# DMA DESIGN

**Objective –**

The purpose of this document is to ensure the efficient design of a District Meter Area (DMA) using such resources as the Calibrated Hydraulic Model and the Geographical Information System (GIS) Database in the Cagayan de Oro City Water District (COWD).

**Work Instructions –**

1. The PNRW Head shall first select an area of the system that is ideal for DMA creation. This should be done in consultation with the Maintenance Department Manager.

2. The WD Division Manager and the PNRW DMA Design Team shall conduct an inspection of the area in order to have a better grasp of field conditions.

3. The PNRW Head shall then select an Initial DMA Design using an assessment of natural boundaries such as roads, bridges, and others.

4. Using information on customers in the GIS Database, the PNRW Head shall refine the design such that the DMA will not cover a very low number of customers nor a very high number. Ideally the range would be from 1000 to 5000.

5. This Refined Design will then be investigated using the Calibrated Hydraulic Model. The Hydraulic Modeler shall identify pipes near the boundaries of the Refined Design that have little hydraulic significance (i.e, flow and velocity are very low and pressures are relatively flat). These pipes, when closed by the Water Distribution Division (WDD) using existing valves, should be able to completely isolate the DMA. (Note: It may be necessary to install additional boundary valves and these should be installed by the DMA Design Team). The boundary points (i.e. valves) of the DMA should, as much as possible be located near the hydraulic balance points.

6. The boundary valves, designed by the PNRW DMA Design Team are then verified by the WD Division Manager and the PNRW Team in the field and checked if they are functioning. Those, which are not, should be replaced.

7. The location of the inflow meter, its size and design including the design of a Pressure Regulating Valve (PRV) should then be determined using the hydraulic model.

8. The final location of the inflow meter and chamber, as well as the monitoring of critical points in the proposed DMA, shall then be finalized after considering actual field conditions.

# MAINLINE LEAKAGE REPAIR

**Objective –**

This procedure defines an efficient preparatory set of activities to ensure the effective implementation of Mainline Leaks Repair covering all aspects related to it from site preparation to restoration of supply.

**Work Instructions –**

**1. Preparing the Area for a Repair**

Equipment needed:

Valve Keys**,** Road Signs, Barriers**,** Lights and Generator, if the work is being carried out after dark

The Team Driver shall park the vehicle in a safe location such that it forms a barrier between operatives working and the oncoming traffic.

The Team Supervisor or Leadman shall identify exactly where the leak is, using pre-mark location and checking using a listening stick or ground microphone.

The Team Supervisor or Leadman shall identify the extent of the dig likely and mark this on the ground with spray paint or chalk.

The Team Supervisor or Leadman shall plan the work area, including access, heavy equipment, power generator, dewatering hose, material storage, and safe area for personnel to plan, layout tools, prepare materials and communicate.

The Team Supervisor shall identify where the spoil will be located pending removal. The Leadman and Team Members shall set up barriers, road cones and road signs to ensure that road users and pedestrians are given warning of the work and kept away from working area. If required, set up temporary traffic lights or locate a Traffic Enforcer to manage traffic flows with a stop/go board.

The Team Members shall unload all mechanical and hand tools required and stack tidily within the mark out working area. Leakage repair materials maybe brought to the site only when the leak is uncovered and the exact requirements are known.

The Leadman and Team Members shall check the area for cables and other underground utilities and mark the location of any cables.

The Team Supervisor or Leadman shall locate the control valves, which will need to be operated to shut down flows once the pipe is uncovered and the leak detection is confirmed.

## 2. Excavation and Exposing the Pipe

Equipment needed:

Road Saw, Hand and Mechanical Excavation Tools, Shoring and ladders for deep excavations

The Equipment Operator (Road Saw/Concrete Cutter) shall cut through the road surface with the Road Saw following the edge of the marked out area. The Equipment Operator shall remove the tarmac road surface using a Mechanical Excavator and set this to one side

The Equipment Operator shall continue excavation using mechanical means provided there is no buried apparatus in the vicinity. If buried cables are within the area, excavation should be carried out by hand by the Team Members. Attention to safety is essential.

The Team Supervisor or Leadman shall ensure that the sides of trenches are shored up if required and that any exposed pipes, cables or ducts are properly secured in place and supported from underneath or hung from above.

The Equipment Operator (Excavator) should continue the excavation up to the depth when the pipe is expected to be exposed. At this point, excavation should be done by hand by the Team Members to avoid damaging the water pipe any further.

The Team Supervisor shall ensure that adequate working space should be allowed for detailed inspection around the pipe. Extra space may need to be provided to allow for any necessary cutting and or jointing equipment to be used safely and effectively.

If water is encountered before the pipe is exposed, the Leadman shall have a pump hose should be lowered into the excavation to keep the excavation as dry as possible. Since a burst pipe under high pressure can quickly fill an excavation, entry to the excavation should not be permitted until the Site Supervisor confirms that the excavation is safe to enter.

Once the excavation has reached the level of the pipe to be repaired, a sump should be dug to allow the dewatering pump to operate continuously. The discharge of any dewatering system should be checked by the Team Supervisor to ensure free outflow and that there is no danger or inconvenience caused by flooding from the outlet.

Once the pipe has been uncovered and the location of the leak has been verified, if the pipeline needs to be drained, the leak should be isolated using the valves which were identified by the Team Supervisor. This is not required if just using a repair clamp.

Extreme care should be taken by the Team Member assigned in operating a valve to ensure it is closed or opened slowly and smoothly. If there are any problems operating the designated valves, the Supervisor should be contacted as a matter of urgency.

### 3. Maintaining Excavation during Repair

Equipment needed:

Portable pumps, Shoring for deep excavation

It is important that the working area is kept as clear and clean as possible in the interests of safety and water hygiene.

The Team Supervisor or Leadman shall ensure that loose materials, tools and equipment should be kept within the limits of the enclosed area for excavation. Equipment for disinfecting tools and equipment should be kept to hand and free from contamination.

The Team Supervisor or Leadman shall ensure that all pipes and fittings should be stored so as to minimize the likelihood of contamination. They should be kept in appropriate wrappings until the last possible moment. Pipe lengths should be kept stoppered until required. All materials and fittings to be used should be checked for cleanliness before use.

To prevent ingress of foreign materials and dirty water into pipelines under repair, the Team Supervisor or Leadman shall ensure that sufficient earth and soil must be removed from around the pipe and sufficient pumps used to keep the water level well below the invert of the pipe until repair has been completed and the line re-commissioned.

The status of pumps must be checked regularly to ensure that the discharge water is kept well away from both the excavation and any spoil piles. Soil piles should be maintained in a tidy order with no mixing of different types of spoil e.g. tarmac and subsoil. Litter such as water bottles should not be thrown into the excavation or onto the spoil piles.

If it seems likely that the excavation will be left open after dark, the Team Supervisor or Leadman shall put lights to mark the extent of the work and prevent accidents.

### 4. Repairing a Main with a Clamp

Equipment needed

Repair clamp, suitable hand tools to fit the clamp.

Excavate where instructed down to the water main to locate the exact position of the leak and identify the size and material for repair. For mains over 12” the calipers will be used to determine the outside diameter

The excavation may need to be extended along the line of the main to locate the leak.

When the leak has been found, the Team Leader will determine the type of repair that is required to repair the leak. If the Team Leader finds evidence of previous repairs, this may indicate that the overall condition of the pipe is poor and a larger section should be replaced.

The excavation must be large enough to allow the work for the repair to be carried out safely and without hindrance to the operatives.

When the water main has been exposed and cleaned, the pipe material and size will be confirmed by the Team Leader and then the correct fitting can be selected to carry out the repair. The fitting that is to be used will be checked for any defects, damage and contamination before it is used.

For split collar repairs, place over the section of faulty pipe and install by the manufacturer's instructions.

When complete, the main shall be recharged.

When the main is fully charged, the repair fitting should be checked for any leaks. If any are seen the above procedure must be repeated.

Once the leak repair has been checked and found to be robust, the excavation can be refilled following the appropriate procedure.

Leaking fitting can be repaired by replacing gasket or the fitting itself.

**5. Repairing a Main with a Cut-Out**

Equipment needed:

Replacement pipe and suitable couplings to join the pipe to the existing main, cutting equipment suitable for the parent pipe, hand tools to make the couplings to the existing main

Excavate to expose the pipe such that the whole extent of the leak can be seen and the whole pipe is exposed.

The Team Supervisor or Leadman shall ensure that the pipe should be replaced to 300 mm beyond the location of damage to the pipe. If in doubt, the whole pipe length should be replaced, in which case both joints may need to be cut out and two replacement pipe sections used.

Where it is possible, the Team Supervisor or Leadman shall ensure that the mains supply should be maintained until ready for the repair of the new section, maintaining positive pressure to reduce the risk of contamination of the water supply.

# MAINLINE LEAKAGE REPAIR

The Team Supervisor shall ensure that the leak has been isolated.

The Team Supervisor or Leadman shall ensure that the section of the main which will need to be removed shall be marked and cut using a disc cutter and temporary support must be placed under the main to prevent any movement while cutting takes place. For HDPE and PVC pipes, this will be done by hand saw.

Once the pipe has been uncovered and the location and of the leak and extent of damage has been verified, the leak should be isolated using the valves which were identified by the supervisor and will be confirmed by opening a hydrant/ferrule or by making a small cut into the pipe. Only suitably trained personnel may carry out this work.
Extreme care should be taken by anyone operating a valve to ensure it is closed or opened slowly and smoothly. If there are any problems operating the designated valves, the Team Supervisor or Leadman should be contacted immediately.

For the section of main that needs to be removed from the excavation, this can be lifted to the surface of the excavation but care must be taken with the manual handling issues involved with lifting. If necessary, the excavator can be used providing the correct lifting sling and tackle is used.

The Team Supervisor or Leadman shall ensure that the removed section of pipe must be placed in a suitable position outside the excavation and without the risk of rolling back into the excavation or rolling into traffic/pedestrians.

The Leadman shall see to it that all cut edges should be prepared i.e. scraped, deburred, chamfered.

If another pipe material is to be inserted, a sleeve coupling or another adaptor shall be used with the new pipe section to be installed. The Leadman shall ensure correct expansion gaps and good alignment of the new pipe section.

The Leadman shall ensure that all bolts should be tightened evenly and sequentially as recommended by the manufacturer.

If any coatings to the pipe are damaged, e.g. polythene wrapping on ductile iron, the Leadman shall ensure that this is replaced.

When complete, the main shall be recharged.

When the main is fully charged, the repair fitting should be checked for any leaks. If any are seen, the repair clamp must be fitted again.

Once the leak repair has been checked and found out to be robust, the excavation can be backfilled using appropriate sand bedding and protection around the pipe.

# ZERO PRESSURE TEST

**Objective –**

The purpose of this document is to ensure the effective conduct of a Zero Pressure Test (ZPT) in the District Meter Area (DMA).

**Work Instructions –**

1. In the afternoon of the day of the conduct of the Zero Pressure Test (ZPT), the Team shall install Data Loggers at all previously identified Pressure Monitoring Points (PMP) both inside and outside the DMA. Each logger shall be programmed to record pressure at One-Minute Intervals.

2. A competent Team Member shall reprogram the logger at the Monitoring Point (MP) to record data at One-Minute Intervals (for this, use the second memory of the logger if available).

3. The Team Supervisor shall confirm that there is water supply in the DMA by taking pressure readings inside the DMA.

4. Competent Team Members shall operate the boundary valves and sound these using a listening stick to ensure that they are closed. (Note: This is a very important step and must be done thoroughly and carefully.)

5. The outlet valve at the MP shall be closed slowly by a competent Team Member. The closure should be confirmed by sounding the valve using a measuring stick. It should not be presumed that flow was stopped simply by looking at the flow meter.

6. After Five Minutes, the Team Supervisor shall check the pressure inside the DMA, which by this time should be dropping down to Zero. (Note: In order to facilitate the attainment of Zero Pressure, hydrants in the DMA may be opened to release water.)

7. The Zero Pressure Test shall end when Zero Pressure is attained inside the DMA and the activity ends.

8. The following day, data from the Data Loggers are analyzed by the Team Supervisor to have a confirmation that Zero Pressure inside the DMA was attained while pressure outside the DMA was maintained.

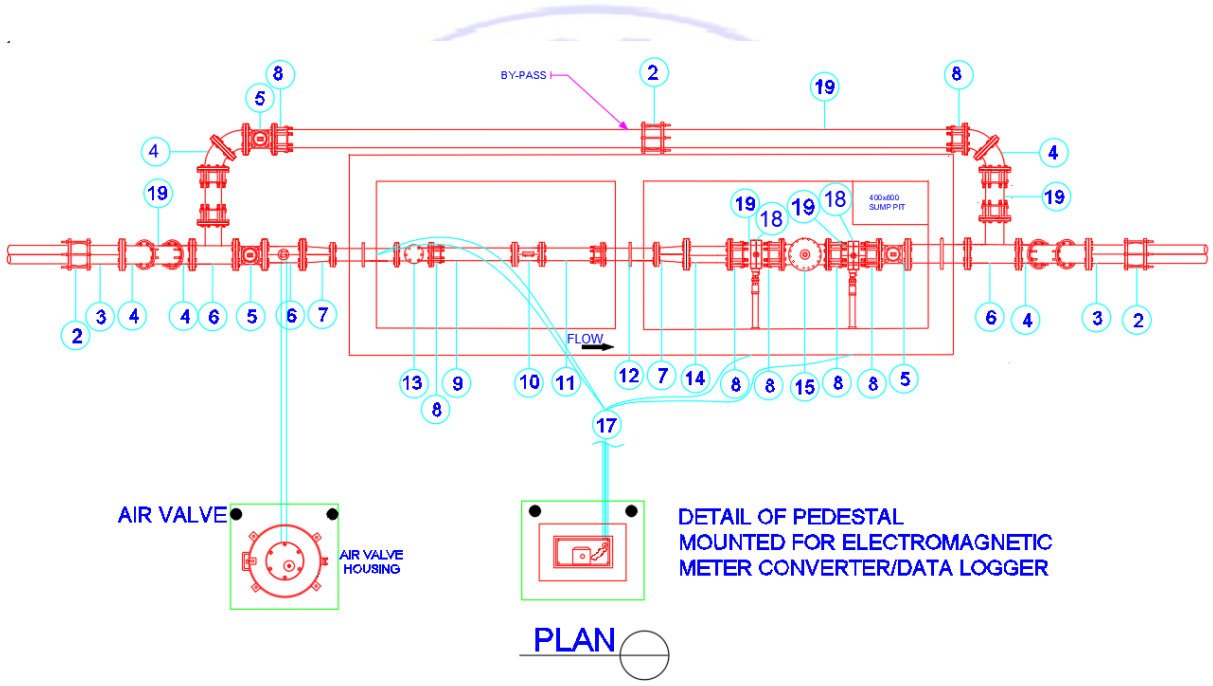
# DMA FIELD CREATION

**Objective –**

The purpose of this document is to ensure the efficient creation and actual building of a District Meter Area (DMA) using such resources as the Calibrated Hydraulic Model and the Geographical Information System (GIS)Database in the Cagayan de Oro City Water District (COWD) and the Standard Designs made by the USAID Be Secure Project.

**Work Instructions –**

**1.** Install the Inflow Assembly for the DMA (By Contract) using Standard Design (see below).



# DMA FIELD CREATION

LEGEND :

| ITEM | DESCRIPTION | END CONNECTION | LENGTH (mm) | ACTUAL SIZE (mm) |
|---|---|---|---|---|
| 1 | EXISTING WATERMAIN | | | 100 - 300 |
| 2 | SLEEVE TYPE COUPLING | MJ X MJ | | 100 - 200 |
| 3 | CI/DI SHORT PIPE (ADAPTOR) | FE X PE | | 100 - 200 |
| 4 | CI/DI BEND 45° | FE X FE | | 100 - 200 |
| 5 | CI/DI SLUICE VALVE WITH OPERATING NUT | FE X FE | | 100 - 200 |
| 5a | SURFACE BOX FOR SLUICE VALVE | | | 100 - 200 |
| 6 | CI/DI TEE | ALL FE | | 100 - 200 |
| 7 | CI/DI REDUCER | FE X FE | | 150 X 100 |
| 8 | CI/DI UNIVERSAL ADAPTOR | FE X MJ | | 100 - 200 |
| 9 | CI/DI SHORT PIPE (10D) | FE X PE | | 100 - 200 |
| 10 | ELECTROMAGNETIC METER | FE X FE | | 100 - 200 |
| 11 | CI/DI SHORT PIPE (5D) | FE X PE | | 100 - 200 |
| 12 | CI/DI SHORT PIPE (WITH COLLAR) | FE X FE | | 100 - 200 |
| 13 | STRAINER | FE X FE | | 100 - 200 |
| 14 | CI/DI SHORT PIPE (ADAPTOR) | FE X FE | | 100 - 200 |
| 15 | PRESSURE REGULATING VALVE (PRV) | FE X FE | | 100 - 200 |
| 16 | CHAMBER FOR PRV AND STRAINER | | | 100 - 200 |
| 17 | INTERNAL PRESSURE TRANSDUCER CONNECTION | | | |
| 18 | SADDLE CLAMP | | | 100 - 200 |
| 19 | PVC PIPE | | | |
| 20 | CI/DI UNIVERSAL ADAPTOR | | | 100 - 200 |

2. Install additional boundary valves and valves inside the DMA (By Contract) using Standard Design (see above).

3. Install Pressure Monitoring Points (By Contract) using Standard Design at the Identified Critical Points in the DMA.
4. After the completion of the above installations, the DMA Engineer shall test all boundary valves and valves inside the DMA to check if they can be operated and shut-off or opened effectively.

5. The DMA Engineer shall record all actual details of the Inflow Assembly, Valves, and Pressure Monitoring Points in the AR-DMC-mm-nnn -- Accomplishment Report of the DMA Construction. These may be corrected later on when the As-Built Plans become available.

# STEP-TEST

**Objective –**

The purpose of this document is to ensure the efficient conduct of a Step Test Procedure in a District Meter Area (DMA). This procedure would allow the identification of possible leakage in the system through a relatively simple procedure without going through a tedious leak detection using electronic equipment.

**Work Instructions –**

The Team Supervisor shall ensure that the DMA can be shut-off by sections (i.e. by Steps) through the closure of valves within the DMA.

The Team Supervisor shall prepare a map of the DMA showing the sections that can be shut-off in steps and the corresponding valves.

The valves (called Step Valves) shall be identified and operated and sounded if they can be shut-off completely.

The Team Supervisor shall verify the latest logged flow data at the Meter Point DMA in order to ascertain the time of Minimum Night Flow.

The Team Supervisor shall then schedule the Step Test Procedure around the time of Minimum Night Flow.

Step-Test Procedure Conduct –

1. The Team Supervisor shall configure a Data Logger to record flow in 10-second intervals and install this at the Meter Point of the DMA.
2. At the start of the activity, the Flow Rate shown by the Flow Meter is recorded.
3. A competent Team Member shall then close the First Step Valve slowly and sound it to check complete shut-off.
4. When the valve is shut-off, the Flow Rate is read and recorded.
5. The Second Step Valve is then shut-off and the Flow Rate is read and recorded.
6. This goes on until all step valves are closed. Care must be taken that an interval of about 10 Minutes must observed between valve closures.
7. At the end of the activity, all valves are opened slowly from the First Valve that was shut-off until the last.
8. The following day, the Team Supervisor shall analyze the data gathered during the Step-Test as well as the data recorded by the Data Loggers.

A clear “step” or reduction in Flow Rate as a section is closed off signifies that the flow is greatest to that section, a clear indication of leakage in the section. Leakage can be estimated as equal to the value of the reduction in flow rate or the “step”.

# ISOLATION VALVE EXERCISE

**Objective –**

The purpose of this document is to ensure the efficient performance of Isolation Valves in the Distribution System and monitor their performance using Standard Procedures.

**Work Instructions –**

1. The Team Supervisor shall prepare a map of the identified area showing the location of the valves to be exercised and water system pipeline sizes in the vicinity.

2. The valves identified shall be operated (fully closed-fully opened) slowly by a competent Team Member.

3. The number of turns to fully close and fully open the valve are noted and recorded.

4. The number of turns of the valve depends on the size and has corresponding number of turns. If the number of turns is equal to the standard number of turns, then the unit is efficient.

   E=Efficient
   D= Defective

5. The Valve Operation Team shall record all actual details of the Valves.

# DATA LOGGER

**Objective –**

To obtain data of water flow and pressure in COWD Pumping Stations, Bulk Water Source, Distribution Systems and Critical Points which are helpful to analyze the following:

- Leak possibilities on the monitored areas.
- Non-Revenue Water (NRW) caused by either physical or commercial loss.
- Non-Revenue Water (NRW) reduction holistic approach.
- Excessive and/or lacking pressure on the Distribution System.
- Water hammers, pressure surges and transients.
- Demand Analysis.
- Night Flow Measurement.
- Over or Under Sized Water Meters.
- District Metering Area (DMA) Formation Program and Analysis.
- Water production from pumping stations and Bulk Water Source.
- Flow and Pressure Monitoring.

**Work Instructions –**

1. The COWD uses Data Loggers to measure and record data of either flow or pressure or both at certain points in the system. This is in order to either monitor the Distribution System or to try to isolate and identify problems. In any case, it is the job of the Water Distribution Division Manager (WDDM) to identify the most appropriate points to install Data Loggers.

2. When the point/s are determined, a competent Distribution Operation Team Member shall configure a Data Logger to:

    a. Enable recording of pressure and/or flow using Channel 1 or 2 or both of the data logger;
    b. Log the data at a pre-determined time interval depending on the resolution required;
    c. Use the appropriate data logger memory either blocked/stopped where recording is stopped when the memory is full or cyclic/rotating where the older data is overwritten once the memory is full.
    d. Synchronize the Date and Time with the computer used in the configuration.

3. When the configuration is done, a Team Member shall install and secure the Data Logger with padlocks and brackets on the field. It will be left there for a certain period of time allowing it to record and obtain data prior to data analysis.

4. After the activity, the logger is retrieved to download its recorded data to the computer using its appropriate software. The Data Logger Software may also be used to produce graphs or other means to visualize the information.

# PRESSURE REDUCING VALVE AND MAINTENANCE

**Objective –**

The purpose of this document if to ensure the proper operation and maintenance of Pressure Reducing Valves (PRV) installed in the distribution system. Usually for more complex problems, a qualified technician should be called to service the PRV.

**Work Instructions –**

1. Before conducting operational maintenance on the PRV, the Team Supervisor shall ensure that the system is depressurized.
2. A competent Team Member shall examine the external surfaces of the PRV, including the flange face surfaces, for any signs of damage.
3. A set of diagnostics is shown below and should be used by a competent Team Member.

| INDICATOR | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Main Valve fails to Open<br><br>Main Valves fails to Close | No Pressure at the valve inlet | Check inlet pressure |
| | Main valve diaphragm assembly inoperative | Disassemble, clean and polish stem, replace defective parts |
| | Pilot valve not opening:<br>1. No spring compression<br>2. Damage spring<br>3. Spring guide not in place<br>4. Yoke dragging on inlet nozzle | 1. Tighten adjusting screw<br>2. Disassemble and replace<br>3. Assemble properly<br>4. Assemble properly |
| | Flow control disc inoperative. Corrosion or excessive scale buildup on stem | Disassemble, clean and polish stem. Replace worn parts |
| | Foreign matter between disc and seat or worn disc. Scale on stem or diaphragm ruptured | Disassemble main valve, remove matter, clean parts and replace defective parts |
| | Flow strainer plugged | Remove and clean or replace |
| | Isolation valves closed | Open isolation valves |
| | Pilot valve remain open:<br>1. Spring compressed solid<br>2. Mechanical obstruction<br>3. Worn disc<br>4. Yoke dragging on inlet nozzle diaphragm nut<br>5. Diaphragm damaged or loose diaphragm nut. Leakage from vent hole in cover | 1. Back of adjusting screw<br>2. Disassemble, remove and replace disc retainer assembly<br>3. Assemble properly<br>4. Assemble properly<br>5. Disassemble, replace diaphragm and/or tighten nut. |
| Fail to Regulate | Air in main valve cover and/or tubing | Loosen top cover plug and fittings and bleed air |
| | Pilot valve yoke dragging on inlet nozzle | Assemble properly |
| | Pilot valve spring not in correct range to control | Check outlet pressure requirements and existing spring |

5. After the activity, submit Accomplishment Report and recommendation to the Department Manager.

| Prepared By: | Approved By: |
|---|---|
| **Nikko M. Tocle**<br>Process Owner | Quality Management Representative |