STANDARD SPECIFICATIONS & DESIGN GUIDELINES
POTABLE WATER FEEDERMAIN CONSTRUCTION

The City of Calgary
Water Resources

2019

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PREFACE: REVISIONS

The following substantive revisions or additions have been made since the 2018 version of this document:

- Addition of AWWA C950 Fiberglass Potable Water Pipe
- Clarification of Water Operations Coordination Committee (WOCC) Approvals
- Water velocity requirements
- Depth of cover considerations
- Vertical risers and shaft clarifications
- Ladder materials
- Steel pipe internal joint repair considerations
- Holiday testing clarifications
- AWWA C301 and C303 specification revisions
- AWWA C900/C909 thickened bell requirements
- Mainline butterfly valve specification revisions
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- Field welded restraint clarifications
- Casing pipe specification revisions
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- Welder certification clarifications
- Clarification of hydrostatic testing of existing feedermains
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- Hot tapping specification revisions
- Revised Reference Drawings and Layout

1. COPYRIGHT AND DISCLAIMER

1.1. Copyright

1.2. Disclaimer

Manufacturers listed in this Standard Specifications Feedermain Construction are approved by The City of Calgary, Water Resources to supply only those materials specified. Unless otherwise specified or directed by City of Calgary Engineers, no alternates will be permitted.

1.3. Warnings

All deviations from these Specifications and approved Construction Drawings shall have the written approval of The City of Calgary Engineer. Any person or organization using this Specification outside the scope of a City of Calgary project, does so at their own risk.

2. INTRODUCTION AND DEFINITIONS

2.1. Definitions

(a) AWWA – refers to the American Water Works Association. All AWWA Standards referenced in this document refer to the latest published version.

(b) C200 – refers to Steel Pipe as per the latest version of AWWA standard C200.

(c) C300 – refers to Reinforced Concrete Steel Cylinder Pipe as per the latest version of AWWA standard C300. This pipe is also referred to as 'RCP'.

(d) C301 – refers to Prestressed Concrete Steel Cylinder Pipe as per the latest version of AWWA standard C301. This pipe is also referred to as 'PCCP', 'C301-L' for lined cylinder pipe or 'C301-E' for embedded cylinder pipe.

(e) C303 – refers to Bar Wrapped Concrete Steel Cylinder Pressure Pipe as per the latest version of AWWA standard C303. This pipe is also referred to as 'BWCCP'.

(f) C900 – refers to Polyvinyl Chloride Pipe as per the latest version of AWWA standard C900. This pipe is also referred to as 'PVC'.

(g) C906 – refers to High Density Polyethelyne Pipe as per the latest version of AWWA standard C906. This pipe is also referred to as 'HDPE'.

(h) C950 – refers to Fiberglass Potable Water Pipe as per the latest version of AWWA standard C950. This pipe is also referred to as 'FRP'.

(i) Engineer – is The City of Calgary's designated Project Engineer or Subject Matter Expert employed by The City of Calgary Water Resources or Water Services. This individual must be a Professional Engineer licensed by APEGA to practice in Alberta.

(j) Inspector – is The City of Calgary's designated field inspector employed by the City of Calgary Water Resources or Water Services.

(k) PVC – refers to Polyvinyl Chloride Pipe also known as C900.

(l) HDPE – refers to High Density Polyethelyne Pipe also known as C906.

(m) WOCC – refers to The City of Calgary's Water Operations Coordination Committee which coordinates feedermain shutdowns in consideration of schedules, system requirements and project risk.

2.2. Purpose

The intent of these specifications and guidelines are to communicate The City of Calgary's requirements involved in the design, construction and commissioning of feedermains for the potable waster supply system. It is to be used as a reference by City of Calgary staff, Consultants, Developers and Contractors.
All plans and drawings constituting the specific Contract Documents to install a feedermain shall be stamped and signed by a Professional Engineer licensed to practice in Alberta.

2.3. Precedent of References

This Standard Specifications & Design Guidelines Feedermain Construction shall be included by reference in the Contract Documents for the installation of feedermains.
Precedence of any specifications concerning the installation of feedermains shall rank in the following order:

1.	Standard General Conditions	of the Contract Documents
2.	Project Specifications, including Special Conditions	of the Contract Documents
3.	Standard Specifications Feedermain Construction (latest edition)	this specification document
4.	Standard Specifications Waterworks Construction (latest edition);	standards for distribution potable water pipe
5.	Manufacturer's specifications or recommendations;	various
6.	AWWA Standards;	approved standard
7.	Any referenced standards or manuals	contained/noted in this specification document

2.4. Prohibited Use

These specifications are not:

(a) in lieu of hiring a professional engineer;
(b) to replace good engineering judgement by the engineers engaged on a project;
(c) a reference for work undertaken for other municipalities or organizations without the written consent of the Engineer;
(d) for designing sanitary or storm forcemains, siphons or gravity mains

2.5. Feedermains and Distribution Mains

The City of Calgary's potable water supply system is separated into two categories of pipe, feedermains (also referred to as transmission mains) and distribution mains.

(a) **Feedermains**

i. Feedermains are typically water pipes 500 mm (20”) nominal diameter or larger, and normally there is no direct hydrant or customer service. Feedermains supply Pump Stations and Reservoirs, and supply the distribution system through cross tie lines.

ii. Feedermains are designed to have the capability to be completely drained to allow access for maintenance, repair and inspection if required.

iii. Feedermains are considered major capital utility infrastructure that are typically funded through The City’s capital budget.

(b) **Distribution Mains**

i. Distribution mains are usually 400 mm (16”) nominal diameter or less, with direct customer service connections and hydrants. Distribution size pipe and related fittings are covered in the Standard Specifications Waterworks Construction.

ii. Distribution mains are typically funded by area developers and then donated to The City of Calgary.

This document will primarily cover water pipes 450 mm (18”) in diameter and larger.
For smaller water pipes which act as transmission lines see Section 2.5(c).

(c) **Small Diameter Feedermains (400 mm and smaller)**

i. In some instances a water pipe less than 500 mm (20”) in diameter acts as a feedermain or must be treated as one Examples of these include:
   a) Intake or discharge headers from a pump station or reservoir.
   b) Regional water lines
   c) Distribution lines which have long distances between other distribution or service connections.

ii. It is up to the discretion of the Engineer as to when a water pipe less than 500 mm shall be treated as a Feedermain.

iii. In these cases, the design of a small diameter Feedermain must incorporate design considerations to allow for filling, draining, sampling, flushing and air release/allowance.

iv. Unique design considerations can include features such as hydrants instead of an air valve or drain chamber at the discretion of the Engineer.

ITEM	**DISTRIBUTION MAIN**	**FEEDERMAIN**
Size	Up to **400** mm Diameter (Exceptions include regional pipelines, 400 mm pipe with long distances between distribution	**500** mm and larger Diameter (can be smaller diameters in unique circumstances)

	ties, or pipes leading in or out of a pump station or reservoir)	
Typical Pipe Availability	In stock locally	Custom designed and fabricated based on a customer's order
Typical Funding Strategy	Developer funded, asset donated to The City of Calgary	Major capital budget item
Typical Magnitude of Failure	Localized impact and damage	Major damage and widespread customer inconvenience. Threat to life and limb.
Designer expertise	Junior to intermediate technician or engineer guided by Standard Specification Waterworks Construction	Senior engineer guided by Standard Specification Feedermain Construction
Line Assignment	Assigned by development guidelines with fixed offset from property line.	Designed to minimize length, provide ease of construction, economize on costs, and avoid environmental areas.

2.6. General Requirements

(a) **Rights of the Engineer**

i. The Engineer will be the ultimate approving authority of feedermain design and material decisions based on input and recommendations from Consultants, Contractors, Inspectors and Manufacturers.

ii. The Engineer is responsible for preparing and awarding the Construction Completion Certificate (CCC)

iii. The Engineer is responsible for preparing and awarding the Final Maintenance Certificate (FMC)

(b) **Responsibility and Authority of the City of Calgary Inspector**

i. The City will supply the inspection service, normally on a full time basis.

ii. The Inspector is the Engineer's representative on site.

iii. The Contractor shall provide the Inspector with free and uninterrupted access to all work areas for the purpose of carrying out inspections.

iv. The Contractor shall provide, at the Contractor's own cost, such labour and equipment as may be required to enable the Inspector to carry out a complete inspection of all materials and installations.

v. The Contractor shall provide adequate samples of materials for testing purposes.

vi. The Inspector has the authority to stop work and order the re-excavation and removal of all installations if any material or installation method employed does not conform to these specifications or City approved drawings.

vii. All defective material found during the progress of the work shall be rejected by the Inspector.

viii. All rejected materials shall be promptly removed from the work site by the Contractor at the Contractor's own cost.

ix. The Inspector will be involved in the pre-construction meeting and work with the Engineer and the Contractor to:
   a) lay out the various rules and regulations;
   b) review the safety procedures and related documentation;
   c) review the contract obligations;
   d) check the manuals and references to use;
   e) preparation of daily quantities of work done.

x. The Inspector is responsible for checking the site during the maintenance period.

(c) **WOCC Approval**

i. Any work requiring a feedermain shutdown, drain or control requires the approval of WOCC.

ii. All WOCC requests must be submitted to WOCC a minimum of six (6) months prior to the proposed work and include the following details:
   a) Scope of work
   b) Location
   c) Schedule and duration
   d) Required valve closures
   e) Single or double valve shutdown if applicable
      1. Note that double valve shutdowns will only be approved where a water network review indicates it is feasible, and the project's design is unable to allow for a single valve shutdown.
   f) Contact info

(d) **Timing and Contacts**

i. In addition to WOCC approval, the Contractor must give the Inspector and Valve Crew Supervisor a minimum of 14 working days notice of the intention to commence construction of any work on new or existing feedermains. It is the Contractor's responsibility to ensure that all work is inspected by Inspectors prior to back-filling. If the Contractor does not ensure this, then the Contractor is responsible for all costs associated with any work required to undertake the inspection.

ii. The Construction Completion Certificate (CCC) and the Final Maintenance Certificate (FMC) will not be issued if the inspection of new construction and/or maintenance work was not requested.

3. DESIGN CONSIDERATIONS AND GUIDELINES

3.1. Design Team Selection

(a) A design team must incorporate the Engineer, Surveyor (City or private), Draftsperson (City or private), Inspector (City) and Consultant (if applicable).

3.2. Planning Guidelines

All planning assumptions shall be finalized by The City prior to design:

(a) Proposed internal pipe diameter;
(b) Proposed route (alignment);
(c) Proposed size and location of connection points to existing Waterworks infrastructure (tie-ins to distribution mains, pump stations and reservoirs);
(d) Potential land requirements;

3.3. Design Basis

First and foremost, all feedermain designs must consider the following factors:

(a) Constructability
  i. Time, including material lead times
  ii. Appropriateness of specifications
  iii. Disruptions
  iv. Routing and obstacles
  v. Tie-ins, man entry and one-valve or two-valve shutdown requirements
(b) Reliability
  i. Target of 100 year lifespan
  ii. Modes of failure
  iii. Impacts of failure
(c) Operability
  i. Lifecycle costs
  ii. Accessibility
  iii. Repairability
  iv. Safety

3.4. Valves

(a) Unless approved by the Engineer, large diameter valves are to be housed in valve chambers.
(b) Typical spacing for valves is:
  i. At a minimum every 1500m.
  ii. At intersections of feedermains
  iii. As otherwise specified by the Engineer

3.5. Confined Entry and Access Manholes

(a) Personnel access is not permitted for pipe 750mm (30") in diameter and smaller.

(b) For all feedermains, flanged 600mm (24") diameter access ports are to be installed for entry and retrieval of equipment and/or personnel.

(c) Access ports typically are buried or are installed in manholes and need to be spaced approximately every 300m. This spacing is recommended due to:

i. The City of Calgary Fire Department will not enter the pipe and travel distances greater than 150m for rescue operations.

ii. Robotic condition assessment limitations.

iii. Welding equipment limitations for interior joint welding.

(d) Access ports are to be installed on top of the pipe at the 12 o'clock position with lengths as per the applicable AWWA standard.

(e) Access ports shall be available within 150 m of each side of a valve.

(f) Any time that entry is required into the pipe a Two Valve Shut Down condition is required on each side of the section of pipe being inspected.

(g) Crews entering the pipe are required to supply their own portable tripod or truck mounted safety hoist, so a permanent winch davit is not required on the manhole slab.

(h) Manholes deeper than 3m do not require internal platforms as they can interfere with confined entry equipment

3.6. Pressure Determination

(a) **Maximum Static Pressure** = reservoir level (or maximum pump head) – lowest elevation of pipeline

(b) **Working Pressure** = maximum static pressure + pump pressure allowance (10 m)

i. Practically, this should normally be based on the maximum reservoir or pump head within any unique pressure zone less the lowest elevation of the specific portion of the system being classified for working pressure.

ii. Working pressure can also be based on hydraulic grade line less pipe elevation, but in this case the designer is cautioned to consider possibility of inadvertent valve closure or very low demand conditions that could expose pipelines to maximum static head. Sections of pipelines close to pumping stations should have both design conditions reviewed to ascertain the maximum applied working pressure (i.e. maximum and minimum flow conditions).

(c) **Recurring Surge Pressure**

i. For thermoplastic materials the consideration of recurring pressure changes due to such things as pump on/off cycles

(d) **Transient Pressure**

i. Shall be the greater of:

a) Simplified or detailed transient analysis

b) 1.5 x Working Pressure

c) Minimum pressure specified in applicable AWWA standard

ii. Pipeline configuration should be reviewed with consideration given to length of pipe run, pipe materials, pressure control devices in the system, automated valves, and valves with the ability for fast closing times.

iii. In the absence of a detailed analysis, a conservative transient allowance may be used based on a reasonable review of system configuration or simplified transient assessment techniques such as the use of the Joukowski Equation solution to an instantaneous stoppage of flow at the maximum design velocity.

$$\Delta P = \rho c \Delta v$$

where:
ΔP = change in pressure
ρ = fluid density
c = sonic velocity in the pipe
Δv = change in fluid velocity

iv. In situations where transient pressures are a significant component of design beyond the minimum allowance noted below or where feedermains are within 2000 m of a pump station, the designer shall carry out detailed assessment.

(e) **Design Pressure**

i. Shall be the greater of:
   a) Transient Pressure
   b) 150 psi.
   c) Maximum Static Pressure

(f) **Test Pressure**

i. Shall be the greater of:
   a) 1.5 x Working Pressure
   b) Design Pressure
   c) Minimum pressure specified in the applicable AWWA Standard

3.7. Water Velocity Confirmation

(a) Infrastructure Planning typically determines the appropriate pipe diameter given The City's design criteria of providing maximum hour demand flows without exceeding velocities of 2 m/sec. Velocities of 3 m/sec or more may be permitted provided an engineering review of the specific feedermain has been made including acknowledgement of transient, head loss and erosion.

Applicable industry standards must be adhered to including:

i. AWWA C509 for valves – 5 m/s
ii. AWWA C205 for cement mortar pipe – 6.1 m/s

iii. AWWA M9 for concrete pipe – 0.6 to 2.1 m/s, or up to 3 m/s for short lengths.

3.8. Pipe Material Selection

(a) Pipe material shall be based on analysis of available pipe material types versus required project specifications, and operations and maintenance during future emergency repairs.

(b) Where any one of the following soil parameters exist in any single sample along the pipe alignment, cement coated AWWA C200, AWWA C300, C301 and C303 that has no additional polyurethane or epoxy barrier coating, will not be permitted at the discretion of the Engineer:

i. pH < 5.5
ii. Sulphates (SO4) >= 2000 mg/L
iii. Chlorides >= 70 mg/L

Soil samples for the purpose of material selection must be taken in 50 m intervals at the proposed pipe zone along the pipe alignment.

(c) Final pipe material selection from approved materials shall be at the Engineer's discretion.

(d) All designs shall be in accordance with the applicable AWWA design manuals for the given material:

i. AWWA M9 Concrete Pressure Pipe;
ii. AWWA M11 Steel Pressure Pipe;
iii. AWWA M23 PVC Pressure Pipe;
iv. AWWA M55 PE Pipe;
v. AWWA M45 FRP Pipe

3.9. Depth and Cover

(a) Designs are to minimize high and low points while keeping cover at an optimal envelope of 2.5 m minimum cover and maximum invert depth of 4.0 m.

(b) Cover of 1.5 to 2.5 m over the top of the pipe may be allowed with insulation at the discretion of the Engineer.

(c) Cover up to 6.0 m to the top of the pipe may be allowed at the discretion of the Engineer.

(d) In spite of the actual installation cover being less, in many cases the pipe shall be ordered designed for 6.0m of cover in order to allow for future cover changes as in many instances the feedermain installation precedes development of roads and subdivisions.

(e) All insulation designs shall use a Degree Days Frost value of 1775 or greater.

(f) Temporary cover of less than 1.5 meters may be allowed at the discretion of the engineer provided that:

i. Frost protection requirements are addressed
ii. Horizontal and vertical thrust block integrity is maintained
iii. Live load and dead load structural impacts are addressed.

3.10. Vertical & Horizontal Alignment

(a) Minimize changes in grade and maximize the lengths between grade changes;
(b) Combine vertical and horizontal bends into combined bend fittings, wherever possible;
(c) Make grade changes at specific points, with straight grade sections between points
(d) Minimize the number of air valve and drain chambers, by minimizing grade changes wherever possible.
(e) Minimum longitudinal pipe slope is 0.1%. While there is no technical requirement for minimum gradients in pressure systems, the minimum grade is utilized to aid in pipeline drainage for inspection
(f) Geotechnical soil samples must be taken at no more than 500 m intervals along the proposed pipe alignment.
(g) Vertical risers or shafts are not allowed unless approved by The Engineer. Vertical shafts prevent future conditions assessment, make repairs difficult, and have the potential of causing cavitation.

3.11. Dead Load

(a) Shall be based on the greater of:
  i. Depth of cover + 0.6 m future cover allowance
  ii. 6 m
(b) Soil unit weights:
  i. 1900 kg/m3 for cohesive materials and silts
  ii. 2200 kg/m3 for granular backfill
(c) Flexible Pipe
  i. For PVC, shall be designed as per AWWA M23 in accordance with AWWA C605.
  ii. For HDPE, shall be designed as per AWWA M55
  iii. For FRP, shall be designed as per AWWA M45
  iv. For non-cement coated or lined AWWA C200 steel, shall be designed as per AWWA M11 with a deflection of no more than five (5) percent of pipe diameter.
(d) Rigid and Semi-Rigid Pipe
  i. For AWWA C301, shall be designed as per AWWA C304.
  ii. For AWWA C303, shall be designed as per AWWA M9.
  iii. For cement coated and/or lined AWWA C200 steel, shall be designed as per AWWA M11 with a deflection of no more than two (2) percent of pipe diameter.

3.12. Live Load

(a) As a minimum, specify AASHTO HS 20 Live loading or CHBDC CL -625 Loading, using an AASHTO LRDF load distribution factor of 1.0 for ordinary fill or 1.15 for select granular backfill. For specific installations, consideration should be given to other live loads if they exist, including larger truck designs, railways and abnormal construction considerations such as large cranes. For these conditions, use

accepted analysis techniques such as Boussinesq theory to compute pressure at surface of pipeline.

(b) Impact Factor shall be applied as per AASHTO LRDF, 33 % at 0 m cover diminishing to 0 % at 2.45 m cover.

3.13. Pipe Bedding

(a) The City of Calgary Standard "Class B" Standard Watermain Bedding Detail will yield a Modulus of Soil Reaction of approximately 1500 psi if properly compacted.

(b) For conservatism and for situations where proper compaction cannot be achieved (winter, groundwater, unstable trenches) E' = 1000 psi is recommended.

(c) For C301 Pipe, designs shall assume AWWA M9 R4 bedding and Olander Moment, thrust and shear coefficients.

3.14. Pipe Layout and Fabrication Drawings

(a) **Pipe Layout Schedules**

Layout drawings shall indicate the lengths of all straight line pipe, standard pipe and all special sections and fittings referenced to the stationing and grade line shown on the plan and profile drawings. All straight line pipe, standard pipe and special sections and fittings shall be assigned a sequential and identifying 'Mark' number or letter. No changes to stationing, alignment or grade shall be made without the approval of the Engineer.

For pipe with field alterable laying lengths, the laying schedule shall include general arrangement of pipes, and shall be designed to minimize the number of field cut pieces. Where short pipe are required, the minimum pipe lengths recommended by the Manufacturer shall be noted.

Minor adjustments to pipe design plans to suit standard pipe lengths, may be allowed on approval of the Engineer.

(b) **Fabrication Drawings**

Fabrication drawings shall show in detail the following:

i. all dimensions required for fabrication
ii. all material specifications
iii. all material thicknesses
iv. all reinforcement detail
v. all tolerances
vi. all welding details
vii. all applicable reference and standard specifications
viii. any variation to the coating and lining specified.

(c) **Verifications**

The Supply Contractor shall submit details of the pipe design for review by the Engineer prior to manufacture. Design shall show details of design loads, pressures and other criteria used; including typical wall sections for the straight pipe, specials and connection Submittals shall include design for each pressure classification and all fittings and specials. Designs shall be stamped by a Professional Engineer registered to practice in the Province on Alberta.

The layout drawings and fabrication drawings as prepared by the pipe supplier and are to be checked by the Engineer and consulting engineer where appropriate. An Affidavit of Compliance signed by an officer of the pipe manufacturing company shall be provided stating that the pipe and fittings comply with this Specification and applicable AWWA specifications. Each drawing shall be signed and dated by the Engineer, and where applicable the consulting engineer, indicating acceptance.

The Supply Contractor shall carefully check all pipe and fittings at the point of delivery against the pipe layout and fabrication drawings prior to commencement of construction and immediately notify the Engineer or of any discrepancies, damaged or faulty pipe and fittings. Upon notification of a discrepancy between the layout drawings and the pipe supplied, or notification of damaged pipe as outlined above, the Engineer and Contractor will work together to make every effort to arrange for a replacement pipe and/or fitting in order that a delay in construction will not occur as a result.

The Supply Contractor shall provide complete Record Drawings for the pipe, including revised laying schedules, closure lengths for field trimmed pieces or other modifications required for the pipe installation. Closure measurements and field trim lengths will be supplied by the Installation Contractor.

3.15. Thrust Blocks

(a) Thrust blocks are permitted as needed to transfer thrust forces to the surrounding soil using thrust blocks made from cast-in-place concrete.
(b) The bearing capacity of the surrounding soil shall be taken as 100 kPA (2000 psf) unless geotechnical studies suggest a lower value be used.
(c) For vertical bends the thrust block shall be sized to provide resistance to thrust forces based on the weight of the thrust block alone. The weight of the soil cover shall not be included in the analysis.
(d) Under normal pressure conditions a thrust block is not required for bends of less than 3 degrees but the Engineer shall confirm this through calculations.
(e) See **Drawing 21** for Thrust Blocks

3.16. Restrained Joints

(a) Restrained joints via welding or mechanical restraints are permitted to resist all thrust forces based on the reactive friction forces caused by the weight of the feedermain, the soil cover, and the water contained inside the line. The Engineer

shall calculate the length of tied feedermain required to provide the resisting forces and the tied joint strength required to transfer forces through the feedermain.

(b) See **Drawings 16 & 19**

(c) Mechanically restrained joints shall be used in accordance with the manufacturer's recommendations.

(d) Restrained joints must factor in pipe design and cylinder strength

3.17. Field Trims

(a) Field trims are required on feedermains to ensure that chainages and feature coordinates match the design as construction proceeds. Spacing and location of the field trims shall be at the discretion of the Engineer.

(b) No field trims shall be allowed on manufactured deflection joints

(c) For field trims on bends, field trims must be spaced a minimum of the following:

i. 0 – 45 degree bends: 0.5D from the centre of the bend.

ii. 46 – 66.5 degree bends: 1D from the centre of the bend.

iii. 67 - 90 degree bends: 1.5D from the centre of the bend.

(d) Field trims must be cathodically protected as per section 6.8(a).

3.18. Valve Chamber (VC)

(a) Valve chambers (VCs) shall be spaced no longer than 1500 m intervals or at intersections of feedermains.

(b) Chambers shall be designed to take a minimum of 6 metres of cover on the roof slab to allow for varying site conditions in the future.

(c) Maintain 500 mm spacing between walls and flanges for future use of impact gun and/or welding equipment to remove seized bolts.

(d) Maintain 500 mm space between top of air valves and chamber ceilings.

(e) Maintain 1000 mm space between top of flanges and chamber ceilings.

(f) All valves shall be capable of being operated from the surface

(g) The Engineer should try to incorporate as many accesses, drains, ties to the distribution system and/or air valve features into the valve chamber as possible.

(h) Valve chambers are to be designed with bypass piping for butterfly valve operations.

(i) Valve chambers are to be designed with removable tops to accommodate future butterfly valve maintenance.

(j) All flange by flange valves (double flanged) must be installed with a flange by Victaulic OGS (Original Groove Style) 44 or AGS (Advanced Groove System) adapter to facilitate ease of future replacement. The total length of the Valve and Flange adapter must be equivalent to the long body dimensions of AWWA C504.

(k) Maintenance vehicle accessibility, including potential all weather access roads, must be incorporated into valve chamber design.

(l) All valves and fittings that have the potential of being flooded must be denso paste and taped.

(m) All ladder materials to either hot dipped galvanized steel or 304 stainless steel

(n) **Drawing #1 & 2**

3.19. Air Valve Manhole (AV)

(a) Air Valves are required at every high point and at significant grade changes to allow for the escape of air due to filling or pumping, allow air into the system when draining, eliminate vacuums and mitigate transients.
(b) Air Valves shall be limited to 100 mm (4") on feedermains up to 1200 mm in diameter.
(c) Air Valves shall include 600 mm access openings;
(d) Maintain 500 mm space between top of air valves and chamber ceilings.
(e) Air Valve manholes shall be 1-S manholes with an 1800 mm diameter barrel.
(f) Consideration may be given to air vent pipes at critical air valve locations;
(g) Air valve outlets must consider appropriate pipe re-inforcement as per the applicable AWWA design manual.
(h) For design and sizing of air valves, refer to AWWA M51;
(i) Considerations should be made to protect chambers from flooding due to groundwater and surface water
(j) Maintenance vehicle accessibility, including potential all weather access roads, must be incorporated into air valve manhole design.
(k) All ladder materials to either hot dipped galvanized steel or 304 stainless steel
(l) **See Drawings 6 -8**

3.20. Drains / Washouts (WOs) and Drain Manhole (DMs)

(a) Drains, also known as Washouts are required at every local low point to allow for draining the feedermain during planned maintenance or emergency repairs.
(b) Drains shall lead into a manhole or chamber for crew access for pumping.
(c) Drains shall be located tangentially off the feedermain, except for PVC. PVC feedermains shall have drains located at the 4:30 or 7:30 o'clock position.
(d) Drain Manholes must not be deeper than 10 m from the bottom of the manhole to the surface grade where a valve crew truck will be positioned. Any deviations of this requirement must be approved by the Engineer.
(e) Drain outlets must consider appropriate pipe re-inforcement as per the applicable AWWA design manual.
(f) Maintenance vehicle accessibility, including potential all weather access roads, must be incorporated into drain manhole design.
(g) All ladder materials to either hot dipped galvanized steel or 304 stainless steel
(h) **See Drawings 3 to 5.**
(i) Drain sizing:

Feedermain diameter (mm)	Drain diameter (mm)
Up to 900	150
1050 and up	200

3.21. Access Manhole (AM)

(a) Access openings shall be incorporated into all designs to allow for construction activities such as welding or joint repairs and future condition assessment inspections and repairs.
(b) Access openings shall be 600 mm diameter;
(c) Access neck lengths shall be in accordance with the applicable AWWA design manual.
(d) Access chambers shall be located at critical locations where a large amount of internal work is required such as welding and lining repairs.
(e) Access chambers are not required when using PVC or HDPE pipe**,**
(f) Accesses must be spaced approximately every 300 meters.
(g) Access opening must consider appropriate pipe re-inforcement as per the applicable AWWA design manual.
(h) At the discretion of the Engineer, one Access Manhole per valve segment must be brought to grade with 1-S manholes as per **Drawing 7 & 8.**
(i) All ladder materials to either hot dipped galvanized steel or 304 stainless steel

3.22. Bypass Piping

(a) Bypass piping is required around every main line valve to equalize pressure on both sides. It is poor practice and potentially dangerous to operate a mainline butterfly valve without first equalizing pressure on both sides.
(b) Bypass piping shall be increased appropriately if by pass piping is used to tie to the distribution system;
(c) All steel bypass piping shall be externally coated and internally lined as per the Standard Specifications Waterworks Construction. Bypass piping may be PVC or HDPE to match the main line material.
(d) Bypasses are to be tangential outlets, but springline is also allowed at the discretion of the Engineer. Tangential outlets are required in the event that a drain is incorporated.
(e) Bypass outlets must consider appropriate pipe re-inforcement as per the applicable AWWA design manual.
(f) Valve bypass piping shall be within chambers, unless otherwise approved by the Engineer.
(g) Bypass piping within a chamber must be supported with approved pipe stands.
(h) Shall be steel pipe conforming to ASTM Specification A53, standard wall, with beveled ends for butt welding.
(i) Approved Victaulic couplings shall be used to facilitate maintenance and repair.
(j) shall be standard weight seamless or welded with beveled ends for butt welding
(k) Flanges shall be AWWA Class D Hub or Ring Flange as per AWWA C207.
(l) Distance between bypass pipes and chamber walls must account for tools and unimpeded access. **Refer to Drawing # 1 & 2.**

(m) Typical bypass sizing:

Feedermain Size (mm)	*Bypass Size (mm)*
500	250
600	250
750	250
900	250
1050 and up	300

3.23. Distribution System Tie-Ins

(a) Connections are only possible if the pressure is compatible, otherwise a Pressure Reducing Valve Chamber (PRV) is required.

(b) The Engineer shall design the feedermain to connect to the distribution system at the appropriate locations in accordance with hydraulic design set in The City of Calgary, Design Guidelines for Subdivisions.

(c) Connections to the distribution system shall be done in conjunction with valve bypass piping, if the location of the valve chamber and the connection are in proximity.

3.24. Feedermain Tie-Ins

(a) Connections to existing feedermains should be designed to eliminate man entry wherever possible. Man entry requires two-valve shutdowns which can be difficult or sometimes impossible to attain, therefore man entry for tie-in work should be avoided. Options for preferred tie-ins are described further in this document.

(b) As standard practice, no existing feedermain shall be drained and/or cut into to facilitate a tie-in until the Engineer or City Inspector confirms all necessary and approved parts are on-site.

(c) See 6.6 Connections

3.25. Cathodic Protection

(a) **Design Criteria**

i. Cathodic protection systems shall be designed to achieve a minimum of protection level of -0.850 volts throughout the protected line as measured between the pipe and earth via a copper sulphate reference electrode.

ii. A maximum potential of -1.00 volt is permitted on concrete feedermains.

iii. Design of all cathodic protection systems shall be in accordance to all applicable NACE (National Association of Corrosion Engineers) Standards.

(b) **Galvanic System**

i. Cathodic protection systems for fittings, appurtenances, bypass piping or alterations with sacrificial anodes as the current source may be designed by a professional Engineer and installed to the relevant standards contained in the

Standard Specifications Waterworks Construction: and the Design Guidelines for Subdivisions.

(c) **Impressed System**

i. Impressed current cathodic protection systems must be designed by a NACE accredited Corrosion Technologist or Corrosion Engineer.

ii. Installation of an impressed current system requires procurement of a right of way, arrangement for an electrical service and circulation of proposed construction and location to all adjacent utility owners for review.

(d) **Test Stations and Leads**

i. Test stations and leads facilitate the future replacement of consumed anodes and allow testing for continuity and electrical isolation.

ii. Test stations and leads must meet the specifications outlined in the Standard Specifications for Waterworks Construction.

iii. Test stations and lead design must be approved by a City Corrosion Technologist.

(e) **Isolation Devices**

i. Isolations are required between dissimilar piping systems to permit the application of appropriate corrosion protection systems to each piping system without compromising the effectiveness of either protection regime.

ii. Isolation designs must be approved by a City Corrosion Technologist.

(f) **Stray Currents / Contaminated Soils / Corrosive Soils**

i. Specific site conditions may involve the presence of stray electrical currents, contaminated soils or extremely corrosive soils. Such conditions have the ability to accelerate the degradation of pipeline infrastructure and require special design considerations not necessarily covered by these guidelines. Should any of these conditions exist, the Engineer must consult with a City subject matter expert during the design.

4. PRE-CONSTRUCTION

4.1. Project Management and Planning

(a) Most feedermain projects take at a minimum a year to design and construct, so it is important that enough time be allotted for the major activities outlined below:

i. preliminary risk assessment;
ii. hydraulic models;
iii. strategic planning session;
iv. route alignment;
v. field visits with surveys;
vi. land procurement;
vii. public engagement;
viii. pipe, fitting and valve (contractor or City supplied) procurement;
ix. contractor pre-qualification;
x. planning timing for necessary tie-ins and shutdowns including Water Operations Coordination Committee (WOCC) scheduling and approval;
xi. regulatory approvals;
xii. access agreements.
xiii. archaeological and environmental investigations
xiv. Development or Building Permits (if located outside City jurisdiction)
xv. Budget allocation and stage gating
xvi. Contract documents specifying roles, responsibilities and timelines.

(b) Refer to the Feedermain Design Checklist in **Appendix 1**

4.2. Pre-Construction Site Inspection

The Engineer, Consultant (if relevant) and Contractor shall carry out an inspection of the work site prior to construction to become familiar with the work required and identify and document any damage or deficiencies that might exist on or adjacent to the work area.
The site inspection shall be documented (written, video, photographs as necessary) and copies supplied to all parties.
Any deficiencies or damage not identified prior to construction may be requested repaired at the Contractor's expense.

4.3. Working Area

The Engineer, Consultant or Contractor shall identify a working space and working easements if necessary to confine all equipment, materials and activities pertaining to construction activities including vehicles, supplies, materials, pipe and fittings, excavated materials, import bedding, backfill materials and all other related items. If possible these areas shall be identified on the construction drawings.

4.4. Surveying

4.4.1. Surveyor Responsibilities

(a) Read and interpret legal plans, block profiles (plan/profile drawings), construction plans and pipe lay sheets.
(b) Calculate horizontal alignment from legal plans using 3 degree UTM coordinates (City database) to determine total length of pipe required, degree of deflection at critical horizontal bends, curve information and cross-ties to existing infrastructure.
(c) Establish survey reference points to create a survey control network to conduct required surveys for the duration of the project.
(d) Attend the Pre-Construction meeting.
(e) Assist the Engineer, Contractor and Inspector as required, for the duration of the project.
(f) Perform compilation of records relating to pipe installation for future use by Drafting, to assist in location of the feedermain during any future adjacent construction, and in identifying components for repair.
(g) Assist geo-technical consultants in the underground investigations and utility locators.
(h) Assist with establishing utility right-of-way if project is not within a City of Calgary road right of way.

4.4.2. Preliminary Alignment Survey

(a) Layout the centerline of the proposed feedermain (distance to property lines determined be engineer) for field inspection by the Engineer and the Inspector.
(b) Indicate any areas of concern, conflict with existing utilities and surface considerations that may require revision to alignment by the design Engineer
(c) Proceed with detailed design survey, upon approval by the Engineer.

4.4.3. Final Alignment Survey

(a) Calculate stationing of main design points and utility crossings of existing underground infrastructure such as: sanitary and storm lines; gas; telecommunication and electric ducts.
(b) Cross-section the existing ground at 20m intervals and the width of the proposed construction zone to provide information to the Engineer for: design of pipe elevations and ground cover pipe; utilities to avoid; location of valve chambers and wash-outs.
(c) Lay out the locations of the proposed hydrovac (daylighting) of utilities to verify their elevations and geotechnical test areas of concern for soil conditions and groundwater infiltration.
(d) Record elevations of these areas for use by the Engineer and Consultants.
(e) Utilize all survey information to prepare plan/profile drawings.

4.4.4. Construction Survey

(a) Recheck the final alignment and indicate the location of the feedermain along the intended route, for review by Contractors, prior to the tender process.

(b) Provide alignment guidance and grade sheets to the Contractor for pipe installation with a stake line (offset distance and location determined by the Contractor) and cuts to existing ground, to determine elevations of pipeline.
(c) Lay out limits of the construction zone to prevent unnecessary disturbance to the adjacent properties.
(d) Assist with pipe installation at critical areas: horizontal and vertical grade changes; valve chambers; tunnel construction and utility crossings in order to avoid conflicts in grade.
(e) Inform the Inspector and the Engineer of the accuracy of pipe installation on a daily basis.

4.4.5. As-Built Survey

(a) Compile an accurate record of how the pipeline was installed by the Contractor for both vertical grades and horizontal alignment, on a daily basis, to ensure proper design criteria are met.
(b) As-builts are to include survey records of each pipe joint.
(c) This compilation of information is provided to Drafting (City of Calgary) in order to upgrade existing records and the database (GIS). These updated records will be used to locate the feedermain for repairs, and for any future construction that is adjacent to the feedermain, if it is different from the design.
(d) Perform final elevation survey of ground and manhole elevations in order to check if the site has been rehabilitated to the original condition and drainage.

4.5. Geotechnical Investigations

A comprehensive soil investigation shall be completed on all feedermains:

(a) to determine if sufficient sub-grade support is available to bed the feedermain properly;
(b) to determine whether the trench walls will stand up during excavation;
(c) to determine whether there are any shallow bedrock areas that could slow down excavation;
(d) to determine the ground conditions;
(e) to determine if there is any potential for corrosive soils:
    i. soil resistivity testing;
    ii. soil chloride content;
    iii. soil sulphate concentration;
    iv. pH
(f) to provide soil bearing and groundwater information for the design of valve chamber or other structures.
(g) The construction documents should have an indemnity clause that the City is unable to guarantee the accuracy or completeness of the soil investigation.

4.6. Environmental Consultant

(a) A comprehensive environmental investigation shall be completed to:

i. determine whether there is any risk that environmental contamination will be discovered during construction;
ii. determine if there are wetlands or water bodies that will be crossed, and to determine City of Calgary Parks' requirements for Biological Impact Assessments, Habit Restoration Framework, Tree Protection Plans, etc.

4.7. Archeological & Historical Resources Investigation

(a) A desktop study shall be completed to ensure Archeological and Historical Resources are not negatively impacted by the project. If there are such impacts, the appropriate consultants shall be retained to guide the project design and construction.

4.8. Design Drawing Standards

(a) Drawings shall conform to The City of Calgary, Standard Block Profile Specifications and shall be stamped by a professional engineer, licensed to practice in Alberta.
(b) **It is important to note that older drawings in imperial format must add 35.56 ft to elevations.**

4.9. Material Procurement

(a) At the discretion of the Engineer, The City of Calgary (owner) may wish to pre-purchase such materials as pipe, butterfly valves, air valves, couplings and pre-cast concrete chambers that have long delivery periods which may impact the efficient scheduling of the project.
(b) Pre-purchasing and/or assigning material contracts to a contractor can significantly reduce construction time and advance the start of construction, if done appropriately.
(c) In general, pipe manufacturers normally allow two months for delivery after approval of the pipe fabrication and layout drawings, for projects of one km in length and longer.
(d) Contract documents shall clearly specify who is procuring the materials and ensuring it is in place.

4.10. Approvals and Crossing Agreements

(a) **Legislated Approvals**
i. Authorization from Alberta Environment is required to extend or upgrade a potable water system in Alberta. These authorizations are obtained annually through blanket approvals obtained by Water Resources.
ii. In accordance with the Provincial Potable Water Regulation (277/2003) a potable water system needs to meet the performance and design requirements set out in Alberta Environment's Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems.
iii. If necessary, authorization from Government of Canada to cross any water body, such as a river.

iv. Approvals related to environmental areas.
v. If the proposed feedermain will cross a water body, the Code of Practice for a Pipeline and Telecommunications Lines Crossing a Water Body must be followed in addition to any necessary Alberta Environment approvals.

(b) **Internal and External Circulations**

i. Feedermains designed by or on behalf of The City are exempt from the normal development approval process but design drawings shall be circulated internally and to certain external utility companies for comments prior to being issued for construction.
ii. Line assignment circulation is required from The City's Infrastructure and Information Services.
iii. City business units such as Calgary Roads, Transportation, and Parks may comment on the proposed design.
iv. External utilities such as Enmax, Telus, Shaw and ATCO Gas also may have comments.
v. Affected hydrocarbon pipeline companies require the designer to approach them directly for comments.

(c) **Crossing Agreements & Formal Approvals**

Formal written approvals and/or crossing agreements are required for:

i. Transportation Utility Corridors (TUC's)
   a) Ministerial Consent by Alberta Infrastructure.
ii. Railways
   a) Handled by CP Rail or CN Rail
iii. Water Bodies
   a) Handled by Alberta Environment under the Water Act. Refer to the Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body
   b) If construction impacts the water body, approvals will need to be obtained from the Federal Department of Fisheries and Oceans (DFO) and Transport Canada if it is a navigable waterway.
iv. City Parks:
   a) Handled by the City Parks department and covered by Level of Rehabilitation Agreement (LORA) listing how all park areas should be protected and rehabilitated, including trees.
v. Provincial Parks:
   a) Handled by Alberta Parks
vi. Private Utilities on Private Land or UROWs
   a) Handled by the owner of the utility.
   b) This includes ATCO Pipelines, Altalink, Enmax, etc.
vii. Private Utilities on City land

a) Typically handled by existing Master crossing agreements between the utility owner and The City.
b) Exceptions exist including ATCO Pipelines.

viii. Highways
a) License agreement with Alberta Transportation / Alberta Infrastructure

ix. Roads or U/ROW's Outside of City of Calgary
a) Development Permit with jurisdiction (ie. Rocky View County, MD of Foothills)
b) License agreement with jurisdiction
1. Ensure protection and access to feedermain and appurtenances is within agreement.

Contract documents must specify who is responsible for obtaining the approvals and when.

Refer to Appendix 3, for specific City of Calgary personnel authorized to enter into temporary and permanent crossing agreements as of January 11, 2016.

5. MATERIALS

5.1. Materials Approval Procedure

The City requires that prior written approval of the Engineer be received for all products to be incorporated in the water system. The Engineer reserves the right to withdraw the approval of any product if in the Engineer's opinion the product does not perform satisfactorily.

Manufacturers whose products conform to these Specifications are encouraged to submit to the City a written request for product approval together with detailed product specifications. Preference will be given to products manufactured in an ISO 9001 certified production facility. The product evaluation process may exceed a period of one year.

Approvals by The City of Calgary, Water Resources are based on submitted materials meeting various Specifications (e.g.. AWWA, CSA, ASTM, NSF, etc.) and testing by The City of samples furnished by the Manufacturers. Subsequent design changes by a Manufacturer to approved items on this list may result in the City withdrawing an approval. If a Manufacturer changes the design or specifications of any approved materials the Manufacturer shall re-apply for approval.

5.2. Reuse of Materials

All materials for installation on new feedermains and alterations shall be new materials. For repair projects, re-use of existing materials is allowed if directed and specifically approved by the Engineer.

5.3. Pipe Specifications

(a) **Approved Pipe Material Summary**

Pipe Product	**Acceptable Manufacturers**	**Size Range Utilization**	**Purpose**
AWWA C200 (Steel)	Northwest Pipe Company Ameron Water Transmission Group Imperial Pipe	>=500 mm	Mainline, bypasses, chambers
AWWA C301-L and C301-E (PCCP)	Forterra Pressure Pipe (previously Hanson, Hyprescon, Canron) Decast (previously Munro) Ameron Water Transmission Group	>=600 mm	Mainline, Chambers
AWWA C303 (BWCCP)	Ameron Water Transmission Group	>=500 mm	Mainline, Chambers

AWWA C900 (PVC)	IPEX Inc Royal Building Products (North American Pipe) Diamond Pipe	< 900 mm	Mainline Bypasses
AWWA C906 (HDPE)	CP Chemical Performance Pipe; CS Rinker;	<= 900 mm	Mainline Bypasses
AWWA C909 (PVCO)	IPEX Inc	<= 900 mm	Mainline Bypasses
AWWA C950 (FRP) LIMITED APPROVAL	Thompson Pipe Group - Flowtite	< 900 mm	Mainline Bypasses

i. The materials listed in the above table are approved for use where:
   a) Pressures are up to 150 psi. Material approval for projects with pressures greater than 150 psi is at the discretion of the Engineer.
   b) Jointed pipe is allowed
   c) Not exposed to stray electrical currents (for metallic pipe)
   d) Not exposed to contaminated and/or corrosive soils

ii. The Engineer must approve all material selections and the material selections are specific for each project.

iii. The Engineer may approve alternate materials at their discretion for a given project.

(b) **Pipe Material Considerations**

i. The City of Calgary will take the following factors into consideration when selecting a material for any given project:

Pipe Product	**Typical Failure Mode In Calgary Via Deterioration or Damage.**	**Feedermain Pros**	**Feedermain Cons**
AWWA C200 (Steel)	Leak	- Lightweight - Ease of alteration during construction or lifecycle - Ease of repair	- Lightweight - Prone to corrosion if not protected adequately. - Flexible pipe requiring proper bedding
AWWA C301-L and C301-E	Catastrophic rupture	- Rigid pipe - High pressure capacities - Deep bury applications	- Subject to catastrophic failure - Prone to accelerated mortar deterioration and

(PCCP)			corrosion in Calgary soils - Heavy - Difficult to alter during construction or lifecycle - Resource intensive to repair
AWWA C303 (BWCCP)	Leak or catastrophic rupture	- Semi-Rigid pipe - High pressure capacities	- Subject to catastrophic failure - Prone to accelerated mortar deterioration and corrosion in Calgary soils - Heavy - Difficult to alter during construction or lifecycle - Resource intensive to repair
AWWA C900 (PVC)	Catastrophic rupture	- Corrosion proof - Relative ease of installation	- Flexible pipe requiring proper bedding
AWWA C906 (HDPE)	Sudden rupture (rare)	- Corrosion proof - Relative ease of installation	- Flexible pipe requiring proper bedding
AWWA C909 (PVCO)	Sudden rupture (unlikely)	- Corrosion proof - Relative ease of installation	- Flexible pipe requiring proper bedding
AWWA C950 (FRP)	Leak	- Corrosion Proof - Relative ease of installation	- Flexible pipe requiring proper bedding

(c) **Pipe Ends & Seals**

The pipe Manufacturer, Distributor, and Installer shall ensure that the end of each pipe length remain sealed in a manner acceptable to the Engineer during the transportation and storage of the pipe. The purpose of the end-seals is to prevent contaminants from entering the interior of the pipe from the time of manufacture to the time of installation.

Additionally, front sections of loads must be covered with tarps for ground transportation.

(d) **Pipe Marking**

Each section of pipe and each fitting shall be plainly marked with a waterproof marking material to indicate:

i. The classification
ii. The date of manufacture
iii. Location in the line by reference to laying schedule
iv. Angle of deflection and field orientation (if a bend or beveled pipe)
v. Any other markings as required by the applicable AWWA and CSA standards.

5.4. Steel Pressure Pipe – AWWA C200

(a) **Specifications**

i. AWWA C200
ii. AWWA C207
iii. AWWA C220
iv. At the discretion of the engineer, mild steel may be substituted with Stainless Steel SS316 or SS304 in accordance with C220 with no external coating as an option provided that soil samples and field data indicate:
   a) No high moisture content
   b) A pH more than 4.5
   c) Resistivity more than 1000 ohm-cm
   d) Chlorides < 20 mg/L
   e) Sulphides < 0.2 mg/L
   f) Sulphates < 500 mg/L
   g) No stray currents

   No internal lining is required for Stainless Steel.

v. Standard straight lengths of pipe as follows:
   a) Cement mortar coated and lined: 7.3 m (24 feet)
   b) Polyurethane or epoxy coated and cement lined: 14.6 m (48 feet)
   c) Polyurethane or epoxy coated and lined: 15.2 m (50 feet) or 18.3 m (60 feet)

(b) **Approved Joints**

i. Double lap welded joint, with each joint welded inside and outside.
   a) Ends for field welding as per AWWA C200 Sec 4.13.2.
   b) Each joint supplied with a 9.5 mm (3/8 inch) threaded hole and plug for pressure testing each joint 25 mm (1") from the bell end, along with a 38 mm (1 ½ inch) threaded hole and plug for a pass hole for welding approximately 300 mm (12") from the bell end, both on the top centerline of the pipe. The 38 mm pass hole shall be a threaded forged steel half coupling. Both threaded holes shall be provided with countersunk hex head forged steel threaded plugs
   c) See **Drawing # 19**
ii. Butt weld joints at the discretion of the Engineer.
   a) Ends for field welding as per AWWA C200-05 Sec 4.13.2.
   b) **See Drawing # 19**
iii. Butt straps at the discretion of the Engineer only.
   a) See Section 6.13(a)
   b) See **Drawing # 19**
iv. Bell and Spigot Joints
   a) Carnegie shaped double gasket testable joints.

b) Requires a steel plug with o-ring gasket on interior of spigot between the double gaskets to facilitate an air test.

v. Grooved Joints suitable for Victaulic AGS (Advanced Groove System) Couplings **at discretion of Engineer only.** Victaulic OGS (Original Groove System) are not approved in this application.

a) Pipe ends shall meet Victaulic AGS Roll Groove Specifications

b) Joints shall be individually testable during construction using in-line testing tools or other means approved by The Engineer.

c) Pipe lengths with field grooved joints should factor in pipe length expansion from grooving procedure. Estimated at 3.2 mm per AGS groove.

d) Pipe ends shall be clean and free from indentations, projections (including welds) and roll marks in the area from pipe end to (and including) groove.

e) Coatings of the AGS groove, bolt pad mating surface, and gasket seating surface shall not exceed 0.25 mm (0.01”).

f) Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service.

g) Groove joints shall be factory supplied unless otherwise approved by the Engineer.

h) A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor’s field personnel in product installation.

(c) **Pipe Manufacture Quality Control**

i. All straight line or standard pipe sections shall be hydrostatically tested as per AWWA C200 to 75% of specified minimum yield strength with 30 second minimum pressure hold time.

ii. All factory machine welds shall be spot tested by radiographic inspection.

a) Each spot test shall be one random 150mm section of weld on each pipe

iii. All hand welds shall be tested 100% by radiographic inspection, magnetic particle or equivalent.

iv. Prior to shipping any product, provide a quality control report, compiling all project quality control records, including steel tests, mortar absorption tests, coating thickness tests, bell and spigot ring dimensional records and any other quality control records normally documented during the manufacture process.

(d) **Wall Thickness and Steel Strength**

i. Steel grade:

a) Mainline: ASTM A1018 Grade 40 or approved equal.

b) Outlets: ASTM A53, Grade A or B, Type E or S

c) Other: ASTM A572, Grade 50

ii. Minimum pipe yield strength of 290 MPa (42,000 psi)

iii. The following table details minimum required steel wall thicknesses:

Pipe Size	Minimum Wall Thickness (mm)
500 mm to 1500 mm	9.5 (0.375”)
1650 mm	11.1 (0.438”) 12.7 (0.500”) for Victaulic AGS

Assuming:

a) Accounting for corrosion allowance.
b) Full internal Vacuum (14.7 psi). City of Calgary may remove vacuum valves during winter for freezing issues. This can expose pipelines to vacuum in event of a system break or transient event. In absence of system design for vacuum and adequate control to ensure protection remains active at all time, this is recommended procedure.
c) Assumes 2.5 m cover and groundwater at grade. For designs where cover exceeds standard cover, especially in high groundwater table, this should be reviewed.
d) Assumes Modulus of Soil Reaction of 1500 psi, using City of Calgary standard bedding detail.

iv. Nominal diameter shall be the outside diameter (O.D.)

(e) **Approved Manufacturers**

i. Ameron
ii. Northwest Pipe Company
iii. Imperial Pipe
iv. Or approved equal as determined by the Engineer

(f) **Design**

i. As per latest version of AWWA M11
ii. Pipe shall be designed for performance limits including wall buckling and wall crushing, assuming full internal vacuum and groundwater conditions.

(g) **Cathodic Protection**

i. All dielectrically isolating coated steel feedermains must be designed with impressed current cathodic protection unless otherwise approved by the Engineer.

(h) **Fittings**

i. To be as per AWWA C208
ii. Any special sections and fittings not covered by this Standard but specified by the Engineer shall be thoroughly detailed in the fabrication drawings.
iii. Shall be coated and lined as per 5.4 (i) and 5.4 (j).
iv. Flanges

a) Shall be minimum AWWA C207 Class D or as otherwise specified by the Engineer in accordance with AWWA C207 Standard for steel ring flanges. Hub or ring flanges will be permitted.
b) Bolt drilling patterns shall be the same as AWWA C207 Class D or as otherwise approved by the Engineer.

v. Gaskets
a) All non-isolating flange gaskets must be either:
1. Nitrile (Buna-N) or EDPM as per AWWA 207.
2. Type E (full face) nitrile faced phenolic.

vi. Flange Bolts & Nuts
a) Where stainless steel bolts and nuts are not specified, they must be Denso primed, mastic moulded and taped.
b) Bolts: ASTM A193 or SS 304, Grade B7, hex head, coarse thread, Class 2A fit
c) Nuts: ASTM A194 or SS 304, Grade 2H, heavy hex, coarse thread, Class 2B fit
d) Washers: F436, Type 1
e) Yellow Zinc Dichromate finish if not stainless steel.

(i) **Linings (internal)**

i. Feedermain pipe and fitting lining systems including factory and field repairs, and field joint treatment shall be integrally designed to provide complete system protection. Pipe closure kits and field repairs shall be certified by the pipe supplier to function integrally with the pipe lining system.
ii. Shall be in compliance with NSF/ANSI 61 Drinking Water System Components – Health Effects
iii. Internal Field closure and repair systems shall ensure that appropriate curing times as specified by coating manufacture, prior to Immersion, are considered in design.
iv. Shall be inspected and approved by a NACE Certified Coating Inspector
v. Epoxy or Polyurethane (Preferred)
a) 100% solids, Low VOC liquid (<200g/l), or Polyurethane
b) Surface preparation and application as per:
1. AWWA C210 for Liquid Epoxy
2. AWWA C213 for Fusion-Bonded Epoxy
3. AWWA C222 for Polyurethane
c) Conform to pipe preparation, coating application and thickness constraints as specified by the Manufacturer for immersion service.
d) Minimum dry film thickness (DFT)
1. Liquid Epoxy: 16 mils
2. Fusion Bonded Epoxy: 12 mils
3. Polyurethane and 100% solids epoxy – 20 mils minimum
e) Holdback shall be 150 mm (6") minimum each end, or as specified by the pipe manufacturer.

f) Angular surface profile shall be SSPC-SP10/NACE No. 2 with a minimum profile of 3 mils, or as specified by the coating manufacturer, whichever is greater.

g) Acceptable 100% Solids Liquid products
   1. SP-7888 from Specialty Polymer Coatings, Inc.
   2. Devoe 233H by ICI Paints
   3. SPC 1386 DW
   4. Enviroline 230

h) Acceptable 100% solids two-component polyurethane products
   1. Durashield 210-61 from LifeLast, Inc.
   2. Chemline Chemthane 2265
   3. Plasite 4500S – Internal Lining Only

vi. Cement Mortar Lining (Optional)

a) as per A.W.W.A. C205

b) Thickness: Notwithstanding the applicable AWWA standard, mortar thickness shall be a minimum 12.7 mm (0.5”) for all pipes greater than 400 mm.

c) Holdback: 150 mm (6") minimum each end, or as specified by the pipe manufacturer.

d) Cracking: Notwithstanding the applicable AWWA standard, cracks greater than 1.2 mm (1/21”) before or after installation must be repaired.

e) Cement mortar lined pipe requires internal mortar application at the 25 mm pass plug locations post welding.

(j) **Coatings (external)**

i. Pipe and fitting coating systems including factory and field repairs, and field joint treatment shall be integrally designed to provide complete system protection. Pipe closure kits and field repairs shall be certified by the pipe supplier to function integrally with the pipe coating system.

ii. Shall be holiday free

iii. Shall be inspected and approved by a NACE certified Coating Inspector

iv. Where potable water contact may occur, such as couplings, shall be in compliance with NSF/ANSI 61 Drinking Water System Components – Health Effects

v. Epoxy or Polyurethane (Preferred)

a) 100% solids, Low VOC liquid (<200g/l), or Polyurethane

b) Surface preparation and application as per:
   1. AWWA C210 for Liquid Epoxy
   2. AWWA C213 for Fusion-Bonded Epoxy
   3. AWWA C222 for Polyurethane

c) Conform to pipe preparation, coating application and thickness constraints as specified by the Manufacturer for immersion service.

d) Minimum dry film thickness (DFT):
   1. Liquid Epoxy: 25 mils in minimum three coat application.
   2. Fusion Bonded Epoxy: 20 mils, plus or minus 5 mils in a single coat
   3. Polyurethane and 100% solids epoxy – 25 mils minimum

e) Holdback
   1. 150 mm (6") minimum each end, or as specified by the pipe manufacturer.

f) For Victaulic grooved pipe, external coating thickness to meet manufacturers recommended thickness. Transition coating method from line pipe coating thickness to groove area to be detailed and approved by Engineer prior to pipe production

g) Angular surface profile
   1. 3 mils, or as specified by the coating manufacturer, whichever is greater.

h) Acceptable 100% Solids Liquid products
   1. Devoe 233H
   2. SPC 1386 DW
   3. SP-3888 from Specialty Polymer Coatings, Inc.

i) Acceptable 100% solids two-component polyurethane products
   1. Durashield 210-61 from LifeLast, Inc.
   2. Chemline Chemthane 2265

vi. Cement Mortar (optional)

a) To be as per AWWA C205

b) Only to be used where soil samples demonstrate:
   1. pH > 5.5
   2. Sulphates (SO4) < 2000 mg/L
   3. Chlorides < 70 mg/L

c) Notwithstanding the applicable AWWA standard, mortar coating shall be a minimum of 25 millimetres thick as measured from the outside of the reinforcement.

d) Portland Cement for external pipe coating shall be CSA A3000 Type HS Sulphate Resistant Cement.

e) External mortar coating shall contain 10 percent silica fume by weight of cement.

f) Approval in writing is required if the Contractor proposed to use fly ash or pozzolan as a supplementary cementing material in conformance with applicable AWWA specification.

g) Approval requests should be accompanied by a submission from an independent testing laboratory complete with sampling and testing results of the material conforming to ASTM Standard C311.

h) Notwithstanding the applicable AWWA standard, absorption tests shall be carried out by the Contractor on specimens of the exterior coating of the pipe. These tests shall be carried out in accordance with ASTM

Standard C497 Method of Testing Concrete Pipe, Sections or Tile, method A.

i) Notwithstanding applicable AWWA standard, no individual absorption test may exceed 10%.

j) Notwithstanding applicable AWWA standard, mortar tests shall be conducted on a daily basis for the entire production run.

k) Every effort shall be taken to limit this absorption to 8% as measured in accordance with the ASTM Standard C497. Pipe with an absorption rate in excess of 10% will not be accepted. No pipe shall be shipped until the absorption results related to the particular shipment have been provided to the Engineer, and are satisfactory.

(k) **Internal Joint Repairs**

i. CCB joint sleeves will be accepted as an alternate for joint linings of epoxy, polyurethane or mortar lined pipe.

ii. Cement mortar lined pipe requires internal mortar application at the 25 mm pass plug locations post welding.

(l) **Joint and Coating Repairs**

i. Coatings for joints, welds and repair of external coating damage (holidays) as per NACE RP0105

ii. Repair coatings shall be as recommended by the primary pipe coating manufacturer, and shall be fully compatible with the primary pipe coating system and conditions of service.

iii. Repair coatings shall be installed in accordance with the manufacturer's recommended procedures based on environmental conditions at the time of coating installation.

iv. Coating repairs shall meet minimum thickness of host coating, be holiday free and shall be tested to confirm adhesion and thickness.

v. Only personnel that are fully trained by the manufacturer in the proper installation of the coating shall install the coating

vi. Internal coatings containing VOC's or other solvents shall be allowed to fully cure in accordance with manufacturer recommendation prior to being immersed or placed in service.

vii. Acceptable products include:

a) Those products identified above under 5.4.8(d)

b) Petrolatum Tape Coating Systems comprised of petrolatum paste primer, profiling mastic, petrolatum tape and protective outer wrap, as manufactured by Denso North America, Inc., Trenton Corporation, or equal.

c) Xypex Megamix 2 for the patching and resurfacing of mortar lining and coatings.

d) Heat Shrinkable Sleeves

1. Heat shrinkable cross-linked polyolefin coatings as per AWWA C216

2. Heat shrinkable coatings shall be fully compatible with the primary pipe coating system and conditions of service, and acceptable for use by the primary pipe coating manufacturer.
3. Only personnel that are fully trained by the manufacturer in the proper installation of heat shrinkable coating shall install the coating.
4. Acceptable products include:
   i. Aqua-Shield from CANUSA-CPS
   ii. GTS-65 from CANUSA-CPS

(m) **Coating and Lining Quality Assurance Requirements**

i. Coating installer(s) shall submit a Quality Control Testing Plan, including test data recording forms, to the Engineer for approval prior to commencing coating installation.

ii. Quality control test data shall be neatly recorded and filed in a timely manner, and upon request shall be made available for examination by the Engineer. Copies of all quality control records shall be provided to the Engineer at the time of project completion.

iii. The following environmental parameters shall be tested and recorded a minimum of once every 4 hours when performing sandblasting and coating operations:
   a) Date and time.
   b) Weather conditions.
   c) Precipitation.
   d) Dry bulb and wet bulb ambient temperatures.
   e) Relative humidity.
   f) Dew point.

iv. The following pipe and coating preparation parameters shall be tested and recorded a minimum of once every 4 hours when performing sandblasting and coating operations:
   a) Substrate temperature at time of surface preparation.
   b) Visual inspection of blasted steel substrate per SSPC-VIS 1.
   c) Blasted pipe anchor profile per NACE RP0287.
   d) Substrate temperature at time of coating application.

v. The following finished factory and field applied coating parameters shall be tested for each steel pipe, fitting and appurtenance, in accordance with the applicable AWWA coating standard and detail following:
   a) Dry Film Thickness per SSPC PA2.
   b) Holiday testing at 100 Volts per mil of coating per NACE SP0188 or at the test voltage as recommended by the coating manufacturer. 100% of the coated surfaces shall be tested, and all coating repairs shall be retested.
   c) Adhesion tests per ASTM D4541, Annex 5.
   d) Final visual coating observations.

5.5. Concrete Pressure Pipe – AWWA C301-L, C301-E, and C303

(a) **Minimum soil sample requirements**

i. Concrete Pressure Pipe shall not be used where soil samples or other data indicate that:
   1. pH < 5.5
   2. Sulphates (SO4) >= 2000 mg/L
   3. Chlorides >= 70 mg/L

(b) **AWWA C301-L and C301-E Prestressed Concrete Cylinder Pipe (PCCP)**

i. Specifications
   a) NSF 61
   b) AWWA C301

ii. Approved Manufacturers
   a) Forterra Pressure Pipe
   b) Munro Concrete Products
   c) Ameron

iii. Design
   a) AWWA C304
   b) For restrained type pipe joints, thrust design shall be as per latest version of AWWA M9 Design Manual.

iv. Barrier Coating
   a) All mortar coated pipe shall have an impermeable epoxy or polyurethane coating appropriate for mortar substrates, applied by the manufacturer and approved by the Engineer.
   b) All joints must have external impermeable joint wrappers as recommended by the pipe manufacturer and approved by the Engineer.

v. Cathodic Protection
   a) C301 pipe shall NOT have impressed current installed.
   b) Flanged outlets and field trims shall be protected with zinc anodes and field wrapped as per Standard Specifications Waterworks Construction.

vi. Baseline Steel Component Integrity Report
   a) All pipe lengths must be either:
      1. Electromagnetically inspected either prior to or after installation.
      2. Accompanied by a comprehensive report showing photos of every individual pipe on both sides prior to application of the mortar coating. Therefore clearly showing the steel cylinder and steel reinforcement wires or bars.
   b) Any pipes with one or more broken bars or steel cylinder anomalies, will be rejected and require replacement or repair at the discretion of the Engineer.
   c) All pipe lay sheets require a specification page showing at a minimum:
      1. Bar or wire thickness
      2. Bar spacing

3. Steel cylinder thickness

vii. Acoustic Monitoring Outlets
   a) 100 mm outlets must be incorporated into the pipe design on each side of a main valve.
   b) Appropriate pipe reinforcement must be designed as per AWWA M11.
   c) Outlets must be located either in a 5A manhole or valve chamber.
   d) Outlet orientation will be at the discretion of the Enigneer.
   e) Outlets must be designed with a minimum of AWWA Class D flange.
   f) Outlets can be blind flanged for future use.

viii. Tethering Cable
   a) To facilitate leak detection following installation, a corrosion resistant lightweight cable must be placed in the line prior to commissioning.
   b) Temporary termination points will be approved by the Engineer.
   c) The tethering cable must remain in place during the FAC period, and must be removed prior to FAC completion.

ix. Approved Restrained Pipe Joints
   a) Harnessed clamp joints
   b) Snap ring joints
   c) Welded joints
   d) Victaulic AGS Couplings at the discretion of the Engineer. Victaulic joints shall be individually testable during construction using in-line testing tools or other means approved by The Engineer.

x. Bell and Spigot Joints
   a) Carnegie shaped double gasket testable joints are required.
   b) Requires a steel plug with o-ring on the inside of the spigot between the two gaskets to facilitate an air test.

xi. Fittings
   a) Fittings shall be manufactured using minimum steel thicknesses specified in AWWA C301

xii. Flanges
   a) Shall be minimum AWWA C207 Class D or as otherwise specified by the Engineer in accordance with AWWA C207 Standard for steel ring flanges. Hub or ring flanges will be permitted.
   b) Bolt drilling patterns shall be the same as AWWA C207 Class D or as otherwise approved by the Engineer.

xiii. Gaskets
   a) All non-isolating flange gaskets must be either:
      1. Nitrile or EDPM as per AWWA 207.
      2. Type E (full face) nitrile faced phenolic.

xiv. Flange Bolts & Nuts
   a) Bolts: ASTM A193 or SS 304, Grade B7, hex head, coarse thread, Class 2A fit
   b) Nuts: ASTM A194 or SS 304, Grade 2H, heavy hex, coarse thread, Class 2B fit

c) Washers: F436, Type 1
d) Yellow Zinc Dichromate finish. Denso primed, mastic moulded and taped.
e) As an alternate, stainless steel bolts and nuts may be specified at the discretion of the Engineer.

xv. Chambers
a) Pipe sections passing through chamber walls shall be manufactured with a minimum 12 mm thick by 75 mm wide water stop located at the midpoint of the chamber walls. The water stop Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i).

xvi. Closures
a) AWWA C219 bolted sleeve (mechanical) couplers should be used where man entry for repair of internal coatings cannot be done. Sleeve coupler middle ring should be 250 mm wide to cover closure gap and allow for design joint deflection. A filler piece should be used between cut pipe ends. Welded steel split ring closures (butt straps) should only be used where coating damage from welding can be repaired internally and externally.

xvii. Field Trims
a) The plain steel end of each closure piece shall extend 300 mm longer than the required length of the piece to provide an overlap in order to compensate for any correction required when installed.
b) Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i).

xviii. Mortar/Epoxy Repairs
a) The Contractor shall be responsible for repairs of any interior and/or exterior mortar and epoxy coating damage.

xix. Electrical Continuity
a) Concrete pressure pipe shall be supplied with bonding clips or straps to make the entire pipeline electrically continuous.

xx. Quality Control
a) Prior to shipping any product, provide a quality control report, compiling all project quality control records, including steel tests, concrete compressive tests, mortar absorption tests, cylinder pressure tests, coating thickness tests, bell and spigot ring dimensional records and any other quality control records normally documented during the manufacture process.

(c) **AWWA C303 Bar Wrapped Concrete Cylinder Pressure Pipe (CCP)**

i. Specifications
a) NSF 61
b) AWWA C303

ii. Approved Manufacturers
a) Forterra Pressure Pipe
b) Ameron
c) Northwest Pipe

iii. Design
  a) Design as per AWWA M9
  b) designed for a maximum deflection of one degree

iv. Approved Restrained Joints:
  a) Harnessed clamp joints
  b) Snap ring joints
  c) Welded joints

v. Bell and Spigot Joints
  a) Double gasket testable joints are required

vi. Fittings
  a) Fittings shall be manufactured using minimum steel thicknesses specified in AWWA C301.

vii. Barrier Coating
  a) All mortar coated pipe shall have an impermeable epoxy or polyurethane coating appropriate for mortar substrates, applied by the manufacturer and approved by the Engineer.
  b) All joints must have external impermeable joint wrappers as recommended by the pipe manufacturer and approved by the Engineer.

viii. Baseline Steel Component Integrity Report
  a) All pipe lengths must be either:
    1. Electromagnetically inspected either prior to or after installation.
    2. Accompanied by a comprehensive report showing photos of every individual pipe on both sides prior to application of the mortar coating. Therefore clearly showing the steel cylinder and steel reinforcement wires or bars.
  b) Any pipes with one or more broken bars or steel cylinder anomalies, will be rejected and require replacement or repair at the discretion of the Engineer.
  c) All pipe lay sheets require a specification page showing at a minimum:
    1. Bar or wire thickness
    2. Bar spacing
    3. Steel cylinder thickness

ix. Tethering Cable
  a) To facilitate leak detection following installation, a corrosion resistant lightweight cable must be placed in the line prior to commissioning to
  b) Temporary termination points will be approved by the Engineer.
  c) The tethering cable must remain in place during the FAC period, and must be removed prior to FAC completion.

x. Flanges
  a) Shall be minimum AWWA C207 Class D or as otherwise specified by the Engineer in accordance with AWWA C207 Standard for steel ring flanges. Hub or ring flanges will be permitted.
  b) Bolt drilling patterns shall be the same as AWWA C207 Class D or as otherwise approved by the Engineer.

xi. Gaskets
  a) All non-isolating flange gaskets must be either:
    1. Nitrile or EDPM as per AWWA 207.
    2. Type E (full face) nitrile faced phenolic.

xii. Flange Bolts & Nuts
  a) Where stainless steel bolts and nuts are not specified, they must be Denso primed, mastic moulded and taped.
  b) Bolts: ASTM A193 or SS 304, Grade B7, hex head, coarse thread, Class 2A fit
  c) Nuts: ASTM A194 or SS 304, Grade 2H, heavy hex, coarse thread, Class 2B fit
  d) Washers: F436, Type 1
  e) Yellow Zinc Dichromate finish if not stainless steel.

xiii. Chambers
  a) Pipe sections passing through chamber walls shall be manufactured with a minimum 12 mm thick by 75 mm wide water stop located at the midpoint of the chamber walls. Water stops Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

xiv. Field Trims
  a) The plain steel end of each closure piece shall extend 300 mm longer than the required length of the piece to provide an overlap in order to compensate for any correction required when installed.
  b) Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

xv. Mortar Repairs
  a) The Contractor shall be responsible for repairs of any interior and/or exterior mortar coating and epoxy damage.

xvi. Electrical Continuity
  a) Concrete pressure pipe shall be supplied with bonding clips or straps to make the entire pipeline electrically continuous.

xvii. Quality Control
  a) Prior to shipping any product, provide a quality control report, compiling all project quality control records, including steel tests, concrete compressive tests, mortar absorption tests, cylinder pressure tests, coating thickness tests, bell and spigot ring dimensional records and any other quality control records normally documented during the manufacture process.

5.6. PVC Pressure Pipe – C900 / C909

(a) **Acceptable Manufacturers**

i. IPEX inc.
ii. Royal Building Products
iii. Diamond Pipe

(b) **Pipe Sizes**

Pipe Size	Dimension Ratio (DR) / Class	Conform / Certified
Up to 600 mm	18 / 150	AWWA C900 / C909.
750 mm	25 / 100	AWWA C900 / C909

(c) **Specifications**

i. This pipe shall be no more than 750 mm in diameter only.

ii. Polyvinyl Chloride (PVC) Pressure Pipe, in 6.1 meter lengths.

iii. All pipes shall be bell and spigot pipe supplied with integral wall thickened bell ends and continuous gaskets. All bells must be completely thickened bells having the equivalent or greater wall thickness of the pipe barrel and DR rating.

iv. Gaskets shall be SBR, EPDM, or NBR of a pressure actuated seal design.

v. NBR (Nitrile) gaskets shall be used where fittings are to be installed in areas contaminated or potentially contaminated with organic compounds (organic solvents or petroleum products), i.e. near buried petroleum fuel tanks, abandoned gas stations, petrol storage areas or petrol refinery sites.

vi. PVC pipe shall be certified under the CSA or by an SCC accredited testing organization.

vii. AWWA C900 / C909 and CSA B137.3, with the following dimension ration (DR)

viii. AWWA C900 / C909 PVC pipe supplied in Canada has limited selection of Dimension Ratio (DR) based on pipe size in transmission applications. It will not meet all design cases within the City's system and the designer shall ensure that the selected product is adequate to meet the design objectives on a project specific basis. The following is a summary of approved sizes and pressure ratings at 23 ° C.

DR	Maximum Diameter (mm)	Pressure Rating (psi)	Occasional Surge Pressure Capacity (psi)
18	600	235	376
25	750	165	264

i. For water temperatures higher than 23°C, a temperature factor must be applied. Consult AWWA C900 / C909.

b) Further to AWWA C900 / C909, 4.3.2.2 Elastomeric-gasket bell ends shall conform to the requirements of Section 4.3.2.2 a). Designs not meeting the requirements of Sec. 4.3.2.2(a) will not be permitted.

c) Note: Spec 5.6(c)viii.b) AWWA 4.3.2.2 has provision for thinning of bells provided it can be demonstrated that hydrostatic integrity is not

compromised. This practice is not recommended due to concerns with bell stress caused by joint over insertion.

(d) **Fittings**

i. Cast Iron or Ductile Iron fittings must be used unless otherwise approved by the Engineer.
ii. Cast Iron must conform to AWWA C110
iii. Ductile Iron fittings must conform to AWWA C153
iv. Approved Manufacturers:
    a) Terminal City
    b) Sigma
    c) Star
    d) or approved equal
v. Cast and ductile iron full body fittings for use in chambers shall have laying lengths conforming to the AWWA C110 Standards.
vi. Flanges, where approved, shall conform to AWWA C110 and drilling and bolt pattern must match AWWA C207 Class D flanges.
vii. Unless otherwise specified, all fittings shall be supplied with continuous, molded rubber-ring gaskets conforming to the AWWA C111 Standards.
viii. Compact ductile iron fittings conforming to AWWA C153 shall be permitted for direct bury use only.
ix. The exterior and interior (except flange faces) of all fittings shall be fusion bond epoxy coated in the factory or by an approved third party coating facility with NSF61 compliant epoxy in accordance with AWWA C116.
    a) Fittings shall be cathodically protected as per section 6.8(a).

(e) **Fabricated Fittings**

i. Fabricated or heat formed PVC fittings shall only be specified and used upon approval by the Engineer
ii. Fabricated fittings shall conform to AWWA C900/ C909 and CSA B137.3
    a) Acceptable manufacturers
        1. Galaxy Plastics
        2. IPEX
        3. Royal Pipe / North American Pipe
iii. Heat formed PVC bends must be made with PVC pipe one DR thicker than the mainline pipe.
    a) Acceptable manufacturers
        1. Galaxy Plastics
        2. IPEX
        3. Royal Pipe
iv. Where non-standard fittings and bend angles are required, fittings shall be constructed in every way to conform to the nearest AWWA or CSA certified standard fitting.

v. Submit details of all fabricated fittings and specials, including details of proposed connections to existing pipelines.
vi. Submit Fabricated fitting design notes and overwrap reinforcing details
vii. Fabrication details to be stamped by a Professional Engineer, registered in the Province of Alberta.
viii. PVC fittings must not be encased in concrete, including for vertical thrust blocks.

(f) **Closures**

i. Shall be fabricated PVC slide collars conforming to AWWA C900 / C909 and CSA B137.3.
ii. Pipe class to be the same as for mainline piping.

(g) **Joint Restraints**

i. Are only required where required in lieu of thrust blocks, where there is risk of pipe/fitting separation or otherwise specified by the Engineer.
ii. shall be constructed of ductile iron to ASTM A536 Grade 65-45-12
iii. Approved Materials
    a) EBAA Iron Series 2500
    b) Uniflange Series 1360
    c) or Approved Equal.
iv. Joint restraints shall be protected from corrosion by wrapping in approved corrosion protection system and installation of anode nuts.

(h) **Dimensional Checks**

i. Notwithstanding AWWA C900 / C909, Section 5.1.1, dimensional checks shall be carried out for each and every pipe in the production run.
ii. All bells must be completely thickened bells having the equivalent or greater wall thickness of the pipe barrel and DR rating.

(i) **Joints**

i. No PVC pipe joint be encased in concrete.
ii. No PVC joint shall be deflected more than one (1) degree.

5.7. AWWA C906 HDPE Pressure Pipe

(a) **Specifications**

i. HDPE pipe and fittings must conform to AWWA C906
ii. Shall be 3408 or 4710
iii. DR-11 or as specified by the Engineer.
iv. Minimum operating pressure of 160 psi.
v. Polyethylene pipe for potable water use shall be clearly identified by blue longitudinal printing, striping or a blue outer-shell.
vi. The outside diameter (OD) shall conform to ductile iron (DIPS) or steel pipe (IPS) as approved by the Engineer.

vii. The pipe Manufacturer, Distributor, and Installer shall ensure that the ends of each pipe length remain sealed in a manner acceptable to the Engineer during the transportation and storage of the pipe. The purpose of the end-seals is to prevent contaminants from entering the interior of the pipe from the time of manufacture to the time of installation.

(b) **Installation and Joints**

i. Installation of HDPE shall be in compliance with the manufacturer's guidelines and under the approval of the Engineer.

ii. Anchor Blocks for thermal expansion and contraction must be incorporated into the design. Design details must be designed specific to each project and pipe specifications and designed by a Professional Engineer in accordance with AWWA M55.

iii. Fusion Joints

a) HDPE fusion joints shall be made by factory trained or industry certified personnel using the appropriate manufacturers specified butt, sidewall or electrofusion equipment, procedures, and fittings.

b) Operator certification shall be available for inspection and issued no more than one calendar years ahead of construction to be considered valid. Fusion equipment must be serviced and maintained to the manufacturer's specifications.

c) Fusion equipment must be serviced and maintained to the manufacturer's specifications.

d) Butt and sidewall fusion machines shall be A H McElroy or approved equal.

e) Electrofusion fittings and equipment shall be by Friatec or Central Plastics.

iv. Grooved Joint Couplings

a) Grooved ends shall be factory supplied or performed on-site by manufacturer trained personnel trained in the use of grooving tools, application of groove, and product installation. A manufacturer representative must visit the job site to review the installation and ensure best practices in grooved joint installation are followed.

b) Grooved end couplings shall be installed in accordance with the manufacturer's instructions. Gaskets shall be manufactured by the coupling manufacturer and verified as suitable for the intended service.

c) Double-Groove Coupling for HDPE Pipe, double-bolted coupling to engage double-grooved HDPE pipe conforming to PE100, PE4710 / ASTM D3035 or ASTM F714, and PE100 / ISO 4427, consisting of two ductile iron housings conforming to ASTM A 536, Grade 65-45-12 with two keys designed for use with AGS style wedge shaped grooves.

d) Grooved end couplings shall be coated as per Section 5.4 (j) and (i) be electrically continuous and be wrapped and cathodically protected with anode nuts as per Waterworks Specifications

5.8. AWWA C950 FRP Pressure Pipe

FRP Pipe has only limited approval, and will only be approved by the Engineer on a case by case basis.

(a) **Specifications**

i. FRP pipe and fittings must conform to AWWA C950
ii. FRP pipe and fittings must be NSF 61 approved
iii. The pipe shall be no more than 750 mm in nominal diameter.
iv. Standard pipe lengths shall be 12.2 m, unless otherwise approved by the Engineer.
v. The pipe must have a minimum operating pressure of 150 psi.
vi. The outside diameter (OD) shall conform to ductile iron (DIPS) or steel pipe (IPS) as approved by the Engineer.
vii. Manufacturer of pipe and fittings shall employ product technology used in the manufacture of fiberglass pipe for a minimum of twenty five years and the facility shall have at least 10 years of manufacturing experience producing fiberglass pipe. The facility shall be ISO 9001 Certified and have the NSF 61 certification for the fiberglass pipe and fittings.
viii. Cell Classification: The FRP Pipe must meet AWWA C950 Type 1, Liner C, Grade 4.
ix. Resin: The manufacturer shall use only polyester or vinyl ester resin systems designed for the service intended.
x. Filler: sand shall be at least 95% silica sand and have a maximum moisture content of 0.2%.
xi. Glass Reinforcement**:** Continuous filaments and chop rovings shall be of the highest commercial grade E-glass fibers with a finish compatible with the resin.
xii. Gaskets:
    a) shall be SBR, EPDM, or NBR of a pressure actuated seal design.
    b) NBR (Nitrile) gaskets shall be used where fittings are to be installed in areas contaminated or potentially contaminated with organic compounds (organic solvents or petroleum products), i.e. near buried petroleum fuel tanks, abandoned gas stations, petrol storage areas or petrol refinery sites.
xiii. FRP Couplings
    a) All FRP couplings shall be manufactured using the same process as the pipe.
    b) The pipe may be field connected with a fiberglass coupling that utilizes an elastomeric sealing gasket as the sole means to maintain joint water tightness. The joints shall meet the performance requirements of ASTM D4161.
xiv. Restrained Joints:

a) The pipe may be connected with a fiberglass reinforced sleeve/coupling utilizing a double bell with elastomeric sealing gaskets as the sole means to maintain joint water-tightness and locking rods to transfer axial thrust from one pipe section to another. On each side, the coupling bell shall have a standard rubber gasket and a rod-groove system, through which the load is transferred via compressive and shear action. The pipe spigot shall have a matching rod-groove. The joint shall meet the performance requirements of ISO 7432.

b) The pipe may be field connected with a fiberglass laminate as the sole means to maintain joint water tightness and to transfer axial loads. The joints shall meet the performance requirements of ASTM D4161.

xv. FRP Fittings

a) All FRP fittings shall be of the same structural design as adjoining pipe. Fittings shall be manufactured with mitered sections of pipe and joined by fiber-glass overlay.

b) Biaxial fitting with restrained joints shall be required when thrust blocking is not an acceptable means of restraining the fittings.

xvi. End Squareness

a) All points around each end of a pipe unit shall fall within $\pm$ 6 mm (1/4 inch) or $\pm$0.5% of the nominal diameter of the pipe, whichever is greater, to a plane perpendicular to the longitudinal axis of the pipe.

5.9. Mainline Valves

(a) **Specifications**

i. All valves shall open with clockwise operation of the operator nut.

ii. All valves shall incorporate a shaft locking mechanism designed to lock the valve disc either in the fully open or fully closed position and mounted to the valve top mounting plate. The shaft locking design shall be lockable in the open or closed position and permit the independent removal of the actuator with the disc locked open or closed. The shaft locking mechanism shall be designed to withstand the full output torque of the actuator in the locked position. The lock out device shall be lockable for tag out / lock out guidelines for actuator repairs or removal.

iii. All mounting hardware shall be Stainless Steel.

iv. All valves must incorporate an independent packing retaining plate or recessed packing retaining device to accommodate the actuator removal under fully system pressure.

v. The actuator must not be used to retain the valve packing on any valve size.

vi. The coating requirements will be per the valve exterior coating specification.

vii. All materials, dimensions, equipment and testing shall comply with the latest edition of AWWA C504 for Rubber-Seated Butterfly Valves in addition to specific requirements or options specified or detailed below.

viii. The City of Calgary will defer to the valve Manufacturer's specifications and recommendations covering all materials, dimensions, equipment and testing not specified or detailed herein.

ix. The valve Manufacturer shall have a minimum of five (5) years of experience in the manufacture of valves and actuators for municipal potable water service.

x. All valves shall be zero leakage at rated pressures for bi-directional flow conditions and satisfactory for applications involving operation after long periods of inactivity.

xi. All materials shall be in compliance with ANSI/NSF Standard 61.

(b) **Approved Manufacturers**

i. Valves
   a) PRATT
   b) Mueller
   c) Val-Matic
   d) Crispin – At discretion of the Engineer only
   e) or approved equal at discretion of Engineer

ii. Actuators
   a) AUMA
   b) Or approved equal at discretion of Engineer

(c) **Double Flanged Valves (All new valve installations)**

i. AWWA C504 Class 150 B (20 inch to 72 Inch) and Class 250B (20 inch to 48 inch):
   a) Each valve shall be manufactured with flanged ends (flat-faced).
   b) The flanged ends shall be faced and drilled to match AWWA Class D flanges unless otherwise specified by the Engineer.
   c) Unless otherwise specified, valves shall be supplied with continuous, molded rubber-ring gaskets conforming to the AWWA C111 Standard.
   d) The laying length for these double-flanged valves shall conform to the Short Body dimension specified in AWWA C504.
   e) The valve body and ends shall be cast in one piece.

Diameter (mm)	Flange x Flange Valve Lay Length (mm)
500 (20")	203 (8")
600 (24")	203 (8")
750 (30")	305 (12")
900 (36")	305 (12")
1050 (42")	305 (12")
1200 (48")	381 (15")
1350 (54")	381 (15")
1500 (60"	381 (15")

(d) **Grooved End Butterfly Valves - At Discretion of Engineer**

i. **Grooved end valves shall only be used for retrofits and only at the discretion of the Engineer**

ii. Each valve shall be manufactured with either one end flanged (flat-faced) and one end Victaulic Style 44 (OGS), or both ends Victaulic Style 44 (OGS).

iii. The lay length for Victaulic 44 by Victaulic 44 shall be the Long Body dimensions specified in AWWA C504.

iv. Grooved ends shall have ends compliant with AWWA C606 and/or C200 with overall design conforming to AWWA C504

Diameter (mm)	Flange x Victaulic Lay Length (mm)	Victaulic x Victaulic Lay Length (mm)
500 (20”)	229 (9“)	457 (18”)
600 (24”)	260 (10.25”)	457 (18”)
750 (30”)	330 (13”)	559 (22”)
900 (36”)	432 (17”)	559 (22”)
1050 (42”)	432 (17”)	610 (24”)
1200 (48”)	483 (19”)	660 (26”)

(e) **Class, Pressure, Flow and Water Temperature**

i. All valves shall be designed for
   a) bi-directional flow service
   b) a maximum velocity of 5 m/s.
   c) Water temperature ranges from 0C to 15C.

(f) **Shaft, Shaft Bearings and Shaft Seal**

i. The shaft shall be constructed of ASTM A-276 Type 304 stainless steel for Class 150B and ASTM A-564 Type 630 H1100 stainless steel for Class 250B

ii. The shaft shall be keyed for operator connection.

iii. All valves shall be designed with standard self adjusting and wear compensating V-Type packing.

iv. Upper and lower journal bearings shall be sleeve type, non-metallic, non-corrosive and self-lubricating.

v. Bearing material shall be Teflon lined with fiberglass backing or valve Manufacturer’s approved equal such as Duralon®.

(g) **Body Materials**

i. Class 150B valve bodies shall be cast iron ASTM A126 Grade B or ductile iron ASTM A536 Grade 65-45-12.

ii. Class 250B valve bodies shall be ductile iron ASTM A536 Grade 65-45 -12.

iii. Grooved end valve bodies shall be ductile iron ASTM A536 Grade 65-45-12.

iv. The Serial Number shall be a distinctive identifying number for each valve and not a batch number.

v. All butterfly valve bodies shall have riveted stainless steel or aluminum labels which shall contain the following data and information:

Manufacturer:	Size:	Class:
Model No:	Serial No:	Year:
Flange Pattern:	Weight:	

(h) **Drilled and Tapped Lift Lug Holes and Lifting Lugs**

i. The valve Manufacturer shall drill and tap four (4) radial holes in each flange wall. The tapped holes shall be located in all four (4) quadrants at 60 degrees minus to the horizontal, centered between bolt holes. Total of 8 tapping holes required.

ii. The tapped holes shall be drilled to a suitable depth to accommodate drop forged eye bolts where a minimum of two (2) eye bolts will be used to lift the valve in its upright position and four (4) eye bolts will be used to lift the valve in its horizontal position. The holes shall be plugged with a plastic cap to prevent corrosion and contamination during shipment and storage or they may be supplied with the eye bolts installed.

iii. Flanges drilled at 10 and 2 o'clock positions to accept 1" HR125UNC at 8 threads per inch with 4" length of bolt (from under head) swivel hoist rings for lifting (by Crosby or equal).

iv. The valve Manufacturer shall determine the size of the eye bolts and provide the criteria for determining the size of the eyebolts and the recommended lifting procedure if requested by the Purchaser.

v. In addition to AWWA Standard C504 all butterfly valves shall be supplied with lifting lugs included as supplied by the manufacturer.

(i) **Valve Disc**

i. All valve discs shall be constructed of ductile iron Class ASTM A-536 Grade 65–45–12 and all valves shall have a stainless steel ASTM 316 stem.

ii. The valve disc shall be of the flow-through or solid disc design. All valves must be shipped with valve discs 2 to 3 degrees open.

iii. The disc shall be free of hollow chambers.

iv. Any deviation of disc material for size, Class or type of service must be clearly declared by the valve Manufacturer for consideration.

(j) **Valve Seats and Mating Surfaces**

i. Valve seats shall be designed to provide zero leakage shut off at a pressure differential across the valve equal to the Class pressure.

ii. Buna-N rubber seats shall be applied to the valve disc or body and retained by the Pratt E-Lok® method, Crispin L2 method, Val-Matic Tri-Loc™ method or other approved means.

iii. The seat mating surface shall be stainless steel Type 316.

(k) **Orientation During Installation**

i. Unless otherwise specified, all butterfly valves used in underground conditions shall be installed with the shaft in a horizontal position with its valve actuator operated via the 2-inch AWWA operating nut from the vertical position.

ii. Normal operation is done by a service valve assembly connected to the operating nut extending to the ground or road surface.

iii. Hand wheel or electric actuator operation will be considered for special applications only and will be specified separately.

(l) **Valve Actuator**

i. All valves shall incorporate a shaft locking mechanism designed to lock the valve disc either in the fully open or fully closed position and mounted to the valve top mounting plate. The shaft locking design shall be lockable in the open or closed position and permit the independent removal of the actuator with the disc locked open or closed. The shaft locking mechanism shall be designed to withstand the full output torque of the actuator in the locked position. The lock out device shall be lockable for tag out / lock out guidelines for actuator repairs or removal.

ii. All mounting hardware shall be Stainless Steel.

iii. All valves must incorporate an independent packing retaining plate or recessed packing retaining device to accommodate the actuator removal under full system pressure.

iv. The actuator must not be used to retain the valve packing on any valve size.

v. The coating requirements will be per the valve exterior coating specification.

vi. Unless otherwise specified, manual actuators are required for underground conditions and approved for submerged service.

vii. Actuators must be designed for the full rating of the valve and bi-directional flow.

viii. Valve Manufacturers are to meet all applicable requirements of AWWA C504 for manual actuators. Manual actuators shall be tested in compliance with the provisions of AWWA C504.

ix. All valves shall open right (clockwise) and be supplied with a 50 mm (2 inch) AWWA operating nut painted red to indicate open right (clockwise).

x. All valve actuators are to be supplied and mounted by the valve Manufacturer only unless the Engineer requests an alternate actuator Manufacturer.

xi. All valves in underground concrete chambers shall be equipped with manual actuators of the travelling nut or worm gear design fully enclosed complete with an external rotating disc position indicator. External arrow position indicators will not be approved.

xii. All valves for direct burial shall be equipped with manual actuators of the travelling nut or worm gear design fully enclosed and 90% grease packed. No external disc position indicators are required or allowed for this type of valve service.

xiii. Actuators shall be designed to produce the required torque for efficient manual operation using a valve key on the 2-inch operating nut from the ground surface position. Stop limiting devices shall be provided for the open and closed positions. Buried gear stops shall be capable of withstanding 450 ft. lbs of input torque. Preference may be given to valve Manufacturers providing external closed stop adjustments.

xiv. The valve Manufacturer is ultimately responsible for sizing, mounting and operation of the actuator for the service use specified herein. Any deviation from the requirements requested above by The City of Calgary must be clearly declared by the Manufacturer for consideration.

xv. All actuators shall have riveted stainless steel or aluminum labels which shall contain the following data and information:

Manufacturer:	Year:
Model No:	Gear Ratio:
Serial No:	Number of Turns:

xvi. The Serial Number shall be a distinctive identifying number for each actuator and not a batch number.

xvii. All actuators must have the following number of turns to open:

Size (mm)	Turns
500 (20”)	60
600 (24”)	60-70
750 (30”)	85 - 90
900 (36”)	130
1050 (42”)	150 - 160
1200 (48”)	200 - 215

xviii. Any deviation from the requirements requested above by The City of Calgary must be clearly declared by the valve Manufacturer for consideration by The Engineer.

(m) **Ambient Conditions**

i. The valve and actuator shall be designed to operate between minus 32 ^{o}C (- 25 ^{o}F) to 27 ^{o}C (80 ^{o}F).

(n) **Protective Coatings on Valves and Actuators**

i. All interior and exterior coatings to be in compliance with AWWA C504 Components in contact with potable water shall be coated in compliance to NSF 61 and AWWA C550.

ii. Liquid epoxy coating coatings – internal valve coating thickness to be 8mils minimum. External coating thickness for valves and actuators shall be 12 mil minimum and 25 mil for direct bury applications.

iii. Fusion bonded epoxy coatings – internal valve coating to be 10mils minimum. External coating thickness for valves and actuators shall be 20mils minimum and 25 mil for direct bury applications.

iv. Manufacturer or third party supplied operators/actuators shall be externally coated to the thicknesses specified above for external coatings. Supplemental coatings to be applied as per coating Manufacturers specifications and SSPC – SP-10.

v. Internal and external coatings to be holiday tested and pinhole free as per ANSI/AWWA C550.

(o) **Testing by Manufacturer**

i. The valve Manufacturer is to conduct all tests in compliance with AWWA C504 Section 5.1 pertinent to The City of Calgary underground service conditions and shall report any non-conformance.

ii. Pursuant to Section 5.1.2.5.3, The City of Calgary requires the disc be leakage tested in both directions. The leak test shall be at the maximum rated differential pressure and shall include opening the valve to release the test pressure and re-closing while applying the test pressure.

(p) **Shop Drawings**

i. For formal supply Tender(s) issued by The City of Calgary where six (6) or more valves are required (irrespective of size) the valve Manufacturer shall provide in his Tender package a generic shop drawing for each size of valve and model of actuator.

ii. The City of Calgary defers to Imperial measurement on Shop Drawings for all butterfly valves manufactured in the U.S.A. Conversion to Metric is not recommended.

iii. For formal supply Tender(s) awarded the successful valve Manufacturer shall then submit for approval certified engineered drawings showing principal dimensions, general construction and material specifications for all parts of the valves and valve actuators specified in the Tender

(q) **Marking, Shipping and Invoicing**

i. All valves shall be packed in individual wooden crates or strapped to pallets where the actuator is shielded and the flanges are fully protected by plywood or similar means. Any valves arriving damaged that can be attributed to a deficiency in the packing specified will not be accepted and returned at the Manufacturer's expense.

ii. The valve Manufacturer or Supplier shall clearly indicate size, quantity and Serial Numbers of all butterfly valves being supplied on their invoices.

iii. City of Calgary valve crews must inspect and accept or reject each valve upon delivery.

iv. This specification document may be used in some form by The City of Calgary, local Suppliers or local Contractors for valve orders where the quantity requested would be less than six (6) and therefore the requirement for marking, shipping and invoicing in this case would be modified or waived unless otherwise specified.

(r) **Maintenance Manual**

i. For formal supply Tender(s) issued by the City of Calgary where six (6) or more valves are required (irrespective of size) the valve Manufacturer shall provide an operation and maintenance manual pertinent to the size range of valves and actuators supplied. The manual shall include the valve Manufacturer's recommended storage, lifting, operation, in-line maintenance and part replacement procedures. The manual shall be mailed separately to the City of Calgary Water Resources and not shipped with the order.

ii. This specification document may be used in some form by The City of Calgary, local Suppliers or local Contractors for valve orders where the quantity requested would be less than six (6) and therefore the requirement for a Maintenance Manual to be furnished in this case would be waived unless otherwise specified.

(s) **Affidavit of Compliance**

i. For formal supply Tender(s) issued by the City of Calgary where six (6) or more valves are required (irrespective of size) the successful valve Manufacturer will be required to furnish an Affidavit of Compliance and certified copies of all test reports describing procedures and results considered standard to AWWA C504, standard to the valve Manufacturer's quality assurance program and any specifically requested by The City of Calgary.

ii. The City of Calgary will not accept delivery of any valve supplied under the Tender unless certified copies of test reports have been furnished. All documents shall be mailed separately to The City of Calgary Water Resources and not shipped with the order.

iii. This specification document may be used in some form by The City of Calgary, local Suppliers or local Contractors for valve orders where the quantity requested would be less than six (6) and therefore the requirement for an Affidavit of Compliance to be furnished in this case would be waived unless otherwise specified.

5.10. Air Valve Control Valve

(a) **Specifications**

i. Control valves for Air Valves shall be butterfly valves conforming to Section 5.9 unless specified below:

a) 50 mm (2") & 75 mm (3")

1. Centerline/Jenkins 200 Fig# CV04435-2 DI. (200 PSI Rated)
   Jenkins 2231-ELJ
2. Ductile Iron body, Epoxy Coated, Lug Style Butterfly Valves With 316 Stainless Steel Stem And Disc, Potable Water EPDM seal, With Ductile Iron Lever Operator.

b) 100 mm (4") and 150 mm (6")

1. Centerline/Jenkins 200 Fig# CV04431-2 DI.(200 PSI Rated)
2. Ductile Iron body, Epoxy Coated, Lug Style Butterfly Valves With 316 Stainless Steel Stem And Disc, Potable Water EPDM Seal, With Ductile Iron Lever Operator.

5.11. Air Valves

(a) **Specifications**

i. As per AWWA 512
ii. Air valves shall be connected to the feedermain with the use of a lug style butterfly valve as per Section 5.10, situated between the air valve and the flanged outlet top centerline.
iii. The installation shall be complete with hand control, for manual operation.
iv. To be supplied with a written Lifetime Warranty for all internal parts.
v. Air valves shall come with provisions for draining.
vi. Air valves shall have a non-slam or three stage design to reduce transients.

(b) **Approved Models and Manufacturers**

i. ARI D-060-C-HFNS (2" to 10")
ii. ARI S-052-C (1/2" to 1")
iii. Ventomat RBX
iv. Other as approved by Engineer.

5.12. Bypass / Drain Valves

(a) **Specifications**

i. All valves shall be flange by flange gate valves, with a diameter to match the bypass piping.
ii. Valves shall come with a flange isolating kit where specified only by the Engineer.
iii. All valves shall be equipped with a 50 mm square operating nut and shall turn clockwise (right) to open unless otherwise specified. Operating pressure shall be 1380 kPa (200 psi) for valves 300 mm and smaller, and 1030 kPa (150 psi) for valves 400 mm and larger.
iv. The stem seal shall be of an O-ring or other pressure actuated seal design.
v. All valves shall conform to AWWA C509 or AWWA 515 and be an approved maker under the Standard Specifications Waterworks Construction.
vi. Valves shall be ductile iron body; resilient rubber seated disc with non-rising stem.
vii. The interior (ferrous parts) of the valve shall be factory coated with epoxy coating to conform to AWWA C550

viii. All valves shall be supplied with a circular bottom box guide plate.
ix. Metallic type guide plates shall be coated. The guide plate shall be located below the operating nut and shall be designed to center the operating nut inside the designated bottom box.
x. Unless otherwise specified, valves shall be supplied with continuous, molded rubber-ring gaskets conforming to the AWWA C111 Standard.
xi. NBR (Nitrile) gaskets shall be supplied for valves which will be installed in areas contaminated or potentially contaminated with organic compounds (organic solvents or petroleum products), i.e. near buried petroleum fuel tanks, abandoned gas stations, petrol storage areas or petrol refinery sites.
xii. The exterior (except flange faces) of all valves shall be factory coated.

5.13. Distribution System Tie-In Valves

(a) **Specifications**

i. Distribution tie-in valves shall meet the specifications set out in the previous Bypass / Drain Valves topic, and they shall also be flange by hub gate valves, with a diameter to match the feedermain flanged outlet.
ii. Isolating kits must be provided where isolation is required by the Engineer
iii. Zinc Dichromate fasteners must be used unless otherwise specified by the Engineer

5.14. Connection Materials

(a) **Welded Steel Butt Straps**

i. Only allowed on tie-in connections or repairs
ii. Allowed only on pipe 750 mm in diameter and larger since internal coating repairs are required
iii. Double welded butt strap with threaded testing ports are permitted.
iv. Plain steel end of each closure for steel or concrete pressure pipe is to be 300 mm longer than required to compensate for chainage corrections required during installation.
v. See **Drawing 20**

(b) **Welded Joints**

i. For steel and concrete pipe only
   a) For steel pipe see Section 6.4(b)(1)
   b) For concrete pipe, joints shall be tested with either:
      1. Test plugs
      2. Magnetic Particle Inspection (MPI)
ii. As per AWWA M9
iii. ***See* Drawing 16 & 19**

(c) **Holdfast Couplings**

i. For concrete pipe only

ii. Each joint shall require assembly of the joint and then installation of a grout diaper.

iii. Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

(d) **In-Line Mechanical Sleeve Couplings**

i. Approved Materials
   a) Romac Series 400
   b) Smith Blair Series 400
   c) Robar Series 1906
   d) Or Approved Equal

ii. Mechanical couplings must be sized to accommodate for final pipe OD including coatings without utilizing manufacturer tolerances.

iii. All welds must be ground flush and coatings repaired, where coupling mating surfaces come in contact with the pipe.

iv. Specifications
   a) Design as per AWWA C219
   b) Designed for minimum deflection specified in AWWA C219 but in no case less than 2 degrees
   c) Centre Sleeve shall be minimum thickness of:
      1. 9.5 millimetres for sized less than 1200 millimetre nominal pipe diameter
      2. 12.7 millimetres for sizes greater or equal to 1200 mm nominal pipe diameter
      3. Minimum thickness required for working pressure as per AWWA C219
   d) Centre sleeve length shall be minimum of
      1. Minimum 305 millimetres
      2. Length to suit pipe closure gap plus design deflection allowance
   e) Electrical continuity
      1. All couplings shall have continuity points to provide for electrical continuity bonding between all metallic part and pipe.
      2. Insulating boots where specified shall comply with AWWA C-219.
   f) Interior and Exterior Coating
      1. Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i).
      2. Post installation requires application of Denso mastic paste and tape as were Standard Specifications Waterworks Construction.
   g) Gaskets
      1. Gaskets shall consist of NBR (Nitrile) rubber listed under NSF61.
   h) Installation Hardware
      1. Type 304 passivated Stainless Steel as per ASTM F 593. Nut threads shall be coated with anti- galling compound
   i) Transitions
      1. Transition couplings to accommodate different pipe OD's must have adequate thrust restraint via either mechanical or welded restraints per manufacturer recommendations. Field welded restraints are only permitted when approved by The Engineer due to lining

damage that is difficult to repair in all field conditions. Where welded restraints are permitted by The Engineer, linings and coatings must be repaired. Where mechanical restraints are used, the materials and method of restraint must be approved by the Engineer.

(e) **Split Sleeve Grooved Joint Couplings & Fittings**

i. Design as per AWWA C227

ii. Approved
   a) Victaulic Style 232 (Depend O Lok)
   b) Victaulic Style 44 (OGS – Original Groove System)
   c) Victaulic AGS W07 (Rigid) (AGS – Advanced Groove System)
   d) Victaulic AGS W77 (Flexible)(AGS – Advanced Groove System)
   e) Victaulic AGS X07 (Rigid) (AGS – Advanced Groove System)
   f) Victaulic W257 (Flexible)
   g) Or approved equal

iii. Split Sleeve Grooved Couplings are to be bolted, split-sleeve type and consist of four basic components with a single or double arch cross section which closes around pipe ends that are smooth for expansion or contraction requirements or pipe ends with rings or grooves for end restraint requirements:

iv. Coupling sections to be electrically continuous or provided with bonding harnesses.

v. Style 44 Victaulic couplings shall be assembled with a minimum clear gap of 6 mm between the pipe ends.

vi. Style 44 Victaulic end rings manufactured by Victaulic shall be supplied by the pipe Manufacturers unless otherwise specified on the Drawings.

vii. Bodies shall be either
   1. Ductile iron ASTM A536, Grade 65-45-12
   2. Carbon steel ASTM A36

viii. Gaskets shall be Nitrile

ix. Installation Hardware
   1. For buried applications: Type 304 passivated Stainless Steel as per ASTM F 593. Nut threads shall be coated with anti- galling compound
   2. For chamber applications: Carbon steel zinc dichromate plated bolts conforming to ASTMA449 and ASTM A183. Zinc plated heavy hex nuts conforming to ASTM A-563, Grade B.

x. Grooving tools shall be of the same manufacturer as the grooved components.

xi. Grooved Joints shall be installed in accordance with the manufacturer's latest published installation instructions.

xii. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove.

xiii. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service.

xiv. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for pipe manufacturer and contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.

xv. Interior and Exterior Coating
   a) For dry service applications:
      1. Shall be coated and lined as per Section 5.4 (j) and 5.4(i), and holiday free.
   b) For chamber, damp or intermittently wet applications,
      1. As per (i) above.
      2. Requires Denso profile mastic, paste and tape as the Standard Specifications Waterworks Construction.
   c) For direct buried or submerged service
      1. as per (ii) above
      2. Requires an approved anode cap on each bolt.

xvi. Housing shall be drilled and tapped with bolt to accept a point for continuity bonding.

(f) **Tapping Couplings**

i. Shall be designed as per AWWA C223

ii. Refer to Section 9

iii. Feedermains are permitted to be tapped to tie into a distribution mains, only when approved by the City's Engineer.

iv. Tapping should only be done by qualified personnel, as permitted by the Engineer.

(g) **Flanges**

i. Specifications
   a) Shall be minimum AWWA C207 Class D or as otherwise specified by the Engineer in accordance with AWWA C207 Standard for steel ring flanges. Hub flanges will not be permitted.

ii. Gaskets
   a) All non-isolating flange gaskets must be either:
      1. Nitrile or EDPM as per AWWA 207.
      2. Type E (full face) nitrile faced phenolic.

iii. Flange Bolts & Nuts
   a) Bolts: ASTM A193, Grade B7, hex head, coarse thread, Class 2A fit
   b) Nuts: ASTM A194, Grade 2H, heavy hex, coarse thread, Class 2B fit
   c) Washers: F436, Type 1
   d) Yellow Zinc Dichromate finish

(h) **Restrained Joints**

i. The following connection types are approved to restrain pipe joints due to thrust forces.
   a) Bolted Harnesses
      1. For steel pipe only
      2. Designed in accordance with AWWA M11
   b) Flanges
   c) Victaulic Couplings
   d) Holdfast Couplings
   e) Welded joints
   f) Steel butt straps
   g) Other connection type only as approved by the Engineer

5.15. Feedermain Outlets

(a) **Drains**

i. Drain outlets shall come with minimum AWWA Class D flanges.
ii. Drain piping coming off of a feedermain shall be PVC from the drain valve to the drain manhole
iii. Drain manholes must be 5A manholes

(b) **Accesses**

i. Access openings shall be minimum AWWA Class D flanges centered on top of the feedermain pipe.
ii. See **Drawings 7 & 8**
iii. To be supplied with minimum AWWA Class D Blind Flanges c/w lifting handles.

(c) **Distribution System Ties**

i. Minimum Class D flange located at the feedermain pipe springline.
ii. Isolation kits will be required on AWWA C301 or C303 pipe, or as specified by the Engineer.
iii. See **Drawing Sheet 25**.
iv. Flange by hub gate valve.
v. The size of opening has to match the distribution pipe to which it is to be tied.

5.16. Cathodic Protection Materials

(a) **Basic Design Principles:**

i. Non-metallic piping systems using metallic appurtenances shall be designed so that all metallic elements are dielectrically coated and protected with galvanic anodes.
ii. Metallic piping shall be dielectrically coated, electrically continuous and be installed with cathodic protection by a galvanic or impressed current system approved by the Engineer.

iii. Piping of dissimilar materials, age, or coatings shall be electrically isolated from each other.

iv. Cathodically protected piping at building and structure entries shall be isolated from the structure to prevent contact with the electrical system ground grid.

(b) **Test Stations and Leads**

i. Test stations shall be the Cott "Big Fink"® type, as detailed on Sheets 12 & 20 in the Standard Specifications Waterworks Construction.

ii. Flush mount stations where approved, shall be Waterworks main valve casing assemblies as detailed on Sheet 4, in the Standard Specifications Waterworks Construction or Cott Flush Fink (blue) where the number of terminated test leads exceeds eight.

iii. Test leads shall be AWG #10/7 stranded copper wire with type RWU-90 insulation.

iv. Structure test leads shall be doubled for redundancy, with each red or black lead being duplicated with independent thermo-welded connections 300mm apart on the respective structure.

(c) **Galvanic System**

i. All Magnesium and Zinc sacrificial anodes shall conform to Section 503.02.16 of the Standard Specifications Waterworks Construction.

(d) **Impressed System**

i. Anodes

a) Impressed current anodes shall conform to ASTM A518 Grade 3 (latest edition).

b) Anodes shall be the "Chill Cast" High Silicon Cast Iron rod type, complete with 300mm by 1.8 m long "canode" casing and coke breeze backfill.

c) The anode wire shall be a seven (7) strand copper conductor with HMWPE insulation.

ii. Rectifiers

a) Rectifiers shall be CSA listed under LR-45382 and be equipped with AC/DC, lightning surge, and magnetic trip input overload and short circuit protection.

b) They shall be single or three phase as specified.

c) Transformers shall meet Class "H" temperature requirements and have a minimum efficiency of 95%.

d) Output controls shall have a minimum of 5 coarse and 5 fine steps of tap link-bar output adjustment.

e) The case shall be rated NEMA 3R, and shall be constructed of 12-guage galvanized steel with a fusion bonded polyester powder paint finish.

(e) **Cathodic Protection Cable**

i. Standard cable for direct burial is a stranded copper conductor covered with an insulation of high molecular weight polyethylene (HMWPE) designed for direct burial use, and shall bear "Cathodic Protection Cable" on the surface of the cable.

ii. Header and negative cable size, placement, and burial depth shall be approved by the Engineer.

iii. Anode wire and header cables shall conform to the following details:

a) Conductor

1. Seven (7) strand copper conductor conforming to ASTM Specification B-8.

b) Insulation

1. Insulation is high molecular weight polyethylene conforming to ASTM D-1248, Type 1, Class A, Category 5, Grades E4 & E5. Tensile Strengths Jl, J3.

(f) **Isolation Devices**

i. Isolating Flange Kits

a) Isolating flange kits shall be designed to fit flat face flanges conforming in dimensions and drillings to AWWA C110 Standards.

b) The gaskets backing material shall be type "E" G-10 or G-11, 3 mm thick, epoxy glass, complete with Nitrile O-rings or seal rings imbedded on opposite sides of the gasket, or NBR full faced.

c) The bolt sleeves shall be G10 material.

d) The double washers sets shall be G-10 or G-11 epoxy glass backed up with zinc plated steel washers.

e) The location of the O-rings, if applicable, shall be compatible with the flanges.

ii. Isolating Couplings

a) Isolating boots shall be made of molded rubber conforming to the latest issue of the ASTM D 2000, AA615, B13 compounded to have high insulating properties.

b) Approved coupling manufacturers are listed in Section 5.14(d) for in-line mechanical couplings.

c) All other coupling components shall meet Section 5.14(d) for in-line mechanical couplings.

d) Electrical conductivity must be provided between bolts and endplates and between endplates and sleeves.

e) Electrical conductivity between bolts and end plates is to be provided by removing the coating from the bolt nut, bolt head and end-plate bearing area or by approved alternate means.

iii. IsoStops

a) Shall be used only at the request and under the approval of the Engineer and are required where isolations on steel pipe under cathodic protection will be permanently inaccessible for maintenance or correction.
b) Isostops shall be factory supplied with API 5L steel pipe pups, and be constructed with internal materials suitable for the conveyance of potable water.
c) Dielectic test rating shall be 3-5kV a.c.
d) Insulation resistance in air shall be greater than 5kV at 1000 Volt. d.c.

(g) **Lining and Coating Materials**

i. Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

5.17. Bedding Materials

(a) Suitable material for bedding shall consist of material free from large rocks, boulders and frozen lumps.
(b) The suitability of this material shall be determined at the sole discretion of the Engineer.
(c) Bedding material shall not be dropped onto pipe from a height exceeding 600 mm. Where this requirement cannot be met, rockshield material approved by the Engineer shall be supplied at no extra cost.
(d) Suitable granular bedding material shall be pea gravel conforming to the following gradation, unless otherwise specified:

Sieve Size	***Percent Passing by Weight***
20 mm	100
12 mm	60 - 100
10 mm	20 - 80
4.75 mm (#4)	0 - 10
2.36 mm (#8)	0 - 3

Refer to Class B Bedding as per **Drawing 14**.

5.18. Warning Tape

(a) Warning tape must be installed above all feedermain installations at the discretion of the Engineer.
(b) Strips to be placed a minimum of 300 mm above the pipe crown.
(c) Three strips to be provided for pipe 900 mm and larger.
(d) Approved manufacturers:
i. Empire – Magnatec
ii. ACP – MTP 61000
iii. Pro-Line 10314-3
iv. or approved equal

5.19. Concrete Thrust Blocks

(a) **Specifications**

i. Concrete thrust blocks, if required, shall be designed as per AWWA M9, M11 or M23 for the applicable pipe material.

ii. Alternative restraints may be used in place of thrust blocks at the discretion of the Engineer.

iii. There must be consideration for allowable soil bearing strength, as determined by the Geotechnical Engineer.

iv. See **Drawing 21**.

5.20. Crossing Materials

(a) **Overview**

i. A feedermain crossing is defined as a feedermain across another utility, highway, major road, railway track or a TUC (Alberta Transportation Utility Corridor).

ii. Crossing requirements must meet the minimum standards of this document in addition to the requirements of the owner of the utility or right of way that is being crossed, or any other applicable standards and specifications.

(b) **Joints**

Pipe Type	***Joint Restraint***
Steel or HDPE	Weld or fuse joints completely as per normal procedures. Use unrestrained casing insulator for steel pipe only. Casing insulator not required for HDPE.
Concrete	Tack weld around joint circumference. Use unrestrained casing insulator.
PVC	Use restrained casing insulator, except for fusible PVC.

(c) **Casing Pipe**

i. The Engineer, utility owner or right of way owner may require feedermain crossings of roads, rights of way, and easements to be constructed by means of a carrier and encasement pipe.

ii. Casing Pipe shall be for use in either the auguring or the open cut method.

iii. Casing Thickness
   a) Minimum as per CSA Z662

iv. Coating and lining are not required if 1.6 mm extra wall thickness corrosion allowance is provided.

v. Sacrificial anode(s) and a test point are required at each end of the encasement pipe in accordance with **Drawing 31.**

vi. Approved Casing Materials:
   a) Tunnel Liner Plates as supplied by ARMTEC;
   b) Steel pipe with a minimum standard schedule wall thickness;
   c) Corrugated Structural Plate (CSP);
   d) Corrugated Metal Pipe (CMP);
   e) Concrete jacking pipe (micro-tunneling installations).

vii. Casing Insulators
   a) As per Standard Specifications Waterworks Construction or as approved by the Engineer;
   b) Engineering calculations shall be completed to determine the correct casing insulator.
   c) A spacer shall be placed at 0.3 m from each end of the casing. The spacers for the remaining pipe barrel shall not exceed a separation of 3 metres.
   d) Spacers must be insulating for steel carrier pipe within steel casings.

viii. Restrained Casing Insulators / Spacers

a) UNI-FLANGE or approved equivalent

ix. Casing Pipe End Treatment

a) Non-Steel Carrier Pipe

1. Manufactured End Seals are not required;
2. The ends of the encasement pipe shall be wrapped with suitable filter fabric.

b) Steel Carrier Pipe in Steel Encasement

1. End Seals

i. Provide Link seals and Viscotaq end seal system at both ends of the encasement pipe as shown in **Drawing 31.**

The intent is to keep the interior of the encasement dry by means of a watertight end seal system. If this can be achieved then internal to the casing carrier pipe corrosion will be mitigated by means of the absence of an electrolyte within the encasement. This also ensures the ease of future carrier pipe withdrawal if necessary.

2. Encasement Vent Pipes

i. Refer to Drawing 31.

ii. Vent pipes to be 50mm on steel encasement pipe up to 750mm, and 80mm on steel encasement pipe larger than 750mm.

iii. One vent pipe is required on the crown of the encasement pipe at the upstream (higher elevation) end.

iv. One vent pipe is required on the invert of the encasement pipe at the downstream (lower elevation) end.

v. Vent pipes are to be mild steel, minimum Schedule 40 pipe, coated to City of Calgary Waterworks Specifications. Lining is not required.

vi. Vent pipes are to be welded to the encasement pipe.

vii. Casing vent relief valves are not required.

viii. Vent pipes to be in a snorkel configuration terminated 1 m. above grade, open ended with mesh. The intent is to allow for moisture reducing air flow and protect from intrustion.

ix. If groundwater is present or anticipated, a Vapor Phase Corrosion Inhibitor (VCPI) is to be installed via the casing vents into the casing annulus.

In the event that the sealing system fails, access is required to determine that fact. The downstream (lower elevation) vent allows periodical inspection of the encasement's water tightness by means of a pump down test. If no water can be drawn from the encasement, the seals are verified as intact. Depending on the degree of seal failure, if and when

identified, the vent pipe system also permits future deployment of either a dry Vapour Phase Inhibitor (VPI), a petrolatum hot wax grout, or a VPI gel, which could be installed to mitigate the degree of corrosion anticipated. The effectiveness of the method selected could then be monitored by means of an ER probe installed via the upper vent pipe at the time of mitigation.

5.21. Structures Materials

(a) **Overview**

i. structures are used to house mainline butterfly valves, air valves, and drain valves. Until recently structures had to be constructed in the field which led to long delays and inconvenience to the public while the Contractor waited for the concrete to cure. Today the use of prefabricated structures is gaining more and more acceptance as they can substantially reduce the time needed to build and back fill a structure.

ii. Valve Chamber
   a) Pre-cast 6 piece vaults, as supplied by PRECON or an approved alternate.
   b) See **Drawing 1 & 2**

iii. Drain Manhole
   a) City of Calgary manhole, Type 5A or 1S.
   b) See **Drawing 3 - 5**.

iv. Air Valve Chamber
   a) City of Calgary manhole, Type 1S.
   b) See **Drawings 6 & 7**.

v. Access Chamber (AM)
   a) City of Calgary manhole, Type 1S.
   b) See **Drawings 7 & 8**.

6. INSTALLATION AND CONSTRUCTION

6.1. Water Quality Protection

The following steps shall be employed to help ensure water quality is maintained in the distribution system:

(a) pipe interiors shall be kept clean (free of dust, dirt, wind blown debris). This includes the removal of any visible foreign or biological matter on pipe prior to installation;
(b) pipe and fittings shall be safely elevated to keep them out of standing and/ or flowing water;
(c) pipe caps shall remain in place until pipe is ready for installation;
(d) any pipe caps displaced, lost, or removed shall be replaced immediately;
(e) pipe plugs shall be used nightly;
(f) plugs shall be kept clean of all dirt and debris;
(g) pipe shall be stored away from obvious drainage paths;
(h) pipe lubricant and any product applied to the pipe interior shall be approved for potable water service by the manufacturer or be NSF61 listed.

6.2. Asbestos Abatement

(a) Contractors and project managers should be aware that various water pipe materials and coatings can contain asbestos.
  i. AWWA C203 up until 1997 allowed for steel pipe costings to contain asbestos.
  ii. Asbestos Cement pipe still exists as a distribution piping material in Calgary.
(b) It is up to the contractor to refer to and adhere to the appropriate industry standards and Provincial regulations when working with materials that may have the potential of containing asbestos.

6.3. Inspection, Handling & Storage of Materials

(a) **Overview**
  i. Pipe, fittings, valves, hydrants and accessories shall be loaded, unloaded and lowered into the trench using adequate lifting and rigging equipment satisfactory to the Engineer.
  ii. Under no circumstances shall such material be dropped, piled or rolled in such a way as to cause excessive impact.
  iii. The handling and moving of all materials shall be kept to a minimum.
  iv. Damaged coating or lining shall be repaired to the satisfaction of the Engineer

(b) **Inspection of Materials Before Installation**
  i. All pipe and fittings shall be examined for cracks and defects prior to installation. Defective materials shall be set aside for further inspection by the Engineer.
  ii. Epoxy coated metallic pipe shall be jeeped with a holiday detector at 100 Volts per mil of coating per NACE SP0188 or at the test voltage as recommended by

the coating manufacturer in the presence of the Engineer. Defective coating shall be repaired with material specified in Sec. 505.03.00 of the Standard Specifications Waterworks Construction and in accordance with the Manufacturer's Specifications.

iii. For AWWA C300, C301 or C303:

a) All pipe lengths must be either:

1. Electromagnetically inspected either prior to or after installation.
2. Accompanied by a comprehensive report showing photos of every individual pipe on both sides prior to application of the mortar coating. Therefore clearly showing the steel cylinder and steel reinforcement wires or bars.

b) Any pipes with one or more broken bars or steel cylinder anomalies, will be rejected and require replacement or repair at the discretion of the Engineer.

c) All pipe lay sheets require a specification page showing at a minimum:

1. Bar or wire thickness
2. Bar spacing
3. Steel cylinder thickness

(c) **Handling Concrete Pipe (AWWA C301 and C303)**

i. Concrete pipe may not be stored directly on the ground. Suitable support such as sand bags, tires or fabric wrapped timber shall be used. Timber blocking shall be required when the pipe is placed on soft or sloping ground and in locations where local activity or vandalism could be a problem.

ii. Concrete pipe shall be handled and placed using wide slings and padded cradles of canvas, leather or other suitable material to prevent damage to pipe and coating.

iii. The use of bare metal cables, chains, hooks or other equipment that may cause damage to coatings will not be permitted. Pipe shall be supported on sandbags or suitable wooden blocks.

iv. When it is necessary to walk on coated pipe, soft-soled shoes shall be used.

v. Stacking of concrete pipe will not be permitted.

vi. Interior pipe bracing shall not be removed until after the pipe has been placed in the trench and back-filled.

vii. Joint gaskets which form part of the pipe shipment shall be stored flat in an area which is clean and dry, free from dirt, oil, grease, solvents and not exposed to sunlight.

(d) **Handling Steel Pipe**

i. Steel pipe shall be handled and placed using wide slings and padded cradles of canvas, leather or other suitable material to prevent damage to pipe and coating.

ii. The use of bare metal cables, chains, hooks or other equipment that may cause damage to coatings will not be permitted.

iii. Coated pipe shall be supported on sandbags or suitable fabric wrapped wooden blocks. When it is necessary to walk on coated pipe, soft-soled shoes shall be used.

iv. Pipe with cement mortar lining shall be moistened with sprayed potable water to ensure the mortar remains damp and limits cracking.

(e) **Handling PVC Pipe**

i. As per manufacturer's recommendations

(f) **Handling HDPE Pipe**

i. As per manufacturer's recommendations

6.4. Excavation

(a) **Trench Requirements (including Sub-Grade)**

i. A standard trench is defined as a trench with vertical walls at a width of 750 mm greater than the outside pipe diameter. Unless otherwise specified the Contractor shall be responsible for all costs incurred as a result of exceeding the standard trench width.

ii. The Contractor shall maintain all excavations free of all water whether originating from infiltrating river water, surface water, and ground water or from utilities and shall carry out the work under dry conditions. In no case shall water be allowed to enter the newly laid pipe. Concrete shall not be placed in water.

iii. The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe and bedding on solid and undisturbed ground. Bell holes shall be dug where required for exterior welding.

iv. Any part of the trench excavated below the bottom of the specified pipe shall be back-filled to grade with approved material and thoroughly as directed by the Engineer. A minimum of 150 mm of bedding is required below the pipe.

v. The Contractor shall have sole responsibility for the design, supply, installation, maintenance and removal of temporary bracing and shoring. Shoring shall not be withdrawn until back-fill has been completed to a depth of at least 300 mm above the top of the pipe. Shoring shall be removed in a manner that will avoid trench cave-in.

vi. Where the bottom of the trench is found to be unstable or includes ashes, cinders, refuse, organic or other material which in the judgment of the Engineer or Inspector should be removed, the Contractor shall excavate and remove such unsuitable material and back-fill with an approved imported fill material that shall be paid for at the backfill unit rate included in the schedule of quantities.

vii. Where the trench bottom consists of material which is unsuitable to such a degree, that in the opinion of the Engineer or Inspector, it cannot be removed and replaced with an approved material to support the pipe adequately, the

Contractor shall construct a foundation for the pipe. This foundation may consist of piling, concrete or other materials as deemed necessary, in accordance with plans approved by the Engineer. Extra compensation will be allowed for the additional work.

(b) **Rock Excavation**

i. Please reference the Standard Specifications Waterworks Construction.

(c) **Handling Excavated & Salvage Materials**

i. All pavement, sidewalks, curb and gutters removed shall be kept separate from other excavated material and disposed of in a manner satisfactory to the Engineer.

ii. In any location where the use of trenching machinery may cause property damage or damage to other utilities the Engineer or Inspector shall have the authority to order the trenching to be carried out manually with hand-tools or other non-destructive method (Hydrovac).

iii. All excavated material shall be piled in such a manner as to not endanger the work and obstruct sidewalks and driveways. Hydrants, main and service valve, or other utility controls shall be left unobstructed and accessible. Gutters and natural water courses shall not be obstructed. Where it is impractical in the opinion of the Engineer or Inspector to place the earth at the side of the trench it shall be removed and deposited in a location designated by the Engineer or Inspector.

(d) **Bedding & Backfill**

i. Bedding

a) Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 150 mm below and on each side of the pipe. This is the minimum clear distance that will be permitted between any part of the pipe and the closest projection of rock, boulder and stone.

b) In areas where the strata is predominantly gravel, such gravel shall be removed to provide a clearance, as per Sheet 39 in the Standard Specifications Waterworks Construction, below the pipe and at least 75 mm on each side of the pipe.

c) The pipe sub-grade shall be established by back-filling with an approved bedding material and thoroughly compacted as directed by the Engineer or Inspector to provide uniform and continuous bearing and support for the pipe. **Refer to Drawing 13 & 14.**

d) The contractor can use an alternate 38 mm bedding material, if that is the contractor's choice.

e) An engineered bedding shall be designed and approved by the Engineer for special foundations in unstable soil.

ii. Backfill

a) Approved warning tape must be installed above all feedermain installations at the discretion of the Engineer or Inspector.

b) Inspection of Sacrificial Anodes and Test Points PRIOR to Backfilling

1. All installations of sacrificial anodes, test points and related wiring shall be inspected by the Engineer or Inspector prior to backfilling.
2. It is the Contractor's responsibility to notify the Engineer or Inspector and request inspection of each cathodic protection installation.
3. If backfilling over anodes and test wires has been carried out prior to inspection, the Contractor shall, when requested by the Engineer or Inspector, re-excavate and expose all anodes and test wires, at no cost to the City, for the purpose of inspection.

iii. Compaction

a) Soil shall be back-filled in 150 mm compacted layers.

b) Compaction and density shall conform to the Standard Specifications Roads Construction.

c) Heavy compaction equipment as approved by the Engineer shall not be used within 300 mm above the top of the pipe.

(e) **Water Stops or Water Plugs**

The purpose of the water stop is to provide a barrier to stop migration of ground water through the trench bedding gravel.

i. Water stops shall be installed as required or shown on the drawings to stop migration of ground water within the trench;
ii. Use clay or Filcrete. This is per specifications in Standard Specifications Waterworks Construction;
iii. Install bedding gravel up to and beyond location for water stop, leaving at least a one (1) metre gap for the clay or Filcrete;
iv. Place clay or Filcrete around and under the pipe to a depth level to the granular bedding material.

(f) **Replacement of Unsuitable Backfill**

i. Where the excavated material above the pipe zone is judged (by the Engineer or Inspector) to be unsuitable for backfill, the Contractor shall provide a suitable import material paid for by The City.

6.5. Installation

(a) **Overview**

i. Feedermain pipe shall be installed in accordance with the design drawings, contract documents and manufacturers recommendations.
ii. Every precaution shall be taken to prevent foreign material from entering the pipe. When pipe laying is not in progress, the open end of the pipe shall be closed to the satisfaction of the Engineer or Inspector.
iii. All joint deflection shall be carried out in strict conformity to the pipe Manufacturer's specifications as per the shop/design drawings.

(b) **Feedermain Tie-ins**

i. **See 6.6 Connections**

(c) **Installation of Concrete Pressure Pipe (AWWA C300, C301 and C303**)

i. Refer to the Manufacturer's recommended specifications, and to AWWA M9 which provides the primary specifications and directions.
ii. Rubber gaskets, joint lubricant (NSF61 approved) pipe soap and cloth diapers shall be supplied by the Manufacturer with the pipe.
iii. Prior to joining two lengths of concrete pressure pipe, the spigot groove, the rubber gasket and the first 50 mm of the bell shall be thoroughly cleaned and lubricated with an approved vegetable based soap.
iv. The gasket shall be positioned in the spigot groove so that the rubber is distributed with an even tension uniformly around the circumference.
v. When the pipe is lowered into position, the spigot is partially inserted in the bell of the previously laid pipe. Force shall then be applied to engage the joint

using a come-along or similar suitable pulley system, as recommended by the pipe manufacturer.

vi. Pipe spigot joints shall be inserted into bell within the minimum and maximum insertion marks on the pipe spigot. Under no circumstances shall the pipe spigot be forced to the maximum bell depth of the pipe.

vii. The spigot shall be advanced into the bell against a steel insert placed between the tip of the spigot and the shoulder of the bell. The insert will allow the laying length shown on the contract drawings to be maintained and will also provide a space for inserting a feeler gauge.

viii. The entire circumference of the joint shall be checked with a feeler gauge to determine if the rubber gasket is in the proper position.

ix. If the gasket cannot be "felt" all around, the joint shall be disassembled. If the gasket is not damaged, as determined by the Engineer, it may be reused but only after the bell and gasket have been re-soaped before the joint is re-assembled.

x. When it has been determined that the gasket is in its proper position, the steel inserts shall be removed and the pipe shall be placed in its final position.

xi. Each pipe joint shall be electrically joined using two welded bonding clips, as per Drawing Sheet 14. The clips shall be located at 3 o'clock and 9 o'clock positions.

xii. The inside joint recess of concrete pipe shall be wiped clean, moistened, then filled and pointed with a stiff cement mortar. Pipe zone bedding and back-fill shall be completed at the joint prior to performing this activity.

a) The mortar shall be one (1) part cement and two (2) parts sand with a consistency dry enough so that it will not fall when placed in the top of the joint. The finished joint shall be smooth and flush with the adjacent pipe surfaces.

xiii. The outside joint recess shall be filled with a cement mortar contained by a cloth diaper with a minimum width of 200 mm.

a) The mortar shall be one (1) part cement and two (2) parts sand with a consistency of thick cream.

b) Prior to placing the mortar, the diaper shall be fastened securely with metal strapping leaving an access opening at the top.

c) With the diaper in place, moisten the pipe joint space with water and pour the grout so it will flow down one side and rise on the other. A length of stiff wire wrapped around the joint recess and worked back and forth to keep the grout flowing may be used.

d) After the recess has been filled, the opening shall be closed and the mortar allowed to set-up before the pipe zone bedding and back-fill commences at this joint.

e) All mortar cement used shall be sulfate resistant.

f) The use of high strength quick setting grout as approved for potable water use by the Engineer or Inspector may permit backfilling to proceed more rapidly and reduce the amount of open trench.

xiv. Heating of the pipe, bedding, mortar and gaskets shall commence when the ambient temperature falls below -5 ^{o}C. The pipe shall be heated throughout with a low heat immediately prior to installation (warm to the touch).
   a) All mortar for joints shall be heated, and heated sand shall be placed around the pipe for the full height of the specified bedding and initial backfill and to at least 600 millimetres on either side of the joint, all to the satisfaction of the Engineer or Inspector.

xv. Where steel bell and spigot joint rings are provided with a coating system such as epoxy or metalized bell and spigots, inspect the joint rings for coating damage prior to installation. Repair defects in coating as per manufacturer instructions.

xvi. Placement and compaction of bedding and initial backfill shall be completed in a manner to not damage external mortar coatings. Hand tools and compaction equipment shall not be permitted to contact the pipe. Where mortar is cracked or otherwise damaged, the pipe shall be removed. Field repair of mortar coatings is not permitted.

xvii. Field Trims & Closures
   a) Any butt strap field trims shall each require 4 continuous full fillet welds between the steel pipe ends and the butt strap around the circumference of the pipe (2 outside & 2 inside) and 200 mm longitudinal 'V' groove welds to join the halves of the butt strap together.
   b) Refer to **Drawings 17 & 18**

xviii. Flange Torques
   a) Bolted flanges must be torqued as per AWWA M11 or the manufacturers requirements.
   b) Bolts may need to be retorqued depending on the gasket manufacturers requirements, generally within the first 4 – 6 hours after assembly.
   c) Care must be taken to prevent overcompressing rubber gaskets.
   d) Bolt torque may need to be increased when using full face gaskets, and therefore refer to the manufacturers guidelines in those cases.

(d) **Installation of Steel Pipe**

i. Refer to the Manufacturer's recommended specifications, and to AWWA M11 which provides the primary specifications and directions.

ii. End preparation for steel pressure pipe shall be as follows:
   a) Steel pipe 600 mm and smaller shall have beveled ends suitable for butt joint welding.
   b) Steel pipe 750 mm and larger shall have bell and spigot ends suitable for lap joint welding or beveled ends suitable for butt joint welding.

iii. All in-field welding shall be in accordance with these specifications and the latest edition of CSA–Z662 or AWWA C206. Welders shall possess a current Alberta Class "B" Pressure Welding Certificate with either AWS D1.1 or CSA-Z662 qualifications.

iv. Welded lap joints, butt strap joints and butt joints will be permitted when installing steel pressure pipe.

v. Butt strap joints shall be used for field trim sections and closures only.

vi. The bell end of a lap joint and each end of a butt strap shall be provided with a 9.5 mm (3/8") threaded test hole and plug for pressure testing.

vii. After welding, the lap joints and butt strap joints shall be pressure tested using soapsuds and compressed air at 275 kPa (40 psi). All air tests must be witnessed by the City Inspector.

viii. Any leaks found in testing shall be repaired to the satisfaction of the Engineer or Inspector and re-tested. Surface peening to stop pinhole leaks will not be permitted.

ix. Where the pipe Manufacturer of large diameter steel pipe has supplied pass plugs, the Contractor shall securely tighten the threaded plug in the pass hole upon completion of the welded joint. A single seal weld shall then be placed between the plug and the tank flange or half coupling.

x. The bare exterior joint area shall be thoroughly cleaned of all foreign materials and coated as per Section 5.4(j).

xi. Field Trims & Closures

a) Any butt strap field trims shall each require 4 continuous full fillet welds between the steel pipe ends and the butt strap around the circumference of the pipe (2 outside & 2 inside) and 200 mm longitudinal 'V' groove welds to join the halves of the butt strap together. (Steel pipe is not specified smaller than 750 mm).

b) Refer to **Drawing Sheet 17 & 18**

xii. Coating and Lining of Steel Pressure Pipe Field Joints

a) Joints shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

xiii. Flange Torques

a) Bolted flanges must be torqued as per AWWA M11 or the manufacturers requirements.

b) Care must be taken to prevent overcompressing rubber gaskets.

c) Bolt torque may need to be increased when using full face gaskets, and therefore refer to the manufacturers guidelines in those cases.

(e) **Installation of PVC Pipe (C900 / C909)**

i. PVC pipe shall be jointed in conformity to the pipe Manufacturer's specifications. Bell and spigot joints shall be made such that the factory insertion line is visible after installation. Joints without a visible insertion line shall be re-made at the Engineer's request.

ii. Spigot to spigot joints on PVC pipe shall be made with an approved coupling unless otherwise directed by the Engineer or Inspector.

iii. Metallic spigots shall not be inserted into PVC fittings nor joined by use of a PVC fitting.

iv. Bell and spigot end-seals shall not be removed until the pipe is to be jointed in the trench.

v. Care should be taken to ensure end seals, bags and fastenings do not to interfere or obstruct the jointing of the bell and spigot ends. The Contractor shall ensure that the pipe is not cut or otherwise damaged when removing the end seal or bag.

vi. All pipe joint lubricants and sealant shall be approved for potable water application by the National Sanitation Foundation (NSF).

(f) **Installation of FRP Pipe (C950)**

i. FRP pipe shall be jointed in conformity to the pipe Manufacturer's specifications.

ii. Pipe end, gasket and sealing surfaces shall be inspected for damage and cleaned of all debris.

iii. Apply joint lubricant to the sleeve coupling interior and the elastomeric gasket. Use only lubricants approved by the pipe manufacturer. All pipe joint lubricants and sealant shall be approved for potable water application by the National Sanitation Foundation (NSF).

iv. Use suitable equipment and end protection to push the pipes together per manufacturer guidelines.

v. Do not exceed joining or pushing forces recommended by the manufacturer.

vi. Bell and spigot end-seals shall not be removed until the pipe is to be jointed in the trench. The Contractor shall ensure that the pipe is not cut or otherwise damaged when removing the end seal or bag.

(g) **Installation of HDPE Pipe**

i. HDPE fusion joints shall be made by factory trained or industry certified personnel using the appropriate manufacturers specified butt, sidewall or electro-fusion equipment, procedures, and fittings. Operator certification must be available for inspection and issued no more than one calendar year previous to be considered valid.

ii. Fusion equipment must be serviced and maintained to the manufacturer's specifications.

iii. Butt and sidewall fusion machines shall be AH McElroy or approved equal

iv. Electro-fusion fittings and equipment shall be by Friatec Plasson, Central Plastics or approved equal.

6.6. Crossings

(a) **Utility Crossings**

i. In advance of construction, some utilities crossing the feedermain may have been located to determine their depth. This information must be shown on the construction drawings. The Contractor is not relieved of his obligation to meet all Occupational Health and Safety requirements for locating and excavating buried utilities.

ii. Any utility crossings (including water and sewer lines) must be supported, as per Sheet 41, if requested by the Engineer.

iii. The Contractor shall excavate and expose the following facilities in advance of pipe installation:
   a) Existing watermains at tie-in locations;
   b) Utilities crossing the proposed feedermain.

iv. The Contractor shall carefully check the elevation and alignment of the exposed utilities against the Construction Drawings and notify the Engineer or Inspector immediately of any potential conflict with the proposed watermains.

v. Upon notification of a conflict with another utility the Engineer will make every reasonable effort to avoid the conflict and not delay the pipe installation.

vi. In cases where the alignment and/or grade of the watermain cannot be adjusted to avoid the conflict, the Engineer will:
   a) Arrange to have the conflicting utility altered if feasible, or
   b) Provide the Contractor with a detailed fabrication drawing for special fittings to be fabricated by the Contractor, or
   c) Provide the Contractor with the special fittings required to avoid the conflict.

(b) **Oil / Gas Pipeline Crossings**

i. All oil / gas mains crossed during construction of the feedermain must be supported as shown on Sheet 41 of the Standard Specifications Waterworks Construction.

ii. The Contractor shall contact the appropriate utility company owner, well in advance of construction, in order to fulfill the crossing requirements. (These requirements should already have been agreed at the pre-construction phase by the designer/consultant and the utility.)

(c) **Major Road Crossings**

i. Approved Crossing Methods
   a) Augured with carrier pipe and casing. Casing will be augured steel pipe.
   b) Open cut still requiring casing pipe. Casing pipe can be corrugated metal pipe (CMP) or steel pipe.
   c) Tunneling

ii. Requirements
   a) Carrier pipe shall be installed through the casing pipe using pipe insulators with spacing via manufacturer's specifications.
   b) Cased crossings will require end treatment with filter fabric.
   c) Annular space between the casing and the carrier pipe to be treated as specified in the construction drawings and approved by the Engineer.
   d) Tunnel method requires use of tunnel liner plates, which are supplied with grout nipples. Grouting is done between the casing and the earth.

(d) **Railway Crossings**

i. Crossing a Railway shall be by carrier pipe and casing as per the *Standards Respecting Pipeline Crossings Under Railways* published by Transport Canada.
ii. The casing pipe may be either augured, micro-tunnelled or tunnel liner plates.
iii. Limits of the crossing will be determined by the Railway Company.
iv. The Engineer shall make an application for a Crossing Agreement to the applicable Railway Company, and requires approval before proceeding.
v. Crossing a Railway usually requires the use of jointless pipe such as welded steel or HDPE.

(e) **Transportation Utility Corridor (TUC) Crossings**

i. Usually requires the use of jointless pipe such as welded steel or HDPE subject to Alberta Transportation approvals.
ii. Usually requires the use of a casing pipe subject to Alberta Transportation approvals.

(f) **Electrical Transmission Lines**

i. Installation of monitoring test points are required whenever a feedermain crosses or is perpendicular to an overhead or buried power line with a voltage rating of over 22kV. The installation of the test point in this case is the responsibility of the last utility to cross the other.
ii. Any power line regardless of distance or voltage may also require corrosion monitoring at the discretion of the Engineer. In this case the test point installation is the responsibility of the water feedermain constructor.
iii. Further reference can be found in:
    a) NACE SP0169 (Control of External Corrosion on Underground Piping)
    b) NACE SP0177 (Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems)
    c) CSA Standard C22.3 No. 6-13 (Principles and Practices of Electrical Coordination Between Pipelines and Electric Supply Lines) for safety standards that apply to electrical supply lines 60 kV and greater.
    d) Alberta Electrical Utility Code (AEUC) for safety codes that apply to electrical supply lines above 22 kV.

6.7. Connections

(a) **Design**

i. Connections need to allow for pipe movement, ground movement, thrust and reliability.

(b) **Connections to Existing Feedermains**

i. Connections to existing feedermains should be designed to eliminate man entry wherever possible. Man entry requires two-valve shutdowns which can be

difficult or sometimes impossible to attain, therefore man entry for tie-in work should be avoided.

(c) No existing feedermain shall be drained and/or cut into to facilitate a tie-in until the Engineer or City Inspector confirms all necessary and approved parts are on-site.

i. Connection to Existing C300, C301, C301
   a) Connections to pressurized concrete feedermains are undertaken via a special adapter fitting supplied by the pipe manufacturer or custom fabricated, matching the existing bell or spigot to the new pipe system bell and/or spigot.
   b) Unless otherwise specified by the Engineer or Inspector, the joint of the adapter to the existing bell or spigot shall be done via a gasket and an external full circumferential weld. The weld shall be completed in an alternating pattern as to not damage the gasket.
   c) The annular space between the weld and gasket shall be drilled, tapped and air tested.
   d) The existing pipe and new adapter shall be coated and lined in such a fashion that no man entry will be required to repair lining damage following the tie-in.

ii. C200 Steel Connections
   a) Unless otherwise specified by the Engineer, connections to steel feedermains shall be done with a mechanical coupling mating two plain steel ends (PSE).
   b) Where two-valve shutdowns can be achieved, welded joints or flanged connections will be acceptable at the discretion of the Engineer.
   c) Where the outside diameter (OD) of the pipe are not the same, either a steel reducer shall be fabricated to match the OD of the existing pipe with the use of a mechanical coupling, or a mechanical transition coupling shall be used.
   d) Where mechanical transition couplings are used, the coupling shall be restrained.

(d) **Connections to Reservoirs and Pump Stations**

i. Connections shall be with an isolating bolted sleeve type coupling.
ii. Both sides of the connection are to be supported with concrete cradles and / or grade beams.
iii. See **Drawing 26**.

(e) **Connections to Distribution Systems**

i. Distribution system tie-ins shall be designed as springline flanged openings with minimum AWWA Class D flanges, manufactured by the pipe manufacturer.
ii. Distribution valves attached to the feedermain outlet shall be flange by hub.
iii. An insulating flange kit shall be provided at the flanged outlet.

iv. If there is a requirement for a Pressure Reducing Valve (PRV) Chamber, see the Standard Specification Waterworks Construction for information.

v. Any other types of connections to the distribution system, where outlets on the distribution main have not been provided, shall be permitted using tapping saddles (sleeves) at the discretion of the engineer. Actual tapping work for any type of connection will only be permitted by personnel and companies approved by the Engineer.

(f) **Work Related to Connections and Tie-Ins**

i. There are timing issues related to tie-ins (commissioning) based on seasonal water demand and circumstances.

ii. Water Services shall be contacted ahead of time, to determine an appropriate tie-in schedule and details on commissioning the feedermain. All Feedermain controls and shutdowns are subject to approval by WOCC.

iii. Only Water Services employees may operate valves for shut-downs.

iv. A Site meeting shall be held to discuss all aspects of the proposed tie-in. Meetings on a regular basis shall be held to decide on progress, stage of work, next tie-in, and reviewing what will be needed.

v. All shut-down work shall be done by Water Services staff only.

vi. The Contractor shall not operate any valves without the permission of the Engineer or Water Services.

vii. Sequence of required events for a tie-in to occur:

a) Contractor must have the permission of WOCC to do the tie-in and must confirm with the Inspector.

b) Verify the existing water system is still operational with main shut down, during construction. This includes obtaining hydraulic models from Water Resources.

c) Shut off distribution mains using Water Services staff.

d) Shut off feedermain butterfly valves and install lockouts using Water Services staff.

e) Drain the feedermain and dispose of the drained water, in compliance with environmental guidelines and regulations which may involve drainage permits and dechlorination.

f) Do the tie-in work.

g) On completion of work, re-pressure and perform a pressure test as outlined by the Engineer.

h) Before opening large butterfly valves and commissioning, have Water Services obtain water quality samples that pass required lab testing at each end of the feedermain, and selected area(s) of the feedermain.

(g) **Installation of Couplings**

i. Couplings shall be installed in conformity to the Manufacturer's Specifications.

ii. The Contractor shall ensure that the connecting pipe-ends and all parts of the coupling are thoroughly cleaned prior to installation.

iii. Wrenches used to tighten nuts and bolts shall be the type and size recommended by the coupling Manufacturer.

iv. To avoid undesirable stress concentrations, all bolts shall be tightened uniformly and in a manner which will keep all coupling parts symmetrically around the pipe. Final tightening shall be done with torque wrenches set for the torque recommended by the coupling Manufacturer.

v. All non-coated threads and bolting surfaces on couplings shall be wrapped with an approved petrolatum paste and tape as listed in the Standard Specifications Waterworks Construction.

vi. All coupling, (i.e. non-isolating or isolating coupling and electrical continuity wires and/or isolating boots as required) shall be installed as detailed on the approved construction drawings. The set screw in the end-plates (on bolted sleeve couplings only) shall be tightened to provide electrical continuity between the end-plates and the sleeve. Unless couplings are cathodically protected from an existing energy source, a separate anode shall be installed as detailed in Section 504.07.00 of the Standard Specifications Waterworks Construction.

vii. Electrical continuity or discontinuity as required across the coupling shall be checked with a voltmeter, test probe or a similar device approved by the Engineer. City of Calgary Corrosion Technicians are required to confirm the installation prior to backfill.

viii. Once, the electrical continuity/discontinuity has been confirmed, the entire coupling including any continuity wires shall be primed and wrapped with material specified in Section 505.03.00 00 of the Standard Specifications Waterworks Construction. (Specifically Sec. 504.06.03 - Victaulic Couplings)

6.8. Installation of Structures

(a) **General Requirements**

i. The Contractor shall be aware that should unsuitable soil conditions be discovered when excavating for the valve chamber, the Engineer will instruct the Contractor to either excavate the unsuitable soil and replace it with gravel, or the Engineer will have a piled foundation designed.

(b) **Waterproofing and Sealing**

i. Approved waterproofing systems include:
   a) DryVault System by Mountain Waterproofing

(c) **Preparation and Installation of Concrete**

i. Refer to The City of Calgary Standard Specifications Waterworks Construction.

(d) **Valve Chambers**

i. Install according to Manufacturer's specifications and the Engineer's drawings.

ii. See **Drawings 1 & 2** for examples of typical one valve standard chambers. For larger chambers, check with the Engineer for approval.

(e) **Drain Manholes**

i. Install according to Manufacturer's specifications and the Engineer's drawings.
ii. **Drawings 3 - 5**.

(f) **Air Valve Chambers**

i. Install according to Manufacturer's specifications and the Engineer's drawings.
ii. See **Drawing 6 & 7**

(g) **Access Chambers**

i. Install according to Manufacturer's specifications and the Engineer's drawings.
ii. See **Drawings 7 & 8**

6.9. Installation of Cathodic Protection

(a) **General**

i. Pre-stressed concrete and mortar coated metallic feedermain pipe and fittings require three (3) 3.4 kg zinc anodes and approved test points for field trims and flanged outlets. Field trims and flanged outlets must also be denso taped and pasted.
ii. Dielectrically coated steel feedermains require active cathodic protection provided by either a galvanic or an impressed current system as determined by the Engineer, Inspector or Corrosion Technicians. Both of these corrosion prevention designs require the minimum possible number of defects in the respective coatings.
iii. Feeder mains must be electrically continuous along sections of like materials.
iv. Where feedermains of different materials/coatings connect, then electrical isolation is required.
v. The Engineer shall determine the type of cathodic protection required. All cathodic protection details for feedermain projects shall be reviewed and approved by the Engineer.

(b) **Installation of Test Stations and Leads**

i. Test stations and leads shall be installed as per the requirements set out in the Standard Specifications Waterworks Construction.

(c) **Installation of Isolation Devices**

i. Isolation devices shall be installed as per the Manufacturer's specifications.
ii. Isolation devices are to be verified by the City's Corrosion Technicians Corrosion immediately after construction completion and before the Final Maintenance Certificate (FMC).
iii. Testing shall be arranged by the site Inspector.
iv. Failed isolations will be repaired to the satisfaction of the Engineer.

6.10. Coating Repairs

(a) Pipe, Fittings, Valves, Couplings and other Appurtenances

i. Factory coated line pipe and appurtenances shall be inspected for shipping and handling damage, and such damage shall be brought to the Engineers attention.

ii. Minor field coating and lining repairs shall be done in accordance with Section 5.4(j) and Section 5.4(i).

iii. Where approved the Engineer may permit the use of field coating materials listed in the Standard Specifications Waterworks Construction.

(b) Joints

i. Joints shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

ii. Alternate joint coating methods may be submitted to the Engineer for approval.

(c) Testing of Coatings and Repairs

i. The Engineer or Inspector may request third party testing at any time to verify coating characteristics such as dielectric strength, presence of holidays, thickness, adhesion, toughness and surface preparation.

ii. The Manufacturer's specifications shall be the standard for this performance testing.

iii. The Engineer or Inspector reserves the right to reject any coating or coating repair not carried out to their satisfaction.

6.11. Commissioning (Cleaning, Hydrostatic Testing, Disinfecting)

(a) General

i. Prior to commissioning lock out devices shall be installed on all associated valves.

ii. Commissioning must be performed in compliance with:
   a) AWWA Standard C651
   b) Alberta Environment License To Operate
   c) DFO Letter of Advice (if applicable)

iii. Discharge of hyper chlorinated or potable testing and/or commissioning water must comply with Section 504.10.00 of the Standard Specifications Waterworks Construction

(b) High Level Commissioning Steps

i. The preferred commissioning method is:
   a) Ensure lock-out tag-out devices are installed on applicable valves as determined by Water Services
   b) Clean feedermain interior thoroughly during or after installation;
   c) Fill with potable water
   d) Perform pressure / hydrostatic test
   e) Check allowable make up water volume. If not okay, repair problem and restart at step (a).

f) Drain, Dechlorinate and Dispose in accordance with Water Services requirements.
g) Refill with highly chlorinated water (min 25 ppm after 24 hrs)
h) Drain, Dechlorinate and Dispose in accordance with Water Services requirements
i) Refill with potable water
j) Have Water Services obtain water quality samples from the feedermain
k) City of Calgary Water Quality Services processes samples (minimum 24 hrs)
l) If lab samples are approved, proceed to next steps, otherwise restart at step v.
m) Remove lock-out tag-out devices on applicable valves as determined by Water Services.
n) Water Services to operate valves to put feedermain into operation

ii. Any variation on this method is only to be done with the advice and agreement of Water Services.
a) Including potential to perform pressure test with highly chlorinated water, eliminating one load and drain procedure from the work sequence.

(c) **Filling of Feedermain**

i. Only Water Services shall operate new or existing feedermain valves.
ii. The maximum filling rate shall not exceed a flow velocity in the pipeline greater than 0.3 m/s to avoid transients.
iii. The Contractor shall ensure that all butterfly valves under air valves are fully open prior to filling the feedermain.
iv. The Contractor shall not fill the feedermain unless the Engineer or his authorized representative is present.
v. Under no circumstances shall the feedermain be filled by throttling the large diameter butterfly valves.
vi. Once the feedermain has been filled and has reached line pressure (zone pressure), it shall be allowed to soak for a period of twenty-four (24) hours prior to the pressure and leakage test being performed.

(d) **Disinfection**

i. Disinfecting of feedermains shall be carried out after successful completion of the hydrostatic testing. This procedure shall be carried out in the presence and to the satisfaction of the Engineer. The use of hydrants and temporary service connections shall be carried out as detailed in the Standard Specification Waterworks Construction.
ii. It is the Contractor's responsibility to ensure that water from the feedermains is not used for drinking and that the feedermains are not placed into service until satisfactory water quality test results have been received.

iii. All feedermains shall be disinfected in sections as specified by the Engineer. A solution of calcium hypochlorite (HTH) at 65% shall be injected while sufficient water is being discharged through the main to bring the chlorine content to a concentration of 25 mg/L.

iv. Calcium Hypochlorite shall conform to the AWWA B300 Standard. Liquid chlorine shall conform to the AWWA B301 Standard. The chlorine solution shall be injected near the tie to the existing system and the discharge point(s) shall be near the extremities of the system.

v. Once the chlorine has reached the extremities of the system, the intake and discharge valves shall be closed and the system shall be left to stand 24 hours (unless otherwise directed by the Engineer). At the beginning of this contact period all valves (including hydrant valves) and hydrants shall be operated to ensure that all parts have been in contact with the chlorine solution.

vi. The system shall then be drained to expel all water with high chlorine content. Disposal of chlorinated water must be in compliance with environmental standards.

vii. After the high chlorine content water has been drained the feedermain shall be reloaded with potable water and tested until the turbidity level of 1.0 NTU or less and positive residual chlorine of 0.4mg/L is achieved. The inspector will use field instruments to confirm these levels. Immediately after reloading, the Contractor shall arrange for the City Inspector to obtain water samples to be tested at the Waterworks laboratory for turbidity, chlorine residual and microbiological parameters at no expense to the Contractor.

viii. After completion of the disinfecting, the draining and reloading operation and closing of the feedermain shall be performed in the presence of the Engineer. Care shall be taken to ensure no water from the excavation or other foreign matter will enter the feedermain. The Contractor shall not put feedermains into service without the approval of the Engineer.

(e) **Hydrostatic Testing**

i. All newly installed piping shall be subjected to a hydrostatic pressure and leakage test in the presence of the Engineer or Inspector.

ii. Where alterations or repairs on a feedermain have occurred, no hydrostatic pressure test shall be performed on the existing pipe. Pre-installed alterations must have temporary bulk-heads installed in order to perform a pressure test prior to tie-in to the existing pipe. Welds at tie-ins to existing pipe shall be air tested or NDT inspected as required by The Engineer. Couplings and flanged connections at tie-ins to existing pipe shall be visually inspected at normal operating pressure once the line is commissioned.

iii. Hydrostatic testing and chlorination may be done together as per Section 7.10 at the discretion of the Engineer and not in areas where environmental concerns exist should there be a release of super chlorinated water during testing.

iv. Hydrostatic testing is to be conducted by competent and experienced personnel with equipment and procedures appropriate for the piping being tested and

test pressure applied. The pressure shall be monitored with a suitable pressure gauge. Oil filled pressure gauges shall not be used due to the risk of cross contamination.

v. Pressure testing shall not commence until at least five (5) days have elapsed after the last concrete thrust block has been cast.

vi. Fire hydrants shall be operated in a full-open or full-closed position only. Flow control shall be achieved by throttling a secondary valve which must be installed on the hydrant outlet(s) on a temporary basis.

vii. The Engineer or Inspector may specify that an approved back-flow prevention device be provided at any temporary connection, including connections to hydrants. An approved air gap at the discharge point of the hose is a suitable alternate to this requirement, if it is approved by the Engineer or Inspector.

viii. Only Field Services shall operate new or existing feedermain valves.

ix. The Contractor shall perform hydrostatic pressure and leakage testing in accordance with the Manufacturer's specifications, and as specified in the Special Conditions or Project Specifications of the contract documents.

x. Procedure

a) After completion cleaning and after cement mortar lined pipe has been left to soak for 48 hours under low pressure, the Contractor shall subject the pipe to the noted water pressure by way of pumping water from a potable water source into the main. The Engineer or Inspector may limit the length of pipe to be tested from one location.

b) The test section shall be subjected to 150% of the normal operating pressure or 1 MPa (150 psi), whichever is the greater at the lowest elevation and not less than 120 % of the normal operating pressure or 860 kPa (125 psi) whichever is the greater at the highest elevation. The test pressure shall not exceed the Manufacturer's recommended maximum test pressure.

c) The test pressure shall be maintained (by additional pumping if necessary) for 2 hours.

d) While the line is under pressure, all exposed fittings valves and hydrants shall be carefully examined for leakage. All defective elements shall be repaired or replaced and the test repeated until all visible leakage has been stopped and the allowable make up requirements have been met.

xi. The Engineer or Inspector at his sole discretion may stop the test after one hour, if in his opinion the leakage is well below the allowable make up water.

xii. All required repairs to the pipe shall be carried out to the satisfaction of the Engineer and the excavation shall not be back-filled until inspected by the Engineer or Inspector.

xiii. Allowable Make Up Water

a) Allowable make up water is defined as the quantity of water that must be supplied into the newly laid pipe to maintain pressure within 5 psi (34.75 kPa) of the specified test pressure.

b) Allowable make up water shall be as per the Manufacturer's specifications or the appropriate AWWA manual, or as specified in the Special Conditions or the Project Specifications of the contract documents.

(f) **Commissioning Into Service**

i. Following the successful pressure testing and chlorination of the feedermain, the Contractor shall drain the entire feedermain and then refill the main at which time a water sample will be taken for laboratory analysis. If the results of the analysis are satisfactory, the main shall be put into service.

ii. Determination of the responsibility for all work involved in commissioning the feedermain shall be clearly defined in the Special Conditions or the Project Specifications of the contract documents.

6.12. Post Construction Requirements

(a) **Pre-Final Inspection**

i. A pre-final inspection must be performed with the Inspector and Contractor including but not limited to:
   a) Pressure test
   b) Continuity tests where applicable
   c) Operation of valves
   d) Confirmation of valve position to ensure proper system function and regional metering.
   e) Adjustments on valve boxes
   f) Operations of hydrants
   g) Adjustments on access manholes
   h) Marker posts

ii. A deficiency list will be generated by the Inspector for the Contractor to resolve.

(b) **Construction Completion Certificate (CCC)**

i. When ready, the Contractor shall arrange a construction completion inspection with the Engineer and Inspector.

ii. The Construction Completion Certificate (CCC) will be issued in accordance with the terms and conditions of the Standard General Conditions and the Builders Lien Act.

(c) **Final Maintenance Certificate (FMC)**

i. The maintenance period shall be for 2 years and shall begin on the date that the Construction Completion Certificate (CCC) is issued.

ii. Prior to issuing the Final Maintenance Certificate, a final maintenance inspection will be conducted approximately 3 months prior to the expiration of the maintenance period; and will include the Contractor's representative, the

Inspector, and other City of Calgary Inspectors where applicable such as Parks and Roads.

iii. Any deficiencies identified during the final maintenance inspection shall be corrected by the Contractor and be completed 30 days prior to expiration of the maintenance period. If this work is not completed, the Law Department will notify the Contractor's Surety Company to extend the maintenance bonding beyond the maintenance period.

iv. Record Drawings (As-Builts)

a) Record drawings are critical to water system operation and maintenance.

b) Prior to CCC, record drawings shall be prepared with the input of the Contractor, Surveyor, Inspector and/or Consultant in accordance with the terms and conditions of the construction contract.

c) Submission and approval of the record drawings shall be specified in the contracts by the City's project manager.

7. PROXIMITY GUIDELINES

7.1. Introduction

(a) To ensure the safety of the public and to protect City infrastructure, any work in the proximity of feedermains must be reviewed and approved by the Engineer or Inspector. This includes excavating, digging, trenching, plowing, drilling, tunneling, directional drilling, auguring, backfilling, blasting, stripping topsoil, leveling, removing peat, quarrying, clearing, grading or pounding posts.

7.2. Proximity Guidelines

(a) No structure or utility should be within 3.0 metres (edge to edge).

(b) If the 3.0 metre horizontal clearance is maintained, then conventional utility locates are all that are necessary. The feedermain does not require hydrovacing. However, survey will be required to confirm clearance.

(c) If heavy equipment is crossing over the feedermain and the loads exceed H-20 loading or other concerns exist, the contractor is to install Rig-Mats at the discretion of the Engineer or Inspector.

(d) If a structure or utility must encroach into the 3.0 meter zone and Water Resources permits this because relocation of the feedermain is not practical, then the following criteria must be observed:

i. Hydrovac feedermain to determine depth, width and alignment at appropriate intervals depending on the extent of the encroaching structure(s) or utility at the contractors expense;

ii. Encroachment shall not be within 1.0 meter (edge to edge) because the loss of Class B bedding material will impair the integrity of the pipeline if the encroachment is inside 1.0 meter clearance;

iii. Structural foundations or sign supports shall be required to penetrate to minimum depth of 1.5 meters below invert of the feedermain if the encroachment is within the 1.0 to 3.0 meter range;

iv. Sign support piles shall be augured or hydrovaced with casings;

v. No vibratory or impact equipment should be used in the 1.0 to 3.0 meter zone.

vi. Refer to **Drawings #27 to 30**

7.3. Cover Guidelines

(a) All feedermains shall be hydrovacced and/or hand exposed to determine pipe elevation and alignment.

(b) If cover is reduced to between 0.6 m to 1.5 m, there shall be no vibratory equipment and live loads shall be limited to 5 tons maximum unless otherwise approved by The Engineer.

(c) If cover is reduced to less than 0.6 m, only hand operated or hydrovac equipment will be allowed unless otherwise approved by The Engineer.

(d) Refer to **Drawing #27**.

7.4. Crossing Guidelines

(a) All feedermains shall be hydrovacced and/or hand exposed to determine pipe elevation and alignment.
(b) Method of Construction and scheduling for crossing over or under these mains shall be determined with Water Resources.
(c) Refer to **Drawing #30**.

7.5. Required Information for Approval

(a) **Prior to Construction**

i. For permission to construct in proximity of a feedermain a letter of intent (electronic or hardcopy) must be provided to Water Resources that includes:
   a) Complete name(s) of the landowner/company and agent (if applicable)
   b) Legal land description of worksite
   c) Description of the activity/scope of work
   d) Equipment to be used
   e) Access requirements

ii. In addition to the letter of intent, construction drawings are required; see section 7.6(b) for details below.

(b) **Construction Drawings**

i. All construction work in proximity of a feedermain must be approved by Water Resources. Submit three (3) sets of plan and profile drawings (stamped, signed and dated by a Professional Member of APEGA), to City standards, showing:

   a) Location of the feedermain
   b) Location of proposed utility or structure
   c) Distance maintained from the feedermain
   d) Depth of proposed work
   e) Grade changes (existing and ultimate)
   f) Construction schedule
   g) Relevant cross-sections
   h) Additional static or live loading
   i) Scale and north arrow

ii. Water Resources will respond to a request within 14 business days of receipt and will be available upon request to meet and discuss project requirements. One set of plans will be returned to the applicant (either approved or not approved), one set is filed and the final set goes to the Inspection Group.

7.6. Utility Locates

(a) The applicant must contact Alberta One-Call, Shaw and all other utility owners that are not a part of Alberta One-Call for locates. Alberta One-Call will notify Water

Services to complete locates. Please note that locate slips issued by the locator are only valid for 14 calendar days, then new locates are required.

7.7. Inspection

(a) The applicant will also have to make arrangements with the Capital Inspections Group (403-268-5752 or 311) a minimum of two (2) working days prior to hydrovac locating and prior to start of construction. An inspector will be onsite during construction to assist/direct activities that may affect the feedermain.

7.8. During Construction

(a) The Inspector shall have free and uninterrupted access to work areas for the purpose of carrying out inspections.

(b) If a feedermain is to be exposed, the Inspector must be present during hydrovacing, excavation and backfilling operations. As well, compaction testing that meet the Standard Specification Waterworks Construction must be adhered to unless otherwise directed by the Inspector.

(c) The feedermain shall be supported to the satisfaction of Water Resources if greater than half the pipe length is undermined.

(d) Copies of the following permits and agreements shall be provided to the Inspector:

i. Excavation Permit (City Roads at 403-268-4936 or 311)
ii. Utility Line Assignment (Land Info & Mapping at 403-268-5794 or 311)
iii. Indemnification Agreement Number (Water Services at 403-268-5006 or 311)

(e) The cost of inspection will be at The City's expense.

7.9. Post Construction

(a) Once construction is completed, 'drawings of record' are required to update City files as soon as possible.

7.10. Emergency Response Procedure

(a) If a feedermain is hit or damaged, the contractor must:

i. Stop work and clear all people from the vicinity
ii. Contact Water Services for help at 311
iii. Remain at a safe distance while waiting for assistance

8. HOT TAPPING OF FEEDERMAINS

8.1. Approved Contractors for Existing Feedermains

(a) Only specialized and experienced hot tapping contractors as approved by The City of Calgary may be used to hot tap existing feedermains.
   a) Alta-West Hot Tapping
   b) Pacific Flow Control

(b) Hot tapping contractors shall come equipped with a spare diamond bit cutter.

(c) Weld-on tapping saddles for steel pipe will not be considered for hot taps where:
   i. The pipe is full of water to ensure weld integrity
   ii. The internal lining can create water quality concerns

8.2. Hot Tap Saddle

(a) Approved tapping saddle manufacturers
   i. JCM Industries
      a) Style 412 for steel with sufficient wall thickness per manufacturer and for PVC
      b) Style 414 for steel with insufficient wall thickness or strength per manufacturer
      c) Style 415 for concrete pressure pipe
   ii. Smith Blair
      a) Style 622 for steel with sufficient wall thickness per manufacturer and for PVC
      b) Style 623 for steel with insufficient wall thickness or strength per manufacturer
      c) Style 625 for concrete pressure pipe

(b) Prior to ordering the hot tap saddle, the Engineer must review and approve the saddle material and applicable specifications for the specific pipe length being tapped:
   i. Steel
      a) Pipe Outside Diameter (OD)
      b) Coating and lining
         1. If a steel pipe has a coal tar, epoxy or polyurethane lining, no weld-on tapping saddle will be allowed.
   ii. PVC, Cast Iron, Ductile Iron
      a) Pipe Outside Diameter (OD)
   iii. Pressurized Concrete
      a) Pipe Outside Diameter (OD)
      b) Steel cylinder diameter
      c) Exterior mortar thickness

(c) Hardware
   i. All bolts, nuts and related hardware to be SS 304

(d) Wall thickness

i. Saddle neck and body to have a minimum wall thickness of 9.5 mm (3/8") unless otherwise approved by the Engineer.

(e) Cathodic Protection

i. Provide cathodic protection with zinc anodes to hot tap saddle.

ii. Electrically isolate valve and provide cathodic protection as per Standard Specifications Waterworks Construction.

8.3. Pre-Construction Meeting

(a) Scheduling in accordance with other feedermain work

(b) Risk mitigation evaluation

(c) Identification of roles and responsibilities, and communication protocol.

8.4. Hot Tapping Feedermain Control/Shutdown Protocol

(a) Positive pressure must be maintained on all hot taps

(b) Applies to any size tap that has been approved by Water Resources and is performed in accordance with Waterworks Standard Specifications or Standard Specifications & Design Guidelines for Potable Water Feedermain Construction.

Diameter	Material			
	Steel (C200)	Concrete (C300/C301/C303)	HDPE	PVC
400 mm	No Control	No Control (Control may be required by The City/WOCC on case by case basis)	No Control	Control Mandatory Requires WOCC Review
500 – 900 mm	No Control (Control may be required by The City/WOCC on case by case basis)	No Control (Control may be required by The City/WOCC on case by case basis)	No Control (Control may be required by The City/WOCC on a case by case basis)	Control Mandatory

8.5. Pressurized Concrete Pipe Hot Tap Procedure

(a) Clean pipe

(b) Verify pipe OD and saddle dimensions

(c) Fit saddle on pipe with outlet in horizontal position and mark outlet hole

(d) Remove the saddle and score the outlet hole area.

(e) Carefully remove the mortar within the outlet hole area with hand tools ensuring no damage to the wires, bars or steel cylinder

(f) Verify steel cylinder OD by measuring mortar thickness
(g) If a cylinder weld is present, if possible relocate saddle to a different position on the pipe and start over. This decision is at the discretion of the Engineer.
(h) Install saddle with grouting horns up and aligned with the outlet hole
(i) Tighten saddle with sufficient torque to seal the grout gaskets, alternating from one side to the other, and starting from the outside towards the centre.
(j) Pour grout into saddle through grout horns, vibrating continuously while pouring.
(k) Tighten sleeve according to manufacturers torque specifications when grout has set, alternating bolts and starting from the outside towards the centre.
(l) Cut wires or bars as close to edge of outlet hole as possible and remove. Do not damage the steel cylinder.
(m) Remove remaining mortar from steel cylinder.
(n) If cylinder welds are present, at the discretion of the Engineer, flatten weld flush with cylinder using a peening hammer and/or hand file. Do not use a grinder.
(o) Lubricate the gasket on the draw flange and insert into the saddle ensuring the gasket properly contacts the cylinder.
(p) Torque the draw flange bolts according the manufacturer specifications. Check the gasket spacing with a feeler gauge.
(q) Install support bolts for supporting valve according to manufacturer specifications.
(r) Install approved valve with sufficient support.
(s) Install tapping machine onto face of valve with sufficient support.
(t) Open valve, counting and recording number of turns.
(u) Pressure test assembly to ensure no leaks.
(v) Tap pipe through steel cylinder and inner concrete.
    i. The tapping chamber must be filled with water to lubricate and cool pilot bit and cutter.
(w) Upon completion of tap, close valve ensuring same number of turns as above.
(x) Remove tapping machine.
(y) Pour grout between sleeve outlet hole and between the flanges, vibrating while pouring.

8.6. PVC Hot Tapping

(a) Tapping shall not be permitted on visibly curved or bent pipe.
(b) Tapping shall not be permitted within 1.5 m of a joint, fitting or existing tap.
(c) A heavy protective blanket shall be placed over the pipe in the tapping area and personnel shall follow suitable safety procedures.

8.7. Steel Hot Tapping

(a) Smith Blair Style 623 must be used on pipes with wall thickness less than 9.5 mm.
(b) Welded outlets will typically not be allowed and will only be permitted at the discretion of the Engineer.
(c) Tapping shall not be permitted within 300 mm of a joint, fitting or existing tap.
(d) Tapped connections are required to be isolated with an approved isolating flange gasket kit or a length of PVC pipe at the discretion of the Engineer.

9. MAINTENANCE, ASSESSMENT, AND REPAIR OF FEEDERMAINS

9.1. Condition Assessment of New or Existing Feedermains

(a) While this document is not intended to outline The City of Calgary's feedermain condition assessment or leak detection programs, it is intended to bring attention to the reader the various technologies The City uses which influence feedermain design and construction.

(b) This section does not cover all condition assessment or leak detection techniques available or in development.

(c) Feedermains to be assessed may be newly constructed or existing infrastructure that is already in service.

9.2. Leak Detection Techniques

TECHNOLOGY	APPLICABLE MATERIALS	DESCRIPTION	REQUIREMENTS
Correlators	Steel	Above ground mobile acoustic sensors applied directly to pipe or pipe features at two or more points	• Access to pipe
Sahara	All	Tethered acoustic sensor carried through the pipe by flow via a parachute	• 50 mm port • Sufficient velocity • Depressurized or live insertion/extraction
SmartBall	All	Free swimming acoustic sensor housed in a foam ball which rolls through the pipe by flow.	• 100 mm Access ports at the 12 o'clock position • Full port valve for live insertion and retrieval • Sufficient velocity

9.3. Condition Assessment Techniques

TECHNOLOGY	APPLICABLE MATERIALS	DESCRIPTION	REQUIREMENTS
Robotic Remote Field Technology (Electromagnetic)	Steel, C301, C303	• Detects cylinder corrosion • Detects broken wires / bars	• Minimum 450 mm Access ports • Depressurized pipeline

Free Swimming Remote Field Technology (Electromagentic)	Steel, C301, C303	• Detects cylinder corrosion • Detects broken wires / bars	• Sufficient flow • Varying size access ports depending on pipe diameter • Varying overhead clearance
Acoustic Emissions Monitoring	C301	• Actively detects wires as they break	• 50 mm access ports

9.4. Repairs

(a) **Critical Parts Inventory**

i. For emergency repairs of feedermains identified as critical to continued water system operation, The City of Calgary maintains an inventory of parts located at the Bearspaw Storage Yard.

ii. Parts in the Critical Parts Inventory are only to be used for emergency repairs at the discretion of Water Resources – Asset Planning which is responsible for inventory levels.

iii. The inventory includes but is not limited to:
   a) Concrete Bell and Spigot to Plain Steel End Adapters
   b) Straight and Transition Couplings for Steel, PVC, CI and DI.
   c) Lengths of Steel and PVC pipe
   d) Gaskets

iv. Feedermain repairs which require parts not available in this inventory may require lead times of three to four (3 – 4) weeks or more.

(b) **Steel Pressure Pipe for Critical Parts**

i. As per AWWA C200, C210, and C222. Pipe will be manufactured by one of the following processes: seamless; electric resistance welded; or submerged arc welded.

ii. Minimum steel pipe wall thickness to be 9.5 mm (3/8”)

iii. Specified minimum yield strength of steel to be 240 MPa (35,000 psi)

iv. Each completed straight line or standard pipe section may contain only one longitudinal seam with no girth seams or may be spiral welded.

v. All pipe sections will be hydrostatically tested as per AWWA C200 maintained for a minimum of five (5) seconds.

vi. Plain or beveled ends for mechanically coupled field joints as per AWWA C200. All pipe will be free from surface defects and have welds ground flush.

vii. Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

viii. All pipes to have temporary end caps / seals.

ix. All pipe sections will be sufficiently strutted to avoid distortion during transport and storage.

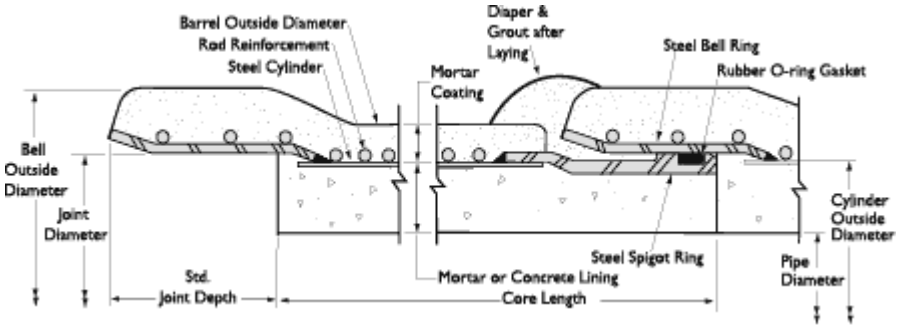
(c) **PVC for Critical Parts**

i. As per AWWA Standard C900 / C909.
ii. All pipe sections will have a dimension ratio of 18 and be a pressure class of 150.
iii. All pipe sections are to be supplied with nitrile gaskets.
iv. All pipes to have temporary end caps / seals.

(d) **CANRON/HYPRESCON VINTAGE C-303 Concrete Cylinder Pipe to Steel Adaptors**

i. As per AWWA C303.
ii. Joint diameters are to be scribed on the adaptor.
iii. All adaptors are to have dimensions equal to the table below
iv. Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

Pipe Diameter (mm)	Joint Diameter (mm)
400	454
500	565
600	696
750	870



(e) **AMERON C-303 Concrete Cylinder Pipe to Steel Adaptors**

i. As per AWWA C303.
ii. Joint diameters are to be scribed on the adaptor.
iii. All adaptors are to have dimensions equal to the table below
iv. Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

Pipe Diameter (mm)	Joint Diameter (mm)
500	566
600	667
750	822
900	975
1050	1127
1200	1280
1350	1432

1500	1584

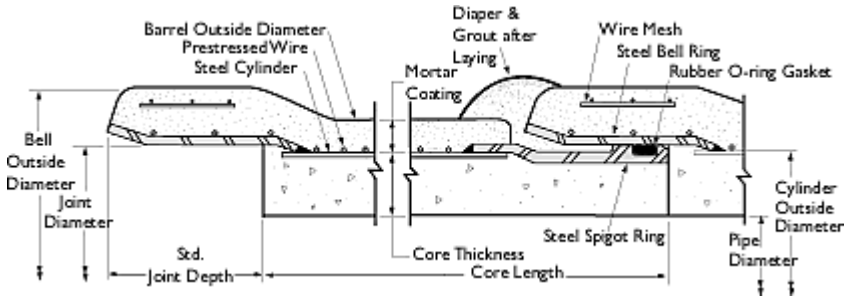
(f) **C-301 Lined Concrete Cylinder Pipe to Steel Adaptors**

i. As per AWWA C301 for lined-cylinder pipe. Joint diameters are to be scribed on the adaptor.

ii. All adaptors are to have dimensions equal to the table below

iii. Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

Pipe Diameter (mm)	Joint Depth (mm)	Joint Diameter (mm)
500	83	584
600	83	699
750	83	870
900	86	1041
1050	95	1200
1200	98	1372
1350	105	1565 (Forterra – Stouffville Plant) 1565 – (Decast – Utopia Plant) 1543 – (Forterra – St. Eustache) 1543 – (Former Canron – Cochrane, AB Plant)



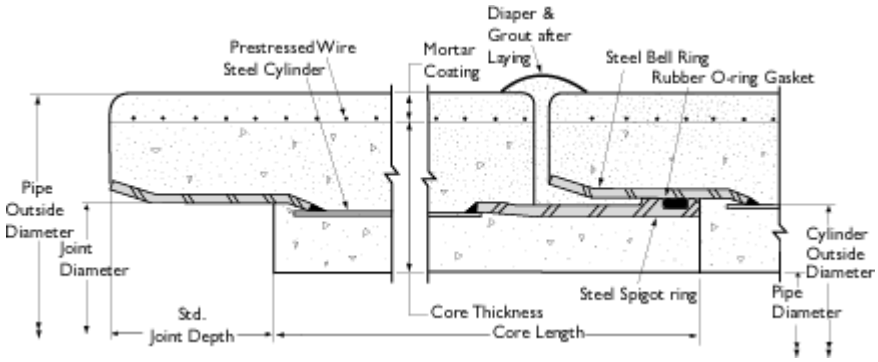
(g) **C-301 Embedded Concrete Cylinder Pipe to Steel Adaptors**

i. As per AWWA C301 for embedded-cylinder pipe. Joint diameters are to be scribed on the adaptor.

ii. All adaptors are to have dimensions equal to the table below

iii. Shall be coated as per Section 5.4(j) and lined as per Section 5.4(i)

Pipe Diameter (mm)	Standard Joint Depth (mm)	Joint Diameter (mm)
1350	105	1469
1500	108	1622
1950	117	2095
2100	121	2254



(h) **Couplings**

i. As per AWWA C219.
ii. All couplings are to be insulating couplings with an insulating boot unless otherwise specified by the Engineer.
iii. All couplings are to be provided with wedge-style, NSF 61 nitrile gaskets.
iv. All couplings are to be provided with nuts and bolts that are 304 stainless steel.
v. All couplings sleeves and flanges are to be coasted with a 100% solid, fusion-bonded, NSF 61 approved epoxy. Epoxy coating will be 15 mils, plus or minus 5 mils maximum.
vi. The sleeve length is to be 400 mm (16”, of carbon steel, with minimum yield of 207 MPa (30,000 PSI).

(i) **Isolating Flange Kits**

i. As per AWWA C207 for Class D ring flanges.
ii. All flange kits are to have a Nitrile, full-faced (Type E), gasket.
iii. All flange kits are to have G-10 retainer.
iv. All sleeves are to be one piece G-10 sleeve and double washer sets made of G-10.

(j) **Joint Leak Repairs**

i. Hydratight or Weko Seal internal joint seals will be considered at the Engineer’s discretion for repair of leaking joints.

(k) **Steel Pipe Failure Repairs**

i. Most failure modes of steel feedermains are in the form of a hole due to either corrosion or third party damage.
ii. Prior to repair, The City’s Inspections and Corrosion Technicians must be called out to inspect the failure and assist the Engineer in determining root cause and recommended repair steps.
iii. All repairs must be approved by the Engineer and will involve either a welded patch or replaced section of pipe.

iv. All required materials including bolts and gaskets must be acquired by the contractor prior to construction.

v. Due to the variation in pipe design and operational requirements, all repairs will be designed or dictated by the Engineer on specific site requirements. However the Engineer must consider inputs from:
   a) City Inspections
   b) City Corrosion Technicians
   c) City Infrastructure Engineer
   d) Water Services valve operations staff
   e) Water Services construction staff or Contractor
   f) Assigned welders

vi. Patches
   a) Steel welded patches may be in the form of partial for full circumferential patches
   b) Repairs with only external welds will be allowed, but only with a visual pressure test.
   c) Welders must be Pressure B Certified in Alberta
   d) Return to service requirements will be dictated by Water Services.

vii. Replaced Sections
   a) Pipe replacements do not have to remain the same type of pipe that was removed; however continuity and other cathodic protection requirements must be maintained.
   b) It is not a requirement to replace a full length of pipe, partial cut outs are allowed.
   c) All pipe replacements must meet the appropriate requirements in this document.
   d) Return to service requirements will be dictated by Water Services.

(l) **C300, C301, C303 Pipe Repairs**

i. Most failure modes of concrete pressure pipe are in the form of a rupture due to either corrosion or third party damage.

ii. Prior to repair, The City's Inspections and Corrosion Technicians must be called out to inspect the failure and assist the Engineer in determining root cause and recommended repair steps.

iii. All required materials including bolts and gaskets must be acquired by the contractor prior to construction.

iv. All repairs must be approved by the Engineer and will involve either a welded patch on the steel cylinder or replaced section of pipe.

v. Due to the variation in pipe design and operational requirements, all repairs will be designed or dictated by the Engineer on specific site requirements. However the Engineer must consider inputs from:
   a) City Inspections
   b) City Corrosion Technicians
   c) City Infrastructure Engineer

d) Water Services valve operations staff
e) Water Services construction staff or Contractor
f) Assigned welders

vi. Steel Cylinder Patches
a) Welded steel cylinder patches are not recommended or approved by any concrete pressure pipe manufacturer and must be carefully reviewed at the discretion of the Engineer based on condition assessment information including the number of broken wires/bars.
b) Steel cylinder patches may not be used on any repair where
1. the cylinder defect exceeds 300 mm by 300 mm.
2. the cylinder defect was caused by corrosion.
c) Broken bars and wires must be welded to the steel patch.
d) Repairs can only be done with external welds, and therefore a visual pressure test may be necessary at the discretion of the Engineer. Extreme caution must be exercised during the visual tests should the pipe suddenly rupture.
e) The steel patch thickness should match the thickness of the steel can being repaired. Thicker plates can be used at the discretion of the welder.
f) A reinforced concrete cage should be poured around the pipe over the repair.
g) Welders must be Pressure B Certified in Alberta
h) Return to service requirements will be dictated by Water Services.

vii. Repair Sleeves
a) Smith Blair or JCM repair sleeves may be considered at the discretion of the Engineer for minor third party damage that is not associated with corrosion or deterioration due to soils.

viii. Replaced Sections
a) Pipe replacements do not have to remain the same type of pipe that was removed, however continuity and other cathodic protection requirements must be maintained.
b) Where bell and spigot adapters are used:
1. Full circumferential welds may be used in place of the rubber gasket.
2. Couplings or butt straps with external welds may be used
c) Only full length of pipes may be replaced.
d) All pipe replacements must meet the appropriate requirements in this document.
e) Return to service requirements will be dictated by Water Services.

(l) **PVC Pipe Repairs**

i. Most failure modes of PVC pipe are in the form of a rupture due to either improper installation such as over insertion, over deflection or third party damage.

ii. Prior to repair, The City's Inspections and Corrosion Technicians must be called out to inspect the failure and assist the Engineer in determining root cause and recommended repair steps.
iii. All required materials including bolts and gaskets must be acquired by the contractor prior to construction.
iv. All repairs must be approved by the Engineer and shall involve a replacement section of PVC pipe and straight mechanical couplings unless otherwise directed by the Engineer.
v. Appropriate cathodic protection must be placed as directed by the Inspector and Corrosion Technicians.

(m) **Cast Iron Repairs**

vi. Most failure modes of Cast Iron (CI) pipe are in the form of a hole or rupture due to corrosion or third party damage.
vii. Prior to repair, the Inspector and Corrosion Technicians must be called out to inspect the failure and assist the Engineer in determining root cause and recommended repair steps.
viii. All required materials including bolts and gaskets must be acquired by the contractor prior to construction.
ix. All repairs must be approved by the Engineer and shall involve a replacement section of PVC or Steel pipe and appropriate transition mechanical couplings unless otherwise directed by the Engineer.
x. All transition mechanical couplings must have thrust restraints to hold the transition coupling in place as approved by the Engineer.
xi. Appropriate cathodic protection must be placed as directed by the Inspector and Corrosion Technicians.

(n) **Large Diameter Valve Replacement in Chambers**

i. Valve and pipe dimensions must be determined prior to construction.
ii. All required materials including bolts and gaskets must be acquired by the contractor prior to construction.
iii. Chambers without removable roofs may have the roof cut
iv. New valves shall have the valve opened fully to check open position and open stop, in addition to the valve closed stop.
v. For Victaulic 44 by flange spools, there must be a minimum of 3 mm (1/8") to 12 mm (1/2") space tolerance between the rings.
vi. An approved sealing material must be used to reseal walls to roof of chamber.
vii. Return to service requirements will be dictated by Field Services.
viii. Spools shall have both internal and external welded rings or flanges. Field fitting with tack welding will be required to achieve this prior to performing full welds.
ix. Welders must be Pressure B Certified in Alberta

10. APPENDICES

APPENDIX 1: FEEDERMAIN DESIGN & CONSTRUCTION CHECKLIST
APPENDIX 2: DELEGATION OF AUTHORITY FOR CROSSINGS
APPENDIX 3: REFERENCE DRAWINGS & LAYOUTS

APPENDIX 1

FEEEDERMAIN DESIGN & CONSTRUCTION CHECKLIST

FEEDERMAIN DESIGN & CONSTRUCTION CHECKLIST

Project Name:	
Common Name:	
Engineer/ Designer:	

SECTION	DESCRIPTION	INITIATED	COMPLETED
1. Initiation	1.1 Handover Document from IP 1.2 Corporate Project Management Framework a) Business Case b) Project Charter c) Project Plan (including procurement plan) d) Risk Register e) Project Change Log f) Communications Plan		
2. Budget	2.1 Stage Gate 1 2.2 Stage Gate 2 2.3 Stage Gate 3		
3. Design Strategy	3.1 Design Basis Memo a) Diameter b) Pressure c) Length d) Route		
4. Design Team	4.1 Design Team a) City Project Engineer b) Designing Engineer c) Inspector d) Surveyor e) Corrosion Technician f) Geotechnical Consultant g) Corporate Properties Contact h) City Finance & Supply i) Assigned Communications Planner		
5. Special Interest Groups	5.1 Councillor Contact 5.2 Community Association Contact 5.3 Other (First Nations, Environmental, Engage!, etc)		
6. Survey	6.1 Preliminary Line Assignment 6.2 Preliminary Survey 6.3 Line Assignment Approval 6.4 Final Survey 6.5 As-Built Survey		
7. Environmental & Archeological Assessment	7.1 Preliminary Environmental Assessment 7.2 Preliminary Archeological Assessment 7.3 Environmental Consultant a) Request for Proposal b) Award		

	7.4 Archeological Consultant a) Request for Proposal b) Award 7.5 Biophysical Impact Assessment Consultant a) Request for Proposal b) Award		
8. Pre-Design	8.1 Consulting Engineer a) Request for Proposal b) Award 8.2 Preliminary Design 8.3 Preliminary Design Approval 8.4 Preliminary Budget Report		
9. Pipe Tender	9.1 Preparation of Pipe Tender & Pipe Specs 9.2 Pipe Tender 9.3 Pipe Tender Award 9.4 Chainage List & Plan/Profile Drawings to Supplier 9.5 Fabrication/Layout Drawings		
10. Land	10.1 UROW or Easement Identification 10.2 Cost Estimates for Land 10.3 Land Purchase		
11. Design	11.1 Grade Design Sheets 11.2 Geotechnical Report 11.3 Biophysical Impact Assessment 11.4 Archeological Report 11.5 Working Pressure Calculations 11.6 Thrust Blocks & Restrained Joints 11.7 Air Valve Manholes 11.8 Valve Chambers 11.9 Washouts 11.10 Distribution System Tie-Ins 11.11 Alterations to Existing Utilities 11.12 Crossings 11.13 Casings 11.14 PRV Chambers 11.15 Erosion and Sediment Control 11.16 Construction Drawings		
12. Procurement of Materials	12.1 Valve Chambers 12.2 Valves 12.3 Air Valves 12.4 Misc.		
13. Circulations / Approvals	13.1 Alberta Environment Letter of Authorization 13.2 Development Approvals Circulations 13.3 ESC Review 13.4 External Municipality Approvals 13.5 Water Operations Coordination Committee 13.6 Misc		

14. Crossings & Utility Agreements	14.1 CP / CN Agreement 14.2 River a) Alberta Environment Notice of Crossing b) DFO Letter of Advice 14.3 Natural Areas a) Alberta Parks 14.4 Highway/TUC a) Ministerial Consent 14.5 Private Roads a) Right of Entry / ROW 14.6 ATCO Gas Agreement 14.7 ATCO Pipelines Agreement 14.8 Transalta/Enmax Agreement 14.9 Telus/Shaw Agreement		
15. Installation Contract	15.1 Front End Documents 15.2 Schedule of Quantities 15.3 Special Conditions 15.4 Specifications 15.5 Erosion and Sediment Control Plan 15.6 Environmental Responsibilities 15.7 Tender 15.8 Award 15.9 Contractor Documents 15.10 Eco Plan / Environmental 15.11 Contract Signing		
16. Installation Contract Execution	16.1 Notice to Proceed 16.2 Pre-Construction Meeting 16.3 Budget Status Reports 16.4 Construction Drawings 16.5 Copies of Permits 16.6 Shop Drawings 16.7 Safety Meeting / Construction Meetings 16.8 Construction Schedule 16.9 ESC Inspections 16.10 Environmental Inspections		
17. Installation Completion	17.1 Deficiencies 17.2 Construction Completion Certificate (CCC) 17.3 Contractor Performance Evaluation 17.4 Substantial Completion and holdbacks 17.5 Lien Search 17.6 Record drawings in Livelink 17.7 Record drawings input into GIS 17.8 Final Maintenance Certificate (FMC)		
18. 2 Year Maintenance Period	18.1 Deficiencies 18.2 Environmental Monitoring 18.3 ESC Monitoring 18.4 Maintenance by Contractor		

	i. Hydrovac and clean chambers ii. Check bolt torque on valves and flanges iii. Landscape maintenance		

APPENDIX 2

**DELEGATION OF AUTHORITY BY CITY MANAGER
OF CROSSING AGREEMENTS**

THE CITY OF CALGARY

Delegation of Authority
by the City Manager

RE: Temporary Crossing Agreements, Permanent Crossing Agreements, Partnership Agreements, Conference Sponsorship Agreements and any documents related thereto

Pursuant to Section 5 of the City of Calgary Bylaw 43M99, I hereby exercise my powers as City Manager of The City of Calgary ("The City"), which includes the authority of the Chief Administrative Officer under the *Municipal Government Act* and Chief Executive Officer under Bylaw 43M99, and authorize as follows:

1. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individuals holding the following positions:

   (a) Leader, Project Engineering Underground;
   (b) Leader, Development Planning;
   (c) Leader, Asset Planning; and
   (d) Manager, Wastewater Treatment;

   or to any employees acting in any of the above positions from time to time, or to any successor of any of the above positions, the authority to enter into Temporary Crossings Agreements and any documents related thereto on behalf of The City without execution by the City Clerk, or the affixing of the Corporate Seal.

2. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individual holding the position of Manager, Infrastructure Planning, Manager, Infrastructure Delivery or to any employee acting in this position from time to time, or to any successor of this position, the authority to enter into Permanent Crossing Agreements and any documents related thereto on behalf of The City without execution by the City Clerk, or the affixing of the Corporate Seal, which involve a value of goods or services in an amount equal to or less than Twenty-Five Thousand Dollars ($25,000.00).

3. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individual holding the position of Director, Water Resources, or to any employee acting in this position from time to time, or to any successor of this position, the authority to enter into Permanent Crossing Agreements and any documents related thereto on behalf of The City without execution by the City Clerk, or the affixing of the Corporate Seal, which involve a value of goods or services in an amount from Twenty-Five Thousand Dollars ($25,000.00) to and including One Hundred Thousand Dollars ($100,000.00).

4. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individual holding the position of Manager, Watershed Planning, or to any employee acting in this position from time to time, or to any successor of this position, the

THE CITY OF CALGARY

authority to enter into Partnership Agreements and Conference Sponsorship Agreements and any documents related thereto on behalf of The City without execution by the City Clerk, or the affixing of the Corporate Seal, which involve a value of goods or services in an amount equal to or less than Twenty-Five Thousand Dollars ($25,000.00).

5. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individual holding the position of Director, Water Resources, or any employee acting in this position from time to time, or to any successor of this position, the authority to enter into Partnership Agreements and Conference Sponsorship Agreements and any documents related thereto on behalf of The City without execution by the City Clerk, or the affixing of the Corporate Seal, which involve a value of goods or services in an amount from Twenty-Five Thousand Dollars ($25,000.00) to and including One Hundred Thousand Dollars ($100,000.00).

6. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individuals holding the following positions:

   (a) Senior Project Engineer;
   (b) Project Engineer;
   (c) Planning Engineer; and
   (d) Regulatory Program Specialist

   or to any employees acting in any of the above positions from time to time, or to any successor of any of the above positions, the authority to approve Temporary Crossing Agreements as to content.

7. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individual holding the position of Leader, Project Engineering Underground, or to any employee acting in this position from time to time, or to any successor of this position, the authority to approve Permanent Crossing Agreements as to content which involve a value of goods or services in an amount equal to or less than Twenty-Five Thousand Dollars ($25,000.00).

8. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individuals holding the following positions:

   (a) Manager, Infrastructure Delivery; and
   (b) Manager, Infrastructure Planning

   or to any employees acting in any of the above positions from time to time, or to any successor of any of the above positions, the authority to approve Permanent Crossing Agreements as to content which involve a value of goods or services in an amount from Twenty-Five Thousand Dollars ($25,000.00) to and including One Hundred Thousand Dollars ($100,000.00).

9. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individual holding the position of Leader, Resource Planning and Policy,

THE CITY OF CALGARY

or to any employee acting in this position from time to time, or to any successor of this position, the authority to approve Partnership Agreements and Conference Sponsorship Agreements as to content which involve a value of goods or services in an amount equal to or less than Twenty-Five Thousand Dollars ($25,000.00).

10. Pursuant to section 209 of the *Municipal Government Act*, R.S.A. 2000, c. M-26, as amended, I hereby delegate to the individual holding the position of Manager, Watershed Planning, or to any employee acting in this position from time to time, or to any successor of this position, the authority to approve Partnership Agreements and Conference Sponsorship Agreements as to content which involve a value of goods or services in an amount from Twenty-Five Thousand Dollars ($25,000.00) to and including One Hundred Thousand Dollars ($100,000.00).

11. In the event of any reorganization or restructuring or administrative offices of The City, the employee or employees whose duties encompass the positions described above will have authority to execute or approve as to content any such agreement or other document on behalf of The City.

12. Any previous delegations of power or authority authorizing execution of agreements or approvals as to content of agreements of the type described herein are hereby superceded by this delegation letter.

Dated at Calgary effective as of the 1st day of January, 2016

APPROVED	
AS TO CONTENT	
ROB PRITCHARD, GENERAL MANAGER UTILITIES & ENVIRONMENTAL PROTECTION	
AS TO FORM SOLICITORS	

Jeff Fielding
City Manager

cc. Janette Mi, City Clerk's, Records Unit
Cindy Whitehead, Law Department
Rob Pritchard, General Manager, Utilities & Environmental Protection
Rob Spackman, Director, Water Resources

APPENDIX 3

REFERENCE DRAWINGS AND LAYOUTS

List of Drawings

Valves, Access, Drains & Air Valves

1. Valve Chamber Detail (Method A)
2. Valve Chamber Detail (Method B) With Inspection Access
3. Drain Manhole for PVC Pipe Up To 750 mm
4. Drain Manhole (Method A) for Steel / Concrete / PVC
5. Drain Manhole (Method B) for Steel / Concrete
6. Air Valve Manhole for PVC
7. Access and/or Air Valve Manhole for Concrete / Steel
8. Retrofit Only - Access and/or Air Valve Manhole for Concrete / Steel
9. Temporary Access Opening for Steel
10. Temporary Air Valve
11. Hinged Manhole Cover
12. Buried Access Manhole

Bedding & Trench

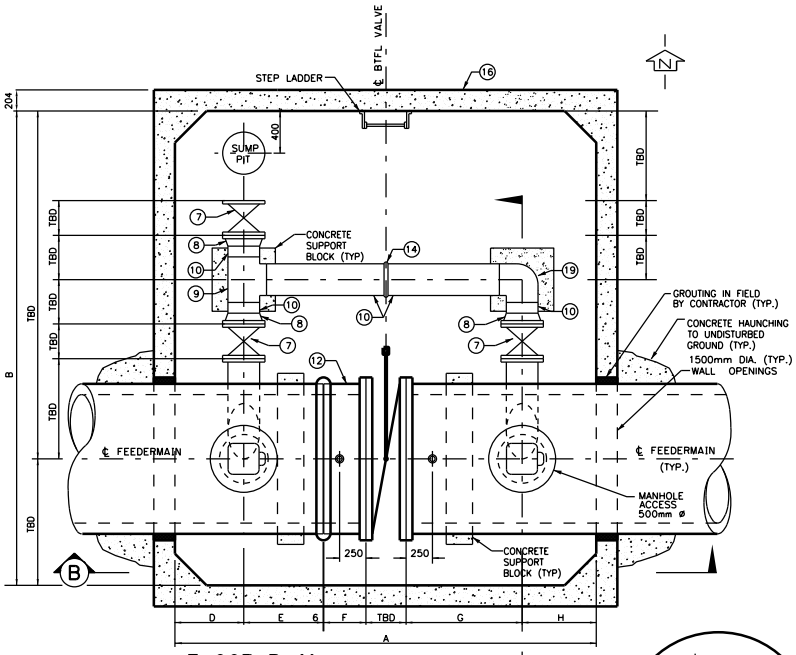
13. Class A Bedding & Concrete Encasement
14. Class B Bedding & Standard Trench

Joints

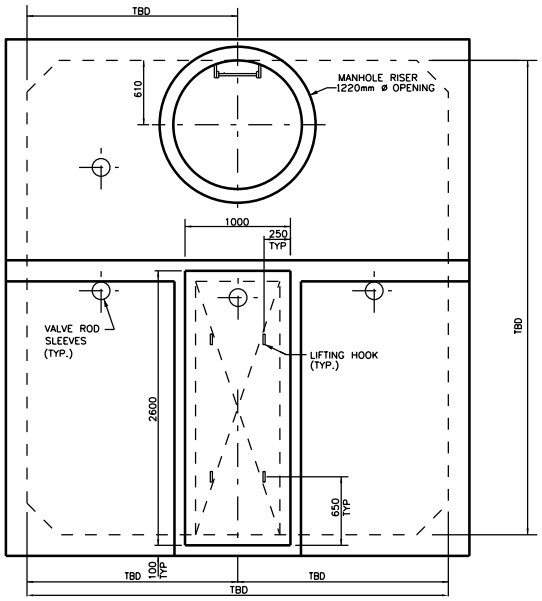
15. Bonding Clips / Continuity for Concrete Pipe
16. Tied Joint Welding for Concrete Pipe
17. Concrete Pipe Field Trim – Butt Strap
18. Concrete Pipe Field Trim – Mechanical Joint
19. Welded Joints for Steel Pipe
20. Butt Strap and Field Trim Detail

Miscellaneous

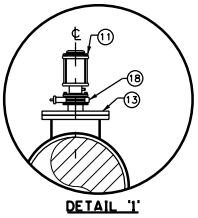
21. Typical Thrust Block Detail
22. Pipe Nomenclature
23. Concrete Pipe Repair - Option 1 should be couplings
24. Tunnel Casing Pipe & Carrier Pipe
25. Examples of Distribution System Tie-Ins / Alterations
26. Pump Station & Reservoir Tie-Ins
27. Ultimate Grade Cover Required
28. Structures Inside of 3 Metres Clearance of a Feedermain
29. Structure Outside of 3 Metres Clearance of a Feedermain
30. Utility Crossing
31. Cathodic Protection of Steel Carrier Pipe in Steel Encasement Pipe



A FLOOR PLAN



C ROOF PLAN



DETAIL '1'

TBD=TO BE APPROVED BY ENGINEER

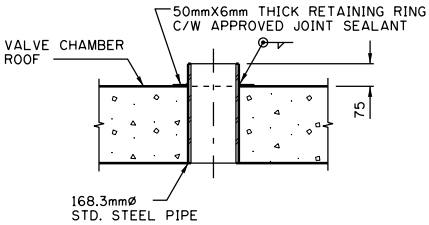
B SECTION

SCHEDULE OF MATERIALS (MECHANICAL)
VALVE CHAMBER No. 2 AT STA. 3+188.561

ITEM No.	QUANTITY	DESCRIPTION
1	1	PRATT TRITON XR-70 BUTTERFLY VALVE (FLANGED ENDS)
2	2	NEOPRENE FACED PHENOLIC GASKET TYPE E C/W INSULATION SLEEVES AND WASHERS (PSI OR APPROVED EQUAL)
3	16	ZINC DICHROMATE PLATED STUDS C/W WASHERS FOR TAPPED HOLES (GRADE 8)
4	72	ZINC DICHROMATE PLATED STUDS C/W WASHERS AND NUTS (GRADE 8)
5	1	VICTAULIC STYLE 44 COUPLING
*6	2	50mm IPT OUTLET C/W PLUG
7	3	DOUBLE FLANGED GATE VALVES C/W NUTS. BOLTS AND GASKETS
8	3	ASME FORGED STEEL WELD NECK FLANGE
9	1	ASME WELDING TEE
10	3.0m±	ASTM STANDARD STEEL PIPE
11	2	VENT-O-MAT DN150 PN16 RBX DBL ACTING AIR VALVE
*12	1	ADAPTER PIECE (FLANGE X VIC AGS ENDS)
*13	2	600mm BLIND FLANGE C/W FLANGE OUTLET FOR AIR VALVE C/W NUTS. BOLTS AND THICK NEOPRENE FACED PHENOLIC GASKET
14	1	VICTAULIC STYLE AGS AND COUPLING
15	4	CITY OF CALGARY STD. VALVE BOX ASSEMBLY C/W ROD. OPERATING NUTS. LID. TOP AND BOTTOM BOX
16	1	VALVE CHAMBER
17	1	TYPE 5A MANHOLE. FRAME AND COVER
18	2	CENTERLINE RESILIENT SEATED BUTTERFLY VALVE. LUG STYLE BODY (SERIES 250) C/W STAINLESS STEEL DISC
19	1	90° ASME WELDING BEND
20	1	FLANGE OULET c/w BLIND FLANGE

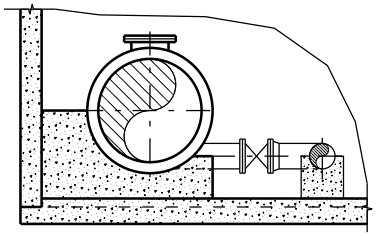
* MATERIALS SUPPLIED BY PIPE SUPPLIER

DIMENSION (mm)	FEEDERMAIN DIAMETER (mm)							
	500	600	750	900	1050	1200	1350	1500
A	3750	3750	4000	4000	4000	4000	4000	4000
B	3750	3750	4000	4000	4500	4500	4750	5000
C	MIN. 3000							
D	750							
E	MIN. 786							
F	MIN. 400							
G	MIN. 750							
H	MIN. 750							
I	2700							
J	1000							



SLEEVE OPENING TO BE CORED WHEN ROOF SLAB IS IN PLACE

VALVE ROD SLEEVE DETAIL



D SECTION

NOTES:

1. IMPORTANT: THIS DETAIL IS FOR REFERENCE ONLY.
2. ALL VALVE CHAMBER NEED TO BE DESIGNED BASED ON LOCATION AND PROJECT SPECIFIC REQUIREMENTS SUCH AS AIR VALVES.
3. MAINTAIN 500mm SPACE BETWEEN TOP OF AIR VALVES AND CHAMBER CEILINGS.
4. MAINTAIN 1000mm SPACE BETWEEN TOP OF FLANGES AND CHAMBER CEILINGS.

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

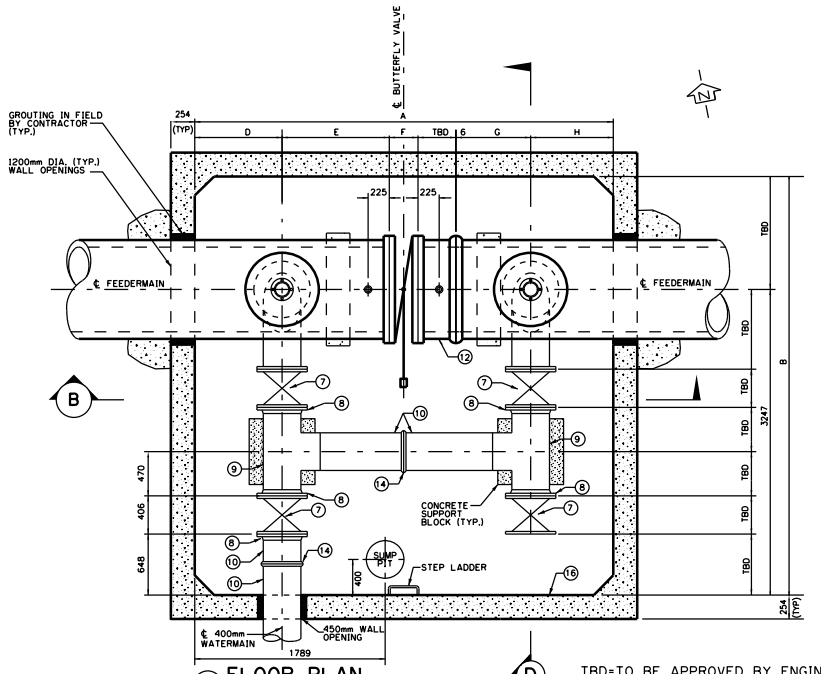
Date 2018/12/18
Scale N.T.S.
Approved by Russ Dueck for The City of Calgary

FEEDERMAIN CONSTRUCTION

METHOD 'A' VALVE CHAMBER DETAIL

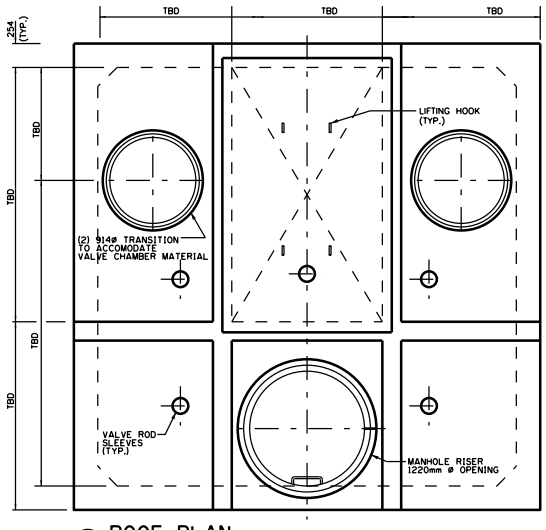
Sheet 1
File Number 501.0001.001

ISC: Unrestricted

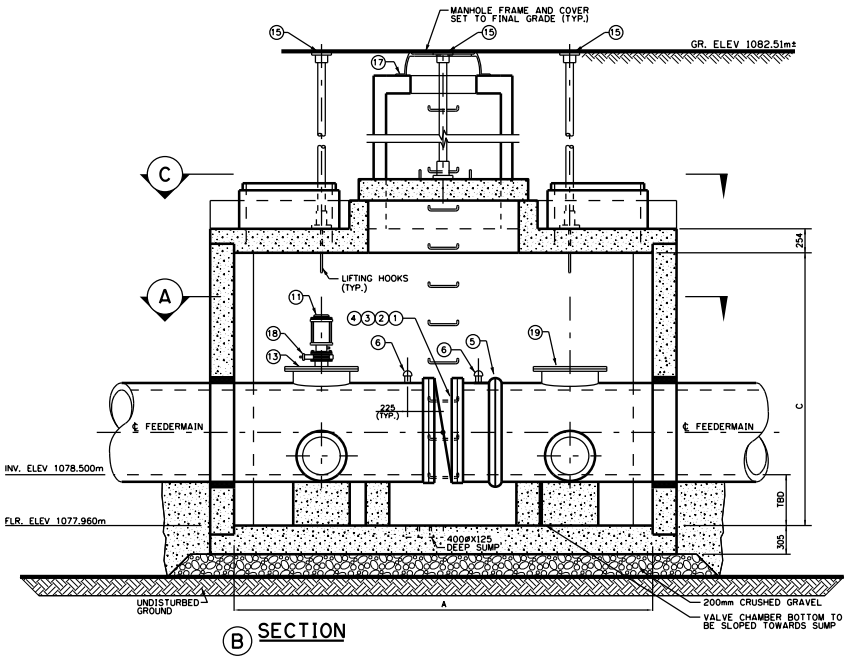


A FLOOR PLAN

D TBD=TO BE APPROVED BY ENGINEER



C ROOF PLAN



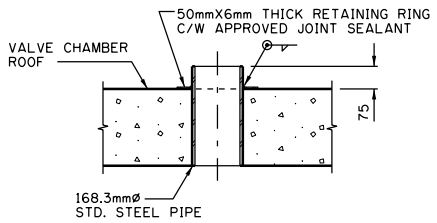
B SECTION

SCHEDULE OF MATERIALS (MECHANICAL)
VALVE CHAMBER No. 1 AT STA. 1+775.000

ITEM No.	QUANTITY	DESCRIPTION
1	1	PRATT TRITON XR-70 BUTTERFLY VALVE (FLANGED ENDS) RIGHT HAND OPENING
2	2	NEOPRENE FACED PHENOLIC GASKET TYPE E C/W INSULATION SLEEVES AND WASHERS (PSI OR APPROVED EQUAL)
3	16	ZINC DICHROMATE PLATED STUDS C/W WASHERS FOR TAPPED HOLES (GRADE 8)
4	72	ZINC DICHROMATE PLATED STUDS C/W WASHERS AND NUTS (GRADE 8)
5	1	VICTAULIC AGS COUPLING
•6	2	50mm IPT OUTLET C/W PLUG
7	4	DOUBLE FLANGED GATE VALVES C/W NUTS, BOLTS AND GASKETS
8	5	ASME FORGED STEEL WELD NECK FLANGE
9	2	ASME WELDING TEE
10	3.0m±	ASTM STANDARD STEEL PIPE
11	2	VENT-O-MAT DN150 PN16 RBX DBL ACTING AIR VALVE
•12	1	ADAPTER PIECE (FLANGE X VIC 44 ENDS)
•13	2	600mm BLIND FLANGE C/W FLANGE OUTLET FOR AIR VALVE C/W NUTS, BOLTS AND THICK NEOPRENE FACED PHENOLIC GASKET
14	2	VICTAULIC AGS COUPLING
15	5	CITY OF CALGARY STD VALVE BOX ASSEMBLY C/W ROD, OPERATING NUTS, LID, TOP AND BOTTOM BOX
16	1	VALVE CHAMBER
17	1	TYPE 5A MANHOLE, FRAME AND COVER
18	2	CENTRELINE RESILIENT SEATED BUTTERFLY VALVE, LUG STYLE BODY (SERIES 250), C/W STAINLESS STEEL DISC
19	1	600mm BLIND FLANGE c/w NUTS, BOLTS AND THICK NEOPRENE FACED PHENOLIC GASKET

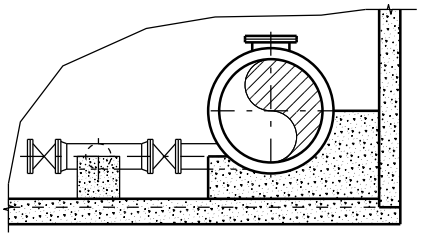
• MATERIALS SUPPLIED BY PIPE SUPPLIER

DIMENSION (mm)	FEEDERMAIN DIAMETER (mm)							
	500	600	750	900	1050	1200	1350	1500
A	3750	3750	4000	4000	4000	4000	4000	4000
B	3750	3750	4000	4000	4500	4500	4750	5000
C	Min. 3000							
D	750							
E	Min. 786							
F	Min. 400							
G	Min. 750							
H	Min. 750							
I	2700							
J	1000							



SLEEVE OPENING TO BE CORED WHEN ROOF SLAB IS IN PLACE

VALVE ROD SLEEVE DETAIL



D SECTION

NOTES:

1. IMPORTANT: THIS DETAIL IS FOR REFERENCE ONLY.
2. ALL VALVE CHAMBER NEED TO BE DESIGNED BASED ON LOCATION AND PROJECT SPECIFIC REQUIREMENTS SUCH AS AIR VALVES.
3. MAINTAIN 500mm SPACE BETWEEN TOP OF AIR VALVES AND CHAMBER CEILINGS.
4. MAINTAIN 1000mm SPACE BETWEEN TOP OF FLANGES AND CHAMBER CEILINGS.

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

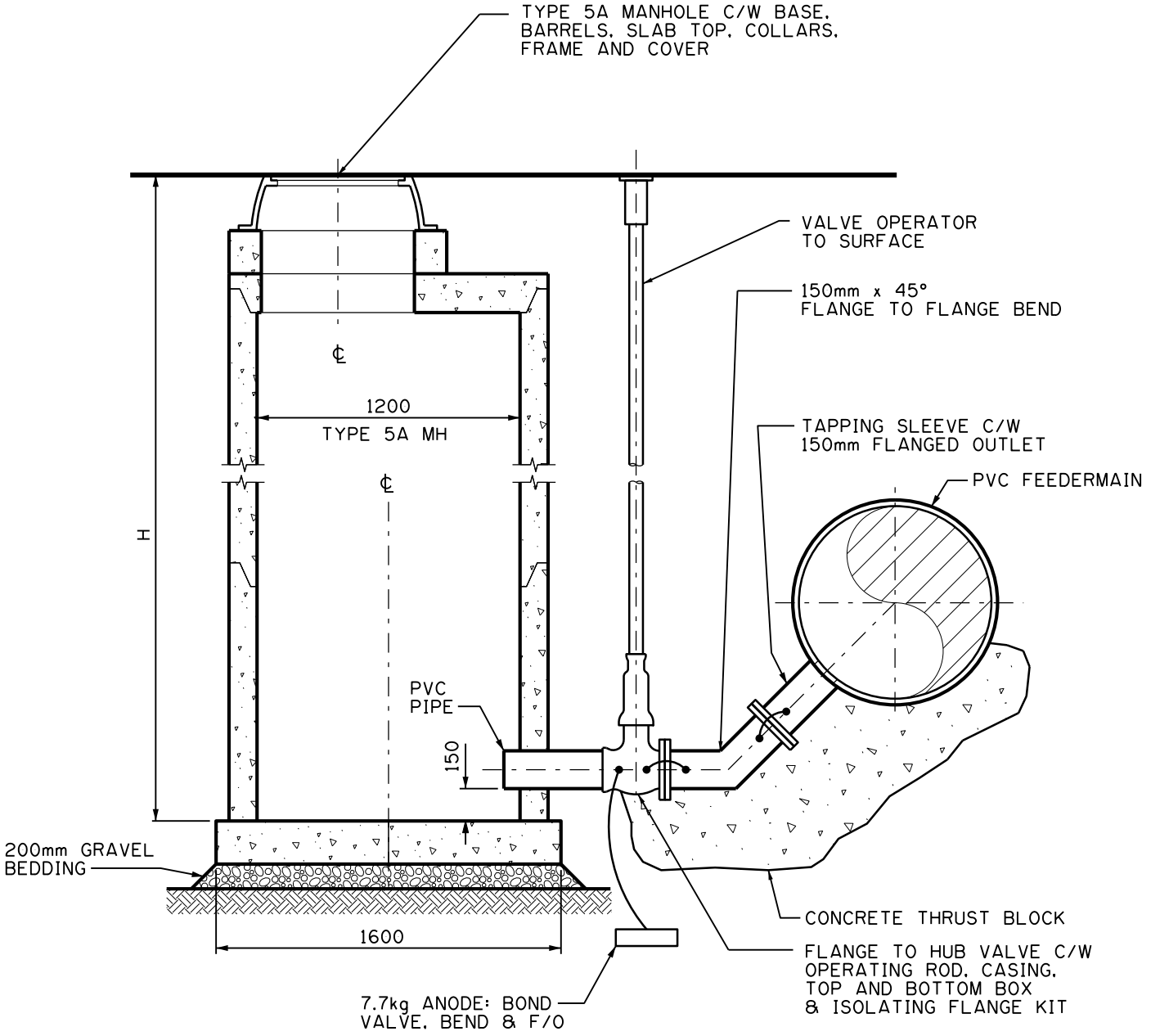
Date 2018/12/18
Scale N.T.S.
Approved by Russ Dueck for The City of Calgary

FEEDERMAIN CONSTRUCTION

METHOD 'B' VALVE CHAMBER DETAIL WITH INSPECTION ACCESS

Sheet 2

File Number 501.0002.001



NOTES:

1. TAPPING SLEEVE AT 45°
2. MANHOLE TO BE WATERTIGHT
3. ALL EXTERIOR METAL SURFACES SHALL BE TAPE WRAPPED
4. DRAIN MANHOLES DEEPER THAN 4 M MAY REQUIRE VALVE WITHIN CHAMBER - SEE SHEET #4
5. FOR PVC PIPE, MATERIAL MUST TRANSITION TO STEEL THROUGH CHAMBER.

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

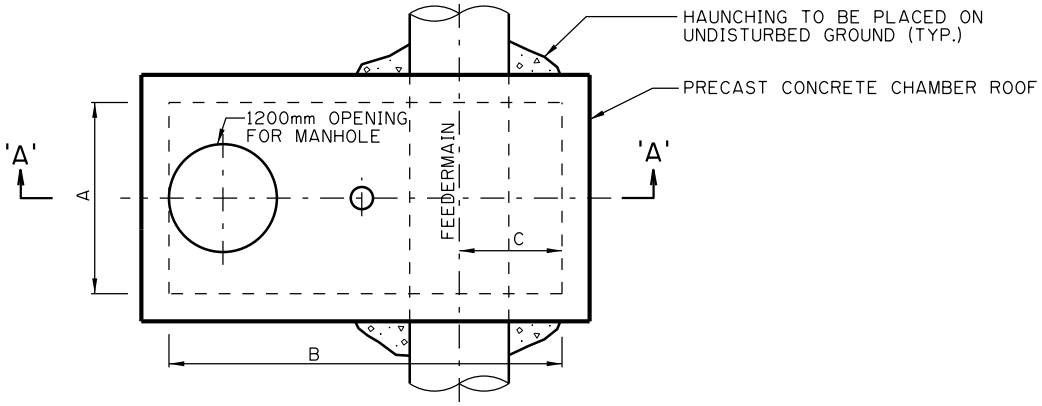
Date: 2019/02/25
Scale: N.T.S.
Approved by: Russ Dueck for The City of Calgary

FEEDERMAIN CONSTRUCTION

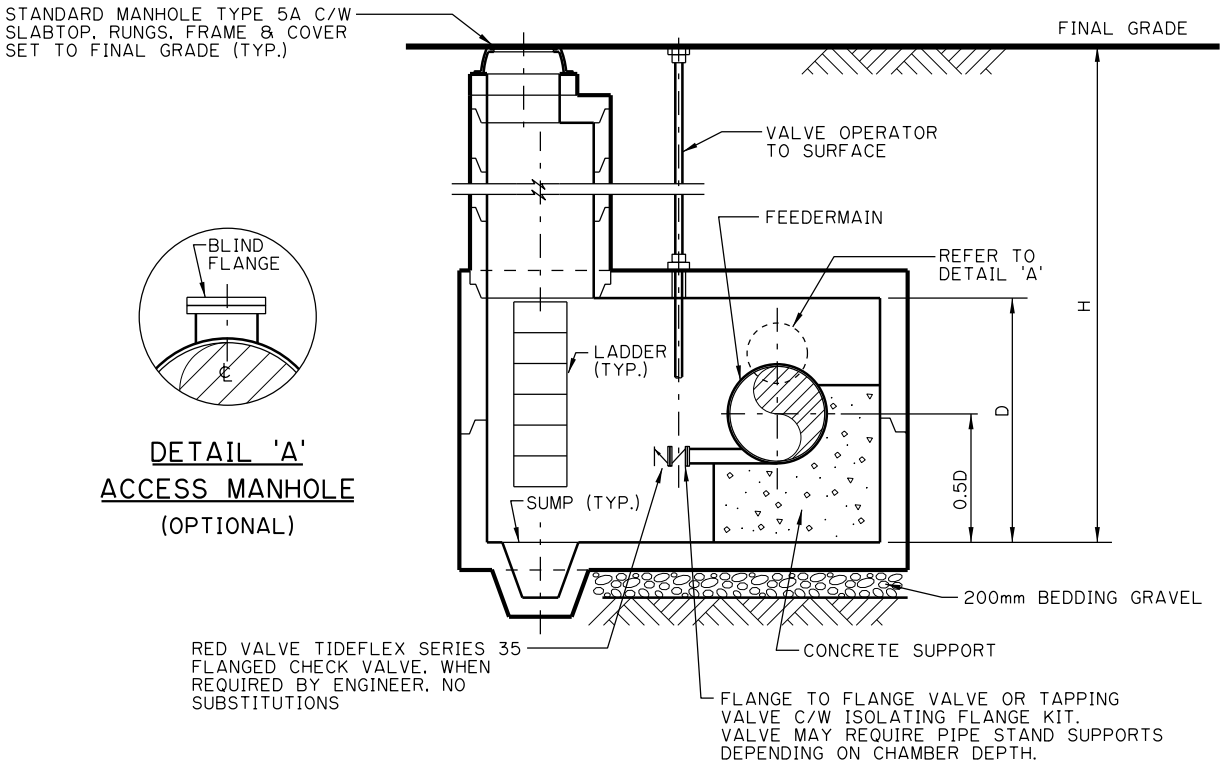
DRAIN MANHOLE FOR PVC PIPE UP TO 750mm

Sheet: 3
File Number: 501.0003.001

ISC: Unrestricted



PLAN



DETAIL 'A'
ACCESS MANHOLE
(OPTIONAL)

SECTION 'A-A'

NOTES:

1. MANHOLE TO BE WATERTIGHT.
2. DRAIN MANHOLES MUST NOT BE DEEPER THAN 10m.
3. FOR PVC PIPE, MATERIAL MUST TRANSITION TO STEEL THROUGH CHAMBER.

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

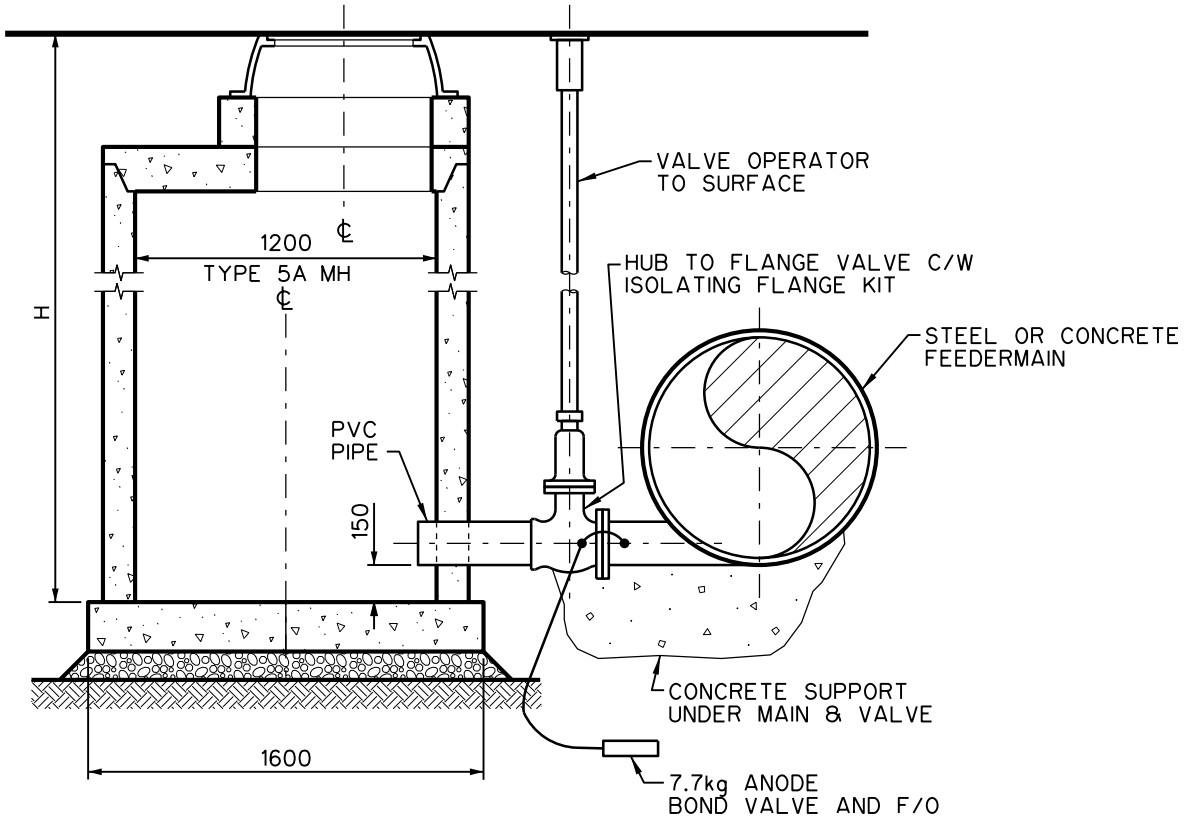
Date: 2019/02/25
Scale: N.T.S.
Approved by: Russ Dueck for The City of Calgary

FEEDERMAIN CONSTRUCTION

DRAIN MANHOLE FOR STEEL, CONCRETE, OR PVC PIPE (ANY DIAMETER)

Sheet: 4
File Number: 501.0004.001

ISC: Unrestricted



NOTES:

1. MANHOLE TO BE WATERTIGHT.
2. VALVE & FITTINGS TO INCLUDE CATHODIC PROTECTION. ALL TO BE IN ACCORDANCE WITH CURRENT STANDARD SPECIFICATIONS WATERWORKS CONSTRUCTION.
3. DRAIN MANHOLES DEEPER THAN 4 M MAY REQUIRE VALVE WITHIN CHAMBER - SEE SHEET #4
4. METHOD ONLY TO BE USED AT DISCRETION OF CITY OF CALGARY ENGINEER.

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

Date: 2018/12/11
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

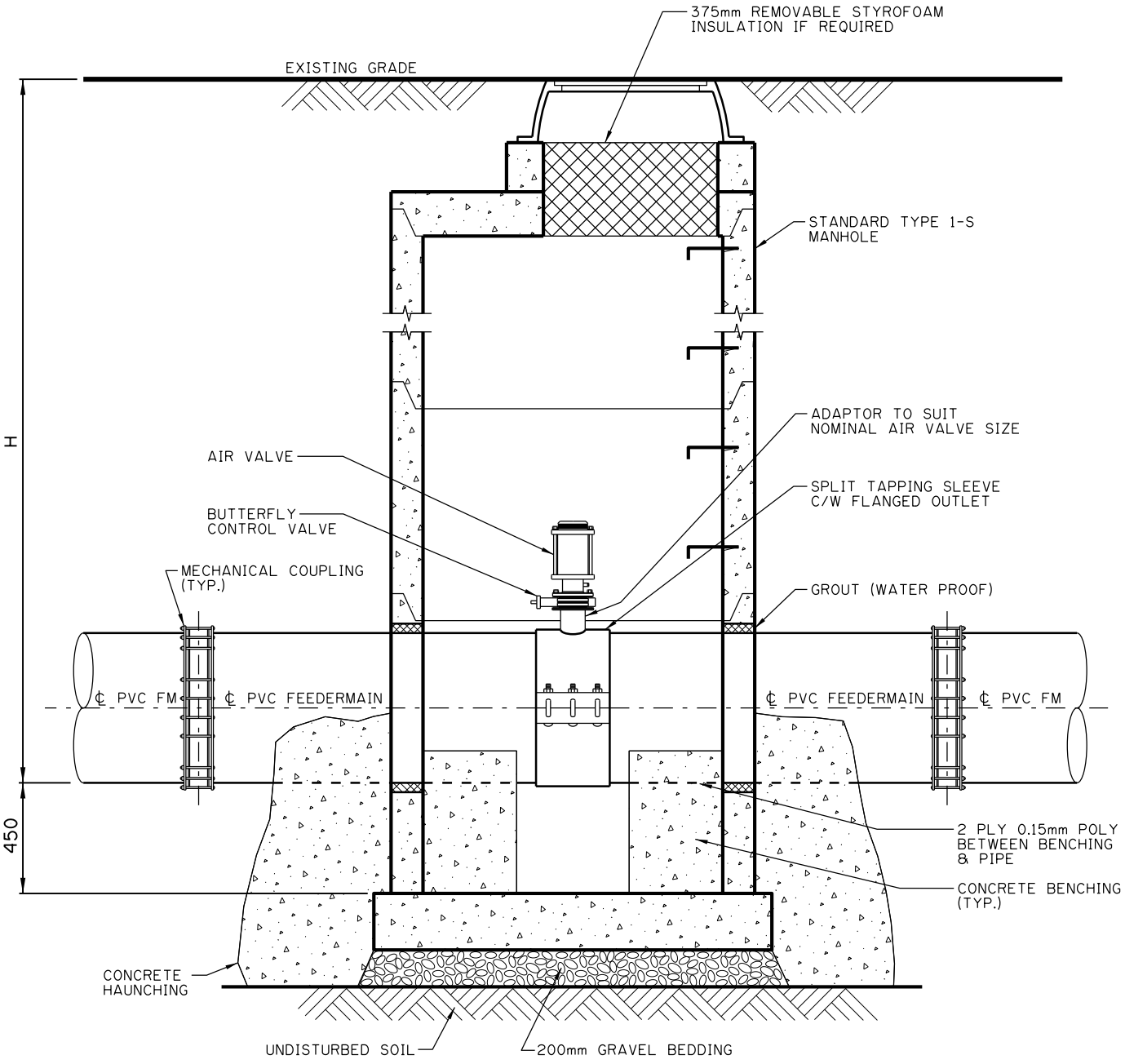
FEEDERMAIN CONSTRUCTION

DRAIN MANHOLE FOR CONCRETE & STEEL PIPE (ANY DIAMETER)

Sheet: 5

File Number: 501.0005.001

ISC: Unrestricted



NOTE:

1. MAINTAIN 500mm SPACE BETWEEN TOP OF AIR VALVES AND CHAMBER CEILINGS.

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

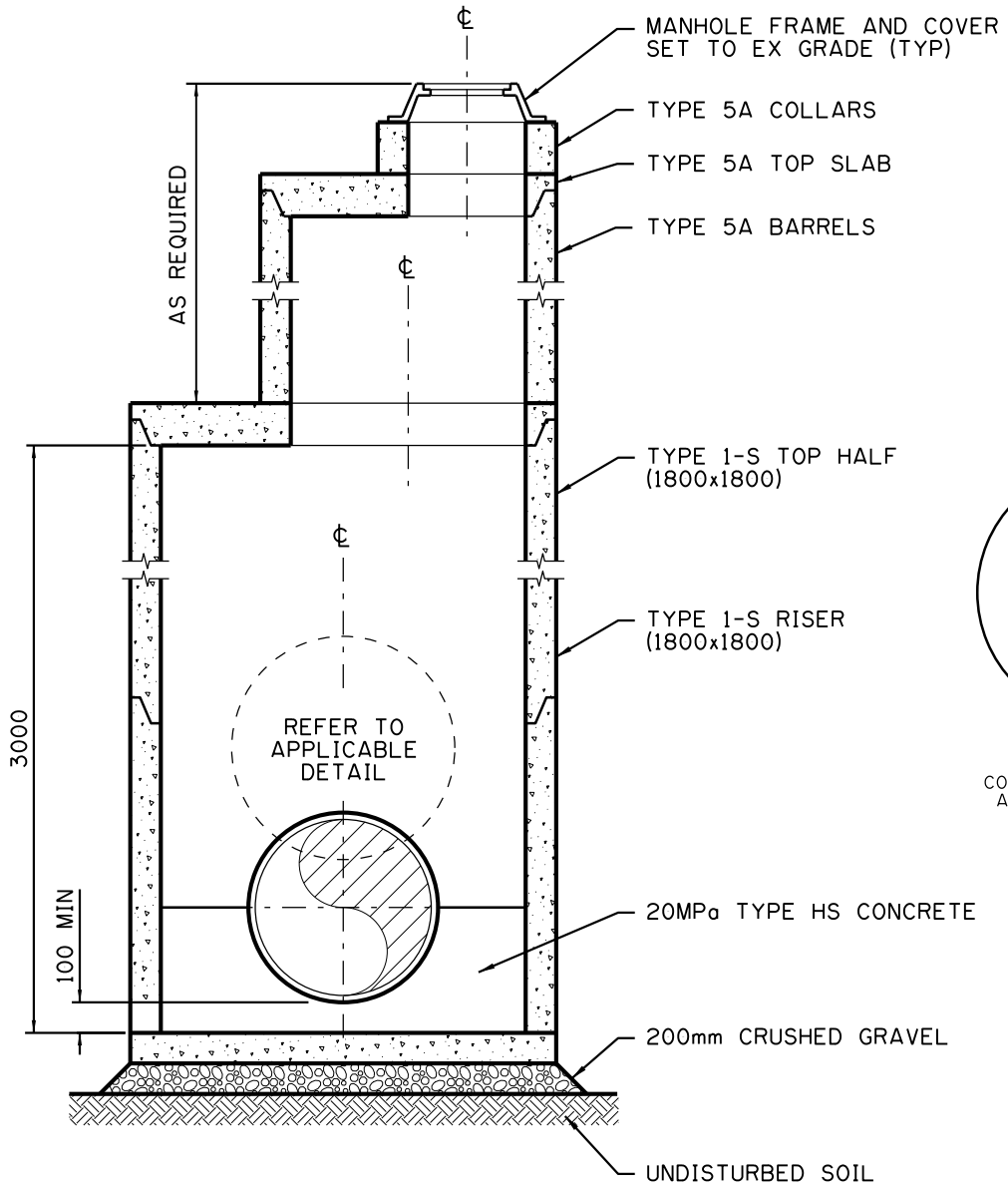
Date: 2019/02/25
Scale: N.T.S.
Approved by: Russ Dueck for The City of Calgary

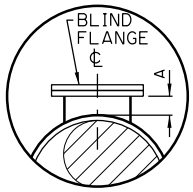
FEEDERMAIN CONSTRUCTION

AIR VALVE MANHOLE FOR PVC PIPE

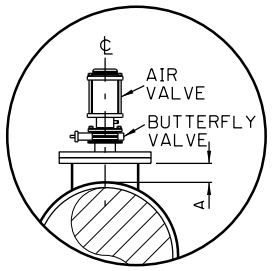
Sheet: 6
File Number: 501.0006.001

ISC: Unrestricted





DETAIL 'A'
ACCESS MANHOLE



DETAIL 'B'
COMBINATION AIR VALVE AND ACCESS MANHOLE

NOTES:

1. MANHOLE TO BE WATERPROOFED USING MOUNTAIN WATERPROOFING DRYVAULT SYSTEM.
2. AIR VALVE AND BUTTERFLY CONTROL VALVES TO BE SUPPLIED BY THE CONTRACTOR INCLUDING NUTS. BOLTS AND GASKETS.
3. ALL 600mm FLANGED OUTLETS C/W BLIND HUB FLANGES WILL BE SUPPLIED BY PIPE SUPPLIER.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL OTHER MATERIALS REQUIRED FOR COMPLETE CONSTRUCTION OF THE MANHOLES.
5. ALL WORK SHALL BE IN ACCORDANCE WITH CITY OF CALGARY STANDARD SPECIFICATIONS WATERWORKS CONSTRUCTION. (CURRENT EDITION).
6. LENGTH 'A' BETWEEN PIPE AND FLANGE TO BE AS PER AWWA C208 AND DESIGNED AS PER AWWA M11.
7. MAINTAIN 500mm SPACE BETWEEN TOP OF AIR VALVE AND CHAMBER CEILINGS.

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

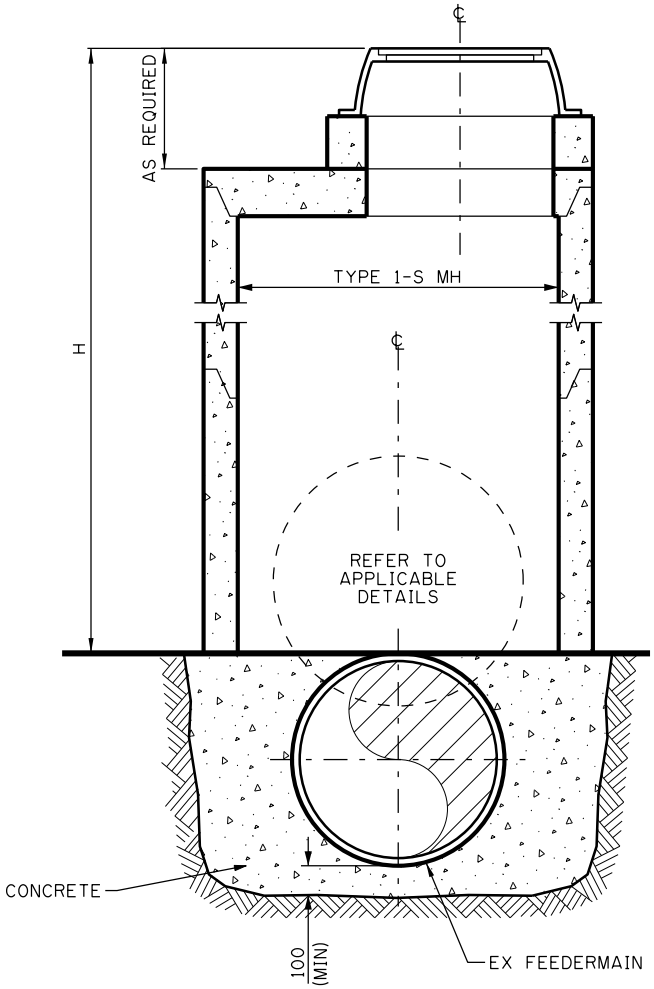
Date: 2018/12/11
Scale: N.T.S
Approved by: Russ Dueck for The City of Calgary

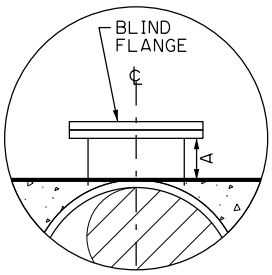
FEEDERMAIN CONSTRUCTION

ACCESS AND/OR AIR VALVE MANHOLE FOR CONCRETE/STEEL

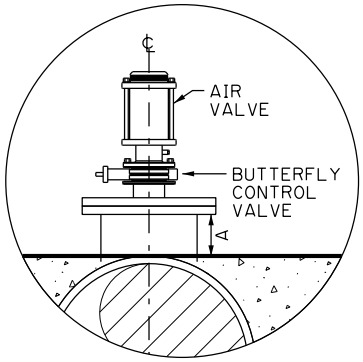
Sheet: 7
File Number: 501.0007.001

ISC: Unrestricted





DETAIL 'A'
ACCESS MANHOLE



DETAIL 'B'
COMBINATION AIR VALVE
AND ACCESS MANHOLE

NOTES:

1. MANHOLE TO BE WATERTIGHT.
2. LENGTH 'A' BETWEEN PIPE AND FLANGE TO BE AS PER AWWA C208 AND DESIGNED AS PER AWWA M11.
3. CROWN BOTTOM BARREL TO MINIMIZE POINT LOADING ON PIPE.

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

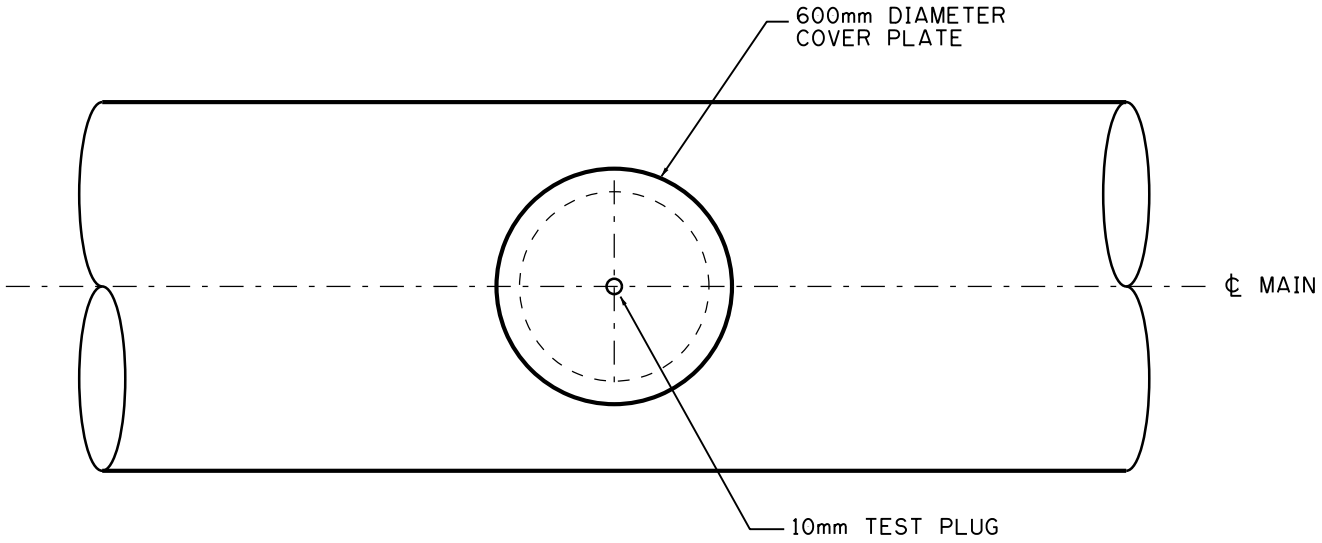
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

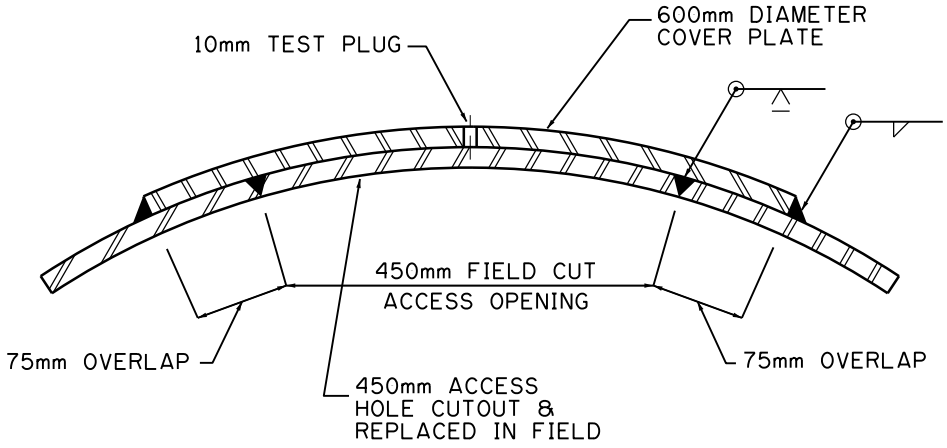
RETROFIT ONLY-
ACCESS AND/OR AIR VALVE
MANHOLE FOR CONCRETE/STEEL

Sheet: 8
File Number: 501.0008.001

ISC: Unrestricted



PLAN



SECTION

NOTE:

1. COVER PLATE 600mm O.D. FORMED TO FIT PIPE C/W 10mm TEST PLUG.

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

Date: 2018/12/11
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

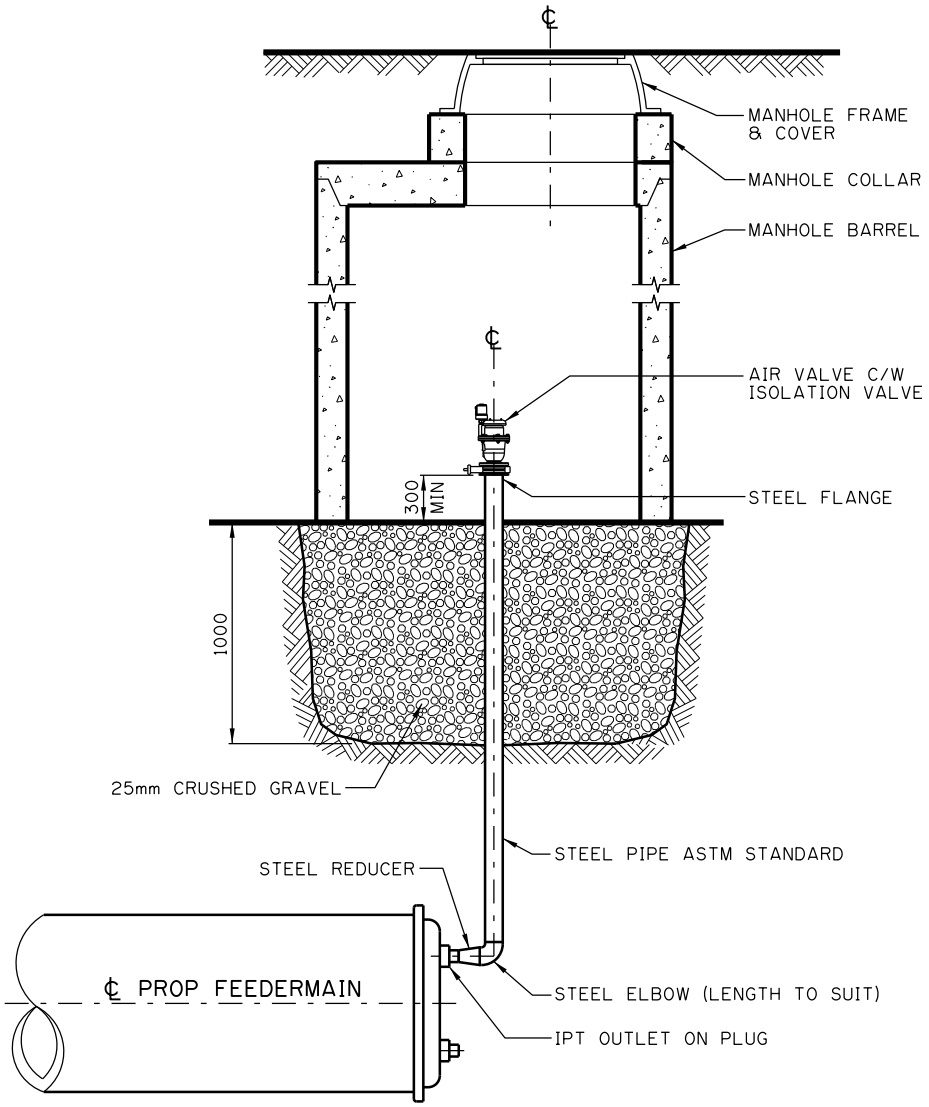
FEEDERMAIN CONSTRUCTION

TEMPORARY ACCESS OPENING
FOR STEEL PIPE ONLY

Sheet: 9

File Number: 501.0009.001

ISC: Unrestricted



NOTE:

1. THRUST BLOCK DETAILS TO BE DETERMINED BY DESIGN ENGINEER

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

Date: 2018/12/18
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

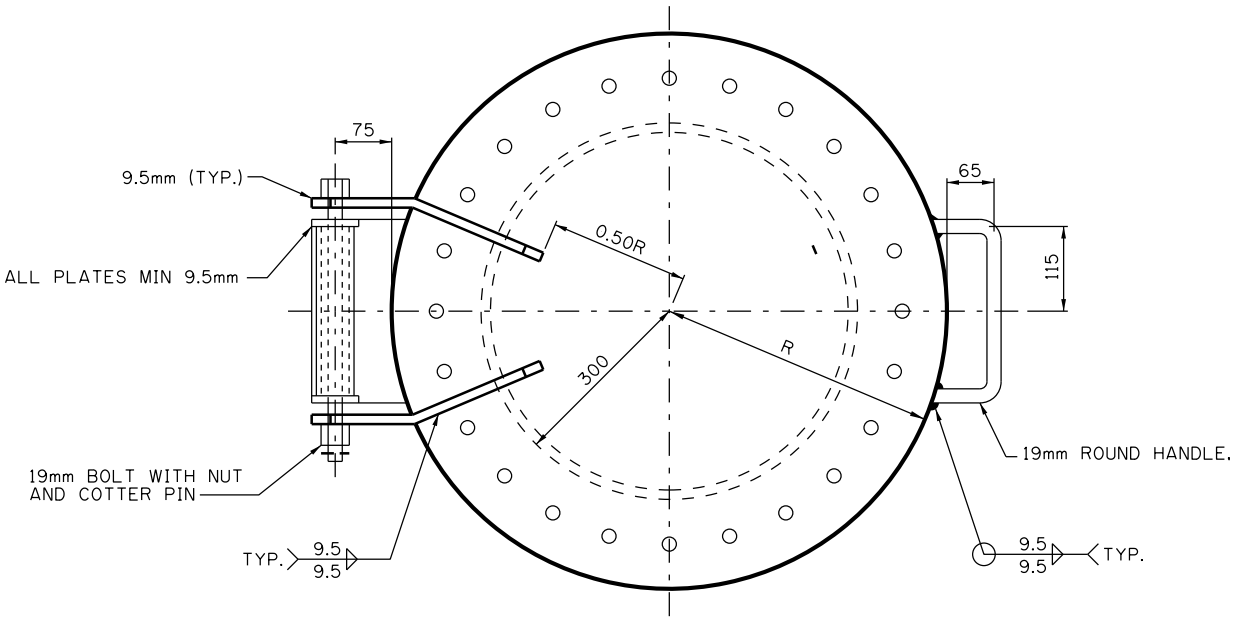
FEEDERMAIN CONSTRUCTION

TEMPORARY AIR VALVE

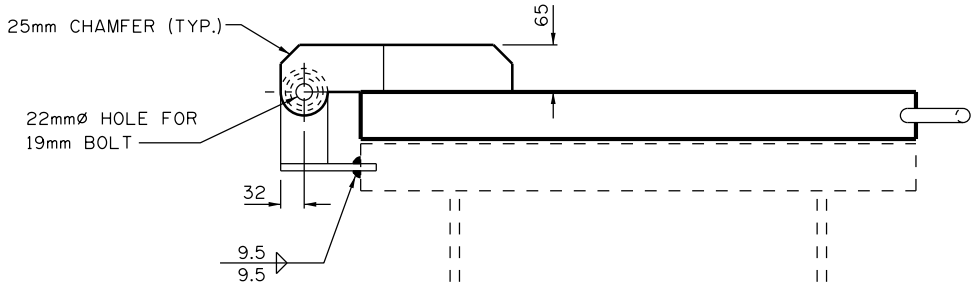
Sheet: 10

File Number: 501.0010.001

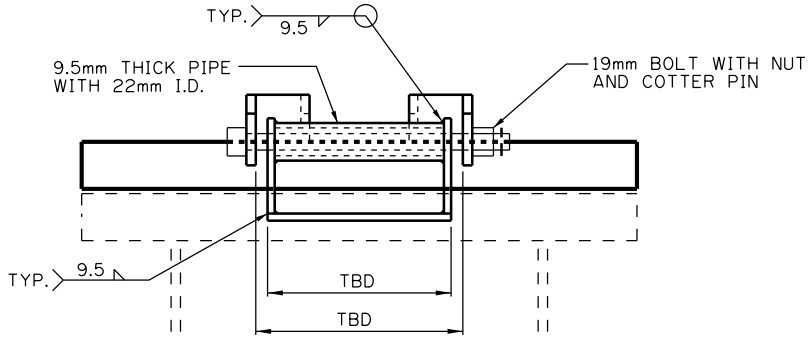
ISC: Unrestricted



PLAN



SIDE ELEVATION



NOTE:
TBD=TO BE DETERMINED BY ENGINEER

FRONT ELEVATION

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

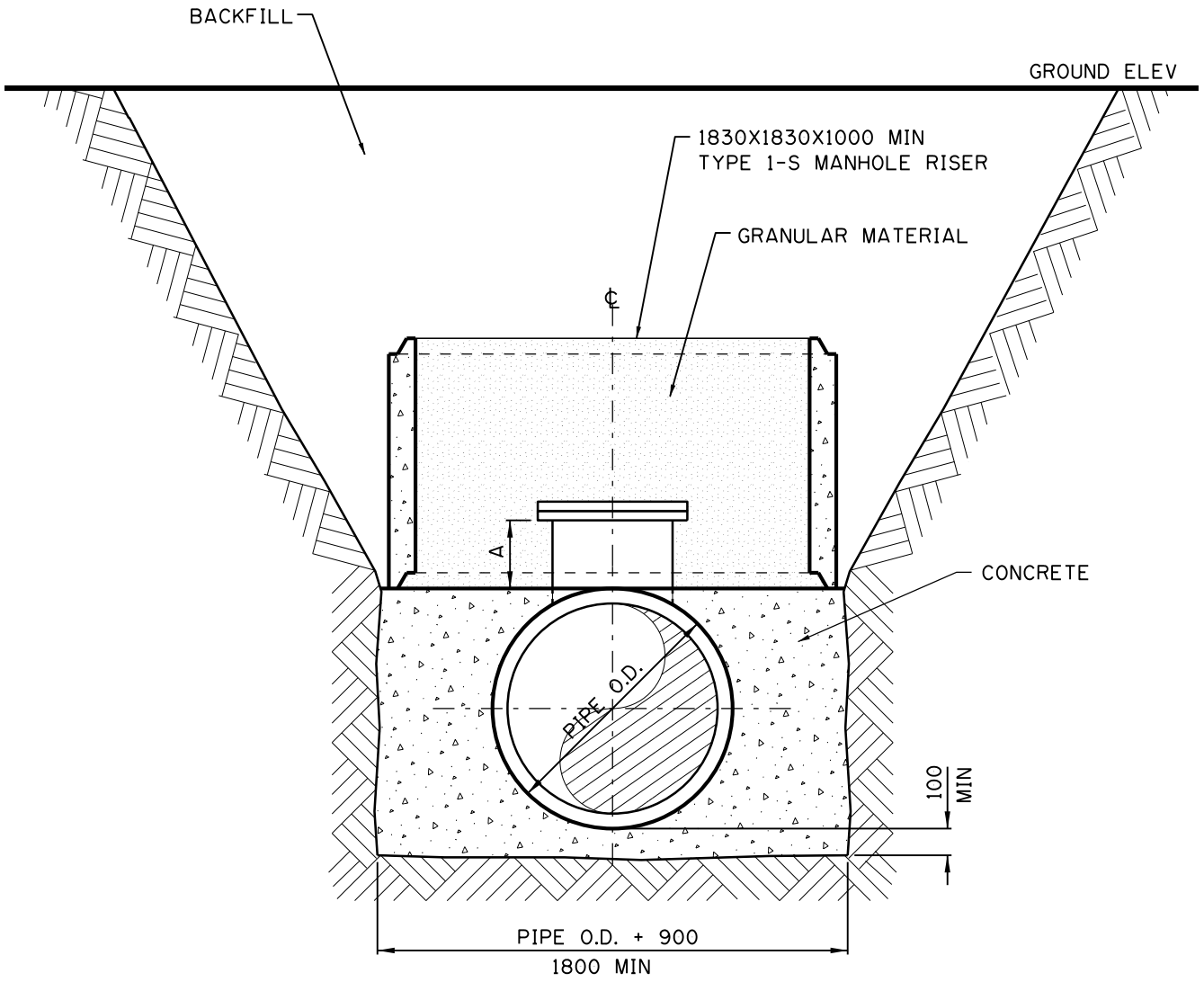
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

HINGED MANHOLE COVER

Sheet: 11
File Number: 501.0011.001

ISC: Unrestricted



NOTES:

1. 600mm FLANGED ACCESS OUTLETS ON FEEDERMANS USED FOR ACCESS DURING CONSTRUCTION ONLY SHALL BE BURIED PER DETAIL THIS SHEET.
2. CROWN BOTTOM BARREL TO MINIMIZE POINT LOADING ON PIPE.
3. LENGTH 'A' BETWEEN PIPE AND FLANGE TO BE AS PER AWWA C208 AND DESIGNED AS PER AWWA M11.

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

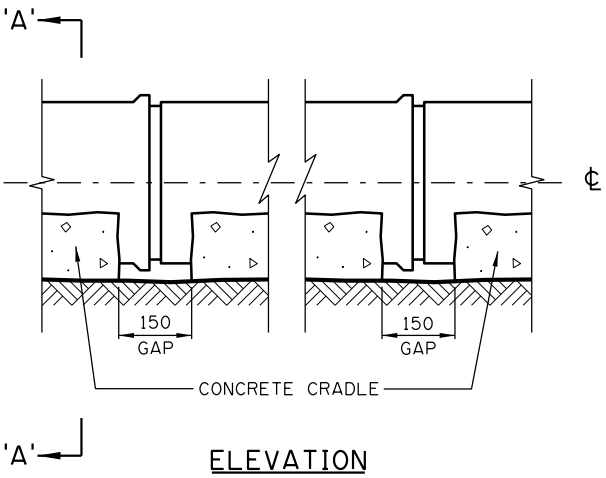
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck for The City of Calgary

FEEDERMAIN CONSTRUCTION

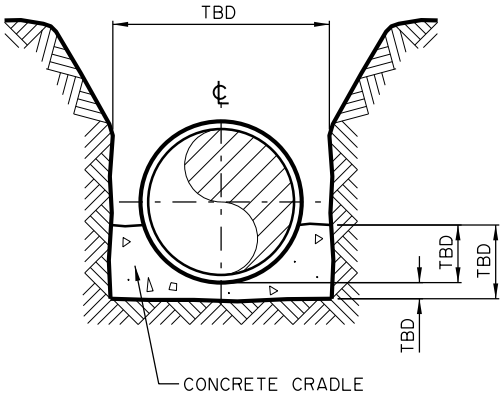
BURIED ACCESS MANHOLE

Sheet: 12
File Number: 501.0012.001

ISC: Unrestricted



ELEVATION

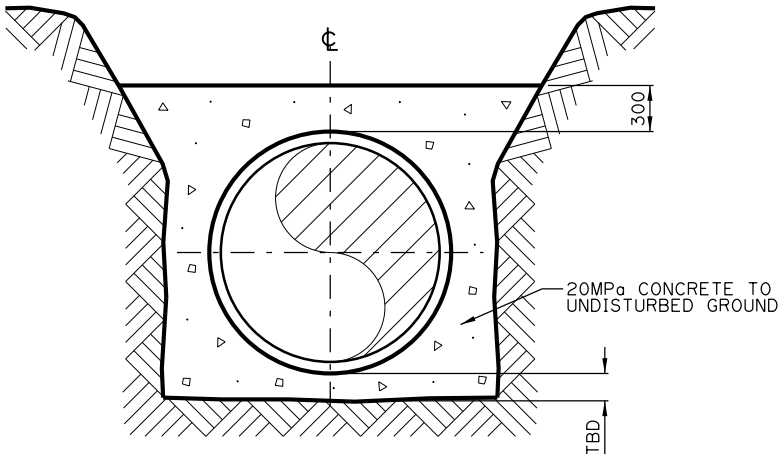


SECTION 'A-A'

NOTES:

1. FOR CLASS 'A' BEDDING PROVIDE A 150mm GAP IN THE CONCRETE BEDDING FOR A FLEXIBLE JOINT UNLESS OTHERWISE SPECIFIED. (FIELD WELD TIED JOINTS DO NOT REQUIRE THE 150mm GAP)
2. CONCRETE STRENGTH 20MPa
3. DIMENSION TO BE DETERMINED BY ENGINEER (TBD)

TYPICAL CONCRETE CLASS 'A' BEDDING



NOTES:

1. PIPE JOINTS SHALL NOT BE ENCASED IN CONCRETE.
2. DIMENSION TO BE DETERMINED BY ENGINEER (TBD)

TYPICAL CONCRETE ENCASEMENT

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

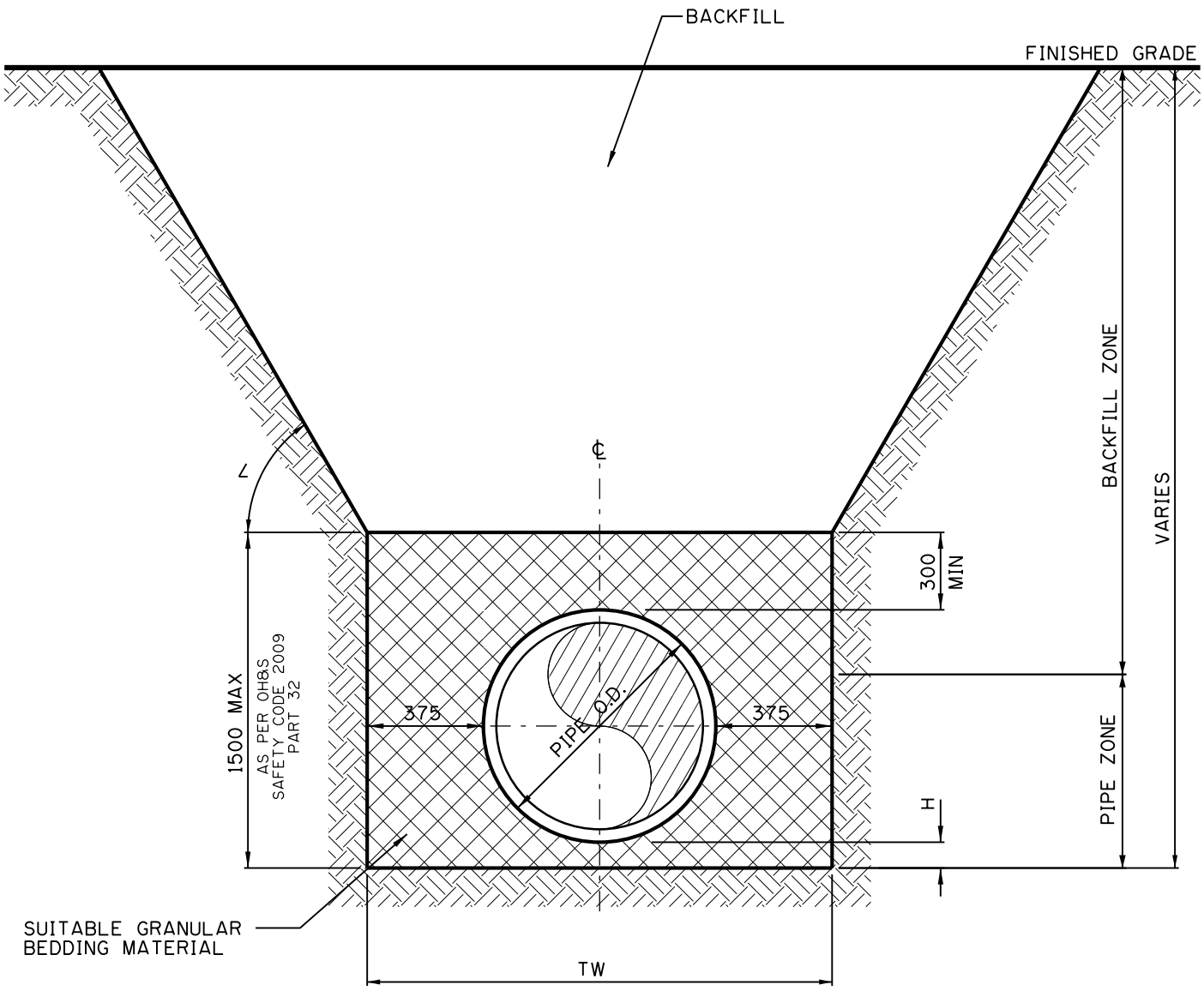
Date: 2018/12/10
Scale: N.T.S
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

CLASS 'A' BEDDING & CONCRETE ENCASEMENT

Sheet: 13
File Number: 501.013.001

ISC: Unrestricted



NOTES:

1. TW = STANDARD TRENCH WIDTH = O.D. + 750mm UNLESS SPECIFIED OTHERWISE
   H = 75mm FOR 675mm AND SMALLER PIPE
   H = 100mm FOR 750mm - 1500mm PIPE
   H = 150mm FOR 1650mm AND LARGER PIPE.

   ∠ =45° FOR HARD & COMPACT SOIL
   ∠ =30° FOR LIKELY TO CRACK OR CRUMBLE SOIL
   OR AS PER OH&S SAFETY CODE (CURRENT EDITION)

2. SUITABLE GRANULAR BEDDING MATERIAL AS PER SEC. 504.03.05 STANDARD SPECIFICATIONS WATERWORKS CONSTRUCTION (CURRENT EDITION).

3. STANDARD TRENCH WIDTH AS PER SEC. 504.01.06 STANDARD SPECIFICATIONS WATERWORKS CONSTRUCTION (CURRENT EDITION).

4. DIMENSIONS SHALL BE DETERMINED BY ENGINEER

5. BENCHING MAY BE USED AS AN ALTERNATE TO CUTTING BACK EXCEPT IN SOFT, SANDY OR LOOSE SOIL OR AS PER OH&S SAFETY CODE (CURRENT EDITION)

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

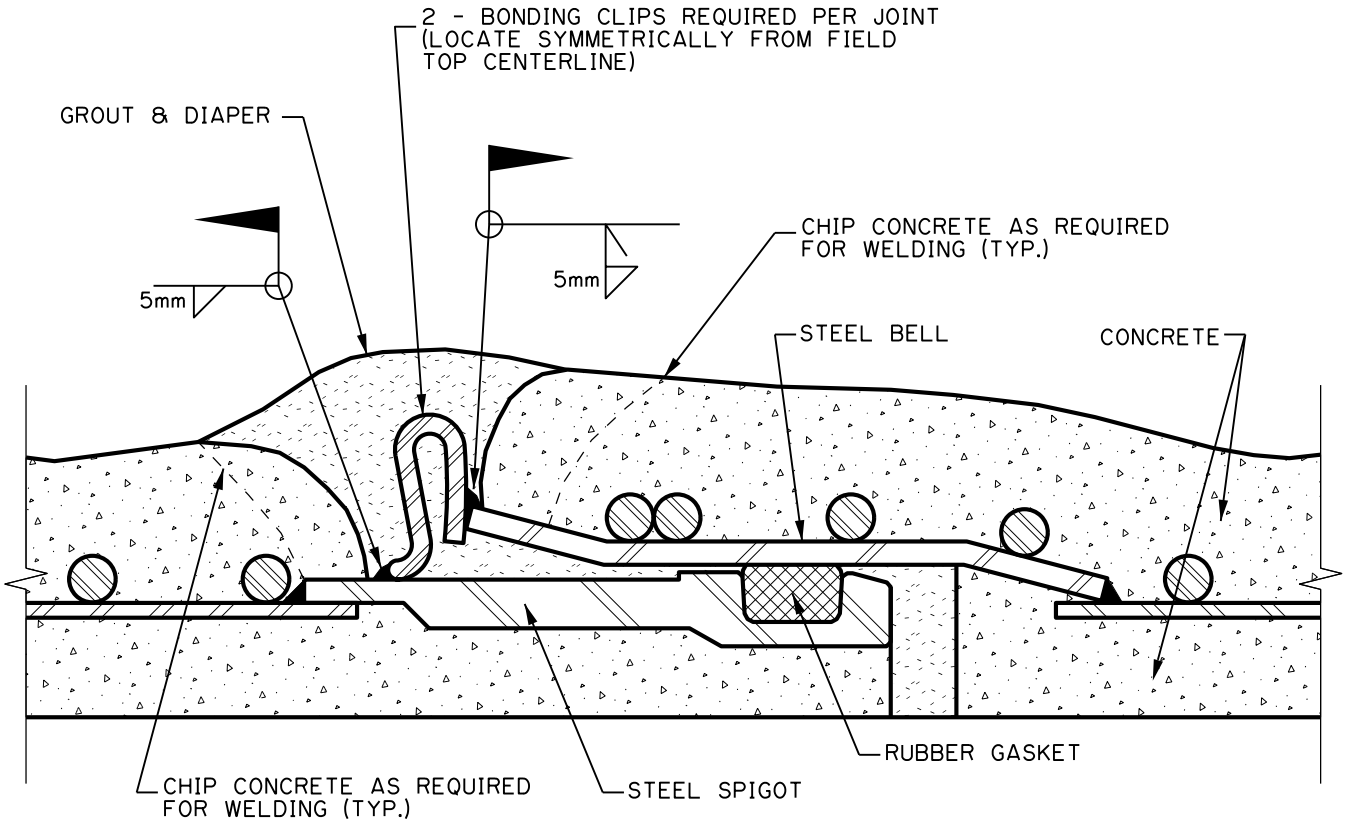
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

CLASS 'B' BEDDING & STANDARD TRENCH

Sheet: 14
File Number: 501.0014.001

ISC: Unrestricted



DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

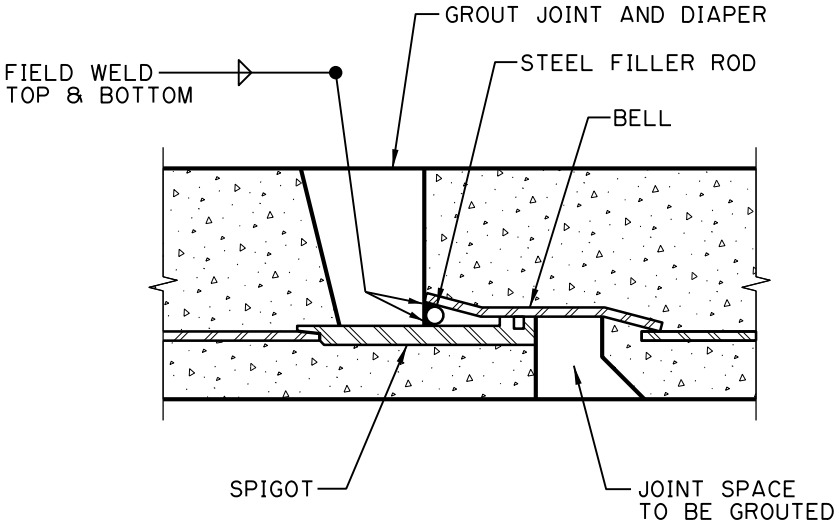
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

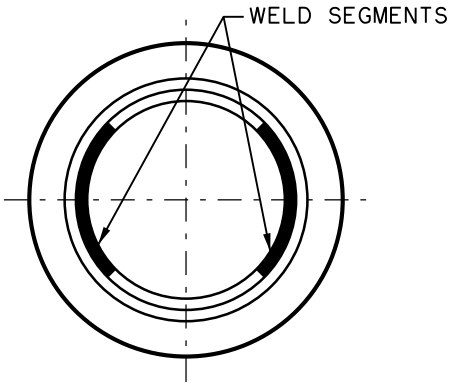
FEEDERMAIN CONSTRUCTION

BONDING CLIPS/CONTINUITY
FOR CONCRETE PIPE
(C301 & C303)

Sheet: 15
File Number: 501.0015.001

ISC: Unrestricted





SYMMETRICAL WELDING ARRANGEMENT

OPERATIONS TO BE PERFORMED IN FIELD:

1. TOTAL WELDED LENGTH IS DEFINED AS: THE TOTAL LENGTH OF STEEL FILLER ROD WELDED IN PLACE AS SHOWN ABOVE.
2. MAKE JOINT PUSHING SPIGOT HOME. TACK WELD FILLER ROD TO BELL.
3. WELD FILLER ROD TO BELL & SPIGOT. STAGGERING WELD IN ORDER TO MINIMIZE HEAT CONCENTRATION. THE MAXIMUM LENGTH OF ANY WELD MADE WITHOUT SKIPPING SHOULD BE 50mm LONG.
4. WELDS MUST BE PLACED SYMMETRICALLY ABOUT THE VERTICAL AXIS AND SHALL BE UNIFORM IN SIZE AND SPACING.
5. USE FLEET WELD 35 OR 5P ELECTRODE 4mm MAX. DIA; SET MACHINE AT ±125 AMPS; BUILD UP STRINGER PASSES TO THICKNESS OF BELL. ALLOW TO COOL BETWEEN PASSES.
6. MINIMUM TOTAL WELDED LENGTH FOR A TIED JOINT SHALL BE 400mm.
7. MAXIMUM WELDED LENGTH TO BE DETERMINED BY ENGINEER. REFER TO PIPE FABRICATION DRAWINGS.

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

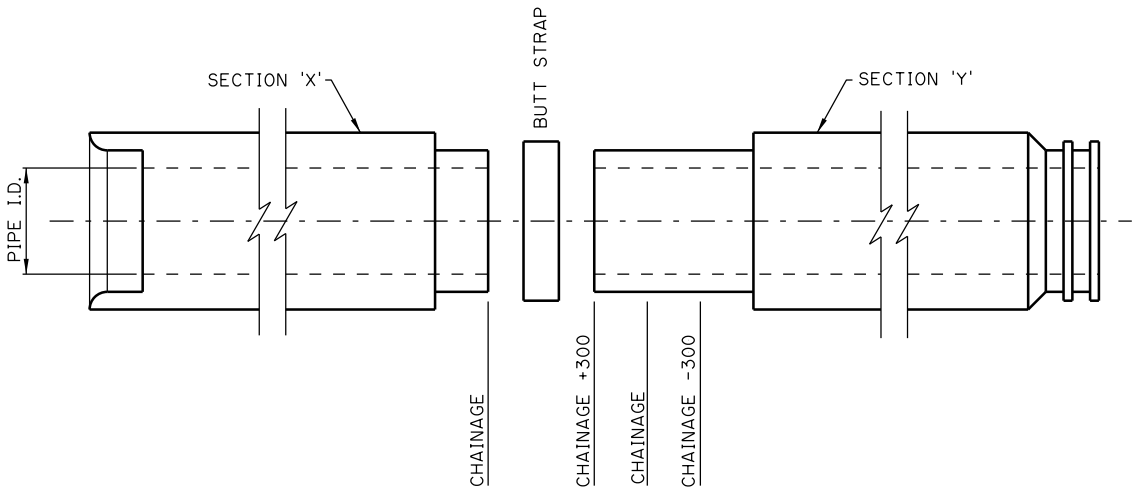
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

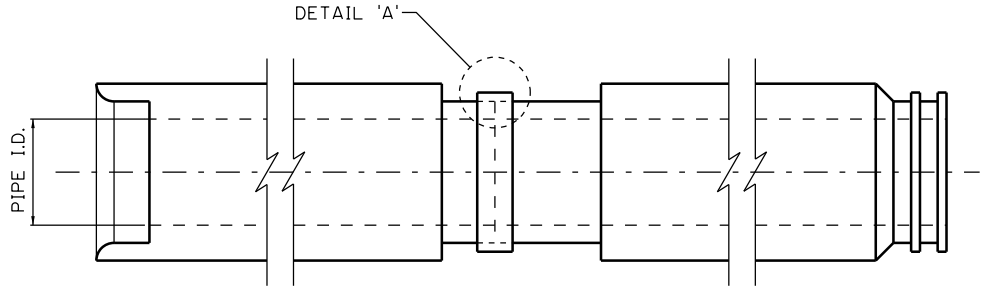
FEEDERMAIN CONSTRUCTION

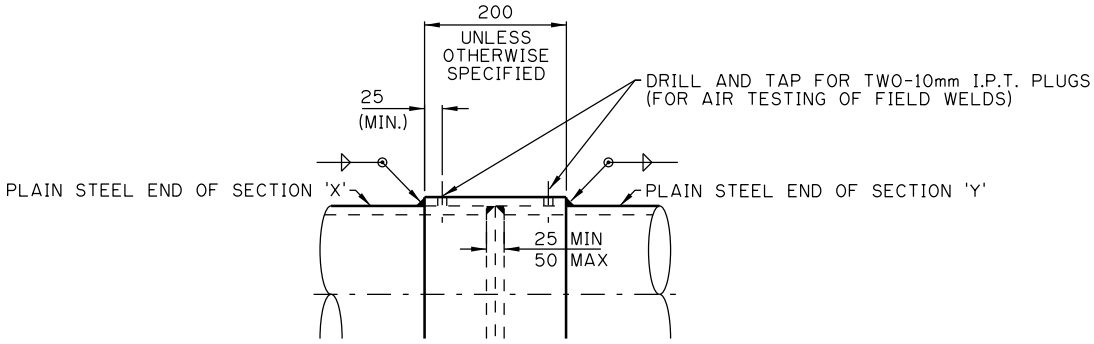
TIED JOINT WELDING FOR CONCRETE PIPE (C301 & C303)

Sheet: 16
File Number: 501.0016.001

ISC: Unrestricted







DETAIL 'A'

NOTES:

1. TWO PLAIN (UNCOATED) STEEL END SECTIONS ARE TO BE SUPPLIED C/W BUTT STRAP (DRILLED AND TAPPED FOR TWO-10mm I.P.T. PLUGS) AS SHOWN
2. BUTT STRAP MAY BE SUPPLIED IN TWO (2) HALF SECTIONS
3. BUTT STRAP IS TO BE TACK WELDED (TO PLAIN STEEL END OF SECTION 'X') FOR SHIPPING
4. PIPE MANUFACTURER SHALL NOT USE WIRE MESH WITHIN THE CEMENT MORTOR LINING OF THE FIELD TRIM PORTION (PLAIN STEEL END OF SECTION 'Y')

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

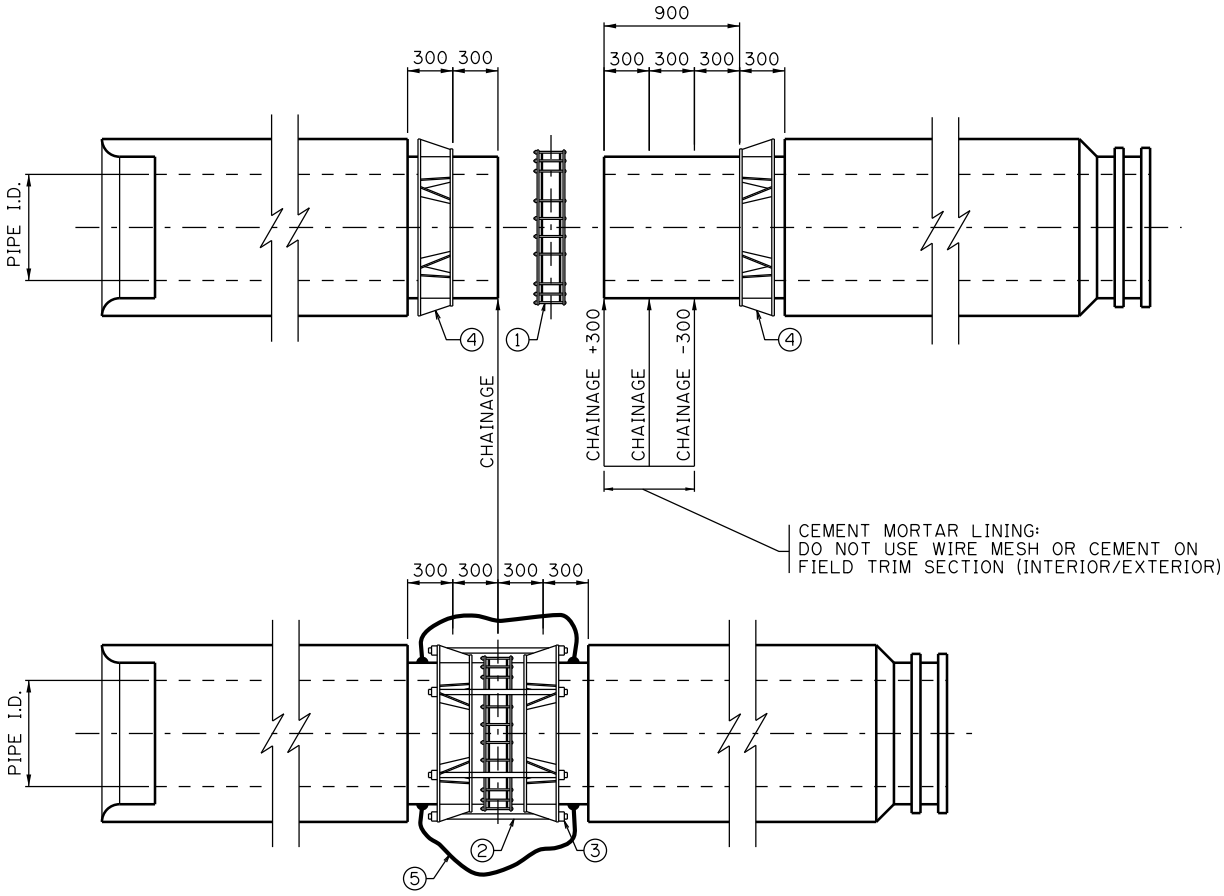
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

CONCRETE PIPE
FIELD TRIM
(BUTT STRAP)

Sheet: 17
File Number: 501.0017.001

ISC: Unrestricted



SCHEDULE OF MATERIALS		
ITEM No.	QUANTITY	DESCRIPTION
1	1	MECHANICAL COUPLING
2	4	ZINC DICHROMATE THREADED ROD AS REQUIRED
3	16	AS REQUIRED ZINC DICHROMATE NUTS AND TEFLON WASHERS AS REQUIRED ON EACH SIDE OF HARNESS
4	1	AWWA M-11 RESTRAINER WHERE REQUIRED FOR THRUST RESTRAINT
5	2	BONDING WIRES ARE TO BE 180° APART

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

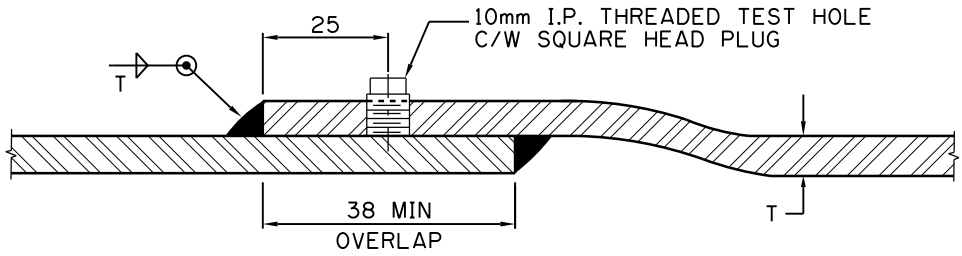
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

CONCRETE PIPE
FIELD TRIM
(MECHANICAL JOINT)

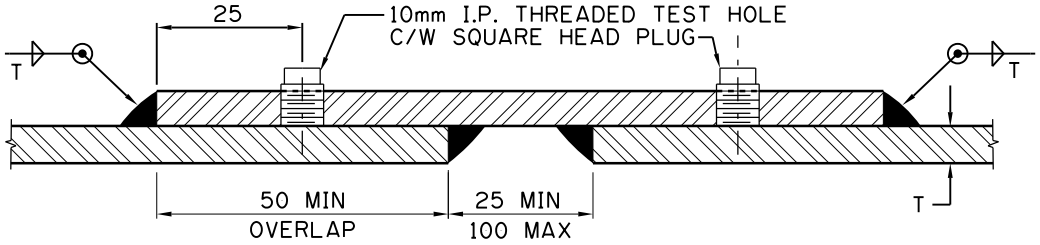
Sheet: 18
File Number: 501.0018.001

ISC: Unrestricted



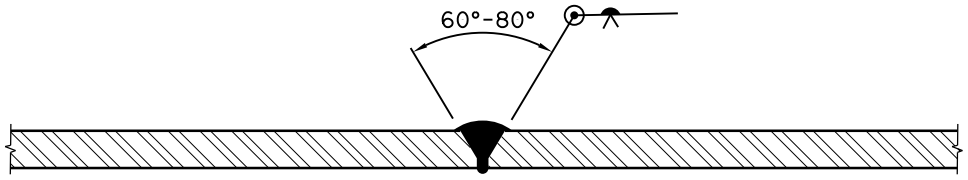
REF. SPEC. -A.W.W.A. C206-88
-A.W.W.A. C200-86
(SEC. 3.6.2.)

LAP JOINT



REF. SPEC. -A.W.W.A. C206-88
-A.W.W.A. C200-86
(SEC. 3.6.5.)

BUTT STRAP JOINT



REF. SPEC. -A.W.W.A. C206-88
-A.W.W.A. C200-86
(SEC. 3.6.4.)

BUTT JOINT

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

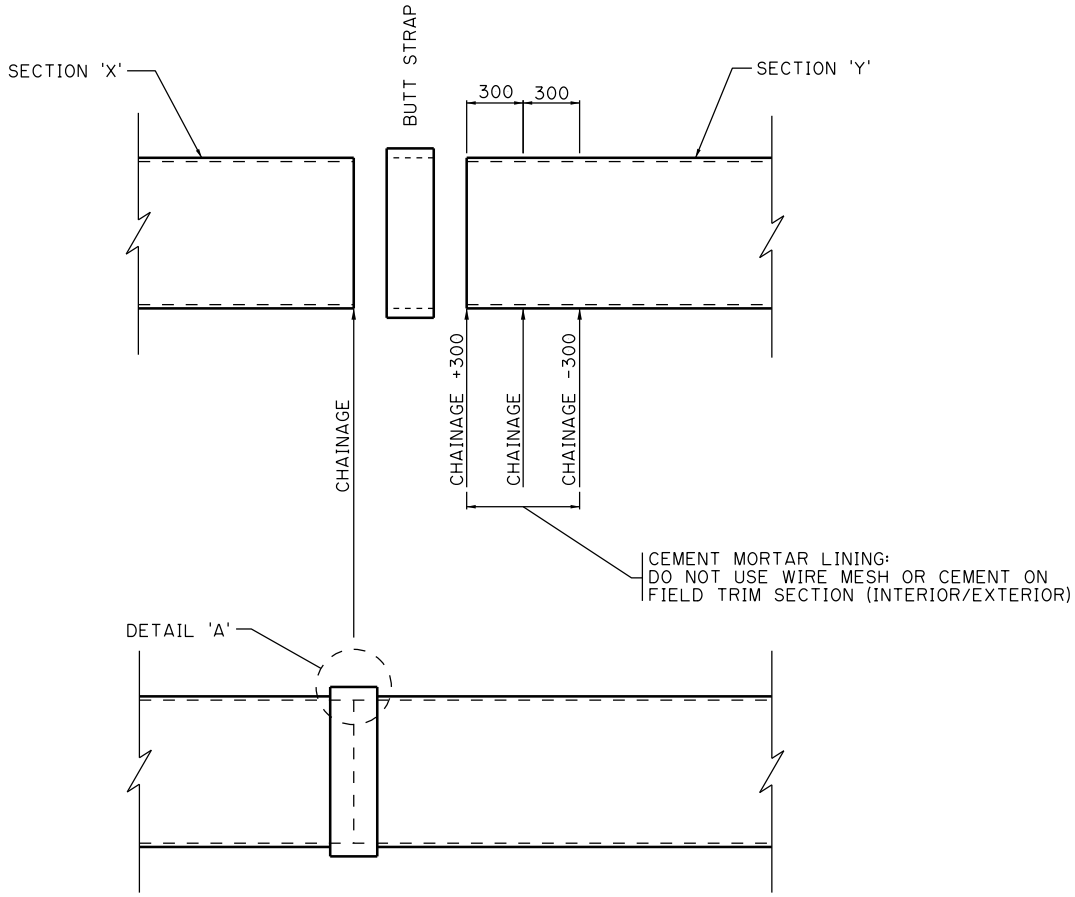
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

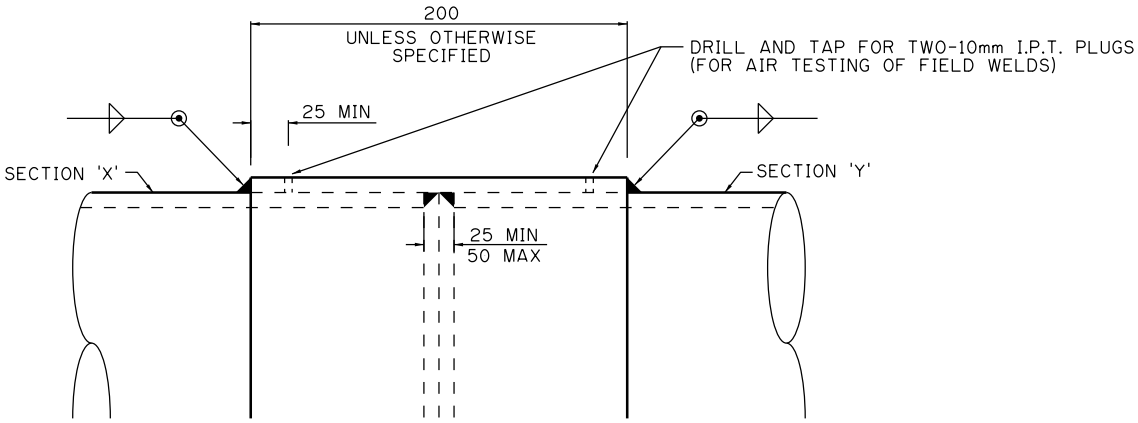
FEEDERMAIN CONSTRUCTION

WELDED JOINTS
FOR STEEL PIPE

Sheet: 19
File Number: 501.0019.001

ISC: Unrestricted





DETAIL 'A'

NOTES:

1. TWO PLAIN (UNCOATED) STEEL END SECTIONS ARE TO BE SUPPLIED C/W BUTT STRAP (DRILLED AND TAPPED FOR TWO-10mm I.P.T. PLUGS) AS SHOWN
2. BUTT STRAP MAY BE SUPPLIED IN TWO (2) HALF SECTIONS
3. BUTT STRAP IS TO BE TACK WELDED (TO PLAIN STEEL END OF SECTION 'X') FOR SHIPPING

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

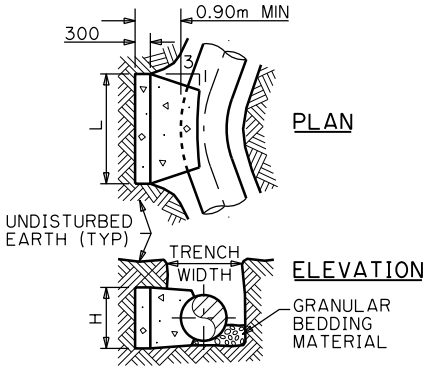
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

STEEL PIPE
FIELD TRIM
(BUTT STRAP)

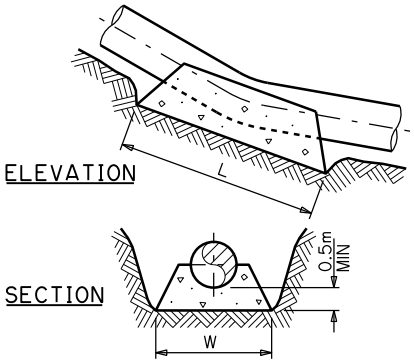
Sheet: 20
File Number: 501.0020.001

ISC: Unrestricted



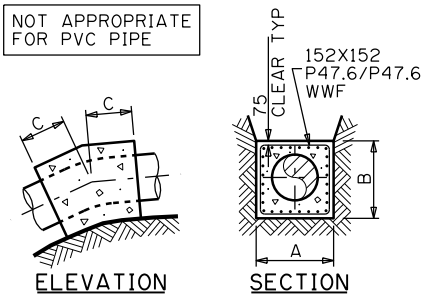
HORIZONTAL THRUST BLOCK FOR HORIZONTAL BENDS (H.B.L., H.B.R..)

DETAIL A



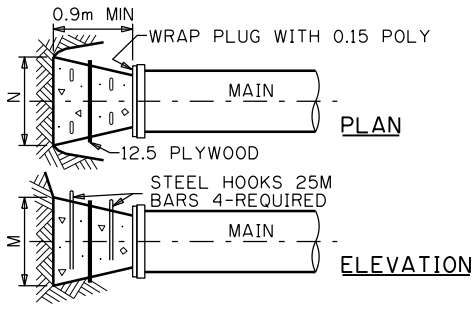
VERTICAL THRUST BLOCK FOR VERTICAL BENDS UP (V.B.U.)

DETAIL B



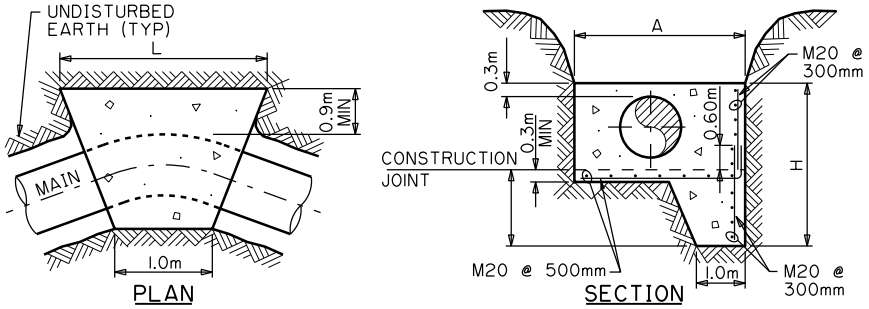
VERTICAL THRUST BLOCK FOR VERTICAL BENDS DOWN (V.B.D.)

DETAIL C



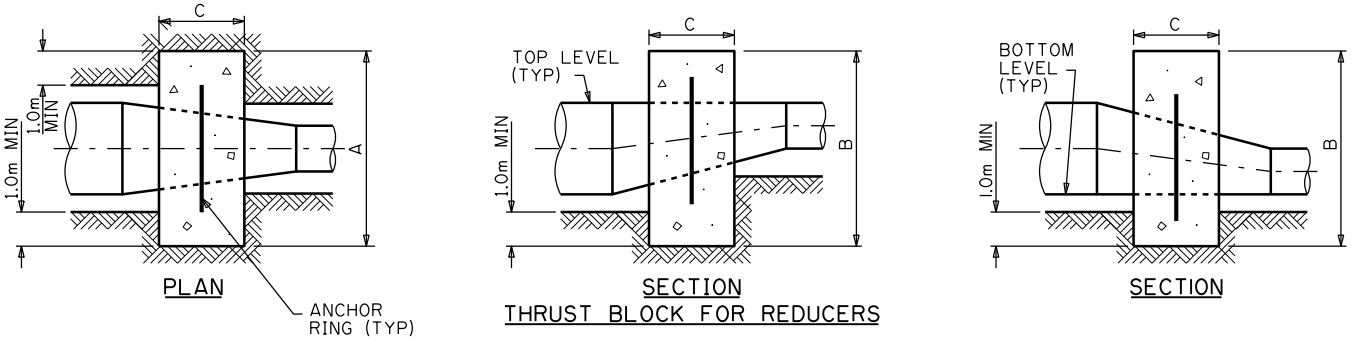
THRUST BLOCK FOR TEMPORARY PLUG

DETAIL D



THRUST BLOCK FOR TEE & BENDS

DETAIL E



DETAIL F

NOTES:

1. FOR HORIZONTAL BENDS (H.B.) AND VERTICAL BEND UP (V.B.U.) THE ALLOWABLE SOIL BEARING CAPACITY IS 96 kPa MIN
2. FOR VERTICAL BEND DOWN (V.B.D.) THE DEAD WEIGHT OF THE CONCRETE BLOCK IS 2373 kg/m^3.
3. ALL CONCRETE FOR SUB-SURFACE CONSTRUCTION SHALL BE SULPHATE RESISTANT 20 MPa AT 28 DAYS STRENGTH.
4. ALL WORK SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS & DESIGN GUIDELINES POTABLE WATER FEEDERMAIN CONSTRUCTION (CURRENT EDITION).

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

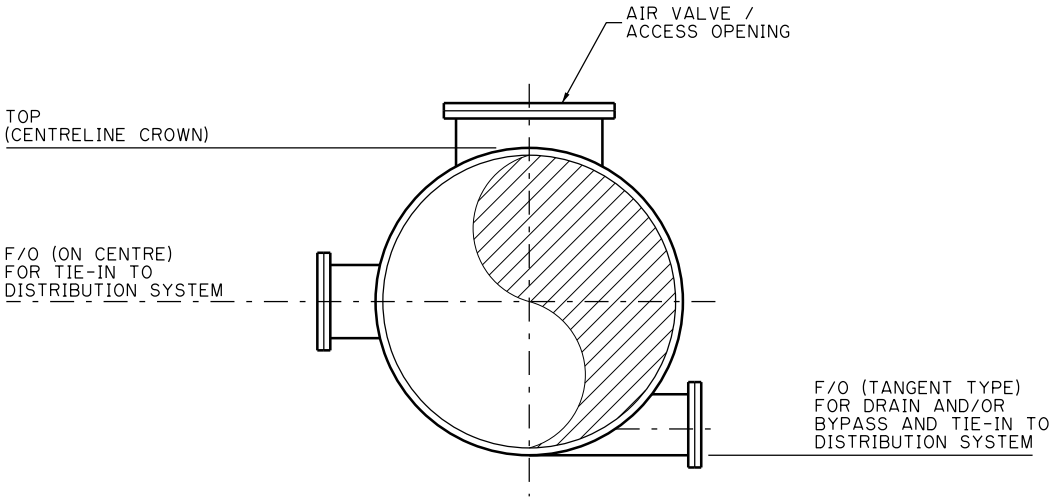
Date: 2018/12/18
Scale: N.T.S.
Approved by: Russ Dueck for The City of Calgary

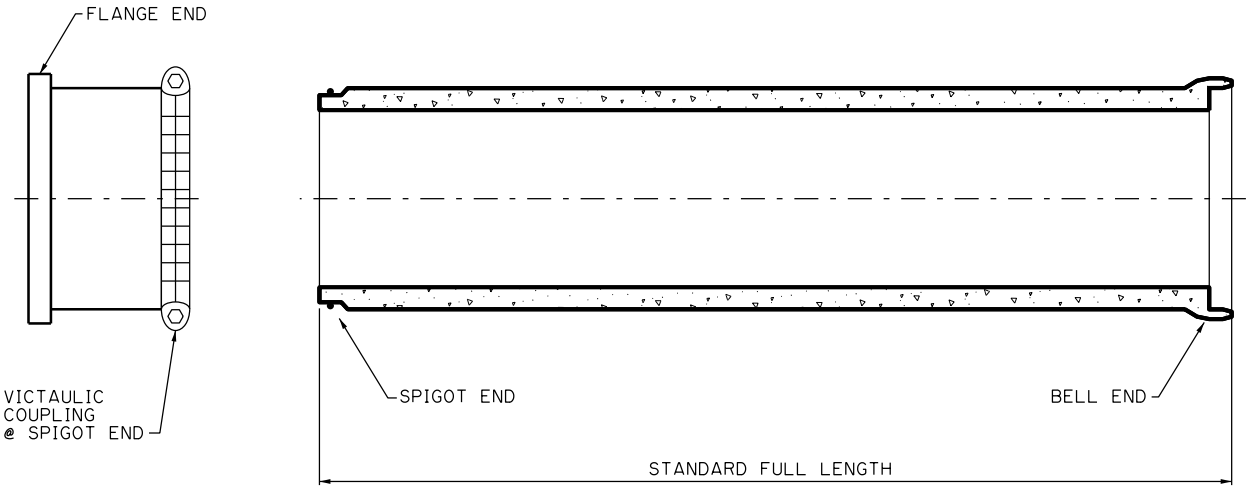
FEEDERMAIN CONSTRUCTION

TYPICAL THRUST BLOCK DETAILS

Sheet: 21
File Number: 501.0021.001

ISC: Unrestricted





DIMENSIONS ARE IN MILLIMETRES
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No.	Date	Revision	App'd

Date
2018/12/18

Scale
N.T.S.

Approved by
for The City of Calgary

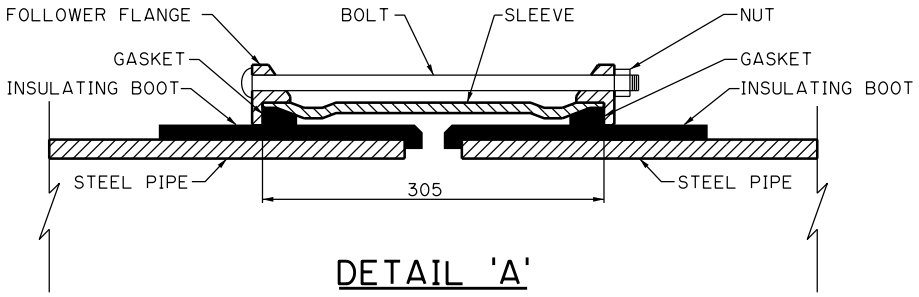
FEEDERMAIN CONSTRUCTION

PIPE NOMENCLATURE

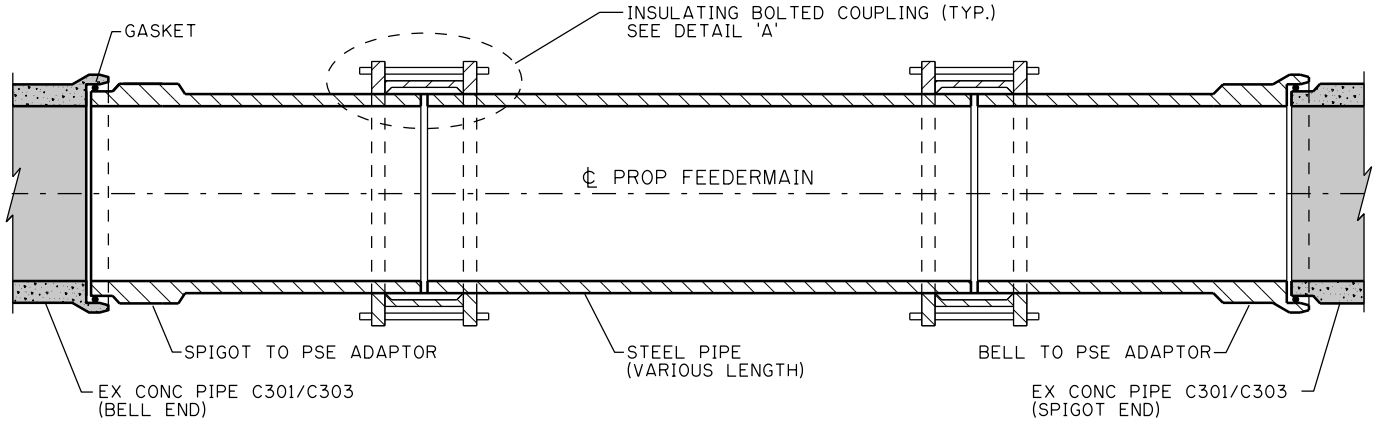
Sheet
22

File Number
501.0022.001

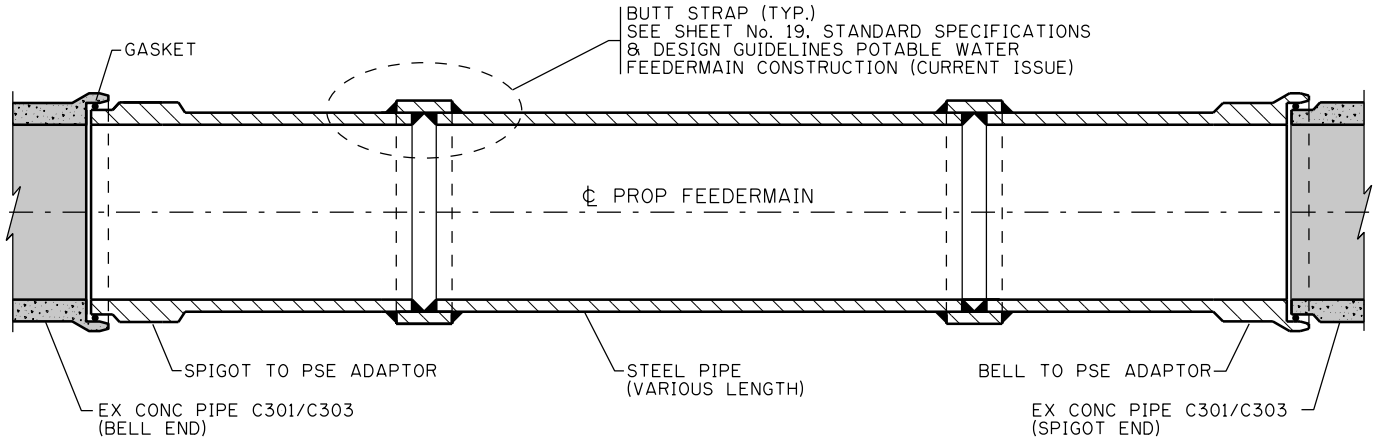
ISC: Unrestricted



DETAIL 'A'



OPTION 1: USING BOLTED COUPLINGS



OPTION 2: USING BUTT STRAPS

(AT ENGINEERS DISCRETION)

NOTES:

1. ALL STEEL PIPE AND FITTINGS TO BE COATED AND LINED PER STANDARD SPECIFICATIONS & DESIGN GUIDELINES POTABLE WATER FEEDERMAIN CONSTRUCTION (CURRENT EDITION).
2. INSTALL ANODES, PROFILE MASTIC, DENSO PASTE AND TAPE AS REQUIRED BY CORROSION TECHNICIANS.

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

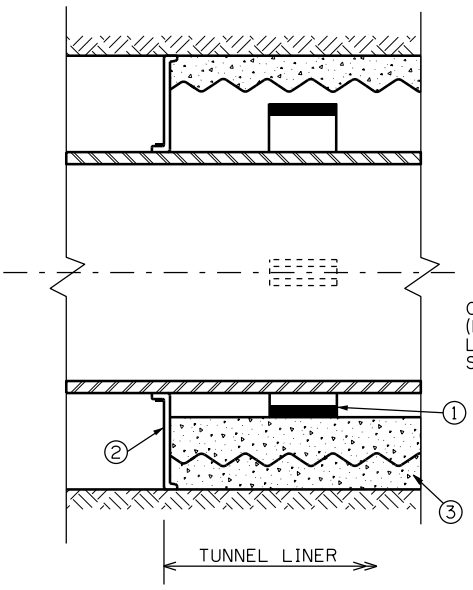
Date: 2018/12/18
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

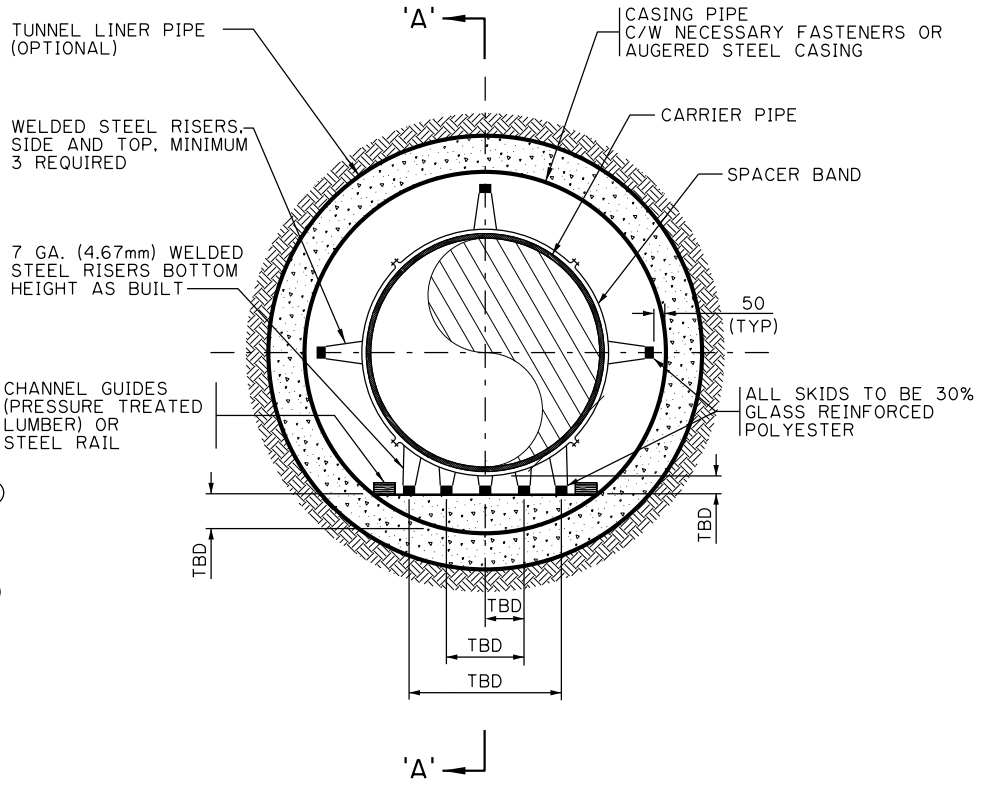
REPLACEMENT/REPAIR TO CONC PIPE (USING BUTT STRAPS AND/OR BOLTED COUPLINGS)

Sheet: 23
File Number: 501.0023.001

ISC: Unrestricted



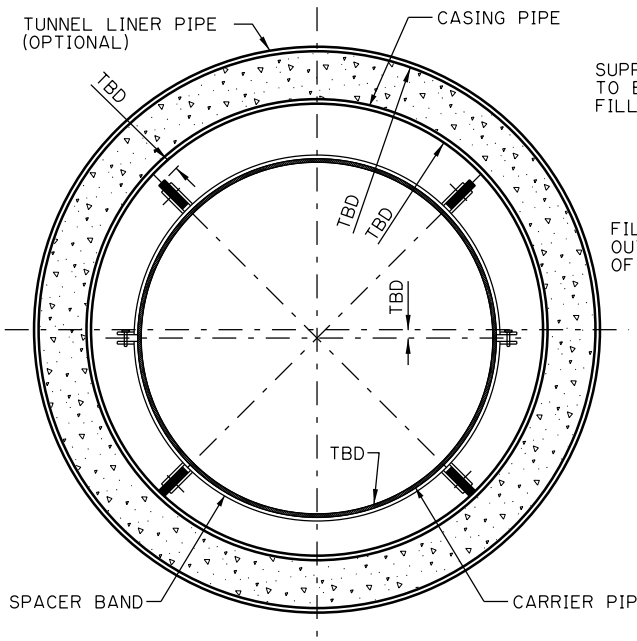
SECTION 'A-A'



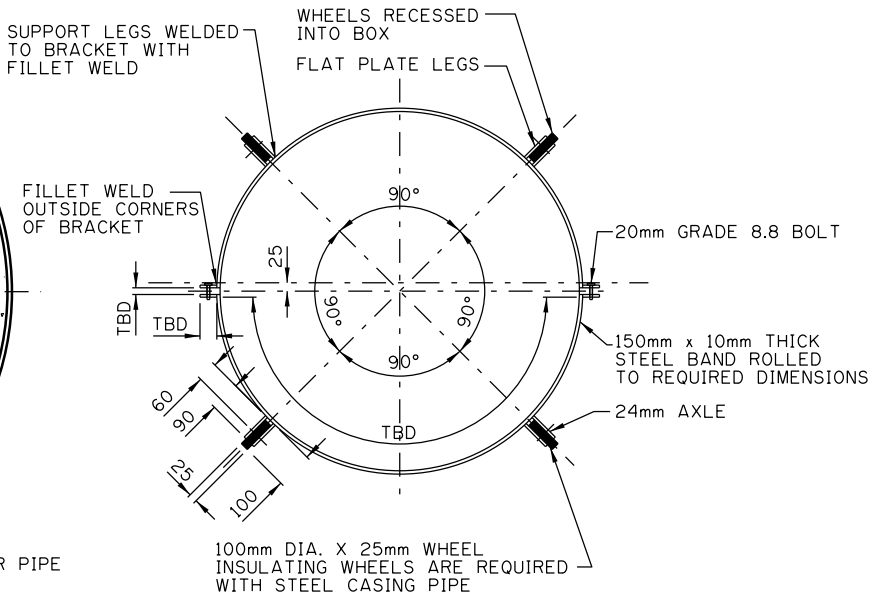
SPACER SETUP SECTION USING RISERS

NOTES:

1. PIPE SUPPORTS C/W PLASTIC CASING INSULATORS AT INTERVALS DETERMINED BY ENGINEER.
2. END SEALS C/W STRAPS OR FILTER FABRIC AS DETERMINED BY ENGINEER.
3. VOID SPACES BETWEEN TUNNEL LINER/CASING AND NATIVE SOIL TO BE PRESSURE GROUTED. GROUT HOLES IN TUNNEL LINER EVERY 5.0m.
4. DIMENSIONS TO BE DETERMINED BY ENGINEER



ALTERNATE SPACER SETUP SECTION USING ROLLERS



SPACER SETUP USING ROLLERS

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

Date 2019/04/05
Scale N.T.S.
Approved by Russ Dueck for The City of Calgary

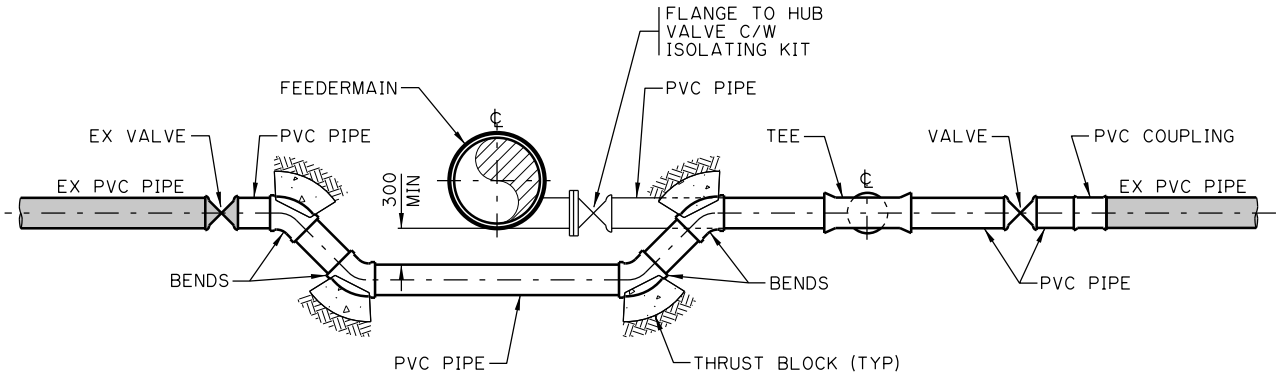
FEEDERMAIN CONSTRUCTION

TUNNEL LINER PIPE, CASING PIPE, CARRIER PIPE AND SPACER SETUP

Sheet 24

File Number 501.0024.001

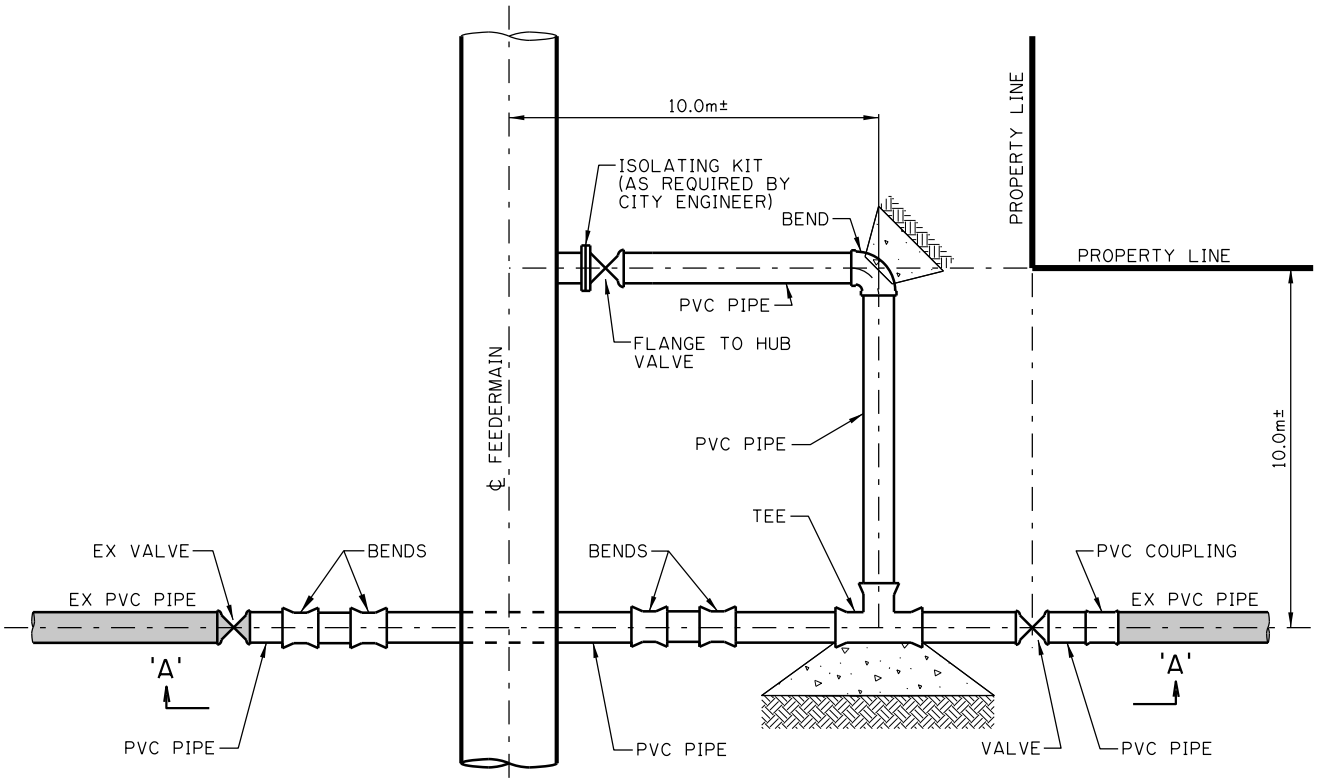
ISC: Unrestricted



SECTION 'A-A'

NOTES:

1. THE DISTRIBUTION VALVE SHOULD BE ALIGNED WITH THE NEAREST PROPERTY LINE IF POSSIBLE
2. CEMATRIX FILL OPTION MAY BE USED AS DETERMINED BY ENGINEER



PLAN

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Duck
for The City of Calgary

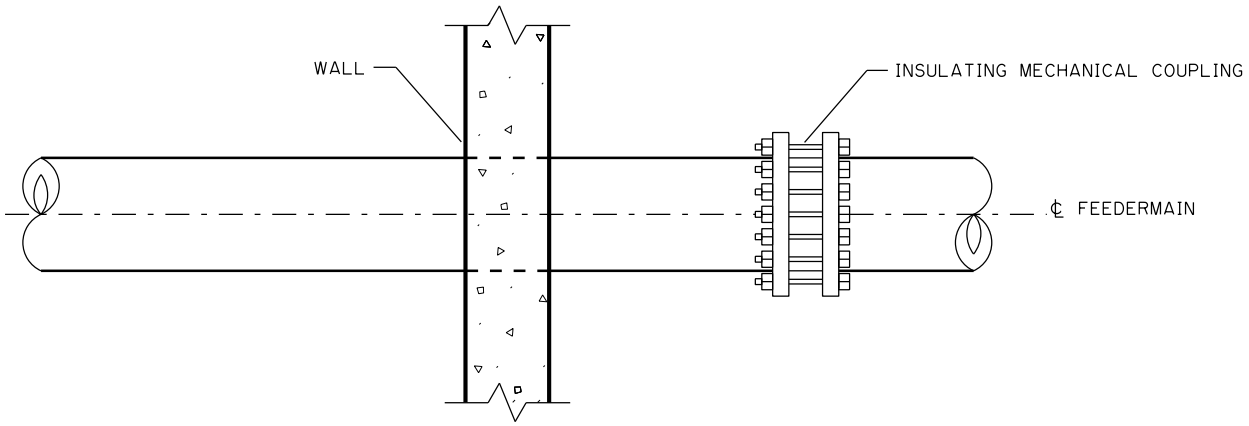
FEEDERMAIN CONSTRUCTION

EXAMPLE OF DISTRIBUTION SYSTEM TIE-IN/ALTERATION

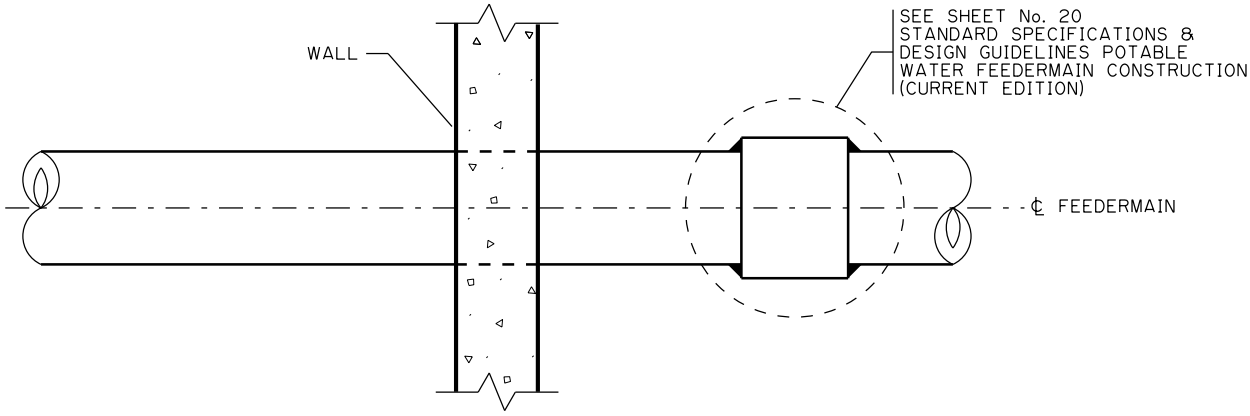
Sheet: 25

File Number: 501.0025.001

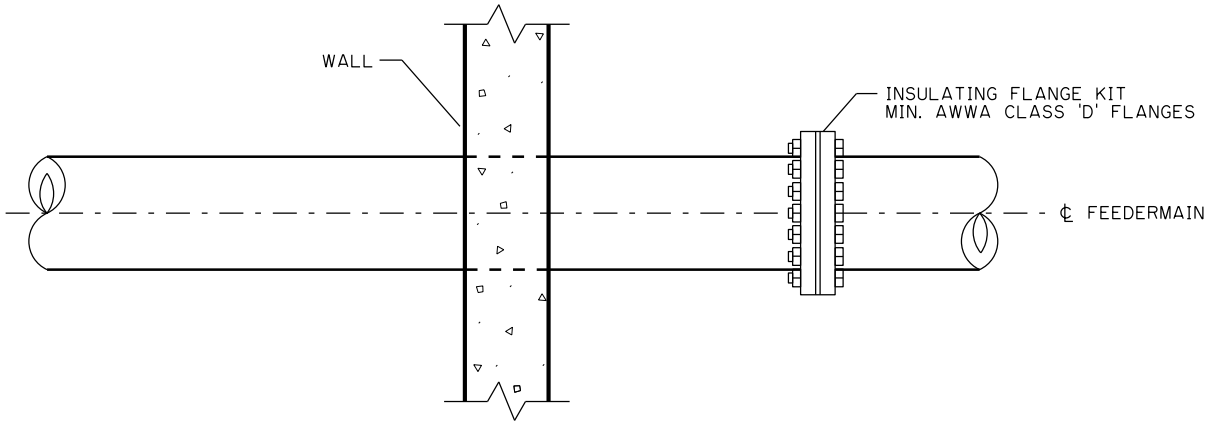
ISC: Unrestricted



OPTION 1: TIE-IN WITH INSULATING ROBAR COUPLING



OPTION 2: TIE-IN WITH BUTT-STRAP



OPTION 3: TIE-IN WITH INSULATING FLANGE KIT

NOTE:

1. PIPE RESTRAINING METHODS TO BE DETERMINED BY ENGINEER

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

Date 2019/02/25
Scale N.T.S.
Approved by Russ Dueck for The City of Calgary

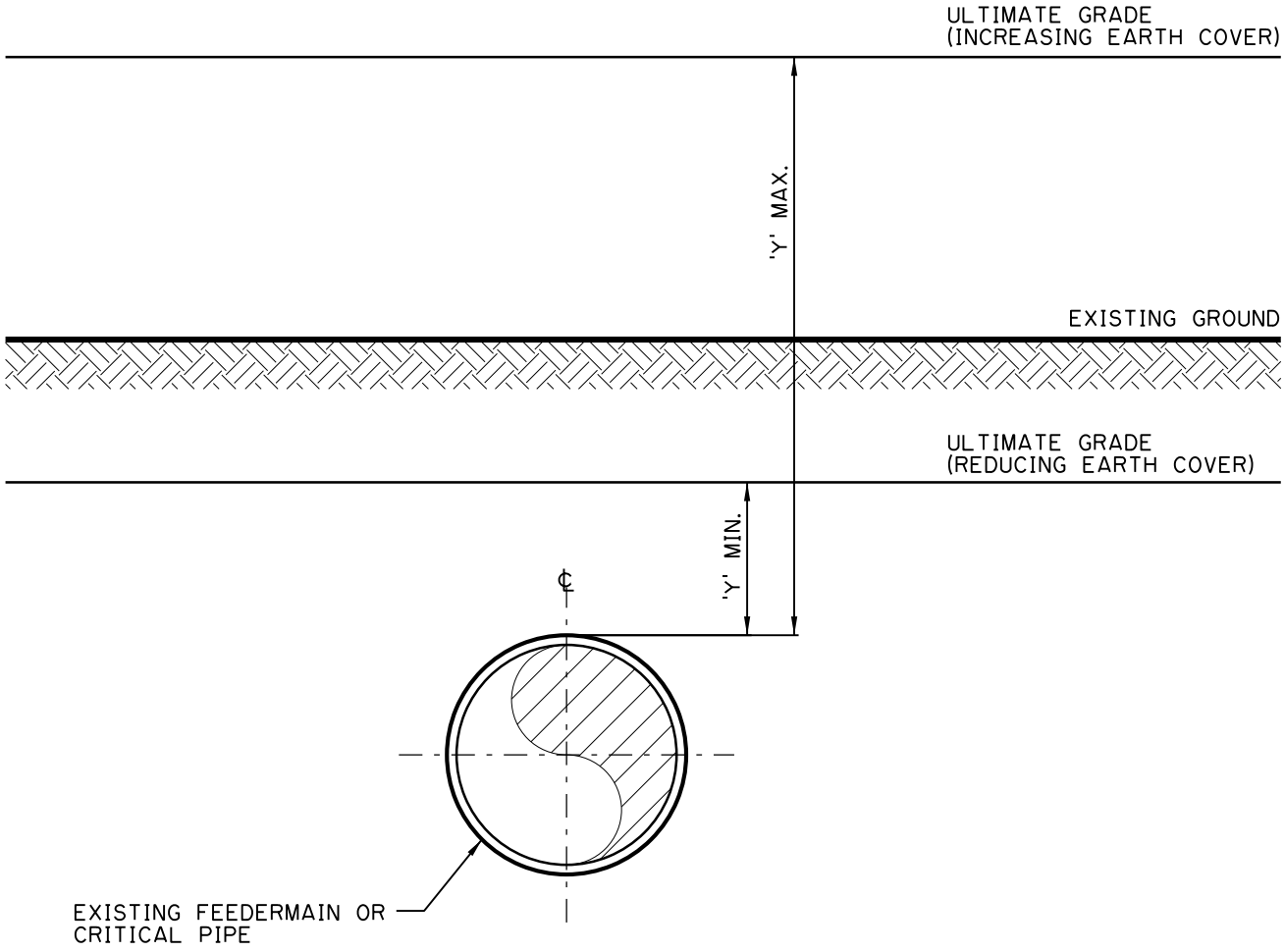
FEEDERMAIN CONSTRUCTION

PUMP STATION & RESERVOIR TIE-INS

Sheet 26

File Number 501.0026.001

ISC: Unrestricted



DESIGN CONSIDERATIONS FOR 'Y' MINIMUM:

1. EARTH LOAD DECREASED
2. LIVE LOAD INCREASED
3. FROST PROTECTION
4. CONSTRUCTION LOADING
5. DEFLECTION LIMITS OF EXISTING PIPE
6. ENCASEMENT/SLAB
7. MIN. 1.5m FROM CROWN TO UNDISTURBED SUBGRADE

DESIGN CONSIDERATIONS FOR 'Y' MAXIMUM:

1. EARTH LOAD DECREASED
2. LIVE LOAD INCREASED
3. ACCESS/MAINTENANCE
4. DEFLECTION LIMITS OF EXISTING PIPE
5. ENCASEMENT/SLAB
6. MAX. 6.0m FROM CROWN TO FINISHED GRADE
   (ALLOWABLE DEPTH TO BE CONFIRMED BY PIPE SUPPLIER)
7. MAX. WASHOUT DEPTH CONSIDERATIONS

NOTE:

PIPE IS DESIGNED TO ACCOMODATE A MAX. LOAD
(COMBINATION OF EARTH AND LIVE)

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

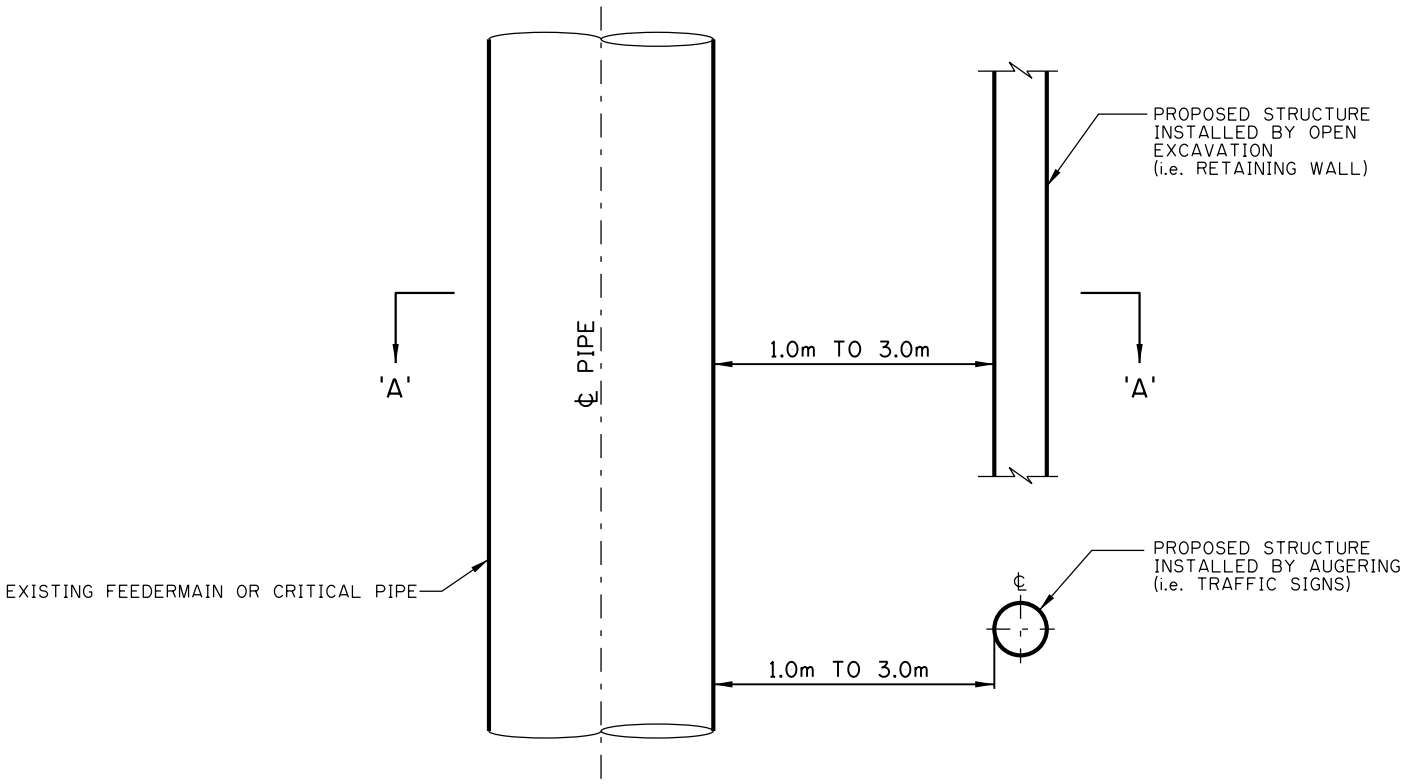
Date: 2019/02/25
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

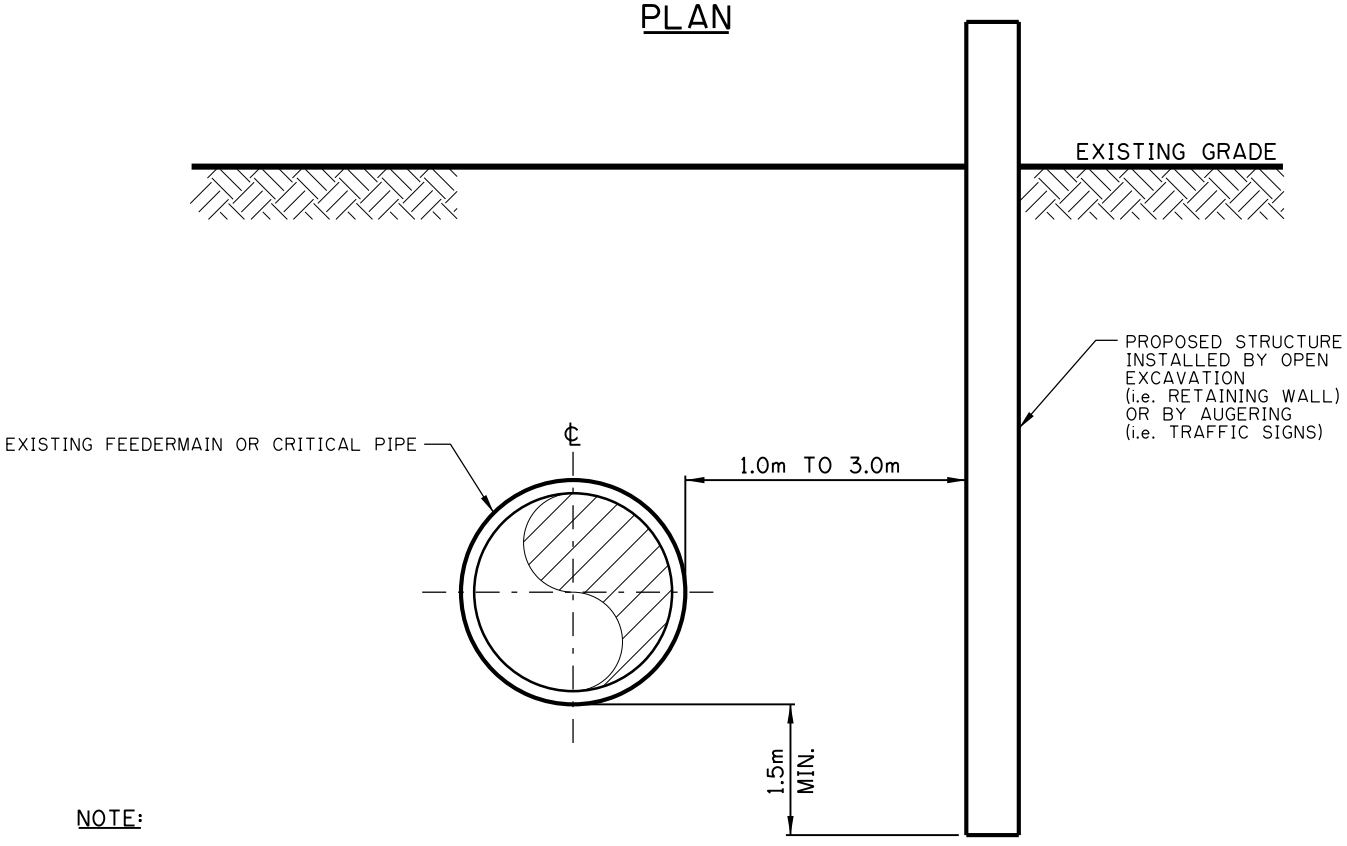
ULTIMATE GRADE COVER REQUIRED

Sheet: 27
File Number: 501.0027.001

ISC: Unrestricted



PLAN



NOTE:

PIPE TO BE EXPOSED BY HYDROVAC/HAND
EXPOSING IN PRESENCE OF ENGINEER

SECTION 'A-A'

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

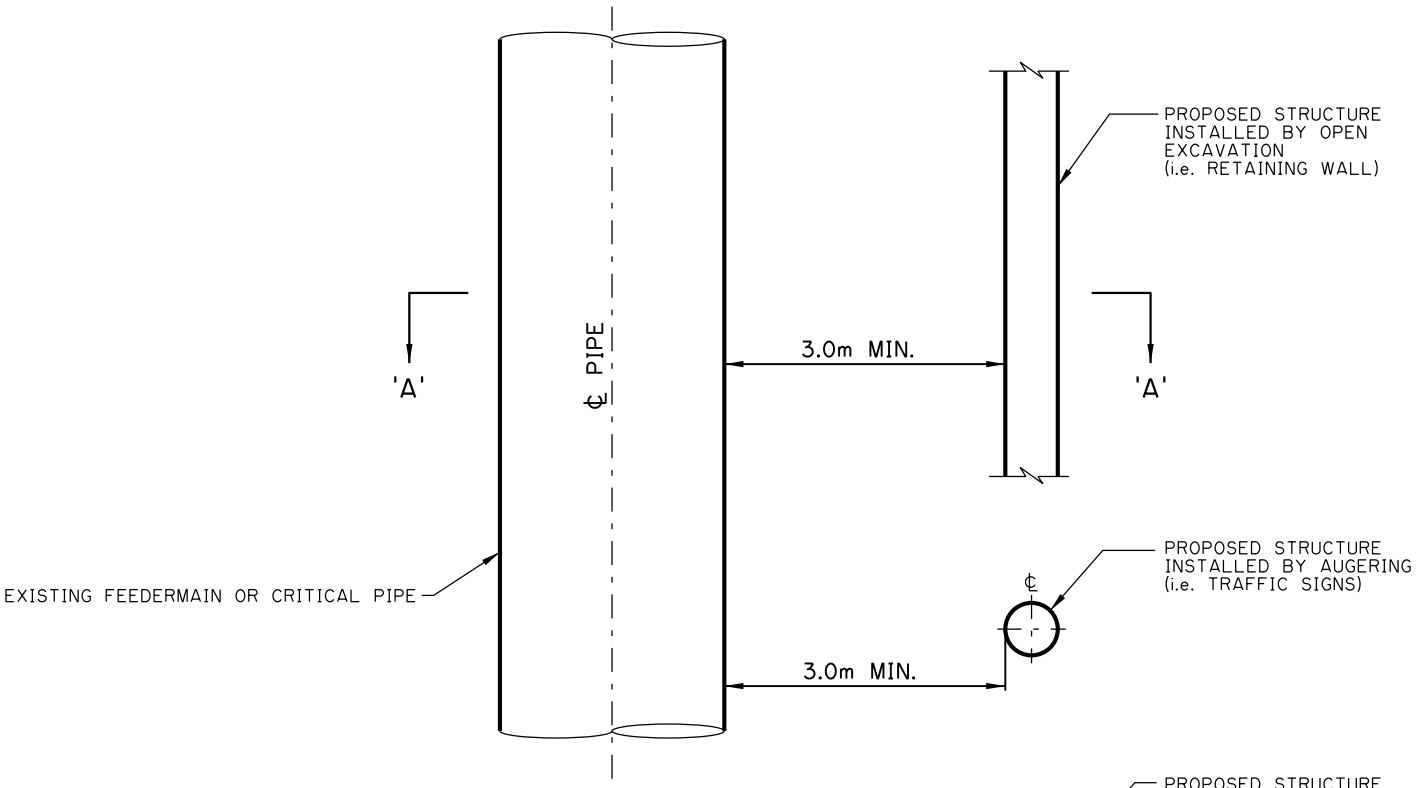
Date: 2019/02/25
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

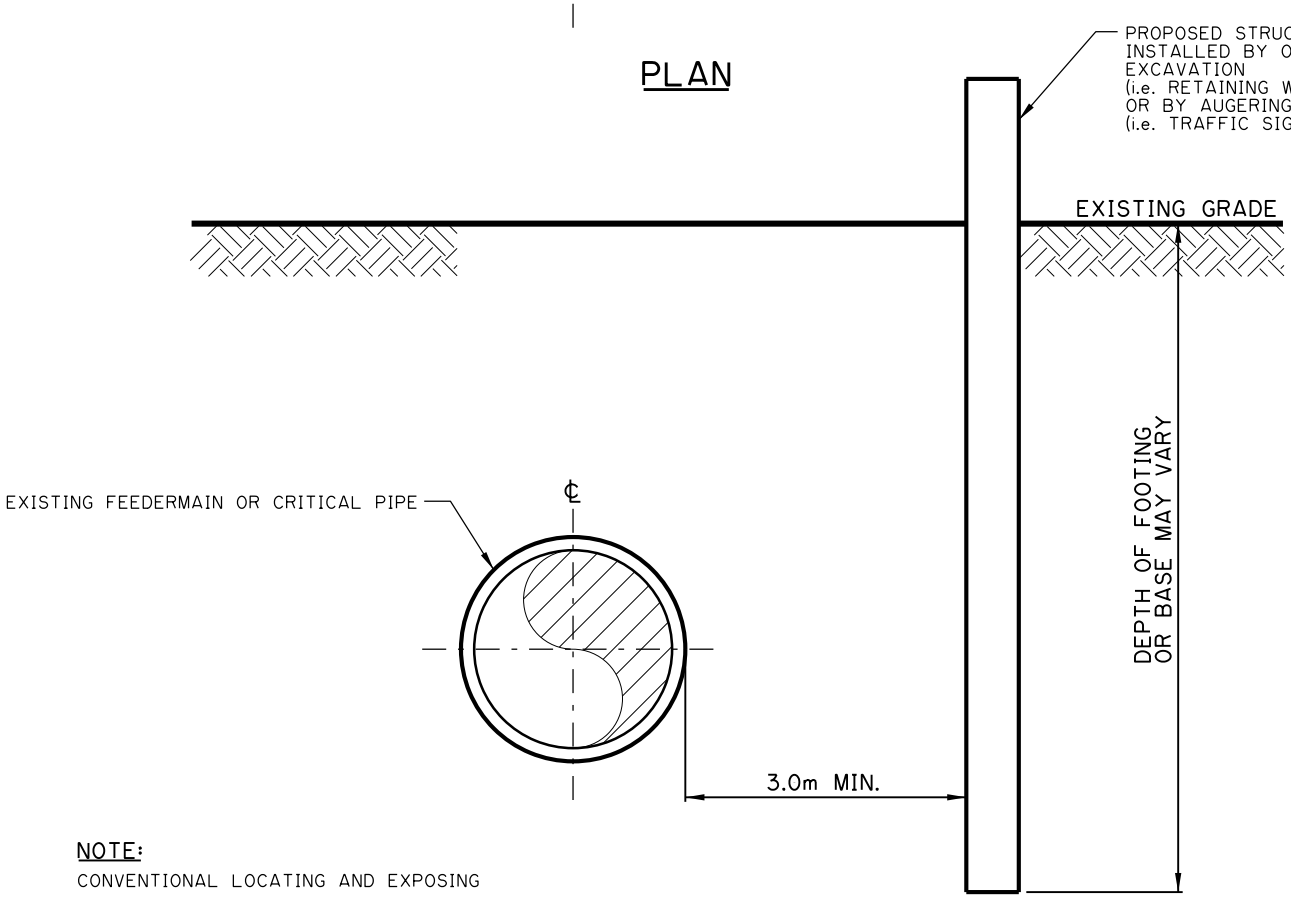
STRUCTURES INSIDE
3.0m CLEARANCE
OF A FEEDERMAIN

Sheet: 28
File Number: 501.0028.001

ISC: Unrestricted



PLAN



NOTE:
CONVENTIONAL LOCATING AND EXPOSING

SECTION 'A-A'

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

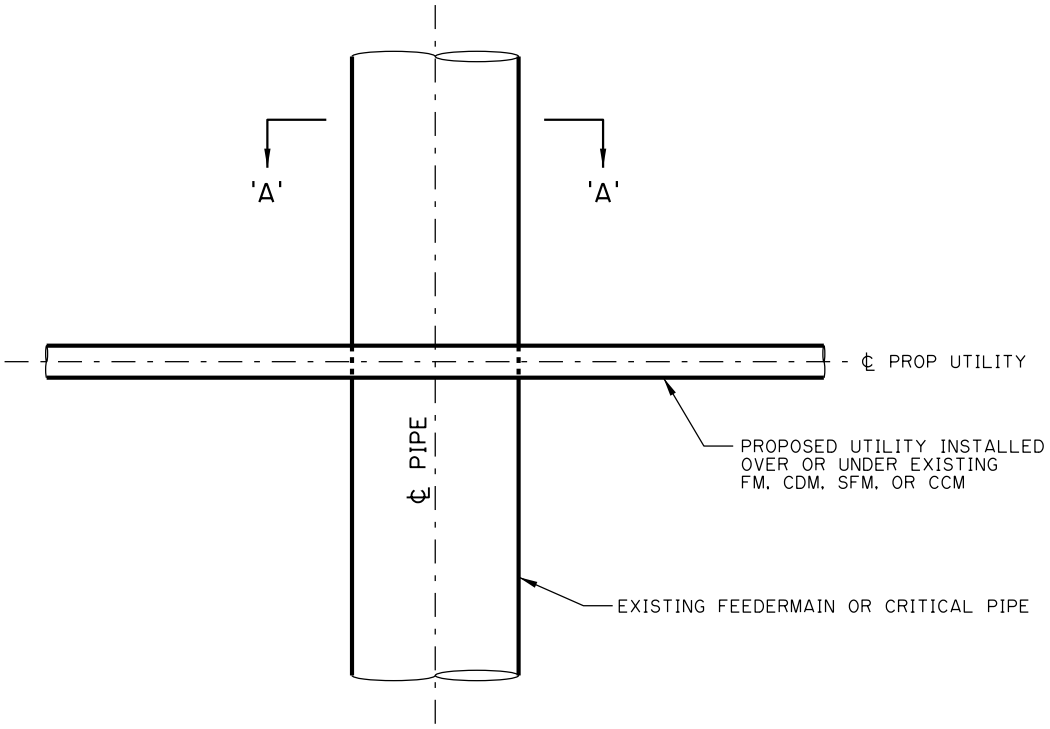
Date: 2018/12/17
Scale: N.T.S.
Approved by: Russ Dueck
for The City of Calgary

FEEDERMAIN CONSTRUCTION

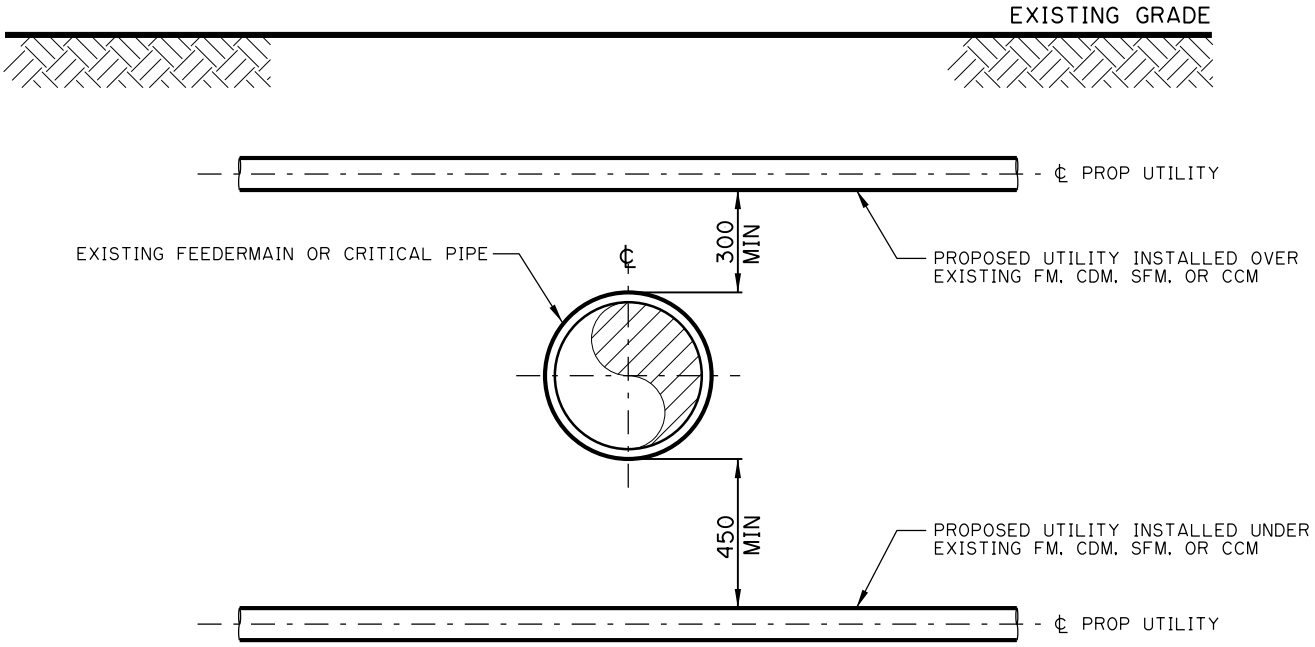
STRUCTURES OUTSIDE
OF 3.0m CLEARANCE
OF A FEEDERMAIN

Sheet: 29
File Number: 501.0029.001

ISC: Unrestricted



PLAN



SECTION 'A-A'

NOTES:

ALL EXISTING FEEDERMAINS OR CRITICAL PIPES MUST BE HYDROVAC/HAND EXPOSED TO DETERMINE PIPE ELEV AND ALIGNMENT

METHOD OF CONSTRUCTION AND SCHEDULING FOR CROSSING OVER OR UNDER TO BE DETERMINED WITH WATER RESOURCES

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd

Date 2018/12/18
Scale N.T.S.
Approved by Russ Dueck for The City of Calgary

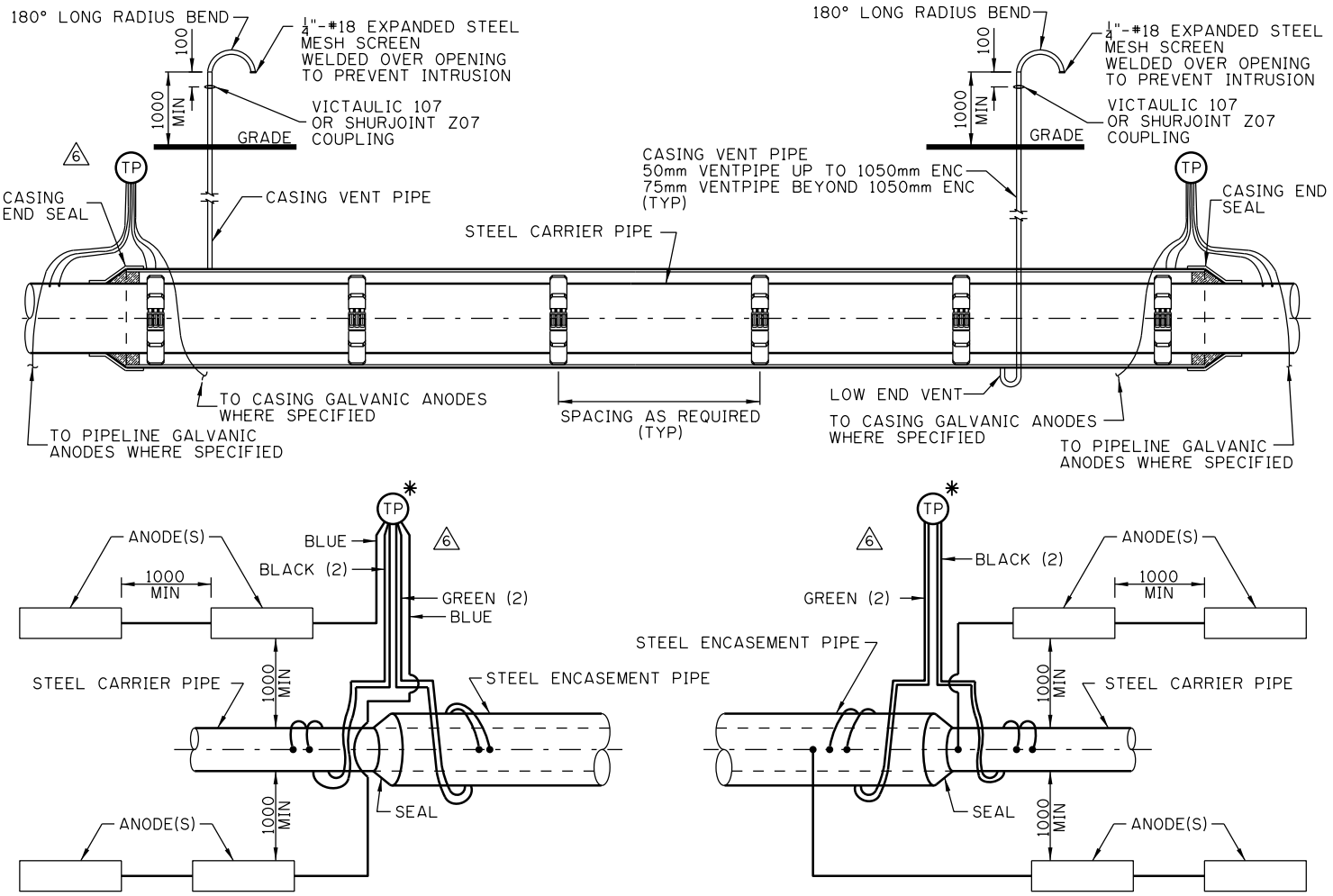
FEEDERMAIN CONSTRUCTION

UTILITY CROSSING

Sheet 30

File Number 501.0030.001

ISC: Unrestricted



6 METALLIC CARRIER UNDER C.P. IN STEEL ENCASEMENT

METALLIC ENCASEMENT PIPE NOMINAL ID (mm)	NUMBER OF 14.7kg MAG. ANODES * REQUIRED AT EACH END ON ENCASEMENT PIPE LESS THAN 30 METRES IN LENGTH	No. OF 14.7kg MAG. ANODES * REQUIRED AT EACH END ON ENCASEMENT PIPE GREATER THAN 30 METRES IN LENGTH
300 - 650	2	3
660 - 1370	4	6
GREATER THAN 1370	6	9

NOTES:

* 1. WHERE ENCASEMENT PIPE IS LOCATED WITHIN 7 METRES OF HIGH VOLTAGE ELECTRICAL INFRASTRUCTURE, OR IS CROSSED BY SAME, SUBSTITUTE THREE 5.4kg ZINC ANODES FOR EACH 14.7kg MAG. ANODE AS SPECIFIED IN THE ABOVE TABLE. WHERE ZINC ANODES ARE USED, TEST LEADS SHALL BE WHITE. INSTALL A.C. MONITORING REFERENCE ELECTRODE AS PER SHEET 16

6 2. END SEALS SHALL BE APPROVED LINK SEALS AND VISCOTAQ END SEAL SYSTEM

3. WELD REDUNDANT STRUCTURE TEST LEADS (2 LEADS 150mm APART) ON BOTH CARRIER & ENCASEMENT (TOTAL 4) WHERE STEEL IN STEEL

4. WHERE D.C. TRACTION SYSTEM WITHIN 50m, INSTALL D.C. COUPON C/W REFERENCE TUBE AS PER SHEET 16A (CSCL CPMP 210)

5. WHERE A.C. CURRENT SOURCE ABOVE 25KVH WITHIN 50m INSTALL A.C. ELECTRODE (STELTH 7AC-200 OR CSCL-ACC-1-2)

6. WHERE TEST STATION IN PAVEMENT, CONCRETE OR CONTACT WITH REMOTE EARTH UNAVAILABLE, INSTALL CuSo4 REFERENCE ANODE (STELTH 2 OR EDL-UL)

WIRE SIZES & COLORS:

#10 BLACK
#10 GREEN
#10 BLUE
#10 WHITE (WHERE ZINC ANODES INSTALLED)

ALL WIRE TO BE 7 STRAND RWU INSULATION

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

No.	Date	Revision	App'd
6	2018/08/22	REVISED NOTES. TITLE & ADDED NEW DETAIL	B.N.
5	0000/00/00	REVISED ENCASEMENT PIPE SIZE	B.N.
4	2009/12/10	ADDED ENCASEMENT PIPE SIZE	B.N.
3	2009/04/24	REVISED DRAWING	B.N.
2	2008/12/03	REVISED DETAIL & TITLE	B.N.
1	2008/10/30	REV STD TO INCLUDE METALLIC & NON METALLIC PIPE SYSTEM	B.N.

Date 2008/10/30
Scale N.T.S.
Approved by
for The City of Calgary

WATERWORKS CONSTRUCTION

CATHODIC PROTECTION (C.P.) FOR METALLIC CARRIER IN SEALED STEEL ENCASEMENT 6

Sheet 31

File Number 453.1017.006

ISC: Unrestricted