Santa Maria WATER DISTRICT	**Procedure 02** **DESIGN AND DEVELOPMENT (PIPE LAYING)**	Date prepared : January 6, 2017 Date approved : January 10, 2017 Effectivity Date : January 11, 2017 Revision No. : 00 Revision Date : Control No. : ***PM02-01***
Reviewed by: Engr. Carlos N. Santos Jr. - GM		Approved by: Dir. Miguela G. Pleyto - BOD Chairperson

1.0 OBJECTIVE

Design and develop processes for extension/expansion and rehabilitation of water supply distribution pipelines.

2.0 SCOPE

Requirements as specified in SMWD and LWUA.

3.0 REFERENCES

3.1 ISO 9001:2015 Clause 8.3
3.2 Procedure for documented information

4.0 RESPONSIBILITY

Board of Directors, General Manager, Department Manager (Operations), Division Manager (Water Resource, Construction and Maintenance, Engineering)

5.0 PROCESS

5.1 Design and Development Planning

a) Design and Development Stages

i. The need for the Expansion/Extension and Rehabilitation of Pipelines by request of the concessionaires or as needed.
ii. Prepare Program of Work
iii. Allotment of Budget

b) With the requirements set forth by SMWD and LWUA, the design and development planning for the pipe laying requirements shall take into account their provisions.

c) The Top Management shall initiate design and development planning and shall observe the following stages in design and development:

1) Determination of regulatory requirements, applicable national regulations;

2) Determination of ways or processes to satisfy or meet these requirements;

3.) The distribution pipe lines must be designed to handle the peak hour demand of the system;

4.) Completion of all regulatory and SMWD's requirements by the Department Manager and Division Manager;

5.) Review, verification and validation stages / tasks and corresponding responsibilities and authorities.

REVIEW

The Operations Dept. Manager reviews the existing requirement if it is in accordance with the SMWD's requirements, applicable regulatory and national requirements.

VERIFY

The General Manager conducts final verification of the designed extension/expansion and rehabilitation programs, if any to ensure that the input requirements can be fully met.

VALIDATE

The BOD shall validate the performance of the SMWD to ensure that the newly implemented extension/expansion and rehabilitation programs shall meet all the identified requirements. Water testing and Inspection shall measure the quality of the water produced.

5.2 Sources and Basis of Design and Development (Design and Development Input)

a) The design and development shall take into account the following requirements:

1) SMWD standards and specifications;
2) LWUA's requirements and instructions;
3) PNSDW regulations;
4) DPWH regulations;

b) If there are new laws or regulations that would exist, the General Manager shall be responsible in determining the amendments or changes in regulations by coordinating with the relevant national and international regulatory organizations.

5.3 Pipe laying and Interconnection

Pipelines are simple to install, requiring only minimum of specialized installation equipment and knowledge of correct methods and procedures. The following are general guidelines to follow:

a) Excavation

Preparation:

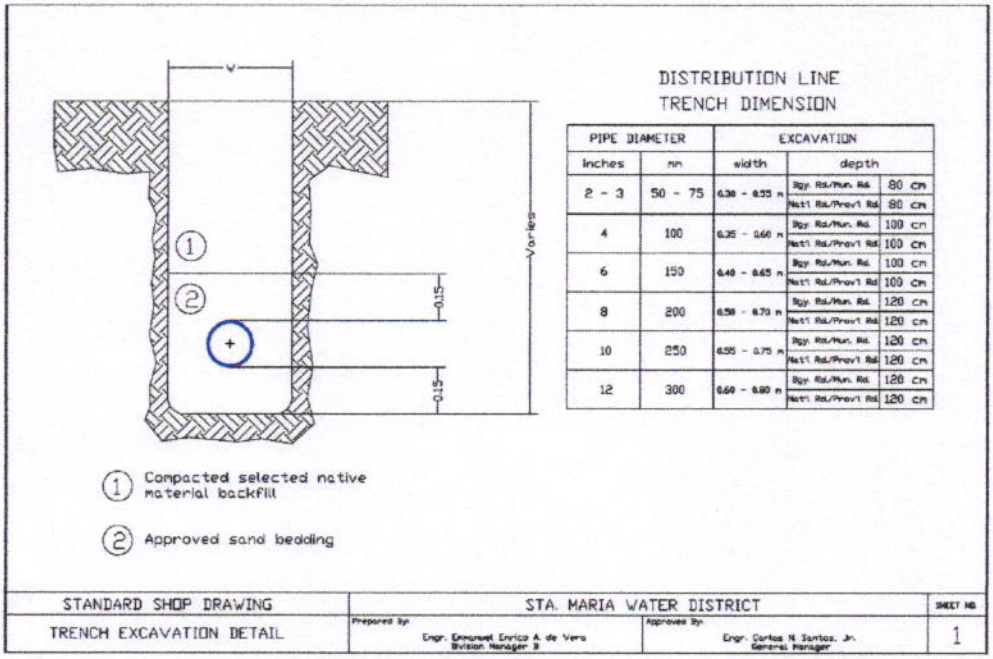
1. Advance written notice should be given to the government agencies concerned, affected driveways of households and other establishments for information.
2. Excavation permits, if necessary, should have been secured from the government agencies that have jurisdiction over the project.
3. Always refer to the detailed plans for the correct field location, alignment, trench and bedding specifications before mobilization and excavation begins.

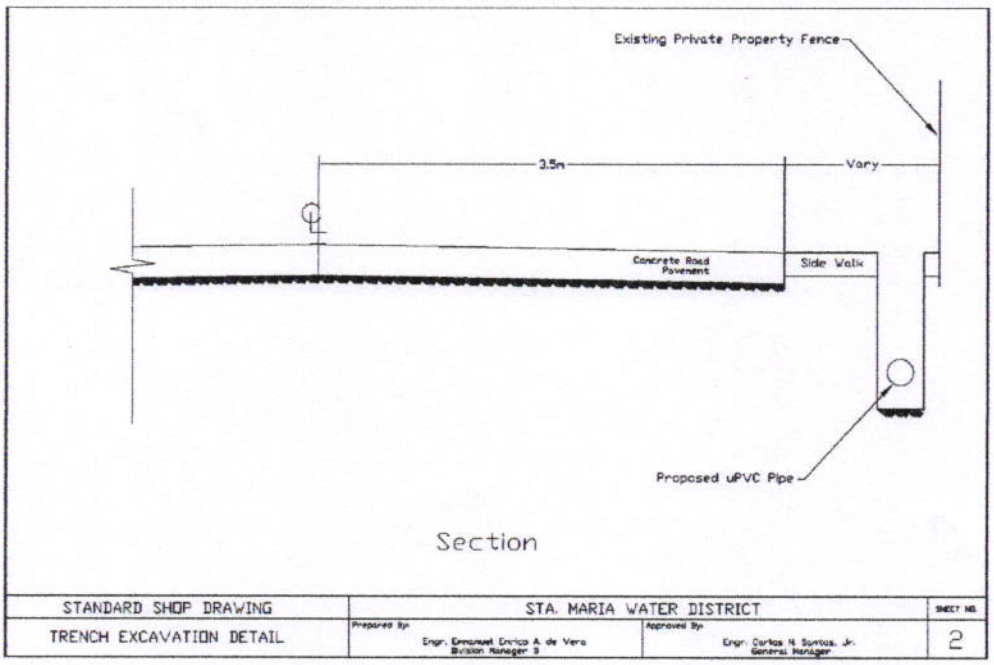
4. Make sure that all the necessary bollards, barricades and warning devices or whatever is needed are properly placed to protect the safety of the construction crew and the public.
5. It is advisable that the alignment of the pipeline trench should always be between the existing drainage and the private property; or always near and adjacent to the private property.
6. If the proposed location of the trench is below asphalt or concrete pavements, concrete cutter should be used to ensure smooth edge cuts. Jackhammers/Backhoe Breakers should be used in breaking asphalt and concrete pavements.
7. Asphalt/Concrete cutting and breaking should be implemented in advance prior to the schedule of the excavation and pipe laying activities.
8. All asphalt and concrete debris should be hauled away immediately to avoid using them as backfill materials.
9. No trenching should be allowed to start and proceed without the required bollards, barricades and warning devices.
10. All pipelines, valves and fittings, construction materials, tools, equipment, etc. must be prepared, ready and available. No excavation for any section of pipeline installation shall be performed until pipelines, valves and fittings, construction materials and all other materials necessary to complete the installation are on-hand.

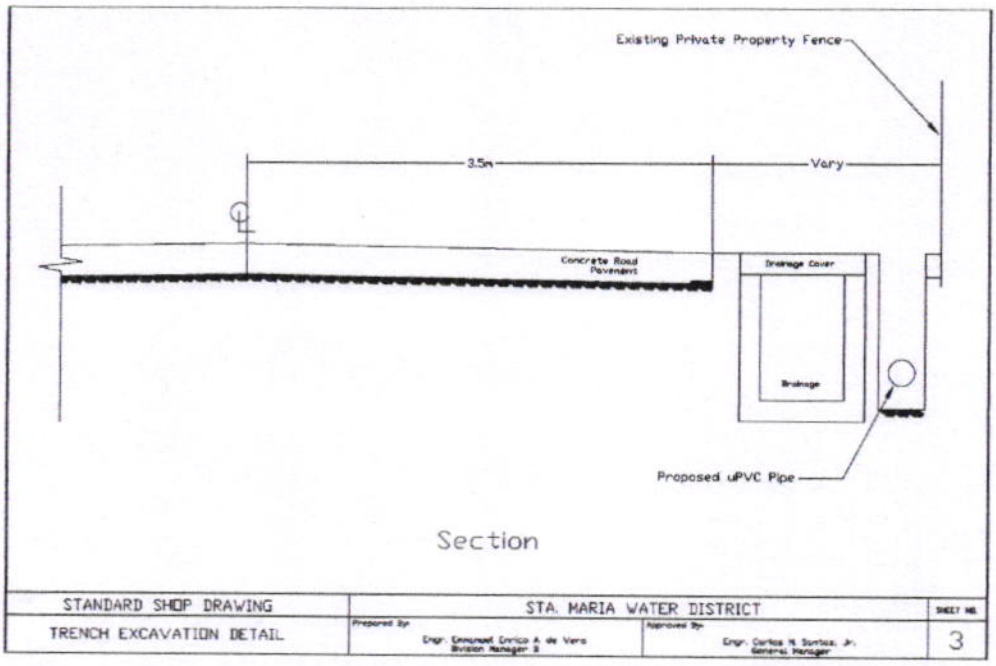
Trench Excavation:

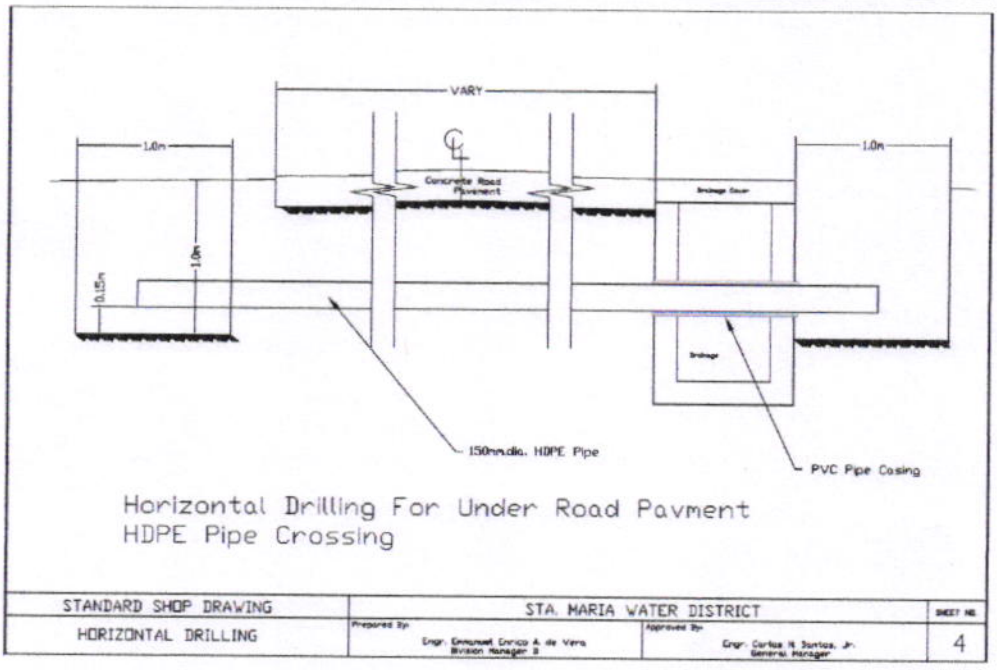
1. Unless otherwise shown or ordered, excavation for pipelines shall be open-cut trenches. Trench should be straight, with vertical sides centered on the pipe centerline.
2. Trench excavation should not extend too far ahead of pipe laying for safety reasons. The maximum amount of open trench permitted at any one time in one location shall be 300 meters, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater.
3. Barricades and warning lights shall be provided and maintained for all trenches left open overnight, except at intersections and driveways in which case of heavy steel plates adequately braced bridges or other type of crossing capable of supporting vehicular traffic shall be furnished as directed by the Engineer. Or, do not leave open trenches overnight at all. An open trench presents a danger to the construction crew and the public, especially at night.
4. Always refer to the "Trench Excavation Detail" for the depth and width depending on the pipe sizes and location.
5. The trench width should not be more that 0.30 to 0.60 meter greater that the outside diameter of the pipe.
6. The trench walls may have to be "sloping" when the soil is not stable.
7. For curve alignments, the trench width should be greater than the usual to accommodate the permissible deflection of the joints.
8. Trench bottom must be uniform, free from humps, abrupt change of direction, hard objects, large and/or sharp stones, and tree roots.

9. Trenches shall be over-excavated beyond the designed depth only when ordered by the Engineer. Such over-excavation shall be to the depth ordered. The trench shall then be refilled to the grade of the bottom of the pipe with sand until the pipe is covered with the specified thickness, and then with selected granular materials obtained from the excavation.
10. In unstable ground, during over-excavation, the trench walls maybe shored or sloped.
11. Except where trees are shown on the drawings to be removed, trees shall be protected from injury during construction operations and no tree is to be removed without written permission or permit if necessary. Tree roots can be trimmed and cut if it is an obstruction only with the permission of the Engineer.
12. Water must be kept out of the trench during construction so that the pipe will not become contaminated. Dewatering pumps should be used in the trench, if necessary, to remove any building up of water.


V
Varies
0.15
0.15
1
2
+
1 Compacted selected native material backfill
2 Approved sand bedding
DISTRIBUTION LINE
TRENCH DIMENSION
PIPE DIAMETER
Inches
mm
EXCAVATION
width
depth
2 - 3
50 - 75
0.30 - 0.55 m
Bgy. Rd./Mun. Rd. 80 cm
Natl Rd./Prov'l Rd. 80 cm
4
100
0.35 - 0.60 m
Bgy. Rd./Mun. Rd. 100 cm
Natl Rd./Prov'l Rd. 100 cm
6
150
0.40 - 0.65 m
Bgy. Rd./Mun. Rd. 100 cm
Natl Rd./Prov'l Rd. 100 cm
8
200
0.50 - 0.70 m
Bgy. Rd./Mun. Rd. 120 cm
Natl Rd./Prov'l Rd. 120 cm
10
250
0.55 - 0.75 m
Bgy. Rd./Mun. Rd. 120 cm
Natl Rd./Prov'l Rd. 120 cm
12
300
0.60 - 0.80 m
Bgy. Rd./Mun. Rd. 120 cm
Natl Rd./Prov'l Rd. 120 cm
STANDARD SHOP DRAWING
TRENCH EXCAVATION DETAIL
STA. MARIA WATER DISTRICT
Prepared By: Engr. Emmanuel Enrico A. de Vera, Division Manager III
Approved By: Engr. Carlos N. Santos, Jr., General Manager
SHEET NO. 1

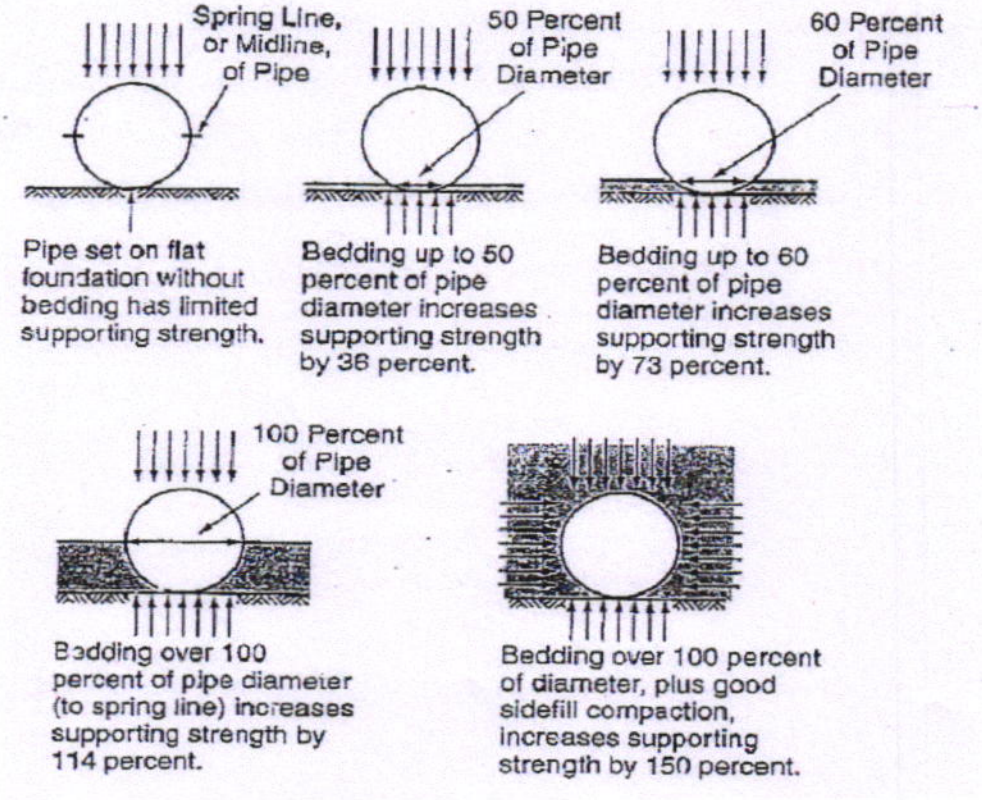

Existing Private Property Fence
3.5m
Vary
Concrete Road Pavement
Side Walk
Proposed uPVC Pipe
Section
STANDARD SHOP DRAWING
TRENCH EXCAVATION DETAIL
STA. MARIA WATER DISTRICT
Prepared By: Engr. Emmanuel Enrico A. de Vera, Division Manager III
Approved By: Engr. Carlos N. Santos, Jr., General Manager
SHEET NO. 2


Existing Private Property Fence
3.5m
Vary
Concrete Road Pavement
Drainage Cover
Drainage
Proposed uPVC Pipe
Section
STANDARD SHOP DRAWING
STA. MARIA WATER DISTRICT
TRENCH EXCAVATION DETAIL
Engr. Emmanuel Enrico A. de Vera
Division Manager II
Engr. Carlos N. Santos, Jr.
General Manager
3


VARY
1.0m
1.0m
Concrete Road Pavement
Drainage Cover
Drainage
1.0m
0.15m
150mm dia. HDPE Pipe
PVC Pipe Casing
Horizontal Drilling For Under Road Pavment
HDPE Pipe Crossing
STANDARD SHOP DRAWING
STA. MARIA WATER DISTRICT
HORIZONTAL DRILLING
Engr. Emmanuel Enrico A. de Vera
Division Manager II
Engr. Carlos N. Santos, Jr.
General Manager
4

Sand Bedding:

1. The trench bottom must be properly leveled and free from large and/or sharp stones and objects so that the full length of the pipe will have continuous, firm support.
2. Sand bedding should be spread over the trench bottom to the full width of the trench with the thickness of 150mm.
3. Compacted sand shall also serve as a backfill material to the both sides of the pipelines and 150mm. above the outside diameter of the pipe. Also refer to the "Trench Excavation Detail".



b) Pipe Handling

1. If possible, pipe materials should be loaded/unloaded using some form of mechanical lifting equipment. Whatever method used should prevent abuse and damage to the pipe materials.
2. In handling the pipes, no hooks, chains, or similar metal devices should contact the pipe at any failure points.
3. In smaller sizes of pipes, it can be loaded/unloaded by two or more people carrying at both ends or with person/s at the middle.
4. Pipes should never be dragged along the ground or road.
5. All pipes, fittings and gasket material should be kept as clean as possible and be protected from any contamination.
6. Pipes should be unloaded as near to the trench as possible to where they are to be used, so as to avoid excessive handling.
7. The pipe should be laid on the side opposite the excavated material or equipment, or, if trench is not yet opened, opposite where these will be positioned.
8. Pipes should be secured against rolling into the trench and kept safe from traffic and heavy equipment.
9. The bell end of the pipe should be placed towards the direction of the work, as during the installation the spigot end will enter the bell end of the previously laid section.
10. Lifting equipment should be used to lower larger pipes; for which a webbing sling should be attached to the pipe.

Unloading of Pipes

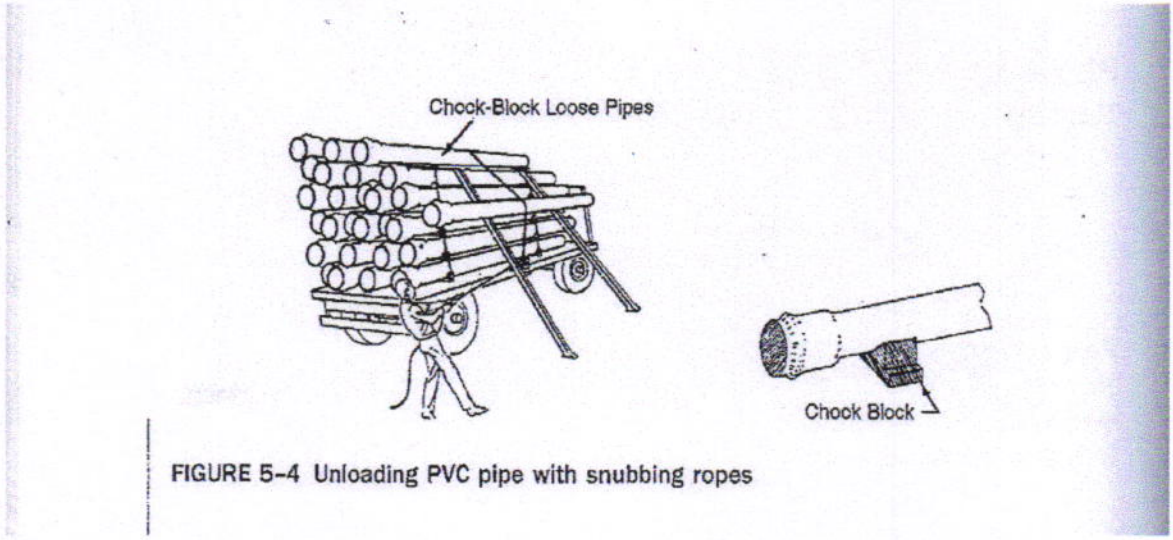
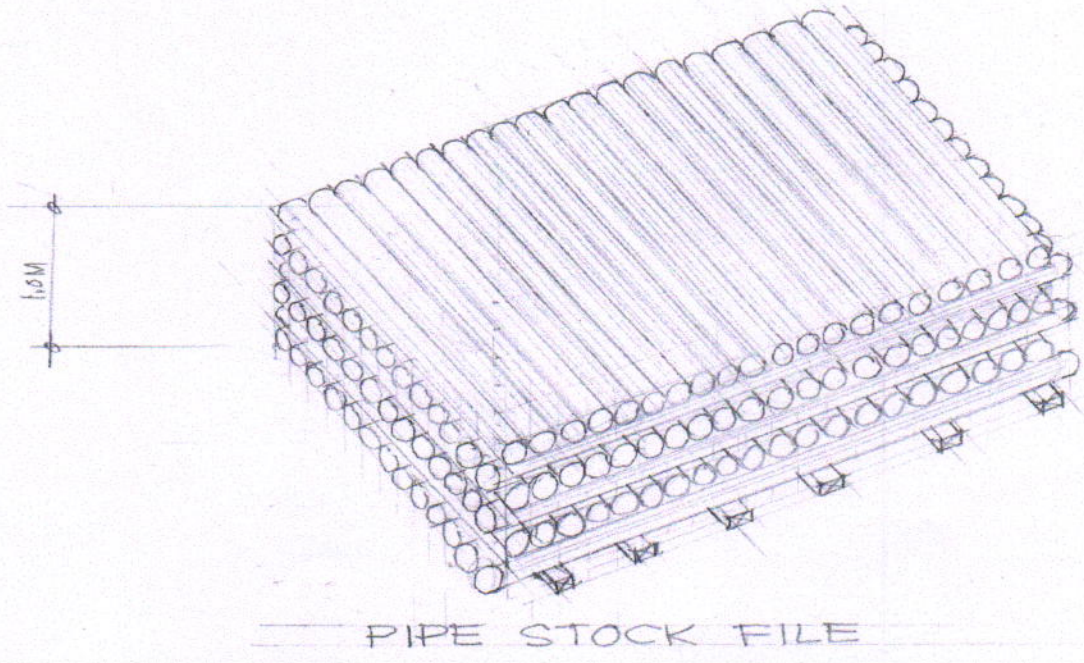


FIGURE 5-4 Unloading PVC pipe with snubbing ropes

Stacking



c) Pipe laying

1. After the trench bottom has been prepared and the 150mm. thickness of sand bedding has been placed, the pipe may be set in place.
2. Pipes should be free from damage. Any unsatisfactory sections should be rejected.
3. The inside of each pipe length should be clean. Any dirt, oil, grease, animals and other foreign materials should be removed.
4. The proper procedure in joining of pipe varies somewhat with the type of pipe:

   uPVC Pipes (Unplasticized Polyvinyl Chloride)

   i. Clean the bell of all dirt or foreign material that could interfere with the proper seating of the rubber gasket. Examine interior of pipe for any soil or debris which, if found, shall be removed by brushing, scraping or rinsing.

   ii. Fold the gasket into a heart shape with the color marking on the gasket facing out. Insert the gasket into the bell and snap it into the gasket groove until the gasket is free and smooth from waves.

   iii. Clean then apply approved lubricant to the tapered end of the pipe spigot from the taper to the reference mark.

   iv. Align the spigot and bell, then push the spigot all the way into the bell until the reference mark is flush with the end of the bell. This mark should never exceed 9mm from the end of the bell after jointing.

v. When making field cuts, it is best to use pipe cutter to assure a square end, but a conventional wood saw or hacksaw maybe used but cut the pipe carefully.

vi. Field cut end needs to be beveled. Use a file to bevel the pipe and be sure to copy the factory bevel angle of 15 degrees. Also, be sure to copy the guide mark on each pipe joint end. Use factory marked end of the same pipe size as a guide.

vii. During the lowering of uPVC pipes, one man should apply pressure against the unjointed end of the string to insure that none of the pipe ends slip back from the seating against the stop.

viii. Examine the guide mark on each joint of the pipelines to insure that it has not moved more than 9mm from the end of the bell, after lowering.

HDPE Pipes (High Density Polyethylene)

i. HDPE Pipes are being joined by heat fusion. The principle of heat fusion is to heat two surfaces to a designated temperature, then fuse them together by application of a sufficient force. This force causes the melted materials to flow and mix, thereby resulting in fusion. When fused according to the proper procedures, the joint area becomes as strong as or stronger than the pipe itself in both tensile and pressure properties.

ii. Field-site butt fusion maybe made readily by using butt fusion machines that secure and precisely align the pipe ends for the fusion process.

iii. Clean the inside and outside of the pipe to be joined by wiping with a clean cloth. Examine interior of pipe for any soil or debris which, if found, shall be removed by brushing, scraping or rinsing.

iv. Clamp the components in the machine. Check alignment of the ends and adjust as needed.

v. The pipe ends must be faced to established clean, parallel mating surfaces. Most, if not all, equipment manufacturers have incorporated the rotating planer block design in their facers to accomplish this goal. Facing is continued until a minimal distance exists between the fixed and movable jaws of the machine and the facer is locked firmly and squarely between the jaw bushings. Remove any pipe chips from the facing operation and any foreign matter with a clean, lint-free cotton cloth. Bring the pipe ends together with minimal force and inspect the face off. A visual inspection of this operation should verify that faces are square, perpendicular to the pipe centerline on each pipe end and with no detectable gap.

vi. The pipe profiles must be rounded and aligned with each other to minimize mismatch (high-low) of the pipe walls. This can be accomplished by tightening clamping jaws until the outside diameters of the pipe ends match. The jaws must not be loosened or the pipe may slip during fusion. Re-face the pipe ends and remove any chips from re-facing operation with a clean, lint-free cotton cloth.

vii. Use a heating tool that can simultaneously heat both pipe ends. These heating tools are normally furnished with thermometers to measure internal heater temperature.

viii. The operator should monitor the temperature before each joint is made.

ix. Make sure that the heater surface that come into contact with the pipe should be clean, oil-free and coated with a non-stick coating as recommended by the manufacturer to prevent molten plastic from sticking to the heater surfaces. But, never use chemical cleaners or solvent to clean heating tool surfaces unless recommended by the manufacturer.

x. Install the heater in the butt fusion machine and bring the pipe ends into full contact with the heater. To ensure that full and proper contact is made between the pipe ends and the heater, the initial contact should be under moderate pressure. Set the heater to approximately 170 deg. Celsius. Sustain the pressure while a bead of molten polyethylene develops between the heater and the pipe ends. Bead size must be uniform all throughout the circumference of the pipe. Remove excess beads until the ends of pipe is melting uniformly. When the proper bead size is formed against the heater surfaces all around the pipe or fitting ends, remove the heater. Melt bead size is dependent on pipe size.

Pipe Size (diameter) Approximate Melt Bead Size:

50mm to 75mm: 2mm

100mm to 200mm: 3-5mm

200mm to 300mm: 5-6mm

300mm to 600mm: 6-11mm

600mm to 900mm: 11-14mm

xi. After the heating tool is removed, quickly inspect the pipe ends (NOTE: If a concave melt surface is observed, unacceptable pressure during heating has occurred and the joint will be low quality. Do not continue. Allow the component ends to cool completely, and restart at the beginning. Except for a very brief time to seat the components fully against the heater tool, do not apply pressure during heating.), then immediately bring the molten pipe ends together with sufficient fusion force to form a double rollback bead against the pipe wall.

xii. For manually operated fusion machines, use a torque wrench to apply the proper force. For hydraulically operated fusion machines, hydraulic gauge reading for the fusion pressure shall be recommended by the manufacturer.

xiii. Hold the joint immobile under fusion force until the joint has cooled adequately to develop strength. Allowing proper cooling times under fusion force prior to removal from the clamps of the machine is important in achieving joint integrity. The fusion force should be held between the pipe ends for approximately 30-90 seconds per inch of pipe diameter or until the surface of the melt bead is cool to the touch. NOTE: Avoid pulling, installation or rough handling for an additional 30 minutes. Additional time may be required for pipes with a wall thickness greater than 2".

xiv. Visually inspect and compare the joint against the manufacturer's recommended appearance guidelines. Visually, the width of butt fusion beads should be approximately 2-2 ½ times the bead height above the pipe and the beads should be rounded and uniformly sized all around the pipe circumference. The v-groove between the beads should not be deeper than half the bead height above the pipe surface. In such cases, visual evaluation is based mainly on the size and shape of the pipe-side bead.

xv. Visually unacceptable joints should be cut out and re-fused using the correct procedure.

Steel Pipes (Surface Painted/Cement Coated/Cement Lined)

i. Always check lining and coating for damage. Repair the large cracks and/or loose mortar in coating. Small cracks in in lining are less a concern as they will heal after introduction of water.

ii. Look at pipe ends and body of pipe for damage that may have occurred during transportation. Badly damaged sections have to be discarded while others shall be repaired.

iii. The interior of each pipe section shall be clean and free from foreign materials at all times especially during pipe laying activities.

iv. Pipe larger than 600mm is almost always assembled in the trench. Smaller pipe is sometimes assembled above the trench and lowered into it by means of a chain hoist or by a mechanical equipment.

v. Welded joints are either lap joint or butt strap joint.

vi. Lap joints and butt strap joints may be welded from the outside of the pipe or from the inside if the diameter is large enough.

vii. The butt strap shall have a minimum plate thickness of 3.5mm. Provide a hand hole where the lining of the butt strap joint cannot be reach for repair by the crew.

viii. Inside joints of cement lined steel pipes shall be plastered with cement mortar.

ix. For diameters smaller than 450mm, the shoulder of the bell is buttered with a stiff mortar containing 1 part cement and 3 parts sand prior to installing the next section of pipe.

x. Use a swabbing device, such as an inflated rubber ball wrapped in burlap, to wipe away the excess mortar, making a smooth, flush, inside joint. A wire is threaded through the pipe section to be laid and attached to the ball prior to joining the pipe. When the sections are joined, the spigot squeezes the mortar into position against the shoulder of the bell, and the swabbing device is pulled from the previously laid sections passing the joint.

xi. For larger diameters than 450mm, the inside joint is hand pointed with the stiff mortar after the pipe is in place. The mortar shall contain 1 part cement and 2 parts sand, dry mixed and moistened with just sufficient water to permit caulking and troweling without crumbling.

xii. The pipe shall not be put in service or be subjected into a hydraulic test until the mortar has cured a minimum of 24 hours.

xiii. Exterior joint spaces are filled with a cement mortar grout consisting of 1 part cement to not more than 3 parts of sand mixed to a flowing consistency.

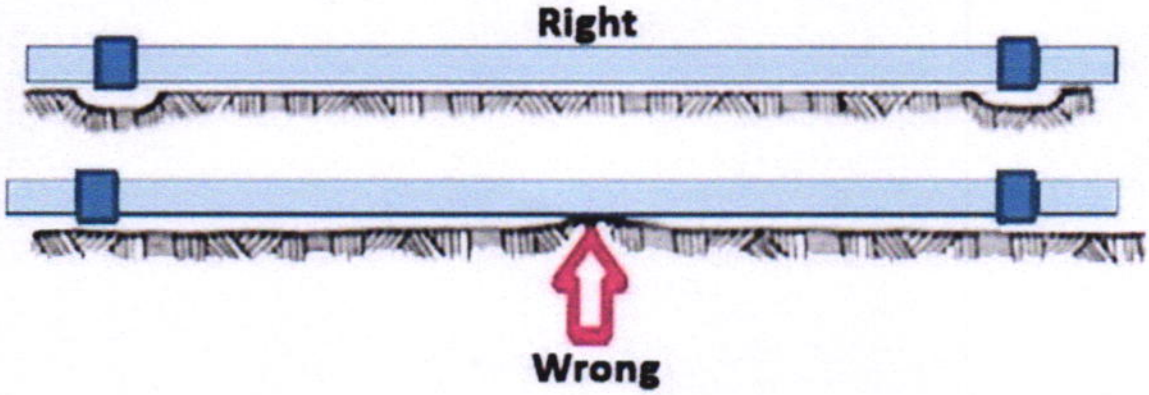
xiv. A diaper should be placed around the joint and fastened with metal strapping or similar material. The grout is poured into an opening at the top of the pipe. The grout poured down one side of the pipe will flow up the other; then the top of the pour can be covered with protective material.

xv. Surface painted steel pipes shall be used in exposed environment, such as bridge and culvert crossing, etc.

xvi. Outside joints of surface painted steel pipes shall be painted with galvanized iron primer.

xvii. The final coating for the surface painted steel pipe shall be a semi-gloss enamel.

5. Lower the pipe into the trench by using chain hoist or mechanical equipment, if possible. In smaller diameters of pipelines, pipes maybe lowered into the trench by two people using ropes, one rope looped around near each end of the pipe. Do not roll the pipes into the trench from the top.
6. Larger pipe sizes are best handled with appropriate equipment. The pipe is usually supported by a sling in the middle of the pipe length when lowered by a machine. The sling must be removed once the pipe is inside the trench.
7. Make sure that the entire length of the pipe section is in contact with the ground.
8. Pipe lengths should never be deflected in the joints to any degrees than that recommended by the manufacturer.
9. Always check the inside of the pipe. Do not leave open ends of installed pipes. It should be plugged and secured to prevent the entry of animals, dirt, trench water and any other foreign materials.



d) Interconnection

1. Prepare all the necessary materials, fittings, tools, equipment, barricades, warning devices, etc.
2. Inspect all valves and fittings for conformance to shop drawing and materials.
3. Notify the Customer Service Section of SMWD and/or the concessionaire/s on the affected area for low supply of water or possible water interruption.
4. Isolate the sections of the mainline by closing the nearest isolating values.
5. Open a hydrant/blow-off valves or tap to relieve line pressure.
6. Cut the interconnection portion of the pipe line. It is best to use pipe cutter to assure a square end, but a conventional wood saw or hacksaw maybe used but cut the pipe carefully.
7. Dewater the excavation.
8. Maneuver the fittings into the proper position after making sure that the pipe ends are properly cut.

9. Always check the alignment of all valves and fittings involved.
10. Make sure that the rubber gaskets are not damaged, clean and free from dust and other foreign materials.
11. Nut tightening should follow a definite sequence. One "round and round" and the other is "crisscross". Either should be satisfactory.
12. Inspect pipe flange for warping. If bolts are tightened against a warped flange, there is a danger of cracking the cast iron valve flange.
13. After all valves and fittings are joined and interconnected, subject it in a low pressure to check for leakage. Increase the pressure gradually.
14. If there are leaks at any joints, cut the supply of water and repair it immediately. Repeat the interconnection sequence until no leak is present in the interconnection.
15. Provide concrete thrust blocks and anchors to prevent movement of fittings.
16. Let the concrete mixture dry and prepare the area for backfilling and compaction.

e) Thrust Blocks and Anchors

Any pressurized pipeline will generate thrusts that could create gradual movement in the fitting or pipeline that will eventually cause leakage or completely separate the coupling or fitting. Pipe thrust is generated at locations where any of the following situations exists:

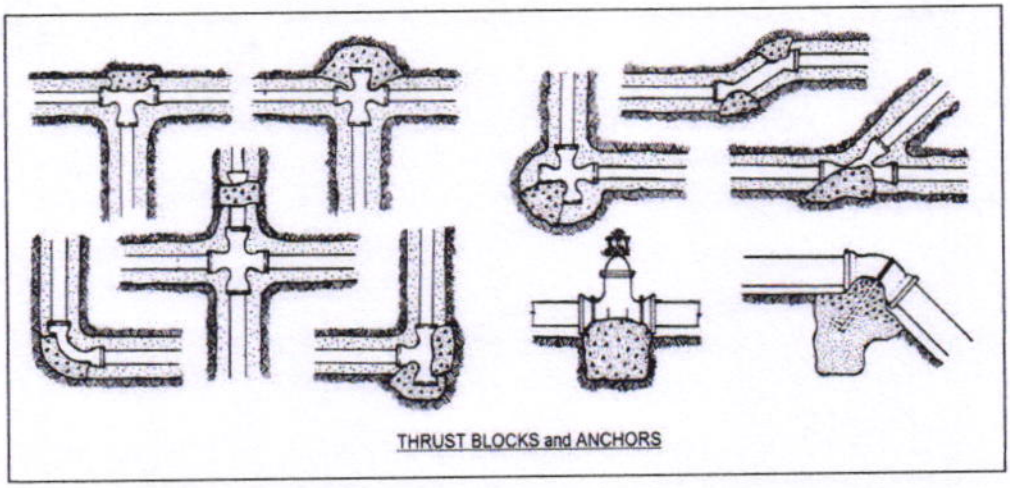
Pipe Thrust Blocks - is a mass of concrete poured in place between the pipe fitting and undisturbed soil at the bottom or side of the pipe trench. It effectively transfers the load from the pipe fitting to a wider surface area on the soil.

Pipe Thrust Anchors - is a mass of concrete with embedded steel strap rods to resist upward thrusts induced by pressure on pipes or fittings.

Generally the concrete mass is poured in place below the fitting to be anchored.

Installation Procedures of Thrust Blocks and Anchors:

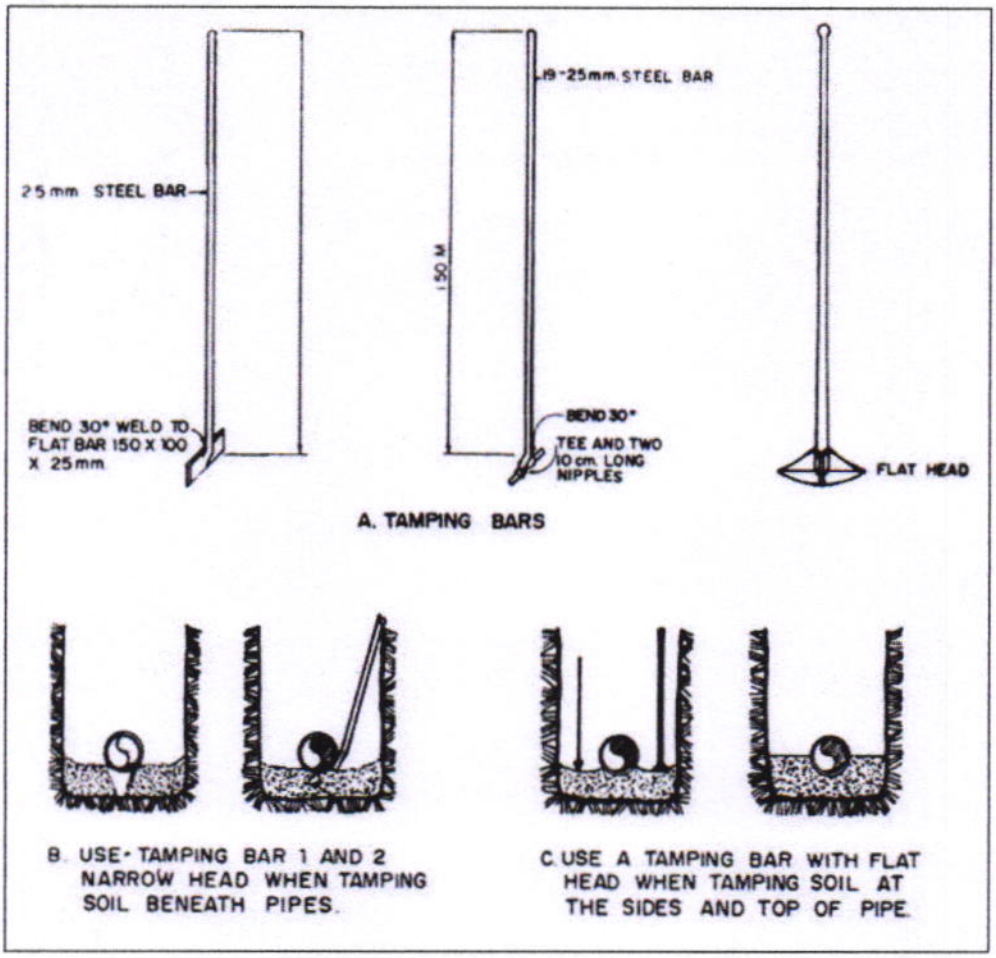
1. Non-structural concrete (2,000 psi) should be placed between the fitting and the undisturbed bearing soil.
2. The concrete should be kept behind the bell of the fitting. It should not be allowed to run over against the pipe or into the join.
3. The concrete should fill in completely around the fitting. The pipe or fitting should not be encased, as there should be allowance for slight movement due to temperature changes and pressure.
4. Thrust blocks are not needed at the welded flanged joints of steel pipes.



THRUST BLOCKS and ANCHORS

f) Backfilling and Compaction

1. Water, if present, must be removed first from the trench using a dewatering pump or other means before backfilling.
2. Backfill always follows pipe installation as closely as possible. This protects the pipe from falling sharp and big rocks, eliminates the possibility of the pipe getting lifted due to flooding of the open trench, and avoids the pipe shifting out of the line due to cave-ins.
3. The person in charge should insist that the backfill be done gently and thoroughly.
4. The first layer of the backfill must always be clean granular material such as sand. Suitable soil can be used if recommended by the engineer.
5. The pipe must be covered evenly for at least 150mm thick from the pipe's surface. Manually compact the sand firmly to avoid damage or movement of the pipe.
6. The succeeding layers of backfill must be selected soil materials, free of large and/or sharp stones and lumps.
7. The remainder of the trench should be filled in layers, 100mm to 150mm thick, with each layer being carefully and thoroughly compacted before the next layer is placed.
8. Use a tamping bar or any other approved mechanical equipment during compaction.
9. If trenches are in a road right-of-way or where there will be a sidewalk, the completed backfill must meet the compaction requirements of the agency concerned. Backfill in other trenches need not be compacted to such a degree.



g) Surface Restoration

1. All damaged and disturbed area due to pipe laying activities must be restored to its original condition.
2. Damaged concrete/asphalt pavement restoration is strictly enforced upon the completion of the pipe laying and hydro testing activities.

3. All concrete pavement surfaces and all concrete base under an asphaltic mix surfaces to be restored shall be scored with concrete cutting equipment into clean straight lines.
4. Clean the sides of the pavements removing foreign particles using clean tap water.
5. In the cases of damaged, adjacent pavements, the damaged area should be included in the surface restoration and inside the perimeter of the scored portion.
6. In the cases of damaged, removed or disturbed fences, post, street signs, surface structures, and other properties, whether through failure or deliberately to efficiently perform the repair works shall be replaced or repaired accordingly to its original appearance and specifications.
7. The prepared concrete mixture for the surface restoration should have a compressive strength of 3000 psi. A concrete mixture ratio of 1 part cement, 2 parts sand and 3 parts aggregate will produce a concrete mix of approximately 3000 psi.
8. The restored portion should have the same thickness or greater than the existing concrete/asphalt pavement.
9. When the concrete is slightly hardened, scrape it using a stick broom.
10. Secure the area using the barricades, warning devices and steel plates (if necessary) to protect the newly restored portion until the concrete reaches its maximum strength.
11. Barricades, warning devices and steel plates should be removed on the site three (3) to five (5) days, depending upon the condition of the restored portion, after the completion of the restoration activities. These should be properly accounted and should be returned to the General Services Section.

12. Accomplished all corresponding documents, signed and dated for record purposes and turn it over to the supervisor.

h) Pipeline Testing

Before being put into service, new pipelines must be hydrostatically pressure tested. All pipeline testing and disinfections operations should adhere to the following practices:

- Pressure and leakage tests are usually done at the same time.
- Testing of pipeline should be done in sections before any permanent resurfacing.
- That pipeline trench is partially backfilled, but all the joints are exposed for observation except in heavily travelled roadways.
- Regardless of the type and size of the laid pipe, maximum lengths of test sections shall be limited to 500 meters for distribution mains and 1,000 meters for transmission mains, so repairs and backfill can be completed as the work progresses. Mistakes in installation can be noted and corrected before a lot of pipes have been laid.

Pressure and Leakage Testing:

For Pressure and leakage testing of pipelines, the following three (3) steps are implemented:

1. Inspection before testing
    - Pipe section must be partially backfill 0.45 m over pipe, to secure from movement, leaving only the joints open for usual visual inspections. All pipe ends must be capped and restrained to prevent movement. Make provisions to relieve trapped air from high points and pipe ends.

2. Visual inspection of leakages
   - Prior to any testing, the pipe section must be cleaned by flushing with a minimum flushing velocity of 0.80 m/s (2.5 feet per second).
   - After filling, apply a slight pressure of at least 20 psi and allow 48 hours for the line to settle and stabilize. During the 48-hour period visually examine all exposed pipe joints, couplings, valves and fittings for possible leaks. Also during this period, examine all thrust blocks especially at test ends for excessive movements due to thrust forces which developed.
3. Pressure and leakage testing/inspection
   - Refer to the applicable specification and procedures as given or follow the specifications as presented below.

"As per LWUA standards, the test shall consist of holding test pressure on each section of the line for a period of two (2) hours. The test pressure at the lowest point shall be 1.0 Mpa (150 psi) according to the class of pipe installed, Class 100 or Class 150. Pressure gauges shall also be provided at all ends of the section tested. The water necessary to maintain the pressure shall be measured through a meter or by other satisfactory means. The leakage shall be considered through a meter or by other means. The leakage shall be considered the amount of water entering the pipeline during the two (2) hour test period."

Formula: AL (allow. leakage) = 1.85 liter/mm [dia.] per [length in km] per [day]

"For all other types of pipes except cast iron or ductile pipe, the allowable leakage should not exceed 1.85 liters/ mm of pipe diameter/ km/ 24 hours."

"Must ensure that all newly installed closure pipes shall be tested and pass leakage test by subjecting the joints (of closure pipes) to a pressure of 50 psi for a period of five minutes and visually checking for leakages."

Refer to the Pressure and Leakage Report as presented.

i) Flushing and Disinfection

Pipe

1. Pipe Flushing
    i. It is important to make sure that the water main is clean before starting disinfection to remove any foreign materials that may interfere with the disinfection activity.
    ii. Flushing should be done through a hydrant or blow-off.
    iii. Minimum flushing velocity is 0.8 m/s (2.5 fps) to attain proper flushing action. On how much water must be used to flush different pipe sizes at residual pressure of 28 m (40 psi).
2. Introduction of Chlorine Solution
    i. Determine pipeline capacity to determine amount of chlorine needed.

ii. A chlorine solution of not more than fifty milligrams per liter (50 mg/l) is pumped at the beginning of a valved section of pipeline until full. Determine chlorine solution with the aid of "Chlorine Residual Test Kit".

iii. The preferred application point is usually at one end of the pipe section through a stop inserted on top of the laid pipe.

iv. The high points of pipe section being disinfected should be properly vented.

v. At the opposite end of the pipe section, a draw-off valve should be provided to bleed or drain water during the injection process.

3. Retention Period of Chlorine Solution

i. The average retention or contact period for 50-mg/l-chlorine solution is 24 hours.

ii. All pipeline valves and appurtenances should be operated to ensure that they are also disinfected.

iii. During the 24-hour contact period, chlorinated water should not be allowed to flow into the potable water distribution system.

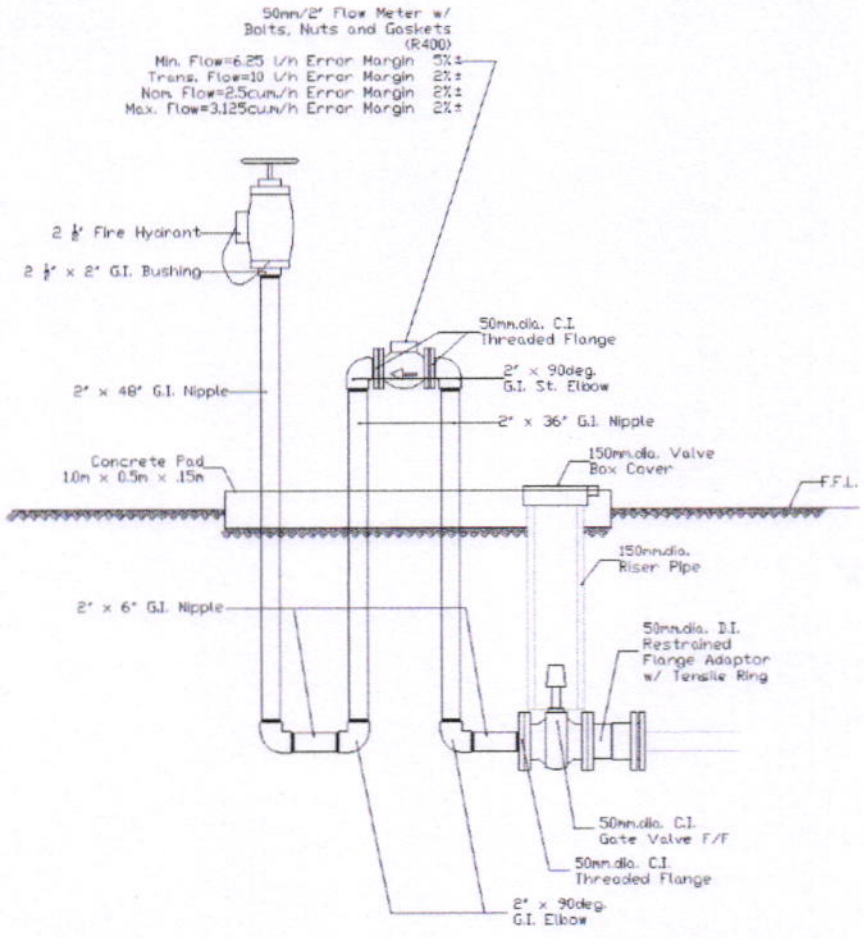
iv. After a contact period of 24 hours, samples should be taken along the entire length of the pipeline and tested for chlorine residual. Residual chlorine shall not be less than 25 mg/l; otherwise the treatment procedure shall be repeated until satisfactory results are obtained.

v. Never discharge highly chlorinated water to the surrounding area to avoid possible damage to properties and persons.

4. Draining and Final Flushing
    i. Drain the chlorine solution through the draw-off valve into a storm-sewer line.
    ii. Use clean water to flush the disinfected pipeline.
    iii. After flushing, the residual chlorine should be between 0.20 to 0.75 mg/l.

j) Drawings

STANDARD FIRE HYDRANT DESIGN



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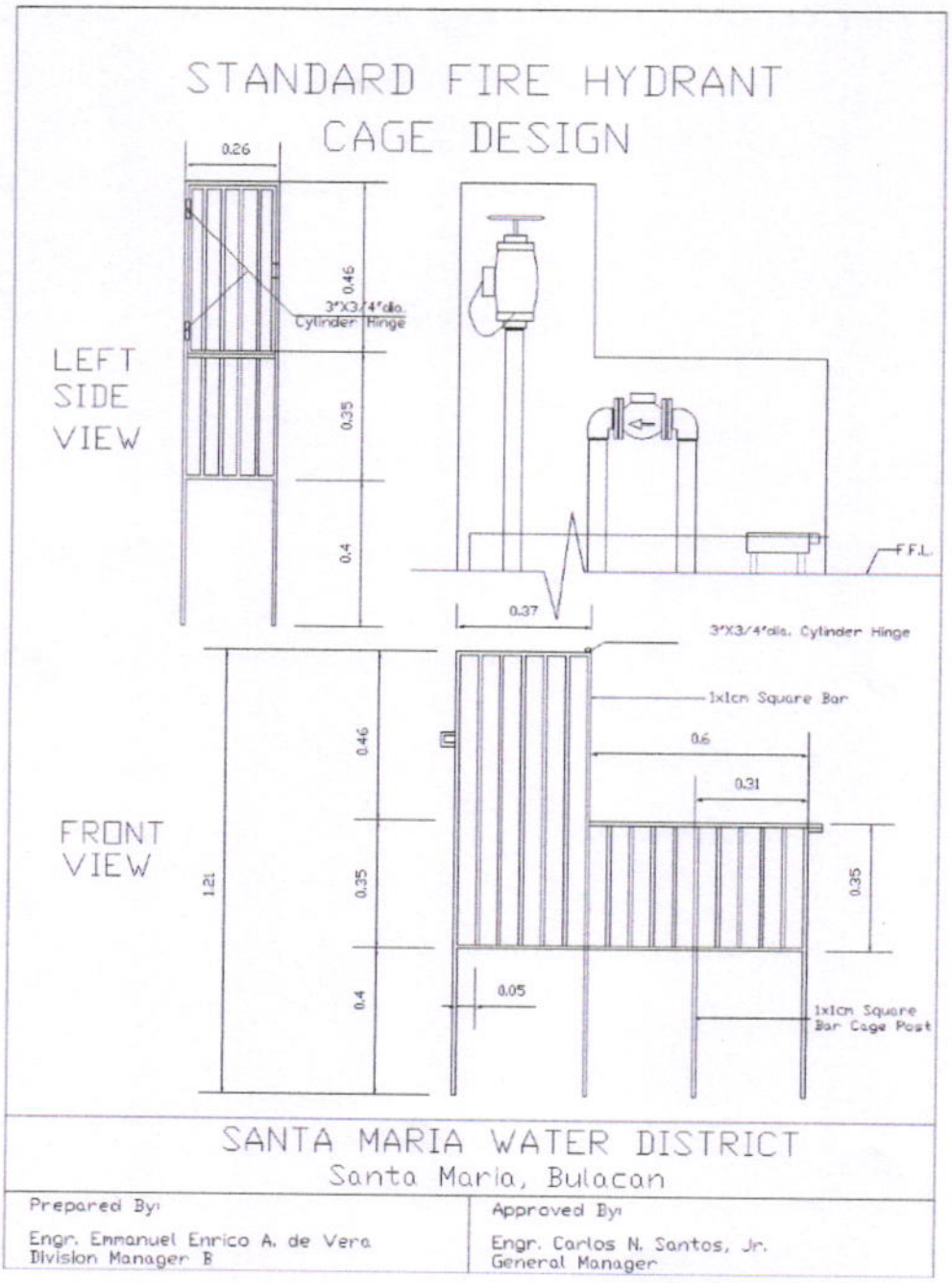
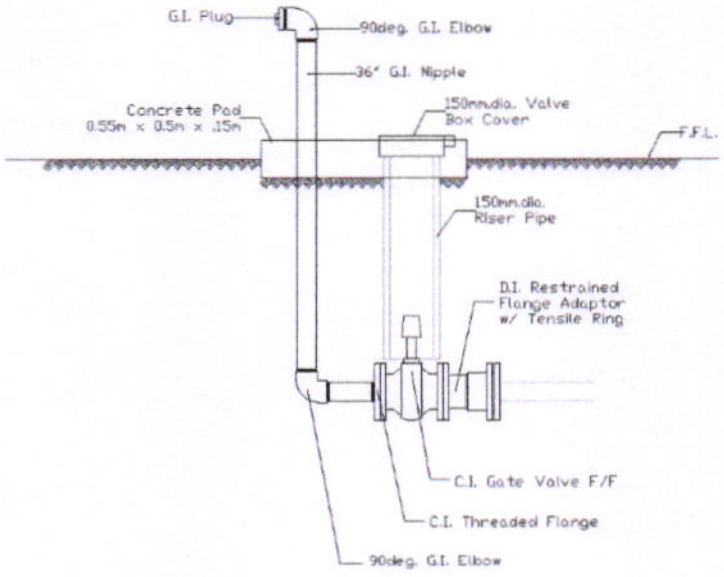

STANDARD FIRE HYDRANT
CAGE DESIGN
LEFT SIDE VIEW
FRONT VIEW
0.26
0.46
0.35
0.4
1.21
3"X3/4"dia. Cylinder Hinge
F.F.L.
0.37
1x1cm Square Bar
0.6
0.31
0.05
1x1cm Square Bar Cage Post
SANTA MARIA WATER DISTRICT
Santa Maria, Bulacan
Prepared By:
Engr. Emmanuel Enrico A. de Vera
Division Manager B
Approved By:
Engr. Carlos N. Santos, Jr.
General Manager

STANDARD BLOW-OFF VALVE DESIGN



Note:
200mm.dia. C.I. and G.I. fittings for 200mm.dia. pipeline.
150mm.dia. C.I. and G.I. fittings for 150mm.dia. pipeline.
100mm.dia. C.I. and G.I. fittings for 100mm.dia. pipeline.
75mm.dia. C.I. and G.I. fittings for 75mm.dia. pipeline.
50mm.dia. C.I. and G.I. fittings for 50mm.dia. pipeline.

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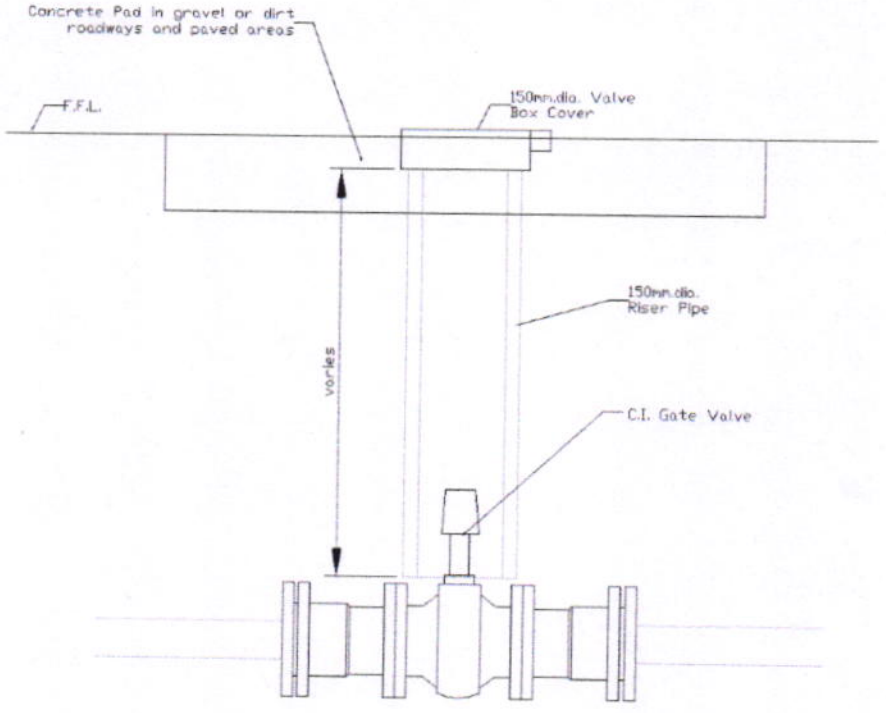
VALVE BOX COVER DESIGN



Note:
- Valves shall have a minimum cover of 0.30m measured to the top of the operating nut.
- Valve box cover shall be adequately designed to carry traffic loads.

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5.4 Outcome of Design and Development (Design and Development Output)

a) Result of the Design and Development will provide additional service connections.

b) The Board of Directors and General Manager shall approve the new design form/requirements as the case maybe.

c) All changes due to the Design and Development outcome will be in accordance with the company's Procedure on Document Control.

5.5 Control of design and development changes

a) Design and development changes may be initiated by the Board of Directors, General Manager, QMR, Department Managers and Division Managers on the bases of the following:
   - newly issued regulations by the national regulatory body
   - new LWUA's requirements
   - new Government requirements/regulations
   - new SMWD requirements

b) Changes or amendments to existing work instructions or processes may be adopted to enhance the Company's capability to cope or comply with the LWUA's and other regulatory requirements.

c) Changes on the Design and Development shall be evaluated by the General Manager, Department Manager (Operations Department) and Division Manager (Engineering Division) and report to the Board of Directors the effect of such changes.

d) The Engineering Division shall maintain records of the results of the review of changes.

6.0 RECORDS/FORMS

STA. MARIA WATER DISTRICT
STA. MARIA, BULACAN

PROJECT:

PIPELINE PRESSURE AND LEAKAGE TEST

Date: _____
Location (street): _____
Pipe Diameter: _____ mm Pipe Materials: _____
Station: _____ to _____ Pipe Class (100/150): _____
Length: _____ m (max 500 m for distribution pipeline)
Check: flushing finished: _____ 48 hours standing by: _____
Any repair done: _____

Sketch (indicate schematically connection of pipes, pressure gauge, pump, valve etc.)

Test Pressure = 120 psi
Allowable leakage = 1.85 liter/mm [dia.] per [length in km] per [day]

Calculations:

Time	Pressure (KPa/psi)	Meter Reading	Difference in M.R.	Accumulative	Remarks

Passed: _____ Failed: _____

Checked By:

_____
Senior Engineer A

Date: _____

Noted By:

_____
Division Manager

Date: _____

PIPE DISINFECTION REPORT

PROJECT: | CONTRACTOR:

FLUSHING BEFORE DISINFECTION

a. Date & Time Duration : _____

b. Velocity : _____

FORM OF CHLORIDE USED:

☐ Powder ☐ Granular ☐ Liquid ☐ Gas

AVAILABLE CHLORINE : _____

PIPELINE DISINFECTED:

LOCATION:	Material	Size	Length

TOTAL CAPACITY OF PIPE TO BE DISINFECTED: _____ Liters

CHLORINE REQUIRED (See Computations)

Weight: _____ Kgs.

RETENTION PERIOD: TIME & DATE STARTED: _____ TIME & DATE FINISHED: _____

CONCENTRATIONS:	A	B	C	A	B	C
Start						
6 hours						
12 hours						
18 hours						
24 hours						
AFTER FLUSHING:						

POINT LOCATIONS: _____ POINT LOCATIONS: _____

Remarks: Failed ☐ Passed ☐

Project Inspector	Contractor	Deputy Resident Engineer	Resident Engineer

Note: 2 Comparator Used

STA. MARIA WATER DISTRICT
Sta. Maria , Bulacan

PROJECT REPORT SUMMARY

PROJECT:
LOCATION:
SOURCE OF FUND:
PROJECT COST:
DURATION:
TOTAL LENGTH:

Dates:	**Construction Materials Used for Restoration:**
Concrete Cutting/Breaking:	White Sand (cu.m):
Excavation:	Gravel (cu.m):
Pipelaying (completed):	Cement (bags):
Interconnection to existing:	Others (if any):
Flushing:	
Hydrotesting:	
Transfer of existing water meters:	
Surface Restoration (started):	
Surface Restoration (completed):	

Length Concrete Cut and Broke:

Length of Surface Restored:	**Volume of Surface Restored:**

Pipelines:

200mm.:	100mm.:	50mm.:
150mm.:	75mm.:	

Fittings:

Prepared By:

ENGINEER

STA. MARIA WATER DISTRICT
Sta. Maria , Bulacan

PROJECT REPORT SUMMARY

Drawings:

Page 2

Prepared By:

ENGINEER

STA. MARIA WATER DISTRICT
Sta. Maria, Bulacan

Concrete Cutting and Breaking Record

Name of Project:
Location:
Fund Source:

DATE	PARTICULARS	START	END	DURATION	LINEAR METERS

Prepared By:

Certified By:

ENGINEER

STA. MARIA WATER DISTRICT
Sta. Maria, Bulacan

Pipe Laying Record

Name of Project:
Location:
Fund Source:

DATE	SIZE x LENGTH	PIECES	TOTAL LENGTH	OTHER FITTINGS / MATERIALS	START	END	DURATION

Prepared By:

Certified By:

ENGINEER

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Sta. Maria, Bulacan

Interconnection and Installation of B.O.V. Record

Name of Project:
Location:
Fund Source:

DATE	VALVES / FITTINGS / OTHER MATERIALS USED		START	END	DURATION

DRAWINGS:

Prepared By:

Certified By:

ENGINEER

STA. MARIA WATER DISTRICT
Sta. Maria, Bulacan

Surface Restoration Record

Name of Project:
Location:
Fund Source:

DATE	CEMENT	SAND	GRAVEL	OTHER MATERIALS	LENGTH	WIDTH	THICKNESS	VOLUME

Prepared By:

Certified By:

ENGINEER