



# Anatomy of a Petroleum Storage Tank System As It Relates to Cleanup

**Presenter: Chip Green, PE, Palm Beach County  
Department of Environmental Resources Management  
(DERM)**

Tallahassee, FL | April 28-30, 2026



# COMPLIANCE-CLEANUP CONNECTION

- An “incident” is defined as a condition or situation indicating that a release or discharge may have occurred from a storage tank system or system component and must be reported on an Incident Notification Form.



# COMPLIANCE-CLEANUP CONNECTION

- Discharges must be reported on a Discharge Reporting Form (DRF), except for “de minimis discharges”, which are defined as discharges of petroleum or petroleum products of less than 25 gallons onto a pervious surface or that move onto a pervious surface from an impervious surface.
  - Such discharges are exempt from the notification requirements of subsection 62-780.220(1), rules 62-780.500 and 62-780.525, Florida Administrative Code (F.A.C.) as long as the discharge is removed and properly treated or properly disposed, or otherwise remediated, pursuant to the applicable provisions of rule 62-780.500 or 62-780.525, F.A.C., so that Cleanup Target Levels (CTLs) or background concentrations pursuant to subsection 62-780.680(1), F.A.C., are achieved.



# HISTORY OF TANK REGULATION IN FLORIDA - NOTABLE LANDMARKS

- **1983:** Florida was one of the first states to pass legislation and adopt rules for storage tank systems in the Water Quality Assurance Act. This included monitoring requirements and line leak detectors.
- **1988:** Line leak detectors are required by federal mandate.
- **1990:** Overfill protection first required (per original rule, Ch. 17-61, FAC).
- **1994:** Current rule first adopted (Ch. 62-761 and 62-762, FAC, both since revised).



# HISTORY OF TANK REGULATION IN FLORIDA - NOTABLE LANDMARKS

- **1992:** The deadline for owner/operators to install spill containment.
- **1998:** The deadline for owner/operators to install dispenser liners.
- **2010:** The deadline by which all existing Underground Storage Tanks (UST's), underground PRODUCT piping (except vertical fill pipes) and piping over water had to be upgraded to double-wall.



# SITE HISTORY

- OCULUS – In the “Discovery\_Compliance” Profile, inspection reports, etc.
- FIRST Cover Page for tank info.
  - <https://prodapps.dep.state.fl.us/firstreports/>
- Local sources, e.g. Palm Beach County’s “Cinema” database, or archived files.

A screenshot of a web browser displaying the "FIRST PUBLIC REPORTS" website. The page title is "FIRST PUBLIC REPORTS" and the subtitle is "Division of Waste Management Storage Tank Compliance". The main heading reads "Welcome to FIRST Public Reports" with the date "Thursday, December 11, 2025". Below the heading is a list of report types: "Inspections", "Areas of Concern and Violations Report", "Cover Page Report", "Journal Report", "Percent Routine Compliance Completed Report", "Inspections By County And Date Range", "Inspector Activities Report", and "Compliance And Enforcement Activity By Date Range". A red arrow points to the "Cover Page Report" link, which is circled in red. The footer includes the PHP logo, version information "firstreports - 1.0.85", and contact information for the Florida Department of Environmental Protection.

prodapps.dep.state.fl.us/firstreports/

Outlook Web App USACE Jaxbo new... isopach - Google Se... Relationship of void... How Much Void in... Packing and voids f... Large XYZ File - Aut... All Bookmarks

**FIRST PUBLIC REPORTS** Division of Waste Management  
Storage Tank Compliance

Home Help Login

Welcome to FIRST Public Reports  
Thursday, December 11, 2025

Inspections

Areas of Concern and Violations Report

Cover Page Report

Journal Report

Percent Routine Compliance Completed Report

Inspections By County And Date Range

Inspector Activities Report

Compliance And Enforcement Activity By Date Range

php firstreports - 1.0.85  
Florida Department of Environmental Protection  
Site Map - For Business Issues, call (850) 245-2465 ; For Technical Assistance, call (850) 245-7555 or Contact us via ema

https://prodapps.dep.state.fl.us/firstreports/

Page 5 of 8 2 of 3512 Words Text Predictions: On Accessibility: Unavailable



# COMPLIANCE DOCUMENTS

**OCULUS** Search Actions Tools Help

### Search

**Catalog**

- Solid waste
- State 404 Programs
- State Revolving Fund
- Storage Tanks
- Underground Injection Control
- Waste Cleanup
- Wastewater

**Search By**

Profile

**Profile**

- Administrative
- Cleanup\_Remediation
- Discovery\_Compliance**
- DWM Historical Repository
- Eligibility
- Enforcement\_Legal

**Sort By** Document Date  **Type** Any

**Creator** **Folder Name**

**Created** MM-DD-YYYY

**County** =

**District** =

**Facility-Site ID** =  ...

**Document Date** From MM-DD-YYYY  To MM-DD-YYYY

**Received Date** From MM-DD-YYYY  To MM-DD-YYYY

**Document Type** =

**Contractor ID** =  ...

**Inspection Type** =

**Facility Type** \*

**Application Number** =

**Permit Number** =

**Document Subject** =



# SITE HISTORY - FIRST COVER PAGE

Tank	Tank Size	Content	Installed	Placement	Status
1R1	15000	Unleaded Gas (B)	05/01/2006	UNDERGROUND	In Service (U)

**Constructions**

(A) Ball check valve  
 (E) Fiberglass  
 (I) Double wall  
 (M) Spill containment bucket  
 (O) Tight fill  
 (P) Level gauges/alarms

**Pipings**

(C) Fiberglass  
 (F) Double wall  
 (J) Pressurized piping system  
 (K) Dispenser liners

**Monitorings**

(1) Continuous electronic sensing  
 (3) Electronic monitor pipe sumps  
 (4) Visual inspect dispenser liners  
 (F) Monitor dbi wall tank space  
 (H) Mechanical line leak detector  
 (K) Monitor dbi wall pipe space

Tank	Tank Size	Content	Installed	Placement	Status
2R1	12000	Unleaded Gas (B)	05/01/2006	UNDERGROUND	In Service (U)

**Constructions**

(A) Ball check valve  
 (E) Fiberglass  
 (I) Double wall  
 (M) Spill containment bucket  
 (O) Tight fill  
 (P) Level gauges/alarms

**Pipings**

(C) Fiberglass  
 (F) Double wall  
 (J) Pressurized piping system  
 (K) Dispenser liners

**Monitorings**

(1) Continuous electronic sensing  
 (3) Electronic monitor pipe sumps  
 (4) Visual inspect dispenser liners  
 (F) Monitor dbi wall tank space  
 (H) Mechanical line leak detector  
 (K) Monitor dbi wall pipe space

Tank	Tank Size	Content	Installed	Placement	Status
3R1	10000	Vehicular Diesel (D)	05/01/2006	UNDERGROUND	In Service (U)

**Constructions**

(A) Ball check valve  
 (E) Fiberglass  
 (I) Double wall  
 (M) Spill containment bucket  
 (O) Tight fill  
 (P) Level gauges/alarms

**Pipings**

(C) Fiberglass  
 (F) Double wall  
 (J) Pressurized piping system  
 (K) Dispenser liners

**Monitorings**

(1) Continuous electronic sensing  
 (3) Electronic monitor pipe sumps  
 (4) Visual inspect dispenser liners  
 (F) Monitor dbi wall tank space  
 (H) Mechanical line leak detector  
 (K) Monitor dbi wall pipe space

Tank	Tank Size	Content	Installed	Placement	Status
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1	12000	Unleaded Gas (B)	07/01/1982	UNDERGROUND	Removed from Site (B)
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**Constructions**

(A) Ball check valve  
 (E) Fiberglass  
 (M) Spill containment bucket

**Pipings**

(C) Fiberglass  
 (F) Double wall  
 (J) Pressurized piping system  
 (K) Dispenser liners

**Monitorings**

(4) Visual inspect dispenser liners  
 (H) Mechanical line leak detector  
 (L) Automatic tank gauging - USTs

Tank	Tank Size	Content	Installed	Placement	Status
2	10000	Unleaded Gas (B)	07/01/1982	UNDERGROUND	Removed from Site (B)

**Constructions**

(A) Ball check valve  
 (E) Fiberglass  
 (M) Spill containment bucket

**Pipings**

(C) Fiberglass  
 (F) Double wall  
 (J) Pressurized piping system  
 (K) Dispenser liners

**Monitorings**

(4) Visual inspect dispenser liners  
 (H) Mechanical line leak detector  
 (L) Automatic tank gauging - USTs

Tank	Tank Size	Content	Installed	Placement	Status
3	6000	Unleaded Gas (B)	07/01/1982	UNDERGROUND	Removed from Site (B)

**Constructions**

(A) Ball check valve  
 (E) Fiberglass  
 (M) Spill containment bucket

**Pipings**

(C) Fiberglass  
 (F) Double wall  
 (J) Pressurized piping system  
 (K) Dispenser liners

**Monitorings**

(4) Visual inspect dispenser liners  
 (H) Mechanical line leak detector  
 (L) Automatic tank gauging - USTs

Tank	Tank Size	Content	Installed	Placement	Status
4	6000	Unleaded Gas (B)	07/01/1982	UNDERGROUND	Removed from Site (B)

**Constructions**

(A) Ball check valve  
 (E) Fiberglass  
 (M) Spill containment bucket

**Pipings**

(C) Fiberglass  
 (F) Double wall  
 (J) Pressurized piping system  
 (K) Dispenser liners

**Monitorings**

(4) Visual inspect dispenser liners  
 (H) Mechanical line leak detector  
 (L) Automatic tank gauging - USTs

Tank	Tank Size	Content	Installed	Placement	Status
5	250	Waste Oil (L)	04/01/1982	UNDERGROUND	Removed from Site (B)

**Constructions**

(A) Ball check valve  
 (E) Fiberglass  
 (M) Spill containment bucket

**Pipings**

(C) Fiberglass

**Monitorings**



# WHY IS THIS HISTORY IMPORTANT?



Credit: PBCo DERM

- Facilities that are out of compliance are now in cleanup.
- Many discharges currently being remediated were reported 30 years ago or more.



# WHY IS THIS HISTORY IMPORTANT?

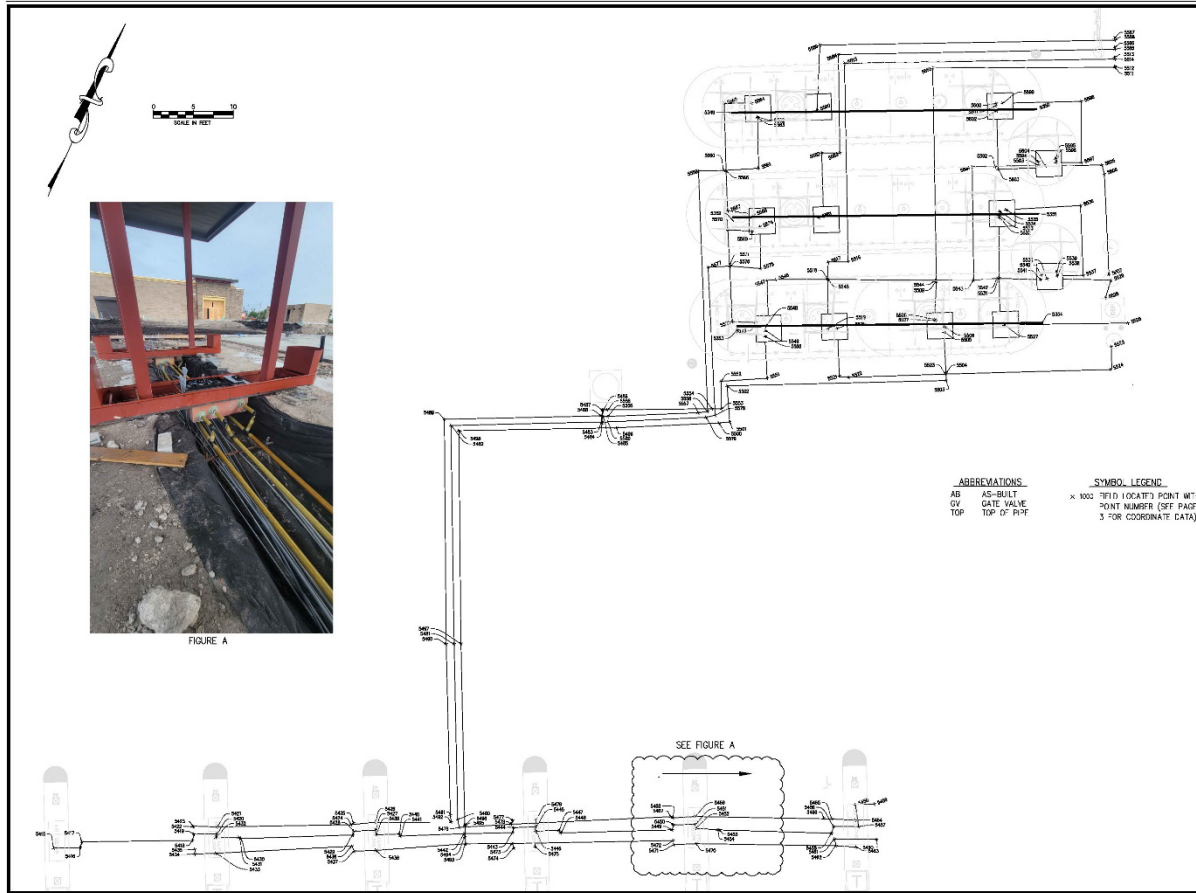


Credit: PBCo DERM

- Understanding of site characteristics, past and present, is germane to remediation design and implementation.
- As-built drawings have been required since 2017.



# AS-BUILTS, REQUIRED SINCE 2017

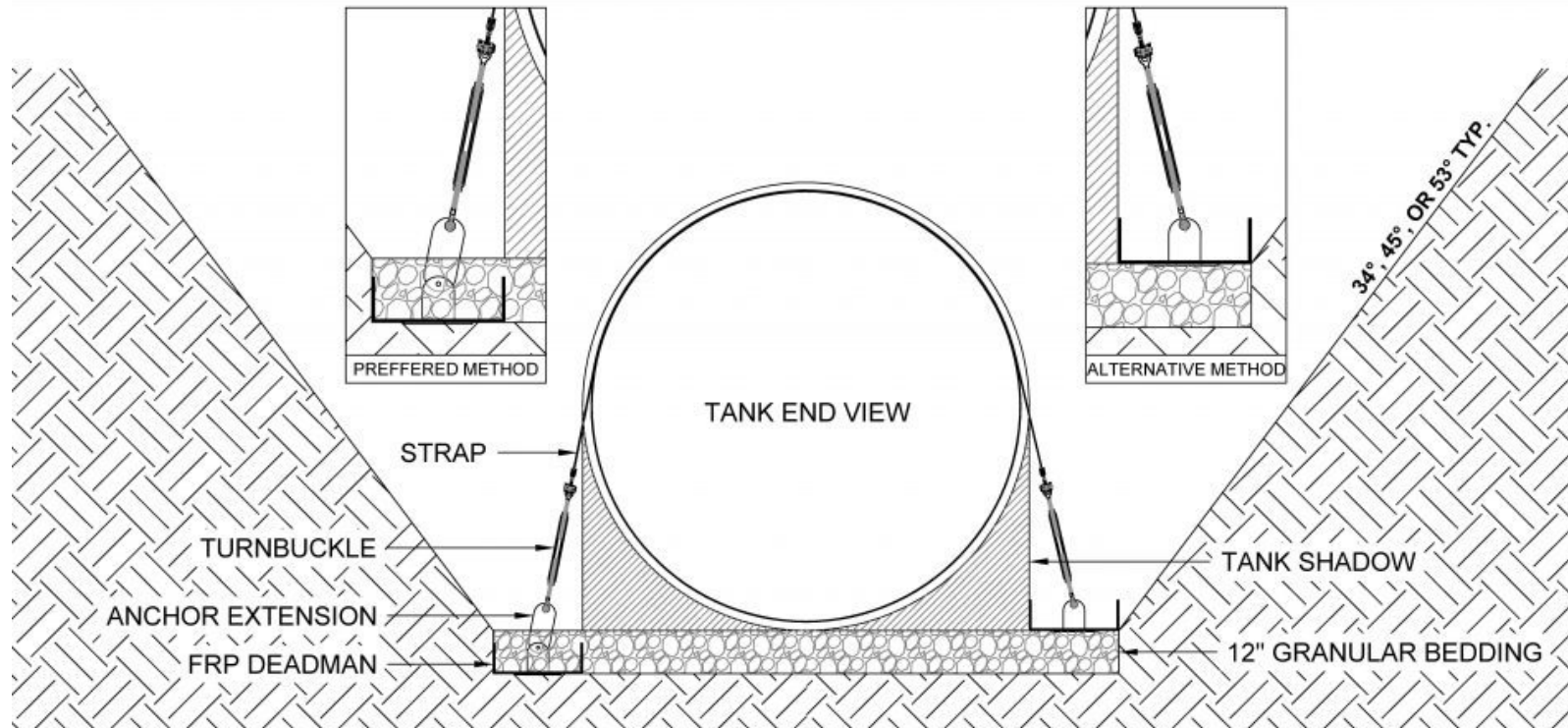


AS-BUILT PIPING				
Point #	Description	Elevation	Horizontal	Existing
5415	TOP 80 AB	11.491	850280.7380	746874.5870
5416	TOP 80 AB	11.517	850280.1772	746877.5582
5417	TOP 80 AB	8.978	850285.9230	746877.4752
5418	TOP 80 AB	8.605	850276.7730	746880.8902
5419	TOP 80 AB	11.332	850276.5740	746889.8902
5420	TOP 80 AB	11.340	850276.7380	746892.4180
5421	TOP 80 AB	11.304	850277.5780	746892.3872
5422	TOP 80 AB	11.082	850276.3520	746893.2222
5423	TOP 80 AB	8.596	850272.4200	746898.7982
5424	TOP TEE AB	8.425	850284.9880	746901.2870
5425	TOP 80 AB	10.662	850283.0712	746907.4642
5426	TOP 80 AB	10.830	850286.2840	746908.0770
5427	TOP 80 AB	11.173	850286.4320	746910.3170
5428	TOP 80 AB	11.149	850284.1682	746907.8202
5429	TOP 80 AB	8.981	850283.9480	746908.8700
5430	TOP 80 AB	8.472	850277.4720	746895.4270
5431	TOP 80 AB	11.151	850276.5520	746895.1580
5432	TOP 80 AB	11.363	850276.3370	746892.2322
5433	TOP 80 AB	11.571	850271.5200	746883.2002
5434	TOP 80 AB	11.517	850273.3380	746893.9572
5435	TOP 80 AB	9.946	850273.8972	746893.4242
5436	TOP TEE AB	8.372	850282.3420	746908.8002
5437	TOP 80 AB	11.789	850281.8982	746908.8970
5438	TOP 80 AB	11.356	850283.1002	746907.8020
5439	TOP 80 AB	11.168	850281.8820	746905.8580
5440	TOP 80 AB	11.156	850280.1572	746911.9002
5441	TOP 80 AB	8.357	850288.0380	746915.1640
5442	TOP 80 AB	8.324	850288.5740	746915.8352
5443	TOP 80 AB	8.332	850282.1832	746916.2842
5444	TOP 80 AB	11.020	850282.8280	746923.3872
5445	TOP 80 AB	11.034	850284.2712	746928.4270
5446	TOP 80 AB	11.013	850285.5530	746933.9882
5447	TOP 80 AB	11.077	850285.8072	746933.2450
5448	TOP 80 AB	8.395	850284.0300	746933.8720
5449	TOP 80 AB	8.494	850300.7500	746941.1330
5450	TOP 80 AB	10.893	850301.3782	746944.2082
5451	TOP 80 AB	10.808	850302.5500	746946.4392
5452	TOP 80 AB	10.903	850303.1780	746948.3172
5453	TOP 80 AB	10.685	850303.1110	746945.5270
5454	TOP 80 AB	8.726	850300.0470	746950.7880
5455	TOP 80 AB	8.728	850303.4920	746951.4982
5456	TOP 80 AB	11.713	850306.4900	746952.3662
5457	TOP 80 AB	10.628	850303.7502	746958.2100
5458	TOP 80 AB	10.533	850343.0902	746963.1270
5459	TOP 80 AB	10.800	850343.5502	746963.5352
5460	TOP 80 AB	8.924	850303.3302	746967.8402
5461	TOP 80 AB	10.863	850303.3850	746968.1800
5462	TOP 80 AB	10.863	850303.3850	746968.1800
5463	TOP 80 AB	10.863	850303.3850	746968.1800

Credit: Betsy Lindsay, A Division of Haley Ward, Inc.



# UST BALLASTING



Credit: Fiberglass Tank Solutions, LLC



# UST BUOYANCY CALCULATIONS

## Assumptions:

- Complete submersion.
- Empty tank.

**Deadmen are not always necessary. Buoyancy calculations must be provided.**

TANK OVER-BUOYANCY CALCULATION				
	#1	#2	#3	TOTAL
FUEL STORAGE TYPE	GASOLINE	GASOLINE	DIESEL	
TANK CAPACITY	15,000	12,000	10,000	
TANK MATERIAL	FIBERGLASS	FIBERGLASS	FIBERGLASS	
TANK LENGTH (ft)	46.8	37.0	31.5	
TANK DIA (ft)	8.0	8.0	8.0	
BURIAL DEPTH (ft)	3.0	3.0	3.0	
TANK WEIGHT (lb)	6,400	5,000	4,300	15,700
TANK PROFILE (cu.ft.)	1122	888	756	
ADDITIONAL COVER	759	624	548	
FILL COVER WEIGHT *	112,884	90,743	78,253	281,879
CONCRETE SLAB **	34'x53'x8"	@87.6 lb/cu.ft.		66,686
DEADMAN (12'x12") **	8,191	6,482	5,519	20,192
DEADMAN COVER WEIGHT	61,710	48,840	41,580	152,130
EQUIPMENT ON TANKS	25	25	25	50
MANWAY DISPLACEMENT WEIGHT				(5,170)
<b>TOTAL DOWN WEIGHT</b>				<b>531,466</b>
TANK CAPACITY	15,000	12,000	10,000	
CAVITY VOLUME	284	227	189	
TANK BUOYANCY	(127,499)	(101,998)	(84,997)	<b>(314,493)</b>
<b>NET OVERBURDEN</b>				<b>216,973</b>
<b>FACTOR OF SAFETY</b>				<b>1.69</b>
* 60 lb/ cu.ft.				
** 87.6 lb/ cu.ft.				

Credit: Bob Marshall, PE



# UST BALLASTING – WHY DO IT?

Hurricane  
Matthew 2016



Credit: US EPA Underground Storage Tank Flood Guide and  
North Carolina Dept. of Environmental Quality



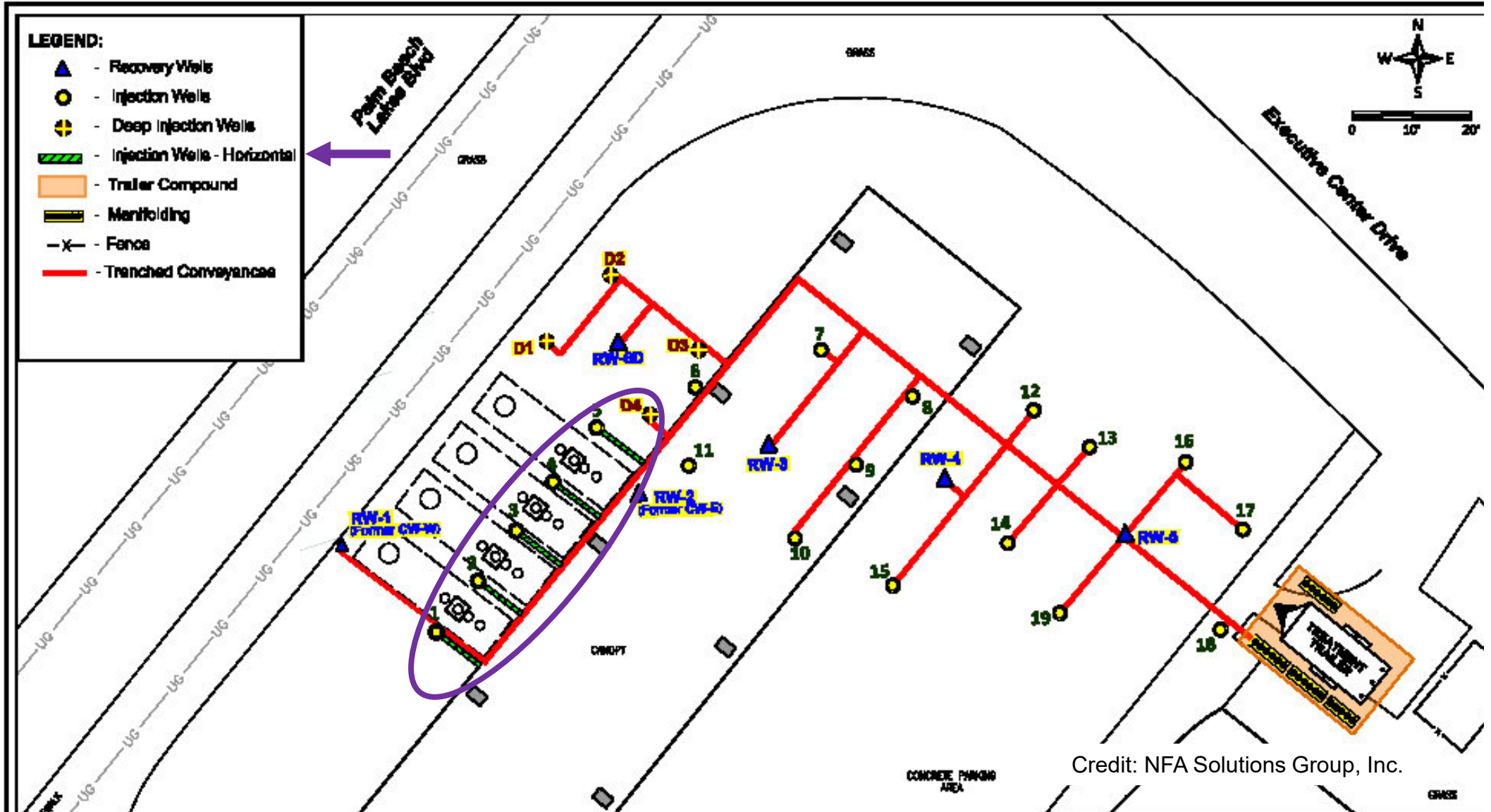
# UST BALLASTING – WHY DO IT?



Credit: tanksdirect.com (Octagon Services, Inc.)



# REMEDIATION IN AN UST TANK PIT... BE CAREFUL!





# PEA ROCK CONSIDERATIONS



- The majority of tanks are backfilled with pea rock, a.k.a., pea gravel.
- It compacts well and flows into voids such as the tank shadow better than sand.

Credit: PBCo DERM



# PEA ROCK CONSIDERATIONS



- Grain/particle size is small enough, so the tank surface is not damaged.
- Protects the tank from damage by rocks and debris in native soil.

Credit: PBCo DERM



# PEA ROCK CONSIDERATIONS



Credit: PBCo DERM

- Is technically #78 stone (3/8"-1/4").
- #67 crushed stone is often sold as “pea rock”. Particle size is ~3/4”.
- The hydraulic conductivity (k) of pea rock is 1,000-30,000 ft/day (depending on compaction).



# PEA ROCK CONSIDERATIONS



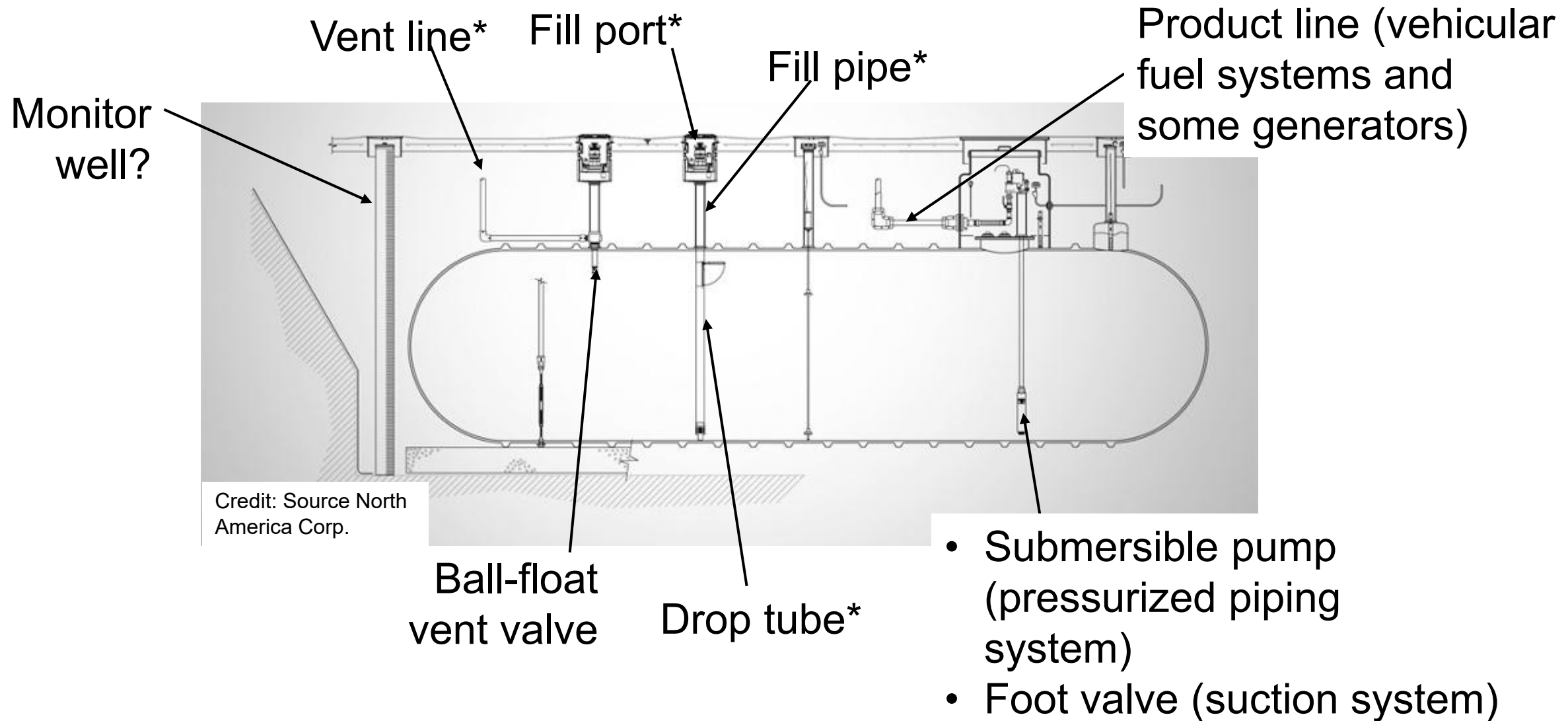
Credit: PBCo DERM

- The hydraulic conductivity ( $k$ ) of consolidated sand is 10-1,000 ft/day.
- Silty and clayey soils have even less conductivity/permittivity.



# SINGLE-WALL UST COMPONENTS

## SIDE VIEW





# SINGLE-WALL UST MONITORING

At the annual Department of Environmental Protection (DEP) compliance inspection, inspectors would typically:

- Review monthly monitor well logs kept by the facility.
- Review weekly inventory reconciliation done by the facility.
- Use a vapor analyzer in the monitor wellheads.
- Bail the wells.



Credit: ebay.com

Gastech Vapor Analyzer



# AUTOMATIC TANK GAUGING (ATG) AND ELECTRONIC MONITORING



Credit: The Veeder-Root Company.

- First saw limited use in the 1980's, primarily with single-wall systems as a form of electronic inventory control capable of detecting a leak of 0.2 gallons per hour (gph).
- They proved to be reliable and gained popularity due to their facilitation of fuel inventory. Tank owners no longer had to stick their tanks; they could have a very accurate measurement instantly.



# AUTOMATIC TANK GAUGING (ATG) AND ELECTRONIC MONITORING

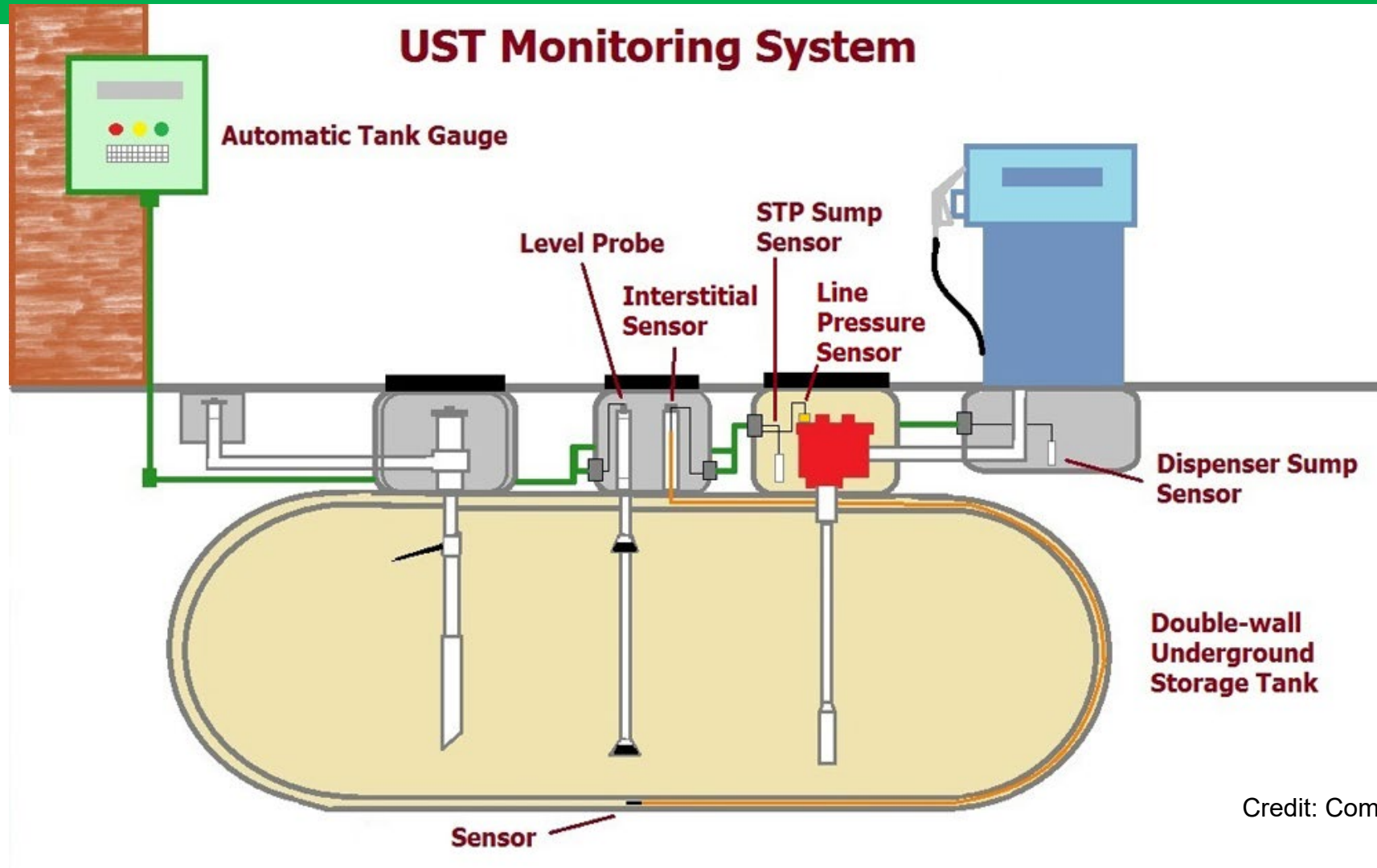


Credit: The Veeder-Root Company.

- With the advent of secondary containment components in the 1990's, liquid sensors became commonplace accessories.



# DOUBLE-WALL UST MONITORING



Credit: CommTank, Inc.



# D.W. FIBERGLASS UST



Collar for attaching a sump with epoxy.

Tank annulus (i.E., Interstice) is brine-filled. For operational monitoring, a liquid level sensor is installed here.

Credit: PBCo DERM



# D.W. FIBER-GLASS-CLAD STEEL UST



Sump is bolted to tank top and sealed with an o-ring on this model.

Tank is shipped with the annulus under vacuum. Operational monitoring is normally by vacuum gauge/sensor or liquid detecting sensor, though a tank stick could be used.

Credit: tanksdirect.com (Octagon Services, Inc.)



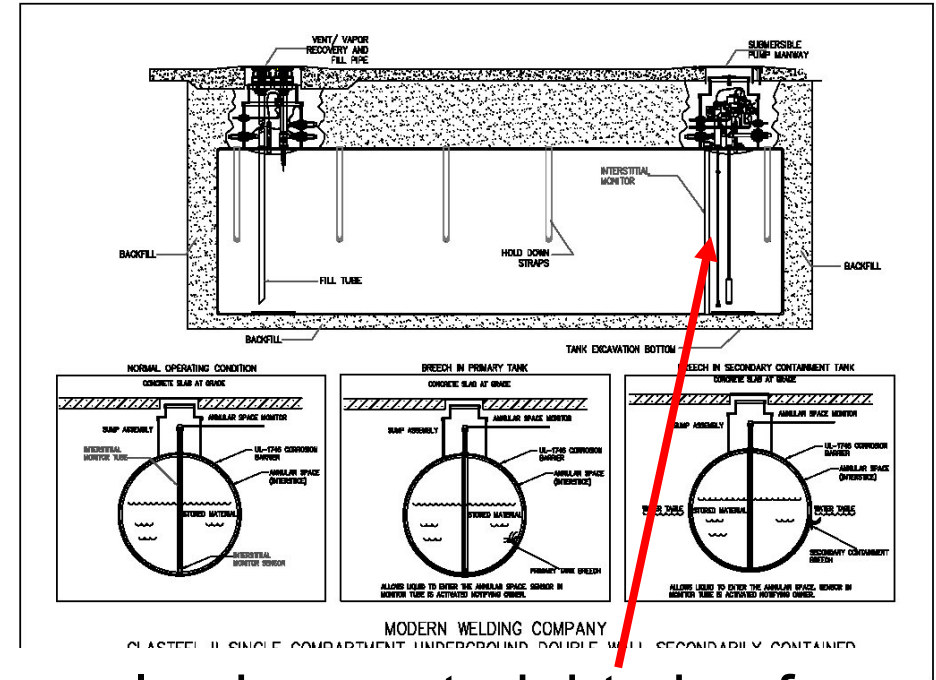
# D.W. FIBER-GLASS-CLAD STEEL UST

Credit: Modern Welding Co., Inc.



Credit: Modern Welding Co., Inc.

These tanks have optional sump collars.

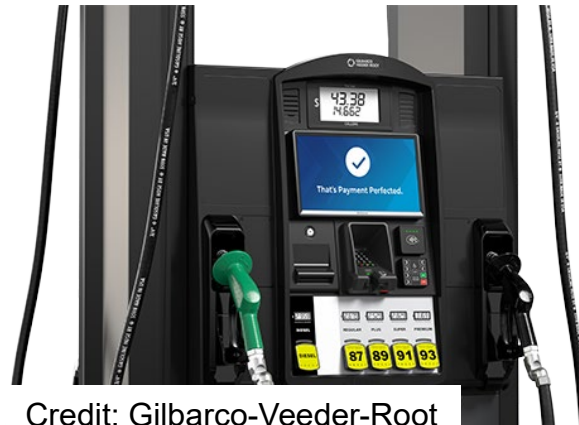


The annulus has a straight pipe for monitoring. Annulus is intended to remain dry. Operational monitoring is normally by vacuum or liquid sensor, though a tank stick could be used.



# SUPPLY PIPING (“PRODUCT LINES”) MAJOR TYPES

I. Pressurized System  
– almost all retail stations, and the majority of other **vehicular** fueling facilities. A Submersible Turbine Pump (STP) pushes the fuel from the bottom of the tank to a dispenser. The line stays pressurized, even when the pump is off.



Pressurized Piping: Multi-product dispenser (MPD)

Credit: John M. Ellsworth Co., Inc.





# SUPPLY PIPING (“PRODUCT LINES”) MAJOR TYPES

II. Suction System – small private vehicular fueling systems, and most emergency generator tanks. The pump is in the dispenser, and pulls the fuel from the tank.



Pressurized Piping: Multi-product dispenser (MPD)

Credit: John M. Ellsworth Co., Inc.



Typical suction pump and dispenser



# RETAIL PRODUCT LINES

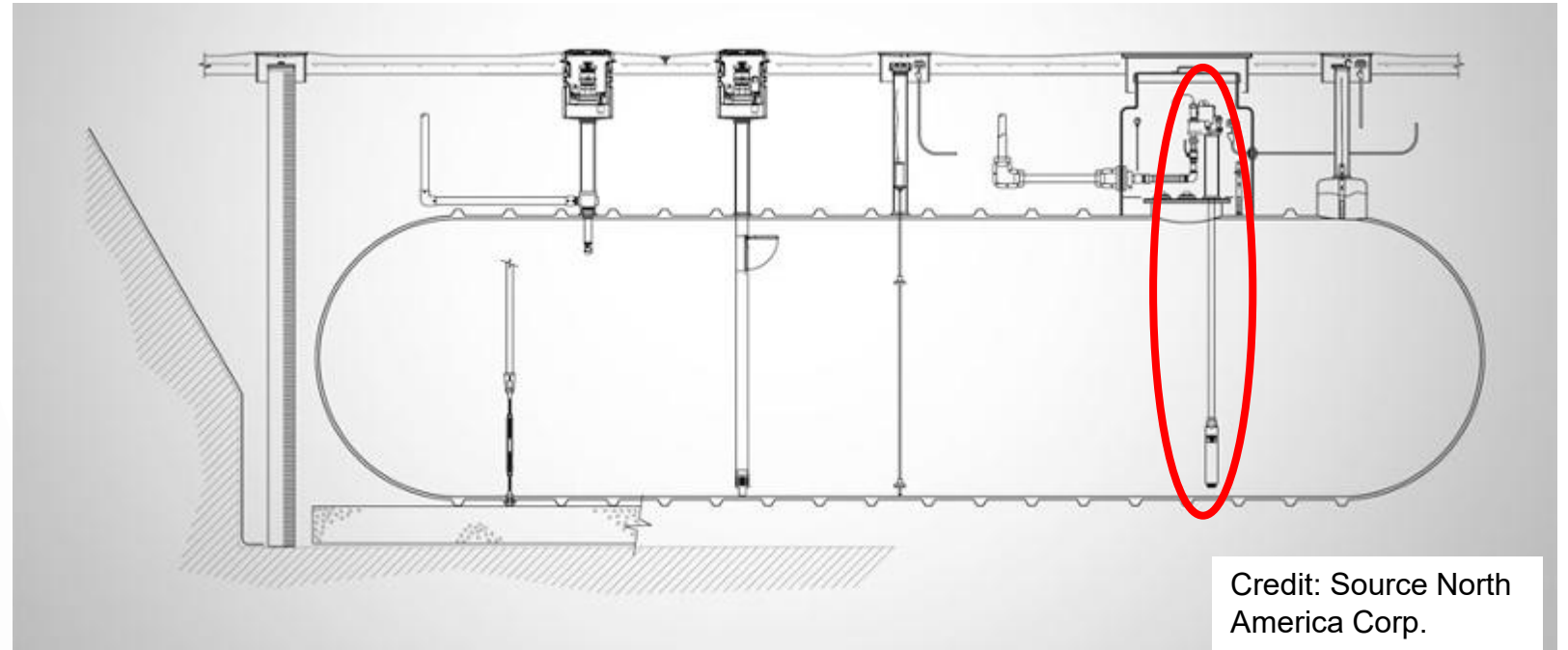
- Pressurized systems. Fuel is pushed by a submersible pump located at the bottom of the tank.
- Could be fiberglass or plastic (a.k.a. “flex” pipe).
- Primary pipe almost always 2” diameter, typically delivering 8-12 gallons per minute (gpm) @ 30 pounds per square inch (psi).
- Secondary (outer containment pipe) is either coaxial with the primary or 1” larger in diameter than the primary line.
- Many truck stops have “high-flow” STP’s, or two standard STP’s per line, and 3” diameter primary pipe. These systems deliver 30+ gpm @ 40-80 psi.



# SUBMERSIBLE TURBINE PUMPS (STP's)

“Manifold”,  
or “Packing”

Turbine  
Pump

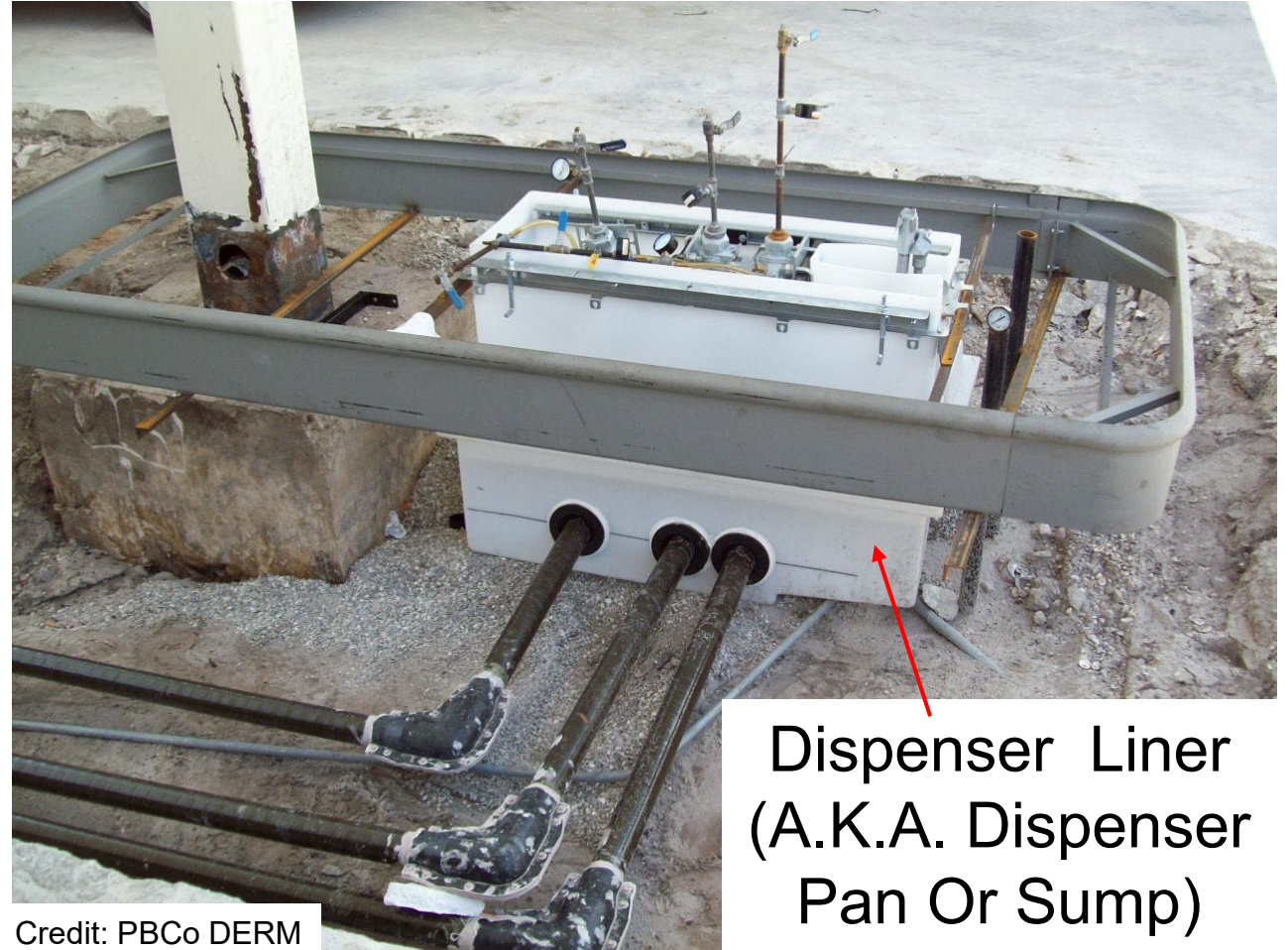
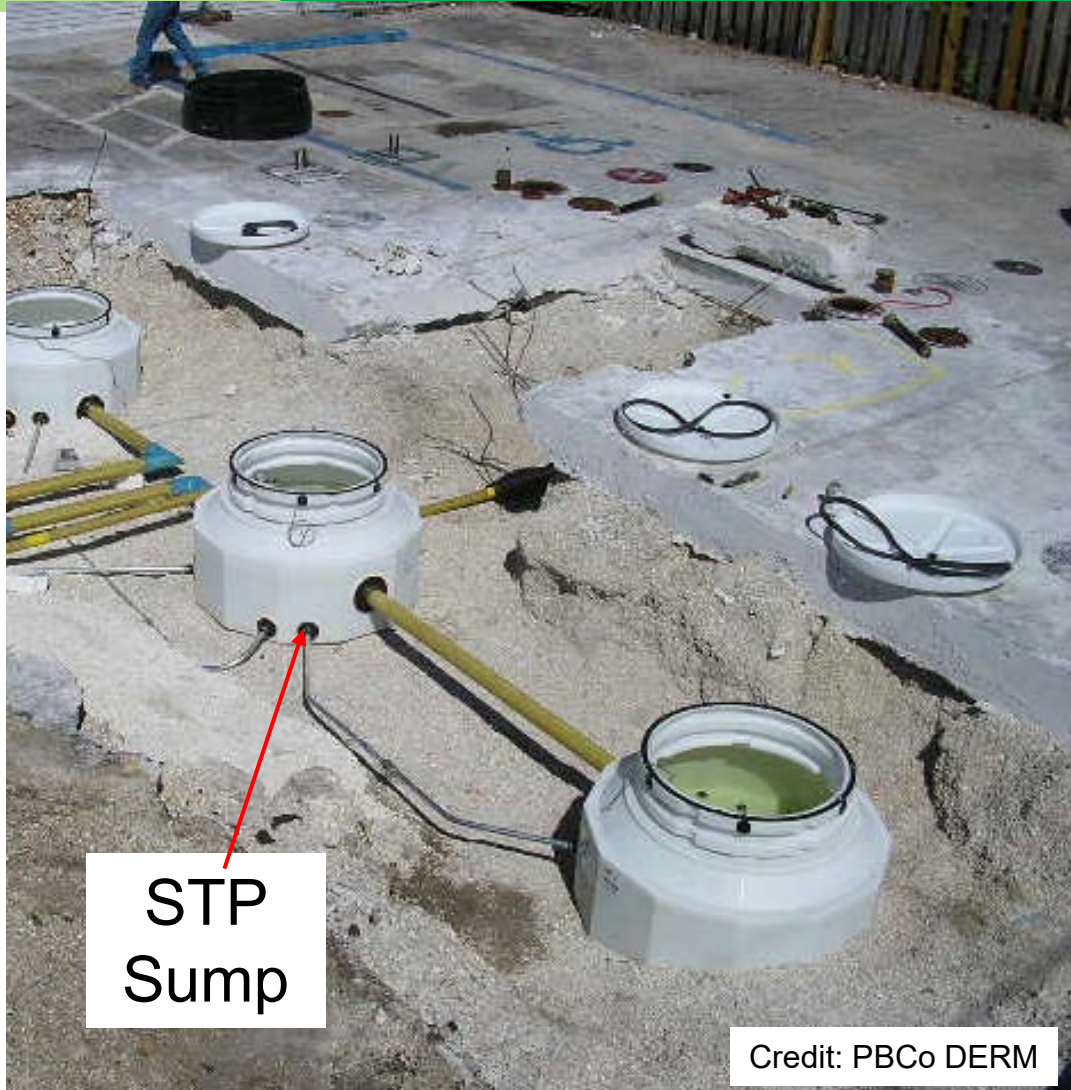


Credit: Source North  
America Corp.

Credit: The John W.  
Kennedy Co.



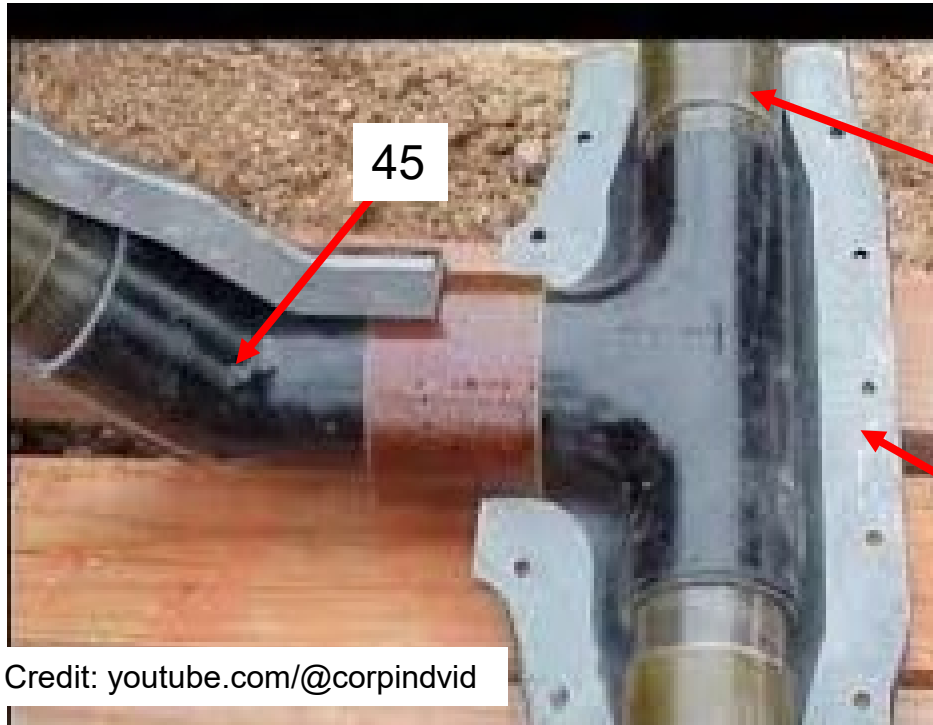
# DOUBLE-WALL FIBERGLASS PIPING





# DOUBLE-WALL FIBERGLASS PIPING

- Primary fittings are slip fittings, sealed with epoxy glue.
- Secondary fittings are “clamshell fittings”, with the two halves bolted together and sealed with an epoxy/fiber mix.

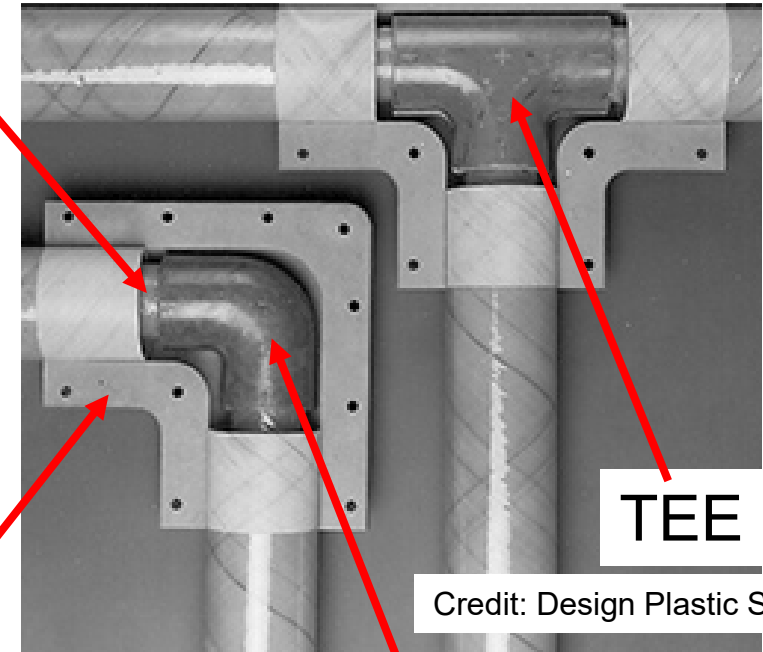


Credit: youtube.com/@corpindvid

2"  
COAXIAL  
PIPE

2 2/3"  
PIPE

Clamshell  
secondary fitting



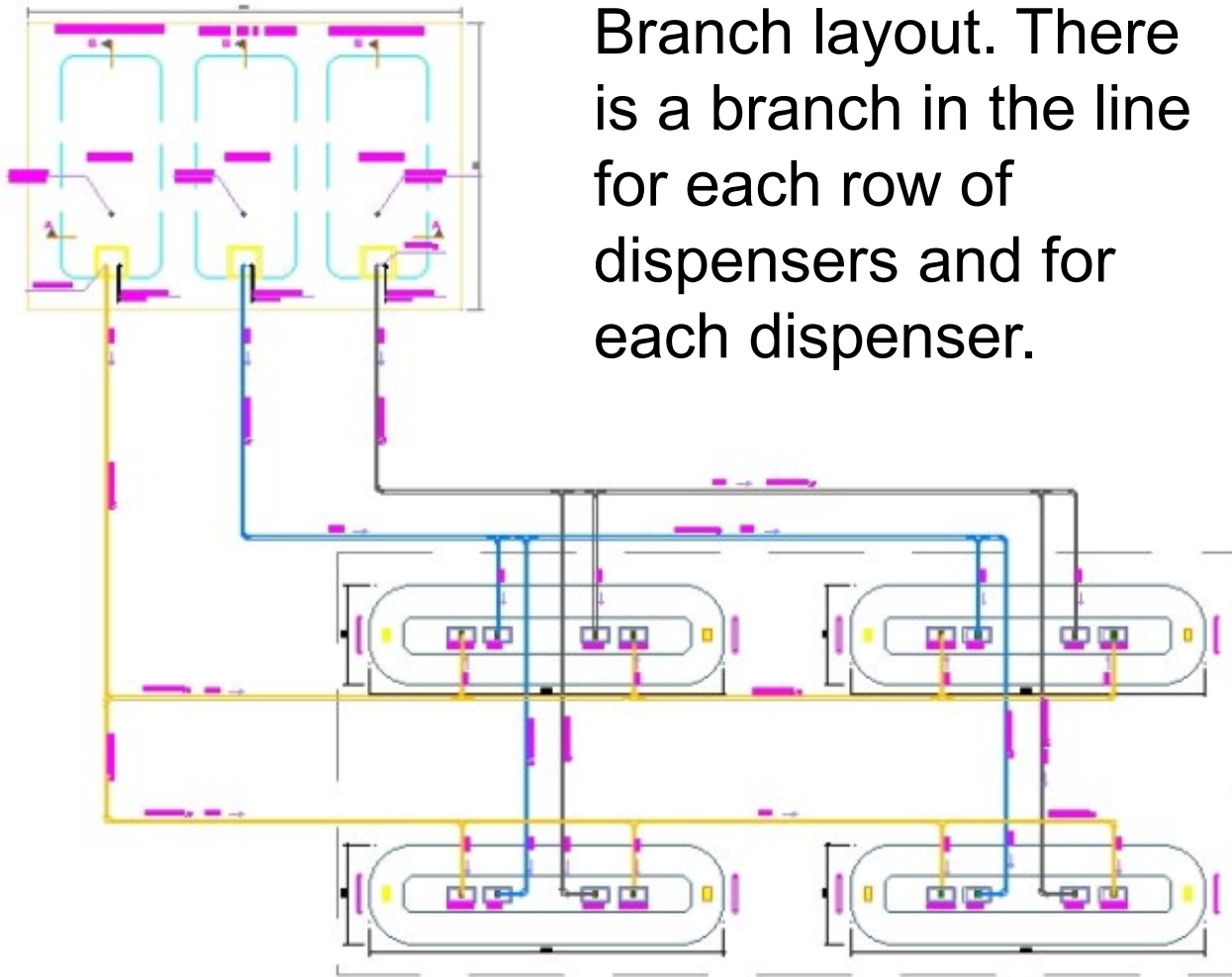
Credit: Design Plastic Systems, Inc.

90 (A.K.A., “ELL”)

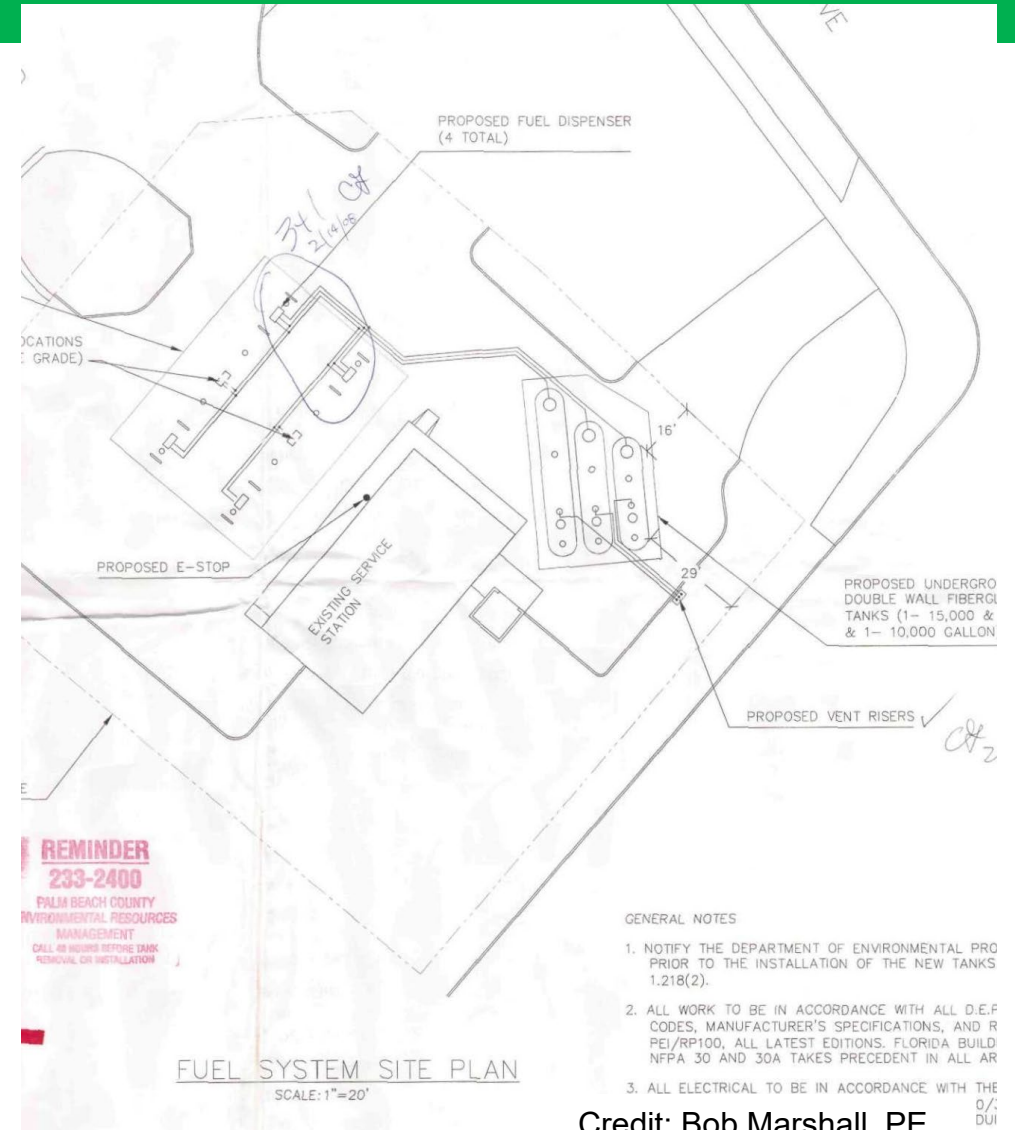


# FIBERGLASS PIPE LAYOUT

## 90's ("ELL's") and 45's



Branch layout. There is a branch in the line for each row of dispensers and for each dispenser.



Credit: Bob Marshall, PE



# PLASTIC FLEX PIPING

Only the product lines are plastic. Vent and vapor recovery piping is almost always fiberglass, since it does not have to be double-wall.



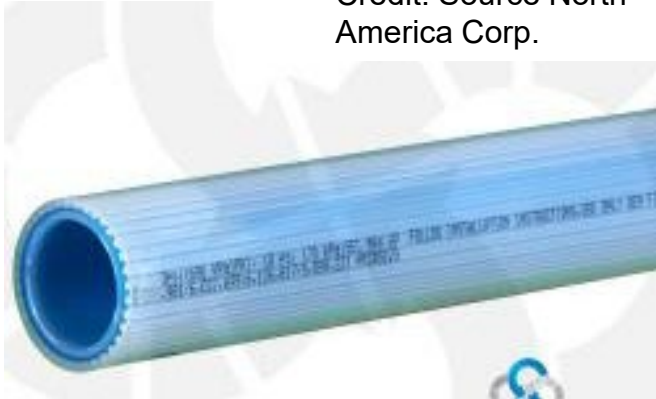
Credit: PBCo DERM



Credit: PBCo DERM



# DOUBLE-WALL FLEX PIPING



Credit: Source North America Corp.

### Coaxial Flex-Pipe

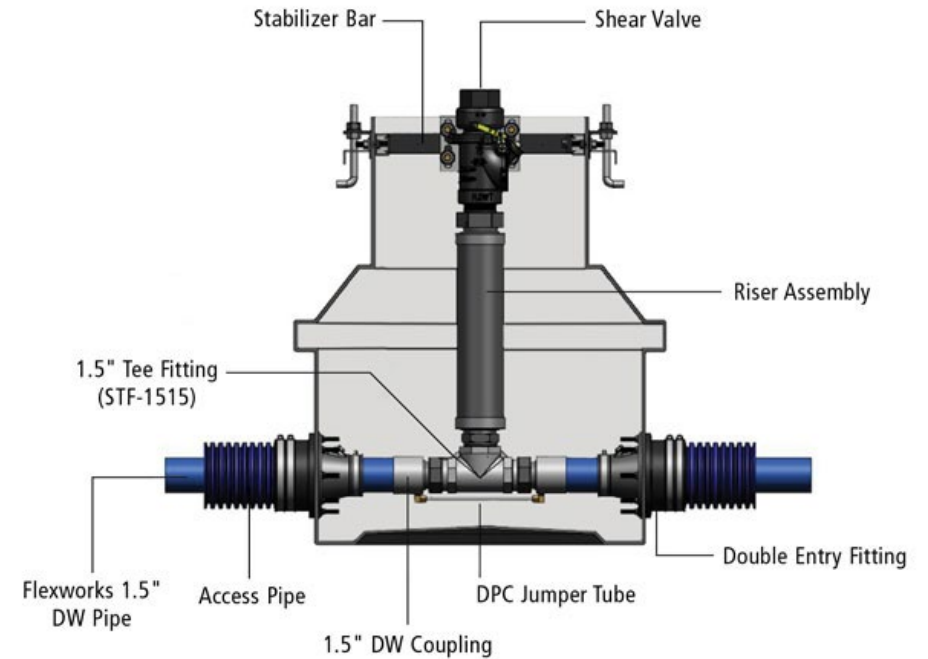


Credit: Source North America Corp.

### Access pipe

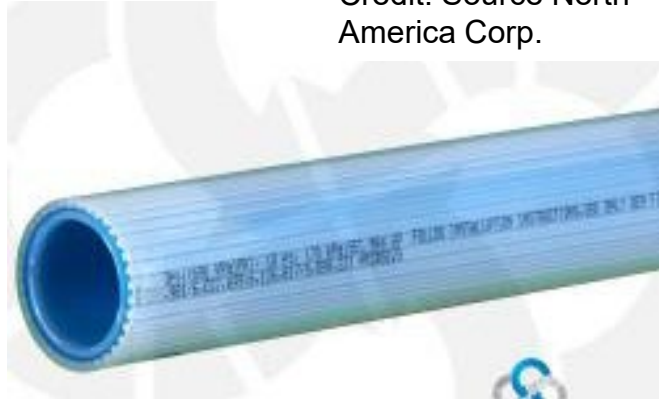
- Provides ducting for periodic replacement of the coaxial product line

Credit: OPW Retail Fueling, a Division of Dover Corp.





# DOUBLE-WALL FLEX PIPING



Credit: Source North America Corp.

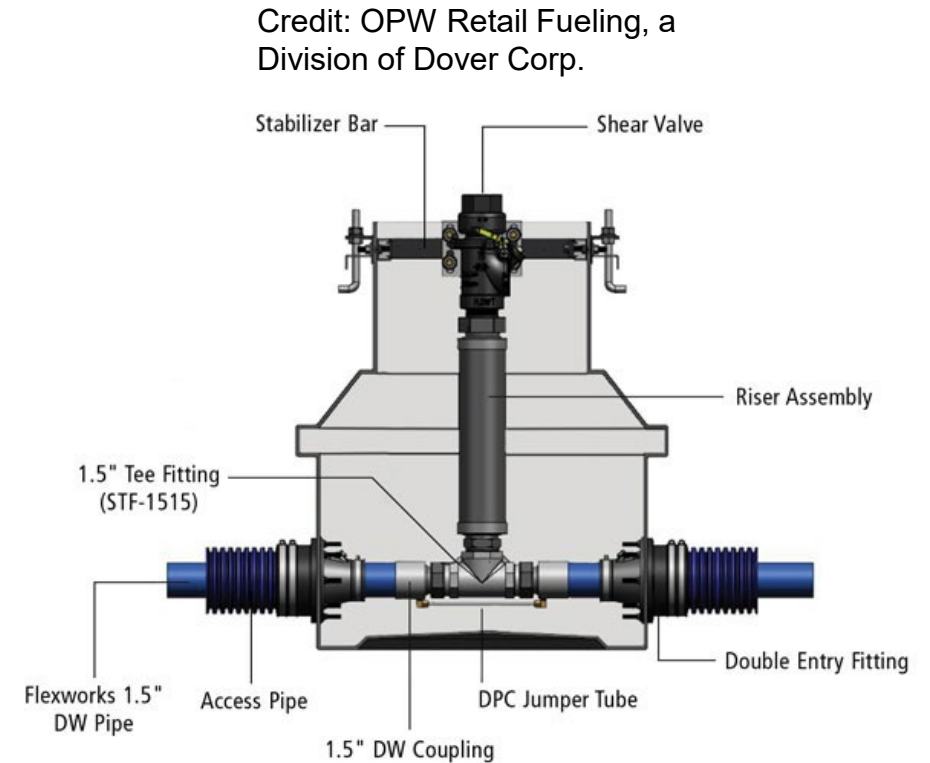
## Coaxial Flex-Pipe



Credit: Source North America Corp.

## Access pipe

- Optional.
- May provide some tertiary containment but is not designed for that or rated as such.





# DOUBLE-WALL FLEX PIPING

Credit: National Petroleum, Inc.



Coaxial flex-pipe with duct

- Metallic ducting.
- The duct protects the flex-pipe from UV exposure.
- Rated for use aboveground and over water.



Credit: CommTank, Inc.

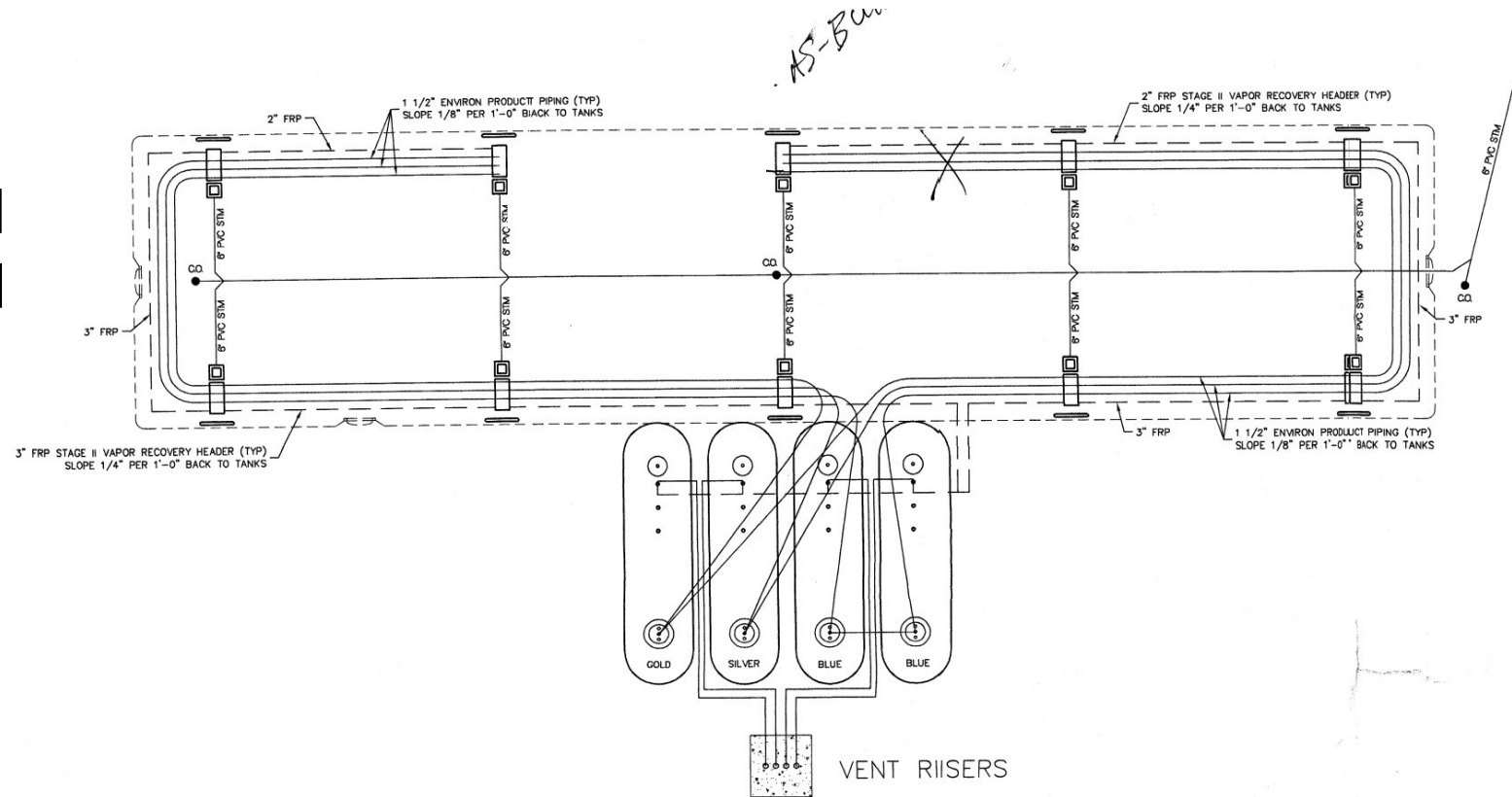
Semi-rigid pipe

- Plastic coaxial pipe.
- Fittings are welded.



# PLASTIC FLEX PIPING LAYOUT

Loop layout. All fittings are contained in a sump. No buried fittings.



Credit: Progressive Development Group, Inc.



# LINE LEAK DETECTORS (LLD'S)



Credit: PBCo DERM

“Old School”: Mechanical Line Leak Detector (MLLD). Shuts off the product line @ 3 gph, then slowly re-sets.

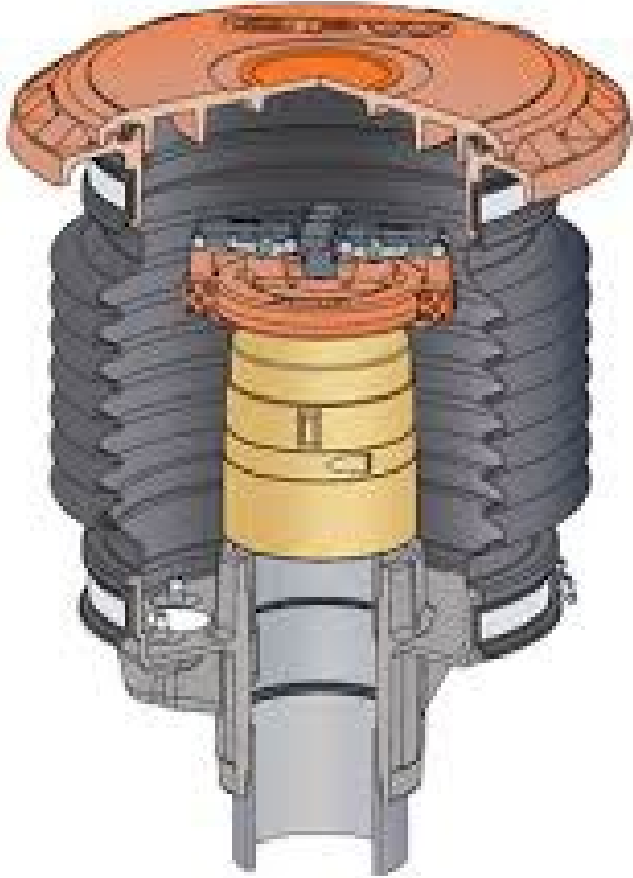


Credit: Alaska Dept. of Environmental Conservation

Preferred technology: Electronic Line Leak Detector (ELLD or “PLLD”). Shuts off the product line @ 0.1 gph with audible alarm and automatic shut-down.

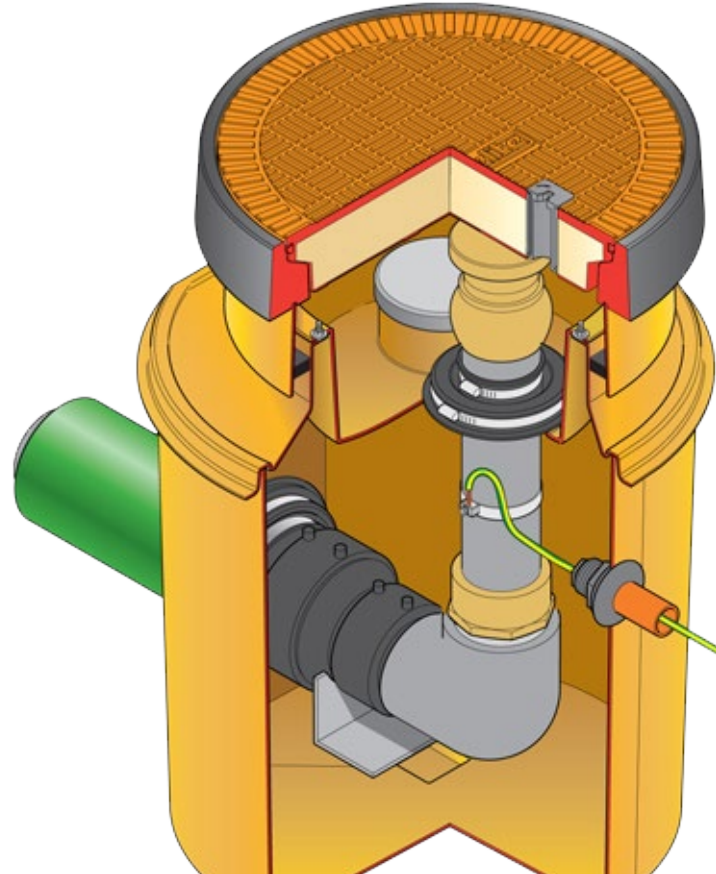


# SPILL CONTAINMENT



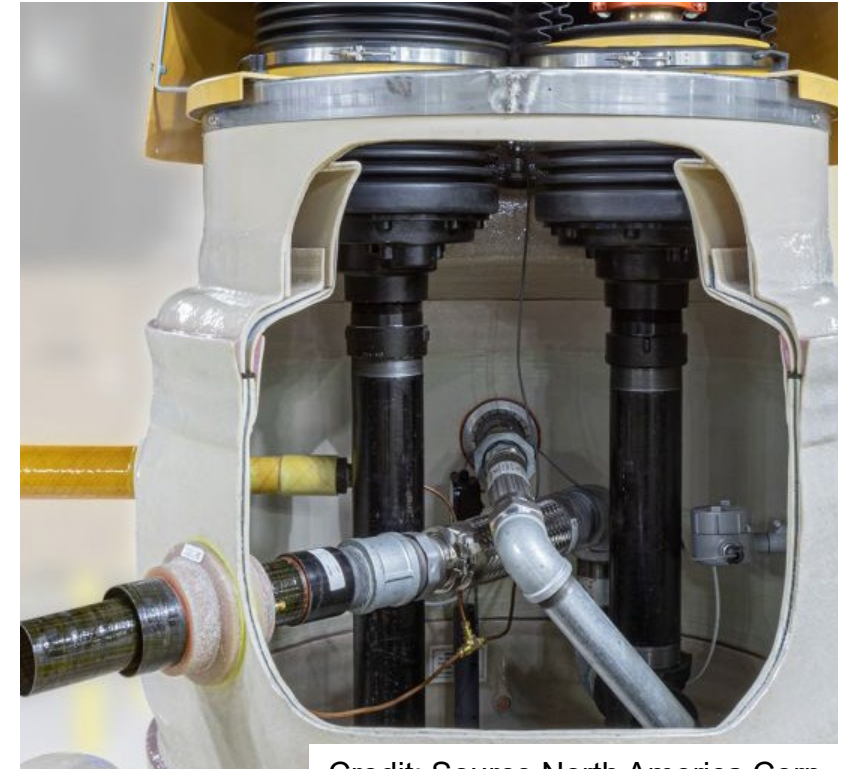
Credit: OPW Retail Fueling, a Division of Dover Corp.

**Bucket**



Credit: OPW Retail Fueling, a Division of Dover Corp.

**Sump**



Credit: Source North America Corp.

**Both**

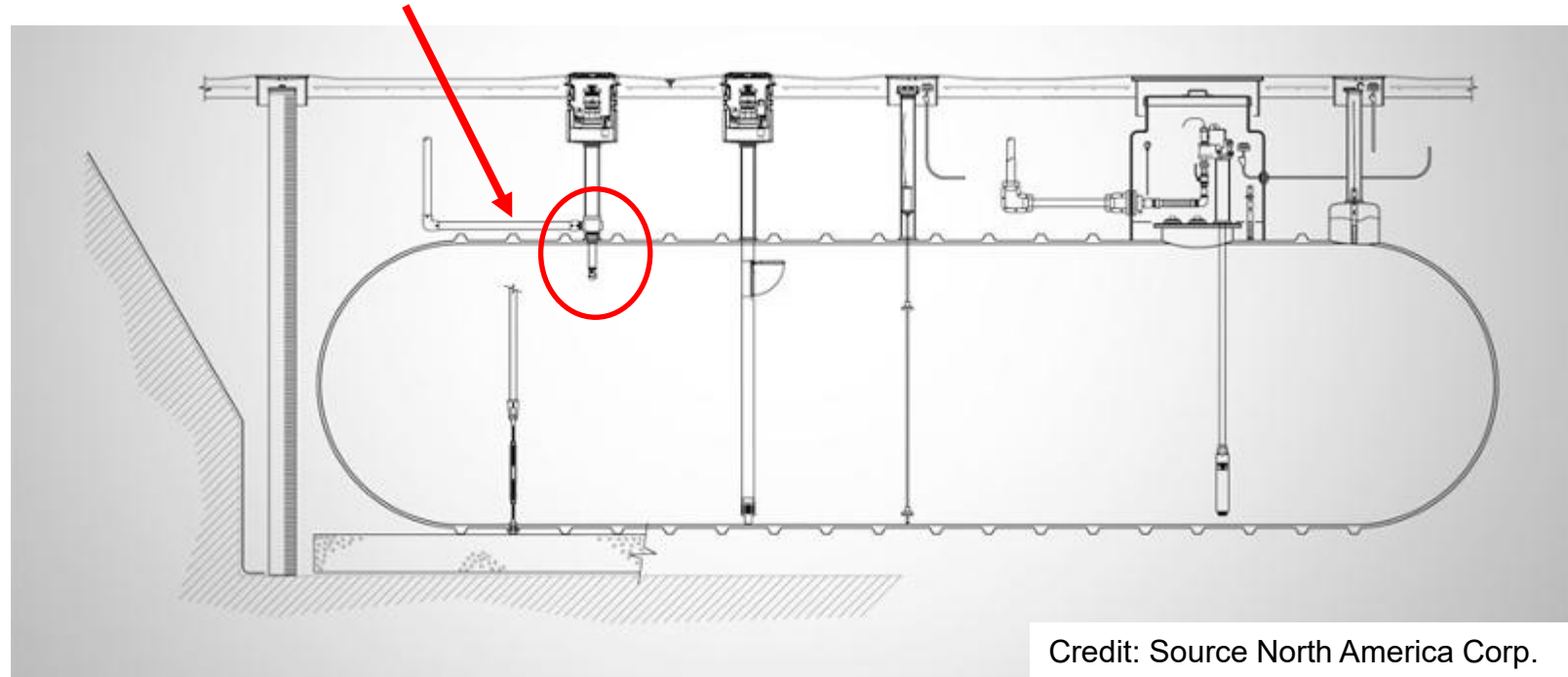


# OVERFILL PROTECTION: BALL-FLOAT, THE "OLD SCHOOL" METHOD.



Credit: PBCo DERM

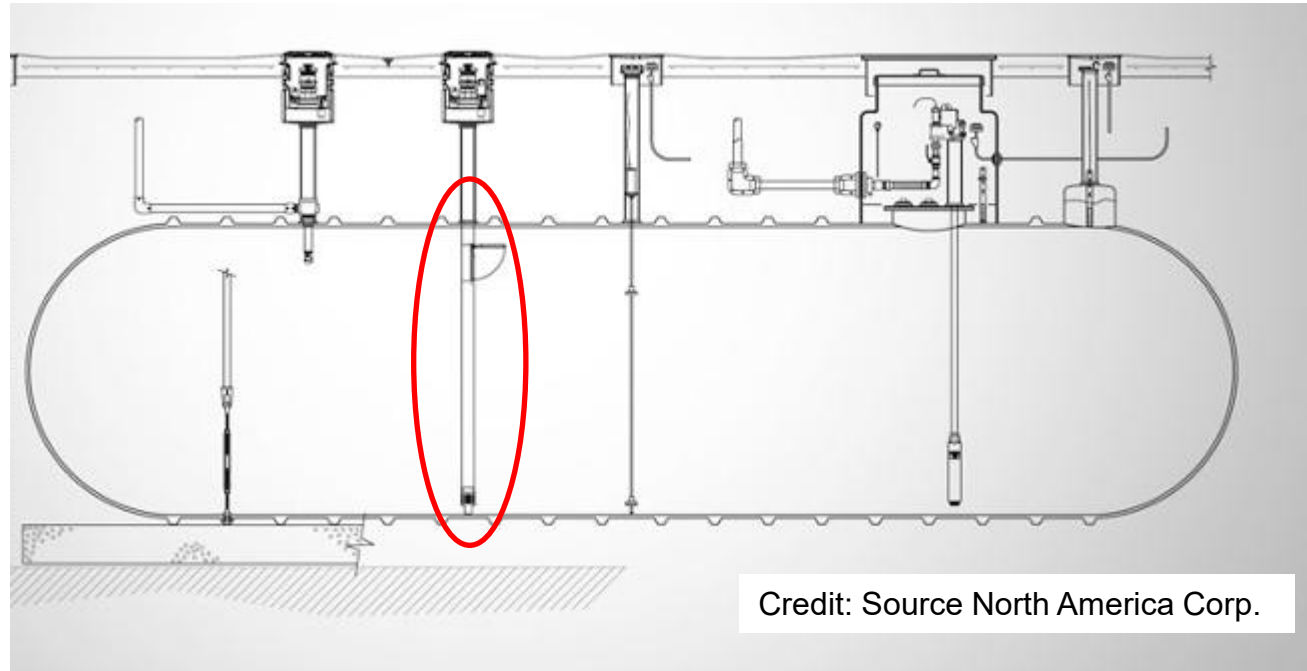
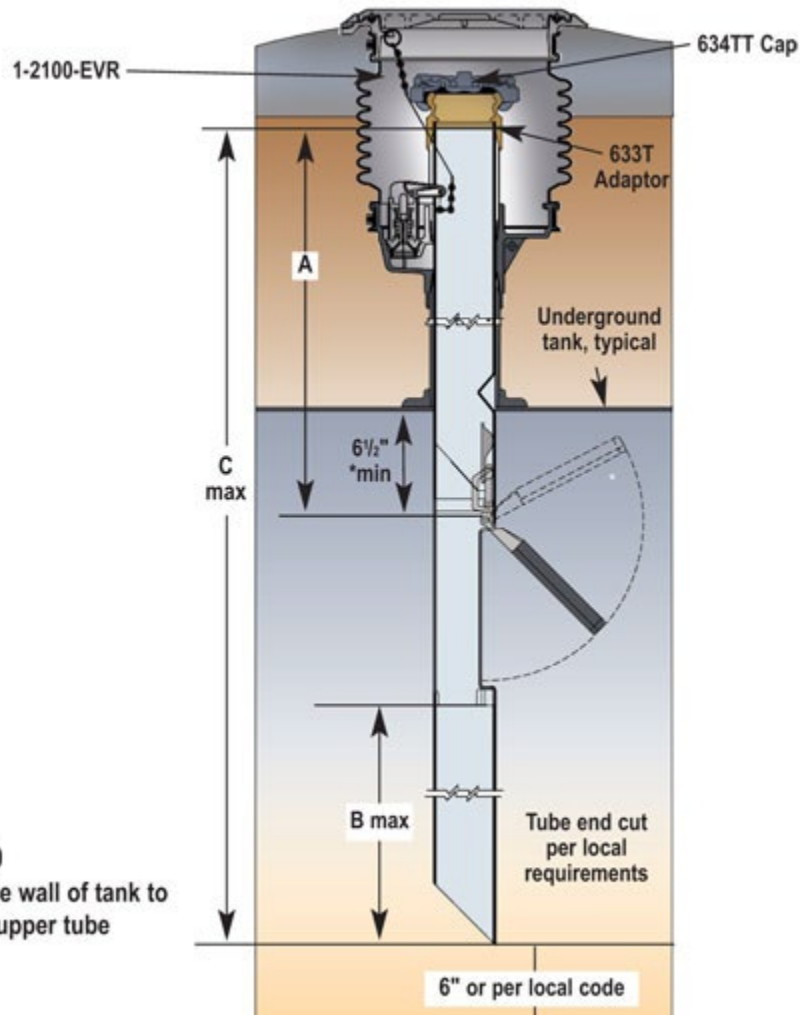
Vent line



Credit: Source North America Corp.



# OVERFILL PROTECTION (PREFERRED METHOD): OVERFILL PREVENTION DROP TUBE (“FLAPPER”)



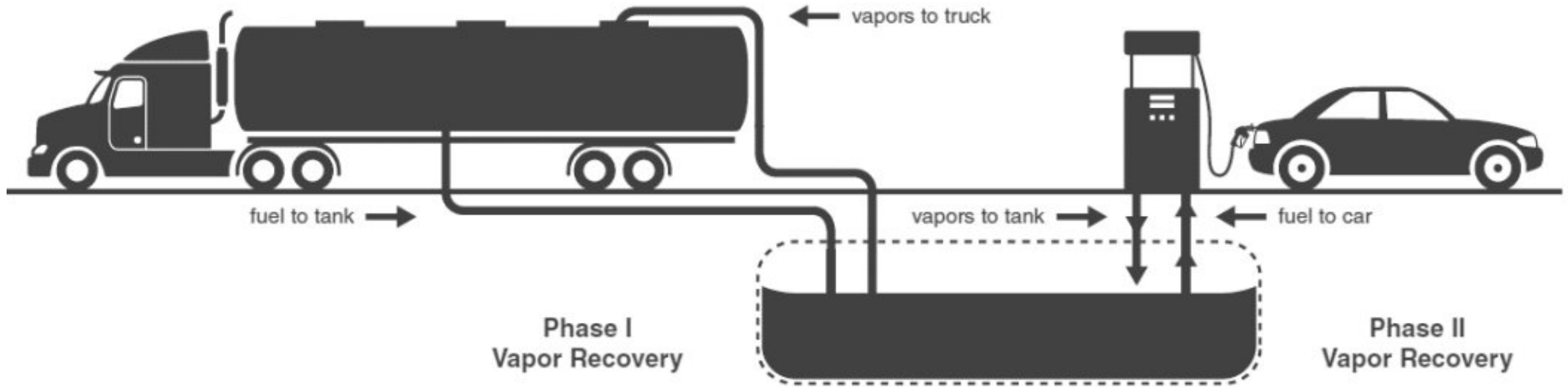
Credit: Source North America Corp.

Called “flow shut-off” in the tank registration codes that appear in the first cover page report for each facility.

Credit: OPW Retail Fueling, a Division of Dover Corp.



# VAPOR RECOVERY



Credit: California Air Resources Board



# VAPOR RECOVERY

- Federally mandated.
- Purpose is to reduce vapor emissions, save fuel.
- Stage 1 (Phase 1):
  - UST-to-delivery tanker .
  - Vapors are routed back into in the delivery tanker, where they condense under pressure (3 psi max).
  - Can be a 2-point or coaxial connection.
  - First required in Florida in 1993 and is still required.
  - Approx. 2300 tons annually are recovered nationwide.



# VAPOR RECOVERY

- Stage 2 (Phase 2):
  - Vehicle-to-UST.
  - Required from 1993-2007 in Florida.
  - Captures vapors from the dispenser nozzle and routes them back into the UST by way of coaxial dispenser hoses and underground piping (normally single-wall fiberglass).
  - Most stations de-commissioned their Stage 2 components. Underground piping was often abandoned in place.



# DISCHARGES DURING FILLING OPERATIONS

- Possibility of discharge is greatest when flow is the greatest, i.e., at delivery (tank filling).
  - A typical retail station receives about 8000 gallons at each delivery, from a 9000-gallon tanker truck.
  - A typical retail station has around 100,000 gallons throughput per month (4,000 gpd).
  - Gravity drop is the prevailing method.
  - Delivery flow rate ~ 200-300 gallons per minute gpm @ 20-30 psi.



# DISCHARGES DURING FILLING OPERATIONS

- Spill containment, i.e., spill buckets, were not required until 1991. Fuel delivery hoses hold about 18 gals and were often emptied into the ground around the fill port before the advent of spill buckets.
- A 2004 Leak Autopsy Study by DEP revealed that the most common cause of discharges was leaky spill buckets.
- Spill buckets are problematic to this day.
- Overfill protection measures are often **circumvented** by delivery personnel.
  - Ball-float vent valves.
  - Flapper drop tubes.



# DISCHARGES DURING FILLING OPERATIONS - CASE STUDY 1



Credit: PBCo DERM



Credit: PBCo DERM



# DISCHARGES DURING FILLING OPERATIONS - CASE STUDY 1



Credit: PBCo DERM



Credit: PBCo DERM



# TANK FAILURE DUE TO IMPROPER FILLING - CASE STUDY 2



Credit: PBCo DERM

6000 Gallon  
Double-wall  
Emergency  
Generator Tank



# TANK FAILURE DUE TO IMPROPER FILLING - CASE STUDY 2

Discovery, as described in the PBCO DERM discharge inspection found in OCULUS:

“Product discharged and amount: 5,500 TO 6,000 gals of diesel.

After an overfilling of the UST, the Veeder-Root alarmed and water and fuel started showing up in the piping sump and tank interstitial. Next morning UST was put out of service and emptied. Days/weeks following, fuel and water was repeatedly pumped from the piping sump and tank primary. Eventually recovery and monitoring wells were installed.”



# TANK FAILURE DUE TO IMPROPER FILLING - CASE STUDY 2

- The tank should have been filled via a gravity drop. Instead, it was routinely filled using a pressurized power take-off system (PTO).
- A gravity drop delivers 200-300 gpm @ 20-50 psi, while a PTO delivers up to 600 gpm @ 90+ psi.
- There was no flapper drop tube to shut-off the flow, so the ball-float was the only overflow prevention device.



# TANK FAILURE DUE TO IMPROPER FILLING - CASE STUDY 2

- The tank suffered from fatigue failure. Each time the tank was filled, it was pressurized beyond its design capacity.
- This was an emergency generator tank, so even though the tank was installed in 2004, it wasn't filled very often.



# TANK FAILURE DUE TO IMPROPER FILLING - CASE STUDY 2

## Remediation:

- Repeated pumping from recovery wells.
- Source removal at tank removal. The tank removal excavation was sheet-piled.
- Skimming immediately following tank removal.
- Open-hole sparging.
- Good results were obtained from these efforts within the sheet-piling.
- The area outside the sheet-piled area remains contaminated.



# TANK FAILURE DUE TO IMPROPER FILLING - CASE STUDY 2



Credit: PBCo DERM



Credit: PBCo DERM



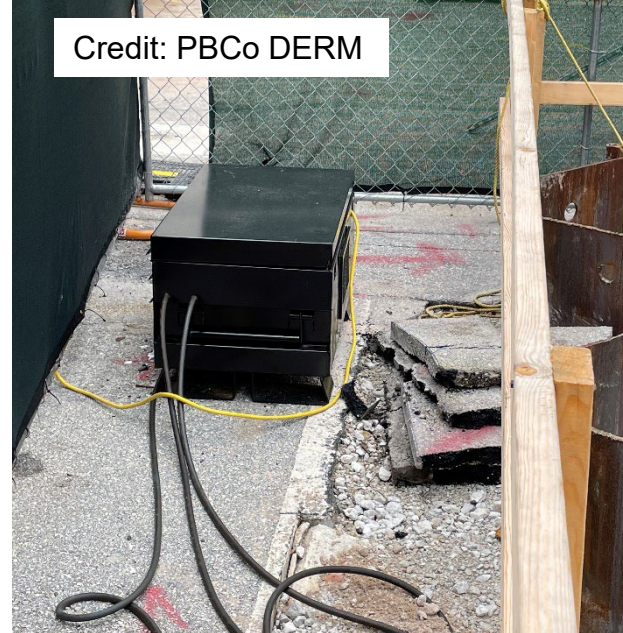
Credit: PBCo DERM



# TANK FAILURE DUE TO IMPROPER FILLING - CASE STUDY 2



Credit: PBCo DERM



Credit: PBCo DERM



Credit: PBCo DERM



# DISCHARGES DURING DRILLING OPERATIONS - CASE STUDY 3

Excerpt from Memo to file from Site Manager:

- Start installation of MW #15 borehole, removed asphalt, hand auger to approximately 3.5-4 feet hit pea gravel material mixed with sand. Continued to hand auger and back into sand. Approximately a foot lens of pea gravel. *(photos-Page 2)*
- Called Steve Rial with PBCERM to check if site UST system plans are available at the PBCERM office. Steve checked, no plans were available.
- Driller opened sump to check piping direction, piping from the sump was oriented in a E/NE direction. MW # 15 was in a North direction.
- Continued to hand auger to 6 feet bls, sand. Borehole appeared to be cleared of piping, continued split spoon to 15 feet bls. Took soil samples every two feet. *(photos-Page 3)*
- Driller started to auger-drill the borehole for MW installation. Completed the auger to 8 feet bls and discovered product fluid on the auger.

Credit: PBCo DERM



# DISCHARGES DURING DRILLING OPERATIONS - CASE STUDY 3



Credit: PBCo DERM



Credit: PBCo DERM

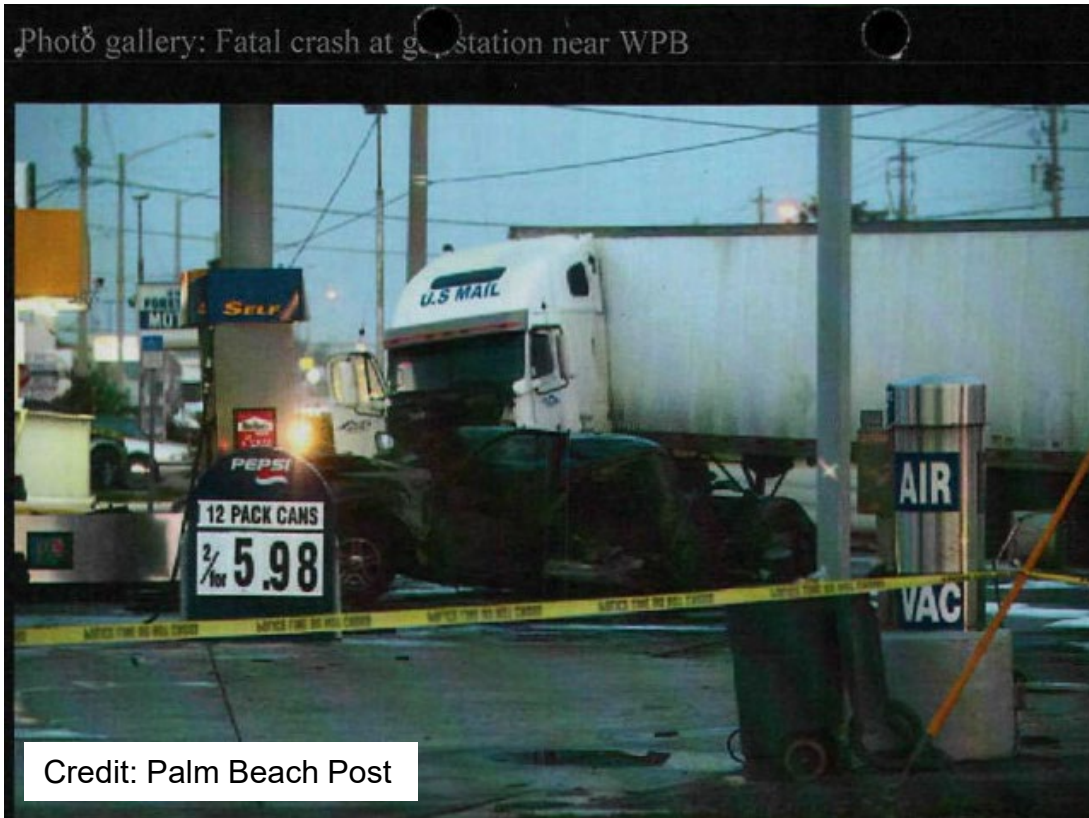


# DISCHARGES DURING DRILLING OPERATIONS - CASE STUDY 3

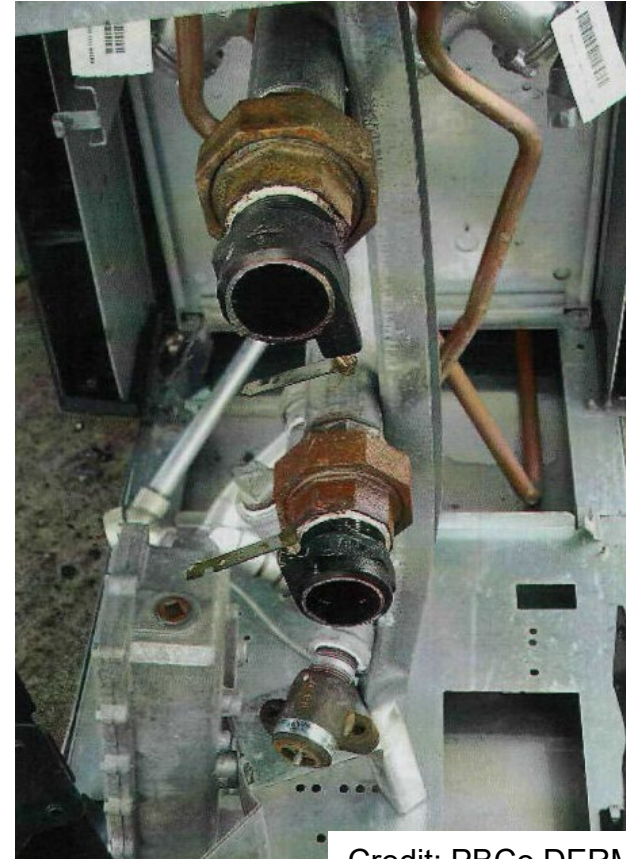




# INCIDENTS @ MPD's VEHICLE CRASH



Credit: Palm Beach Post



Credit: PBCo DERM

**Shear  
Valves  
Work!**



# INCIDENTS @ MPD's LEAKY HOSE FITTINGS



Credit: PBCo DERM



Credit: UPI.com

**Breakaways Work!**



# CONTACT INFO

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