Design and Construction

Day 1

Main Topics

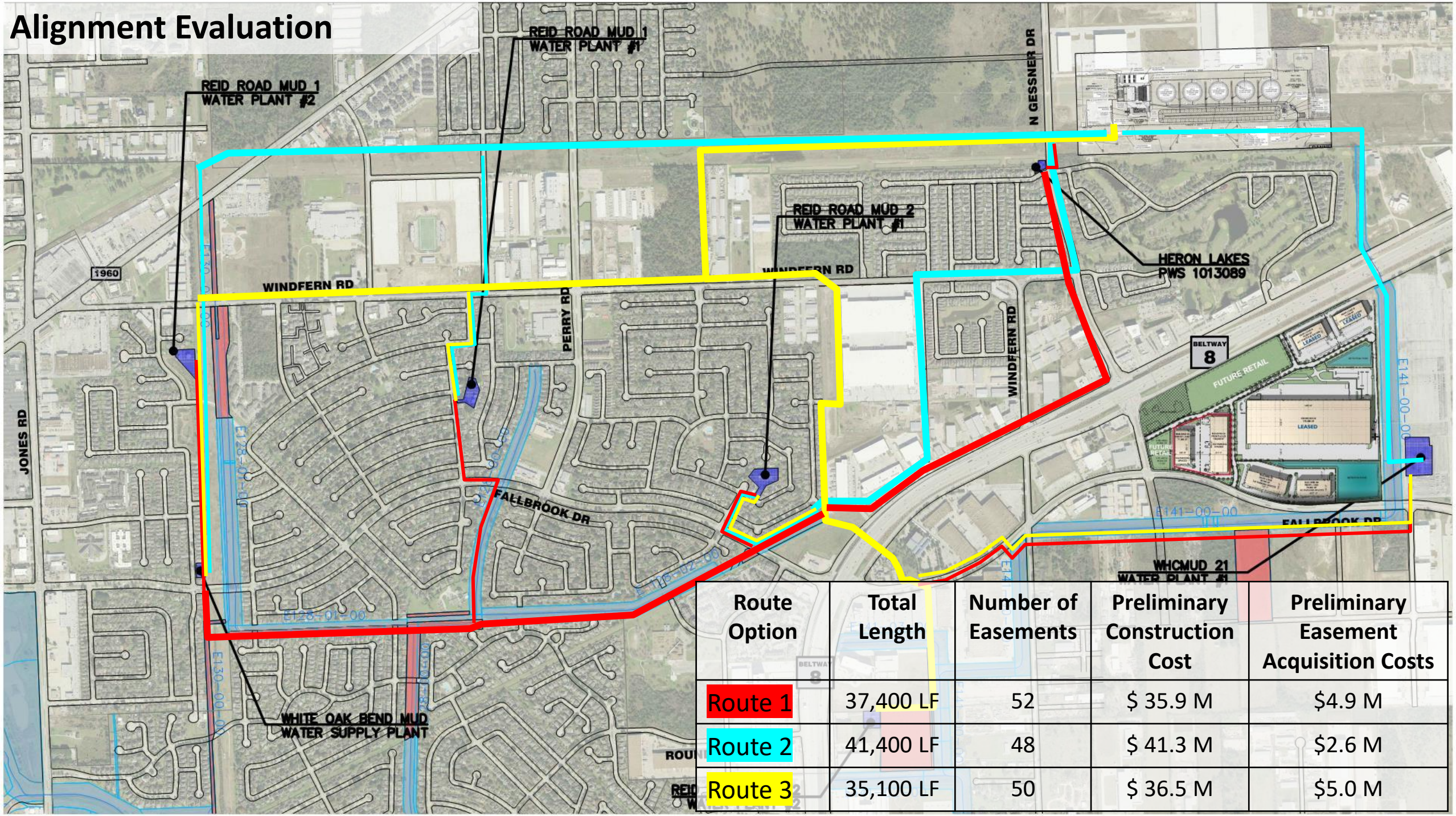
1. Preliminary Design and Route Study Considerations
2. Design Consideration – Pipe Material & Coating
3. Design Considerations – Appurtenances
4. Design Consideration – Open-Cut Construction (Day 2)
5. Design Consideration – Tunnel Construction (Day 2)

Preliminary Design – General Approach

Preliminary Design – Route Considerations

1. Accessibility & Maintainability
2. Impacts to Community, Businesses & Major Roadways
3. Land Acquisition (Clear ROW>Undeveloped>Developed>HCFD>Roadway)
4. Permits and Approval
5. Constructability
6. Utility Conflicts
7. Construction Cost

Alignment Evaluation



Route Option	Total Length	Number of Easements	Preliminary Construction Cost	Preliminary Easement Acquisition Costs
Route 1	37,400 LF	52	$ 35.9 M	$4.9 M
Route 2	41,400 LF	48	$ 41.3 M	$2.6 M
Route 3	35,100 LF	50	$ 36.5 M	$5.0 M

3 – Completely Satisfies
2 – Somewhat Satisfies
1 – Does not Satisfy

Alignment Evaluation

Consideration	Route 1	Route 2	Route 3
Accessibility & Maintainability	1	2	2
Reduces Impacts to Community, Businesses & Major Roadways	2	2	2
Reduces Land Acquisition Effort	2	3	2
Reduces Permits and Approval Effort	1	2	2
Constructability	1	2	2
Reduces Utility Conflicts	2	1	2
Minimizes Construction Cost	2	1	2
Totals	**11**	**13**	**14**

Design – Pipe Material: Ductile Iron

- **Advantages:**

-Common Material for SDWL

-Long Lasting and High-strength pipe

- **Disadvantages:**

-Custom Fitting Fabrication not feasible

-Field Modification difficult to do

-Cathodic Protection Needed

Design – Pipe Material: Ductile Iron

Design – Pipe Material: Steel

- **Advantages:**

-Highly adaptable and easily modified in the field

-Can be used on a wide ranges of pipe diameters from Small (<24”) to Extra Large (>84”)

-Well suited for high internal and external pressures surges

-Custom fitting fabrication feasible

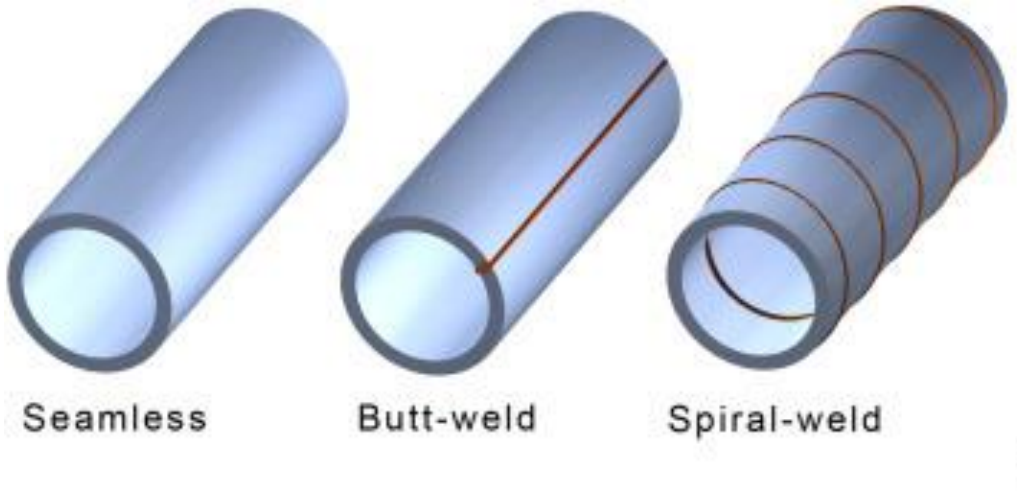
- **Disadvantages:**

-Pricing can be erratic

-Proper Backfilling Critical to Integrity

-Cathodic Protection Needed

Design – Pipe Material: Steel



Design – Pipe Material: Fiberglass (FRP)

- **Advantages:**

-Modifications allowed on Field

-No Cathodic Protection Needed

-Custom fitting fabrication feasible

- **Disadvantages:**

-Fittings often not suitable for Pressure Pipe

-Proper Backfilling Critical to Integrity of pipe

-Not well suited for high internal pressure surges

Design – Pipe Material: Fiberglass (FRP)

Design – Pipe Material High Density Polyethylene (HDPE)

- **Advantages:**

-Flexible and Fully Restrained

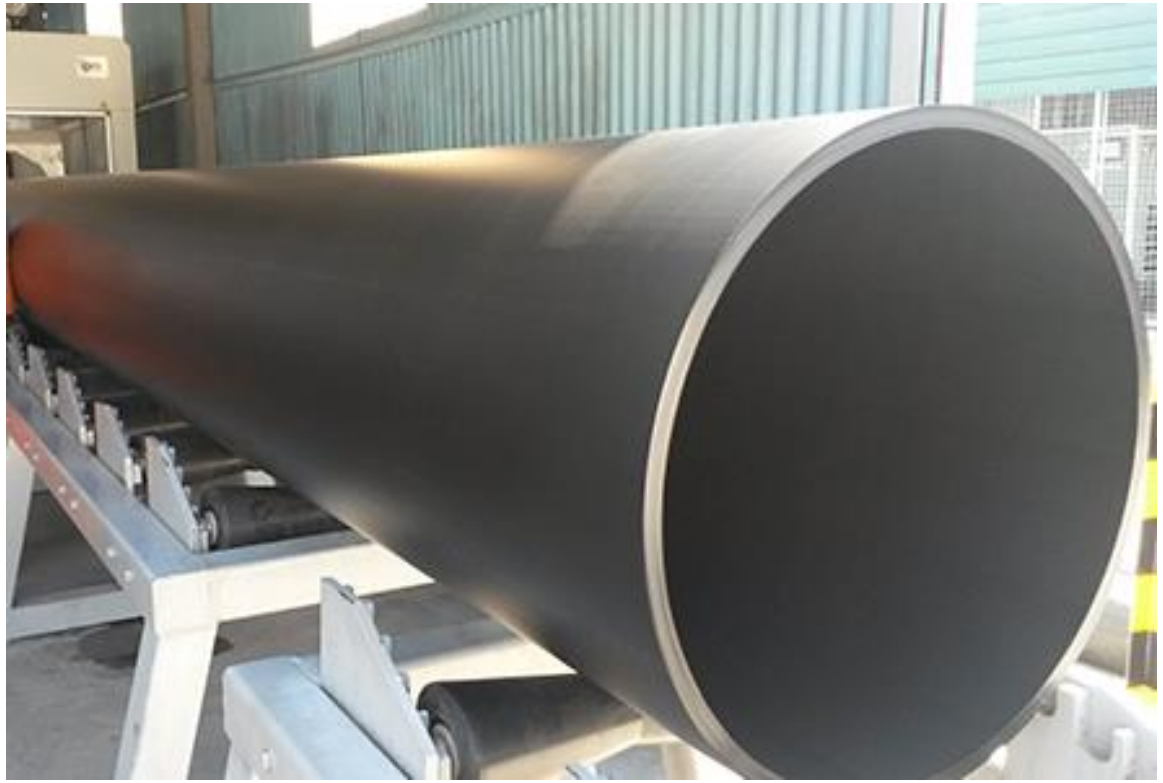
-No Cathodic Protection Needed

- **Disadvantages:**

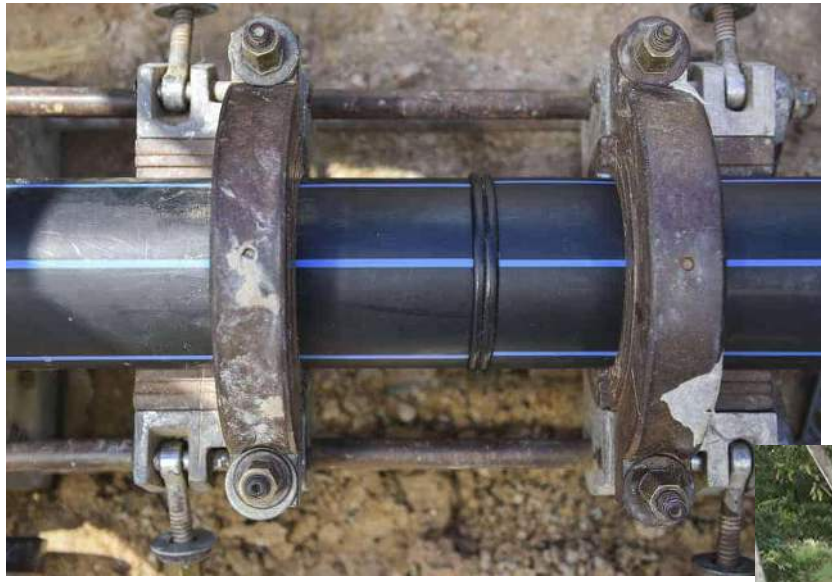
-Special Installation Needed

-Pipe Walls are very thick

-Susceptible to Temperature Fluxuations



Design – Pipe Material High Density Polyethylene (HDPE)



Design – Pipe Material PVC

- **Advantages:**

-Most common material for Small Diameter Water Pipe

-No Cathodic Protection Needed

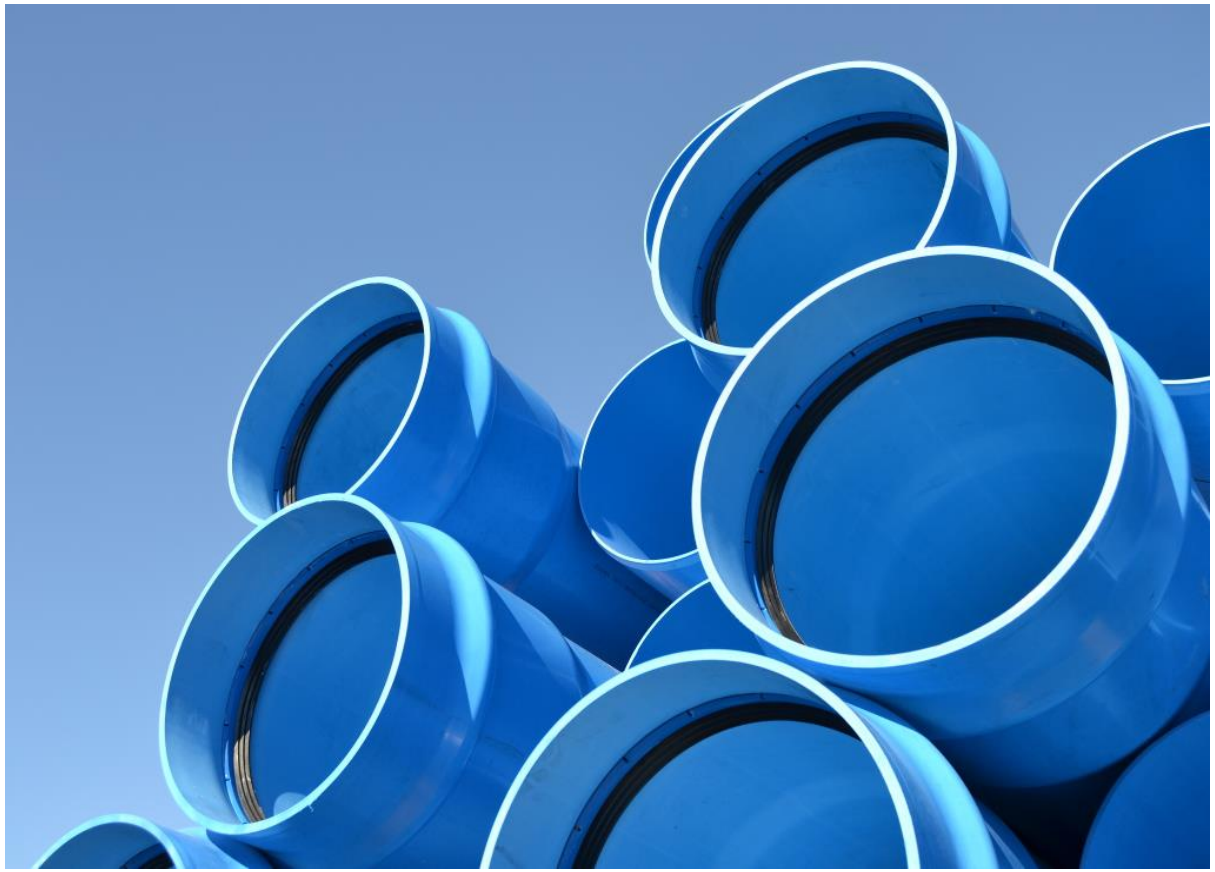
- **Disadvantages:**

-Not suitable for larger pipe (>42”)

-Looses structural integrity when exposed to sunlight for long periods of time

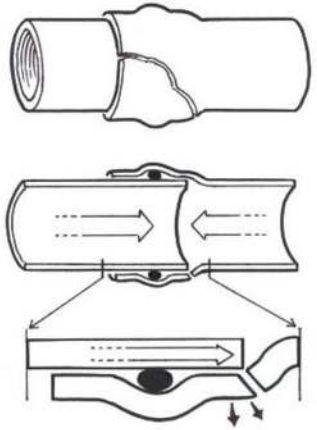
-Custom fitting fabrication not feasible

-Catastrophic failure



Design – Pipe Material PVC

PVC
Compression/Overstabbing/
Telescoping



Overstabbing or bending

Overstabbing wedged against the inside of the bell

Design – Pipe Material: Pre-stressed Concrete Cylinder Pipe (PCCP)

- **Advantages**:

-Rigid Pipe, Strongest Material

-Typically Cheaper than Steel

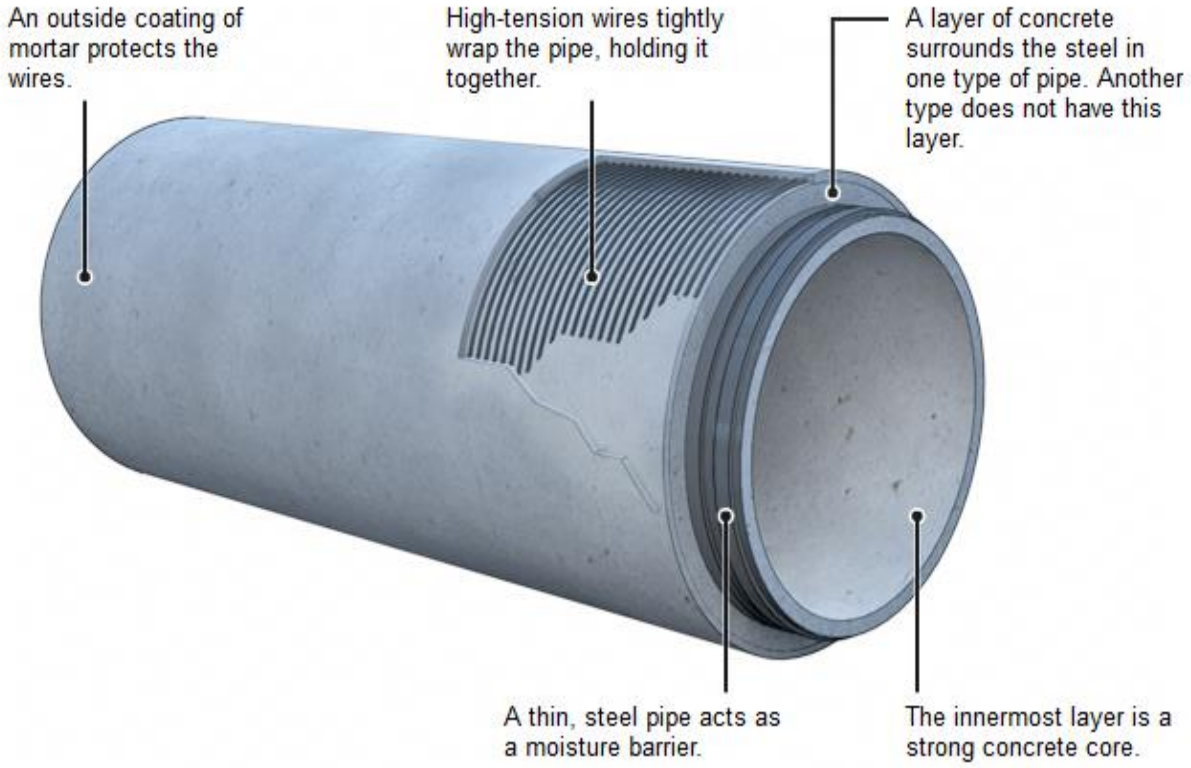
-Can be used for extra large diameter pipe (>84”)

- **Disadvantages:**

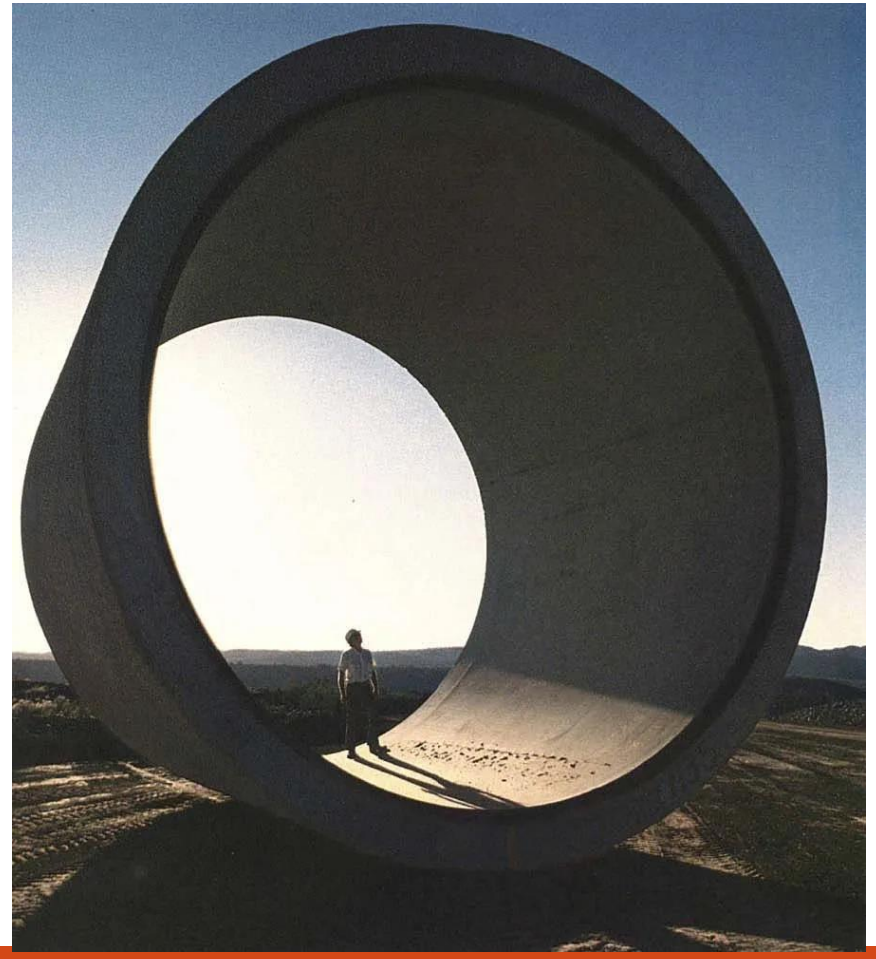
-Requires Cathodic Protection

-Difficult to Handle on Field, Cannot be easily field modified

-Catastrophic Failure Mode



Design – Pipe Material: Pre-stressed Concrete Cylinder Pipe (PCCP)



Design – Pipe Material: Bar Wrap Pipe (BWP)

❑ Advantages:

-Cheaper Alternative then PCCP

-More flexible than PCCP

-Better suited for medium size pipe (36” - 60”)

❑ Disadvantages:

-Requires Cathodic Protection

-Cannot be easily modified in the field

Design – Pipe Material: Bar Wrap Pipe (BWP)

Design – Pipe Material Summary

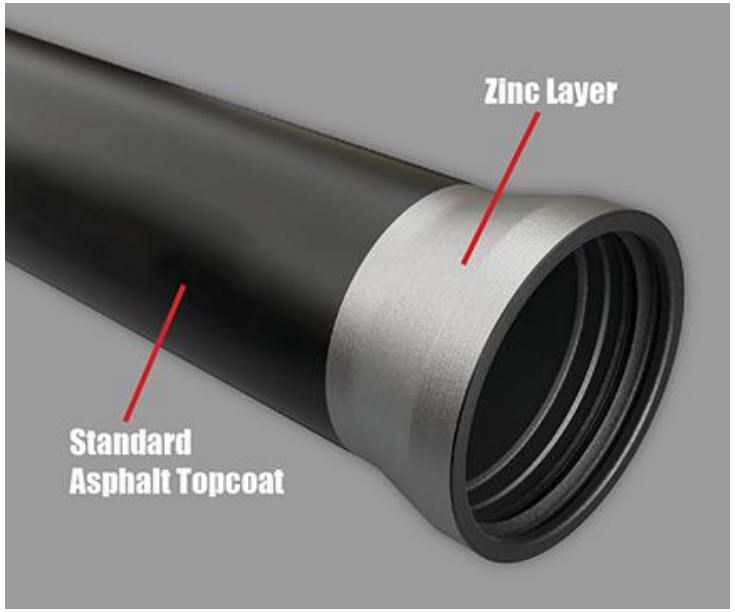
Material	Pipe Design	Joint Type	Corrosion Protection Need?	Field Modification Allowed	Field Welding Allowed	Typical Pipe Diameters Range
Ductile Iron	Rigid	Gasketed	Y	N	N	4” – 42”
Steel	Flexible	Gasketed & Welded	Y	Y	Y	8” – 120”
Fiberglass Pipe	Flexible	Gasketed & Welded	N	Y	N	24” – 72”
HDPE	Flexible	Fused	N	Y	Y	4” – 60”
PVC	Flexible	Gasketed & Fused	N	Y	Y	2” – 24”
PCCP	Rigid	Gasketed & Welded	Y	N		24” – 144+”
Bar Wrap Pipe (BWP)	Flexible	Gasketed & Welded	Y	N		24” – 66”

Design – Pipe Coating & Lining

1. Coatings (Outside of Pipe)

Cement Mortar Coating

Plastic Polymer Lining (Epoxy, Polythelyne)



Asphalt Topcoat

Design – Pipe Coating & Lining

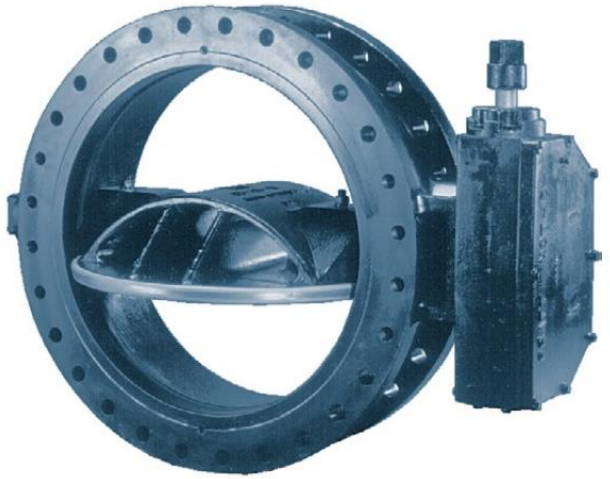
1. Lining (Inside of Pipe)

Cement Mortar Lining

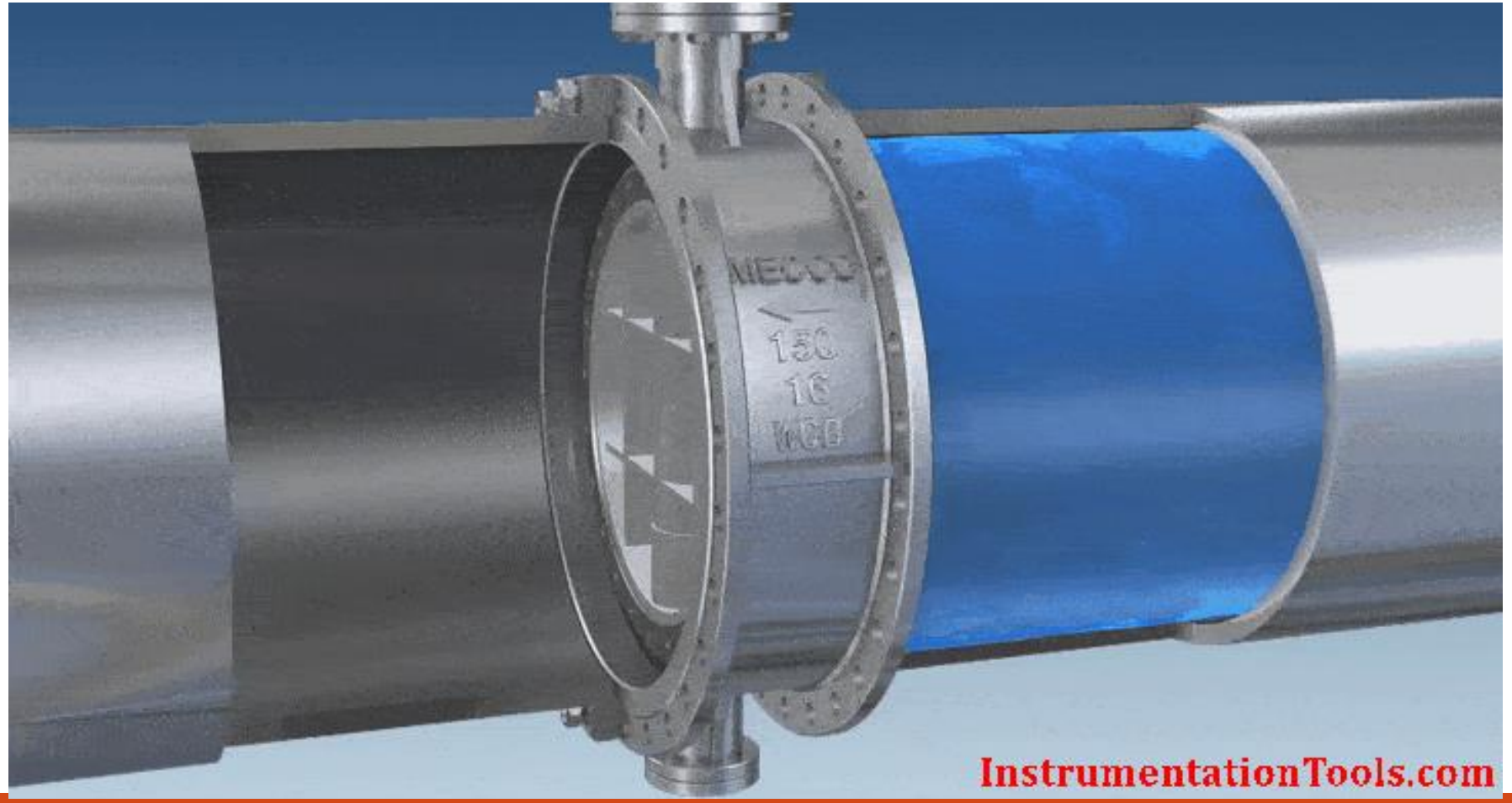
Plastic Polymer Lining (Epoxy, Polythelyne)

Isolation Valve - Butterfly

- Butterfly Valves common on large diameter waterline (>24” diameter).
- Compact Size
- Need valves near an interconnection or tee
- Spaced no more than 3,000 – 4,000 ft.
- Need to be placed in areas easily accessible to trucks to operate
- Require regular maintenance

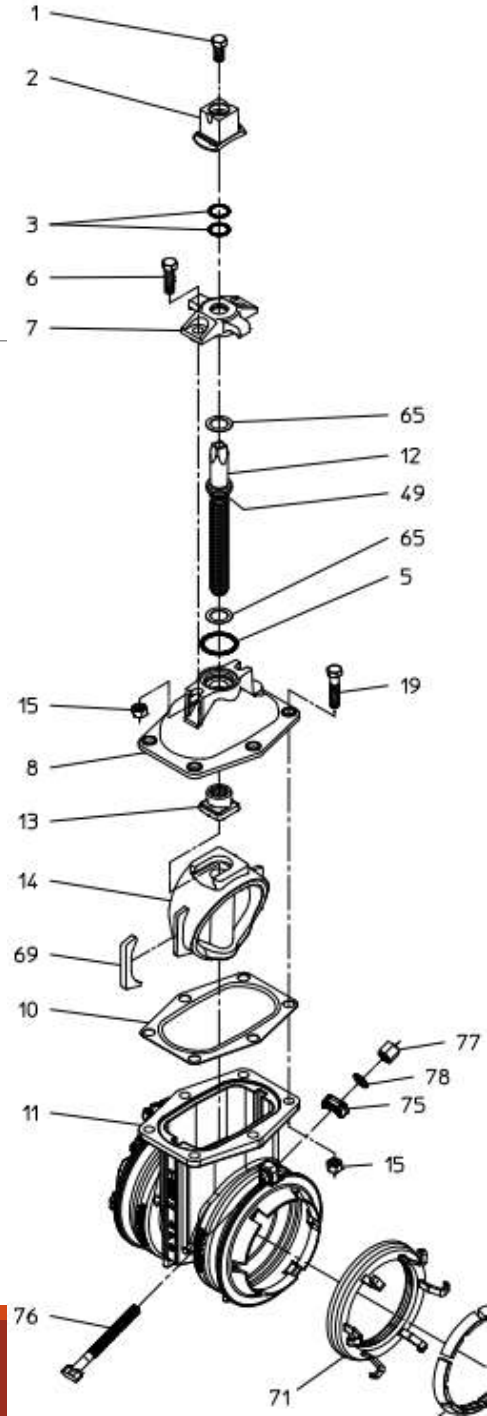


Isolation Valve - Butterfly

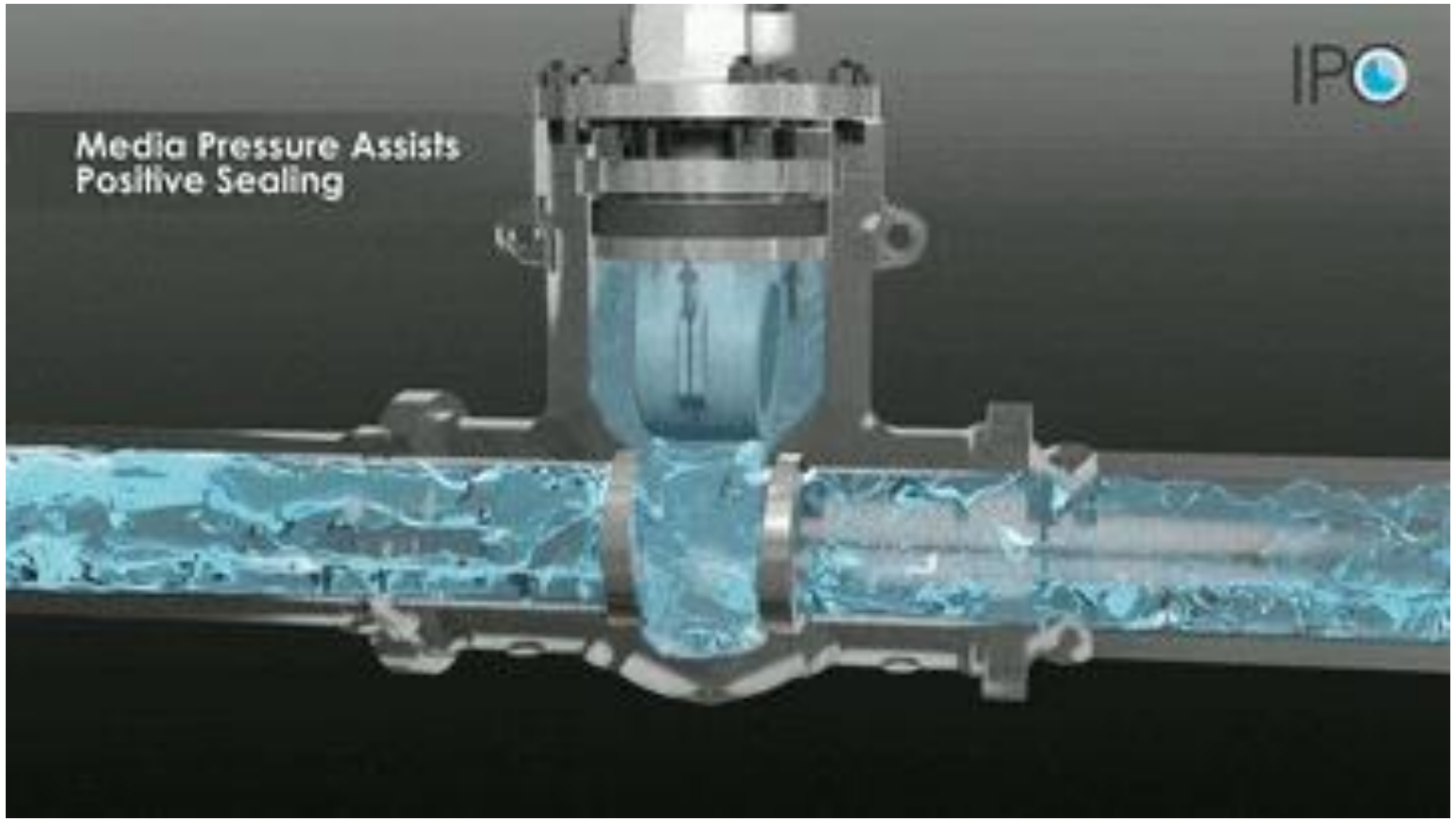


Isolation Valve – Gate Valve

- Gate Valves common on small diameter waterline (<24” diameter).
- Used in pump station, critical intersections
- Using when connecting to active pipe (Hot-Taps)
- More reliable and longer lasting than BFVs.
- Require much larger footprint than BFVs
- Need to be placed in areas easily accessible to trucks to operate

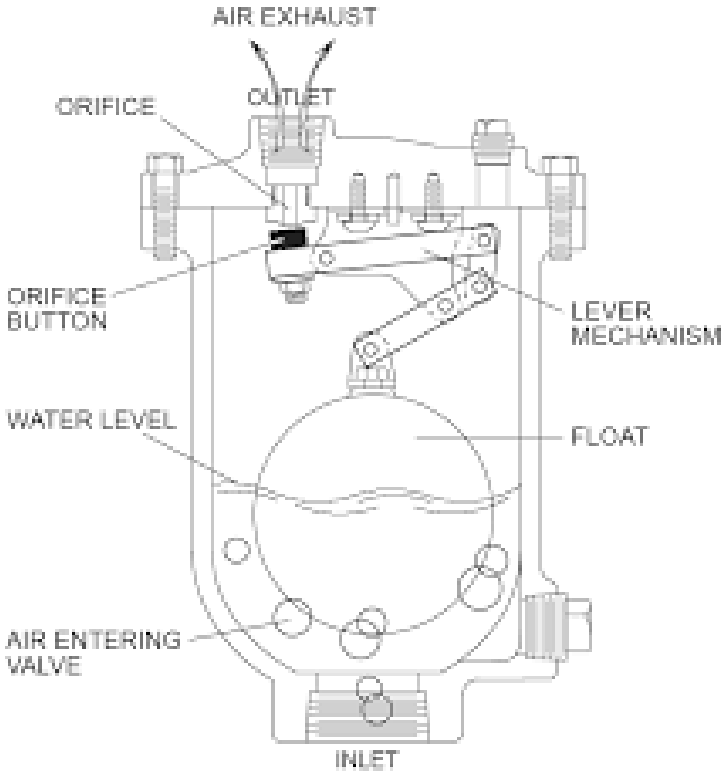


Isolation Valve – Gate Valve



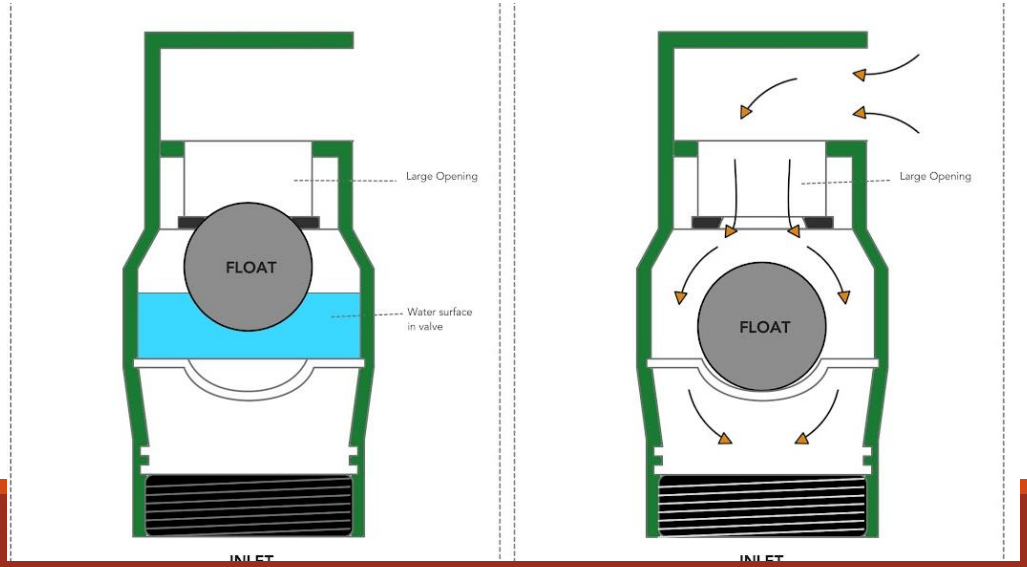
Air Valve - Air Release Valve

- Operate while waterline is in service
- Vents small pockets of air
- Small orifice required



Air Valve - Vacuum Valve

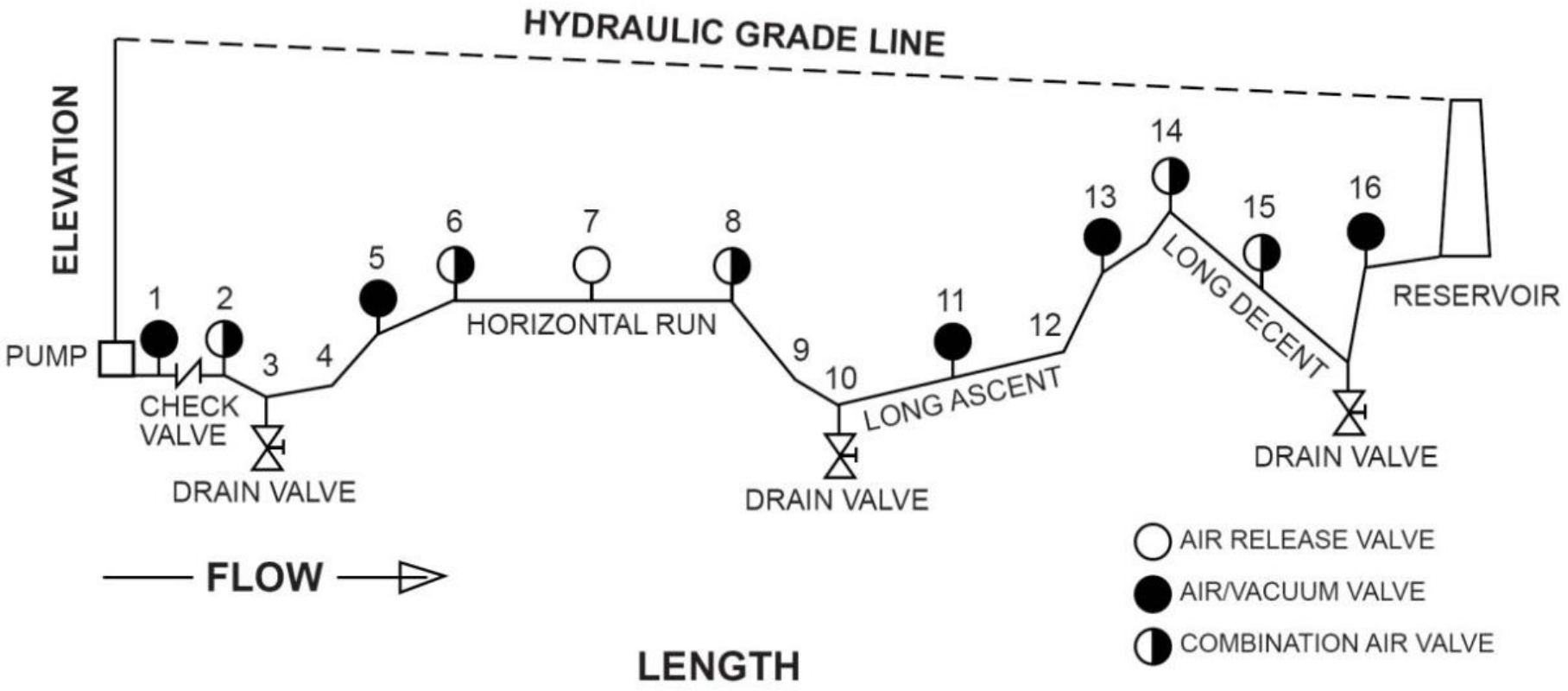
- Operate during normal fill/empty operation
- Protect line form damaging vacuum pressure conditions during transients
- Large orifice required



Air valve – Combination Air Valve

- Combines functionality of Air Release and Vacuum Valves
- Most common on pipe projects

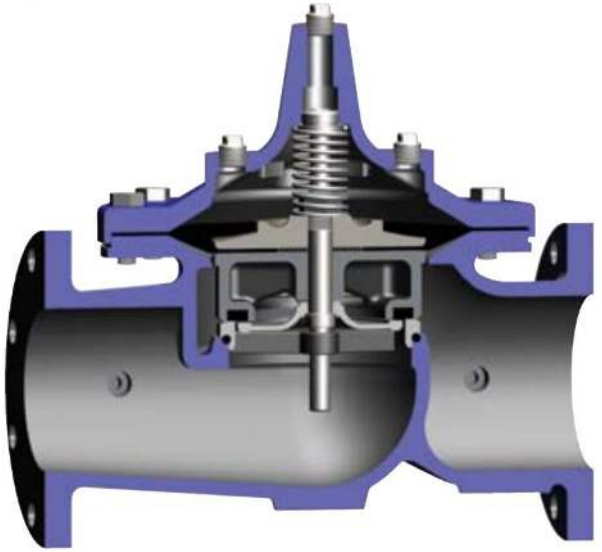
Air valve – Placement



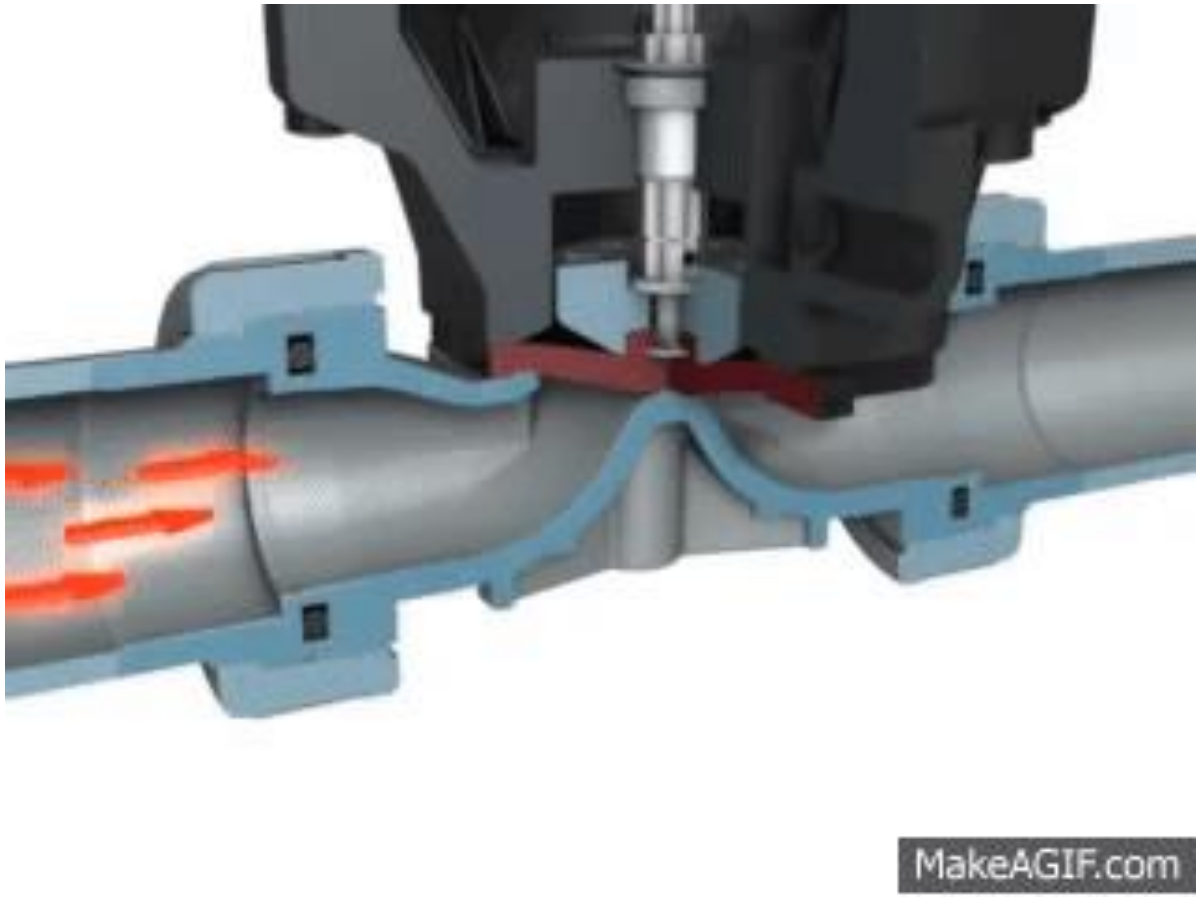
Control Valves – Globe Valves

3 Main Types:

- Pressure reducing valve
- Pressure sustaining valve
- Pressure relief valve



Control Valves – Globe Valves

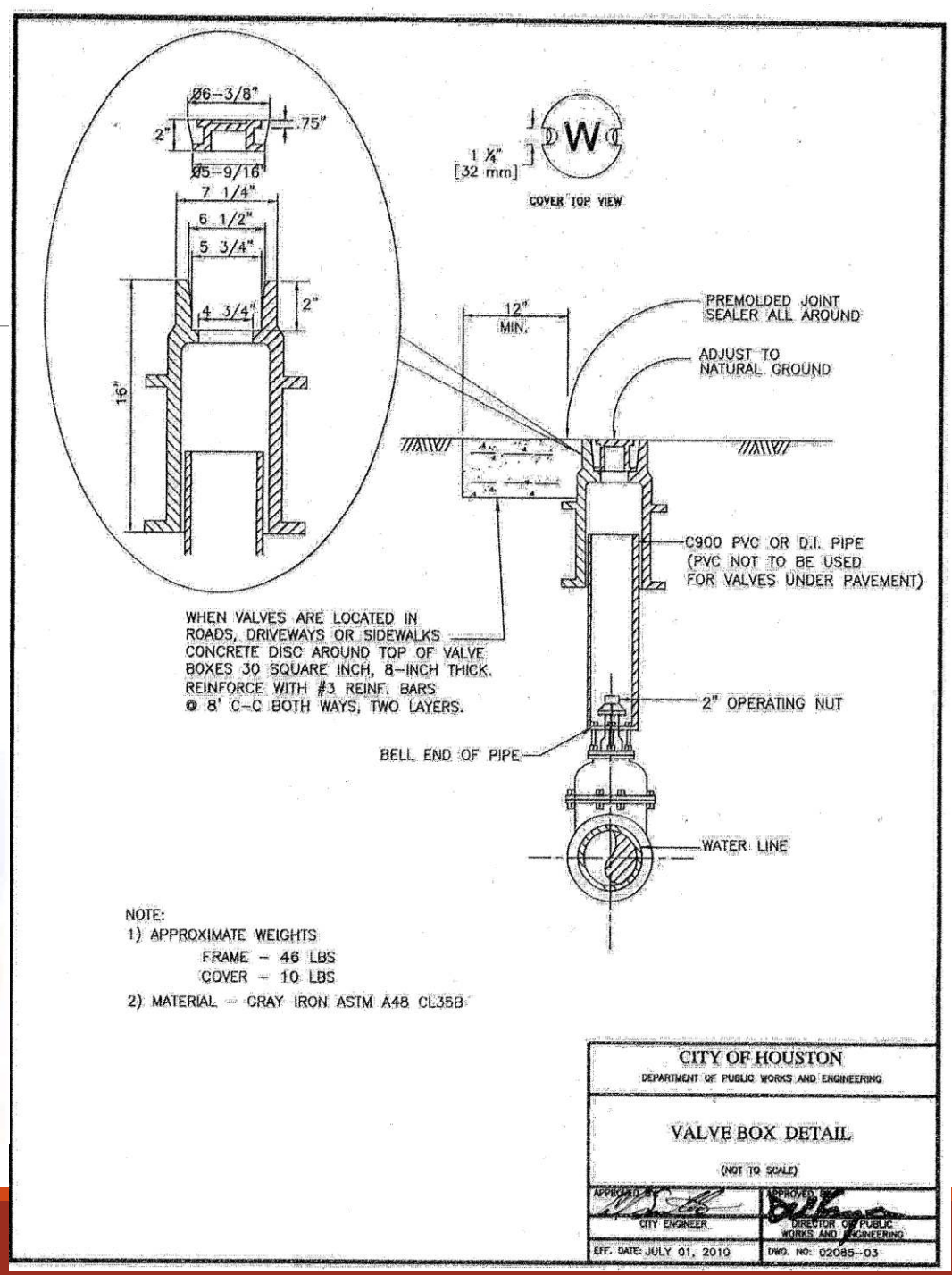


Access Manways

- Require minimum 24” Access point
- No needed on pipe smaller then 24” diameter
- Recommend placing access manway no more than 1,000 ft spacing
- Recommend at both sides of isolation valves
- Recommended near the beginning and end of project
- Often combined with Air Valves

Valve Box

- Required for direct-bury valves
- House the operating nut that is necessary to open/close a valve



Cathodic Protection – Sacrificial Anode

- Easily to Install, Passive Protection
- Requires Multiple Anodes for a Pipe
- Typical Last 50-60 Years then needs to be replaced

Cathodic Protection – Impressed Current

- Requires Power
- Last as longs as there is power. Active system
- If not designed correctly, can overprotect pipe and accelerate corrosion