

# Vacuum Excavation Used in an Integrated Damage Prevention Program

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## ■ Introduction

- Ben Schmitt
  - Vactor Manufacturing Product Manager
  - 13 Years



# Why Are

## Inspection Detail

# 1 dead, 1 County

However, at 10:45 p.m. the accident. Pipeline line".

"Typically we don't see some third party striking federal Pipeline and H

"That's now the leading

Case Status: CLOSED

Inspection: 1188290.015 - L.E. Bell Construction Company, Inc.

### Inspection Information - Office: Birmingham

Nr: 1188290.015	Report ID: 0418300	Open Date: 11/01/2016
L.E. Bell Construction Company, Inc.		
1305 River Road		Union Status: NonUnion
Helena, AL 35080		
SIC:		
NAICS: 237120/Oil and Gas Pipeline and Related Structures Construction		
Mailing: 1226 County Road 11, Heflin, AL 36264		
Inspection Type:	Fat/Cat	
Scope:	Complete	Advanced Notice: N
Ownership:	Private	
Safety/Health:	Safety	Close Conference: 11/01/2016
Emphasis:	N:Trench	Close Case: 04/10/2017
Related Activity:	Type	ID
	Accident	1151690
		Safety
		Health

Case Status: CLOSED

### Violation Summary

	Serious	Willful	Repeat	Other	Unclass	Total
Initial Violations	2					2
Current Violations	1			1		2
Initial Penalty	\$25,350					\$25,350
Current Penalty	\$12,675			\$12,675		\$25,350
FTA Amount						

### Violation Items

#	ID	Type	Standard	Issuance	Abate	Curr\$	Init\$	Fta\$	Contest	LastEvent
1.	01001	Other	19260065 Q01	03/14/2017	03/24/2017	\$12,675	\$12,675	\$0		I - Informal Settlement
2.	01002	Serious	19260651 B03	03/14/2017	03/24/2017	\$12,675	\$12,675	\$0		I - Informal Settlement

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# What is Vacuum Excavation?

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- Non-Mechanical
- Non-Destructive
- Safely Visually Locate
- Precise Excavation
- Minimally Disruptive



# Is Vacuum Excavation New?

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# Vacuum Excavation History

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- 1960's Vactor ExcaVACtor
- Sewer Cleaners Adapted in 70's – 80's
- First Dedicated Machines in 80's for Canadian Oilfields
- Mainstream in the late 1990's



# Why Vacuum Excavate?

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## Las Vegas natural gas line catches fire after backhoe accident

By [Sun Staff](#) ([contact](#))

Published Tuesday, July 26, 2016 | 12:27 p.m.

Updated Tuesday, July 26, 2016 | 3:56 p.m.

A backhoe hit a natural gas line in a residential neighborhood today, sparking an intense blaze that firefighters allowed to burn until the gas could be shut off, according to Las Vegas Fire & Rescue officials.

Fire department spokesman Tim Szymanski said the fire was “extremely intense,” and the first concern was that the radiant heat would set nearby houses on fire. Firefighters sprayed water on the houses to keep them from catching fire, he said.

The fire was reported about 11:45 a.m. on Acacia Tree Drive at Anasazi Drive, not far from John W. Bonner Elementary School. Up to 90 people were evacuated, officials said.

No houses were involved, and nobody was injured, officials said.

The backhoe was digging in the street when it ruptured a gas main, officials said. Details of who was operating the machinery was not immediately released.

Gas was shut off to the area by about 1:30 p.m., and firefighters stood by as the remainder of the gas in the line burned off, officials said.

Metro Police said officers assisted with traffic control and evacuations. Streets in the area were closed.



# Why Vacuum Excavate?

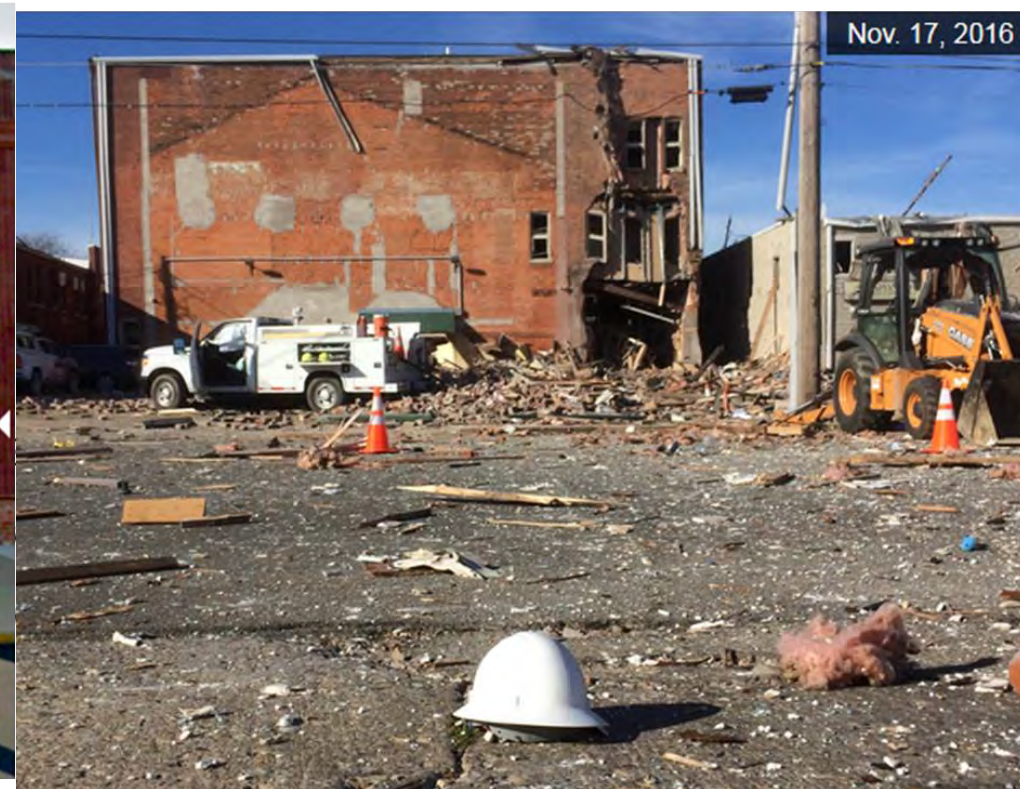
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# Why Vacuum Excavate

## Ameren worker killed in large gas explosion in downtown Canton

Wednesday



The explosion took place shortly before 6 p.m. The Ameren workers arrived about 5:30 following a report a contractor damaged a gas-service line, according to utility spokesman Tucker Kennedy.

# Not All Hits Result in a Fireball

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4/15/2015 2:56:00 PM

## **UPDATE: Peru school evacuated after contractor ruptures gas line**

Lauren Blough

NewsTribune Reporter

[Share With Friend](#)

Students were able to get out of school early after a contractor working at the construction site of the new addition at Northview School in Peru struck a gas line.

Peru police chief Doug Bernabei spelled out a whirlwind string of events, starting with the first 911 call logged at 2:45 p.m. Police were on scene two minutes later and the first fire crew was in place at 2:52 p.m. The school was evacuated at 2:55 p.m. — preschoolers were dismissed earlier in the school day — and the gas was shut off at 3:09 p.m.

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# Not All Hits Result in a Fireball

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# News Travels Fast!

Home Notifications Messages Search

**deadmau5** @deadmau5

TWEETS 28.9K FOLLOWING 315 FOLLOWERS 3.24M FAVORITES 28 LISTS 1

Yeah Numbnuts, you're supposed to call before you dig. Thanks for digging up my power line. Appreciate it.



RETWEETS 168 FAVORITES 726

11:08 AM - 4 Aug 2015 Details

\_id=tweet:628600925821628418

**deadmau5** @deadmau5 · 3h

... hey... you know all those "call before you dig" things you see everywhere?

RETWEETS 50 FAVORITES 338

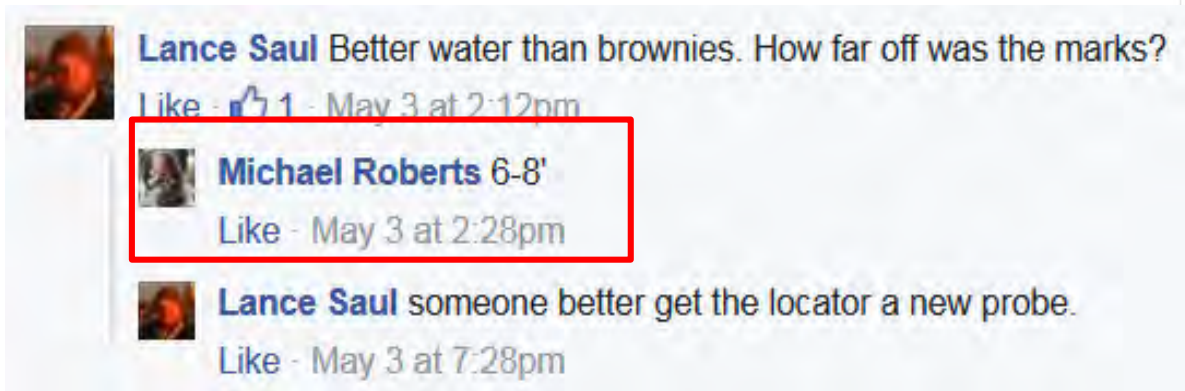


11:06 AM - 4 Aug 2015 - Details



# Why Do They Happen?

- Electronic Locates can be Inaccurate

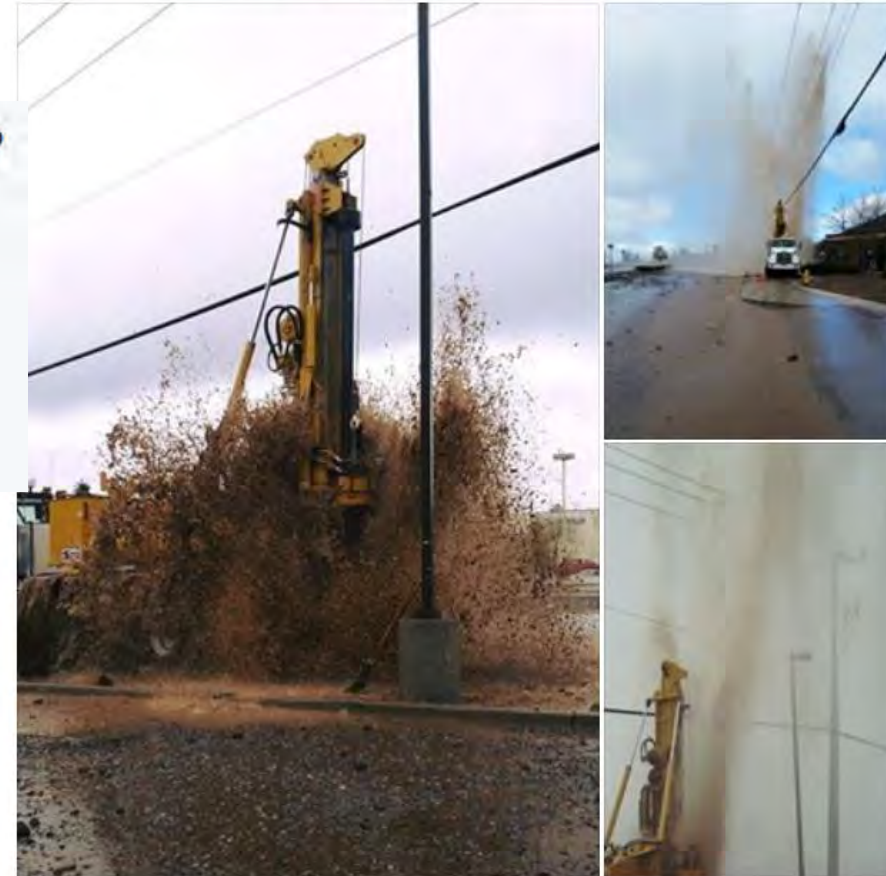


Michael Roberts

May 3 at 1:27pm

Blue Stake was way off....

All those baseball size rocks were launched in the air about 60'.  
Rocks sand blasted all the paint off the back of the digger.



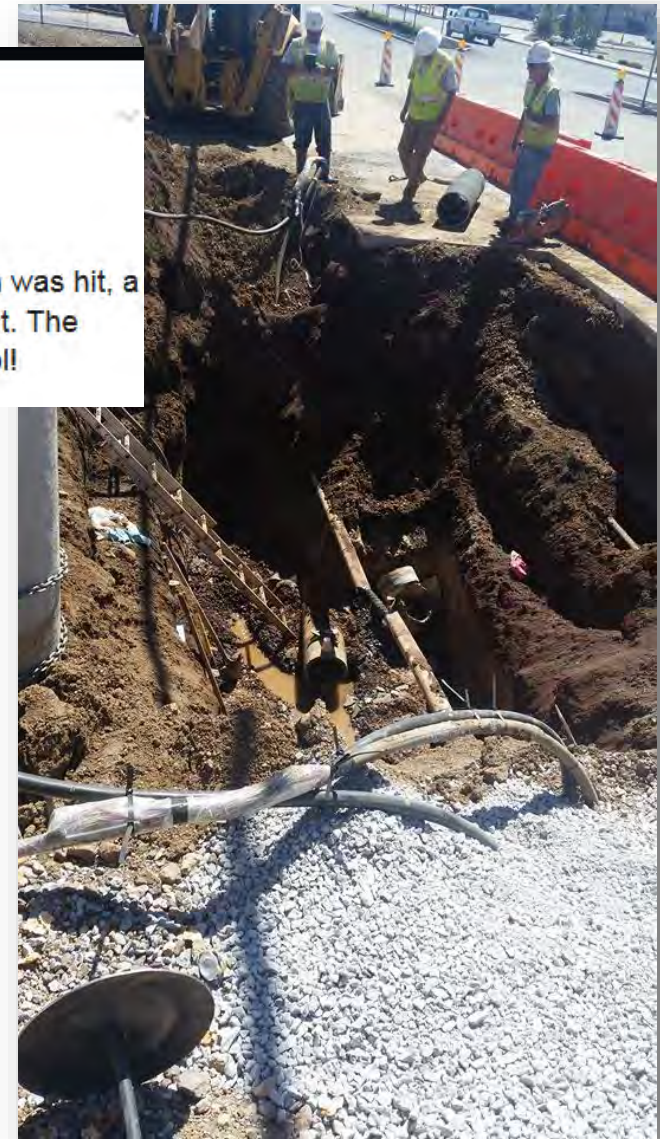
# Why Do They Happen?



**Michael Roberts**

May 4 ·

Update....was only a 12" pipe  
Also found out right before the water main was hit, a  
600 pair telecommunications cable was hit. The  
telephone was located but not marked. Lol!



# Why Do They Happen?

**Q** Why doesn't the locator provide the depth of a buried pipe? It would sure make it easier when we're digging!

**A** Bob Nighswonger, President, Utility Training Academy (UTA)


This is a very common question. My simple answer would be that for several reasons, including signal strength and shape, the electronic depth estimation provided by locate equipment is not guaranteed. For the locator to provide a depth estimation may give an excavator a false sense of security when crossing over or under a buried line. The electronic depth reading is not a reading that you would want to bet anyone's life on. The depth readings provided by the handheld line locating equipment is an estimation of distance from the bottom of the signal receiver to the center of a locatable signal broadcasting from an underground line. The only sure way to know the depth of any buried line is to safely expose the line and see it with your own eyes.

## Electronic Depth Estimation and Signal Fields

An electronic depth measurement is a distance calculation from the bottom of the locator's signal receiver to the center of the signal field being detected. This reading is not a depth of cover over a buried pipe. Since the receiver is estimating distance to the center of a perfectly round signal, if you're locating a large diameter pipe the depth calculation is to the center of the pipe. It has been claimed in many equipment manuals that in suitable conditions the accuracy of the depth reading provided by the signal receiver should +/- 5% for lines up to 10 to 15 feet in ideal conditions. The likelihood of error increases with the depth of the line because signals created on deeper lines are weaker and less reliable when detected at surface level.

Suitable conditions for depth measurement are when the signal transmitter is directly connected to a facility that is buried in a straight line without any adjacent facilities in the ground. The locatable signal would be a strong signal that is perfectly round in shape as it radiates or broadcast out from the underground line. It would be similar to a water ripple created by a golf ball in the middle of a pond of calm water. In areas of signal wave distortion, the signal is not perfectly round which causes the mathematical

calculable signal broadcasting from an underground line. The only sure way to know the depth of any buried line is to safely expose the line and see it with your own eyes.

With countless variables which can cause an electronic depth reading to be in error, it will never be as reliable as safely exposing a buried line prior to digging across, above or beneath a buried line. If the depth of the line is important, the only way to guarantee it... is to see it. Dig Safe! 

calculation of distance to line to be incorrect. In an area of signal distortion caused by target signal coupling with a nearby line, the depth reading can be in error up to 50% off the actual depth. That means a line buried 10 feet deep can produce a depth reading of either 5 feet or 15 feet.

## A Few Tips for Electronic Depth Estimating

Choose point along the target line where it runs in a straight line for at least 10 feet in both directions from that point. Avoid taking a depth measurement within 15 feet of the transmitter due to interfering fields being broadcast for the temporary ground stake and wire connection leads.

# Why Do They Happen?

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## WEIRD NEWS

### Cards Against Humanity Threw \$100,000 Into A Giant Hole Over Thanksgiving Weekend



*Is the hole bad for the environment?*

*No, this was just a bunch of empty land. Now there's a hole there.*



# Why Do They Happen?

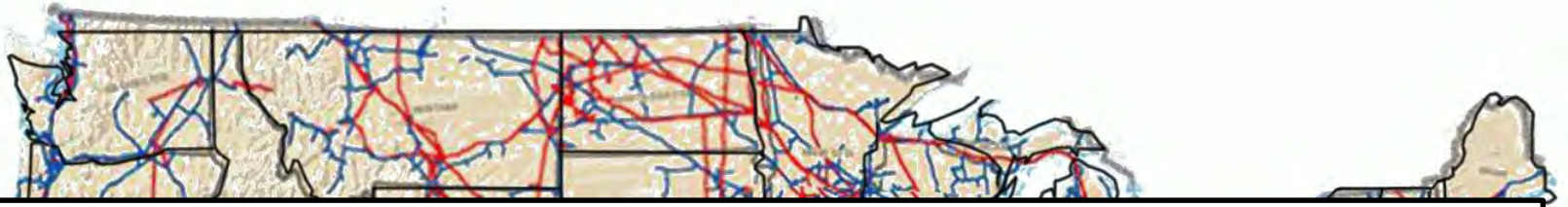
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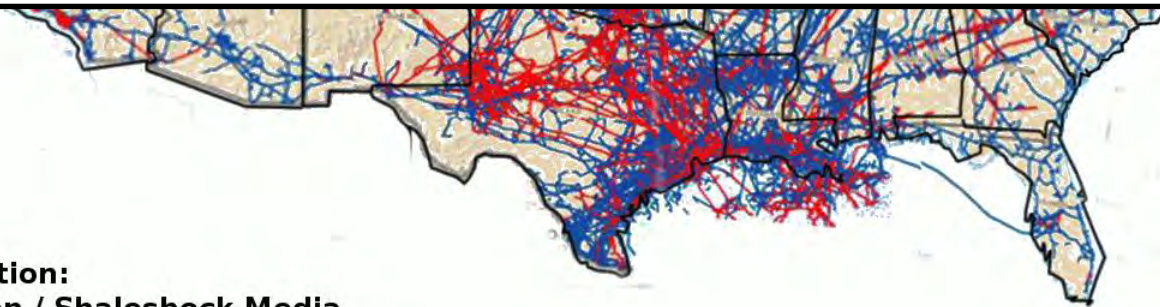
# Why Do They Happen?

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North American Pipelines from PHMSA: <http://opsweb.phmsa.dot.gov/pipelineforum/faq/>



**> 2.5 MILLION MILES IN  
US!**

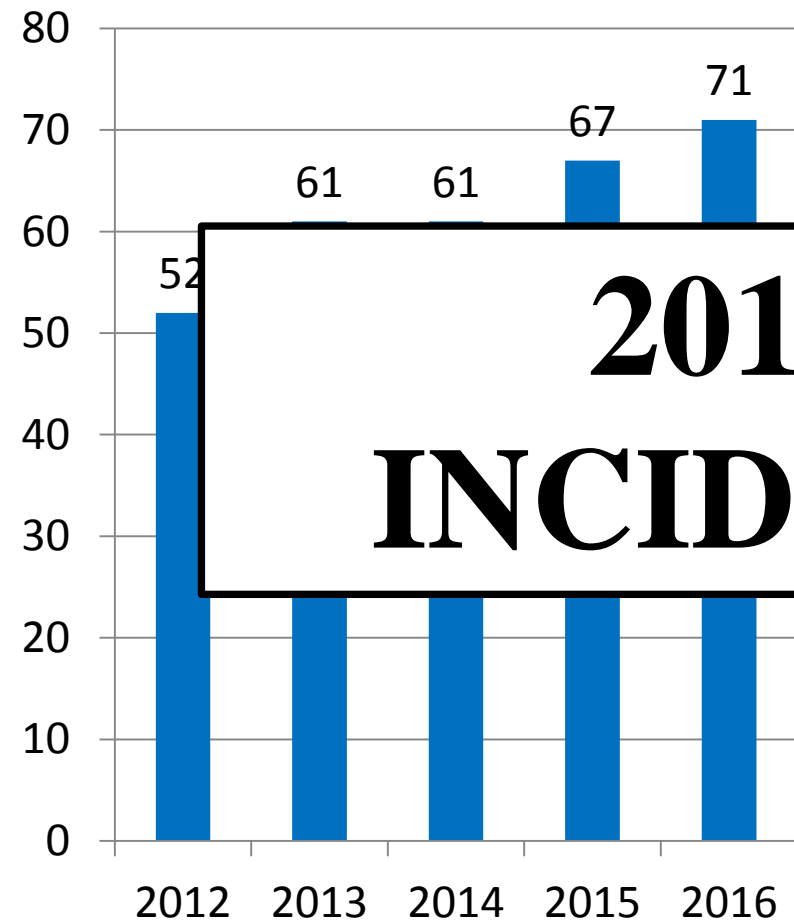


Map Composition:  
William Huston / Shaleshock Media  
[WilliamAHuston@gmail.com](mailto:WilliamAHuston@gmail.com)

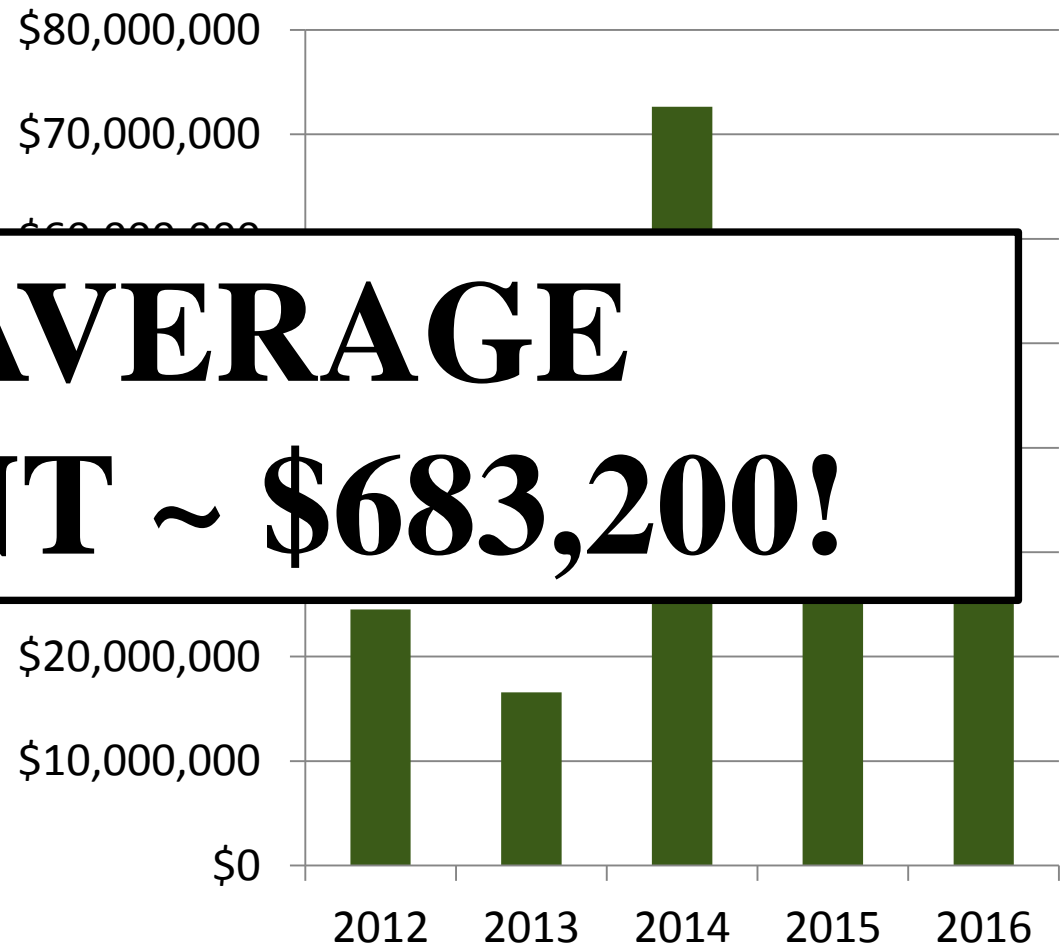
# Why Do They Happen?

## ■ Natural Gas Distribution Disruption

### Significant Instances



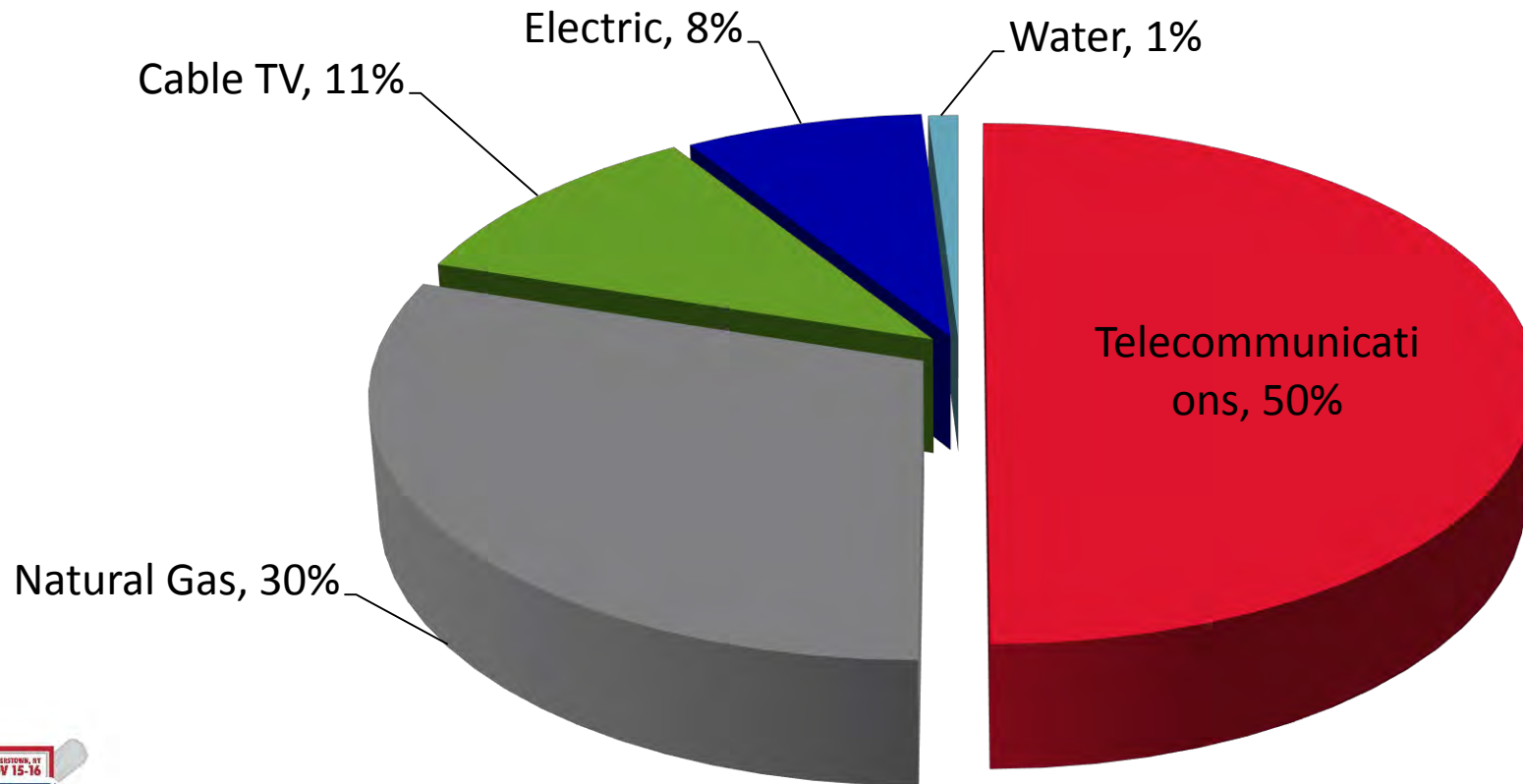
### Property Damage



**2016 AVERAGE  
INCIDENT ~ \$683,200!**

# Affected Utilities

- Over 19 million miles of buried utilities in the United States
- 288,346 known strikes in 2015!
  - **That's one every 2 minutes!**
  - **5% increase from 2014**



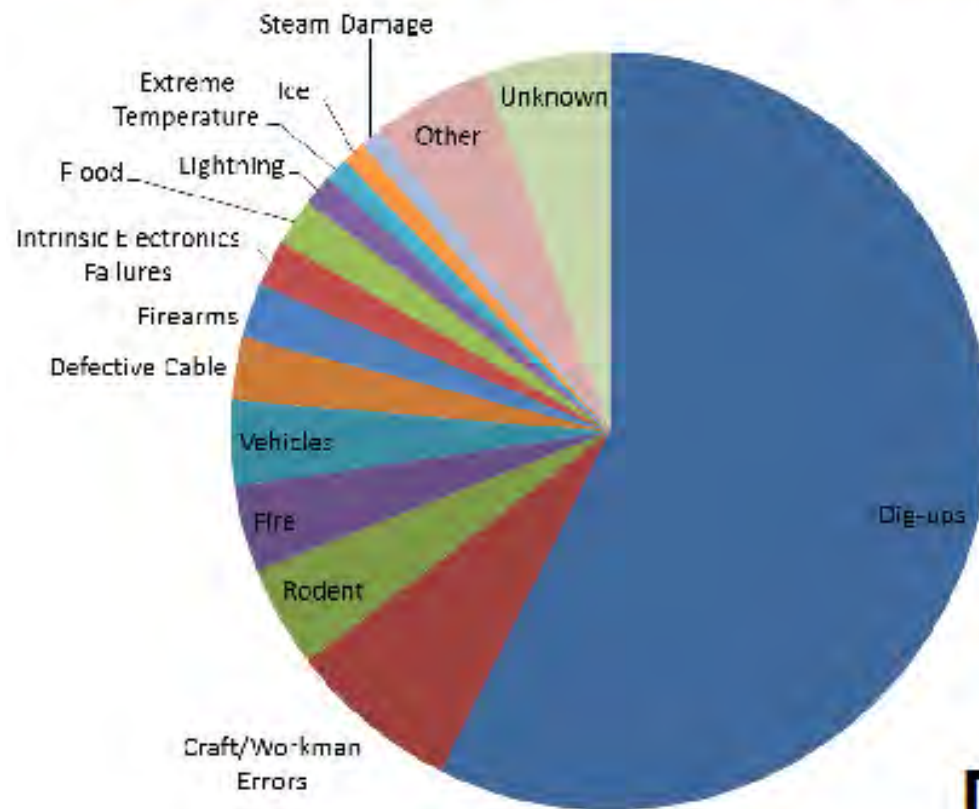
*Source: 2015 CGA DIRT Report*



# Root Cause Analysis



## Studies of Historical Cable/Fiber Failure



Causes	Reported Failures	%
Dig-ups	172	57%
Craft/Workman Errors	22	7%
Rodent	13	4%
Fire	11	4%
Vehicles	11	4%
Defective Cable	8	3%
Firearms	7	2%
Intrinsic Electronics Failures	6	2%
Flood	6	2%
Lightning	4	1%
Extreme Temperature	3	1%
Ice	3	1%
Steam Damage	3	1%
Other	15	5%
Unknown	16	5%
	300	100%

**Dig-ups dominate!**

Ref: V. Hou, "Update on Interim Results of Fiber Optic System Field Failure Analysis", *NFOEC Proceedings* Vol. 1, p. 539-545, (1991)

# Root Cause Analysis

(220 ILCS 50/4)

**Sec. 4. Required activities.** Every person who engages in nonemergency excavation or demolition shall:

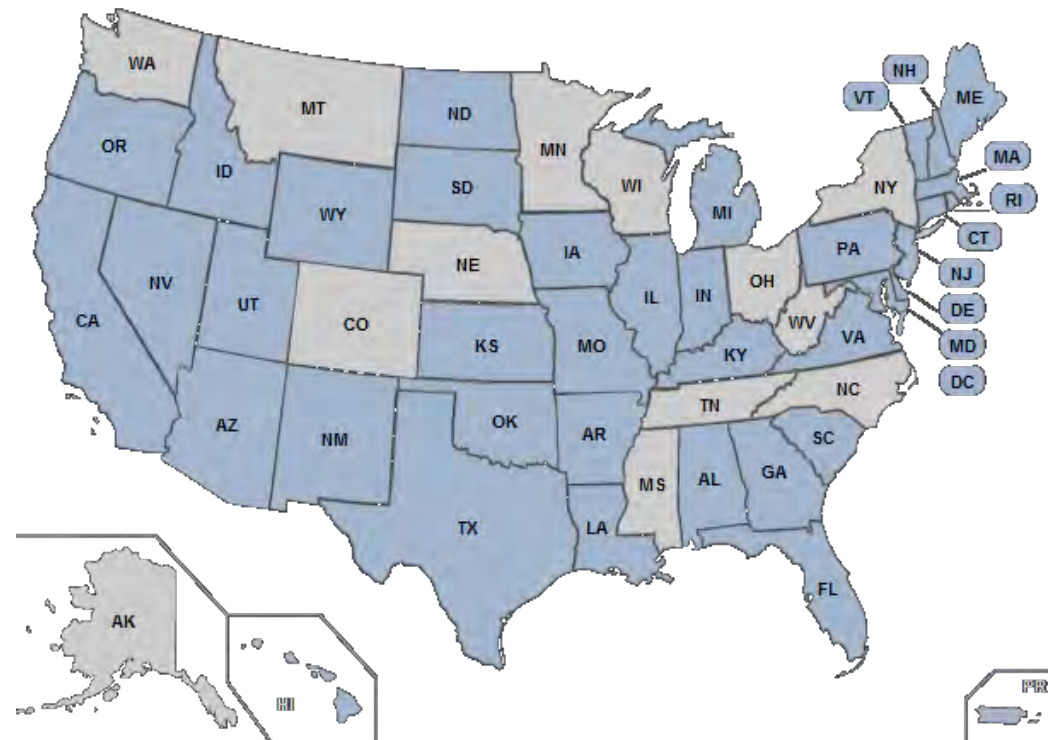
- (a) take reasonable action to inform himself of the location of any underground utility facilities in and near the area for which such operation is to be conducted;
- (b) plan the excavation or demolition to avoid or minimize interference with underground utility facilities within the tolerance zone by utilizing such precautions that include, but are not limited to, hand excavation, vacuum excavation methods, and visually inspecting the excavation while in progress until clear of the existing marked facility;

**Source:** [www.illinois1call.com](http://www.illinois1call.com)



**Source:** [www.georgia811.com](http://www.georgia811.com)

## States Requiring Hand Dig or Soft Dig in Tolerance Zone



# What They Think...



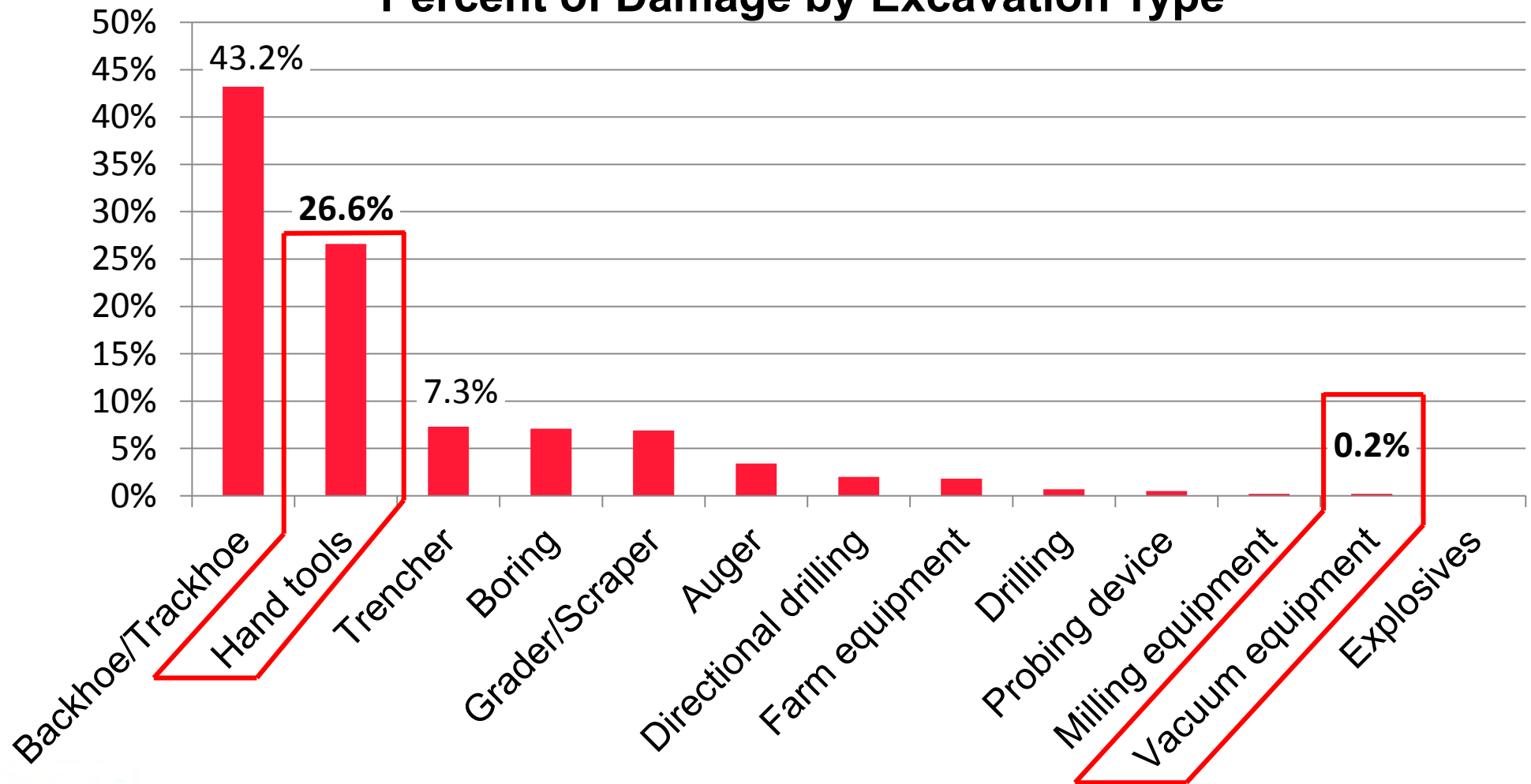
# What We Do

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# Root Cause Analysis

## Percent of Damage by Excavation Type



Source: 2015 CGA DIRT Report

# Shovel vs. Nozzle Testing

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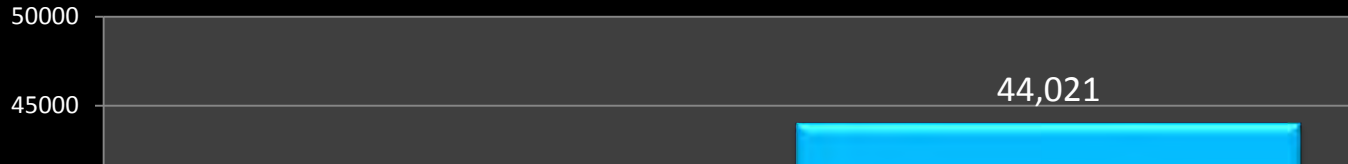
# Shovel vs. Nozzle Testing

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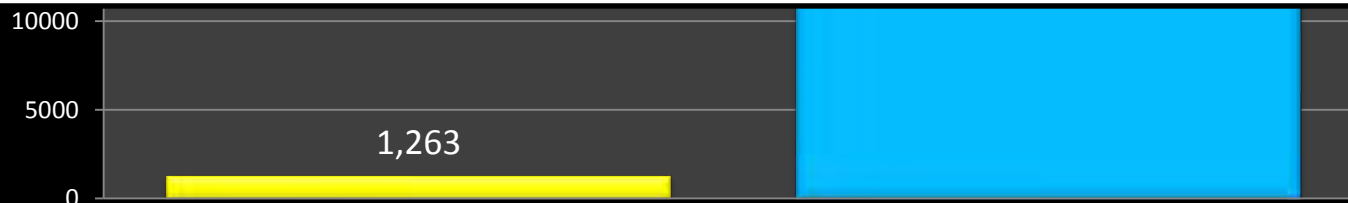


# Shovel vs. Nozzle Testing

## Nozzle Vs. Shovel Contact Pressure



**OVER 34 TIMES MORE PSI  
THAN HYDRO  
EXCAVATION!**



Equipment

# Hand Tool Damage

04-26-2014, 07:14 AM


#1

[miamicuse](#)  
Member  
Join Date: Nov 2011  
Posts: 1,297  
Rewards Points: 1,458  
[View miamicuse's Album](#)

**A shovel accidentally hit an outside buried coax cable**

Had some landscaping work done yesterday and must have hit the coax cable with the shovel. It was buried like 1" below, I thought it would be deeper.

In any event, my cable TV is still working, and in close examination, that cable was basically severed all around except for the copper conductor in the middle. There is another damaged spot to it's right but didn't damage as much.

 This image has been resized. Click this bar to view the full image.

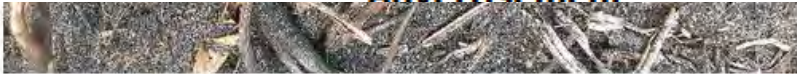
04-26-2014, 06:04 PM

#2

[DIYRemodeler](#)  
Member  
Join Date: Feb 2014  
Posts: 119  
Rewards Points: 75  
[View DIYRemodeler's Album](#)

**I did the SAME thing a few years ago while working on my foundation planting. I pulled up the damaged cord and had the cable company come out and connect a new cord from the box to the house. And then I buried the new line about 6" below the surface and re-seeded. Usually landscaping companies have the utility, telephone and cable lines marked off before they start a project.**

Advertisement



For now I put some [electrical tape](#) over that. There is no slack in that cable. Obviously the [orange cable](#) is the damaged Comcast cable, next to it is the phone cable which wasn't damaged.

What is the best way to fix this? Do I cut it and put two connectors on each end and then splice in a new piece of this...is this a special waterproof coax cable? Or is there some sort of a waterproof splicer that I can "clamp" onto and protect the damaged section inside? I remember seeing a connector that is basically two halves and you put the damaged section in and it has grease or whatever in it, and you tighten them together with screws and compression the middle portion is then protected from the weather and "pull" from either end.

# Hand Tool Damage

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Shovel  
Damage

# Upgrade for IED Interrogation!

## UPGRADES

■ **Air/Water Digger** - The use of air or air/water jet combination is very effective for interrogating in hard compacted soil. The stream will penetrate soil with compaction values of over 20 tons/ ft<sup>2</sup> creating a trench 5" deep and 10" long. Using the air to blast away debris to expose pressure sensitive explosives allows for a much safer interrogation process.



**VEHICLE MOUNTED  
INTERROGATION ARM**

**DETECT. INVESTIGATE. REMOVE.**

# Advantages of Hydro Excavation

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- Can Dig in Virtually All Soils
- Can Dig in Frozen and Hard Soils
- Water is a Lubricant
- Eliminates Sandblasting Effect
- Eliminates Fugitive Silica Dusts
- Reduces Static Hazard
- Varied Water Pressure and Flow
- Can be used for Alternate Applications
- Highly Productive in Virtually all Soil Conditions



# Advantages of Air Excavation

- Air is Limitless
- On-Demand Generation
- Non-Conductive
- Lighter Weight Unit
- Faster Excavation in Loose Soil
- Dry Spoils for Backfill
- Drought Proof



# Advantages of Vacuum Excavation

- Jobsite Safety – 100% Verification of Utility
- Non-Visual Utility Locating Methods are Often Inaccurate
- Much Faster than Manual Excavating Methods (Hand Digging)
- Versatile – Equipment can be used for many Applications
- Easily Reach Hard to Reach Areas
- Reduces Landscape Reconstruction
- Improves Public Perception
- Reduces Risk with Non-Destructive Methods
- Safety as a Value Proposition
- Reduces Job-Site Congestion
- Reduces Operator Fatigue



# Competitive Advantage

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## ALA Benefits for the Excavator

- Reduces the wait time for a locate providing the ability to expedite Customer requests
- Reduces the administrative burden related to managing locate requests (e.g. relocates for project work).
- Competitive advantage
- Improved response time on locates that do not fall under the ALA



# What Can You Do With a Vacuum Excavator

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- Light Pole Installation
- Directional Drilling Mud Recovery
- Potholing/Daylighting
- Safe Excavation around Utilities
- Water Main Repair
- Pit Cleaning (Car Wash, Elevator, etc.)
- Electrical Fault Repair
- Fence Installation
- Telephone Pole Installation and Removal
- Anode Replacement
- Large Excavations
- Water Valve Exercising
- Water Valve Replacement
- Gas Line Repair/Shutoff
- Fire Hydrant Maintenance
- Excavation around Tree Roots
- Spill Cleanup
- Fiber Optic Repair
- Sand Filtration System Cleanout
- Vacuum Roof Rock
- Valve Box Cleanup
- Catch Basin Cleaning
- Portable Toilet Cleanup
- Recovery of Material
- Cleaning of Lateral Lines
- Lift Station Cleaning
- Culvert Cleanout
- Utilize as a Water Truck
- Natural Gas Extraction
- Cathodic Protection
- Service Cut-Off
- Connecting Service Tee or Lateral
- Pipeline Inspection
- Pressure Testing
- Slot Trenching
- Frozen Ground Excavation
- Telephone Line Repair
- Vault/Hole Digging
- Window Well Installation
- And More!



# Subsurface Utility Engineering (SUE)

- Utility mapping utilizing different quality levels based on risk
- Quality Level A is visual verification via vacuum excavation
- A Penn State study found that up to \$34 can be saved in damage prevention for every \$1 invested in SUE.
  - A Purdue study found that on average \$4.62 can be saved for every \$1 invested in SUE.
- Both studies do not include the qualitative savings.



# Water Main Repair

- Minimal Grouse Removal
- Can Dig in Mud



Anthony White  
@AnthonyWhiteTX



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Seriously? Acton Municipal Utility District employees are dedicated.

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# WATERMAIN **BREAK** CLOCK.COM

*Corrosion is not Sustainable*

Each day, 850 water main breaks occur in North America. Since January 2000, we have suffered:

**5,348,432** **broken** water mains (including **267** so far today),



RETWEETS  
76

LIKES  
69



8:18 AM - 23 Aug 2016



76



69



# Excavate in Hard to Reach Areas

- Easily Access Remote Locations
- Minimal Disruptions
- Does Not Damage Surrounding Area



# Excavate in Hard to Reach Areas

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# Excavate Around Tree Roots

- Fast and Efficient
- Non-Destructive to Tree Roots
- Mandated by some Cities



## TREE PROTECTION POLICY AND SPECIFICATIONS FOR CONSTRUCTION NEAR TREES

### Within a TPZ there must be:

- no construction;
- no altering of grade by adding fill, excavating, trenching, scraping, dumping or disturbance of any kind.
- no storage of construction materials, equipment, soil, construction waste or debris.
- no disposal of any liquids e.g. concrete sleuth, gas, oil, paint.
- no movement of vehicles, equipment or pedestrians.
- no parking of vehicles or machinery.
- directional micro-tunnelling and boring may be permitted within the limits of a TPZ subject to approval by Urban Forestry.
- open face cuts outside a TPZ that are consistent with an approved plan and that require root pruning, require the services of a qualified arborist or approved tree professional. An exploratory dig, either by hand or **using a low water pressure hydro vac method**, must be completed prior to commencing with open face cuts outside the TPZ.

# Prevent Cross Bores

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*Source: People's Gas*

## Methods Used for Cross Bore Elimination and Prevention



1. Records review
2. Inspection mains and lateral sewers from sewer main with robotic CCTV cameras
3. Inspection of lateral with push rod CCTV cameras
4. Pot holing using vacuum excavation
5. Combining 1, 2, 3 or 4 with GPS/GIS sub foot accuracy mapping saved into permanent data base – accessible to multiple users with aerial photo overlay.

*Source: Cross Bore Safety Association*

# Prevent Cross Bores

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# Utility Pole Install/Removal

- Not All Utility Poles are Clear



# Surface Preparation

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# Contain and Transport

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# Vacuum Roof Rock

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Source: Great Lakes Power Vac



Source: Dunn Service Group

# Fish Line through Conduit

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Source: Done-Rite Daylighting

# Trench Collapse Rescue

## Person identified after being pulled from collapsed trench in Washington Twp.

BY WRGT/WKEF | WEDNESDAY, JUNE 15TH 2016



Fire crews trying to recover body from collapsed trench in Washington Township

WASHINGTON TOWNSHIP (WRGT) -- Fire officials on the scene of a trench collapse say they are looking for a male victim.

Washington Township Fire Chief Bill Gaul said they have multiple resources at the scene of the accident and the township has exhausted all its resources, except for one engine and one medic in case of another call.

Gaul said they also are using a vacuum truck from Kettering Fire Department to remove loose dirt from the hole; however, crews still don't know the exact location of the man's body.

Gaul said the weather could become a factor for rescue crews, with the heat and especially if it begins to rain.



POSTED ON [NOVEMBER 3, 2015](#) BY [ALTON TELEGRAPH](#)

## Rescuing 'Randy': Alton firefighters, Public Works employees practice trench rescue scenarios

NEWS

### Alton firefighters, Public Works employees practice trench rescue scenarios Tuesday

By Linda N. Weller - [lweller@civitasmedia.com](mailto:lweller@civitasmedia.com)



Alton Public Works employee Bob Herring, left, guides the tube of the city's vacuum truck as it picks up dirt from a trench Tuesday to free a mock victim of a trench collapse. Public Works employees were working with the Alton Fire Department's technical rescue team.

ALTON — A powerful, long metal suction tube pulled out dirt and rock from a 10-foot-deep trench Tuesday as Alton firefighters took turns "saving" a mannequin trapped under soil.

Up above, four employees of the Alton Public Works Department's Sewer Division operated the newer, Vector Plus 2100 combination sewer cleaner tube connected to a large truck with a holding receptacle.

A firefighter guided the open end in the trench, working side to side to clear out loose soil as fellow firefighters observed the process from above.

"This is the first time the Public Works Sewer Maintenance Department and the Alton Fire Department trained together in trench rescue," said Chief Bernie Sebold of the Alton Fire Department. A Public Works crew had dug the long, deep trench near the Police Training Facility at end of Emma L. Kaus Lane as preparation.



Alton firefighter Steve Perry uses the long "tube" on the vacuum truck to pick up dirt around the mock victim's body. The training was held in a trench dug by city workers near the public works

Firefighters on Tuesday morning then installed the trench rescue equipment. It is comprised of horizontal metal struts that exert pressure on vertical shoring boards placed against two sides of the hole to keep the dirt from tumbling into the trench and endangering the rescuers and victim.

Parked nearby was the department's new, long technical equipment truck loaded up on its "maiden voyage," Battalion

# Swine Transport Cleaning

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## Hydrovac Based Swine Transport Cleaning Expected Soon

17 August 2016

**CANADA - A Professor with the University of Saskatchewan hopes to have a manual hydrovac system for cleaning and disinfecting swine transport equipment operational by the end of 2016, writes Bruce Cochrane.**

As part of research being conducted on behalf of Swine Innovation Porc scientists are working to automate the washing and disinfection of swine transport vehicles to reduce the risk of spreading disease.

The Prairie Agricultural Machinery Institute is developing a hydrovac based system for washing the equipment, VIDO-Intervac is examining methods to ensure the pathogens are deactivated and the Prairie Swine Centre is evaluating the design of the trailers.

Dr Terry Fonstad, a Professor in the College of Engineering at the University of Saskatchewan, says the goal is to reduce the time it takes to clean swine transportation equipment and ensure all organisms capable of causing disease have been killed.



ManitobaPork



Sask PORK

Farm-Scape is sponsored  
by  
Manitoba Pork Council and  
Sask Pork

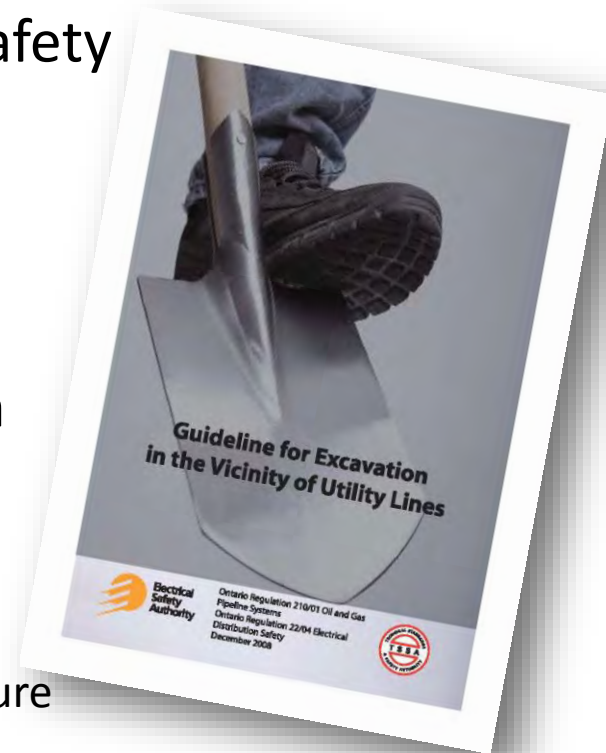
FarmScape is a  
[Wonderworks Canada](#)  
production and is  
distributed courtesy of  
Manitoba Pork Council  
and Sask Pork.

**Dr Terry Fonstad-University of Saskatchewan:**



# Best Practices

- Electrical Safety Authority – Technical Standards & Safety Authority
  - Guideline for Excavation in Vicinity of Utility Lines
  - TSSA is an Ontario based, not-for-profit, self-funded organization dedicated to enhancing public safety in Ontario
- ESA guideline specifies pressure for hydro excavation
  - Max pressure with a straight tip nozzle – 2,500 PSI
  - 1,500 PSI max pressure when below 18" of the road surface.
  - Max pressure with a spinner (orbital) nozzle – 3,000 PSI
  - An 8" distance shall be maintained between the end of the pressure wand nozzle and soil.



# Best Practices

- Gas Technology Institute (GTI)
  - Vacuum Excavation Best Practices & Guidelines
- GTI guideline specifies pressure for hydro excavation
  - Same as TSSA
  - Max pressure with a straight tip nozzle – 2,500 PSI
  - 1,500 PSI max pressure when below 18” of the road surface.
  - Max pressure with a spinner (orbital) nozzle – 3,000 PSI
  - An 8” distance shall be maintained between the end of the pressure wand nozzle and soil.



# Best Practices

## ■ OSHA

- Specific Excavation Guidelines
  - 1923.651 Subpart P



### 1926.651(b)(2)

Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used.

### 1926.651(b)(3)

When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means.

### 🔍 Standard Interpretations - Table of Contents

- **Standard Number:** 1926.651; 1926.651(b)(2); 1926.651(b)(3)



# This Concludes the Education Portion of this Session

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