HORIZONTAL DIRECTIONAL DRILLING USING DUCTILE IRON PIPE

AGENDA

1. Construction Options for New Pipelines
2. Joint Types and Uses
3. Sustainable Infrastructure Practices
4. Utilizing Horizontal Directional Drilling
5. HDD Planning and Operation
6. HDD Using Ductile Iron Pipe-Advantages
7. McWane Makes It Easy—The Pocket Engineer
8. Questions and Answers

Construction Options
For
New Pipeline Construction

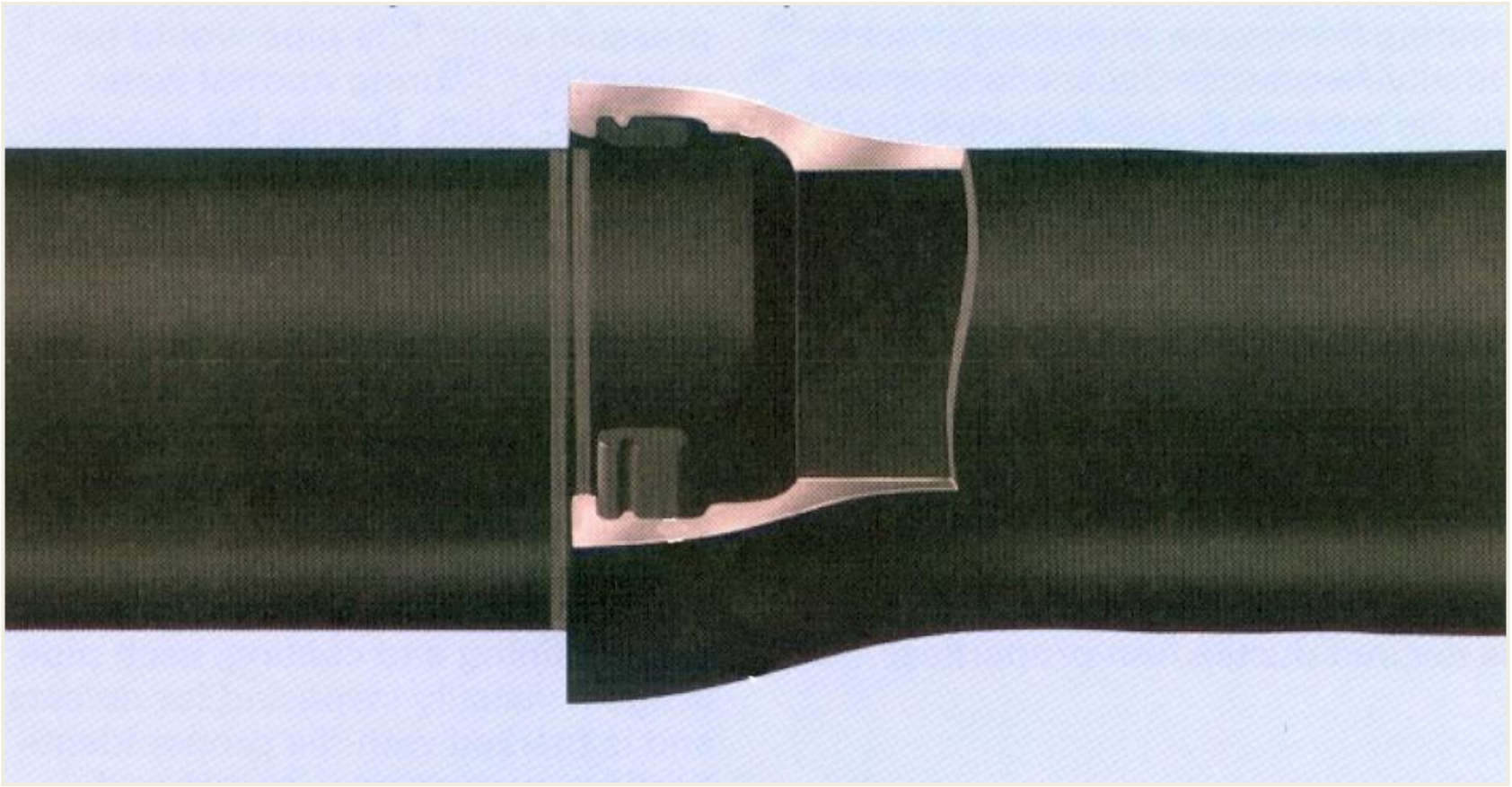
"To the man who only has a hammer in the tool kit, every problem looks like a nail."

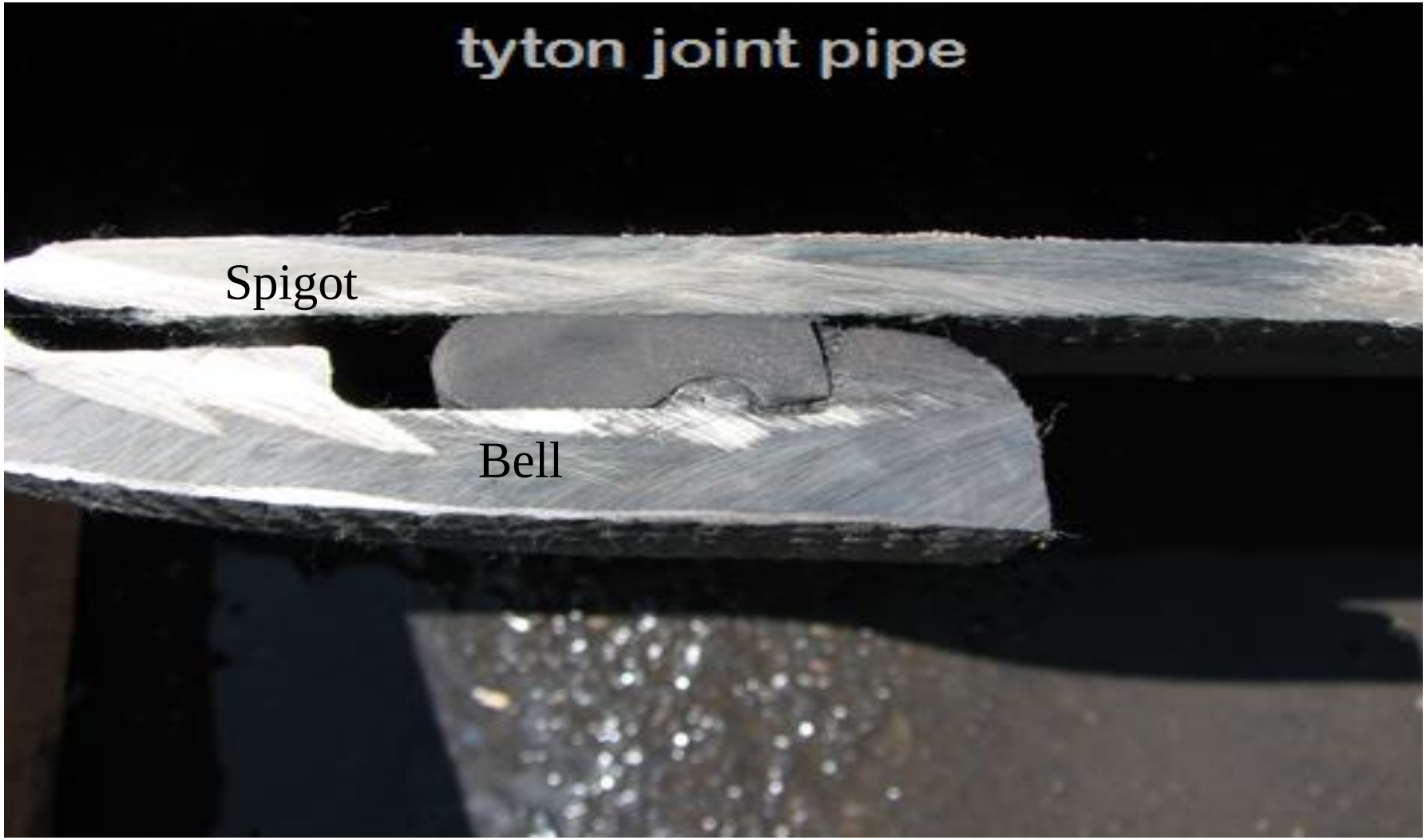
Abraham Maslow

Construction Options for new Pipelines

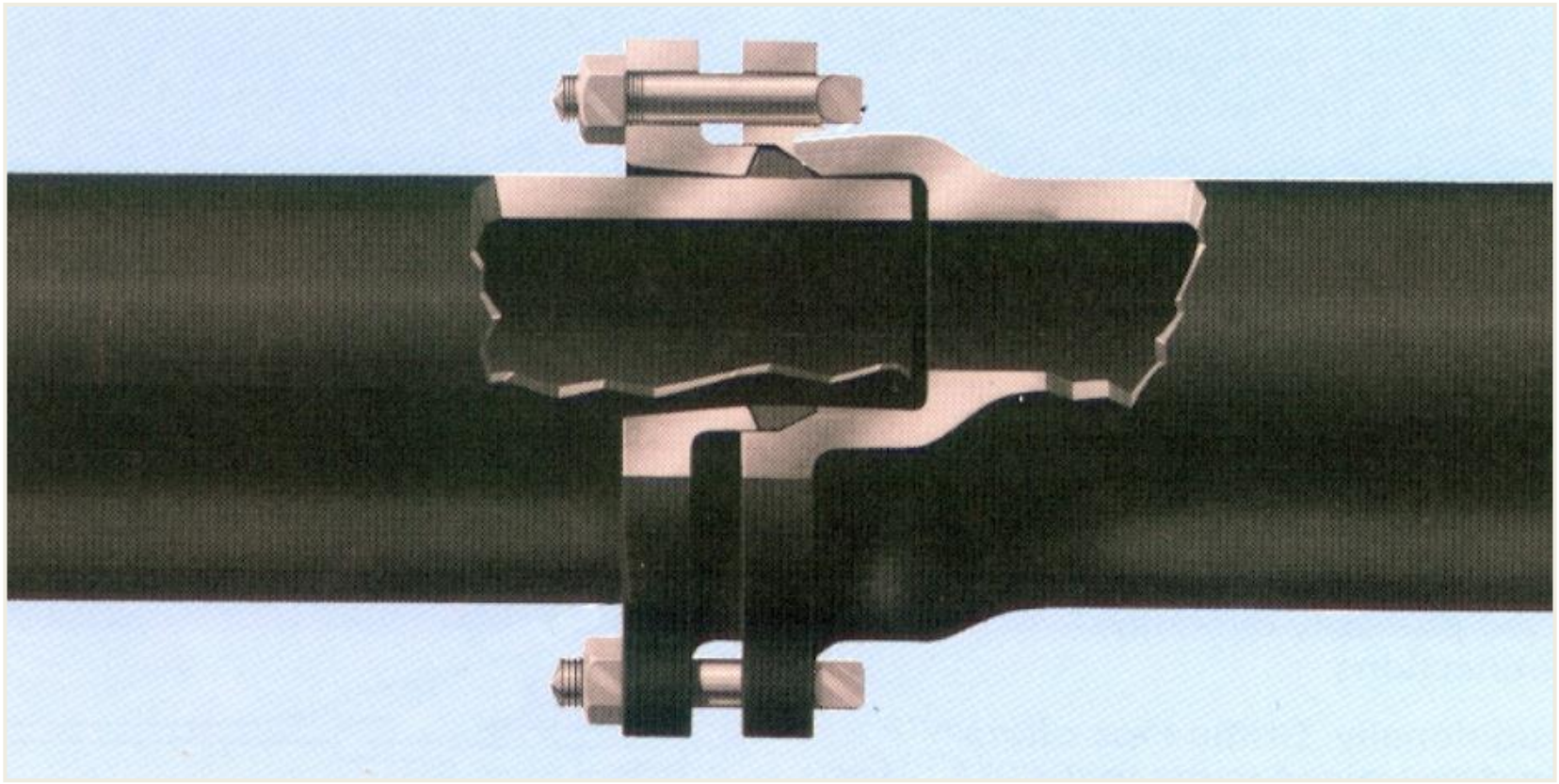
1. Open trench / Cut

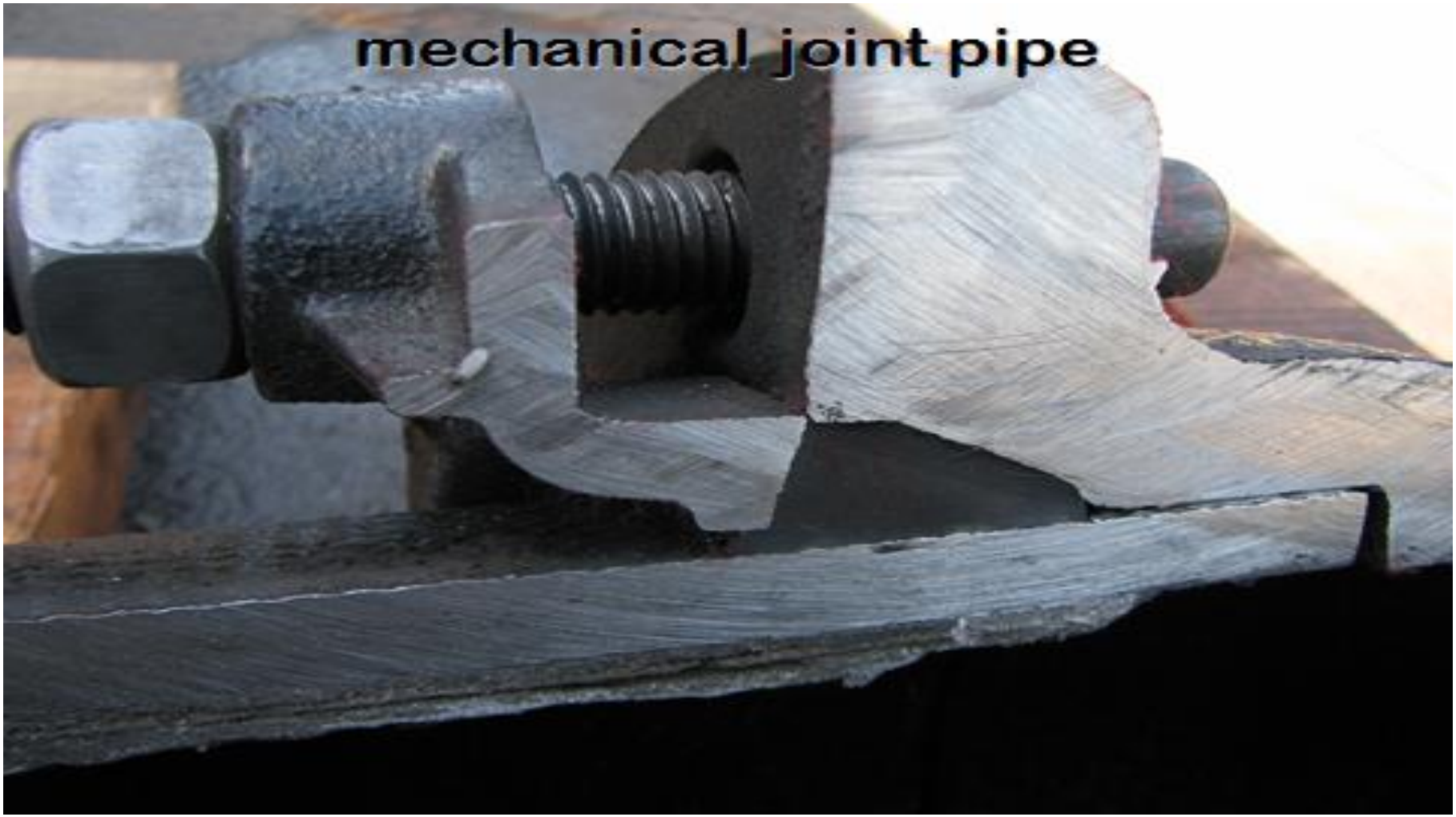
TYTON JOINT®

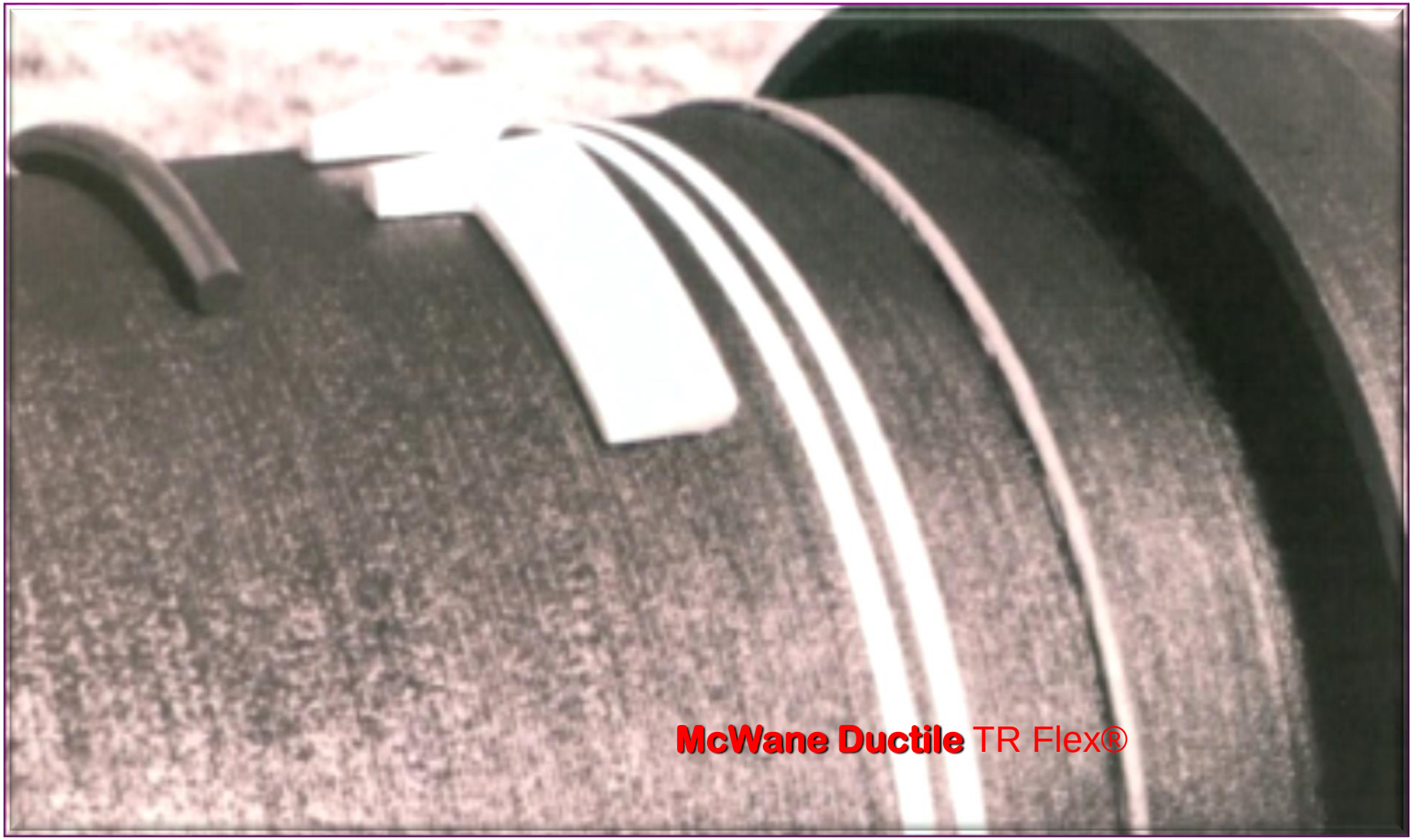



tyton joint pipe
Spigot
Bell

Mechanical Joint




mechanical joint pipe


McWane Ductile TR Flex®

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Increasing number of Engineering Professionals are looking at Sustainable Infrastructure practices for future projects.

Envision® Rating System

Environmental Impact

Lakes / Rivers / Streams.

Urban Impact

Equipment noise.

Sidewalks / Driveways / Roads.

Trench space: 18’ box.

Installation Costs

Weather / time.

Pumping Costs

ID comparison

"To the man who only has a hammer in the tool kit, every problem looks like a nail."

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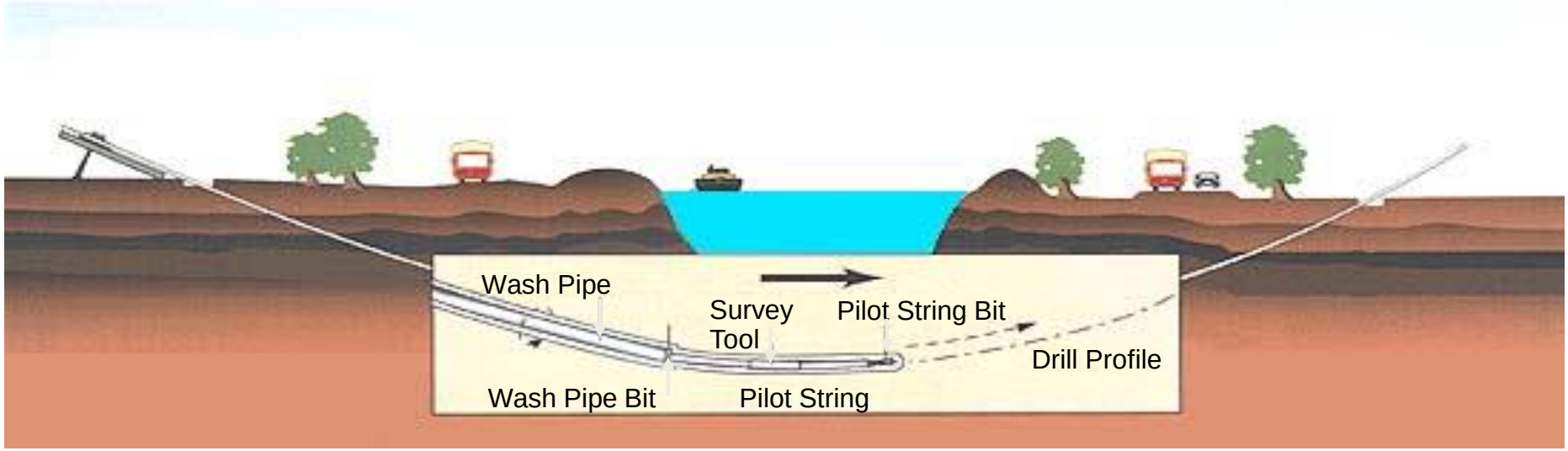
Construction Options for new Pipelines

2. Spanning Utilizing Pier System

Construction Options for new Pipelines

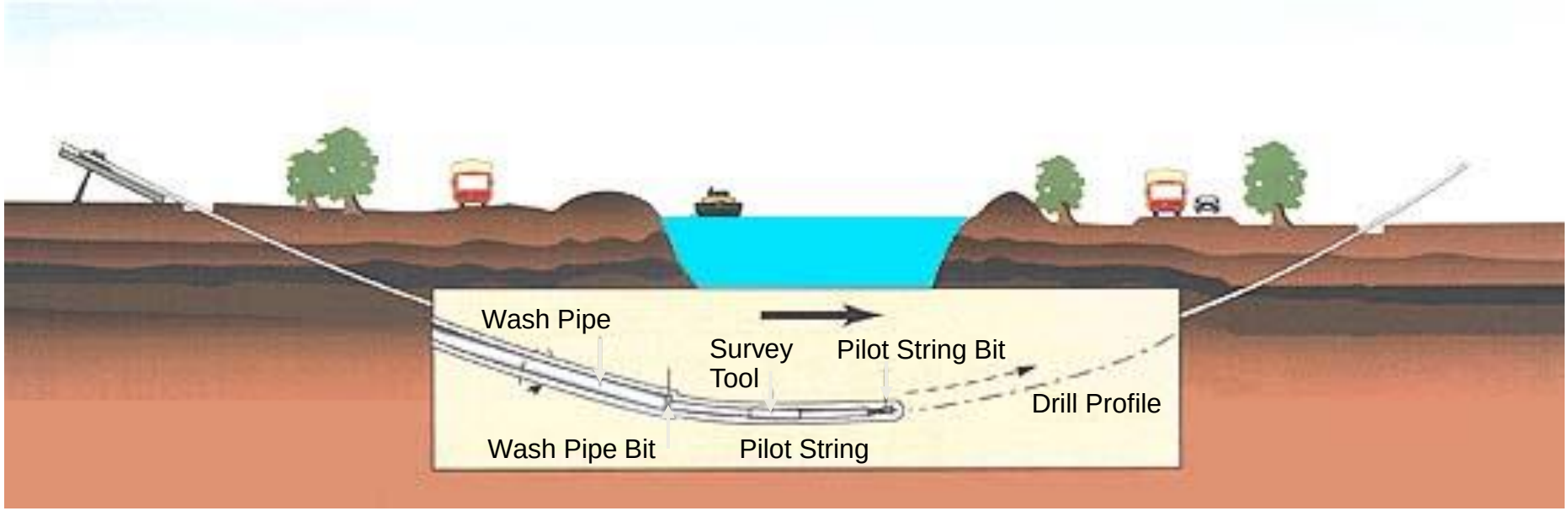
3. Horizontal Directional Drilling

Pilot Hole



- **Set-up Workspace & Equipment**
  - Survey route and establish entry and exit pit locations
  - Set-up drill-rig, power-pack, mud system and navigation system

Pilot Hole

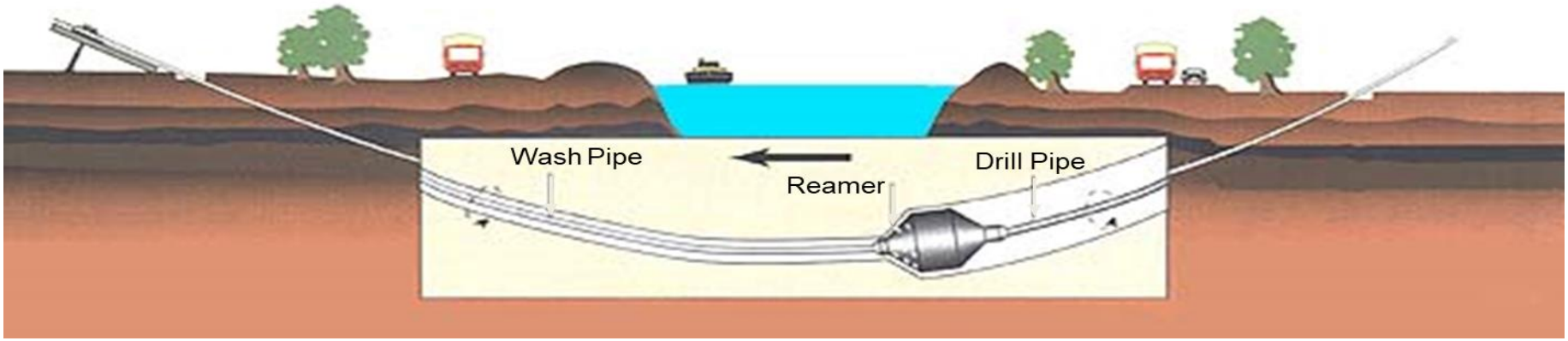


- **Drill Pilot Hole**
  - **Various steerable drill heads used based on soil type**
  - **Walk-over or wire-line type navigation used during drilling**


Inn
BRASS


DustTrak

Preream



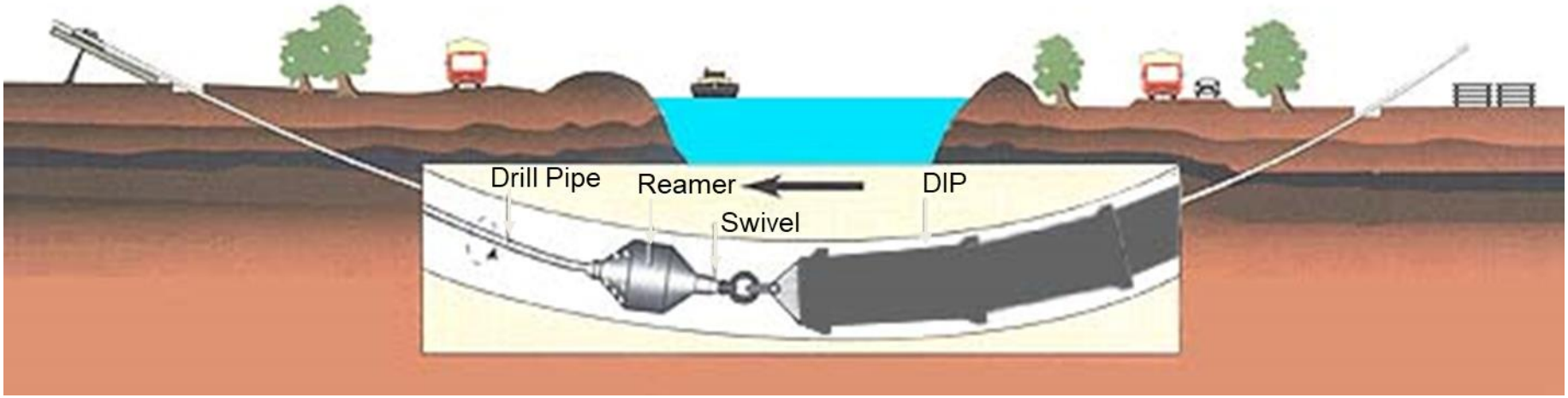
- Typically required for larger pipe diameters
- Hole diameter 1-1/2 times the product pipe diameter

BORING THE HOLE

- Bore size
  - Example: 12” barrel is 13.20
  - Bell OD is 16.43
  - ID of Bore is 24.65”

- Boring Machine
  - Rod Length / pipe length

Pullback



- Installation of product pipe
- Reamer may be used ahead of pipe to maintain clear hole opening
- Drilling fluid (mud slurry) used to lubricate product pipe

hdd with dip

McWANE DUCTILE | IRON STRONG

ACCORDING TO DIPRA

DUCTILE IRON PIPE
HDD Jobs to date:

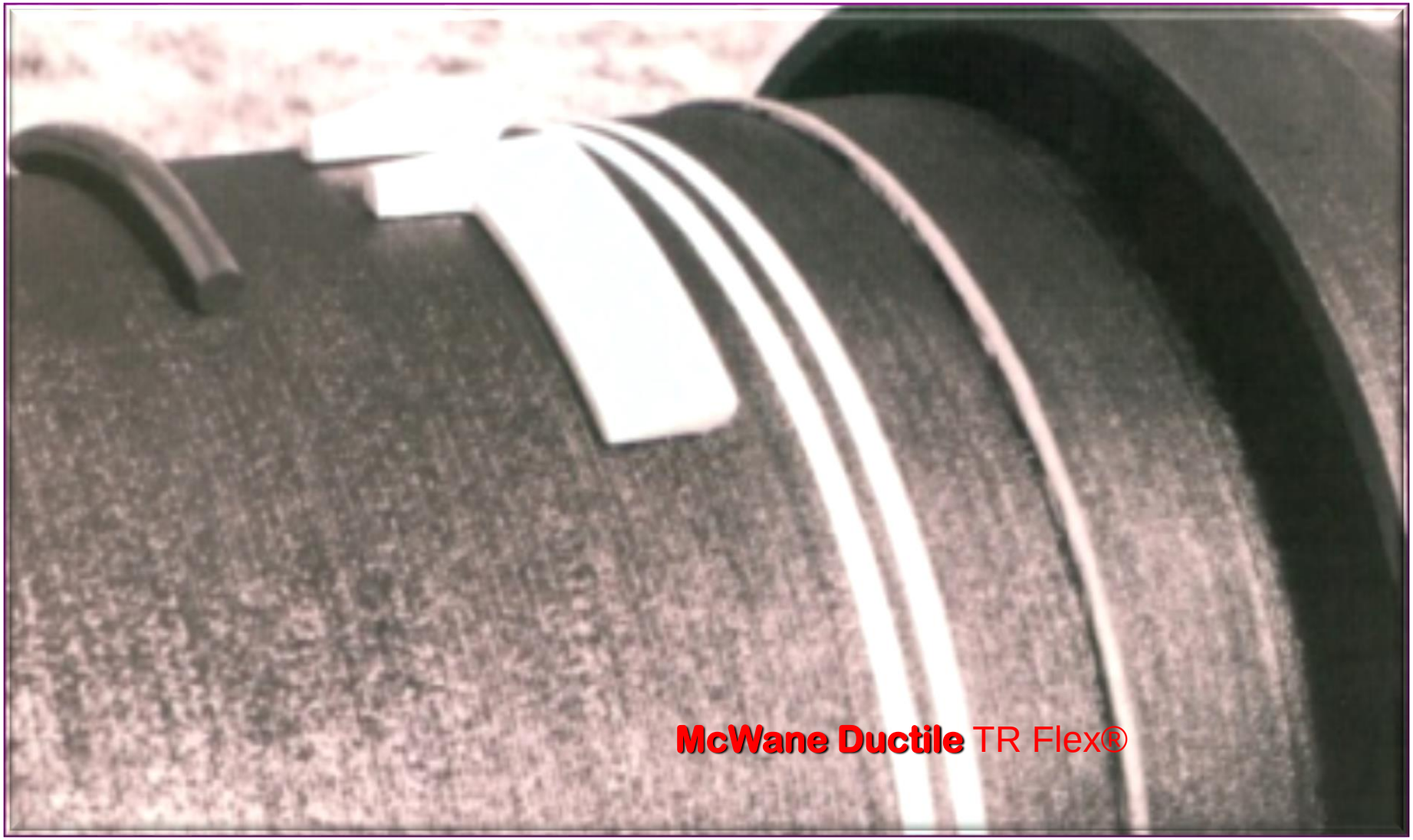
> 200 Pulls in 75+ Locations

- Real Life example: Mobile, Alabama 2016
  - 440 American Auger
  - 440,000 thrust / pull back rating.

  - Pulled:

2700’ 12” TR Flex
C 52
127,500 lbs

  - No Bentonite
  - No spacers


McWane Ductile TR Flex®

RESTRAINED JOINTS

TR Flex

puller heads provided

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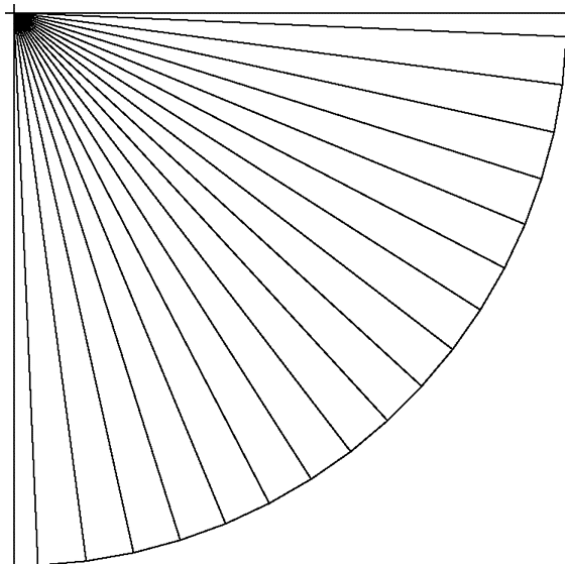
ASSEMBLED – LINE METHOD
STRING OUT METHOD

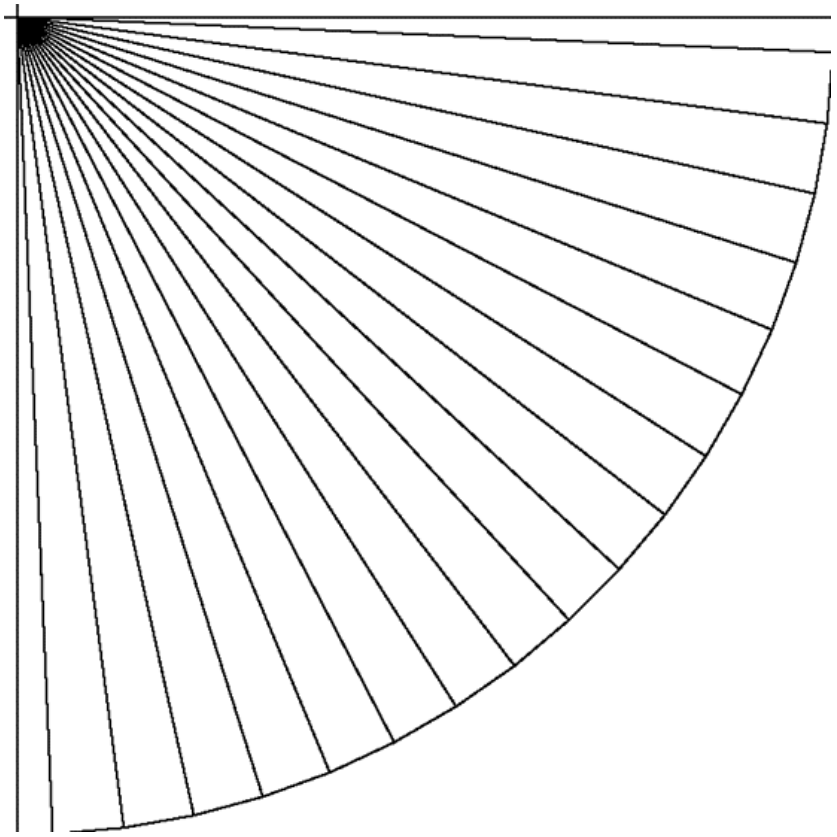
Cartridge Method

The cartridge method involves connecting the joints during installation, one at a time, and is preferred in locations where rights of ways or easements are limited. Ductile Iron pipe restrained joint systems can be quickly assembled as the drill string is retracted. During pull-back the joint assembly normally requires little more time than it takes to disassemble the drill stem sections and store them on the rack. This installation method requires significantly less space or right-of-way requirements than the assembled-line method.

18’ pipe



20’ pipe



18’ = 206’ / 20’ = 229’

Pulling Force Capability

Today some HDD machines are capable of generating tremendous pulling forces. The pipe joint must be capable of withstanding these forces. Ductile Iron pipe manufacturers have proprietary restrained joints with substantial strength that they recommend for HDD applications.

Pipe Bore Path Friction

Case histories have given indications “that pulling loads were less for Ductile Iron pipe than they typically were for similar size HDPE pipe.” One reason for this is that the bulk density of empty Ductile Iron pipe is normally closer to that of the soil/fluid slurry than it is with lighter pipe materials. Therefore, there may often be very little normal force from gravity or buoyancy to result in increased friction against the walls of the bore hole as the pipe is pulled back.

TR FLEX class 52 - PIPE DATA and COMPUTED VALUES USED WITHIN HDD CALCULATOR - TR FLEX class 52

NOMINAL PIPE SIZE	TR FLEX : BARREL OD	TR : BELL OD	TR : AS-CAST LENGTH	TR : JOINT DEFLECTION	TR : MAX TESTED PRESSURE	TR : MAX PULL FORCE	TR : WEIGHT / LENGTH cl 52	TR : MAX PULL LENGTH cl 52	TR : MAX PCS PULL cl 52	NOMINAL PIPE SIZE
(inches)	(inches)	(inches)	(ft - in)	(degrees)	(psi) *	(lbs) **	(lbs)	(feet) ***	(feet) ****	(inches)
4	4.80	7.00	18.10	5.00	1,000	18,096	240	1,365	75	4
6	6.90	9.27	18.06	5.00	1,600	59,829	345	3,132	173	6
8	9.05	11.68	18.02	5.00	1,800	115,788	380	5,491	305	8
10	11.10	14.12	18.00	5.00	1,170	113,221	700	2,911	162	10
12	13.20	16.43	17.98	5.00	1,040	142,323	890	2,875	160	12
14	15.30	18.80	17.85	3.25	1,420	261,075	1,110	4,198	235	14
16	17.40	21.45	17.84	3.25	1,140	271,080	1,305	3,706	208	16
18	19.50	23.40	17.82	3.00	1,010	301,637	1,505	3,572	200	18
20	21.60	25.68	17.80	2.50	1,040	381,096	1,725	3,932	221	20
24	25.80	30.25	17.76	2.25	940	491,429	2,170	4,022	226	24
30	32.00	36.38	17.64	1.75	670	538,851	2,860	3,324	188	30
36	38.30	43.45	17.59	1.50	500	576,051	3,910	2,591	147	36

- Bentonite Clay
- Ductile Iron tends to float in the slurry.
  - Reduces the amount of pulling force required.
    - Unlike HDPE which “rides” on the top side of the bore.
  - TR Flex pipe / sections of chain
- Slurry may not be required for clay or silt soils.

•Will the polywrap remain intact?

•ANSI/AWWA C105-A21 “Alternate Method A for Wet Trench Conditions”

Cathodic Protection may be applied / installed.
Polywrap / V-BIO
Cad weld / bonding joints
Cable Bond is not sufficient
for Cathodic Protection.
TR Flex metal contact is not
sufficient Cathodic Protection.

Why DIP for HDD?

- Strength for installation and operating loads
- Flexible restrained joints
- Hydraulic Advantages – Bigger inside diameter
- Installation options (assembled line & cartridge)
- Locating pipe
- No effect with temperature change/contraction
- No inventory / training issues
- Pipe wall impermeable to VOC's
- Proven Longevity

Why DIP for HDD?

- Effect of scratches on pipe- Gouges deeper than 10%
- Sun exposure – UV Degradation
- No fusion welded joint in the pipe – Speed bump
- Surge Allowance is included in Ductile Iron design
- Future Connections on ductile iron pipe will not require specialized coatings or specialized fusion equipment
- 30” HDPE Requires One Hour To Cool After Fusing
- Odor from fusing HDPE in Urban Areas

OXIDATIVE DEGRADATION

Hamilton, Ohio

We’ve got about 21 miles of HDPE piping in our system now, and it is catastrophically failing, about 60 years ahead of when it should have,” Logan said. “This, back about 20 years ago, was the future of water mains, and unfortunately, the chemicals we use attack the pipe and then cause it to fail. -“You’re starting to see a lot of other municipalities that use standard chlorine, and are still going back to iron pipes,” Logan said. “I don’t know that there is 100-percent agreement out there on which is the best material.” “We’re going back to iron piping.”

(Article in Journal News-Butler County)

McWane makes it easy for you

McWANE DUCTILE

Variable Profile - HDD GEOMETRY CALCULATOR - Variable Profile

McWANE DUCTILE

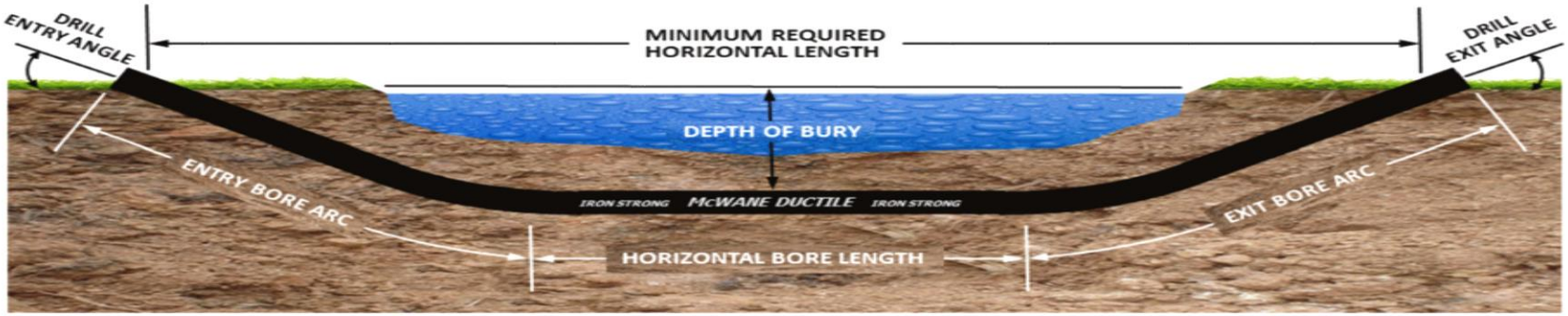
BORE ENTRY INPUT			HORIZONTAL BORE SECTION			BORE EXIT INPUT		
nominal pipe diameter	24	inches	nominal pipe diameter	24	inches	nominal pipe diameter	24	inches
pipe length	17.76	feet	pipe length	17.76	feet	pipe length	17.76	feet
rated deflection	2.25	degrees				rated deflection	2.25	degrees
percentage of deflection used	75.0	percent				percentage of deflection used	75.0	percent
avg. deflection used each joint	1.69	degrees				avg. deflection used each joint	1.69	degrees
depth of bore	30.0	feet	*20-foot minimum clearance of waterway bottom or other obstructions is recommended*			depth of bore	30.0	feet
total planned horizontal length across surface	1,000.0	feet	computed length of horizontal bore section	624.4	feet			

BORE ENTRY COMPUTED RESUTS			HORIZONTAL BORE COMPUTED RESULTS			BORE EXIT COMPUTED RESUTS		
min. avg deflection used	1.69	degrees				min. avg deflection used	1.69	degrees
min. radius of entry bore (arc)	603.0	feet				min. radius of exit bore (arc)	603.0	feet
avg. offset per pipe length	6.3	inches				avg. offset per pipe length	6.3	inches
central angle	0.63	degrees				central angle =	0.63	degrees
min. required horiz surface length	187.8	feet	← *(i.e. computed chord length)* →			min. required horiz surface length	187.8	feet
computed : drilling entry angle (typical range 8° - 16°)	9.2	degrees	*recommendations per 2011 Trenchless Technology Horizontal Directional Drilling Guide*			computed : drilling exit angle (typical range 5° - 12°)	9.2	degrees
min. bore (arc) lay-length down to 30.0 ft	191.0	feet	min. central horizontal bore length	624.4	feet	min. bore (arc) lay-length up from 30.0 feet	191.0	feet
min. number of pipe used for bore entry (arc)	10.8	pieces	min. number of pipe used in central section	35.2	pieces	min. number of pipe used for bore exit (arc)	10.8	pieces

COMPUTED RESULTS ACROSS THE ENTIRE BORE

min. computed horizontal length	1,000.0	feet	
min. total lay-length of entire directional bore	1,006.4	feet	
min. total number of pipe for entire bore	56.7	pieces	
entire bore (with no buoyancy / no drag force) considered utilizes	47.1	percent	of the max. recommended pull force for 24 inch TR Flex class 52 RJ DIP

Contact a McWane Ductile Product Engineer http://mcwaneductile.com/sales-support/marketing-specifications/ for additional design considerations and information



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QUESTIONS?