MINISTRY OF LOCAL GOVERNMENT, RURAL DEVELOPMENT AND CO-OPERATIVES
CHITTAGONG WATER SUPPLY AND SEWERAGE AUTHORITY
PEOPLE'S REPUBLIC OF BANGLADESH

PROJECT FOR ADVANCING NRW REDUCTION INITIATIVE (PANI) OF CHITTAGONG WASA IN THE PEOPLE'S REPUBLIC OF BANGLADESH

PROJECT COMPLETION REPORT

July 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

NJS CONSULTANTS CO., LTD.

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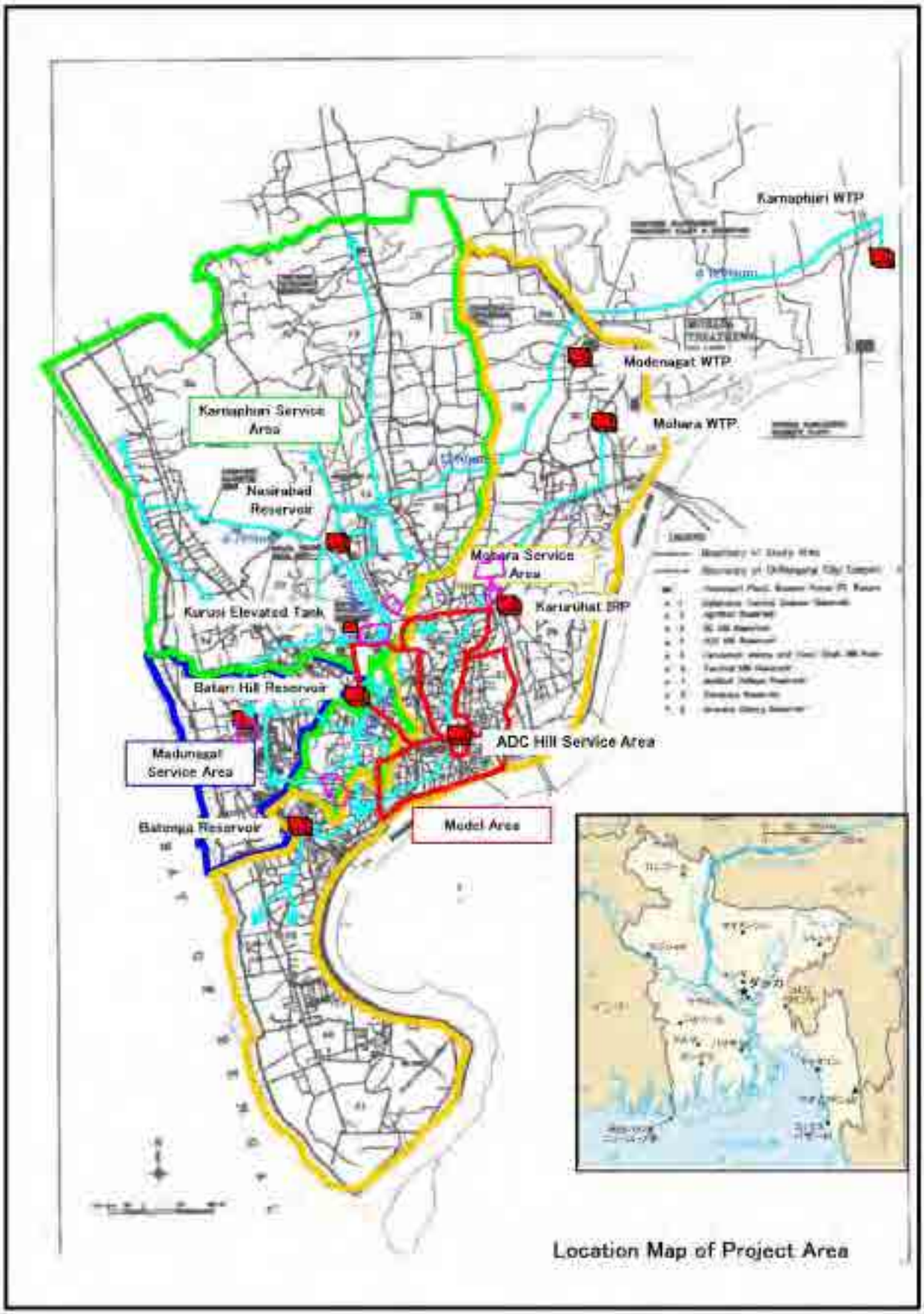
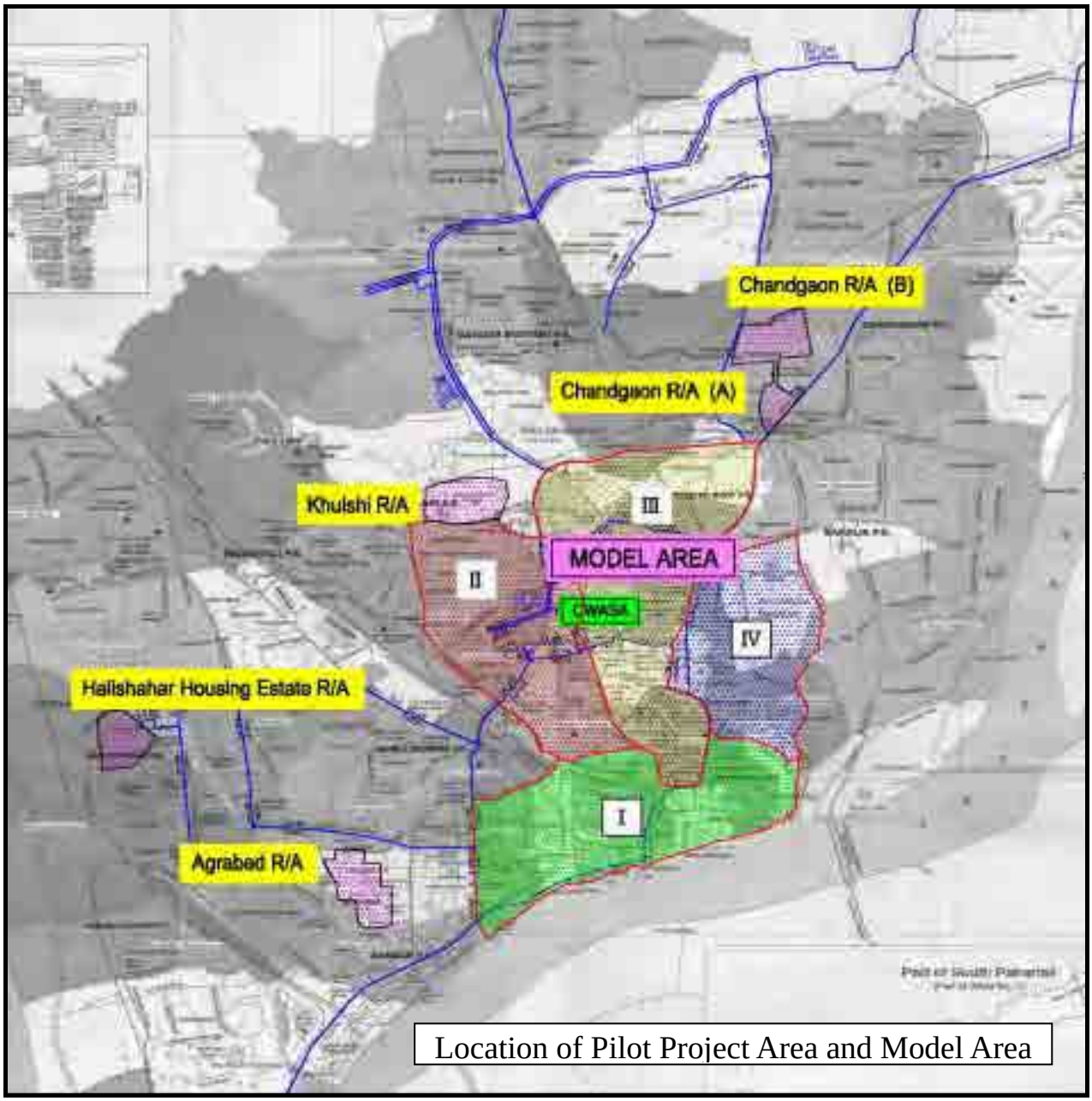


Location Map of Project Area



Location of Pilot Project Area and Model Area

PREFACE

The ***P***roject for ***A***dvancing ***N***RW Reduction ***I***nitiative of Chittagong WASA (hereinafter referred to as ***PANI***) was commenced on July 18, 2009 by dispatch of Japanese Experts (hereinafter referred to as JICA Expert Team) to Bangladesh. This Project Completion Report covers activities carried out, issues and problems encountered, recommendations thereof from the commencement of work until completion of activities in June 2012.

Previously prepared report:

1. Inception Report (July 2009)
2. Progress Report 1 (March 2010)
3. Progress Report 2 (January 2011)
4. Progress Report 3 (October 2011)

TECHNICAL COOPERATION PROJECT FOR ADVANCING NRW REDUCTION INITIATIVE OF CHITTAGONG WASA

PROJECT COMPLETION REPORT

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SECTION 1 INTRODUCTION

1.1 Project Background

Chittagong City, the largest commercial city of Bangladesh, has a present total population of 4.6 million with a population growth rate of 3.3 % per year from 1991 to 2001 in the administrative area of about 200 sq.km. While a rapid growth of population corresponding to expansion of economic activities has been observed, provision of basic infrastructures including water supply service was not progressed. Water supply service is thoroughly taken care of by Chittagong Water Supply and Sewerage Authority (CWASA), but its supply capacity is limited to only 48% (168,000 cu.m/day) of water demand in the existing service area and an immediate action to cater for this water gap is deemed urgent task of CWASA.

CWASA has availed of the Japan's ODA Loan to augment supply capacity of Karnaphuli Water Treatment Plant up to 286,000 cu.m/day based on the recommendations provided by the Study on the Chittagong City Mohara Water Treatment Plant Expansion Project (1999) and is now implementing its Phase-1 (143,000 cu.m/day) project, while Phaese-2 (143,000 cu.m/day) project including thorough rehabilitation of distribution network is under preparatory survey by JICA's technical assistance. CWASA is proceeding to develop Modunaghat Water Treatment Plant under the World Bank financial assistance at present. Rehabilitation work of Mohara Water Treatment Plant and Kalrughat Iron Removal Plant was recently completed with the use of Japan's Debt Cancellation Fund.

Although significant increase of water supply capacity is expected in the near future, there are several subject issues being left, such as an improvement of transmission and distribution system. A large possibility on leakage increase which may be caused by superannuated transmission/distribution pipelines has been pointed out to CWASA, while CWASA does not posses appropriate technology and skilled staffs to implement leakage prevention measures. In this connection, the Government of Bangladesh (GOB) has requested the Government of Japan (GOJ) for implementation of technical cooperation project for leakage prevention and NRW reduction measures. GOJ then decided to take up this request in April 2007 upon conduct of project formulation study in July 2006.

JICA held a series of discussion with GOB from January to February, 2008 and exchanged the Minutes of Meeting (M/M) to formulate content of technical cooperation and both parties signed on Record of Discussion (R/D) in March 2009.

1.2 Project Design Matrix (PDM)

1.2.1 PRM (Version 1)

In March 2009, JICA, CWASA and concerned authorities of Bangladesh agreed and executed the Record of Discussions (R/D) including PDM (Version 1) as shown in Table 1-1.

Table 1-1 Project Design Matrix (Version 1)

Project Design Matrix			**別添1**
Project title: Project for Advancing NRW reduction Initiative (PANI) of Chittagong WASA	**Duration: 2009 - 2012**		
Target Area: Chittagong City, Bangladesh	**Target Group: Officers and staff of CWASA**		**Version 1**
Narative Summary	**Objectively Verifiable Indicators**	**Means of Verification**	**Important Assumptions**
Overall Goal To reduce Non-Revenue Water (NRW) in Chittagong City	By 2016, NRW ratio is reduced compared to the level at the Project completion in 2011.	CWASA monthly operation reports	
Project Purpose To enhance CWASA's capacity to reduce Non-Revenue Water (NRW)	1. The overall action plan for NRW reduction is periodically updated. 2. The functions of the action teams are incorporated into the routine work of CWASA. 3. CWASA officers/staff apply appropriate techniques developed by the project on leak detection, service connection and pipe reparing.	1. Project records 2. Project final evaluation report 3. Project records	1. CWASA secures the budget for the expansion of the NRW activities. 2. Pipes, saddles and meters are provided to customers by CWASA. 3. Devastating natural disaster does not occur.
Outputs			
1 To develop capacity to formulate NRW reduction plans	1-1. An overall action plan for NRW reduction is developed. 1-2. A NRW reduction annual implementation plan is prepared every year.	1-1. Project records 1-2. Project records	Officers and staff trained in the Project do not leave CWASA
2 To strengthen management and techniques in implementing NRW reduction activities through pilot project	2-1. The action teams are organized and implement the NRW reduction work plan as scheduled. 2-2. A manual for service connection and pipe reparing is developed. 2-3. 22 CWASA officers/staff are trained on leak detection skills, service connection and pipe reparing.. 2-4. NRW ratio is reduced in the pilot project areas.	2-1. Project records 2-2. Project records 2-3. Project records 2-4. Project records	
Activities	**Inputs**		
1-1 Organize a NRW reduction management team.	Japan	Bangladesh	
1-2 Review current activities of CWASA for NRW reduction.	1. Personnel Expert on NRW reduction planning (Team Leader) Expert on Leak DetectionTechniques Expert on Service Connection Techniques	1. Personnel Project Head Deputy Project Head Project Director NRW Reduction Management Team members NRW Reduction Action Team members	
1-3 Prepare a provisional overall action plan for NRW reduction			
1-4 Prepare an annual implementation plan for NRW reduction.			
1-5 Monitor the annual implementation plans.			
1-6 Review the provisional overall action plan based on feedback from the pilot projects.			
2-1 Select pilot project areas.	2. Equipment Leak detection equipment Portable ultla-sonic flow meter Vehicle for experts	2. Facilities Office space, furniture and faicility.	
2-2 Organize NRW reduction action teams at the operational level.			
2-3 Develop pipeline network drawings of the pilot project areas using GIS.			
2-4 Isolate the pilot project areas and conduct a survey on actual conditions of NRW in the pilot project areas including NRW ratio.		3. Local cost Cost for the isolation of pilot project areas Pipe-reparing cost Project management cost	**Pre-conditions**
2-5 Prepare a NRW reduction work plan for the pilot project areas incorporating leak detection, pipe-reparing, service connection, and activities for the reduction of non-physical losses*.			CWASA secures the budget for pilot project activities.
2-6 Implement the NRW reduction work plan.			
2-7 Conduct on-the-job training on leak detection skills, service connection and pipe repairing for CWASA officers & staff, and prepare a manual on service connection and pipe reparing..	3. Overseas Training Overseas Training for CWASA counterpart personnel	4. Others GIS settings	
2-8 Conduct public awareness activities for water conservation and reduction of illegal activities related to water-use.			
2-9 Measure the outcome of the pilot projects and provide feedback to the provisional overall action plan.			

*Activities for non-physical losses reduction include measures against illegal connections and bypass conections, and replacement of defective meters.

1.2.2 PDM (Version 2)

Through Interim Evaluation of the Project, PDM (Version 1) was revised taking into account the delayed deployment of NRW Reduction Management Team and Action Team from CWASA. The revised PDM excluded monitoring of NRW reduction activities as shown in Table 1-2.

Table 1-2 PDM (Version 2)

Project Design Matrix			**ANNEX 1**
Project title: Project for Advancing NRW reduction Initiative (PANI) of Chittagong WASA	**Duration: 2009 - 2012**		
Target Area: Chittagong City, Bangladesh	**Target Group: Officers and staff of CWASA**		**Version 2(for terminal evaluation)**
Narative Summary	**Objectively Verifiable Indicators**	**Means of Verification**	**Important Assumptions**
Overall Goal			
To reduce Non-Revenue Water (NRW) in Chittagong City	By 2016, NRW ratio is reduced compared to the level at the Project completion in 2011.	CWASA monthly operation reports	1. The Incentive Plan is approved by the CWASA's Board within six (6) months after the completion of the Project, and thereafter immediately implemented on a continuous basis. 2. The water meter technical standard and its accreditation system established in the Project are approved by the CWASA's Board within six (6) months after the completion of the Project, and therefore immediately put into effect for procurement of new water meters. 3. The revisions proposed to be made regarding the ownership of water meters and service lines are approved by the CWASA's Board within three (3) months after the completion of the Project and thereafter immediately applied to new service connections and progressively to all existing connections.
Project Purpose			
To enhance CWASA's capacity to reduce Non-Revenue Water (NRW)	1. The overall action plan for NRW reduction is periodically updated. 2. The functions of the action teams are incorporated into the routine work of CWASA. 3. CWASA officers/staff apply appropriate techniques developed by the project on leak detection, service connection and pipe reparing.	1. Project records 2. Project final evaluation report 3. Project records	1. CWASA secures the budget for the expansion of the NRW activities. 2. Pipes, saddles and meters are provided to customers by CWASA. 3. Devastating natural disaster does not occur.
Outputs			
1 To develop capacity to formulate NRW reduction plans	1-1. An overall action plan for NRW reduction is developed. 1-2. A NRW reduction annual implementation plan is prepared every year. 2-1. The action teams are organized and implement the NRW reduction work plan as scheduled. 2-2. A manual for service connection and pipe reparing is developed. 2-3. 22 CWASA officers/staff are trained on leak detection skills, service connection and pipe reparing.. 2-4. NRW ratio is reduced in the pilot project areas.	1-1. Project records 1-2. Project records 2-1. Project records 2-2. Project records 2-3. Project records 2-4. Project records	Officers and staff trained in the Project do not leave CWASA
2 To strengthen management and techniques in implementing NRW reduction activities through pilot project			
Activities	**Inputs**		
1-1 Organize a NRW reduction management team.	Japan	Bangladesh	
1-2 Review current activities of CWASA for NRW reduction.	1. Personnel Expert on NRW reduction planning (Team Leader) Expert on Leak DetectionTechniques Expert on Service Connection Techniques	1. Personnel Project Head Deputy Project Head Project Director NRW Reduction Management Team members NRW Reduction Action Team members	
1-3 Prepare a provisional overall action plan for NRW reduction			
1-4 Prepare an annual implementation plan for NRW reduction.			
~~1-5 Monitor the annual implementation plans.~~			
~~1-6 Review the provisional overall action plan based on feedback from the pilot projects.~~			
2-1 Select pilot project areas.	2. Equipment Leak detection equipment Portable ultia-sonic flow meter Vehicle for experts	2. Facilities Office space, furniture and faicility.	
2-2 Organize NRW reduction action teams at the operational level.			
2-3 Develop pipeline network drawings of the pilot project areas using GIS.			
2-4 Isolate the pilot project areas and conduct a survey on actual conditions of NRW in the pilot project areas including NRW ratio.		3. Local cost Cost for the isolation of pilot project areas Pipe-reparing cost Project management cost	**Pre-conditions**
2-5 Prepare a NRW reduction work plan for the pilot project areas incorporating leak detection, pipe-reparing, service connection, and activities for the reduction of non-physical losses*.			CWASA secures the budget for pilot project activities.
2-6 Implement the NRW reduction work plan.			
2-7 Conduct on-the-job training on leak detection skills, service connection and pipe repairing for CWASA officers & staff, and prepare a manual on service connection and pipe reparing..	3. Overseas Training Overseas Training for CWASA counterpart personnel	4. Others GIS settings	
2-8 Conduct public awareness activities for water conservation and reduction of illegal activities related to water-use.			
2-9 Measure the outcome of the pilot projects and provide feedback to the provisional overall action plan.			
*Activities for non-physical losses reduction include measures against illegal connections and bypass conections, and replacement of defective meters.			

1-3 Outline of Project Activities

The Project was commenced in July 2009 in accordance with the Project Implementation Program (1st year) based on the Terms of Reference. At the beginning of the Project, it was revealed that the existing distribution network drawings (CAD drawing) and customer data did not have required accuracy for preparation of NRW reduction plan and relevant project activities, though reliability of these data/information were assured by CWASA at the time of project preparation stage. Scope of Project was then revised to include development of GIS database for distribution network and customer database. Model Area having densely populated area was then designated as target area for GIS database

development. Field verification survey, test excavation and supplemental topographic survey as well as customer survey were carried out.

Project activities pertaining to outputs 1 and 2 were carried out as OJT for leakage detection/repair and replacement/installation of service connections and water meters. Although increase of counterpart staffs for technology transfer of GIS mapping was repeatedly requested to CWASA, it was realized only in 3rd year operation of the Project due to shortage of technical staffs in CWASA and technology transfer to counterpart staffs were delayed.

In the 3rd year operation, collaboration with on-going project, "Karnaphuli Water Supply Project" under JICA's ODA Loan was taken up so as to attain synergy effects of Japan's ODA projects. GIS map of existing distribution network including results of test excavation was provided to Transmission and Distribution Main Construction Component of the said project.

1.3.1 Project Administration and Coordination

Overview of Executing Agency

(1) Water Supply Service by CWASA

Water supply service in Chittagong was commenced in 1892 when Asam Bengal Railway Company placed its head office in Chittagong under British colonial time. In 1963, CWASA was formed and technical/financial assistance of the World Bank was started. For more than 30 years implementation of water supply facilities and management system, CWASA faced difficulty to undertake recommendations of the World Bank under the 3rd improvement program (1989 – 1997). At the request of CWASA, the World Bank's direction of assistance was shifted to Dhaka WASA and the Bank's assistance to CWASA was then suspended. Afterward, CWASA developed deep well sources and installation of distribution pipelines in peripheral area. However, shortage of supply capacity has not been improved as shown in Table 1-4 and CWASA is forced to carry out rationing of water supply by controlling valves in distribution network. Usage of direct suction pump at every consumer and supply interruption are causing negative pressure in distribution pipelines resulting fears of intrusion of polluted water to pipelines and deterioration of water quality as well as insufficiency of sup0ply amount.

Under the above mentioned circumstances, "Karnaphuli Water Supply Project" under Japan's ODA Loan is being implemented, while "Modunaghat Water Treatment Plant Project" by Italian ODA (currently taken over by the World Bank) is under preparatory stage for implementation and "Rehabilitation of Mohara and Kalrughat Water Treatment Plants" under Japan's Debt Cancellation Fund has been completed in June 2011. Once these projects are completed, CWASA's supply fapacity will be increased to a total of 432,000 cu.m/day by 2013. On the other hand, dilapidated distribution net-

work will create further leakage throughout the city.

Table 1-3 Major Indicators of Water Supply Services by CWASA

Indicator	2000	2005	2007
a. Total Population	2,550,000	2,694,000	-
b. Served Population	1,142,000	1,286,000	-
c. Service Coverage	45%	48%	-
d. Nominal Supply Capacity (m^3/day)	192,000	182,000	200,000
e. Actual Supply Capacity (m^3/day)	162,000	168,000	192,000
f. Water Demand (m^3/day)	360,000	328,000	423,000
g. Non Revenue Water Ratio	35%	29%	45%
h. No. of Registered Connections	31,481	40,398	43,268
i. Water Meter Installation Ratio		62%	99%

Note: PANI Project has revealed that water meter installation ratio is about 80% and40% out of installed water meter are malfunctioning.

(2) Organizational Set-up of CWASA

The present organizational set-up of CWASA is shown in Figure 1-?. CWASA is headed by Chairman (currently called as Managing Director) and consists of three (3) divisions, namely Administration, Engineering, and Finance. Organizational features are summarized in Table 1-5.

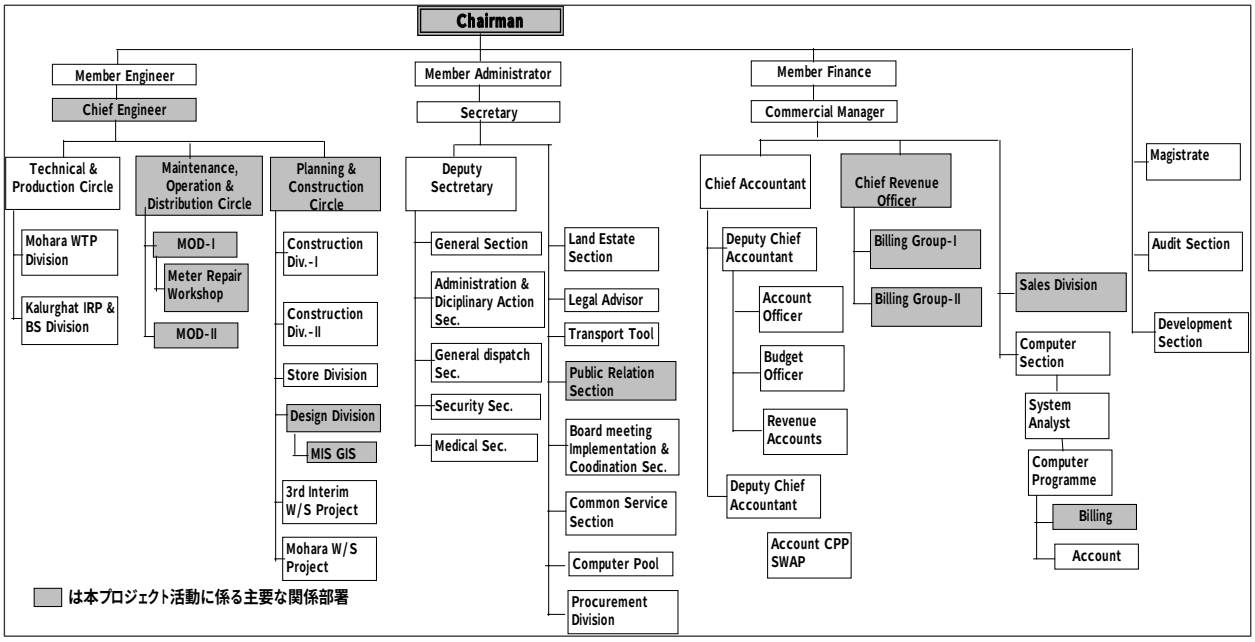


Figure 1-1 Organizational Set-up of CWASA

Table 1-4 Typical Features of CWASA

Feature	Description
Decision Making	• Top Down method which is commonly observed in many public organization in Bangladesh. • Senior officials for 2 to 3 years rotating assignments, who are appointed by central government, are holding decision making role. • Incentives are not properly considered to original CWASA staffs.
Daily Operation	• Top officials without knowledge on water supply service are occupying top positions. • Daily operation is managed by the Chief Engineer. • Successors to senior positions are not properly developed yet.
Behavioral Culture	• Senior officers are not visiting fields as common practice in Bangladesh. • Management of field operations is depending on field personnel.
Manpower Allocation	• Although several hundreds of personnel are working at CWWASA, technical staffs are insufficient. • Many Executive Engineers of CWASA do not have appropriate engineering knowledges and experiences.

(3) Present Conditions of Non Revenue Water (NRW) Reduction

1) NRW Ratio

The NRW of CWASA is reported to be 30.4% from July 2006 to October 2007 and water consumption in volume is recorded to be 43% by 6,350 service connections out of 38,000 service connections in November 2007.

There are reported cases on failure water meter, need to installation of new water meter, identification of public faucets and illegal/unmetered service connections of about 520 locations.

2) Present measures for Non-Revenue Water (NRW) reduction work

The NRW reduction work of CWASA is mainly repair work of pipe leakage and change of broken water maters and being undertaken by each MOD.

The repair work is classified to over 100mm diameter pipe for registered contractor, below 100mm diameter pipe by employee by CWASA. Actual repair work is approximately 200 places per month and these repair works are completed by the following day after receiving the claim from customers.

3) Pipe Materials

In case of new application for water supply, all applicants are required to purchase the material by themselves. However, there is a problem of leakage issue because of cheap and sub-standard materials being purchased by applicants.

4) Breakdown of Water Meters

CWASA had purchases 15,000 units of water meter with the use of fund allocated by the national government. Replacement of broken meters is carried out directly by CWASA at 250 units/month together and 8,000 units of replacement through contractors. CWASA established water meter workshop at MOD-1 in 1990 through the World Bank project for calibration and repair. This workshop is no longer operated due to breakdown of power switching board.

5) Public Faucets

There are about 690 public faucets in Chittagong City. There is a program of NGO to provide low cost water supply by individual connections for poor residents, but CWASA does not have such program for poor people. Due to absence of water meter at public faucets, KCC is paying flat rate of water charges to CWASA for most of public faucets.

6) Present Status of Distribution Network Drawings

Information on distribution network of CWASA consists of AutoCAD drawings and PC ARCINFO which were developed in 1993 to 1997 under the World Bank's NRW Reduction Program, service connection drawings with water meters, customer database. These information have been updated by JICA's technical assistance in 1999 to 2000, particularly for distribution network in the right bank of Karnaphuli River. However, such information on CAD and GIS have been corrupted owing to repeatedly happened system error and failure in data recovery as well as resignation of skilled staffs. These databases had stopped their functions in 2008 and CWASA introduced AutoCADMAP3D to give priority on reconstruction of distribution network drawings with only one CAD operator at GIS Section in Design Division.

Project Implementation Set-Up

The Project is so named as ***PANI*** (***P***roject for ***A***dvancing ***N***RW Reduction ***I***nitiative, PANI means "Water" in Bengali). CWASA appointed Project Director (PD) from among Executive Engineers and assigned NRW Reduction Management Team and Action Team with following functions and objectives.

Table 1-5 Relationship of PANI and CWASA Organization

Name of Organization	Expected Performance
NRW Reduction Management Team	• Preparation of NRW Reduction Plan Preparation • Develop capacity for plan preparation
NRW Reduction Action Team	• In charge of NRW reduction field management and operation • Develop capacity of NRW reduction technique and knowledges
MOD Office 1 & 2	• Customer service and daily O&M of water supply service • Officers shall participate in PANI, especially in identifying distribution pipelines in Model Area and Pilot Project Area
Sales Division	• Customer data and water consumption/bills are recorded. • Meter inspectors are checking water consumption of all customers.
Design Division	• GIS Section has defunct GIS system provided by the World Bank. • CAD operator of GIS Section will participate to PANI for OJT.

Collaboration with Relevant Agencies

Table 1-6 Collaboration with Relevant Agencies

Name of Agency	Work Collaboration
Karnaphuli Gas Company	• Numerous number of gas pipelines have been installed throughout Chittagong City and their location information is vital for smooth implementation of NEW reduction work. • Various field offices have drawings of gas pipelines and rendered collaboration for field confirmation with CWASA.
Bangladesh Telephone Company	• There are many telecommunication lines buried underground. • Only schematic drawings are available. Officers of company had collaborated with CWASA for field confirmation of their locations.

Collaboration with Other Japan's ODA Projects

Table 1-7 Collaboration with Other Japan's ODA Projects

Name of Project	Work Collaboration
Karnaphuli Water Supply Project	• Sharing of information on new transmission/distribution mains and existing distribution network • PANI provided GIS database/maps on existing distribution network including survey results on underground utilities by test excavation. • GIS mapping of new transmission/distribution mains for future O&M materiaqls. • Institutional Development Consulting Services is providing organizational restructuring plan and management renovation. PANI provides relevant information and database for realization of their recommendations.
Preparatory Survey on Chittagong Water Supply Improvement Project	• PANI provides various information on Model Area which is expected to be major target area for improvement of distribution network under Phase 2 of Karnaphuli Water Supply Project.
Mohara and Kalrughat Water Treatment Plant Rehabilitation Project	• Sharing technical information on water supply capacity improvement. • PANI absorbed project information for developing database of water supply facilities.

Collaboration with Other Donor Agencies

Table 1-8 Collaboration with Other Japan's ODA Projects

Name of Project	Work Collaboration
World Bank	• A series of discussions were held with the mission for smooth implementation of projects. • Short listing of consultants have been carried out and RFP is issued by CWASA.
KOICA	• Participation to final presentation seminar and discussion with KOICA team for water supply and sewerage master plan.

1.3.2 Project Inputs and Activities

(1) Project Input

JICA dispatched a total of 3 Japanese Experts for the commencement of PANI which consisted of Team Leader, Leakage Detection/Service Connection Exprt-1, and GIS Expert. Leakage Detection/Service Connection Expert-2 was scheduled to be deployed from the 2nd year operation.

During the course of 1st year operation, CWASA has recognized significant importance of re-establishment of GIS system particularly for managing distribution network for day-to-day operation and maintenance including NRW reduction activity, together with mapping of priority area for urgent rehabilitation of main distribution lines. A request for augmentation of PANI operation to include provision of GIS equipment and development of GIS-based distribution network mapping in model area was submitted to JICA.

In response to the request from CWASA, JICA decided to expand PANI operation and an additional Japanese Expert in charge of distribution network survey was deployed from January 2010 for approximately 2.8 months. Subsequently, GIS Expert will also be considered for additional input during the same period, while his prearranged one (1) month input for early 2010 has been advanced during November and December, 2009 so as to keep up operation of the said additional task on GIS. Composition and deployment duration of JICA Experts is shown in Table 1-9 and their work schedule is shown in Figure 1-2.

Table 1-9 Deployment of Japanese Experts

Positions	Duration of Deployment (Man-Months)			
	1st Year (2009.07-2010.03)	2nd Year (2010.05-2011.03)	3rd Year (2011.06-2012.06)	Total
Team Leader/NRW Reduction Planning	7.33	8.24	10.97	26.54
Leader, Leakage Detection/ Service Connection Exprt-1	4.17	4.80	5.30	14.27
Leader, Leakage Detection/ Service Connection Exprt-2	-	6.40	4.50	10.90
GIS System Designer	5.00	5.50	4.90	15.40
Distribution Network Survey Expert	2.77	7.80	5.30	15.87
Total	19.27	32.74	30.97	82.98

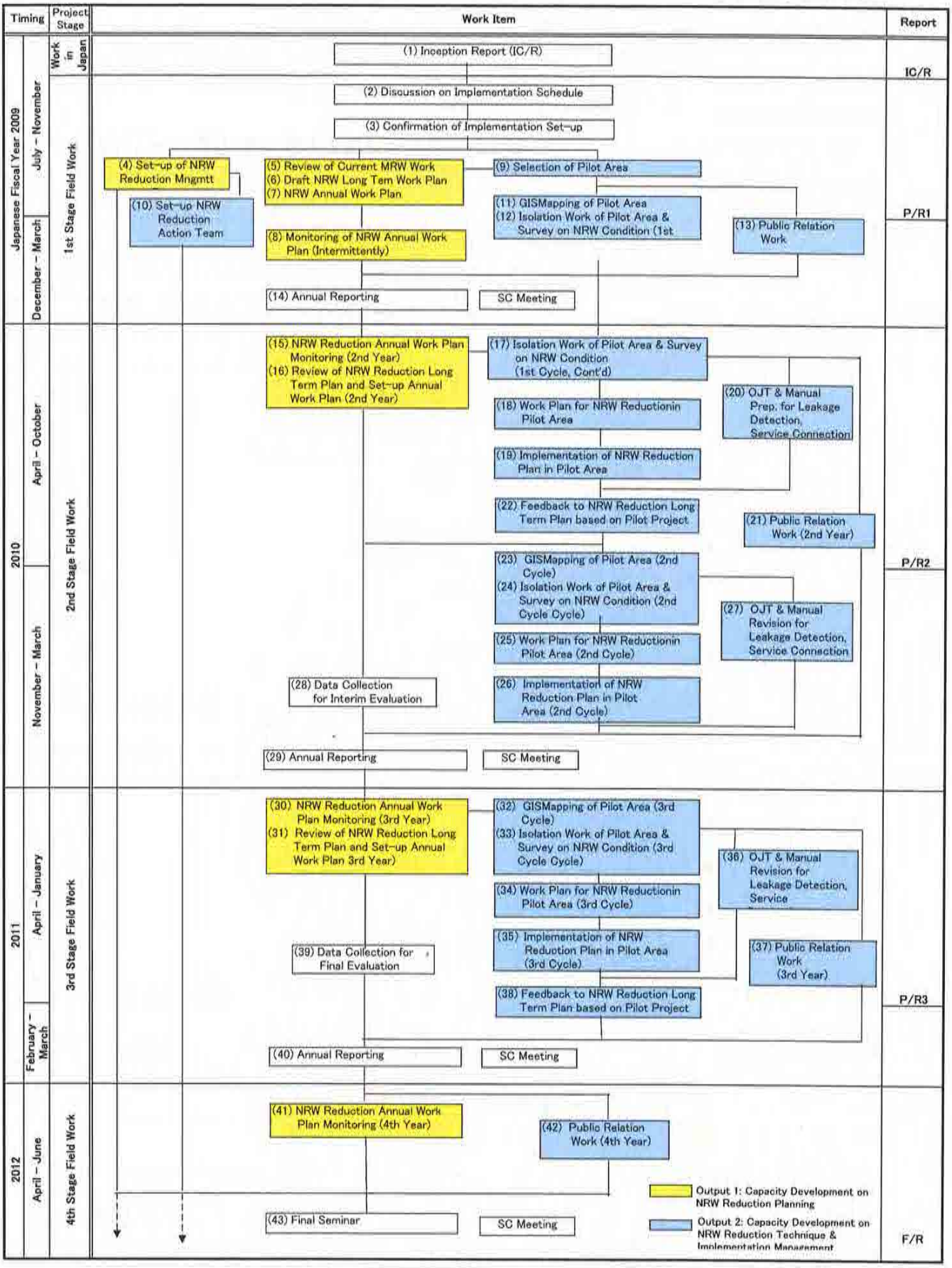


Figure 1-2 Work Flow of PANI Project

(2) Major Activities of the Project

Major activities of the Project are presented hereunder in accordance with the annual work plan. Table 1-20 presents listing of work items and detailed description are presented in Appendices.

Table 1-10 Major Activities Undertaken in the Project

Major Work Item		
1st Year Operation	(1)	Submission and Explanation of Inception Report
	(2)	Formulation of NRW Reduction Management Team
	(3)	Review of Current Practices of NRW Reduction Activities
	(4)	Review of Current NRW Reduction Measures
	(5)	Preparation of Provisional NRW Reduction Long Term Plan
	(6)	Monitoring of Annual Implementation Plan
	(7)	Selection of Pilot Project Area
	(8)	Formulation of NRW Reduction Action Team
	(9)	Preparation of Distribution Network Drawings by GIS Mapping
	(10)	Isolation work of Pilot Project Area
	(11)	Public Campaign for Water Conbservation, Prohibition of Illegal connections
	(12)	GIS Mapping in Model Area
2nd Year Operation	(13)	Monitoring of BRW Reduction Annual Work Plan
	(14)	Review of NRW Reduction Overall Plan
	(15)	Isolation Work of Pilot Project (1st Cycle)
	(16)	Preparation of NRW Reduction Work Plan for Pilot Project (1st Cycle)
	(17)	Implementation of NRW Reduction Work Plan of Pilot Project (1st cycle)
	(18)	Implementation of ojt ON Leakage Detection and Service Connection with Preparation of Manuals
	(19)	Public Campaign
	(20)	Post Evaluation of Pilot Project and Feedback to Overall Plan
	(21)	GIS Mapping of Distribution Network in Pilot Project Area
	(22)	Field Verification Survey in Model Area
	(23)	GIS Database Development of Service Connections & Water Meters in Model Area
	(24)	Data Collection for Interim Evaluation of Project
3rd Year Operation	(25)	Preparation of NRW Reduction Long Term and Annual Work Plan based on Pilot Project and Model Area Survey
	(26)	Water Meter Replacement in Zone 3 of Model Area and Monitoring of NRW Reduction Effect through Meter Reading
	(27)	Study and Recommendations on Technical Standards and Accreditation System of Water Meters based on the Interim Project Review
	(28)	Support to CWASA on Study of Incentive Mechanism of CWASA Employees based on the Interim Project review
	(29)	Support to CWASA for Transfer of Ownership of Service Connections and Water Meter from Customer to CWASA based on the Interim Project Review
	(30)	Support to CWASA in Obtaining Autonomy based on Terminal Project Evaluation
	(31)	Support to CWASA in Obtaining Approval of Organogram and Restructuring
	(32)	Information Sharing of GIS Database and Test Excavation Result with KWSP
	(33)	Completion of GIS Database and Handing Over to CWASA
	(34)	Collaboration with CWASA and JICA Preparatory Survey Team on Additional Database to be covered by Proposed CWSIP
	(35)	Support to Test Excavation in Zone 1 of Model Area and Reflect on GIS Database/Mapping
	(36)	Conduct Seminar on Underground Utilities based on Test Excavation Survey Result

Table 1-10 Major Activities Undertaken in the Project (Cont'd)

Major Work Item		
3rd Year Operation	(37)	Isolation Work and Post Evaluation of Pilot Project
	(38)	Preparation of NRW Reduction Work Plan in Pilot Project (3rd Cycle)
	(39)	Implementation of NRW Reduction Work Plan in Pilot Project Area (3rd Cycle)
	(40)	Implementation of Public Campaign
	(41)	Post Evaluation of Pilot Project (3rd Cycle)
	(42)	Conduct Final Seminar of PANI

SECTION 2 PROJECT INPUTS/OUTCOME AND ACHIEVEMENT STATUS OF PROJECT TARGET

2-1 Project Purpose and Verifiable Indicator

Project Design Matrix defines project purpose, objectives, etc. as shown in Table 2-1.

Table 2-1 Project Purpose & Objectives

Purpose & Objectives	Description
1) Overall Goal	To reduce NRW in Chittagong City
2) Project Purpose	To enhance CWASA's capability to reduce NRW
3) Outputs	1) To develop capacity to formulate NRW reduction plan 2) To strengthen management and techniques in implementing NRW reduction activities through Pilot Projects

The project outputs and their verifiable indicators are shown in Table 2-2.

Table 2-2 Project Outputs and Verifiable Indicators

Outputs	Verifiable Indicators
(1) Capacity Development to Formulate NRW Reduction Plan	A provisional overall action plan for NRW is developed. A NRW reduction annual implementation plan is prepared every year.
(2) Strengthen Management Capacity and Techniques to Implement NRW Reduction Activities	The action teams are organized and implement the NRW reduction work plan as schedule. A manual for service connection and pipe repairing is developed. NRW ratio is reduced in the pilot project areas.

2-2 Output 1 "Capacity Development on NRW Reduction Plan Preparation"

2-2-1 Stream of Project Activities

Due to limited time duration of 1st year operation for 9 months and problems on the reliability of existying distribution network drawings of CWASA, the scope of project was revised to include GIS mapping and database development. In addition, frequent changes of senior officials of CWASA had influenced insufficient movement of NRW Reduction Management Team, because majority of this team consisted of senior officers of CWASA management body. Resultant from this, preparation of NRW reduction plan was delayed seriously and prolonged through to the 2nd year operation.

The Interim Project Review concluded the need to reshuffle the NRW Reduction Management Team in January 2011 and NRW reduction plan preparation was postponed to the 3rd year operation.

2-2-2 Achievement of Output 1

Prerequisite of NRW Reduction Long Term Plan was:

(1) reconstruction of GIS database of existing distribution network to enable sub-dividing service area for measurement of distributed water volume, and

(2) reconstruction of customer database and pinpoint location of every customer on GIS map.

However CWASA did not poses this principal information and the Project was forced to reestablish fundamental information through massive field survey. This additional task consumed more than one year of OJT for GIS database operation, field verification survey, test excavation, etc.

The former task was carried out by (1) overlaying CAD drawings on the high resolution satellite images and (2) location confirmation of distribution pipelines through field verification survey and test excavation. The latter was carried out to process customer data being kept by Sales Division of CWASA to indicate on administrative divisions of City (ward-wise realignment). This task was focused onto Model Area by sub-dividing into 4 zones. House-to-house survey of customers was carried out in each zone and confirmed location of customers is pinpointed on GIS map. Survey results are summarized in Table 2-3.

Table 2-3 Fundamental Survey for NRW Reduction Long Term Plan Preparation

Activity		Zone-3	Zone-1	Zone-2 & 4
1.	Field Verification Survey of Distribution Network	Completed		
2.	Test Excavation to Confirm Exact Location of Distribution Network	Completed (42 locations in 2nd year)	Completed (36 locations in 3rd year)	To be carried out during extension period of Project (About 30 locations)
3.	Customer Survey (Location & Functional Status of Water Meter) ↓ Database of Customer & Water Meter	Completed (5,568 connections in 2nd & 3rd year)	70% (about 3,600 locations) completed in 3rdyear (Total about 5,000 locations). Remaining 1,400 customers will be surveyed during extension period of Project.	To be carried out during extension period of Project: Zone-2: 4,000 customers Zone-4: 4,300 customers

Above mentioned activities were carried out in the course of Project for CWASA NRW Reduction

Management/Action Teams and principal knowledge and skills on GIS database development and its operation as well as field operation were adhered.

It shall be noted, however, knowhow on developing NRW Reduction Plan is yet subject to further training and practices during the extension period of Project. The achievement of this task is deemed at about 70%.

Along with the implementation of preparatory survey for Chittagong Water Supply Improvement Project, so called Karnaphuli Phase-2, a massive improvement of distribution network in Model Area is being programmed. Once this improvement takes place, the existing distribution network in Model Area will be replaced with new pipes and NRW reduction work will be then focused to service connections and water meters. At present, PANI has already started installation/replacement of water meters in Zone 3 of Model Area as actual implementation/application of skills learned from PANI OJT.

2-3 Output 2: "Capacity Development on NRW Reduction Techniques and Field Management"

2-3-1 Stream of Project Activities

Khulshi Pilot Project revealed that:

- 88 customers have functioning water meters out of a total 173 customers,
- Remaining customers do not have water meters or malfunctioning water meters.

During water meter installation/replacement of the above mentioned customers, 6 new water meters are found defunct at the time of installation. This means quality control of water meters by manufacturers and CWASA is not properly carried out. Referring to this fact, the Interim Project Evaluation recommended the introduction of technical standards of water meters and accreditation system of manufacturers/suppliers of water meters.

GIS database development for Model Area encountered delay on delivery of computers, etc. It also associated with insufficient participation of CWASA counterparts for field survey. Resultant from these incidences, a series of field survey was completed in the 2nd year and revalidation work took place in the 3rd year to complete the database development.

Along with the implementation of various activities in PANI, JICA enhanced collaboration of its technical cooperation and ODA loan, particularly sharing of information/data between PANI and Karnaphuli Water Supply Project (KWSP C-2 Transmission/Distribution Main Construction component). PANI already started to provide technical data/information on GIS database/map to

KWSP in the later part of 3rd year operation.

2-3-2 Achievement of Output 2

(1) NRW Reduction Technique/Skill

CWASA Action Team had acquired basic skills and knowledge of leakage detection/repair, service connection and water meter installation/replacement in the course of PANI. Furthermore, this Action Team is currently working in Zone 3 of Model Area as advanced action for installation/replacement of water meters.

GIS group of Action Team is continuously working with field operation group to process field data on GIS database and mapping.

(2) NRW Reduction Management Capability

GIS group of Action Team with some members of Management Team had acquired knowhow and skills to update various data obtained from Pilot Projects and various survey in Model Area. Their skills are currently applied for continuous operation in Model Area, particularly for customer survey in Zone 1 and water meter installation/replacement in Zone 3 of Model Area. It is further expected to expand their activities to outside of Model Area.

2-3-3. Activities in Pilot Projects

(1) Overview of Pilot Project Area

The overview of Pilot Project Area is summarized in Table 2-4.

Table 2-4 Result of Customer Survey in Pilot Project Area

Pilot Project Area	CWASA Registered Customers		Survey Result		Remarks
	No. of Customers	%	Actual Number	%	
Chandgaon-B	630	36.5	511	33.2	Survey was completed in Sep. 2011.
Chandgaon-A	250	14.5	218	14.1	
Khulshi	200	11.6	173	11.2	
Agrabad	480	24.3	505	32.8	
Halishahar	168	13.1	134	8.7	
Total	1,728	100.0	1,541	100.0	

Table 2-5 Chandgaon-A

Plumbing Materials		Purpose	Unit	Quantity	
Distribution Pipe	DN 100 PVC	For sub-distribution line	Meter	1,766	
	DN 150 PVC	For distribution line		329	
	DN 200 DI	For distribution line, aged material		20	
	DN 200 PVC	For distribution line		823	
	DN 200 PVC (T.W)*	For sub-distribution line, aged material		211	
	DN 300 PVC (T.W)	For distribution line		211	
	DN 300 AC	For distribution line		607	
	DN 450 DI (T.W)	For distribution line		221	
Service Pipe		It seem to be each connector is unsatisfactory connection method to use		3,348	
Fittings		For distribution line	Pcs	12	
Valves		Some valves are buried by pavement.		7	
Water Meter		Functioning	Connection	170	78%
		Not Functioning		37	17%
		No Meter installed		11	5%
		Total		218	100%

Note: T.W： Pipes from Deep Tube Well

Table 2-6 Agrabad

Plumbing Materials		Purpose	Unit	Quantity	
Distribution Pipe	DN 100 PVC	For sub-distribution line	M	2,988	
	DN 150 PVC	For distribution line		214	
Service Pipe		It seem to be each connector is unsatisfactory connection method to use		3,480	
Fittings		For distribution line	Pcs	20	
Valves		Some valves are buried under pavement.		15	
Water Meter		Functioning	Connection	334	66%
		Not Functioning		133	26%
		No Meter installed		38	8%
		Total		505	100%

Table 2-7 Khulshi

Plumbing Materials		Purpose	Unit	Quantity	
Distribution Pipe	DN 100 PVC	For sub-distribution line	M	1,641	
	DN150 AC	For sub-distribution line and short distance		25	
	DN 200 PVC	For distribution line		324	
	DN 225 AC	For distribution line but, it aged material		401	
	DN 300AC	For distribution line but, it aged material		401	
	DN 600AC	For distribution line but, it aged material		401	
Service Pipe		It seems to be each connector is unsatisfactory connection method to use such as spaghetti.		11,084	
Fittings		For distribution line	Pcs	16	
Valves		Some valves are buried under pavement.		16	
Water Meter		Functioning	Connection	89	51%
		Not Functioning		57	33%
		No Meter installed		27	16%
		Total		173	100%

Table 2-8 Chandgaon-B

Plumbing Materials		Purpose	Unit	Quantity	
Distribution Pipe	DN 100 PVC	For sub-distribution line	M	3,034	
	DN 150 PVC	For sub-distribution line and short distance		2,700	
	DN 200 PVC	For distribution line		1,570	
	DN 300 PVC	For distribution line		505	
	DN 450 DI	For distribution line		834	
Service Pipe		It seems to be each connector is unsatisfactory connection method to use such as spaghetti.		6,193	
Fittings		For distribution line	Pcs	28	
Valves		Some valves are buried under pavement.		7	
Water Meter		Functioning	Connection	367	72%
		Not Functioning		127	25%
		No Meter installed		17	3%
		Total		511	100%

Table 2-9 Halishahar

Plumbing Materials		Purpose	Unit	Quantity	
Distribution Pipe	DN 100 PVC	For sub-distribution line	M	558	
	DN 150 PVC	For sub-distribution line and short distance		103	
	DN 200 PVC	For distribution line		11	
Service Pipe		It seems to be each connector is unsatisfactory connection method to use such as spaghetti.		627	
Fittings		For distribution line	Pcs	14	
Valves		Some valves are buried under pavement.		13	
Water Meter		Functioning	Connection	85	63%
		Not Functioning		40	30%
		No Meter installed		9	7%
		Total		134	100%

Results of Pilot Project in 5 areas show that there is an average of 34% (22% in Chandgaon A to 49% in Khulshi) of malfunctioning or no installation of water meters. In other words, approximately one-third of customers are applied for flat rate water charges resulting significant revenue loss of CWASA.

(2) Achievements of Pilot Project on NRW Reduction

Table 2-10 NRW Reduction Effects in Pilot Project

Pilot Project Area	No. of Customers	Served Population (person)	NRW Reduction Work		Functioning Water Meter (pcs)	(1) Supplied Volume	(2) Consumed Volume	(3) Meter Reading by CWASA (Bill Collection))	NRW Ratio (%) (2)/(1)
			Before/ After	Timing					
Khulshi	172	1,049	Before	2011.1	72	1,474	659	587	**55%**
			After	2011.2	129	1,086	776	625	**29%**
				2012.5	152	2,756	2,230	NA	**19%**
Chandgaon A	201	1,226	After	2011.10	191	3,957	3,390	3,303	**14%**
				2012.2	199	1,626	1,403	NA	**13%**
Chandgaon B	304	1,854	After	2012.2	302	1,951	1,700	NA	**12%**
Agrabad	234	1,427	After	2012.4	229	1,079	891	524	**17%**
Halishahar	128	781	After	2012.4	84	Could not measured due to low pressure		NA	-

As shown on the above, approximately 30% of NRW has been reduced. Especially in Khulshi area, NRW went down from 55% to 19% through implementation of water meter replacement and leakage repair work. Similarly in other areas, NRW ratio went down to 12% to 17%.

It shall be noted that remaining NRW ratio of more than 10% after NRW reduction work owes to:

- There is high possibility of presence of unidentified illegal connections and leakages due to inaccurate information of distribution pipelines.
- Water meters, which are observed as functioning during the survey, are not tested to validate its accuracy and may be inaccurate at present.

When the existing distribution network is replaced in the KWSP Phase 2, the NRW ratio can be further reduced to about 5%.

Looking into above mentioned outcome, NRW reduction impact is estimated as shown in Table 2-11 that approximately one-third of monthly revenue will be recovered from NRW.

Table 2-11 Estimate of NRW Reduction Impact in whole Chittagong City

NRW Ratio (Present) (1)	After NRW Reduction Measure (2)	NRW Reduction Effect (1)-(2)	Expected Improvement of Revenue (Taka)	Formula	Ratio of Improvement against Present NRW
35%	15%	20%	10,300,000	=33,483,963/(1-0.35)x0.20	31%
40%	20%	20%	11,160,000	=33,483,963/(1-0.40)x0.20	33%
45%	20%	25%	12,180,000	=33,483,963/(1-0.55)x0.25	36%
Water Tariff Revenue (February in 2012 33,483,963 Taka/Month					

2-4 Achievement of Project Objectives

The Project has principal objective to enhance "CWASA's capacity to reduce NRW." Through 3 year project operation, The Action Team has shown significant achievement to adhere required techniques, skills and knowledge and is now deemed to stand by them.

The Management Team is however less operational in comparison to Action Team owing to double assignment of each member as they have their own original assignments/positions in CWASA. Only one member of Management Team could participate in the series of OJT in PANI. Resultant from this, this person is expected to lead Action Team from now on to implement various activities of NRW reduction worki in CWASA.

2-5 Counterpart Staff

CWASA reorganized NRW Reduction Management Team in September 2011 as shown in Table 2-12. However, this Management Team participated to PANI only half day in the morning time. In 2017, only one member is regularly attending for OJT. Day-to-Day training has been carrying out by JICA GIS Expert and local consultant.

Table 2-12 Composition of Management Team

SL. No.	Name & Designation	Division	Designation of Management Team
~~1~~	~~Md. Nurul Absar, Executive Eng.~~	~~Design Division~~	~~Convener~~
~~2~~	~~Md. Mahbubul Alam, Executive Eng.~~	~~Construction Division~~	~~Member~~
3	Mr. Shohel Rana, Asst. Eng.	MOD-2	Member
~~4~~	~~Mr. Ashik Mahmud Chowdhury, Asst. Ang.~~	~~Construction Division-1~~	~~Member~~
~~5~~	~~Mr. Sadli Bin Nur, Deputy Asst. Eng.~~	~~Design Division~~	~~Member~~
~~6~~	~~Mr. Tridib Chowdhury, Overseer~~	~~Design Division~~	~~Member~~

In contrast to Management Team, Action Team consisting of GIS Group and Field Operation Group has been working actively for full-time basis as shown in Table 2-13. GIS Group has started with six (6) members and it has decreased to four (4) regularly working staffs. Field Operation Group is undertaking leakage detection and repair, water meter installation/replacement. Their Day-to-Day training has been carried out by JICA Leakage Detection/Service Connection Experts and local consultants both in field and in class-room lecture. Trainees assigned in 2011 are all newly hired casual workers without any previous experience in water supply. On the other hand, existing plumbers of CWASA are not appointed for OJT due to their on-going duties. In this regard, re-orientation and training of CWASA plumbers are required to ascertain their skills and knowledge on this field.

Table 2-13 Composition of Action Team

SL. No.	Name	Original Position	Deployment to PANI
GIS Group			
1*	Md. Saiful Islam	Asst. Eng./KWSP	Jun. 21, 2011
2	Md. Talebul Hassan	Data Entry Operator/KWSP	Jun. 21, 2011
3	Md. Saifur Rahman Bhuiyan	Asst. Engr./Store Div.	Aug. 02, 2011
4	Hasnatul Zannat Sweety	Sub. Asst. Engr./CD-2	Aug. 02, 2011
~~5.~~	~~Abdur Rouf~~	~~Asst. Engr./MOD-1~~	~~Oct. 11, 2011~~
6.	Talisma Akter	Sub. Asst. Engr./CD-2	Oct. 19, 2011
Field Operation Group			
7	Nurul Absar	APM/MOD-2	Jun. 22, 2010
~~8~~	~~Md. Jabeb~~	~~APM/MOD-1~~	Jun. 22, 2010
9	Jewel Barua	Helper/HOD-1	Jun. 22, 2010
10	Sanzoy Basu	Helper/Transport Pool Section	Sep. 2011～
11	Md. Reazul Islam		
12	Md. Rasel Mia		
~~13~~	~~Md. Raihan Shardar~~		
14	Md. Shohel Rana		
15	Yousuf Mirza		
16	Md. Shohel		
17	Md. Akhter Hossain		
18	Md. Ariful Islam		

Note: * - Half day in the morning is spent for OJT.

SECTION 3 APPROACH AND METHODOLOGY OF TECHNOLOGY TRANSFER

3-1 Approach of Technology Tr4ansfer

3-1-1 Approach of Technology Transfer in the Project

The Project is designed to transfer technology on NRW reduction work at management and field level of CWASA covering such techniques, skills, monitoring and feedback procedures through seminars and OJTs.

Japanese Experts deployed to the Project had evaluated institutional and individual capacity of concerned offices/individuals of CWASA and prepared training program suitable to respective targets of trainees.

3-1-2 Capacity Development at Individual Level

For capacitating planning technique and skills on NRW reduction work, such counterpart who undertook group training course of JICA was enlisted as member of Action Team. The initial training was focused to recognize importance of setting up fundamental information of distribution network, customer and water meters, as well as collaboration and sharing of pertinent information of relevant agencies, such as gas and telecommunication companies. These fundamental activities shall be continued through the future as distribution network extends registered customers increase.

GIS operation is not such easy task to acquire in short period. Continuous updating and integration of various information as well as sharing with concerned offices of CWASA are deemed never ending tasks for GIS group in Action Team. In this regard, CWASA is now convinced the importance to establish GIS group in their organizational structure together with NRW reduction group.

3-1-3 Capacity Development at Organizational Level

The World Bank once implemented the similar project to reduce NRW in 1990s, but no particular achievement has been recorded, except for Consumer Service Connection Completion Report (CSCCR) as key information sheet of customer service. This format is yet the standard at CWASA and PANI has integrated into GIS database

PANI had focused to integrate efforts of CWASA into GIS database and visualized as principal tool for water supply service management. Counterparts assigned to Action Team were then appointed

from concerned offices/divisions of CWASA so as to share information and expertise acquired through OJT and lectures of PANI.

3-2 Subjects of Technology Transfer

Table 3-1 Subjects of Technology Transfer

Training Subjects	Description
(1) Preparation of NRW Reduction Plan and Monitoring	• Identification of principal data/information • Compilation and evaluation of present situation • Delineation of service block for NRW reduction work • Field survey plan preparation • Processing of field data on GIS dataqbase/mapping • Implementation/monitoring of NRW reduction plan • Evaluation of NREW reduction impact and feedback for further action
(2) OJT in Pilot Projects	• Customer survey • Field verification of distribution network • Leakage detection and repair work • Field measurement of supplied volume with installation of flow meter in distribution lines • Replacement/installation of water meters • Measurement of water consumption • Post evaluation of NRW reduction work and feedback
(3) Preparation of distribution network drawing in Pilot Project area	• Conduct field verification survey • Test excavation • Data processing on GIS mapping •
(4) Field verification of distribution network in Model Area and compilation on GIS database/map	• Conduct field verification survey • Test excavation to pinpoint exact location of pipelines • GIS mapping and data processing • Customer survey to confirm location of customers and functional status of water meter
(5) Public campaign for water conservation and prohibition of illegal connection	• Prepare campaign program in collaboration with Public Relations Office (PRO) of CWASA • Conduct press conference and seminars • Conduct school campaign and community meeting

3-3 International Training

The Project has a schedule foe international training, but is postponed to the extension period of Project. Dispatch of counterpart staffs to JICA's group training was carried out as follows:

1st Year: 1 person to Non Revenue Water Management Course
2nd Year: 1 person to the same as above
3rd Year: 2 persons to Water Works Engineering

SECTION 4 ARRANGEMENTS OF PROJECT OPERATIONS AND LESSONS LEARNED

4-1 Technical Aspects

4-1-1 Deployment of GIS and Distribution Network Experts

During the preparatory stage of PANI, it was considered that the existing CAD drawings of distribution network and customer database are readily available and reliable to proceed to develop NRW reduction plan. However upon commencement of the Project, it was revealed that CAD drawings have serious error on its coordinate system and customer database being maintained at Sales Division of CWASA can not indicate exact location of customers.

JICA immediately decided to deploy experts for GIS mapping/database and distribution network and procure various equipment such as work stations with GIS software, plotter. In addition, local consultants and survey assistance were also mobilized to process high resolution satellite images as base map to indicate distribution network and customer location.

The massive operation of GIS activities resulted to carry out intensive OJT to CWASA counterpart staffs to process various key information on GIS database/mapping. This activity is now deeply recognized key input to modernize operation and management of water supply service of CWASA.

4-1-2 Development of GIS Customer Database

As mentioned above, CWASA has more than 50,000 customer data, but not indicated on the map due to absence of accurate/reliable map. Introduction of GIS mapping could initiate mapping out of all customers on accurate map. Thus, customer data of Sales Division are now transformed as GIS database associated with maps.

4-1-3 Development of GIS Water Meter Database

In addition to the customer database, management and technical information of water meters have not been properly managed. In line with developing customer database, water meter database was also developed to indicate its location of installation together with historical background on repair/replacement.

4-2 Managerial Aspects

4-2-1 Deployment of Local Consultants and Survey Assistants

Introduction of GIS mapping and database development necessitated increase of manpower in the Project, while CWASA counterparts are not trained for this feature. Local consultants and survey assistances were then mobilized to form support team to smoothly carry out the OJT in both office and field.

Members of Action Team were continuously supported by these support staffs and attained requied techniques and skills.

4-2-2 Collaboration with Other On-Going Japan's ODA Projects

PANI was tasked to collaborate with Karnaphuli Water Supply Project, particularly "C-2 Transmission/Distribution Main Pipeline Construction Component." PANI already provided relevant technical data/information, such as cross-section profile of underground utilities which were obtained from test excavation of existing distribution network.

PANI will receive monthly progress information of C-2 Component and process it on GIS map, so that digital As-Built Drawing will be produced on GIS database/map and it will finally a vital tool for O&M activities of CWASA upon completion of the Project.

4-2-3 Information Exchange/Collaboration with Other Donors

PANI had a series of discussion with the World Bank Mission in the course of its project implementation. Major points of discussions were delineation of service area boundary of the World Bank's Modunaghat Water Treatment Plant Project and Karnaphuli Water Supply Project. Model Area of PANI is also one of focusing points in this respect.

4-2-4 Cooperation with Relevant Sector Agencies

PANI had close cooperation with sector agencies, particularly such agencies having underground utilities in Chittagong City. Karnaphuli Gas Company is one of them providing their drawing of gas pipelines. Through participation to the seminar on underground utilities, PANI is now providing technical guidance to this company to develop their own GIS map of gas pipelines. In the near future, information of underground utilities will be shared by these agencies concerned.

4-2-5 Public Campaign

Table 4-1 Public Campaign

Target Area	Activities
1 Ispahani Public School and College, Khlushi	Date: 11am-12pm., Sep. 26, 2011 School teachers: 5 persons Students: 150 persons
2 P.H Amen Academy Halishahor	Date: 12am-1pm, Sep. 29, 2011 School teacher: 7 persons Students: 90 persons
3 CDA School and College, Chandgaon	Date: 12pm-1pm, Oct. 9, 2011 Teacher**:** 7 persons Students: 300 persons
4 Agrabad Balika Biddaloy, Agrabad	Date: 10am – 11 am, Oct. 13, 2011 School teachers: 5 persons Students: 100 persons
5 Press Conference	Date: Mar. 15, 2011 Media: TV, Radio, Newspaper, 9 companies, 17 persons

SECTION 5 OTHERS

5-1 Steering Committee, Seminar, Workshop

5-1-1 SC

Steering Committee was held for two times as follows:

(1) 1st Meeting August 12, 20-10 at LGD

(2) 2nd Meeting December 21, 2011 at LGD

Both meetings were attended by representatives from LGD, CWASA, JICA and PANI Expert Team.

5-1-2 Internal Seminar of PANI

PANI had carried out several seminars/workshop internally for CWASA counterparts as part of technology transfer activities.

(1) Lectures to Action Team (Field Operation Group)

Following four counterparts were given lectures on June 21, 2010.

Table 5-1 Composition of Action Team (Field Operation Group)

Name of Trainee		Position in CWASA	Assigned Office
1	Nurul Abser	Assistant Plumber	MOD2
2	Jewel Barua	Assistant Plumber	MOD1
3	Jabed Khan	Assistant Plumber	MOD1
4	Nurul Kabir	Assistant Plumber	MOD2

Four days continuous lectures were given covering the following topics:

1) NRW Reduction
2) Basic Knowledge
3) Pipe Rehabilitation
4) Trial Device Operation
5) Pressure Measurement
6) Flow Measurement
7) Leakage Detection and Repair Work
8) Data Analysis and Evaluation of NRW Reduction Effect

(2) Lectures to Action Team (GIS Group)

Five counterpart staff of GIS Group were given continuous lectures since October 2010.

Table 5-2 Technology Transfer on GIS

Item	Contents
Target of Training	- Master level of basic operation of GIS software individually
Candidate	- 5 persons: (Minimum: 2 persons, Maximum: 5 persons)
Affiliation of a Candidate and Conditions of Basic Skill	- Affiliation of target is: Design Division (one person), MOD (two persons), and Sales Division (one person). - Candidate personnel is who can operate basics of CAD or who can operate database such as Excel of a spreadsheet).
Term	- The work period of the second phase from the middle of June, 2010 to March, 2011
Training Time	- Basically a full time arrangement of the personnel is required. In case of hard to be a full time assignment, a day half assignment at least is required to participate a training in consideration of daily personnel business.
Contents of Training	- Basic training of GIS operation (4 weeks about instruction by lessons and practice by operations manuals):
	- Lesson (1 week) about Understanding of GIS, Understanding of database, Understanding of GIS software and Understanding of CWASA GIS data
	- Practice(3 weeks) about basic operation of GIS software including map digitizing editing of figure, database entry and attribute editing, map projection and geometric correction, database operation and map drawing
	- Capability required to master: Understanding of GIS required for GIS output, Understanding of issues on CWASAGIS data and Understanding of basic operation of GIS software
	- Advance training producing the project output by OJT (Remaining period)
	- Practical work for production of GIS data about facility management by the OJT: Production of GIS data about distribution water pipe line network and consumer service connection and Facility management Form and GIS maintenance
	- Capability required to master: Map digitizing by screen digitizing, Editing for figure of GIS data, database edit, map projection transformation, operation of relational database, updating work of consumer service connection completion form data, overlay processing, cross tabulation and map drawing
Training Instructor	- Japanese GIS Expert, local GIS Expert, and other project staffs
Target Area for Training	- Zone3 for master of basic training, Zone2 and one of the pilot project areas for production of HIS data by the CWASA counterpart personnel.
Result to be Produced	- Updating of GIS data about main pipe network over 100 millimeters and related facilities - Updating of GIS data about service pipe network about service pipe, service meter and customer data - - Production of GIS data for underground utilities(Only Zone3 is managed by vector data but other zones are managed by display of map image)

(3) Lectures to **CWASA Senior Officers**

Intensive and continuous technology transfer could be commenced since August 2011 upon reorganization of Management and Action Teams. On Oct. 15, 2011, a special session focusing to seminar officers of CWASA was carried out based on the result of field survey and OJT to Action Team.

5-1-3 External Seminar

(1) Seminar on Underground Utilities

A Special Seminar on Underground Utilities was held to share information/experience of PANI. Chittagong Development Authority (CAD), Chittagong City Corporation (CCC), agencies concerned for underground utilities (power, gas, telecommunication), CWASA and media were invited.

Venue: Agrabad Hotel, Chittagong City
Date: January 11, 2011
Number of Participants: 125 persons

Table 5-3 Seminar Program of Underground Utilities

Time	Contents
10:00 - 10:30	Registration
10:30 - 10:50	Opening(National anthem & Prayer)
10:50 - 11:10	Opening Address by CWASA
11:10 - 11:20	Welcome Address-1 by JICA
11:20 - 11:30	Welcome Address-2 by CDA
11:30 - 11:40	Welcome Address-3 by CCC
11:40 - 11:50	Coffee Break
11:50 - 12:20	Overview of PANI Project & Underground Utilities (JET Team Leader: Mr. Hiroyama)
12:20 - 12:40	Outline of the Presentation (JET: Mr. Oba)
12:40 - 13:40	Presentation (Current Situation of Underground Utilities in Chittagong. And its Survey Procedure and Data Processing)
☞ 12:40 - 13:00	-Data Collection & Identification Field Verification Survey by GPS (Mr. Zahid)
☞ 13:00 - 13:20	-Test Pit Excavation (Mr. Mondol)
☞ 13:20 - 13:40	- Data Processing on GIS Mapping (Mr. Dalower)
13:40 - 14:30	Lunch Break
14:30 - 15:00	Finding Obtained from the Survey in Underground Utilities
15:00 - 15:30	Open Forum
15:30 - 16:00	Issues/Problems & Countermeasures toward the Effective and Efficient Management of Underground Utilities
16:00 - 16:30	Conclusion & Recommendations
16:30 - 16:40	Closing Address

(2) Final Seminar

Final seminar was held at the end of PANI operation.

Venue: Peninsula Hotel, Chittagong City

Date: May 23, 2012

Paqrticipants: 124 persons

Table 5-4 Program of Final Seminar

Time	Contents	Remarks
9:30-10:00 am	• Registration	Happy Chakma and Susmita Roy
10:00 am	• Seminar will Start	Kazi Nurjahan Shila, PRO & Asst. Secretary of CWASA And Rosemary Joydhar,Communication Specialist of PANI Project.
10:00-10:10 am	• National Anthem	All Participant
10:10 -10:20am	• Prayer/ Holy Quran Teloat	Name: Abdul kader
10:20 - 10:30 am	• Opening Address by CWASA	Name: Eng A.k.M Fazlullah Desig : Managing Director Chittagong WASA.
10:30 - 10:40 am	• Welcome Address 1 by JICA	Name: Hiroyuki TOMITA Desig: Senior Representative JICA Bangladesh Office
10:40-10:45 am	• Greeting Speech by the Mayor Chittagong City Corporation	Name: Al-haz M. Manjur Alam Desig: Mayor Chittagong City Corporation.
10:45 - 10:50 am	• Greeting Speech by the Chairman CDA	Name: Abdus Salam Desig: CDA Chairman.
10:50-10:55 am	• Greeting Speech by the Cheep Eng ,PDB	Name: Engr, Md Raisuddin Sarker Desig: Chief Engr, PDB
10:55-11:00 am	• Greeting Speech by the Director Telecom -1, BTCL	Name:Prabal Kumar Sil Desig: Director Telecom -1, BTCL
11:00-11:05 am	Greeting Speech by the MD Karnafuli GAS Distribution Co.,Ltd.	Name: Jameel Ahmed Aleem Desig: Managing Director
11:05-11:40 am	Coffee Break	
11:40am - 12:40 pm	Overview of PANI Project& Underground Utilities (JET Team Leader: Mr. Hiroyama)	Name: Mr. Masuomi Hiroyama Desig: Team Leader of PANI Project.
12:40 - 1:30 pm	• Lunch Break	

Table 5-4 Program of Final Seminar (Cont'd)

Time	Contents	Remarks
1:30 – 3:00 pm	• Technology Transfer in Pilot Project 1) Setting up of Pilot Project Area 2) Isolation of Pilot Project Area 3) Customer Survey to Identify location of customers, service connections and function of water meters 4) Leakage detection/repair 5) Replacement/new installation of water meter 6) Post evaluation of NRW reduction work output	Engr,Sayed Joinal Hossain Abedin Joy Leakage detection Asstt of PANI Project
3:00 – 4:30 pm	• Technology Transfer in Model Area Field Survey: 1) Field verification of distribution network 2) Test excavation to identify location of underground utilities 3) Household survey to identify customer locations and status of water meters • Database Development: 1) Introduction of High Resolution Satellite Images as base-map 2) Scanning/Overlay of existing drawings 3) Modification/correction of GIS map of distribution network 4) Development of customer database 5) Development of water meter database • Collaboration with Karnaphuli Water Supply Project by exchanging technical information on GIS database and map	Part-1 Engr, Aourongojeb Mondal Distribution Network Survey or of PANI Project. Part-2 1) Engr.Saiful,Asst Engr.Chittagong WASA 2) Engr.Saiful,Asst Engr.Chittagong WASA 3) Engr,Md, Dalower Hossain GIS Expert of PANI Project 4) Kazumi Suwabe GIS Expert ,JICA Expert Team
4:30 – 4:50 pm	• Summation	Mr. Masuomi Hiroyama Team Leader of PANI Project.
4:50 - 5:00 pm	• Closing Address	Engr. A.K.M. Nazrul Haque Project Director、CWASA

5-2 Provision of Equipment

In the course of Project, following equipment were procured and provided to CWASA.

Table 5-5 List of Procured Equipment

Name of Equipment		Quantity	
(1)	Metal Detector	2	Sets
(2)	Water Pipe Detector	3	Sets
(2)	Leakage Co-relater	2	Sets
(3)	Listening Rod	8	Sets
(4)	Portable Ultrasonic Flow Meter	8	Sets
(5)	Leak Detector	1	Sets
(6)	Ultrasonic Flow Meter	8	Sets
(7)	Pipe threader	1	Set
(8)	GPS Receiver (High Sensitivity)	4	Set
(9)	GPS Receiver (Medium Sensitivity)	1	Set
(10)	High Resolution Satellite Images (Wordld View 1) (1:5,000)	1	Set
(11)	A3 Multi-function Copier	1	Set
(12)	GIS Work Station	2	Sets
(13)	Plotter	1	Set
(14)	GIS Software	1	Set
(15)	Van (for survey work)	1	Unit

Appendices

Appendix-1 Detailed Description of Project Activities

1.1 Basic Approach for Project Implementation

1.1.1 Overall Strategy for Project Implementation

The Technical Cooperation Project with the supreme objective is to reduce NRW in Chittagong City and it is expected to further reduce NRW in 2016 from the time of project termination. In this connection, strengthening of institutional set-up and adherence of technical capability are indeed important so as to continue NRW reduction work after completion of this Technical Cooperation Project in 2012.

1.1.2 Capacity Development for NRW Reduction Work of CAWASA and Appointment of Counterpart Staff (C/P)

CWASA had previously developed NRW Reduction Program under the World Bank project, but the program was not implemented yet. JICA had also dispatched Experts and provided with leakage detection devices, but such equipment had not been fully utilized. NTRW reduction is less cost activity in comparison to construction of new water supply facility, when water supply capacity and revenue improvement are sought. Due to the lack of skilled staffs and technical expertise associated with insufficient will of CWASA resulted significant delay in achievement of NRW reduction in the past.

The Technical Cooperation Project therefore aims at technology transfer to CWASA staffs and attain adherence of continuous implementation of NRW reduction activities, by dispatch of JICA Experts and collaboration with CWASA staffs from planning to implementation of pilot project.

1) Organization of NRW Reduction Management Team and Action Team

CWASA will appoint appropriate counterpart staffs who have sufficient patience and strong will to absorb required expertise for NRW reduction.

2) Daily Routine Work of NRW Reduction

The NRW reduction work is one of routine activities to be undertaken by CWASA through the future. Through implementation of this technical cooperation project, visible output of NRW reduction will be obtained and shared with CWASA staffs.

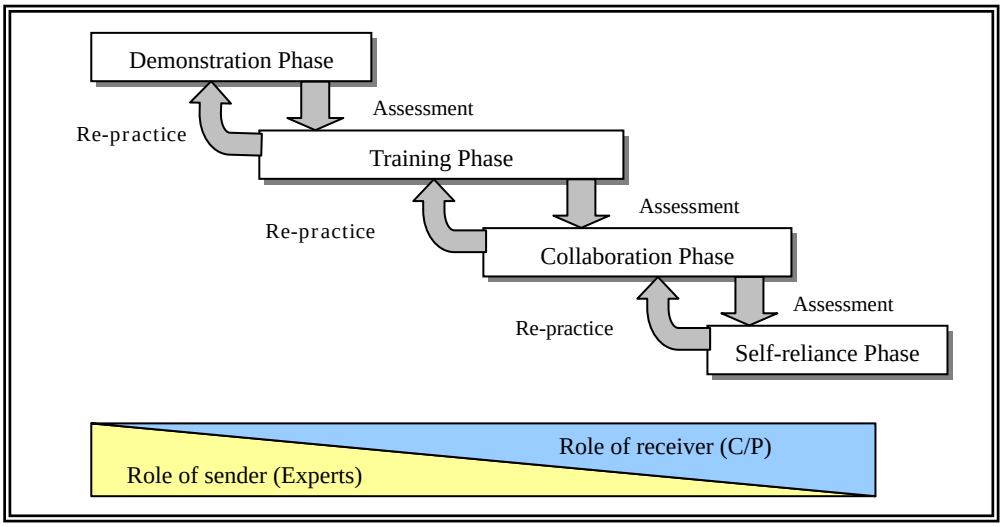


Figure 1-1 Image of Phased Capacity Development in Technical Cooperation

1.1.3 Selection of Pilot Project Areas

Following five (5) criteria are considered in the selection of Pilot Project Area.

Table 1-1 Selection Criteria of Pilot Project Area

Criteria		Description
1	Continuous water supply is available	24 hours continuous supply is desirable or considerably long time supply with reasonable water pressure is available. For smooth implementation of leakage survey, less noise and vibration in night time with appropriate water supply conditions.
2	Sub-division to form small service area can be made smoothly	Sub-divided area will be isolated with other areas by installation of valves and water flow will be measured by flow meters at strategic locations and water meters at each consumers. Ratio of non-functioning meters shall be minimal.
3	Water meters are properly installed to consumers	Functioning water meters shall be secured in the pilot project area, otherwise temporary water meter shall be installed at consumers.
4	Less traffic	Pilot project includes installation of isolation valve and flow meters in the streets and water meters at consumers. For smooth implementation of these works, less traffic is desirable.
5	Exemption of other project area	Areas being planned for replacement of distribution lines shall be excluded from the pilot project.

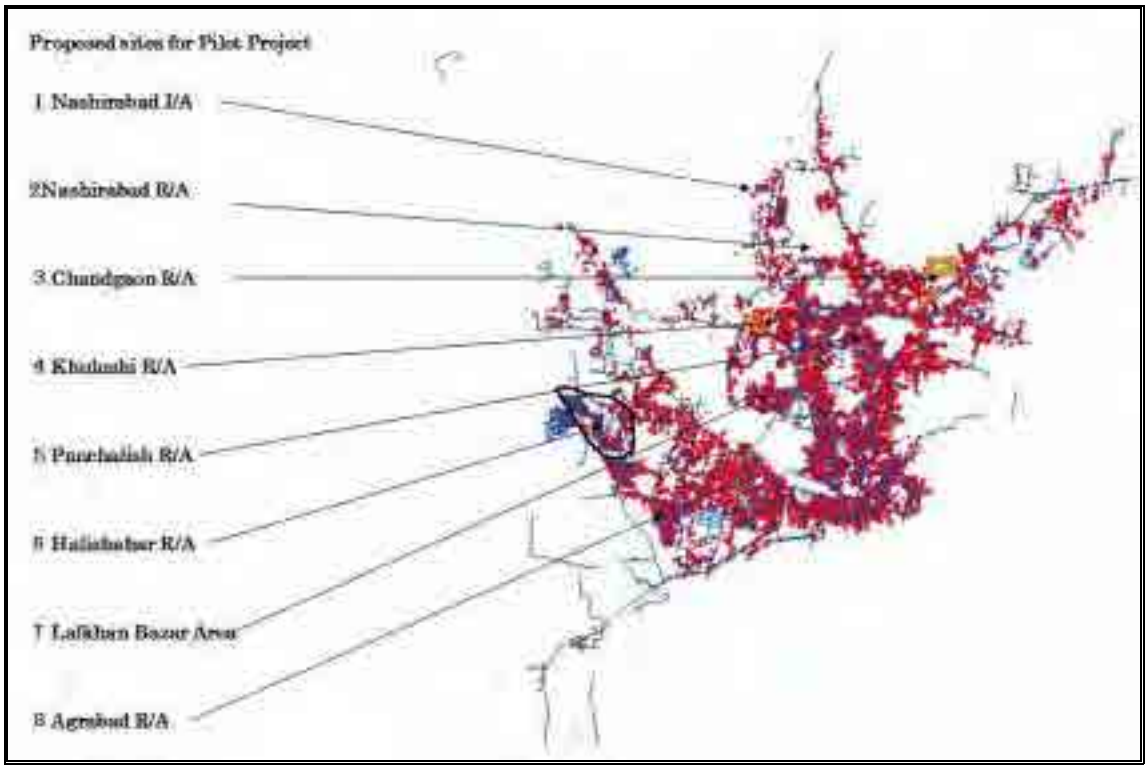


Figure 1-2 Proposed Pilot Project Areas

1.1.4 Basic Steps of Pilot Project

1) Collection and processing of existing information and data
2) Isolation work of pilot project area
3) Leakage survey including technology transfer to CWASA C/Ps through OJT
4) Repair work of leakage and service connection and activities on non-physical losses with OJT
5) Mater reading (monitoring of NRW ratio)

1.1.5 Basic Steps to Develop Distribution Network Drawing by GIS

NRW reduction techniques and skills transferred by the PANI shall be adhered and carried out permanently by CWASA. Maintenance of various basic data/information of distribution network, service connections, water meters as well as customer data is deemed indispensable. However there were existing technical problems about systems of GIS and CAD, and issues of capacities about human resources as shown in Table 1-2.

Table 1-2 Present Issues and Problems of CWASA

Category	Actual Condition	Issue
GIS, CAD System	• No GIS Data	• Restoration of GIS data in 1998
	• Insufficient update of CAD data	• Recompilation of data
	• No updating record since 1998	• Updating of map data since 1998 and Updating of geographic features
	• Mismatching of pipe network among maps	• Unification of base map to GIS
	• Problem of map projection	• Establishment of Geo-referencing system
	• Fault caused by different data structure between CAD and GIS: Text layer in CAD and its data handling to GIS	• Editorial work for restoring GIS data: • Technical capacity, hardware, software, system, human resource, budget • Restoration of GIS data • Conversion from CAD to GIS • Utilization of database
	• Problems caused by figure structure: • Line fragmentation, Symbol object(Double line, Circle point, Network Junction), No link with customer data, Problems of data in Distribution System (unknown pipe section and unknown data of facilities)	• Cleaning of fragmentations • Establish of pipe line network: Main Pipe, Service Pipe、Service Meter • Link of customer data and figure • Updating to present customer • Requirement of field verification • Urgent recompiling of pipe line network • Maintenance of facility management form • Switching to digital archive for paperless management • Database development and system development • Utilization of GIS to Facility Management
Human Resource	• Shortage of development capacities: • CAD, Mapping, Database, GIS(Hardware &Software), human resource, organization	• Capacity development and strengthen of organization for Cad Mapping, Database and GIS for Asset management

Considering current situations and issues, the NRW reduction work in pilot project areas was implemented utilizing GIS as follows:

- Preparation of GIS data utilizing existing data resources
- Updating of related data and field verifications: location and relevant technical data of distribution network and service connections
- Editing for data faults relating to data structures and data conditions
- Strengthening of CWASA capacity relating to CAD/GIS/Database

Capacity for CAD/GIS was quite insufficient in CWASA, so the arrangement of distribution network affecting the entire project management was an urgent issue to prepare basic mapping in pilot project areas in earlier stage.

Thus, the Project dispatched Japanese GIS Expert whose task arranges distribution network data quickly and transfers the technologies to counterparts. A CAD operator was locally employed to support the JICA Expert.

1.2 Basic Policies of Project Operation

1.2.1 Mobilization of human resource and local resource

Mobilization of CWASA staffs was maximized in accordance with the Minutes of Discussions between CWASA and JICA for effective transfer of technology. In this connection, NRW Reduction Management Team and Action Team were formulated through close coordination with CWASA Project Director and concerned offices.

1.2.2 Collaboration with Other Projects

With the use of JICA's ODA Loan, "Karnaphuli Water Supply Project (KWSP)" is being implemented. Due consideration was given for the maximum attainment of harmonious collaboration of JICA's technical cooperation and financial assistance among on-going projects. For instance, field survey results of PANI, i.e. maps and data of underground utilities, were provided to KWSP to assist its construction activities of transmission and distribution mains.

1.2.3 Information Exchange with Other Donors

KOICA assisted "Master Plan and Feasibility Study on Water Supply and Waste Water Treatment for Detailed Planning of CDA" was completed during PANI operation. The World Bank is also starting Modunaghat Water Treatment Plant Project.

In carrying our PANI Project, close communication and information exchange were taken up for smooth implementation of project activities to avoid unnecessary overlapping each other.

1.2.4 Establishment of Close Cooperation with Relevant Sector and Organizations

The JICA Expert Team maintained close cooperation with LGD, DPHE, ERD, CWASA and other relevant authorities, either directly or through CWASA. The JICA Expert Team also supported CWASA to establish Steering Committee (SC) consisting of JICA Bangladesh Office、Japanese Experts, and nominated members by relevant authorities for the project. The SC was held, at least, once a year and as needed to attain smooth implementation of the project.

1.2.5 Public Relations Activity (P/R Activity)

In order to attain proper understanding of citizens on project objectives and activities of PANI, public campaign with the use of public media, internet and distribution of leaflets was carried out jointly by CWASA and JICA Expert Team,.

1.3 Methodology of Project

PANI project activities were carried out in accordance with the work flow for the duration of four Japanese fiscal Years as follows:

1st year:	From July 2009	to	March 2010
2nd year:	From July 2010	to	March 2011
3rd year	From June 2011	to	June 2012

1.3.1 Preparation of Work Plan

Based on the existing data, basic approach, methodology, contents and schedule will be examined.

1.3.2 Preparation of Inception Report

Inception Report (IC/R) including basic approach, implementation method and procedure, schedule and items to be covered by counterpart will be prepared.

1.3.3 Discussion on Inception Report

Explanation and discussion on Inception Report (IC/R) will be carried out with authorities concerned.. Based on the series of discussions, implementation plan will be finalized.

1.3.4 Setting-up of NRW Reduction Management Team

NRW Reduction Management Team has primary responsibility to prepare the NRW reduction Provisional Long Term Plan and the Annual NRW Reduction Work Plan. The Management Team shall be vested a capacity on decision-making in order to arrangement of future finance, material and equipment supply, and personnel assignment.

- NRW Reduction Management Team will be composed by CWASA's existing key staffs.
- Corroborate with existing organization of CWASS, particularly with Chief Engineer (CE).

- Cooperate with NRW Reduction Action Team to practical and sustainable project implementation.

1.3.5 Review of existing data of NRW Reduction

NRW reduction of CWASA is mainly focused to repair of leakage appearing to ground surface, installation of new water matter, replacement of malfunctioning water meter, and procurement of required materials, etc. Review results of these activities will be reflected upon preparation of NRW Reduction Provisional Long Term Plan.

- Ratio of NRW: definition of NRW, volume of distributed, consumed and accounted-for-water, revenue data, etc.
- Implementation set-up of NRW reduction: offices in charge of service connections and leakage repair, work force and their level of skill, logistics, etc.
- Leak detection: Leak detection accomplishment, work classification by direct undertaking/contractual work, equipment and materials applied, work record, etc.
- New service connection: Site inspection, type of water meter, installation method, work manual, etc.
- Malfunctioning water meter: Confirmation procedure of malfunctioning, plan of replacement, operation of workshop including calibration, etc.
- Others: Procurement/supply of water meters and other materials, criteria to evaluate local contractor, technical training, and information of NRW reduction for relevant project.

1.3.6 Preparation of Provisional NRW Reduction Long Term Plan

A Provisional NRW Reduction Long Term Plan shall be drawn up in cooperation of JICA Expert Team and CWASA NRW Reduction Management Team. In preparation of Long Term Plan, following steps may be taken up:

1) Provisional sub-zoning plan shall be established based on the existing distribution network.
2) Selection of target area for NRW Reduction Work by type of activity, i.e. leakage of distribution/service connections, illegal connections, replacement of defective water meters, etc.

3) Preparation of Long Term Plan consisting of time table, budgetary requirement, required equipment and materials, prioritization of field work. Due attention will be paid to on-going major projects, such as Mohara and Karnaphuli Water Supply Project in view of their scope of work and area to be covered for new transmission/distribution lines.

The Long Term Plan may consist of:

1) Main and sub-main transmission/distribution lines as major work to be implemented by contractor
2) Replacement of transmission/distribution lines (Asbestos Cement Pipe, AC pipe), where Japanese Grant Aid Project is proposed.
3) NRW reduction in residential and commercial areas.

1.3.7 Preparation of NRW Annual Work Plan

NRW Reduction Annual Work Plan shall be drawn up by CWASA NRW Reduction Management Team in accordance with its Long Term Plan. This annual work plan shall be prepared in advance to secure necessary budget in the succeeding year for continuous operation including pilot area activities.

Provision of piping materials for new service connections, which are currently purchased by applicants, shall be taken into account to attain reduction of NRW.

Following work items shall be incorporated in the annual plan:

1) Selection of target area for NRW reduction work
2) Scope of work for NRW reduction (field survey, type of NRW reduction work, magnitude of work, etc.)
3) Cost estimate
4) Procurement plan
5) Implementation schedule

1.3.8 Monitoring of NRW Reduction Annual Work Plan

NRW Reduction Annual Work in pilot project area was monitored in view of its progress and achievement. This monitoring was carried out through out the course of PANI until May 2012.

Monitoring Items

1) Comparison with Annual Plan and actual implementation status,
2) Budget allocation at CWASA
3) Deployment status of CWASA staffs
4) Logistic supports (procurement, supply and storage of piping materials and water meter, etc.)
5) Number of undertaking (new service connections, leakage repair, removal/formalization of illegal connections, NRW reduction ratio)
6) Public relation activity

1.3.9 Selection of Pilot Project Area

Selection criteria of Pilot Project Area are summarized in Table 1-3.

Table 1-3 Selection Criteria of Pilot Project Area

Item	Criteria
Size	One (1) Pilot Project Area will consist of 300-500 connections (average of 400 connections) with following conditions: ・ Excludes south part of Chittagong City, where Asbestos Cement Pipe is used, but possible collaboration with proposed Japanese Grant Aid Project will be considered. ・ Includes at least 2 project areas covered by the World Bank project. ・ Progress of PANI Project in terms of adherence of NRW reduction technique, budgetary arrangement at both CWASA and JICA.
Water Supply Situation	・ water supply service period (sypply period in a day, night time supply), water pressure, leakage condition, accident/trouble history
Isolation Work	・ Technical information (distribution network and location of valves, water meter, public faucet, etc.) ・ Flow measurement
Service Connection and Water Meter	・ Service connection (number, diameter, location), water meter (presence and operational status), public faucet (location, number of users), fire hydrant
Surrounding Environment	・ Traffic condition (traffic volume in day/night time) ・ Public relations (public campaign)
Budget	・ Budgetary arrangement at both CWASA and JICA, ・ Progress of concerned project implementation

In selecting Pilot Project Area, such areas covered by the World Bank project, i.e. Agrabad Residential Area (R/A) and Nashirabad Industrial Area (I/A) will be considered as candidate area from the view points of available data and distribution system.

1.3.10 Set-up CWASA NRW Reduction Action Team

NRW Reduction Action Team was organized by CWASA to implement field survey, situation analysis, preparation of work plan and field operation of NRW reduction under the guidance of JICA Expert Team. Members for this Action Team was nominated from among various offices of CWASA covering technical, administration and financial management, where members have their own assignments in daily activity. In this regard, Action Team members was mobilized in accordance with the work plan corresponding to their role and assignment for NRW reduction.

1.3.11 Mapping work for Pilot Project Areas by GIS

Data resources of CAD and GIS in CWASA and planning materials for rehabilitation programs in KOICA and the World Bank were utilized. A work flow of this particular activity is shown below:

(1) Mapping work for pilot project areas by GIS

Mapping for base line survey to identify service connection by GIS is carried out in a pilot project area where customers about 300 to 500 are located. Pilot project area was shall be discussed with CWASA in order to select five (5) pilot project areas including two (2) areas where the World Bank implemented and other three (3) areas where the project selects. The existing drawings of proposed Pilot Project Areas are shown in Figure 4-5.

The workflow of mapping consists of the following steps as shown in Figure 4-6.

- Preparation for collection of data and materials required for mapping;
  Existing Record Drawing Map, AUTOCAD data, As-Built Drawing of water supply facilities, materials of service connection form and maps, present customer database as of July in 2009,
- Archive entry and database entry of service connection form,
- Consumer application form, cadastral map being prepared by Land Registry Department (so called BS map) and sketch map for service connection,
- Complete of customer database for GIS,
- Data editing of existing distribution network: restoration of CAD data to GIS in 1998
- Updating 1: water supply map verified by of As-Built Drawing and updating attribute
- Updating 2: water supply map updated by mapping of water meter and service connection and consumer.
- Link of data with mapping data and customer data
- Confirmation and verification in the field: verification of facilities by hand held GPS or offset surveying
- Complete of pipe line network
- Preparation of GIS database supporting for Advancing NRW

1 Nashirabad Industry Area

2 Nashirabad Residential Area

3 Chandgaon Residential Area

4 Khulshi Residential Area

5 Panchalish Residential Area

6 Halishahar Residential Area

7 Lalkhan Bazar Area

8 Agrabad Residential Area

Record Drawing Map as a Base Map

Figure 1-3 Existing Drawings in Proposed Pilot Project Area

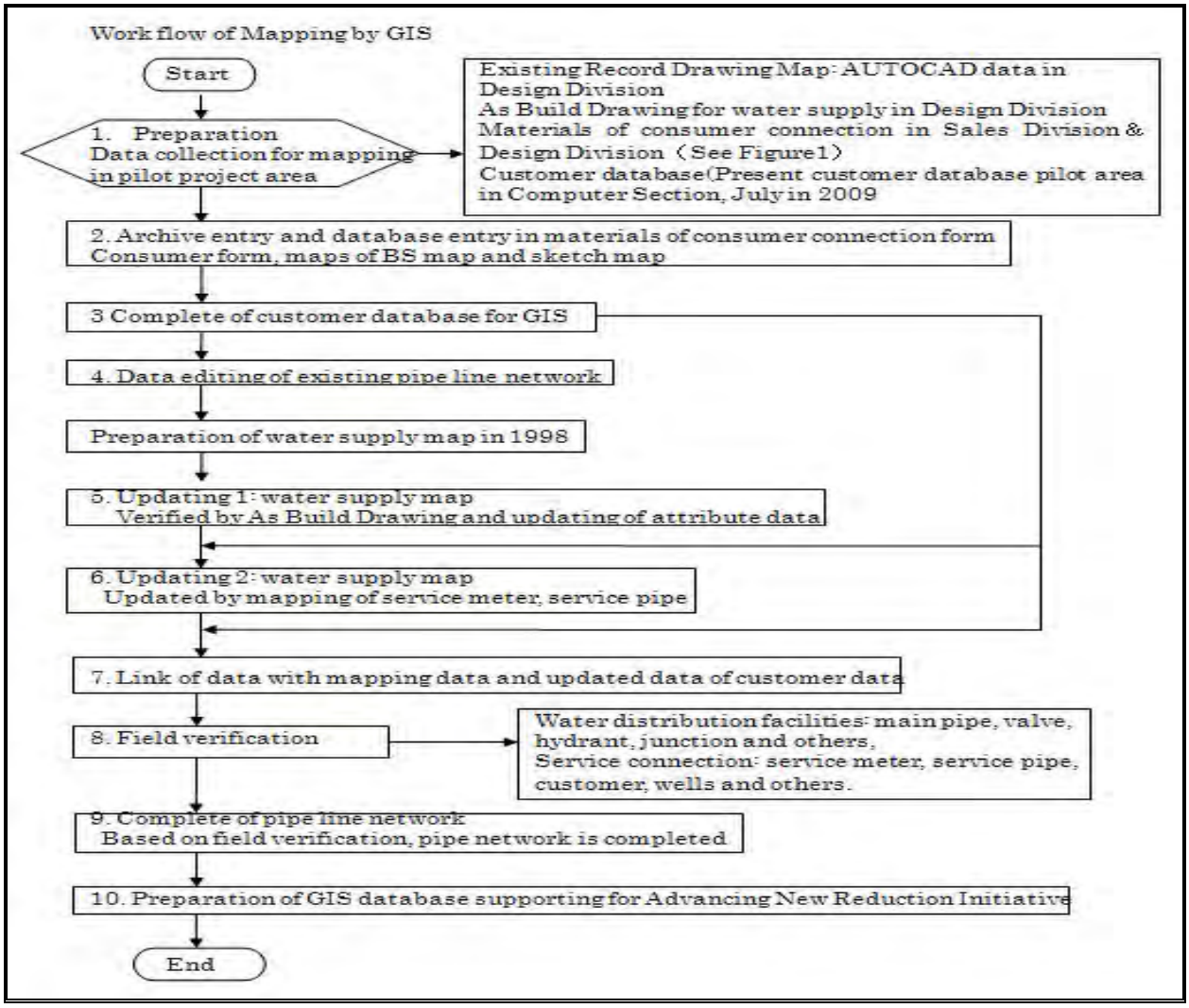


Figure 1-4 Flow of Mapping Work

(2) Preparation and collection of data

The existing data were collected as shown in Table 1-4.

Table 1-4 Collected Data

Item	Object
Existing CAD map	Confirmation of CAD Map in pilot project area in the CWASA backup data
Existing maps and forms for distribution network and service connection	Collection of As-Built Drawing and management form in water supply (distribution pipeline section and its properties), location of valves, hydrants, junction points, washout, etc.
Application form of service connection	Archiving and database preparation based on paper form and maps for service connection: paper form of service connection, sketch map for service connection, BS map
Customer data	Customer data for billing collection

(3) Preparation of Distribution Network Drawing

Updated distribution network drawing in pilot project areas were prepared by mapping in GIS through editing CAD drawing data and field verifications based on CWASA data.

(4) Establish update system for distribution network drawing

Based on arrangements of distribution network drawing and data to be prepared as described in the above, additional data acquired in pilot project area were encoded and integrated on GIS database.

In order to correspond to adequately update data consisting of newly confirmed information and surveyed in the pilot project area, additional information available from daily operation in the succeeding work phases, a concept of system and its rule for data maintenance was be prepared in the first phase.

(5) Preparation of database for NRW reduction work

Throughout data collection in GIS mapping, maintenance and production of database were deemed indispensable to promote rationalization of NRW reduction work.

Application procedure of GIS mapping for service connection was firstly established by NRW program in the World Bank Project and systems of water supply and billing/collection are being operated systematically, but there are issues for paperless management for modernization in other divisions in CWASA, except customer management database in billing/collection. The solution for this rationalization which is indispensable to archive and database preparation/update was proposed through the pilot project.

1.3.12 Isolation work of pilot project areas and initial survey on current situation of NRW

Isolation work took place to “isolate” pilot project area from other service area in terms of water distribution. Location and function of existing valves were confirmed on-site including placement of new valves required for execution of pilot projects. Installation of new valves was undertaken by NRW Reduction Action Team under guidance/supervision of JICA Expert.

Following the isolation work, initial survey was carried out by the said Action Team to confirm present status of NRW in respective pilot project areas. In the course of initial survey, various survey instruments were applied and OJT for the Action Team was carried out repeatedly.

Table 1-5 Isolation Work and Initial Survey in Pilot Project Area

Item	Content and items to be studied
Isolation Work	・ Confirmation of water flow, direction and volume, ・ Confirmation of valve location and size ・ Identification of new valve installation location (working condition for installation, surrounding environment, future usage in distribution control) ・ Identification of flow measurement point
Initial Survey of NRW	・ Flow measurement (inflow volume to pilot area, night time flow, flow direction) ・ Estimation of leak volume ・ Water consumption data (identification of illegal connection) ・ Ground surface leakage (historical data of leakage) ・ Public faucet (location, type and usage) ・ Fire hydrant

Difficulty in measurement of the minimum flow in the night time was anticipated due to water supply rationing, since many consumers keep faucet opened to store drinking water (refer to Figure 4-9). This consumers' behavior subsequently caused further difficulty to estimate NRW in the target area. When the actual measurement of the minimum night time flow was not practical, NRW was estimated by the measured total inflow volume and the measured water consumption from meter reading refer to Figures 2-6 and 2-7.

Total Inflow Volume（ΣF） ＝F1＋F2+F3・・・・・
Accounted-for-Water（ΣM） ＝M1+M2+M3+・・・・
Unaccounted-for-Water (NRW) ＝ΣF－ΣM

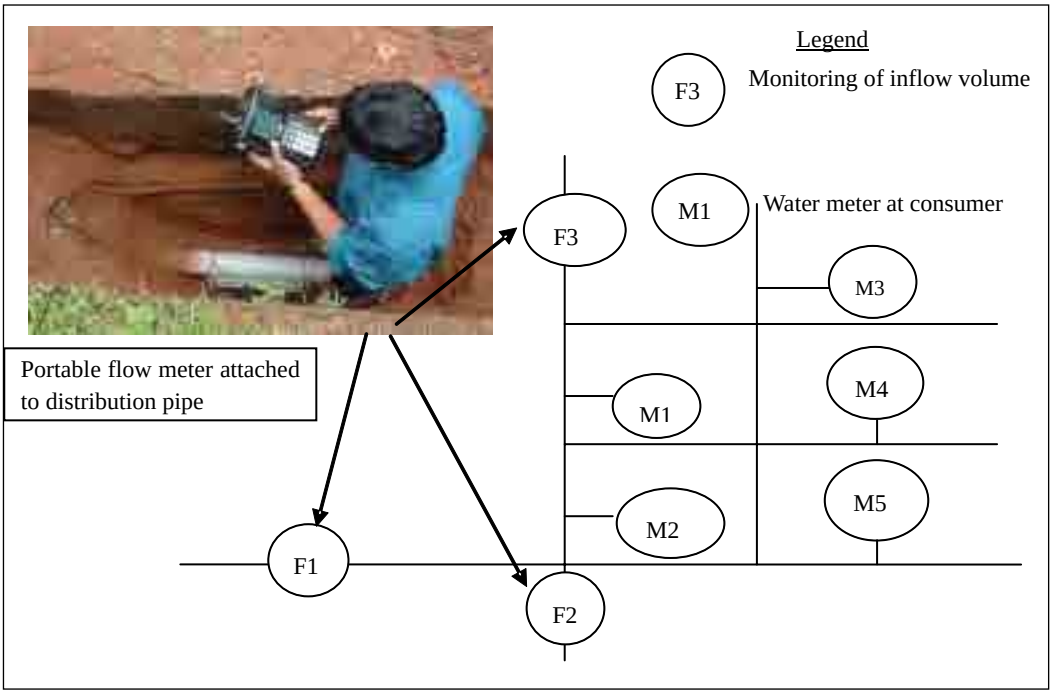
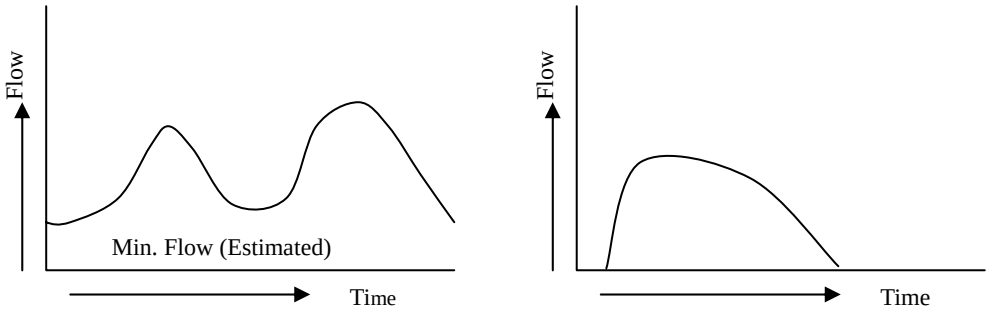


Figure 1-5 Flow Measurement Model



Typical view of flow rate by time in 24 hours continuous supply

Typical view of flow rate by time under rationed supply

Figure 1-6 Typical View on Hourly Fluctuation of Flow Rate

1.3.13 Implement public relations activities

It has been reported that there are many cases of illegal connections and arrears of water bill. Public campaign to consumers was deemed indispensable to attain awareness to delinquent water bill payment, prohibition of illegal connection and appropriate use of supplied water.

(1) Overall work plan for public relations activities

Public relations activities were carried out not only directly to consumers, but also through media. The first year of PANI focused onto preparation of detailed work plan and information dissemination materials and their implementation took place from second year. General idea/concept is summarized in Table 1-6.

Table 1-6 General Idea/Concept of Public Relations Activities

Activity	Target	Subject Issues	Implementation Term/Timing	Method
1. Direct PR activities to residents in Chittagong	Residents living in Pilot Project Area	・ Objectives of PANI Project ・ Introduction of on-going activities being taken up by CWASA and JICA in PANI Project ・ Request for understanding and cooperation to PANI Project	2nd - 3rd year During every A water supply activities, all 5 times	Distribute flyers
	Residents living in Chittagong	・ Remind the attention to illegal connection; steal water, prevention for non-payment, save water, meter failure, report of leaked water, etc. ・ Introduction of on-going activities being taken up by CWASA and JICA in PANI Project	2nd-3rd year, once for each	Distribute flyers
	Elementary school students in Pilot Project Area	・ Introduction about water conservation, importance of sanitary ・ Introduction of on-going activities being taken up by CWASA and JICA in PANI Project	2nd - 3rd year, During every A water supply activities, all 5 times	Presentation at elementary schools
2. PR activities through media resources	Citizen of Bangladesh	・ Introduction of on-going activities being taken up by CWASA and JICA in PANI Project	2nd - 4th year, Once/year	TV and radio
	Citizen of Bangladesh and Japan		2nd - 4th year, renewal as needed	Website
	Residents in Chittagong	・ Remind the attention to illegal connection; steal water, prevention for non-payment, save water, meter failure, report of leaked water, etc. ・ Introduction of on-going activities being taken up by CWASA and JICA in PANI Project	2nd – 4th year	Newspaper

(2) Implementation of public relations activities

i) Distribution of flyers in Pilot Project Area

Flyers were designed as A5 size for 8 pages written in Bengali language. Each Pilot Project Area was provided at 500 flyers. Distribution of flyers was undertaken by the Action Team through visiting each household. Briefing to meter inspector, etc. was also arranged prior to actual distribution of flyers.

ii) Distribution of flyers in Chittagong City

Flyer (10,000 copies, Bengali language) was prepared and distributed in 2nd and 3rd year of project operation. An English version was also prepared for distribution as needed.

iii) Presentation to elementary school

Preliminary education to children for proper usage of water and sanitary behavior associated with water conservation, prohibition of illegal connection, prevention of leakage/wastage was taken up to elementary schools in Pilot Project Area. Materials were prepared in both English and Bengali languages.

To maximize campaign impact, attention of media was called during school presentation.

iv) Mobilization of media (TV and radio)

Exposure of project operation to public media was arranged from 2nd year.

1.3.14 Annual Reporting and SC Meeting

Annual implementation result and achievement were reported to SC.

Appendix-2 Development of GIS Database

1. Introduction

Main activities to develop GIS database cover instruction of GIS training and activity report in the seminar. There are activities in completion of GIS databases about production of database in Test Pit Excavation Survey which was carried out until the second year of the project, and completions of GIS databases in the Pilot Areas and the Model Area. In the instructions of GIS training, basic training about operation of GIS software was carried out against nine (9) counterparts by using training text and a draft document of Terms of Works which were prepared in the second year. In order to report GIS activities in the seminar, counterparts were instructed about contents of their presentations regarding to technology transfer on GIS and the achievements in the project were reported to participants in the seminar.

2. Completion of GIS database

2.1 Preparation of database for Test Pit Excavation Survey

Test Pit Excavation data was classified into relational databases in each survey item and GIS data according to the report of Test Pit Excavation which was implemented in the second year, and the databases were compiled in GIS system which could make each data to display and to refer. The detail of database preparation is shown in ANNEX1: PRODUCTION OF TEST PIT EXCAVATION DATABASE. GIS data to show a Test Pit Excavation site was mutually linked to databases in each survey items. Test Pit Excavation data is expected to make the Operation and Maintenance utilize on Facility Management in CWASA. Examples of Test Pit Excavation database is shown in Figure2.1.

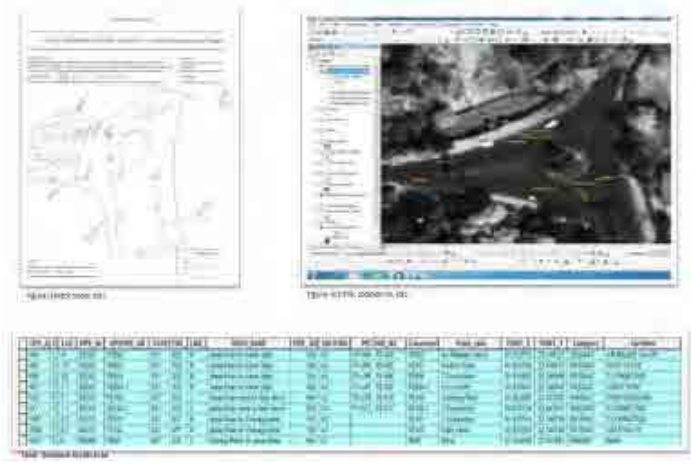


Figure2.1a Survey form at Utility Crossing Point in thePipeline Survey

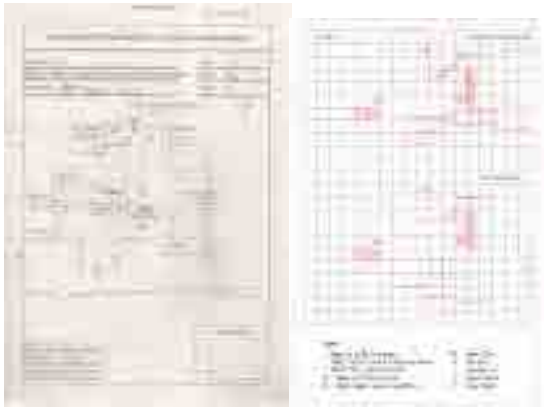


Figure2.1b Sketch Drawings and Cross-section Portray in Test Pit Excavation

2.2. Completion of GIS databases

(1) Completion of GIS databases in the Pilot Areas

GIS databases in five (5) Pilot Areas were completed with including updating of data on pipeline network in accompany of completions of field verification surveys for leakage water and replacement works of water meters in the NRW management by Action Team. Numbers of Service Connections in the Pilot Areas is shown in Table2.1.

Also billing collection data as an indicator of the NRW measure was verified about irregularity in meter reading data since 2009 until 2012, and the faults of monthly records were modified by re-adjustment in tabular data. Based on the result, re-calculation of monthly water consumption and monthly billing data were prepared to supply the monitoring data of the NRW measures.

Results of GIS databases and bill collection data in each pilot area are shown in from Figure2.2 to Figure2.6 as follows:

- Pipeline network map: line map
- Pipeline network map on overlay of satellite image: Line map displayed on satellite image
- Underground utility line map
- Time series map of water consumption volumes: bar charts of water consumptions for five (5) months, data is compiled by two (2) months data before meter replacement and two (2) months data after the replacement
- Same map of monthly bill in the above.

Table 2.1 Numbers of Service Connections in Pilot Project Areas

Pilot area	Khulisi	ChandgaonA	Chandgaon B	Agrabad	Halishahar
Numbers of Service Connection: 1,255	174	218	506	220	137

Figure2.2 GIS OUTPUT IN KHULSHI AREA

Figue2.2a Pipeline network (Line map)

Figure2.2b Pipeline network on satellite image

Figure2.2c Underground Utility Map on satellite image

Figure2.2d Monitoring of Water Consumption(5 months)

Figure2.2e Monitoring of bill collection(5 months)

Figure2.3 GIS OUTPUT IN CHANDGAON-A AREA

Figue2.3a Pipeline network (Line map)

Figure2.3b Pipeline network on satellite image

Figure2.3c Underground Utility Map on satellite image

Figure2.3d Monitoring of Water Consumption(5 months)

Figure2.3e Monitoring of bill collection(5 months)

Figure2.4 GIS OUTPUT IN CHANDGAON-B AREA

Figue2.4a Pipeline network (Line map)

Figure2.4b Pipeline network on satellite image

Figure2.4c Underground Utility Map on satellite image

Figure2.4d Monitoring of Water Consumption(5 months)

Figure2.4e Monitoring of bill collection(5 months)

Figure2.5 GIS OUTPUT IN AGRABAD AREA

Figue2.5a Pipeline network (Line map)

Figure2.5b Pipeline network on satellite image

Figure2.5c Underground Utility Map on satellite image

Figure2.5d Monitoring of Water Consumption(5 months)

Figure2.5e Monitoring of bill collection(5 months)

Figure2.6 GIS OUTPUT IN HALISHAHAR AREA

Figue2.6a Pipeline network (Line map)

Figure2.6b Pipeline network on satellite image

Figure2.6c Underground Utility Map on satellite image

Figure2.6d Monitoring of Water Consumption(5 months)

Figure2.6e Monitoring of bill collection(5 months)

Figure2.7 GIS OUTPUT IN MODEL AREA

Figue2.7a Main pipes verified by GPS Survey data

Figure2.7b Test Pit Excavation sites in Zone3.

Figure2.7c result of Service Connection Survey in Zone3(5,580 cons)

Figure2.7d Annual water consumptions in 3 years in Zone3

Figure2.7e Averaged water consumptions in each sub zone in Zone3

(2) Completion of Service Connection database in Zone3 of the Model Area

GIS database in Service Connection was completed, based on the results of field verification survey for Service Connections about five thousand and five hundred fifty-eights (5568) connections which Action Team conducted in Zone3 of the Model Area. And also irregularity of meter reading data in each Account was verified in bill collection data and re-calculation of monthly water consumption volumes and monthly water bill were done as well as those in the Pilot Areas. In order to show the result of GIS databases by using Service Connection data, bill collection data and thirty two (32) sub-zones in Zone3, zone maps were prepared to show the present situations of the NRW in GIS training as follows:

- Annual water consumptions for three (3) years (since 2009 to 2011)
- Averaged annual water consumption volumes per connection in 2009

Results of GIS database in the Model Area are shown in Figure2.7.

(3) Revision of a draft document about Terms of Works for technology transfer

A draft document about Terms of Works prepared in the second year was revised in the activity of the third year. The major changes were to add a road map for production of Test Pit Excavation database, to add contents of work details in production of GIS databases and those of GIS data in Leakage Survey. The detail is referred to APPENDIX: TERMS OF WORKS VERSION2. Terms of Works consists of twelve (12) roadmaps show in Table2.2 and Figure2.8.

Table 2.2 Item of Road Map

Road Map	Contents
ROADMAP1	Compiling GIS Datasets to Restore Initial Data at year 1998 from CAD Drawing Files with Georeferencing in ROAD MAP2
ROADMAP2	Transform to make CWASA Coordinate System shift to a general coordinate system of WGS1984 and BTM(Bangladesh Transverse Mercator)
ROADMAP3	Compiling Existing Relational Databases of Service Meter & Customer with Updating
ROADMAP4	Compiling Database of CSCCR
ROADMAP5	Compiling Customer Data and Monthly Billing Data
ROADMAP6	Compiling Existing As Built Drawing Maps
ROADMAP7	Compiling Building Survey Data
ROADMAP8	Compiling Field Verification Survey data To Update GIS Datasets in the Model Area
ROADMAP9	Compiling GIS Datasets of the Underground Utility Map
ROADMAP10	Compiling Field Verification Data of Pipe Survey and Pipe Leakage Survey in the Pilot Project Areas
ROADMAP11	Compile NRW Databases to support Monitor & Action for the NRW
ROADMAP12	Compile Test Pit Excavation Databases to verify Utility Crossing for O&M on FM

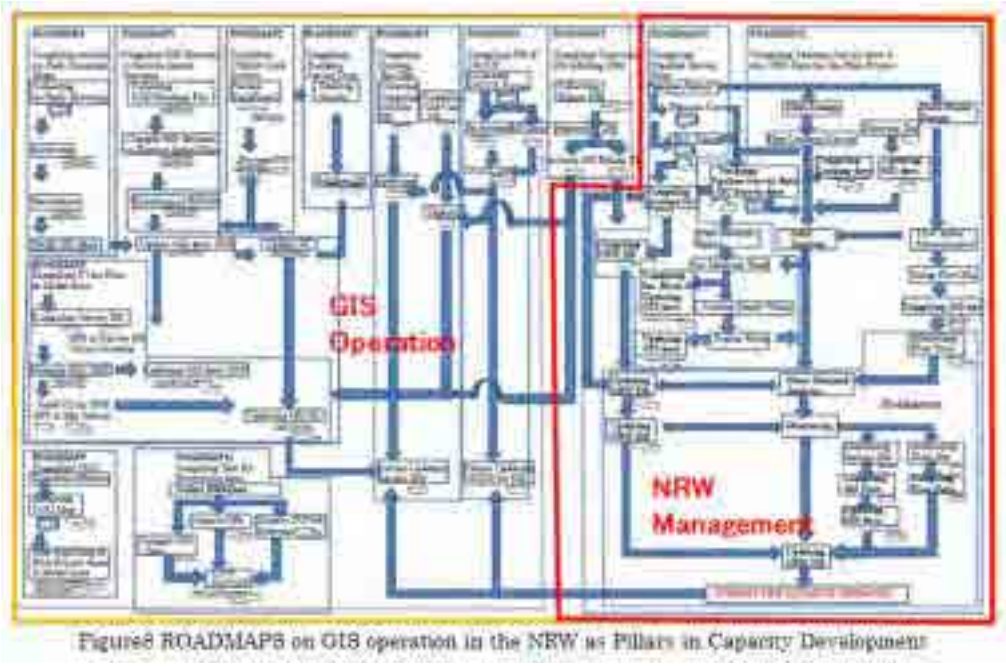


Figure2.8 ROADMAPS on GIS operation in the NRW management

(4) Role of GIS in the NRW Management

In order to instruct role of GIS in the NRW management to counterparts, GIS activities in the work process in the management was arranged as shown in Figure2.9. GIS activities are mainly divided in two (2) roles as follows:

- Supply and Maintenance on Information: preparation of initial data for pipeline network map, preparation of baseline data required for the NRW measure, updating of baseline data by field verification surveys on pipeline survey and leakage survey, and collections of billing data with data arrangements
- Support for Operation and Maintenance in the NRW management: utilization of GIS and real time updating of baseline data in the NRW management

Figure3 NRW Management and GIS Operation

3. GIS training

Full-scale training of GIS to CWASA counterparts was carried out three (3) times in Table3.1 about a training of GIS instruction and the follow up trainings against eight (8) target persons who were assigned to the PANI in the third year.

Table 3.1 Activity of GIS training

Training	Term in the period	Contents
The first training	From September 21th in 2011 to October 20th	Enforcements of workshop for 3 days and basic training
The second training	From December 19th in 2011 until February 16th in 2012	Enforcements of workshop for 4 days and the follow up training
The third training:	From April 16th in 2012 to May 30th	Enforcements of internal meeting for 2 days, the follow-up training and report in the seminar

Text for GIS training which was prepared in the second year was utilized, as that was shown in the APPENDIX: GIS TRAINING TEXT. Initially eight (8) counterparts participated in the beginning of the training, but there were finally four (4) counterparts who finally could understand the training about Md. Shohel Rana, Md. Saiful Islam, Md. Saifur Rahman Bhuiyan and Hasnatul Zannat Sweety. The GIS basic training was terminated due to the report of their achievements on technology transfer in four (4) counterparts in the seminar.

There was two (2) times of the evaluations in their training to check their understanding of the operation and it was checked to consider the future instruction and the indicators for their next advanced

training. Training result is show in Table3.2 and overall evaluations in two (2) times are shown in Table3.3 and Table3.4. The detail of GIS training is shown in ANNEX2: GIS TRAINING.

4. Activity report in the seminar

In order to report GIS activity in the seminar, four (4) counterparts were instructed about preparation of presentation materials, that of exhibition material and contents of their presentation. Items of the instruction were about introduction of technology transfer and training, explanation of the problem institution which CWASA data was holding, and the concrete solution, explanation of a work process and, results and subjects in the training.

Information Management on GIS in NRW management was reported in the seminar. The detail is referred to ANNEX3: INFORMATION MANAGEMENT ON GIS FOR NRW MANAGEMENT.

Table3.2 Training Evaluation: February 12th / May 20th in 2012

Training Item		**Md. Shohel Rana**	Mr. Tridib Chowdhury	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**
Data Entry	Map digitizing	**B / A**	B / ×	**A / A**	**A / A**	**B Slow/ A**
Editing	Edit of figure	**A / B**	A / ×	**A / A**	**A / A**	**B Slow/ A**
	Database Operation	**B / A**	B / ×	**A / A**	**A / A**	**B / A**
	Transform	**B Slow / B**	B Slow / ×	**A / A**	**A / A**	**C to B / B**
Production of thematic map	Production of map	**B / B**	B / ×	**A / A**	**A / A**	**B / A**
	Query Operation	**B / B**	B not practical/ ×	**A / A**	**A / A**	**B / B**
	Relational Database	**A / B**	A / ×	**A / A**	**A / A**	**A / A**
Printing	Map Layout	**A / A**	A / ×	**A / A**	**A / A**	**A / A**
	Map output	**A / A**	A / ×	**A / A**	**A / A**	**A / A**
Database operation	Tabulation of billing data	**B-C slow / B**	B-C / ×	**A / A**	**A / A**	**B but stable / A**
Abilities of GIS operation		**B/ B-A**	B / ×	**A / A**	**A / A**	**B / B-A**

Criteria of score is as follows: A: Operate by oneself, B: Operation-able, C: hard to operate,

×: Out of evaluation,

BOLD: present counterparts

Table 3.3 Evaluation in the second training raining: February12th in 2012

Training Item	Md. Shohel Rana	Tridib Chowdhury	Md. Saiful Islam	Md. Saifur Rahman Bhuiyan	Hasnatul Zannat Sweeety
Overall evaluation	**Understand basic operation but not practical**	Understand basic operation but not practical	**Understand basic operation but not practical**	**Understand basic operation**	**Understand basic operation but took time to do but practiced very much with pressures**
Issues to overcome for practical operation	**Require more practical training**	Require more practical training。	**Require practical work**	**Require practical work**	**Improve basic operation and PC skills in MS Excel**
Self-Sustainability	**Questionable**	Questionable	**Providing**	**Providing**	**Questionable**
Comments	**Evaluation-able his training altitude to take memo to try to understand. Required more practical works but expected his management abilities for GIS development, diffusion of GIS: particularly O&M in MODs, Customer Management and etc.**	Expecting self-sustainability by concentrations of practical trainings in certain term. Expecting his overall ability in maintenance of GIS data because of only a person in charge CAD operator in CWASA before PANI started	**Experienced understanding GIS and operation but remaining issues about practical developments because of no practical experiences in water supply. Expecting his ability for practical work through NRW management in PANI: GIS, database and system. Issue building capacity for System Administrator**	**Quickly understand GIS and operation. Provided ability for self-rescue in trouble. Expecting his ability: Analysis, planning and implementation of operation in PANI NRW management, because of engineer in water supply. Issue building capacity for GIS developer**	**Late to understand and operation, but make sure to achieve operation against her understandings. Issues will be solved due to improvements of knowledge and PC skill. Evaluation-able her altitude making sure to stabled work**
Comments for counterpart team in the inter evaluation:	Technical transfer was well going on in the four and half (4.5) months period including the follow up training for 2.5 months and the OJT for 2 months after GIS operation training started from October in 2011. GIS team was well balanced by two (2) practical counterparts of Saiful and Sayful, and three (3) stable counterparts of Tridip, Sweety and Sohel. Since GIS development is required to provide with planning ability, development ability, decision making and management ability such as work, process, quality, staffs, equipment and budgeting and etc., it is required to assign engineers who are more than level of assistant engineer. Next target of their training is fixations of basic training skills.				

BOLD: present counterparts

Table3.4 Final evaluation in the third training: May 20th in 2012

Training Item	Md. Shohel Rana	Tridib Chowdhury	Md. Saiful Islam	Md. Saifur Rahman Bhuiyan	Hasnatul Zannat Sweeety
Overall evaluation	**Understand basic operation but took time to do but practiced very much with pressures**	Understand basic operation but not practical	**Understand basic operation but not practical**	**Understand basic operation**	**Understand basic operation but took time to do but practiced very much with pressures**
Issues to overcome for practical operation	**Require more practical training**	Require more practical training。	**Require practical work**	**Require practical work**	**Improve basic operation and PC skills in MS Excel**
Self-Sustainability	**Questionable**	Questionable	**Providing**	**Providing**	**Questionable**
Comments	**Required more practical works in order to do fixate more practical operation. But expected his management abilities for GIS development, diffusion of GIS: particularly O&M in MODs, Customer Management and etc.**	Expecting self-sustainability by concentrations of practical trainings in certain term. Expecting his overall ability in maintenance of GIS data because of only a person in charge CAD operator in CWASA before PANI started	**Experienced understanding GIS and operation but remaining issues about practical developments because of no practical experiences in water supply. Expecting his ability for practical work through NRW management in PANI: GIS, database and system. Issue building capacity for System Administrator**	**Quickly understand GIS and operation. Provided ability for self-rescue in trouble. Expecting his ability: Analysis, planning and implementation of operation in PANI NRW management, because of engineer in water supply. Issue building capacity for GIS developer**	**Late to understand and operation, but make sure to achieve operation against her understandings. Issues will be solved due to improvements of knowledge and PC skill. Evaluation-able her altitude making sure to stabled work**
Comment for a counterpart team in the final evaluation:	Four (4) counterparts was mastered about basic GIS operation in the eight (8) months period including the follow-up training for four (4) months and the OJT for four (4) months after GIS operation training started from October in 2011. GIS team was well balanced by two (2) practical counterparts of Saiful and Sayful, and two (2) stable counterparts of Sweety and Sohel. Since GIS development is required to provide with planning ability, development ability, decision making and management ability such as work, process, quality, staffs, equipment and budgeting and etc., it is required to assign engineers who are more than level of assistant engineer. Next target of their training is mastering the advanced GIS operation supported by practical works in the NRW management.				

BOLD: present counterparts

Table 3.2 Evaluation in the second training raining: February12th in 2012

Training Item	**Md. Shohel Rana**	Tridib Chowdhury	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**
Overall evaluation	**Understand basic operation but not practical**	Understand basic operation but not practical	**Understand basic operation but not practical**	**Understand basic operation**	**Understand basic operation but took time to do but practiced very much with pressures**
Issues to overcome for practical operation	**Require more practical training**	Require more practical training。	**Require practical work**	**Require practical work**	**Improve basic operation and PC skills in MS Excel**
Self-Sustainability	**Questionable**	Questionable	**Providing**	**Providing**	**Questionable**
Comments	**Evaluation-able his training altitude to take memo to try to understand. Required more practical works but expected his management abilities for GIS development, diffusion of GIS: particularly O&M in MODs, Customer Management and etc.**	Expecting self- sustainability by concentrations of practical trainings in certain term. Expecting his overall ability in maintenance of GIS data because of only a person in charge CAD operator in CWASA before PANI started	**Experienced understanding GIS and operation but remaining issues about practical developments because of no practical experiences in water supply. Expecting his ability for practical work through NRW management in PANI: GIS, database and system. Issue building capacity for System Administrator**	**Quickly understand GIS and operation. Provided ability for self-rescue in trouble. Expecting his ability: Analysis, planning and implementation of operation in PANI NRW management, because of engineer in water supply. Issue building capacity for GIS developer**	**Late to understand and operation, but make sure to achieve operation against her understandings. Issues will be solved due to improvements of knowledge and PC skill. Evaluation-able her altitude making sure to stabled work**
Comments for counterpart team in the inter evaluation:	Technical transfer was well going on in the four and half (4.5) months period including the follow up training for 2.5 months and the OJT for 2 months after GIS operation training started from October in 2011. GIS team was well balanced by two (2) practical counterparts of Saiful and Sayful, and three (3) stable counterparts of Tridip, Sweety and Sohel. Since GIS development is required to provide with planning ability, development ability, decision making and management ability such as work, process, quality, staffs, equipment and budgeting and etc., it is required to assign engineers who are more than level of assistant engineer. Next target of their training is fixations of basic training skills.				

BOLD: present counterparts

Table3.4 Final evaluation in the third training: May 20th in 2012

Training Item	**Md. Shohel Rana**	Tridib Chowdhury	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**
Overall evaluation	**Understand basic operation but took time to do but practiced very much with pressures**	Understand basic operation but not practical	**Understand basic operation but not practical**	**Understand basic operation**	**Understand basic operation but took time to do but practiced very much with pressures**
Issues to overcome for practical operation	**Require more practical training**	Require more practical training。	**Require practical work**	**Require practical work**	**Improve basic operation and PC skills in MS Excel**
Self-Sustainability	**Questionable**	Questionable	**Providing**	**Providing**	**Questionable**
Comments	**Required more practical works in order to do fixate more practical operation. But expected his management abilities for GIS development, diffusion of GIS: particularly O&M in MODs, Customer Management and etc.**	Expecting self- sustainability by concentrations of practical trainings in certain term. Expecting his overall ability in maintenance of GIS data because of only a person in charge CAD operator in CWASA before PANI started	**Experienced understanding GIS and operation but remaining issues about practical developments because of no practical experiences in water supply. Expecting his ability for practical work through NRW management in PANI: GIS, database and system. Issue building capacity for System Administrator**	**Quickly understand GIS and operation. Provided ability for self-rescue in trouble. Expecting his ability: Analysis, planning and implementation of operation in PANI NRW management, because of engineer in water supply. Issue building capacity for GIS developer**	**Late to understand and operation, but make sure to achieve operation against her understandings. Issues will be solved due to improvements of knowledge and PC skill. Evaluation-able her altitude making sure to stabled work**
Comment for a counterpart team in the final evaluation:	Four (4) counterparts was mastered about basic GIS operation in the eight (8) months period including the follow-up training for four (4) months and the OJT for four (4) months after GIS operation training started from October in 2011. GIS team was well balanced by two (2) practical counterparts of Saiful and Sayful, and two (2) stable counterparts of Sweety and Sohel. Since GIS development is required to provide with planning ability, development ability, decision making and management ability such as work, process, quality, staffs, equipment and budgeting and etc., it is required to assign engineers who are more than level of assistant engineer. Next target of their training is mastering the advanced GIS operation supported by practical works in the NRW management.				

BOLD: present counterparts

ANNEX 1 PRODUCTION OF TEST PIT EXCAVATION DATABASE

1. Production of databases for Test Pit Excavation

Database was compiled by relational data in each survey item and GIS data, according to the report of Test Pit Excavation which was carried out in the second year of the project. The report of Test Pit Excavation consists of survey items shown in Table1. Production of database was carried out by the work flow shown in Figure1.

Table1 Items of TestPit Excavation Report

Test Pit Excavation Information	
Location Map	
Summery Sheet	
Cross- Section Drawing (Field Verification Survey H Test-Pit Excavation Result)	
Photo Sheet-1(Operation)	
Photo Sheet-l(Measurement)	
Finding from Test pit Excavation	
Appendix about	Site Observation Sheet (Conflicts Identification)
	Site Observation Sheet
	Test Pit Observation Sheet
	Pavement Chart
	Procedure of Test Pit Excavation
	Road Cutting Permission from CDA

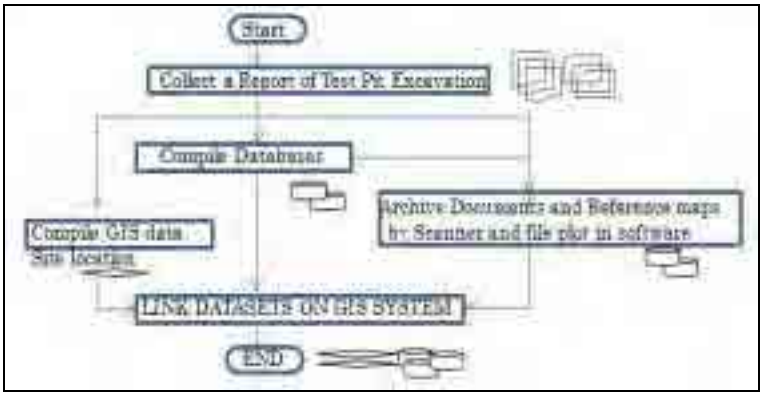


Figure1 Work flow in production of database for Test Pit Ex-

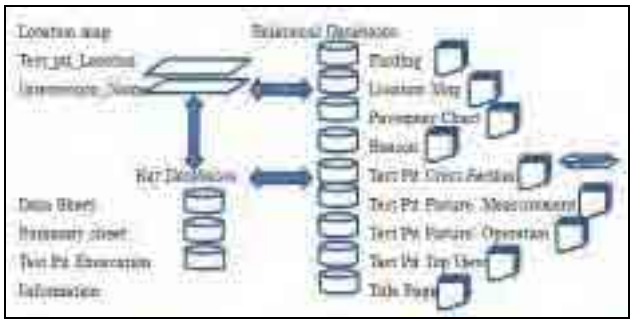


Figure2 Relationships of databases in Test Pit Excavation data

2. Database design

Test Pit Excavation data was arranged into location map of Test Pit Excavation site and several relational databases in each survey item, according to data structures as shown in Figure2 based on the survey report.

3. Preparation of database

The database was mutually linked to make each relational database to display and to refer with GIS data showing the excavation sites as shown in Figure3. Test Pit Excavation data becomes important information in the Operation and Maintenance on Facility Management in CWASA.

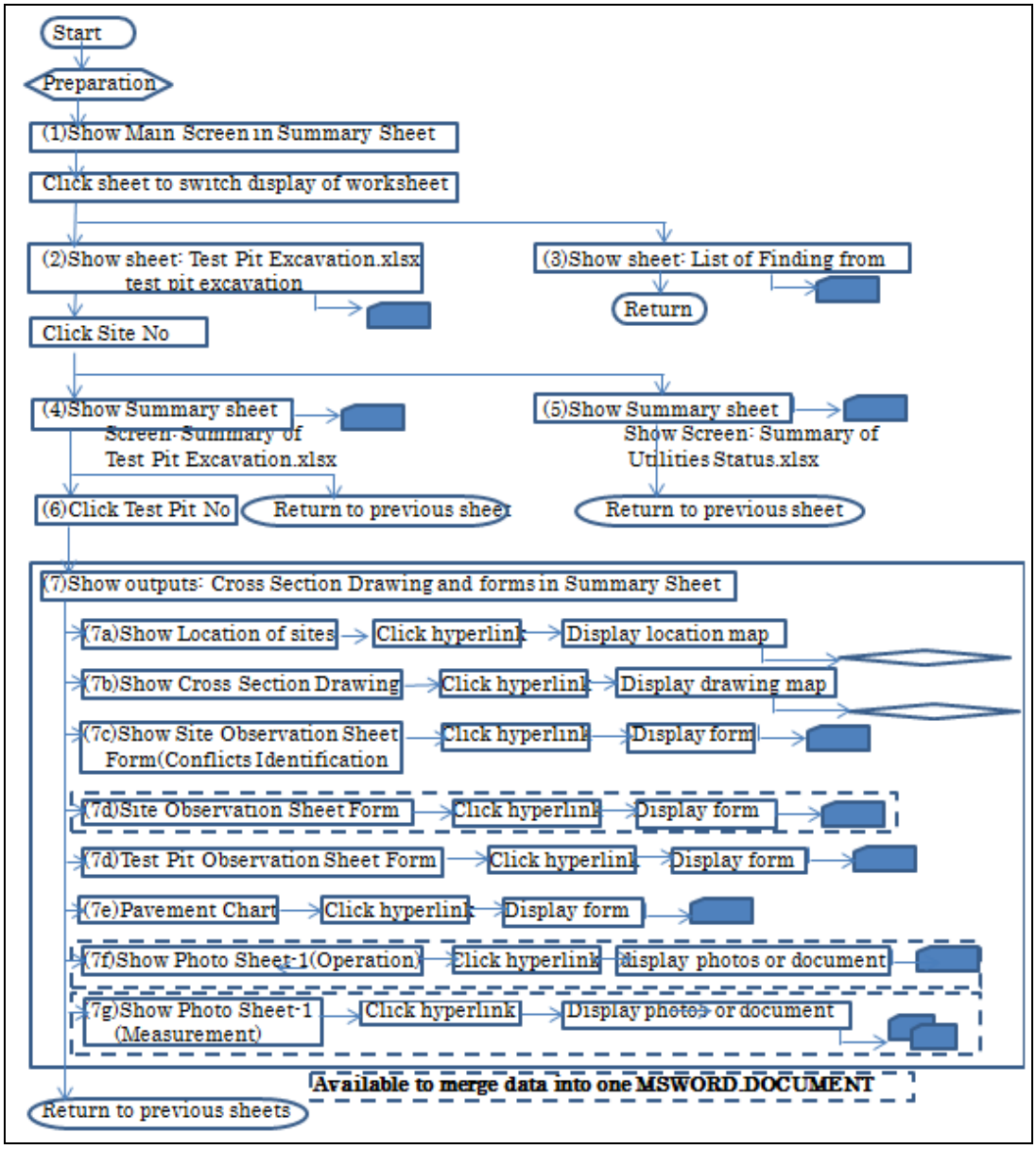


Figure3 Flowchart to display Test Pit Excavation databases

ANNEX2 GIS TRAINING

1. GIS training and assessment

Instruction for GIS training in PANI was started from September 27th in 2012 in the third year of the project. Four (4) counterparts was over the first training about basic operation of GIS software and data processing of bill collection data, which were relating to the NRW measure in the period of eight (8) months. The evaluation in the operation was done to check the understanding of the training and it was reviewed about fixation of skill in counterparts and issues for the instructions.

2. Review of GIS training in the second year

Since three (3) counterparts in Table1 were irregularly assigned to GIS training in the second year, the training must have been carried out gradually against each counterpart. The training was done about instructions of GIS by text book and practice of GIS software for one (1) month and OJT work for the remaining period. Two (2) counterparts except Talebul Hasan stopped their GIS training because of change of their change in other division. Difficulty about fixation of the employment was judged, since other (1) person who was originally a local consultant of CAD and was temporally employed for Karunaphuli Water Supply Project, was assigned to the project for technology transfer in PANI. Furthermore, there were unsuitable work attitudes found in his training so that the project switched to use him for supplemental works in PANI.

There were three (3) counterparts assigned to GIS training in the second year of the project, but the training had to limit only for explanation for GIS introduction and basic training of GIS software.

Table1 GIS taining in the second year

Name	Charge in CWASA	Term in OJT	Note
Talebule Hasan	Contracted C/P for KSWP (CAD operator in private Consultant)	Permanent	Up to the present
MD.Sayful Islam	Assistant engineer, Joined CWASA from October, 2010	1month from October 15th, 2010	Moved to another section from Nov. 16 in 2010
Md. Alam	Former GIS C/P in CWASA, Revived in CWASA from 2011	3 months from January 1st, 2011	Moved to System Analyst from April, 2011

3. GIS training in the third year

GIS training in the third year was carried according to assignment schedule of expert shown in Table2. During the absent term of expert, the OJT was continuously going on by instruction of the project.

Table2 GIS taining in the third year

Training	Term period with Expert	Main activity
The first training	September 21th in 2011 – October 20th	Workshop: 3 days and basic training
The second training	December 19th in 2011-February 16th in 2012	Workshop: 4 days and follow up training
The third training	April 16thin 2012 – May 30th	Internal meeting: 2 days and follow up training

The counterpart for GIS training was assigned to the project in accompany with a new recruit of the CWASA employment in July, 2011, and eight (8) counterparts shown in Table3 were newly assigned for the training at the end of September in 2011.

This training became the full-scale technology transfer on GIS against the CWASA full-time employment after the project had started in 2009, and the training was carried out from September 27th in 2011. The training material was utilized about the training text and a draft document of Terms of Works which were prepared in the second year. The homework about production of initial GIS datasets from CAD data and geometric corrections of those data in the outside of the project areas were given to counterparts, during the absent period of expert in the project. Training records in GIS training in the third year are referred to the ATTACHMENT: TRAINING RECORDS.

(1) The first training : Period from September 21 th to October 20th in 2011

The first training was carried out for one (1) month about workshops for three (3) days and basic training of GIS software. Text prepared in the second year was used in the training. Objective of training was training of GIS introduction and it aimed at understandings consisting of understanding GIS, understanding of technical term, understanding of CWASA datasets and understanding of basic operation in GIS software required for the project activities.

In the period after the first training finished, practice works in counterparts by themselves was made to enforce to process data in the outside of project areas by their managements, in order to make counterparts not to forget the first training.

(2) The second training: Period from December 19th in 2011 to February 16th in 2012

The second training, as a follow-up training was carried out about workshops for four (4) days and basic trainings.

Objective of the training was to fixate the first training and it was instructed about more understanding of GIS software operation, database operation, link operation between external data and GIS data, and production of map. And also, it was instructed to train field verification survey with survey form and GPS data guided by Action Team, learning of Consumer Service Completion Report, and practice for data process of bill collection data indispensable for the NRW monitoring.

In order to make counterparts fixate the training, internal workshop was opened to confirm contents of their training and to explain roadmaps in a document of Terms of Works, and it was instructed for counterpart to improve acknowledgements for GIS operation. Since counterparts in charge of GIS are required to provide skills to manage and to report in their works, the skill training was instructed through questions and answers and free discussions with them.

After this training, counterparts carried out to verify meter reading data in monthly billing data and calculate monthly bill water consumptions and monthly bill in Zone3.

(3) The third training : Period from April 16th to May 30th in 2012

The third training was instructed to produce GIS data in the area of Karunaphuli Water Supply Project where area was out of the project area, in order to make basic training fixate in the past. The internal meeting was held twice instead of the workshops about confirmations of their work progress and reparation for the seminar. In order to summarize the basic training of GIS, the training was terminated by the training report of counterparts themselves in the seminar.

Table 3 List of counterparts in GIS training at October 1st, 2011

Name		Position in CWASA		Academic Profile	Date to start to work	Date to be assigned to PANI
①	Md. Mahbubul Alam	Executive Engineer	Construction Division	Graduated University Mechanical	2006	Joined on 2011.09
②	**Md. Shohel Rana**	**Assist Engineer**	**MOD-2**	**Graduated University Civil**	**2011 Jul20**	**Joined on 2011.09**
	Sadil Bin Nur,	Deputy Assistant Engineer	Design Division	Graduated University Electrical	2011 Aug01	Joined on 2011.09
	Tridib Chowdhury,	Overseer	Design Division	Graduated Diploma	1998	Joined on 2011.09
	Md. Saiful Islam	**Assist Engineer**	**Action Team in PANI**	**Graduated University Science**	**2010 Oct01**	**Joined on 2010.10**
	Md. Saifur Rahman Bhuiyan	**Assistant Engineer**	**Action Team in PANI**	**Graduated University Electrical**	**2011 Jul26**	**Joined on 2011.09**
	Hasnatul Zannat Sweeety	**Sub Assistant Engineer**	**Action Team in PANI**	**Graduated Diploma Electrical**	**2011 Jul**	**Joined on 2011.09**
	Abdur Rouf	Assistant Engineer	MOD-1	Graduated University Mechanical	2011 Jul20	Joined on 2011.10.10

○: new counterpart to be assigned to PANI, **Bold:** present counterpart, one person in counterpart training in Japan(Md.Saiful Islam, Study GIS in the university)

Table4 Activities of GIS training in the third year

Name	Charge in CWASA	Term in OJT	Note
Md. Mahbubul Alam	Executive Engineer Construction Division	1month from September 21th, 2011	Fully participated. Left PANI from Nov. 16,2010
			Left PANI
			Left PANI
Md. Shohel Rana	**Assist Engineer MOD-2**	**1 month from September 21th, 2011**	**Participated**
		2 month from December 21th, 2011	**Participated**
		1.5 month from April16th, 2012	**Participated**
Sadil Bin Nur,	Deputy Assistant Engineer Design Division	1 month from September 21th, 2011	Participated in a few days
		2 month from December 21th, 2011	Never participated
		1.5 month from April16th, 2012	Never participated
Tridib Chowdhury,	Overseer Design Division	1 month from September 21th, 2011	Participated
		2 month from December 21th, 2011	Mostly participated
		1.5 month from April16th, 2012	Never participated
Md. Saiful Islam	**Assist Engineer Action Team in PANI**	**1 month from September 21th, 2011**	**Out of Bangladesh**
		2 month from December 21th, 2011	**Fully participated**
		1.5 month from April16th, 2012	**Fully participated**
Md. Saifur Rahman Bhuiyan	**Assistant Engineer Action Team in PANI**	**1 month from September 21th, 2011**	**Fully participated**
		2 month from December 21th, 2011	**Fully participated**
		1.5 month from April16th, 2012	**Fully participated**
Hasnatul Zannat Sweeety	**Sub Assistant Engineer Action Team in PANI**	**1 month from September 21th, 2011**	**Fully participated**
		2 month from December 21th, 2011	**Fully participated**
		1.5 month from April16th, 2012	**Fully participated**
Abdur Rouf	Assistant Engineer MOD-1	1 month from September 21th, 2011	Never participated
		2 month from December 21th, 2011	Never participated
		1.5 month from April16th, 2012	Never participated

Bold: present counterpart

4. Evaluation of training

In order to understand magnitudes of mastering in the counterpart training, the evaluations in the second training and the third training were done about the items of training shown in Table5.

Table5 Evaluation items in the training

Training Item	
Data Entry	Map digitizing
Editing	Edit of figure
	Database Operation
	Transform
Production of thematic map	Production of map
	Query Operation
	Relational Database
Map printing	Map Layout
	Map output
Database operation	Data processing of billing data
Abilities of GIS operation	

Items of the evaluation were those in basic training consisting of operation items in GIS software and data processing of billing data. Criteria of evaluation was to check reliability to other persons as follows:

A is Operate by oneself, B is Operation-able and C is hard to operate;

The target persons to have candidate in the first evaluation was screened to five (5) persons who participated in the second training from the first nine (9) counterparts.

In the final evaluation, target persons became four (4) persons who was participated in the third training with having excluded one (1) person to candidate the first evaluation. Result of training evaluation is shown in Table6. It was judged form that four (4) counterparts already understood contents of the basic training.

In order to arrange competency of GIS operation in counterparts, a training suitability in each counterpart was evaluated as the item shown in Table7.

Table 7 Items in overall evaluation in the training

Training Item
Overall evaluation
Issues to overcome
Sustainability
Comments

Overall evaluation in counterpart is shown in Table8 and Table9. It was judged that four (4) terminated the basic training and they were ready to candidate the next more practical advance training.

Comment in each evaluation to each counterpart was as follows:

- Comments in the first evaluation

  Technical transfer was well going on in the four and half (4.5) months period including the follow up training for 2.5 months and the OJT for 2 months after GIS operation training started from October in 2011. GIS team was well balanced by two (2) practical counterparts of Saiful and Sayful, and three (3) stable counterparts of Tridip, Sweety and Sohel. Since GIS development is required to provide with planning ability, development ability, decision making and management ability such as work, process, quality, staffs, equipment and budgeting and etc., it is required to assign engineers who are more than level of assistant engineer. Next target of their training is fixations of basic training skills.

- Comment in the final evaluation

  Four (4) counterparts was mastered about basic GIS operation in the eight (8) months period including the follow-up training for four (4) months and the OJT for four (4) months after GIS operation training started from October in 2011. GIS team was well balanced by two (2) practical counterparts of Saiful and Sayful, and two (2) stable counterparts of Sweety and Sohel. Since GIS development is required to provide with planning ability, development ability, decision making and management ability such as work, process, quality, staffs, equipment and budgeting and etc., it is required to assign engineers who are more than level of assistant engineer. Next target of their training is mastering the advanced GIS operation supported by practical works in the NRW management.

Four (4) counterparts are only available human resources who can understand and operate GIS in the history of GIS operation in CWASA. Since they become core persons for human resources development to the future, it is strongly recommended to CWASA about fixation of GIS counterpart and continuous capacity building with self-sustainability.

Table6 Training Evaluation: February 12th / May 20th in 2012

Training Item		**Md. Shohel Rana**	Tridib Chowdhury	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**
Data Entry	Map digitizing	**B / A**	B / ×	**A / A**	**A / A**	**B Slow/ A**
Editing	Edit of figure	**A / B**	A / ×	**A / A**	**A / A**	**B Slow/ A**
	Database Operation	**B / A**	B / ×	**A / A**	**A / A**	**B / A**
	Transformation	**B Slow / B**	B Slow / ×	**A / A**	**A / A**	**C to B / B**
Production of thematic map	Production of map	**B / B**	B / ×	**A / A**	**A / A**	**B / A**
	Query Operation	**B / B**	B not practical/ ×	**A / A**	**A / A**	**B / B**
	Relational Database	**A / B**	A / ×	**A / A**	**A / A**	**A / A**
出図	Map Layout	**A / A**	A / ×	**A / A**	**A / A**	**A / A**
	Map output	**A / A**	A / ×	**A / A**	**A / A**	**A / A**
Database operation	Tabulation of billing data	**B-C slow / B**	B-C / ×	**A / A**	**A / A**	**B but stable / A**
Abilities of GIS operation		**B/ B-A**	B / ×	**A / A**	**A / A**	**B / B-A**

Criteria of score is as follows: A: Operate by oneself, B: Operation-able, C: hard to operate, ×: Out of evaluation, **BOLD: present counterparts**

Table 8 First evaluation: in the Second training at February12th in 2012

Training Item	**Md. Shohel Rana**	Tridib Chowdhury	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**
Overall evaluation	**Understand basic operation but not practical**	Understand basic operation but not practical	**Understand basic operation but not practical**	**Understand basic operation**	**Understand basic operation but took time to do but practiced very much with pressures**
Issues to overcome for practical operation	**Require more practical training**	Require more practical training。	**Require practical work**	**Require practical work**	**Improve basic operation and PC skills in MS Excel**
Self-Sustainability	**Questionable**	Questionable	**Providing**	**Providing**	**Questionable**
Comments	**Evaluation-able his training altitude to take memo to try to understand. Required more practical works but expected his management abilities for GIS development, diffusion of GIS: particularly O&M in MODs, Customer Management and etc.**	Expecting self- sustainability by concentrations of practical trainings in certain term. Expecting his overall ability in maintenance of GIS data because of only a person in charge CAD operator in CWASA before PANI started	**Experienced understanding GIS and operation but remaining issues about practical developments because of no practical experiences in water supply. Expecting his ability for practical work through NRW management in PANI: GIS, database and system. Issue building capacity for System Administrator**	**Quickly understand GIS and operation. Provided ability for self-rescue in trouble. Expecting his ability: Analysis, planning and implementation of operation in PANI NRW management, because of engineer in water supply. Issue building capacity for GIS developer**	**Late to understand and operation, but make sure to achieve operation against her understandings. Issues will be solved due to improvements of knowledge and PC skill. Evaluation-able her altitude making sure to stabled work**

BOLD: present counterparts

Table 9 Final evaluation: in the Third training at May 20th in 2012

Training Item	**Md. Shohel Rana**	Tridib Chowdhury	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**
Overall evaluation	**Understand basic operation but took time to do but practiced very much with pressures**	Understand basic operation but not practical	**Understand basic operation but not practical**	**Understand basic operation**	**Understand basic operation but took time to do but practiced very much with pressures**
Issues to overcome for practical operation	**Require more practical training**	Require more practical training。	**Require practical work**	**Require practical work**	**Improve basic operation and PC skills in MS Excel**
Self-Sustain ability	**Questionable**	Questionable	**Providing**	**Providing**	**Questionable**
Comments	**Required more practical works in order to do fixate more practical operation. But expected his management abilities for GIS development, diffusion of GIS: particularly O&M in MODs, Customer Management and etc.**	Expecting self- sustainability by concentrations of practical trainings in certain term. Expecting his overall ability in maintenance of GIS data because of only a person in charge CAD operator in CWASA before PANI started	**Experienced understanding GIS and operation but remaining issues about practical developments because of no practical experiences in water supply. Expecting his ability for practical work through NRW management in PANI: GIS, database and system. Issue building capacity for System Administrator**	**Quickly understand GIS and operation. Provided ability for self-rescue in trouble. Expecting his ability: Analysis, planning and implementation of operation in PANI NRW management, because of engineer in water supply. Issue building capacity for GIS developer**	**Late to understand and operation, but make sure to achieve operation against her understandings. Issues will be solved due to improvements of knowledge and PC skill. Evaluation-able her altitude making sure to stabled work**

BOLD: present counterparts

ATTACHEMENT: TRAINING RECORDS IN GIS TRAINING IN THE THIRD YEAR

Table 1 List of Counterparts for GIS training at October 1st, 2011

Name		Position in CWASA		Academic Profile	Date to start to work	Date to be assigned to PANI
C/P1	Md. Mahbubul Alam	Executive Engineer	Construction Division	Graduated University Mechanical	2006	2011.11 shifted to Mohara project
C/P2 ①	**Md. Shohel Rana**	**Assist Engineer**	**MOD-2**	**Graduated University Civil**	**2011 Jul20**	**Joined on 2011.09**
C/P3	Mr. Sadil Bin Nur,	Deputy Assistant Engineer	Design Division	Graduated University Electrical	2011 Aug01	No participate & Out of PANI
C/P4 ②	**Mr. Tridib Chowdhury,**	**Overseer**	**Design Division**	**Graduated Diploma**	**1998**	**Joined on 2011.09**
C/P5 ③	**Md. Saiful Islam**	**Assist Engineer**	**GIS in Kalnaphuli Water Supply Project**	**Graduated University Science**	**2010 Oct01**	**Joined on 2010.10**
C/P6 ④	**Md. Saifur Rahman Bhuiyan**	**Assistant Engineer**	**Store Division**	**Graduated University Electrical**	**2011 Jul26**	**Joined on 2011.09**
C/P7 ⑤	**Hasnatul Zannat Sweeety**	**Sub Assistant Engineer**	**COD-1**	**Graduated Diploma Electrical**	**2011 Jul**	**Joined on 2011.09**
C/P8	Abdur Rouf	Assistant Engineer	MOD-1	Graduated University Mecanical	2011 Jul20	No participate & Out of PANI

Bold is the present counterpart at May, 2012

Table 2 Training Record in the first training (Training period: September 27th in 2011- October 17th)

Date in 2011	Place	Contents of Training	Md. Mahbubul Alam	Md. Shohel Rana	Sadil Bin Nur,	Tridib Chowdhury,	Md. Saiful Islam	Md. Saifur Rahman Bhuiyan	Hasnatul Zannat Sweeety	Abdur Rouf
9/27	4F, Meeting room	Workshop Day1(10:00-13:00): Training of GIS installation against 6C/Ps: Delivery of training text book, Introduction of GIS by text book, understanding CWASA data, Problems and Issues on CWASA data 、 Understanding GIS data structure, Q&A	○	○	○	○	C/P Training in Japan	○	○	

Table 2 Training Record in the first training (Training period: September 27th in 2011- October 17th)

(Cont'd)

Date in 2011	Place	Contents of Training	Md. Mahbubul Alam	Md. Shohel Rana	Sadil Bin Nur,	Tridib Chowdhury,	Md. Saiful Islam	Md. Saifur Rahman Bhuiyan	Hasnatul Zannat Sweety	Abdur Rouf
9/28	4F, Meeting room	Workshop Day2(10:00-13:00): Training of GIS installation against 5C/Ps: Delivery of materials for software operation, Introduction of GIS by training test book, technical issues inside CWASA data and correspondences in PAN(Miss-matching of map locations, problems on Geo-Coding, Issues on Data Quality and etc.) , Introduction of work contents in NRW, Introduction of GIS software, Q&A	○		○	○	Ditto	○	○	
9/29	4F, Meeting room	Workshop Day3(10:00-13:00): Training of GIS installation against 6C/Ps: Introduction of GIS software in production of GIS data, explanation of functions in GIS software and instruction of practice(Display data), Q&A	○	○	○	○	Ditto	○	○	
10/ 2	PANI	Practice of GIS software(10:00-13:00): Basic operation of ARCGIS, Map digitizing: Instruction, Practice: Point, Line and Polygon) and Group training:1PC for 2 persons	○	○	○	○	Ditto	○	○	×
10/3	PANI	Practice of GIS software(10:00-13:00): Basic operation of ARCGIS, Map digitizing: Instruction, Practice: Point, Line and Polygon) and Group training:1PC for 2 persons	○	○	○	○	Ditto	○	○	×
10/4	PANI	Practice of GIS software(10:00-13:00): Basic operation of ARCGIS, Georeferencing: Instruction, Practice of GCP) and Group training:1PC for 2 persons	○	○	○	○	Ditto	○	○	×
10/5	PANI	Practice of GIS software(10:00-13:00): Basic operation of ARCGIS, Georeferencing: Instruction, Practice of GCP and Group training: 1PC for 2 persons	○	○			Ditto	○	○	×

○:participated, : partially participated, ×: not participated

Table 3 Training Record in the first training(Training period: September 27th in 2011- October 17th)

Date	Place	Contents of training: 10am to 13;00	Md. Mahbubul Alam	Md. Shohel Rana	Sadil Bin Nur,	Tridib Chowdhury,	Md. Saiful Islam	Md. Saifur Rahman Bhuiyan	Hasnatul Zannat Sweeety	Abdur Rouf
10/9	PANI	Practice of GIS software(10:00-13:00): Basic operation of ARCGIS, Transform process: Practices of Transform and Map Projection, Group trainingng:1PC for 2 persons	○	○			C/P Training in Japan	○	○	×
10/10	PANI	Practice of GIS software(10:00-13:00): Basic operation of ARCGIS, Transform process: Practices of Transform and Map Projection, Group trainingng:1PC for 2 persons	○	○	×	×	Ditto	○	○	○
10/11	PANI	Practice of GIS software(10:00-13:00): Basic operation of ARCGIS, Transform process: Practices of Transform and Map Projection, Group trainingng:1PC for 2 persons	○	○		×	Ditto	○	○	×
10/12	PANI	Practice of Production of GIS data by OJT(10:00-13:00): Editing of GIS data, Preparation of GCP for Transform) and Group training: 1PC for 2 persons	○	○	○		Ditto	○	○	×
10/13	PANI	Practice of Production of GIS data by OJT(10:00-13:00): Editing of GIS data, Preparation of GCP for Transform) and Group training: 1PC for 2 persons	×	○	○		Ditto	○	○	×
10/16	PANI	Practice of Production of GIS data by OJT(10:00-13:00): Editing of GIS data, Preparation of GCP for Transform) and Group training: 1PC for 2 persons	×	○	○	○	Ditto	○	○	×
10/ 17	PANI	Practice of Production of GIS data by OJT(10:00-13:00): Editing of GIS data, Preparation of GCP for Transform) and Group training: 1PC for 2 persons	×	○	○	○	Ditto	○	○	×

○:participated, : partially participated, ×: not participated

Table 4 List of counterpart in the second GIS training at December 27th, 2011

Name		Position in CWASA		Academic Profile	Date to start to work	Date to be assigned to PANI
~~C/P1~~	~~Md. Mahbubul Alam~~	~~Executive Engineer~~	~~Construction Division~~	~~Graduated University Mechanical~~	~~2006~~	~~2011.11 shifted to Mohara project~~
C/P2	**Md. Shohel Rana**	**Assist Engineer**	**MOD-2**	**Graduated University Civil**	**2011 Jul20**	**Joined on 2011.09**
~~C/P3~~	~~Mr. Sadil Bin Nur,~~	~~Deputy Assistant Engineer~~	~~Design Division~~	~~Graduated University Electrical~~	~~2011 Aug01~~	~~No participate & Out of PANI~~
C/P4	**Mr. Tridib Chowdhury,**	**Overseer**	**Design Division**	**Graduated Diploma**	**1998**	**Joined on 2011.09**
C/P5	**Md. Saiful Islam**	**Assist Engineer**	**GIS in Kalnaphuli Water Supply Project**	**Graduated University Science**	**2010 Oct01**	**Joined on 2010.10**
C/P6	**Md. Saifur Rahman Bhuiyan**	**Assistant Engineer**	**Store Division**	**Graduated University Electrical**	**2011 Jul26**	**Joined on 2011.09**
C/P7	**Hasnatul Zannat Sweeety**	**Sub Assistant Engineer**	**COD-1**	**Graduated Diploma Electrical**	**2011 Jul**	**Joined on 2011.09**
~~C/P8~~	~~Abdur Rouf~~	~~Assistant Engineer~~	~~MOD-1~~	~~Graduated University Mecanical~~	~~2011 Jul20~~	~~No participate & Out of PANI~~

Bold is the present counterpart, ~~C/P~~ is a counterpart who already left from PANI to another division

.

Table 5 Training record in the second training(Training period: December 27th in 2011- February 13th in 2012)

Date in 2011/ 2012	Place	Contents	~~Md. Mahbubul Alam~~	**Md. Shohel Rana**	~~Mr. Sadil Bin Nur~~	**Tridib Chowdhury**	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**	~~Abdur Rouf~~
12/ 27	PANI	OJT(10:00-13:00): Follow up of GIS operation, Reviews of past trainings about activities of Sohel, Saifur, and Tridip	×	○	×	○	×	○	×	×
12/ 28	PANI	OJT(10:0-13:00): Follow up of GIS operation, Reviews of past trainings about activities of Sayful and Sweety.	×	○	×	×	×	○	×	×
12/29	PANI	OJT(10:0-13:00): Follow up of GIS operation, Introduction about tabulation of billing data	×	○	×	×	×	○		×

Table 5 Training record in the second training(Training period: December 27th in 2011- February 13th in 2012) (Cont7d

Date in 2011/ 2012	Place	Contents	Md. Mahbubul Alam	**Md. Shohel Rana**	Mr. Sadil Bin Nur	**Tridib Chowdhury**	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**	Abdur Rouf
1/ 1	PANI	OJT(10:0-13:00): Follow up of GIS operation, Instruction about tabulation of billing data in Zone3	×	○	×	○	○	○	○	×
1/ 2	PANI	OJT(10:0-13:00): Follow up of GIS operation, Instruction about tabulation of billing data guided by Md. Saiful Islam and self-practice of tabulation in Khulshi data	×	○	×	○	○	○	○	×
1/3	PANI	OJT(10:0-13:00): Follow up of GIS operation, Practice about tabulation in Zone3 data	×	×	×	×	○	×	○	×
1/4	PANI	OJT(10:0-13:00): Follow up of GIS operation, Practice about tabulation in Zone3 data	×	○	×	○	○	○	○	×
1/5	PANI	OJT(10:0-13:00): Follow up of GIS operation, Instruction of Relational Database, Practice of tabulation in Zone3	×	○	×	×	○	○	○	×
1/8	PANI	OJT(10:0-13:00): Follow up of GIS operation, Instruction of Map Layout, Practice of tabulation in Zone3	×	○	×	○	○	○	○	×
1/9	PANI	OJT(10:0-13:00): Follow up of GIS operation, Instruction of Map Layout, Practice of tabulation in Zone3	×	○	×	○	○	○	○	×
1/10	PANI	OJT(10:0-13:00): Follow up of GIS operation, Instruction of Map Layout and Database operation, Practice of tabulation in Zone3	×	○	×	○	○	○	○	×

○:participated, : partially participated, ×: not participated

Table 2 Training record in the second training

(Training period: December 27th in 2011- February 13th in 2012)

Date in 2012	Place	Contents	~~Md. Mahbubul Alam~~	**Md. Shohel Rana**	~~Mr. Sadil Bin Nur~~	**Mr. Tridib Chowdhury**	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**	~~Mr. Abdur Rouf~~
1/11	PANI	9:00-16:00: Participation of Underground Utility Seminar	×	○	×	×	○	○	○	×
1/12	PANI	OJT(10:0-13:00): Follow up of GIS operation, Map Lay-out, Tabulation of monthly billing data in Zone3	×	○	×	○	○	○	○	×
1/15	PANI	OJT(10:0-13:00): Follow up of GIS operation, Review of GIS Document, Tabulation of monthly billing data in Zone3	×	×	×	×	○	○		×
1/16	PANI	OJT(10:0-13:00): Follow up of GIS operation, RDBMS, Tabulation of monthly billing data in Zone3	×	×	×	○	○	○	○	×
1/17	PANI	OJT(10:0-13:00): Follow up of GIS operation, RDBMS, Tabulation of monthly billing data in Zone3	×	×	×		○	○	○	×
1/18	PANI	OJT(10:0-13:00): Follow up of GIS operation, Tabulation of monthly billing data in Zone3	×		×	×	○	○	○	×
1/ 19	PANI	OJT(10:0-13:00): Follow up of GIS operation, Review GIS operations in training	×	×	×	○	○	○	○	×
1/ 22	PANI	OJT(10:0-13:00): Work Shop1: More understanding of Training Document, Issues on GIS operation for NRW measures	×	○	×	○	○	○	○	×
1/ 23	PANI	OJT(10:0-13:00): Follow up of GIS operation, Understanding CSCCR Database, Updating GIS dataset with CSCCR	×	○	×	○	○	×	○	×

Table 3 Training record in the second training

(Training period: December 27th in 2011- February 13th in 2012) (Cont'd)

Date in 2012	Place	Contents	~~Md. Mahbubul Alam~~	**Md. Shohel Rana**	~~Mr. Sadil Bin Nur~~	**Mr. Tridib Chowdhury**	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**	~~Mr. Abdur Rouf~~
1/ 24	PANI	OJT(10:0-13:00): Follow up of GIS operation, Understanding of updating GIS datasets in Zone3 with Field Verification data. Tabulation about billing data in Zone3	×	○	×	○	○	×	○	×
1/ 25	PANI	OJT(10:0-13:00): Follow up of GIS operation, Tabulation of monthly billing data in zone3, Training supports	×	○	×	○	○	×	○	×

○:participated, : partially participated, ×: not participated

Table 7 Training record in the second training

(Training period: December 27th in 2011- February 13th in 2012)

Date in 2012	Place	Contents	~~Md. Mahbubul Alam~~	**Md. Shohel Rana**	~~Sadil Bin Nur~~	**Mr. Tridib Chowdhury**	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**	~~Abdur Rouf~~
1/ 26	PANI	OJT(10:0-13:00): Follow up of GIS operation, Self- practice of GIS operation, Tabulation of monthly billing data in zone3	×		×	○	○	○	○	×
1/ 29	PANI	Work Shop2(10:0-13:00): More understanding of Training Document, Issues on GIS operation for NRW measures with free discussions	×		×	○	○	○	○	×
1/ 30	PANI	OJT(10:0-13:00): Follow up of GIS operation, Instruction of GPS Survey guided by Mr. Mondol	×		×	○	○	○	○	×
1/ 31	PANI	OJT(10:0-13:00): Follow up of GIS operation, Instruction of downloading GPS data and compiling data of field survey form guided by Mr. Alamin	×		×	○	○	○	○	×

Table 7 Training record in the second training

(Training period: December 27th in 2011- February 13th in 2012) (Cont'd)

Date in 2012	Place	Contents	~~Md. Mahbubul Alam~~	**Md. Shohel Rana**	~~Sadil Bin Nur~~	**Mr. Tridib Chowdhury**	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**	~~Abdur Rouf~~
2/ 1	PANI	OJT(10:0-13:00): Follow up of GIS operation, Instruction of utility software of GPS guided by Mr. Dalower	×		×	×	○	○	○	×
2/ 2	PANI	OJT(10:0-13:00): Follow up of GIS operation, Tabulation of monthly billing data in zone3	×		×	×	○	○	○	×
2/ 6	PANI	Work Shop3(10:0-13:00): Understanding of GIS operation in the NRW management with free discussions	×	×	×	○	○	○	○	×
2/ 7	PANI	OJT(10:0-13:00): Follow up of GIS operation, Tabulation of monthly billing data in zone3	×	×	×	×	○	○	○	×
2/ 8	PANI	OJT(10:0-13:00): Follow up of GIS operation, Introduction of topology in Geodatabase, Tabulation of monthly billing data in zone3	×	×	×	×	○	○	○	×
2/ 9	PANI	OJT(10:0-13:00): Follow up of GIS operation, Follow up of GIS operation, Introduction of topology in Geodatabase, Tabulation of monthly billing data in zone3	×	×	×	×	×	○	×	×
2/12	PANI	Work Shop4 OJT(10:0-13:00): GIS operation for NRW measures	×	×	×	×	×	○	○	×
2/13	PANI	OJT(10:0-13:00): Production of GIS data out of PANI	×	×	×	×	×	○	○	×

○:participated, : partially participated, ×: not participated

Table8 Training record in the third training(Training period: April 18th in 2012- Mat 27th)

Date in 2012	Place	Contents	~~Md. Mahbubul Alam~~	**Md. Shohel Rana**	~~Mr. Sadil Bin Nur~~	~~Tridib Chowdhury~~	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**	~~Abdur Rouf~~
4/ 18	PANI	Follow up of GIS operation (10:0-13:00): Review of training	×	○	×	×	×	○	×	×
4/ 19	PANI	Follow up of GIS operation (10:0-13:00):Review of training, instruction of prepa-ration of GIS data in P Thana	×	○	×	×	×	○	×	×
4/ 22	PANI	Follow up of GIS operation (10:0-13:00): tabulation of monthly billing in Zone3	×	○	×	×	○	○	○	×
4/ 23	PANI	Follow up of GIS operation (10:0-13:00): tabulation of monthly billing in Zone3	×	○	×	×	○	○	○	×

Table8 Training record in the third training(Training period: April 18th in 2012- Mat 27th)

Date in 2012	Place	Contents	~~Md. Mahbubul Alam~~	**Md. Shohel Rana**	~~Mr. Sadil Bin Nur~~	~~Tridib Chowdhury~~	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**	~~Abdur Rouf~~
4/24	PANI	Follow up of GIS operation (10:0-13:00): tabulation of monthly billing in Zone3	×	×	×	×	○	×	○	×
4/25	PANI	Follow up of GIS operation (10:0-13:00): tabulation of monthly billing in Zone3	×	○	×	×	○	○	○	×
4/26	PANI	Follow up of GIS operation (10:0-13:00):internal meeting(Training progress and preparation of seminar)	×	○	×	×	○	○	○	×
4/29	Closed	Hartal								
4/30	Closed	Hartal								
5/1	Closed	Hartal								
5/2	PANI	Follow up of GIS operation (10:0-13:00):Preparation of GIS data in P Thana	×	○	×	×	○	○	○	×
5/3	PANI	Follow up of GIS operation (10:0-13:00): Preparation of GIS data in P Thana	×	○	×	×	○	○	×	×
5/6	Closed	Hartal								
5/7	PANI	Follow up of GIS operation (10:0-13:00): Preparation of GIS data in P Thana	×	○	×	×	○	○	○	×
5/8	PANI	Follow up of GIS operation (10:0-13:00): Preparation of GIS data in P Thana	×	○	×	×	○	○	○	×
5/9	PANI	Follow up of GIS operation (10:0-13:00): Preparation of GIS data in P Thana	×	○	×	×	○	○	○	×

○:participated, : partially participated, ×: not participated

Table 4 Training record in the third training(Training period: April 18th in 2012- Mat 27th)

Date in 2012	Place	Contents	~~Md. Mahbubul Alam~~	**Md. Shohel Rana**	Sadil Bin Nur	~~Tridib Chowdhury~~	**Md. Saiful Islam**	**Md. Saifur Rahman Bhuiyan**	**Hasnatul Zannat Sweeety**	~~Abdur Rouf~~
5/10	PANI	Follow up of GIS operation (10:0-13:00): Preparation of GIS data in P Thana	×	○	×	×	○	○	○	×
5/13	PANI	OJT(10:00-13:00) Preparation of initial GIS data in P Thana	×	○	×	×	○	○	○	×
5/14	PANI	Instruction for preparation of Seminar	×		×	×	○	○	○	×
5/15	PANI	Instruction for Preparation of Seminar	×		×	×	○	○	○	×
5/16	PANI	Internal meeting, Preparation of material for Seminar	×		×	×	○	○	○	×
5/17	Closed	Hartal								
5/20	PANI	Preparation of material for Seminar	×		×	×	○	○	○	×
5/21	PANI	Preparation material for Seminar	×		×	×	○	○	○	×
5/22	PANI	Preparation material for Seminar	×	○	×	×	○	○	○	×
5/23	PANI	Seminar		○	×	×	○	○	○	×
5/24	PANI	Set up GIS equipment	×		×	×	○	○	○	×
5/27	PANI	OJT(10:00-13:00) Preparation of initial GIS data in P Thana	×	○	×	×	○	○	○	×

○:participated, : partially participated, ×: not participated

JICA Expert ON GIS Design
SUWABE Kazumi
CWASA Counterpart GIS Team in PANI

Information Management on GIS for NRW Management

1. GIS operation in PANI

Objective of GIS operation is to support Information Management in PANI as follows:

- To prepare initial GIS datasets of baseline data for the NRW Management.
- To challenge capacity building of GIS operation on Information Management in CWASA.

However, PANI had to re-build initial GIS datasets for the NRW management, because of no usable Asset data in veil. As GIS operations experienced in CWASA, PANI guided to start over capacity building on GIS with the On Job Training for GIS operation.

There were mainly four (4) activities in GIS operation as follows:

- Prepare initial GIS datasets of Water Supply Facility on existing data.
- Update initial GIS datasets by Field Verification Surveys: Pipeline Survey, Leakage Survey and the NRW management
- Re-compile billing databases for monitoring of the NRW measures.
- GIS Operation supports for the NRW Management.

GIS operation in PANI is actually supported by series of Field Verifications in the NRW operation to set baseline data. There is key information about locations of Water Supply Facilities, Account Number and the connection details in Service Connection are required to verify and to update in baseline data by real time daily operation. But reality was too far to enforce those preparations easily, so that GIS operation had to start from zero with past negative impacts without acting data except billing database.

GIS operation has drastically changed to solve technical issues supported by utilizations of High Resolution Satellite Image: World View1, in order to prepare baseline data for the NRW management. Experiences in GIS activity are being feed-back to basic training of GIS operation for capacity building against counterparts to the future.

2. Activity of GIS operation

2.1 Existing data resources for baseline datasets in CWASA

There were five (5) available data resources for the NRW Management as follows:

(1) Design Division

- CAD drawing datasets
- Two (2) databases about service meters and customer information
  Those databases in Service Connection are relating to a document of Consumer Service Connection Completion Report (CSCCR) in Sales Division.
- Paper maps of As-Built Drawings

(2)Sales Division

- Paper Documents of CSCCR, CSCCR data was available to access since 2000.

(3)Computer Section

- Billing databases

Data resources except As-Built drawings were already developed to digital maps and databases in the 1990's, but the data were not updated well yet. Facts found were as follows:

- Absences of acting Asset data about maps and databases in daily operations on Facility Management except billing databases
- No updating of data since the end of 1990's.
- Missing Service Connections about 30,000 records since 1998

2.2 Realities of Datasets faced to the NRW Management in PANI

Realities of data availabilities were too far to compile necessary baseline data for the NRW Management easily because of absences of acting data about usable maps and usable databases which were supported by daily operations.

There was no updating of initial data since the end of 1990's. So, PANI started GIS Operation from nothing else with solutions of past negative impacts in the beginning of PANI.

Many absences caused by past problems, are directly indicating issues of GIS operation to make data supply difficult to the NRW Management. Those absences were as follows;

- Absences of past GIS datasets and GIS system
- Absences of Quality Control in past Asset data in the 1990's
- Absences of updating activities in the Operation and Maintenance: No synchronized updating of data among divisions about Asset mapping data, Service Connection details and maintenance records, CSCCR, and billing records
- Absences of missing service connections in CAD drawings about 30,000 records since 1998, and no correspondences in billing databases
- Absences of items in CSCCR: Null data of Geo-Codes and null data in items of Service Connec-

tion details in CSCCR

- Absences of Geo-Codes and missing locations in billing database since 1998
- Absence of Quality Control in the Operation and Maintenance in daily operation

There were many critical paths to make any GIS operation stack. The facts concerned were formulated by complexes of those spiral problems in Asset Management as shown in Table1. Main problems were mostly caused by a setup of a local coordinate system in CAD dataset and absence of Quality Control in the production.

There were mainly five (5) key issues to make it difficult to update maps and Service Connection data as follows:

- Absences of GIS datasets and GIS capacities
- Inadequate Map Coordinate System in CAD datasets never to match mapping features with available maps in CDA, satellite image and GPS data
- Absences of Geo-Code: Mauza Number and CWASA Holding Number in CSCCR, and Billing databases never to indicate location of Service Connection since 1998
- Miss-Matching of Geo-Codes between Mauza Number and CWASA Holding Number in CSCCR and Mohallah in billing databases
- Irregularity of monthly billing records requiring to check and to re-calculate monthly water consumptions and monthly billing data.

The problems in Table1 made next spiral problems with complexes in Table2 relating to absences of Quality Control and Operation and Maintenance (O&M). Those issues made it hard to maintain acting data in daily operation and the mapping operation had stacked until the present.

2.3 GIS Operation in PANI

GIS operation started from nothing else with solutions of technical problems to recover reliability of mapping datasets and to improve data quality, which made it sure to solve structural problems in existing data. The next activities were taken to set up initial GIS datasets as follows:

- Restore past GIS datasets from CAD drawing: Re-build GIS datasets from CAD Drawing data by editing data to restore initial GIS datasets in 1998.
- Transform GIS data to a new coordinate system on World View1:
  CWASA local map coordinate system was made to transform to a general map coordinate system according to coordinate system on High Resolution Satellite Image of World View1 with spatial adjustments to handle distortions in original data.
- Verify data and Update initial GIS data by existing data (As-Built drawings and CSCCR)

Locations and attributes of GIS data were verified by As-Built drawings. Service Connection details were verified about locations of Service Connection by attached map of Mauza map and sketch drawings, and Account Number, CWASA Holding Number, the connection details were done by reference of the form.

In order to preserve paper document of CSCCR, documents since 2001 were encoded to database which data were accessible in Sales Division.

- Verify and Update initial GIS data by Field Verification Surveys:
  Updating of GIS datasets are mostly supported to verify baseline data by Field Verification Surveys on Pipeline Survey and Leakage Survey in the NRW Management, and GIS datasets was verified about locations and attributes in GIS data by Field Survey data. Field survey data was compiled to survey database.
- GIS support for the NRW management
  Real time updating GIS datasets in the NRW Management, Visualization of data: Display of monitoring data and cross tabulations data on maps, Data analysis: overlay for cross tabulation among GIS datasets and simulation of the NRW counter measures, production of map, and map printing to support for operation and planning in the NRW Management.

2.4 Supporting GIS system

GIS system installed in PANI to set equipment in Figue1 as follows:

- Two(2) sets of PC Workstations
- Two(2) licenses of GIS software: ARCGIS ARCINFO Version10 and ARCGIS ARCVIEW version10
- One(1) set of A1 Color Inkjet Plotter and other output devices

3. GIS Activities in PANI

3.1 Production of initial GIS data for the NRW operation

GIS operation was implemented in the pilot project areas and in the model area as locations shown in Figure2. There are almost two hundreds (200) CAD drawing files compiled to initial GIS datasets within the areas, where were covered by fifty (50) percent in CWASA CAD drawings data.

3.2 Main activities of GIS operation

There were three (3) key activities to produce initial GIS datasets for the NRW operation as follows:

(1) Activity1 on GIS and Database

Activity1 is the main activity on GIS operation which is relating to preparation of the first initial GIS datasets. The activity is divided in six (6) items inTable3 as follows:

- Compile existing map for initial GIS datasets to restore missing GIS datasets

- Rebuild GIS data and update GIS data: Transform GIS data from CWASA local coordinate system to a new coordinate system with spatial adjustment and verify and update GIS data by reference of As-built drawings
- Compile database of CSCCR: to encode records of missing CSCCR into databases since 2000.
- Compile billing data: generate billing databases with re-arrangement of customer database and master files of monthly billing records.
- Desktop Survey for field verification survey: Buildings(Types, Stories and structures) in Service Connection and pre-survey of pipelines to check items for pipeline survey
- Map digitizing of Underground Utilities Maps to support the NRW operation.

CWASA GIS data in 1998 was restored by this activity with references of existing data resources so that the first base line data was ready to update data by Field Verifications in the following activities.

(2) Activity2 supported by Pipeline Survey

Activity2 is a supporting activity of GIS operation on Pipeline Survey, which is relating to verification of initial GIS data by Pipeline Survey. The activity is divided in three (3) items in Table4 as follows:

- Prepare survey database and verify GIS data on DSR and Service Connection by Pipeline Survey in Pilot Project Areas in order to update GIS data
- Prepare survey database and GIS verification data on main pipes supported by Route Survey of Pipeline Network with GPS Survey in Model Area in order to update GIS data
  To compile GIS data and survey databases in Test Pit Excavations tin order to support maintenance work in the O&M.
- Prepare GIS data of Underground Utility lines in order to support for utility crossings in field operations on the O&M

(3) Activity3 supported by Leakage Survey and the NRW Management

Activity3 is a supporting activity on GIS operation for Leakage Survey and the NRW Management. The activity is divided in two (3) items inTable5 as follows:

- To Prepare GIS data and survey database in order to support Leakage Survey
- To compile supporting databases for District Meter Analysis and monitoring of the NRW measures about monthly billing databases with cross check of irregularity data records and re-calculations of monthly water consumptions and billing charges and,
  To update GIS data in maintenance works on Block Isolations in the NRW operation if required.
- To support the NRW Management about:
  - ✓ Real time updating of GIS data in the NRW operation and
  - ✓ GIS support: compile DB and tabulations into GIS data, data analysis about Overlay and Cross tabulation, production of map and others.

4. GIS operation supporting the NRW Management

GIS operation provides definitive functions to support Information Management and the NRW Management in Figure3 as follows:

(1) Supply and Maintenance

There are several steps required to develop baseline data for the NRW operations. GIS operation supplies preparation of baseline data from initial GIS datasets and relational databases for activities on the NRW Management. Then the data will be verified and updated by activities on Field Verification Surveys on Pipe line Survey and Leakage Survey in the NRW Management. GIS activity supports supply and maintenance as follows:

- Preparation of Baseline data with updating data by existing data resources:
  GIS datasets, service connection database, database of CSCCR and Billing database in the earlier stage of the NRW Management
- Support to compile GIS data and survey databases in Field Verification Surveys on the NRW Management
- Update GIS data and databases supported by Field Verification data in the operations of the NRW Management,
- Preparation of monitoring database in billing data for monitoring and assessment in the NRW Management

(2) Support for Operation and Maintenance

GIS operation to support for Operation and Maintenance is required in activities in the NRW management as follows:

- Utilization of definitive GIS functions to support preparation of maps and data for data analysis and activities in the NRW Management
- Real time updating of GIS data required by the Maintenance in the NRW management

GIS operation provides to support the NRW Management by visualization of monitoring data and tabulation data on maps, Query databases, Data Analysis of overlay and cross tabulations among spatial data, buffering, Production of maps and Map printing and etc.. Sample outputs of GIS Operation are shown in Figure 4 to Figure7.

5. ROADMAP of GIS Operation for Information Management

Through GIS Operation in PANI, the activities guided to preparations of ROADMAPs which became mile stones for Capacity Building on GIS operation and the On Job Training (OJT). The ROADMAPs were divided in twelve (12) ROAD MAPs in Table6 supporting GIS operation for the NRW Management in Figure8.

ROAD MAP is explained to guide GIS operation to support NRW operation in a document of "Terms of Works" from point view on capacity building for GIS on Information Management. This document is going on version up to establish work guide lines for GIS operation. Road Map is being instructed to counterparts in the OJT from June in 2011 against five (5) counterparts. ROADMAP hopefully will be fixated in CWASA with practical operations through the NRW Management in CWASA.

6. Better futures in GIS operation (Discussions and Recommendations)

In order to make GIS operation strengthen, CWASA shall not stop capacity building on GIS operation with overcoming the past negative impacts with challenges through the NRW management. PANI just orientated technical assistances for GIS operation to set up the Right of Way to overcome difficulties in the developments toward Information Management. But realities are still too far to overcome difficulties in the developments. Past history shall not be repeated with next negative impacts again. CWASA operation must be supported by database system in the future. GIS operation will never function without acting Asset data about active maps and active databases, so key issues shall be discussed about

- Modernizations for Development, Management and Operations with fast efficiencies in CWASA.

This is a common issue on Information Management in Water Sector and other stake holders in Bangladesh. There are absences of awareness required to modernize Operation and Management. Also there is another key issue of absence of Spatial Data Infrastructures on Mapping, which is directly indicating to absences of reliable base maps for Asset Management in Bangladesh.

PANI shall recommend to CWASA for better tomorrow as follows;

(1) Quick Completion of Initial Mapping of Service Connection

The initial mapping shall be put in the first priority of work in Asset Management. The activity is directly relating to Customer Management: Billing operation, Customer Relations and O&M on Facility Management. Based on this activity, CSCCR will be provided in database by the completions. The NRW operation never starts without verifications of locations and completion of connection details in Service Connection.

Geo-Code shall be set in Asset data. CWASA Holding number or a new Geo-Coding on Wards will be provided in Asset data and billing databases according to the completions.

(2) Start up for database development for Operation and Maintenance

Database development shall be challenged to modernize the management in CWASA. GIS operation requires developments of active Asset Maps and active databases to be supported by daily op-

erations in relevant divisions at CWASA. GIS systems never functions without databases and supporting system. This is a challenge against conventional management with paper documents and human protocols. Particularly, database development is key activity on Facility Management to develop databases and supporting system in CWASA. GIS datasets shall be feed-back to those developments in order to establish the management system as follows:

- Customer Lodgers supported by CSCCR and relevant data for Customer Management and Customer Relation in Sales Division
- Asset databases to maintain GIS datasets and relational databases in Asset Mapping in Design Division and MODs
- Management Lodgers for O&M in the supporting system for Facility Management in MODs
- Re-development of billing databases providing Gee-Code to handle geographic locations of Account records in Computer Section

(3) Requirement of development strategy and action plans for Modernization and Development

Top decision for the modernization shall be required to develop Information Management to support Operation and Maintenance. Top to Down & Bottom to Up Actions shall be required for development to build capacities and to strengthen databases for daily operations. GIS operation has never realized about definitive functions to contribute for Facility Management since the 1990''s.

Challenges for Modernizations and Development shall be required to make any developments to accelerate by GIS, Database and System on Information Management. PANI experience and baseline data shall be to make Feed-Back to utilize daily operation with fixation of capacity on GIS. However it is still too far to fixate the capacity into daily operation in CWASA.

GIS operation is very simply and essentially supported by daily operations in real time. Daily operation makes it ensure to utilize data for the NRW management. But it is still too far from realities to fixate Capacity Building on Information Management without any developments for Modernizations.

Table 2 Issues on Information Management in daily operation in CWASA

Issues on Development and Management	Issues caused by		
	Technical	Quality Control	O&M
Absences of Technical Quality Control in preparation of initial datasets	●	●	
Absences of Quality Control in the Operation and Management	●	●	●
Absences of Modernizations in the daily operation: Paper documents and human protocols in conventional management	●	●	●
Absences of System except billing system	●	●	●
Absences of Management Lodgers: Customer Management, Facility Management for Operation and Maintenance and Information Management	●	●	●
Absences of Customer Relations	●	●	●

●Related to problems

Table 1 Realities facing to the PANI

Issues found in existing data and daily operation	Issues caused by		
	Technical	Quality Control	O&M
Absence of GIS datasets in CWASA	●	●	●
Inadequate map coordinate system in CAD datasets for map projection	●	●	
Miss-matching of geographic location in mapping features of CAD drawings	●	●	
Absences of updating in databases about service meters and customer information, directly linking to those in CSCCR and billing data since 1998	●	●	●
Absences of incomplete items in CSCCR since 1998, particularly Mauza Number, Geo-Codes of CWASA Holding No, Service Connection details, sketch drawings and sketch maps.		●	●
Miss-Matching of mapping features on Asset Maps between CAD drawings and paper As-built drawings	●	●	
Absence of Mauza Number and CWASA Holding No in billing system: customer database and monthly billing databases	●	●	●
Miss matching of different Geo-Codes between CWASA Holding No in Mauza No in CSCCR and Mohallah in billing database	●	●	●
Irregularity of monthly billing records in billing database		●	●

●Related to problems

Table 2 Activities1 GIS and Database to prepare Initial GIS datasets in PANI

Activity	Objective in GIS Operation	Process required to
1.1Compile Existing Map for Initial GIS datasets	Restore GIS data in 1998	Compile GIS data: DBR'89C
		Compile DBs of Service Meters and Customer data in CSCCR
1.2Re-build GIS data & Update GIS data	Transform GIS data and Update GIS data by Asset Maps	Transform GIS data from CWASA coordinate system to new coordinate system
		Verify and Update GIS data by As Built Drawing
1.3 Compile DB of CSCCR	Compile DB of CSCCR to verify GIS data of SC	Compile DB & archived maps in CSCCR for O&M on FM about 18,000 records from Year 2000
1.4Compile Billing data	Re-compile billing DB for monitoring and measures in NRW	Generate billing DB: Customer information and monthly billing DB
		Arrange & Re-compile monthly billing records for NRWM
		Link DB to GIS data mutually for NRW Monitoring & Tabulations for NRW Counter measures
1.5Desktop Survey for Buildings and pipelines	Survey baseline data for field verifications and Compile surveying DBs	Survey buildings on satellite image(Types: Stories and Structures) and locations of Utility Crossing and River Crossing for field verification survey
1.6Map digitizing of Underground Utilities Maps	Compile reference map of GIS data	Compile GIS data: Archiving(Scan map), Georeferencing of archived map and Map Digitizing

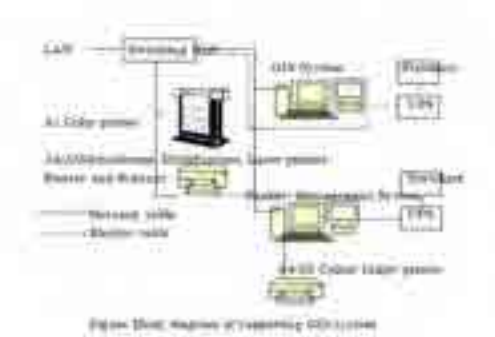


Figure1 GIS System in PANI

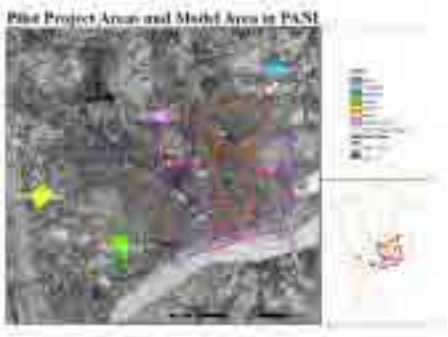


Figure2 PANI Project Area
5 Pilot Project Areas and Model Area

Table 3 Activitie1 GIS and Database to prepare Inital GIS datasets in PANI

Activity	Objective in GIS Operation	Process required to
1.1Compile Existing Map for Initial GIS datasets	Restore GIS data in 1998	Compile GIS data: DSR'&SC
		Compile DBs of Service Meters and Customer data in CSCCR
1.2Re-build GIS data & Update GIS data	Transform GIS data and Update GIS data by Asset Maps	Transform GIS data from CWASA coordinate system to new coordinate system
		Verify and Update GIS data by As Built Drawing
1.3 Compile DB of CSCCR	Compile DB of CSCCR to verify GIS data of SC	Compile DB & archived maps in CSCCR for O&M on F/M about 18,000 records from Year 2000
1.4Compile Billing data	Re-compile billing DB for monitoring and measures in NRW	Generate billing DB: Customer Information and monthly billing DB
		Arrange & Re-compile monthly billing records for NRWM
		Link DB to GIS data mutually for NRW Monitoring & Tabulations for NRW Counter measures
1.5Desktop Survey for Buildings and pipelines	Survey baseline data for field verifications and Compile surveying DBs	Survey buildings on satellite image(Types, Stories and Structures) and locations at Utility Crossing and River Crossing for field verification survey
1.6Map digitizing of Underground Utilities Maps	Compile reference map of GIS data	Compile GIS data: Archiving(Scan map) Georeferencing of archived map and Map Digitizing

Table4 Activity2: GIS/DB supported by Pipeline Survey

Activity	Objective in GIS Operation	Process to be required
2.1 Pipeline Survey in pilot project area	Prepare Survey DB Update GIS data by Field Verification data Update GIS data by Maintenance works in the NRW operation	Compile DB of field verification survey data about DSR facilities. Verify and update GIS data
		Compile DB of field verification survey about SC. Verify A/C No and details and Update GIS data in SC. Compile billing data in GIS data. Verify CSCCR from GIS data
		Update GIS data in DSR and SC by references of repair works in DMA of NRW Management
2.2 Route Survey of Pipeline Network with GPS Survey in Model Area	Prepare survey DB Update GIS data in DSR Prepare GIS data and DBs in Test Pit Excavation	Compile DB of field verification survey about locations by GPS positioning data and survey forms of pipelines and facilities, and survey forms of utility crossing and river crossing. Verify and Update GIS data.
		Compile surveying database in Test Pit Excavation
2.3Collect Underground Utility Maps	Prepare GIS data of Underground utility lines	Compile reference maps by scanning Georeferencing of scanned map and Map digitizing

Table 5 Activity 3: GIS/DB supported by Leak Water Survey and NRW Management

Activity	Objective in GIS Operation	Process to be required
3.1 Water Leakage Survey DSR&SC	Prepare GIS data and survey DB	Compile GIS data and survey DB as leakage records in Map
3.2 District Meter Analysis and Block Isolation in NRWM	Compile billing DB for monitoring Update GIS data according to maintenance events As activity of Block Isolation work	Compile monthly billing data with error check of records, re-arrangement monthly billing records for DMA Update GIS data in maintenance works for block isolation in DMA, if required
3.3 NRW Management Monitoring of NRW counter measures and Operation support for NRWM	Real updating of GIS data in the NRW operation Support to compile DB and tabulations into GIS data. Support data analysis Visualization of data, Overlay analysis and Cross tabulation Support production of map and others	Support to compile monitoring data in GIS data: flow data, water consumptions and billing data about tabular data in the NRW management Update GIS data due to maintenance works in NRW Management Supports for data analysis on GIS data and databases and preparation of maps and materials for NRW Management, if required.

Figure3 NRW Management and GIS Operation

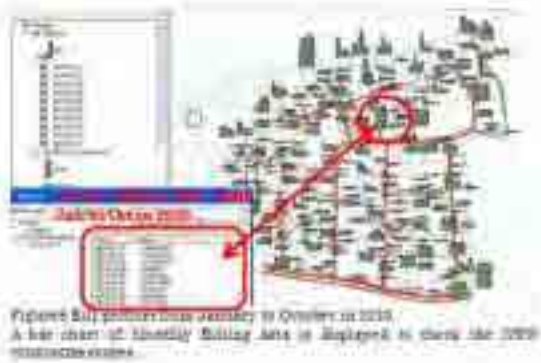


Figure4 Visualization of Monitoring data 1
Monthly billing records were plotted on service meters with bar charts.

Figure5 Visualization of Monitoring data 2
Differences of Bill Amounts were plotted on service meters with bar charts: Actual data VS. Estimated data in Meter Readings

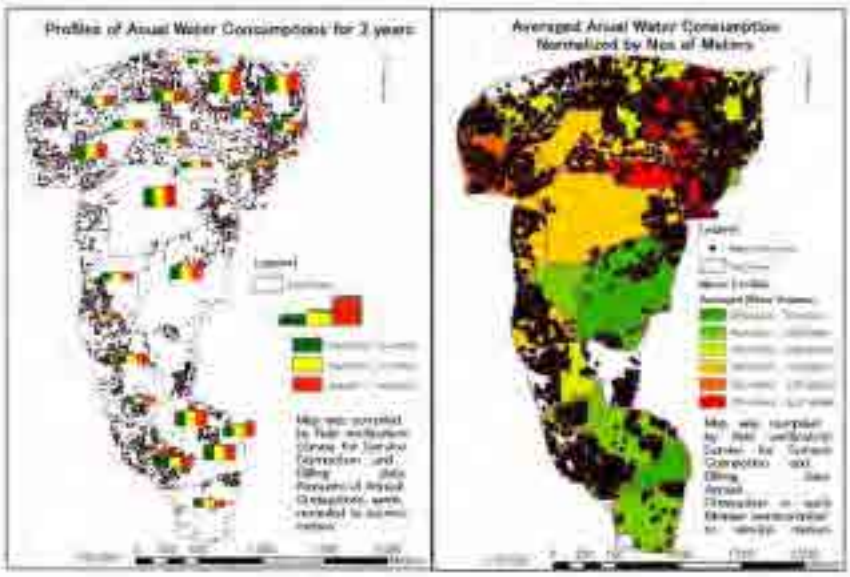


Figure6 Example of Cross Tabulations in GIS Data Analysis: Amounts of annual water consumptions for 3 years were plotted on Sub zoning maps

Figure7 Example of Cross Tabulations to support planning and management: Averaged ratios of annual water consumptions normalized by numbers of Service Connections was calculated in each sub-zone

Table6 Item of ROADMAP

ROADMAP	Contents
ROADMAP1	Compiling GIS Datasets to Restore Initial Data at year 1986 from CAD Drawing Files with Georeferencing in ROAD MAP2
ROADMAP2	Transform to make CWASA Coordinate System shift to a general coordinate system of WGS1984 and BTM(Bangladesh Transverse Mercator)
ROADMAP3	Compiling Existing Relational Databases of Service Meter & Customer with Updating
ROADMAP4	Compiling Database of CSCCB
ROADMAP5	Compiling Customer Data and Monthly Billing Data
ROADMAP6	Compiling Existing As Built Drawing Maps
ROADMAP7	Compiling Building Survey Data
ROADMAP8	Compiling Field Verification Survey data To Update GIS Datasets in the Model Area
ROADMAP9	Compiling GIS Datasets of the Underground Utility Map
ROADMAP10	Compiling Field Verification Data of Pipe Survey and Pipe Leakage Survey in the Pilot Project Areas
ROADMAP11	Compile NRW Databases to support Monitor & Action for the NRW
ROADMAP12	Compile Test Pit Excavation Databases to verify Utility Crossing for O&M in Fld

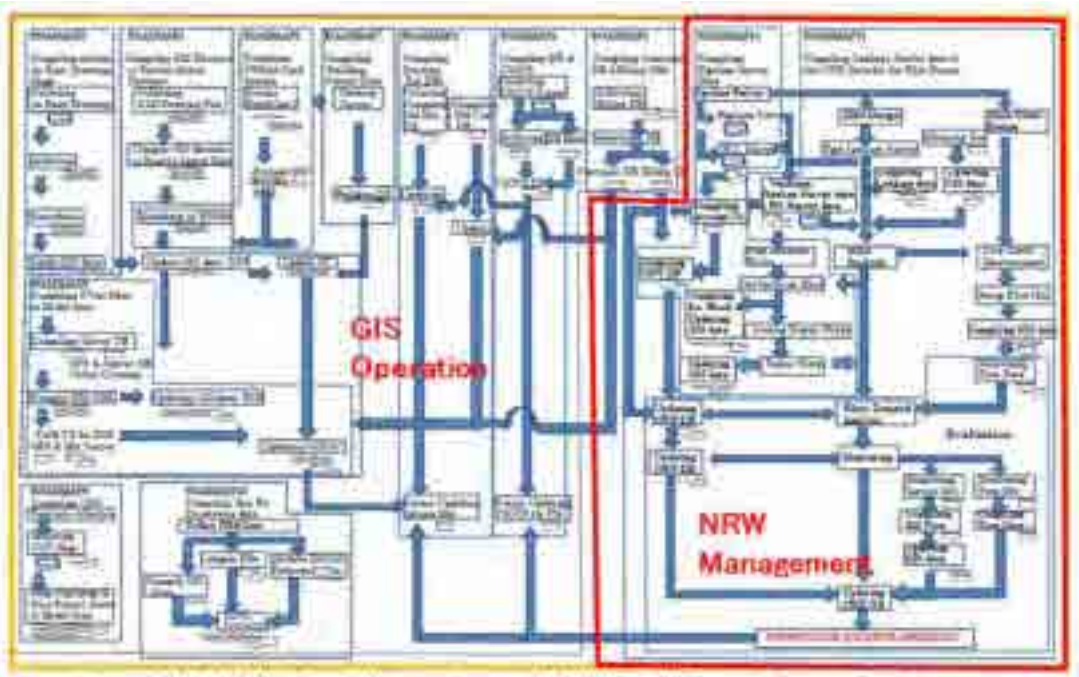
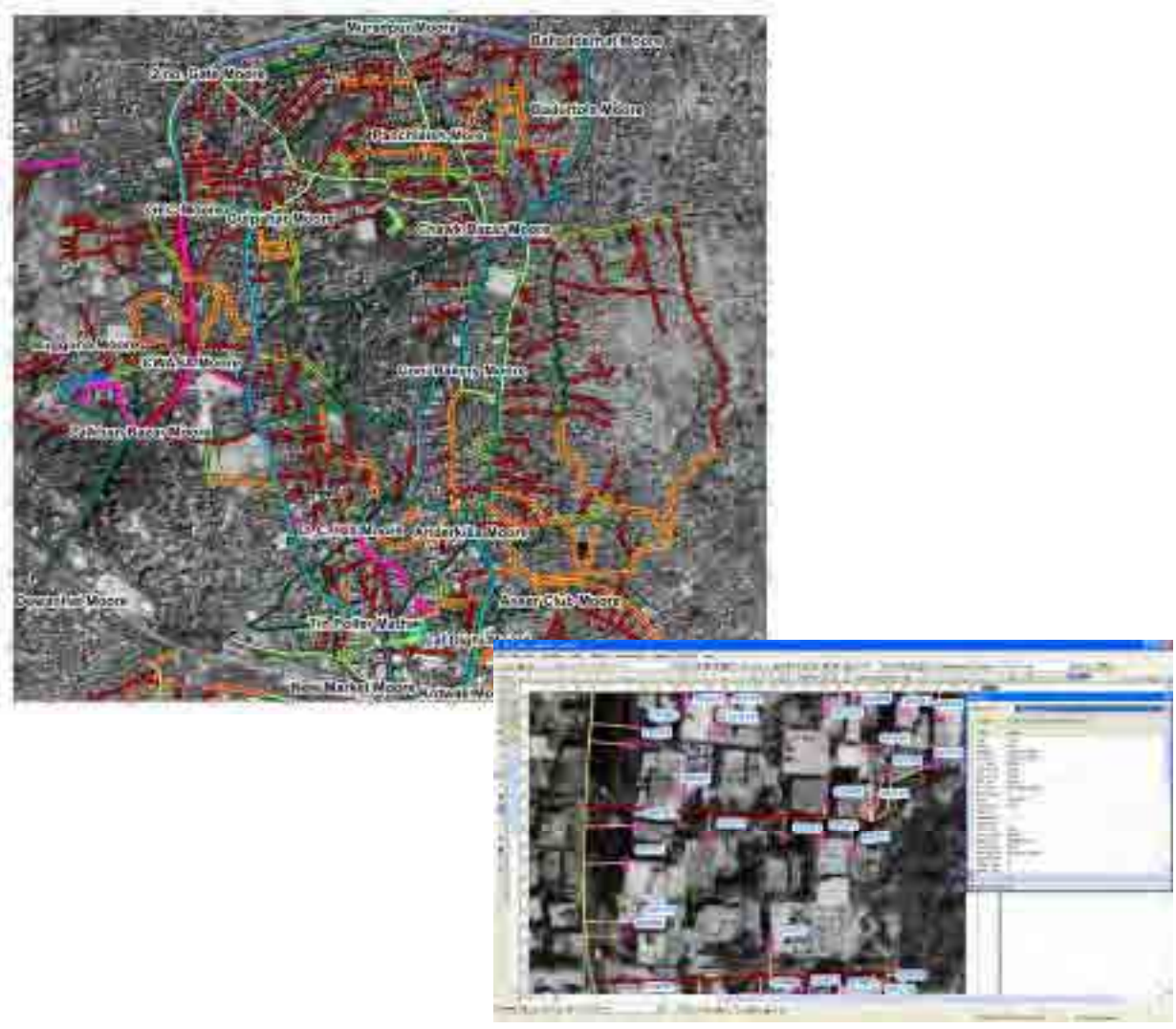


Figure8 ROADMAPS on GIS operation in the NRW as Pillars in Capacity Development

Appendix-3 Survey Procedure Manual in Model Area

Survey Procedure Manual (ver.1)

For Field Verification Survey by GPS



JICA PANI PROJECT TEAM

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Introduction

This Survey Procure manual (ver.1) was made by PINI Project Team on January, 2012.

At present, Chittagong Water Supply and Sewerage Authority (CWASA) have the capacity to supply water around 50% of the demand of the city area. CWASA has taken initiative to overcome the gap between the demand and the supply of water. CWASA has availed the Japan's ODA Loan to establish Karnaphuli Water Treatment Plant which will be able to supply up to 286,000 cubic meters per day. There are several subject issues being left for realization of overall improvement of water supply condition.

A report of CWASA in 2007 shows that around 30% of total supply amount has been lost as non-revenue water. CWASA considers leakages in pipeline as the major cause of this wastage. However CWASA has lack of appropriate technology and skilled staffs to implement leakage prevention measures.

In this connection, the Government of Bangladesh (GOB) has requested the Government of Japan (GOJ) for implementation of technical cooperation project regarding leakage prevention and non-revenue water reduction measures. GOJ then decided to take up this request. As a result, GOB and JICA signed a technical cooperation agreement to initiate a project to reduce non-revenue water supply of CWASA. The project has been named as 'The Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA.

In this project, Model Area has been designated to redevelop distribution network drawings by introduction of GIS (Geographical Information System) mapping with the use of High Resolution Satellite Images to compensate absence of accurate topographic map of Chittagong City.

To be established the accurate map, those survey have been implemented as a part of PANI project. In any survey, the methodology and its procedure always have been changed with the situations and/or the purposes of the spot. It also has been made the methodology and its procedure with trial and update in the process in which advance survey. And it goes repeatedly. It is also from such a reason to have been described it on the title as ver.1. This is only one manual in the world which did so and was wrote down is here. It expresses an appreciation for the opportunity to share with you.

Don-nova. Assalam-alaikun.

PANI Project Team
Eng. Yuki Oba (JICA Expert Team)
Eng. Md. Aourongojeb Mondal
Eng. Zahidul Islam

Field Verification Survey by GPS

1. General

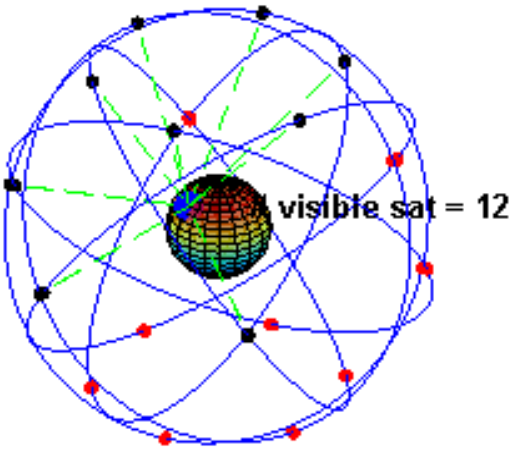
This section presents guidance to field personnel performing GPS surveys for PANI project. The primary emphasis in this chapter is on GPS Horizontal positioning techniques. The following are some general GPS field survey procedures that should be performed at station, observation, and/or session on a GPS survey.

2. GPS Field Survey

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites.

The receiver uses messages received from satellites to determine the satellite positions and time sent. The x, y, and z components of satellite position and the time sent are designated as [xi, yi, zi, ti] where the subscript i denotes the satellite and has the value 1, 2, ..., n, where n > 4 and the survey with a supplemental satellite has been required.

Situation of GPS Survey



A visual example of the GPS constellation in motion with the Earth rotating. Notice how the number of satellites in view from a given point on the Earth's surface, in this example at 45°N, changes with time.

$$(x-x_i)^2+(y-y_i)^2+(z-z_i)^2=\left([t_r+b-t_i]c\right)^2,\ i=1,2,\ldots,n$$

One of the theoretical formulas (simultaneous equations model) is as follows. Unknown factors are four, therefore four or more satellites are required.

3. Receiver Setup

GPS receivers shall be set up in accordance with manufacturer's specifications prior to beginning any observations. To eliminate any possibility of missing the beginning of the observation session, all equipment should be set up with power supplied to the receivers at least 5 min prior to the beginning of the observation session. Most receivers will lock-on to satellites within 1-2 min of powering.

4. Preparing to collect data

This topic introduces you to the concepts of :

- GPS data collection
- features
- attributes

It shows you how to:

- open a data dictionary
- print a data dictionary
- transfer a data dictionary to a field computer running data collection software

GPS data collection

Organizations such as utility companies, scientific organizations, and local governments have billions of dollars of fixed assets and equipment located throughout their region. They must be able to accurately locate, monitor, and maintain these assets.

The large task of managing these assets is greatly reduced with the use of proper field information management tools such as GPS data collection systems and GIS databases.

Information on assets can be collected in the field using a field computer running data collection software. Data collection software stores information in the form of “features” and “attributes”.

Features

A feature is a physical object or an event in the real world for which you want to collect position and descriptive information. For example, you may want to collect information about lakes or roads.

Each feature has a feature name. Feature names are equivalent to themes or layers in a GIS or CAD system. Each occurrence of a feature is equivalent to a record in that theme or layer in a GIS system.

GPS data collection software uses feature classification to determine the way the data collection software

logs GPS positions.

A feature can be one of three different types. See Table 1.

Table 1 Feature types

Feature type	Examples
Point 	Accident sites Water faucets in a park
Line 	Paths Pipelines
Area 	Lakes Wetlands

Attributes

You can define a set of attributes for each feature type. An attribute is a piece of descriptive information about the feature. For example, for the feature, Path, you could have the attribute, Width. Each Path feature that you collect in the field will have its own value for this attribute.

For each attribute you must define an attribute name. Attribute names are equivalent to items, columns, or fields in a GIS or CAD system.

An attribute can be one of six different types. See Table 2.

Table 2 Attribute types

Attribute type	Example
Menu	The surface type for a path
Numeric	The width of a path
Text	The name of the path
Date	The date when information about the Path feature was collected
Time	The time when information about the Path feature was collected
File Name	Linking the Path feature to an image of the feature on a computer

5. Differential GPS horizontal positioning techniques

GPS surveying is used to obtain the highest precision from GPS and has direct application to most topographic and engineering survey activities. PANI uses two different GPS differential surveying techniques:

A. Static
B. Real Time Kinematic

Procedures for performing each of these methods are described below. These procedures are guidelines for conducting a field survey. Manufacturers' procedures should be followed, when appropriate, for conducting a GPS field survey. Project horizontal control densification can be performed using any one of these methods. Procedurally, both methods are similar in that each measures a 3D baseline vector between a receiver at one point (usually of known state plane coordinates) and a second receiver at another point, resulting in a vector difference between the two points occupied. The major distinction between static and kinematic baseline measurements involves the method by which the carrier wave integer cycle ambiguities are resolved; otherwise, they are functionally the same processes.

A. Static GPS Survey Techniques - Two GPS receivers are used to measure a GPS baseline distance. The line between a pair of GPS receivers from which simultaneous GPS data have been collected and processed is a vector referred to as a baseline. The station coordinate differences are calculated in terms of a 3D, earth centered coordinate system that utilizes X-, Y-, and Z-values based on the WGS 84 geocentric ellipsoid model. These coordinate differences are then subsequently shifted to fit the local project coordinate system.

a) General - GPS receiver pairs are set up over stations of either known or unknown location. Typically one of the receivers is positioned over a point whose coordinates are known (or have been carried forward as on a traverse), and the second is positioned over another point whose coordinates are unknown, but are desired. Both GPS receivers must receive signals from the same four (or more) satellites for a period of time that can range from a few minutes to several hours, depending on the conditions of observation and precision required.

b) Static Baseline Occupation Time - Station occupation time is dependent on baseline length, number of satellites observed, and the GPS equipment used. In general, 30 min to 2 hr is a good approximation for baseline occupation time for shorter baselines of 1- 20 miles (1-30kilometers).

Since there is no definitive guidance for determining the required baseline occupation time, the results from the baseline reduction (and subsequent adjustments) will govern the adequacy of the observation

irrespective of the actual observation time. The most prudent policy is to exceed the minimum estimated times, especially for lines where reoccupation would be difficult or field data assessment capabilities are limited.

c) Satellite Visibility Requirements - The stations that are selected for survey must have an unobstructed view of the sky for at least 15 deg or greater above the horizon during the "observation window." An observation window is the period of time when observable satellites are in the sky and the survey can be successfully conducted.

d) Common Satellite Observations - It is critical for a static survey baseline reduction/solution that the receivers simultaneously observe the same satellites during the same time interval. For instance, if receiver No. 1 observes a satellite set during the time interval 1,000 to 1,200 and another receiver, receiver No. 2, observes that same satellite set during the time interval 1,100 to 1,300, only the period of common observation, 1,100 to 1,200, can be processed to formulate a correct vector difference between these receivers.

e) Data Post-processing. - After the observation session has been completed, the received GPS signals from both receivers are then processed (i.e., "post-processed") in a computer to calculate the 3D baseline vector components between the two observed points. From these vector distances, local or geodetic coordinates may be computed and/or adjusted.

f) Receiver Operation and Data Reduction - Specific receiver operation and baseline data post-processing requirements are very manufacturer-dependent. The user is strongly advised to consult and study manufacturer's operations manuals thoroughly along with the baseline data reduction examples.

B. RTK (Real Time Kinematic) Surveying Techniques - RTK surveying requires two receivers, recording observations simultaneously, and allows the rover receiver to be moving. RTK surveying techniques also use dual-frequency LI/L2 GPS observations and can handle loss of satellite lock.

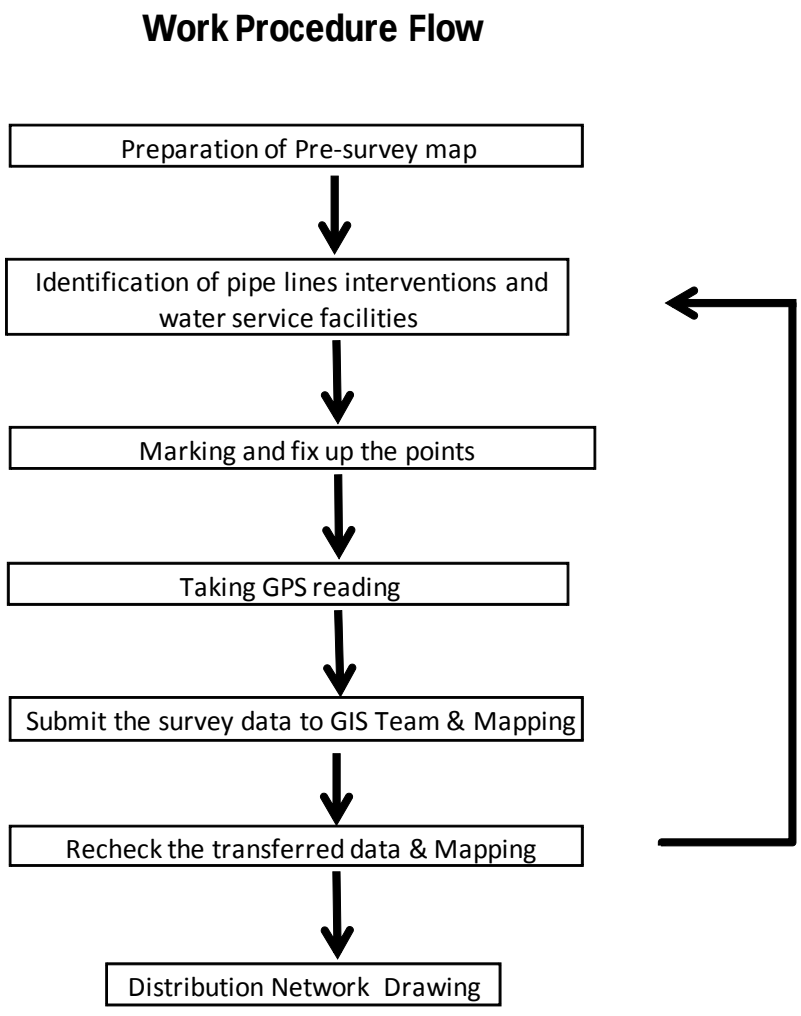
a) General - The RTK technology allows the rover receiver to initialize and resolve the integer ambiguities without a period of static initialization. With RTK, if loss of satellite lock occurs, initialization can occur while in motion. The integers can be resolved at the rover within 10-30 sec, depending on the distance from the base station.

b) Survey Procedure - RTK surveying requires dual frequency LI/L2 GPS receivers. One of the GPS receivers is set over a known point, while the other receiver may be free to travel from point to point. If the survey is performed in real time, a radio link and a processor or data collector are needed. The radio link is used to transfer the raw data from the reference station to the rover.

c) Accuracy of RTK Surveys - RTK surveys can be accurate to within 0.02 to 0.05 feet, providing a good static network and calibration were performed prior to performing the RTK survey.

6. Field Survey Procedure:

A. Work Procedure Flow:



B. Process of Survey Done:

i) Preparation of Pre-survey map.
ii) Identification of pipe lines interventions and water service facilities.
iii) Marking and fix up the points.
iv) Taking GPS reading.
v) Submit the field data to GIS Team & Mapping.
vi) Recheck the transferred data & Mapping

i) Preparation of Pre-survey map.

The Pre-survey map which supports road information, boundary of Model Area, boundary of Word (province of Chittagong City), and As-Built Drawings (1990) of CWASA & World Bank. In addition, it has Location number at the branching point of the Distribution Network. It has been made for convenience survey work.

ii) Identification of pipe lines interventions.

CWASA reserved As-Built Drawings that is not more accurate with respect to the continuous rehabilitation of pipe line. So Survey Team verifies all pipeline intervention and water service facilities with the help of senior CWASA private plumber.

iii) Marking and fix up the points.

For conclusive work, all interventions are marked and fixed up by putting the nails and the photographs. These are recorded in Observation Sheet-1 & 2. Major survey points are sketched.

iv) GPS reading.

GPS reading on actual point is done on the marked point of interventions.

v) Submit the survey data to GIS Team & Mapping:

Distribution survey engineers compile their daily survey data and submit to map surveyor for proc-

essing GIS data.

vi) Recheck the submitted data & Mapping

Distribution survey engineers again check every pipeline & junction of the processed GIS Map.

C. Field GPS Observation Recording Procedures:

Field recording log sheets will be completed for each station and/or session. The amount of record-keeping detail will be project-dependent; low-order topographic mapping points do not need to have as much descriptive information as would permanently marked primary control points. The typical data sheet may be included on this field log record.

a. Site observation, Data collection Sheet-1

This observation sheet is used to record details information like pipe observation No., description of point, pipe size, materials, line location, Road name, picture no etc. of every points in a pipe line and linked with GPS data by giving a pipe section no. these information helps GIS team to draw Distribution Network Drawing.

b. Site observation Sheet-2 (Point Description Sheet)

This observation sheet is used to Sketch details information of every circle/more. It gives GIS team a clear indication about pipe line junction.

D. Explanation and the Use of Machine Parts:

To open the GPS machine first the power button is pressed and wait for a while. Then the required setting is checked. To take GPS reading of a point the receiver is placed over that point and press the resume button. In the field the minimum number of resuming is kept to 180.

GPS Receiver

Survey Sheet-1 (Form)

Site Observation, Data Collection Sheet – 1

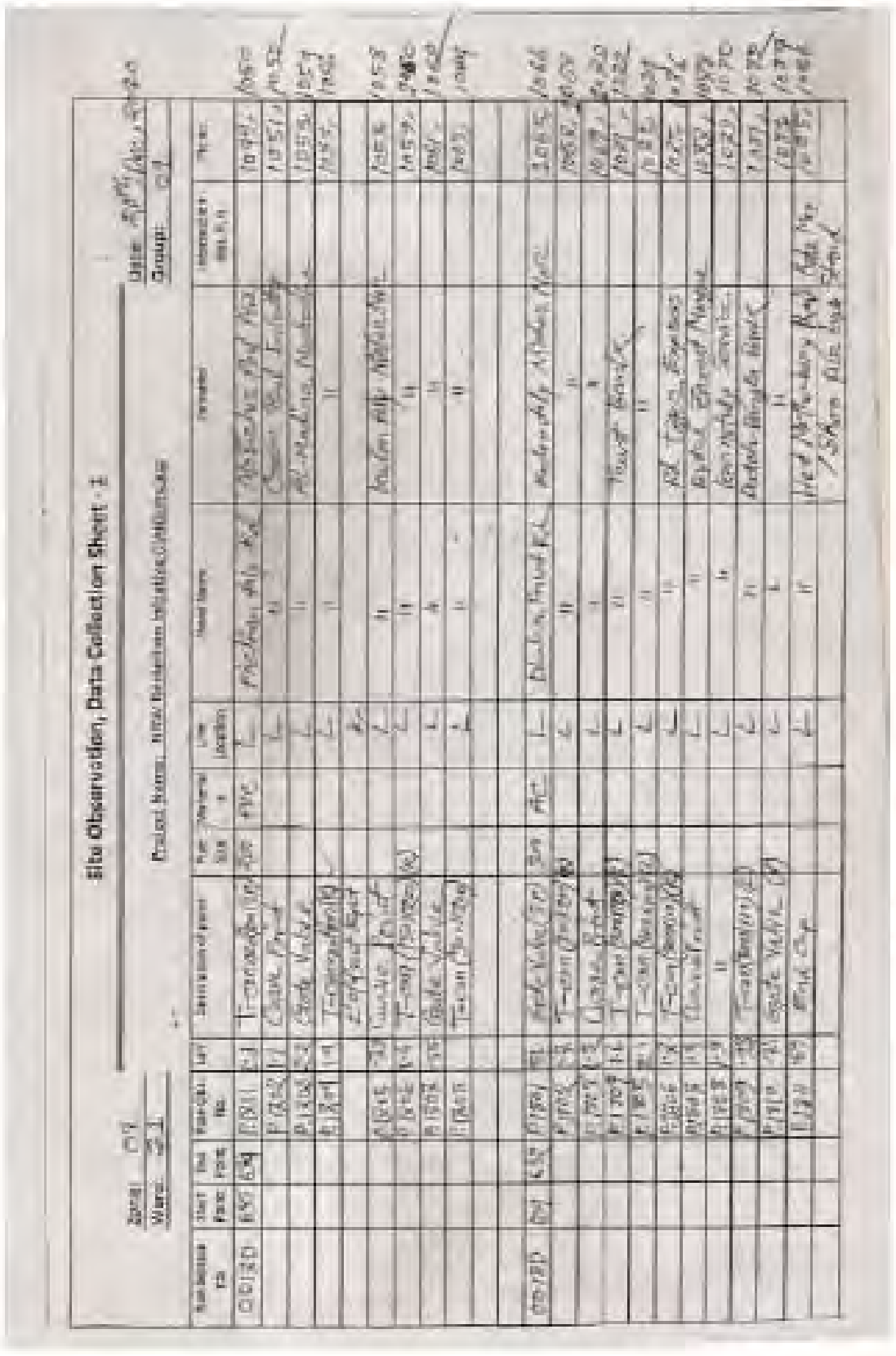
Zone:
Ward:

Project Name: NRW Reduction Initiative [illegible] Project

Date:
Group:

Pipe Section no	Start Point	End Point	Pipe Obs No	[illegible]	Description of point	Pipe Size	Materials	Line Location	Road Name	Remarks	Intersection obs P.n	File no

Survey Sheet-1 (Sample)



Survey Sheet -2 (Sketch Form)

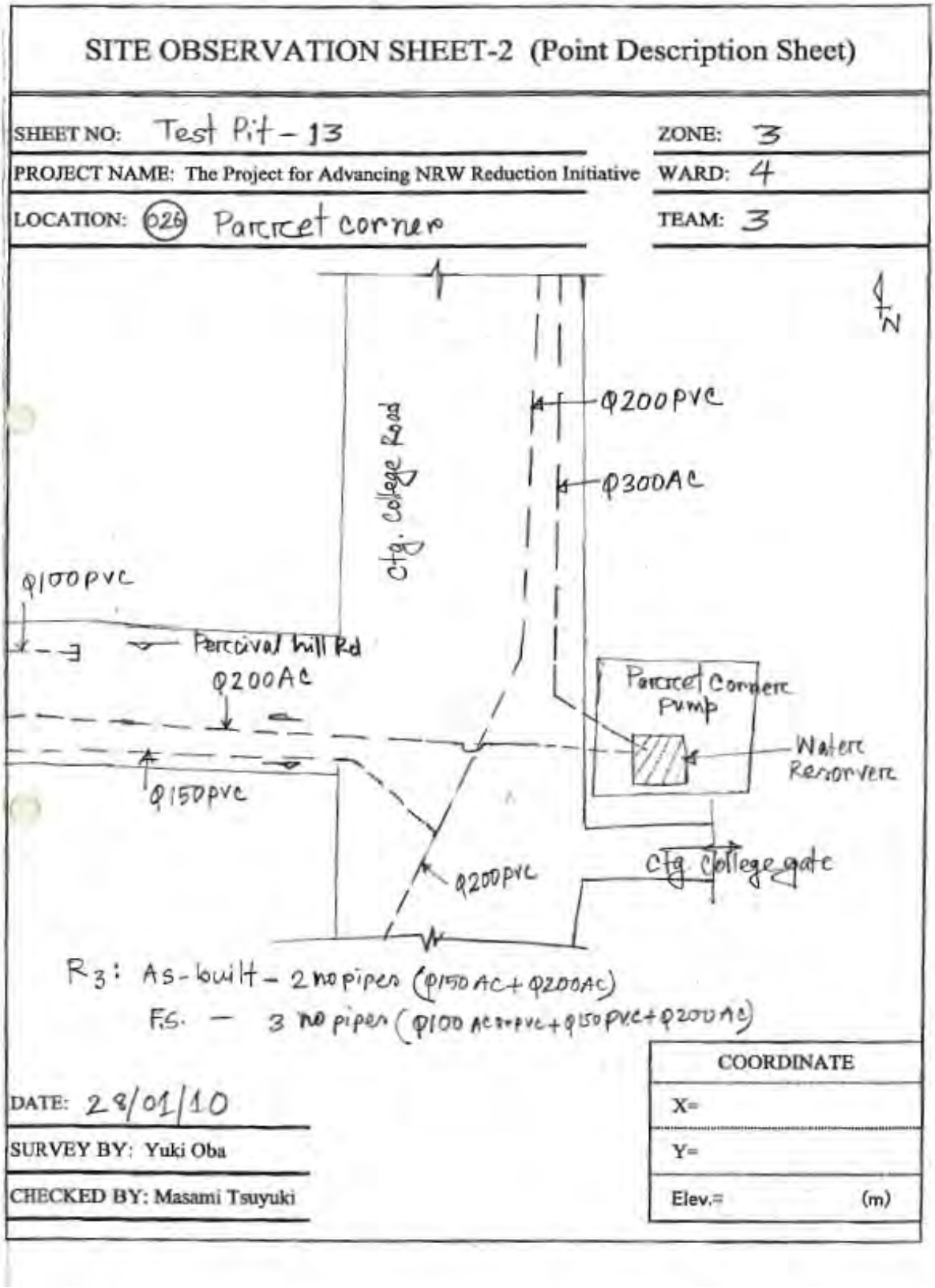
SITE OBSERVATION SHEET-2 (Point Description Sheet)

SHEET NO:	ZONE:
PROJECT NAME: The Project for Advancing NRW Reduction Initiative	WARD:
LOCATION:	TEAM:

DATE:
SURVEY BY: Yuki Oba
CHECKED BY: Masami Tsuyuki

COORDINATE
X=
Y=
Elev.= (m)

Survey Sheet -2 (Sample)



Survey Situation

Identification of pipe lines interventions

Road Location

Culvert Location

Over Head Tank Location

Reservoir Location

Deep Well Location

Hydrant Location

Making and fix up the points

Road Location

Road Location

Deep Well Location

Deep Well Location (90°-Bend)

Non-Return Valve

Gate Valve

Taking GPS reading

T-Connection (Road Location)

90°-Bend (Road Location)

Gate Valve (Deep Well Location)

S-Bend (Deep Well Location)

90°-Bend (Reservoir Location)

Gate Valve (Over Head Tank Location)

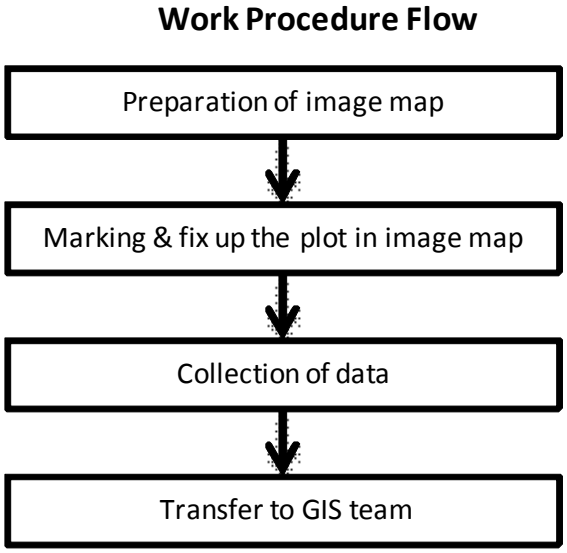
7. House to House Survey

7.1 General

The Project for Advancing NRW reduction Initiative (hereinafter referred to as PANI) is intended to enhance capability of Chittagong WASA in reduction of Non-Revenue Water (NRW) through technology transfer from JICA Expert Team. House to House Survey is another important part of PANI Project. The purpose of this survey is to prepare the data base of all houses within Zone-3 of CWASA. From this data base monthly consumption of water can be calculated for a given specific area/block within Zone-3. This specific area/block within Zone-3 can be monitored for NRW activity.

House to House Survey includes the survey of house location map, address (i.e. road name, block / lane, plot location / number), number of household, use category, photo of structure, account number, meter number, photo of service meter, name of account holder, meter status (i.e. meter present or not, meter ok or not, meter box present or not, meter valve present or not, meter valve functioning or not, meter level, meter glass intact or not, meter seal intact or not, read out clear or not), service connection (i.e. connection size, type of unit, name of DN, length of service line, material of service pipe), irregularity information (By pass line present or not, present meter reading, billing meter reading, billing system, meter buried or not, payment category), In-line pump present or not, leakage of water, type of tube well, volume of ground level tank, volume of high level tank, main water source, water availability, meter installation year etc.

7.2 Work Procedure Flow



7.3 Process of Survey

i) Preparation of image map
ii) Marking & fix up the plot in the image map
iii) Collection of data
iv) Transfer the survey data to GIS

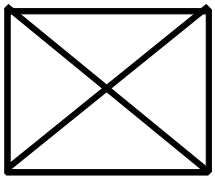
i) Preparation of Image Map & Data Collection Sheet:

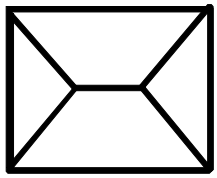
Image map is prepared with the help of Distribution Network Drawing. This map has all the required information such as Zone boundary, Word boundary, pipeline information, image of house etc. to perform the survey.

ii) Marking & Fix up the Plot in Image Map:

The surveyor goes to every house with the help of image map and mark the plot boundary and structure by specific symbol as mentioned below. They also marked Meter position, Deep Tube Well (DT) , Shallow Tube Well (ST) if any.


Building / Pacca

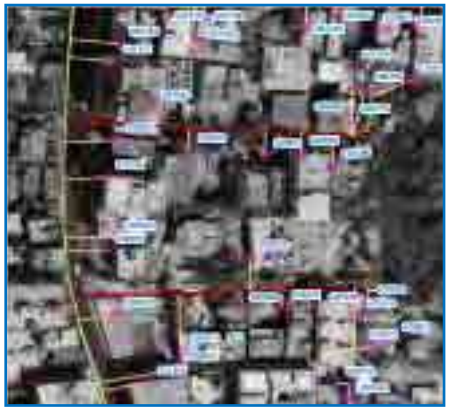

Semi Pacca


Katcha / Hut


Blank Plot

iii) Collection of Data

The respective person goes to every house and notify the consumer by letter about house to house survey. They also provide leaflet to the consumer to aware them and make them concern about the use of water. They collect all the data according to the following form.



iv) Transfar the survey data to GIS

Survey engineers compile their daily survey data and submit to map surveyor for processing data.

7.4 House to House Survey Sheet

CONSUMER INFO. IN SHORT

SL. No. | Date

Plot Location/ Number | Road No.

Block/Lane

Type Of House | No. of Storied | Number Of Household | Use Category | Photo of Structure

Account Nr. | Meter Number | Photo of Service meter

Name of Ac. Holder

Use Category: 1.Domestic 2.Industrial 3. Office 4.Recreational 5.Religious 6.Commercial 7.Public/Govt 8.Mixed.

Meter Status

	Y/N		Y/N
Meter present		Meter glass Intact	
Meter OK		Meter-seal Intact	
Meter Box present		Read out Clear	

Meter Valve Present	Yes	No	
Meter Valve Functioning	Yes	No	
Meter From GL Height	At	Above	Below

Service Connection

Connection Size	1"	¾"
Type of Unit	Gallon	M^3
Name of DN		
Length of service pipe (In Meter)		
Material of service pipe		

Others

In-Line Pump Y/N		Leakage of Water		Type of Tubewell	DT / ST
GL Tank Y/N		HL Tank Y/N			

Volume of GL Tank	L	W	D	V

Volume of HL Tank	L	W	D	V

Hearing Information

Main Water Source	WASA	DT	ST	Others
Water Available (hr)				
Meter Installation (yr)				
Comments/ Remarks:				

Irregularity Information

By Pass Line	Yes	No	
Meter Reading	Present meter reading	Billing Meter Reading	
Billing System	Minimum	Low Bill	Average

Meter Buried Y/N

Payment Category

Use Category: 1. Domestic 2.Industrial 3. Office 4.Recreational 5.Religious 6.Commercial 7.Public/Govt 8.Mixed.

Comments/ Remarks:

CONSUMER INFO. IN SHORT

SL. No. | Date

Plot Location/ Number | Road No.

Block/Lane

Type Of House | No. of Storied | Number Of Household | Use Category | Photo of Structure

Account Nr. | Meter Number | Photo of Service meter

Name of Ac. Holder

Use Category: 1. Domestic 2.Industrial 3. Office 4.Recreational 5.Religious 6.Commercial 7.Public/Govt 8.Mixed.

Meter Status

	Y/N		Y/N
Meter present		Meter glass Intact	
Meter OK		Meter-seal Intact	
Meter Box present		Read out Clear	

Meter Valve Present	Yes	No	
Meter Valve Functioning	Yes	No	
Meter From GL Height	At	Above	Below

Service Connection

Connection Size	1"	¾"
Type of Unit	Gallon	M^3
Name of DN		
Length of service pipe (In Meter)		
Material of service pipe		

Others

In-Line Pump Y/N		Leakage of Water		Type of Tubewell	DT / ST
GL Tank Y/N		HL Tank Y/N			

Volume of GL Tank	L	W	D	V

Volume of HL Tank	L	W	D	V

Hearing Information

Main Water Source	WASA	DT	ST	Others
Water Available (hr)				
Meter Installation (yr)				
Comments/ Remarks:				

Irregularity Information

By Pass Line	Yes	No	
Meter Reading	Present meter reading	Billing Meter Reading	
Billing System	Minimum	Low Bill	Average

Meter Buried Y/N

Payment Category

Use Category: 1. Domestic 2.Industrial 3. Office 4.Recreational 5.Religious 6.Commercial 7.Public/Govt 8.Mixed.

Comments/ Remarks:

House to House Survey Sheet (Sample-1)

CONSUMER INFO. IN SHORT

SL. No	M-51
Plot Location/ Number	30/SE
Road No.	Katalgonj R/A · R-04
Block/Lane	Katalgonj; Panchlaish R-04
Type Of House	Building
No. of Storied	2
Number Of Household	4
Use Category	1
Photo of Structure	488
Account No.	041919
Meter Number	009536
Photo of Service Water	489
Name of Ac. Holder	Mr. Amiya Chowdhury
Date	25/04/2010

Meter Status

Meter present	Y	Meter glass intact	Y
Meter OK	Y	Meter-seal intact	Y
Meter Box present	N	Read out Clear	Y
Meter Valve Present	Yes	No	
Meter Valve Functioning	Yes	No	
Meter From GL height	✓ Above	Below	

Service Connection

Connection Size	✓	½"
Type of Unit	Gallon	✓
Nature of DN	Φ100 PVC	
Length of service pipe (In Meter)	5m	
Material of service pipe	G.I	

Others

In-Line Pump	Y	Leakage of Water		Type of Tubewell	DT / ST
GL Tank	Y			HL Tank	Y
Volume of GL Tank	L 2.4	W 1.8	D 1.2	V	
Volume of HL Tank	L 2.2	W 1.2	D 1	V	

Irregularity Information

By Pass Line	Yes	No ✓	
Meter Reading	Present meter reading 4382	Billing Meter Reading 4045	
Billing System	Minimum	Low Bill	Average
Meter Stolen	N		
Payment Category	1		

Hearing Information

Main Water Source	✓ WASA	DT	ST	Others
Water Available (hr)	3 hrs/day			
Meter Installation (yr)	1985			
Comments/ Remarks				

CONSUMER INFO. IN SHORT

SL. No.	M-52
Plot Location/ Number	29
Road No.	Katalgonj R/A; R-04
Block/Lane	Katalgonj; Panchlaish R/A · R-04
Type Of House	Building
No. of Storied	2
Number Of Household	4
Use Category	1
Photo of Structure	490
Account No.	040104
Meter Number	98-471489
Photo of Service meter	491
Name of Ac. Holder	Mr. Saleh Ahmed Chy
Date	25/04/2010

Meter Status

Meter present	Y	Meter glass intact	Y
Meter OK	N	Meter-seal intact	Y
Meter Box present	Y	Read out Clear	Y
Meter Valve Present	✓ Yes	No	
Meter Valve Functioning	Yes	✓ No	
Meter From GL height	At	✓ Above	Below

Service Connection

Connection Size	½"	✓
Type of Unit	Gallon	✓
Nature of DN	Φ100 PVC	
Length of service pipe (In Meter)	34m.	
Material of service pipe	G.I	

Others

In-Line Pump	Y	Leakage of Water		Type of Tubewell	DT / ST
GL Tank	Y			HL Tank	Y
Volume of GL Tank	L 2.6	W 1.6	D 1.2	V	
Volume of HL Tank	L 2	W 1.4	D 1.2	V	

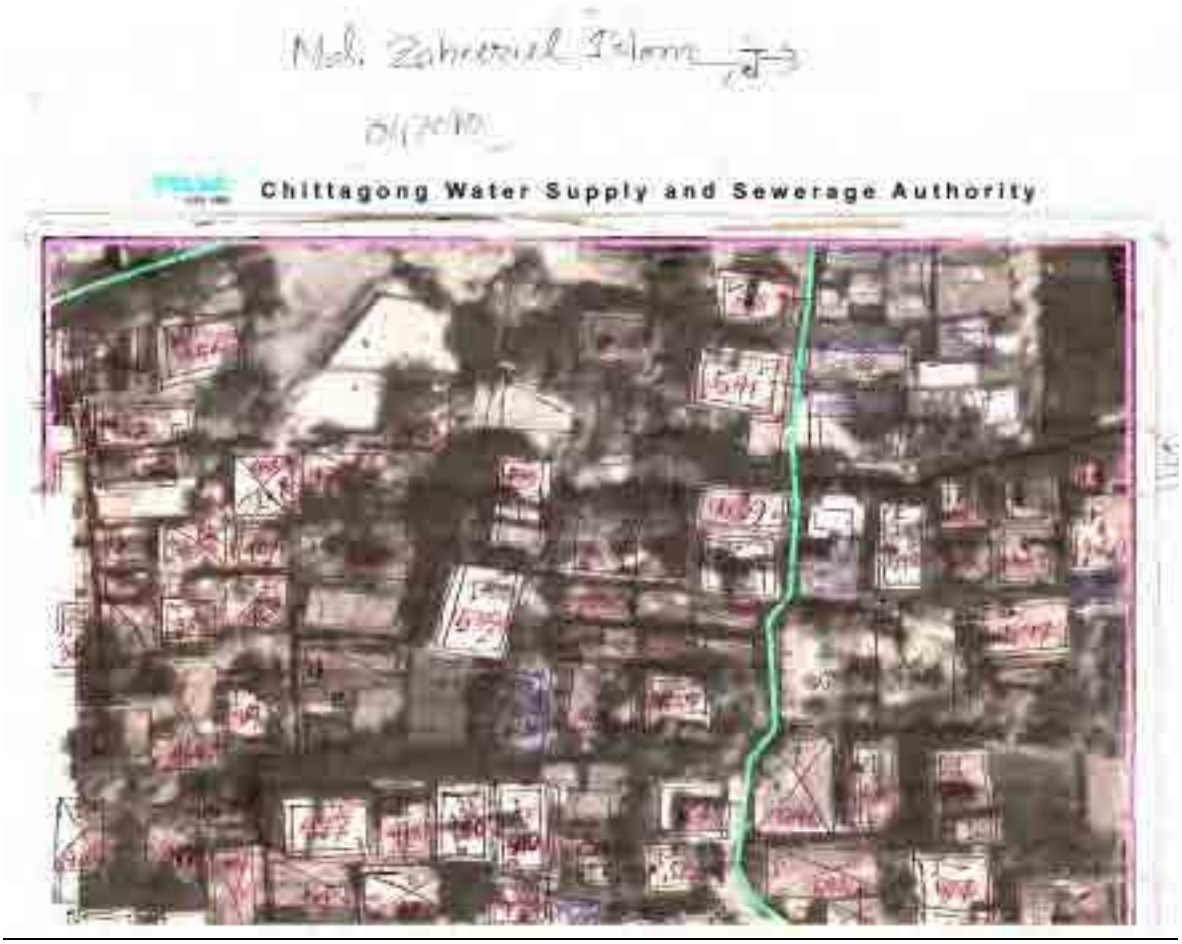
Irregularity Information

By Pass Line	Yes	No ✓	
Meter Reading	Present meter reading 9620	Billing Meter Reading 9450	
Billing System	Minimum	Low bill	✓ Average
Meter Stolen	N		
Payment Category	1		

Hearing Information

Main Water Source	✓ WASA	DT	ST	Others
Water Available (hr)	3 hrs/day			
Meter Installation (yr)	1998			
Comments/ Remarks	Meter is not OK			

House to House Survey Sheet (Sample-2)



Survey Situation

Marking & fix up the plot in image map

Commercial Area

Residential Area

Collection of data

Photo of Bill Copy

Photo of Service Meter

Photo of Structure

Photo of Deep Tube Well

Photo of By Pass Line

Photo of Shallow Tube Well

Appendix-4 Seminar on Underground Utilities

4-1 List of Participants

WASA

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
1	Mohammed Ashraful Islam	Executive Engr.	CWASA	11/01/12
2	MD. Mozahidul Islam	S.A.E	KWSP	
3	Zahangir Alamdry	DS	CWASA	11.1.2012
4	Mohammad Mahbubul Alam	XEN	CWASA	20/1/12
5	Muhammad Nurul Amin	Executive Engr.	CWASA.	
6	Mahbubul Alam	Executive Engr.	CWASA	
7	Soumit Paul	Assistant Engr	CWASA	23/01/12
8	NJAMDA DUZAL BANK	SECRETARY	CWASA	11.1.12

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
9	MOSTAK AHMED CHY	XEN	WASA	11/01/12
10	A. H. M. SAIFUL-LAH	XEN	WASA	
11	[illegible]		[illegible]	
12	~~A.H.M. [illegible] HAQUE~~	—	—	—
13	Md. Abdul Awal	DMD (ADMIN) CWASA	CWASA	11/1/12
14	Muhammad Zahirul Haque	XEN, CWASA KWSP	11	
15	EJAZ RASUL	Deputy Chief (Development)	4	
16	Anwarul kayum chy	SDE-KWSP C-1	WASA	11.01.12

WASA

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

JICA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
17	Quazi Yeakub Siddiqui	XEN	Ctg WASA	
18	Kazi Nurjahan Shilla	PRO & Asst. Secrety	CWASA	
19	Engr. Md. Nurul Absar	XEN, WASA	CWASA	
20	Md Abu Taher	XEN WASA	CWASA	
21	MD. NOROL ALAM	System Analyst	CWASA	
22	Md. Sanjoy Akter	XEN - CD-II	C. WASA.	
23	MD. JAKIR HOSSAIN BHUIYAN	CA.	C. WASA	
24				

WASA

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
25	Ratan Kumar Sarker	DMD/Engr.	CWASA	
26	Anwar Hossain chy.	photographer.	CWASA.	
27	M.H. Kabir.	A-EP	CWASA	
28	Ashik Mahmood Chy.	Asstt. Engineer.	CWASA	
29	Md. Md. Sohel Rana.	Assistant Engg.	C.WASA	
30	Md. Nazrul Islam Khan	Assistant Engr.	CWASA	
31	Golam Sarwar	E.E WASA	CWASA	
32	JAPAN DAS	SE (MIS)	CWASA	

WASA

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
33	Md. Sumonkar	S.A.E	CWASA	
34	Abdur Rouf	AE	CWASA	
35	IFTEKHAR ULLAH MAMUN	S.AE.	CWASA	
36	A.K.M. Harun-ur-Rashid	AE	CWASA	
37	S.M. Badruddoza	Revenue Officer	CWASA	
38	Md Liaquat Ali	" "	"	
39	Al Mehedi	"	CWASA	
40	Md. Nasir Uddin	Revenue officer	CWASA	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
41	Nur Hoss ain	Revenue officer	C.WASA	
42	MD. JASIM UDDIN	Sub. Asstt. Engineer	CWASA/Rob.-1	
43	Akhtaruzzaman.	P.L.S.	Do.	
44	Md. Jahangir alam.	S AE	DO	
45	MD Abul Kalam	LDA	DO	
46	Mohd. Abdul Karim Chy	C.E	CWASA	
47	Md Babul Alam	P.A.C.E	e WASA	
48	Md. Abdul Goni Chy	AE	CWASA	

Others

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
49	Mohammad Saiful Islam	Asst. Engr. (GIS) PANI Action team	CWASA	
50	Md Al-Amin	GIS Assistant	JICA/PANI	
51	Mohammad Dalower Hossain	GIS Expert	JICA PANI	
52	Montaja Ali Hyder	GIS Assistant	JICA PANI	
53	Sayed Joinal Hossain	NRW Assistant Engr.	JICA PANI	
54	Md. Apel Mahmud	Asst. Engineer (Test Pit Excavation)	JICA PANI	
55	Md. Abu Sayed	Assistant Survey Engineer (Topographic Survey)	JICA PANI	
56	Md. Tuaibur Rahman	Survey Engineer (Topographic Survey)	JICA PANI	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
57	Md. Aourongojeb Mondal	Distribution Network Survey Engineer	JICA PANI	
58	Taslima Akter	Sub. Asst. Engg (Pani Action team)	CWASA	
59	Md. Sohel	HELPER pani Action Tim	C. WASA	Sohel.
60	MD. Hossain ali Jony	Field Survey Assist	JICA PANI	
61	Md. Ibrahim Khalil	Field Survey Assi	JiCa PANI	
62	MD: Salim	Field Survey ASSt	11	
63	MD. Latif	11	11	
64	JEWEL BARUA	HELPER PANI ACTION TEAM	C; WASA	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
65	RIAZULISLAM	HALPER PANI Action tim	C.WASA	
66	Jabed khan	A. P. M (Action Team Mem)	C, WASA	
67	MD. Razul Mia	Halper Pani Action team	C.Wasa	
68	MD. AKTHAR HOSSEIN	Halper Pani Actionfor	C. Wasa	
69	Sanjoy Bosnu	Halpor pani action team	C. Wasa	
70	Nasir Uddin Ahomed	Field Servey Ast	jica Pani	
71	MD. MOSTAFA	Field Servey Ast	JICA pani	
72	MD. Raihan shorder	HELPER pani Action Tim	C. WASA	

others

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
73	G.B. Young	TL/Engineer KWSP	NJS/BETS	[signature]
74	TAKAO OCHIAI	Pipeline Eng. KWSP	〃	[signature]
75	ENGR SUDHIR kr. SAHA ROY	DGM (TRANSMISSION)	KGDCL	[signature]
76	ENGR. ABUL KALAM MIZI	DGM (STORE)	KGDCL	[signature]
77	Masahiko Kashimura	JICA	Representative	[signature]
78	Engr. Khondaker Matiur Rahman	DGM (Sales-South)	KGDCL	[signature]
79	Engr. Jahangir A. Chowdhury	DTL KWSP	NJS/BETS	[signature]
80	Engr. Khair Ahmed.	DGM (DIST.)	KGDCL	[signature]

Other

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
81	MD. NAHID ALAM	Manager (CM)	KGDCL	
82	NANDA DULAL BANIK.	SECRETARY	CWASA	11.1.12
83	ENGR. MD. ALI chy	DGM	KGDCL	১১/১/১২
84	NURUL AZAM	News Editor	BTV	
85	SAFAR ALI	Cameraman	BTV	
86	Sajjad	Reporter	Desher	
87	SARWAR UDDIN AHMAD	Deputy Chief Town Plan	CDA	
88	MD. ABUTALHA TALUKDAR	Secretary, ~~BIP~~	BIP	

Other

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
89	Ryota Saito	civil engineer	CWASA	saito
90	S. FUSAKABE	Civil engineer	KMJV	FUSAKABE
91	A. OHTAKE	civil engineer	KM. JV.	
92	TAMAL KANTI NANDY	DIRECTOR	BTCL	
93	Engr. PRABAL KUMAR SIL	DIRECTOR	BTCL	
94	~~Eng. Md. Sohel Rana.~~			
95	ISMAIL HOSSAIN	cameraman	Banglavision	
96	KAJIYAMA KOJI	Construction Engineer	KUBOTA-MARUBENI	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
97	Shakil Md Rabel Chy	Admin	Kubota-Maruben JV	
98	Hamim	Manager KWSP	NJS	
99				
100				
101	Md. Quddusur Rahman	consultants NJS-BETS	BETS	
102			RTV	
103	AKIKA SHIKAI	KUBOTA-MARUBENI JV	PM	
104	AKITAKA SETO	KUBOTA-MARUBENI JV	Construction Superintendent	

Other

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
105	Maximo L. Bugarin	Construction Specialist	NJS/KWSP	
106	Md. Arif ullah	Inspector	NJS/KWSP	
107	Ferdous Shipon	Reporter	Dainik Azadi	
108	Engr. Mukhtar Alam	CE, Ctg City Corpn.	City Corpon.	
109	Subash Karan	The Daily Azadi	Photographer	
110	Anisuzzaman Dalal	The daily Suprobhat Bangladesh	photo r	
111	Yuki OBA	PANI EX	JICA/PANI	
112	Kazumi Suwabe	JICA EXPERT	JICA/PANI	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date: January 11, 2012

Seminar on Underground Utilities

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
113	Masanori Hirayama	TL / PANI	JICA Expert Team	
114	Sumita Roy	Data Encoder	JICA PANI	Sumita
115	Happy Chakma	Data Encoder	JICA PANI	
116	Rosemary Joydhar	Communication Specialist	JICA PANI	Rjydhar.
117	Hasnatul Jannat sweety	Sub Assistant Engineer GIS team PANI	CWASA	H. Jannat
118	Mohammad Saiful Rahman Bhuiyan.	Assistant Engineer Action Team Member, JICA PANI	CWASA	
119	Md Tabebul Hasan	Data Entry Operator (GIS Team members, PANI Project)	CWASA	
120	Ayesha Parvin Rimy	Administrative Officer	JICA PANI	

Other

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

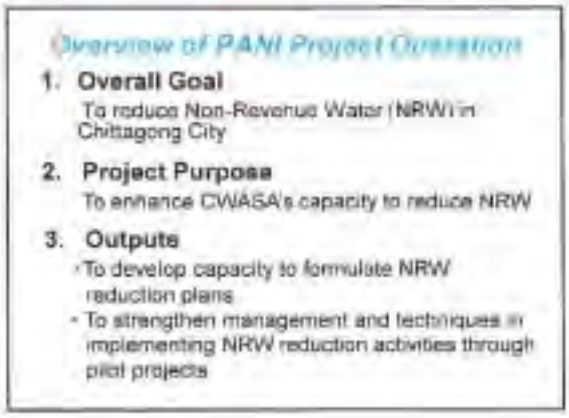
Date: January 11, 2012

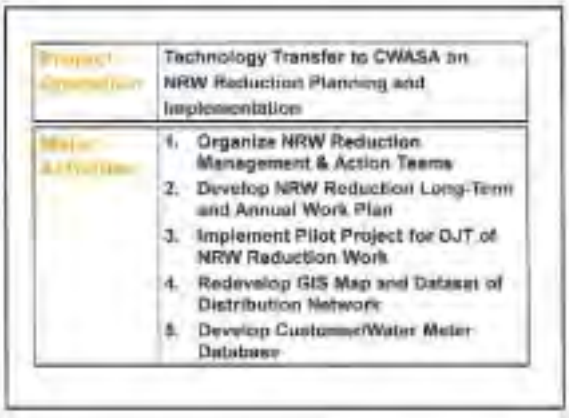
Seminar on Underground Utilities

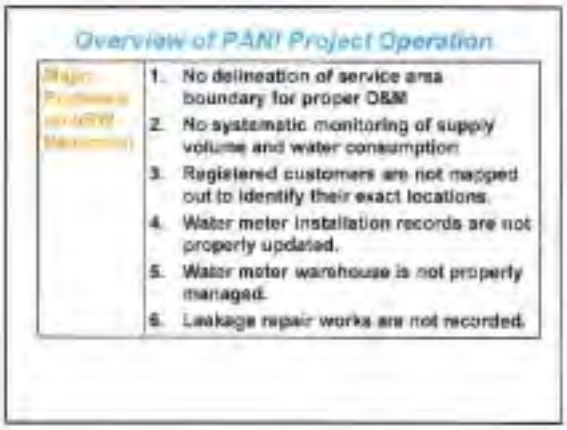
Attendance Register:

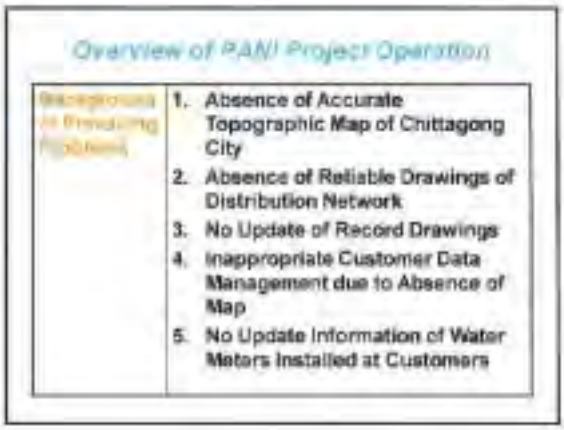
Reg. No.	Name	Designation	Agency	Signature
121	M.D. NURL AFDAR	APM (PANI Action Team)	CWASA	
122	MD. shohel Rana	helper PANI ACTION TEAM	Cwasa	
123	MD. ARIFUL ISLAM.	helper PANI ACTION TEAM	Wasa	Asif
124	Wahedul Hoque Akhand	Field Survey Assist.	JICA PANI	
125	Mohamad Anowar Hossain	Field Surveyor Assistant	JICA PANI	
126	Shakil Mahamud Mitun	Office Assit.	JICA PANI	
127				
128				

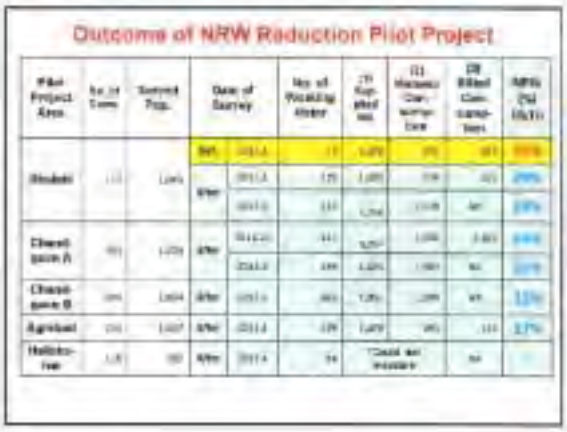
4-2 Presentation Materials

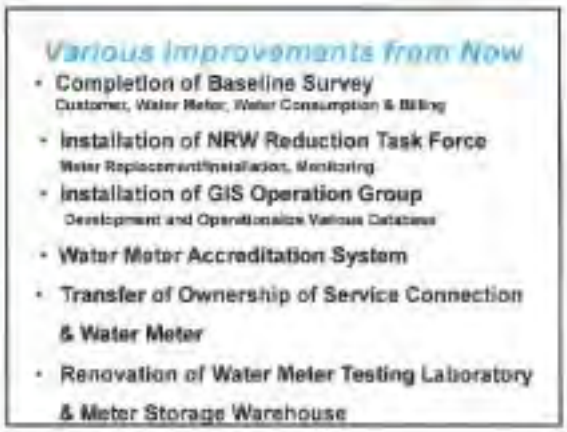




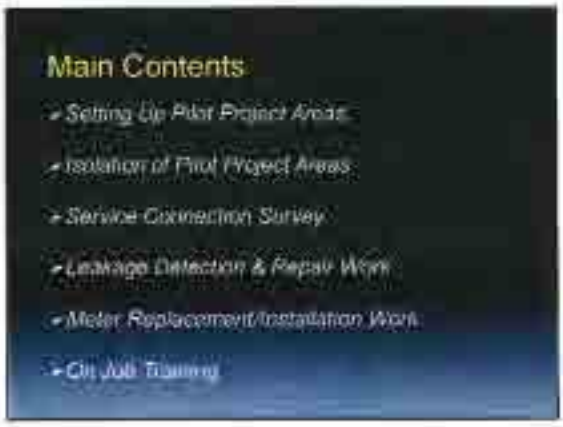

Overview of PANI Project Operation
1. No delineation of service area boundary for proper O&M
2. No systematic monitoring of supply volume and water consumption
3. Registered customers are not mapped out to identify their exact locations.
4. Water meter installation records are not properly updated.
5. Water meter warehouse is not properly managed.
6. Leakage repair works are not recorded.


Overview of PANI Project Operation
1. Absence of Accurate Topographic Map of Chittagong City
2. Absence of Reliable Drawings of Distribution Network
3. No Update of Record Drawings
4. Inappropriate Customer Data Management due to Absence of Map
5. No Update Information of Water Meters Installed at Customers

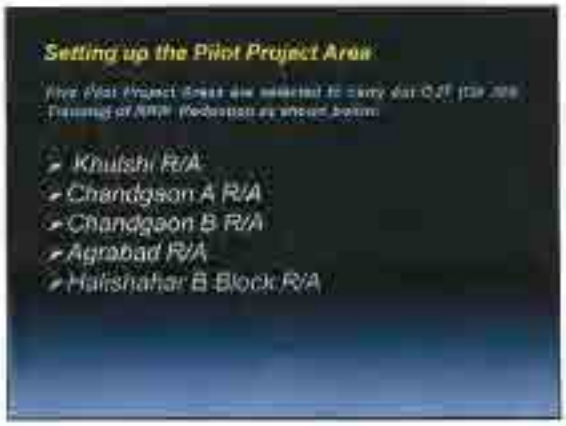

Outcome of NRW Reduction Pilot Project


Various Improvements from Now
• Completion of Baseline Survey
Customer, Water Meter, Water Consumption & Billing
• Installation of NRW Reduction Task Force
Meter Replacement/Installation, Monitoring
• Installation of GIS Operation Group
Development and Operationalize Various Database
• Water Meter Accreditation System
• Transfer of Ownership of Service Connection & Water Meter
• Renovation of Water Meter Testing Laboratory & Meter Storage Warehouse


JICA
Presentation on
Pilot Project


Main Contents
Setting Up Pilot Project Areas
Isolation of Pilot Project Areas
Service Connection Survey
Leakage Detection & Repair Work
Meter Replacement/Installation Work
On Job Training

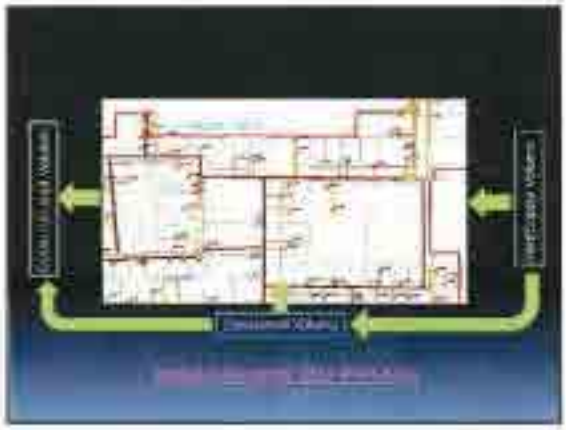

Setting Up The Pilot Project Areas


Setting up the Pilot Project Area
Khulshi R/A
Chandgaon A R/A
Chandgaon B R/A
Agrabad R/A
Halishahar B Block R/A


Pilot Project Areas at a Glance


Setting up the Pilot Project Area
•Water Supply
•Water Pressure
•Easiness of Isolation Work
•Location Conditions
•Less Traffic


Isolation of Pilot Project Areas

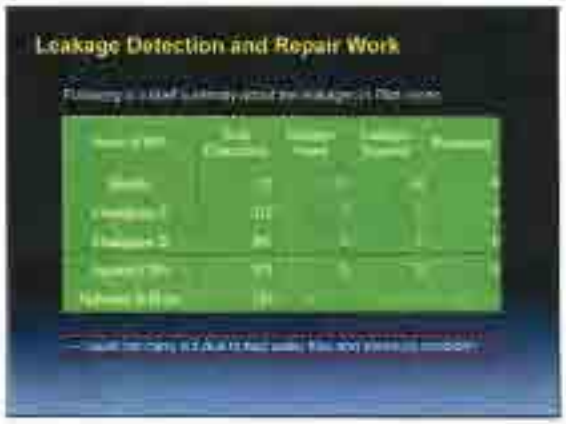



SERVICE CONNECTION SURVEY

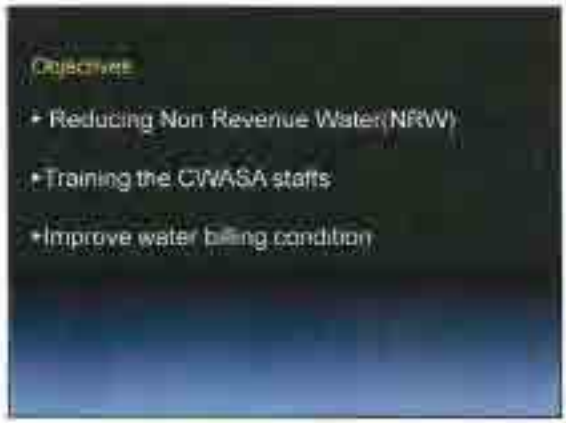

Service Connection Survey

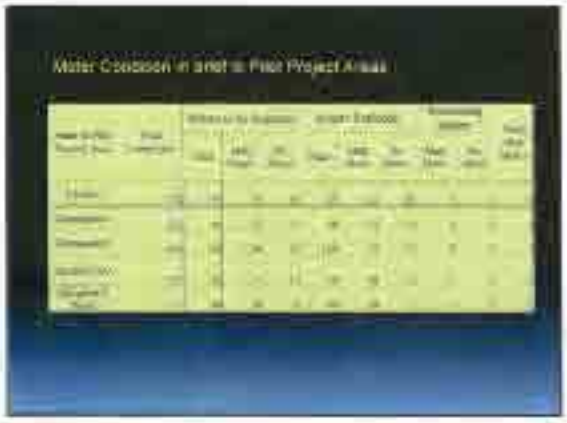

Leakage Detection and
Repair Work

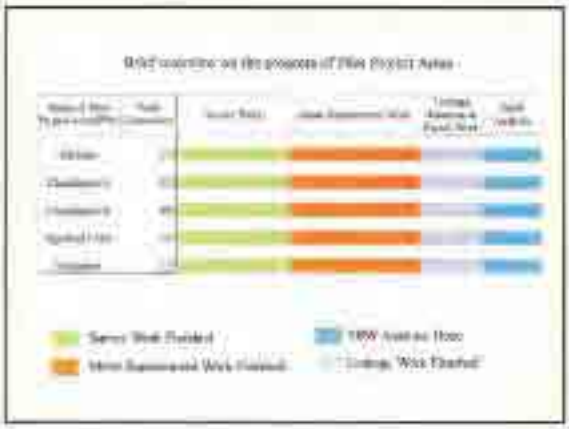

Leakage Detection and Repair Work at a glance
Detected Leakages
Repaired Leakages

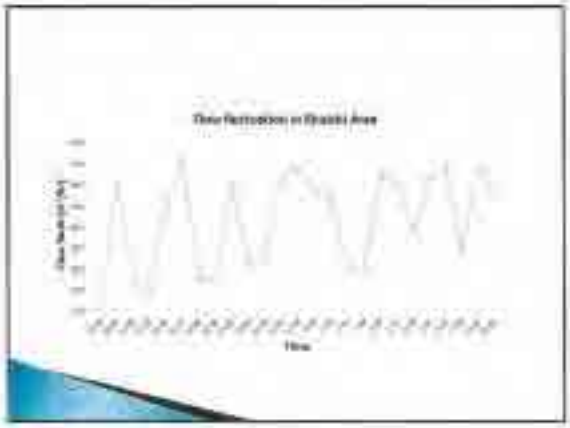

Leakage Detection and Repair Work

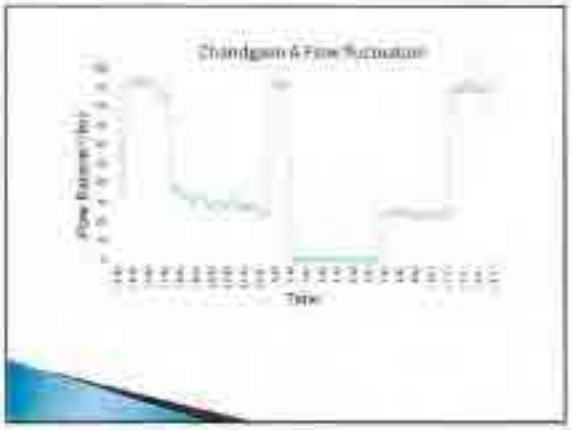

Meter Replacement/Installation Work

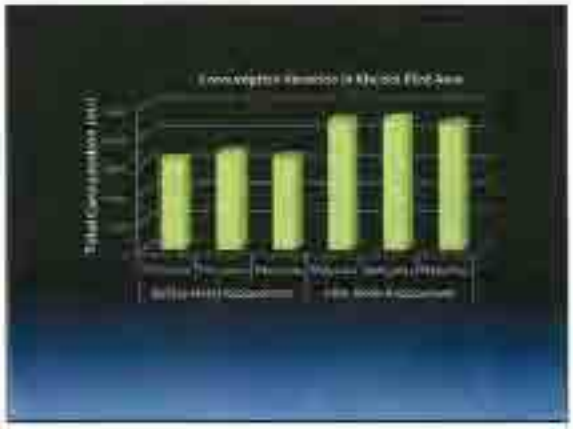

Objectives
• Reducing Non Revenue Water(NRW)
•Training the CWASA staffs
•Improve water billing condition

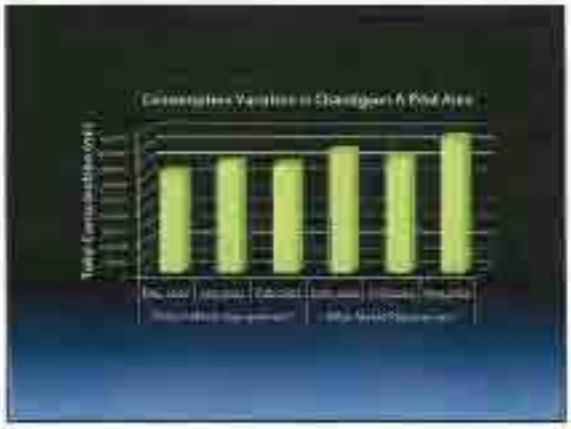

Meter Condition in brief in Pilot Project Areas

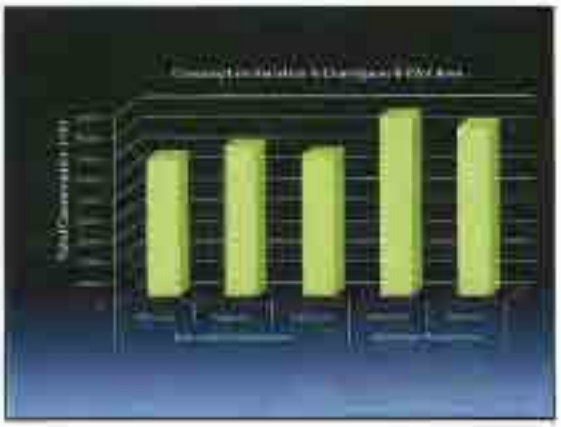













Outcome of NRW Reduction Pilot Project


On Job Training


Conclusion

Activities in Model Area

JICA PANI PROJECT TEAM
Engr. Md. Anurengniab Mondal
Yuki OBA

Survey Activities by Zone in Model Area

	Content of activities	Zone 3	Zone 6	Zone 2	Zone 1
1	[illegible]	○	○	○	○
2	[illegible] (Gas, Telecom)	[illegible]	[illegible]		
3	[illegible]	○	○	×	×
4	[illegible]	○	○	×	×
5	[illegible]	○	On going	×	×
6	[illegible]	Ongoing	×	×	×

Notes: ○-Done, ×- Not yet started

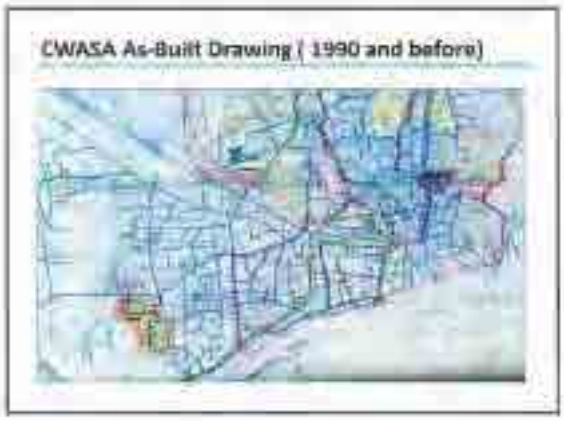
Objectives of Field Verification Survey

- To clarify conflicts among the drawings which are collected
- To identify current situation because the information was not updated
- To identify the exact position of distribution network and its facilities (Gate valve, Reducer, T-connection, Hydrant etc.) in real world
- To establish the GIS based digital mapping and database for operation and maintenance work

Data collection & Identification

A) Drawings:
- i) CWASA As Built Drawing ([illegible] and before)
- ii) World Bank Drawing (CAD drawing, [illegible])
- iii) High Resolution Image Map
- iv) As Built Drawings of Other Agencies

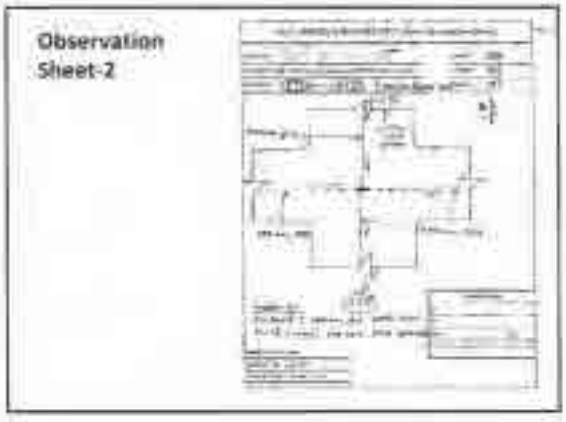
B) Devices:
- i) GPS device
- ii) Other [illegible]

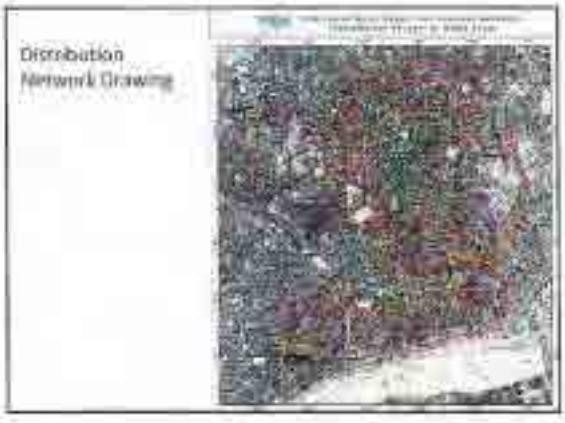

CWASA As-Built Drawing (1990 and before)


Field Verification Survey by GPS
Work Procedure Flow
Preparation of Pre survey map
Marking and fixing the points
Taking GPS reading
Distribution Network Drawing & Database


Taking GPS reading


Observation Sheet-1


Observation
Sheet-2


Distribution
Network Drawing

Summary of Model Area

-Pipeline Length & its Coefficient of Extension

Zone	Area (km2)	Pipeline Length(km)		Coefficient of Extension(%)
		As-Built Drawing 1990's	PANI Survey 2012	
Zone I	4.49	46.1	52.6	114%
Zone II	4.12	26.6	33.4	125%
Zone III	4.84	61.7	66.8	108%
Zone IV	2.63	20.6	25.3	123%
Model Area	16.08	155.0	178.1	115%

- Pipe Length(km) & Pipe Material Composition(%)

Zone		Pipe Length(km) & Pipe Material Composition(%)					Total (km)
		AC	DI	CI	MS	PVC	
Zone I		19.6	3.4		0.2	29.4	52.6
Zone II		11.9	4.9	1.5	0.5	34.6	33.4
Zone III		30.9	5.1	-	1.1	29.8	66.8
Zone IV		8.0	-	-	0.1	17.2	25.3
Mizan Area	Total(km)	70.3	13.4	1.5	1.9	90.3	178.1
	(%)	39.4%	7.5%	0.9%	1.1%	51.1%	100.0%

Test Pit Excavation Work

Objectives of Test Pit Excavation

- To clarify conflicts between the collected drawings and field verification survey.
- To identify exact position of every underground utilities.
- To establish the accurate database for operation and maintenance work. (Effective and efficient management)

Procedure of Test Pit Excavation

➢ Site Selection

1. Where many underground utilities are considered existing.
2. Considerably narrow road width.
3. Conflicts information of underground utilities between CWASA As-built drawing and information obtained from CWASA personnel working for plumbing.
4. Conflicts on information of underground utilities between CWASA personnel and local residents.

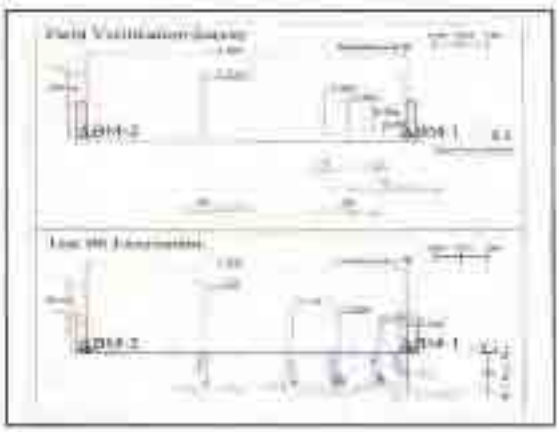

Test Pit Information Chart


Marking the existing underground utilities by spray such as yellow indicates water line, red indicates gas line, blue indicates T&T(Telecommunication) and mobile lines.

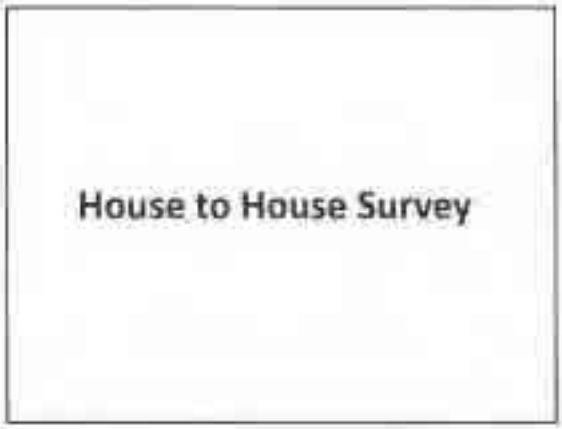

Expose all the utilities clearly and marked the utilities.
Test Pit No. 13
Test Pit No. 15

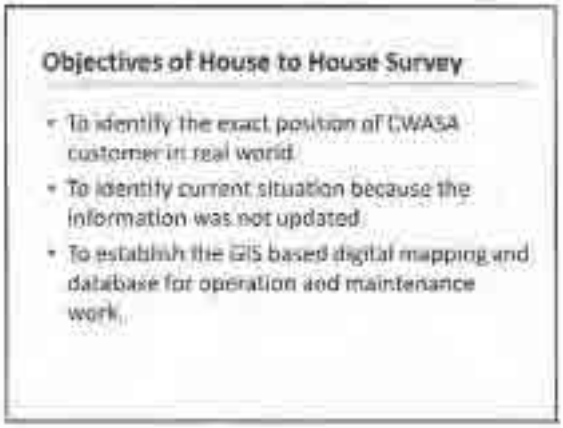

Distances are measured from ABM.

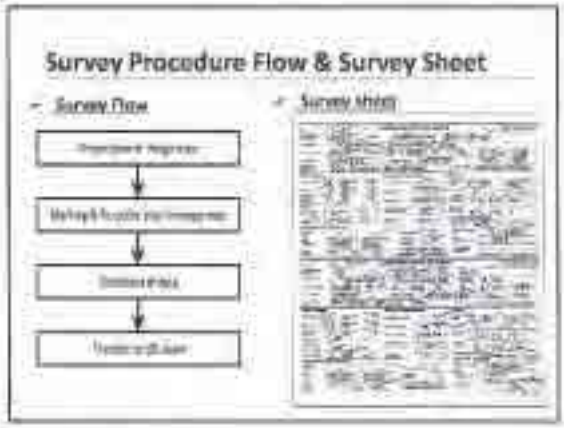

SUMMARY SHEET OF TEST EXCAVATION RESULT



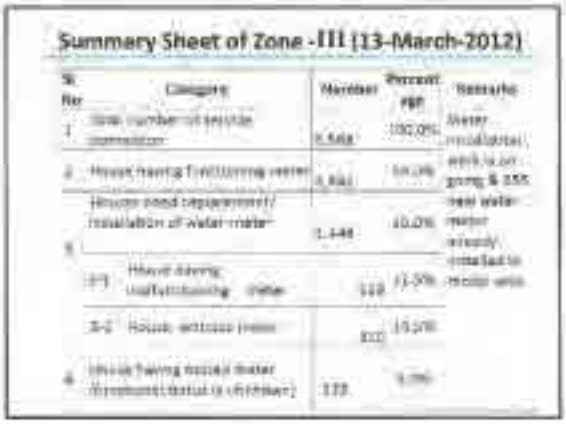

Seminar on Underground Utilities


House to House Survey


Objectives of House to House Survey
To identify the exact position of CWASA customer in real world.
To identify current situation because the information was not updated.
To establish the GIS based digital mapping and database for operation and maintenance work.


Survey Procedure Flow & Survey Sheet


Marking and fix up the plot in image map & data collection
Commercial Area
Residential Area
Photo of Bill Copy
Photo of Service Meter


Summary Sheet of Zone -III (13-March-2012)


On the Job Training in Model Area


This is a reason why, what we are doing!


This is a reason why, what we are doing!
= 33,333,636 BDT/year
= 10,333,017 BDT/year


JICA
Angatou-gozaimasu! Assalamu-alaikum !

On the Job Training in Model Area

JICA PANI PROJECT TEAM
Ms. Taslima (CWASA)

Through the Activities in Model Area, I understood.

1. Necessity of systematic procures alike PANI.
2. Necessity of database establishment for all activities.
3. Problem of absence of technical standard for the Meter installation.
4. Difficulty of the survey.
5. We knew the real poor water supply condition and costumer's opinion. We have to work more serious.

Recommendation

1. More active participation from CWASA to PANI.
2. NRW activities should be routine work.
3. Establishment of NRW Division for CWASA's operation.
4. It's just end of beginning.

Arigatou-gozaimasu! Assalamu-alaikun !


GIS Mapping

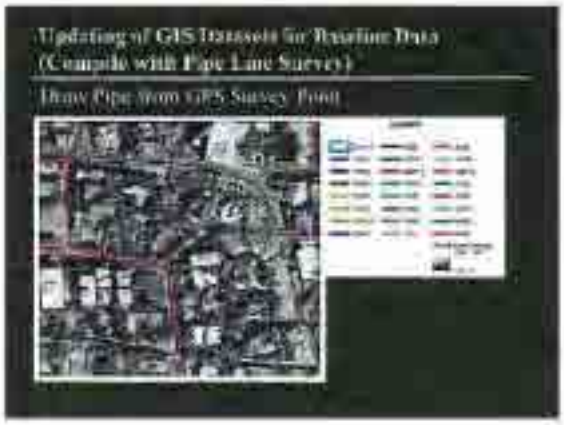

Activities on GIS / DB in PANI

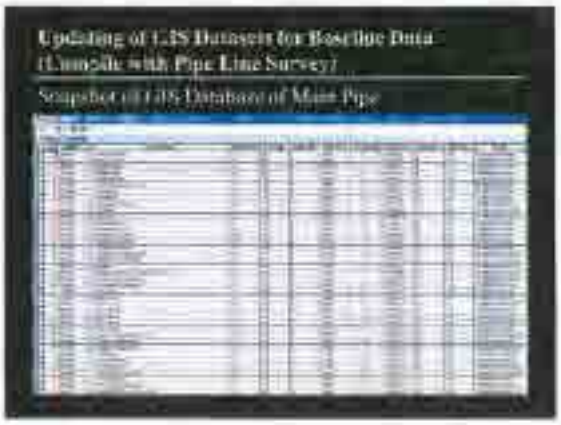

Preparation of Initial GIS dataset
Minimal Adjustment at Small Blocks

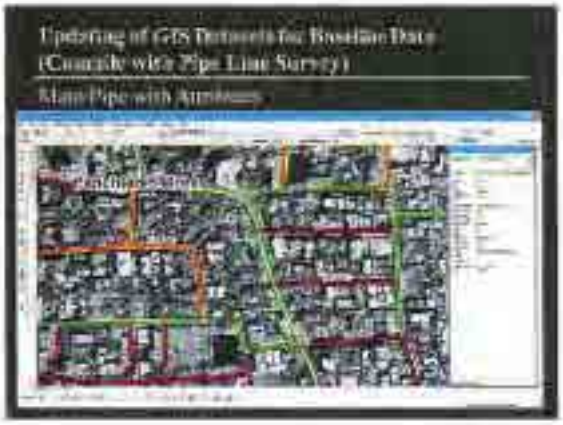

Preparation of Initial GIS dataset
Compile with As Built Drawing


Updating of GIS Datasets for Baseline Data
(Desktop Survey)

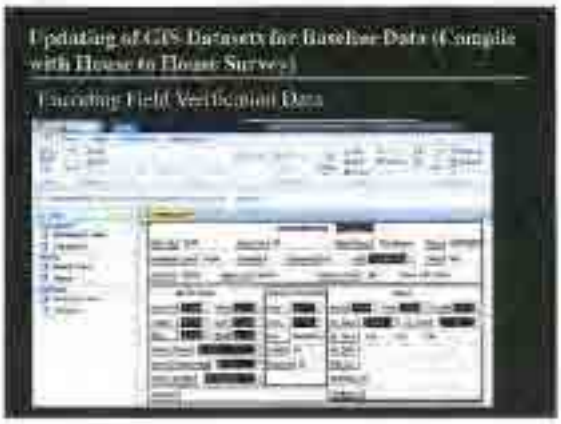

Updating of GIS Datasets for Baseline Data
(Compile with Pipe Line Survey)
Imported GPS Survey Points for Facilities


Updating of GIS Datasets for Baseline Data
(Compile with Pipe Line Survey)


Updating of GIS Datasets for Baseline Data
(Compile with Pipe Line Survey)
Snapshot of GIS Database of Main Pipe


Updating of GIS Datasets for Baseline Data
(Compile with Pipe Line Survey)


Updating of GIS Datasets for Baseline Data
(Compile with House to House Survey)
Service Connection Survey Map


Updating of GIS Datasets for Baseline Data (Compile with House to House Survey)
Encoding Field Verification Data


Updating of GIS Datasets for Baseline Data (Compile with House to House Survey)
Identification of Customer's Location

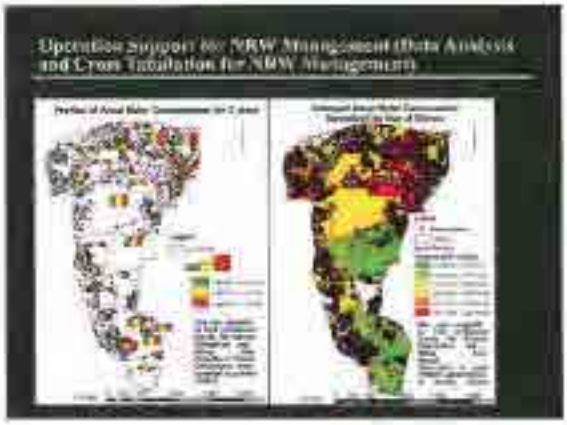

Updating of GIS Datasets for Baseline Data (Compile with House to House Survey)
Development of Customer Database


Updating of GIS Datasets for Baseline Data (Compile with Leakage Survey)


Updating of GIS Datasets for Baseline Data (Calculate Monthly Consumption and Bill)

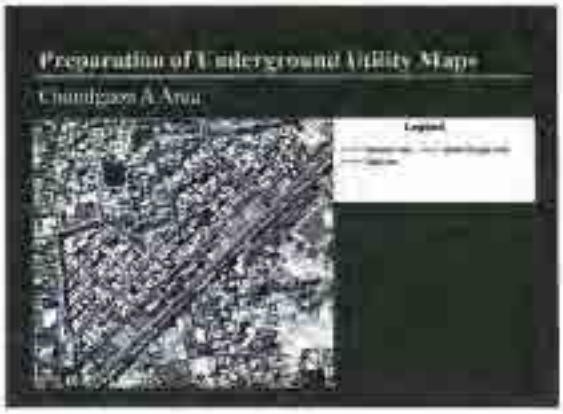

Operation Support for NRW Management (Update GIS


Operation Support for NRW Management (Data Analysis

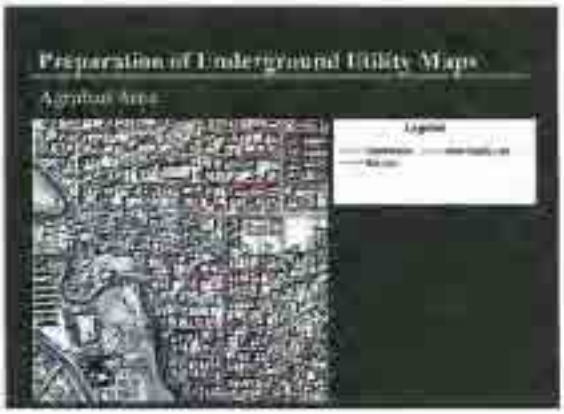

Operation Support for NRW Management (Data Analysis


Preparation of Underground Utility Maps


Preparation of Underground Utility Maps
Khulshi Area

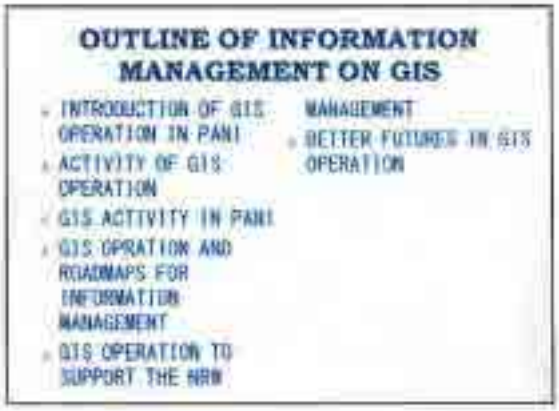

Preparation of Underground Utility Maps
Chandgaon A Area

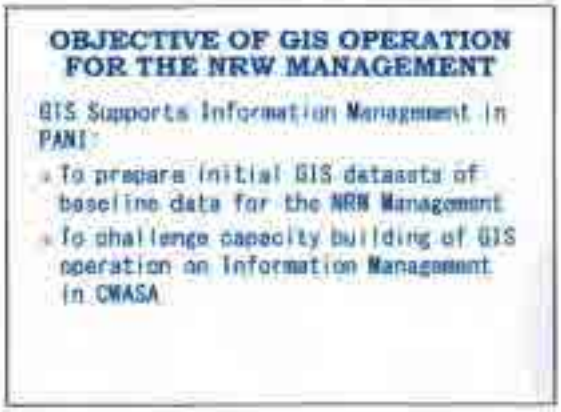

Preparation of Underground Utility Maps
Chandgaon B Area

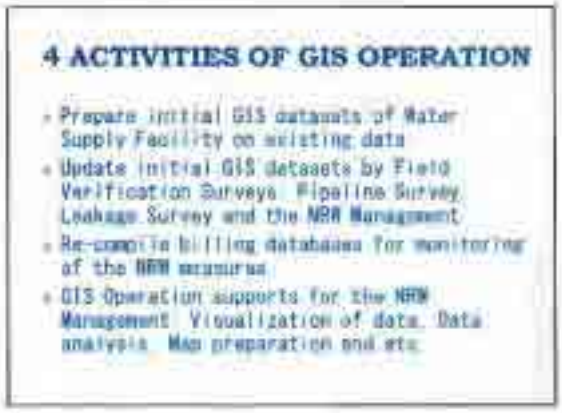

Preparation of Underground Utility Maps
Agrabad Area


Preparation of Underground Utility Maps
Halishahar Area


INFORMATION MANAGEMENT ON GIS FOR THE NRW MANAGEMENT
Presented by
SUMABE Kazumi
JICA EXPERT ON GIS DESIGN

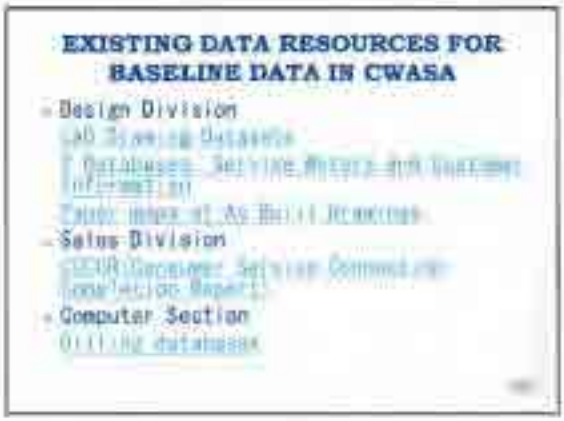

OUTLINE OF INFORMATION MANAGEMENT ON GIS
INTRODUCTION OF GIS OPERATION IN PANI
ACTIVITY OF GIS OPERATION
GIS ACTIVITY IN PANI
GIS OPRATION AND ROADMAPS FOR INFORMATION MANAGEMENT
GIS OPERATION TO SUPPORT THE NRW
MANAGEMENT
BETTER FUTURES IN GIS OPERATION


OBJECTIVE OF GIS OPERATION FOR THE NRW MANAGEMENT
GIS Supports Information Management in PANI
To prepare initial GIS datasets of baseline data for the NRW Management
To challenge capacity building of GIS operation on Information Management in CWASA


4 ACTIVITIES OF GIS OPERATION
Prepare initial GIS datasets of Water Supply Facility on existing data
Update initial GIS datasets by Field Verification Surveys Pipeline Survey, Leakage Survey and the NRW Management
Re-compile billing databases for monitoring of the NRW measures
GIS Operation supports for the NRW Management Visualization of data, Data analysis Map preparation and etc.

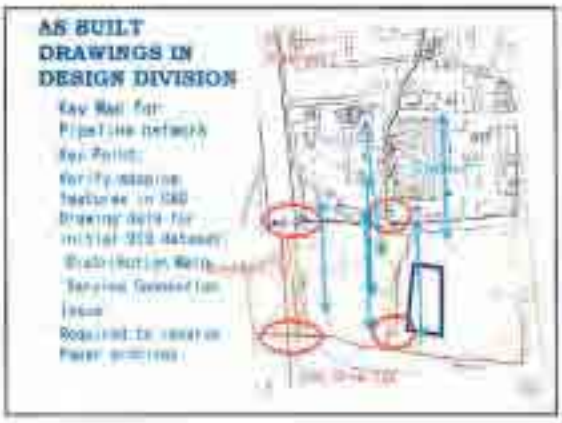

NECESSITY OF UPDATING GIS DATASETE BY FIELD VERIFICATIONS
GIS operation in PANI is Supported by Field Verifications in daily operation
Locations of Water Supply Facilities,
Account Number Geo-Code in CSCCR
Service Connection data's
The key data shall be verified and updated by field operations to set baseline data for the NRW Management


ACTIONS FOR PRODUCTION OF INITIAL GIS DATASETS
Re-Compile initial GIS datasets for the NRW Management
CWASA Asset Mapping Data has Drastically Changed to Solve Technical Supported By Utilization of High Resolution Satellite Image: World View1
FEED- BACK TO TRAINING
Makes Experiences Feed- Back to Capacity Building on GIS in order to start over GIS operation in CWASA to the future


EXISTING DATA RESOURCES FOR BASELINE DATA IN CWASA
- Design Division
- Sales Division
- Computer Section


ASSET MAPS OF CAD DRAWING IN DESIGN DIVISION


2 DATABASES IN DESIGN DIVISION
- Relational DBs
- Key Information for Mapping


AS BUILT DRAWINGS IN DESIGN DIVISION


CSCCR SALES DIVISION


BILLING DATABASES IN COMPUTER SECTION

FACT FOUND IN DATA RESOURCES

Data resources already developed to digital maps and databases in the 1990' s

Facts found

- Absences of Acting Asset data in daily operations on Facility Management except billing databases
- No updating of data since the end of 1990' s
- Missing Service Connections in Asset Map count 30,000 records since 1998

REALITIES OF DATASETS FACED TO THE NRW MANAGEMENT

Realities of data availabilities were too far to compile necessary baseline data for the NRW Management easily

- Absences of Acting data resources
  - Usable Asset maps
  - Usable databases in daily operations
- No updating of initial data since the end of 1990' s
- PANI had to start GIS Operation from nothing also with solutions of past negative impacts

ABSENCE OF USABELE DATA AND ISSUES IN GIS OPERATION

Many absences caused by past problems directly indicating issues in GIS operation to make data supply difficult to the NRW Management

- Absences of past GIS datasets and missing GIS system
- Absences of Quality Control in the past Asset data in the 1990' s
- Absences of updating Asset Data among divisions in the O&M. No synchronize updating. Mapping data, Service Connection details, maintenance records, CSCOR, and billing records
- Absences of missing service connections in CAD drawings about 30,000 records since 1998, and no correspondences in billing databases

ABSENCE OF USABELE DATA AND ISSUES IN GIS OPERATION

- Absences of items in CSCOR. Null data of Geo-Codes and null data in items of Service Connection details in CSCOR
- Absences of Geo-Codes and missing locations in billing database since 1998
- Absence of Quality Control in the Operation and Maintenance in daily operation

There were many critical paths not to make any GIS operation easy. The facts formulated complexes of those mutual problems in Asset Management

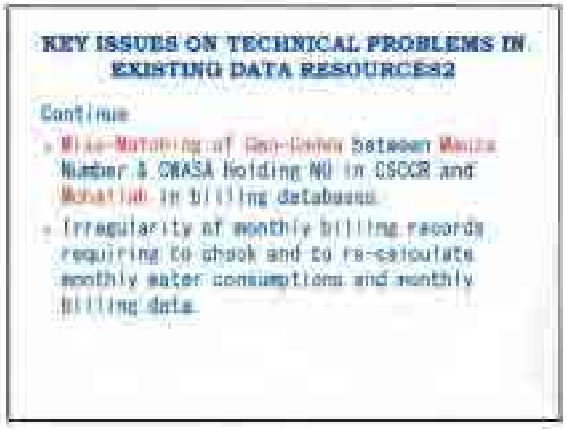
Main problems were caused by setup of a local coordinate system in CAD datasets with absence of Quality Control in the production

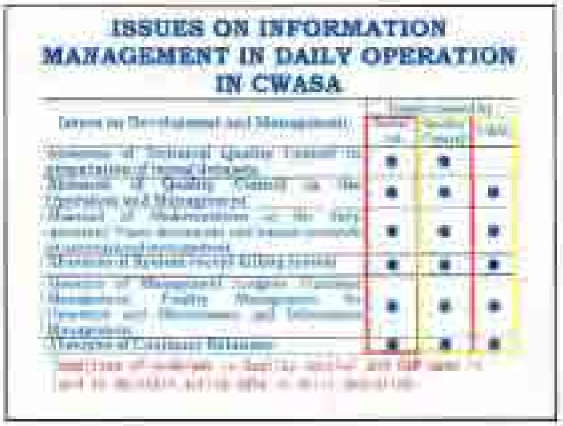
ABSENCE OF USABELE DATA ON ISSUES IN GIS OPERATION2

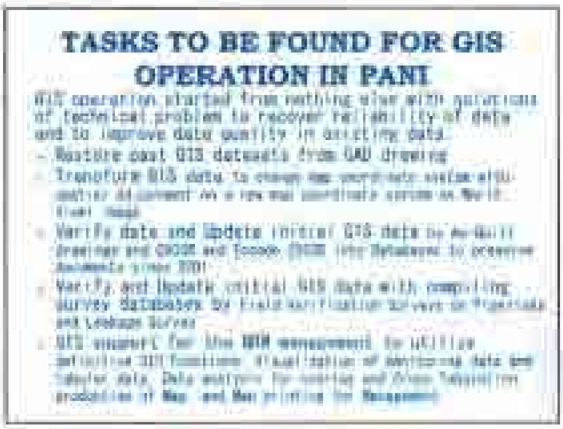
KEY ISSUES ON TECHNICAL PROBLEMS IN EXISTING DATA RESOURCES1

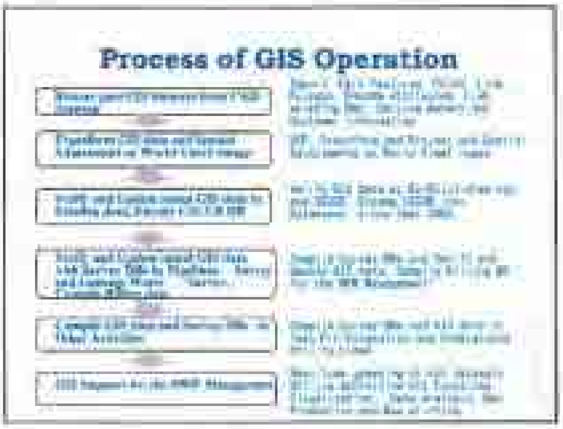
Key Issues on Technical Problems to make it hard to update maps and Service Connection data as follows

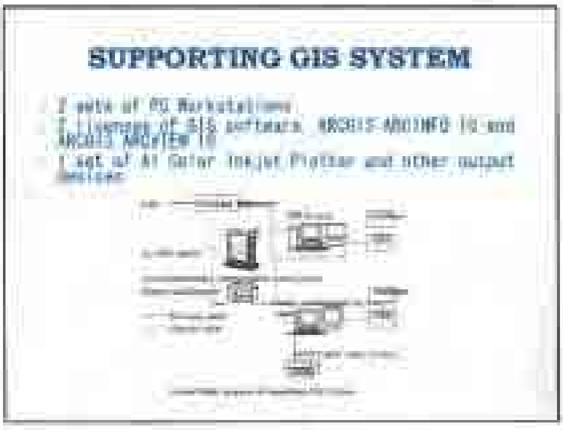
- Absence of GIS Datasets in CWASA
- Inadequate Map Coordinate System in CAD drawing datasets never to match mapping features with available maps in CDA, satellite image and GPS data
- Absences of Geo-Codes, Wards NO and CWASA Holding NO in CSCOR and Billing databases never to indicate location of Service Connection since 1998


KEY ISSUES ON TECHNICAL PROBLEMS IN EXISTING DATA RESOURCES2
Continue
Miss-Matching of Geo-Codes between Mouza Number & CWASA Holding NO in CSCCR and Mohallah in billing databases
Irregularity of monthly billing records requiring to check and to re-calculate monthly water consumptions and monthly billing data


ISSUES ON INFORMATION MANAGEMENT IN DAILY OPERATION IN CWASA


TASKS TO BE FOUND FOR GIS OPERATION IN PANI
GIS operation started from nothing else with solutions of technical problem to recover reliability of data and to improve data quality in existing data
Restore past GIS datasets from CAD drawing
Transform GIS data
Verify data and Update initial GIS data
Verify and Update initial GIS data with compiling survey Databases
GIS support for the NRW management

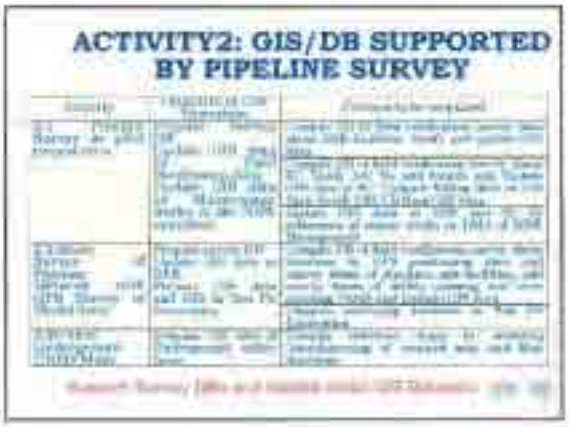

Process of GIS Operation


SUPPORTING GIS SYSTEM
2 sets of PC Workstations
2 Licenses of GIS software, ARCGIS ARCINFO 10 and ARCGIS ARCVIEW 10
1 set of A1 Color Inkjet Plotter and other output devices


PROJECT AREAS FOR GIS OPERATION
Pilot Project Areas and Model Areas in PANI


MAIN ACTIVITIES ON GIS AND DATABASE IN PANI


ACTIVITY1: MAIN ACTIVITY ON GIS/DB


ACTIVITY2: GIS/DB SUPPORTED BY PIPELINE SURVEY


ACTIVITY3: GIS/DB SUPPORTED BY LEAKAGE & NRW MANAGEMENT


GIS OPERATION TO SUPPORT THE NRW MANAGEMENT


GIS OPERATION TO SUPPORT THE NRW MANAGEMENT

GIS OPERATION TO SUPPORT THE NRW MANAGEMENT

- Support for Operation and Maintenance

GIS operation in support for Operation and Maintenance is required in activities in the NRW management as follows:

- Real time updating of GIS data required by the Maintenance in the NRW management
- Utilization of definitive GIS functions to support preparation of maps and data for data analysis and solution in the NRW Management
- Support the NRW Management: Visualization of Monitoring data and Tabular data on maps, Query in databases, Data Analysis, Overlay and Cross Tabulations in spatial data, Buffering, Map production, and Map printing to support for Operation and Maintenance in the NRW Management

SUPPORT FOR THE NRW MANAGEMENT

GIS SUPPORT FOR THE NRW MANAGEMENT

EXAMPLE OF GIS OPERATION: Display Map

Image of GIS datasets in Map Windows

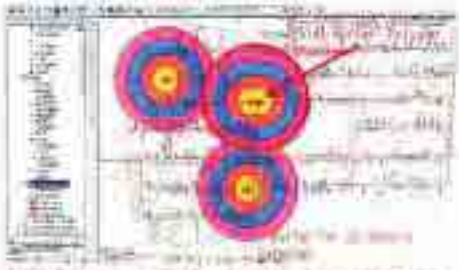
EXAMPLE OF GIS OPERATION: Reference of Attribute

EXAMPLE OF GIS OPERATION: Query

- Selection of Service Connection for Domestic Use

EXAMPLE OF GIS OPERATION: Buffer Analysis

- Buffer operation from valves



EXAMPLE of GIS OPERATION: Buffer and Tabulation

GIS OPERATION AND ROADMAPs FOR INFORMATION MANAGEMENT

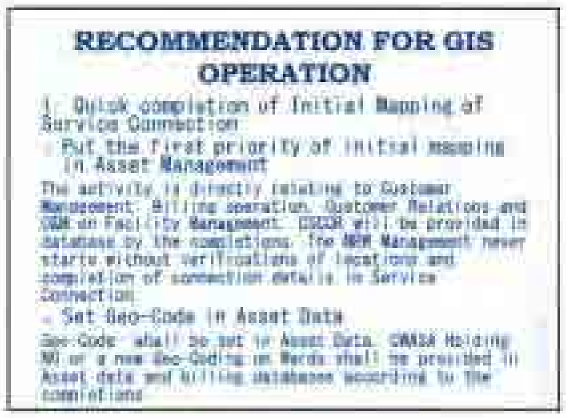
- GIS operation with experiences guides preparations of ROADMAPS which becomes mile stones for Capacity Building on GIS operation
- 12 ROAD MAPs are guided by a document of Terms of Works for GIS operation
- OJT training is being guided by ROADMAPS to Counterparts to build up operation capacities on GIS in PWMI

GIS OPERATION AND ROADMAPS FOR INFORMATION MANAGEMENT

GIS OPERATION AND ROADMAPS FOR INFORMATION MANAGEMENT

BETTER FUTURES FOR GIS OPERATION

- Don't stop Capacity Building on GIS operation with overcoming the past negative impacts with challenges through the NRW Management
- PWMI oriented Technical Assistances for GIS operation to Set up Right of Way to overcome difficulties in the developments
- GIS operation never functions without any solutions of technical problems in Asset datasets; so key issues shall be discussed.
- Modernizations for Development, Management and Operations with fast efficiencies in CWASA
- This is a common issue in Water Sector and other stake holders in Bangladesh. Also another key issue is absence of Spatial Data Infrastructures on Mapping directly indicating to absence of reliable base maps for Asset Management in Bangladesh


RECOMMENDATION FOR GIS OPERATION
1. Quick completion of Initial Mapping of Service Connection
Put the first priority of initial mapping in Asset Management
Set Geo-Code in Asset Data

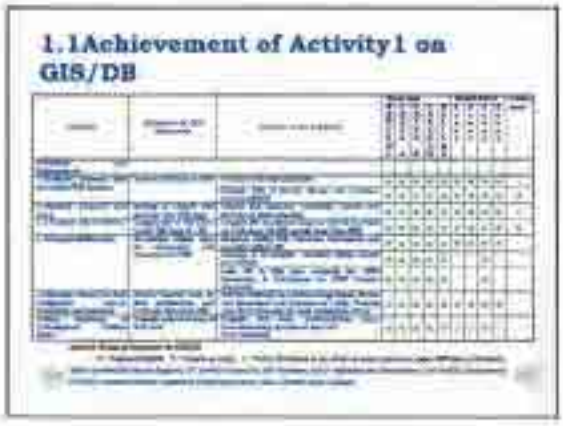

BETTER FUTURES FOR GIS OPERATION
2. Start up for database development for the Operation and Maintenance


BETTER FUTURES FOR GIS OPERATION
(Continue)


BETTER FUTURES FOR GIS OPERATION
3.Requirement of Development Strategy and Action Plans for Modernization and Development

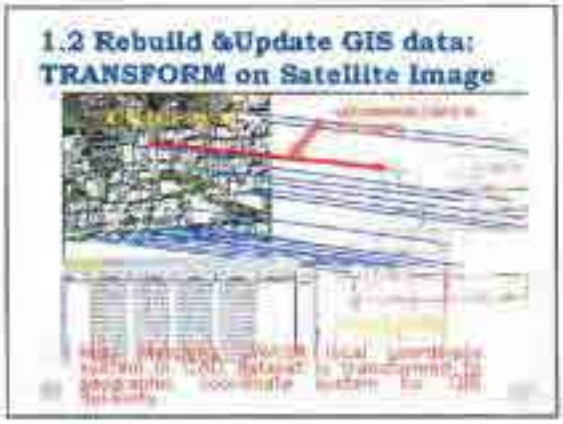

ASPIRATION FOR GIS OPERATION
GIS operation is very simply and essentially supported by daily operations in real time
Daily operation makes it ensure to utilize data for the NRW management. But it is still too far from realities to fixate Capacity Building on Information Management without any developments for Modernizations
Think about How CWASA can start developments for modernizations through PANI and this make it sure for CWASA to development Information Management
Please Don't Stop GIS operation for better tomorrow with the NRW Management.


THANK YOU FOR YOUR ATTENTIONS & HOEFULLY TAKE ACTIONS FOR BETTER TOMMOROW
Presented By SUWASE PANI & GIS Counterparts Team

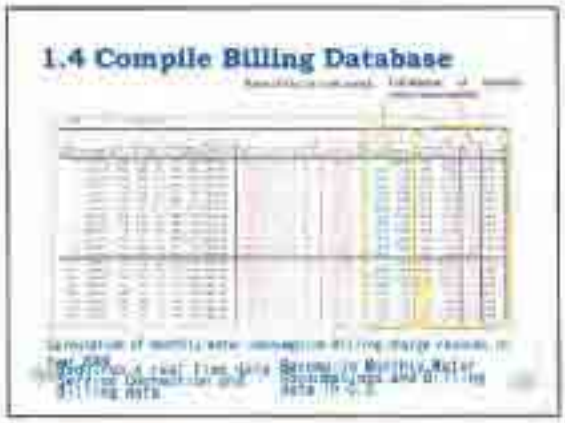

1.1Achievement of Activity1 on GIS/DB


1.1 Rebuild &Update GIS Datasets: Available Data in CWASA 1


1.1 Rebuild &Update GIS Datasets: Available Data in CWASA 2


1.2 Rebuild &Update GIS data: TRANSFORM on Satellite Image


1.3 Verify GIS data in S.C. and Develop DB of CSCCR


1.4 Compile Billing Database

1.5 Desktop Survey: Building Survey

- Survey Buildings to arrange Type of Building, Building Stories and Building Structures to Provide Baseline data for Wate

1.5 Desktop Survey: Building Survey

Building Survey arranging Type of Building, Building Stories and Building Structures to Provide Baseline data for Water Demand Analysis for Water District

1.6 Map digitizing of Underground Utilities Maps

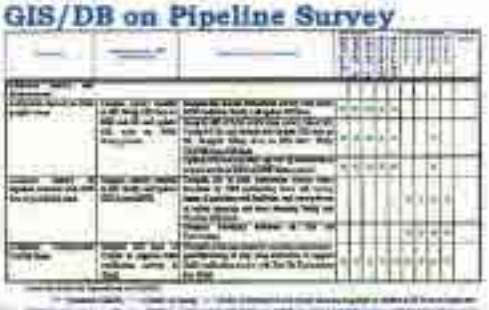
- Compile GIS data for Utility Maps:
  - GAS Pipes and
  - Tele-Communication Lines

1.6 Collect Underground Utility Maps And Map digitizing

Maps Collection for Field Verifications of Utility Crossing in Route Survey of Pipeline Networks and Compile GIS datasets

Gas Pipes

2. Achievement of Activity2: GIS/DB on Pipeline Survey



2.1 Pipeline Survey in Pilot Project Areas

- Surveying form of Service Connection Details for NRW in Pipeline Survey to Update GIS datasets of Service Pipes and Service Meters

2.1 Rebuild &Update GIS data:

2.2Route Survey of Pipelins Networks

- Survey Main Pipelines and the Facilities w/th GPS Survey and Survey Forms toVerify Main pipes and facilities on Main Pipes
- Survey Utility Crossing with Survey Forms
- Survey River Crossing with Survey

2.2.Route Survey of Pipeline Network GPS Survey Result and Updating data

Main Pipes Verified by GPS Survey

2.2 Test Pit Excavation

- Sketch Drawing of Utility Crossing and Cross Section Portray Result in Test Pit Excavation

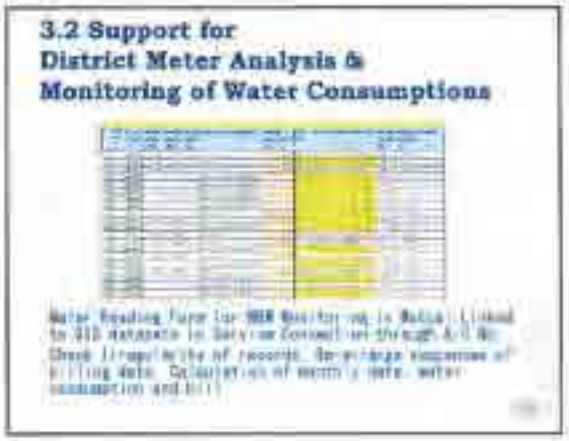
2.3 Rebuild &Update GIS data: Updating GIS Datasets

- Produce Initial GIS Datasets for NRW updated by Field Verifications on Pipeline Survey and Leakage Water Survey
- Monitor NRW measures through A/C No. Water Consumptions and Bills

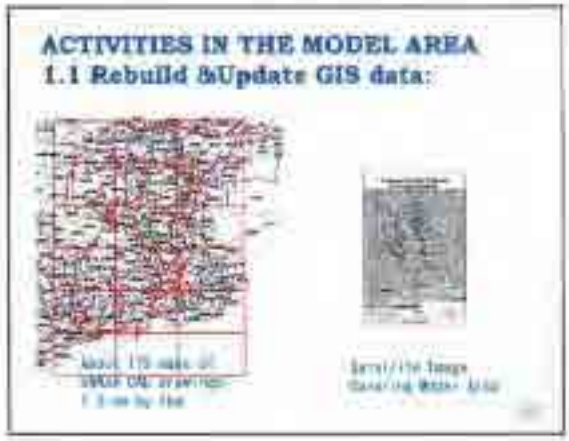
Initial GIS datasets on Satellite Image for NRW in Khulushi

3. Achievement of Activity3 : GIS/DB On Leakage Measures and the NRWM

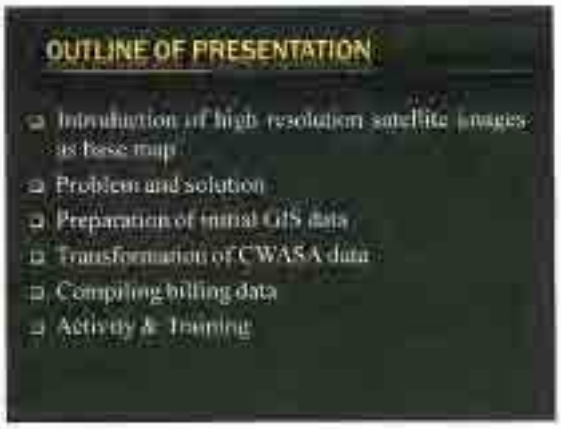

3.1 Support for Leakage Survey: DSR&S.C.

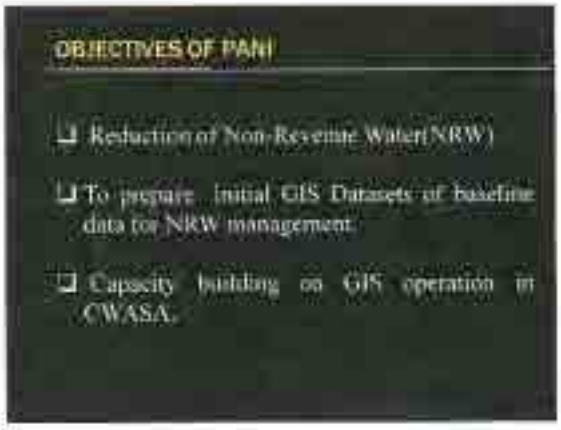

3.2 Support for
District Meter Analysis &
Monitoring of Water Consumptions

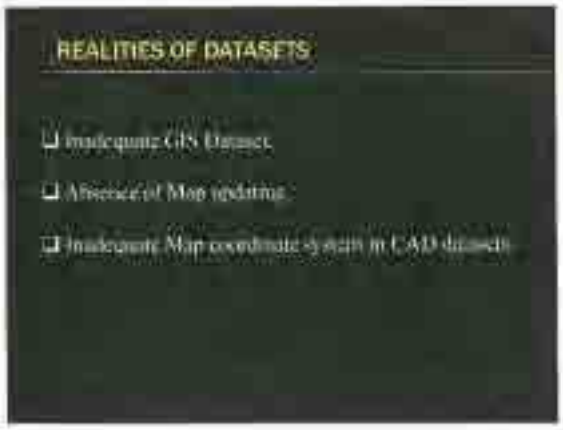

3.3 Support for the NRW Management


ACTIVITIES IN THE MODEL AREA
1.1 Rebuild &Update GIS data:

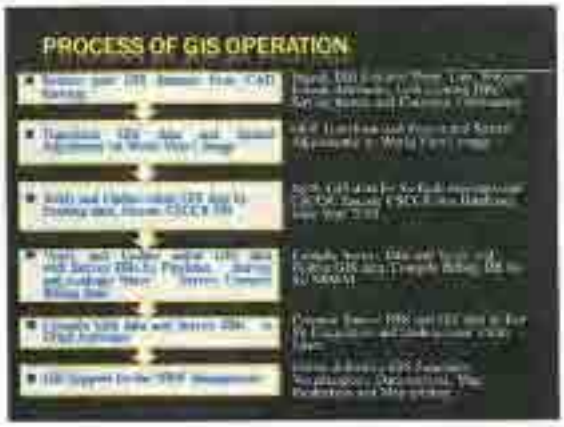

On Job Training
& Achievement
WELCOME


OUTLINE OF PRESENTATION
Introduction of high resolution satellite images as base map
Problem and solution
Preparation of initial GIS data
Transformation of CWASA data
Compiling billing data
Activity & Training


OBJECTIVES OF PANI
Reduction of Non-Revenue Water(NRW)
To prepare Initial GIS Datasets of baseline data for NRW management.
Capacity building on GIS operation in CWASA.

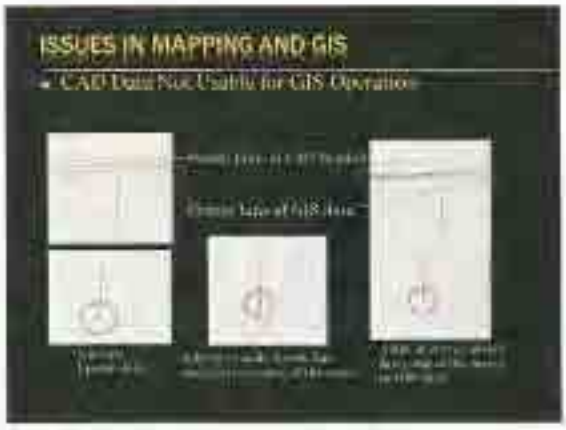

REALITIES OF DATASETS
Inadequate GIS Datasets
Absence of Map updating
Inadequate Map coordinate system in CAD datasets

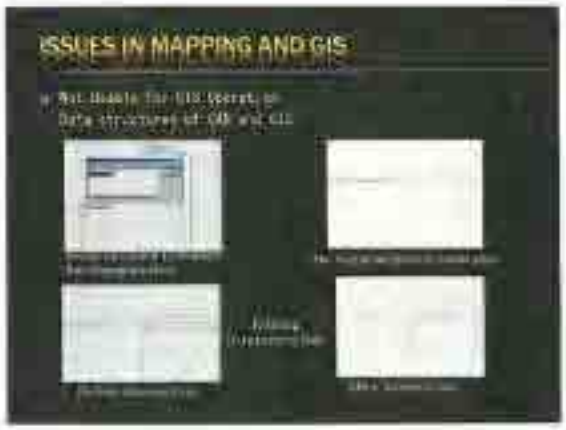

INTRODUCTION OF HIGH RESOLUTION SATELLITE IMAGES AS BASE MAP


PROCESS OF GIS OPERATION


CAD DATA AND GIS DATA
RESTORE INITIAL GIS DATA
CAD Drawings


REQUIREMENT OF EDITING WORK IN CAD DRAWING DATA

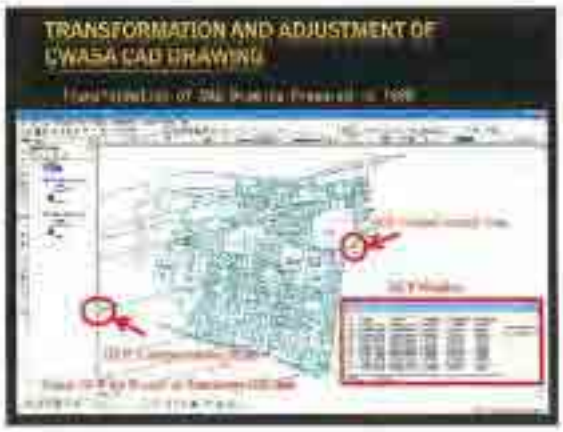

ISSUES IN MAPPING AND GIS
CAD Data Not Usable for GIS Operation


ISSUES IN MAPPING AND GIS


TRANSFORMATION AND ADJUSTMENT OF CWASA CAD DRAWING
Snapshot of CAD Drawing Prepared in 1998


FLOW CHART OF TRANSFORM AND SPATIAL ADJUSTMENT


TRANSFORMATION AND ADJUSTMENT OF
CWASA CAD DRAWING


TRANSFORMATION AND ADJUSTMENT OF
CWASA CAD DRAWING

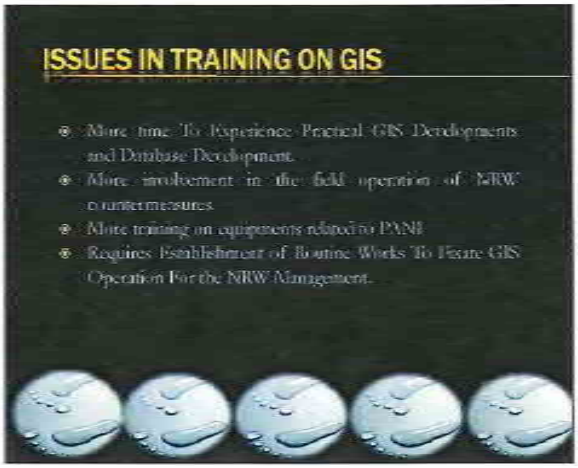

COMPILE BILLING DATABASES FOR THE NRW
OPERATION


COMPILE BILLING DATABASE


SUPPORT OF GIS OPERATION FOR THE NRW
MANAGEMENT: VISUALIZATION OF BILLING DATABASES


ACTIVITY
Work Items
Status
Comments


ROAD MAP FOR NRW MANAGEMENT
ROAD MAP1 : Compiling GIS Datasets to Restore Initial Data at year 1998 from CAD Drawing Files with Georeferencing in ROAD MAP2
ROAD MAP2 : Transform to make CWASA Coordinate System shift to a general coordinate system of WGS1984 and BTM(Bangladesh Transverse Mercator)
ROAD MAP3 : Compiling Existing Relational Databases of Service Meter & Customer with Updating
ROAD MAP4 : Compiling Database of Customer Service Connection Completion Report(CSCCR)
ROAD MAP5 : Compiling Customer Data and Monthly Billing Data
ROAD MAP6 : Compiling Existing As Built Drawing Maps
ROAD MAP7 : Compiling Building Survey Data
ROAD MAP8 : Compiling Field Verification Survey data To Update GIS Datasets in the Model Area
ROAD MAP9 : Compiling GIS Datasets of the Underground Utility Map
ROAD MAP10 : Compiling Field Verification Data of Pipe Survey and Pipe Leakage Survey in the Pilot Project Areas
ROAD MAP11 : Compile NRW Databases to support Monitor & Action for the NRW
ROAD MAP12 : Compile Test Pit Excavation Databases to verify Utility Crossing for O&M or PM


ISSUES IN TRAINING ON GIS
More time To Experience Practical GIS Developments and Database Development.
More involvement in the field operation of NRW counter measures.
More training on equipments related to PANI.
Requires Establishment of Routine Works To Create GIS Operation For the NRW Management.

Appendix-5 Final Seminar

5-1 List of Participants

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
01	N.M.A. Bashar	Asst. Engr.	C. WASA	
02	Abbas Sadeq	Executive Engineer	C. WASA	
03	Quazi Yeakub Siraj	Executive Engineer	CWASA	
04	A.H.M. Saifullah	Executive Engr.	C. WASA	
05	Mokshud Alam	Executive Engr.	C. WASA	
06	[illegible]		[illegible]	
07	MD SYEDUR RAHMAN	A.E.	C. WASA	
08	~~Liaquat Ali Chowdhury~~	~~Executive~~		
09	Md. Sohel Rana	AE: WASA.	WAS-2	
10	Mir Hossain	R/O C. WASA	Revenue	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
11	Md. Liaquat Ali	R/O	Ravan Eng.	[illegible]
12	Md. Saiful Islam	AE	CWASA	[illegible]
13	Mohammad Saifur Rahman [illegible]	AE	CWASA	[illegible]
14	Md. Abu Taher	XEN	CWASA	[illegible]
15	Md. Sarfaraj Ataley	XEN	CD-2, CWASA	[illegible]
16	Mostak Ahmed Chy	XEN	Booster CWASA	[illegible]
17	Tapan Das	SE	M/D	[illegible]
18	Saleh Noman	[illegible]	[illegible]	[illegible]
19	Mohd. Zohurul Haque	XEN	CWASA	[illegible]
20	Engr. Ejaz Rasul	Dy. Chief (Eng)	CWASA	[illegible]

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
31	Md. Jakir Hossain Sht	Chief Account	CWASA	
32	Md. Abdul Adal	DMD (ADMIN	CWASA	
33	A.T.M. Mamunur Rashid	DMD (Finance)	CWASA	
34	Md Nizamul Haq Chy	System Analyst (EX)	CWASA	
35	Soumit Paul	Asstt. Engr.	CWASA	
36	Abdur Rouf	Asst Engr.	CWASA	
37	Nanda Dulal Bhowmik.	Secretary	CWASA	
38	Mohammed Abdul Goni Chowdhury	Assistant Engineer	CWASA	
39	MD Nurul Absar	[illegible]	CWASA	
40	Md. Bobel Alam	Accountant	CWASA	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
41	Mokhlesur Rahman	XEN (R&I)	C.WASA	[illegible]
42	Golam Sultan	C.R.O	"	[illegible]
43	Kazi Nurjahan Shila	PRO & Asst. Sec	WASA	[illegible] 23-5-12
44	Md. Nasim Uddin	R.O.	WASA	[illegible]
45	Anwar Hossain Hazi chy	Photographer	WASA	[illegible]
46	Ashik Mahmud Chy.	Asstt. Engr.	WASA	[illegible]
47	S.M. Badruddoza	Revenue Officer	C.WASA	[illegible]
48	MD. SALIM	Field Survey Asst.	JICA PANI PROJECT	[illegible]
49	MD. RIAZ UL ISLAM	A.P.M	WASA	[illegible]
50	MD. SOHEL	A.P.M	C.WASA	Sohel.

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
51	Mohammad Dalowar Hossain	GIS Expert	JICA PANI Project	[illegible]
52	Md. Aourongojeb Mondal	Distribution Network Survey Engineer	JICA PANI Project	[illegible]
53	Zahidul Islam	Distribution Network Survey Engr.	JICA PANI Project	[illegible]
54	Md. Al-Amin	GIS Assistant	JICA PANI Project	[illegible]
55	Sayed Joinal Hossain	NRW Asst. Engr.	JICA PANI Project	[illegible]
56	Mortoza Ali Hyder	Leak detection Asst. Engr.	JICA PANI PROJECT	[illegible]
57	Nasir Uddin Ahmed	Field Survey Asst.	JICA PANI Project	[illegible]
58	Md. Mustafa	Field Survey Asst.	"	[illegible]
59	Md. Ibrahim Khalil	"	"	[illegible]
60				

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
61	MD. RASEL	A.P.M	C. WASA	
62	Yousup Manga	A.P.M	C WASA	Yousup Manga
63	Sanjoy Barua	A-D.M	C. WASA	
64	SHOHEL Rana	A.D.M	C. WASA	
65	MD. AKHTAR HOSSEIN	A.P.M.	C. WASA	Akhtar
66	MD. ARIFUL ISLAM	A.P.M	C. WASA	Arif
67	JEWEL BARUA	A.P.M	C. WASA	
68	NURL AZAR	A.P.M	C. WASA	
69	MD. LATIF.	S.A	JICA.	
70	MD JONY	S.A	JICA	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
71	Sumita Roy	GIS Encoder	JICA	Sumita
72	Happy Chakma	GIS Encoder	JICA	
73	Tasima Akter	S.A.E	CWASA	
74	Md. Talebul Aagan	Data Entry Operator	CWASA	
75	Hasnatul Jannat Sweety	SAE	CWASA	H. Jannat
76				
77				
78				
79				
80				

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
101	Monjurul Alam Mamun	Photo Journalist	Daily Purbokone	[illegible]
102	Engr. Subash Chandra Barua	Secretary	FRC	[illegible]
103	Engr Prabal Kumar Sil	Dir-1 BTCL	BTCL	[illegible]
104	Engr. Md Abdul Mozaddem	DIV . BTCL	BTCL	[illegible]
105	Engr. Kamalesh Biswas.	Dir-2 BTCL	BTCL	[illegible]
106	Mohammad Feroz Shah	~~AOTS~~ President	CAAS	[illegible]
107	Samir Chakma	Divisional Engr	BTCL	[illegible]
108	Saleh Noman	Chief of News	Radio Today	[illegible]
109	Md. Obaidul Islam	QS	NJS Consultant	[illegible]
110	Mr. Shafiullah	DTL	"	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
111	Md. Nurul Amin	[illegible] (Mor) WASA	CWASA	[signature]
112	Muhammad Mahbubul Alam	XEN, Mohara	CWASA	[signature]
113	A Mehadi Shawkat Azam	RO-5	CWASA	[signature]
114	Milan Chakraborty	Chemist, Mohara	CWASA	[signature]
115	Nazrul Islam	Asst. Engr.	CWASA	[signature]
116	Mohammad Arifur Islam	XEN	CWASA	[signature]
117	Sofia Tasnim	AE	CWASA	[signature]
118	MD. NURUL ALAM	System Analyst	CWASA	[signature]
119	Md. Rejaul Ahsan Chowdhury	Assistant Engineer	CWASA	[signature]
120	AKM Nazmul Hoque	~~[illegible]~~ PD PANI	CWASA	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
121	Suresh Kumar Das.	Production	BTV.	
122	Shozo Asaoka	Officials	JICA	
123	Rawl Islam	SPO, -	JICA	
124	Hiroyuki Tomita	Senior Representative	JICA	
125	Sayed Iqbal	GM	Rose Axiata	
126	SAWARA Sadanobu	Technical Advisor	JICA	
127	George B. Young Jr	TL/Engineer	KWSP NJS/PETS	
128	AKIJAKA SETO	Site Manager	KUBOTA-MARUBENI JV	
129	KOJI KAJITAMA	Project Engineer	KUBOTA-MARUBENI	
130	Nobuhito Izumi	Administrator	KUBOTA-MARUBENI	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
131	Zakir Hossain	Prof. BUET	CUET	
132	Ranabeer Chakraborty	Reporter	The daily star	
133	Nazrul Islam	Water Supply Engr.	KWSP	
134	Md. Rubel Khan	Daily Samakal	Daily Samakal	
135	M. OMOTE	NJS/JICA S-T		
136	Patrik Takeuchi	Financial Specialist	NJS/JICA	
137	[illegible]	[illegible]	[illegible]	
138	[illegible]	[illegible]	[illegible]	
139	[illegible]	[illegible]	BTV	
140	Maxim L Bygarin	Construction Specialist	NJS	

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

Date : May 23, 2012

Seminar on Overall Operation of PANI Project

Attendance Register:

Reg. No.	Name	Designation	Agency	Signature
141	Kentaro YOKOTA	Deputy Director	JICA	[signature]
142	Md. Haruf Hossain	Assistant Engineer	BR	[signature]
143	Akira Shirai	Project Manager	KUBOTA HARU ... JV	[signature]
144	KAZI MUNZURUL ISLAM	Reporter	RTV	[signature]
145	[illegible]	C. [illegible]	RTV	[signature]
146	Md. Shak Nowaz	Special Correspondent	bartha24.net	[signature]
147	DR. S.M. SAYEDUR RAHMAN	Retd. CMO Jack		[signature]
148	ARIS AHMED SHAH	STAFF REPORTER	ntv	[signature]
149	[illegible]	NTV		
150	RONY DUTTA	CHANEL-24		[signature]

Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA

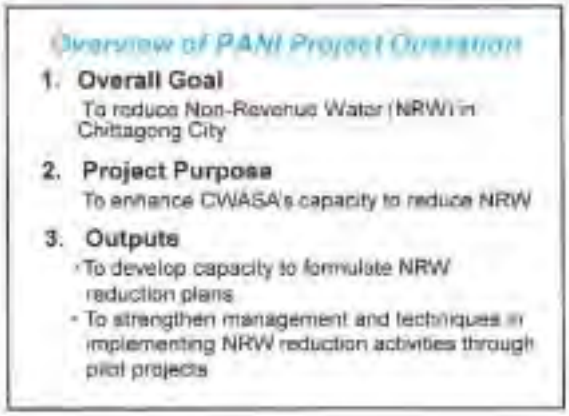
Date : May 23, 2012

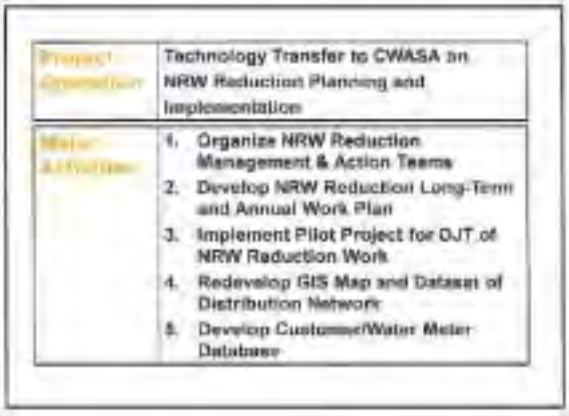
Seminar on Overall Operation of PANI Project

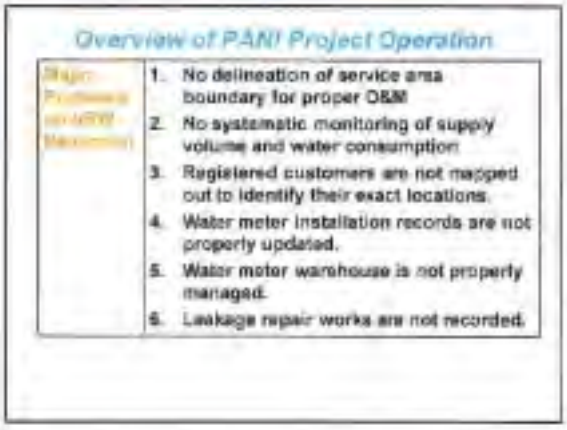
Attendance Register:

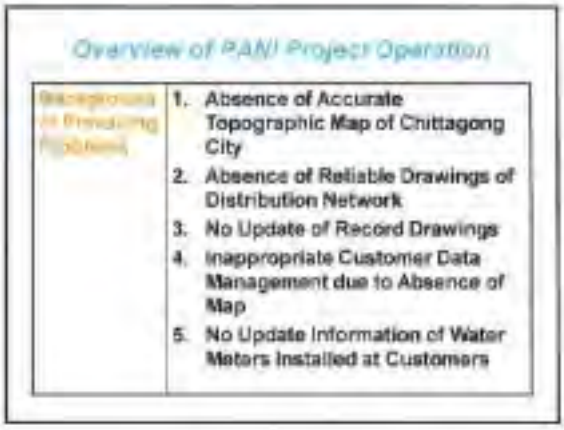
Reg. No.	Name	Designation	Agency	Signature
151	Dipankar Das	Cameraman	Ch-24	[signature]
152	MD TOFAJJAL	BTV	—	[signature]
153	AKIHIRO OHTAKE	KUBOTA JV	— " —	[signature]
154	Mizanur Rahman [illegible]	Staff Reporter	The Independent	[signature]
155	[illegible]	The Daily Sun ... Bangladesh		[signature]
156				
157				
158				
159				
160				

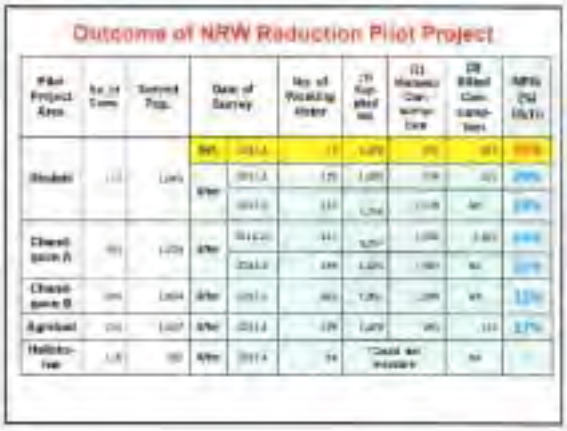
5-2 Presentation Materials

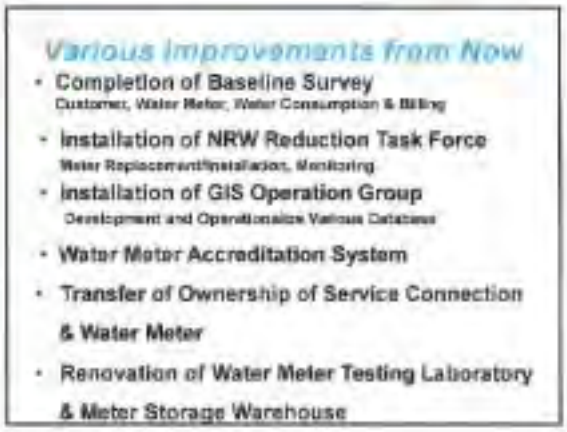




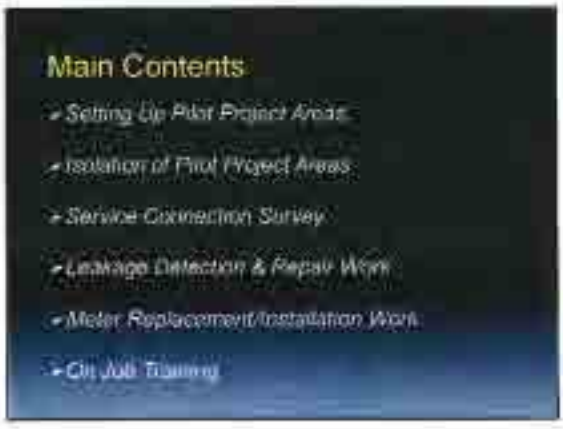

Overview of PANI Project Operation
1. No delineation of service area boundary for proper O&M
2. No systematic monitoring of supply volume and water consumption
3. Registered customers are not mapped out to identify their exact locations.
4. Water meter installation records are not properly updated.
5. Water meter warehouse is not properly managed.
6. Leakage repair works are not recorded.


Overview of PANI Project Operation
1. Absence of Accurate Topographic Map of Chittagong City
2. Absence of Reliable Drawings of Distribution Network
3. No Update of Record Drawings
4. Inappropriate Customer Data Management due to Absence of Map
5. No Update Information of Water Meters Installed at Customers

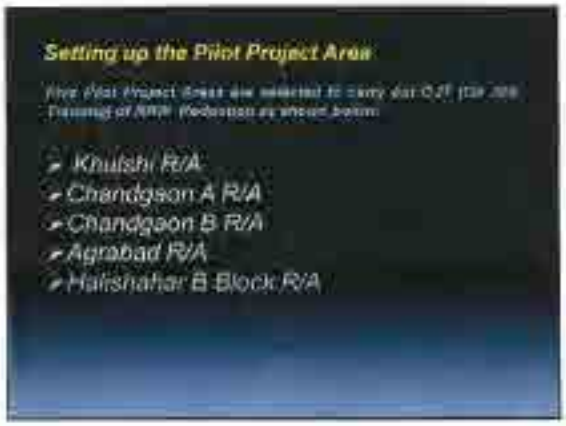

Outcome of NRW Reduction Pilot Project


Various Improvements from Now
• Completion of Baseline Survey
Customer, Water Meter, Water Consumption & Billing
• Installation of NRW Reduction Task Force
Meter Replacement/Installation, Monitoring
• Installation of GIS Operation Group
Development and Operationalize Various Database
• Water Meter Accreditation System
• Transfer of Ownership of Service Connection & Water Meter
• Renovation of Water Meter Testing Laboratory & Meter Storage Warehouse


JICA
Presentation on
Pilot Project


Main Contents
Setting Up Pilot Project Areas
Isolation of Pilot Project Areas
Service Connection Survey
Leakage Detection & Repair Work
Meter Replacement/Installation Work
On Job Training

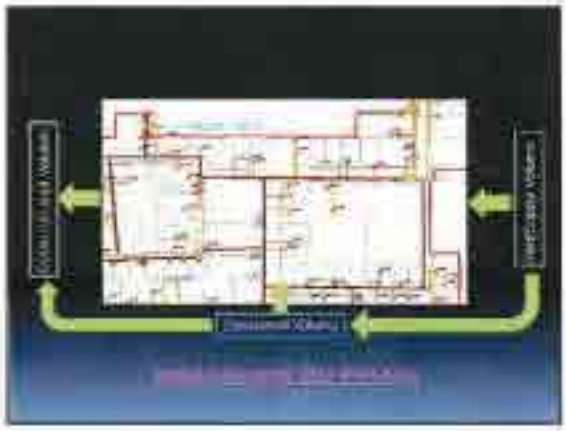

Setting Up The Pilot Project Areas


Setting up the Pilot Project Area
Khulshi R/A
Chandgaon A R/A
Chandgaon B R/A
Agrabad R/A
Halishahar B Block R/A


Pilot Project Areas at a Glance


Setting up the Pilot Project Area
•Water Supply
•Water Pressure
•Easiness of Isolation Work
•Location Conditions
•Legal Rights


Isolation of Pilot Project Areas

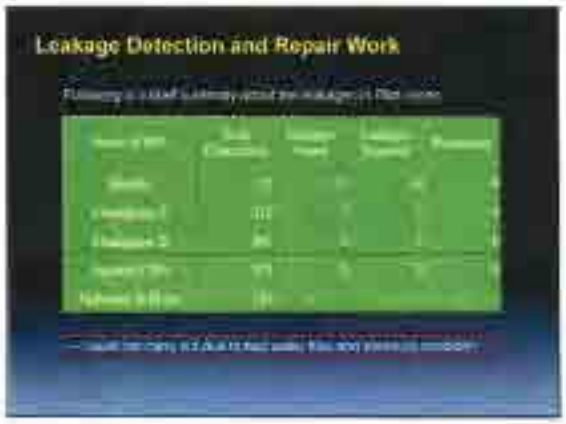



SERVICE CONNECTION SURVEY

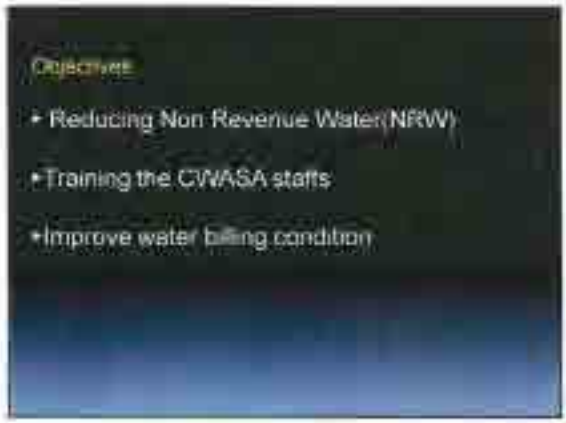

Service Connection Survey

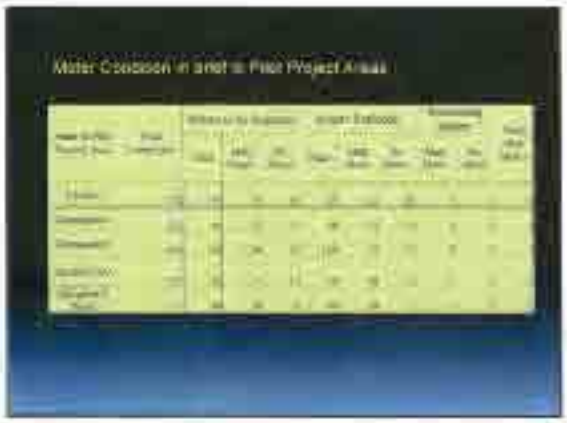

Leakage Detection and
Repair Work

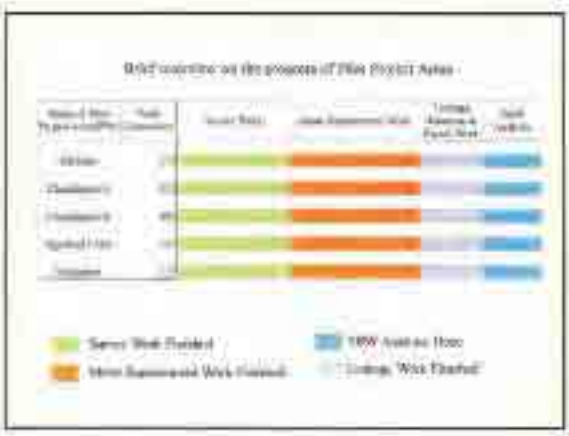

Detected Leakages
Repair Work

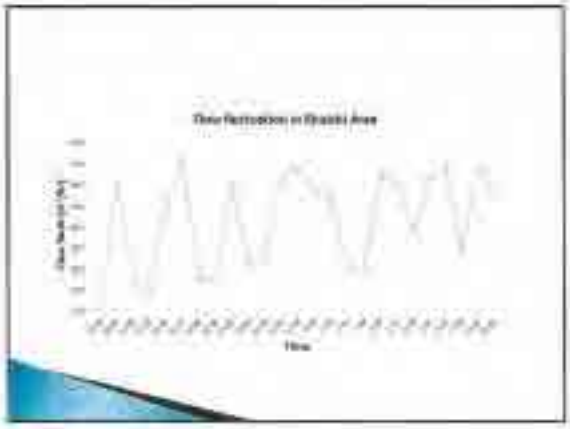

Leakage Detection and Repair Work

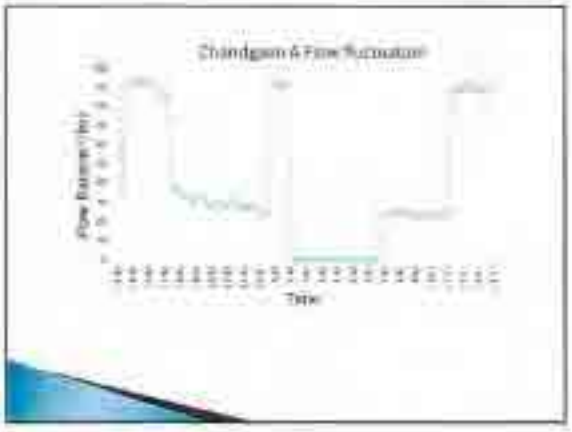

Meter Replacement/Installation Work

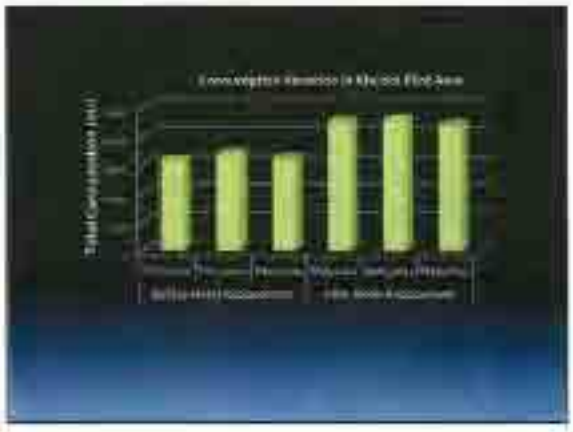

Objectives:
• Reducing Non Revenue Water(NRW)
•Training the CWASA staffs
•Improve water billing condition

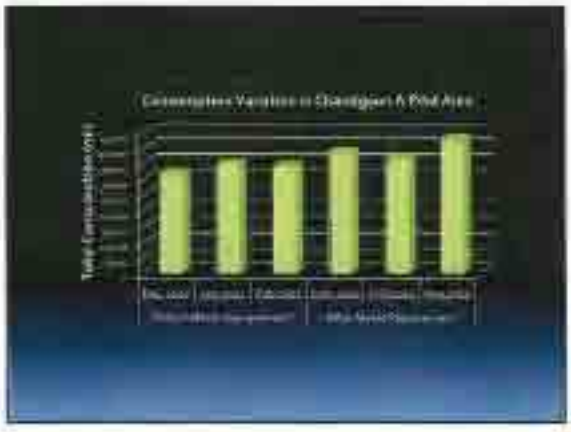


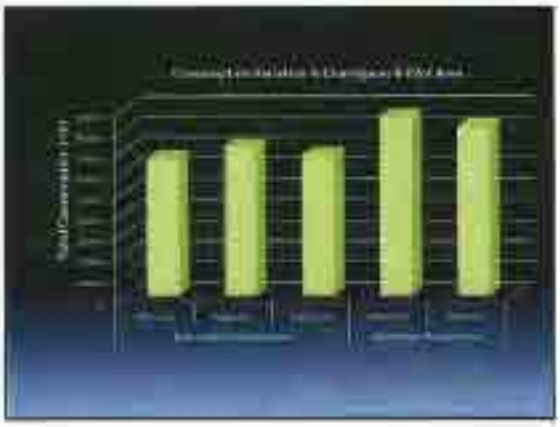













Outcome of NRW Reduction Pilot Project


On Job Training


Conclusion

Activities in Model Area

JICA PANI PROJECT TEAM
Engr. Md. Aourangzeb Mondal
Yuki OBA

Survey Activities by Zone in Model Area

Content of activities	Zone 3	Zone 6	Zone 2	Zone 1
1				
2				
3				
4				
5				
6				

Notes: ○ Done, × Not yet started

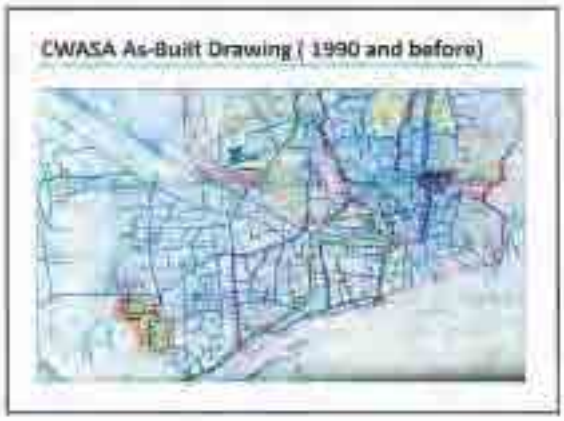
Objectives of Field Verification Survey

- To clarify conflicts among the drawings which are collected.
- To identify current situation because the information was not updated.
- To identify the exact position of distribution network and its facilities (Gate valve, Reducer, T-connection, Hydrant etc.) in real world.
- To establish the GIS based digital mapping and database for operation and maintenance work.

Data collection & Identification

A) Drawings:
- i) CWASA As-Built Drawing (2000 and before)
- ii) World Bank Drawing (CAD drawing, 1998)
- iii) High Resolution Image Map
- iv) As-Built Drawings of Other Agencies

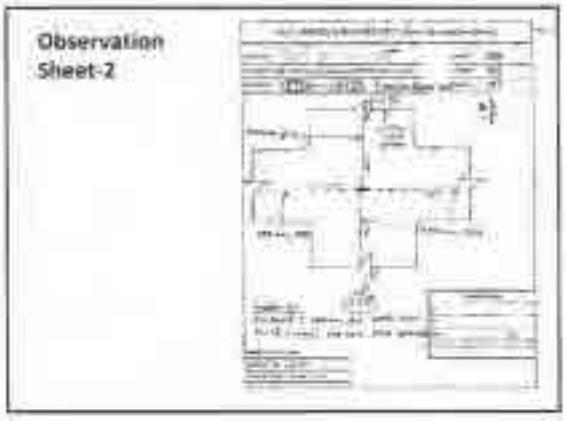
B) Devices:
- i) GPS device
- ii) Others accessories like Ranging pol, Measuring Wheel, Camera, Rod & Weather, Harness etc.

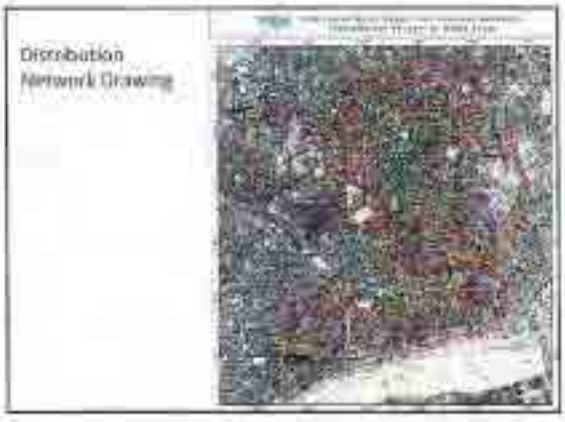

CWASA As-Built Drawing (1990 and before)


Field Verification Survey by GPS
Work Procedure Flow
Preparation of the survey map
Marking and fix up the points
Taking GPS reading
Distribution Network Drawing
& Database


Taking GPS reading


Observation Sheet-1


Observation
Sheet-2


Distribution
Network Drawing

Summary of Model Area

-Pipeline Length & its Coefficient of Extension

Zone	Area (km2)	Pipeline Length(km)		Coefficient of Extension(%)
		As-Built Drawing 1990's	PANI Survey 2012	
Zone I	4.49	46.1	52.0	114%
Zone II	4.12	26.6	33.4	125%
Zone III	4.84	61.7	66.8	108%
Zone IV	2.63	20.6	25.9	126%
Model Area	16.08	155.0	178.1	115%

- Pipe Length(km) & Pipe Material Composition(%)

Zone		Pipe Length(km) & Pipe Material Composition(%)					Total (km)
		AC	DI	CI	MS	PVC	
Zone I		19.6	3.4		0.2	29.4	52.6
Zone II		11.9	4.9	1.5	0.5	34.6	33.4
Zone III		30.9	5.1	-	1.1	29.8	66.8
Zone IV		8.0	-	-	0.1	17.2	25.3
Model Area	Total(km)	70.3	13.4	1.5	1.9	90.3	178.1
	(%)	39.6%	7.5%	0.9%	1.1%	51.0%	100.0%

Test Pit Excavation Work

Objectives of Test Pit Excavation

- To clarify conflicts between the collected drawings and field verification survey
- To identify exact position of every underground utilities.
- To establish the accurate database for operation and maintenance work. (Effective and efficient management)

Procedure of Test Pit Excavation

- Site Selection

1. Where many underground utilities are considered existing.
2. Considerably narrow road width.
3. Conflicts information of underground utilities between CWASA As-built drawing and information obtained from CWASA personnel working for plumbing.
4. Conflicts on information of underground utilities between CWASA personnel and local residents.

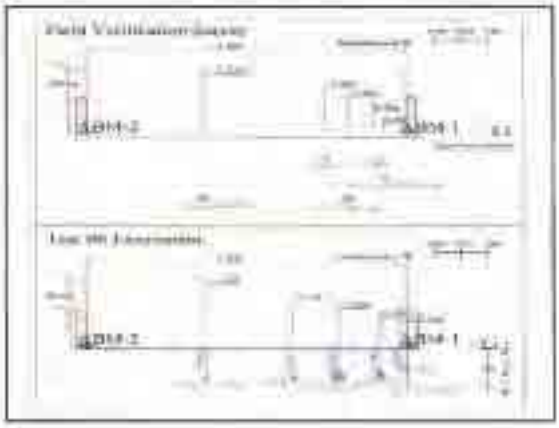

Test Pit Information Chart


Marking the existing underground utilities by spray cans as yellow indicates water line, red indicates gas line, blue indicates T&T(Telecommunication) and mobile lines.

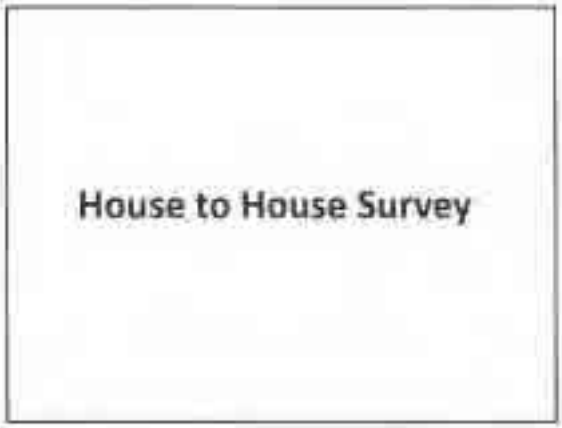

Expose all the utilities clearly and marked the utilities.
Test Pit No. 13
Test Pit No. 15

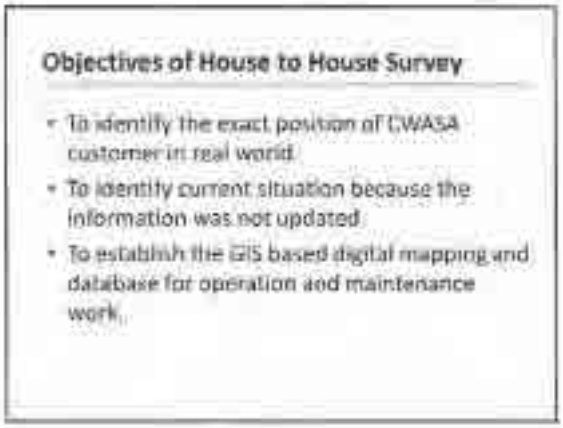

Distances are measured from ABM.

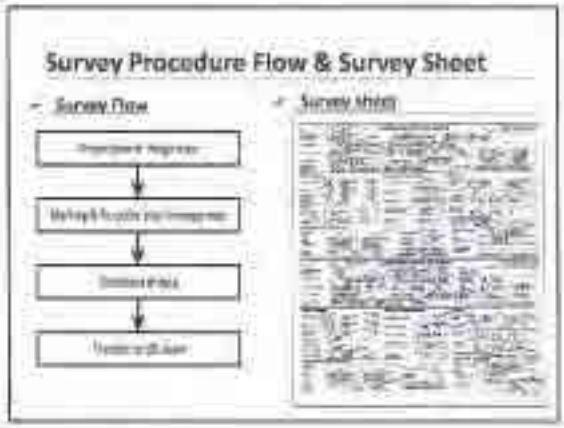

SUMMARY SHEET OF TEST EXCAVATION RESULT



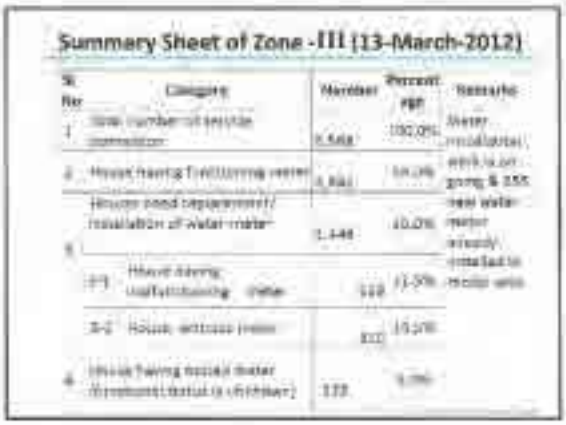

Seminar on Underground Utilities


House to House Survey


Objectives of House to House Survey
To identify the exact position of CWASA customer in real world.
To identify current situation because the information was not updated.
To establish the GIS based digital mapping and database for operation and maintenance work.


Survey Procedure Flow & Survey Sheet


Marking and fix up the plot in image map & data collection
Commercial Area
Residential Area
Photo of Bill Copy
Photo of Service Meter


Summary Sheet of Zone -III (13-March-2012)


On the Job Training in Model Area


This is a reason why, what we are doing!


This is a reason why, what we are doing!
= 33,333,636 BDT/year
= 10,333,057 BDT/year


JICA
Angatou-gozaimasu! Assalamu-alaikum !

On the Job Training in Model Area

JICA PANI PROJECT TEAM
Ms. Taslima (CWASA)

Through the Activities in Model Area, I understood.

1. Necessity of systematic procures alike PANI.
2. Necessity of database establishment for all activities.
3. Problem of absence of technical standard for the Meter installation.
4. Difficulty of the survey.
5. We knew the real poor water supply condition and costumer's opinion. We have to work more serious.

Recommendation

1. More active participation from CWASA to PANI.
2. NRW activities should be routine work.
3. Establishment of NRW Division for CWASA's operation.
4. It's just end of beginning.

Arigatou- gozaimasu! Assalamu-alaikun !


GIS Mapping


Activities on GIS / DB in PANI

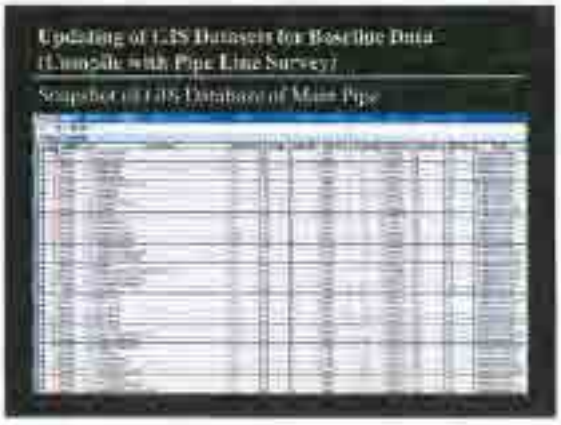

Preparation of Initial GIS dataset
Minimal Adjustment at Small Blocks

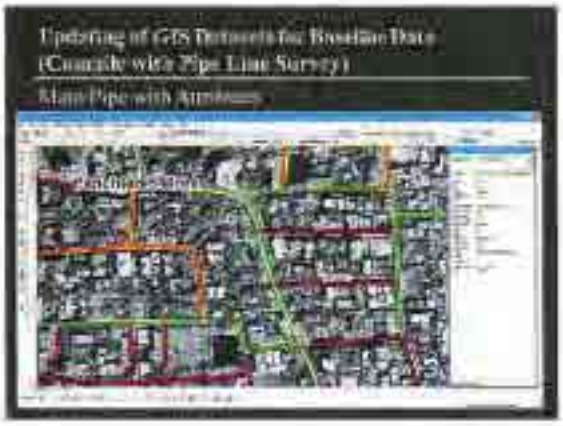

Preparation of Initial GIS dataset
Compile with As Built Drawing

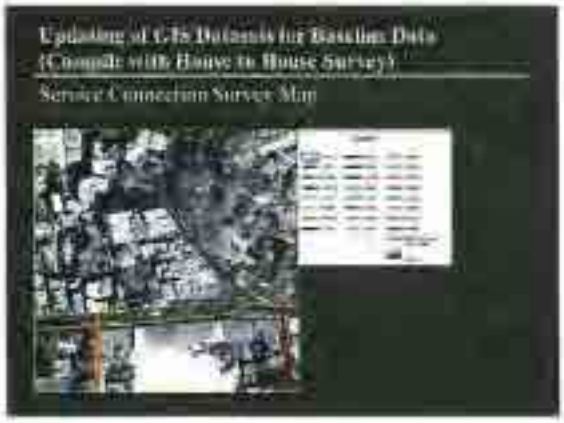

Updating of GIS Datasets for Baseline Data
(Desktop Survey)

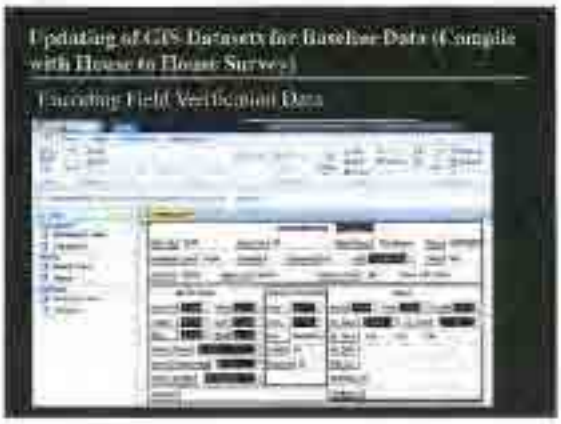

Updating of GIS Datasets for Baseline Data
(Compile with Pipe Line Survey)
Imported GPS Survey Point for Facilities


Updating of GIS Datasets for Baseline Data
(Compile with Pipe Line Survey)


Updating of GIS Datasets for Baseline Data
(Compile with Pipe Line Survey)


Updating of GIS Datasets for Baseline Data
(Compile with Pipe Line Survey)


Updating of GIS Datasets for Baseline Data
(Compile with House to House Survey)

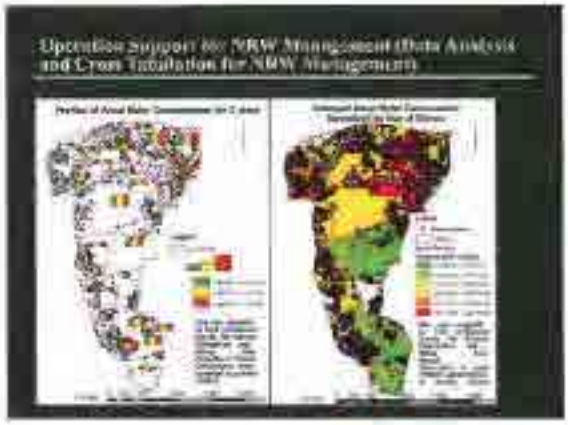

Updating of GIS Datasets for Baseline Data (Compile with House to House Survey)
Encoding Field Verification Data


Updating of GIS Datasets for Baseline Data (Compile with House to House Survey)
Identification of Consumer's Location


Updating of GIS Datasets for Baseline Data (Compile with House to House Survey)
Development of Consumer Database

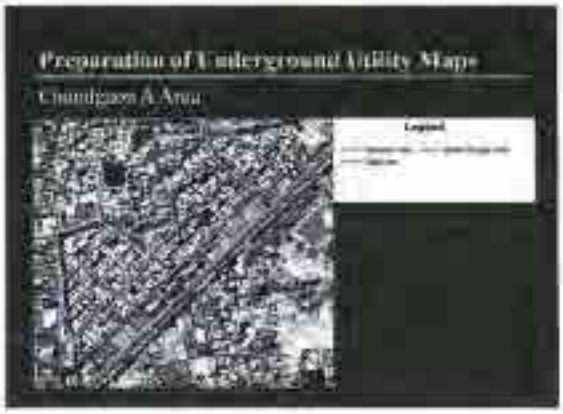

Updating of GIS Datasets for Baseline Data (Compile with Leakage Survey)


Updating of GIS Datasets for Baseline Data (Calculate Monthly Consumption and Bill)

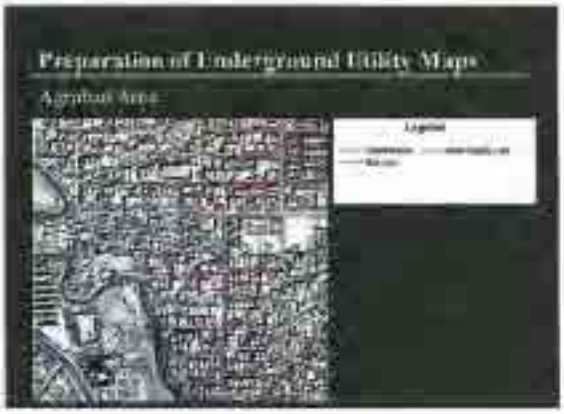



Preparation of Underground Utility Maps


Preparation of Underground Utility Maps
Khulshi Area

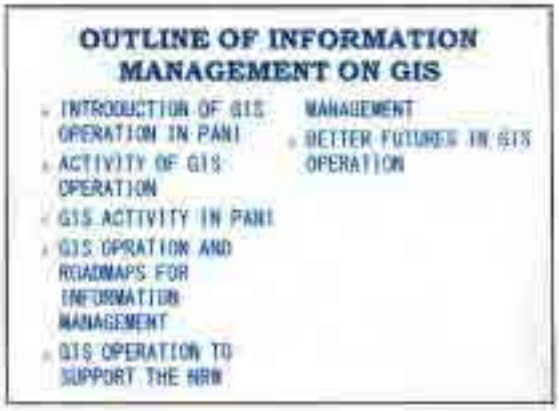

Preparation of Underground Utility Maps
Chandgaon A Area

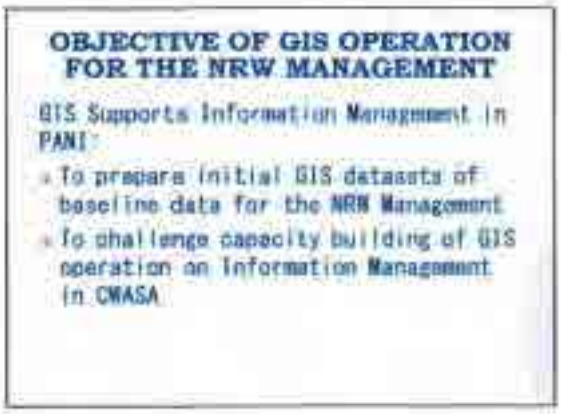

Preparation of Underground Utility Maps
Chandgaon B Area

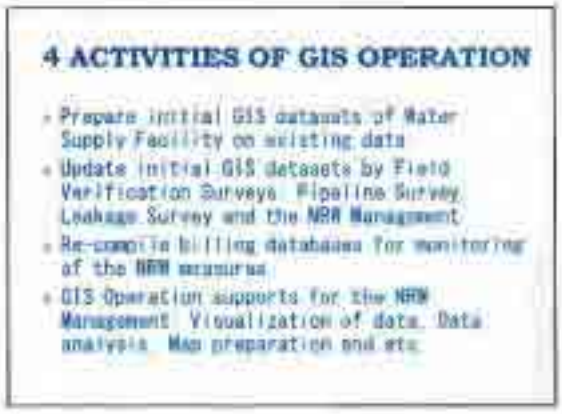

Preparation of Underground Utility Maps
Agrabad Area


Preparation of Underground Utility Maps
Halishahar Area

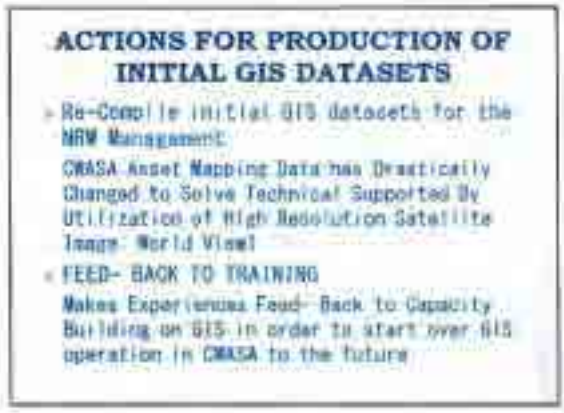

INFORMATION MANAGEMENT ON GIS FOR THE NRW MANAGEMENT
Presented by
SUMABE Kazumi
JICA EXPERT ON GIS DESIGN

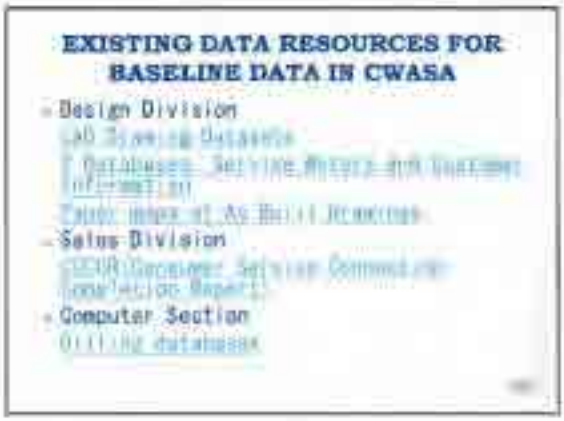

OUTLINE OF INFORMATION MANAGEMENT ON GIS
INTRODUCTION OF GIS OPERATION IN PANI
ACTIVITY OF GIS OPERATION
GIS ACTIVITY IN PANI
GIS OPRATION AND ROADMAPS FOR INFORMATION MANAGEMENT
GIS OPERATION TO SUPPORT THE NRW MANAGEMENT
BETTER FUTURES IN GIS OPERATION


OBJECTIVE OF GIS OPERATION FOR THE NRW MANAGEMENT
GIS Supports Information Management in PANI
To prepare initial GIS datasets of baseline data for the NRW Management
To challenge capacity building of GIS operation on Information Management in CWASA


4 ACTIVITIES OF GIS OPERATION
Prepare initial GIS datasets of Water Supply Facility on existing data
Update initial GIS datasets by Field Verification Surveys Pipeline Survey, Leakage Survey and the NRW Management
Re-compile billing databases for monitoring of the NRW measures
GIS Operation supports for the NRW Management Visualization of data, Data analysis Map preparation and etc

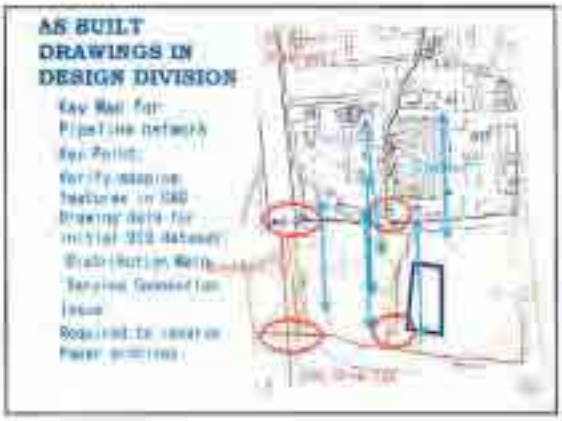

NECESSITY OF UPDATING GIS DATASETE BY FIELD VERIFICATIONS
GIS operation in PANI is Supported by Field Verifications in daily operation
Locations of Water Supply Facilities,
Account Number Geo-Code in CSCCR
Service Connection data's
The new data shall be verified and updated by field operations to set baseline data for the NRW Management


ACTIONS FOR PRODUCTION OF INITIAL GIS DATASETS
Re-Compile initial GIS datasets for the NRW Management
CWASA Asset Mapping Data has Drastically Changed to Solve Technical Supported By Utilization of High Resolution Satellite Image World View1
FEED- BACK TO TRAINING
Makes Experiences Feed- Back to Capacity Building on GIS in order to start over GIS operation in CWASA to the future

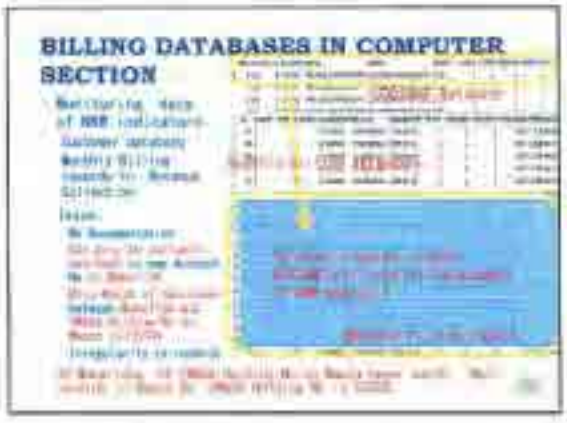

EXISTING DATA RESOURCES FOR BASELINE DATA IN CWASA
- Design Division
- Sales Division
- Computer Section


ASSET MAPS OF CAD DRAWING IN DESIGN DIVISION
- Record Drawing
- General Drawing
- Key Information


2 DATABASES IN DESIGN DIVISION
- Relational DBs
- Key Information for Mapping
- Issues


AS BUILT DRAWINGS IN DESIGN DIVISION
Key Map for Pipeline Network
Key Point:
Issue


CSCCR SALES DIVISION
Issue


BILLING DATABASES IN COMPUTER SECTION
Issue

FACT FOUND IN DATA RESOURCES

Data resources already developed to digital maps and databases in the 1990' s

Facts found

- Absences of Acting Asset data in daily operations on Facility Management except billing databases.
- No updating of data since the end of 1990' s
- Missing Service Connections in Asset Map count 30,000 records since 1998.

REALITIES OF DATASETS FACED TO THE NRW MANAGEMENT

Realities of data availabilities were too far to compile necessary baseline data for the NRW Management easily

- Absences of Acting data resources
  - Usable Asset maps
  - Usable databases in daily operations
- No updating of initial data since the end of 1990' s
- PANI had to start GIS Operation from nothing also with solutions of past negative impacts

ABSENCE OF USABELE DATA AND ISSUES IN GIS OPERATION

Many absences caused by past problems directly indicating issues in GIS operation to make data supply difficult to the NRW Management

- Absences of past GIS Datasets and missing GIS system
- Absences of Quality Control in the past Asset data in the 1990' s
- Absences of updating Asset Data among divisions in the O&M. No synchronize updating. Mapping data, Service Connection details, maintenance records, CSCCR, and billing records
- Absences of missing service connections in CAD drawings about 30,000 records since 1998, and no correspondences in billing databases

ABSENCE OF USABELE DATA AND ISSUES IN GIS OPERATION

- Absences of items in CSCCR, Null data of Geo-Codes and null data in items of Service Connection details in CSCCR
- Absences of Geo-Codes and missing locations in billing database since 1998
- Absence of Quality Control in the Operation and Maintenance in daily operation

There were many critical paths not to make any GIS operation easy. The facts formulated complexes of those mutual problems in Asset Management

Main problems were caused by setup of a local coordinate system in CAD datasets with absence of Quality Control in the production.

ABSENCE OF USABELE DATA ON ISSUES IN GIS OPERATION2

KEY ISSUES ON TECHNICAL PROBLEMS IN EXISTING DATA RESOURCES1

Key Issues on Technical Problems to make it hard to update maps and Service Connection data as follows

- Absence of GIS Datasets in CWASA
- Inadequate Map Coordinate System in CAD drawing datasets never to match mapping features with available maps in CDA, satellite image and GPS data
- Absences of Geo-Codes, Mauza NO and CWASA Holding NO in CSCCR and Billing databases never to indicate location of Service Connection since 1998.

KEY ISSUES ON TECHNICAL PROBLEMS IN EXISTING DATA RESOURCES2

Continue

- Miss-Matching of Geo-Codes between Mauza Number & CWASA Holding NO in CSCCR and Mohallah in billing database.
- Irregularity of monthly billing records requiring to check and to re-calculate monthly water consumptions and monthly billing data.

ISSUES ON INFORMATION MANAGEMENT IN DAILY OPERATION IN CWASA

Issues on Development and Management	[illegible]	[illegible]	[illegible]
[illegible]	●	●	
[illegible]	●	●	●
[illegible]	●	●	●
[illegible]	●	●	●
[illegible]	●	●	●
[illegible]	●	●	●

[illegible]

TASKS TO BE FOUND FOR GIS OPERATION IN PANI

GIS operation started from nothing else with solutions of technical problem to recover reliability of data and to improve data quality in existing data.

- Restore past GIS datasets from CAD drawing
- Transform GIS data to change map coordinate system with [illegible] on a new map coordinate system on World [illegible]
- Verify data and Update initial GIS data by As-Built drawings and CSCCR and [illegible] into Database to [illegible] since [illegible]
- Verify and Update initial GIS data with compiling survey databases by Field Verification Surveys on Pipelines and Leakage Survey
- GIS support for the NRW management to utilize [illegible] GIS functions, Visualization of [illegible] data and tabular data, Data analysis for [illegible] and [illegible] production of Map, and Map printing for Management

Process of GIS Operation

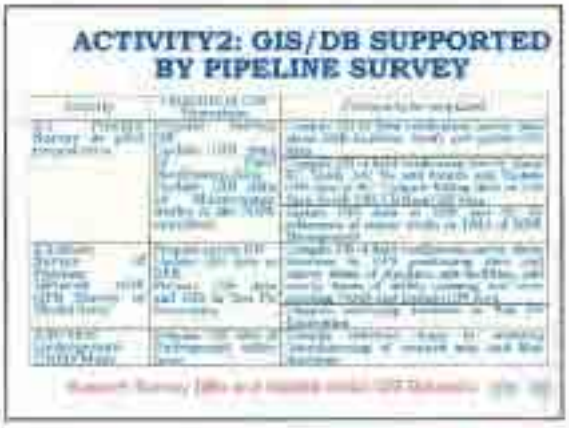
SUPPORTING GIS SYSTEM

- 2 sets of PC Workstations
- 2 Licenses of GIS software, ARCGIS ARCINFO 10 and ARCGIS ARCVIEW 10
- 1 set of A1 Color Inkjet Plotter and other output devices

PROJECT AREAS FOR GIS OPERATION


MAIN ACTIVITIES ON GIS AND DATABASE IN PANI


ACTIVITY1: MAIN ACTIVITY ON GIS/DB


ACTIVITY2: GIS/DB SUPPORTED BY PIPELINE SURVEY


ACTIVITY3: GIS/DB SUPPORTED BY LEAKAGE & NRW MANAGEMENT


GIS OPERATION TO SUPPORT THE NRW MANAGEMENT


GIS OPERATION TO SUPPORT THE NRW MANAGEMENT

GIS OPERATION TO SUPPORT THE NRW MANAGEMENT

- Support for Operation and Maintenance

GIS operation in support for Operation and Maintenance is required in activities in the NRW management as follows:

- Real time updating of GIS data required by the Maintenance in the NRW management
- Utilization of definitive GIS functions to support preparation of maps and data for data analysis and solution in the NRW Management
- Support the NRW Management: Visualization of Monitoring data and Tabular data on maps, Query in databases, Data Analysis, Overlay and Cross Tabulations in spatial data, Buffering, Map production, and Map printing to support for Operation and Maintenance in the NRW Management

SUPPORT FOR THE NRW MANAGEMENT

GIS SUPPORT FOR THE NRW MANAGEMENT

EXAMPLE OF GIS OPERATION: Display Map

Image of GIS datasets in Map Windows

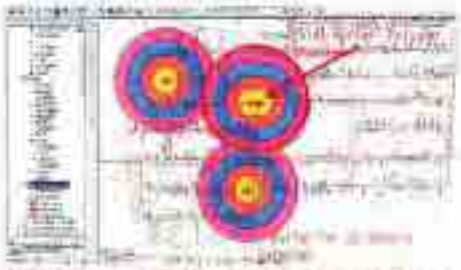
EXAMPLE OF GIS OPERATION: Reference of Attribute

EXAMPLE OF GIS OPERATION: Query

- Selection of Service Connection for Domestic Use

EXAMPLE OF GIS OPERATION: Buffer Analysis

- Buffer operation from valves



EXAMPLE of GIS OPERATION: Buffer and Tabulation

GIS OPERATION AND ROADMAPs FOR INFORMATION MANAGEMENT

- GIS operation with experiences guides preparations of ROADMAPS which becomes mile stones for Capacity Building on GIS operation
- 12 ROAD MAPs are guided by a document of Terms of Works for GIS operation
- OJT training is being guided by ROADMAPS to Counterparts to build up operation capacities on GIS in PWMI

GIS OPERATION AND ROADMAPS FOR INFORMATION MANAGEMENT

GIS OPERATION AND ROADMAPS FOR INFORMATION MANAGEMENT

BETTER FUTURES FOR GIS OPERATION

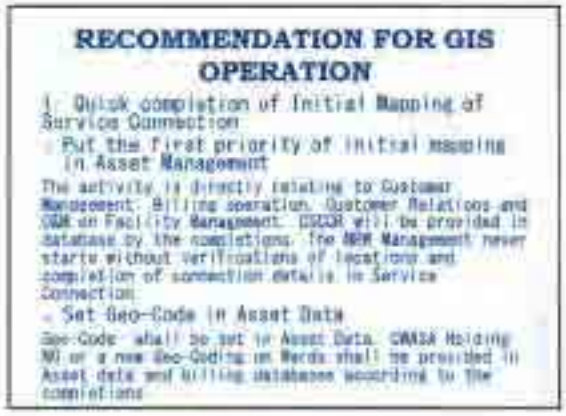
Don't stop Capacity Building on GIS operation with overcoming the most negative impacts with challenges through the NRW Management

PWMI oriented Technical Assistances for GIS operation to Set up Right of Way to overcome difficulties in the developments

GIS operation never functions without any solutions of technical problems in Asset datasets, so key issues shall be discussed.

Modernizations for Development, Management and Operations with Cost efficiencies in CWASA

This is a common issue in Water Sector and other stake holders in Bangladesh. Also another key issue is absence of Spatial Data Infrastructures on Mapping directly indicating to absence of reliable base maps for Asset Management in Bangladesh


RECOMMENDATION FOR GIS OPERATION
1. Quick completion of Initial Mapping of Service Connection
- Put the first priority of initial mapping in Asset Management
The activity is directly relating to Customer Management: Billing operation, Customer Relations and O&M on Facility Management. GSCCR will be provided in database by the completions. The NRW Management never starts without verifications of locations and completion of connection details in Service Connection.
- Set Geo-Code in Asset Data
Geo-Code shall be set in Asset Data. CWASA Holding NO or a new Geo-Coding in Words shall be provided in Asset data and billing databases according to the completions

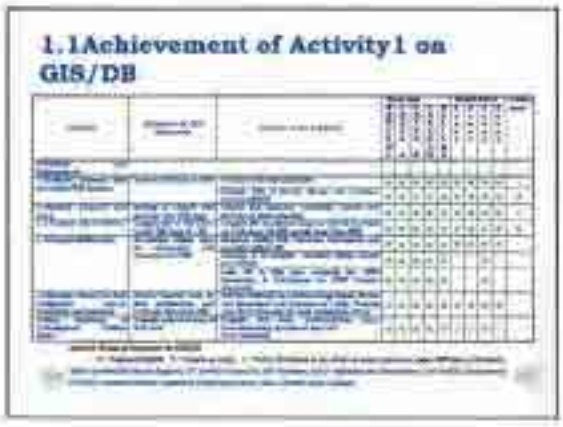

BETTER FUTURES FOR GIS OPERATION
2. Start up for database development for the Operation and Maintenance
- Database development shall be challenged to modernize the management in CWASA.
- GIS requires more database developments. Active Asset Maps and CRs supported by daily operations in CWASA
- Challenge Development against conventional management with paper documents and human protocols.
- Database development is key activity on Facility Management for devising Databases and supporting system.


BETTER FUTURES FOR GIS OPERATION
(Continue)
- GIS datasets in PANI shall be feed-back to those developments in order to establish the management system as follows:
Customer Ledgers supported by GSCCR and relevant data for Customer Management and Customer Relation in Sales Division.
Asset databases to maintain GIS datasets and relational databases in Asset Mapping in Design Division and WOs(Maintenance Operation Divisions)
Management Ledgers for the O&M in the supporting system for Facility Management in WOs
Re-development of billing databases providing Geo-Code to handle geographic locations of Account records in Computer System


BETTER FUTURES FOR GIS OPERATION
3. Requirement of Development Strategy and Action Plans for Modernization and Development
- Top Decision is strongly required for Modernization to develop Information Management to support O&M.
- Top to Down & Bottom to Up Actions are required for development to strengthen databases for daily operations. GIS operation had never realized about definitive functions to develop Facility Management.
- Challenge Development for Modernizations means new developments to accelerate by GIS, Database and System as Information Management.
- PANI experience and baseline data make it Feed Back to utilize daily operation with fixation of capacity on GIS.

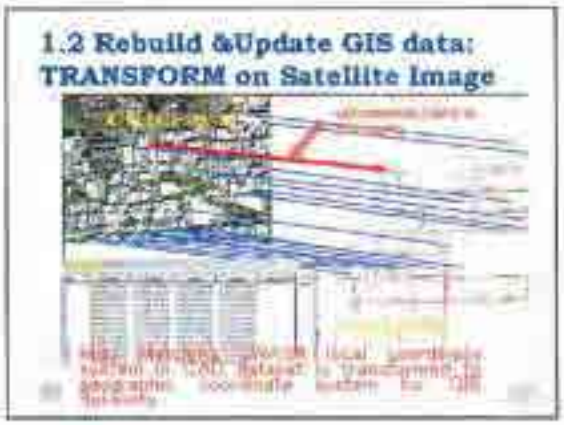

ASPIRATION FOR GIS OPERATION
- GIS operation is very simply and essentially supported by daily operations in real time.
- Daily operation makes it ensure to utilize data for the NRW management. But it is still too far from realities to fixate Capacity Building on Information Management without any developments for Modernizations.
- Think about how CWASA can alert developments for modernizations through PANI and this make it sure for CWASA to development Information Management.
- Please Don't Stop GIS operation for better tomorrow with the NRW Management.


THANK YOU FOR YOUR ATTENTIONS & HOEFULLY TAKE ACTIONS FOR BETTER TOMMORROW
Presented By SUMARE PANI & GIS Counterparts Team


1.1Achievement of Activity1 on GIS/DB


1.1 Rebuild &Update GIS Datasets: Available Data in CWASA 1


1.1 Rebuild &Update GIS Datasets: Available Data in CWASA 2

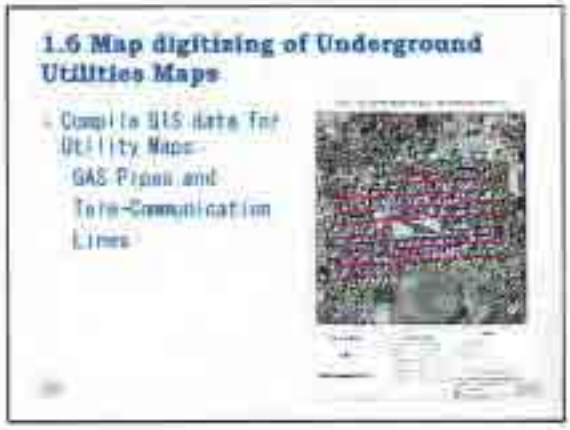

1.2 Rebuild &Update GIS data: TRANSFORM on Satellite Image


1.3 Verify GIS data in S.C. and Develop DB of CSCCR

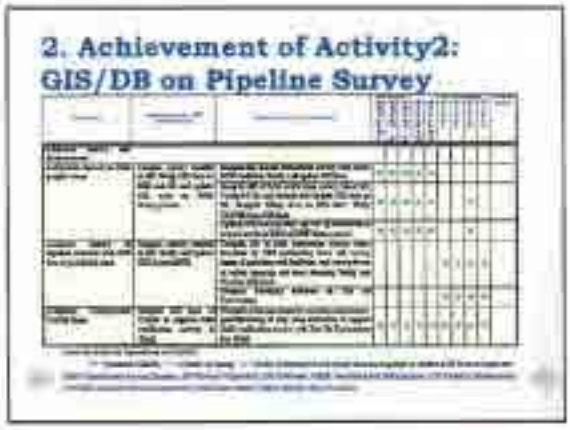

1.4 Compile Billing Database

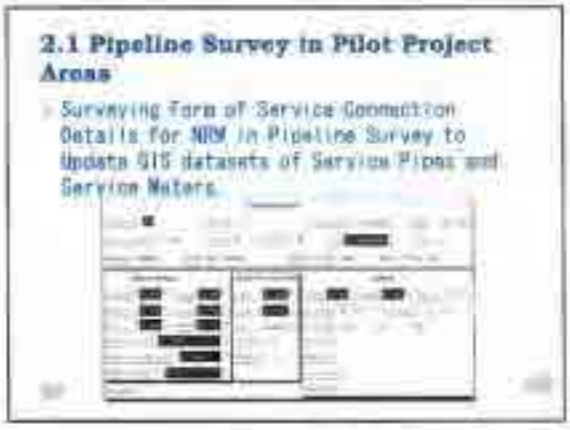

1.5 Desktop Survey: Building Survey
- Survey Buildings to arrange Type of Building, Building Stories and Building Structures to Provide Baseline data for Wate


1.5 Desktop Survey: Building Survey


1.6 Map digitizing of Underground Utilities Maps
- Compile GIS data for Utility Maps:
GAS Pipes and
Tele-Communication
Lines


1.6 Collect Underground Utility Maps And Map digitizing


2. Achievement of Activity2: GIS/DB on Pipeline Survey


2.1 Pipeline Survey in Pilot Project Areas
- Surveying form of Service Connection Details for NRW in Pipeline Survey to Update GIS datasets of Service Pipes and Service Meters

2.1 Rebuild &Update GIS data:

2.2Route Survey of Pipelins Networks

- Survey Main Pipelines and the Facilities with GPS Survey and Survey Forms toVerify Main pipes and facilities on Main Pipes
- Survey Utility Crossing with Survey Forms
- Survey River Crossing with Survey

2.2.Route Survey of Pipeline Network GPS Survey Result and Updating data

Main Pipes Verified by GPS Survey

2.2 Test Pit Excavation

- Sketch Drawing of Utility Crossing and Cross Section Portray Result in Test Pit Excavation

Sketch Drawing of Utility Crossing

2.3 Rebuild &Update GIS data: Updating GIS Datasets

- Produce Initial GIS Datasets for NRW updated by Field Verifications on Pipeline Survey and Leakage Water Survey
- Monitor NRW measures through A/C No. Water Consumptions and Bills

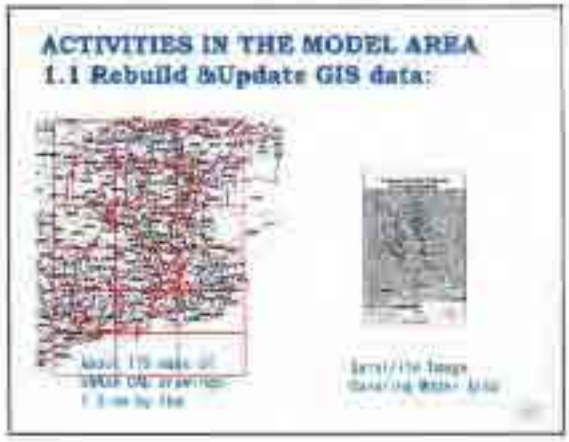
Initial GIS datasets on Satellite Image for NRW in Khulushi

3. Achievement of Activity3 : GIS/DB On Leakage Measures and the NRWM

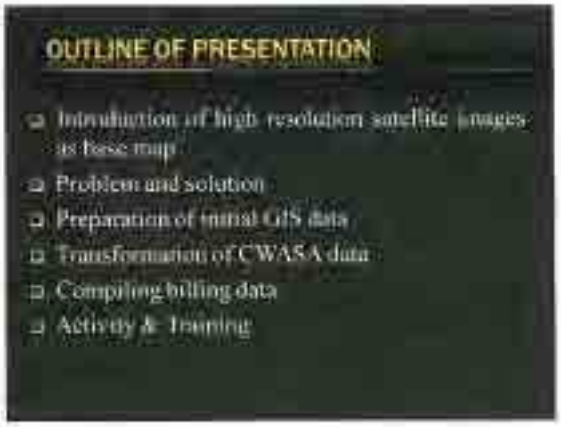

3.1 Support for Leakage Survey: DSR&S.C.

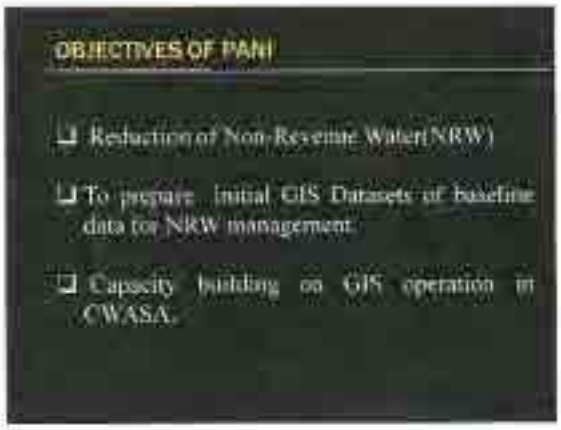

3.2 Support for
District Meter Analysis &
Monitoring of Water Consumptions

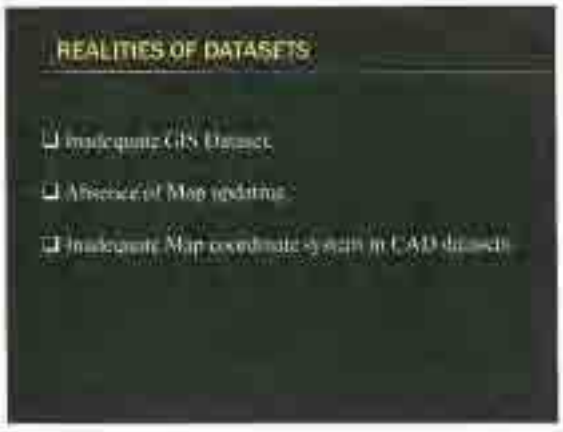

3.3 Support for the NRW Management


ACTIVITIES IN THE MODEL AREA
1.1 Rebuild &Update GIS data:

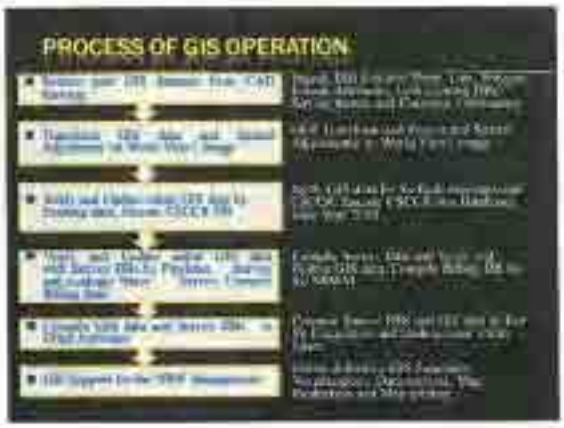

On Job Training
& Achievement
WELCOME


OUTLINE OF PRESENTATION
Introduction of high resolution satellite images as base map
Problem and solution
Preparation of initial GIS data
Transformation of CWASA data
Compiling billing data
Activity & Training

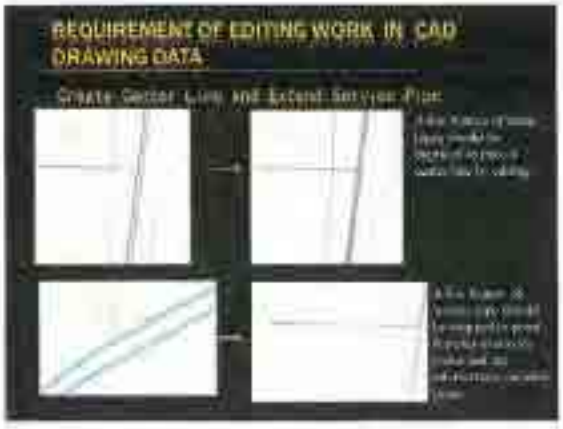

OBJECTIVES OF PANI
Reduction of Non-Revenue Water(NRW)
To prepare Initial GIS Datasets of baseline data for NRW management.
Capacity building on GIS operation in CWASA.

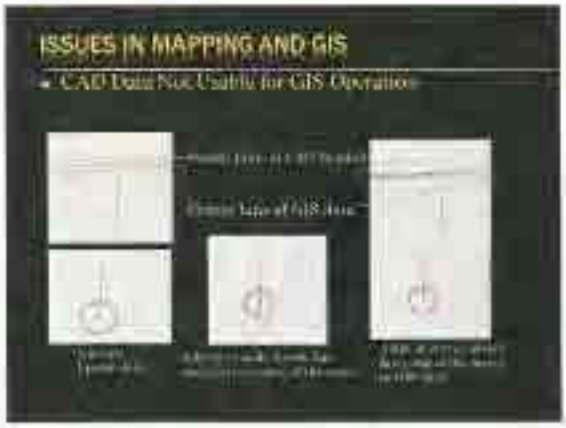

REALITIES OF DATASETS
Inadequate GIS Datasets
Absence of Map updating
Inadequate Map coordinate system in CAD datasets

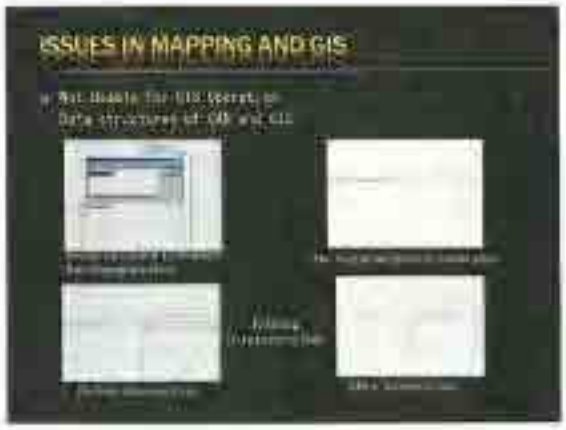

INTRODUCTION OF HIGH RESOLUTION SATELLITE IMAGES AS BASE MAP


PROCESS OF GIS OPERATION


CAD DATA AND GIS DATA
RESTORE INITIAL GIS DATA
CAD Drawings
GIS Data


REQUIREMENT OF EDITING WORK IN CAD DRAWING DATA


ISSUES IN MAPPING AND GIS
CAD Data Not Usable for GIS Operation


ISSUES IN MAPPING AND GIS


TRANSFORMATION AND ADJUSTMENT OF CWASA CAD DRAWING
Snapshot of CAD Drawing Prepared in 1998


FLOW CHART OF TRANSFORM AND SPATIAL ADJUSTMENT


TRANSFORMATION AND ADJUSTMENT OF
CWASA CAD DRAWING


TRANSFORMATION AND ADJUSTMENT OF
CWASA CAD DRAWING

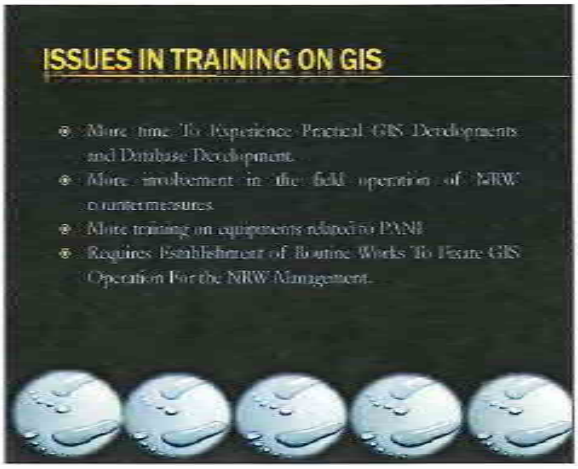

COMPILE BILLING DATABASES FOR THE NRW
OPERATION


COMPILE BILLING DATABASE


SUPPORT OF GIS OPERATION FOR THE NRW
MANAGEMENT: VISUALIZATION OF BILLING DATABASES


ACTIVITY
Work Items
Status
Comments


ROAD MAP FOR NRW MANAGEMENT
ROAD MAP1 : Compiling GIS Datasets to Restoe Initial Data at year 1998 from CAD Drawing Files with Geo-referencing in ROAD MAP2
ROAD MAP2 : Transform to make CWASA Coordinate System shift to a general coordinate system of WGS1984 and BTM(Bangladesh Transverse Mercator)
ROAD MAP3 : Compiling Existing Relational Databases of Service Meter & Customer with Updating
ROAD MAP4 : Compiling Database of Customer Service Connection Completion Report(CSCCR)
ROAD MAP5 : Compiling Customer Data and Monthly Billing Data
ROAD MAP6 : Compiling Existing As Built Drawing Maps
ROAD MAP7 : Compiling Building Survey Data
ROAD MAP8 : Compiling Field Verification Survey data To Update GIS Datasets in the Model Area
ROAD MAP9 : Compiling GIS Datasets of the Underground Utility Map
ROAD MAP10 : Compiling Field Verification Data of Pipe Survey and Pipe Leakage Survey in the Pilot Project Areas
ROAD MAP11 : Compile NRW Databases to support Monitor & Action for the NRW
ROAD MAP12 : Compile Test Pit Excavation Databases to verify Utility Crossing for O&M on PM


ISSUES IN TRAINING ON GIS
More time To Experience Practical GIS Developments and Database Development.
More involvement in the field operation of NRW counter measures.
More training on equipments related to PANI.
Requires Establishment of Routine Works To Create GIS Operation For the NRW Management.

Appendix-6 Minutes of Steering Committee

6-1 1st Steering Committee (June 2011)

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
AUTHORITIES CONCERNED OF THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
ON
THE PROJECT FOR ADVANCING NRW REDUCTION INITIATIVE (PANI) OF CHITTAGONG WASA

The Japanese Mid-term Review Team, organized by the Japan International Cooperation Agency and headed by Mr. Hiroyuki Tomita, stayed in the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh") from January 26th to February 3rd, 2011 for the purpose of conducting the joint mid-term review on the "Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA" with the Bangladesh Mid-term Review Team, which consists of members from the Economic Relations Division, Ministry of Finance, the Local Government Division, Ministry of Local Government, Rural Development and Co-operatives and Chittagong Water Supply and Sewerage Authority.

After intensive study and discussion on the achievement of the project and its activities by both teams, both parties of the Joint Review Team agreed upon the Joint Mid-term Review Report attached hereto.

Dhaka, June 2011

Mr. Hiroyuki Tomita
Leader
Japanese Mid-term Review Team
Japan International Cooperation Agency
Japan

Ms. Khadiza Begum
Deputy Secretary
Economic Relations Division
Ministry of Finance
Bangladesh

Engr. A.K.M. Fazlullah
Managing Director,
Chittagong Water Supply and Sewerage Authority

Ms. Zuena Aziz
Joint Secretary
Local Government Division,
Ministry of Local Government,
Rural Development and Co-operatives
Bangladesh

Attachment: Joint Mid-term Review Report

6-2 2nd Steering Committee (Dec. 2011)

**MINUTES OF MEETING BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY AND
AUTHORITIES CONCERNED OF THE PEOPLE'S REPUBLIC OF
BANGLADESH AND CHITTAGONG WASA ON
TERMINAL EVALUATION OF
THE PROJECT FOR
ADVANCING NRW REDUCTION INITIATIVE (PANI)
OF CHITTAGONG WASA**

The Japanese Terminal Evaluation Team (hereinafter referred to as 'the Japanese Team'), organized by Japan International Cooperation Agency (hereinafter referred to as 'JICA') headed by Mr. Hiroyuki Tomita, stayed in the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh") from December 3rd to 23rd, 2011 for the purpose of conducting the joint terminal evaluation on the "Project for Advancing NRW Reduction Initiative (PANI) of Chittagong WASA" (hereinafter referred to as "the Project") on the basis of the Record of Discussions signed on 31st March, 2009.

The Joint Evaluation Team, which consists of members from the Local Government Division, Ministry of Local Government, Rural Development and Co-operatives (hereinafter referred to as "LGD"), Economic Relations Division, Ministry of Finance (hereinafter referred to as "ERD"), Chittagong WASA (hereinafter referred to as "CWASA") and the Japanese Terminal Evaluation Team, was organized for the purpose of conducting this evaluation.

After intensive study and discussion on the achievements of the project and its activities, both parties agreed upon the contents of the attached document.

Dhaka, February 2012

Mr. Hiroyuki Tomita
Leader
Japanese Terminal Evaluation Team
Japan International Cooperation Agency
Japan

Ms. Khadiza Begum
Deputy Secretary
Economic Relations Division
Ministry of Finance
Bangladesh

Engr. A.K.M. Fazlullah
Managing Director,
Chittagong Water Supply and Sewerage Authority

Ms. Zuena Aziz
Joint Secretary
Local Government Division,
Ministry of Local Government,
Rural Development and Co-operatives
Bangladesh

1. Joint Terminal Evaluation Report

The Joint Terminal Evaluation Team confirmed the Joint Terminal Evaluation Report attached as Appendix, which was submitted to the Project Steering Committee meeting (hereinafter referred to as "the Committee") held on December 21, 2011.

2. Extension of the Project

Though the project purpose and outputs have been partially achieved, the "Efficiency" and "Sustainability" of the project are still insufficient as some C/Ps have not been fully allocated in most of the project period. Also, at the beginning of the Project duration, the draft NRW plan and implementation of NRW measures and activities were not fully achieved due to the lack of information in basic database .

In the committee meeting, the Bangladesh side, Managing Director (MD) of CWASA committed to realize the recommendations made in the Joint Terminal Evaluation Report (attached as APPENDIX), particularly to the recommendations regarding institutional development, and requested to extend the Project period.

The Japanese Team agreed to convey the extension request to the concerned authorities in Japan. At the same time, the Japanese team also stated that they will recommend to JICA Bangladesh office and the concerned authorities in Japan that the decision about project extension shall be made by JICA, taking account of the progress made by CWASA to respond to the recommendations in the Joint Terminal Evaluation Report.

In addition, the Japanese team strongly recommended CWASA to take immediate actions for the establishment of the management board. Both sides agreed that CWASA shall report the progress with official request for project extention to JICA Bangladesh by the end of March, 2012 for JICA to make judgment on the extension of the project period.

APPENDIX Joint Terminal Evaluation Report