



Calamba Water District

Lakeview Subdivision, Halang, Calamba, Laguna
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PROJECT TITLE : **REHABILITATION OF PUMP SUCTION PIPE**
LOCATION : **BUCAL PUMPING STATION, BGRY. BUCAL, CALAMBA CITY**

I. SCOPE OF WORKS AND SPECIFICATIONS

FOR THE SUPPLY OF LABOR , MATERIALS AND SUPERVISION FOR THE ABOVE PROJECT TITLE

A. EARTHWORKS

- 1 Removal of Existing Pavement: All concrete pavement surfaces to be removed shall be scored with concrete sawing equipment; provided, that any Portland cement concrete base under asphaltic mix surface will not be required to be scored by sawing. Asphaltic concrete pavement shall be removed to clean straight lines.
- The width and length of the pavement area required to be removed for the installation of valves; valve chambers shall not exceed the maximum linear dimensions of such structures by more than 0.30 meters on each side.
- Concrete sidewalks, curbs and gutter required to be removed shall be cut to the nearest score marks.
- 2 Excavation for pipelines shall be open-cut trenches. Excavate trenches with even bottoms, uniform width and vertical sides. The bottom of the trench, including any shoring shall have a minimum and maximum width shown in table of Typical Trench Detail drawing (SD-1). The maximum amount of open trench permitted at any one time and 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.
- When excavating in rock or shale, dig trench 10 – 15 cm below the desired pipe bottom and backfill with compacted sand to proper grade.
- 3 Disposal of excess Excavated Material: Remove and dispose all excess excavated material in manner approved by Engineer.
- 4 Excavation in Lawn Areas: The sod shall be carefully removed and stockpiled to preserve it for replacement. Excavated material from the trench may be placed on the lawn provided a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of back filling and testing of the pipeline, the sod shall be replaced in a manner so as to restore the lawn as near as possible to its original condition.
- 5 Excavation in Vicinity of Trees: Except where trees are shown on the drawing to be removed, trees shall be protected from injury during construction operations and no tree is to be removed without written permission from Engineer. Trees shall be supported during excavation.
- 6 Rock excavation shall include removal and disposal of any kind of rock which cannot be excavated without blasting or the use of rippers, and all boulders or other detached stones each having a volume of 0.25 cubic meter or more as determined by physical measurements by the Engineer.

B. PIPE LAYING

- 1 Installation: Install pipes, specials, fittings, closure pieces, valves, supports, bolts, nuts, gaskets, jointing materials and all other appurtenances as shown and as required to provide a complete and workable installation. Where pipe supports details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all exposed piping shall be complete and adequate regardless of whether or not supporting devices are specifically shown. At all times when the work of installing pipes is not in progress, all openings into the pipe and the ends of the pipe in trenches shall be kept tightly closed to permit entrance of animals and foreign materials.
- 2 Laying of Pipes into Trench: Trenches shall be in a reasonably dry condition when the pipe is laid. The pipe sections shall be laid to the line and grade when shown and they shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointing, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- 3 Field welding of steel pipe joints shall conform with the requirements of the "AWWA Standards for Field Welding of Steel Water Pipe Joints" (AWWA C206). Welded joints shall be inspected and approved by the Engineer before any protective coating is placed around the outside of the joint.
- 4 Electrofusion welding method of HDPE pipe joints is carried out in accordance with DVS 2207 standard.
- 5 Protective Coatings : With pipe smaller than 450 mm (18 in.) in diameter before the spigot is inserted into the bell, the bell shall be daubed with mortar containing one (1) part cement to three (3) parts sand. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of joint shall be swabbed out. With pipe 450 mm (18 in.) in diameter and larger, joints shall be pointed on the inside with mortar as specified for field joints in AWWA Standard C205 after the backfill has been placed. After coated pipe sections have been joined, the coating shall be made continuous across the joints, forming a coating equivalent to the factory-applied coating of adjacent pipe sections. Coating and spark testing of coal tar enamel field joints shall be as specified in AWWA Standard C203 and shall be performed at the expense of the Contractor. The use of coat tar tape to provide the required protection will not be permitted.
- 6 After the pipe sections on cement mortar coated pipe have been joined, but before backfilling has been completed, the outside annular space between pipe sections shall be completely filled with grout. The grout shall be poured in such a manner that all exposed portions of metal joints shall be completely protected with cement mortar. Grout shall consist of one (1) part cement to three (3) parts sand, by weight, and shall be sufficiently fluid to permit it to be poured into the joint space. Exterior field joints shall be coated with cement mortar, retained by suitable forms, so as to bridge the joint.
- 7 The mortar shall be compacted within the form to produce dense coating without voids. The joint coating shall be kept moist until the backfill is placed.
- 8 Connections to Existing Water Mains: Preassemble fittings, valves etc., as far as possible and have all necessary tools and equipment on-site before shutting off the existing main. Pour concrete thrust blocks, if required, to the new line and allow curing for at least eight days before the pipe is put under pressure.
- 9 Thrust Blocking: Concrete thrust blocks, anchor blocks or welded joints shall be provided at all junctions, changes in directions exceeding 11½° or where otherwise shown. Concrete should have a compressive strength of at least 140 kg/cm², 28 days after pouring. This can be accomplished by mixing the following proportions:
 - One part Portland cement
 - 2½ parts clean sand (do not use beach sand)
 - Five parts crushed stone (1 – 3 cm)
 - Enough water to make a workable mix

C. BACKFILL/RESTORATION

- 1 A newly laid pipe shall be backfilled at least 150mm (6in) above the top of the pipe at the end of each day with selected material obtained from the excavation. Materials used for backfill shall be selected, free from grass, roots, brush or other vegetation, or rocks having maximum dimensions larger than 150mm (6 in). If in opinion of the Engineer, said material is unsuitable for backfill purposes, borrow material having the sand equivalent value of not less than twenty (20) (ASTM – D2419) shall be used for this portion of the trench backfill. Selected material shall first be brought up to mid – diameter of the pipe and compacted; then the remainder of the backfill to 150mm (6in) above the pipe maybe placed and compacted. Such material shall be compacted to ninety five percent (95%) of max. density where the trench is located under proposed structures and ninety percent (90%) of max. density elsewhere. Compaction shall be obtained by tamping it not more than 150mm (6 in) layers or by using excess water and passing a concrete vibrator between the pipe and the side of the trench. Obtain and complete (IR) inspection request form prior to backfilling; the works may proceed upon approval of the Supervising Engineer. Remainder of the trench shall be backfilled not later than the following day.
- Barricades and warning lights satisfactory to the Engineer shall be provided and maintain for all in which case of heavy steel plates, adequately braced bridges or other type of crossing capable of supporting vehicular traffic shall be furnished.
- 2 Concrete pavement shall be replaced with the same kind or better material in conformance with the latest specifications, rules and regulation, and subject to the inspection and approval of the agency having jurisdiction.

D. HYDROTESTING/DISINFECTION

- Prior to permanent resurfacing after the trench is backfilled, but with joints exposed, all pipes, slowly with water and has been completely filled; it shall be allowed to stand under a slight pressure for a minimum of 48 hours. The test pressure shall be 100 psi and leakage shall not be less than 0.0777 li per mm per kilometer of length per hour.
- All new domestic water mains or extensions to existing systems, or valve section of such extension or any replacement in the existing water system shall be disinfected with chlorine. Disinfections shall be completed not more than 3 days prior to placing the pipeline into service unless otherwise approved by the Engineer and care shall be taken to prevent recontamination of the pipeline.

II. MATERIALS SPECIFICATIONS

A. PIPES AND FITTINGS

Mortar lined and Enamel or Mortar Coated Steel Pipe

Cylinder Material

- Cylinders shall be fabricated from hot-rolled carbon steel sheets or plates conforming with ASTM A-570 Grades C, D, or E, ASTM A-283 Grade D; steel pipe conforming with ASTM A-139 Grade B or, if approved by the Engineer, high-strength low-alloy steel conforming with ASTM A-572 Grade 42.

Mortar

- The cement mortar used for the lining and coating shall be composed of mixtures of portland cement, aggregate and water, well-mixed and of the proper consistency to produce dense, homogeneous lining and coating that will adhere firmly to the steel cylinder. The cement mortar shall develop compressive strength of not less than 18 MPa (2,600 psi) at twenty-eight (28) days.

Cement

- Cement shall conform with ASTM C-150 and shall be Type 1 for Pipe linings and coatings.

Aggregate

- Aggregate shall conform with ASTM C33.

Welded Joints

- Where welded joints are provided, weld bell type joints may be used, or the bell may be cut back, or a filler rod added so as to permit a field weld between the bell and spigot joint rings.

Pipe Design

Design parameters shall be as follows:

- For cement-lined steel pipes

Class 150

Nominal Diameter (mm)	Thickness (mm) of Steel Cylinder, Mortar-coated	Thickness (mm) of Steel Cylinder, Surface Painted
300 and under	3.4	4.7
350 – 500	4.7	6
600 – 700	6	7.9
750 – 900	7.9	9.5
1000 – 1200	9.6	11.1

- Outside diameters of cement-lined/cement-coated, coal-tar coated and surface-painted steel pipes

Nominal Diameter (mm)	Outside Diameter (mm)
100	114.3
150	168.3
200	219.1
250	273.1
300	323.9
350	391
400	441.8
450	506.6
500	557.4
600	661.6
700	763.2
750	817.8
800	868.6
900	970.2
1000	1075
1100	1176.6
1200	1278.2

Lining

- The mortar for pipe lining shall consist of one part cement to not more than three (3) parts sand by weight. The cement mortar lining shall be applied by the centrifugal method or by a method obtaining equivalent results. The process used in the application of the lining shall produce a smooth, dense durable surface, free from pockets, voids, over-sanded areas, blisters, and excessively cracked areas. Except where otherwise specified or shown, lining thickness shall be as follows, with a tolerance of plus or minus twenty-five percent (25%):

Nominal Pipe Diameter	Lining Thickness
Under 300 mm	6 mm
300 to 400 mm	13 mm
over 400 mm	20 mm

Cement Mortar Coating

- The steel reinforcement in the mortar coating shall consist of: (a) Helically wound cold drawn steel wire or, (b) a cage of self-furring welded steel wire fabric of 50 mm x 50 mm No. 14 gage fabric or 50 mm x 100 mm No. 13 gage fabric, or (c) 25 mm No. 18 gage or 37 mm hexagonal No. 17 gage ribbon mesh, twisted wire fabric, salvaged both edges using steel wire. Helically wound steel wire shall be not less than the thickness of No. 14 gage and shall be embedded at the approximate center of the cement mortar coating.
- Mortar for pipe coating shall consist of one (1) part cement to not more than three (3) parts sand by weight. The cement mortar coating shall be applied by pneumatic placement or by a method producing equivalent results. Except as otherwise specified or shown, coating shall be 25 mm for all sizes.

Special Pipes and Fittings

Specials are defined as bends, reducers, wyes, tees, crosses, outlets, and manifolds, wherever located, and all piping above ground or in structures.

Design

- Except as otherwise provided herein, materials, fabrication, and shop testing of straight pipe shall conform with the 'AWWA Standard for Steel Water Pipe 6 Inches and Larger" (AWWA C-200). Minimum plate thickness of specials shall be computed using the following formula:

$$T = DP/2(Y/S)$$

Where:

T = plate thickness in inches

D = diameter of steel cylinder in inches

P = design pressure (psi)

S = factor of safety, 2.50

Y = specified yield point of steel in psi

- but in no case shall the design stress (Y/S) exceed 91 MPa (13,200 psi) nor shall plate thickness be less than the following:

Nominal Pipe Diameter (mm)	Piping Above Ground Piping in Structures Fittings above Ground (mm)	Fittings Underground Installation (mm)
300 and under	4.7 mm	4.7 mm
350 - 500	6.0 mm	4.7 mm
600 - 700	7.9 mm	6.0 mm
750 - 900	9.5mm	7.9 mm
1000 - 1200	11.1 mm	9.5mm

Outlets, Tees, Wyes, and Crosses

- Outlets shall be welded to the steel cylinder of the pipe following application of mortar coating to the cylinder. Following this, all outlets larger than 50 mm (2 in.) in diameter shall be provided with steel reinforcing saddles, wrapper plates, or crotch plates, or they shall be fabricated in their entirety of steel plates having a thickness equal to the sum of the required thickness of the saddle or wrapper plate, plus the cylinder to which they are attached.

- Such saddles or wrapper plates shall be of steel plate at least 1.25 times the thickness of the pipe cylinder to which the outlet is attached. The total cross-sectional area of the saddle or wrapper plates shall be at least 1.25 times the product of the cut-out length and the plate thickness of the pipe, as determined by the equation in Clause (n) (2). The overall width of the saddle or wrapper plate shall not be more than 2 times, and not less than 1.67 times, the maximum dimension of the cut-out. Outlets 300 mm (12 in.) and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters, i.e., 324 mm (12-3/4 in.), 273 mm (10-3/4 in.), 219 mm (8-5/8 in.), 169 mm (6-5/8 in.), and 114 mm (4-1/2 in.).
- Where required, crotch plates shall be provided, designed according to the nomograph method described in AWWA Manual M-11, Clause 19.5, or AWWA Journal, Vol. 47, No.6, June 1955, pp. 617 to 623.
- Tees, wyes, and crosses shall either be fabricated of steel plate or provided with wrapper plates or with crotch plates. The thickness of the plate or plates, exclusive of crotch plates, being such that when multiplied by the diameter of the opening, will be not less than 1.25 times the cross-sectional area of the cut-out. Where tees, wyes, or crosses are fabricated from steel plate without wrapper plates, the thickness of the plate shall not be less than 2.5 times the required plate thickness shown in the preceding table for such fittings.

Dimensions

- Unless otherwise shown, dimensions of specials shall conform with "AWWA Standard for Dimensions for Steel Water Pipe Fitting" (AWWA C-208) for Service in Transmission and Distribution Systems.

Steel Welding Fittings

- Steel welding fittings shall conform with ASTM A234.

Ends for Mechanical-Type Couplings

- Except as otherwise provided herein, where mechanical-type couplings are indicated, the ends of the pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 300 mm (12 in.) and smaller is furnished in standard schedule thickness, and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

Flanges

- Where the design pressure is 1.2 MPa (175 psi) or less, flanges shall conform with either AWWA C-207 Class D, or E, or ANSI B16.5 1.0 MPa (150 psi) class. Where the design pressure is greater than 1.2 MPa (175 psi), flanges shall conform with ANSI B16.5 2.0 MPa (300 psi) class. Flanges shall have flat or raised faces. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe.

Marking

- A mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.

Lining

- All requirements pertaining to thickness, application, and curing of lining specified for straight pipe shall apply to specials, with the following: provision. If the special cannot be lined centrifugally, it shall be lined by hand. In such case, the lining shall be reinforced with 50 mm x 100 mm (2 in. x 4 in.) No. 12 welded wire fabric positioned approximately in the center of the lining. The wire spaced 50 mm (2 in.) on centers shall extend circumferentially around the pipe with the fabric securely fastened to the pipe. Splices shall be lapped 100 mm (4 in.) and the free ends tied or looped to assure continuity.

Coating

- All requirements pertaining to thickness, application, and curing of coating specified for straight pipe shall apply to specials. Unless otherwise shown, the coating on the buried portion of a pipe section passing through a structure wall shall extend 50 mm (2 in.) inside the outer surface of the wall, or to the wall flange, if one is indicated. Pipe above ground or in structure shall be field-painted.

Shop testing

- Upon completion of welding, but before lining and coating, each special shall be bulk-headed and tested under a hydrostatic pressure of not less than one and one-half (1-1/2) times the pressure for which the pipe has been designed; provided, however, that if straight pipe used in fabricating the special has been previously tested in accordance with Clause (n) (2) herein, the circumferential welds may be tested by a dye penetrant process using Turco Dy-Check or approved equal, with no further hydrostatic test. Any pinholes or porous welds which may be revealed by the test shall be chipped out and re-welded and the special retested.

HDPE Pipe and Fittings

- 1 Materials : Shall be made from PE 100 virgin compounds as defined in PNS ISO 4427:2002/AMD 01:2002; PWWA NM 201:2002(Philippine National Standard for Polyethylene Pipes for Potable WaterSupply) or approved equivalent. All compounds shall qualify for a rating of PN 16 (232 psi) for water and as per requirements of above mentioned standards.
- HDPE compound used to make pipes shall contain no ingredients that has been demonstrated to migrate into water in quantities considered to be toxic and microbial growth hazard. Pipe should be free from unpleasant taste and odor.
- Pipe shall have a wall thickness of DR-11 and a working pressure rating of 160 psi.
- Pipe shall be furnished in steel pipe pipe sizes (DIPs).
- Joints shall be thermally butt-fused according to the recommendations of the manufacturer.
- 2 HDPE to Steel Pipe and Steel Pipe Fittings;
 - a. Mechanical Joint Adapters shall be used to connect polyethylene pipe to mechanical joint fittings and appurtenances that meet AWWA C111/ANSI A21.11.
 - b. Flanged joints shall be used to attach HDPE pipe to valves or Steel Pipe fittings using HDPE Flange Adapter, Back-Up Ring, Gaskets and Bolts, Nuts and Washers.
- 3 Marking - All HDPE pipes shall be clearly marked at intervals of not more than 1.0 LM with nominal size, type of material, manufacturer's trade name and production code.
- 4 Random Testing: For every size, two (2) sample pipes representing each lot of one hundred (100) pieces or less shall be tested for compliance with this specification. Any visible defect or failure to meet the quality standards herein will be grounds for rejecting the entire order.
- 5 Certification: The manufacturer shall furnish a sworn statement that the inspection and metallurgical and pressure tests have been results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification shall be submitted to Calamba Water District.

B. VALVES

Gate Valves

1 Valve Description

- All valves shall conform to the AWWA Specifications C509 (STANDARD FOR RESILIENT SEATED GATE VALVES). Component parts are constructed of heavy, rugged proportions for extra strength to withstand pipe strain and possible shifting in underground service. Gate valves shall be flange or mechanical joint where the pipelines design pressure is 1.0MPa (150 psi) or less be designed for minimum water working pressure of 1.0 MPa (150 psi).

2 Valve Construction

- The body shall be cast iron.
- The gate valve shall be flanged and mechanical joint. Flanges and drilling shall conform to ISO 7005 – 2
- All the resilient gate valves have a full bore with same nominal diameter as the pipeline. The full bore ensures minimum pressure loss, as the valve does not cause any reduction in the flow path, other great advantages are that the full bore allows drilling and facilitates pipe pigging to ensure high quality potable water.
- The ductile iron core is full vulcanized with EPDM rubber internally and externally. No iron parts are exposed to the medium and the excellent rubber vulcanization prevents creeping corrosion underneath the rubber.
- The fixed integral wedge nut reduces the number of moveable valve parts and risk of malfunction.
- The valve shall have 50mm (2 in) square operating nut with cast arrow showing direction in which the nut is to be turned open the valve.
- The body and cover bolts and nuts shall meet specifications of ASTM A-307 (rust proofed).

3 Coatings

- All valve casting to be shot blasted prior to epoxy coating. Epoxy coating shall conform to AWWA Specifications C550 (PROTECTIVE EPOXY INTERIOR COATINGS FOR VALVES AND HYDRANTS). Body and bonnet are coated internally and externally. Layer thickness shall be 250-400 microns on flat and pressurized parts and 150-300 microns on convex outer edge.

4 Testing

- For every size and type of wedging mechanism, two sample gate valves representing each lot of one hundred (100) pieces or less shall be tested for reliability of operation. This test is in addition to those required under section 28.2 and 28.3 of AWWA C500. The shell and seat should be tested equal to 1.5 MPa and 1.1 MPa respectively. The manufacturer shall furnish one certified copy of the test reports to the Calamba Water District.

5 Certification

- The manufacturer shall furnish a sworn statement that the inspection and metallurgical test and pressure test have been results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI 61 shall be submitted to Calamba Water District.

Foot Valves

- 1 The foot valve shall have a heavily constructed cast iron globe style body with internal flanges. The flow area through the body shall be 10% greater than the equivalent pipe size.
- 2 The plug and seat shall be bronze.
- 3 The plug shall be center guide from both ends to ensure shut-off. The downstream side of the plug stem shall be guided by a bronze bushing inside the hub of the body spokes. The upstream side of the plug stem shall be guided by the bore in the center hub of the bronze seat.
- 4 The seat shall have a resilient Buna-N seal compression molded, not glued or chemically bonded, for positive water tight shut-off at low pressure head.
- 5 The strainer cap shall be stainless steel expanded metal with a steel flange. The strainer cap shall be bolted to the foot valve body.
- 6 All parts easily repaired on-site.
- 7 ANSI Class 125 # Flanged connection. Sufficient flange bolts; nuts and gaskets shall be furnished.
- 8 Epoxy lining and coatings for valves shall conform to AWWA C550 (PROTECTIVE EPOXY INTERIOR COATINGS FOR VALVES AND HYDRANTS).

- 9 The manufacturer shall furnish a sworn statement that the inspection and metallurgical test and pressure test have been results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification including compliance with NSF/ANSI shall be submitted to Calamba Water District.

Valve Box Cover / Manhole Frame

- 1 The manhole frame and cover shall be round manufactured from cast iron or ductile iron conforming to ASTM A-126, Class B or ASTM A-536-80, Class 400 respectively.
- 2 The frame depth shall not exceed 200mm and four (4) bolt holes shall be provided for anchoring purposes.
- 3 The cover shall be 575mm – 625mm in diameter. The face of the cover shall include the name and/or logo of Calamba Water District. The name/logo shall be cast into the cover during manufacture.
- 4 The cover shall be connected to the frame with a hinged. A locking mechanism shall be included to prevent unauthorized access.
- 5 The cover shall be one-man operable and shall be designed for a maximum highway loading.
- 6 Certification: The manufacturer shall furnish a sworn statement that the inspection and metallurgical and pressure tests have been results thereof comply with the requirements of the applicable Standard(s) herein specified. A copy of the Certification shall be submitted to Calamba Water District.

Concrete

- 1 Portland cement: Cement shall conform to the Standard Specifications for READY MIXED CONCRETE, ASTM C-94. An air-entraining admixture, conforming to ASTM C-260, shall be added to Type I, Type II or Type III Portland Cement.
- 2 Aggregates: All aggregates used for concreting shall conform to ASTM-33 and shall be checked daily for any variances in moisture current. Said variances shall be corrected and/or taken into consideration for each batch.
 - a. Coarse Aggregates: Shall be uniformly and evenly graded for each application in accordance A.C.I. Standard 318. Unless otherwise approved, aggregate shall be sound, crushed, angular granitic stone. Smooth or rounded stone (river rock) shall not be acceptable.
 - b. Fine Aggregates: Shall consist of natural sand, manufactured sand or a combination thereof.

III. REFERENCE DRAWINGS

BSP 1 - Location Plan
BSP 2 - Distribution Plan View
BSP 3 - Detail Plan
SD 1 - Typical Trench Details
SD 2 - Horizontal Concrete Thrust Block Details
SD 3 - Vertical Concrete Thrust Block Details
SD 4 - Installation of Buried Gate Valve
SD11 - Concrete Encasement Detail

IV. ACCEPTANCE

- 1. No Leaks
- 2. Proper Waste/Debris Disposal
- 3. Proper Concrete Restoration

V. WARRANTY

- One year against defects of materials and workmanship from the date of issuance of Certificate of Completion.

VI. OPTIONS

- Trenchless installation of underground pipes with concrete encasement. Contractor shall submit detailed scope of works and Bill Of Quantity.

VII. OTHERS

- 1. Contractor should submit all the necessary documents such as Materials Mill Certificate or equivalent prior to inspection/delivery, Detailed Daily Schedule of Activities during Kick off Meeting, etc...
- 2. Construction Safety and Good Housekeeping must be observed at all Times.
- 3. Contractor should include product catalogue of materials in their proposal for evaluation purposes.

NOTES :

1. All embedded pipe across the highway should be with concrete encasement
 2. Dismantling of existing steel pipe to be replaced should be included.
 3. Reference - LWUA TECHNICAL STANDARDS and CWD EXISTING STANDARDS.
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