REPUBLIC OF THE PHILIPPINES
CAGAYAN DE ORO CITY WATER DISTRICT
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WATER SAFETY PLAN

Managing Drinking Water – Quality from Catchment to Consumer

Document Control:

VERSION NO.	:	01
Formulation Date	:	15 November 2016
Approved by	:	Board of Directors BOD Resolution No. 167, S-2016
Approval Date	:	27 December 2016
Circulation List	:	BOD – ETAG OGM OAGM – Technical Services Engineering Department Production Department Maintenance – NRW Management Department

TABLE OF CONTENTS

Introduction

In 2013, COWD technical personnel were first introduced to the concept of Water Safety Plan (WSP) during a seminar facilitated by the COWD Regional Training Center and attended by employees of different local water districts. The resource speakers came from the Local Water Utilities Administration (LWUA) and experts from Maynilad.

The first COWD WSP Team was then created thru GM Memorandum No. 252, s2013 dated September 24, 2013 (Appendix A). The responsibilities of the team were as follows:

1. Assess the existing COWD Water Supply System.
2. Develop Water Safety Plan for COWD.
3. Spearhead the implementation of the WSP
4. Monitor the Implementation of the WSP
5. Revise the WSP as may be necessary.

In June 30, 2014, the WSP Team had completed the first WSP of the office and the same was approved for implementation by virtue of COWD Board Resolution No. 110, S-2014, dated October 2, 2014 (Appendix B).

The COWD WSP went through its 1st revision after a new format was introduced by LWUA and DOH. This time, it adopted the principle and the 11-step approach of the World Health Organization.

On _____, COWD Board Resolution No. _____ (Appendix C) was passed to signify its support for the WSP development activities. An office order (Appendix D) was also issued creating a new set of WSP Team to review and revise the existing WSP to conform to the new format. This is pursuant to Administrative Order No. 2014-0027 dated September 4, 2014 (Appendix E) issued by the Department of Health (DOH) declaring the development and implementation of the water safety plan by all drinking-water service providers as a National Policy for drinking-water quality management. The LWUA, in the

same manner, through Memorandum Circular No. 010-014 dated December 1, 2014 (Appendix F), had ordered all water districts and rural waterworks and sanitation associations to develop and implement a water safety plan and to comply with the provisions of DOH AO 2014-0027.

The primary objectives of a water safety plan in protecting human health and ensuring good water supply practice are the minimization of contamination of source waters, the reduction or removal of contamination through appropriate treatment processes and the prevention of contamination in the distribution network and the domestic distribution system.

With the formulation and implementation of the Water Safety Plan, it is hoped that COWD will be seen by the community it serves to have done its best in ensuring the production and delivery of safe and potable water free from all contaminants and in compliance with the parameters set by the Philippine National Standards for Drinking Water (PNSDW). This WSP was approved for implementation per Board Resolution No. _____, dated _____ (Appendix G)

To ensure the strict implementation of the approved WSP, the Team will meet quarterly to discuss compliance, possible changes, monitoring and auditing schedule to determine if all provisions in this WSP had been followed.

1. MANAGEMENT SUPPORT AND THE WATER SAFETY PLAN TEAM

1.1 COWD WSP TEAM

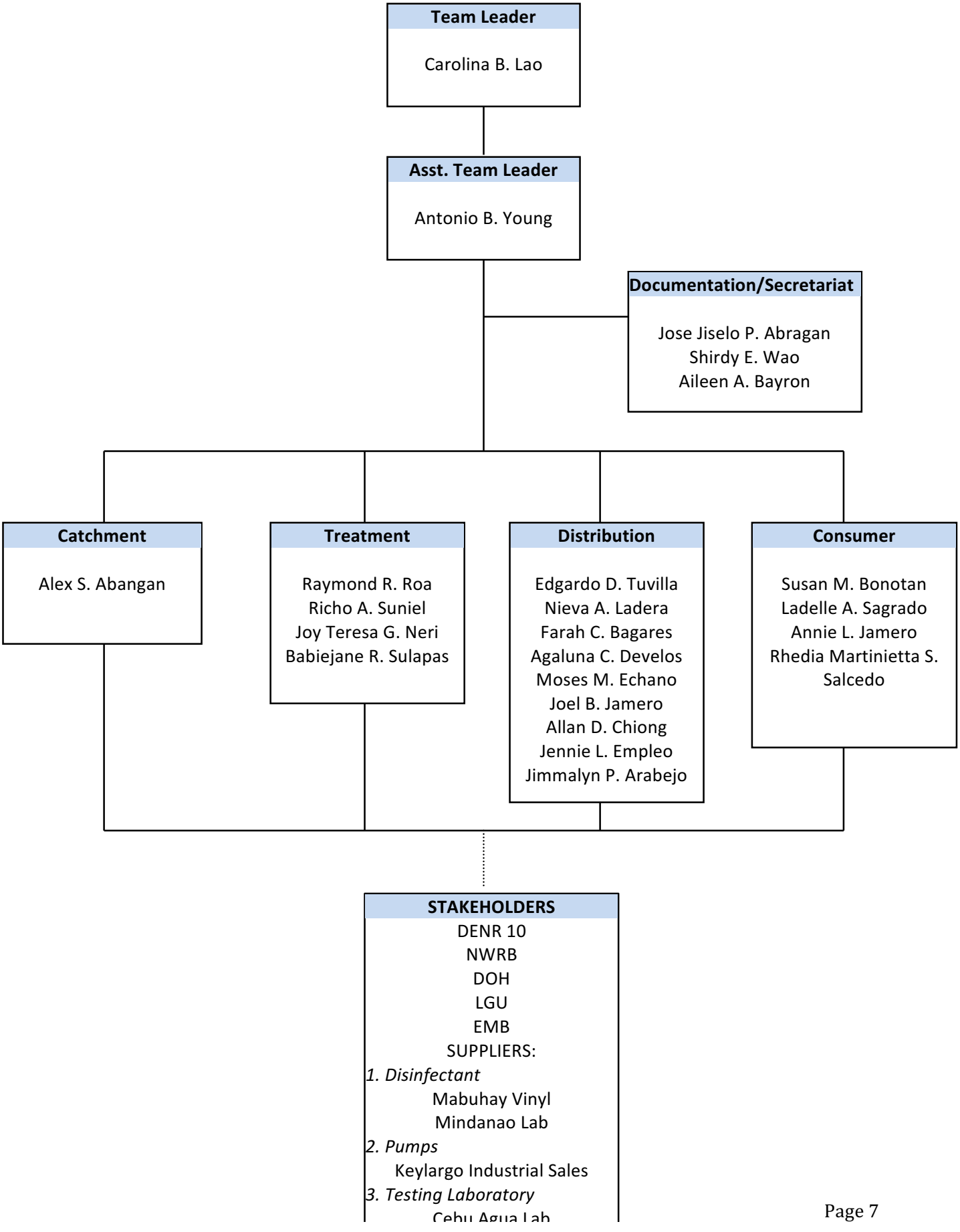
By virtue of COWD Board Resolution No. 160, dated December 16, 2016 and GM Memorandum No. 004, S-16, dated January 2, 2015, the new set of WSP Team was created and tasked to do the following responsibilities:

1. Assess the existing COWD Water Supply System
2. Develop Water Safety Plan for COWD
3. Spearhead the implementation of the WSP
4. Monitor the Implementation of the WSP

5. Revise the WSP as may be necessary
6. Regularly meet to ensure strict implementation of the WSP

The members of the Team were chosen according to relevant experience and the needed expertise in formulating this WSP. Please refer to succeeding pages for the organogram and the WSP Team composition.

Figure 1. COWD WSP TEAM ORGANOGRAM



1.2 WSP TEAM, ROLES AND FUNCTIONS

COWD WSP Team is composed of representatives from each of the 7 departments of the office: Production, Engineering, Maintenance and NRW Management, Commercial, Finance, Administrative and Management Services. All the members were chosen based on the required knowledge on either of the following:

1. Technical expertise on the operation & maintenance of:
    a. Source
    b. Storage
    c. Treatment
    d. Distribution

2. Provide operational support for the WSP in terms of:
    a. Administrative
    b. Financing
    c. Technical

3. Capable of communicating the WSP objectives and outcomes:
    a. Inside the water district
    b. Outside the water district.

4. Understand water quality targets to be met (specific knowledge on product water)
5. Understand the impact of proposed water quality controls on the environment.
6. Knows the regulations
7. Familiar with training and awareness programmes.
8. With authority
9. Other members:
    a. consultants
    b. Coordinator
    c. Secretariat
    d. Documentation Committee.

The WSP Team will meet once every quarter to discuss the implementation of this safety plan as well as the possible revisions following a change in operation, near miss, incidents and emergency situations.

Table 1: WSP Team Composition

Name	Job Title	Role in the WSP Team	Contact Details	Expertise																
				1				2			3		4	5	6	7	8	9			
				a	b	c	d	a	b	c	a	b						a	b	c	d
Carolina B. Lao	Dept. Manager	Team Leader	0917-728-5677	■						■	■	■	■	■	■	■	■				
Antonio B. Young	Div. Manager A	Asst. Team Leader	0917-773-3270	■	■					■	■	■	■	■	■	■					
Alex S. Abangan	Principal Engineer D	Member-Catchment	0921-658-1115	■	■					■	■		■	■	■	■					
Richo A. Suniel	Sr. Water Utilities Mngmt Officer	Member-Treatment	0935-191-9662	■	■					■	■		■	■	■	■					
Raymond R. Roa	Sr. Water Utilities Mngmt Officer	Member-Treatment	0916-529-2409	■	■					■	■		■	■	■	■					
Joy Teresa G. Neri	Sr. Quality Control Inspector	Member- Water Quality	0916-285-5715			■				■	■		■	■	■	■					
Babiejane R. Sulapas	Medical Technologist	Member- Water Quality	0995-634-7797			■				■	■		■	■	■	■					
Edgardo D. Tuvilla	Div. Manager A - Pipelines	Member-Distribution	0917-706-3025	■			■			■	■		■	■	■	■					
Nieva A. Ladera	Div. Manager A - Water Distribution	Member-Distribution	0917-771-8098	■			■			■	■	■	■	■	■	■					
Farah C. Bagares	OIC, Water Losses Control Div.	Member-Distribution	0917-772-5126	■			■			■	■	■	■	■	■	■					
Agaluna C. Develos	Division Manager A	Member-Distribution	0917-656-5228	■			■			■	■	■	■	■	■	■					
Joel B. Jamero	Principal Engineer D	Member-Distribution	0906-324-8106	■			■			■	■	■	■	■	■	■					
Moses M. Echano	Principal Engineer D	Member-Distribution	0905-249-5309	■			■			■	■	■	■	■	■	■					
Jennie L. Empleo	Principal Engineer D	Member-Distribution	0927-702-2440	■			■			■	■	■	■	■	■	■					
Jimmalyn P. Arabejo	Engineering Staff	Member-Distribution	0916-335-1618	■			■			■	■	■	■	■	■	■					
Allan D. Chiong	Customer Service Assistant A	Member-Distribution	0917-799-0846	■			■			■	■	■	■	■	■	■					
Susan M. Bonotan	Div. Manager A	Member - Customer Service	0917-707-6026					■				■	■		■						
Annie L. Jamero	OIC, Customer Accounts Div.	Member - Customer Service	0919-631-8209					■				■	■		■						
Rhedia Martinietta S. Salcedo	Div. Manager - HRD	Member - Consumer	0939-917-0917					■			■	■	■	■	■						
Jose Jiselo P. Abragan	Corporate Planning Specialist	Documentation	0916-702-1734					■			■	■	■	■	■						■
Shirdy E. Wao	Sr. Customer Service Officer A	Documentation	0905-645-0166							■	■	■		■	■						■
Ailene A. Bayron	Engineering Staff	Documentation	0916-236-9778							■	■	■		■	■						■

1.3 THE STAKEHOLDERS

In the organogram presented above, the stakeholders or external parties that may have a direct or indirect influence to the quality of water were also indicated.

These stakeholders are identified and partnered with to ensure that health-based targets are met in the production, transmission and delivery of safe water from catchment to consumers as embodied in this WSP.

Table 2 below shows the stakeholders from each stage of the water supply system (catchment to consumer) including the contact persons and respective contact details.

Table 2. WSP Stakeholders Identification

Stakeholder	Contact Person	Office Designation	Address	Email address	Contact Number
Catchment					
Department of Environment & Natural Resources	Ruth M. Tawan-tawan	Regional Director - Region 10	DENR 10 Macabalan, Cagayan de Oro City	r10@denr.gov.ph	(088)856-9066/ (088)856-8200
National Water Resources Board	Dr. Sevillo David Jr.	Executive Director	8th Flr., NIA Building, EDSA, Diliman, Quezon City	nwrbphil@gmail.com	(632)928-2365 / (632)920-2641
Local Government Unit – LGU of Cagayan de Oro City	Engr. Isidro Obligado	Housing Agencies Coordinator fo the Shelter & Housing Dev't Multi-Sectoral Task Force			0927-570-9008
Environmental Management Bureau (EMB)	Dr. Sabdullah Abubacar	Regional Director – Region 10	DENR 10 Macabalan, Cagayan de Oro City	www.emb.gov.ph	(088)856-9362
Rio Verde Water Consortium Inc. (RVWCI)	Engr. Ulysses E. Braciro	Maintenance Manager	Pualas, Baungon, Bukidnon		0939-935-8372
Supplier - Pumps					
Keylargo Industrial Sales	Victoriano Ocho	Sales Manager	Quezon City		0915-901-2022

Driller					
Speed Drill Construction & Trading Inc.	Engr. Edgar B. Pagatpat, ChE, MBA	Sales/Marketing Executive	Door 1, Cui Building, San Pedro, Gusa, National Hig Way, Cagayan De Oro City		0926-698-5612 / 0917-704-5260 / 0923-749-0867
Sinian International Corporation	Joy B. Isorena	Sales Manager	9th Floor Rm. 902 Dona Maria Natividad Bldg., T.M. Kalaw Cor. Cortada St., Manila	isorenaj28@yahoo.com	0921-234-0310 / 0917-596-6751
Treatment					
Department of Health (DOH)	Nimfa Torriso	Regional Director	Serina St., Carmen, CDOC		088 828-7123
Supplier of Disinfectant					
Mabuhay Vinyl Corporation	Romeo G. Dela Cruz	VP-Marketing	3rd Flr, Philamlife Salcedo Building, 126 L.P. Leviste St., Salcedo Village 1227 Makati City	www.mvc.com.ph	(632)817-8971 / (632)816-4785
Mindanao Laboratory Services	Julius Vincent R. Catanyag	Proprietor - General Manager	Davao St., Aluba Subd., Macasandig, CDOC		0917-626-0102
Testing Laboratory					
Cebu Agua Lab Incorporated	Eugene Aquilam		Unit 2-J Freestar Arcade, H. Cortes St., Subangdaku, Mandaue City,		(32)422-7275

			Cebu		
Department Of Science And Technology	Joanah S. Magto	Science Specialist Ii	J.V. Seriña St., Carmen, Cagayan De Oro City	rstl_dost10@yahoo.com	(088)858-3931 to 33 loc 26
Distribution					
Department Of Public Works And Highways (DPWH)	Evelyn T. Barroso	Regional Director	Engineers Hill, Bulua , CDO		088 853-2002
Local Government Unit – LGU of Cagayan de Oro City	Engr. Isidro Obligado	Housing Agencies Coordinator fo the Shelter & Housing Dev't Multi-Sectoral Task Force			0927-570-9008
Supplier of Pipes And Appurtenances					
Aluminates Metering Supply Company Inc.	Gloria B. Bertumen	General Manager	20c Malaya St., Malanday Marikina City, Philippines, 1805	aluminatesmetering@yahoo.com / www.vikingjohnson.com / www.itron.com	0917-577-02227 / 0922-855-3276 / (632)408-0789
Moldex Products, Inc.	Kenneth B. Handugan	Sales Engineer	Moldex Building, Ligaya St., Cor., West Ave., Quezon City	sales@moldex.com.ph / www.mpi.moldex.com.ph	0917-863-9238
MIGS System, INC.	Ray G. Ferrera	General Manager	316 Mc Arthur High Way Malinta, Valenzuela City	www.migsystems.com.ph	0920-925-7959 / 0922-862-6051

AVK Philippines Inc.	Elmerson Dela Cruz	Product Sales Specialist	#70 West Avenue Brgy. West Triangle, Quezon City	sales@avk.ph / www.avkvalves.com	0916-141-4808
Mechanical Handling Equipment Co., Inc.	Jose Ronnel B. Militar	Sales Supervisor	Door #108 Lyl Building, Kimwa Compound, Cagayan De Oro City	mhecocdo@mhecoinc.com.ph	0916-544-5883 / (6388)856-4493 / (638822)73-3320
Techno-Trade Resources (Davao) Inc.	Chris Micarandayo	Sales Engineer	Unit 1502 Jollibee Center Cond., San Miguel Ave., Ortigas Center	manila@ttri.ph	(02)636-0970 / 919-6601 / 0923-622-9682
Uptown Industrial Sales, Inc.	Reynaldo F. Palasan	Sr. Gse	Door #6 Vicky Tan Bldg., Kauswagan, Cagayan De Oro City	rpalasan@uptown.com.ph	0905-224-5228 / 72-3835
La Rein Engineering & Industrial Sales	Engr. Sennen Sagun	Operations Manager	97 Toma Saco St. - Nazareth 1st., Cagayan De Oro City	larein_engineering@yahoo.com	0936-213-8836 / 0916-944-1911
Tradepoints, Inc.	Anecito C. Lluisma	Account Manager	431 Tabayog St., Mandaluyong City, Philippines, 1550	a.lluisma@mytradepoints.com / tradepts@pldtdsl.net	0927-871-8472 / (632)746-4688
Uni-Field Enterprises, Inc.	Marlon A. Liban	Area Manager	150 Corporate Center No. 150 Panay Ave., South Triangle Quezon City, Philippines	unifield@unifield-ent.com / marlonliban@unifield-ent.com	0919-360-1168 / (632)441-1290

Environmental Management Bureau (EMB)	Dr. Sabdullah Abubacar	Regional Director – Region 10	DENR 10 Macabalan, Cagayan de Oro City	www.emb.gov.ph	(088)856-9362
Consumer					
Local Government Unit – LGU of Cagayan de Oro City	Engr. Isidro Obligado	Housing Agencies Coordinator fo the Shelter & Housing Dev't Multi-Sectoral Task Force			0927-570-9008
Department of Health (DOH)	Nimfa Torriso	Regional Director	Serina St., Carmen, CDOC		088 828-7123

2. SYSTEM ASSESSMENT & CONTROL MEASURES

2.1 General Information on COWD Water System

The Cagayan de Oro City Water District (COWD) is a Government – Owned and Controlled Corporation created by virtue of the Presidential Decree No. 198 or otherwise known as the "Provincial Water Utilities Act of 1973." The said Decree declared a national policy favoring local operation and control of water systems thereby authorizing the formation of local water districts in the Philippines. Soon after the Decree was signed, the COWD was created as the first Water District in the country on 01 August 1973.

True to its mandate, the District envisions "to be an outstanding Water District in the country" while it carries the mission "to provide excellent water service to the community we serve." A fast growing government corporation of more than 400 workforces, the District operates embracing the core values of accountability, being result-driven, teamwork and faith in One Almighty. These vision, mission and core values serve as COWD's guide and lead in all opportunities to plan and program for the delivery of best service to the public.

One of the thrusts of the COWD is water security, which can only be addressed through a holistic, integrated planning approach, that is, taking both internal and external environmental factors at all times. The major strategies would include NRW Reduction Program, Climate Change Resiliency and Wastewater and Septage Management. Thus, this vulnerability assessment of the COWD plays a very important part in performing its mandate to ensure availability of potable water for the public of today's and the future's generation. Through this vulnerability assessment, COWD shall be able to optimize use of limited resources through more scientific and more intelligent planning. This exercise shall help ensure the resiliency of the facilities, in general, in order to continue providing water services during and soonest after any calamity.

2.2 Service Area

Generally, the service area of the COWD covers the entire of the City of Cagayan de Oro that comprises 80 barangays: 40 urban and another 40 classified as rural barangays. Being the largest city in Northern Mindanao, it has a total land area of about 57,000 hectares with a

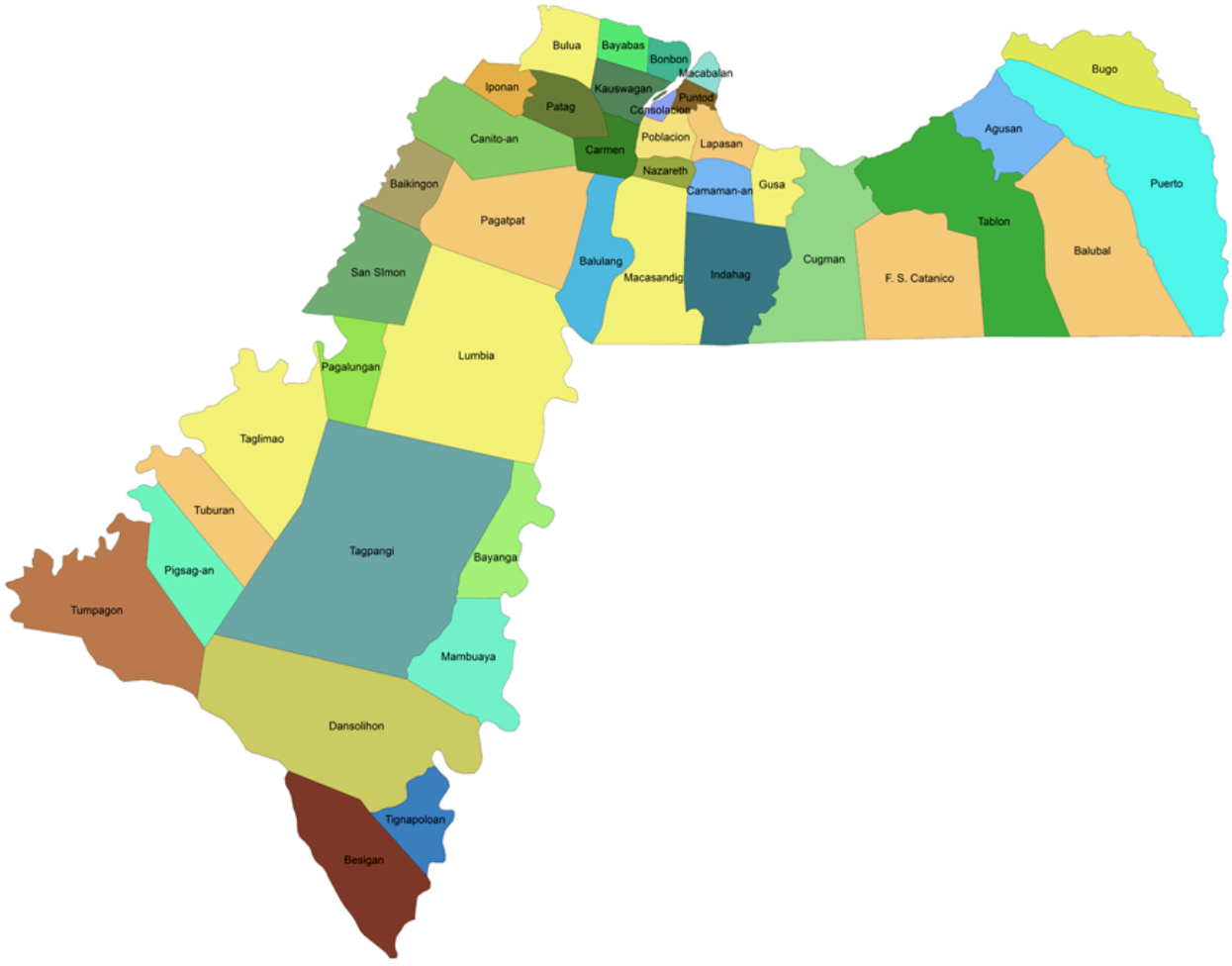
population of more than 600,000 in 2010. As such, the City was ranked as 10th most populous city in the Philippines in 2010 (Wikipedia).The Macajalar Bay in the north, Bukidnon in south, Tagoloan in the east and Opol in the west, bound Cagayan de Oro. The topography of the City is characterized by a narrow plain along the Macajalar Bay and by the highlands separated by steep inclined escarpment in the south expanding from east to west. The lowlands are relatively flat with elevation not exceeding 10 meters above the mean sea level while the highlands consist of plateaus, terraces and gorges. Only 28% of the City's total land area has slope between 0 and 8 percent while the rest of 72% is sloping higher than 8%, posing greater challenge to development.

The terrain and topography of Cagayan de Oro allows all seven rivers and six major creeks to drain to the Macajalar Bay. These rivers are the Cagayan de Oro River, Iponan, Alae, Agusan, Gusa, Cugman and the Bigaan River. On the other hand, the most notable creeks are the Binono-an creek, Bitan-ag, Indulong, Kolambog, Sapong and Umalag creek. The headwaters of these rivers are from the adjacent province of Bukidnon. For instance, the Cagayan de Oro River, which serves as the natural boundary between Bukidnon and Cagayan de Oro, has its headwaters in the Kalatungan Mountain Range. This traverses 3 more municipalities in the Bukidnon province, namely: Talakag, Baungon and Libona. This suggests that more tributaries along the way are draining into the Cagayan River and down to the Macajalar Bay passing through the major parts of Cagayan de Oro at the lowlands.

Presently, the District has extended services to 64 barangays or 80% of the total 80 barangays within Cagayan de Oro and eight (8) coastal barangays of Opol. Opol is a municipality of the province of Misamis Oriental located adjacent and west of Cagayan de Oro. In terms of land area, served area covers a little more than 40% while in terms of population, served population equates to more than 80%. The barangays that remained unserved up to present are those that are located in the hinterlands up to more than 35 kilometers from the City proper and altitude of more than 400 meters. Table 3 summarizes the service area of COWD as of 2015 while Table 4 lists the name of barangays served with corresponding population as of 2010. Figure 2 shows a map of Cagayan de Oro indicating the relative locations of the barangays.

Table 3
Summary of COWD Service Area
(Excluding Opol)

PARTICULAR	TOTAL	SERVED	UNSERVED
LAND AREA (has)	56,967	23,597	33,369
% to TOTAL	100%	41%	59%
NO. of BRGYS	80	64	16
% to TOTAL	100%	80%	20%
POPULATION (est)	602,422	560,783	41,305
% to TOTAL	100%	93%	7%



Source: cagayandeoro.gov.ph

Figure 2
Relative Locations of Barangays

Table 4
List of Barangays and Population

Table 4 List of Barangays and Population					
NO.	**NAME**	**POPULATION**	**NO.**	**NAME**	**POPULATION**
1	Barangay 39	46	48	Agusan	14,812
2	Barangay 37	77	49	Canitoan	15,069
3	Barangay 05	83	50	Patag	17,219
4	Barangay 02	84	51	Puntod	18,399
5	Barangay 33	86	52	Tablon	18,608
6	Barangay 38	94	53	Macabalan	20,303
7	Barangay 04	108	54	Cugman	20,531
8	Barangay 20	121	55	Iponan	20,707
9	Barangay 09	132	56	Macasandig	23,310
10	Barangay 16	143	57	Camaman-an	24,651
11	Barangay 08	157	58	Gusa	26,117
12	Barangay 03	177	59	Bugo	27,122
13	Barangay 06	212	60	Bulua	31,345
14	Barangay 21	254	61	Balulang	32,531
15	Barangay 11	342	62	Kauswagan	34,541
16	Barangay 19	419	63	Lapasan	41,903
17	Barangay 01	453	64	Carmen	67,583
18	Barangay 12	469	***SUB-TOTAL***		***560,783***
19	Barangay 14	479	**UNSERVED BARANGAYS**		
20	Barangay 29	485	65	Pigsag-an	1,256
21	Barangay 28	541	66	San Simon	1,346
22	Barangay 07	542	67	Tuburan	1,395
23	Barangay 10	616	68	Besigan	1,404
24	Barangay 34	621	69	Taglimao	1,418
25	Barangay 36	791	70	F.S. Catanico	1,710
26	Barangay 40	830	71	Pagalungan	1,806
27	Barangay 30	875	72	Tumpagon	2,232
28	Barangay 23	916	73	Baikingon	2,342
29	Barangay 24	929	74	Mambuaya	2,490
30	Barangay 25	1,295	75	Tagpangi	2,684
31	Barangay 27	1,380	76	Bayanga	2,769
32	Barangay 32	1,410	77	Balubal	2,893
33	Barangay 18	1,496	78	Tignapoloan	4,514
34	Barangay 31	1,506	79	Dansolihon	4,811
35	Barangay 22	1,944	80	Indahag	6,235
36	Barangay 13	2,330	***SUB-TOTAL***		***41,305***
37	Barangay 17	2,342	**SERVED BARANGAYS IN OPOL**		
38	Barangay 26	2,383	81	Barra	14,334
39	Barangay 35	2,395	82	Bonbon	2,698
40	Barangay 15	2,966	83	Igpit	10,123
41	Pagatpat	5,178	84	Luyong Bonbon	3,491
42	Bonbon	9,195	85	Malanang	3,593
43	Consolacion	9,919	86	Molugan	9,575
44	Nazareth	10,658	87	Poblacion	3,690
45	Puerto	11,475	88	Taboc	2,918
46	Bayabas	12,999	***SUB-TOTAL***		***50,422***
47	Lumbia	14,079	**OVERALL TOTAL**		**652,510**

2.3 WATER SOURCES

Cagayan de Oro's abundant water supply mostly comes from ground water. Seventy percent (70%) is sourced through deep wells. The remaining 30% comes from surface water purchased from a bulk supplier.

The potable water COWD serves to the public comes from twenty-seven (27) wells distributed in the six (6) well fields situated at Macasandig, Balulang, Calaanan, Bugo, Tablon and Agusan. There is one spring source located at Malasag. Since 2007, about 40 MLD of the District's total water production capacity has been supplied by a bulk water contractor. Production facilities include three (3) major booster pumping stations and eight (8) reservoirs while transmission and distribution lines extend up to 565.50 kilometers ranging from 50mm – diameter to 800mm – diameter in size.

Table 5. COWD Water Sources

WATER SOURCES	DISCHARGE		Actual YTD
	lps	gpm	
a. Deep Well Source (28)	1475	23380	
b. Spring Source	2	30	
Total Wells & Spring	1477	23410	39,459,345
Booster Pumps (13)	622	9859	
BWSP (Bulk Water)			14,384,550

Table 6. Production Well Capacity

WELLFIELD	NO. OF WELLS	CAPACITY, CMH
East Service Zone		
Agusan	1	342
Bugo	5	1,205
Macasandig	8	1,786
Tablon	2	493
Sub total	16	3,825
West Service Zone		
Balulang	7	1,076
Calaanan	4	216
Sub total	11	1,292
GRAND TOTAL	27	5,117

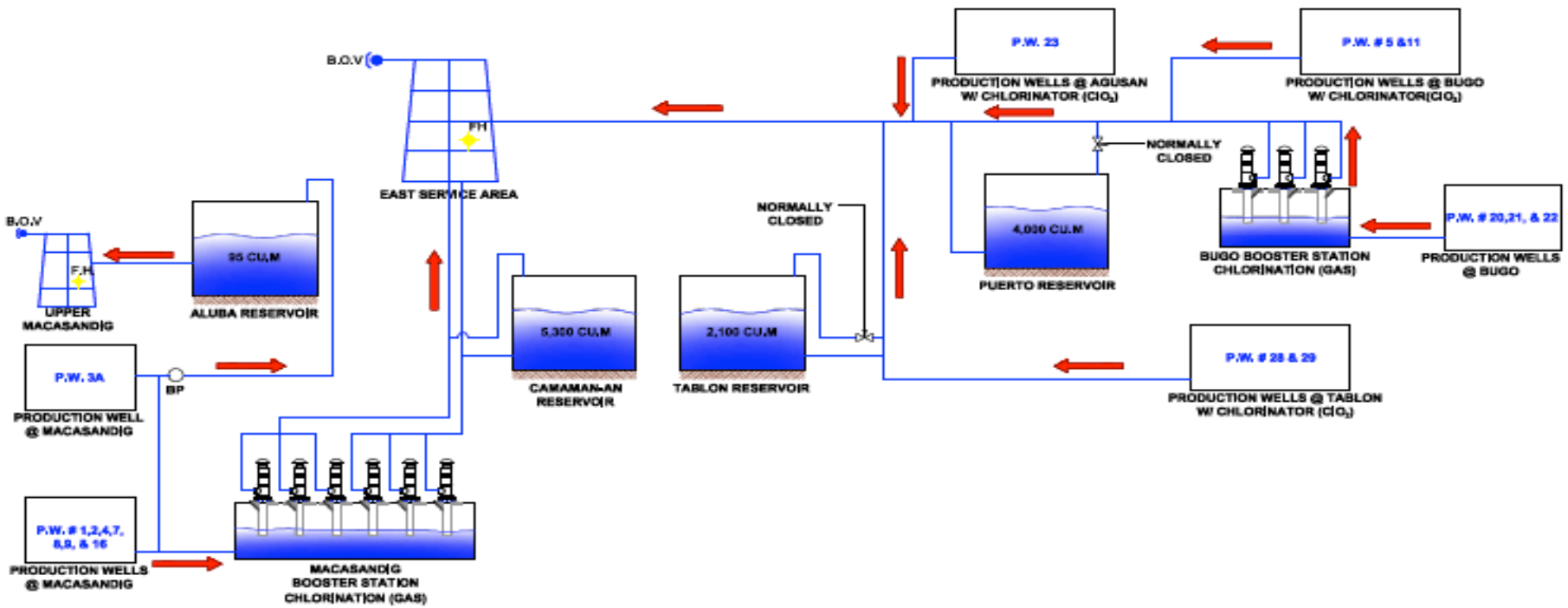
Table 7. Production Well Profile

Well No.	Location	Depth (m)	Casing Dia (mm)	SWL (m)	PWL (m)	Year Const'd	Discharge, (cmh) Actual
1	Pilot de Lara, Macasandig	248	400 - 200	10.26	32.93	1975	378
2	Bontula, Macasandig	219.4	400 - 250	17.7	30.34	1976	114
3A	Tomas Saco, Macasandig	204	450 - 300	23.32	46.04	1991	43
4	Macasandig	210	450 - 250	13.11	21.95	1975	331
5	Reyes Subd., Bugo	75.6	300 - 250	4.75	14.33	1975	145
7	Biasong Macasandig	200	450 - 200	9.57	19.05	1984	231
8	Ramonal Village, Nazareth	255	400 - 300	9.14	30.79	1986	192
9	Biasong Macasandig	236	400 - 300	9.21	25.91	1986	370
10	PN Roa Subd., Calaanan	123	400 - 250	6.74		1986	145
11	Bantiles, Bugo	151.9	400 - 250	3.81	14.63	1986	365
12	PN Roa Subd., Calaanan	139	400 - 250	4		1990	not operational
14	Balongis, Balulang	150	400 - 250	17.52	27.44	1994	236
15	CDO Resettlement, Calaanan	104.3	400 - 250	7.14	20.88	1994	not operational
16	Tomas Saco St., Macasandig	187	450 - 300	11.88	27.59	1995	218
17	Balongis, Balulang	187	300 - 250	16.16	20.58	1996	145
18	Pueblo de Oro, Calaanan	132	350 - 250	17	27.44	1997	71
19	Balulang	216	350 - 250	11.28	15.85	1997	230
20	Suntingon, Bugo	200	350 - 250	12.2	15.55	1997	140
21	Villa Trinitas Subd., Bugo	193.5	450 - 300	12.07	19.66	1998	325
22	Villa Trinitas Subd., Bugo	200	450 - 300	16.7	24.7	1998	230
23	Agusan	200	450 - 300	9.35	13.11	1998	342
24	Caballero Cpd., Balulang	57.2	250	4.51	5.79	1998	102
25	Villa Angela Subd., Balulang	226	450 - 300	11.32	15.7	1998	136
26	Balulang	216	450 - 300	15.24	40.55	1999	86
27	Macanhan, Carmen	207	450 - 300	16	33.54	1999	140
28	Phasco Village, Tablon	159	450 - 300	4.22	15.24	1999	388
29	Phasco Village, Tablon	201	450 - 300	0	14.02	1999	248

Table 8. Summary of COWD Water System

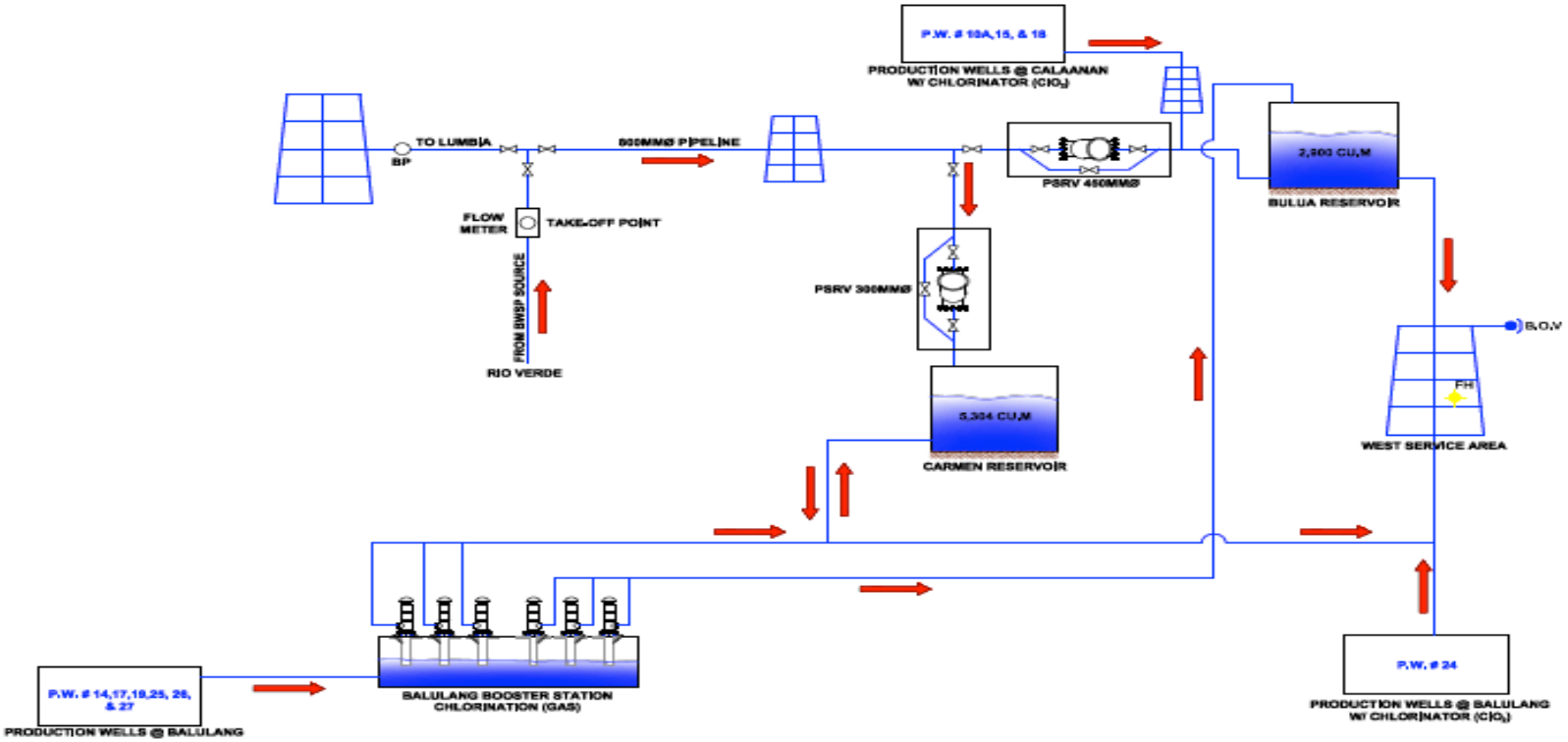
I. Production/Water Resources		
a	Number of Operational Production Wells	27
b	Number of Spring Source	1
c	Number of Reservoir	7
d	Number of Elevated Water Tank	2
e	Type of Treatment	Disinfection with chlorine and chlorine dioxide
f	Production capacity, cubic meters per day	134,366
g	% Utilization of Sources of Water	100%
h	Billed Consumptions (Metered Only), cubic meters	2,215,072
i	Per Capita Daily Consumption,	121
j	% NRW	50.50%
k	No. of Generating sets	31
II. Customer Satisfaction		
a	Total Active Service Connections	86,946
	Residential/Government Connections	80,860
	Commercial Connections	6,086
b	Population Served	608,622
c	Average monthly new service connection installed	300
d	Average monthly reconnected service connection	264
e	Average monthly disconnected service connection	326
f	Average monthly Inactive service connection	34,147
g	Average monthly operating hours (PWs)	17.135
III. Distribution Network		
a	Length of Pipelines, kilometers	549.638
b	Sizes of water meters	1/2"Ø - 24"Ø
c	Leaks repaired (service connection/mo. Average)	338
d	Complaints reported/mo. Average	1,150
e	Leaks repaired (mainline/mo. Average)	5
f	Average mainline leak repair response time, days	1.34
g	No. of Major Valves	479
h	No. of Fire Hydrants	297
IV. Human Resource Management		
a	Total number of employees	410
	Number of Regular employees	303
	Number of Non-regular Employees (casual)	107
b	Number of Daily Employees (Job Order)	86
c	No. of Employee per service connection	1:212

2.4 SYSTEM FLOW DIAGRAM (SCHEMATIC DIAGRAM)



COWD WSS Schematic Diagram – East

Prepared by:	Checked by:	Approved by:
CRIS REY G. JOAQUIN	**CAROLINA B. LAO**	**RACHEL M. BEJA**
Draftsman A	Manager, Engineering Dept.	General Manager

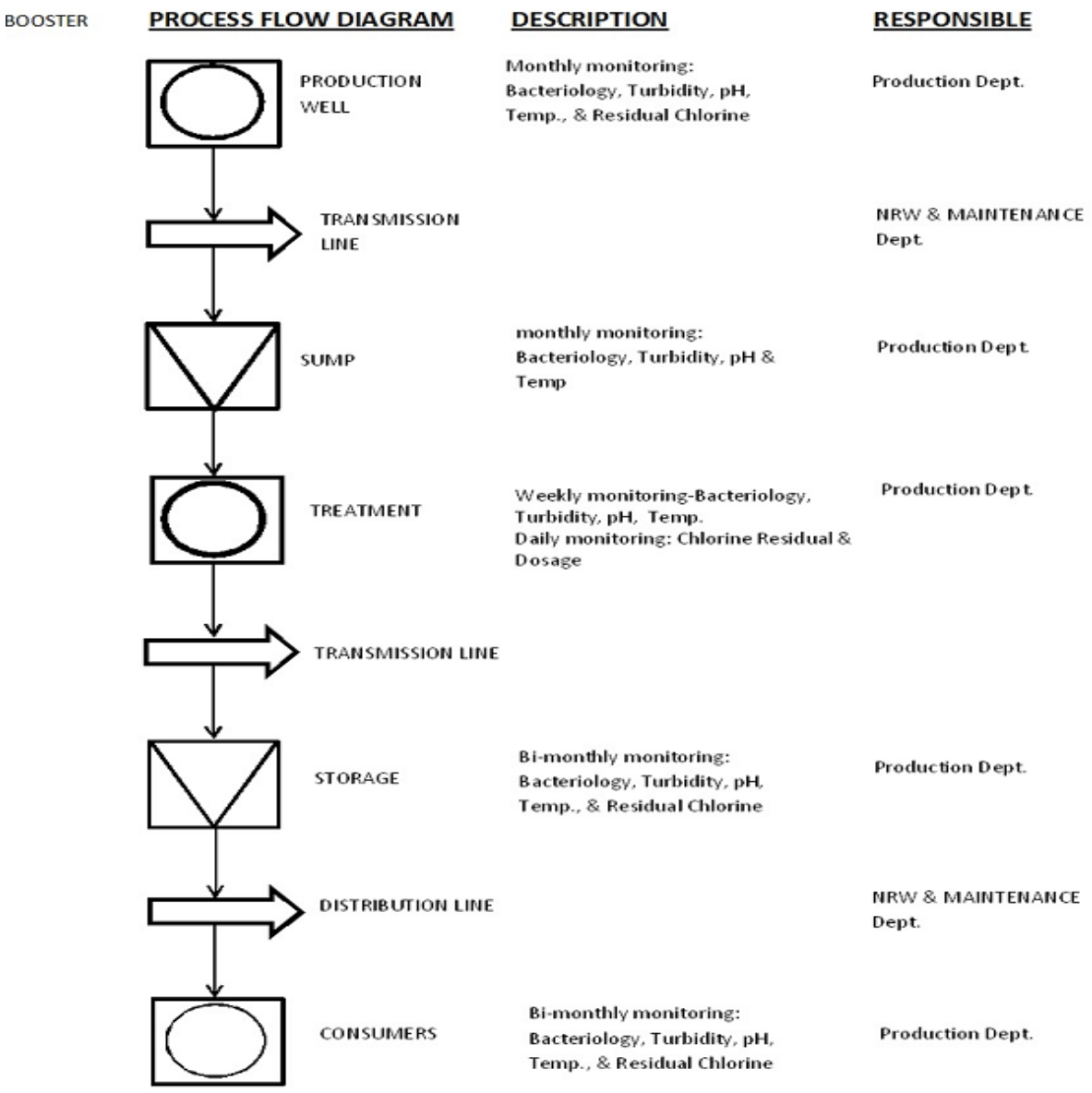


COWD WSS Schematic Diagram – West

Prepared by:	Checked by:	Approved by:
CRIS REY G. JOAQUIN	**CAROLINA B. LAO**	**RACHEL M. BEJA**
Draftsman A	Manager, Engineering Dept.	General Manager

2.5 SYSTEM FLOW DIAGRAM (PROCESS FLOW)

Process Flow Diagram – Booster Station



Prepared by:	Reviewed by:	Approved by:
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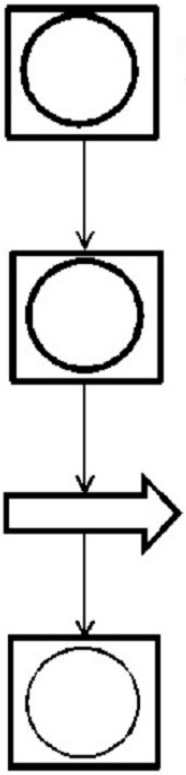
Cust. Service Asst. A	Manager, Engg Dept.	General Manager
Date _____	**Date** _____	**Date** _____

Process Flow Diagram – Production Well

PRODUCTION WELL (DIRECT)	PROCESS FLOW DIAGRAM	DESCRIPTION	RESPONSIBLE
		Weekly monitoring-Residual Chlorine Monthly monitoring – Bacteriology Test Annual monitoring – Physical/Chemical (14 PAR) Weekly monitoring-Bacteriology, Turbidity, pH, Temp. Daily monitoring: Chlorine Residual & Dosage Bi-monthly monitoring: Bacteriology, Turbidity, pH, Temp., & Residual Chlorine	Production Dept. Production Dept. NRW & MAINTENANCE Dept. Production Dept.

Prepared by:	Reviewed by:	Approved by:
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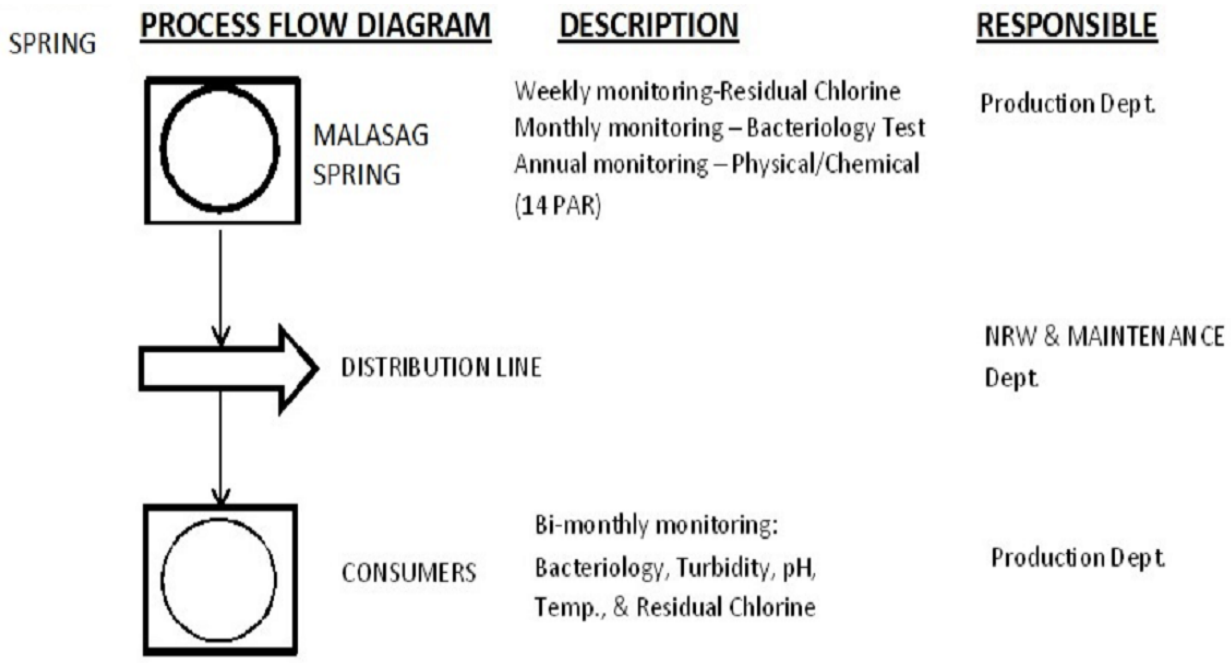
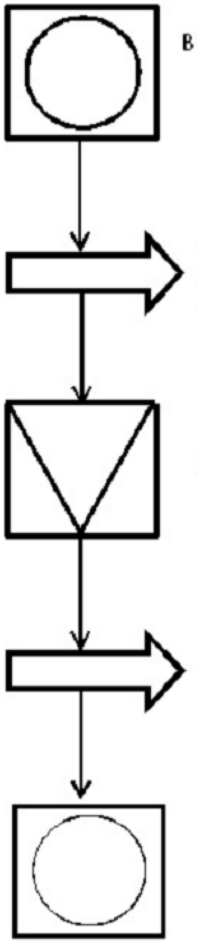
Cust. Service Asst. A	Manager, Engg Dept.	General Manager
_____	_____	_____
Date	**Date**	**Date**

Process Flow Diagram – Spring Source



Prepared by:	Reviewed by:	Approved by:
ALLAN D. CHIONG	**CAROLINA B. LAO**	**RACHEL M. BEJA**
Cust. Service Asst. A	Manager, Engg Dept.	General Manager
_____	_____	_____
Date	**Date**	**Date**

Process Flow Diagram – Bulk Water Supply

BULK WATER	PROCESS FLOW DIAGRAM	DESCRIPTION	RESPONSIBLE
			
	BULK	Weekly monitoring at take-off point: Bacteriology, Turbidity, pH, Temp., & Residual Chlorine	Production Dept.
	DISTRIBUTION LINE		NRW & MAINTENANCE Dept.
	STORAGE	Bi-monthly monitoring: Bacteriology, Turbidity, pH, Temp., & Residual Chlorine	Production Dept.
	DISTRIBUTION LINE		NRW & MAINTENANCE Dept.
	CONSUMER	Bi-monthly monitoring: Bacteriology, Turbidity, pH, Temp., & Residual Chlorine	Production Dept.

Prepared by:	Reviewed by:	Approved by:
ALLAN D. CHIONG	**CAROLINA B. LAO**	**RACHEL M. BEJA**
Cust. Service Asst. A	Manager, Engg Dept.	General Manager
_____	_____	_____
Date	**Date**	**Date**

2.6 TREATMENT PROCESS

From the Production Wells, water is conveyed to the collector well or sump of the booster station where the disinfection process takes place using gas chlorine as the primary disinfectant. To ensure continuous disinfection, redundancy program is implemented where chlorine dioxide is also used as an alternative disinfectant. However, for directly fed wells, chlorine dioxide is used for safety reasons.

As soon as water enters the collector well, gas chlorine is injected using an automatic chlorinating system. Chlorine concentration or dosage in pounds per day (ppd) automatically adjusts based on volume of water treated as well as the residual chlorine of water that leaves the booster station. The COWD Quality Control Division regularly monitors free chlorine at end points of service area and accordingly adjusts set points or limits of the automatic chlorinating system. This is to ensure that residual chlorine is present and within the required standard of 0.3ppm to 1.5 ppm for Gas Chlorine and 0.2ppm to 0.4ppm for Chlorine Dioxide as set by the PNSDW.

2.7 DISTRIBUTION SYSTEM

The District has 569,000 linear meters of pipelines ranging from 50mmØ to 800 mmØ and of different pipe materials, namely CI, GI, BI, PE, ACP, uPVC, CCI and Steel. Table 9 below shows the installed pipeline inventory of COWD's water distribution system. From these main conveyances, water is then distributed to the service areas by primary distribution lines, secondary distribution lines and an overhead reservoir.

Table 9: Summary of Pipelines

SIZE	MAKE	MAINTAINED	SERVED
50mmØ (2”)	uPVC	13,159	13,159
	GI	505	505
	BI	411	411
	PE	70,573	70,573
63mmØ (2.5”)	PE	3,055	3,055
	GI	680	680
75mmØ (3”)	uPVC	58,968	58,968
	ACP	5,422	5,422
	GI	96	96
	CI/BI	195	195
100mmØ (4”)	uPVC	108,888	118,441
	Steel	5,078	5,078
	ACP	6,048	9,208
	CCI	320	320
	GI	75	75
	CI/BI	411	411
150mmØ (6”)	uPVC	81,395	85,325
	Steel	28,503	28,529
	ACP	2,280	3,400
	CCI	998	998
	CI/BI	204	204
200mmØ (8”)	uPVC	23,269	23,719
	Steel	4,760	4,760
	CCI	2,322	2,322
	BI	26	26
250mmØ (10”)	uPVC	3,747	3,747
	Steel	10,842	10,842
300mmØ (12”)	Steel	62,906	62,906
350mmØ (14”)	Steel	2,531	2,531
400mmØ (16”)	Steel	29,586	29,586
500mmØ (20”)	Steel	5,687	5,687
600mmØ (24”)	Steel	14,960	14,960
800mmØ (30”)	Steel	2,638	2,638
TOTAL		**550,517**	**568,756**

2.8 COWD CONCESSIONAIRES

As of July 2016, the COWD has a total of more than 89,000 active service connections, 93% of which are residential including government accounts and 7% are commercial. The percentage illustrates that the water being supplied by COWD is mainly used by households for drinking and domestic purposes. The table below shows the summary of active service connections.

Table 10: Summary of Active Connections

Classification	East	West	Total
Residential/Government	38,026	45,763	83,789
Commercial	4,245	1,811	6,056
Total			89,845

As observed by the WSP Team, some connections are installed along drainage lines or open canals. Others are improperly installed and cross connections have also been noticed. Unauthorized connections have also been unearthed. A great number of these connections are aged more than 10 years. COWD also receives an average of 700 leak reports per month. All of these are seen as potential sources of contamination of the treated water.

Table 11: Reported Leakages
2016

Month	Leakages Reported	Total Leak Repaired
January	644	562
February	687	587
March	751	648
April	682	604
May	610	546
June	637	559
July	705	614
August	749	662
September	640	557

2.9 WATER QUALITY POLICY AND COMMITMENT

Being the sole water provider in the City of Cagayan de Oro, COWD is committed to provide safe and potable water to the community it serves. This commitment is coupled with the greater responsibility of protecting public health and safety through delivery of water which adheres to generally accepted standards of drinking water.

In partnership with our stakeholders, COWD is committed to:

- Comply with the government mandated and internationally accepted standards of drinking water;
- Manage, maintain and ensure water quality from all points along the water delivery chain –catchment to the customer's tap;
- Adopt a health-based approach in which potential hazards are identified and managed to minimize any threat to water quality, thus ensuring that effective incident and emergency response are in place;
- Establish effective monitoring programs to systemically monitor the quality of drinking water and respond to all concerns in a timely manner;
- Develop contingency and incident plans that will be periodically reviewed and updated; and
- Participate in research and development to ensure that COWD is up to date with current standards.

All drinking water supplied by COWD should pass the quality standards set by the Philippine National Standards for Drinking Water. It should not pose any significant health risk to the consuming public. Water must be free of pathogenic organisms responsible for waterborne diseases. No objectionable color, odor and taste should be detected. Residual chlorine reading should be within 0.3 – 1.5 ppm for gas chlorine and 0.2-0.4ppm for chlorine dioxide throughout the distribution system. The water quality requirements are listed below.

TABLE 12: **COWD TARGET WATER QUALITY**

(Based on the mandatory parameters required by PNSDW 2007 ed.)

PARAMETER	STANDARD VALUES
I. MICROBIOLOGICAL	
1. Total Coliform	MTFT: <1.1 MPN/100 mL CST: Absent or <1.1 MPN/100mL
2. Thermotolerant Coliform / *E.coli*	MTFT: <1.1 MPN/100 mL CST: Absent or <1.1 MPN/100mL
3. Heterotrophic Plate Count (HPC)	<500 CFU/mL
II. PHYSICAL	
Color	
- **Apparent**	10 color units
- **True**	5 color units
Turbidity	≤ 5 NTU
III. CHEMICAL	
Arsenic	0.05 mg/L
Cadmium	0.003 mg/L
Lead	0.01 mg/L
Nitrate	≤ 50 mg/L
Benzene	0.01 mg/L
Iron	≤ 1 mg/L
pH	6.5 – 8.5
Manganese	≤0.40 mg/L
Chloride	≤ 250 mg/L
Sulfate	≤ 250 mg/L
Total Dissolved Solids	≤ 500 mg/L
IV. RESIDUAL DISINFECTANT	
Chlorine Residual (as free chlorine)	0.3 ppm to 1.5 ppm

**MTFT – Multiple Tube Fermentation Technique, CST – Chromogenic Substrate Test*

2.10 INTENDED USERS AND USE OF WATER

The water supplied by COWD is primarily intended for general domestic use and consumption such as drinking, personal hygiene, foodstuff preparation, washing of clothes, utensils and other human activities that utilize water.

The intended consumers do not include those who are significantly immuno-compromised or industries with special water quality needs. It should be noted that the water is not recommended for use for Hospital products, medical procedures and pharmaceuticals requiring special purification process. These groups are advised to provide additional points-of-use treatment.

The water is not safe also for use with freshwater aquarium fish species, amphibians and other sensitive domesticated animals that may be intoxicated by the chlorine present in the water.

3. RISK ASSESSMENT, HAZARD TABLE AND CONTROL MEASURES

3.1 Risk Assessment Methodology

The plan shall focus on meeting the health-based targets in water quality by ensuring the safety of drinking water from the catchment to the consumer. This is based on the concept of “multi-barrier approach”, wherein if one barrier fails, the drinking water still stays safe.

The COWD Water Safety Plan shall include the following:

1. Hazard identification and risk prioritization
2. Operational Monitoring
3. Plan for corrective action

In identifying the hazards and hazardous events, the WSP Team discussed all possible sources of contaminants from the catchment to consumer after which an ocular inspection

was conducted to come up with reliable data and analysis on the identified potential hazards which may affect the quality of the water supply.

Hazards were then assessed and ranked using the semi-quantitative risk assessment method in order to streamline the list of risks which need priorities. Table 13, as shown below, describes the semi-quantitative risk matrix that the WSP Team used in prioritizing hazardous events which pose the most significant hazards and the highest risks.

Table 13: Semi-Quantitative Risk Matrix

Risk Factor Matrix		Severity/ Consequence				
		Insignificant (No Impact) 1	**Minor** (Compliance Impact) 2	**Moderate** (Aesthetic Impact) 3	**Major** (Regulatory Impact) 4	**Catastrophic** (Public Health Impact) 5
Likelihood/ Severity	**Almost Certain** (Once a day) Rating: 5	5	10	15	20	25
	Likely (Once a week) Rating: 4	4	8	12	16	20
	Moderate (Once a month) Rating: 3	3	6	9	12	15
	Unlikely (Once a year) Rating: 2	2	4	6	8	10
	Rare (Once every five years) Rating: 1	1	2	3	4	5
Risk Score			<6	6-9	10-15	>15
Risk Rating			Low	Moderate	High	Very High

Table 14: Hazard Table Rating

Hazards	Consequence	Severity Rating
Microbial	May cause mortality; Should have highest severity rating	5
Chemical	With health significance (toxic); Should have very high severity rating but lower than microbial	4
	With no health significance (non-toxic) but will make water objectionable	3
Physical	Will make water objectionable and lead to its non – use (e.g. turbidity)	3
	May make water objectionable but may not lead to its non – use	2

Table 15: Risk Prioritization Rating

Priority Level	Priority Type	Risk Score	Action Levels
1	High	15 – 25	The risk requires immediate control measures
2	Moderate	6 – 14	The risk requires determination of additional control measure
3	Low	1 – 5	Risk should be documented and requires revisiting in the future

Annex A and B shows the output of hazard, risk assessment and the control measures using the semi – quantitative approach covering the various points of the COWD Water System.

4. Improvement Plan

Based on hazard assessment, improvement plans were developed for those identified as high risks in order to eliminate or control the hazard. **Annex C** shows the improvement plan developed by the WSP Team.

5. Operational Monitoring and Corrective Action

The operational parameters and critical limits were defined for all identified control measures with hazardous event classified as high risk for monitoring purposes. These are criteria that indicate whether the control measure is functioning.

Monitoring is done by comparing the actual operational parameters with agreed critical limits. **Annex D** shows what should be monitored, the frequency of monitoring, who and how it will be monitored. Certain corrective actions are also indicated if the operation deviates from the normal situations (normal or critical limits) to prevent contamination of supplied water.

6. Verification

Verification activities are necessary to determine the compliance of WSP with the existing standards. This includes internal and external auditing, monitoring of water quality and customer satisfaction. **Annex E** shows the verification monitoring programs which are part of the COWD regular operation.

7. Management Procedures

Part of the WSP is the integration of COWD's standard operating procedures particularly those that affect the quality of water from catchment to consumer. **Annex F** shows the Standard Operating Procedures under normal, incident and emergency situations.

8. Support Programmes

The effective implementation of the Water Safety Plan is greatly dependent on management's support and commitment to equip and capacitate its employees to efficiently carry out their task in the production and delivery of safe water.

The table below shows the types of programs that are believed to provide a solid backbone for the implementation of this Water Safety Plan.

Table 16. COWD Support Programs

Activity	Objective	Program/System	Schedule	Responsible Unit	Participants
Training and Awareness	To ensure that COWD personnel and the conscessionaires understand their role in the effective implementation of the WSP and the effect of their action on water quality.	WSP General Awareness Program for all COWD Employees	1st Quarter of 2017	OGM: WSP Team	All COWD Employees
		WSP Orientation for every new member of the WSP Team			
		Training for Water Facility Operators and Laboratory Personnel on Chlorne handling, dosing, residual monitoring, water quality, etc.	RTC Training Calendar 2017	COWD RTC	Facilities Operator, Laboratory Staff
		Orientation of New Service Applicants on proper handling of water, use of standard materials, effect of cross connections, etc	Every Week	Commercial Department	New Service Coonection Applicants
		Training on selected employees on emergency preparedness and response (disaster risk reduction)	RTC Training Calendar 2017	COWD RTC	Selected employees of COWD. Members of COWD DRRMC
		Training on supervisors on pressure management.	RTC Training Calendar 2017	COWD RTC	Supervisors in Technical Departments
Calibration and preventive maintenance of system appurtenances and equipment	To ensure that all COWD equipment are performing well and accurately measuring critical limit operational parameters.	Calibration program on the following:			
		Process Instruments (Flow meters, data loggers, pressure gauges, level sensors)	Per calibration Program and as needed.	Production Department Manager	with Supervisors
		Laboratory Equipment	Per calibration Program and as needed.	COWD Laboratory	with laboratory staff
		Chlorine Dosing Equipment	Per calibration Program and as needed.	Operation Division Manager	with supervisors and operators
		Water meters and valves	per approved program	Maintenance Dept.	Division managers and supervisors
Training on Hygiene and sanitation	To ensure that all personnel directly in responsible with the supply and delivery of safe water will practice proper hygiene and sanitation to prevent water contamination.	Occupational Safety and Health and Water Quality Monitoring.	Part of regular quarterly pocket meetings of responsible departments	All Technical Department and Commercial Department	Pump operators, laboratory staff, pump repair section, plumbers
Customer Care	To enhance customer satisfaction	Customer Servie Program	RTC Training Calendar 2017	COWD RTC	Customer care employees, all COWD employees doing frontline services
Watershed Protection and Preservation	To ensure the protection of watershed and the sustainability of water supply	Adopt a Tree Program, Watershed Management Program, River clean-up program	2017 strategic initiatives	Environment Division, Eng'g Dept. and P.R. Division	DENR, Partnership with barangays

9. WSP Review Procedures

WSP should evolve with the change of time. It is important to learn from emergencies, incidence or near misses. This should be subjected to periodic review to keep it updated to ensure the effective implementation of the program.

The WSP team shall review this plan based on the following:

1) At least once a year, to ensure that new risks from all stages of the water supply system are assessed and addressed,
2) Following an emergency, incident or near miss,
3) Change in members of the WSP Team.

ANNEXES

Annex A: Risk Assessment

			RAW RISK						RESIDUAL RISK			
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating
Catchment	1. Entry of contamination due to:											
	a. Presence of septic tank within the 25 meter radius from Production Wells	Microbial	5	5	25	High	Cement Grouting around annulus of casing	Existing cement grouting of all PWs meet the Sanitation Code Standard (>10meters). Compliance with PNSDW - No presence of contamination per monthly microbiological test result.	5	1	5	Low
	b. Leaching of paints used in pipes	Chemical	3	5	15	High	Regular Cleaning		3	1	3	Low
	c. open sounding tube/intake box/cable wire passage	Microbial	5	5	25	High	Sealing of all openings	Seal are in place. No presence of contamination per monthly microbiological test result.	5	1	5	Low
	d. Flooding	Microbial	5	2	10	Medium	Sealing of all openings	Microbiological tests showed negative results. Physical and Chemical analysis is within the PNSDW.	5	1	5	Low
		Physical	3	2	6	Low						
		Chemical	4	2	8	Low						

			RAW RISK						RESIDUAL RISK			
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating
Catchment	1. Entry of contamination due to:											
	e. Backyard hog raising and poultry near the well	Microbial Chemical Physical	5	5	25	High	Cement Grouting around annulus of casing	Existing cement grouting of all PWs meet the Sanitation Code Standard (>10meters). No presence of contamination per monthly microbiological test result.	5	1	5	Low
	f. During pump repair	Microbial	5	3	15	High	Flushing after re-installation of pump	Ensure that the water is clear before feeding	5	2	10	Medium
	2. Presence of stagnant water around the pumpbase	Microbial	5	5	25	High	Sealing of all openings	No presence of contamination per monthly microbiological test result.	5	1	5	Low
	3. Turbid water caused by Power fluctuation	Physical	2	4	8	Low	SOP - Start up of production well	Turbidity tests results is within the PNSDW.	2	1	2	Low
	4. Vandalism	Chemical	4	1	4	Low	Perimeter fencing, Presence of SG	No incidence of vandalism. No presence of contamination per monthly microbiological test result.	4	1	4	Low

			RAW RISK						RESIDUAL RISK			
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating
Treatment	1. No disinfection due to the following:											
	a. non-availability of gas chlorine	Microbial	5	3	15	High	Use of chlorine dioxide as alternative for disinfection	No presence of contamination per Monthly Microbiological tests results.	5	1	5	Low
	b.1 power interruption	Microbial	5	3	15	High	Generator and stepdown transformer for 220 volt supply	Defective stepdown transformer. No 220 volt supply during brownout	5	3	15	High
	c.loss of vacuum due to pump trip-off	Microbial	5	3	15	High	SOP ON PUMP TRIP OFF	Logsheet showing immediate restoration of pump operation	5	1	5	Low
	d. Leakage in chlorine gas cylinder	Microbial	5	1	5	Low	Regular checking. SOP in proper chlorine handling.	Microbiological tests showed negative results.	5	1	5	Low
	2. Low quality of disinfectant	Microbial	5	5	25	High	none	none	5	5	25	High
	3. Underdosing of chlorine	Microbial	5	3	15	High	Maintain appropriate dosage.	Operator logsheet shows occasional underdosing	5	2	10	Medium
	4. Defective chlorinating system	Microbial	5	3	15	High	SOP for chlorinator operation and maintenance. Availability of spare units.	Occasional downtime due to unavailability of some parts	5	2	10	Medium

PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating
Distribution - Storage	1. Improper storage and handling of materials (pipes with no end caps stored in open stockyard allowing the entry of animals which are known as carriers of harmful micro organisms to contaminate water with their feces and urine).	Microbial	5	5	25	High	none	none	5	5	25	High
Distribution - Leakage	1. Entry of contaminants at leaking pipeline, fittings and valves due to low pressure and no water.	Microbial Chemical Physical	5	5	25	High	1. Conduct re-active leak detection and repair. 2. Pipeline & appurtenances Rehabilitation program	Reduction of frequency of leak reported and repair; No presence of contamination per monthly microbiological test result.	5	2	10	Medium
	2. Entry of contaminants during pipe burst.	Microbial Chemical Physical	5	4	20	High	Conduct flushing after repair	Cannot be determined due to non conduct of the following tests: turbidity, residual chlorine and microbiological.	5	2	10	Medium

			RAW RISK						RESIDUAL RISK			
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating
Distribution - New Construction	1. Entry of contaminants due to:											
	a. presence of welding flux residue after fabrication of fittings	Chemical Physical	3	5	15	High	fittings are properly clean after fabrication	No reported presence of residual welding flux	3	1	3	Low
	b. improper handling/stocking of pipes on site	Microbial Chemical Physical	5	5	25	High	none	not in place	5	5	25	High
	c. unsecured pipe/fittings on open trench:											
	c.1 during construction	Microbial Chemical Physical	5	5	25	High	plug/closed-off the end pipe and backfill with same soil materials every after lay out	not fully effective since foreign objects are occasionally recoverd	5	3	15	High
	c.2 during interconnection	Microbial Chemical Physical	5	5	25	High	proper dewatering/sealing & conduct flushing and disinfection	1. Not in place (turbidity and microbiological test) by not using the appropriate apparatus	5	2	10	Medium
Distribution - Reservoir & Sump	1. Entry of contaminants due to:											
	a. animal defecation through open vents/manholes	MICROBIAL	5	5	25	High	Sealing of openings & installation of screens	In place screens and sealing of all openings	5	1	5	Low
	b. Presence of nearby canals and Disposal of domestic waste water from nearby households	MICROBIAL	5	5	25	High	NONE		5	5	25	High
	c. presence of generator set situated on top of collector wells.	CHEMICAL	4	5	20	High	NONE		4	5	20	High
	2. Sediments accumulation and biofilm growth	MICROBIAL	5	5	25	High	Scheduled cleaning & disinfection	In place residual chlorine, turbidity, pH and microbiological test	5	1	5	Low
	3. Vandalism	MICROBIAL	5	3	15	High	Security fencing, locked gates, routine security patrols	In place security guards. Carmen and Camaman-an Reservoir fence are defective.	5	2	10	Medium

			RAW RISK						RESIDUAL RISK			
PROCESS STEP	**HAZARDOUS EVENT**	**HAZARD**	**SEVERITY**	**LIKELIHOOD**	**Risk Score**	**Risk Rating**	**EXISTING CONTROL MEASURE**	**EFFECTIVENESS OF EXISTING CONTROL MEASURES**	**SEVERITY**	**LIKELIHOOD**	**Risk Score**	**Risk rating**
Distribution - Newcon, Discon & Recon	Intrusion of contaminants in service connection due to:											
	a) Existing service connections with Water meters at ground level	Microbial, Chemical Physical,	5	3	15	High	none		5	3	15	High
	b) improper disconnection procedure	Microbial, Chemical Physical,	5	5	25	High	none		5	5	25	High
	c) Service Connection leakage	Microbial, Chemical Physical,	5	3	15	High	Replace leaking valves and fittings	1. Not in place (turbidity and microbiological test) by not using the appropriate apparatus	5	2	10	Medium

			RAW RISK						RESIDUAL RISK			
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating
Consumer	Intrusion of contaminants due to :											
	1. Cross connection and Use of sub-standard materials after the meter	Microbial Chemical Physical	5	3	15	High	Consumer Education for new connections applicants.	Cannot be determined	5	3	15	High
	2. Illegal tapping	Microbial Chemical Physical	5	5	25	High	Policy on illegal connection	Cannot be determined due to no baseline data.	5	5	25	High
	3. Contamination through submerged pipes crossing the canal, septic tanks	Microbial	5	5	25	High	none		5	5	25	High
	4. Improper handling and storage of water	Microbial	5	3	15	High	Consumer Education and IEC	No reported incidence	5	1	5	Low
	5. In-line boosting (booster pump)	Microbial	5	3	15	High	Policy on use of in-line boosting per BOD Resolution No. 076, S-11	No baseline data	5	3	15	High

Annex B: Control Measures

			RAW RISK						RESIDUAL RISK				
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating	PROPOSED CONTROL MEASURES
Catchment	1. Entry of contamination due to:												
	a. Presence of septic tank within the 25 meter radius from Production Wells	Microbial	5	5	25	High	Cement Grouting around annulus of casing	Existing cement grouting of all PWs meet the Sanitation Code Standard (>10meters). Compliance with PNSDW - No presence of contamination per monthly microbiological	5	1	5	Low	Continue water quality monitoring
	b. Leaching of paints used in pipes	Chemical	3	5	15	High	Regular Cleaning		3	1	3	Low	Implement Use of food grade paints of all discharge pipes
	c. open sounding tube/intake box/cable wire passage	Microbial	5	5	25	High	Sealing of all openings	Seal are in place. No presence of contamination per monthly microbiological test result.	5	1	5	Low	
	d. Flooding	Physical	3	2	6	Low							
		Chemical	4	2	8	Low							

			RAW RISK						RESIDUAL RISK				
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating	PROPOSED CONTROL MEASURES
Catchment	1. Entry of contamination due to:												
	e. Backyard hog raising and poultry near the well	Microbial Chemical Physical	5	5	25	High	Cement Grouting around annulus of casing	Existing cement grouting of all PWs meet the Sanitation Code Standard (>10meters). No presence of contamination per monthly microbiological test result.	5	1	5	Low	
	f. During pump repair	Microbial	5	3	15	High	Flushing after re-installation of pump	Ensure that the water is clear before feeding	5	2	10	Medium	SOP - pump repair
	2. Presence of stagnant water around the pumpbase	Microbial	5	5	25	High	Sealing of all openings	No presence of contamination per monthly microbiological test result.	5	1	5	Low	
	3. Turbid water caused by Power fluctuatio	Physical	2	4	8	Low	SOP - Start up of production well	Turbidity tests results is within the PNSDW.	2	1	2	Low	
	4. Vandalism	Chemical	4	1	4	Low	Perimeter fencing, Presence	No incidence of vandalism. No presence of contamination per monthly microbiological test result.	4	1	4	Low	
	5. Presence of solid waste in well area	Microbial	5	3	15	High	Regular Cleaning	Microbiological tests showed negative results.	5	1	5	Low	

			RAW RISK						RESIDUAL RISK				
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating	PROPOSED CONTROL MEASURES
Treatment	1. No disinfection due to the following:												
	a. non-availability of gas chlorine	Microbial	5	3	15	High	Use of chlorine dioxide as alternative for disinfection	No presence of contamination per Monthly Microbiological tests results.	5	1	5	Low	
	b.1 power interruption	Microbial	5	3	15	High	Generator and stepdown transformer for 220 volt supply	Defective stepdown transformer. No 220 volt supply during brownout	5	3	15	High	Provide stepdown transformer for 220 volts supply.
	c.loss of vacuum due to pump trip-off	Microbial	5	3	15	High	SOP ON PUMP TRIP OFF	Logsheet showing immediate restoration of pump operation	5	1	5	Low	
	d. Leakage in chlorine gas cylinder	Microbial	5	1	5	Low	Regular checking. SOP in proper chlorine handling.	Microbiological tests showed negative results.	5	1	5	Low	
	2. Low quality of disinfectant	Microbial	5	5	25	High	none	none	5	5	25	High	Compliance with COWD specifications. Require supplier to submit Material Safety Data Sheet or Certificate of Analysis.
	3. Underdosing of chlorine	Microbial	5	3	15	High	Maintain appropriate dosage.	Operator logsheet shows occasional underdosing	5	2	10	Medium	Use of automatic chlorination system
	4. Defective chlorinating system	Microbial	5	3	15	High	SOP for chlorinator operation and maintenance. Availability of spare units.	Occasional downtime due to unavailability of some parts	5	2	10	Medium	Back up chlorinating system

			RAW RISK						RESIDUAL RISK				
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating	PROPOSED CONTROL MEASURES
Distribution - Storage	1. Improper storage and handling of materials (pipes with no end caps stored in open stockyard allowing the entry of animals which are known as carriers of harmful micro organisms to contaminate water with their feces and urine)	Microbial	5	5	25	High	none	none	5	5	25	High	
Distribution/ Leakage	1. Entry of contaminants at leaking pipeline, fittings and valves due to low pressure and no water.	Microbial Chemical Physical	5	5	25	High	1. Conduct re-active leak detection and repair. 2. Pipeline & appurtenances Rehabilitation program	Reduction of frequency of leak reported and repair; No presence of contamination per monthly microbiological test result.	5	2	10	Medium	NRW Reduction Program (Physical Losses Component)
	2. Entry of contaminants during pipe burst.	Microbial Chemical Physical	5	4	20	High	Conduct flushing after repair	Cannot be determined due to non conduct of the following tests: turbidity, residual chlorine and microbiological.	5	2	10	Medium	SOP on pipeline repair
Distribution - New Construction	1. Entry of contaminants due to:												
	a. presence of welding flux residue after fabrication of fittings	Chemical Physical	3	5	15	High	fittings are properly clean after fabrication	No reported presence of residual welding flux	3	1	3	Low	
	b. improper handling/stocking of pipes on site	Microbial Chemical Physical	5	5	25	High	none	not in place	5	5	25	High	SOP on handling of materials for repair
	c. unsecured pipe/fittings on open trench:												
	c.1 during construction	Microbial Chemical Physical	5	5	25	High	plug/closed-off the end pipe and backfill with same soil materials every after lay out	not fully effective since foreign objects are occasionally recoverd	5	3	15	High	SOP on pipeline construction
	c.2 during interconnection	Microbial Chemical Physical	5	5	25	High	proper dewatering/sealing & conduct flushing and disinfection	1. Not in place (turbidity and microbiological test) by not using the appropriate apparatus	5	2	10	Medium	SOP on interconnection & Conduct turbidity and microbiological test

			RAW RISK						RESIDUAL RISK				
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating	PROPOSED CONTROL MEASURES
Distribution - Newcon, Discon & Recon	Intrusion of contaminants in service connection due to:												
	a) Existing service connections with Water meters at ground level	Microbial, Chemical Physical,	5	3	15	High	none		5	3	15	High	Set SOP on service connection
	b) improper disconnection procedure	Microbial, Chemical Physical,	5	5	25	High	none		5	5	25	High	Set SOP on disconnection
	c) Service Connection leakage	Microbial, Chemical Physical,	5	3	15	High	Replace leaking valves and fittings	1. Not in place (turbidity and microbiological test) by not using the appropriate apparatus	5	2	10	Medium	

			RAW RISK						RESIDUAL RISK				
PROCESS STEP	HAZARDOUS EVENT	HAZARD	SEVERITY	LIKELIHOOD	Risk Score	Risk Rating	EXISTING CONTROL MEASURE	EFFECTIVENESS OF EXISTING CONTROL MEASURES	SEVERITY	LIKELIHOOD	Risk Score	Risk rating	PROPOSED CONTROL MEASURES
Consumer	Intrusion of contaminants due to :												
	1. Cross connection and Use of sub-standard materials after the meter	Microbial Chemical Physical	5	3	15	High	Consumer Education for new connections applicants.	Cannot be determined	5	3	15	High	Prevent back flow and SOP on inspection of materials/pipelaying prior to the installation of service connections
	2. Illegal tapping	Microbial Chemical Physical	5	5	25	High	Policy on illegal connection	Cannot be determined due to no baseline data.	5	5	25	High	NRW Reduction Program
	3. Contamination through submerged pipes crossing the canal, septic tanks	Microbial	5	5	25	High	none		5	5	25	High	SOP on new SC Installation and Rehabilitation program for existing connections
	4. Improper handling and storage of water	Microbial	5	3	15	High	Consumer Education and IEC	No reported incidence	5	1	5	Low	
	5. In-line boosting (booster pump)	Microbial	5	3	15	High	Policy on use of in-line boosting per BOD Resolution No. 076, S-11	No baseline data	5	3	15	High	Strict Policy implementation

Annex C: Improvement Plan

Process Step	Action (Proposed Control Measure)	HAZARDOUS EVENT	Identified specific improvement plan	Accountabilities	Cost	Funding Source	Due	Status
Catchment		1. Entry of contamination due to:						
	SOP - pump repair	f. During pump repair	Feed to line if turbidity below or equal 5 NTU	Pump Operator	Salary	O & M Expenses	every after repair	on going

Process Step	PROPOSED CONTROL MEASURES	HAZARDOUS EVENT	Identified specific improvement plan	Accountabilities	Cost	Fund Source	Due	Status
Treatment		1. No disinfection due to the						
	Provide stepdown transformer for 220 volts supply.	b.1 power interruption	Install stepdown transformer for 220 volt requirement of chlorinating unit	Production Dept.	50,000.00	Capex 2016	Dec-16	procurement
	Compliance with COWD specifications. Require supplier to submit Material Safety Data Sheet or Certificate of Analysis.	2. Low quality of disinfectant	Require the Supplier to submit certificate of analysis from DOH accredited laboratory with Official Receipt (OR)	Production Dept/QC	N/A		Every delivery	to be implemented
	Use of automatic chlorination system	3. Underdosing of chlorine	Procurement of automatic chlorination equipment	Production Dept.	3M	Capex 2016	CY 2016-2020	On-going (Bugo Booster Station)
	Back up chlorinating system	4. Defective chlorinating system	Provide parallel chlorinating system	Production Dept.	3M	Capex 2017	2016-2020	Procurement

PROPOSED CONTROL MEASURES	HAZARDOUS EVENT	Identified specific improvement plan	Accountabilities	Cost	Funding Source	Due	Status
	1. Improper storage and handling of materials (pipes with no end caps stored in open stockyard allowing the entry of animals which are known as carriers of harmful micro organisms to contaminate water with their feces and urine).		Property Division	60,000.00	Capex 2017	CY 2017	for formulation
NRW Reduction Program	1. Entry of contaminants at leaking pipeline, fittings and valves due to low pressure and no water.	NRW program - statement	NRW Dept	11,000,000.00	Capex 2017 - 2021	5 years	on going
SOP on pipeline repair	2. Entry of contaminants during pipe burst.	Conduct turbidity and Residual Chlorine test ; collect sample for microbiological test	NRW Dept. - leakage repair team & valve operation team	100,000.00	Capex 2017	CY 2017	for formulation
	1. Entry of contaminants due to:						
	a. presence of welding flux residue after fabrication of fittings						
SOP on handling of materials for repair	b. improper handling/stocking of pipes on site	1. Cover pipes with canvas (trapal) to avoid exposure directly to sunlight & rain. 2. Cover end pipes to prevent the entry of contaminants.	ENG'G-Construction Division	50,000.00	Capex 2017	CY 2017	for formulation
	c. unsecured pipe/fittings on open trench:						
SOP on pipeline construction	c.1 during construction		ENG'G dept.			CY 2017	for formulation
SOP on interconnection & Conduct turbidity and microbiological test	c.2 during interconnection	1. Conduct turbidity and Residual Chlorine test ; collect sample for microbiological test. 2. Closed-off at the end pipe, sand bedding & backfill with new soil materials every after lay out.	ENG'G-Construction Division	charge to Production (same as above)		CY 2017	for formulation

	1. Entry of contaminants due to:						
	a. animal defecation through open vents/manholes						
Construction of concrete fence on all reservoirs	b. Presence of nearby canals and Disposal of domestic waste water from nearby households	Construction of concrete fence on all reservoirs	ENGINEERING DEPARTMENT	2,000,000.00	Capex 2018	2018	for implementation
No generator set on top of collector well	c. presence of generator set situated on top of collector wells.	Relocate all generating set on top of the collector well	Engineering Department	2,500,000.00	Capex 2018	2018	For evaluation and implementation
In place residual chlorine, turbidity, pH and microbiological test	2. Sediments accumulation and biofilm growth		Production Department				On going
rehabilitation of defective fence	3. Vandalism	rehabilitation of defective fence	Engineering and Production Department	covered in perimeter fence of all reservoir budget	Capex 2018	2018	for implementation
	Intrusion of contaminants in service connection due to:						
Set SOP on service connection	a) Existing service connections with Water meters at ground level	Inventory of existing service connections with Water meters at ground level, conduct rehabilitation and implement the revised standard design as recommended by the Consultant (MIYA)	Engineering Dept. & Maintenance and NRW Management Department & Commercial Dept.	Covered under the 400M NRW Reduction Program	Loan	CY 2025	For Implementation
Set SOP on disconnection	b) improper disconnection procedure	Implement design standard on disconnection and fix-cutting	Commercial Dept. -Disconnection Team (CAD) and Maintenance & NRW Management Dept.- Water Loss Control Division	N/A		CY 2025	For Implementation
	c) Service Connection leakage	Implement SOP on repair of SC leakages	Engineering Dept - New Service Installation Section and Maintenance & NRW Management Dept - Leakage Control Division	N/A		2025	For Implementation

PROPOSED CONTROL MEASURES	HAZARDOUS EVENT	Identified specific improvement plan	Accountabilities	Cost	Funding Source	Due	Status
	Intrusion of contaminants due to :						
Prevent back flow and SOP on inspection of materials/pipelaying prior to the installation of service connections	1. Cross connection and Use of sub-standard materials after the meter	Install check valves to existing service connections and Implement SOP on Pre-installation inspection for new Service connections	NRW & Maintenance Dept/Service Connection Rehab; Commercial Dept/Meter Readers & CCSD		Capex 2017 -2027	CY 2027	On going on new service connection installation; Propose Rehab Plan for SC installed in 2008 and below
NRW Reduction Program	2. Illegal tapping	Implementation of NRW Reduction Program	NRW and Maintenance Dept.	Covered under the 400M NRW Reduction Program	Loan	CY 2022	On going
SOP on new SC Installation and Rehabilitation program for existing connections	3. Contamination through submerged pipes crossing the canal, septic tanks	Implementation of Rehab Program & SOP	Maintenance & NRW Management Dept./Engineering Dept./Commercial Dept.-Customer Service Div		Capex 2017 -2027	CY 2027	For Proposal
	4. Improper handling and storage of water						
Strict Policy implementation	5. In-line boosting (booster pump)	SOP on implementation and monitoring	Engineering Dept - E & W Div/Commercial Dept.		N/A	CY 2017	For formulation

Annex D: Operational Monitoring & Corrective Action

Process Step: Control Measure	Critical limit	What	Where	When	How	Who	Corrective action
Catchment: Continue water quality monitoring	a. zero (0) b. 500 cfu	a. Coliform b. HPC	Production Wells	Monthly	Microbial	COWD Laboratory	Stop Operation and Investigate
Catchment: Implement Use of food grade paints of all discharge pipes	Covers in place (tightly seal)	condition of seal	site (well)	daily	Ocular inspection	pump operator	Repair/Replace
Catchment: SOP - pump repair	less or equal to 5 NTU	turbidity	source	after repair	through turbidimeter	operator	increase flushing time

Process Step: Control Measure	Critical limit	What	Where	When	How	Who	Corrective action
Treatment: Provide stepdown transformer for 220 volts supply.	Generator and stepdown transformer in good condition	Functionality of the unit	Production wells	weekly	Preventive Maintenance	Preventive Maintenance Team	replace/repair
Treatment: Compliance with COWD specifications. Require supplier to submit Material Safety Data Sheet or Certificate of Analysis.	Gas chlorine - 100% purity	Concentration	COWD Lab	Upon delivery	Verify result/Acceptance from end user	QC Lab	Require supplier to replace the delivered product
Treatment: Use of automatic chlorination system	corresponding feed rate	chlorine feed rate	Treatment sites	hourly	gauge reading	Pump operator	adjust dosage to comply to standard feeding
Treatment:Back up chlorinating system	continuous disinfection/treatment	chlorinator	Treatment sites	hourly	equipment check up	PMS/Operator	Replace or use of parallel disinfection system

Process Step: Control Measure	Critical limit	What	Where	When	How	Who	Corrective action
Distribution: SOP on storage handling	No roofing; cover not in place	Pipes	Warehouse area	Daily	Ocular inspection	Property custodian	Cover end pipes
Distribution: NRW Reduction Program (Physical Losses Component)	2,500 leaks repaired per year	number of leaks repaired	on site	per sched	Foot Patrol (find & fix)	leak detection team	Memo, additional manpower
Distribution: SOP on pipeline repair	not more than 5 NTU; not less than 0.3 ppm	turbidity & residual chlorine; coliform; HPC	with in affected area	after every pipe burst repair	turbidimeter and residual chlorine test kit	NRW Dept. -Valve Operation team	extend flushing time if turbidity is above critical limit. 2. Notify Production Dept for increase of chlorine dosage
Distribution: SOP on handling of materials for repair	end pipes are properly covered	pipes	on site	During Pipe Construction	Ocular inspection	Project Engr. In-charge	Cover pipes & end pipes
Distribution: SOP on pipeline construction	Presence of foreign objects inside the pipe	Foreign Objects	Construction area	during pipelaying	Visual checking	Eng'g.-Construction Division	remove foreign objects & clean pipes
Distribution: SOP on interconnection & Conduct turbidity and microbiological test	1. Not more than 5 NTU; not less than 0.3 ppm. 2. Presence of foreign objects recovered during flushing	1. Turbidity & residual chlorine; coliform; HPC 2. Foreign objects	Construction area	After every pipeline interconnection	turbidimeter and residual chlorine test kit & visual checking of foreign objects.	Eng'g.-Construction Division	extend flushing time if turbidity is above critical limit. 2. Notify Production Dept for increase of chlorine dosage

Process Step: Control Measure	Critical limit	What	Where	When	How	Who	Corrective action
Distribution: Construction of concrete fence on all reservoirs	no run-off within the perimeter area	domestic waste	Around the reservoir site	daily and monthly	OCULAR INSPECTION	Guards on duty (for daily); Prod. Dept. (for monthly)	repair perimeter fence
Distribution: No generator set on top of collector well	No fuel and lubricants	generator set	collector well	daily	ocular inspection	operator on duty	remove fuel and lubricants on top of collector well
Distribution: In place residual chlorine, turbidity, pH and microbiological test	Positive result of total coliform and E-coli	Bio-film growth	Reservoir and sump	Per schedule	Microbiological test	Production Department	
Distribution: Rehabilitation of defective fence	all fences are properly maintained and no possible unauthorized access	perimeter fence	reservoir	daily	ocular inspection	guard on duty	repair defective perimeter fence
Distribution: Set SOP on service connection	Standard on installation of service connection	Service Connection	COWD Service Area	Monthly	Ocular Inspection	Meter Readers & New Service Installation Inspectors/Post Inspection	Request Rectification to the ff: 1.Maintenance and NRW Dept - Existing SC 2. Engg Dept - for new SC 3. Commercial Dept. - Reconnection
Distribution: Set SOP on disconnection	Standard on disconnection and fix-cutting	Disconnected Service Connection	COWD Service Area	Monthly	Ocular Inspection	Meter Readers & New Service Installation Section & Post Inspection	Request to the ff: 1.Maintenance and NRW Dept - fix cutting 2. Commercial Dept. - Rectification
Distribution: SOP on repair of SC leakages	Standard on repair of SC leakages	Leakage	Service Connection	Monthly	During Monthly Meter Reading/ Ocular Inspection/Customer Care Service Desk/Foot Patrol	Meter Readers/ Leakage Control Division	Endorse for repair to Maintenance and NRW Dept - Leakage Control Division

Process Step: Control Measure	Critical limit	What	Where	When	How	Who	Corrective action
Consumer: Prevent back flow and institutionalize the use of check valves	Check valves in place	back flow protection	Service line	monthly - during meter reading	ocular inspection	Meter reader	Install/replace check valves
Consumer: NRW Reduction Program	Attainment of NRW Percentage Reduction Target	Approved Yearly NRW Target	Service Area	Monthly/Yearly	Monthly Operations Report	All Dept.	Review and evaluate NRW Program
Consumer: SOP on new SC Installation and Rehabilitation program for existing connections	No SC submerged in canals	Service Connection line	Drainage Line/Canals	Monthly	Ocular Inspection	Commercial Dept. - Meter Readers/Post Inspectors	Report to Maintenance & NRW Dept for appropriate action
Consumer: Strict Policy implementation	In place - standard design	In-line boosting	Service connection line	Quarterly	Inspection	Engineering Dept	Notify and Impose disconnection if recommended standard design is not followed

Annex E: Verification Monitoring Program

VERIFICATION ACTIVITY	LOCATION OF ACTIVITY	TYPE OF ACTIVITY	FREQUENCY OF MONITORING	RESPONSIBLE UNIT	RECORDS	PNSDW PARAMETERS
Microbiological Testing	Source	Water Quality Testing	Monthly	Quality Control Assurance Section	QCAS Database	Total Coliform, Fecal Col
	Distribution system		Daily /as needed			
	Booster Pumping Station		Twice a day			
	Bulk Water Source		Weekly			
Physical/Chemical Testing	Source	Water Quality Testing	Annual	Quality Control Assurance Section	QCAS Database	Arsenic,Cadmium,Lead, Nitrate,Benzene,Color, Turbidity,Iron,pH,Manganese,Chloride,Sulfate, Total Dissolved
	Distribution system	Water Quality Te	Annual			
		Flushing	Twice a week/as			Turbidity
	Booster Pumping Station	Water Quality Testing	six samples per day		QCAS Database	Residual Chlorine, Turbidity, pH
	Bulk Water Source		Weekly			
Laboratory Equipment Calibration/Maintenance	QC Laboratory	Calibration and Maintenance	Annual/as needed	Quality Control Assurance	QCAS Logbook	
Records verification	Pumping Station	Operations Audit	Daily	Supervisor, Operation Production Division	Daily Operational Report/Data Base	
- Pressure						
- Water level						
- Volumetric flow						
- Residual Chlorine						

Verification Monitoring Program

VERIFICATION ACTIVITY	LOCATION OF ACTIVITY	TYPE OF ACTIVITY	FREQUENCY OF MONITORING	RESPONSIBLE UNIT	RECORDS	PNSDW PARAMETERS
Water Treatment	Pumping Station	Maintenance &	Monthly	Quality Control	QCAS Logbook	
Customer Satisfaction Survey	Served Barangays	Random Survey	Semi-annual	CPD	Survey Report	
Customer Feedback (LWUA Form)	Payment/Collection Office & Sub-Offices	Random Survey	Quarterly	CPD	Survey Report	
Records verification	Distribution system	Operations Audit	Monthly	M & NRW Mngt Dept/WDD	Data base	
• Pressure						
• Air release valves						
• Valves						
• Hydrants/blow-offs						
• Maintenance Job Order						
Leak Detection	Pipeline Network	Maintenance	3x a week/as needed	M & NRW Mngt Dept/ Leakage Control Division	Data base	
Regulatory Compliance	Laboratory	External audit	Annual?	DOH	Certification?	

This Water Safety Plan shall be subjected to internal and external audit based on the guidelines set by DOH and LWUA.

Annex E. STANDARD OPERATING PROCEDURE (under normal, incident & emergency condition)

SERVICE CONNECTION NEW INSTALLATION

A. INSTALLATION OF METER STUB-OUT

Materials Needed:

- Saddle Clamp
- Straight Ball Valve w/ Lock wing
- Male Adaptor 45° Bend (Push-in)
- PE Tube ISO
- Female Adaptor 90° Bend (Push-in)
- G.I. Nipple
- Brass Straight Ball Valve w/ Lock wing
- G.I. Cross Tee
- G.I. Tee
- G.I. Tee Reducer
- G.I. Plug
- Plastic Union Coupling (P to P)
- Water Meter
- Water Meter Stand
- Seal Tape (Teflon)
- Portland Cement
- Washed Sand
- Gravel (at least 3/4")
- Food Grade Paint
- Pallet (Palita)

Tools and Equipment Needed:

- Pipe Wrench
- Tapping Machine
- Digging Bar
- Shovel
- Chisel
- Mallet
- Hacksaw w/ Blade
- Boring Machine
- Jack Hammer (concrete road)
- Cutting Machine (concrete road)
- Welding Machine
- Portable Compactor
- Compressor
- Dewatering Pump
- Trailer/Mini Dump Truck
- Concrete Mixer (1 bagger)
- Concrete Vibrator
- Paint Brush

Procedure:

1. Dispatch job orders.
2. Withdraw materials from Property Division.
3. Mobilize manpower, tools, equipment and signages.
4. Excavate trench for mainline tapping.
5. Install saddle clamp on the body of the pipe and straight ball valve w/ lock wing to the saddle clamp.
6. Tap the tapping machine to the straight ball valve and start boring the mainline until water flows out.
7. Allow the water to flow to flush out the cuttings.

8. Close the straight ball valve and connect the P.E. Tube.
9. Lay P.E. Tube at a minimum depth of 40 cm.
10. Backfill excavated area using new materials. Service lines shall be installed with a protective layer of sand bedding under and over the P.E. Tube. The excavated material shall be hauled out from the work site and disposed of properly.
11. Install meter stub-out stand at a minimum depth of 40 cm.
12. Open the straight ball valve at the mainline and meter stub-out for testing and record the existing pressure.
13. Flush out water until clear.
14. Closed the straight ball valve at the meter stub-out.
15. Install concrete pad on the stub-out base.
16. Paint the newly installed meter stub-out.
17. Restore the concrete pavement affected during excavation.

B. INSTALLATION OF SINGLE CONNECTION TAP AT DISTRIBUTION LINE

Procedure:

1. Dispatch job orders.
2. Withdraw materials from Property Division.
3. Mobilize manpower, tools, equipment and signages.
4. Excavate trench for mainline tapping.
5. Install saddle clamp on the body of the pipe and straight ball valve w/ lock wing to the saddle clamp.
6. Tap the tapping machine to the straight ball valve and start boring the mainline until water flows out.
7. Allow the water to flow to flush out the cuttings.
8. Close the straight ball valve and connect the P.E. Tube.
9. Lay P.E. Tube at a minimum depth of 40 cm.
10. Backfill excavated area using new materials. Service lines shall be installed with a protective layer of sand bedding under and over the P.E. Tube. The excavated material shall be hauled out from the work site and disposed of properly.

11. Install meter stand at a minimum depth of 40 cm.
12. Open the straight ball valve at the mainline and meter stub-out for testing and record the existing pressure.
13. Flush out water until clear.
14. Closed the straight ball valve at the meter.
15. Install concrete pad on the meter base.
16. Paint the newly installed meter stand.
17. Restore the concrete pavement affected during excavation.
18. Issue meter receipt to the concessionaire indicating the initial reading, brand and serial number of water meter.

C. TAPPING OF NEW SERVICE CONNECTION TO STUB-OUT

Procedure:

1. Dispatch job orders.
2. Withdraw materials from Property Division.
3. Mobilize manpower, tools, equipment and signages.
4. Locate and verify the house of the applicant.
5. Check after-the-meter pipeline provision.
6. Install water meter to the existing stub-out and connect after-the-meter service line.
7. Advise concessionaire to conduct flushing of water until clear.
8. Check and record the pressure at stub-out and household tap.
9. Install concrete pad on the meter stand.
10. Paint the newly installed meter stand using food grade paint.
11. Issue meter receipt to the concessionaire indicating the initial reading, brand and serial number of water meter.

SERVICE CONNECTION REHABILITATION

A. INSTALLATION OF METER STUB-OUT

The procedure on installation of meter stub-out applies to the following conditions:

1. Overloaded Stub-out
2. Old and Overloaded Service Connection
3. Service lines affected due to road concreting, road widening and construction of drainage canal.
4. Service lines affected by low pressure to no water condition.
5. Relocation of existing stub-out.

Materials Needed:
Saddle Clamp
Straight Ball Valve w/ Lock wing
Male Adaptor 45° Bend (Push-in)
PE Tube ISO
Female Adaptor 90° Bend (Push-in
G.I. Nipple
Brass Straight Ball Valve w/ Lock wing
G.I. Cross Tee
G.I. Tee
G.I. Tee Reducer
G.I. Plug
Plastic Union Coupling (P to P)
Water Meter
Water Meter Stand
Seal Tape (Teflon)
Portland Cement
Washed Sand
Gravel (at least 3/4")
Food Grade Paint

Tools and Equipment Needed:
Pipe Wrench
Tapping Machine
Digging Bar
Shovel
Chisel
Mallet
Hacksaw w/ Blade
Boring Machine
Jack Hammer (for concrete road)
Cutting Machine (for concrete road)
Welding Machine
Portable Compactor
Compressor
Dewatering Pump
Trailer/Mini Dump Truck
Concrete Mixer (1 bagger)
Concrete Vibrator
Paint Brush
Pallet (Palita)

Procedure:

1. Conduct site inspection and seek cooperation with the affected concessionaires or barangay officials in the area.
2. Gather the following data:
    a. Nature of complaint
    b. Number of affected service connection lines
    c. Pressure at the affected service lines
    d. Existing mainlines in the area for possible tapping point

e. Pressure at the mainline

f. Location of proposed meter stub-out (property and road right of ways are well defined)

g. Distance of the proposed stub-out to existing mainline. (Stub-out's shall be installed no farther than 150 linear meters from a distribution line.)

h. Road right of way / define road

i. Excavation permits needed

j. Materials needed for rehabilitation

3. Dispatch job orders.
4. Withdraw materials from Property Division.
5. Mobilize manpower, tools, equipment and signages.
6. Excavate trench for mainline tapping.
7. Install saddle clamp on the body of the pipe and straight ball valve w/ lock wing to the saddle clamp.
8. Tap the tapping machine to the straight ball valve and start boring the mainline until water flows out.
9. Allow the water to flow to flush out the cuttings.
10. Close the straight ball valve and connect the P.E. Tube.
11. Lay P.E. Tube at a minimum depth of 40 cm.
12. Backfill excavated area using new materials. Service lines shall be installed with a protective layer of sand bedding under and over the P.E. Tube. The excavated material shall be hauled out from the work site and disposed of properly.
13. Install meter stub-out stand at a minimum depth of 40 cm.
14. Open the straight ball valve at the mainline and meter stub-out for testing and record the existing pressure.
15. Flush out water until clear.
16. Closed the straight ball valve at the meter stub-out.
17. Install concrete pad on the stub-out base.
18. Paint the newly installed meter stub-out.
19. Restore the concrete pavement affected during excavation.

B. TRANSFER OF SERVICE CONNECTION TO STUB-OUT

Procedure:

1. Locate the concessionaire supplied by the service connection line subject for rehabilitation.
2. Inform the concessionaire that their water service connection line will be transferred to the newly installed water meter stub-out.
3. Excavate and lay after-the-meter pipeline at a minimum depth of 40 cm.
4. Pull-out the existing water meter installed inside the concessionaires' premises.
5. Connect the newly laid P.E. pipe to the in-house service line of the concessionaire.
6. Install the water meter to the newly installed stub-out according to standard.
7. Properly fix cut the old service line according to standard (if applicable).
8. Check the flow of water at the concessionaire's house and record pressure.
9. After rehabilitation, install concrete pad on the stub-out base.
10. Paint the newly installed meter stand.
11. Restore the concrete pavement affected during excavation.
12. Submit accomplishment report with all the necessary data.

C. REALIGNMENT OF SERVICE CONNECTION

The procedure on realignment of service connection applies to the following conditions:

1.) Service lines entering private property.

2.) Service lines affected by road widening, road concreting and construction of drainage canal.

3.) Service lines affected by low pressure to no water condition due to embedded service connection and leakages under concrete pavement.

4.) Service lines located along drainage canal.

Procedure:

1. Conduct site inspection, investigate and coordinate with the concerned parties.

2. Prepare the needed materials, tools and equipment.
3. Secure applicable permits.
4. Withdraw materials from Property Division.
5. Mobilize manpower, tools, equipment and signages.
6. Excavate and realign the affected service line. Service lines shall be buried at a depth of at least 40 cm.
7. Cut the affected area of the old service line and connect all the necessary fittings.
8. Flush out water until clear.
9. Restore the concrete pavement affected during excavation.
10. Submit accomplishment report with all the necessary data.

PIPELINE CONSTRUCTION AND INTERCONNECTION

Materials,

Pipes
Welding rods
Steel Plates
Oxygen and Acetylene
Bolts and nuts
Rubber gaskets
Universal Adaptors
Saddle Clamps
Sand and gravel
Cement
New filling materials
Hard Coal tar
Gasoline/Diesel
Red Oxide
Chlorine Powder
Nails
Coco Lumber
Plywood
Paint brush
Hacksaw blade
Rope
Chalkstone

Tools & Equipment Needed:

Wrenches
Cutting outfit
Hacksaw
Digging bar
Shovel
Vise grip
Air compressor with Jackhammer
Pipe cutter
Generator/Welding Machine
Dewatering Pump
Concrete cutter
Concrete vibrator
Concrete Mixer
Backhoe
Signages
Trailer/Mini Dump Truck
Service vehicle
Measuring tape
Pipe pusher
Pulley Ratchet
Ratchet wrench
A-frame
Swabbing tool
Hydro testing Machine
Water tank

A) Pipeline Construction

Procedure:

1. Coordinate with the local officials for the implementation of the project.
2. Prepare the site and all the necessary needed materials and equipment.
3. Mobilization of all the materials, equipment, tools and manpower needed.
4. Pipes stored on site should be properly covered and with end caps.
5. Ensure that the construction crew is using the prescribed safety equipment, e.g. safety glasses, safety vest, safety shoes.
6. Ensure that safety signages are in place.
7. Conduct excavation works and sand bedding. Swab inside of pipe prior to pipe laying. Backfill with new filling materials. Restore.
8. Openings in the pipeline shall be closed with water tight plug when pipe laying is stop at the close of the days' work.
9. Joints of pipe in the trench shall be completed before work is stopped.
10. If water accumulates in the trench, the plug shall remain in place until the trench is free of standing water and mud that may enter the pipe.
11. Sealing materials or gaskets shall be handled in a manner that avoids contamination.
12. The lubricant used in the sealing gaskets shall be suitable for use in potable water and shall not contribute odor.

B) Pipeline Interconnection:

Procedure:

1. Notify the PR for water supply interruption press release
2. Prepare site for interconnection works.
3. Mobilize all the materials, equipment, tools and manpower needed.
4. Ensure that the construction crew is using the prescribed safety equipment, e.g. safety glasses, safety vest, safety shoes.
5. Ensure that safety signages are in place.
6. Close valve to isolate the area prior to interconnection.

7. Drain the remaining water in the isolated pipeline network
8. Clean all fittings for interconnection.
9. Perform interconnection works.
10. Open isolation valves slowly to restore normal supply of water.
11. Backfill with new filling materials.
12. Notify PR of work completion.

C) Hydro testing

1. Conduct hydro testing with maximum pressure of 150 psi for two (2) hours.
2. If allowable leakage failed, find and fix leakage.
3. Repeat procedure number one (1) until allowable leakage is attained.

D) Disinfection, Flushing and Turn-over

1. Inject the desired concentration of chlorine to the pipeline network.
2. Check for residual chlorine at end point and retain for 24 hours.
3. After 24 hours, re-check if residual chlorine is within the minimum limit of 0.3 ppm.
4. If minimum limit is not attained, repeat disinfection process until desired level of residual chlorine is reached.
5. Conduct flushing and collect water sample to be subjected for water quality test.
6. Ready for turn-over if bacteriological test result is negative.

STORAGE AND HANDLING MATERIALS AND SUPPLIES FOR WATER CONNECTIONS

Procedure:

1. Water connection materials should be placed in a clean and dry storage area.
2. All fitting materials should be grouped according to size, type, purpose and should be packed properly.

3. Liquid and dry disinfectant chemicals such as battery solutions, fuel and lubricants, paints, thinners and other materials which contain toxic substances should be stored in an isolated area away from water connection materials.
4. Turned-over waste materials containing toxic substances should be stored away from water connection materials.
5. Ensure that all pipes have end caps and should not be exposed directly to sunlight.
6. Maintain cleanliness inside and outside the warehouse.

Replacement of Water Meter

Materials and Tools Needed:

New water meter with tailpiece
Water meter gasket
Teflon tape
Pipe wrenches
Adjustable wrenches
Vise grip

For flanged type water meters:

Nuts and bolts
Rubber gasket

Procedure:

1. Inform the concessionaire prior to change of meter
2. Turn off the control valve.
3. Record the cut-off reading, brand and serial number of old water meter in the job order and meter receipt
4. Remove the old water meter and install the new one.
5. Ensure that the new water meter is installed horizontally.
6. Record the initial reading, brand and serial number of the new water meter and issue meter receipt
7. Open the control valve.

Changing Chlorine Cylinders

Procedure:

1. Put on appropriate personal protective equipment.
2. Check the chlorine leak detector. Ensure that the reading is zero and the area is well lighted before entering the room.
3. Close the main cylinder control valve.
4. Allow the system to purge itself of chlorine. Ensure that the float drops to the bottom of the feed rate indicator.
5. Loosen the chlorinator (auxiliary valve or vacuum regulator) and remove it from the empty cylinder.
6. Install the cylinder cap on the empty chlorine cylinder and transfer the cylinder to secured storage.
7. Secure the new cylinder into place.
8. Remove the protective hood from the new cylinder.
9. Ensure that there is no chlorine leaking from the packing gland. Use ammonia vapor from the ammonia test bottle, which contains a strong ammonia solution (25%).
10. Ensure that the cylinder valve is closed. Do not open the valve yet.
11. Remove the cylinder outlet cap and check that the cylinder outlet face is clean and smooth.
12. Using a new lead gasket, connect the vacuum regulator or the yoke assembly to the valve outlet using the supplied wrench only.
13. Crack open the chlorine cylinder valve and then quickly close it again. This will allow enough chlorine to charge the line to check for leaks. The valve should open with no more than a sharp rap from the heel of your hand. Never use a helper wrench or a larger wrench than the one supplied. If the valve will not open, carefully loosen the packing gland slightly.
14. Check all the connections you have made to ensure there are no leaks. Use the vapor from the ammonia test bottle. If the leak is indicated, activate the leak control procedure.
15. When no leaks are indicated, open the chlorine cylinder valve no more than half a turn and leave the cylinder wrench on the valve.

16. Ensure that the alarm system is functioning.
17. Remove your respirator and other personal protective equipment.

Disconnection

1. COWD serves notice for disconnection to customers with delinquent account (3 months and up).

2. Customer Pays the Account.
    a. If full payment or pays partial with 2 months in arrears or less, customer pays directly to teller.

    b. If partial payment with total due amount of more than 2 months in arrears:
        - Customer arranges partial payment and executes promissory note.
        - Customer accounts division extends implementation of disconnection.
        - Failure to pay on any succeeding payment scheme as executed in the promissory note, customer accounts division shall implement disconnection of water connection (note: the executed promissory note serves as a disconnection notice).

    c. If no payment is made or partial payment with total due amount of more than 2 months in arrears without promissory note, implement disconnection of water connection within 48 hours of receipt of notice.

3. Standard Disconnection of Water Connection:

    a. On existing single line connection using PE tube:
        - Pull-out quick angle valve, water meter, meter coupling, check valve and GI elbow.
        - Install plastic end cap
    b. On existing single line connection using GI stand pipe:

- Pull-out right angle valve, water meter, meter coupling, check valve and gi elbow.
- Install GI cap plug

c. On existing stub-out connection:
- Pull-out horizontal control valve, water meter, meter coupling, check valve and GI elbow.
- Install GI cap plug for after the meter connection and GI plug for stub-out connection.

d. On single service connection new standard:
- Pull-out right angle valve, water meter with 1 tail piece, brass check valve (swing type) and GI street elbow.
- Install GS/GI end plug Schedule 40 and tie lock - COWD tag (seal).

4. Turn-over of retrieved fittings and water meter to property division and water meter management section, respectively.

5. Submit list of accounts for fix cutting of disconnected water line if customer will not apply for reconnection after 60 calendar days from disconnection.

6. Fix-cutting of water connection will be implemented by the NRW and Maintenance Department.

Reconnection Inspection

1. Retrieve and review applicant's relevant previous data (e.g. pipeline location and size) from COWD Water Supply System Plan (AutoCAD).

2. Conduct site inspection and gather/confirm the following data:
   a. House and/or Meter Location
   b. Location of the nearest Meter Stub-Out for possible reconnection point
   c. Service connection classification

d. Materials needed, conforming with the COWD Service Connection Standard

e. Meter Size (use Meter Sizing Form)

3. Issue Pre-Layout Inspection Advisory (formerly Inspector's Advice Slip) to applicant for appropriate pipeline layout.

4. Prior to payment, after-the-meter pipeline layout should be in place and comply with COWD standards.

5. The Inspector may require the applicant to secure permits (e.g. Excavation from DPWH/CEO or Barangay Permits) when deemed necessary and such shall be submitted to Public Assistance Customer Desk - CCSD Counter 1.

6. The inspector shall submit within 3 days the accomplished Inspector's Report Form together with the requirements to Pre-Inspection Section for verification & preparation of Job Order for Installation. The said report will then be submitted to Public Assistance Customer Desk - CCSD Counter 1.

7. Applicant advises Public Assistance Customer Desk - CCSD Counter 1 upon completion of after-the-meter pipeline installation. Inspector to conduct post inspection and issues customer a Post Inspection Certification if it conforms to COWD Standards, otherwise advice applicant to rectify the after-the-meter pipeline installation.

8. The applicant proceeds to COWD for payment.

Starting the Deep Well Pump

Perform the following before starting the Pump:

1. Make sure that you are properly oriented and knowledgeable to the location, functions and how to operate/manipulate the following:
    - Circuit breaker, switches, fuses, relays, reset button, autotransformer and variable frequency drive (VFD) of the motor control panel (MCC).
    - Metering devices and gauges like voltmeter, ammeter, pressure gauge and flow meter.
    - Discharge valve, blow-off valve, check valve and pressure transmitter.
2. Open the MCC with the circuit breaker OFF and check visually for its physical condition, signs of overheating, loosed or detached wires, burnt components particularly in the power circuit and ensure that they are in good condition. Report signs of deterioration to the maintenance personnel.
3. Always make it a point to go over the operation log book before powering up the motor and find out the important events that has transpired before your shift of duty.
4. Know the operating current and voltage of the submersible motor. Refer to the data on the logbook. Set the auto-man selector switch to OFF and then turn ON the main circuit breaker of the MCC.
5. Check if the supply line to line voltages are in accordance with the specified values or within safe operating range of the motor such as the following:
    - The supply line voltages should not exceed ± 10 % of the rated voltage of the motor.

    Example:

    Allowable voltage range:

For a 220 volts motor:	198 – 242 volts
For a 440 volts motor:	396 – 482 volts

6. Using a voltmeter, check for availability of three phase power supply. Never attempt to start the pump with single phase electrical power supply. Some MCC however, are automatically inhibited from starting with abnormal power supply condition.

Starting the Pump Unit

1. Fully close the discharge valve, open the blow-off valve at 1/3 opening and set the AOM switch to manual position.
2. After satisfying the above requirements, start the submersible pump by setting the selector switch to manual mode, then press the start button. Should you want to operate in automatic mode, set the selector switch to automatic mode and no need to press the start button.
3. Once the motor control (MCC) have commenced starting sequence, observe its operation. If the controller is a reduce voltage (RVAT) or Soft starter, it will shift state from “starting” to “running” within 4 to 5 seconds. If the motor control is a variable frequency drive (VFD), the output frequency will increase gradually until the set frequency is obtain. This time, fully open the blow-off valve, monitor the condition of water coming out of the blow-off header and also monitor the line current readings.
4. If in starting you have encountered trouble, determine the cause. If it is a minor one, fix it. If it is a major one and you cannot repair it, shut-off the motor by pressing the stop button, switch off the main circuit breaker and report immediately to the preventive maintenance unit.
5. Divert water output into the distribution pipe when the water coming out of the blow-off header is already clear or when turbidity is below 5NTU. However, blow-off must be carried out not less than five minutes even if water is clear in the first time. After this, open the distribution valve while gradually closing fully the blow-off valve.
6. Turn On the chlorine dosing pump and make sure that it is working properly.

a. During Pump Trip-off

1. Fully close the discharge valve, open the blow-off valve at 1/3 opening and set the AOM switch to manual position.
2. Shut-off also chlorine operation.
3. Investigate reason of trip-off. Check fault display. Check for 3-phase supply voltage. If tripping is cause by power fluctuation, resume operation of pump-motor by pressing the start button.

4. Observe the operation. If motor trips-off again, repeat step 3 and restore operation once more. If motor trips-off for the third time, switch-off the breaker and report to preventive maintenance for trouble shooting and repair.
5. If no fault is observed and pump-motor operation is restored, perform steps 5 and 6 above.

b. DURING OPERATION

1. Always be vigilant and alert. Be sure to respond to an emergency in order to protect the equipment and facilities from serious and further damages.
2. Make frequent inspection of the volt meter, ammeter, discharge pressure gauge and flow meter to determine that the pump unit is functioning normally.
3. Record properly and correctly the line voltages, line currents, Kilowatt hour, discharge pressure, discharge flow and flow totalizer reading on the operation log sheet. Always analyze if these values are in accordance with the normal operation.
4. Record in the logbook all important information and events relevant to the smooth and efficient operation to be passed to the incoming personnel. Make it a habit to go over the logbook every time you assume your tour of duty. Maintain a separate record for all repair and preventative maintenance done on pumping unit and facilities.
5. Always observe the schedule of operation. Never deviate from it unless approved by the office or due to an emergency.

c. STOPPING THE PUMP UNIT

1. Stop the operation according to operation schedule.
2. Throttle the discharge valve at 1/3 opening, then press the stop button.
3. Fully close the discharge valve.
4. Record the time, hour-meter reading, flow totalizer reading and the kilowatt-hour reading when the pump is stopped.
5. Turn-Off the main circuit breaker at the MCC.

Chlorine Storage and Handling

1. Keep floor dry
2. Do not drop cylinder or allow to strike other objects.
3. Secure cylinders from falling, cylinders will discharge vapor in upright position and discharge liquid when upside-down.
4. Do not store with ammonia, hydro carbons (ex. methane, ethane, propane octane and such) or under the sun and near fire or heat.
5. Store under the shed, protected from heat & rain.
6. Do not store for more than 4 months for 50 / 68 kg. cylinder and 6 months for 1-ton container.
7. Use cylinders and containers on a first in, first out basis.
8. Use new lead gaskets each time a cylinder or container is connected.
9. Follow the chlorine suppliers recommended disposal procedures for leaking containers.

Incident and Emergency Condition:

PUMP REPAIR

Tools/equipment needed:

Pipe wrench
Oxy-acetylene outfit
Adjustable wrench
Hook
Elevator clamp
Vise grip
Hammer
Chain tongs
Electric hoist
Steel brush
Open and close wrenches
Boom truck
Welding machine
Round sling
Files

Materials needed:

Oxygen gas
Acetylene gas
Welding rod
Thread protective compound

Procedure:

1. Notify the Department Manager, Management Department regarding the Repair of pump set and schedules of repair.
2. Ensure that the repair crew is using the prescribed safety equipment, e.g., safety shoes, safety helmets, working gloves.
3. Inspect all Tools, equipment and materials to be used.
4. Mobilization of tools and equipment to site.
5. Coordinates with Operators in charge with the shutdown of pump set. Ensure that the breakers/motor controllers be Lock-out/Tag out.
6. Pull out pump set. Ensure that no foreign objects will fall inside the well.
7. After the pump set have been pulled out. Ensure the well hole be covered with steel plates.
8. Inspect the pump set with damages and defects.
9. Clean the pump sets parts.
10. Install pump set. Ensure that no foreign objects will fall inside the well.
11. Test run the pump set and flush the water until the water is not turbid.
12. Open Valve slowly to feed water to the system.
13. Clean work area and uninstall equipment.
14. Mobilization tools and equipment from site

Mainline Leakages

Materials,

Pipes
Welding rods
Steel Plates
Oxygen and Acetylene
Bolts and nuts
Rubber gaskets
Universal Adaptors
Repair Clamps
Sand and gravel
Cement
New filling materials

Tools & Equipment Needed:

Wrenches
Cutting outfit
Hacksaw
Digging bar
Shovel
Vise grip
Air compressor with Jackhammer
Pipe cutter
Generator/Welding Machine
Dewatering Pump
Concrete cutter
Concrete vibrator
Concrete Mixer
Backhoe
Signages
Trailer/Mini Dump Truck
Service vehicle

Procedure:

1. Assess /Investigate on site, to determine the size & kind of pipe in the preparation of materials needed in the repair.
2. Ensure that PR has issued a Public Service Announcement (includes affected area and duration of repair)
3. Inform the Transmission and Distribution team to isolate the affected area.
4. Mobilize all materials, equipment, tools, signage, lighting & other items needed in the repair.
5. Isolate the affected area.
6. Ensure all safety signages are in place.
7. Excavate the area with leakage.
8. Dewater the trench, clean the leaking pipe.
9. Fix leakage. Check all fittings and tighten all bolts.
10. Open the isolated valves for leak test.
11. If there's no leak, apply sand bedding under and over the pipe.

12. Backfill the excavated area and apply layer by layer compaction (at least 150mm per layer).
13. Conduct flushing at fire hydrant /BOV's and collect water sample for quality test.
14. Inform the COWD Public Relation Officer, Pumping Station/ Pump Operators, & Department Managers that the repair has already been completed (date & time)
15. Apply needed restoration in the area.

Service Connection Leaks

Materials,	Tools & Equipment Needed:
Pipes	Wrenches
Welding rods	Cutting outfit
Steel Plates	Hacksaw
Oxygen and Acetylene	Digging bar
Bolts and nuts	Shovel
Rubber gaskets	Vise grip
Universal Adaptors	Air compressor with Jackhammer
Repair Clamps	Pipe cutter
Sand and gravel	Generator/Welding Machine
Cement	Dewatering Pump
New filling materials	Concrete cutter
	Concrete vibrator
	Concrete Mixer
	Backhoe
	Signages
	Trailer/Mini Dump Truck
	Service Vehicle

A. Tapping Point at Service Connection Line

Procedure:

1. Assess /Investigate on site, to determine the size & kind of pipe in the preparation of materials needed in the repair.
2. Ensure that PR has issued a Public Service Announcement (includes affected area and duration of repair)
3. Inform the Transmission and Distribution team to isolate the affected area.

4. Mobilize all materials, equipment, tools, signage, lighting & other items needed in the repair.
5. Isolate the affected area.
6. Ensure all safety signages are in place.
7. Excavate the area with leakage.
8. Dewater the trench, clean the leaking pipe.
9. Fix leakage. Check all fittings and tighten all bolts.
10. Open the isolated valves for leak test.
11. If there's no leak, apply sand bedding under and over the pipe.
12. Backfill the excavated area and apply layer by layer compaction (at least 150mm per layer).
13. Conduct flushing at fire hydrant /BOV's and collect water sample for quality test.
14. Inform the COWD Public Relation Officer, Pumping Station/ Pump Operators, & Department Managers that the repair has already been completed (date & time)
15. Apply needed restoration in the area.

B. Service Connection Line

Procedure:

1. Assess /Investigate on site, to determine the size & kind of pipe in the preparation of materials needed in the repair.
2. Mobilize all materials, equipment, tools, signage, lighting & other items needed in the repair.
3. Ensure all safety signages are in place.
4. Excavate the area with leakage.
5. Dewater the trench, clean the leaking pipe.
6. Conduct flushing along service line.
7. Fix leakage. Check all fittings.
8. If there's no leak, apply sand bedding under and over the pipe.
9. Backfill the excavated area and apply layer by layer compaction (at least 150mm per layer).
10. Inform the concessionaire or complainant that the repair has been completed.

11. Apply needed restoration in the area.

Gas Chlorine Leak Containment

NOTE: Never apply water to a chlorine leak, it might get worst (corrosion).
If leak occurs during operation, two people should respond with proper equipment and protective gear.

1. Use appropriate personal protective equipment (PPE) before containing leaks.
2. When chlorine gas is in the air, safety glasses and face shields will not protect the eye. Workers in an area that contains a chlorine concentration that may irritate the eyes (for example, greater than 0.5 ppm) must wear eye protection with a tight seal around the eyes or face to prevent chlorine gas entering the eyes. At this concentration, eye protection will be worn with the required respiratory protection. Emergency response workers who are controlling a serious chlorine leak must have access to full-body protective suits and full-face piece respirator with cartridges
3. Prepare appropriate emergency kit (Blind Cap).
4. Approach leak from windward side.
5. Position cylinder to minimize emission. Leak must be on the gas side to prevent liquid from spilling out of the containers which may cause more danger.
6. Contain leak. Neutralize with Sodium Hydroxide (NaOH) and water.

Annex G - RESPONSE PLAN ON EMERGENCY

EMERGENCY	ACTION	REFERENCE
Source/Water Contamination (Outbreaks)	Protocol on isolation and stoppage of operation, issuance of boil water advisory and disinfection	COWD Approved Emergency Respnse Plan
Flooding	Protocol on isolation and stoppage of operation, issuance of boil water advisory and disinfection	COWD Approved Emergency Respnse Plan
El Nino	Protocol of operation and well monitoring during El Nino and water supply rationing.	COWD Approved Emergency Respnse Plan