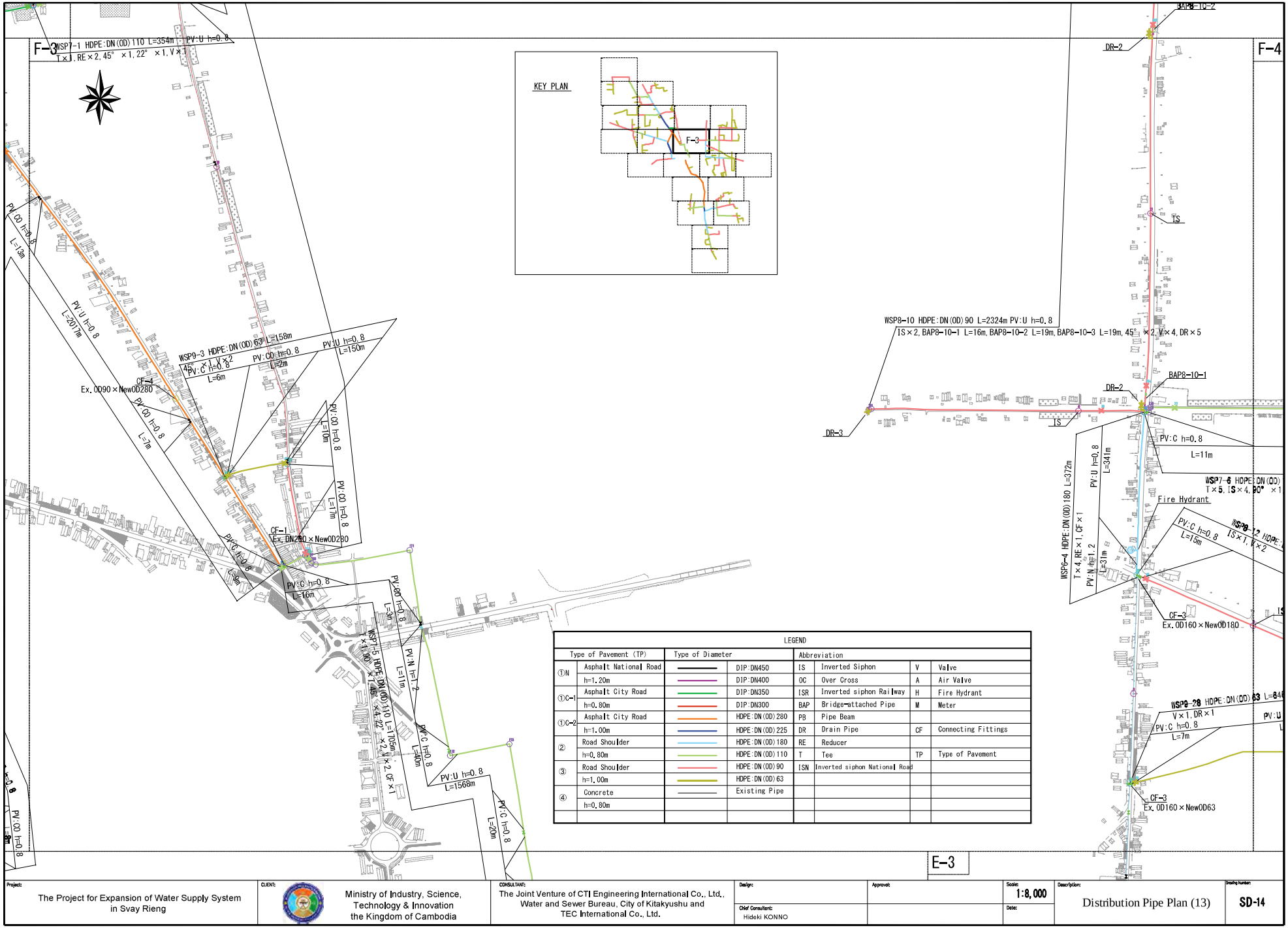
E-1

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (11)	Drawing Number: SD-12
			Chief Consultant: Hideki KONNO		Date:		



LEGEND							
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road h=1.20m		DIP:DN450	IS	Inverted Siphon	V	Valve
			DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road h=0.80m		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
			DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road h=1.00m		HDPE:DN(OD)280	PB	Pipe Beam		
			HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder h=0.80m		HDPE:DN(OD)180	RE	Reducer		
			HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder h=1.00m		HDPE:DN(OD)90	ISN	Inverted siphon National Road		
			HDPE:DN(OD)63				
④	Concrete h=0.80m		Existing Pipe				

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (12)
			Chief Consultant: Hideki KONNO		Date:	Drawing Number: SD-13

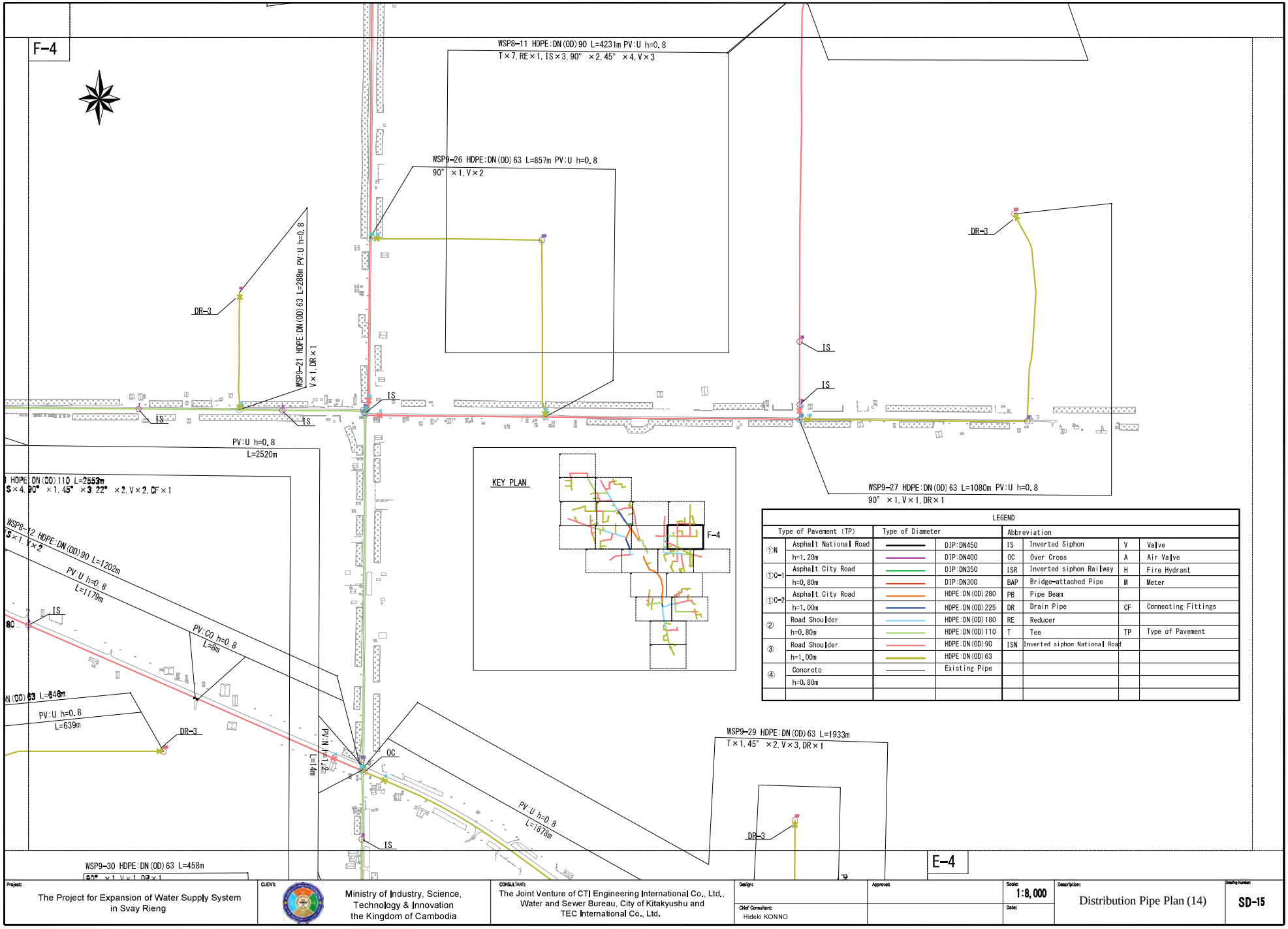


LEGEND

Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road	DIP:DN450		IS	Inverted Siphon	V	Valve
	h=1.20m	DIP:DN400		OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road	DIP:DN350		ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m	DIP:DN300		BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road	HDPE:DN(OD)280		PB	Pipe Beam		
	h=1.00m	HDPE:DN(OD)225		DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder	HDPE:DN(OD)180		RE	Reducer		
	h=0.80m	HDPE:DN(OD)110		T	Tee	TP	Type of Pavement
③	Road Shoulder	HDPE:DN(OD)90		ISN	Inverted siphon National Road		
	h=1.00m	HDPE:DN(OD)63					
④	Concrete	Existing Pipe					
	h=0.80m						

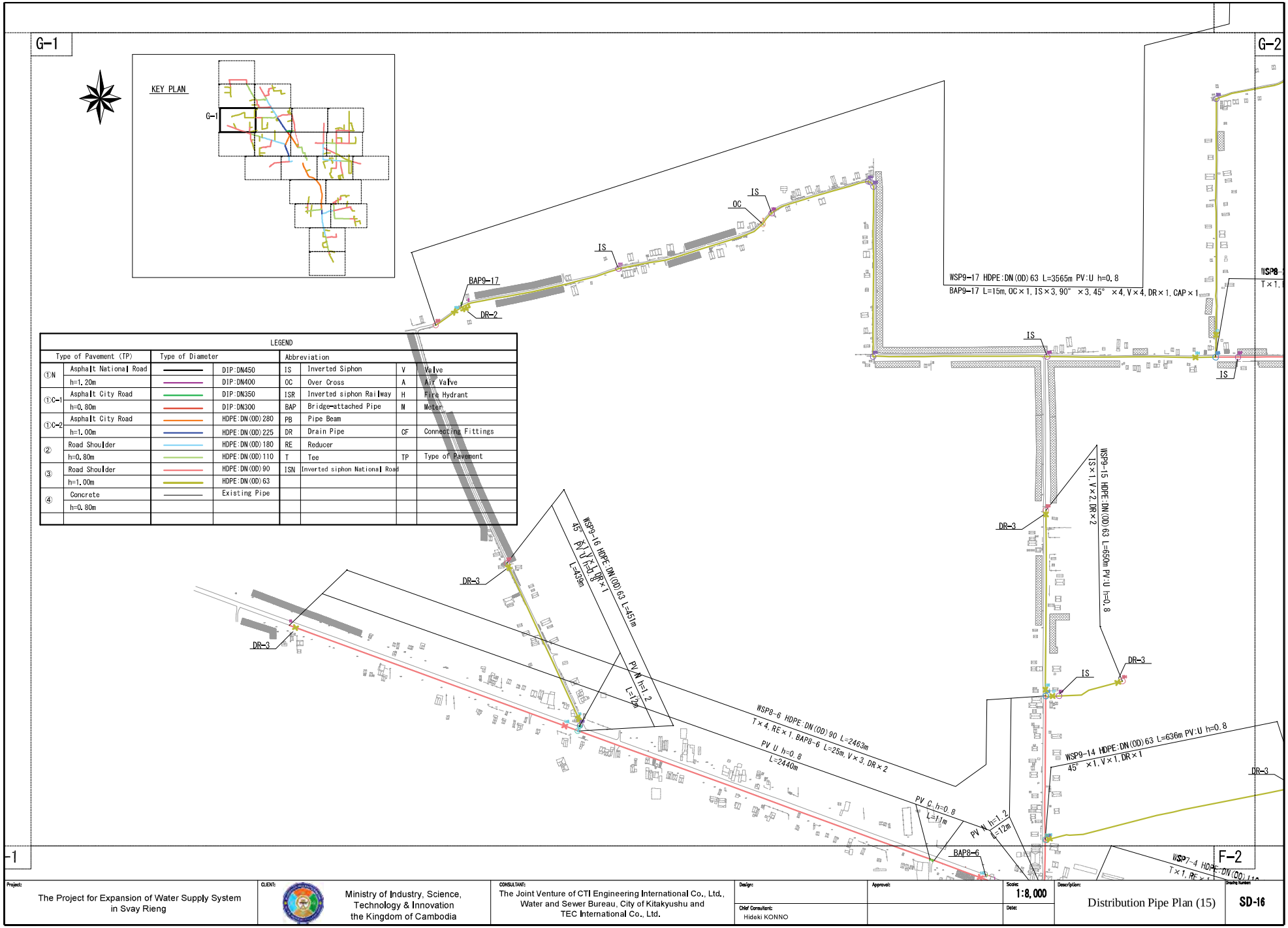
E-3

Project:	CLIENT:	CONSULTANT:	Design:	Approval:	Scale:	Description:	Drawing Number:
The Project for Expansion of Water Supply System in Svay Rieng	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Chief Consultant: Hideki KONNO		1:8,000 Date:	Distribution Pipe Plan (13)	SD-14

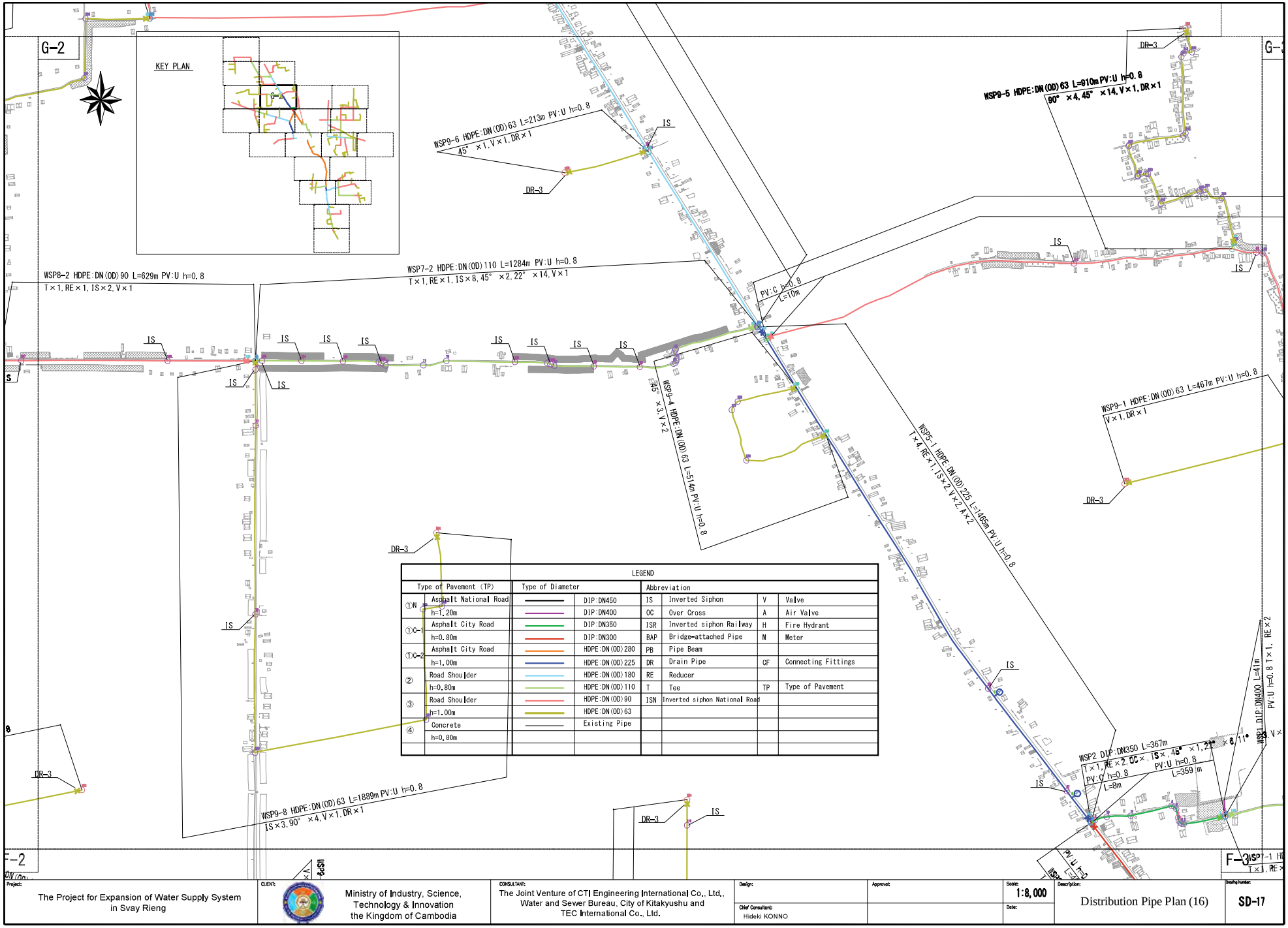


LEGEND							
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road	DIP:DN450		IS	Inverted Siphon	V	Valve
	h=1.20m	DIP:DN400		OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road	DIP:DN350		ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m	DIP:DN300		BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road	HDPE:DN(OD)280		PB	Pipe Beam		
	h=1.00m	HDPE:DN(OD)225		DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder	HDPE:DN(OD)180		RE	Reducer		
	h=0.80m	HDPE:DN(OD)110		T	Tee	TP	Type of Pavement
③	Road Shoulder	HDPE:DN(OD)90		ISN	Inverted siphon National Road		
	h=1.00m	HDPE:DN(OD)63					
④	Concrete	Existing Pipe					
	h=0.80m						

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (14)	Drawing Number: SD-15
			Chief Consultant: Hideki KONNO		Date:		

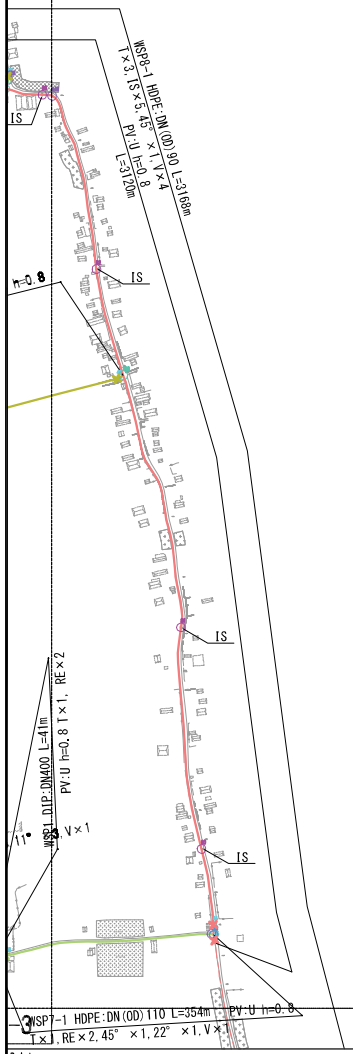


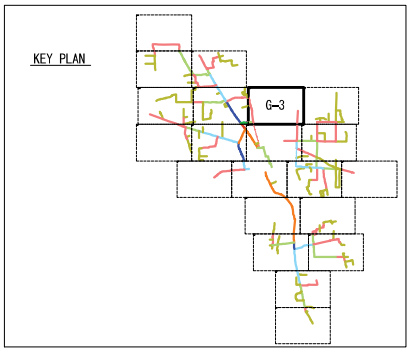
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design: / Chief Consultant: Hideki KONNO	Approval: / Date:	Scale: 1:8,000
Description: Distribution Pipe Plan (15)	Drawing Number: SD-16				

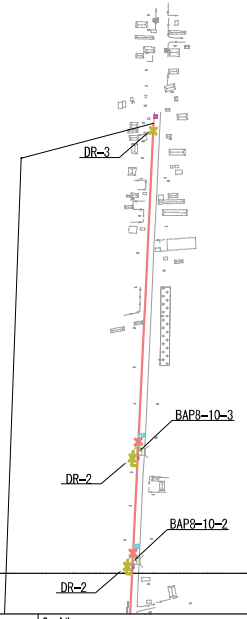

G-2
KEY PLAN
WSP9-6 HDPE:DN(OD)63 L=213m PV:U h=0.8
45° ×1, V×1, DR×1
IS
DR-3
WSP9-5 HDPE:DN(OD)63 L=910m PV:U h=0.8
90° ×4, 45° ×14, V×1, DR×1
WSP8-2 HDPE:DN(OD)90 L=629m PV:U h=0.8
T×1, RE×1, IS×2, V×1
WSP7-2 HDPE:DN(OD)110 L=1284m PV:U h=0.8
T×1, RE×1, IS×8, 45° ×2, 22° ×14, V×1
PV:C h=0.8
L=10m
WSP9-4 HDPE:DN(OD)63 L=514m PV:U h=0.8
45° ×3, V×2
WSP5-1 HDPE:DN(OD)225 L=1465m PV:U h=0.8
T×4, RE×1, IS×2, V×2, A×2
WSP9-1 HDPE:DN(OD)63 L=467m PV:U h=0.8
V×1, DR×1
WSP9-8 HDPE:DN(OD)63 L=1889m PV:U h=0.8
IS×3, 90° ×4, V×1, DR×1
WSP2 DIP:DN350 L=367m
T×1, RE×2, CC×1, IS×1, 45° ×1, 22° ×8, 11°
PV:U h=0.8
L=359.1m
PV:C h=0.8
L=8m
WSP1 DIP:DN400 L=41m
PV:U h=0.8 T×1, RE×2
F-2
F-3
LEGEND
Type of Pavement (TP)
①N Asphalt National Road h=1.20m
①C-1 Asphalt City Road h=0.80m
①C-2 Asphalt City Road h=1.00m
② Road Shoulder h=0.80m
③ Road Shoulder h=1.00m
④ Concrete h=0.80m
Type of Diameter
DIP:DN450
DIP:DN400
DIP:DN350
DIP:DN300
HDPE:DN(OD)280
HDPE:DN(OD)225
HDPE:DN(OD)180
HDPE:DN(OD)110
HDPE:DN(OD)90
HDPE:DN(OD)63
Existing Pipe
Abbreviation
IS Inverted Siphon
OC Over Cross
ISR Inverted siphon Railway
BAP Bridge-attached Pipe
PB Pipe Beam
DR Drain Pipe
RE Reducer
T Tee
ISN Inverted siphon National Road
V Valve
A Air Valve
H Fire Hydrant
M Meter
CF Connecting Fittings
TP Type of Pavement
Project: The Project for Expansion of Water Supply System in Svay Rieng
CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia
CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.
Design:
Approval:
Chief Consultant: Hideki KONNO
Scale: 1:8,000
Date:
Description: Distribution Pipe Plan (16)
Drawing Number: SD-17

G-3

G-4







LEGEND

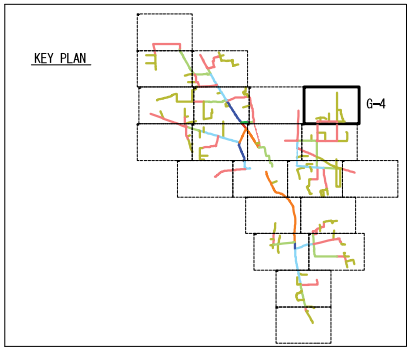
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer		
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m		HDPE:DN(OD)63				
④	Concrete		Existing Pipe				
	h=0.80m						

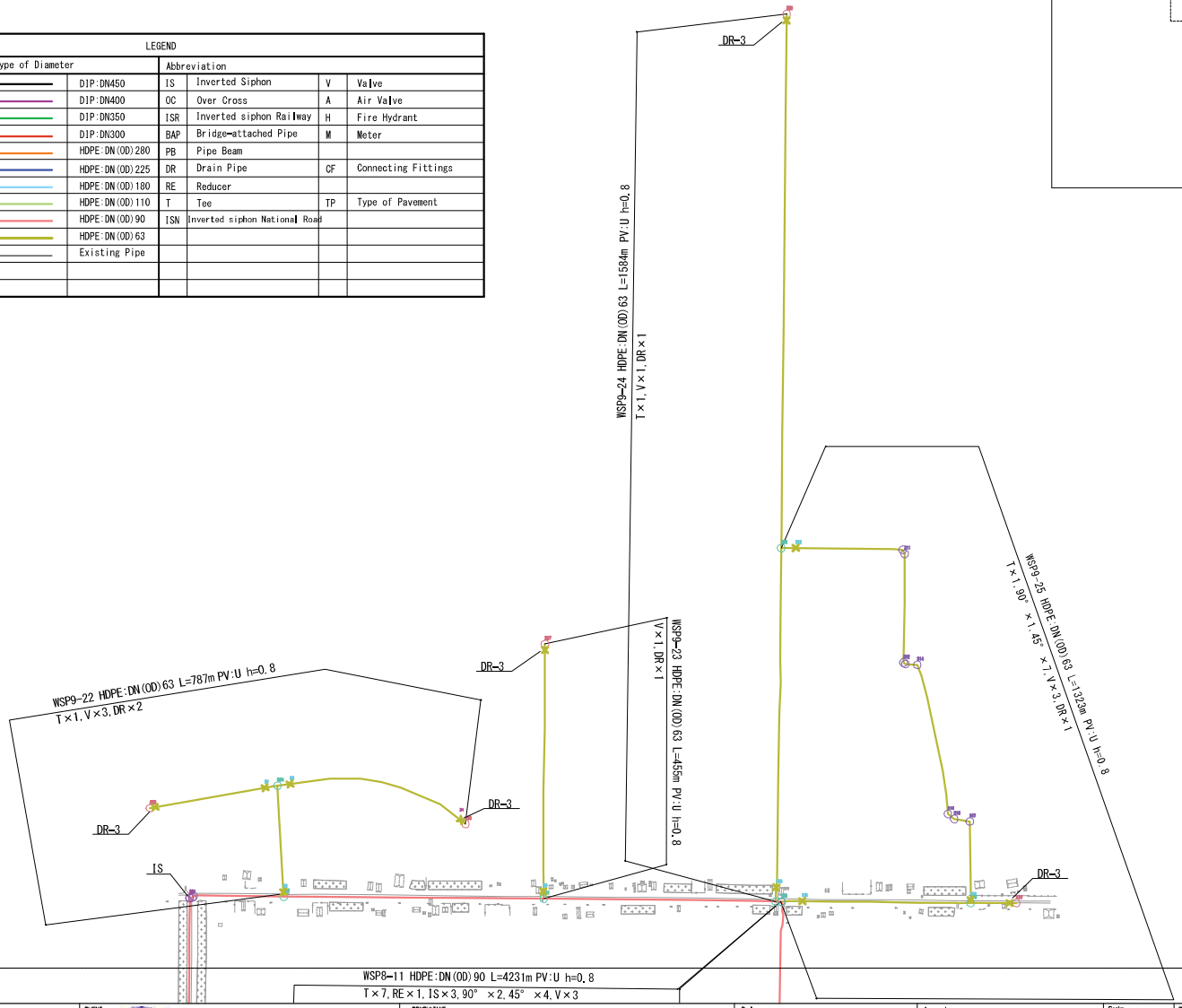
F-4

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (17)	Drawing Number: SD-18
			Chief Consultant: Hideki KONNO		Date:		

G-4

LEGEND							
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer		
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m		HDPE:DN(OD)63				
④	Concrete		Existing Pipe				
	h=0.80m						





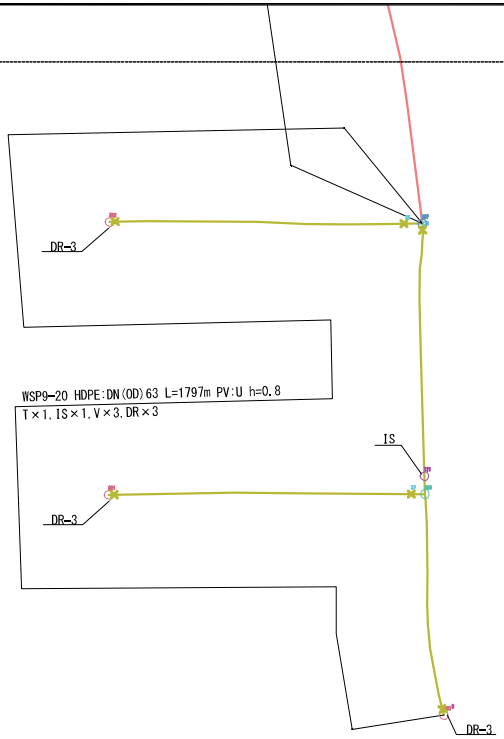
-4

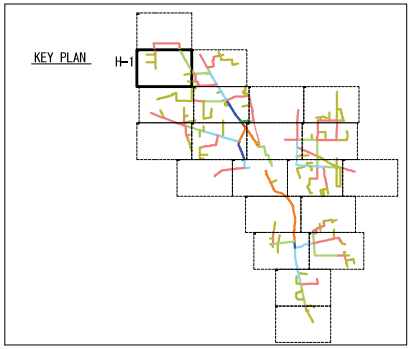
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approved:	Scale: 1:8,000	Description: Distribution Pipe Plan (18)
			Chief Consultant: Hideki KONNO		Date:	Drawing Number: SD-19

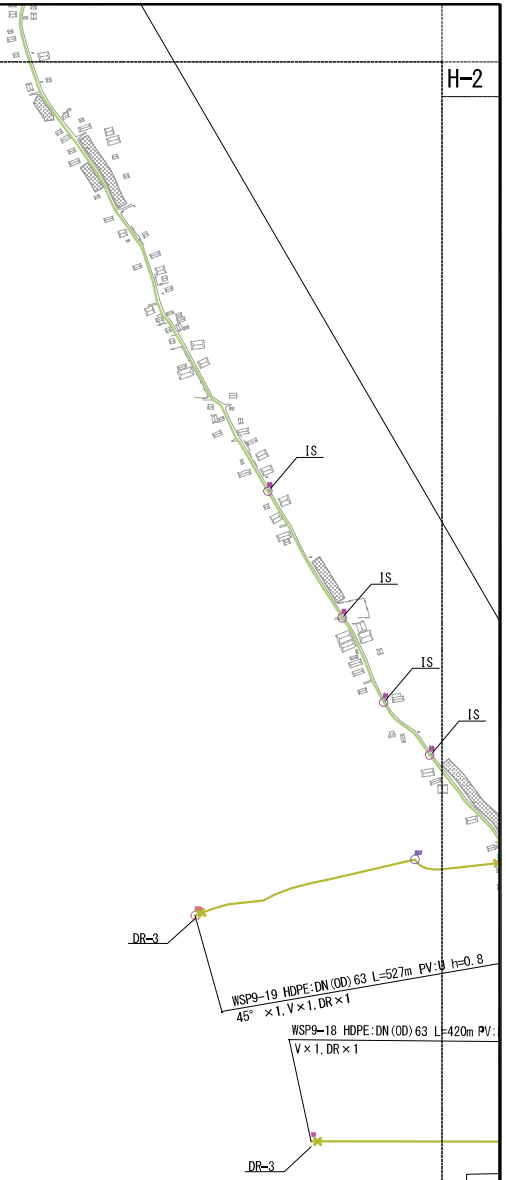
H-1

H-2

G-1



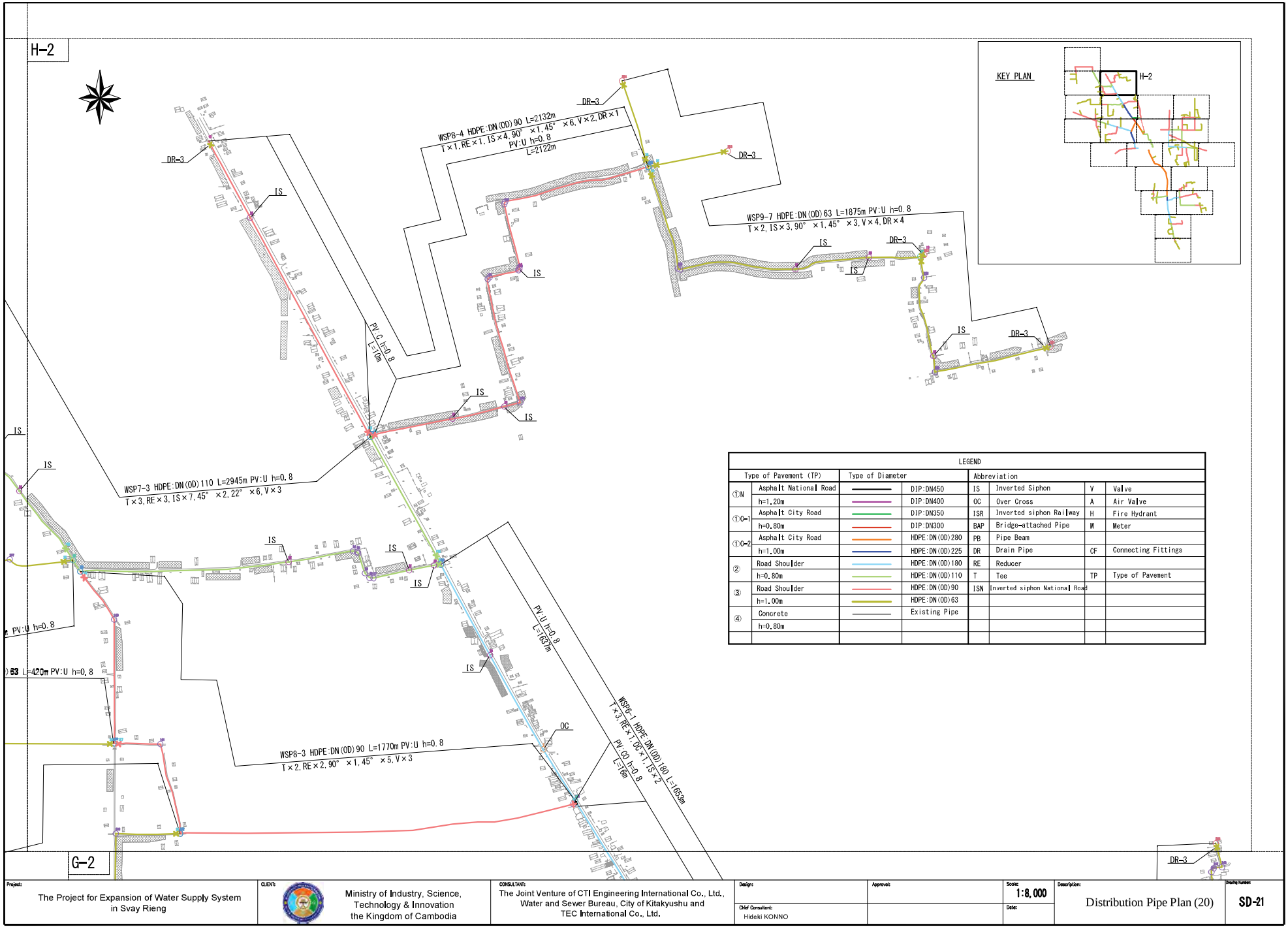




LEGEND

Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam		
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer		
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road		
	h=1.00m		HDPE:DN(OD)63				
④	Concrete		Existing Pipe				
	h=0.80m						

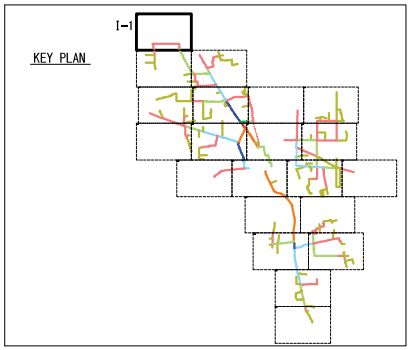
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (19)	Drawing Number: SD-20
			Chief Consultant: Hideki KONNO		Date:		



LEGEND							
Type of Pavement (TP)		Type of Diameter		Abbreviation			
①N	Asphalt National Road	DIP:DN450		IS	Inverted Siphon	V	Valve
	h=1.20m	DIP:DN400		OC	Over Cross	A	Air Valve
①C-1	Asphalt City Road	DIP:DN350		ISR	Inverted siphon Railway	H	Fire Hydrant
	h=0.80m	DIP:DN300		BAP	Bridge-attached Pipe	M	Meter
①C-2	Asphalt City Road	HDPE:DN(OD)280		PB	Pipe Beam		
	h=1.00m	HDPE:DN(OD)225		DR	Drain Pipe	CF	Connecting Fittings
②	Road Shoulder	HDPE:DN(OD)180		RE	Reducer		
	h=0.80m	HDPE:DN(OD)110		T	Tee	TP	Type of Pavement
③	Road Shoulder	HDPE:DN(OD)90		ISN	Inverted siphon National Road		
	h=1.00m	HDPE:DN(OD)63					
④	Concrete	Existing Pipe					
	h=0.80m						

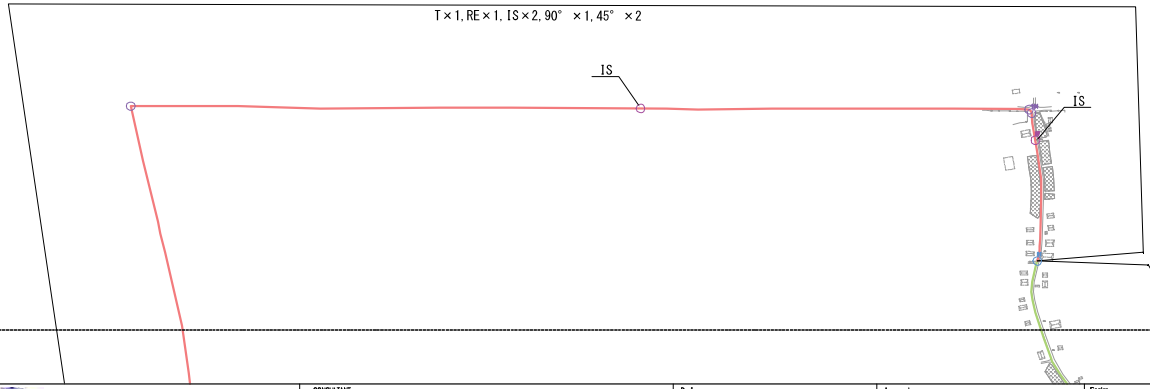
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (20)	Drawing Number: SD-21
			Chief Consultant: Hideki KONNO		Date:		

I-1



LEGEND								
Type of Pavement (TP)		Type of Diameter		Abbreviation				
①N	Asphalt National Road		DIP:DN450	IS	Inverted Siphon	V	Valve	
	h=1.20m		DIP:DN400	OC	Over Cross	A	Air Valve	
①C-1	Asphalt City Road		DIP:DN350	ISR	Inverted siphon Railway	H	Fire Hydrant	
	h=0.80m		DIP:DN300	BAP	Bridge-attached Pipe	M	Meter	
①C-2	Asphalt City Road		HDPE:DN(OD)280	PB	Pipe Beam			
	h=1.00m		HDPE:DN(OD)225	DR	Drain Pipe	CF	Connecting Fittings	
②	Road Shoulder		HDPE:DN(OD)180	RE	Reducer			
	h=0.80m		HDPE:DN(OD)110	T	Tee	TP	Type of Pavement	
③	Road Shoulder		HDPE:DN(OD)90	ISN	Inverted siphon National Road			
	h=1.00m		HDPE:DN(OD)63					
④	Concrete		Existing Pipe					
	h=0.80m							

WSP8-5 HDPE:DN(OD)90 L=2313m PV:U h=0.8
T×1, RE×1, IS×2, 90° ×1, 45° ×2



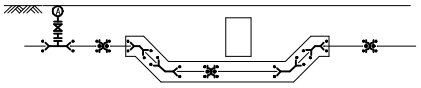
H-1

H-2

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: 1:8,000	Description: Distribution Pipe Plan (21)	Drawing Number: SD-22
			Chief Consultant: Hideki KONNO		Date:		

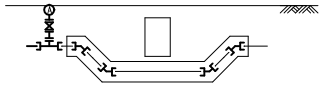
Typical Drawing for Connecting

IS(Inverted siphon)



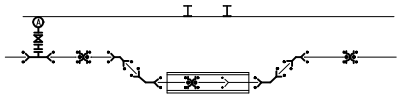
Material	Joint Type	Diameter	Number
Double Socket Bend	DIP(T)	300～450×45°	4
Double Socket Tee	DIP(T)	300～450	1
Collar	DIP(K)	300～450	3
Restrained Coupling	DIP(T)	300～450	10
Restrained Coupling	DIP(K)	300～450	6
Air Valve	—	80	1
Ball Valve	—	80×100H	1
Flange Extension Pipe	—	80×500H (h=1.20m)	1
Flange Extension Pipe	—	80×150H (h=0.80m)	1
Flange Joint	—	80	3

IS(Inverted siphon)



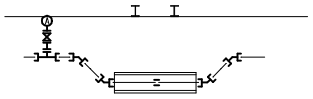
Material	Joint Type	Diameter	Number
Double Socket Bend	HDPE	63～280×45°	4
Double Socket Tee	HDPE	63～280×80	1
Air Valve	—	80	1
Ball Valve	—	80×100H	1
Flange Extension Pipe	—	80×500H (h=1.20m)	1
Flange Extension Pipe	—	80×150H (h=0.80m)	1
Flange Joint	—	80	3

ISR(Inverted Siphon Railway)



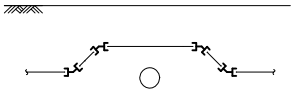
Material	Joint Type	Diameter	Number
Double Socket Bend	DIP(T)	300～450×45°	4
Double Socket Tee	DIP(T)	300～450	1
Collar	DIP(K)	300～450	3
Restrained Coupling	DIP(T)	300～450	10
Restrained Coupling	DIP(K)	300～450	6
Air Valve	—	80	1
Ball Valve	—	80×100H	1
Flange Extension Pipe	—	80×500H (h=1.20m)	1
Flange Extension Pipe	—	80×150H (h=0.80m)	1
Flange Joint	—	80	3

ISR(Inverted Siphon Railway)



Material	Joint Type	Diameter	Number
Double Socket Bend	HDPE	63～280×45°	4
Double Socket Tee	HDPE	63～280×80	1
Socket	HDPE	63～280	1
Air Valve	—	80	1
Ball Valve	—	80×100H	1
Flange Extension Pipe	—	80×500H (h=1.20m)	1
Flange Extension Pipe	—	80×150H (h=0.80m)	1
Flange Joint	—	80	3

OC-2(Over Cross)



Material	Joint Type	Diameter	Number
Double Socket Bend	HDPE	63～280×45°	4

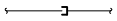
PC-1(Pipe cutting fittings-1)

Material	Joint Type	Diameter	Number
Collar	DIP(K)	300～450	1
Flanged Socket	DIP(T)	300～450	1
Flanged Spigot	DIP(T)	300～450	1
Valve	—	300～450	1
Restrained Coupling	DIP(T)	300～450	1
Restrained Coupling	DIP(K)	300～450	2
Flange Joint	—	300～450	2

PC-2(Pipe cutting fittings-2)

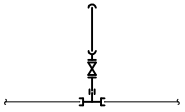
Material	Joint Type	Diameter	Number
Mechanical Adapter	HDPE	63～280	1
Stub Flange	HDPE	63～280	1
Socket	HDPE	63～280	1
Valve	—	63～280	1
Flange Joint	—	63～280	2

PC-3(Pipe cutting fittings-1)



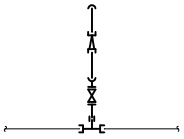
Material	Joint Type	Diameter	Number
Socket	HDPE	63～280	1
			1

PE-1(Pipe end fittings-1)



Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Tee	HDPE	63～280	1
Mechanical Adapter	HDPE	63～280	1
Stub Flange	HDPE	63～280	1
Socket	HDPE	63～280	1
Cap	HDPE	63～280	1
Valve	—	63～280	1
Flange Joint	—	63～280	2

PE-2(Pipe end fittings-2)



Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Tee	HDPE	63～280	1
Double Socket Reducer	HDPE	63～280	1
Mechanical Adapter	HDPE	63～280	1
Stub Flange	HDPE	63～280	1
Socket	HDPE	63～280	1
Cap	HDPE	63～280	1
Valve	—	63～280	1
Flange Joint	—	63～280	2

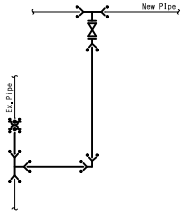
Project:	CLIENT:	CONSULTANT:	Design:	Approval:	Scale:	Description:	Drawing number:
The Project for Expansion of Water Supply System in Svay Rieng	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Chief Consultant: Hideki KONNO		NONE Date:	Typical Drawing for Pipe Laying (1)	TYP-1

Typical Drawing for Connecting

PE-3

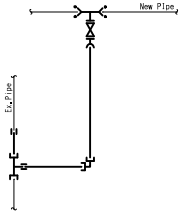
Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Reducer	HDPE	63～280	1
Mechanical Adapter	HDPE	63～280	1
Stub Flange	HDPE	63～280	1
Cap	HDPE	63～280	1
Valve	—	63～280	1
Flange Joint	—	63～280	2

CF-1 (Connecting fittings-1)



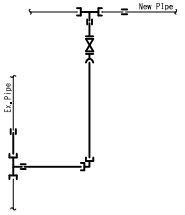
Material	Joint Type	Diameter	Number	Remarks
Straight Pipe	DIP(T)	300～450	2	Ex.Diameter
Triple Socket Tee	DIP(T)	300～450	1	Ex.Diameter
Double Socket Tee	DIP(T)	300～450	1	New×Ex
Double Socket Bend	DIP(T)	300～450×90°	1	Ex.Diameter
Collar	DIP(K)	300～450	1	Ex.Diameter
Flanged Socket	DIP(T)	300～450	1	Ex.Diameter
Restrained Coupling	DIP(T)	300～450	2	New Pipe Diameter
Restrained Coupling	DIP(T)	300～450	6	Ex.Diameter
Restrained Coupling	DIP(K)	300～450	2	Ex.Diameter
Valve	—	300～450	1	Ex.Diameter
Flange Joint	—	300～450	2	Ex.Diameter

CF-2 (Connecting fittings-2)



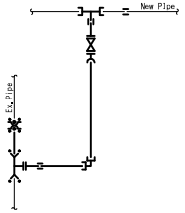
Material	Joint Type	Diameter	Number	Remarks
Straight Pipe	HDPE	63	m	
		80～280	m	
Double Socket Tee	DIP(T)	300～450	1	New×Ex
Double Socket Tee	HDPE	63～280	1	Ex×Ex
Double Socket Bend	HDPE	63～280×90°	1	Ex.Diameter
Socket	HDPE	63～280	2	Ex.Diameter
Mechanical Adapter	HDPE	63～280	1	Ex.Diameter
Restrained Coupling	DIP(T)	300～450	2	New Pipe Diameter
Valve	—	63～280	1	Ex.Diameter
Flange Joint	—	63～280	2	Ex.Diameter

CF-3 (Connecting fittings-3)



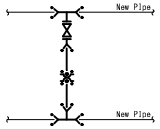
Material	Joint Type	Diameter	Number	Remarks
Straight Pipe	HDPE	63	m	
		80～280	m	
Double Socket Tee	HDPE	63～280	1	New×Ex
Double Socket Tee	HDPE	63～280	1	Ex.Diameter
Double Socket Bend	HDPE	63～280×90°	1	Ex.Diameter
Socket	HDPE	63～280	1	New Pipe Diameter
Socket	HDPE	63～280	3	Ex.Diameter
Mechanical Adapter	HDPE	63～280	1	Ex.Diameter
Stub Flange	HDPE	63～280	1	Ex.Diameter
Valve	—	63～280	1	Ex.Diameter
Flange Joint	—	63～280	2	Ex.Diameter

CF-3-2 (Connecting fittings-3-2)



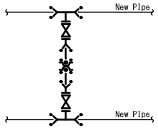
Material	Joint Type	Diameter	Number	Remarks
Straight Pipe	HDPE	63	m	
		80～280	m	
Straight Pipe	DIP(T)	300～450	1	
Double Socket Tee	DIP(T)	300～450	1	New×Ex
Double Socket Tee	HDPE	63～280	1	Ex.Diameter
Double Socket Bend	HDPE	63～280×90°	1	Ex.Diameter
Socket	HDPE	63～280	1	New Pipe Diameter
Socket	HDPE	63～280	2	Ex.Diameter
Mechanical Adapter	HDPE	63～280	1	Ex.Diameter
Stub Flange	HDPE	63～280	2	Ex.Diameter
Valve	—	63～280	1	Ex.Diameter
Flange Joint	—	63～280	3	Ex.Diameter
Collar	DIP(K)	300～450	1	Ex.Diameter
Restrained Coupling	DIP(T)	300～450	2	Ex.Diameter
Restrained Coupling	DIP(K)	300～450	2	Ex.Diameter

CF-4 (Connecting fittings-4)



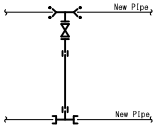
Material	Joint Type	Diameter	Number
Straight Pipe	DIP(T)	300～450	1
Triple Socket Tee	DIP(T)	300～450	1
Double Socket Tee	DIP(T)	300～450	1
Collar	DIP(K)	300～450	1
Flanged Socket	DIP(T)	300～450	1
Restrained Coupling	DIP(T)	300～450	6
Restrained Coupling	DIP(K)	300～450	2
Valve	—	300～450	1
Flange Joint	—	300～450	2

CF-4-2 (Connecting fittings-4-2)



Material	Joint Type	Diameter	Number
Straight Pipe	DIP(T)	300～450	1
Double Socket Tee	DIP(T)	300～450	2
Collar	DIP(K)	300～450	1
Flanged Socket	DIP(T)	300～450	2
Restrained Coupling	DIP(T)	300～450	6
Restrained Coupling	DIP(K)	300～450	2
Valve	—	300～450	2
Flange Joint	—	300～450	4

CF-5 (Connecting fittings-5)

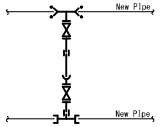


Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Tee	DIP(T)	300～450	1
Double Socket Tee	HDPE	63～280	1
Socket	HDPE	63～280	2
Stub Flange	HDPE	63～280	1
Restrained Coupling	DIP(T)	300～450	2
Valve	—	63～280	1
Flange Joint	—	63～280	2

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approved:	Scale: NONE	Description: Typical Drawing for Pipe Laying (2)	Drawing Number: TYP-2
			Chief Consultant: Hideki KONNO		Date:		

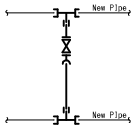
Typical Drawing for Connecting

CF-5-2 (Connecting fittings-5-2)



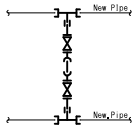
Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Tee	DIP(T)	300～450	1
Double Socket Tee	HDPE	63～280	1
Socket	HDPE	63～280	2
Mechanical Adapter	HDPE	63～280	1
Stub Flange	HDPE	63～280	2
Restrained Coupling	DIP(T)	300～450	2
Valve	—	300～450	2
Flange Joint	—	300～450	4

CF-6 (Connecting fittings-6)



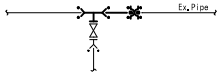
Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63～280	m
Double Socket Tee	HDPE	63～280	2
Socket	HDPE	63～280	2
Mechanical Adapter	HDPE	63～280	1
Stub Flange	HDPE	63～280	1
Valve	—	63～280	1
Flange Joint	—	63～280	2

CF-6-2 (Connecting fittings-6-2)



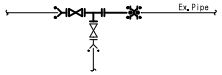
Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Tee	HDPE	63～280	2
Socket	HDPE	63～280	2
Mechanical Adapter	HDPE	63～280	2
Stub Flange	HDPE	63～280	2
Valve	—	63～280	2
Flange Joint	—	63～280	4

CF-7 (Connecting fittings-7)



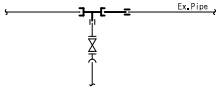
Material	Joint Type	Diameter	Number
Straight Pipe	DIP(T)	300～450	1
Double Socket Tee	DIP(T)	300～450	1
Collar	DIP(K)	300～450	1
Restrained Coupling	DIP(T)	300～450	2
Restrained Coupling	DIP(K)	300～450	2

CF-8 (Connecting fittings-8)



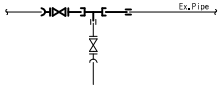
Material	Joint Type	Diameter	Number
Triple Flanged Tee	DIP(T)	300～450	1
Collar	DIP(K)	300～450	1
Flanged Socket	DIP(T)	300～450	1
Flanged Spigot	DIP(T)	300～450	1
Valve	—	300～450	1
Restrained Coupling	DIP(T)	300～450	1
Restrained Coupling	DIP(K)	300～450	2
Flange Joint	—	300～450	3

CF-9 (Connecting fittings-9)



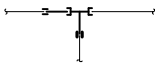
Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Tee	HDPE	63～280	1
Socket	HDPE	63～280	1

CF-10 (Connecting fittings-10)



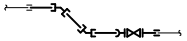
Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Tee	HDPE	63～280	1
Mechanical Adapter	HDPE	63～280	1
Stub Flange	HDPE	63～280	1
Socket	HDPE	63～280	1
Valve	—	63～280	1
Flange Joint	—	63～280	2

CF-11



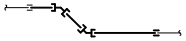
Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Tee	HDPE	63～280	1
Socket	HDPE	63～280	2

CF-12



Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Bend	HDPE	63～280×45°	2
Socket	HDPE	63～280	1
Mechanical Adapter	HDPE	63～280	1
Valve	—	63～280	1
Flange Joint	—	63～280	2
Stub Flange	HDPE	63～280	1

CF-13



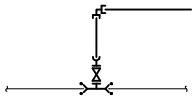
Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Bend	HDPE	63～280×45°	2
Socket	HDPE	63～280	1

A-200

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approved:	Scale: NONE	Description: Typical Drawing for Pipe Laying (3)	Drawing Number: TYP-3
			Chief Consultant: Hideki KONNO		Date:		

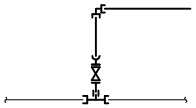
Typical Drawing for Connecting

DR-1 (Drain pipe fittings-1)



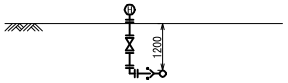
Material	Joint Type	Diameter	Number
Double Socket Tee	DIP(T)	300～450×110,180	1
Restrained Coupling	DIP(T)	300～450	2
Straight Pipe	HDPE	110,180	m
Double Socket Bend	HDPE	110,180×90°	1
Mechanical Adapter	HDPE	110,180	1
Valve	—	110,180	1
Flange Joint	—	110,180	2

DR-2 (Drain pipe fittings-2)



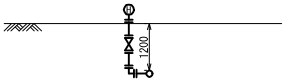
Material	Joint Type	Diameter	Number
Straight Pipe	HDPE	63	m
		80～280	m
Double Socket Tee	HDPE	63～280×63	1
Double Socket Bend	HDPE	63×90°	1
Mechanical Adapter	HDPE	63～280	1
Stub Flange	HDPE	63～280	1
Socket	HDPE	63～280	1
Valve	—	63～280	1
Flange Joint	—	63～280	2

H-1 (Fire Hydrant-1)



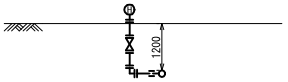
Material	Joint Type	Diameter	Number
Triple Socket Tee	DIP(T)	350～450×100	1
Flanged Spigot	DIP(T)	100	1
Double Flanged Bend	—	100×90°	1
Flange Extension Pipe	—	100×350H	1
Flange Extension Pipe	—	100×650H	1
Ball Valve	—	100×100H	1
Fire Hydrant (Double Mouths)	—	100	1
Restrained Coupling	DIP(T)	100	1
Flange Joint	—	100	5

H-2 (Fire Hydrant-2)



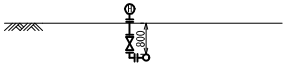
Material	Joint Type	Diameter	Number
Double Socket Tee	DIP(T)	250×80	1
Double Flanged Bend	—	80×90°	1
Flange Extension Pipe	—	80×350H	1
Flange Extension Pipe	—	80×650H	1
Ball Valve	—	80×100H	1
Fire Hydrant (Sigle Mouth)	—	80	1
Flange Joint	—	80	5

H-3 (Fire Hydrant-3)



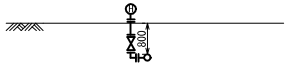
Material	Joint Type	Diameter	Number
Double Socket Tee	HDPE	110～280×80	1
Socket	HDPE	80	1
Stub Flange	HDPE	80	1
Double Flanged Bend	—	80	1
Flange Extension Pipe	—	80×400H	1
Flange Extension Pipe	—	80×650H	1
Ball Valve	—	80×100H	1
Fire Hydrant (Sigle Mouth)	—	80	1
Flange Joint	—	80	5

H-4 (Fire Hydrant-4)



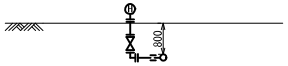
Material	Joint Type	Diameter	Number
Double Socket Tee	DIP(T)	250×80	1
Flanged Spigot	DIP(T)	80	1
Double Flanged Bend	—	80	1
Flange Extension Pipe	—	80×650H	1
Ball Valve	—	80×100H	1
Fire Hydrant (Sigle Mouth)	—	80	1
Flange Joint	—	80	4

H-5 (Fire Hydrant-5)



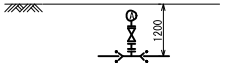
Material	Joint Type	Diameter	Number
Double Socket Tee	DIP(T)	350～450×100	1
Flanged Spigot	DIP(T)	100	1
Double Flanged Bend	—	100	1
Flange Extension Pipe	—	100×650H	1
Ball Valve	—	100×100H	1
Fire Hydrant (Double Mouths)	—	100	1
Flange Joint	—	100	4

H-6 (Fire Hydrant-6)



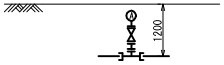
Material	Joint Type	Diameter	Number
Double Socket Tee	HDPE	110～280×80	1
Socket	HDPE	80	1
Stub Flange	HDPE	80	1
Double Flanged Bend	—	80	1
Flange Extension Pipe	—	80×650H	1
Ball Valve	—	80×100H	1
Fire Hydrant (Sigle Mouth)	—	80	1
Flange Joint	—	80	4

A-1 (Air Valve-1)



Material	Joint Type	Diameter	Number
Double Socket Tee	DIP(T)	300～450×80	1
Flange Extension Pipe	—	80×500H	1
Ball Valve	—	80×100H	1
Air Valve	—	80	1
Restrained Coupling	DIP(T)	200～500	2
Flange Joint	—	80	3

A-2 (Air Valve-2)



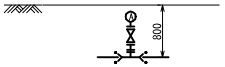
Material	Joint Type	Diameter	Number
Double Socket Tee	HDPE	90～280×80	1
Flange Extension Pipe	—	80×500H	1
Ball Valve	—	80×100H	1
Air Valve	—	80	1
Flange Joint	—	80	3

A-201

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: NONE	Description: Typical Drawing for Pipe Laying (4)	Drawing Number: TYP-4
			Chief Consultant: Hideki KONNO		Date:		

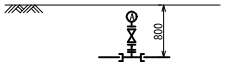
Typical Drawing for Connecting

A-3(Air Valve-3)



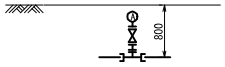
Material	Joint Type	Diameter	Number
Double Socket Tee	DIP(T)	300～450×80	1
Flange Extension Pipe	—	80×150H	1
Ball Valve	—	80×100H	1
Air Valve	—	80	1
Restrained Coupling	DIP(T)	300～450	2
Flange Joint	—	300～450	3

A-4(Air Valve-4)



Material	Joint Type	Diameter	Number
Double Socket Tee	HDPE	63×50	1
Flange Extension Pipe	—	50×150H	1
Ball Valve	—	50×100H	1
Air Valve	—	50	1
Flange Joint	—	50	3

A-5(Air Valve-5)

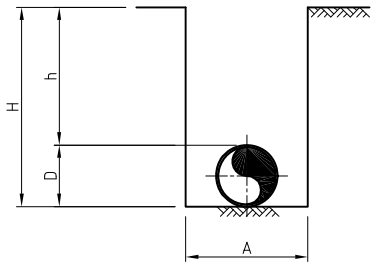


Material	Joint Type	Diameter	Number
Double Socket Tee	HDPE	90～280×80	1
Flange Extension Pipe	—	80×150H	1
Ball Valve	—	80×100H	1
Air Valve	—	80	1
Flange Joint	—	80	3

A-202

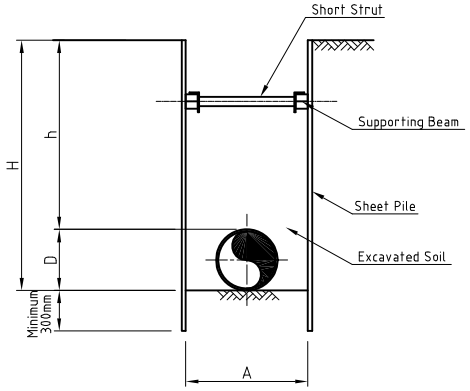
Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT:	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approval:	Scale: NONE	Description: Typical Drawing for Pipe Laying (5)	Drawing Number: TYP-5
				Chief Consultant: Hideki KONNO		Date:		

Typical Drawing for Pipe Laying



MACHINE EXCAVATION

NORMAL PART



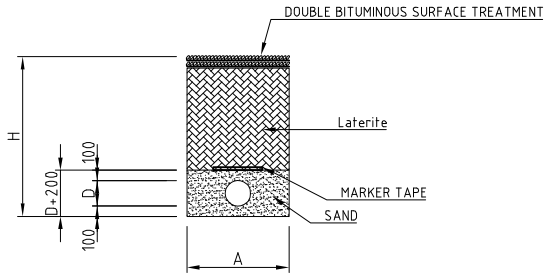
MACHINE EXCAVATION

SHEET PILE PART

TYPICAL SIZE OF TRENCH EXCAVATION (MACHINE EXCAVATION)

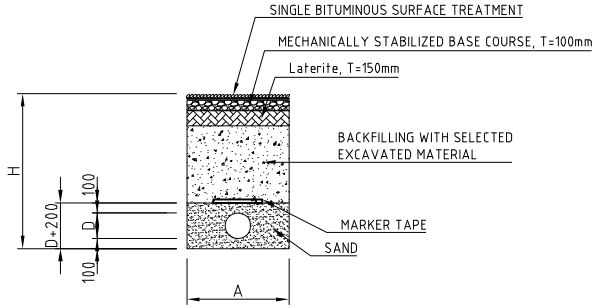
PIPE		NORMAL PART			SHEET PILE PART		
PIPE MATERIAL	NOMINAL PIPE DIAMETER D(mm)	TRENCH WIDTH A(m)	DEPTH OF COVER *1 h(m)	EXCAVATION DEPTH H(m)	TRENCH WIDTH A(m)	DEPTH OF COVER *1 h(m)	EXCAVATION DEPTH H(m)
HDPE	50(63)	0.50	0.8/1.2	0.87/1.27	0.70	–	H ≧ 1.50
	75(90)	0.50	0.8/1.2	0.89/1.29	0.70	–	H ≧ 1.50
	100(110)	0.50	0.8/1.2	0.91/1.31	0.75	–	H ≧ 1.50
	150(180)	0.50	0.8/1.2	0.96/1.36	0.80	–	H ≧ 1.50
	200(225)	0.50	0.8/1.2	1.22/1.42	0.85	–	H ≧ 1.50
	250(280)	0.50	0.8/1.2	1.05/1.45	0.85	–	H ≧ 1.50
DIP	300	0.55	0.8/1.2	1.10/1.50	0.90	–	H ≧ 1.50
	350	0.60	0.8/1.2	1.15/1.55	1.00	–	H ≧ 1.50
	400	0.70	0.8/1.2	1.20/1.60	1.05	–	H ≧ 1.50
	450	0.75	1.0/1.2	1.45/1.65	1.10	–	H ≧ 1.50

*1 Depth of cover : Depend on the site condition.



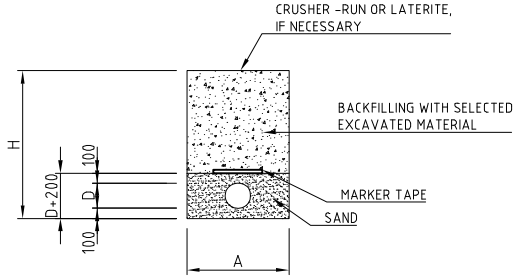
BACKFILL

TP:1N, ROADWAY OF THE NATIONAL ROAD



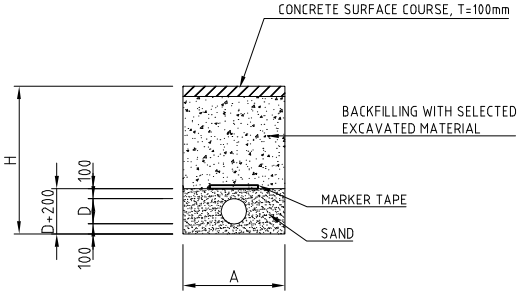
BACKFILL

TP:1C, CITY ROAD (PAVING)
SHOULDER OF THE NATIONAL ROAD



BACKFILL

TP:2,3 . ROAD SHOULDER

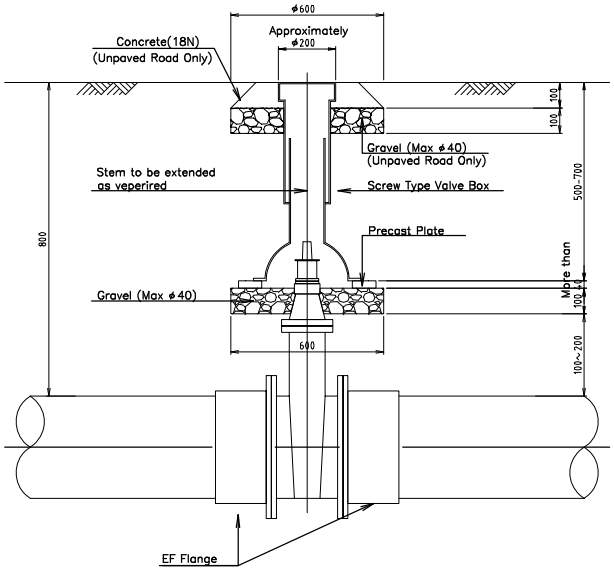


BACKFILL

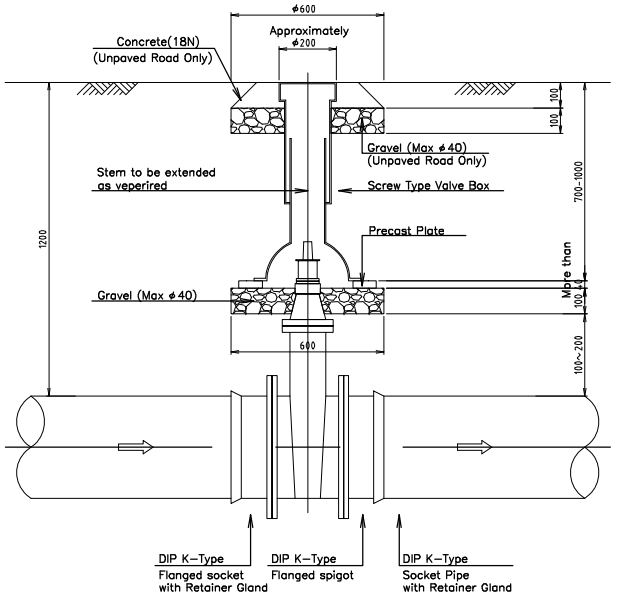
TP: 4, CONCRETE SURFACE COURSE

Project: The Project for Expansion of Water Supply System in Svay Rieng	CLIENT: Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	CONSULTANT: The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Design:	Approved:	Scale: NONE	Description: General Earth Work for Pipe Laying	Drawing Number: TYP-6
			Chief Consultant: Hideki KONNO		Date:		

Typical Drawing for Sluice Valve



SLUICE VALVE INSTALLATION
(HDPE:OD63–280)



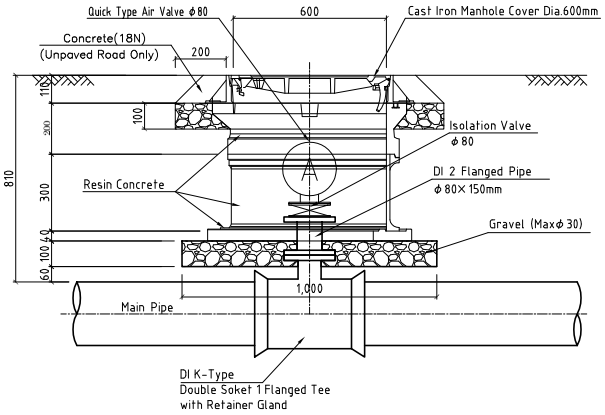
SLUICE VALVE INSTALLATION
(DIP:ND300–400)

NOTE

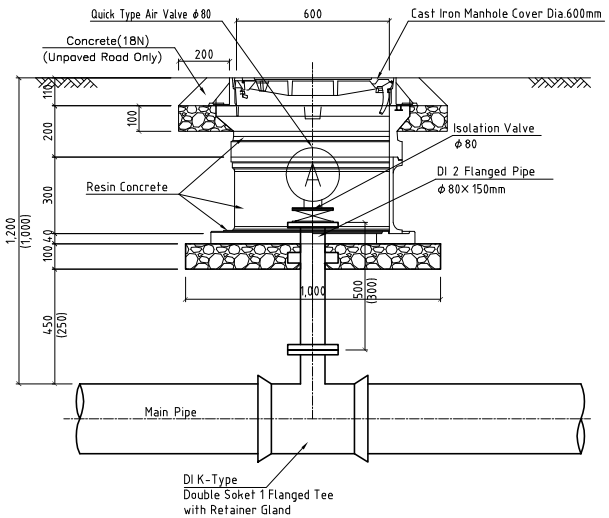
1. ALL SLUICE VALVES 400mm OR LESS WILL HAVE NO CHAMBERS AND WILL BE INSTALLED SEEMLIER TO WASH OUT VALVES HEAVY-DUTY SURFACE BOXES AT THE ROAD LEVEL TO OPERATE THEM.
2. ALL DIMENSIONS ARE IN mm.

Project:	CLIENT:	CONSULTANT:	Design:	Approval:	Scale:	Description:	Drawing Number:
The Project for Expansion of Water Supply System in Svay Rieng	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Chief Consultant: Hideki KONNO		NONE Date:	Typical Drawing for Sluice Valve	TYP-7

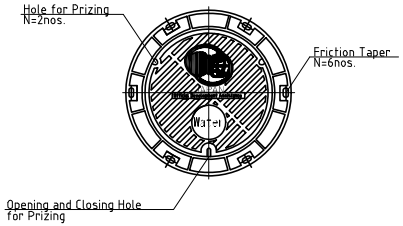
Typical Drawing for Installation of Air Valve and Washout



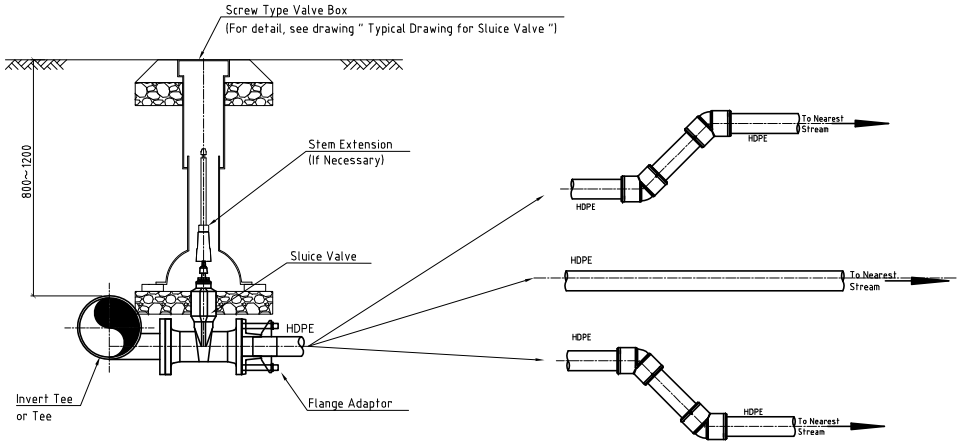
AIR VALVE CHAMBER
MAIN PIPE ≤ OD280 (HDPE)



AIR VALVE CHAMBER
MAIN PIPE DN300~350 (DIP)



CAST IRON MANHOLE COVER
ϕ500 (No.3 Type)



WASHOUT

CRITERIA FOR AIR VALVE AND WASH OUT

MAIN PIPE	MAIN PIPE MATERIAL	BRANCH PIPE for AIR VALVE	BRANCH PIPE for WASH OUT
ϕ50(63)	HDPE	ϕ50	ϕ50
ϕ75(90)		ϕ80	ϕ50
ϕ100(110)		ϕ80	ϕ50
ϕ150(180)		ϕ80	ϕ50
ϕ200(225)		ϕ80	ϕ50
ϕ250(280)		ϕ80	ϕ100
ϕ300	DIP	ϕ80	ϕ100
ϕ350		ϕ80	ϕ150
ϕ400		ϕ80	ϕ150
ϕ450		ϕ80	ϕ150

NOTE

1. THE THICKNESS OF THE BLINDING LAYER SPECIFIED IN THE DRAWING IS FOR NORMAL SOIL TYPES. HOWEVER, IF THE STRUCTURE IS FOUNDED ON VERY WEAK SOIL SUCH AS PEAT, A GROUND STABILIZATION METHOD, AS DIRECTED BY THE ENGINEER, SHALL BE FOLLOWED.
2. THE TOP OF THE AIR VALVE CHAMBER SHOULD BE AT THE SAME LEVEL AS THE ROAD TOP LEVEL.
3. THE VALVE BOXES FOR WASHOUT MAY BE ON THE BANK OF THE ROAD.
4. ALL DIMENSIONS ARE IN mm.

Project:	CLIENT:	CONSULTANT:	Design:	Approval:	Scale:	Description:	Drawing Number:
The Project for Expansion of Water Supply System in Svay Rieng	Ministry of Industry, Science, Technology & Innovation the Kingdom of Cambodia	The Joint Venture of CTI Engineering International Co., Ltd., Water and Sewer Bureau, City of Kitakyushu and TEC International Co., Ltd.	Chief Consultant: Hideki KONNO		NONE Date:	Typical Drawing for Installation of Air Valve and Washout	TYP-8

A-205

7-3　取水ポンプ揚程計算書

揚程計算表を以下に示す。

表 7-2　取水ポンプ揚程計算書

Calculation of Total Head for Intake Pump

Condition

Flow	Q	0.087	m3/s	7480	m3/D
@Pump flow	Qp	0.087	m3/s		

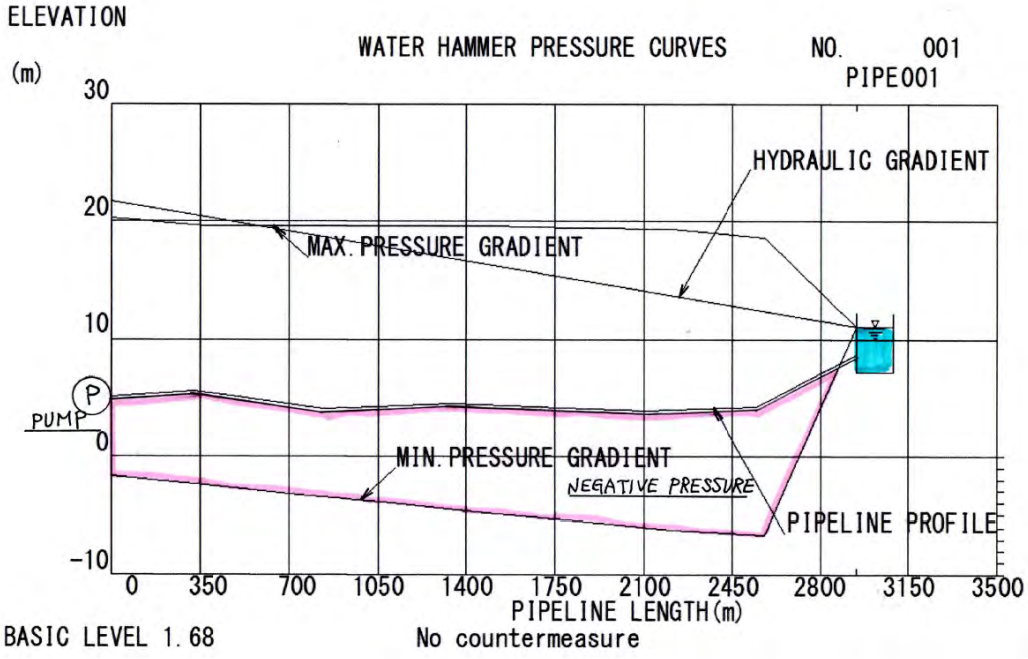
Item	Dia.-1 (mm)	Dia.-2 (mm)	Flow -1 (m3/s)	Velocity-1 (m/s)	Flow -2 (m3/s)	Velocity-2 (m/s)	Flow -3 (m3/s)	Velocity-3 (m/s)	Length (m)	Coefficiency	Q'ty	Loss (m)
1. Screen and Inlet Losses												
Suction screen loss			0.043								1	0.200
Chamber loss			0.043								1	0.150
Total Sction Losses												**0.350 m**
2. Losses of Pump Suction Pipe Line												
Suction Bell	250		0.087	1.765						0.25	1	0.040
250 Sluce valve	250		0.087	1.765						0.24	1	0.038
250/250 T-pipe-γ	250	250	0.087	1.765						0.03	1	0.005
250 Sluice valve	250		0.087	1.765						0.24	1	0.038
250 Pipe	250		0.087	1.765					3	110	1	0.050
250x200Reducer	250	200	0.087	1.765	0.087	2.757			0.2	0.05	1	0.019
200 Pipe	200		0.087	2.757					0.3	110	1	0.015
Total Pump Suction Pipe Losses												**0.204 m**
3. Losses from Pump Discharge to WTP												
125/200 Tape	125	200	0.087	7.058	0.087	2.757				0.15	1	0.142
200 Pipe	200		0.087	2.757					8	110	1	0.391
200 Check valve	200		0.087	2.757						2.8	1	1.086
200 Sluice Valve	200		0.087	2.757						0.23	3	0.089
200 Butterfly Valve	200		0.087	2.757						0.8	1	0.310
200 90-bend	200		0.087	2.757						0.22	4	0.341
200/200 T-pipe-γ	200	200	0.087	2.757	0.087	2.757				1.20	1	0.465
350 90-bend	350		0.087	0.900						0.30	1	0.012
350 Pipe	350		0.087	0.900					2950	130	1	6.944
350/200 Tape	350	200	0.087	0.900		2.757				0.15	1	0.026
350 Butterfly valve	350		0.087	0.900						0.6	3	0.074
350 90-bend	350		0.087	0.900						0.30	6	0.074
350 45-bend	350		0.087	0.900						0.10	10	0.041
Total Pump Discharge Pipe Losses to WTP												**9.998 m**
4. Actual Head												
: Suction LWL											(EL	**1.6**)
: TWP Water Level											(EL	**8.00**)
Actual Head												**6.40 m**
5. Velocity Loss	350		0.087	0.900						1	1	**0.041 m**
6. Any Other Loss												**2.01 m**
7. Pump Total Head												**19.00 m**

出典: JICA 調査団

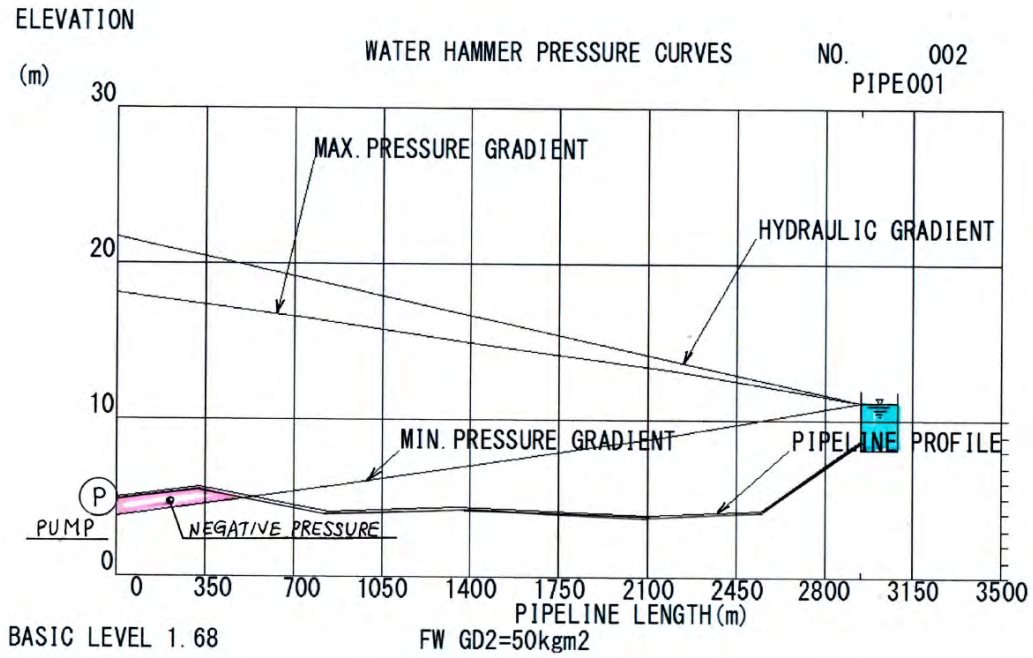
7-4　取水ポンプ～浄水場導水管ウォーターハンマー解析

ウォーターハンマー解析結果を以下に示す。

【無対策】危険負圧 (-10m)が発生



【フライホイール　GD2=50kgm^2 取付】：危険負圧は解消



出典: JICA 調査団

図 7-1　ウォーターハンマー解析結果図

7-5　導水管水理計算

導水管の管径は、取水ポンプから浄水場着水井まで計画導水量を導水する条件で水理計算を行い、適正な流速及び妥当な損失水頭/ポンプ揚程と管径との間の経済的関係を検討し、φ350 とする。

管路の流量公式は、ヘーゼン･ウィリアムズ（Hazen･Williams）公式を用いる。

流量公式:　$H=10.666\times C^{-1.85}\times D^{-4.87}\times Q^{1.85}\times L$

H：摩擦損失水頭（m）
C：流速係数：110
D：管径（m）
Q：流量（m^3/s）7,480m^3/日=5.194m^3/min=0.0866m^3/s
L：延長（m）取水ポンプから浄水場着水井までの導水管延長 2,900m

表 7-3 に各管径の水理計算結果を示す。導水管の流速は、管内の濁質の停滞を防ぐために 0.3m/s 以上を確保する。経済的管径は、流速が 1m 前後とされている。損失水頭をみると、φ300 は計画水量に対して 19.72m の損失が見込まれ、将来の配水区域拡張には対応できないことが予測される。φ350 とφ400 管路の損失水頭差はポンプの仕様に大きく影響しない。よって、導水管の管径は経済性の優れたφ350 とする。

表 7-3　導水管の水理計算結果

流　量（m^3／秒）Q	管　径（mm）D	延　長（m）L	流速係数 C	流　速（m/s）V	動水勾配 I	損失水頭（m）H=L×I	備　考
0.0866	φ400	2, 900	110	0.70	0.0017	4.93	
	φ350			**0.91**	**0.0032**	**9.28**	**採用**
	φ300			1.23	0.0068	19.72	
	φ250			1.78	0.0165	47.85	

出典：JICA 調査団

7-6　管種の選定

高密度ポリエチレン管、ダクタイル鋳鉄管、鋼管の比較表を表 7-4 に示す。カンボジアにおける実績、経済性、施工性、維持管理性を考慮し、導水管、配水管の適用管種は以下のとおりとする。

導水管　一般部：φ350mm　ダクタイル鋳鉄管 (DCIP)
　　河川横断部：φ350mm　鋼管 (SP)（腐食対策）
配水管　一般部：φ250mm 以上：ダクタイル鋳鉄管 (DCIP)、ISO 規格（T 形）
　　φ200mm 以下：高密度ポリエチレン管 (HDPE) (PN10)
　　河川横断部：鋼管 (SP) 防食塗装

表 7-4　管種の比較

管　種	高密度ポリエチレン管 （HDPE）	ダクタイル鋳鉄管 （DCIP）	鋼管 （SP）
適用実績	カンボジアでは 200mm 以下の実績は圧倒的に多い。250mm 以上では適用例が少ない。	カンボジアでは 250mm 以上の実績は圧倒的に多い。	埋設配管としての実績は少ない。添架管、水管橋等では使用されている。
耐性	管体強度は金属管に比べて小さい。 耐食性に優れている。 熱、紫外線に弱い。 有機溶剤による浸透に注意する必要がある。 融着継手により一体化ができ、耐震性が高い。	管体強度が大きく、強靭性に富み、衝撃に強い。 耐久性がある。 プッシュオン方式の継手は融着や溶接継手と比べて、耐震性が低い。	管体強度が大きく、強靭性に富み、衝撃に強い。 耐久性がある。 電食に対する配慮が必要。 内外の防食面に損傷を受けると腐食しやすい。 溶接継手により一体化ができ、耐震性が高い。
施工性	重量が軽く施工性が良い。 雨天時や湧水地盤での施工が困難である。 融着継手は, コントローラや特殊な工具を必要とする。	プッシュオン方式の継手で施工性が良い。 重量が比較的重い。 異形管防護を必要とする。	加工性がよく、複雑な配管も自由な配管が可能。 溶接継手は施工が難しく、施工不良の懸念がある。 内外面の防食対策を必要とする。
維持管理性	200mm 以下は、これまでの実績等より補修等可能。 250mm 以上は、補修管材や接続器具の調達が難しく、迅速な対応ができない可能性がある。	250mm 以上は、これまでの実績等より補修等可能。	施工技術が必要であるため、相対的に時間を要すると考えられる。
経済性	安価	相対的に高価	相対的に高価

出典: JICA 調査団

7-7　管路敷設位置・埋設深さ等

道路管理者（DPWT）と設計対象路線を対象とした道路占用工事条件の確認、また将来関連計画の情報収集を行った。

一般に、カンボジアの道路網は、公共事業省（MPWT）が管理する道路と、農村開発省（MRD）が管理する農村道路で構成されている。

敷設位置・埋設深さ

MPWT は、各タイプの道路について公的施設及びサービスの建設（光ケーブル、給水ネットワークの埋設等）の占用条件を次のように規定している。

- 1 桁の国道（道路中心から 30m 端点より 5m 以内）　公共事業省（MPWT）所管
- 2 桁の国道（道路中心から 25m 端点より 5m 以内）　同上
- 3 桁の国道（道路中心から 20m 端点より 5m 以内）　同上
- 農村道路（道路中心から 15m 端点より 5m 以内）　農村開発省（MRD）所管
- 村の道路（実際の状況に依存する）

これによりがたい場合、路肩部に埋設も可能である。埋設深さは、道路表面から 0.5～1m とする。1 桁の国道横断する場合は、非開削工法を適用する必要があり、また、MPWT へ公式に許可申請する必要がある。

道路構造・舗装構成、舗装復旧

標準道路構造・舗装構成の例を図 7-2 及び図 7-3 に示す。舗装復旧は、敷設配管中心から両サイド 0.5m までとする。

道路橋添架

口径 500mm までの管路の道路橋添架について、番号が 1 桁の国道に対しては MPWT に公式に許可申請する必要がある。番号が 3 桁の国道への添架については DPWT へ、農村道路や村の道路への添架については MRD へ通知するだけでよい。なお、通常、MPWT の許可を求める手続きには約 1 カ月を要する。

将来関連計画

設計対象路線では、具体的な計画はない。

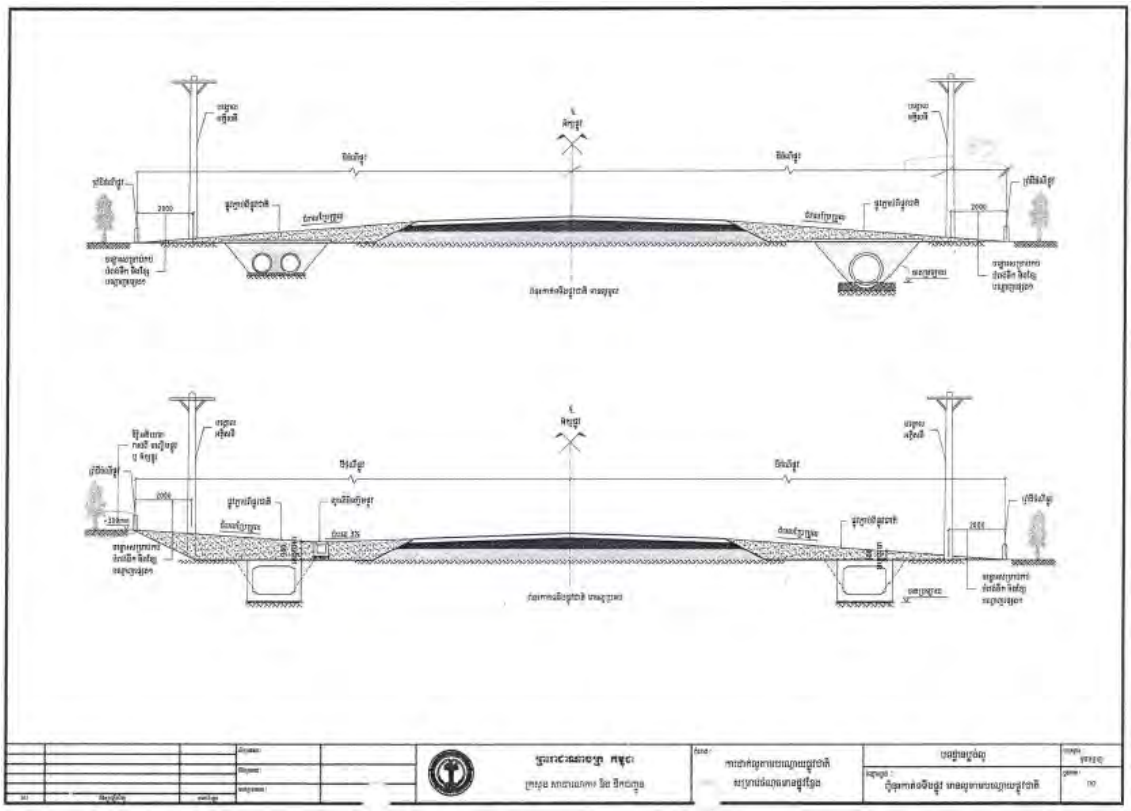


図 7-2　標準道路占有工事条件の例

出典：DPWT

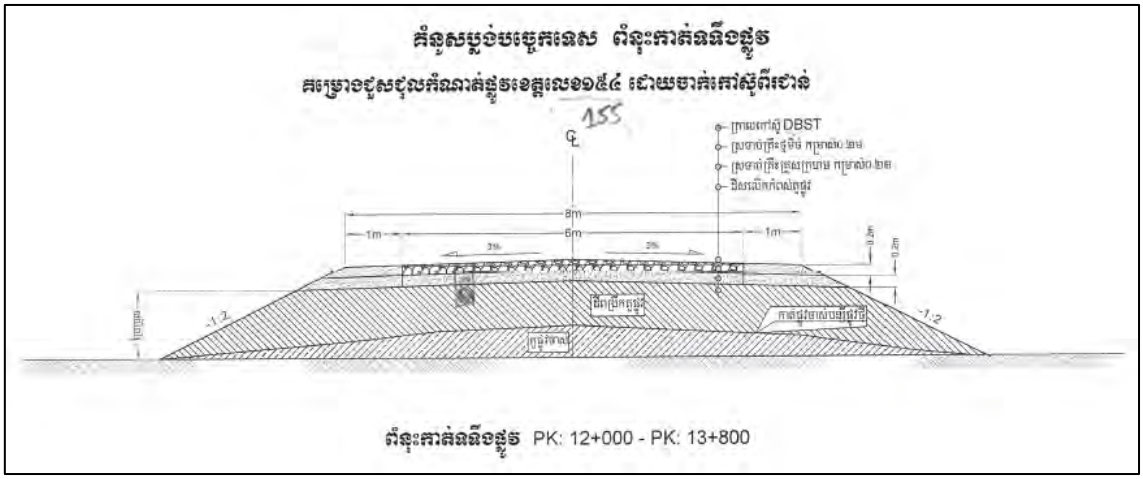


図 7-3　標準道路構造・舗装構成の例

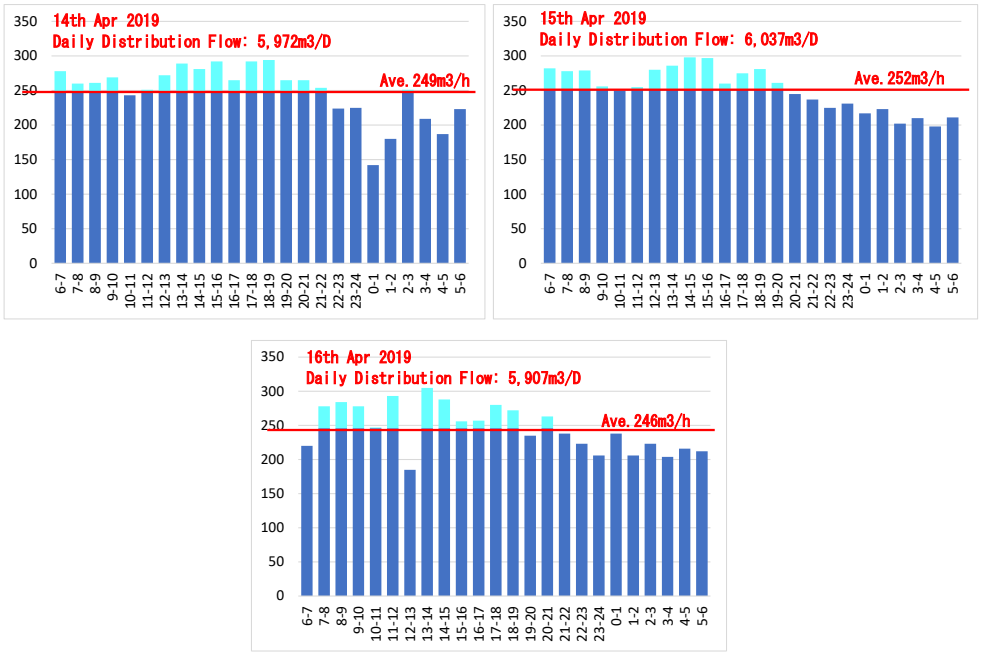
出典：DPWT

7-8　配水池容量の算出

配水池は、需要水量の時間変動が調整でき、かつ、非常時においても一定の時間給水できる機能を持つことが必要である。

既存配水池容量（公称 1,000m^3）の規模の適正を確認した。既存配水池容量は、過去の一日最大配水量（6,037m^3/日）の 4.0 時間分を有している。この値は、カンボジア側と協議して定めた導送配水施設設計基準とした一日最大給水量の 8 時間分と比較すると、半分となる。過去の一日最大配水時の需要変動によると、一日最大配水時の時間当たりの配水量が時間平均配水量を超えた水量の合計は 312～355m3（下図の水色部）であり、最大で一日最大配水量の 1.43 時間分である。したがって、現状の需要変動が続くと考えた場合、既存配水池容量は十分といえる。また、非常時対応容量として配水池より上流側の対応分（水質事故、施設事故等）及び配水池より下流側の対応分（施設事故、消火用水量等）を考慮する必要がある。一方、当該区域と同規模程度での他都市計画(過去の無償支援)では、表 7-5 のとおり、3.5～6.5 時間分となっている。

以上を参考とし、カンボジア国政府との協議結果、常時や非常時の安定給水を図るため、配水池容量は 8 時間分とし、2,200m^3 (6,800 m^3×8/24) とする。



※2019 年の一日最大配水量を記録した上位 3 日間。　出典：JICA 調査団

図 7-4 過去一日最大配水時の時刻別配水量

表 7-5　カンボジア国他都市の計画配水池容量

項　目	コンポンチャム市	バッタンバン市	カンポット市
計画一日最大給水量	16,200 m^3/日	32,473 m^3/日	13,260 m^3/日
配水池容量	5.2 時間分	6.5 時間分	3.5 時間分

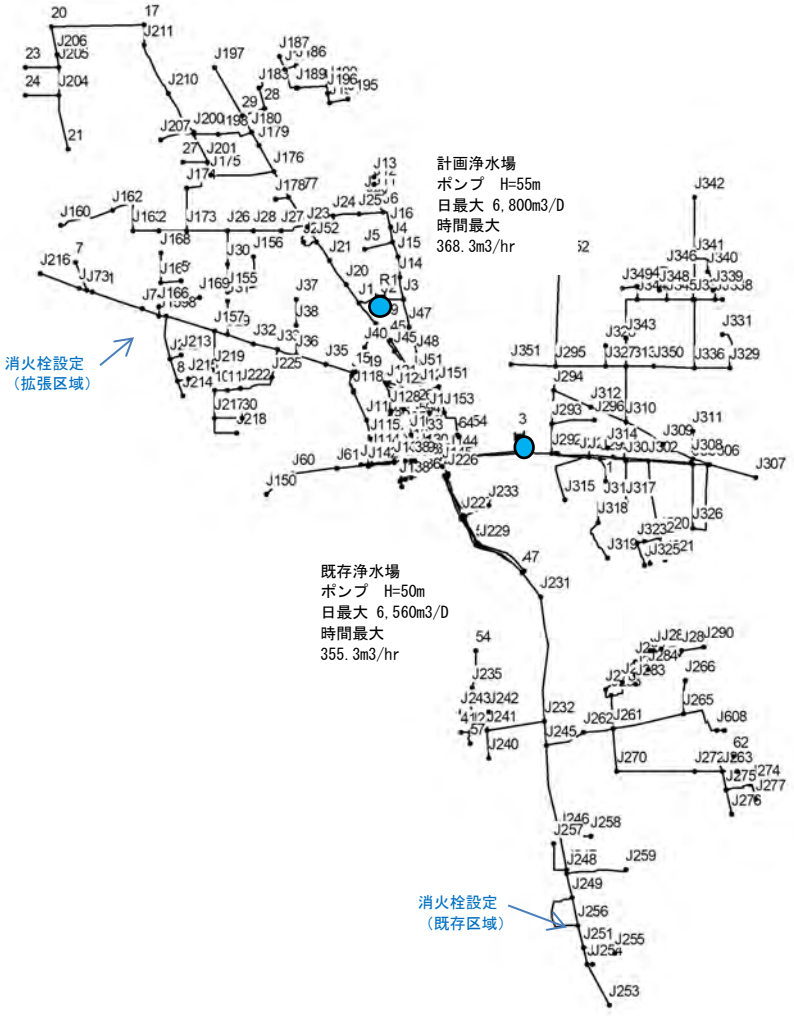
出典: JICA 調査団

7-9　配水管網計算

配水管網の水理計算は、EPANET ver2.0 を用い、下記条件で行った。

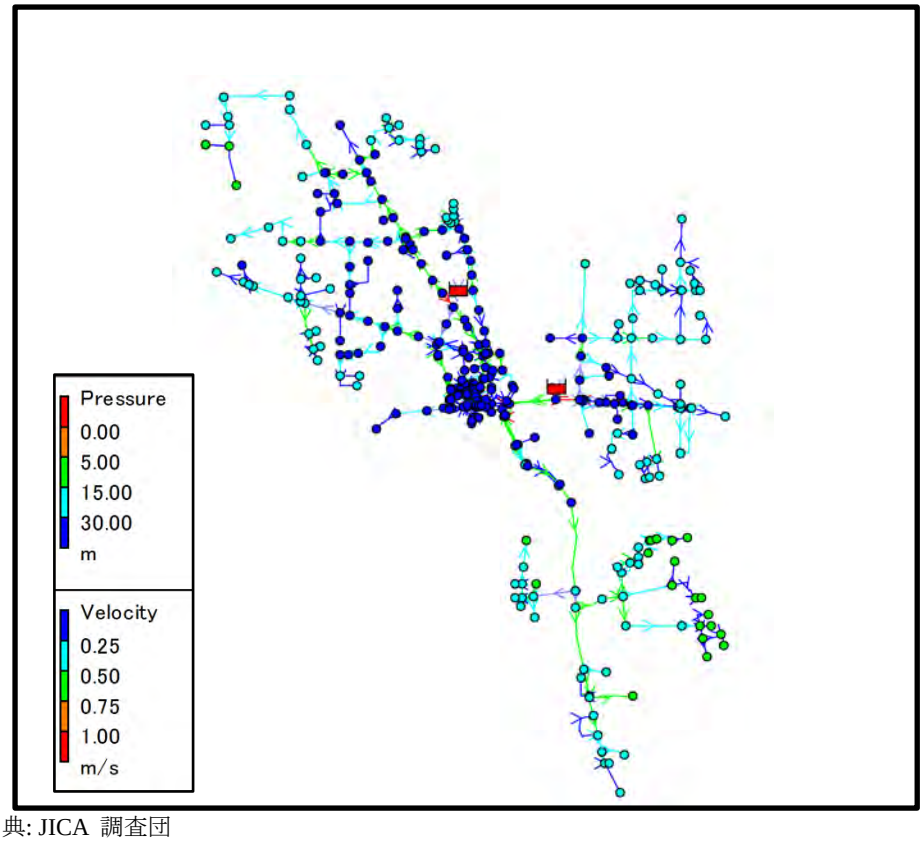
- 管路の流量公式：ヘーゼン・ウィリアムズ式
- 流速係数　　：既存管路、新設 DIP の複雑路線:110、新設 DIP:130、新設 HDPE:150
- 最小残存水圧　：時間最大時 50kPa 以上、消火時 0kPa 以上(負圧とならないこと)
- 時間係数　　：1.30
- 消火時の条件　：各系統において最も条件が悪い（負圧発生が考えられる）と想定される消火栓予定地で単口消火栓(0.5m^3/min)1 栓分を流水

既存施設から配水される区域と新規施設から配水される区域それぞれにおいて時間最大配水量時、消火時において最少残存水圧を確保できるように計画する。配水管網モデル、管網計算データ及び計算結果を以下に示す。



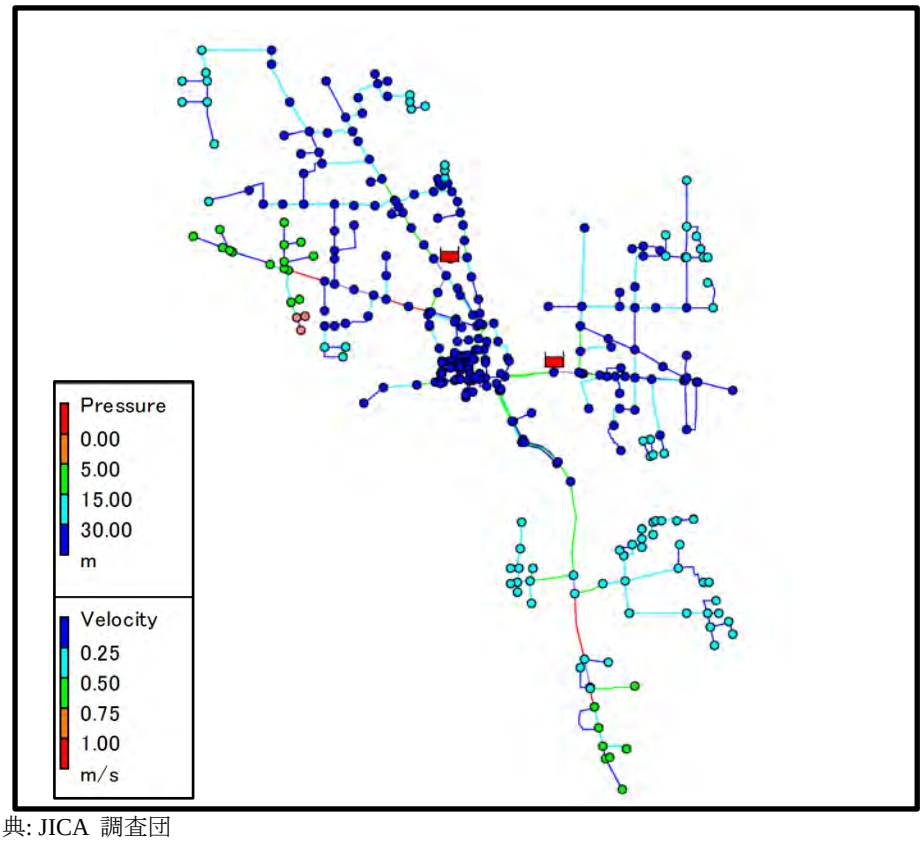
出典: JICA 調査団

図 7-5　配水管網モデル



出典: JICA 調査団

図 7-6　管網計算結果（時間最大配水量時）



出典: JICA 調査団

図 7-7　管網計算結果（消火時）

管網計算データ及び計算結果（交点） -1

NodeID	Elevation	Peak Demand		Extinction Demand	
		Demand	Pressure	Demand	Pressure
	m	LPS	m	LPS	m
Junc 1	0.0	1.6	37.0	1.2	41.7
Junc 10	0.0	0.0	37.1	0.0	36.1
Junc 11	0.0	1.6	38.4	1.3	36.9
Junc 12	3.5	2.9	39.4	2.2	41.4
Junc 13	3.9	0.0	39.5	0.0	41.4
Junc 14	4.6	0.0	39.5	0.0	41.1
Junc 15	4.2	1.3	41.1	1.0	42.0
Junc 16	4.2	0.0	41.1	0.0	42.3
Junc 17	6.1	0.0	22.1	0.0	30.3
Junc 18	4.2	2.6	41.1	2.0	42.0
Junc 19	4.3	1.6	41.1	1.2	42.0
Junc 2	4.4	0.0	27.7	0.0	34.4
Junc 20	5.1	0.0	17.4	0.0	27.8
Junc 21	5.1	0.0	14.0	0.0	25.7
Junc 22	3.6	0.0	39.1	0.0	41.1
Junc 23	5.1	0.0	15.3	0.0	26.5
Junc 24	5.1	0.0	14.0	0.0	25.7
Junc 25	3.8	6.5	38.4	5.0	40.6
Junc 26	3.8	0.0	38.4	0.0	40.6
Junc 27	4.9	0.0	31.2	0.0	36.4
Junc 28	4.8	0.0	32.8	0.0	37.4
Junc 29	4.9	0.0	36.1	0.0	39.4
Junc 30	3.9	0.0	29.3	0.0	29.9
Junc 31	4.6	0.0	38.1	0.0	40.2
Junc 32	3.8	0.0	38.4	0.0	40.7
Junc 33	0.0	6.5	44.3	5.0	45.5
Junc 34	3.9	6.5	36.3	5.0	39.3
Junc 35	3.7	6.5	37.2	5.0	40.0
Junc 36	3.6	0.0	41.1	0.0	42.1
Junc 37	3.6	0.0	39.1	0.0	41.2
Junc 38	3.6	0.0	41.1	0.0	42.1
Junc 39	3.7	6.5	38.9	5.0	41.0
Junc 4	4.5	13.0	43.6	10.0	44.1
Junc 40	3.8	0.0	38.5	0.0	40.7
Junc 41	4.0	0.7	17.6	0.5	22.9
Junc 42	3.6	0.0	39.1	0.0	41.2
Junc 43	3.6	0.0	41.1	0.0	42.1
Junc 44	3.6	2.6	41.0	2.0	42.1
Junc 45	4.0	0.0	41.4	0.0	42.6
Junc 46	3.8	6.5	25.9	5.0	31.0
Junc 47	3.8	4.4	30.6	3.4	33.9
Junc 48	4.1	10.0	34.2	7.7	36.0
Junc 49	4.1	0.0	34.9	0.0	36.4
Junc 5	4.2	0.9	29.0	0.7	7.7
Junc 50	4.1	6.5	31.5	5.0	34.3
Junc 51	4.1	6.5	28.3	5.0	32.4

管網計算データ及び計算結果（交点） -2

NodeID	Elevation	Peak Demand		Extinction Demand	
		Demand	Pressure	Demand	Pressure
	m	LPS	m	LPS	m
Junc 52	4.4	3.9	30.4	3.0	33.5
Junc 53	4.4	6.5	26.2	5.0	31.0
Junc 54	4.0	2.6	12.7	2.0	19.9
Junc 55	4.5	0.0	36.3	0.0	39.6
Junc 56	4.5	3.9	35.8	3.0	39.3
Junc 57	4.5	1.3	16.9	1.0	22.3
Junc 58	4.4	0.0	38.3	0.0	40.4
Junc 59	3.9	3.9	36.2	3.0	39.3
Junc 6	3.8	13.0	40.9	10.0	41.9
Junc 60	3.7	1.3	14.1	1.0	20.3
Junc 61	3.8	0.0	38.4	0.0	40.7
Junc 62	3.7	0.7	13.3	0.5	19.8
Junc 63	3.7	0.7	13.4	0.5	19.8
Junc 64	3.7	6.5	40.7	5.0	41.8
Junc 7	0.0	0.9	31.7	0.7	11.0
Junc 8	4.6	1.4	20.7	1.1	4.1
Junc 9	3.6	3.9	39.1	3.0	41.2
Junc J1	4.0	2.6	44.5	2.0	44.8
Junc J10	4.8	0.7	22.6	0.5	31.1
Junc J100	3.7	0.0	38.5	0.0	40.8
Junc J101	4.4	0.0	38.6	0.0	40.5
Junc J102	3.7	3.1	38.8	2.4	40.9
Junc J103	3.7	3.9	38.8	3.0	41.0
Junc J104	3.7	0.0	38.9	0.0	41.0
Junc J105	3.7	0.0	38.9	0.0	41.0
Junc J106	3.6	0.0	39.1	0.0	41.1
Junc J107	3.6	0.0	39.2	0.0	41.2
Junc J108	3.5	0.0	39.4	0.0	41.4
Junc J11	4.8	2.6	20.4	2.0	29.8
Junc J111	3.7	0.0	39.0	0.0	41.1
Junc J112	3.7	0.0	39.0	0.0	41.1
Junc J113	4.6	0.0	38.2	0.0	40.2
Junc J114	4.4	6.8	38.7	5.2	40.5
Junc J115	3.8	0.0	39.9	0.0	41.5
Junc J116	4.5	6.8	39.5	5.2	40.9
Junc J117	4.2	0.0	40.6	0.0	41.7
Junc J118	4.2	1.3	40.9	1.0	41.8
Junc J119	4.2	2.6	40.8	2.0	41.8
Junc J12	4.8	1.3	19.8	1.0	29.4
Junc J121	4.3	3.9	39.5	3.0	41.0
Junc J122	3.9	1.4	39.9	1.1	41.3
Junc J125	4.2	0.0	41.1	0.0	42.3
Junc J126	4.1	6.5	39.5	5.0	41.3
Junc J127	3.7	2.6	39.9	2.0	41.7
Junc J128	3.7	3.9	39.9	3.0	41.4
Junc J129	3.9	2.6	36.2	2.0	39.3

管網計算データ及び計算結果（交点） -3

NodeID	Elevation	Peak Demand		Extinction Demand	
		Demand	Pressure	Demand	Pressure
	m	LPS	m	LPS	m
Junc J13	4.8	1.3	19.6	1.0	29.3
Junc J130	3.6	0.0	41.1	0.0	42.1
Junc J131	3.6	0.7	41.1	0.5	42.1
Junc J132	3.6	5.2	40.9	4.0	42.0
Junc J133	3.6	3.9	38.8	3.0	41.0
Junc J134	3.5	6.5	39.0	5.0	41.1
Junc J135	3.5	0.0	39.2	0.0	41.3
Junc J136	3.5	2.6	39.0	2.0	41.1
Junc J137	3.6	3.9	39.1	3.0	41.1
Junc J138	3.5	0.0	39.2	0.0	41.3
Junc J139	3.6	0.0	39.1	0.0	41.2
Junc J14	4.0	1.3	40.1	1.0	42.2
Junc J140	4.6	0.0	38.1	0.0	40.2
Junc J141	4.6	0.0	38.1	0.0	40.2
Junc J142	4.6	0.0	38.1	0.0	40.2
Junc J143	3.7	0.0	41.1	0.0	42.1
Junc J144	3.7	0.0	41.1	0.0	42.1
Junc J145	3.8	0.0	37.7	0.0	39.0
Junc J146	4.5	12.4	36.7	9.5	39.8
Junc J147	3.6	0.0	39.1	0.0	41.1
Junc J15	4.0	1.3	37.4	1.0	40.6
Junc J150	4.0	2.6	31.5	2.0	36.3
Junc J151	4.1	1.3	40.1	1.0	41.8
Junc J153	3.5	6.0	39.3	4.6	41.5
Junc J154	3.7	10.7	38.3	8.2	40.8
Junc J155	4.3	1.3	33.3	1.0	37.9
Junc J156	4.3	0.9	32.8	0.7	37.6
Junc J157	3.9	1.6	36.2	1.3	30.7
Junc J158	5.2	2.9	29.0	2.2	8.9
Junc J159	4.2	2.2	29.7	31.7	8.2
Junc J16	4.0	2.6	35.3	2.0	39.3
Junc J160	4.2	2.2	18.5	1.7	28.8
Junc J162	4.2	0.0	21.2	0.0	30.5
Junc J163	4.4	2.2	23.2	1.7	31.6
Junc J166	4.2	1.3	29.4	1.0	8.0
Junc J167	4.2	0.0	29.2	0.0	7.9
Junc J168	4.1	1.3	28.8	1.0	7.6
Junc J169	4.2	0.9	29.1	0.7	7.8
Junc J17	4.9	5.2	40.5	4.0	42.1
Junc J173	4.4	2.2	32.4	1.7	37.3
Junc J174	4.9	2.2	31.3	1.7	36.4
Junc J175	4.9	2.6	31.7	2.0	36.7
Junc J176	4.9	0.0	37.8	0.0	40.4
Junc J177	4.9	5.2	38.9	4.0	41.1
Junc J178	4.9	0.0	38.9	0.0	41.1
Junc J179	4.8	0.0	37.2	0.0	40.1

管網計算データ及び計算結果（交点） -4

NodeID	Elevation	Peak Demand		Extinction Demand	
		Demand	Pressure	Demand	Pressure
	m	LPS	m	LPS	m
Junc J180	4.9	1.9	36.7	1.5	39.7
Junc J183	4.8	1.9	29.9	1.5	35.6
Junc J184	4.8	1.1	26.1	0.9	33.2
Junc J186	4.8	1.1	25.9	0.9	33.1
Junc J187	4.8	1.1	25.9	0.9	33.1
Junc J188	4.8	1.1	21.4	0.9	30.4
Junc J189	4.8	0.0	21.4	0.0	30.4
Junc J19	5.0	2.6	40.7	2.0	42.2
Junc J190	4.8	1.1	18.0	0.9	28.3
Junc J193	4.8	1.1	17.1	0.9	27.7
Junc J194	4.8	0.0	17.1	0.0	27.7
Junc J195	4.8	1.1	16.8	0.9	27.6
Junc J196	4.8	0.0	17.6	0.0	28.0
Junc J197	6.1	1.9	34.7	1.5	38.1
Junc J198	4.9	1.9	32.5	1.5	37.2
Junc J199	4.9	2.1	30.3	1.6	35.8
Junc J2	4.3	0.0	45.6	0.0	45.6
Junc J20	4.1	2.6	43.5	2.0	44.2
Junc J200	4.9	2.1	30.1	1.6	35.7
Junc J201	4.9	0.0	31.2	0.0	36.4
Junc J204	5.1	2.1	14.0	1.6	25.7
Junc J205	5.1	2.1	15.3	1.6	26.5
Junc J206	5.1	2.1	15.6	1.6	26.7
Junc J207	4.9	2.1	28.6	1.6	34.8
Junc J21	4.4	2.6	42.3	2.0	43.3
Junc J210	4.9	4.1	26.7	3.2	33.6
Junc J211	6.1	4.1	23.3	3.2	31.1
Junc J212	4.6	2.9	24.6	2.2	6.5
Junc J213	4.6	1.4	24.3	1.1	6.3
Junc J214	4.4	1.4	20.5	1.1	4.0
Junc J215	4.6	1.4	20.5	1.1	3.9
Junc J216	4.6	2.2	27.1	1.7	6.4
Junc J217	3.9	1.6	29.3	1.3	29.9
Junc J218	3.9	1.6	28.3	1.3	29.2
Junc J219	3.9	0.7	36.0	0.5	30.5
Junc J22	5.0	2.6	40.5	2.0	42.1
Junc J222	3.7	0.0	35.2	0.0	33.5
Junc J225	3.7	1.6	36.3	1.3	34.2
Junc J226	4.1	6.5	34.9	5.0	36.4
Junc J227	4.1	0.0	33.8	0.0	35.3
Junc J229	4.4	0.0	32.7	0.0	34.1
Junc J23	4.8	0.0	40.6	0.0	42.2
Junc J231	3.6	0.0	31.6	0.0	32.9
Junc J232	3.9	0.0	28.5	0.0	29.7
Junc J233	4.1	0.0	33.8	0.0	35.3
Junc J235	4.0	2.6	15.1	2.0	21.4

管網計算データ及び計算結果（交点） -5

NodeID	Elevation	Peak Demand		Extinction Demand	
		Demand	Pressure	Demand	Pressure
	m	LPS	m	LPS	m
Junc J236	4.0	0.0	16.2	0.0	22.0
Junc J237	4.8	5.2	16.9	4.0	22.1
Junc J24	4.8	0.0	38.1	0.0	40.6
Junc J240	4.7	3.3	15.1	2.5	21.1
Junc J241	4.7	0.0	18.0	0.0	22.9
Junc J242	4.7	5.2	13.7	4.0	20.2
Junc J243	4.0	1.6	15.9	1.2	21.9
Junc J245	3.5	3.9	27.8	3.0	28.7
Junc J246	4.4	6.5	22.5	5.0	19.4
Junc J247	4.0	0.0	21.6	0.0	16.9
Junc J248	3.7	6.5	21.8	5.0	17.0
Junc J249	3.8	3.9	20.0	33.0	8.4
Junc J25	4.8	2.7	35.6	2.1	39.1
Junc J250	4.1	3.9	18.4	3.0	7.3
Junc J251	4.4	3.9	17.5	3.0	6.5
Junc J252	4.5	3.9	17.0	3.0	6.2
Junc J253	3.8	1.2	17.0	0.9	6.5
Junc J254	4.5	0.0	17.0	0.0	6.2
Junc J255	4.4	2.6	15.3	2.0	5.2
Junc J256	4.1	0.0	18.4	0.0	7.3
Junc J257	4.0	1.3	20.9	1.0	16.5
Junc J258	4.4	2.0	21.3	1.5	18.7
Junc J259	3.7	10.4	11.9	8.0	10.9
Junc J26	4.3	3.1	36.2	2.4	39.7
Junc J261	4.4	2.6	21.7	2.0	24.7
Junc J262	3.8	2.6	24.4	2.0	26.6
Junc J263	4.3	1.3	19.3	1.0	23.2
Junc J265	4.6	2.6	14.8	2.0	20.4
Junc J266	4.3	1.3	14.5	1.0	20.3
Junc J268	4.0	2.6	14.0	2.0	20.1
Junc J27	4.7	0.0	39.1	0.0	41.3
Junc J270	4.4	6.5	17.8	5.0	22.3
Junc J272	3.7	2.6	15.7	2.0	21.2
Junc J273	3.7	2.1	13.4	1.6	19.9
Junc J274	3.7	0.0	12.5	0.0	19.3
Junc J275	3.7	1.3	13.0	1.0	19.6
Junc J276	3.7	1.3	12.5	1.0	19.3
Junc J277	3.7	1.3	12.2	1.0	19.1
Junc J278	4.4	2.6	18.2	2.0	22.5
Junc J28	4.4	0.0	37.7	0.0	40.5
Junc J280	4.4	1.3	17.7	1.0	22.2
Junc J281	4.4	2.6	15.6	2.0	20.9
Junc J282	4.4	0.0	15.6	0.0	20.9
Junc J283	4.4	0.0	15.6	0.0	20.9
Junc J284	4.4	0.0	14.6	0.0	20.3
Junc J285	4.4	0.0	13.4	0.0	19.6

管網計算データ及び計算結果（交点） -6

NodeID	Elevation	Peak Demand		Extinction Demand	
		Demand	Pressure	Demand	Pressure
	m	LPS	m	LPS	m
Junc J286	4.4	3.9	13.1	3.0	19.4
Junc J287	4.4	0.0	12.6	0.0	19.1
Junc J289	4.0	1.3	10.8	1.0	18.1
Junc J29	4.4	1.0	35.9	0.8	31.0
Junc J290	4.0	1.3	10.5	1.0	17.9
Junc J291	4.5	0.0	36.5	0.0	39.7
Junc J292	4.5	5.3	36.1	4.1	39.5
Junc J293	4.5	7.3	33.8	5.6	38.0
Junc J294	4.5	10.4	31.8	8.0	36.8
Junc J295	4.5	15.6	31.0	12.0	36.4
Junc J296	4.5	2.6	31.0	2.0	36.3
Junc J297	4.5	1.3	34.6	1.0	38.5
Junc J298	4.5	0.0	33.9	0.0	38.1
Junc J299	4.5	3.9	33.1	3.0	37.6
Junc J3	4.2	0.0	43.4	0.0	44.2
Junc J30	4.3	0.0	34.6	0.0	38.6
Junc J300	4.5	0.0	31.8	0.0	36.8
Junc J301	4.5	3.9	31.7	3.0	36.8
Junc J302	4.5	3.9	31.3	3.0	36.5
Junc J304	4.5	0.0	29.8	0.0	35.6
Junc J305	4.5	4.3	29.4	3.3	35.4
Junc J306	4.5	0.0	29.4	0.0	35.4
Junc J307	4.5	2.6	29.1	2.0	35.1
Junc J308	4.5	0.0	28.5	0.0	34.8
Junc J309	4.5	2.6	28.1	2.0	34.6
Junc J31	4.4	0.0	35.9	0.0	31.0
Junc J310	4.5	6.5	29.4	5.0	35.3
Junc J311	4.5	1.3	27.9	1.0	34.5
Junc J312	4.5	1.3	30.2	1.0	35.9
Junc J313	4.5	1.6	27.8	1.2	34.3
Junc J314	4.5	1.4	33.3	1.1	37.7
Junc J315	4.5	2.5	30.7	1.9	36.1
Junc J316	4.5	1.3	29.8	1.0	35.6
Junc J317	4.5	1.3	30.3	1.0	35.9
Junc J318	4.5	1.3	27.9	1.0	34.4
Junc J319	4.5	1.3	27.1	1.0	33.9
Junc J32	4.3	3.3	36.6	2.5	32.8
Junc J320	4.5	3.9	21.0	3.0	30.2
Junc J321	4.5	1.3	20.5	1.0	29.9
Junc J322	4.5	0.0	18.5	0.0	28.6
Junc J323	4.5	1.7	17.7	1.3	28.1
Junc J324	4.5	1.3	17.2	1.0	27.9
Junc J325	4.5	1.3	18.1	1.0	28.4
Junc J326	4.5	3.9	26.8	3.0	33.8
Junc J327	4.5	1.3	28.4	1.0	34.7
Junc J328	4.5	1.6	27.9	1.2	34.4

管網計算データ及び計算結果（交点） -7

NodeID	Elevation	Peak Demand		Extinction Demand	
		Demand	Pressure	Demand	Pressure
	m	LPS	m	LPS	m
Junc J329	4.5	1.3	19.4	1.0	29.2
Junc J33	4.3	1.6	37.2	1.3	34.6
Junc J331	4.5	0.9	19.0	0.7	29.0
Junc J334	4.5	0.0	20.4	0.0	29.8
Junc J335	4.5	1.3	20.4	1.0	29.8
Junc J336	4.5	2.6	21.1	2.0	30.3
Junc J337	4.5	0.0	19.5	0.0	29.3
Junc J338	4.5	0.0	19.5	0.0	29.3
Junc J339	4.5	1.3	19.1	1.0	29.0
Junc J340	4.5	0.0	19.0	0.0	28.9
Junc J341	4.5	1.3	18.8	1.0	28.8
Junc J342	4.5	1.3	17.7	1.0	28.1
Junc J343	4.5	1.3	25.1	1.0	32.7
Junc J344	4.5	1.3	21.5	1.0	30.5
Junc J345	4.5	1.3	20.7	1.0	30.0
Junc J346	4.5	0.0	20.7	0.0	30.0
Junc J347	4.5	1.3	21.3	1.0	30.4
Junc J348	4.5	0.0	21.3	0.0	30.4
Junc J349	4.5	0.0	21.3	0.0	30.4
Junc J35	4.1	6.8	39.5	5.2	39.1
Junc J350	4.5	1.3	24.5	1.0	32.3
Junc J351	4.5	1.3	30.9	1.0	36.3
Junc J352	4.5	6.0	27.6	4.6	34.2
Junc J36	4.3	1.6	37.9	1.3	36.0
Junc J37	4.3	1.3	35.4	1.0	34.5
Junc J38	4.3	1.3	35.8	1.0	34.7
Junc J39	3.9	0.0	43.2	0.0	43.8
Junc J4	4.0	2.3	35.8	1.8	39.6
Junc J40	3.9	13.0	42.2	10.0	43.0
Junc J45	4.0	11.1	42.3	8.5	43.2
Junc J46	4.2	0.0	41.3	0.0	42.5
Junc J47	3.9	4.0	41.9	3.1	43.2
Junc J48	3.9	3.9	41.5	3.0	42.9
Junc J5	4.0	1.3	35.3	1.0	39.2
Junc J50	4.4	0.0	41.4	0.0	42.4
Junc J51	4.4	0.0	41.1	0.0	42.4
Junc J52	5.0	0.0	41.0	0.0	42.4
Junc J55	3.7	0.0	39.0	0.0	41.1
Junc J6	4.8	1.3	34.4	1.0	38.4
Junc J60	5.0	4.2	30.7	3.2	35.4
Junc J61	3.8	6.8	33.8	5.2	37.8
Junc J7	4.8	0.0	29.4	0.0	35.3
Junc J71	4.6	0.0	27.5	0.0	6.7
Junc J72	4.6	0.0	27.4	0.0	6.6
Junc J73	4.6	1.3	27.4	1.0	6.6
Junc J74	5.0	2.9	28.1	2.2	6.8

管網計算データ及び計算結果（交点） -8

NodeID	Elevation	Peak Demand		Extinction Demand	
		Demand	Pressure	Demand	Pressure
	m	LPS	m	LPS	m
Junc J75	4.2	0.0	41.3	0.0	42.4
Junc J78	3.8	6.5	39.7	5.0	41.4
Junc J79	3.8	0.0	39.0	0.0	41.0
Junc J8	4.8	0.0	26.7	0.0	33.7
Junc J80	3.8	6.5	38.5	5.0	40.7
Junc J81	3.8	0.0	38.4	0.0	40.7
Junc J82	3.8	0.0	38.4	0.0	40.6
Junc J83	3.8	0.0	38.4	0.0	40.6
Junc J84	3.8	2.7	38.4	2.1	40.7
Junc J85	3.8	0.0	38.4	0.0	40.6
Junc J86	3.8	6.5	38.5	5.0	40.7
Junc J87	3.8	2.6	38.2	2.0	40.5
Junc J88	3.8	0.0	38.3	0.0	40.5
Junc J89	3.8	3.9	38.2	3.0	40.5
Junc J9	4.8	0.9	24.2	0.7	32.1
Junc J90	3.8	0.0	38.3	0.0	40.5
Junc J91	3.8	6.5	38.3	5.0	40.5
Junc J92	3.8	0.0	38.3	0.0	40.5
Junc J93	3.8	0.0	38.3	0.0	40.5
Junc J94	3.8	2.6	38.2	2.0	40.5
Junc J95	3.7	0.0	38.8	0.0	40.9
Junc J96	3.7	6.5	38.5	5.0	40.8
Junc J97	3.7	0.0	38.5	0.0	40.8
Junc J98	3.7	0.0	38.5	0.0	40.8
Junc J99	3.7	0.0	38.5	0.0	40.8

管網計算データ及び計算結果（管路） -1

LinkID	Node1 (Junction)	Node2 (Junction)	Diameter mm	Length m	Roughness	Peak Demand		Extinction Demand	
						Flow CMH	Velocity m/s	Flow LPS	Velocity m/s
Pipe L1	R1	J2	400	58.7	111	359.1	0.79	306.2	0.68
Pipe L2	J2	J1	350	371.4	111	342.1	0.99	292.6	0.84
Pipe L79	J39	J1	300	406.6	130	-256.8	1.01	-227.0	0.89
Pipe 22	J226	49	250	33.1	150	-122.5	0.69	-124.2	0.70
Pipe 29	3	4	250	350.3	110	174.3	0.99	148.8	0.84
Pipe 30	6	4	250	1,022.4	110	-129.6	0.73	-119.0	0.67
Pipe L241	4	3	250	325.6	110	-181.3	1.03	-154.8	0.88
Pipe L261	J75	J50	250	247.0	150	-95.4	0.54	-78.9	0.45
Pipe L262	J50	J45	250	464.1	150	-96.8	0.55	-79.6	0.45
Pipe L348	J226	J227	250	726.4	150	116.0	0.66	119.2	0.67
Pipe L349	J227	J229	250	517.9	150	116.0	0.66	119.2	0.67
Pipe L350	J229	J231	250	1,283.0	150	116.0	0.66	119.2	0.67
Pipe L351	J231	J232	250	1,961.2	150	116.0	0.66	119.2	0.67
Pipe L67	18	J40	250	429.5	150	-135.9	0.77	-129.0	0.73
Pipe L68	J40	J39	250	401.3	150	-148.9	0.84	-139.0	0.79
Pipe L78	J45	J39	250	525.9	130	-107.8	0.61	-88.1	0.50
Pipe 1	J23	J19	200	139.2	150	-72.3	0.64	-55.6	0.49
Pipe 10	13	14	200	257.4	110	-66.7	0.59	-54.0	0.48
Pipe 23	J112	J55	200	10.0	150	13.1	0.12	8.3	0.07
Pipe 28	J75	J125	200	33.7	111	77.4	0.68	65.1	0.58
Pipe 45	J143	J144	200	4.9	110	-15.0	0.13	-11.5	0.10
Pipe 47	38	43	200	90.7	110	0.0	0.00	0.0	0.00
Pipe 48	9	37	200	64.1	110	0.0	0.00	0.0	0.00
Pipe 49	36	43	200	119.6	110	5.8	0.05	4.5	0.04
Pipe 9	12	13	200	211.9	110	-56.4	0.50	-45.8	0.40
Pipe L102	J55	22	200	98.9	110	13.1	0.12	8.3	0.07
Pipe L176	9	J107	200	98.5	110	-13.7	0.12	-12.4	0.11
Pipe L177	J107	12	200	294.8	110	-34.1	0.30	-28.6	0.25
Pipe L186	J55	J111	200	14.7	110	0.0	0.00	0.0	0.00
Pipe L193	J115	J116	200	285.8	150	-61.2	0.54	-44.4	0.39
Pipe L194	J116	J117	200	492.3	150	-68.0	0.60	-49.6	0.44
Pipe L195	J117	18	200	317.6	150	-68.0	0.60	-49.6	0.44
Pipe L204	J125	14	200	355.5	110	75.8	0.67	61.0	0.54
Pipe L223	J135	42	200	118.3	110	0.0	0.00	0.0	0.00
Pipe L225	9	J137	200	42.6	110	16.9	0.15	13.0	0.11
Pipe L226	J137	J135	200	237.3	110	13.0	0.11	10.0	0.09
Pipe L229	22	J139	200	171.2	110	7.3	0.06	3.9	0.03
Pipe L230	J139	9	200	12.8	110	7.1	0.06	3.6	0.03
Pipe L236	36	J143	200	387.9	110	-15.0	0.13	-11.5	0.10
Pipe L237	J144	6	200	136.0	110	-15.0	0.13	-11.5	0.10
Pipe L238	6	4	200	1,031.7	110	-71.7	0.63	-65.8	0.58
Pipe L239	6	J145	200	210.4	110	166.8	1.47	158.3	1.40
Pipe L240	J145	49	200	169.0	110	166.8	1.47	158.3	1.40
Pipe L242	4	J146	200	620.2	110	141.3	1.25	108.7	0.96
Pipe L26	J1	J20	200	359.4	150	82.7	0.73	63.6	0.56
Pipe L28	J20	J21	200	439.6	150	80.1	0.71	61.6	0.54
Pipe L35	J23	J17	200	23.2	150	63.2	0.56	48.6	0.43

管網計算データ及び計算結果（管路） -2

LinkID	Node1 (Junction)	Node2 (Junction)	Diameter mm	Length m	Roughness	Peak Demand		Extinction Demand	
						Flow CMH	Velocity m/s	Flow LPS	Velocity m/s
Pipe L367	J232	J245	200	365.6	150	93.6	0.83	102.0	0.90
Pipe L92	J21	J52	200	360.3	150	77.5	0.69	59.6	0.53
Pipe L93	J52	J19	200	135.8	150	75.9	0.67	58.4	0.52
Pipe 20	J292	J146	150	87.6	150	-65.5	1.03	-50.4	0.79
Pipe 21	J291	J146	150	26.2	150	-59.5	0.94	-45.8	0.72
Pipe L169	J102	J103	150	157.9	110	-13.1	0.21	-10.3	0.16
Pipe L172	J103	J104	150	40.4	110	-17.0	0.27	-13.3	0.21
Pipe L174	J104	J106	150	73.5	110	-17.0	0.27	-13.3	0.21
Pipe L175	J106	J107	150	99.2	110	-20.4	0.32	-16.1	0.25
Pipe L187	J112	J113	150	278.5	150	-13.1	0.21	-8.3	0.13
Pipe L191	J113	J114	150	177.7	150	-26.8	0.42	-18.8	0.29
Pipe L192	J114	J115	150	235.6	150	-40.5	0.64	-29.0	0.46
Pipe L266	J29	J157	150	228.7	150	27.5	0.43	51.2	0.80
Pipe L293	J17	J177	150	515.5	150	45.1	0.71	34.7	0.55
Pipe L295	J177	J176	150	472.1	150	39.9	0.63	30.7	0.48
Pipe L296	J176	J179	150	453.8	150	32.0	0.50	24.6	0.39
Pipe L297	J179	J180	150	223.5	150	32.0	0.50	24.6	0.39
Pipe L368	J245	J246	150	1,380.3	150	46.0	0.72	65.4	1.03
Pipe L369	J246	J247	150	578.9	150	37.6	0.59	58.9	0.93
Pipe L370	J247	J248	150	48.5	150	36.3	0.57	57.9	0.91
Pipe L386	J261	J262	150	465.3	111	-41.1	0.65	-31.6	0.50
Pipe L387	J262	J245	150	616.2	111	-43.7	0.69	-33.6	0.53
Pipe L422	J292	J293	150	445.5	150	60.2	0.95	46.3	0.73
Pipe L423	J293	J294	150	519.2	150	50.3	0.79	38.7	0.61
Pipe L424	J294	J295	150	399.3	150	35.0	0.55	27.0	0.42
Pipe L426	J291	J297	150	379.2	150	59.5	0.94	45.8	0.72
Pipe L427	J297	J298	150	145.0	150	55.8	0.88	42.9	0.67
Pipe L428	J298	J299	150	182.7	150	54.3	0.85	41.8	0.66
Pipe L429	J299	J300	150	380.0	150	48.9	0.77	37.6	0.59
Pipe L430	J300	J301	150	19.4	150	35.5	0.56	27.3	0.43
Pipe L431	J301	J302	150	338.2	150	26.4	0.42	20.3	0.32
Pipe L53	J29	J32	150	426.3	150	-28.5	0.45	-51.9	0.82
Pipe L55	J32	J33	150	395.9	150	-31.7	0.50	-54.4	0.86
Pipe L60	J35	18	150	438.0	150	-50.9	0.80	-69.1	1.09
Pipe L63	J36	J35	150	492.5	150	-44.1	0.69	-63.9	1.00
Pipe L91	J33	J36	150	274.1	150	-39.9	0.63	-60.7	0.95
Pipe 19	15	19	100	538.4	110	0.0	0.00	-2.9	0.10
Pipe 24	J78	J115	100	19.0	111	-20.7	0.73	-15.4	0.54
Pipe 25	J101	J114	100	42.9	111	-7.0	0.25	-5.0	0.18
Pipe 26	18	15	100	38.2	111	1.3	0.04	-1.9	0.07
Pipe 27	18	J119	100	75.0	111	13.1	0.46	10.1	0.36
Pipe 32	35	34	100	205.6	110	13.0	0.46	10.0	0.35
Pipe 34	12	35	100	240.0	110	19.5	0.69	15.0	0.53
Pipe 40	29	J180	100	317.6	150	-11.8	0.42	-9.1	0.32
Pipe 46	33	36	100	332.1	110	-6.5	0.23	-5.0	0.18
Pipe 5	J302	J304	100	705.8	150	13.0	0.46	10.0	0.35
Pipe 55	49	48	100	42.2	110	29.5	1.04	22.7	0.80

管網計算データ及び計算結果（管路） -3

LinkID	Node1 (Junction)	Node2 (Junction)	Diameter mm	Length m	Roughness	Peak Demand		Extinction Demand	
						Flow CMH	Velocity m/s	Flow LPS	Velocity m/s
Pipe 58	6	64	100	384.9	111	6.5	0.23	5.0	0.18
Pipe 59	50	52	100	447.1	110	8.3	0.29	6.4	0.23
Pipe 60	51	53	100	458.0	110	13.0	0.46	10.0	0.35
Pipe 65	55	56	100	1,201.8	110	3.9	0.14	3.0	0.11
Pipe 67	58	31	100	161.4	110	0.0	0.00	0.0	0.00
Pipe 68	59	34	100	124.7	110	-3.9	0.14	-3.0	0.11
Pipe 71	32	61	100	143.4	110	0.0	0.00	0.0	0.00
Pipe L137	J78	J79	100	149.4	110	14.2	0.50	10.4	0.37
Pipe L138	J79	J80	100	112.3	110	14.2	0.50	10.4	0.37
Pipe L139	J80	J81	100	77.6	110	6.1	0.22	4.6	0.16
Pipe L140	J81	25	100	17.7	110	8.8	0.31	6.6	0.23
Pipe L141	J82	J83	100	24.7	110	0.0	0.00	0.0	0.00
Pipe L142	25	J83	100	3.3	110	0.0	0.00	0.0	0.00
Pipe L143	J81	J84	100	84.5	110	-2.6	0.09	-2.0	0.07
Pipe L144	32	J84	100	16.8	110	0.0	0.00	0.0	0.00
Pipe L145	J84	40	100	66.9	110	-5.4	0.19	-4.1	0.15
Pipe L146	J80	40	100	89.8	110	1.6	0.06	0.8	0.03
Pipe L147	J83	26	100	191.4	110	0.0	0.00	0.0	0.00
Pipe L148	26	J85	100	65.0	110	0.0	0.00	0.0	0.00
Pipe L149	J86	13	100	446.7	110	-10.3	0.36	-8.3	0.29
Pipe L150	40	J86	100	76.2	110	-3.8	0.13	-3.3	0.12
Pipe L151	J87	J88	100	177.4	110	-2.6	0.09	-2.0	0.07
Pipe L152	J88	J89	100	161.8	110	3.9	0.14	3.0	0.11
Pipe L153	J88	J90	100	21.7	110	-6.5	0.23	-5.0	0.18
Pipe L156	J91	J92	100	16.5	110	2.6	0.09	2.0	0.07
Pipe L157	25	J91	100	80.3	110	2.3	0.08	1.6	0.06
Pipe L158	J91	J90	100	2.7	110	-6.8	0.24	-5.4	0.19
Pipe L159	J93	J92	100	183.6	110	0.0	0.00	0.0	0.00
Pipe L160	J92	J94	100	276.0	110	2.6	0.09	2.0	0.07
Pipe L161	J95	J96	100	190.1	110	6.5	0.23	5.0	0.18
Pipe L163	J95	39	100	53.6	110	-9.8	0.35	-7.5	0.27
Pipe L164	J96	J97	100	1.7	110	0.0	0.00	0.0	0.00
Pipe L165	J97	J98	100	7.2	110	0.0	0.00	0.0	0.00
Pipe L166	J97	J99	100	31.6	110	0.0	0.00	0.0	0.00
Pipe L167	J96	J100	100	11.1	110	0.0	0.00	0.0	0.00
Pipe L168	39	J101	100	355.1	110	-7.0	0.25	-5.0	0.18
Pipe L170	J90	J102	100	71.1	110	-13.3	0.47	-10.4	0.37
Pipe L171	J102	J95	100	7.5	110	-3.3	0.12	-2.5	0.09
Pipe L173	J104	J105	100	1.8	110	0.0	0.00	0.0	0.00
Pipe L178	12	J108	100	156.1	110	0.0	0.00	0.0	0.00
Pipe L179	39	J106	100	190.1	110	-3.4	0.12	-2.8	0.10
Pipe L196	J118	J119	100	235.5	110	-1.3	0.05	-1.0	0.04
Pipe L198	J119	J121	100	600.3	110	9.2	0.33	7.1	0.25
Pipe L201	J121	J122	100	178.7	110	1.4	0.05	1.1	0.04
Pipe L206	J125	45	100	869.6	110	0.0	0.00	0.0	0.00
Pipe L207	16	J125	100	84.0	110	-1.6	0.06	-4.1	0.14
Pipe L208	16	19	100	448.7	110	1.6	0.06	4.1	0.14

管網計算データ及び計算結果（管路） -4

LinkID	Node1 (Junction)	Node2 (Junction)	Diameter mm	Length m	Roughness	Peak Demand		Extinction Demand	
						Flow CMH	Velocity m/s	Flow LPS	Velocity m/s
Pipe L209	14	J126	100	226.9	110	9.1	0.32	7.0	0.25
Pipe L210	J126	J127	100	217.9	110	2.6	0.09	2.0	0.07
Pipe L211	J128	J121	100	413.1	110	-3.9	0.14	-3.0	0.11
Pipe L212	J129	34	100	290.3	110	-2.6	0.09	-2.0	0.07
Pipe L214	43	J130	100	100.0	110	0.0	0.00	0.0	0.00
Pipe L215	36	J131	100	148.4	110	2.6	0.09	2.0	0.07
Pipe L216	43	J131	100	29.9	110	5.8	0.21	4.5	0.16
Pipe L217	J131	44	100	269.2	110	2.6	0.09	2.0	0.07
Pipe L218	J131	J132	100	157.5	110	5.2	0.18	4.0	0.14
Pipe L219	J133	J134	100	252.0	110	-3.9	0.14	-3.0	0.11
Pipe L220	J135	J134	100	44.4	110	13.0	0.46	10.0	0.35
Pipe L221	J134	J136	100	85.3	110	2.6	0.09	2.0	0.07
Pipe L224	J137	J138	100	306.4	110	0.0	0.00	0.0	0.00
Pipe L233	31	J141	100	4.4	110	0.0	0.00	0.0	0.00
Pipe L234	J141	J140	100	130.1	110	0.0	0.00	0.0	0.00
Pipe L235	J141	J142	100	36.2	110	0.0	0.00	0.0	0.00
Pipe L243	J146	55	100	874.0	110	3.9	0.14	3.0	0.11
Pipe L244	22	J147	100	6.5	110	5.9	0.21	4.3	0.15
Pipe L245	J139	J147	100	181.7	110	0.1	0.00	0.4	0.01
Pipe L246	J147	31	100	399.8	110	0.0	0.00	0.0	0.00
Pipe L247	J147	39	100	186.0	110	6.0	0.21	4.7	0.17
Pipe L248	49	50	100	686.3	110	14.8	0.52	11.4	0.40
Pipe L249	48	51	100	700.0	110	19.5	0.69	15.0	0.53
Pipe L250	52	47	100	873.7	110	4.4	0.16	3.4	0.12
Pipe L251	46	53	100	873.7	110	-6.5	0.23	-5.0	0.18
Pipe L255	J75	J151	100	333.2	150	17.9	0.63	13.8	0.49
Pipe L257	J151	J153	100	386.4	150	16.6	0.59	12.8	0.45
Pipe L259	J153	J154	100	516.8	150	10.7	0.38	8.2	0.29
Pipe L267	J157	J158	100	777.6	150	25.2	0.89	49.4	1.75
Pipe L268	J158	J159	100	96.6	150	13.7	0.48	40.5	1.43
Pipe L3	J2	J3	100	347.7	111	17.0	0.60	13.6	0.48
Pipe L318	J180	J198	100	564.7	111	18.3	0.65	14.1	0.50
Pipe L319	J198	J199	100	380.3	111	16.4	0.58	12.6	0.45
Pipe L320	J199	J200	100	22.9	111	18.6	0.66	14.3	0.51
Pipe L330	J200	J210	100	724.2	111	14.5	0.51	11.1	0.39
Pipe L331	J210	J211	100	871.5	111	10.3	0.37	8.0	0.28
Pipe L360	J237	J241	100	255.3	111	-13.9	0.49	-10.7	0.38
Pipe L366	J241	J232	100	910.6	111	-22.4	0.79	-17.2	0.61
Pipe L371	J248	J249	100	388.4	150	19.4	0.69	44.9	1.59
Pipe L372	J249	J250	100	440.5	150	14.2	0.50	10.9	0.39
Pipe L379	J250	J256	100	4.3	150	11.6	0.41	8.9	0.31
Pipe L380	J256	J251	100	372.1	150	11.6	0.41	8.9	0.31
Pipe L388	J261	J263	100	526.1	111	14.3	0.51	11.0	0.39
Pipe L398	J270	J261	100	659.7	111	-16.4	0.58	-12.6	0.45
Pipe L400	J270	J272	100	1,202.9	111	9.9	0.35	7.6	0.27
Pipe L43	J17	J27	100	421.0	111	12.9	0.46	9.9	0.35
Pipe L434	J304	J305	100	212.4	150	10.9	0.39	8.4	0.30

管網計算データ及び計算結果（管路） -5

LinkID	Node1 (Junction)	Node2 (Junction)	Diameter mm	Length m	Roughness	Peak Demand		Extinction Demand	
						Flow CMH	Velocity m/s	Flow LPS	Velocity m/s
Pipe L435	J305	J306	100	40.2	150	4.8	0.17	3.7	0.13
Pipe L443	J310	J313	100	873.1	111	8.8	0.31	6.7	0.24
Pipe L444	J300	J310	100	584.0	111	13.3	0.47	10.3	0.36
Pipe L45	J27	J28	100	441.8	111	12.9	0.46	9.9	0.35
Pipe L46	J28	J26	100	410.6	111	12.9	0.46	9.9	0.35
Pipe L461	J313	J327	100	308.3	111	-9.3	0.33	-7.2	0.25
Pipe L462	J327	J295	100	773.7	111	-12.2	0.43	-9.4	0.33
Pipe L470	J334	J335	100	26.0	111	0.8	0.03	0.6	0.02
Pipe 14	J350	J336	75	621.2	111	7.3	0.46	5.6	0.35
Pipe 17	11	J222	75	215.3	111	-4.9	0.31	-3.8	0.24
Pipe 31	J211	17	75	301.3	111	6.2	0.39	4.8	0.30
Pipe 33	20	17	75	1,426.5	111	-6.2	0.39	-4.8	0.30
Pipe 35	20	J206	75	450.6	111	6.2	0.39	4.8	0.30
Pipe 41	J197	29	75	862.0	150	-1.9	0.12	-1.5	0.09
Pipe 42	J183	28	75	315.0	111	-9.8	0.62	-7.6	0.48
Pipe 43	29	28	75	360.0	111	9.8	0.62	7.6	0.48
Pipe 57	J316	J317	75	329.8	111	-3.9	0.25	-3.0	0.19
Pipe L112	J61	J60	75	700.3	150	6.8	0.43	5.2	0.33
Pipe L132	J73	J72	75	136.7	150	2.2	0.14	1.7	0.10
Pipe L15	J3	J14	75	337.9	111	10.5	0.66	8.1	0.51
Pipe L17	J14	J15	75	318.4	111	9.2	0.58	7.1	0.45
Pipe L18	J15	J4	75	261.9	111	7.9	0.50	6.1	0.38
Pipe L189	J113	J61	75	533.8	150	13.6	0.86	10.5	0.66
Pipe L19	J4	J16	75	242.9	111	4.3	0.27	3.3	0.21
Pipe L20	J16	J6	75	286.6	111	1.7	0.10	1.3	0.08
Pipe L253	J60	J150	75	517.7	150	2.6	0.16	2.0	0.13
Pipe L269	J159	J74	75	291.2	150	7.2	0.45	5.5	0.35
Pipe L270	J74	J71	75	817.7	150	4.3	0.27	3.3	0.21
Pipe L271	J71	J73	75	81.2	150	4.3	0.27	3.3	0.21
Pipe L280	J159	J166	75	144.9	111	4.3	0.27	3.3	0.21
Pipe L281	J166	J167	75	350.6	111	2.2	0.14	1.7	0.10
Pipe L290	J175	J176	75	985.7	111	-7.9	0.49	-6.1	0.38
Pipe L291	J26	J173	75	639.0	111	7.6	0.48	5.9	0.37
Pipe L300	J183	J184	75	609.2	111	7.9	0.50	6.1	0.38
Pipe L321	J199	J201	75	476.9	111	-4.3	0.27	-3.3	0.21
Pipe L322	J201	J175	75	228.5	111	-4.3	0.27	-3.3	0.21
Pipe L327	J205	J206	75	187.1	111	-4.1	0.26	-3.2	0.20
Pipe L332	J158	J212	75	670.2	111	8.7	0.54	6.7	0.42
Pipe L337	J72	J216	75	639.7	150	2.2	0.14	1.7	0.10
Pipe L346	J222	J225	75	586.6	130	-4.9	0.31	-3.8	0.24
Pipe L347	J225	J33	75	439.7	130	-6.5	0.41	-5.0	0.31
Pipe L355	J235	J236	75	387.5	111	-5.2	0.33	-4.0	0.25
Pipe L356	J236	J237	75	304.2	111	-6.8	0.43	-5.2	0.33
Pipe L36	J23	J24	75	418.0	130	9.1	0.57	7.0	0.44
Pipe L374	J251	J252	75	249.6	150	5.1	0.32	3.9	0.25
Pipe L38	J24	J25	75	403.0	130	9.1	0.57	7.0	0.44
Pipe L383	J248	J259	75	953.3	111	10.4	0.65	8.0	0.50

管網計算データ及び計算結果（管路） -6

LinkID	Node1 (Junction)	Node2 (Junction)	Diameter mm	Length m	Roughness	Peak Demand		Extinction Demand	
						Flow CMH	Velocity m/s	Flow LPS	Velocity m/s
Pipe L39	J25	J6	75	374.6	130	6.4	0.40	4.9	0.31
Pipe L390	J261	J265	75	1,105.8	111	7.8	0.49	6.0	0.38
Pipe L394	J265	J268	75	788.0	111	3.9	0.25	3.0	0.19
Pipe L401	J272	J273	75	414.2	111	7.3	0.46	5.6	0.35
Pipe L403	J273	J275	75	286.2	111	3.9	0.25	3.0	0.19
Pipe L407	J263	J278	75	215.2	111	6.7	0.42	5.2	0.32
Pipe L409	J278	J280	75	289.5	111	4.1	0.26	3.2	0.20
Pipe L410	J263	J280	75	371.9	111	6.3	0.40	4.9	0.30
Pipe L411	J280	J281	75	255.7	111	9.1	0.57	7.0	0.44
Pipe L414	J281	J284	75	232.8	111	6.5	0.41	5.0	0.31
Pipe L415	J284	J285	75	281.4	111	6.5	0.41	5.0	0.31
Pipe L416	J285	J286	75	58.4	111	6.5	0.41	5.0	0.31
Pipe L436	J306	J307	75	751.8	150	2.6	0.16	2.0	0.13
Pipe L441	J310	J312	75	598.3	111	-3.6	0.23	-2.8	0.17
Pipe L442	J312	J294	75	613.7	111	-4.9	0.31	-3.8	0.24
Pipe L448	J301	J317	75	645.7	130	5.2	0.33	4.0	0.25
Pipe L453	J302	J320	75	1,179.5	111	9.5	0.60	7.3	0.46
Pipe L471	J335	J336	75	1,055.1	111	-2.5	0.16	-1.9	0.12
Pipe L482	J313	J343	75	430.3	111	7.9	0.50	6.1	0.38
Pipe L483	J343	J344	75	782.8	111	6.6	0.42	5.1	0.32
Pipe L486	J344	J345	75	469.4	111	4.0	0.25	3.1	0.19
Pipe L487	J345	J334	75	402.8	111	2.7	0.17	2.1	0.13
Pipe L492	J313	J350	75	448.5	111	8.6	0.54	6.6	0.42
Pipe L494	J295	J351	75	693.8	111	1.3	0.08	1.0	0.06
Pipe L495	J295	J352	75	1,632.1	150	6.0	0.38	4.6	0.29
Pipe L82	J47	J3	75	433.8	111	-6.5	0.41	-5.5	0.34
Pipe L84	J48	J47	75	469.9	111	-2.5	0.16	-2.4	0.15
Pipe L89	J46	J51	75	224.6	111	0.0	0.00	0.0	0.00
Pipe L90	J51	J48	75	298.3	111	1.4	0.09	0.6	0.04
Pipe 11	J212	8	50	352.2	130	4.3	0.61	3.3	0.47
Pipe 12	8	J214	50	260.4	130	1.4	0.20	1.1	0.16
Pipe 13	8	J215	50	160.1	130	1.4	0.20	1.1	0.16
Pipe 15	10	J217	50	447.4	111	3.3	0.46	2.5	0.35
Pipe 16	10	11	50	204.7	130	-3.3	0.46	-2.5	0.35
Pipe 18	J335	J337	50	324.0	130	2.0	0.28	1.5	0.22
Pipe 2	J299	1	50	366.0	130	1.6	0.22	1.2	0.17
Pipe 3	J163	2	50	406.2	130	-4.3	0.61	-3.3	0.47
Pipe 36	21	J204	50	875.5	130	0.0	0.00	0.0	0.00
Pipe 37	23	J205	50	502.9	130	0.0	0.00	0.0	0.00
Pipe 38	24	J204	50	510.7	130	0.0	0.00	0.0	0.00
Pipe 39	27	J201	50	367.1	130	0.0	0.00	0.0	0.00
Pipe 44	30	J217	50	426.7	130	0.0	0.00	0.0	0.00
Pipe 50	41	J237	50	153.7	130	-0.7	0.09	-0.5	0.07
Pipe 51	54	J235	50	567.1	130	-2.6	0.37	-2.0	0.28
Pipe 52	57	J237	50	188.7	130	-1.3	0.18	-1.0	0.14
Pipe 53	J268	60	50	125.2	130	1.3	0.18	1.0	0.14
Pipe 54	62	J273	50	496.2	130	-0.7	0.09	-0.5	0.07

管網計算データ及び計算結果（管路） -7

LinkID	Node1 (Junction)	Node2 (Junction)	Diameter mm	Length m	Roughness	Peak Demand		Extinction Demand	
						Flow CMH	Velocity m/s	Flow LPS	Velocity m/s
Pipe 56	63	J273	50	235.3	130	-0.7	0.09	-0.5	0.07
Pipe 6	5	J167	50	342.6	130	-0.9	0.12	-0.7	0.09
Pipe 7	2	J173	50	424.4	130	-4.3	0.61	-3.3	0.47
Pipe 8	7	J73	50	461.8	130	-0.9	0.12	-0.7	0.09
Pipe L10	J9	J10	50	83.1	130	5.9	0.83	4.5	0.64
Pipe L12	J11	J10	50	141.8	130	-5.2	0.74	-4.0	0.57
Pipe L13	J11	J12	50	144.2	130	2.6	0.37	2.0	0.28
Pipe L14	J12	J13	50	137.0	130	1.3	0.18	1.0	0.14
Pipe L263	J155	J156	50	875.7	130	0.9	0.12	0.7	0.09
Pipe L264	J30	J155	50	420.6	130	2.2	0.31	1.7	0.23
Pipe L275	J162	J163	50	765.4	130	-2.2	0.31	-1.7	0.23
Pipe L279	J160	J162	50	856.0	130	-2.2	0.31	-1.7	0.23
Pipe L282	J167	J168	50	458.6	130	1.3	0.18	1.0	0.14
Pipe L283	J166	J169	50	643.5	130	0.9	0.12	0.7	0.09
Pipe L288	J173	J174	50	635.9	130	1.2	0.16	0.9	0.13
Pipe L289	J174	J175	50	521.6	130	-1.0	0.14	-0.8	0.11
Pipe L294	J177	J178	50	214.8	130	0.0	0.00	0.0	0.00
Pipe L303	J184	J186	50	203.1	130	1.1	0.16	0.9	0.12
Pipe L304	J184	J187	50	213.6	130	1.1	0.16	0.9	0.12
Pipe L306	J189	J190	50	475.7	130	3.4	0.48	2.6	0.37
Pipe L307	J184	J189	50	391.8	130	4.5	0.64	3.5	0.49
Pipe L308	J189	J188	50	0.5	130	1.1	0.16	0.9	0.12
Pipe L312	J194	J195	50	290.8	130	1.1	0.16	0.9	0.12
Pipe L314	J194	J193	50	0.2	130	-1.1	0.16	-0.9	0.12
Pipe L315	J190	J196	50	142.3	130	2.3	0.32	1.7	0.25
Pipe L316	J196	J193	50	140.1	130	2.3	0.32	1.7	0.25
Pipe L32	J22	J19	50	249.1	130	-1.0	0.14	-0.8	0.11
Pipe L326	J204	J205	50	435.3	130	-2.1	0.29	-1.6	0.22
Pipe L329	J200	J207	50	520.3	130	2.1	0.29	1.6	0.22
Pipe L333	J212	J213	50	190.2	130	1.4	0.20	1.1	0.16
Pipe L339	J217	J218	50	569.3	130	1.6	0.23	1.3	0.18
Pipe L340	J157	J219	50	617.4	130	0.7	0.09	0.5	0.07
Pipe L352	J227	J233	50	439.1	130	0.0	0.00	0.0	0.00
Pipe L359	J240	J241	50	448.0	130	-3.3	0.46	-2.5	0.35
Pipe L361	J241	J242	50	278.4	130	5.2	0.74	4.0	0.57
Pipe L363	J236	J243	50	164.0	130	1.6	0.22	1.2	0.17
Pipe L375	J252	J253	50	733.5	130	1.2	0.17	0.9	0.13
Pipe L376	J252	J254	50	93.4	130	0.0	0.00	0.0	0.00
Pipe L377	J251	J255	50	500.8	130	2.6	0.37	2.0	0.28
Pipe L378	J250	J249	50	1,049.2	130	-1.3	0.18	-1.0	0.14
Pipe L381	J247	J257	50	587.0	130	1.3	0.18	1.0	0.14
Pipe L382	J246	J258	50	491.6	130	2.0	0.28	1.5	0.21
Pipe L391	J265	J266	50	505.0	130	1.3	0.18	1.0	0.14
Pipe L404	J275	J276	50	398.8	130	1.3	0.18	1.0	0.14
Pipe L405	J275	J274	50	401.1	130	1.3	0.18	1.0	0.14
Pipe L406	J274	J277	50	257.9	130	1.3	0.18	1.0	0.14
Pipe L412	J281	J282	50	194.2	130	0.0	0.00	0.0	0.00

管網計算データ及び計算結果（管路） -8

LinkID	Node1 (Junction)	Node2 (Junction)	Diameter mm	Length m	Roughness	Peak Demand		Extinction Demand	
						Flow CMH	Velocity m/s	Flow LPS	Velocity m/s
Pipe L413	J281	J283	50	170.0	130	0.0	0.00	0.0	0.00
Pipe L417	J286	J287	50	113.5	130	2.6	0.37	2.0	0.28
Pipe L419	J289	J290	50	334.9	130	1.3	0.18	1.0	0.14
Pipe L420	J287	J289	50	522.4	130	2.6	0.37	2.0	0.28
Pipe L425	J293	J296	50	651.0	130	2.6	0.37	2.0	0.28
Pipe L437	J306	J308	50	285.4	130	2.2	0.32	1.7	0.24
Pipe L438	J308	J309	50	530.6	130	0.9	0.13	0.7	0.10
Pipe L439	J309	J310	50	679.0	130	-1.7	0.23	-1.3	0.18
Pipe L440	J308	J311	50	444.8	130	1.3	0.18	1.0	0.14
Pipe L445	J298	J314	50	460.6	130	1.4	0.20	1.1	0.16
Pipe L446	J297	J315	50	994.5	130	2.5	0.35	1.9	0.27
Pipe L450	J316	J318	50	435.4	130	2.6	0.37	2.0	0.28
Pipe L451	J318	J319	50	671.9	130	1.3	0.18	1.0	0.14
Pipe L454	J320	J321	50	376.9	130	1.3	0.18	1.0	0.14
Pipe L455	J320	J322	50	231.2	130	4.3	0.61	3.3	0.47
Pipe L456	J322	J323	50	146.8	130	3.0	0.42	2.3	0.33
Pipe L457	J323	J324	50	350.8	130	1.3	0.18	1.0	0.14
Pipe L458	J322	J325	50	342.1	130	1.3	0.18	1.0	0.14
Pipe L459	J304	J326	50	999.3	130	2.1	0.30	1.6	0.23
Pipe L460	J326	J305	50	1,192.8	130	-1.8	0.25	-1.4	0.19
Pipe L463	J327	J328	50	297.9	130	1.6	0.22	1.2	0.17
Pipe L466	J329	J331	50	602.7	130	0.9	0.13	0.7	0.10
Pipe L473	J336	J329	50	554.8	130	2.2	0.31	1.7	0.24
Pipe L476	J337	J338	50	90.5	130	0.0	0.00	0.0	0.00
Pipe L477	J337	J339	50	167.4	130	2.0	0.28	1.5	0.22
Pipe L478	J339	J340	50	297.5	130	0.7	0.10	0.5	0.07
Pipe L479	J340	J341	50	405.7	130	0.7	0.10	0.5	0.07
Pipe L480	J334	J341	50	629.4	130	1.9	0.27	1.5	0.21
Pipe L481	J341	J342	50	954.8	130	1.3	0.18	1.0	0.14
Pipe L485	J345	J346	50	456.1	130	0.0	0.00	0.0	0.00
Pipe L488	J344	J347	50	196.5	130	1.3	0.18	1.0	0.14
Pipe L489	J347	J348	50	362.4	130	0.0	0.00	0.0	0.00
Pipe L49	J26	J30	50	538.3	130	2.2	0.31	1.7	0.23
Pipe L490	J347	J349	50	225.7	130	0.0	0.00	0.0	0.00
Pipe L5	J4	J5	50	466.5	130	1.3	0.18	1.0	0.14
Pipe L52	J31	J29	50	518.6	130	0.0	0.00	0.0	0.00
Pipe L64	J36	J38	50	479.9	130	2.6	0.37	2.0	0.28
Pipe L65	J38	J37	50	393.3	130	1.3	0.18	1.0	0.14
Pipe L7	J6	J7	50	200.0	130	6.8	0.96	5.2	0.74
Pipe L8	J7	J8	50	104.3	130	6.8	0.96	5.2	0.74
Pipe L88	J50	J51	50	154.0	130	1.4	0.20	0.6	0.09
Pipe L9	J8	J9	50	101.4	130	6.8	0.96	5.2	0.74
Pipe L94	J52	J22	50	263.5	130	1.6	0.23	1.2	0.17

7-10　貧困世帯数の想定

(1)　計画給水区域における貧困世帯数

2010 年及び 2011 年のカンボジア計画省（Ministry of Planning）が実施した”Identification of Poor Household Programme”の貧困層データをもとに、次式により推定する。2027 年の計画給水区域における貧困世帯数 (Poor Level 1)は 410 世帯と推定される。

貧困世帯数(F) = Σ{ビレッジ別貧困層の割合(C)×ビレッジ別世帯数(E)
ビレッジ別世帯数: 2027 年給水人口÷世帯構成人数 4.63*
*世帯構成人員:給水人口 55,964÷給水戸数 12,087 (2027 年時)

(2)　無償の機材供与対象となる貧困層世帯数

無償の機材供与対象となる貧困層世帯数は、2027 年の計画給水区域内における貧困世帯数 410 世帯から接続済の貧困世帯数の 35 世帯を控除し、375 世帯が見込まれる。

表 7-6　計画給水区域内の貧困世帯数の算出

Commune	Village	Population in 2027	Number of IDPoor in 2011					HHs in 2027	Poor 1 HHs in 2027	Poor 2 HHs in 2027
			Poor 1	Poor 2	Total HHs	% of Poor 1	% of Poor 2			
Svay Rieng	Veal Yon	3,119						674		
	Svay Rieng	1,640						354		
	Kien Sang	1,524						329		
	Me Phleung	2,208						477		
	Srah Vong	2,161						467		
	Roung Banlae	2,202						476		
	Chong Preaek	2,517	16	46	456	3.5%	10.1%	544	19	55
Prey Chhlak	Suon Thmei	528	4	8	154	2.6%	5.2%	114	3	6
	Rub Kou	1,495	5	7	145	3.4%	4.8%	323	11	16
	Sala Srok Chas	816	1	8	153	0.7%	5.2%	176	1	9
	Prey Chhlak	579		17	131		13.0%	125		16
	Andoung Ta Sei	955	4	10	127	3.1%	7.9%	206	6	16
Koy Trabaek	Koy Trabaek	2,217	14	27	306	4.6%	8.8%	479	22	42
	Tarang Bal	1,568	11	16	330	3.3%	4.8%	339	11	16
Pou Ta Hao	Kbal Spean	395	8	9	76	10.5%	11.8%	85	9	10
	Thnal Kaeng	836	7	18	116	6.0%	15.5%	181	11	28
	La	1,942	10	15	136	7.4%	11.0%	419	31	46
	Pou Ta Hao	265	3	10	97	3.1%	10.3%	57	2	6
Chek	Chek	1,791	14	17	378	3.7%	4.5%	387	14	17
	Chambak	1,866	4	19	359	1.1%	5.3%	403	4	21
	Svay	1,249	10	10	239	4.2%	4.2%	270	11	11
	Thmol	1,181	2	13	267	0.7%	4.9%	255	2	12
	Svat	184	2	3	48	4.2%	6.3%	40	2	3
	Totea	1,838	11	22	335	3.3%	6.6%	397	13	26
	Kandal	466	5	9	108	4.6%	8.3%	101	5	8
	Meloung	798	4	7	165	2.4%	4.2%	172	4	7
	Khleang	694	4	10	117	3.4%	8.5%	150	5	13
	Kok Pae	674	3	14	96	3.1%	14.6%	146	5	21
Svay Toea	Ta Chour	397	4	10	94	4.3%	10.6%	86	4	9
	Ta Nar	1,649	16	29	332	4.8%	8.7%	356	17	31
	Khousang	931	7	12	182	3.8%	6.6%	201	8	13
Sangkhoar	Bak Ronoas	1,209	8	23	235	3.4%	9.8%	261	9	26
	Thlok	813	5	11	167	3.0%	6.6%	176	5	12
	Chambak Peam	693	3	10	144	2.1%	6.9%	150	3	10
	Thmei	1,942	5	10	210	2.4%	4.8%	419	10	20
	Srama Chrum	746	4	4	100	4.0%	4.0%	161	6	6
Basak	Svay Ta Phlo	1,926	24	61	399	6.0%	15.3%	416	25	64
	Sala Rien	2,516	26	61	485	5.4%	12.6%	543	29	68
	Payab	2,232	30	57	474	6.3%	12.0%	482	31	58
	Basak	1,901	44	62	338	13.0%	18.3%	411	54	75
	Pou Ta Ros	1,301	18	46	274	6.6%	16.8%	281	18	47
TOTAL		**55,964**	**209**	**450**	**4,226**			**12,089**	**410**	**844**

出典: JICA 調査団

(3) 貧困世帯への給水管接続に伴う負担区分の根拠

2027 年時点で想定される貧困世帯数 1254 世帯（レベル 1 : 410 世帯、レベル 2 : 844 世帯）から、2019 年時点の既接続の貧困世帯（レベル 1 : 35 世帯、レベル 2 : 18 世帯）を差し引き、整備の必要な貧困世帯数は、1,201 世帯（レベル 1 : 375 世帯、レベル 2 : 826 世帯）となる。貧困レベル 2 の世帯の 60%については、受益者負担が可能とのヒアリング情報から、レベル 1 世帯の材料費及び工事費、レベル 2 世帯の 40%の材料費及び工事費については、本邦及びカンボジア負担とする。このうち、本邦負担は、レベル 1 世帯の材料費 375 世帯分のみで、レベル 2 の 330 世帯の材料費及びレベル 1・2 の 705 世帯の工事費はカンボジア負担を想定する。増加する 7,378 世帯から 1,201 世帯を引いた 6,177 世帯は、貧困世帯に分類されない一般世帯に区分される。

表 7-7 貧困世帯への給水管接続に伴う負担区分

単位：世帯

項目	貧困レベル 1	貧困レベル 2	合計
2027 年時点の貧困世帯数	410	844	1254
貧困世帯のうち、2019 年時点の既接続数	35	18	53
2027 年までに整備の必要な貧困世帯数	375	826	1201
材料費	375：本邦	826 x 0.4 =330 : カンボジア 826 x 0.6 =496：受益者	375：本邦（機材調達） 330：カンボジア 496：受益者
工事費	375：カンボジア	826 x 0.4 =330 : カンボジア 826 x 0.6 =496：受益者	705：カンボジア 496：受益者

出典: JICA 調査団

7-11　水道事業全体　基本情報チェックシート

上水道案件 セクター／水道事業体　基本情報チェックシート

国名：カンボジア　水道事業体名：スバイリエン水道局

	指標・情報	重要度	数値・情報	単位	出典
セクター概要					
1	国家人口	★★	1,530	万人	2019年カンボジア国勢調査
	一人当たりGDP	★★	1,655	USD／人	2020年、IMF
2	年間降水量	☆	1,480	mm／年	MOWRAM, 2000-2019
	気候帯	☆	熱帯モンスーン		Statistic Yearbook 2008 カンボジア国計画省
3	改善された水源へのアクセス率	★★	75	%	JMP2017
4	水道セクターのガバナンス	★★	都市部への水供給は、工業科学技術革新省工業総局水道部が管轄しており、各州の工業科学技術革新局の下部組織である水道局が実際の水供給に係る運営・維持管理を行っている。 全24州のうち、プノンペン市及びシェムリアップ市の水供給は水道公社、12州の州都が公営水道（水道局）、それ以外は民間企業が水供給を行っている。 農村部への水道供給は農村開発省技術総局農村給水局が所管している。		カンボジア国上水道セクター情報収集・確認調査、2010年6月
5	主要な開発方針、開発課題	★★	カンボジア国政府は、水道セクターの国家方針として、「国民が安全な水の供給を受け、衛生施設を有し、安全で衛生的かつ環境に適応した生活環境を享受する」を掲げている。 MISTI によれば、2025 年の目標として、都市部での安全な水にアクセスできる人の割合を100%としている。 水道法等の関連法律がなく、現在その制定を進めている。 工業手工芸省から飲料水に関する水質基準が出されている。		National Strategic Development Plan, 2019 国家戦略開発計画（NSDP, 2019-2023）
水道事業体の概要					
1	水道事業体の形態、監督・規制体制	★★	スバイリエン州都市部への水供給は、スバイリエン州工業科学技術革新局の管轄下にあるスバイリエン水道局が行っている。		カンボジア国水道事業人材育成プロジェクト・フェーズ3、終了時評価報告書、2019年7月
2	当該水道事業体の計画給水区域	☆	2区 (Krong Svay Rieng, Svay Chrum)、8コミューン、41ビレッジ		
3	水源	★★	表流水：ワイコ湖		
4	水源開発余力	☆	ワイコ湖の乾季（2015年）の湖の最小残水量は約13MCM 取水量は、ADBによる新設浄水場運用開始後約3.8MCM		
5	水道普及率	★★	23.6 (2019年、(給水人口(都市部内)23,545人+給水人口(都市部外)0人)/管理区域内人口99,571人)	%	

水道事業体の概要					
6	給水人口	★★	23,545（2019年）		
7	一日平均給水量	★★	4,627（2019年）	m^3／日	
8	一人一日平均給水量	★★	既存部135、新規部115（2010年～2019年の平均値）	リットル／人／日	
9	給水時間	★★	24（2019年）	時間／日	
10	漏水率	★★	11.3	%	
11	財務規模、収支	★★	＜2020年度＞ 総収益：2,238百万リエル (59.56百万円) 総費用：2,107百万リエル (56.07百万円)（原価償却費込） 純利益： 131百万リエル (3.49百万円)		
12	水道料金水準	★★	1,200リエル/m^3 (0.29USD/m^3)	円またはUSD／m^3	
13	料金徴収率	☆	100 （2019年）	%	
14	メーター設置率	☆	100 （2019年）	%	
15	1,000接続当たりの職員数	☆	6.4 （2019年）	人／1,000栓	
16	施設の状況、施設の運転・維持管理状況	★★	既存上水道施設は 2019年にADB が改修事業を行うとともに、カンボジア国側で拡張を行って2019年現在の給水能力は6,560m^3/日となっている。 施設の運営維持管理については、技術協力プロジェクト「水道事業人材育成プロジェクト・フェーズ3」の実施により、基本的な技術力をスバイリエン水道局は有している。		
17	水道事業体の業務目標と課題	★★	スバイリエン水道事業に係る中長期計画はなく、毎年、水道局が年次事業計画(Business Plan)を策定し、スバイリエン州工業科学技術革新局（DISTI）の承認を受け、DISTI から工業科学技術革新省（MISTI）大臣宛てに提出されている。 近年年間400戸の接続が進捗しているが、上水施設の拡張に伴い維持管理職員の増員が更に必要となる。無収水率は10%程度で、途上国としては低い値を示している。		

出典: JICA 調査団

プロジェクトモニタリングレポート

Project Monitoring Report

on

Project Name

Chapter 1. *Grant Agreement No. XXXXXXX*

20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge(Designation) Contacts Address: Phone/FAX: Email:
Executing Agency	**Ministry of Industry, Science, Technology & Innovation (MISTI)** Person in Charge H.E. OUM SOTHA , Secretary of State Ministry of Industry, Science, Technology & Innovation Contacts Address: 45, Preah Norodom Boulevard Phone/FAX: +855-97-77-11111 Email: oumsotha@gmail.com
Line Ministry	Person in Charge(Designation) Contacts Address: Phone/FAX: Email:

General Information:

Project Title	The Project for Expansion of Water Supply Systems in Svay Rieng
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY mil. Government of ( ):

1: Project Description

1-1 Project Objective

The overall goal of the project is to contribute to the social development through the expansion of water supply system in Svay Rieng, Cambodia. The purpose of the project is as follows;

1) Increasing water supply amount, water supply population and water supply ratio
2) Improving living environment of the residents
3) Increasing house connections for the poor household

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

Ability of water supply to the residents in Svay Rieng City will be improved under the project. The water supply ratio in the administrative area was 23.6% in 2019 and will increase by 52.6% in the target year of 2027. The water supply ratio in urban areas, which MISTI targets, will be 86.7%. The number of beneficiaries increased (population newly served) will be approximately 32,419 (22,543 persons in urban areas while 9,876 persons in rural areas).

Although Svay Rieng City operates an existing water service system, its water supply ratio remains at 23.6% as of 2019. Accordingly, the expansion of the water supply facilities is urgently needed to further improve water supply ratio.

The National Strategic Development Plan (NSDP) 2019-2023 sets a target of achieving 100% water supply ratio in urban areas by 2025. 90% of the urban population served are presently covered by water pipes, while the remaining 10% are covered by other means. This target will be more or less achieved when the area is limited to urban population in the administrative area managed by the SWWs and the project will help achieve this aim in Svay Rieng City. Moreover, the project will procure material and equipment to poor households to encourage them to connect to service pipes, the installation cost of which is borne by the Cambodian side. Accordingly, the project ensures consistency with measures for the poor, the largest target group in the NSDP.

"Improving the quality of life" is also included in the priority areas of the Country Assistance Policy for Cambodia (July 2017) of the Government of Japan, support for which is provided in sectors that help improve the urban living environment, such as water supply and sewage, water discharge, electric power (reducing areas with no electricity), urban transportation (urban railway, bus and vehicle registration). Accordingly, the project implementation is consistent with Japan's assistance policy.

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Baseline (Measured in 2019)	Target (in 2027) [two years after

Quantitative indicators to measure the attainment of project objectives			
			completion]
Dairy average water supply amount (m^3/day)		4,627	10,009
Population served (Person)		23,545	55,964
Water supply ratio	Whole administrative area	23.6	52.6
	Urban area	48.9	86.7
House connections for the poor household (level 1 and level 2)		53	1254
Qualitative indicators to measure the attainment of project objectives			
➢ Improving the living environment of residents (improving the public health environment of residents who used to use rainwater, etc., and improving convenience)			

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1. Intake Pump Station	(1) the north side along National Highway No.1 in Vay Kor Lake	
2. Water Treatment Plant	(2) 2 km northwest direction of the water intake location	

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1. Intake Facility, 7,480m^3/day	(1) Intake Gate: 2 gates (2) Intake Pump Facility Pump Room Administration Building intake pump: (5.2m^3/min x 2 sets) Electrical Equipment	
2. Conveyance Facility	(1) DCIPφ350 x 2.9km	
3. Water Treatment Plant	(1) Receiving well (1Basin) Volume: 26.9m^3, Retention Time: 5.2min (2) Mixing Well (1Basin) Volume: 9.43m^3, Retention Time: 1.82min (3) Flocculation Basin (2Basin) Up-and-Down Roundabout Type (zigzag flow) (4) Sedimentation Basin (2Basin) Surface Loading: Q/A=18.6mm/min Mean Velocity (V): 0.08m/min (5) Rapid Sand Filter (4Basin) (Reference)	

Components	Original* *(proposed in the outline design)*	Actual*
	Filtration Rate (V): 124.7m/day Backwash Method: Air Wash + Water Wash (6) Service Reservoir (2Basin) Effective Volume: 2,188m^3 (1,094m^3×2Basins) Retention Time: 8hours (7) Drainage Basin (2Basin) Volume: 198m^3 (99m^3×2Basins) (8) Drying Bed (4Bed) Effective Area: 550.4m^2 (9) Chemical Feeding Facilities (1Unit) (10) Power Generator Equipment (in Chemical Building) (1Unit) Capacity: 350KVA (11) Chemical Building (1Unit) 3Storey Building, Total Floor Area (A):425.8m^2 (12) Administration Building (1Unit) 1 Story Building, Total Floor Area (A): 266.7m^2	
4. Distribution Facility	(1) Service Reservoir (inside new WTP) Capacity: V=1,094 m^3×2 (2) Distribution Pump Facilities (inside new WTP) Horizontal Volute Pump 3.5m^3/min (3 Pumps) (3) Distribution Mains (DCIP: T type) φ400mm L= 0.1km / φ350mm L= 0.4km / φ300mm L= 0.4km / (HDPE) φ250mm L= 6.6km φ200mm L= 2.9km / φ150mm L= 9.5km / φ100mm L= 15.4km / φ 80mm L= 33.2km / φ 50mm L= 43.3km (4) Bridge-piggybacked Water Main (Steel Pipe) φ 80mm 5 Places φ 50mm 1 Place (5) Monitoring equipment of water distribution (1LS)	
5. Procurement of equipment	(1) Distillation apparatus, Turbidity Meter, pH Meter, Electric Conductivity Meter, continuous measurement water quality analyzer for Turbidity and residual chlorine, UPS, reagents, glassware, laboratory table etc. (2) Tools for Mechanical Equipment	

Components	Original* *(proposed in the outline design)*	Actual*
	Clamp Power Meter, Insulation resistance meter, Ground resistance meter, Vibration Checker, Mechanical Torque Wrench, Portable Ultrasonic Flow meter, Sieve Shaking Machine (3) Equipment for Maintenance of distribution pipes Electrofusion Machine and Accessories for PE Pipes (4) Equipment and materials for house connection to poor households Water supply pipes, water meters and accessories (5) Accounting system SUMS system (PC and extra software license)	
6. Soft Component	(1) Formulation and understanding of procedures for operation and maintenance of the new WTP (2) Formulation and understanding of procedures for water quality tests using new equipment (3) Acquired capability in water distribution monitoring (4) Strengthening construction supervision system for service connection installation (5) Implementation of educational activities to promote applications for service connections (6) Improved capability of production management; and Revision and creation of SOP	
7. Consulting Services	Detailed design, bidding assistance and construction supervision	

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	***(at the time of signing the Grant Agreement)***	
Cabinet approval	02/2022		
E/N	02/2022		
G/A	03/2022		
Detail Design	03/2022-08/2022		
Tender Notice	09/2022		
Tender	12/2022		
Award to Contract	02/2023		

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	
Completion of Contract	01/2025		
Defect Liability Period	01/2026		
Project Completion	01/2026		

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant (Confidential until the Bidding)

Components			Cost(Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
Construction Facilities	1. Intake Facilities 2. Water Treatment Plant 3. Water Conveyance and Distribution Pipes			
Equipment	1. Water Quality Analysis Equipment 2. Tools for Mechanical Equipment 3. Accounting System Equipment 4. Service Connection Installations			
Consulting Services	1. Detailed Design 2. Construction Supervision 3. Soft Component			
Total				

Note: 1) Date of estimation: December, 2021
2) Exchange rate: 1 US Dollar = 109.97 Yen

2-5-2 Cost borne by the Recipient

Components			Cost (USD)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1)] *(proposed in the outline design)*	Actual
1	Land leveling for the Intake and WTP site		496,340	
2	Rental Cost for Temporary Yard		50,000	
3	UXO Survey for Temporary Yard		22,104	

Components			Cost (USD)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1)] *(proposed in the outline design)*	Actual
4	Environmental Monitoring for Noise, Vibration and Treatment of Dry Sludge		8,842	
5	Contracting process of broadband LAN connection for the distribution information system		4,421	
6	Transmission of electricity to the Intake facilities and WTP		38,424	
7	Bank arrangement Charge and Commission of Authorization to Pay		22,104	
8	Connection equipment for poor households (poor level 2: 330 houses)		22,467	
9	Installation of connection equipment for poor households (poor level 1: 375 houses + poor level 2: 330 houses)		3,527	
			668,229	

Note: 1) Date of estimation: December, 2021

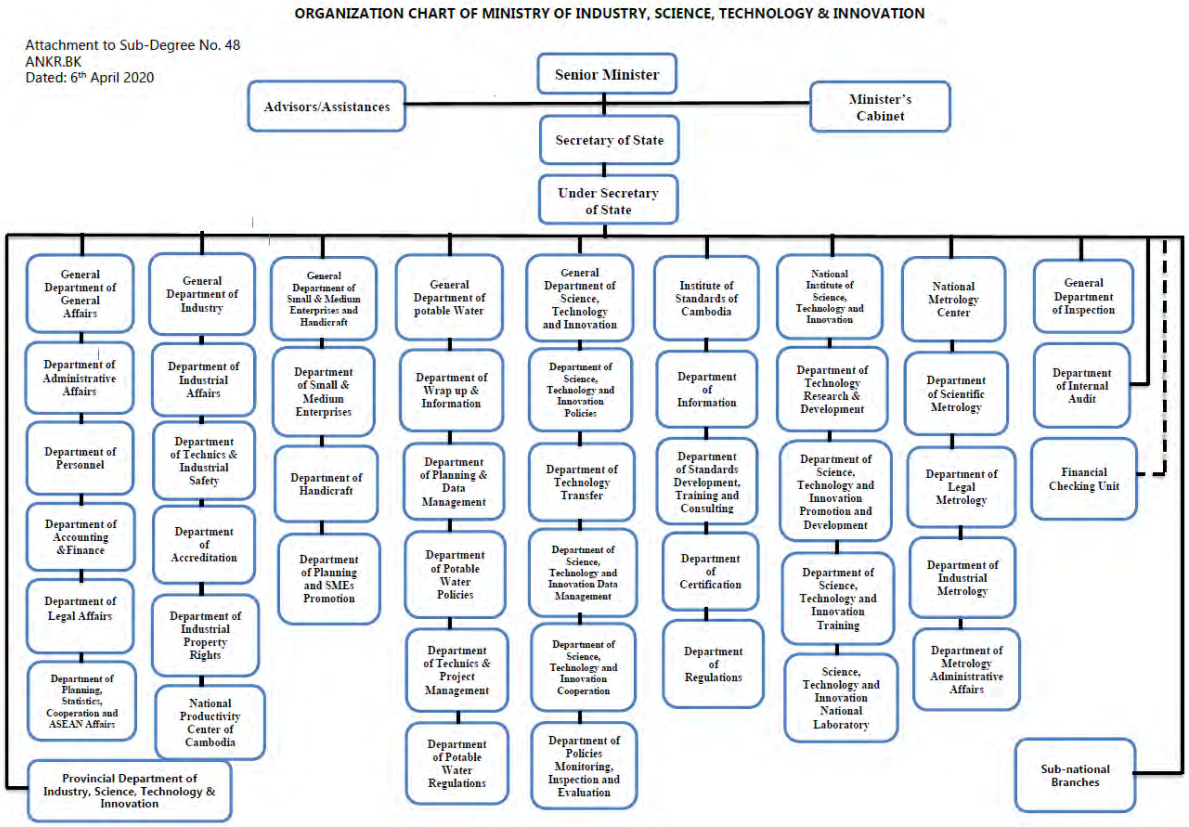
Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)*
name: Ministry of Industry, Science, Technology & Innovation (MISTI)
role:
financial situation:
institutional and organizational arrangement (organogram):
human resources (number and ability of staff):



Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

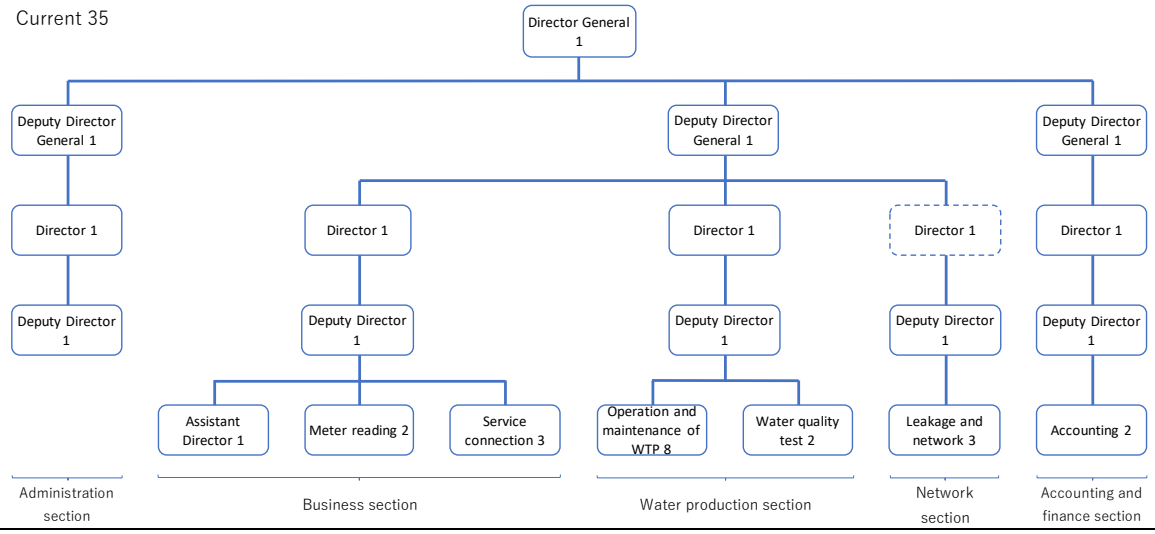
3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*

Current organization of Svay Rieng Waterworks is shown below;



Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Outline of Profit and Loss (PL) Statement in Svay Rieng Waterworks in 2020 is shown below

(Unit: Riel)

Revenue		Expense	
Water Sales	2,091,262,000	Personnel	400,876,400
Other Revenue	147,112,600	Material/Chemical	77,674,384
Revenue Total	2,238,374,600	Electricity/Fuel	319,016,661
		Depreciation	403,971,970
		Interest Payment	34,294,700
		Taxes	26,012,500
		Other	845,207,473
		Expense Total	2,107,054,088
Net Profit			131,320,512

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks (*at the time of outline design*)

Potential Risks	Assessment
1. To complete the investigation and removal of UXO and Mines in all	Probability: High/Moderate/Low
	Impact: High/Moderate/Low

Potential Risks	Assessment
construction and temporary areas	Analysis of Probability and Impact:
	The clearance of UXO/Mines for the construction area is essential for the project commencement. Without the clearance of UXO/Mines, the construction work will not be started.
	Mitigation Measures:
	Discussing the clearance of UXO/Mines in well advance, and to ask the clearance completed prior to the bidding announcement as "Major Undertakings to be taken by the Government of Cambodia".
	Action required during the implementation stage:
	The clearance of UXO/Mines required prior to the bidding announcement.
	Contingency Plan (if applicable):
	The delay of UXO clearance causes the contractor's claims. Therefore, in case UXO clearance may be delayed, the timing of bidding shall be postponed.
2. To secure and clear the temporary construction yard near the Project area	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	The temporary yard will be required prior to the bidding announcement to commence the construction work smoothly.
	Mitigation Measures:
	Discussion of the temporary construction yard in well advance so that the securing of the yard could complete prior to the bidding announcement.
	Action required during the implementation stage:
	The securing of the temporary construction yard is required prior to the bidding announcement.
	Contingency Plan (if applicable):
	The delay of UXO clearance causes the contractor's claims. Therefore, in case UXO clearance may be delayed, the timing of bidding shall be postponed.
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/ Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Attachment 1 Project Location Map

Attachment 2 Specific obligations of the Government of Cambodia which will not be funded with the Grant

(1) Before the Tender

	Items	Deadline	In charge	Estimated Cost
1	To open bank account (B/A) *1)	within 1 month after the signing of the G/A*5)	MEF*6)	$4,421
2	To issue A/P*2) to a bank in Japan (the Agent Bank) for the payment to the Consultant	within 1 month after the signing of the contract(s)	MISTI*7)	
3	To contract land lease in order to secure the temporary yard	before notice of the bidding document(s)	MISTI	$50,000
4	To obtain the planning, zoning, building permit	before notice of the bidding document(s)	MISTI	
5	To clear, level and reclaim the following sites. Embankment at proposed WTP*3) site and intake pump station site.	before notice of the bidding document(s)	MISTI	$496,340
6	To explore landmines and UXO*4) at construction site and temporary yard.	before notice of the bidding document(s)	MISTI	$22,104
7	To submit Project Monitoring Report (with the result of Detail Design)	before notice of the bidding document(s)	MISTI	

Note : *1) B/A : Banking Arrangement, *2) A/P : *Authorization to Pay*, *3) WTP : Water Treatment Plant, *4) UXO : Unexploded Ordnance, *5) G/A : Grant Agreement, *6) MEF: Ministry of Economic and Finance, *7) MISTI: Ministry of Industry, Science, Technology & Innovation

(2) During the Project Implementation

No	Items	Deadline	In charge	Estimated Cost
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	MISTI	$4,421
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A			
	(1) Advising commission of A/P	within 1 month after the signing of the contract(s)	MISTI	
	(2) Payment commission for A/P	every payment	MEF	$13,262
3	To ensure prompt unloading and customs clearance at ports of disembarkation in the country of the Recipient and to assist the Supplier(s) with internal transportation therein	during the Project	MISTI	
4	To accord the Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services as may be necessary, for their entry into the country of the Recipient and stay therein for the performance of their work	during the Project	MISTI	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted.	during the Project	MISTI	
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	MISTI	
7	To submit Project Monitoring Report	every month	MISTI	
	To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	MISTI	
8	To submit a report concerning completion of the Project	within six months after completion of the Project	MISTI	
9	To get permit for construction of temporary access roads for laying water pipes and lease necessary land for approach roads	1 month before the start of the construction	Local Communit	

No	Items	Deadline	In charge	Estimated Cost
			ies, MISTI	
10	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project to the site(s)		MISTI	
	(1) Electricity The distributing line to the main road near the proposed facility	before start of the construction		$38,424
	(2)Electricity The distributing line from the main road to the site of proposed facility	2 months before the commissioning test		
	(3) Information System Contract of Internet line and GPRS[*1)] line for the remote monitoring and control system for intake facility and distribution monitoring system	2 months before completion of the construction		$4,421
11	To take necessary measures for safety construction - traffic control - rope off	during the construction	MISTI	
12	To implement EMP[*2)] and EMOP[*3)]	during the construction	MISTI	
13	To ensure the safety of persons engaged in the implementation of the Project	during the Project	MISTI	
14	To submit results of environmental monitoring to JICA[*4)], by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	MISTI	
15	To obtain permission for occupancy of roads for the pipe laying work	before start of the construction for conveyance, transmission, and distribution pipes	MISTI (WWs)[*5)]	
16	To obtain all permissions required for the project implementation such as construction permission for intake facility and the WTP	before start of the construction	MISTI (WWs)	
17	To conduct service pipe connection work during the project implementation	during the construction	MISTI (WWs)	$4,439
18	To recruit new staff members who are necessary for the operation of new system	up to the end of 2027 Since it is difficult to hire the necessary personnel at once, it is desirable to hire them in stages from 2022.	MISTI (WWs)	
19	To establish the construction scheme for the new service pipe connections, including hiring temporary work force. To carry out the technical guidance, budgeting, planning and publicity for enhancing new connections.	up to the end of 2027	MISTI (WWs)	
20	To identify poor household	up to the end of 2027	MISTI (WWs)	

Note : *1) GPRS : General Packet Radio Service, *2) EMP : Environmental Management Plan, *3) EMOP : Environmental Monitoring Plan, *4) JICA : Japan International Cooperation Agency, *5) WWs: Waterworks,

(3) After the Project

No	Items	Deadline	In charge	Estimated Cost
1	To implement EMP and EMOP	for a period based on EMP and EMOP	MISTI	$8,842
2	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between MISTI and JICA	for three years after the Project	MISTI	
3	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid (1) Allocation of maintenance cost (2) Operation and maintenance structure (3) Routine check/Periodic inspection	After completion of the construction	MISTI	
4	To conduct service pipe connection work after the project completion continuously	up to the end of 2027	MISTI (WWs)	$21,555
	(1) Establishment of construction scheme including hiring temporary staff for service connection work, providing guidance, budgeting, planning and publicity for enhancing new connections.			
	(2) Connection for poor household - Material is procured by Japanese side, connection work is conducted by Cambodian side.			
	(3) Connection for household without poverty group - Material and connection work is under responsibility of Cambodian side.			
	(4) To report the results of service pipe connection work to JICA every year			

Attachment 5 Environmental Monitoring Form / Social Monitoring Form

1) Environmental Check List

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
1 Approvals, explanations	(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) Y (b) Y (c) N (d) Y	(a) (b) MISTI submitted the report pursuant to the requirement to MOE. MOE inspected and approved the report, and the EPC was agreed on March 30, 2021. (c) No conditions. (d) MISTI will obtain official permission letter of water extraction from Vay Kor Lake by MOWRAM by December 2021, and permission letter of construction of water intake by Provincial Hall.
	(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) Y	(a) All related departments of the development project understood the project purpose and contents, and they agreed on the implementation. At the public hearing, the villagers welcomed the project. They wished the early project start. There is no particular objection. (b) The design of the intake facility is considered for the suitable appearance to meet the lake environment with comments from Provincial Hall. The water intake is designed with the consideration to prevent fish invasion by the request from the DOE.
	(3) Examination of Alternatives	(a) Have multiple alternative plans for the Project been analyzed? (Including analysis of items related to the environment/society.)	(a) Y	(a) Alternatives have been examined for the water source, site selection of intake and WTP, and extent of the supply area.
2 Pollution Measures	(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) Y	(a) The Project plans to use breaching power for disinfection. This reagent is stable, and occurrence of air pollution is considered less. The exhaust fan will be situated at the facilities of disinfection. (b) The above measures serve to keep appropriate working condition.
	(2) Water	(a) Do pollutants, such as SS, BOD, COD	(a) N/A	Discharge generated at the

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
	Quality	contained in effluents discharged by the facility operations comply with the country's effluent standards?		treatment process will be recycled, and sludge will be dried. Therefore, any effluent from treatment process will not be generated. Sewage will be treated by septic tanks and clear upper portion will be infiltrated into ground. Therefore, the discharge water is not generated.
	(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) Y	(a) Sludge will be treated and dried at dry-bed, then dry sludge will be disposed at an appropriate site with the permission of the landowner. MISTI is responsible for the arrangement.
	(4) Noise and vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a)Y	(a) The pump will be installed at basement made by the RC with the noise reducing walls. The noise will be controlled within the limit of RGC requirement. So, the noise and vibration will be controlled in permissible limit by the above measures.
	(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 Project does not use groundwater.
3 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) Y	(a) The Vay Kor Lake is divided in two parts by the national road No.1. The intake will be constructed at the upper side but the lower side is designated as protected area for the protection of fishery resources. The measures will be taken to prevent the occurrence of turbid water during construction. In addition, education and training will be provided to the workers not to do the fishing activities. In the design of the water intake, a bar screen will be installed, and the maximum inflow speed is set to 0.1 m / s or less, which is extremely slow, to prevent fish from entering. With the above measures, the impact of project implementation can be avoided.

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
	(2) Ecosystems	(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) N (d) N	(a) The site does not contain any virgin forests, tropical old-growth forests, or important ecological habitats. (b) No habitats for any rare species are present in the site. (c) No major concerns. (d) No major concerns
	(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) Impact on groundwater is not expected. The amount of water taken from the lake is small compared to the amount of the capacity, and the effect on surface water is limited.
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) Are the compensations going to be paid prior to the resettlement? (e) Are 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	(a)N (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) SWW purchased about 1ha of land for the WTP from the landowner. The land was agricultural land and there were no authorized/unauthorized residents, and there is no relocation of residents. (b) Land sales were conducted in the presence of the village chief and sufficient explanations were given. (c) The sale price of land is about 1.2 times the price of the surrounding land and is considered to be the replacement price. (d) SWW already paid the full amount. (e) Conducted as a general land sale. (F) The landowner is a farmer, and his family (wife only) participated the contract process

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
		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?		and agreed to the sales contract. (g) No relocation occurred. (h) DISTI and the village chief were involved, and land sales were carried out appropriately. (i) The full contract amount has already been paid and no monitoring is performed. (j) If there is a complaint, it will be communicated to DISTI or MISTI via the village chief, but no complaint has occurred in this sale.
	(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 has positive impact to improve basic human needs. There is no particular negative impact. (b) The Svay Rieng River has enough discharge capacity and the intake of water supply does not affect significantly.
	(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) No anthropological, historical, cultural, religiously important heritages or historical remains have been identified in 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 intake will be constructed at the roadside, and it will be designed to be harmonized with the environment to meet the request of the stakeholders.
	(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) N/A (b) N/A	(a)(b) There are no ethnic minorities or indigenous peoples living near the project site.
	(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?	(a) Y (b) Y (c) Y (d) Y	(a) Adherence to laws concerning working conditions will be made explicit in contracts with contractors and managed. (b) Countermeasures such as installation of safety handrail are taken. (c) It will be achieved to set as an obligation of contractor in contract document.

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
		(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?		(d) Security guards will be included in target members of worker training. .
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) Y (d)Y	(a) Mitigation measures will be taken under EPM for managing all noise, vibration, turbid water, dust, gas emissions, and waste discharged from the work site. (b)Particular negative impact is not expected. (c) Temporary traffic disturbance will occur. The negative effect will be minimized by the measures such as setting of detours, assignment of traffic guide, installation of signboard, appropriate information sharing. (d) Since the water intake facility will be constructed along the national highway crossing the lake, the temporary reduction of the number of lanes will be required, and it may cause traffic congestion. The measures to be taken are as described above.
	(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) Y (c) Y (d) Y	(a) MISTI is responsible for the monitoring as in previous similar project which they are experienced. (b) It will be determined in EMoP. (c) Monitoring by proponent is a part of usual operation activities. The training will be given as a part of soft component. (d) It is stipulated in the EMP.

Category	Environmental Item	Main Check Items	Yes: Y No : N	Specific Environmental and Social Considerations (Reason for Yes or No, rationale, mitigation measures, etc.)
6 Focal points	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a) N/A	(a) The intake amount is not much, and the intake structure is small scale at the upper flow of existing headwork. Therefore, it is not necessary to refer the checklist of Dam and River Projects
	Precautions when using the 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) N	(a) None

2) Environmental Management Plan / Environmental Monitoring Plan

Impact	Parameter	Monitoring Method	Monitoring Point	Frequency	Responsibility	Cost
Construction						
Air Pollution	Dust	Visual observation	Vicinity of construction site	Daily	Contractor	Construction cost
	Exhaust gas	Inspection of registered vehicle	Construction Office	Monthly	Contractor	Construction cost
Noise and vibration	Working time	Working record	Construction site	Daily during construction	Contractor	Construction cost
	Management of vehicles	Inspection of registered vehicles	Construction Office	Monthly	Contractor	Construction cost
	Guidance to operator	Training record	Construction Office	Once during construction	Contractor	Construction cost
Water Pollution and sediment	Turbidity, oil	Visual inspection	Inlet of discharge	Weekly but daily during construction of foundation	Contractor	Construction cost
	Water quality	pH, EC, COD, turbidity, oil	Outlet of discharge	When abnormal incident is observed	Contractor	Construction cost
Solid Waste (domestic)	Proper management	Visual inspection	Domestic waste	Weekly	Contractor	Construction cost
Solid Waste (Construction)	Proper dumping	Visual inspection	Temporary damping yard	At the time of damping	Contractor	Construction cost
	Preparation of dumping site	Contract document	Dumping site for soil waste	At the time of contract	SWWs, MISTI	No charge
Ecosystem	Ban of hunting and fishing (Training)	Training record	Construction Office	Once during construction	Contractor	Construction cost
	Ban of hunting and fishing (Patrol)	Monthly construction report	Construction Office	Weekly	Contractor	Construction cost
Land and local resource usage	Lease of land	Contract document	Construction Office	At the time of contract of lease	SWWs 、 MISTI	About 300 USD/month
Existing social infrastructure and services	Mitigation measures to prevent traffic disturbance	Monthly construction report	Construction Office	Monthly	Contractor	Construction cost
HIV/AIDS and other infectious disease	Management of occupational safety and hygiene	Monthly construction report	Construction Office	Monthly	Contractor	Construction cost
Working condition	Management of occupational safety and hygiene	Monthly construction report	Construction Office	Monthly	Contractor	Construction cost
Accident	Traffic plan of construction vehicle	Plan	Construction Office	At planning	Contractor	Construction cost
	Safety training	Monthly construction report	Construction Office	Monthly	Contractor	Construction cost

Impact	Parameter	Monitoring Method	Monitoring Point	Frequency	Responsibility	Cost
Miscellaneous	Complaint management	Analysis of complaint	Construction Office	Monthly	Contractor	Construction cost
Operation						
Waste	Appropriate treatment of sludge	Monitoring record	WTP	Every three months	SWWs	O&M cost
	Preparation of dumping site for sludge	Contract document	SWWs	At the time of contract	SWWs	No charge
Noise and vibration	Monitoring with standard operating procedure (SOP)	SOP and monitoring record	Pumping station	Every three months	SWWs	O&M cost
	Guidance for operators	Training record	Pumping station	Every three months	SWWs	O&M cost

3) Environmental and Social Monitoring Form

Monitoring Form (Construction)

Construction site (Daily monitoring)

Monitoring Item		Procedure	Result	Measures to be taken	Reference standard		Frequency
Dust		Visual inspection			Acceptable or not		Daily
Noise		Sensory inspection			Acceptable or not		Daily
		Operation time check			Stated operation time in EMP		Daily
Water Quality (turbidity, oil)		Visual inspection			Acceptable or not		Daily (during foundation work)
Water Quality	pH	Laboratory test			6 - 8	Determined by the monitoring result	In case of abnormal observation of turbidity or oil
	EC				80		
	COD				10		
	Turbidity				500		

Construction site (Weekly monitoring)

Monitoring Item	Procedure	Result	Measures to be taken	Reference standard	Frequency
Waste (Domestic)	Patrol			Acceptable or not	Weekly

Construction site (Monthly monitoring)

Monitoring Item	Procedure	Result	Measures to be taken	Reference standard	Frequency
Condition of construction machinery and vehicles	Maintenance record check			Acceptable or not (Exhaust gas, noise, vibration, and usual safety check)	
Traffic management	Patrol			Stated procedure in EMP	Monthly
Accident	Patrol			Acceptable or not	Monthly
Training and educational meetings to worker	Report check			Stated procedure in EMP (frequency,	

Monitoring Item	Procedure	Result	Measures to be taken	Reference standard	Frequency
				contents, target, etc.)	
Claim and comment	Report check			Acceptable or not	Monthly

Others

Monitoring Item	Procedure	Result	Measures to be taken	Reference standard	Frequency
Land for waste dumping Land for temporary use	Lease condition			Appropriate or not (Size, location, permission (if necessary))	Contract of lease
Plan of safety transportation	Plan check			Acceptable or not	At planning

Monitoring Form (Operation)

Monitoring Item	Procedure	Result	Measures to be taken	Reference standard	Frequency
Waste (treatment sludge)	Patrol			Appropriate or not	Monthly
Land for waste dumping	Procedure check			Appropriate or not (Size, location, permission (if necessary))	At contract agreement
Noise and vibration*	Patrol and maintenance			Normal condition or not	Daily

*Noise and vibration of pump shall be checked in an operation record every day.

Attachment 6 Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C－D	Price (Increased) F=C＋D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

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Attachment 7　Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)

（Actual Expenditure by Construction and Equipment each）

	Domestic Procurement （Recipient Country） A	Foreign Procurement （Japan） B	Foreign Procurement （Third Countries） C	Total D
Construction Cost	（A/D%）	（B/D%）	（C/D%）	
Direct Construction Cost	（A/D%）	（B/D%）	（C/D%）	
others	（A/D%）	（B/D%）	（C/D%）	
Equipment Cost	（A/D%）	（B/D%）	（C/D%）	
Design and Supervision Cost	（A/D%）	（B/D%）	（C/D%）	
Total	（A/D%）	（B/D%）	（C/D%）	