



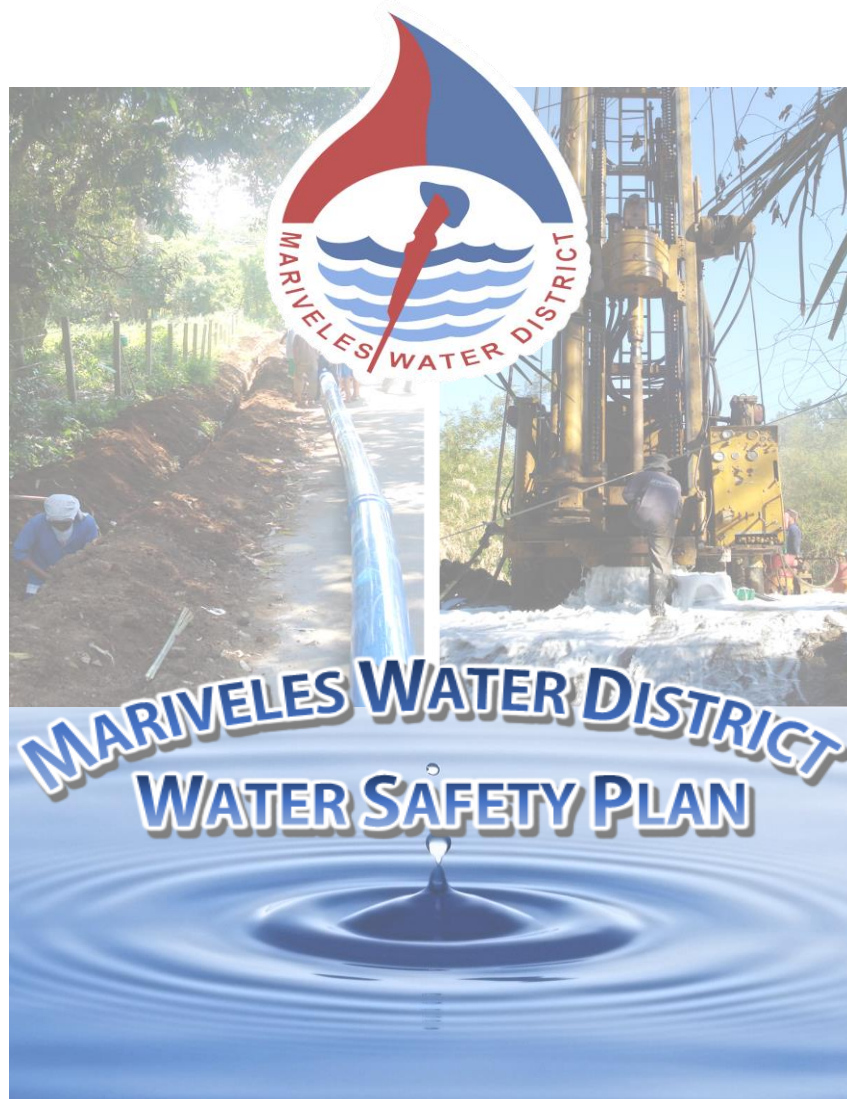
Republic of the Philippines  
**Mariveles Water District**  
Mariveles, Bataan

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## WATER SAFETY PLAN MANUAL



# ...Managing Drinking Water...

**BOARD RESOLUTION NO. 21-18**  
**OFFICE ORDER NO. 02, s.2021**

**Approval Signature**

**CRISTINELA RUTH I. LAMAYRA**  
**General Manager**



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### DEFINITION OF TERMS

1. **Residual Chlorine** – Measure of residual or remaining chlorine in water. Chlorine residual is necessary to control bacterial growth.
2. **Pesticide** – Chemical substance or biological agent used against pests including insects, plant pathogens, birds, mammals, nematodes and microbes that compete with humans for food, destroy property, spread disease or are a nuisance.
3. **Monitoring** – to watch, keep track of, or check for any changes which may occur over time.
4. **Water Sampling** – process of proper collection of water for water analysis.
5. **Storage Tanks** – a structure where the water is temporarily collected for distribution.
6. **Transmission Lines** – a series of pipeline from sources going to distribution line.
7. **Chlorination** – the process of adding chlorine for water disinfection to make it fit for human consumption as drinking water.
8. **Disinfection** – water treatment processes designed to destroy disease-causing microorganisms. The efficacy of disinfection is often assessed by measuring the coliform group of indicator organisms.
9. **Static Water Level** – water level before pumping operation.
10. **Discharge Pipe** – outlet pipe from storage tank going to transmission line.
11. **Water Quality** – is the physical, chemical and microbiological characteristics of water by which the acceptability of the water is evaluated. The term Quality is considered relative to the proposed use of water.
12. **Pre-operation** – an operation which is done before the state of functioning or of being in effect.
13. **Blow Off Valve** – valve used to drain water from transmission line.
14. **Ground Water** – water that occurs below the surface of the earth, where it occupies spaces in soils or geological strata.
15. **Cross Contamination** – the process of mixing contaminated water with uncontaminated source that may affect its quality.
16. **Turbidity** – a cloudiness or haziness of water caused by individual particles that are too small to be seen without magnification.
17. **Service Area** – a place/location covered or provided by such services.
18. **Level III** (waterworks system or individual house connections) – A system with a source, a reservoir, a piped distribution network and household taps. It is generally suited for densely populated areas. This level of facility requires a minimum treatment of disinfection.
19. **Production Yield** -- to produce something as a result of work, activity or calculation.
20. **Physical** – water contaminants that affect the physical characteristic of water which include turbidity, color, taste, odor and Ph.
21. **Distribution Lines** – a series of pipeline from transmission line going to service area.
22. **System check-up** – a process of checking or investigating a method or set of procedures before the operation.



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- 23. Consumer's Tap** – a valve and spout used to regulate delivery of water supply located at the end of the water distribution systems usually within the vicinity of the houses or building.
- 24. Microbial** – water contaminants that is responsible for water borne diseases. These include bacteria, viruses and pathogenic protozoa.
- 25. Chemical** – a water contaminants in the form of chemical constituents which occur naturally in the environment and in raw, water or used in agriculture or industries that may lead to acute health problems.
- 26. Dosing** – feeding chemicals into the process fluid at intervals to give sufficient time for the chemicals to react.
- 27. Flow Meter** – a device for measuring the rate of flow of liquid.

### ABBREVIATIONS

Cl <sub>2</sub>	Chlorine
DOH	Department of Health
DENR	Department of Environment and Natural Resources
DPWH	Department of Public Works and Highway
HTH	High Test Hypochlorite
HPC	Heterotrophic Plate Count
IEC	Information Education Campaign
ISO	International Organization for Standardization
LGU	Local Government Unit
MPN	Most Probable Number
MSDS	Material Safety Data Sheet
MTFT	Multiple Tube Fermentation Technique
PD	Production Division
PNSDW	Philippine National Standard for Drinking Water
PPM	Parts Per Million
MARIWAD	Mariveles Water District
GOCC	Government Owned and/or Controlled Corporation
NAWASA	National Waterworks and Sewerage Authority
LWUA	Local Water Utilities Administration
BATAWD	Bataan Association of Water District
WSP	Water Safety Plan



## **WATER SAFETY PLAN MANUAL**

### **1. INTRODUCTION**

Mariveles is a 1<sup>st</sup> class municipality in the Province of Bataan. It is located at the southern tip of the Bataan Peninsula about 173 km from Manila via the North Luzon Expressway, Gapan-Olangapo Road and Roman Highway. It is bounded on the South by the Manila Bay, on the West by the South China Sea, on the northwest by the municipality of Bagac and northeast by the municipality of Limay.

The municipality of Mariveles is divided into 18 barangays, 17 of which are classified as urban. About 93% of the total land area of the municipality is classified as agricultural while the rest covers residential, commercial, and industrial zones. Mariveles is site of the Authority of the Freeport Area of Bataan (AFAB).

The municipality is predominantly hilly and mountainous. The plains comprise only about three percent (3%) of the total land area and are situated in the coastal areas. The average elevation of the town proper is about 10 m above mean sea level.

The Mariveles Water District (MARIWAD) is a category “B” water district which provides potable water to the municipality of Mariveles.

#### **1.1. MANAGEMENT SUPPORT AND THE WATER SAFETY PLAN TEAM**

The MARIWAD recognized the need and importance of implementing the Water Safety Plan (WSP) to its operations. WSP team are formulated to organized, assess and develop a WSP for the entire water system of MARIWAD from the water sources to the water tap of the consumer (ground water - disinfection - distribution). The WSP covers the water sources, water treatment, pumps, reservoir, and the distribution network up to its consumers.

The adoption of the Water Safety Plan and the coupled commitment to the approach will have a number of benefits. The development and implementation of WSP will include the systematic and detailed evaluation and prioritization of hazards and the operational monitoring of barriers or control measures. It also provides a planned and structured system to reduce the chance of failure through mistake or a lapse in management practices. The process of actions increase the consistency with which a safe and potable water is supplied to MARIWAD consumers and provides contingency plans to respond to system failures or unforeseeable hazardous events.

On the overall, the advantages can be summarized as;

- 1) compliance with water quality targets,
- 2) application of best practices to secure water safety,
- 3) consistent water quality and safety,
- 4) plans are in place to prevent crisis scenario from water quality impairment,





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- 5) potential savings from avoidance of incidents and accidents,
- 6) improvement in asset management and
- 7) Ensure the satisfaction of customers.

In 2016, the WSP Team was created and on October of the same year, the first Water Safety Plan was completed and implemented. The responsibilities of the team was to: (1) Assess the existing water supply system, (2) implement the WSP, (3) monitor the implementation of the WSP, and (4) revise the WSP as may be necessary.

The MARIWAD WSP manual went through its first revision in May of 2021 and adopted the principle and the 11-step approach of the World Health Organization.

MARIWAD Board Resolution No. 21-18 (Adoption of Water Safety Plan and Creation of Water Safety Plan Committee – Appendix A) was passed to signify the Board of Directors support for the WSP development activities. An office order no. 02, s.2021 (Technical Working Group of Water Safety Plan – Appendix B) was also issued creating a new set of WSP team to review and revised the existing WSP manual to conform to LWUA and DOH standard. This is pursuant to DOH Administrative order 2014-0027 (National policy on Water Safety Plan for all drinking water service providers) dated September 4, 2014. And also LWUA Memorandum Circular No. 010-14 (Development and Implementation of Water Safety Plan) dated December 1, 2014.

MARIWAD Board Resolution No. 26 series of 2022 (Resolution supporting the development of Mariwad Water Safety Plan) was passed to signify the Board of Directors support for WSP development.

Water Safety Plan Team composition/selection was based on the roles and functions on the operation, maintenance and operational support of MARIWAD.

### **1.2. MAIN RISK IN THE SYSTEM**

A review of water quality problems was conducted by MARIWAD through the efforts of the Engineering crew. The most common water quality problems encountered, noting their potential hazards and causes, from source to distribution network are:

1. Presence of Iron in the source (Naturally present in the groundwater)
2. Presence of Manganese (Naturally present in the groundwater)
3. Presence of coliforms (due to Low water pressure, Illegal connection, Use of booster pumps, System leaks and others)
4. Presence of suspended solids (due to Low water pressure, Illegal connection, Use of booster pumps, System leaks and others)



## **WATER SAFETY PLAN MANUAL**

Most of the hazard problems identified are common to the pumping stations located at Karagatan Village and Vista Grande. MARIWAD designed and implemented the installation of Filtration System to these sources. However, to the other water sources, the main hazard identified as shown above are only of bacteriological quality and some suspended solids caused by intrusion of water due to the abovementioned causes in the distribution network.

### **1.3. WSP TEAM, ROLES AND FUNCTIONS**

MARIWAD WSP Team is composed of representatives from each of the three (3) departments of the office: Engineering (Production and Construction & Maintenance), Commercial and Administrative. All the members were chosen based on the required knowledge on either of the following:

1. Technical expertise on the operation and 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 in 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 programs
8. With authority
9. Other members:
  - a. Consultant
  - b. Coordinators
  - c. Secretariat
  - d. Documentation committee

To ensure the strict implementation and updating of the WSP, the WSP Team periodic review frequency is twice a year (2x a year) and if need arises (incident), an emergency review/meeting will be scheduled immediately.





## **WATER SAFETY PLAN MANUAL**

### **2. WSP TEAM**

#### **General Objective**

Reliable, Viable, Safe, and Potable water supplies to its consumers are necessary to achieve the commitment to its consumers.

#### **Specific Objectives**

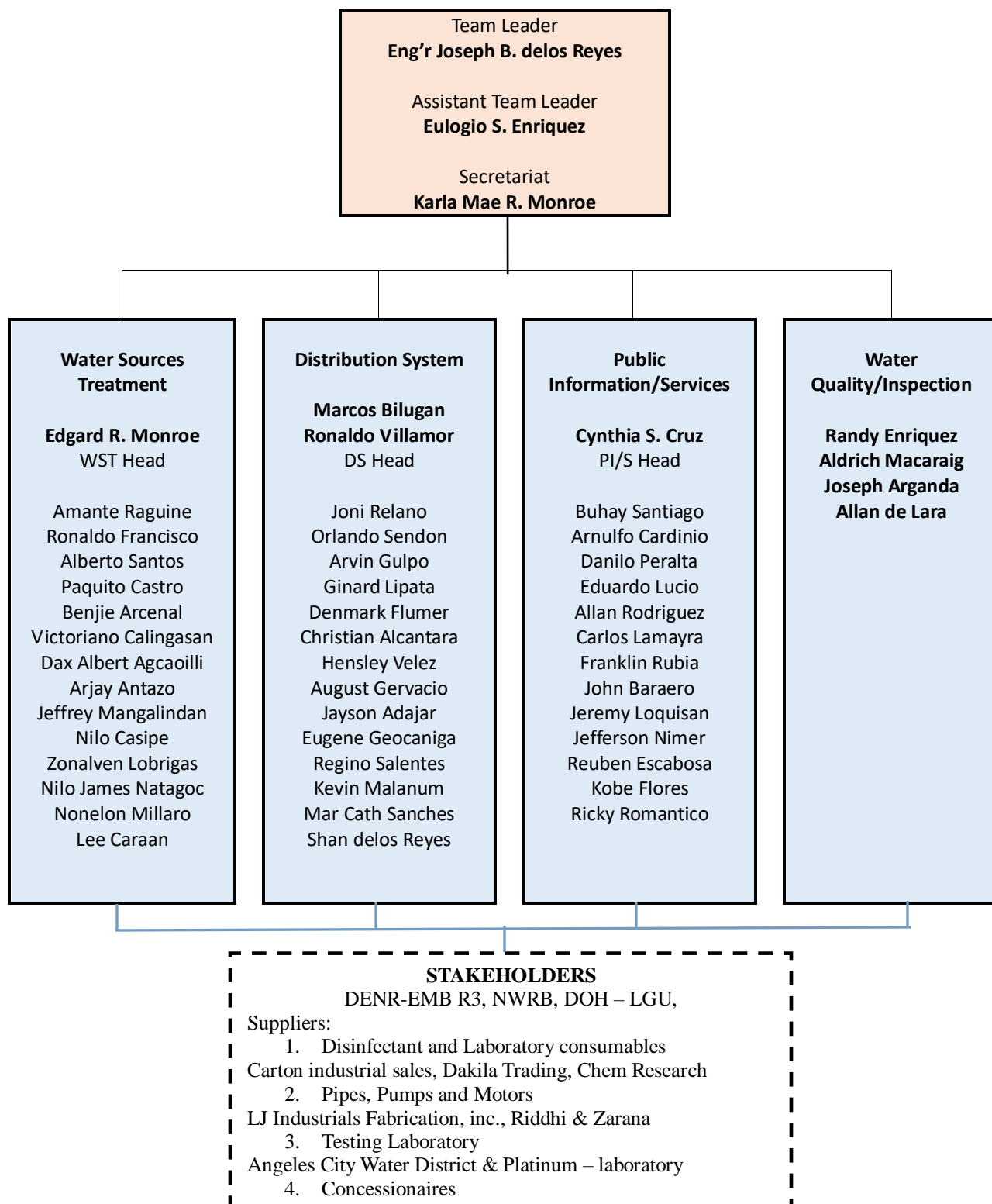
The WSP intends to guarantee that safe drinking water is available to its consumers at all times through a smooth operation of water supply practice. The WSP can be achieved:

- 1) prevents the contamination of the water source and
- 2) provide programs necessary to immediately resolve contamination,
- 3) ensures the delivery of treated water to its consumers are routinely monitored and the water quality results meet the standards set by LWUA/DOH and
- 4) Prevents the re-contamination of its treated water during storage, distribution and handling until it reaches the consumers.



## WATER SAFETY PLAN MANUAL

### MARIWAD WATER SAFETY PLAN TEAM STRUCTURE





## WATER SAFETY PLAN MANUAL

**Table 1: Key Personnel of Water Safety Plan Team from Source to Distribution**

NAME	JOB TITLE	ROLE IN WSP	CONTACT #	EXPERTISE																		
				1				2				3		4	5	6	7	8	9			
				a	b	c	d	a	b	c	a	b							a	b	c	d
Cristinela Ruth I. Iamayra	General Manager	Consultant	(047) 9354635 local 201																			
Eng'r Joseph B. delos Reyes	Department Manager	Team Leader	(047) 9354635 local 204																			
Eulogio S. Enriquez Jr.	OIC-Department Manager	Assistant Team Leader	09179369704																			
Cynthia S. Cruz	OIC-Department Manager	Public information/ Service Head	09212876851																			
Karla Mae R. Monroe	Utilities Customer Service Asst.	Secretariat	09277116786																			
Edgard R. Monroe	Water Utilities Mgmt Officer A	Water Sources Treatment Head	(047) 9354635																			
Marcos Bilugan	OIC-Construction & Maintenance Foreman	Distribution System Head	(047) 9354635																			
Alberto J. Santos	Water Resources Facilities Operator A	Water Quality/ Inspection	(047) 9354635																			
Randy R. Enriquez	Utilities Customer Service Asst. C	Water Quality/ Inspection	(047) 9354635																			
Aldrich I. Macaraig	Utilities Customer Service Asst. C	Water Quality/ Inspection	(047) 9354635																			
Joseph R. Arganda	Utilities Customer Service Asst. C	Water Quality/ Inspection	(047) 9354635																			
Allan de Lara	Utilities Customer Service Asst. C	Water Quality/ Inspection	(047) 9354635																			

### 2.1. STAKEHOLDERS

Stakeholders are identified and partnered with to ensure that health based targets are met in the production, treatment, transmission and distribution of safe water from source to consumers tap.



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**Table 2: Water Safety Plan Stakeholder Identification and Interaction**

Stakeholders				Interaction mechanism	Record of Interaction
Name	Relationship to Drinking Water Supply Issues	Point of Contact with WD/WSP Team	Issues with Drinking Water Supply		
Local Water Utilities Administration	Regulator on water quality	Submission of water quality report	Compliance to water quality standards	Reporting of water quality	Monthly data sheet
Department of Health	Provides National Standards for Drinking Water	Dialogue	Compliance to water quality standards	Dialogue	Report
DENR –EMB Region III	Regulator on environmental issues	Dialogue	Compliance to water quality standards	Dialogue	Report
Municipal Health Office	Regulator on water quality	Dialogue	Compliance to water quality standards	Dialogue	Minutes of Meeting
Local Government Unit	Regulator on water quality	Dialogue	Compliance to water quality standards	Reporting of water quality	Report
Supplier	Source of chemicals, materials and equipment	Dialogue	Chemical, microbial, physical contamination	Purchasing of materials	Report
Power Utility	Source of power supply	Dialogue	No water supply	Dialogue	Report number
Department of Public Works and Highways	Possible damage to pipelines	Dialogue	Water contamination and water interruption	Dialogue	Report number
Municipal Engineering Office	Possible damage to pipelines	Dialogue	Water contamination and water interruption	Dialogue	Report number
Outsource service provider	Possible damage to pipelines, use of sub-standard materials, Poor installation of Pipelines	Dialogue	Water contamination and water interruption	Dialogue	Report number
Schools	Feedback in quality of water	Dialogue	Water contamination	Dialogue	Report number

### 3. SYSTEM DESCRIPTION

**3.1.** Brief description about Mariveles Water District, its mandate, location and the motivation for the development and implementation of its WSP. Details of relevant water quality standards, sources of water, details of the land use in the catchment, abstraction point, information relating to the storage of water, information relating to the treatment of the water, including the processes and chemicals or materials that are added to the water, details of how the water is distributed including network and identification of the users and uses of water are also provided.

#### A) History

Since the early part of 1964, the coastal town of Mariveles had been suffering from lack of water. It's not because the municipality had no existing water, it has, but the water system was built by the Americans by 1938 for the Quarantine Services at Mariveles Harbor. By that time,



## **WATER SAFETY PLAN MANUAL**

there was no rehabilitation undertaken for that deteriorated system. The water was not safe to drink and the design of the system cannot supply or is not sufficient to the increasing population of the Mariveles residents.

When the Bataan Export Processing Zone (BEPZ) established early in 1970's, residents brought hope for a better water supply but it was in vain. BEPZ constructed a water system intended only to serve its enterprises and the residents.

On the year 1973 of May 23, President Ferdinand E. Marcos, promulgated Presidential Decree 198 (amended by PD 768 & 1479) authorizing the formation of water district to operate local water works system. This decree also created the Local Water Utilities Administration or the LWUA, to assist and provide for the needs of the water district such as financial (in terms of loans), technical and skills training assistance (in form of inspections, surveys of the water distribution systems, designs and constructions), institutional development (in training water districts' personnel and provide standards for the successful operation of the water district). The prospective districts creation is materialized through a resolution approved by the local legislative body. Public hearing is done prior to any formative action. It secures nomination for candidates for the district's board of directors coming from the professional, civic, business, educational and women's group of the community.

On June 7, 1977, the Sangguniang Bayan of Mariveles headed by Mayor Carlos L. Sarreal passed a resolution creating the MARIVELES WATER DISTRICT (MARIWAD) to take ones control of the old system. Appointed officials and members of the Board of Directors were created. Soon, an agreement was made with BEPZ for the tapping of their line going to Talaga. But the tapping was not able to supply the entire town sufficient water. In spite of that, MARIWAD put up in strategic places water points wherein people can get and fetch water. The water tenders were assigned to collect P0.60/drum or P0.10/pail. Inconveniences were felt because "pila una, igib una" was the system. These develop the buy and sell states of the water districts.

After a long wait, December 5, 1977, LWUA issued a certificate of conformance to MARIWAD formally making the 48th member of the water district family. Soon LWUA granted the water district a loan of P6M to finance its Interim Improvement Program (IIP).

On June 4, 1980, LWUA contracted PHESCO for the construction of MARIWAD water system for a period of one year at a cost of P1.7M. Involved in the contract were the development of new sources, the installation of new main distribution and transmission pipes, metered service connections and fire hydrants and the construction of pump house and district's office. Supplementary contract was drawn for the construction of reservoir for the amount of P660, 000.00 which bring the total cost up to 2.3M.

The work started on the same year but minor construction problems were encountered



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when the project was on its peak. The inability of the contractor to provide enough manpower to speed up the work, the bad weather condition, the delay in the arrival of construction materials and the installation of the motor pump. Excavations everywhere, pipes of different sizes were seen lying on the streets, constructions workers, district inspectors and LWUA resident engineer were seen by the people that they are all busy in their own duty. Target: to finish the water system and to give water to the public. It is in this stage wherein people began talking about water rates, policies, rules and regulations, incentives and other intriguing questions. Thus, the district scheduled a series of information drive, communications and other means to satisfy the people's curiosity.

At long last, on August 25, 1981, at 6:00 o'clock in the morning, the main valve of the pumping station was opened. Water started to flow and reaches more than 700 concessionaires. It was like a coming of rain after a long dry spell that makes people very happy. The district became an instant hero. Little by little, MARIWAD began implementing its staff pattern and operational format to meet the growing number of concessionaires.

The construction stage is the most challenging yet most rewarding. Since the beginning of its operation stage, the MARIWAD adopts the LWUA regulation to provide a safe and potable water supply to its consumers.

On its initial operation, MARIWAD had more than 700 concessionaires. After its expansion on Brgy. Ipag and Camaya, the service connections increased. And on September 1982, Cristina Square Subdivision was added to the district's service area.

On the year 1989, the district's consumers were almost 3,700, two independent water systems were operated by the district (Mt. View Village was turn over in 1986 and Cabcaben in 1988).

On 1990, MARIWAD had more than 4,000 concessionaires. With the addition of three existing water systems (Polaris Subdivision in 1989, Alion Water Works in 1996, and Mt. View Resort Subdivision in 1998), the district's service connection rose to 7,500.

Millennium year was such a blessing to the district. On November 20, 2001, from Medium Category, Mariveles Water District was categorized as "Big" water district. To augment the growing demands on potable water, three additional pumping stations were constructed and operated (PS-Milagrosa - in town proper, PS-Pambuko - Cabcaben/townsite, PS-Camaya - in town proper).

The district reached 10,000 connections on the year 2006. Alasasin Water Works and Villa Imperial Subdivision Water System were turned over to MARIWAD.





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On the year 2007, Golden Heights Subdivision was also added to the district family. Construction of new well for Brgy. Alasasin had finished and operated. On the last quarter of 2007, the district reached more than 11,000 connections.

On 2010, Constructed and operated the water system for Brgy Lucanin. And on 2014, the MARIWAD serves 14 out of 18 barangay's in the municipality of Mariveles, due to the addition of Brgy Sisiman and Brgy. Baseco to the district's family. And, on 2015, Constructed and operate Two Well Sources for Sitio Parca and Sitio Bakery. Verapaz Subdivision was also turned over to MARIWAD on the same year. And, on 2017, Villa Paroma Subdivision was turned over to MARIWAD.

On 2018, MARIWAD receives the International Organization for Standardization (ISO) certification.

After the completion of the comprehensive improvement, provision of filtration system to some sources (for removal of iron, manganese, color and odor) and expansion of water system of the district, the construction of the modern Administrative building was conceptualized. The projected increase of the number of personnel and the number of concessionaires, a two-storey building that would accommodate at least 60 office personnel was designed. The building was completed in July 2020 and was inaugurated on August of the same year.

With the construction and operation of additional six (6) deep wells/sources, as of January 2022, MARIWAD has an active connection of 19,673.

### **VISION MISSION AND QUALITY POLICY OF MARIWAD**

#### **Vision**

The excellence in life of Mariveles consumers emanates from Mariveles Water District by providing a sustainable and self-reliant water service.

#### **Mission**

To provide the highest level of water service at the lowest cost to the Mariveles consumers and to enhance the quality of life through a convenient living by providing an efficient, responsive and abundant supply of clean and potable water.



## WATER SAFETY PLAN MANUAL

### Quality Policy

WE, the MARIVELES WATER DISTRICT commit our sincere desire to deliver an adequate supply of potable water and quality service to satisfy the needs of Mariveles consumers.

In doing so, we further to meet our consumers expectations and to fulfill the relevant statutory and legal requirements.

We shall further develop our services through continuous trainings of personnel to increase the level of competencies. Likewise, we shall commit to established quality management system and continuously improve our services.

#### Mariveles, Bataan Map (Mariveles Water District Service Area)



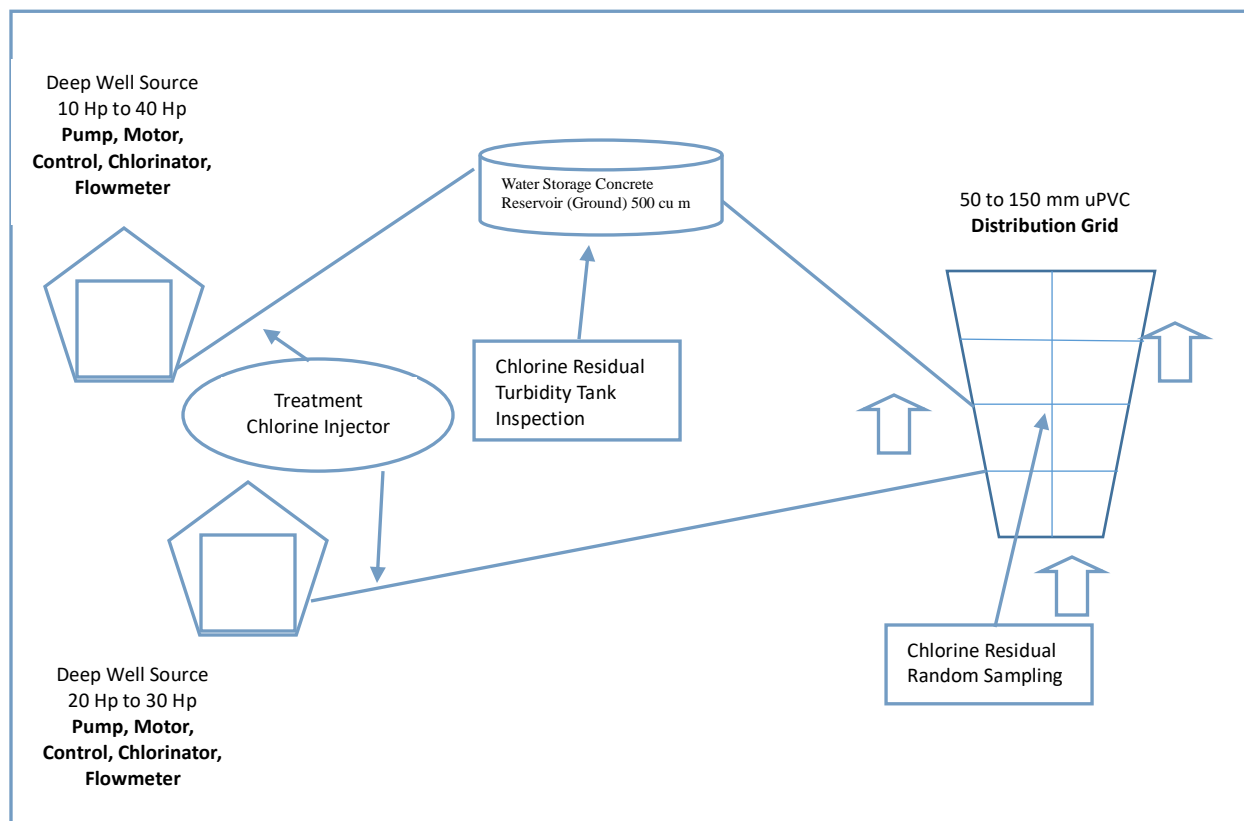
#### A. Schematic Diagram of the Water Supply Systems

Figure 1.1, 1.2 and 1.3 shows the MARIWAD's typical schematic map diagram for the independent water supply systems with existing storage tanks, and interconnected water supply systems with existing storage tanks and direct pumping scheme in the core of the distribution grid, respectively.

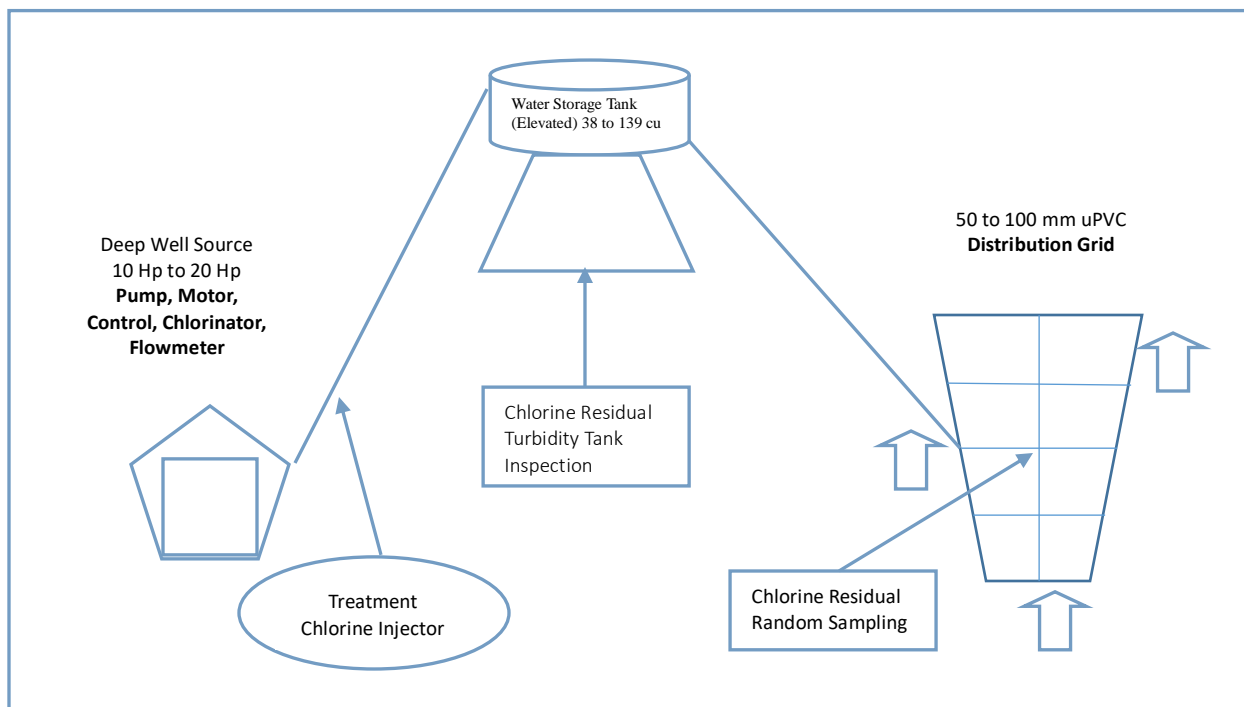


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*Figure 1.1 Typical Schematic Map Diagram for Interconnected Water Supply Systems*



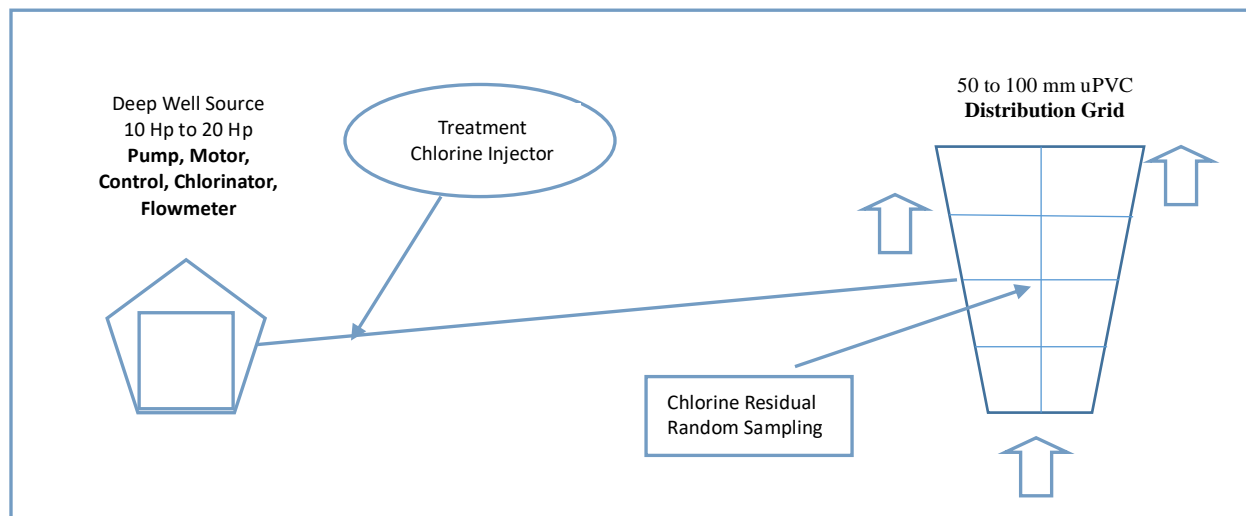
*Figure 1.2 Typical Schematic Map Diagram for Independent Water Supply Systems*



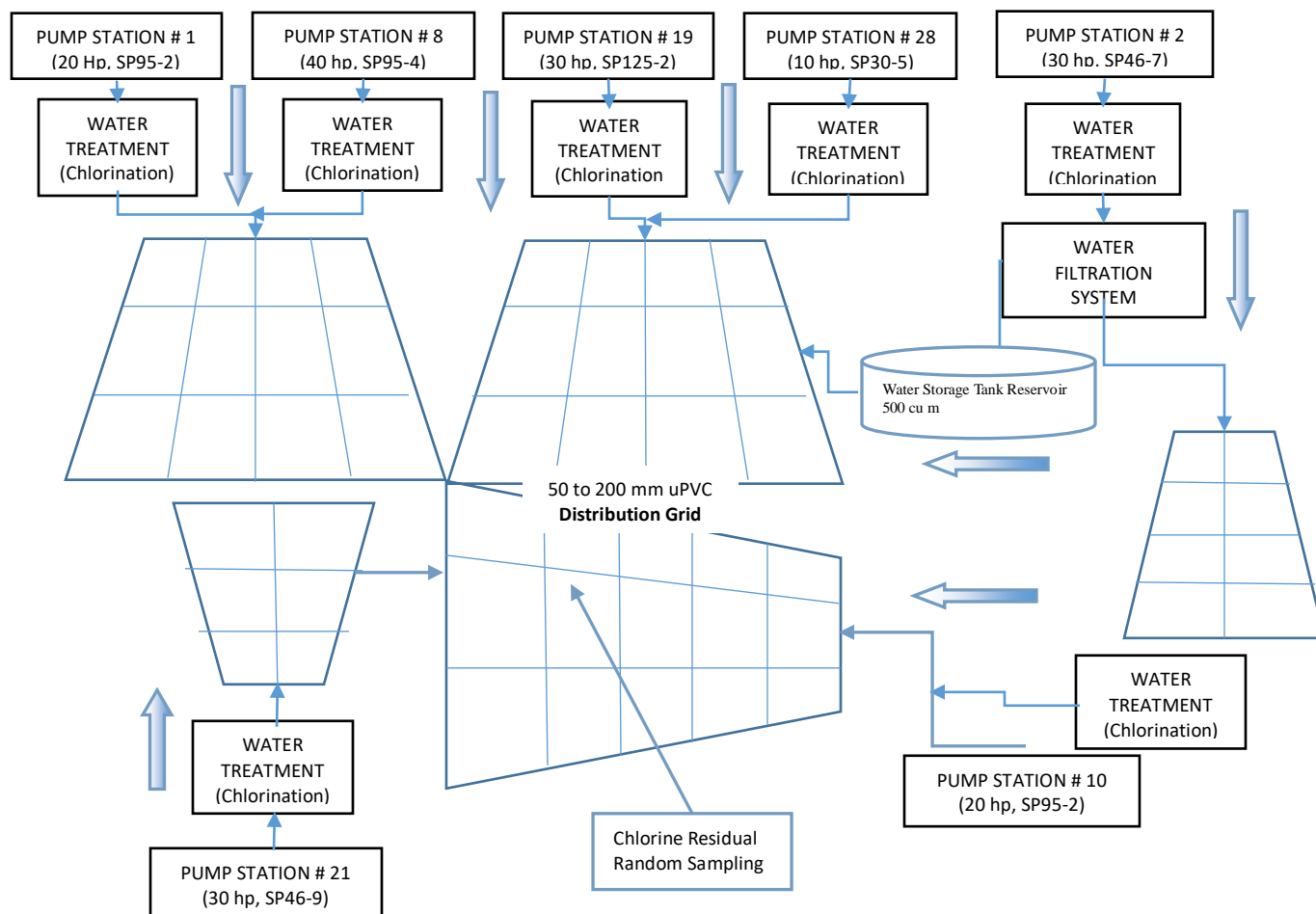


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Figure 1.3 Typical Schematic Map Diagram for Independent Water Supply Systems (Direct)



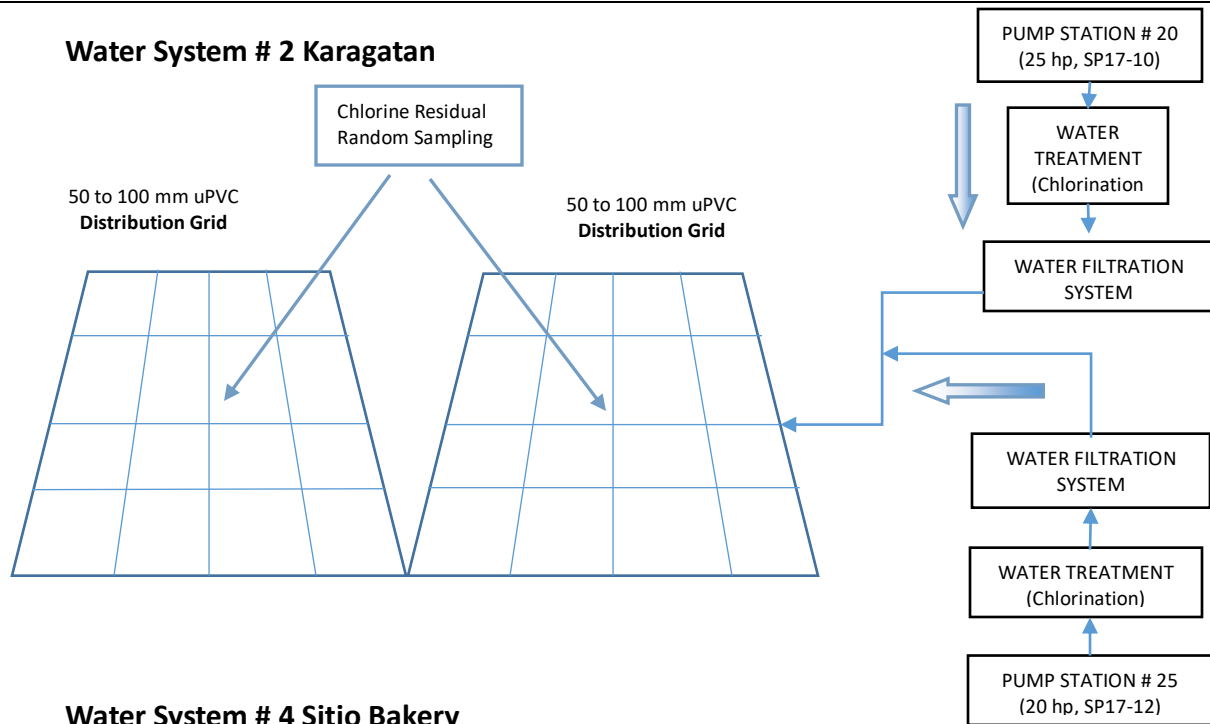
### Water System # 1 Town Proper



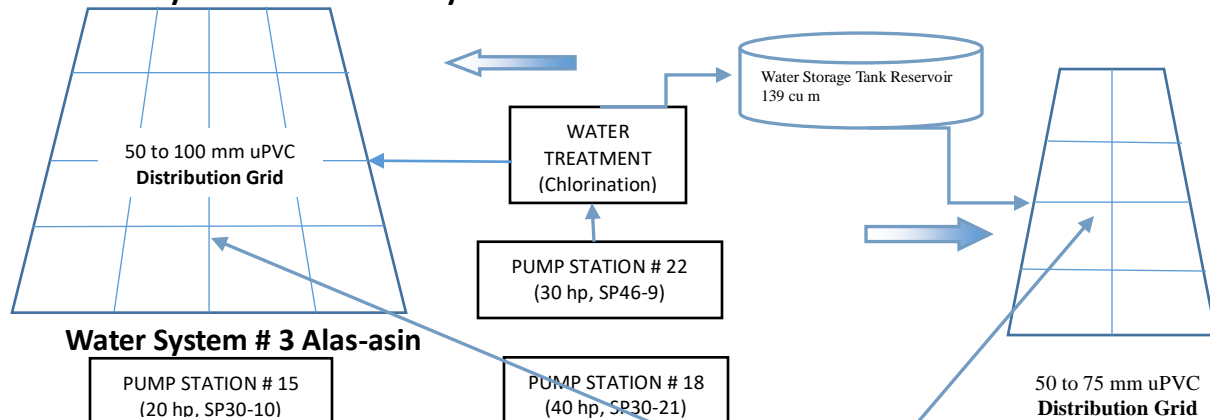


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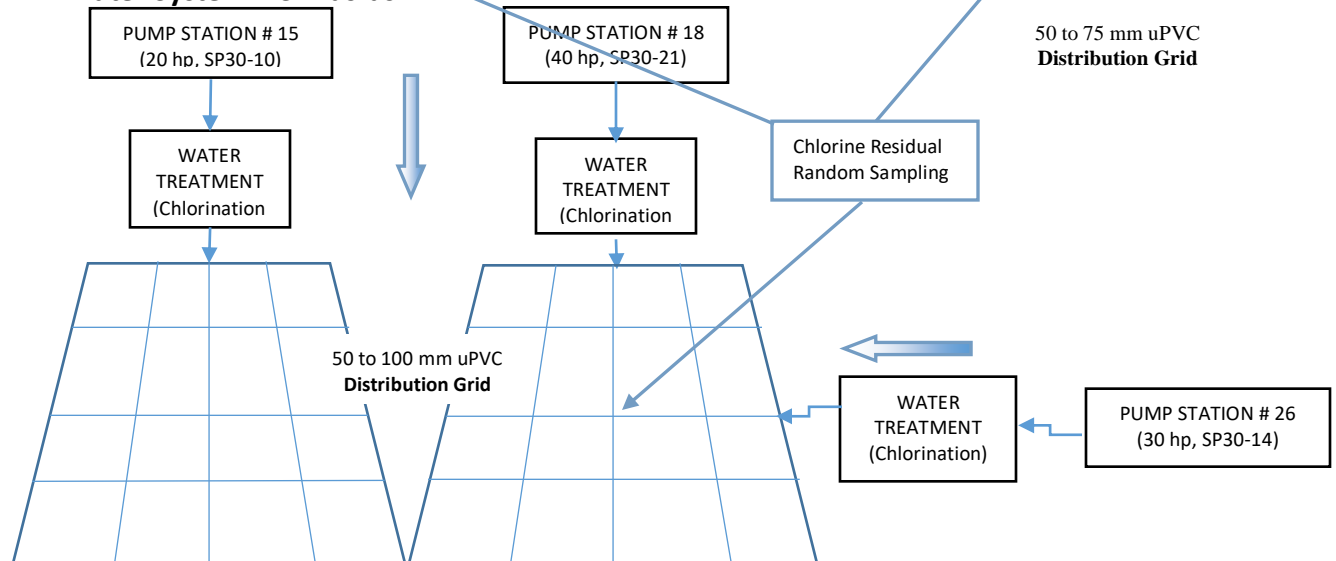
### Water System # 2 Karagatan



### Water System # 4 Sitio Bakery



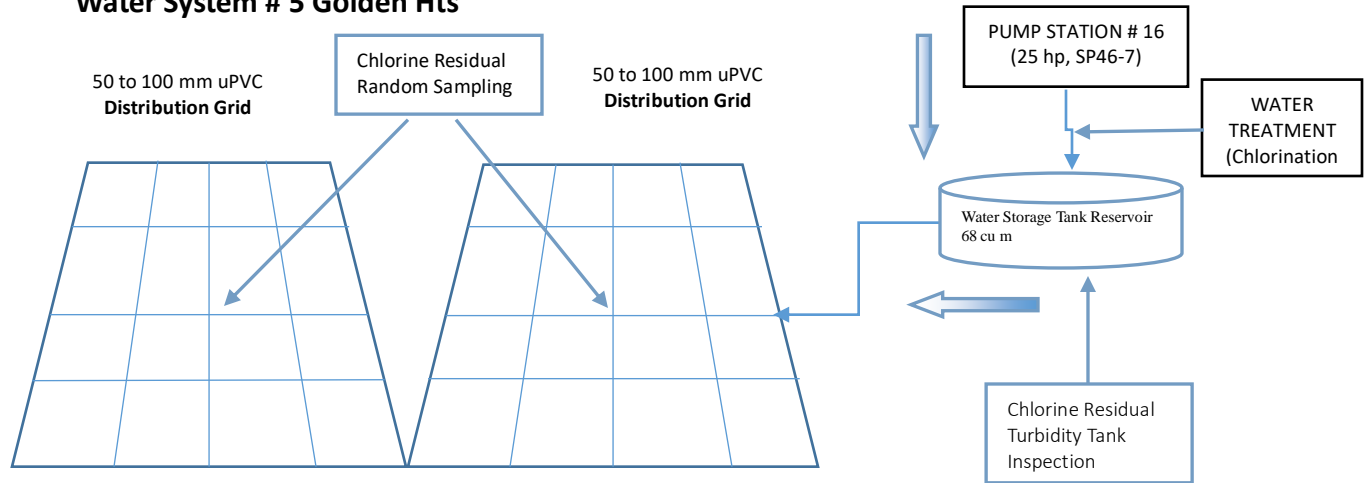
### Water System # 3 Alas-asin



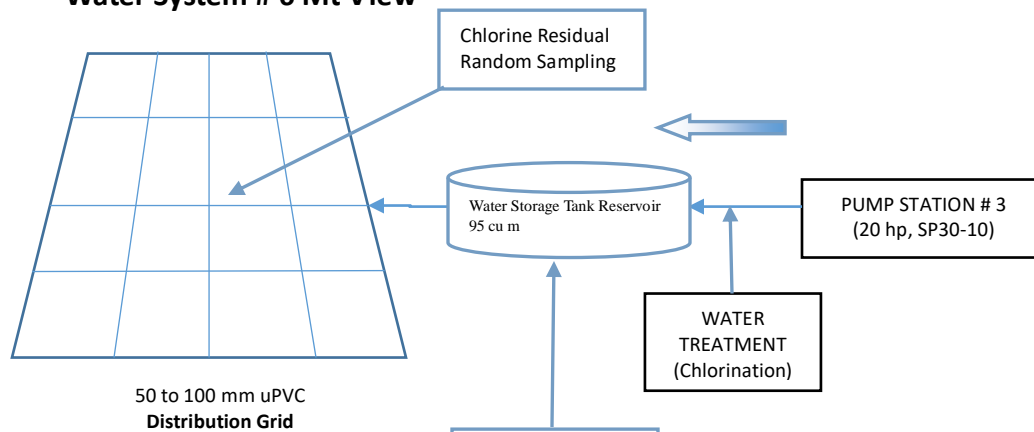


## WATER SAFETY PLAN MANUAL

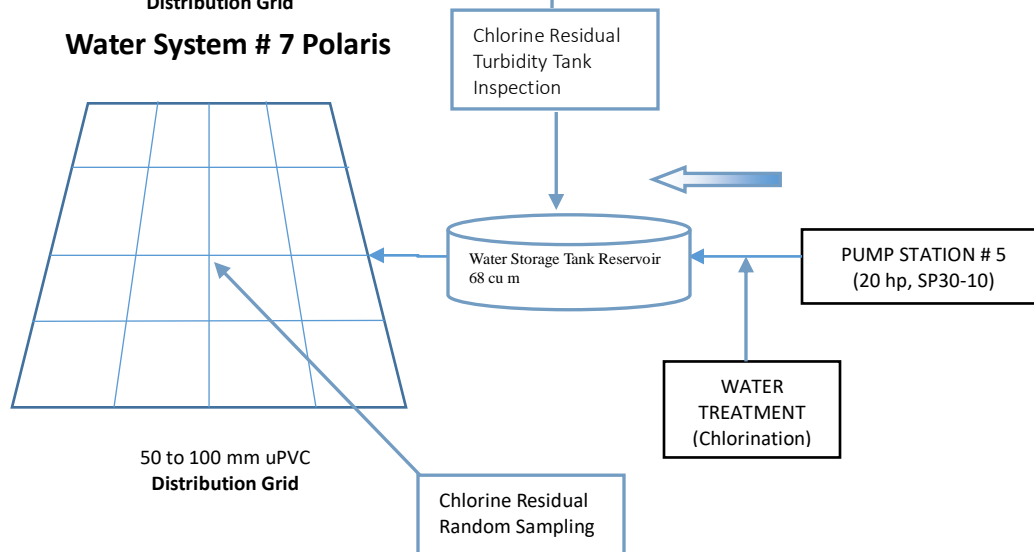
### Water System # 5 Golden Hts



### Water System # 6 Mt View



### Water System # 7 Polaris

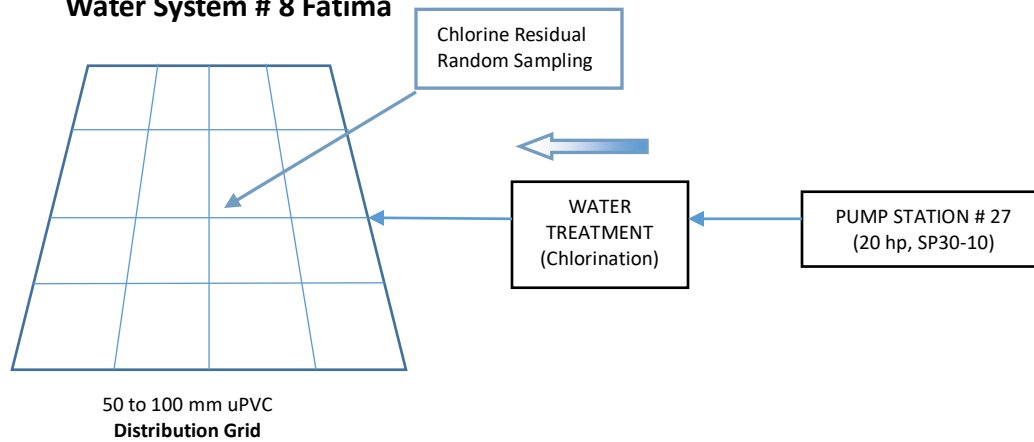




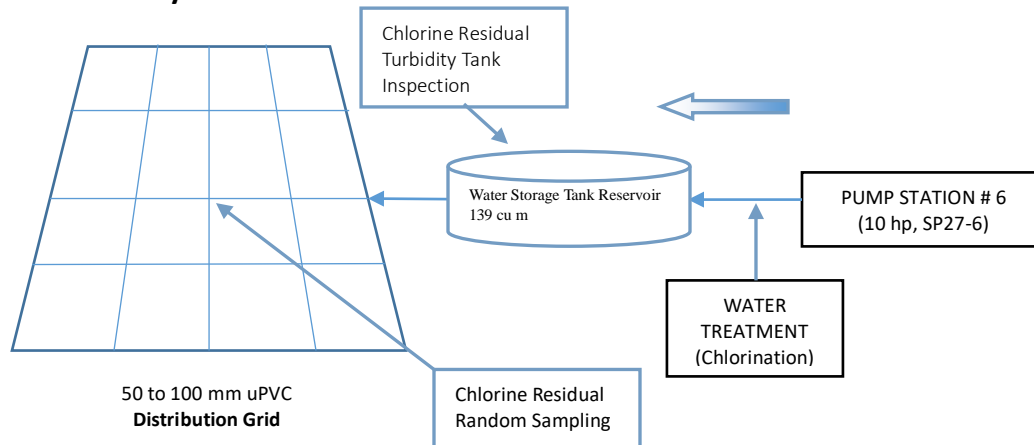


## WATER SAFETY PLAN MANUAL

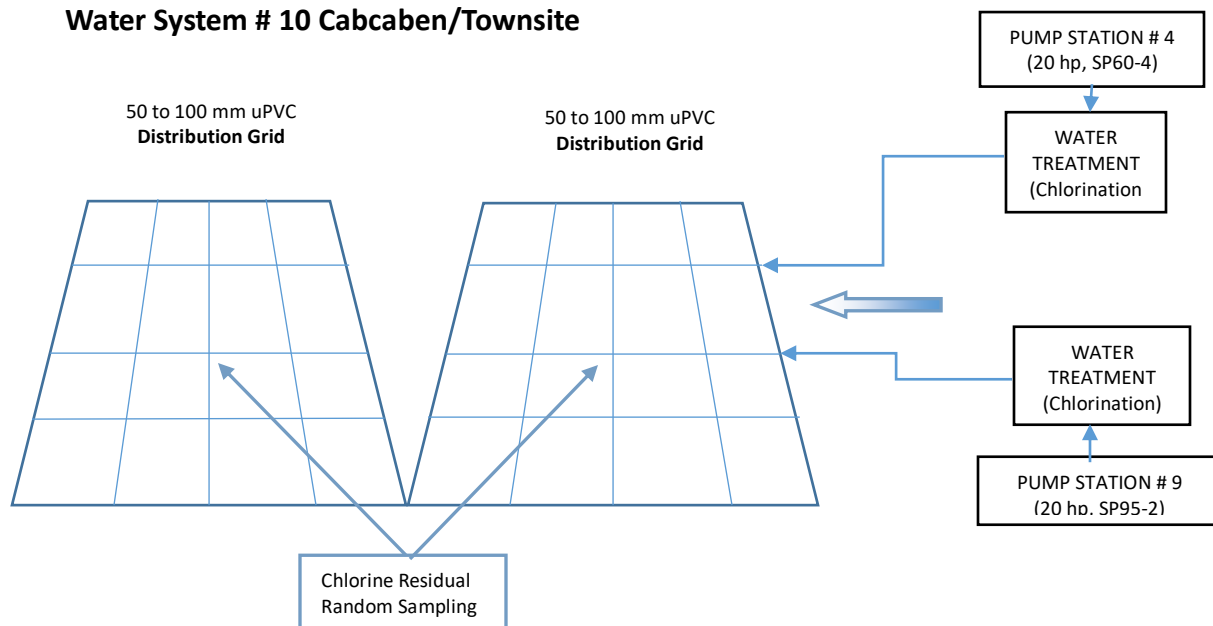
### Water System # 8 Fatima



### Water System # 9 Mt View Resort

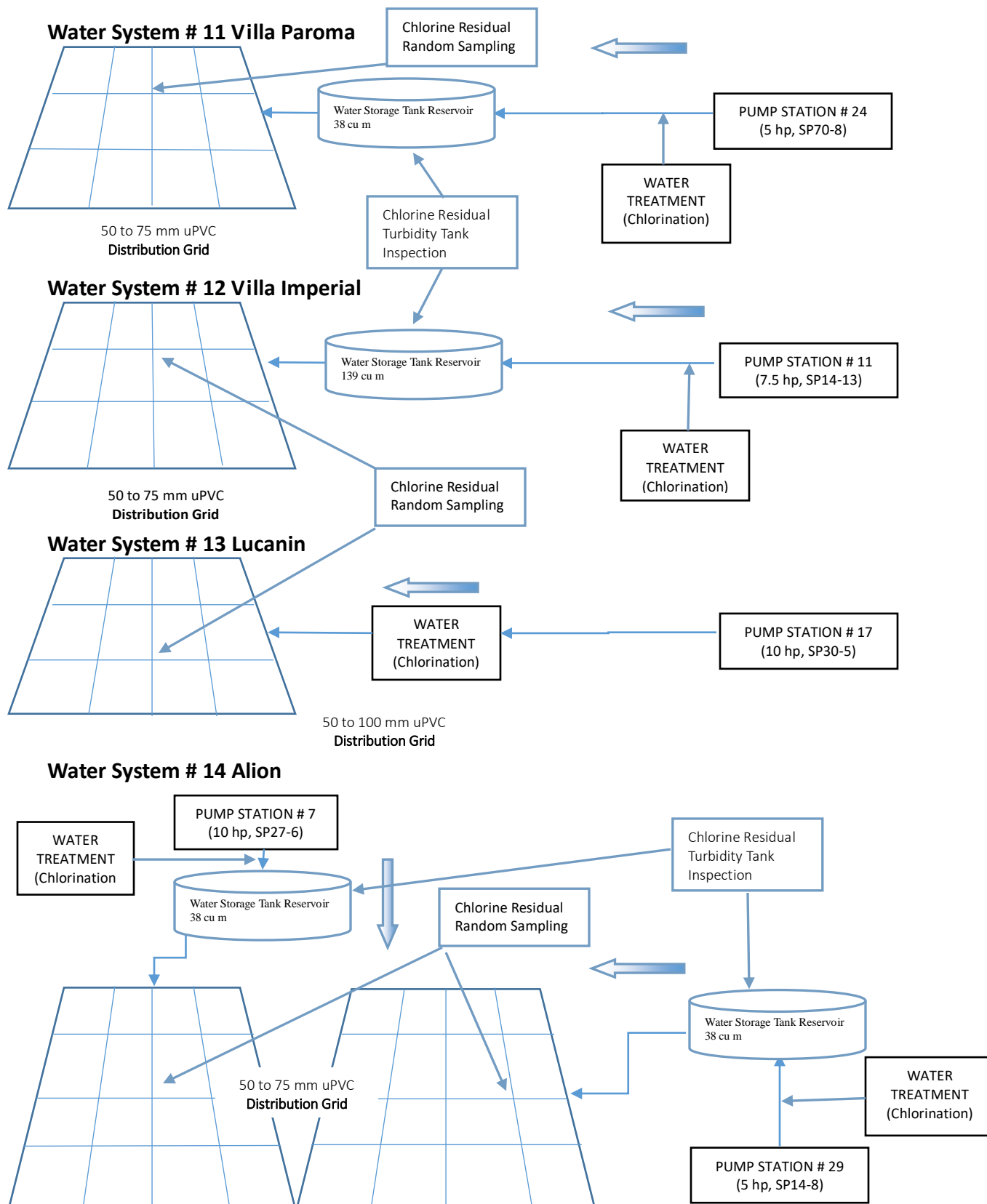


### Water System # 10 Cabcaben/Townsite





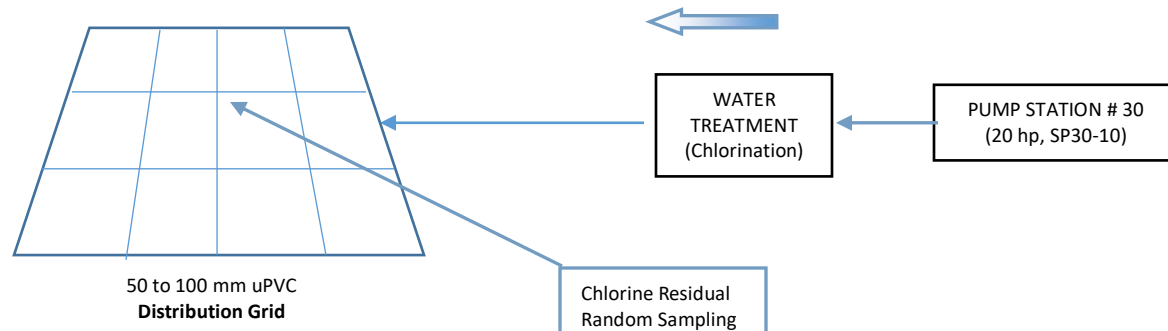
## WATER SAFETY PLAN MANUAL



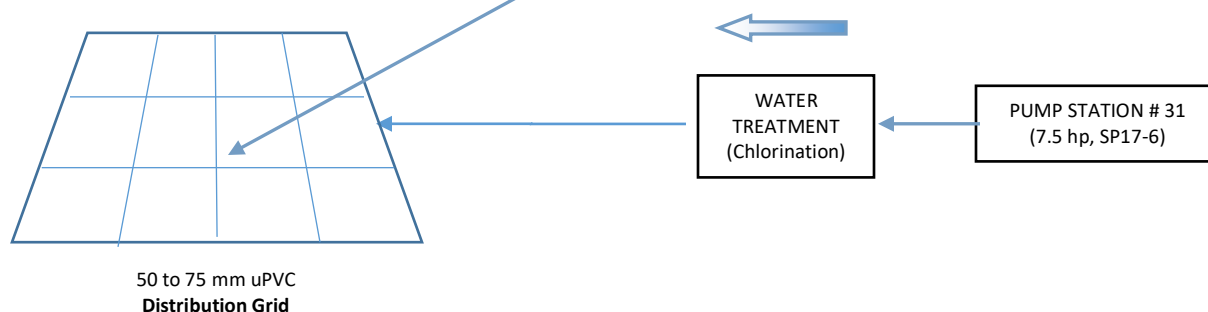


## WATER SAFETY PLAN MANUAL

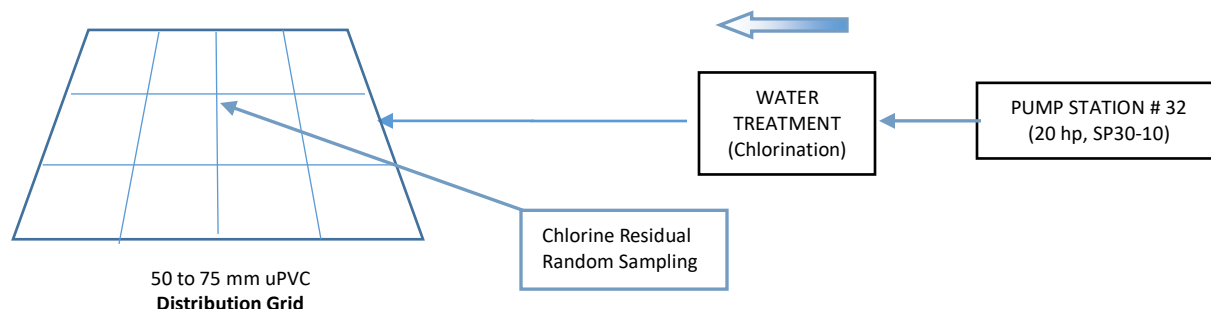
### Water System # 15 Argonza



### Water System # 16 Sitio Mabuhay



### Water System # 17 Phase 9



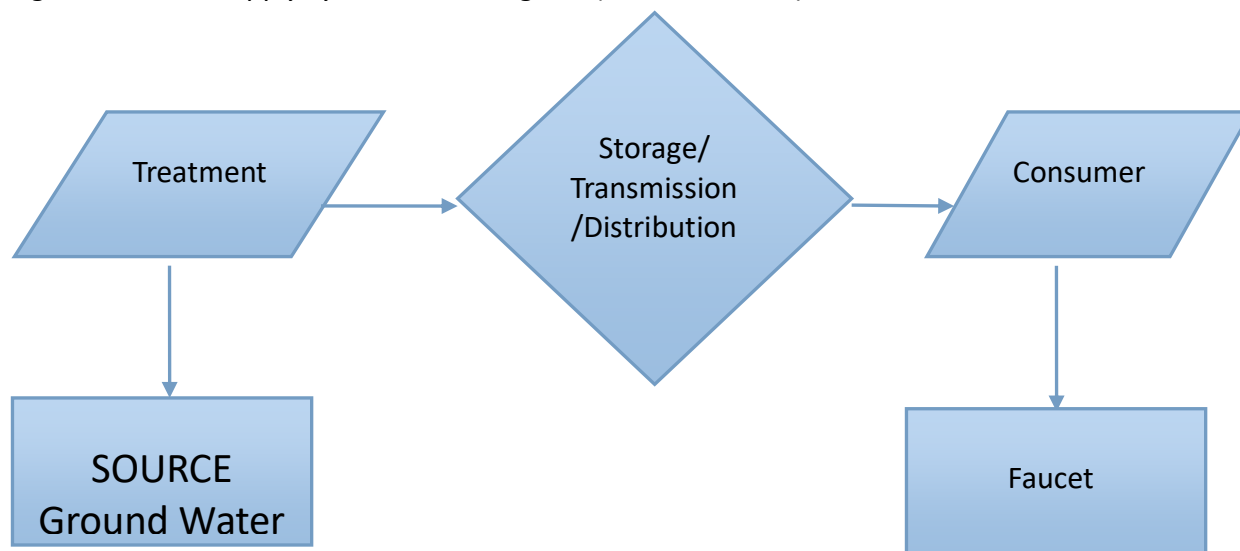
## B. Process Flow Diagram of Water Supply Systems

The seventeen (17) water supply systems were assessed according through the field of surveys and system maps from one and/or different sources to the consumers. The systems were categorized into four processes, which are the basic elements of a water supply system as shown below:



## WATER SAFETY PLAN MANUAL

*Figure 2: Water Supply System Flow Diagram (Basic Elements)*



The systems were further expounded by accurately illustrating a flow diagram from source to customers, which is the main guide for identifying hazards, risks, and control measures. Given the relative size of MARIWAD's water supply, the basic elements (or processes) are divided into sections through the use of standard engineering flow diagram symbols as shown in the following figures (3.1 – 3.17) for water supply systems of MARIWAD:

*Figure 3.1 PROCESS FLOW DIAGRAM – Town Proper Water Supply System # 1*

Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Stations No's: 1 porto del sol 1, 2 vista grande, 8 Milarosa 1, 10 Camaya, 19 Milagrosa 2, 21 Parca, 28 porto del sol 2		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
STORAGE	Reservoirs: Concrete Ground Tank at PS#2 vista grande  Monitoring: Chlorine residual		Production Division Maintenance Division (Pumping operation and Chlorine residual monitoring)



## WATER SAFETY PLAN MANUAL

DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)

*Figure 3.2 PROCESS FLOW DIAGRAM – Karagatan Water Supply System # 2*

Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Stations No's: 20 Karagatan 1, 25 Karagatan 2		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Filtration System (Removal of Iron, Manganese, Color and Odor)  Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)



## WATER SAFETY PLAN MANUAL

*Figure 3.3 PROCESS FLOW DIAGRAM – Alas-asin Water Supply System # 3*

Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Stations No's: 15 Alas-asin 1, 18 Alas-asin 2, 26 Alas-asin 3		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)


*Figure 3.4 PROCESS FLOW DIAGRAM – Sitio Bakery Water Supply System # 4*

Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 22 Sitio Bakery		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)


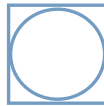
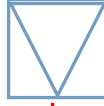
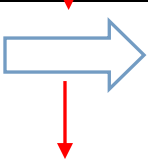
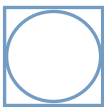





## WATER SAFETY PLAN MANUAL

CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)
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*Figure 3.5 PROCESS FLOW DIAGRAM – Golden Heights Water Supply System # 5*

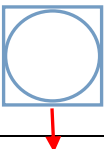
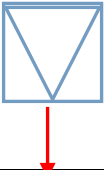
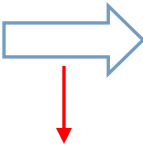
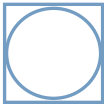
Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 16 Golden Heights		Production Division (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division (Chlorine Dosage Control and Monitoring)
STORAGE	Reservoirs: Elevated Steel Tank at PS#16 Golden Hts  Monitoring: Chlorine residual		Production Division Maintenance Division (Pumping operation and Chlorine residual monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)

*Figure 3.6 PROCESS FLOW DIAGRAM – Mt View Water Supply System # 6*

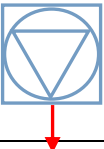
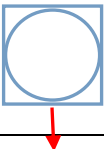
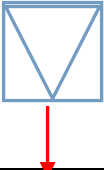
Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 3 Mt view		Production Division (Pump operation and Water Quality Monitoring)



## WATER SAFETY PLAN MANUAL

TREATMENT	Chlorination (Injected via chlorinator)		Production Division (Chlorine Dosage Control and Monitoring)
STORAGE	Reservoirs: Elevated Steel Tank at PS#3 Mt View  Monitoring: Chlorine residual		Production Division Maintenance Division (Pumping operation and Chlorine residual monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)

*Figure 3.7 PROCESS FLOW DIAGRAM – Polaris Water Supply System # 7*

Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 5 Polaris		Production Division (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division (Chlorine Dosage Control and Monitoring)
STORAGE	Reservoirs: Elevated Steel Tank at PS#5 Polaris  Monitoring: Chlorine residual		Production Division Maintenance Division (Pumping operation and Chlorine residual monitoring)



## WATER SAFETY PLAN MANUAL

DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)



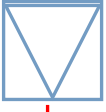
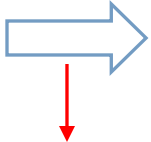
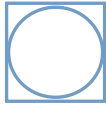
*Figure 3.8 PROCESS FLOW DIAGRAM – Fatima Water Supply System # 8*

Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 27 Fatima Hts		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)

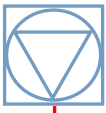
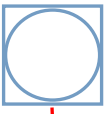


## WATER SAFETY PLAN MANUAL

*Figure 3.9 PROCESS FLOW DIAGRAM – Mt View Resort Water Supply System # 9*

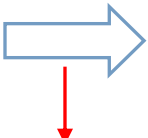
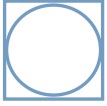
Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 6 Mt View Resort		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
STORAGE	Reservoirs: Elevated Steel Tank at PS#6 Mt view resort  Monitoring: Chlorine residual		Production Division Maintenance Division (Pumping operation and Chlorine residual monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)

*Figure 3.10 PROCESS FLOW DIAGRAM – Cabcaban/Townsite Water Supply System # 10*

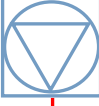
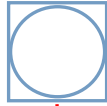

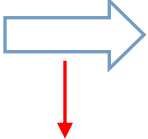
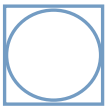
Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Stations No's: 4 Cabcaban, 9 Pambuco		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)



## WATER SAFETY PLAN MANUAL

DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)


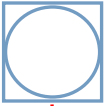

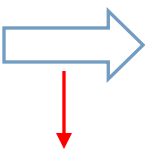
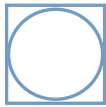
*Figure 3.11 PROCESS FLOW DIAGRAM – Villa Paroma Water Supply System # 11*

Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 24 Villa Paroma		Production Division (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division (Chlorine Dosage Control and Monitoring)
STORAGE	Reservoirs: Elevated Steel Tank at PS#24 Villa Paroma  Monitoring: Chlorine residual		Production Division Maintenance Division (Pumping operation and Chlorine residual monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)


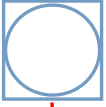


## WATER SAFETY PLAN MANUAL

*Figure 3.12 PROCESS FLOW DIAGRAM – Villa Imperial Water Supply System # 12*

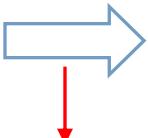
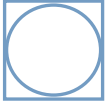
Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 11 Villa Imperial		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
STORAGE	Reservoirs: Elevated Steel Tank at PS#11 Villa Imperial  Monitoring: Chlorine residual		Production Division Maintenance Division (Pumping operation and Chlorine residual monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)

*Figure 3.13 PROCESS FLOW DIAGRAM – Lucanin Water Supply System # 13*

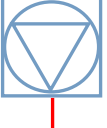
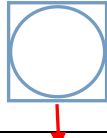
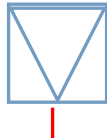
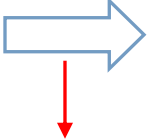
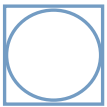
Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 17 Lucanin		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)



## WATER SAFETY PLAN MANUAL

DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)

*Figure 3.14 PROCESS FLOW DIAGRAM – Alion Water Supply System # 14*

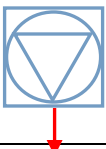
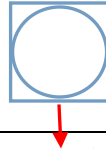
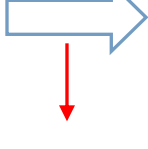
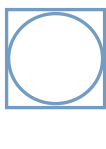
Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Stations No's: 7 Alion 1, 29 Alion 2		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
STORAGE	Reservoirs: Elevated Steel Tank at PS#7 Alion 1 & PS#29 Alion 2  Monitoring: Chlorine residual		Production Division Maintenance Division (Pumping operation and Chlorine residual monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection)  Production Division (Treated water quality monitoring)



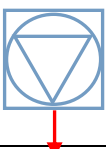
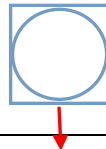
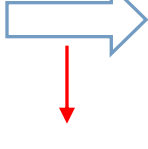
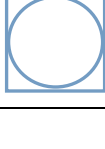


## WATER SAFETY PLAN MANUAL

*Figure 3.15 PROCESS FLOW DIAGRAM – Argonza Water Supply System # 15*

Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 30 Argonza		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection) Production Division (Treated water quality monitoring)

*Figure 3.16 PROCESS FLOW DIAGRAM – Sitio Mabuhay Water Supply System # 16*


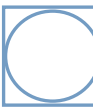

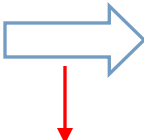
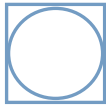
Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 31 Sitio Mabuhay		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Commercial Establishments, Schools and Government		Commercial Services Division (Installation of new service connection)



## WATER SAFETY PLAN MANUAL

	Monitoring: Treated Water Quality		Production Division (Treated water quality monitoring)
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*Figure 3.17 PROCESS FLOW DIAGRAM – Phase 9 Water Supply System # 17*

Process Steps	Sections	Flow Diagram	Responsibility
SOURCE	Pump Station No: 32 Phase 9		Production Division  (Pump operation and Water Quality Monitoring)
TREATMENT	Chlorination (Injected via chlorinator)		Production Division  (Chlorine Dosage Control and Monitoring)
STORAGE	Reservoirs: Elevated Steel Tank at PS#32 Phase 9  Monitoring: Chlorine residual		Production Division Maintenance Division (Pumping operation and Chlorine residual monitoring)
DISTRIBUTION	Treated Water Transfer		Construction & Maintenance Division (Leak Repair and Maintenance, Valve Management)
CUSTOMER	Household, Government  Monitoring: Treated Water Quality		Commercial Services Division (Installation of new service connection) Production Division (Treated water quality monitoring)

Mariveles Water District has a total of twenty eight (28) Deep Wells in operation serving seventeen (17) separate water systems. Water production of MARIWAD comes entirely from deep wells. The table below shows the summary of the seventeen (17) water systems with the corresponding water sources and the Barangays or areas covered.



## WATER SAFETY PLAN MANUAL

**Table 3: Summary of MARIWAD water systems**

SYSTEM	WATER SOURCES	BRGY/AREA COVERED
Water System # 1 Town Proper of Mariveles	PS # 1 Porto del Sol 1 PS # 2 Vista Grande PS # 8 Milagrosa 1 PS # 10 Zone 6 PS # 19 Milagrosa 2 PS # 21 Sitio Parca PS # 28 Porto del Sol 2	Brgy. Balon, Brgy. Poblacion, Brgy. San Carlos, Brgy. San Isidro, Brgy. Camaya, and Brgy. Ipag
Water System # 2 Karagatan	PS # 20 Karagatan 1 PS # 25 Karagatan 2	Brgy. Baseco, Brgy. Sisiman, Sitio E-road (brgy alas-asin), Karagatan Village (brgy alas-asin) and Palao Subdivision (brgy baseco)
Water System # 3 Alas-asin	PS # 12 Alas-asin old PS # 15 Alas-asin 1 (Tarak) PS # 18 Alas-asin 2 (RBC) PS # 26 Alas-asin 3	Brgy. Alas-asin (Brgy Proper)
Water System # 4 Sitio Bakery	PS # 22 Sitio Bakery	Sitio Bakery, Verapaz Subd. (brgy Alas-asin) and Sitio Jericho (brgy Mt View)
Water System # 5 Golden Heights	PS # 16 Golden Heights	Golden Hts Subd., Sitio Pag-asa, Sitio Sto Nino, Portion of Sitio Jericho, (all are in bgry mt view)
Water System # 6 Mt View	PS # 3 Mt View	Mt View Subdivision (Brgy Mt View)
Water System # 7 Polaris	PS # 5 Polaris	Polaris Subdivision and Sitio Libanan (are in brgy mt view)
Water System # 8 Fatima	PS # 27 Fatima	Upper and Lower Balandasan, Samaria Heights, and Villa Carmen (are in brgy mt view)
Water System # 9 Mt View Resort	PS # 6 Mt View Resort	Mt View Resort Subdivision (brgy mt view)
Water System # 10 Cabcaben/Townsite	PS # 4 Cabcaben PS # 9 Pambuco	Barangay Cabcaben and Barangay Townsite
Water System # 11 Paroma	PS # 24 Villa Paroma	Villa Paroma Subdivision (Brgy Cabcaben)
Water System # 12 Imperial	PS # 11 Villa Imperial	Villa Imperial Subdivision (brgy Lucanin)
Water System # 13 Lucanin	PS # 17 Lucanin	Barangay Lucanin
Water System # 14 Alion	PS # 7 Alion 1 PS # 29 Alion 2	Barangay Alion
Water System # 15 Argonza	PS # 30 Argonza	Dona Adela Subd., Nazareth Subd. and Sitio Argonza (Brgy Mt View)
Water System # 16 Mabuhay	PS # 31 Sitio Mabuhay	Sitio Mabuhay (Brgy Cabcaben)
Water System # 17 Phase 9	PS # 32 Phase 9	Phase 9 (Brgy Mt View)

The seventeen (17) water systems were assessed according through the field of surveys and system maps to the interconnection of the transmission and distribution lines supplied by one and/or different sources to the consumers.

- System 1 covers the Town Proper of Mariveles, which includes Six (6) barangays, supplied by seven (7) pumping stations.
- System 2 supplies Barangay's Baseco, Sisiman and part of Alas-asin and two (2) Pumping Station is supplying the area,



## WATER SAFETY PLAN MANUAL

- System 3 is in Barangay Alas-asin Proper with Three (3) Pumping Station as the source,
- System 4 covers part of Barangay Alas-asin and Barangay Mt View where Pumping Station of Sitio Bakery is the source.
- Systems 5, 6, 7, 8, 9 and 15 are also independent distribution system which covers Barangay Mt View with Pumping Stations Golden Hts, Mt View, Polaris, Mt view Resort, Fatima and Argonza supplying the Barangays and Subdivision respectively.
- System 10 is an interconnection of two (2) Pumping Stations namely Cabcaben and Pambuco wherein these water sources supply two (2) barangays (Cabcaben and Townsite),
- System 11 supplied the Villa Paroma Subdivision through its water source at the Subdivion (part of Brgy Cabcaben),
- System 12 supplied the Villa Imperial Subdivision through its water source at the Subdivion (part of Brgy Lucanin),
- System 13 in Brgy Lucanin was supplied by only one (1) pumping station in Lucanin and
- System 14 in Barangay Alion it was supplied by two (2) pumping station in Alion,
- System 16 supplied the Sitio Mabuhay through its water source (part of Brgy Cabcaben)
- System 17 supplied the Phase 9 through its water source (part of Brgy Mt View)

**Table 4: Mariveles Water District's ISO Procedures (Engineering Department Process Flow)**

Item	Title of ISO Procedure	Document No.	Department/Division
1	Water Disinfection Process	P-EPD-01	Production Division
2	Water Extraction Process	P-EPD-02	Production Division
3	Water System Maintenance	P-EMD-01	Maintenance Division
4	Water Meter Calibration	P-EMD-02	Maintenance Division
5	Leak Detection and Repair	WI-EMD-01	Maintenance Division
6	Corrosion Prevention (by paintings)	WI-EMD-02	Maintenance Division
7	Service Connection Installation	WI-EMD-03	Maintenance Division
8	Flushing	F-EMD-02-00	Maintenance Division
9	Tank Preventive Maintenance Checklist	F-EMD-05-00	Maintenance Division
10	Generator Weekly Checklist	F-EMD-06-01	Maintenance Division
11	Hydrants/Exposed Pipes PM Checklist	F-EMD-07-00	Maintenance Division
12	Generator Electrical Maint Checklist	F-EMD-10-00	Maintenance Division
13	Flushing (upper)Weekly Checklist	F-EMD-11-00	Maintenance Division
14	Daily Chlorine Residual Monitoring	F-EPD-07-00	Production Division
15	Chlorine Residual Form	F-EPD-08-00	Production Division
16	Filtration System Weekly Checklist	F-EPD-09-00	Production Division
17	Dosing Pump Weekly Checklist	F-EPD-10-00	Production Division

**Table 5: Mariveles Water District's Information**

Item	Description	Quantity	Units	Remarks
1	Ground Water Source (Deep Well Source)	29	Units	As of 2023
2	Pump Station	28	Units	As of 2023
3	In-line Booster Pumps	1	Units	As of 2023
4	Ground Reservoir	1	Unit	As of 2023
5	Elevated Steel Tank	10	Units	As of 2023



## WATER SAFETY PLAN MANUAL

6	Generator Sets	25	Units	As of 2023
7	Total Area of Mariveles, Bataan	59.42	Sq miles	
8	Total Population of Mariveles, Bataan	167,568	People	As of 2021

### WATER SUPPLY AND PROCESS DESCRIPTION

#### GROUND WATER SOURCE/DEEP WELL WATER SOURCE

Mariveles Water District abundant water supply comes from ground water or deep wells.

The potable water serves to the consumer public comes from twenty seven (28) deep wells distributed in seventeen (17) independent/separate water system. Production facilities include one (1) in-line booster pump and eleven (11) reservoir while transmission and distribution lines extend up to 98,214 linear metres ranging from 50 mm. diameter to 250 mm. diameter in size.







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**Table 6: Deep well Locations**

	LOCATION	LONGITUDE	LATITUDE	GRD ELEV	DEPTH	CASING DIA
PS1	Porto del sol 1	120°27'56.48"	14°26'37.66"	27 m	41 m	350 mm
PS2	Vista Grande	120°28'29.00"	14°26'36.00"	71 m	139 m	300 mm
PS3	Mt View	120°34'29.74"	14°27'25.51	59 m	143 m	250 mm
PS4	Cabcaban	120°35'18.78"	14°27'29.65	16 m	76 m	300 mm
PS5	Polaris	120°34'33.46"	14°26'58.25"	51 m	108 m	300 mm
PS6	MV Resort	120°34'54.13"	14°26'43.35"	22 m	77 m	250 mm
PS7	Alion 1	120°34'38.37"	14°29'35.24"	138 m	123 m	250 mm
PS8	Milagrosa 1	120°27'54.00"	14°27'12.00"	78 m	152 m	300 mm
PS9	Pambuco	120°35'11.00"	14°27'42.00"	15 m	136 m	250 mm
PS10	Camaya	120°28'46.00"	14°26'42.00"	31 m	96 m	250 mm
PS11	V. Imperial	120°35'43.00"	14°28'05.00"	24 m	32 m	150 mm
PS15	Alas-asin 1	120°31'45.15"	14°27'47.13"	281 m	225 m	250 mm
PS16	Golden Hts	120°34'05.11"	14°27'10.30"	85 m	117 m	200 mm
PS17	Lucanin	120°36'09.14"	14°28'49.96"	31 m	150 m	200 mm
PS18	Alas-asin 2	120°32'29.61"	14°27'36.10"	208 m	220 m	200 mm
PS19	Milagrosa 2	120°27'59.05"	14°26'50.91"	65 m	145 m	250 mm
PS20	Karagatan 1	120°31'27.79"	14°26'37.66"	153 m	138 m	200 mm
PS21	Sitio Parca	120°29'05.61"	14°26'40.16"	99 m	200 m	200 mm
PS22	Sitio Bakery	120°33'17.07"	14°27'23.29"	145 m	175 m	200 mm
PS24	Villa Paroma	120°34'59.43"	14°27'35.66"	45 m	120 m	200 mm
PS25	Karagatan 2	120°31'23.96"	14°26'47.23"	169 m	200 m	200 mm
PS26	Alas-asin 3	120°31'37.12"	14°27'29.00"	248 m	220 m	200 mm
PS27	Fatima	120°34'55.56"	14°27'01.95"	34 m	120 m	200 mm
PS28	Porto del sol 2	120°28'01.99"	14°26'27.65"	27 m	60 m	250 mm
PS29	Alion 2	120°34'43.00"	14°29'22.38"	140 m	120 m	200 mm
PS30	Argonza	120°33'58.92"	14°27'27.59"	105 m	150 m	200 mm
PS31	Sitio Mabuhay	120°34'47.29"	14°27'32.74"	43 m	120 m	200 mm
PS32	Phase 9	120°34'06.11"	14°27'01.89"	84 m	152 m	150 mm



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### STORAGE TANK/RESERVOIR

Water from Deep Wells is disinfected before stored in a large reservoir for distribution. The reservoirs of town Proper and Mt view village operates floating on the line while those of Brgy. Sisiman, Verapaz Subdivision, Phase 9, Golden Hts Subdivision, Polaris Subdivision, Mt View Resort Subdivision, Mt View Subdivision, Villa Paroma Subdivision, Villa Imperial Subdivision and Brgy Alion operates on a fill and draw basis. MARIWAD has Ten (10) elevated Steel tanks; one (1) ground concrete reservoirs:

1. Ground Concrete Reservoir at Town Proper with 500 cubic meter capacity
2. Elevated Steel Tank at Verapaz Subd. with 139 cubic meter capacity
3. Elevated Steel Tank at Golden Hts Subd. with 68 cubic meter capacity
4. Elevated Steel Tank at Mt View Vill Subd. with 95 cubic meter capacity
5. Elevated Steel Tank at Polaris Subd. with 68 cubic meter capacity
6. Elevated Steel Tank at Mt View Resort Subd. with 139 cubic meter capacity
7. Elevated Steel Tank at Villa Paroma with 38 cubic meter capacity
8. Elevated Steel Tank at Villa Imperial Subd. with 139 cubic meter capacity
9. Elevated Steel Tank at Brgy Alion with 38 cubic meter capacity.
10. Elevated Steel Tank at Brgy Alion with 38 cubic meter capacity
11. Elevated Steel Tank at Phase 9, Brgy Mt View with 38 cubic meter capacity



All tanks/reservoirs are monitored 24 hours a day and secured with a perimeter fence to avoid entry of unauthorized personnel. The grounds are cleaned and maintained regularly including catwalks and inlet/outlet pipes. The management are planning to improve the perimeter fence of each tanks/reservoir to strengthen the security on the said area.

### 3.2. INTENDED USERS AND USES OF WATER SUPPLY

Mariwad supplies water for direct and general consumption, food preparation, personal





## WATER SAFETY PLAN MANUAL

hygiene, clothes washing and other households and commercial activities of the people of Mariveles, Bataan. Water is provided to the population of the fourteen Barangays including Sitio's and Subdivisions in the area of Mariveles, Bataan. The consumers for Mariveles Water District fall into several categories; Commercial (including schools, hospitals, dental and medical clinics), government and residential users. As of March 2023, there are 20,340 total connections classified as 13,833 residential, 50 government and 6,457 Commercial connections.

Connections	Residential Connections	Government Connections	Commercial Connections
Metered	13,833	50	6,457

### 3.3. WATER TREATMENT PROCESS

A satisfactory supply of potable water must be available to every individual and necessary effort must be done to achieve a drinking water quality as high as practicable. The quality of drinking water may be controlled through a combination of protection of water resources, control of treatment processes and management of the distribution and handling of water. Protection of water sources from contamination is the first line of defense. Failure to provide adequate protection and effective treatment will expose the community to the risk of outbreaks of intestinal and other infectious diseases and other water-related diseases too. The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from source to consumer.

The implementation of water treatment is strictly implemented since the start of Mariveles Water District's operation as required by LWUA. Disinfection/Chlorination is the process used by MARIWAD for disinfecting the water extracted from the well (ground water source). The gas chlorine (99%) was the primary disinfection method used for water treatment by MARIWAD from the start of its operation. In 2005, the shift of disinfection method started by using 70% Calcium Hypochlorite chlorine granules and 10% Stabilize Chlorine Dioxide Powder due to hazard on handling of gas chlorine. Calcium Hypochlorite chlorine granules and 10% Stabilize Chlorine Dioxide Powder is being diluted to water into the container and injected into the water thru a chemical dosing pump (hypo chlorinator – automatic operation) that gives a constant and regulated amount of chlorine solution, as required. Chlorine residual was maintained at each pump station and being monitored by the operator on duty and is also being checked by the inspector (water sampling) at the end point (distribution) with an average of at least 0.3 mg/L of residual chlorine.



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### Maintenance Procedure

Flushing of Blow-off valves and hydrants is done regularly; weekly at water system # 1, monthly for water system # 2, 3, 4, 6, 7, 8, 10, 11, 12, and twice a month for water system # 5 and 9. Cleaning of reservoir is being carried out four (4) times a year. Backwashing of Filtration system is done twice (2x) a week.

### 3.4. WATER QUALITY MONITORING

Water Quality is regularly/constantly (daily) monitored in the distribution line (especially at ends) by the inspector and operators (through test kits - field testing of chlorine residual presence) and on every Pump Stations by the operator on duty (24 hours every shift operator through test kits - on site testing of chlorine residual presence) to make sure that the water is safe and potable. And, also as required by LWUA under Memorandum Circular No. 002-08 monthly Bacteriological Analysis and Twice a year Physical-Chemical Analysis are conducted by Platinum Laboratory (accredited by LWUA) to satisfy safety of water and to ensure the potability of water at the consumer's end (faucet).

### PROCEDURES FOR EXAMINATION OF WATER

- For newly constructed well (ground water source)
  - ◆ Initial examination for physical, chemical and bacteriological examinations of water



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from a newly constructed systems or sources are made before they are operated and opened for public use.

- For existing well (ground water source)
  - ◆ Periodic examination for physical, chemical examinations is conducted in a semi-annual basis.
- For Water supply (from well source to transmission/distribution lines to end user)
  - ◆ Bacteriological examinations is conducted in a monthly basis and semi-annual basis for physical chemical examinations.
- For Consumers Tap (from consumers faucet)
  - ◆ Periodic examination for physical, chemical examinations is conducted in a semi-annual basis.

The three parameters that are examined (by Angeles City Water District laboratory and Platinum Research Laboratory, Inc. - accredited by LWUA) periodically to ensure quality water are:

- i. Residual Chlorine
- ii. Bacteriological Quality Requirement
- iii. Physical and Chemical Quality Requirement

### **WATER QUALITY POLICY AND COMMITMENT**

The Mariveles Water District is committed to provide a safe and reliable potable water to the constituents of Mariveles. To improve, provide and establish the commitment, MARIWAD management adopt the ISO 9001 revised International Standards (ISO 9001:2015 certified since 2018). MARIWAD's vision "The excellence in life of Mariveles consumers emanates from MARIWAD by providing a sustainable and self-reliant water service". MARIWAD's mission "to provide the highest level of water service at the lowest cost to Mariveles consumers and to enhance the quality of life through a convenient living by providing an efficient, responsive and abundant supply of clean and potable water". MARIWAD's core values "unity, dedicated, reliable and transparent". This commitment is coupled with a greater responsibility of protecting public health and safety through a reliable delivery of potable water.

As an ISO 9001:2015 certified, MARIWAD is strictly committed to:

1. Comply with the government mandated and internationally accepted standards of drinking water;
2. Manage, maintain and ensure water quality from all points along the water delivery chain – source – distribution – consumers tap;
3. 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;
4. Establish effective monitoring programs to systemically monitor the quality of



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- drinking water and respond to all concerns in a timely manner;
5. Develop contingency and incident plans that will be periodically reviewed and updated; and
  6. Participate in research and development to ensure that MARIWAD is up to date with current standards.

All drinking water supplied by MARIWAD should pass the quality standards set by the Philippine National Standards for Drinking Water (PNSDW). 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 to 0.4ppm for chlorine granules and chlorine dioxide throughout the distribution system. The water quality requirements are listed below:

**Table 7: Mandatory Parameters based on PNSDW 2017 (DOH AO 2017-0010)**

PARAMETER	STANDARD VALUES
<b>MICROBIOLOGICAL</b>	
1. Total Coliform	MTFT: <1.1 MPN/100mL EST: Absent or <1MPN/100mL MFT: <1 total coliform colonies/100mL
2. Thermotolerant Coliform/E-coli	MTFT: <1.1 MPN/100mL EST: Absent or <1MPN/100mL MFT: <1 total coliform colonies/100mL
3. Heterothropic Plate Count (HPC)	<500 CFU/mL
<b>PHYSICAL</b>	
1. Taste	No objectionable taste
2. Odor	No objectionable odor
3. Color (Apparent)	10 Color Units
4. Turbidity	5 NTU
<b>CHEMICAL</b>	
1. Arsenic	< 0.01 mg/L
2. Nitrate	< 50 mg/L
3. Ph	6.5 – 8.5
4. Total Dissolved Solids	< 600 mg/L
<b>RESIDUAL DISINFECTANT</b>	
1. Residual Chlorine	0.3 – 1.5 ppm
2. Chlorine Dioxide	0.2 – 0.4 ppm

- MTFT – Multiple Tube Fermentation Technique, MPN – Most Probable Number
- EST – Enzyme Substrate Test, CFU – Colony Forming Units
- MFT – Membrane Filter Technique, \* should be verified and approved by DOH

### 3.5. DEEP WELL SOURCE ZONE

Below are tables for the identification of area activities within the 30 meter radius away



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from the deep well source.

Item	Evidence History	Yes	No
1	Wildlife intrusion		None
2	Livestock Production		None
3	Use of pesticides	Some of the Deep Well Source	

Item	Existence of	Yes	No
1	agricultural activity	Some of the Deep Well Source	
2	Septic tanks (nearby houses)	Some of the Deep Well Source	
3	Industrial activity		None

### Recharge Area Activities

Major Activities	Distance from Source	Remarks
1 Agriculture (treatment/pesticide)	10-20 meters	Rice fields and vegetable plantation
2 Pasture (poultry/piggery/livestock)	None	
3 Others	10-20 meters	School and houses

### Competing Water Users

Qty/Capacity (lps)

1	Irrigation	Unknown capacity
2	Resorts (Commercial Pools)	Unknown capacity

### CONSUMERS INSTALLATION

Zone	Plumbing Materials				OH Tanks	Alt WS	OHT + AWS	Big Com Est	5 yrs below	5 yrs above
	GI	PVC	PE	PPR						
011	300	200			4			20	100	400
021	120	80			3			10	50	150
031	200	85			2			22	80	205
041	260	110	2		5			30	100	270
051	245	60	2		5			2	50	250
052	260	60	8		10				60	268
061	250	100	6						100	256
062	300	140	35							
063	240	100	5							
064	150	20								
071	170	70	17							
081	250	60	13							
091	360	90	7							
101	130	90	8							
111	140	90	9							
121	361	90								
131	184	79								
132	225	97								
141	330	80	14							
142	350	80	15							
151	400	100	10							
161	180	110	70							
171	127	90	10							
172	178	83	18							
181	190	100	8							
182	143	128	40							
191	323	139								
201	272	116								
211	42	143	6	2		4			17	172



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221	15	37						9	11	42
231	240	100	14							
241	195	80								
251	190	130	5							
261	185	120	4							
271	20	15		15						
311	120	80	14							
321	180	120	6							
331	70	150	50							
332	90	118	104							
351	35	140								
361	263	176								
362	100	30	90							
411	14	15							1	28
421	97	108	41							
511	184	224	103							
521	136	189	84	18						
531	200	180	77							
541	60	23	22							
551	108	87	192							
552	40	70	30							
611	122	97	125							
621	143	165	20							
711	100	87	20							
721	87	130	38							
811	180	97	29							
821	60	20								

OHT - Over Head Tank  
AWS - Alternative Water Source

### 3.6. TRANSMISSION/DISTRIBUTION LINES

The table shows that Town Proper water system is the largest among the independent system. The estimated total pipe length of the MARIWAD Transmission/Distribution network is about 101,244 linear meters with pipe sizes ranging from 50 mm to 250 mm (Materials: Steel Pipe, GI Pipes, uPVC Pipes, ACP Pipes, PB Tubing and PE Tubing). Table 6 below shows the installed pipeline inventory of MARIWAD water distribution system. From this transmission line, water is then distributed to the service areas by primary distribution lines, secondary distribution lines and or the reservoir.

**Table 8: Transmission Distribution Lines**

Item #	WATER SYSTEM	MATERIALS	LENGTH
1	Town Proper  (2012,2013) (2012,2013) (Sitio Parca 2015) (Brgy Ipag 2019)	Steel Pipes (10", 8" 6" 4" 3")	10,645 meters
		uPVC Pipes & PE Tubing	12,730 meters
		uPVC Pipes (6", 4", 3", 2")	4,000 meters
		GI Pipes (4" , 3")	120 meters
		uPVC Pipes (6", 4", 3", 2")	2,300 meters
		uPVC Pipes (4", 3", 2")	1,710 meters
2	Karagatan  (Karagatan 2017)	uPVC Pipes (6", 4", 3", 2")	12,700 meters
		GI Pipes (4", 3")	160 meters
		uPVC Pipes (4", 3")	1,149 meters
3	Alas-asin proper  (2012, 2014, 2016)	uPVC Pipes (8" 6", 4", 3", 2")	8,200 meters
		GI Pipes (4", 3")	100 meters
		uPVC Pipes (4", 2")	2,250 meters
4	Sitio Bakery	uPVC Pipes (6", 4", 3", 2")	2,650 meters

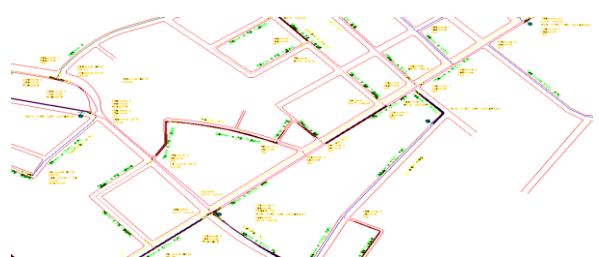
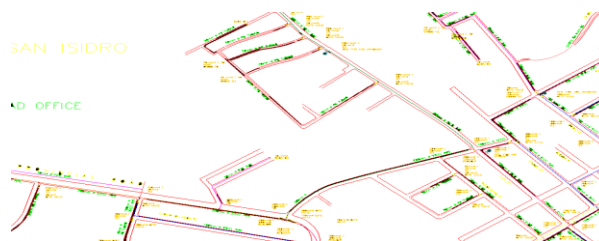
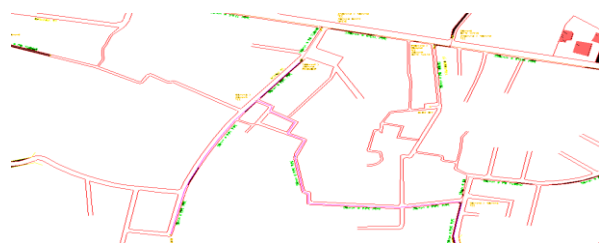




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5	Golden Hts	uPVC Pipes (6", 4", 3", 2")	4,000 meters
		GI Pipes (3", 2")	1,000 meters
6	Mt View	uPVC Pipes (8", 6", 4", 3", 2")	3,900 meters
7	Polaris	uPVC Pipes (6", 4", 3", 2")	4,700 meters
8	Fatima	uPVC Pipes (4", 2")	1,500 meters
9	MV Resort	ACP & uPVC Pipes (4", 3", 2")	1,900 meters
10	Cabcaben/Townsite	uPVC Pipes (8", 6", 4", 3", 2")	7,300 meters
11	Villa Paroma	uPVC Pipes (4", 3", 2")	2,000 meters
12	Villa Imperial	uPVC Pipes (4", 3", 2")	1,900 meters
13	Lucanin	uPVC Pipes (6", 4", 3", 2")	5,600 meters
		GI Pipes (4", 3")	150 meters
14	Alion	GI Pipes & uPVC Pipes (3", 2")	5,550 meters
15	Argonza (2021)	uPVC Pipes (4", 3", 2")	1,000 meters
16	Sitio Mabuhay (2022)	uPVC Pipes (3", 2")	800 meters
17	Phase 9 (2022)	uPVC Pipes (3", 2")	1,230 meters
		TOTAL	101,244 meters

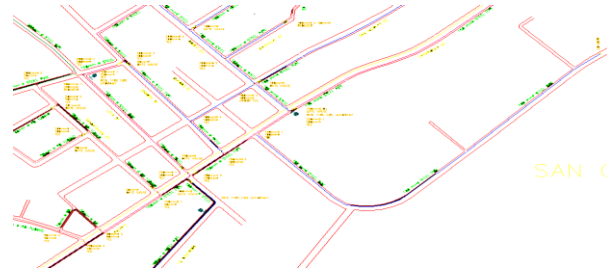
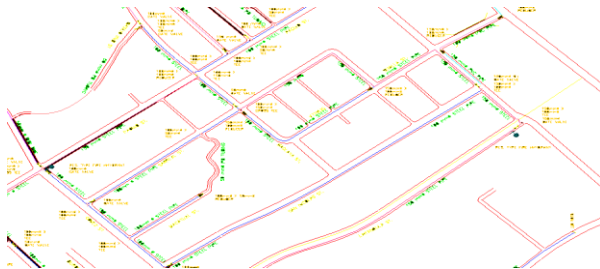
### Town Proper



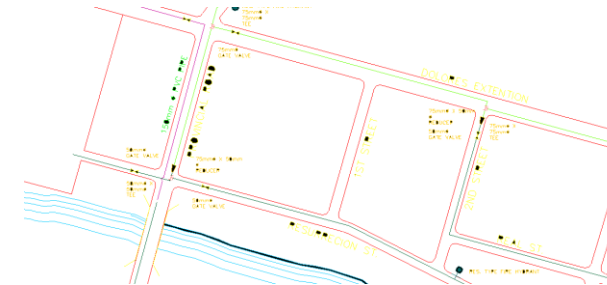
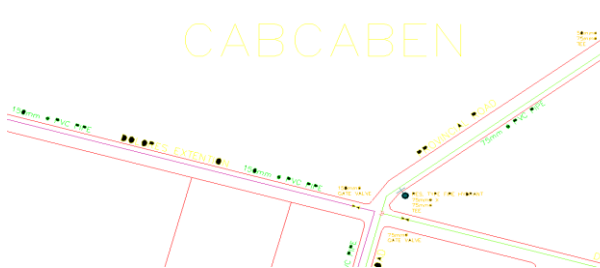
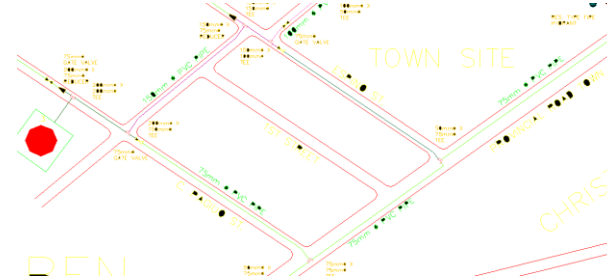
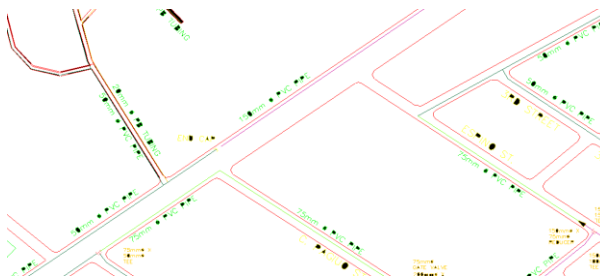




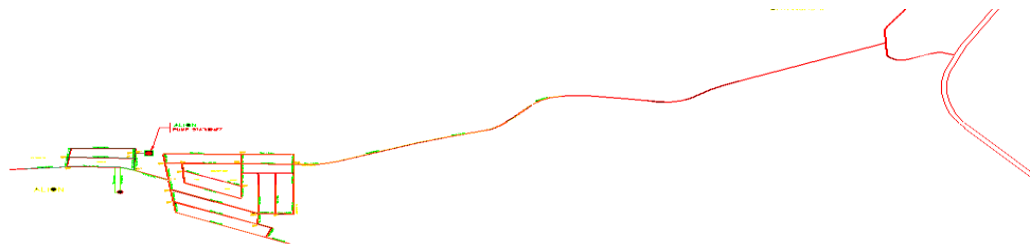
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**Cabcaben**



**Alion**



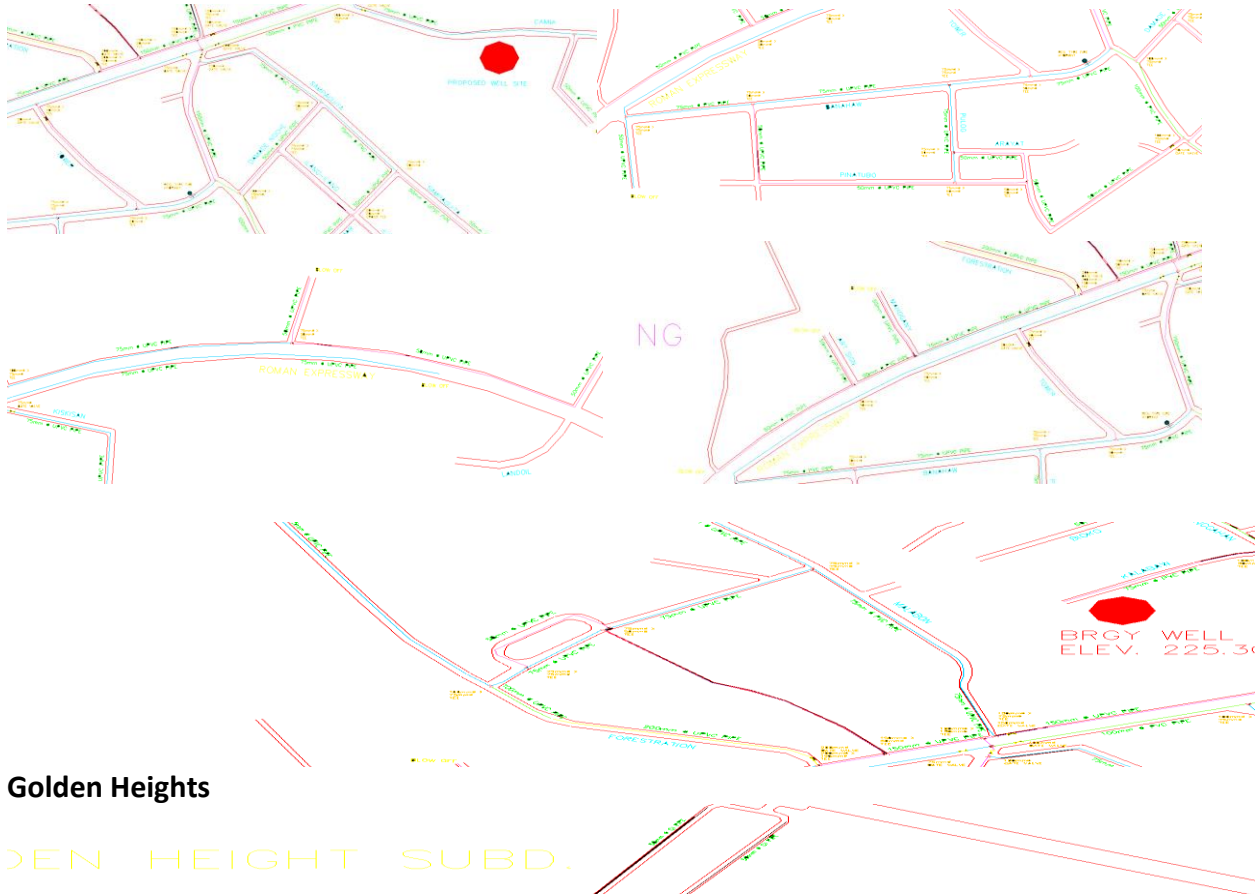


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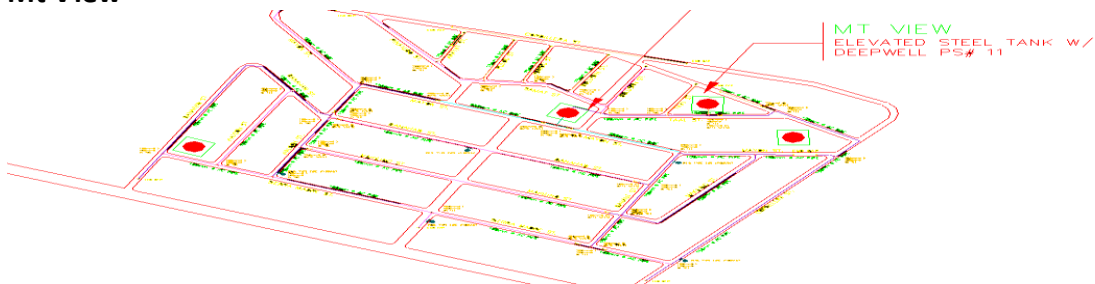


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**Golden Heights**

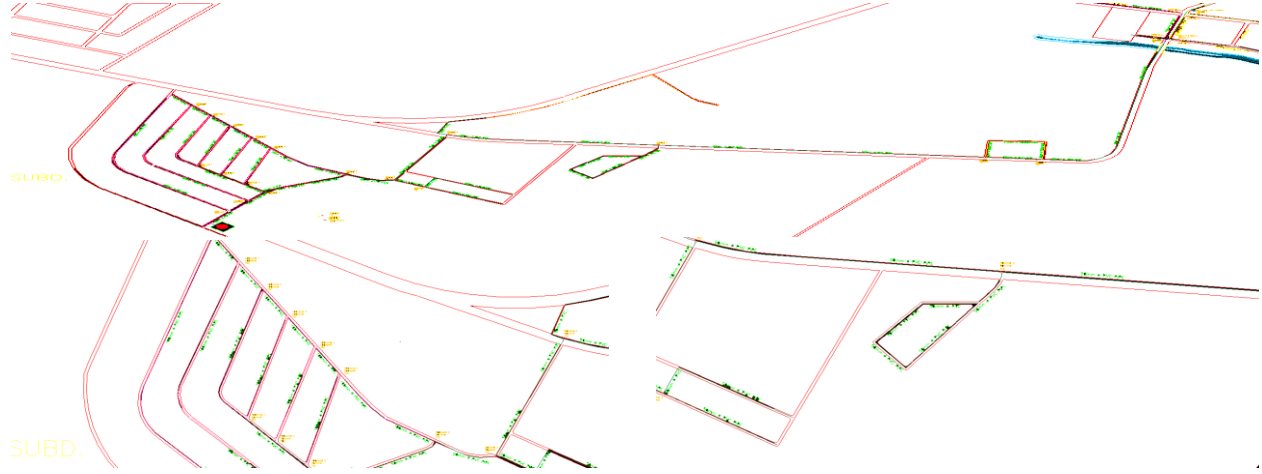
**Mt View**



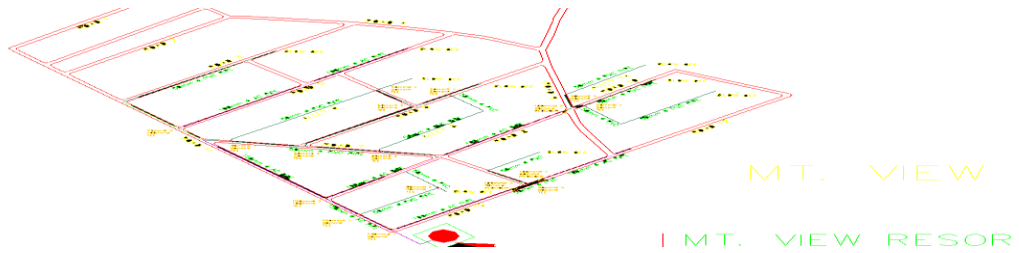


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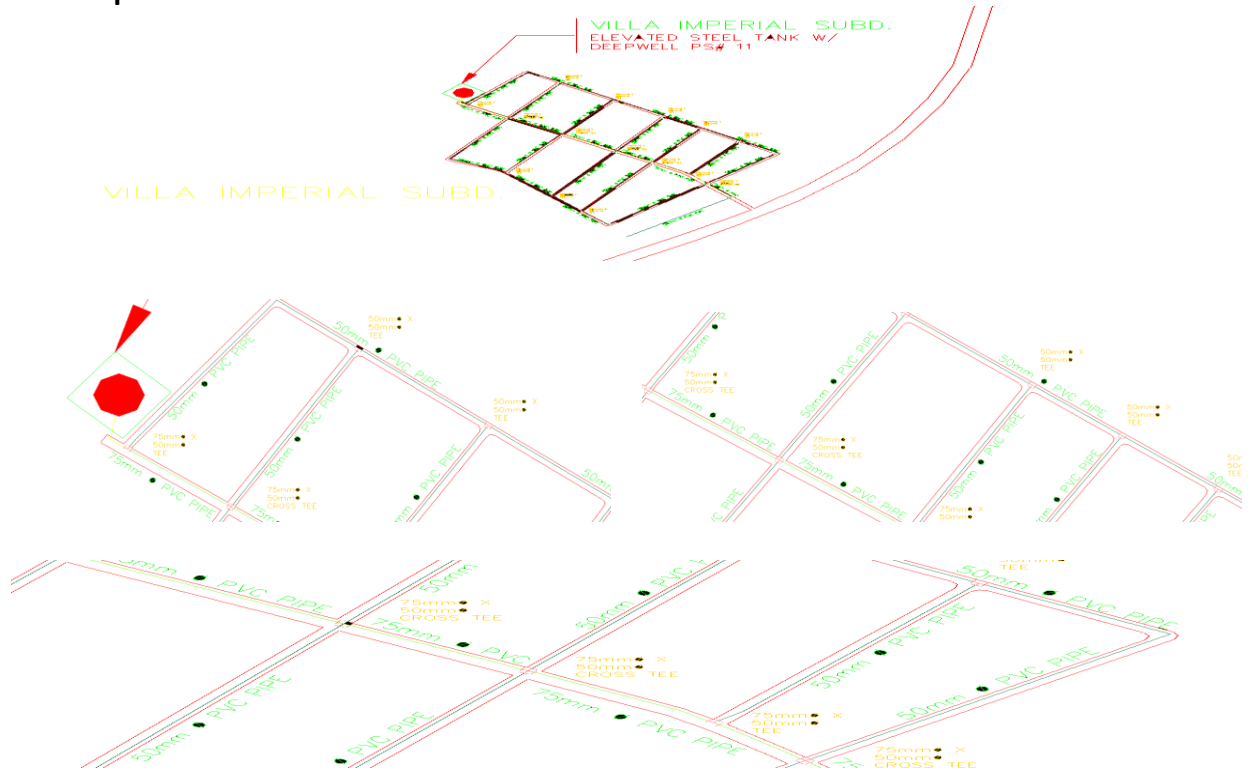
### Polaris



### Mt View Resort



### Villa Imperial





## **WATER SAFETY PLAN MANUAL**

### **4. RISK ASSESSMENT, HAZARD TABLE AND CONTROL MEASURES**

#### **4.1. HAZARD ANALYSIS AND 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 source 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 MARIWAD Water Safety Plan Manual shall include the following:

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

The objective of this Water Safety Plan is to minimize and prevent the contamination of hazards that may enter the water system. For risk assessment methodology, its goal is to determine all types of hazards, specifically: microbial, chemical, and physical. Hazard is defined as any agent that can cause harm to public health. Hazardous event, on the other hand, is any process that introduces hazards to, or fails to remove them from, the water supply.

Risk is the likelihood or probability of the identified hazards that may cause harm to population in a specific time frame and the magnitude and/or consequences of that harm. To obtain the risk, it can either be qualitatively or quantitatively. For this water safety plan, a 5x5 semi-quantitative risk assessment matrix will be used to assess the risks of the water system. To calculate the risk, severity of a certain hazard will be multiplied by the likelihood or frequency of the hazard. To illustrate, equation 1 is provided below:

$$\text{RISK} = \text{likelihood} \times \text{severity}$$

(Equation 1)

Thus the lowest possible risk is 1 and the highest is 25. Risk with score of 10 and above are prioritized for putting in place control measures to prevent the hazardous events from occurring. Table 9 shows the semi-quantitative risk assessment matrix, adopted by MARIWAD in assessing the risk of its water supply system.

Mariwad classified events in which the hazard may be released from the sanitation system which consequently affect human health. For each sanitation step, Mariwad identified the possible hazardous exposure events and its corresponding hazards using the semi-quantitative Risk Matrix table



## WATER SAFETY PLAN MANUAL

**Table 9: Semi-Quantitative Risk matrix Table**

		Severity or Consequence				
		Insignificant No impact None (Rating 1)	Minor Physical (Rating 2)	Moderate Physical - Chemical (Rating 3)	Major Chemical (Rating 4)	Cathastrophic Microbial - Chemical (Rating 5)
Likelihood Frequency	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 5 years (Rating 1)	1	2	3	4	5
Risk Score		1 - 5	6 - 14		15 - 25	
Risk rating		Low	Moderate		High	

Severity ratings, were based on the consequences of the hazardous event. In which microbial hazards are automatically rated 5, chemical hazards are either 4 or 3 depending on whether they are toxic or not, and physical hazards are either 3 or 2 as shown in the following matrix:

**Table 10. Criteria for Severity Ratings for Microbial, Chemical and Physical Hazard**

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	3
Physical	Physical Will make water objectionable and lead to its non-use (e.g. turbidity)	2
	May make water objectionable but may not lead to its non-use	1



## WATER SAFETY PLAN MANUAL

### 4.2. RISK ASSESSMENT OF THE WATER SUPPLY SYSTEM

In identifying the hazards and hazardous events, the WSP Team discussed all possible sources of contaminants from the source – distribution – 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 risk assessment method in order to streamline the list of risks which need priorities. As shown below, describes the risk matrix that the WSP Team used in prioritizing hazardous events which pose the most significant hazards and the highest risks.

The succeeding tables (11.1 – 11.5) show the identified hazards, hazardous events and assessed risks for specific water supply system facilities, presented by process steps, such as, source, treatment, storage, distribution, and consumer.

**Table 11.1: Hazards, Hazardous Events, and Assessed Risks for Specific Water Supply System Facilities at the Source**

HAZARD TYPE	HAZARDOUS EVENT / CAUSE OF CONTAMINATION	WATER SUPPLY SYSTEM	FACILITY	RAW RISK		
				LIKELI HOOD	SEVERI TY	SCORE (RISK)
Micro-Biological	Intrusion of contaminants due to seepage of leachate from nearby septic tanks	#1 Town proper	PS # 1, 2, 10 & 21	1	5	5
		#6 Mt View	PS # 3	1	5	5
		#9 Fatima	PS # 27	1	5	5
		# 10 Cabcaben	PS # 4	1	5	5
Chemical	Intrusion of contaminants during repair of motor, pump, water meter, and other appurtenances	All Water Supply System	All Pump Station	1	4	4
	Intrusion of contaminants due to flooding	#1 Town Proper	PS # 8	3	4	12
Physical	Persistence of color, hardness and TDS due to natural geologic characteristics	All Water Supply System	All Pump Station	1	2	2
	Persistence of iron and manganese due to natural geologic characteristics	#1 Town Proper #2 Karagatan	PS#2 PS#20 & PS#25	2	5	10
	Increase in turbidity due to heavy rain	All Water Supply System	All Pump Station	2	2	4

**Table 11.2: Hazards, Hazardous Events, and Assessed Risks for Specific Water Supply System Facilities at the Treatment**

HAZARD TYPE	HAZARDOUS EVENT / CAUSE OF CONTAMINATION	WATER SUPPLY SYSTEM	FACILITY	RAW RISK		
				LIKELI HOOD	SEVERI TY	SCORE (RISK)
Micro-	Under-dosing of chlorine due to defective auto valve/regulator	All Water Supply System	All Pump Station	2	5	10





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Biological	Under-dosing of chlorine due to insufficient supply of chlorine granules			2	5	10
Micro-Biological	Under dosing of chlorine due to injector clogging	All Water Supply System	All Pump Station	2	5	10
Chemical	Over-dosing of chlorine due to defective auto valve/regulator	All Water Supply System	All Pump Station	2	3	6

**Table 11.3: Hazards, Hazardous Events, and Assessed Risks for Specific Water Supply System Facilities at the Storage**

HAZARD TYPE	HAZARDOUS EVENT / CAUSE OF CONTAMINATION	WATER SUPPLY SYSTEM	FACILITY	RAW RISK		
				LIKELI HOOD	SEVERI TY	SCORE (RISK)
Chemical	Contamination of water due to corroded parts and materials in the reservoir	#1 Town Proper	PS#2	1	3	3
		, #5 Golden Hts	PS#16	1	4	4
		#6 Mt View	PS#3	2	4	8
		# 7 Polaris	PS#5	1	3	3
		#8 Mt View Resort	PS#6	1	4	4
		#11 Villa Paroma	PS#24	1	4	4
		#12 Villa Imperial	PS#11	1	4	4
		#14 Alion	PS#7 & PS#29	1	3	3
		#17 Phase 9	PS#32	1	3	3
	Contamination of water due to accumulated silts inside the reservoir	#1 Town Proper	PS#2	1	3	3
		, #5 Golden Hts	PS#16	1	4	4
		#6 Mt View	PS#3	2	4	8
		# 7 Polaris	PS#5	1	3	3
		#8 Mt View Resort	PS#6	1	4	4
		#11 Villa Paroma	PS#24	1	4	4
		#12 Villa Imperial	PS#11	1	4	4
		#14 Alion	PS#7 & PS#29	1	3	3
		#17 Phase 9	PS#32	1	3	3
Micro-biological	Intrusion of birds, pests, insects, and other waste due to absence or improper covering of air vents, hatches and other openings of the reservoir	All Water Supply System with Storage	All Storage Facility	2	5	10
Physical	Increase turbidity of water due to accumulated silts inside reservoir	All Water Supply System with Storage	All Storage Facility	2	2	4

**Table 11.4: Hazards, Hazardous Events, and Assessed Risks for Specific Water Supply System Facilities at the Distribution**

HAZARD TYPE	HAZARDOUS EVENT / CAUSE OF CONTAMINATION	RAW RISK		
		LIKELI HOOD	SEVERI TY	SCORE (RISK)



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Micro-biological	Entry of contaminated water from drainage canals through leaks in submerged service lines	1	5	5
Micro-biological	Entry of contaminated water through damaged transmission/distribution lines due to natural calamities	1	5	5
	Re-growth of microorganism due to presence of suspended solids long dead ends.	2	5	10
	Re-growth of microorganism due to neglected flushing schedule/improper procedures at the flushing points.	2	5	10
	Inadequate chlorine residual (<0.3 ppm) along dead ends and low pressure zones	3	5	15
	Intrusion of contaminants during leak repairs	1	5	5

**Table 11.5: Hazards, Hazardous Events, and Assessed Risks for Specific Water Supply System Facilities at the Consumers**

HAZARD TYPE	HAZARDOUS EVENT / CAUSE OF CONTAMINATION	RAW RISK		
		LIKELIHOOD	SEVERITY	SCORE (RISK)
Micro-biological	Intrusion of contaminants through pipe cracks or holes during low pressure or water service interruption	1	5	5
	Contamination of water due to improper repair of consumers' pipeline leaks during low pressure or water service interruption	2	5	10
	Contamination of water due to rusty pipes and plumbing fixtures	1	5	5
	Backflow of contaminated water due to defective or absence of check valve	1	5	5
	Entry of contaminants through leaks in service lines submerged in drainage canals	2	5	10
	Intrusion of contaminants due to illegal connection/tapping	1	5	5

### 4.3. RESIDUAL RISK

The very essence of the MARIWAD WSP is to ensure that it provides adequate and safe drinking water to the people of Mariveles. Each step in its water system is revisited to trace the pathways that may lead to contamination of water.

Furthermore, the existing control measures were identified and assessed whether such control measures effectively diminish if not completely eliminate the hazards. Exposure risks were also assessed and prioritized.

## 5. CONTROL MEASURES DETERMINATION AND VALIDATION, RISK ASSESSMENT AND PRIORITIZATION

This chapter specifies the control measures for each hazardous event with high and very high risk (risk scores of 10 and above). Existing control measures are considered ineffective when it fails to lower raw risk to below 10 upon reassessment, in which case, additional or new control measures are proposed. (See tables 12.1 – 12.5)



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### **5.1. CONTROL MEASURES, VALIDATION, RISK REASSESSMENT & PRIORITIZATION**

The existing and potential control measures for each identified hazards from ground water source to consumers water tap are documented by the WSP team. To determine the efficacy of the control measures, the WSP team validates the water supply through site inspection and based on monitoring data.

### **5.2. SIGNIFICANT AND UNCONTROLLED RISK**

To prioritize action for any uncontrolled or ineffectively controlled risk is another important component of WSP. In cases of ineffectively controlled or uncontrolled risk, it is important for the water utility provider to implement short-term, medium-term or long-term activities. Such are important components of a water utility improvement plan. In implementing an improvement plan, it is important that WSP team members conduct an update and regular monitoring of the plan. The team has also to consider the availability of funds and resources.

### **5.3. PROPOSED CONTROL MEASURES**

Identifying control measures that will collectively control identified risks and ensure that the health-based targets are met. For each control measure identified, an appropriate means of operational monitoring should be defined that will ensure that any deviation from required performance is rapidly detected in a timely manner;

The primary objectives of a WSP in ensuring good drinking-water supply practice are the prevention or minimization of contamination of source waters, the reduction or removal of contamination through treatment processes and the prevention of contamination during storage, distribution and handling of drinking-water.

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**Table 12.1: Control Measures, Validation and Reassessed Risks per identified Hazardous Events with High or very High Raw Risk at Source**

HAZARD TYPE	HAZARDOUS EVENT	WATER SUPPLY SYSTEM	FACILITY	RAW RISK			EXISTING CONTROL MEASURE	VALIDATION (Effectiveness of existing control measure)	REASSESSMENT			PROPOSED CONTROL MEASURE
				Likelihood	Severity	Score			Likelihood	Severity	Residual Risk	
Chemical	Intrusion of contaminants due to flooding	# 1 Town Proper	PS#8 Milagrosa 1	3	4	12	Well casing had been tightly sealed; genset, motor controls, and fixtures had been set on elevated location	On-site inspection report  Monthly Accomplishment Report	2	4	8	Periodic source disinfection after the heavy flooding
Physical	Persistence of iron and manganese due to natural geologic characteristics	# 1 Town Proper # 2 Karagatan	PS#2 Vista Grande PS#20 Karagatan 1 PS#25 Karagatan 2	2	5	10	Installation of Filtration system (media filter – removal of iron & manganese) Regular back-washing	<ul style="list-style-type: none"> <li>Monthly Accomplishment Report</li> <li>Back-washing Report</li> </ul>	2	5	10	Rehabilitation or replacement of filtration media

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**Table 12.2: Control Measures, Validation and Reassessed Risks per identified Hazardous Events with High or very High Raw Risk at Treatment**

HAZARD TYPE	HAZARDOUS EVENT	WATER SUPPLY SYSTEM	FACILITY	RAW RISK			EXISTING CONTROL MEASURE	VALIDATION (Effectiveness of existing control measure)	REASSESSMENT			PROPOSED CONTROL MEASURE
				Likelihood	Severity	Score			Likelihood	Severity	Residual Risk	
Micro-biological	Under-dosing of chlorine due to defective auto valve/regulator	All Water Supply System	All pump Stations	2	5	10	Preventive maintenance of chlorinating equipment	<ul style="list-style-type: none"> <li>Records of equipment preventive maintenance</li> <li>Chlorine Residual Test Report</li> </ul>	1	5	5	Provide back-up/ spare of chlorinating equipment
	Under-dosing of chlorine due to insufficient supply of chlorine granules			2	5	10	Provide stocks of chlorine granules	<ul style="list-style-type: none"> <li>Chlorine Residual Test Report</li> <li>Inventory Report</li> </ul>	1	5	5	Monitoring on Residual test report and inventory report
	Under dosing of chlorine due to injector clogging			2	5	10	Preventive maintenance of chlorinating equipment	<ul style="list-style-type: none"> <li>Records of equipment preventive maintenance</li> <li>Chlorine Residual Test Report</li> </ul>	1	5	5	Provide back-up/ spare of chlorinating equipment

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**Table 12.3: Control Measures, Validation and Reassessed Risks per identified Hazardous Events with High or very High Raw Risk at Storage**

HAZARD TYPE	HAZARDOUS EVENT	WATER SUPPLY SYSTEM	FACILITY	RAW RISK			EXISTING CONTROL MEASURE	VALIDATION (Effectiveness of existing control measure)	REASSESSMENT			PROPOSED CONTROL MEASURE
				Likelihood	Severity	Score			Likelihood	Severity	Residual Risk	
Micro-biological	Intrusion of birds, pests, insects, and other waste due to absence or improper covering of air vents, hatches and other openings of the reservoir	All Water Supply System with Storage	All Storage Facility	2	5	10	Keep air vents properly covered with insect screen at all times and close hatchet when not it use Preventive maintenance of facilities	<ul style="list-style-type: none"> <li>On-site inspection report</li> <li>Preventive Maintenance Report</li> </ul>	1	5	5	

 <p style="text-align: center;"> <b>Republic of the Philippines</b>  <b>Mariveles Water District</b>  <b>Mariveles, Bataan</b> </p>	Document No.:	Q-GMO-03-03
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**Table 12.4: Control Measures, Validation and Reassessed Risks per identified Hazardous Events with High or very High Raw Risk at Distribution**

HAZARD TYPE	HAZARDOUS EVENT	WATER SUPPLY SYSTEM	FACILITY	RAW RISK			EXISTING CONTROL MEASURE	VALIDATION (Effectiveness of existing control measure)	REASSESSMENT			PROPOSED CONTROL MEASURE
				Likelihood	Severity	Score			Likelihood	Severity	Residual Risk	
Micro-biological	Re-growth of microorganism due to presence of suspended solids long dead ends.	All Water Supply System	All Distribution Lines	2	5	10	Follow Procedure Manual on System Flushing	• Daily System Flushing Report	2	5	10	Improve procedures on system flushing with strict implementation
	Re-growth of microorganism due to neglected flushing schedule/improper procedures at the flushing points.			2	5	10	Follow Procedure Manual on System Flushing Create schedule of system flushing	• Daily System Flushing Report	2	5	10	
	Inadequate chlorine residual (<0.3 ppm) along dead ends and low pressure zones			3	5	15	Increase chlorine dosage but within allowable level	• Chlorine Residual Test Report	2	5	10	Mobile chlorination and online chlorine analyzer at dead ends and low pressure zones



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**Table 12.5: Control Measures, Validation and Reassessed Risks per identified Hazardous Events with High or very High Raw Risk at Consumer**

HAZARD TYPE	HAZARDOUS EVENT	WATER SUPPLY SYSTEM	RAW RISK			EXISTING CONTROL MEASURE	VALIDATION (Effectiveness of existing control measure)	REASSESSMENT			PROPOSED CONTROL MEASURE
			Likelihood	Severity	Score			Likelihood	Severity	Residual Risk	
Micro-biological	Contamination of water due to improper repair of consumers' pipeline leaks during low pressure or water service interruption	All Water Supply System	2	5	10	No Existing Control Measure		2	5	10	IEC for consumer's on flushing, cross connections, submerged pipes and proper repair and maintenance of consumer's plumbing systems.
	Entry of contaminants through leaks in service lines submerged in drainage canals		2	5	10	No Existing Control Measure		2	5	10	

## IMPROVEMENT PLANS

Based on hazard assessment, improvement plans were developed for those identified as high risks in order to eliminate or control the hazard. Improvement plans can include short, medium or long term programs. These plans should be monitored to confirm improvements have been made and are effective and that WSP has been updated accordingly. As shown below, the improvement plan developed by the WSP Team from source to distribution system.

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**Table 13: Improvement/Upgrade Plans**

WATER SUPPLY SYSTEM	ACTION (Proposed Control Measure)	ARISING FROM (Hazardous Events)	IDENTIFIED SPECIFIC IMPROVEMENT/UPGRADE PLAN	ACCOUNTABILITY	Due	BUDGET	FUNDING SOURCE	STATUS
#1 Town Proper	Periodic source disinfection	Intrusion of contaminants due to flooding	1. Develop well disinfection program 2. Implement source disinfection program	Production Division	2023	50,000.00	Internal	Not yet Started
#1 Town Proper #2 Karagatan	Rehabilitation or replacement of filtration media	High content of iron and manganese, odor and color	Rehabilitation/Replacement of Filter media	Production Division and BAC	2023	500,000.00	Internal	Not yet Started
All Water Supply System	Provide back-up/spare of chlorinating equipment and parts	Under-dosing of chlorine due to defective auto valve/regulator  Under dosing of chlorine due to injector clogging	1. Procurement of chlorinating equipment and parts	Production Division and BAC	2 <sup>nd</sup> Quarter 2023	200,000.00	Internal	On-going
All Water Supply System	Improve procedures on system flushing with strict implementation	Re-growth of microorganism due to presence of suspended solids along dead ends & due to improper procedures on flushing	1. Training of staffs for proper operations including chlorine mixing procedures, system flushing, and chlorine residual testing	Production Division and Construction & Maintenance Division and Inspectors	2 <sup>nd</sup> Quarter 2023	20,000.00	Internal	Not yet Started
All Water Supply System	Mobile chlorination and online chlorine analyzer at dead ends and low pressure zones	Inadequate chlorine residual (<0.3 ppm) along dead ends and low pressure zones	1. Identify and prioritize dead-ends or low pressure zones for installation of chlorine analyzer 2. Install chlorine analyzer as programmed 3. Install chlorine injector provision 4. Procure and use mobile chlorinator	Production Division, Administrative Department and BAC	2026	3 Million	Internal	Not yet Started



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WATER SUPPLY SYSTEM	ACTION (Proposed Control Measure)	ARISING FROM (Hazardous Events)	IDENTIFIED SPECIFIC IMPROVEMENT/UPGRADE PLAN	ACCOUNTABILITY	Due	BUDGET	FUNDING SOURCE	STATUS
All Water Supply System	IEC for consumers on flushing, cross connections, submerged pipes and proper repair and maintenance of consumer's plumbing systems.	Contamination of water due to improper repair of consumers' pipeline leaks during low pres. or water interruption  Entry of contaminants through leaks in service lines submerged in drainage canals	1. Prepare IEC materials to be distributed to customers during MARIWAD events or other means of dissemination  2. Post information materials in social media accounts, website, or any online platforms	Commercial Services Division	2023	20,000.00	Internal	Not yet Started

## 6. OPERATIONAL MONITORING AND CORRECTIVE ACTION

### 6.1. OPERATIONAL MONITORING AND CORRECTIVE ACTION

Operational monitoring includes defining and validating the monitoring of the control measures and establishing procedures to demonstrate that the controls continue to work.

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. As shown below 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.



## WATER SAFETY PLAN MANUAL

**Table 14: Operational Monitoring and Corrective Action**

PROCESS	CONTROL MEASURE	OPERATIONAL LIMIT	CRITICAL LIMIT	WHAT to monitor	WHERE to monitor	WHEN to monitor	HOW to monitor	WHO will monitor	CORRECTIVE ACTION/S
SOURCE	Well casing had been tightly sealed; genset, motor controls, and fixtures had been set on elevated location	No rainfall – Yellow rainfall warning	Orange - Red rainfall warning	Flooding	PS#8 Milagrosa 1	During heavy rains	On-site inspection	Production Division	Extension of well-casing
	Rehabilitation or Replacement of Filtration Media	Water is clear with good pressure	Low pressure to no water	Iron, manganese, odor and color	PS#2 Vista Grande PS#20 Karagatan 1 PS#25 Karagatan 2	Check Daily	Site inspection and water analysis monitoring	Production Division	Regular inspection on open vent covers and Close monitoring on water testing result
	Regular System Flushing and Back washing	Water is Clear		Water Turbidity	All Flushing points (Test Line)	Daily/ Weekly	On-site inspection/ system flushing report	Production Division	Create Schedule of System Flushing
TREATMENT	Preventive Maintenance of chlorinating equipment	All chlorinating equipment are in good condition		Breakdown of Chlorinator	All Chlorinating rooms	Monthly	On-site inspection/ preventive maintenance report	Production Division	Procurement of spare/ back-up of chlorinator
STORAGE	Keep air vents properly covered with insect screen at all times and close hatchet when not in use	All Covers and screens in place and in good condition		All openings	Production wells and Reservoir	Daily	On-site inspection	Production Division	Immediate cover unprotected openings
DISTRIBUTION	Increase chlorine dosage but within allowable level	0.3 – 1.5 ppm	<0.3 ppm	Chlorination	Sources, Flushing points, House hold taps	Daily	Chlorine residual test	Production Division	Adjust Dosage
	Hydro-testing, disinfection of pipelines after installation of new water distribution system	Hydrotest: 100 psi for 24 hrs; Disinfection: 25 ppm for 24 hrs		Hydrotesting, Disinfection of pipelines	Pipelaying projects	Every actual conduct of hydrotest and disinfection	Field Testing	Construction & Maintenance Division	Hydrotest: repair leaks and re-hydrotest Disinfection: adjust chlorine dose as per procedure manual
	Leak Detection and Repair	No un-repaired leaks	Leaks	Main lines and service lines	24 / 7	Leak reports and maintenance order	On-site inspection/ preventive maintenance report	Construction & Maintenance Division	Immediate repair of leaks

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## 7. VERIFICATION

Objective: Confirm that drinking water quality standards are being met, consumers are satisfied and the WSP is complete and effective.

### VERIFICATION ACTIVITIES

Verification provides evidence of activities that are necessary to determine the compliance of WSP with the existing standards (health based targets). This involves three activities; 1) monitoring of water quality, 2) internal and external auditing and 3) customer satisfaction.

### VERIFICATION MONITORING

Verification monitoring activities is provided in Table 15. The program includes three major activities that can assess the performance of the activity: 1) compliance monitoring that focuses whether the water quality targets are being met and maintained. 2) audit of records to assess if the programs are being followed. 3) consumer satisfaction to evaluate the satisfaction level of the concessionaires. Verification shall be undertaken both internally (internal auditors) and externally (regulating bodies such as DOH and LWUA). The frequency of audit depends on the level of confidence required by MARIWAD and the regulatory body (DOH and LWUA). As shown below, the verification monitoring programs which are part of the MARIWAD regular operation.

**Table 15: Verification Monitoring Activities**

Verification Activity	Location of Activity	Type of Activity	Frequency of activity	Analyst	Recipient of Analysis Result	Action on Unusual/ Failing Result	3rd-Party Recipient of Results
<b>7.1 Water Quality</b>							
Chlorine Residual Test	At the extremities of the Distribution system	Sampling (Water quality testing)	Daily	Production Division; Mariwad	Engineering Department and Local Health unit	Conduct inspection for possible causes for failing results (i.e. sampling procedure, contamination on sampling locations)	LWUA
Bacteriological test/heterotrophic plate count test	Consumers tap (randomly selected per water system)	Sampling (Water quality testing – 23 samples per month)	Monthly	Angeles City Water District	Engineering Department and Local Health unit	Conduct inspection for possible causes for failing results (i.e. sampling procedure, contamination on sampling locations)	LWUA



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Verification Activity	Location of Activity	Type of Activity	Frequency of activity	Analyst	Recipient of Analysis Result	Action on Unusual/ Failing Result	3rd-Party Recipient of Results
Physical and Chemical testing	Pump Station (Well Source)	Sampling (Water quality testing – All Pump Station)	Twice a year	Platinum Research Laboratory, Inc.	Engineering Department and Local Health unit	Conduct in-depth analysis on the failing parameters/ characters	LWUA
<b>7.2 Internal Audit</b>							
Verification of field activities on leak detection, transmission & distribution line repairs	Transmission and Distribution line areas	Maintenance verification	Every time there is a repair of damaged pipes	As appointed by WSP team	Engineering Department	Conduct re-inspection for validation of failed results	GM
Water quality monitoring results		Record verification		As appointed by WSP team		Call the attention of the responsible entity for corrective action	GM
System Description Audit	On-site	Internal Audit	Unscheduled at least once every 3 years	As appointed by WSP team	WSP Team Leader	Review/ Revision of concerned module	GM
<b>7.3 External Audit – The MARIWAD will follow the guidelines on WSP auditing to be issued by LWUA and DOH</b>							
System Assessment and Audit	On-site	External Audit	Based on guidelines to be issued by DOH and LWUA	External Audit Team	General Manager, Relevant Department	Comply with audit recommendations	
<b>7.4 Customer Satisfaction</b>							
Customer Feedback	Payment/ collection office; Mariveles Water District	Survey (personal interviews)	Monthly	Administrative and Customer Services Division	Administrative and Commercial Department	Verify complaint/s; call the attention of management for corrective action	GM, concerned unit
Answer of customer's queries	Payment/ collection office; Mariveles Water District	Phone calls, social media accounts, SMS	As needed, everyday	Commercial Services Division	Relevant Departments	No signal or no internet connection	

## MICROBIOLOGICAL WATER QUALITY MONITORING

The PNSDW specifies the minimum frequency of sampling for microbiological examination of drinking water for Level III water service based on population served as shown in Table 16.

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**Table 16: Minimum Frequency of Sampling for Microbiological Examination**

Population Served	Minimum Frequency of Sampling for Total Coliform and Thermotolerant Coliform/ E. coli	Minimum Frequency of Sampling for Heterotrophic Plate Count (HPC)	Compliance
Less than 5,000	2 Samples Monthly	2 Samples Monthly	
5,000 – 100,000	1 Sample per 5,000 population + 2 additional samples monthly	1 Sample per 5,000 population + 2 additional samples monthly	
More than 100,000	1 Sample per 10,000 population, plus 12 additional sample monthly	Required, at least 40 % of the sampling points	<p><b>To Total Coliform:</b> at least 95% of standard samples taken in each month from each reservoir and distribution point is total coliform negative, provided that thermotolerant coliform is absent</p> <p><b>To Thermotolerant Coliform:</b> no sample should test positive for thermotolerant coliform</p>
Source: 2017 Philippine National Standards for Drinking Water			

The MARIWAD has been sampling the minimum requirement of PNSDW to determine the safety of drinking water from microbiological contamination particularly in the areas of the distribution system which are far from the chlorination facilities.

## PHYSICAL AND CHEMICAL WATER QUALITY MONITORING

The PNSDW specifies 10 mandatory parameters which are legally enforceable for Level II and III water service as shown in Table 17.

**Table 17: Mandatory Drinking Water Quality Parameters**

NO.	PARAMETER	SAMPLING LOCATION
1	Thermotolerant coliform	Treatment plant outlet/Source and Consumer's Tap
	E. Coli	1
2	Arsenic (As)	Treatment plant outlet/Source
3	Cadmium (Cd)	Consumer's Tap
4	Lead (Pb)	Consumer's Tap
5	Nitrate (NO3)	Treatment plant outlet/Source
6	Color Apparent	Treatment plant outlet/Source and Consumer's Tap
7	Turbidity	Consumer's Tap
8	Ph	Treatment plant outlet/Source and Consumer's Tap
9	Total Dissolved Solids	Treatment plant outlet/Source
10	Disinfectant Residual	Treatment plant outlet/Source and Consumer's Tap
Source: 2017 Philippine National Standards for Drinking Water		



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## 8. MANAGEMENT PROCEDURES

Part of the WSP is the integration of MARIWAD's standard operating procedures particularly those that affect the quality of water from source to consumer. The Standard Operating Procedures under normal, incident and emergency situations are in the MARIWAD ISO procedures and ISO work instructions.

Records are generated daily as MARIWAD continues to operate providing safe drinking water to its service area aside from the implementation of WSP. The documents were kept simple and short as much as possible and the level of detail in the procedures and work instructions is sufficient to provide assurance of operational control when performed by competent and well trained operators and maintenance.

### Key Terms:

- **Standard Operating Procedure:** a set of step by step instructions to guide staff when carrying out routine tasks under either normal or incident conditions.
- **Incident:** an abnormal event that requires corrective action. An incident represent some degree of loss in system control that could compromise the drinking water supply, or have the potential to escalate to an emergency.
- **Emergency:** a serious situation or occurrence for which there is no SOP in place. Emergencies usually happen unexpectedly, requiring immediate and extensive action.
- **Emergency Response Plan:** steps to guide responses to an emergency.



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**Table 18: ISO Procedures of Mariwad**

Document No.	Procedure Name	Responsible Section/Division/Department
P-EPD-01	Water Disinfection Process	Production Division
P-EPD-02-01	Water Extraction Process	Production Division
P-EPD-03	Monitoring of Water Facilities Procedure	Production Division
P-EPD-04	Preventive Maintenance Procedure	Production Division
WI-EPD-01	Generator Set Operation – alternative power supply	Production Division
WI-EPD-02	Regular Cleaning of Pump Stations	Production Division & Inspectors
WI-EPD-03	Water Sampling Collection (Chlorine Residual Test, Physical-Chemical Analysis & Bacteriological Testing)	Production Division
WI-EPD-04	Maintenance of Chlorination Equipment & Accessories	Production Division
WI-EPD-05	Regular Inspection to all Pump Stations, Facilities and its Equipment	Water Utilities Management Officer A
WI-RPD-06	Pump Testing	Water Utilities Management Officer A
P-EMD-01	Water System Maintenance	Construction and Maintenance Division
P-EMD-02	Water Meter Calibration	Construction and Maintenance Division and Inspector
WI-EMD-01	Leak Detection and Repair	Construction and Maintenance Division
WI-EMD-02	Corrosion Prevention (by Paintings)	Construction and Maintenance Division
WI-EMD-03	Service Connection Installation	Construction and Maintenance Division
WI-EMD-04	Transfer of Service line or stand location	Construction and Maintenance Division
P-ASD-11	Maintenance of Service Vehicles & Equipment	Administrative Department – Plant Mechanic
P-CAD-01-00	Meter Reading Procedure	Commercial Accounts Division
P-CAD-02-00	Billing of Water Bill	Commercial Accounts Division
P-CSD-01-03	New Service Connection Application	Commercial Services Division
P-CSD-02-01	Handling of Service Request and Complaints	Commercial Services Division
P-CAD-05-01	Monitoring of Delinquent Accounts	Commercial Accounts Division
P-CAD-09-00	Reconnection of Water Service	Commercial Accounts Division
P-CSD-04-00	Customer Communication	Commercial Services Division
P-CSD-03-02	Inspection and Investigation	Commercial Services Division
P-AFD-03	Purchase of Material/Equipment Procedure	Administrative Department
P-ASD-10	Receiving and Recording Deliveries	Administrative Department

Note:

P – Procedure

WI – Work Instruction

EPD – Engineering Production Division

EMD – Engineering Maintenance Division

### 8.1 Normal Conditions

These are known as Standard Operating Procedures (SOPs). Table 19 shows the existing standard operating procedures under normal condition.



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**Table 19: List of Existing Standard Operating Procedures under Normal Condition**

CATEGORY	SUB-CATEGORY	SOP TITLE/DESCRIPTION	MAIN USER OF SOP	SOP REFERENCE/REMARKS
<b>NORMAL CONDITION/S SOPs</b>				
Facility Operations	General Tasks	Monitoring of Water Facilities Procedure - Daily Rounds	WUMO A & Operators	P-EPD-03 F-EPD-10-00
		Manages the operation of the equipment	WUMO A & Operators	P-EPD-01 P-EPD-02
		Operates generator set during power interruption (no electric/power supply)	Operators	WI-EPD-01 F-EPD-14-00
		Responsible for the inspection and monitoring of the system pressure	Operators	F-EPD-02
		Cleaning of Pump Stations regularly	Operators	WI-EPD-02
		Records of each pump station to include production data (from flow meter) kilowatt-hr consumption, volts, ampere, chlorine consumption, fuel consumption, etc.	Operators	P-EPD-02 F-EPD-01-00
Facility Operations	Maintenance	Maintain chlorination unit daily	Operators Inspectors	P-EPD-01 F-EPD-08-01
		Conduct system flushing in strategic locations thru the blow-off's and fire hydrants regularly	Maintenance	P-EMD-01-01 F-EMD-02-00 F-EMD-11-00
		Maintenance of Office vehicles	Drivers	P-ASD-11
		Make sure fuel stock for generator set is available to each pump stations	WUMO A & Operators	WI-EPD-01 F-EMD-06-01
Water Treatment	Water Quality Analysis	Water Sampling and Collection	Operators Inspectors	WI-EPD-03 F-EPD-08-01
		Physical and Chemical Analysis	Operators	WI-EPD-03
	Chlorination	Cleaning of Chlorine containers	Operators	WI-EPD-04
		Calibration of Chlorinator	WUMO A Operators	WI-EPD-04 P-EPD-01
		Repair of Chlorinator	WUMO A Operators	WI-EPD-04 F-EPD-10-00
	Testing	Testing of Water samples for chlorine residual daily in the extremities	Operators Inspectors	WI-EPD-03 F-EPD-08-01
		Monthly collection of water sample for bacteriological Test/ HPC Test	Operators Inspectors	WI-EPD-03 F-EPD-08-01
	Monitoring Schedule	Daily and monthly inspection	WUMO A & Operators	P-EPD-02 F-EPD-16-00
Public Relations	Public Information & Communication	Information Dissemination of water service interruption (scheduled/unscheduled)	Inspector	P-CSD-04-00
	Customer Services	New Service Connection application	Inspector	P-CSD-01-03
		Evaluation of new service connection	Inspector	P-CSD-01-03
		Disconnection of Delinquent Accounts	Collector	P-CAD-05-01
		Reconnection of Water Service	Maintenance	P-CSD-02-01



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CATEGORY	SUB-CATEGORY	SOP TITLE/DESCRIPTION	MAIN USER OF SOP	SOP REFERENCE/REMARKS
<b>NORMAL CONDITION/S SOPs</b>				
Water Distribution	Leak Repair	Repair of Distribution and/or Transmission Line	Maintenance	WI-EMD-01
		Repair of Mainline under concrete (Steel, PE and/or uPVC)	Maintenance	WI-EMD-01
		Repair of Service Line	Maintenance	WI-EMD-01
		Repair of service line under concrete from leak detection	Maintenance	WI-EMD-01
		Processing and coordinating leak reports	Inspector	P-CSD-03-02
		Transfer of Service Lines	Inspector	P-CSD-02-01

### 8.2 Incident and Emergency Conditions

Aside from operating procedures under normal conditions, Table 20 shows the possible incident and emergency condition in the MARIWAD operating procedures that needs immediate actions.

**Table 20: List of Incident and Emergency Condition**

INCIDENT CONDITION/S SOPs				
CATEGORY	SUB-CATEGORY	SOP TITLE/DESCRIPTION	PERSON RESPONSIBLE	REMARKS
Disinfection	Primary Disinfection	Chemical (chlorine) under dosing	WUMO A & Operator	Immediate Action
Production	Water Quality	Switching procedure from pumped to drip type chlorination	WUMO A & Operator	Immediate Action
Water Quality	Water Quality Complaint	Conduct flushing in affected areas	Operator & Maintenance	Immediate Action
Water Service Interruption	Water Distribution	Determine the cause of incident and assess impact of incident and perform appropriate corrective action to solve the incident	Operator & Maintenance	Immediate Action
Mainline leak or service line leak			Operator & Maintenance	Immediate Action
EMERGENCY CONDITION/S SOPs				
CATEGORY	NATURE OF EMERGENCY	SOP TITLE/DESCRIPTION	PERSON RESPONSIBLE	REMARKS
Water Quality	Toxic chemical spill	Chemical Contamination of Source	Mariwad DRRMT and Engineering Department	Immediate Action
Damage to facilities due to calamities and/or accidents	Calamities (unexpected)	Perform appropriate SOP to address the problem. Perform procedure for internal and external communication	Mariwad DRRMT, Engineering Department and Commercial Department	Immediate Action



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### 8.3 Corrective Actions/SOPs under Incident or Emergency Conditions

Corrective actions or SOPs are indicated in Table 21 subject for modification depending on the nature of the incident or emergency situations. Aside from normal protocols, emergency response plan should also be documented. In addition, internal and external communication is needed and must inform all the concerned departments and person responsible regarding the incident or emergency situations.

**Table 21: Corrective Actions/SOPs under Incident or Emergency Conditions**

INCIDENT OR EMERGENCY CONDITION	CORRECTIVE ACTION/SOP	ACCOUNTABILITY
1.Back flow or cross connection	1.Isolate affected area	Maintenance
	2.Determine cause of incident	Inspector
2.Main line break/burst/leak	3.Assess impact of incident to water production, distribution and consumption to determine alert and response level	WUMO A, Operator and Maintenance
	4.Perform appropriate SOP or corrective action to address problem causing the incident	WUMO A, Operator and Maintenance
3.Service line leak	5.Perform SOP for flushing	Operator and Maintenance
4.Water service interruption	6.Perform SOP for microbiological and/or physical chemical analysis of water sample from affected area, depending on assessed impact of incident/emergency condition	WUMO A, Inspector, and operator
5.Tampering at system facilities	7.If microbiological analysis returns to positive result, repeatedly do number 2 to 6 until a negative result is achieved	WUMO A Operator
6.Terrorist act at system facilities	8.If physical chemical analysis returns an exceedance of any parameter in the 2017 PNSDW, determine appropriate action based on severity of hazard	WUMO A Operator
7.Damage to facilities due to calamities, accidents or human actions	9.Perform procedure for internal and external communication	Commercial Department
8.Report of water borne disease outbreak in specific coverage areas	10.Provide an alternative drinking water supply if necessary	Engineering and Admin Department
9.Water Quality Complaints	1.Conduct flushing in affected area	Maintenance
	2.Perform SOP for microbiological, Phy-chem analysis or water sample from affected service connection, depending on nature of quality complaints	Inspector Maintenance Operator
	3.If result is positive for either one of the analysis, do number 1 and 2	Inspector Maintenance
	4.If re-sampling still turns a positive, do number 1 and 2 again, but this time, include sampling from adjacent service connections and investigate	Inspector Maintenance
	5.If re-sampling from any adjacent connection returns a positive result, isolate the area and determine the cause of the problem	Engineering Department
	6.Repeat procedure until laboratory analysis returns a negative microbiological or phy-chem analysis returns a value within the allowable limit set by 2017 PNSDW	Engineering Department
	7.Perform procedure for internal and external communication	Commercial Dept
	8.Provide an alternative drinking water supply if necessary	Eng'g Dept



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INCIDENT OR EMERGENCY CONDITION	CORRECTIVE ACTION/SOP	ACCOUNTABILITY
10. Chlorine residual below 0.3 ppm at any point in the distribution system	Perform SOP for increasing chlorine dosage	WUMO A, Operator, Inspector
11. Turbid water due to heavy rains at WSS with high flooding susceptibility	Perform SOP for operation stoppage at affected WSS	WUMO A, Operator

### 8.3.1 Responsible Officers or Mariwad Disaster Risk Reduction Management Team (DRRMT) for Emergency Conditions

During Incidents or emergency situations, it is crucial to have a response team to efficiently manage the situation and restore the operations immediately. To date, the Mariveles Water District (Mariwad) has a special group called Disaster Risk Reduction Management Team (DRRMT) that sustains and ensures continuous water supply during the heights and after the occurrence of calamities and during power outages. The DRRMT has 3 sections in-charge for the early warning (before – prevention, mitigation and preparedness), rescue and evacuation (during – disaster response), and assessment and needs analysis (after – recovery and rehabilitation) of operation. Relative thereto, there are assigned to handle specific functions, to wit: one team handles the availability and control of supplies of fuel for the generator sets. The other is in-charge in the operation of the power generating units and the other is in-charge in the detection of areas affected by low water pressure. Proper coordination between the other team has to be accordingly observed. In Table 22 shows the responsible officers, the responsibilities of each section are illustrated in Figure 4, while Figure 5 shows the organization of DRRMT.

**Table 22: Responsible Officers (Disaster Risk Reduction Management Team)**

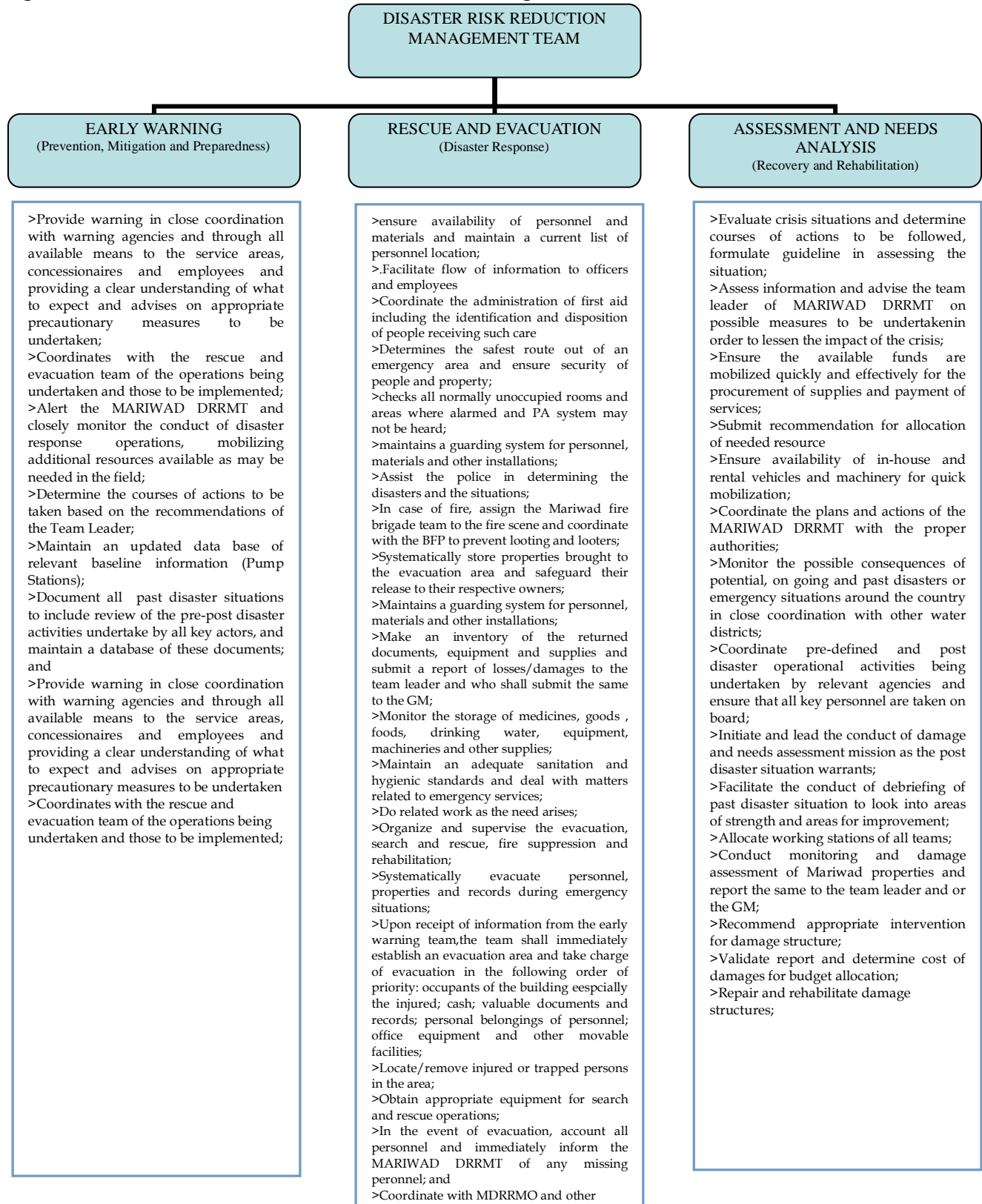
RESPONSIBLE OFFICERS (DISASTER RISK REDUCTION MANAGEMENT TEAM)			
NAME	DESIGNATION	DEPARTMENT	AREA OF CONCERN
Cristinela Ruth I. Lamayra	Team Adviser	Office of the General Manager	Information and Communication
Eng'r Joseph B. delos Reyes	Team Leader	Engineering	Water Supply Command Center
Edgard R. Monroe	Early Warning Head	Engineering	Prevention, Mitigation and Preparedness (Leak restoration, water quality control, water pressure monitoring & assessment)
Cynthia S. Cruz	Rescue and Evacuation Head	Commercial	Disaster Response (Water Rationing)
Eulogio S. Enriquez, Jr.	Assessment and Needs Analysis Head	Administrative	Disaster Recovery and Rehabilitation (Finance and Logistics, Transportation, Evaluation and Documentation)





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Figure 4 FLOW CHART – Disaster Risk Reduction Management Team

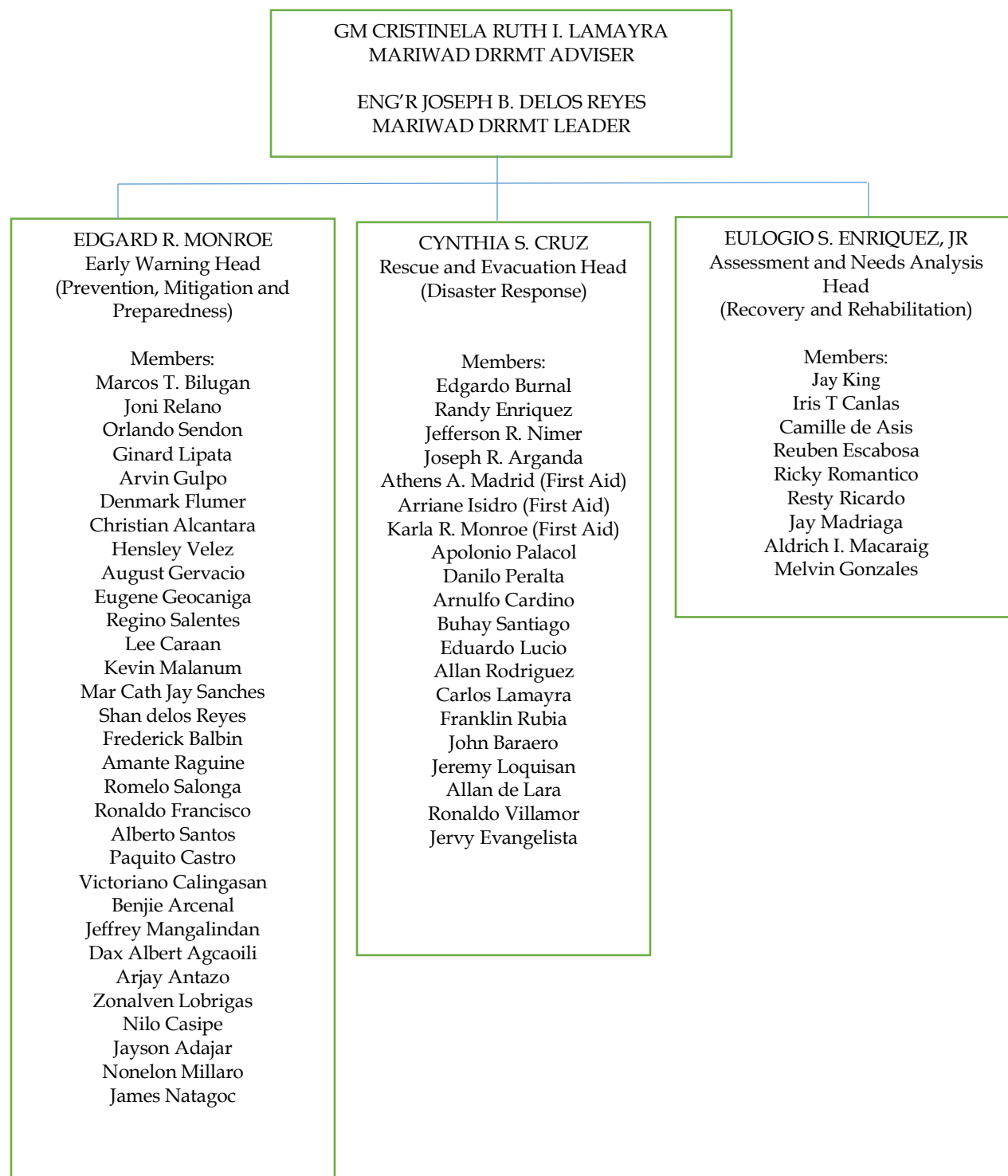






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Figure 5 ORGANIZATIONAL CHART – Disaster Risk Reduction Management Team





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### 9. SUPPORT PROGRAMS

The programs and activities ensures that the WSP are embedded in the MARIWAD's operation in support for the delivery of safe and potable water. As shown in the table below, this are the type of programs that will provide a solid backbone for the effective implementation of the WSP.

**Table 23: Support programs**

SUPPORTING PROGRAMS	PURPOSE	ACTIVITY	PERSON RESPONSIBLE	COST/ FUNDING SOURCE	TARGET DATE
Training and Awareness	To ensure that the MARIWAD personnel and its concessionaires understand their role in the effective implementation of Water Safety Plan and the effect of their action on water quality	WSP Training for general awareness program, emergency preparedness & response – in-house	HR-Admin, WSP Team	Php 10,000/ Training Budget	Second Quarter of 2023
		WSP Training for chlorine handling, dosing, residual monitoring, water quality, etc. – in-house	HR-Admin, WSP Team	Php 10,000/ Training Budget	Second Quarter of 2023
		Orientation for proper handling of water, use of standard materials, effect of cross connections, etc. – in-house	HR-Admin, WSP Team	Php 5,000/ Training Budget	First Semester of 2023
Calibration and Preventive Maintenance of System	To ensure that critical limit monitoring is reliable and of acceptable accuracy	Chlorine Dosing Equipment Orientation/Calibration	Production Division	Php 10,000/ Maintenance and Other Operating Expenses	First Semester of 2023
		Monitoring and Orientation of Water Meters, valves, pressure gauges, data loggers, pressure transmitter, level sensors, etc.	Engineering Department	Php 10,000/ Maintenance and Other Operating Expenses	Regularly or as needed
Customer Complaint Protocols	To ensure that customers are responded to if water quality questions are raised	Monitoring and Orientation for PACD and inspectors	HR-Admin Commercial Dept	Php 2,000/ Training Budget	First Semester of 2023
		Address the complaint	Commercial/ Engineering Department	Php 10,000/ Maintenance and Other Operating Expenses	Regularly or as needed
Preventive Maintenance Program	To ensure that the malfunction of important processes are minimized and all assets are in good working order	Preventive Maintenance program for Reservoir and tank cleaning, Flushing of water system, chlorinator/dosing pump, control panels, generator set, pump and motor.	Engineering Department	Php 50,000/ Maintenance and Other Operating Expenses	Regularly or as needed
Purchasing Materials and Chemicals Specifications	To ensure acceptable quality of goods and to control chemical hazards derived from materials and chemicals used in water production purchased from suppliers	Materials Safety Data Sheet Orientation	Production Division, Warehouseman	Php 50,000/ Maintenance and Other Operating Expenses	First Semester of 2023
		Materials Specifications Orientation	Production Division, Warehouseman	Php 3,000/ Training Budget	First Semester of 2023
		Evaluation report Orientation	Production Division, Warehouseman	Php 3,000/ Training Budget	First Semester of 2023
		Safety stock procedure Orientation	Production Division, Warehouseman	Php 3,000/ Training Budget	First Semester of 2023



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### **10. WSP REVIEW AND AUDIT PROCEDURES**

An audit based approach places responsibility on every unit involved to provide information regarding system performance against agreed indicators. Auditing has both an assessment and a compliance checking role. It gathers information on the level of conformance to the quality system as indicated in the WSP and to ISO standards as well as the degree of compliance to regulatory requirements.

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

1. At least twice a year, to ensure that new risk from all stages of the water supply system are assessed and addressed,
2. Following an emergency, incident or near miss,
3. Internal and external audit report,
4. Monitoring Report,
5. Water Quality Report,
6. Customer Satisfaction report,
7. Changes in stakeholders,
8. Status of improvement programs,
9. Management or Board Directives,
10. New procedures and regulations,
11. Change in members of the WSP team,
12. Other documents as may be determined.

#### **SCHEDULE:**

The WSP will be reviewed twice a year, on the last week of May and November. The WSP should also be reviewed when there are changes in the MARIWAD operations such as new water supply system is developed, new procedures, new treatment process is implemented or planned and WSP team or stakeholders contact information. Any revisions should be properly documented, approved by the management and the Board of Directors, and be disseminated to all key officers and personnel of MARIWAD for implementation and guidance.

### **11. PERIODIC REVIEW OF WSP**

The WSP Team should review it periodically to ensure that the WSP covers emerging hazards and issues. The implementation of the WSP framework reduces the number and severity of incidents, emergencies or near misses affecting or potentially affecting the quality and safety of water. In addition to the periodic review of the WSP, following every emergency, incident or unforeseen event irrespective of new hazards were identified is very important to ensure that the same incident/emergency will not happen again in the future and to determine whether the response was effective or need to be improved. The result of



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a post incident review is always likely to identify areas for improvement whether it is a new hazard, or a revised risk for the risk assessment, a revision for an operating procedure, a training issue and the WSP must be revised to reflect the change and incorporate the lessons learned into the WSP documentation, procedures and supporting programs.

### **12. REVISION OF WSP FOLLOWING AN INCIDENT, NEAR MISS OR EMERGENCY**

In case of incidents, near miss or emergency cases wherein the water quality is at stake, it is the duty of the Water Safety Plan Team to conduct review & process the situation to prepare for the necessary steps that will assure concessionaires that the water they drink is free from contaminants. WSP Team must always be ready to accommodate possible occurrence of incidents.

In addition to the scheduled planned review of the WSP, the MARIWAD WSP team shall arrange an emergency meeting for the revision of WSP following an incident, near miss, or emergency regardless if new hazardous events are identified that will have a major impact on the quality of water and will cost customer dissatisfaction. This will help the WSP team to evaluate whether the changes should be made in the WSP to make it up-to-date to incorporate lessons learned and valuable such as control measures, management procedures, and improvement plan to reduce the likelihood of recurrence and determine the best possible response.

Below are key questions to ask during review due to an Incident, near-miss or emergency:

1. What is the cause of the incident (new or already identified)?
2. How was the incident discovered or recognized?
3. What actions are required and how are they carried out?
4. Effectiveness of internal and external communications?
5. What are the short and longer term consequences of the emergency?
6. How can all aspects of WSP be improved (improvements needed in risk assessments, control measures, and training of personnel)?
7. How did emergency response plan work (assessment)?

The MARIWAD WSP Team shall coordinate with the concerned departments and the Board of Directors on whether changes are necessary and reflect them in new revisions. Any revisions should be properly documented, approved by the management and the Board of Directors, and disseminated to all key officers and personnel of MARIWAD for implementation and guidance.



## WATER SAFETY PLAN MANUAL

### REFERENCES

MARIWAD Records,  
Ground Water Data Bank Report,  
ISO Quality Manual,  
Philippine National Standard for Drinking Water,  
Water Safety Plan Manual,  
Water Safety Plan Manual,  
Water Safety Plan Manual,  
Water Safety Plan Manual,  
Water Safety Plan Manual,  
Water Safety Plan, Manual,  
Water Safety Plan, Manual,

Mariveles Water District  
Local Water Utilities Administration  
Mariveles Water District  
Department of Health  
Maynilad Water  
Hagonoy Water District  
Cagayan De Oro City Water District  
Camarines Norte Water District  
Angeles City Water District  
Balanga Water District  
Baliwag Water District