DIRT

Damage Information Reporting Tool

2018 Analysis & Recommendations

VOL. 15

To download or to access additional analysis, visit CommonGroundAlliance.com/DIRT.

Released, September 2019

Dear Damage Prevention Stakeholders,

The Common Ground Alliance and our Data Reporting and Evaluation Committee are pleased to issue the only comprehensive accounting and analysis of damages to buried infrastructure in the U.S. and Canada with the release of our 2018 DIRT Report and Interactive Dashboard.

The latest DIRT Report includes analysis of 440,749 damages and near miss events submitted for 2018. Through the dedicated efforts of our members, the quantity of data being submitted to DIRT has increased dramatically since the first DIRT Report was issued for 2004. This important information helps the industry better understand where breakdowns in the safe digging process occur and how we can best address them.

Key data points in the 2018 DIRT Report indicate that our progress in reducing damages has plateaued. The Report details how estimates of total U.S. damages have increased in the last few years. Additionally, damages per dollar of construction, damages per one call transmission, and call-before-you-dig awareness—all indicators of damage prevention effectiveness—have also stalled. Simply put, this data shows that while we aren't seeing a significant increase in damages, we aren't seeing a significant reduction in damages either.

It is important to note that many factors are impacting current damage prevention efforts, including increased construction spending, extended construction seasons, fiber-to-the-premises and 5G installations, labor shortages in construction and utility locating, infrastructure replacement programs, as well as population and GDP growth. Relevant forecasts indicate that these trends will continue for the foreseeable future.

As DIRT submissions have grown in scale, CGA has focused on providing analysis of more localized data and industry-specific information. In addition to reporting information at the state and province level and making the Interactive Dashboard available for filtering and data manipulation, CGA introduced updates to the field form for 2018 data entry, resulting in a much more detailed picture of 2018 events, particularly with regard to damage root causes.

In the 2018 DIRT Report, "*Notification NOT Made*" was the single greatest root cause, selected for 23% of damages submitted. Although we continue to make progress, this root cause has hovered around 25% for the past six years.

In short: It's time to double down on our commitment to work together to reduce damages to underground infrastructure. By improving the quality of DIRT submissions as well as the range of stakeholders engaged with damage reporting, we can not only strengthen the DIRT Report but we can more confidently use this data to identify our *biggest* opportunities for significant improvement.

Please take the time to read this Report and to use the Interactive Dashboard to see how your organization, stakeholder group, or region can plan to address persistent issues alongside your fellow CGA members in the months and years to come.

Be safe,

Sarah K. Magruder Lyle

Sarah K. Magruder Lyle
President and CEO
Common Ground Alliance

Table of Contents

CGA Resources

Below are links to other CGA resources and reports referenced throughout this report, all housed on the CGA website:

- 2018 Online DIRT Dashboard: An interactive dashboard that allows users to interact with the complete DIRT dataset, run queries, filter, sort, and extract trends of interest to users. Key features of the interactive DIRT analysis tool include the following:
    - State summaries and interactive visualizations
    - Easy comparisons between states
    - Temporal damage trends over the year
    - Interactive maps
    - Root causes and associated excavation information (type of excavator, work, and equipment)

  It is available at https://commongroundalliance.com/dirt-dashboard.

- CGA White Paper: Data-Informed Insights and Recommendations for More Effective Excavator Outreach: https://commongroundalliance.com/whitepaper

- CGA Technology Advancements & Gaps in Underground Safety: https://commongroundalliance.com/media-reports/technology-advancements-and-gaps-underground-safety-2019

- Past DIRT Reports: http://commongroundalliance.com/media-reports/dirt-reports

Terminology Used in This Report

Damage—Any impact or exposure that results in the need to repair an underground facility due to a weakening or the partial or complete destruction of the facility, including, but not limited to, the protective coating, lateral support, cathodic protection, or housing for the line, device, or facility. There does not need to be a release of product.

DIRT—Damage Information Reporting Tool.

Downtime—Time that an excavator must delay an excavation project due to failure of one or more stakeholders to comply with applicable damage prevention regulations or best practices. There may or may not be a damage associated with the downtime.

Event—The occurrence of facility damage, near miss, or downtime.

Facility Affected—The type of facility that is involved in a damage event: distribution, service/drop, transmission, or gathering.

Facility Damaged—The facility operation that is affected by a damage event: cable TV, electric, natural gas, sewer, water, etc.

Known Data—DIRT data, excluding unknown data. Unknown data depends on the DIRT field but usually is denoted as "unknown" or "unknown/other."

Near Miss—An event where damage did not occur but clear potential for damage was identified.

Pot-Hole—Hand digging or using a "soft excavation" practice such as vacuum excavation to dig a test hole to verify accuracy of markings prior to beginning excavation within the tolerance zone.

Root Cause—The primary reason that the event occurred. For purposes of DIRT, the point where a change in behavior would reasonably be expected to lead to a change in the outcome, i.e., avoidance of the event.

Substantial Reporting States—A set of states at the high end of a continuum of states where DIRT reporting reflects damages occurring in those states. These states are used as the basis for the estimate of total U.S. damages by identifying statistical correlations with independent variables such as construction spending, population, weather, one call transmissions, etc., and using those to estimate damages in the remaining states.

Tolerance Zone—The space in which a line or facility is located and in which special care is to be taken.

Transmissions—The number of initial notices of intent to excavate sent by one call centers to their member facility operators, including those sent directly to locating vendors on behalf of members. Each incoming notice of intent to excavate generates outgoing transmissions to several members, such as electric, gas, cable TV, water, sewer, telecommunications, etc.

Unique Events—The number of events after identifying and consolidating multiple reports of the same event (see footnote 3 on page 10). Unless otherwise noted, this is the number (total 341,609) used in this report and on the online interactive dashboard.

Executive Summary

Reported Damages

The number of damage reports entered into DIRT, both before and after applying the method to match and weight multiple reports of the same event, reached an all-time high at 440,749 and 341,609 respectively.

The estimate of total damages in the U.S. increased from 439,000 in 2017 to 509,000 in 2018, representing a 16% increase. Damages per 1,000 one call transmissions increased by 11%, from 1.87 to 2.08, and damages per million dollars of construction spending (2017 constant dollars) went from 0.359 to 0.392. The large jump in damages from 2017 to 2018 may reflect, in part, the faster rate of growth in the country's economy (e.g., economic growth in 2018 was 2.9% relative to 2.2% in 2017).

Data Quality Index

The Data Quality Index (DQI), a measure of completeness of DIRT reports, has declined in recent years. In terms of the number of companies entering DIRT data, a large percentage score fairly well, although they submit a small percentage of data. Conversely, there are a small number of companies submitting large quantities of poor-quality data. DIRT could become even more useful if the high-quantity, low-DQI stakeholders could improve their scores.

Damage Cause Analysis

Several new root causes introduced in 2018 and an update to the root cause groupings resulted a redistribution of the associated data. The new root causes show that digging before the valid start time is one of the leading individual root causes.[1] It appears many DIRT users were classifying these as Excavation Issues in the past, which explains the shift from Excavation Issues to Other Notification Issues. The percentage of damages due to *Notification Not Made* increased slightly. Excavation Issues decreased, while Other Notification Issues (i.e., other than *Notification Not Made*) increased.

Damages due to Locating Issues increased. This is largely due to moving damages relating to abandoned facilities from the Miscellaneous group to the Locating Issues group.

Thirty-six percent of reported damages with a known cause are the result of Excavation Issues. Approximately a quarter (26%) resulted from *Notification Not Made* and another quarter (24%) from Locating Issues. Approximately 14% are due to Other Notification Issues such as expired tickets, digging outside the stated work area, and digging before the valid start time, which are new root causes added to DIRT in 2018.

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[1] Three new root causes in the Other Notification Issue group were introduced in 2018: *Excavator dug outside area described on ticket*, *Excavator dug prior to valid start date/time*, and *Excavator dug after valid ticket expired*.

Contractors are the leading known type of excavator involved in damages at about 69% of reported damages. This is followed by Utilities at 12%, while Occupants, Municipalities, and Farmers each make up about 5%.

The leading type of known work performed involved in damages is Sewer/Water at about 27%, followed by Energy at 18%, and Construction/Development and Telecommunications at 16% each.

2018 DIRT Report Changes

The following new fields were added to DIRT in 2018:

- Did this event involve a cross bore?
- Was the work area white lined?
- Is facility owner exempt from one call center membership?
- Is excavation activity and/or excavator exempt from 811 notification?
- Measured depth from grade.

Approximately 9% of reports answered the depth question, and 2.6% answered the white lining question. The others were answered on less than 1% of reports. Hopefully the percentage of reports with these questions answered will grow moving forward, because they were added to DIRT to provide deeper insights into the factors contributing to damages.

A comparison of 2018 DIRT damage data to the Call Before You Dig awareness survey data from June 2018 demonstrates that, in general at the U.S. census region level, an inverse relationship between awareness and damages can be observed. As awareness increases, the percentage of damages due to *Notification Not Made* decreases.

DIRT Dashboard

As a complement to this written report, an Online Dashboard is available to CGA members at https://commongroundalliance.com/media-reports/dirt-reports where stakeholders can filter and sort the data by various combinations of variables and DIRT data fields.

- The **State/Provinces** tab demonstrates the spatial distribution of the 2018 damage data.
- The **Root Cause** tab shows the connection between root cause and facility damaged, excavators, and equipment.
- The **DIRT Explorer** tab allows the user to filter and query the damage data.
- The **State Summaries** tab allows users to examine damage data for a particular state.
- The **Calendar Heatmap** tab is a calendar view of the damage data with the ability to filter by geography and other variables.

Recommendations

1. **Minimize "unknown" data entries.** To ensure that maximum value is derived from each event entered into DIRT, efforts should be directed toward minimizing the amount of "unknown" data entries. This is particularly a concern for the excavator information (type of excavator, work performed, equipment used) where the data is valuable but the proportion of the unknown data is significant. Additional training and awareness around DIRT may reduce the amount of unknown data.

2. **Increase awareness of nuances around the 811 notification process.** Efforts could include encouraging excavators to wait for marking to be completed; to stay within the stated work area or to make a new notice if the original work area is extended, and renew notices if marks deteriorate or if work will continue beyond one call ticket expiration.

3. **Reduce no notification damages by professional excavators.** Failure to provide notice of intent to excavate (*Notification Not Made*) is the single largest specific root cause of damages. CGA's awareness surveys have shown that general public awareness of Call Before You Dig services has been consistently in the mid-40% range since 2010. Aided 811 awareness[2] has hovered in the mid-30% range, and unaided 811 awareness comes in at less than 10%. DIRT shows professional excavators are involved in the majority of damages. Although general public awareness campaigns cast a wide net and will capture professional excavators to some extent, information targeting professional excavators would be beneficial. The following recommendations come from CGA's White Paper, Data-Informed Insights and Recommendations for More Effective Excavator Outreach published April 2019.

- Stakeholders should develop public awareness campaigns that can effectively reach both DIY diggers and professional excavators with the 811 message. While professional excavator awareness of 811 (76% aided awareness) is nearly double that of the general public (36% aided awareness), continued promotion of 811 to both groups remains incredibly important, especially among smaller excavation firms.
- Mass media has the power to reach both audiences at the same time, making campaigns more efficient. When promoting the 811 message, mass media—both traditional and digital—has the potential to reach both audience groups with the same campaigns, which allows for more efficient targeting of advertising dollars.
- Targeted efforts that promote 811 also matter. Educational tactics that tap into existing communications channels—such as facility operators including 811 information in bill inserts and on company websites—were identified as memorable outreach efforts by attendees of both excavator focus groups. CGA encourages all stakeholders to consider additional ways to directly target all types of excavators.

[2] The survey questions include the following:
• Are you aware of a free national phone number that people can call to have underground utility lines on their property marked prior to starting any digging project? (general awareness)
• Do you recall what the number is? (unaided recall)
• Does the phone number "811" sound familiar? (aided recall)

- Campaigns focused on 811/notification should highlight projects that may be performed by both homeowners and professional excavators. To be successful in targeting both groups with advertising and public service announcements that resonate equally, CGA recommends showcasing projects that occur in a residential setting, including landscaping, fence installation, deck or patio building, excavation for a swimming pool, etc., in marketing and educational materials.

4. **Promote pot-holing as a best practice.** The excavation issues root cause group includes failure to pot-hole; maintain clearance; maintain marks; and protect/shore/support facilities; improper backfilling; and improper excavation practices not listed above. When combined, they form the largest root cause group, and failure to pot-hole is the largest known (i.e., setting aside "not listed above") root cause within the group. The CGA White Paper stated the following:

> "…excavators have limited knowledge about regulations beyond the need to notify before beginning work, while the online survey showed that concepts such as pot-holing/test-pitting, needing to maintain marks or request re-marks, and other critical but lesser-emphasized excavation best practices do not have the same level of awareness and compliance as making the notification. These findings indicate the need to highlight specific excavation best practices in detail, which is best achieved through scalable educational training programs."

and included the following recommendation:

> "Make damage prevention training more easily accessible, relevant and actionable. Excavators want comprehensive damage prevention training and value the experience of more seasoned crew members. The report highlights strategies for incorporating training into existing safety and damage prevention programs, scaling training via online modules, and focusing on the specifics of 'digging with care' to reduce damages."

5. **Improve on-time locate metrics.** Contract locating firms and facility operators that use internal personnel should staff appropriately to ensure that locate requests are responded to within the local established timeframes (see Best Practice 4-17). This can include predicting notification volume and staffing accordingly to meet volume fluctuations. The new root causes brought out digging before marks are complete as the third leading known root cause of damages. When markouts are late, contractors incur delays (downtime) and potentially added costs for demobilization, change in plans, etc. Multiple attempts to be proactive and to renotify the one call center, as Best Practice 5-9 suggests and many state laws require, with still no results, leads to excavation proceeding without marks complete leading to in damages.

6. **Educate excavators to reduce over-notifications.** Abuses of the one call system exacerbate issues with late locating and/or no response to one call tickets:

- excavators repeatedly update locate tickets for which some or all of the work has already been completed,
- false emergency notifications are made when proper advance planning has not occurred;
- marking of work areas larger than actually required are requested; or

- multiple contractors submit tickets in anticipation of being awarded a job.

These all hamper on-time locate efforts. Excavators should manage their ongoing work and update tickets judiciously. They should request locates only for those areas not yet completed and that can be accomplished within a reasonable timeframe. They should not call in tickets when a job has not yet been awarded. Refer to Best Practices 5-23 and 5-26.

7. **Use the DIRT Dashboard to identify leading damage causes and maximize damage prevention resources.**

- Use the DIRT Explorer page to filter and sort by various combinations of variables such as state, industry, root cause, type of excavator, work, and equipment. Focus on the largest contributors to damages. For example, contractors doing sewer/water work is the largest known excavator/type-of-work combination. Look at their root cause mix and facilities damaged and develop campaigns to modify behaviors.
- Use the Calendar Heat Map to filter and sort by various combinations of variables. For example, Saturdays are the leading day for damages involving occupants. In many states they would need to make their 811 notifications by the prior Tuesday for a Saturday start. The biggest days for contractors seem to be Wednesdays and Thursdays. They should be making their 811 notices late in the prior week. Look at variations in root causes, types of excavators, types of work, and state/province. For example, the frequency of damages in Arizona and New Mexico remain fairly consistent throughout the year. In Michigan and Minnesota, they noticeably increase in summer. Use this data to deliver targeting messaging to the right audiences when peak damage periods are approaching.

8. **Adopt new technologies to prevent damages.** Technology has greatly advanced over last 20 years. Consult the CGA Technology Report and explore ways to use technologies to reduce damages by improving one call center processes and locating and excavating practices.

- **Locate and track abandoned facilities.** Locating issues are a significant slice of the root cause pie chart, and abandoned facilities are a significant part of that slice. The CGA Technology Report identifies "locating and tracking abandoned facilities" as an opportunity for technology development.
- **Selectively adopt vacuum excavation.** Vacuum excavation is a safe and acceptable method of digging and pot-holing in the vicinity of buried facilities. Vacuum excavating contractors, manufacturers, and subsurface utility engineering (SUE) firms dig many (likely millions of) 'holes' near buried utilities, and a relatively small number of damages are reported to DIRT each year (268 in 2018) with vacuum excavation as the equipment type as compared to hand tools (20,333 in 2018). Vacuum excavation activity should be tracked sufficiently (e.g., number of holes, depth, linear feet, etc.) to statistically demonstrate its effectiveness in damage prevention. With statistical evidence, it is assumed that vacuum excavation use will become more standardized, leading to a reduction in cost and even greater usage by excavators as a means to avoid damage. Refer to Best Practices 2-14, 5-19, 5-20, and 5-32, and also see Case Study 2 Hydrovac Excavation—The Safest Way to Excavate around Buried Utilities from CGA's 2019 Technology Report.

Introduction

The Damage Information Reporting Tool (DIRT) is a product of the Common Ground Alliance (CGA). It is a system for gathering data regarding damage and near miss events from excavation activities related to buried facilities. An event is defined in the CGA DIRT User's Guide as "the occurrence of facility damage, near miss, or downtime." DIRT allows industry stakeholders in the U.S. and Canada to submit data to a comprehensive database. The database is used to identify the characteristics, themes, and contributing factors leading to damages, downtime, and near misses. Such findings are summarized in an annual DIRT Report. This Report provides a summary and analysis of the damage events submitted in 2018.

The number of events reported via DIRT for the U.S. and Canada in 2018 totalled 440,749. After consolidating multiple reports of the same events[3] and filtering out near misses, the number of unique damages was 341,609, comprised of 11,164 in Canada and 330,445 in the U.S. (Table 1). The Interactive Dashboard is based on reported unique damages and shows a total of 341,609 when no filters are applied.

Table 1—Reported events, near misses, and damages in Canada and the U.S., over time

	2016	2017	2018
Total Events Entered in DIRT	390,366	411,867	440,749
Near Misses (unique events)	6,093	1,588	4,198
Damages (unique events)	317,869	316,442	341,609

Understanding the Data

The DIRT database has grown significantly since data collection began in 2004. The DIRT data is a rich source of industry intelligence on damage and near miss events from excavation activities related to buried facilities. Despite this, uncertainties remain that limit the ability to draw firm conclusions on the trends in damage events over time and across jurisdictions. There are four reasons for this:

1. Reporting to DIRT is voluntary in many jurisdictions.[4]
2. In some cases, details pertaining to damage events are unknown or not collected, which translates into unknown data in the DIRT database.
3. Reported data is not a complete census of damage to all buried facility operators.
4. There is limited knowledge of the population of companies or entities performing excavation work that might cause damages.

These considerations result in the following issues that must be kept in mind while interpreting the data:

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[3] See the 2015 Annual DIRT report for a description of the method used to match and weight multiple reports of the same event. Also see the May 2016 and July 2016 Monthly Updates (http://commongroundalliance.com/media-reports/cga-monthly-updates).

[4] Although some states' laws and/or rules require reporting all or some specific facility type events to DIRT, compliance may not be 100%.

1. Some jurisdictions contain more comprehensive data than others. Thus, the damages reported via DIRT are not necessarily a reflection of the actual total damages that take place in a given jurisdiction in a particular year.
2. Changes over time may be due to variations in the number and combination of entities reporting damages or from actual increases or decreases in the number of damages.

To allow stakeholders to draw firm conclusions about the trends in damage events, a subset of the data that reflects damages for consistently reporting sources was extracted from the DIRT database.

Consistently Reporting Sources

Because of the voluntary nature of DIRT, it can be difficult to interpret trends in damages over time. Changes may be caused by an actual increase or decrease in damages, by more or fewer entities submitting data in any given year, or by some combination of these factors. To allow for year-over-year comparisons with a higher degree of confidence that changes reflect differences in actual damages rather than shifts in reporting, it is useful to examine annual damages reported for the subset of sources that have employed DIRT on a consistent basis. Consistently reporting sources are comprised of those companies that reported into DIRT during 2016, 2017, and 2018.

Table 2—Reported damages in DIRT and for consistently reporting sources in Canada and the U.S., over time

	2016	**2017**	**2018**
Reported Damages in DIRT	317,869	316,442	341,609
Reported Damages for Consistently Reporting Sources	312,046	308,783	325,606
Reported Damages Attributed to Consistently Reporting Sources	98%	98%	95%

As shown in Table 2, consistently reporting sources account for the clear majority of reported damages in 2018, albeit a smaller percentage in 2018 than in 2016 and 2017. Subsequent sections of this Report employ the consistently reporting sources dataset to demonstrate temporal trends in the DIRT data. Given the high percentage of total reported damages captured by the consistently reporting sources, readers can be confident that the trends over time are a solid representation of changes in actual damages.

A Note About Unknown Data

Consideration was also given to the proportion of any DIRT field characterized by unknown data entries. In cases where the unknown data was deemed to have an insignificant impact on the overall trend in the data (i.e., the unknown data does not skew overall data trends), it is excluded from the data presented in the discussion, exhibit, and/or table for that field. However, in cases where the unknown data has a significant impact on the overall trend, it is included and presented along with known data. Including the unknown data where it plays a significant role in the data trend serves two important purposes:

1. It improves transparency about what is known and what is unknown and can highlight the areas where improved reporting will enhance overall understanding of the data.
2. Suppressing unknown data where it accounts for a significant proportion of reported damages can lead to misinterpretation of overall trends in damages. Allowing unknown data to remain allows the reader to be more cautious when interpreting such variables.

Data Quality Index

The data quality index (DQI) is a measure of the completeness of DIRT reports. Whenever a DIRT report is successfully entered, the system provides a DQI score. When a bulk upload file is entered, the average DQI score of all the individual reports in the file is provided.

Damage Report Submitted Successfully:	
Damage Report Id:	**3238321**
Overall Data Quality Score out of 100: (**more info...**)	**49**

Starting with a theoretical score of 100 (i.e., information is provided for all fields within DIRT), points are subtracted when *unknown, other, or data not collected* (for pre-2018 data) is used. Each non-mandatory DIRT question is assigned a relative 'weight,' depending upon the value that it provides to statistical analysis. For example, Root Cause is worth 30 points, while Joint Trench is worth 1 point. The affected facility and excavation information questions fall in between, at 6 to 8 points apiece. The intent is for DIRT users to reference their DQI score to look for opportunities to gather additional data points during field investigations of damages and near misses.

Table 3 shows that in terms of the number of companies entering DIRT data, a large percentage score fairly well, although they submit a small percentage of data. Conversely, there are a small number of companies submitting large quantities of poor-quality data.

Table 3—2018 data quality index distribution

DQI	# Companies	# Records	% of Companies	% of Records
30-40	5	6,908	1.05%	1.57%
40-50	7	32,426	1.46%	7.36%
50-60	18	285,279	3.77%	64.73%
60-70	25	27,946	5.23%	6.34%
70-80	48	23,749	10.04%	5.39%
80-90	143	49,310	29.92%	11.19%
90-100	232	15,131	48.54%	3.43%
Total	**478**	**440,749**	**100.00%**	**100.00%**

Table 4 presents DQI trends over time by event source. Starting in 2018, One Call Center and Insurance were removed as selections to the event source question (formerly referred to as Reporting Stakeholder). One reason for this is that several one call centers take “damage tickets” from excavators and use them as the source of DIRT reports. When they listed one call center as the event source, it masked the number of reports originating from excavators. However, some of these one call centers do not collect the root cause or other key data fields on these damage tickets, which contributes to their poor DQI scores. Reports from excavators submitting to DIRT through their own registrations rather than via one call centers have an average DQI of 81. The DQI of locators has been trending downward, pulling down the overall DQI because they submit the largest percentage of data.

Table 4—Data quality index over time by event source

Event Source	2016 DQI	2017 DQI	2018 DQI (A)	% Reports (B)	(A) x (B)
Electric	65	68	72	1.525%	1.098
Engineer/Design	58	64	74	0.004%	0.003
Equipment Manufacturer	70	75	47	0.002%	0.001
Excavator	51	49	54	7.664%	4.139
Insurance	80	89			
Liquid Pipe	77	84	81	0.179%	0.145
Locator	71	63	59	63.703%	37.585
Natural Gas	71	73	80	16.464%	13.171
One Call Center	45	43			
Private Water	84	81	87	0.036%	0.031
Public Works	74	78	75	0.591%	0.443
Railroad	69	71	74	0.004%	0.003
Road Builder	67	70	65	1.114%	0.724
State Regulator	67	66	74	0.027%	0.020
Telecommunications	53	56	54	8.199%	4.428
Unknown	56	44	56	0.486%	0.272
Overall DQI	**67**	**63**	**62**		**62**

Figure 1 shows the number of reports within DQI bands of 10 points.

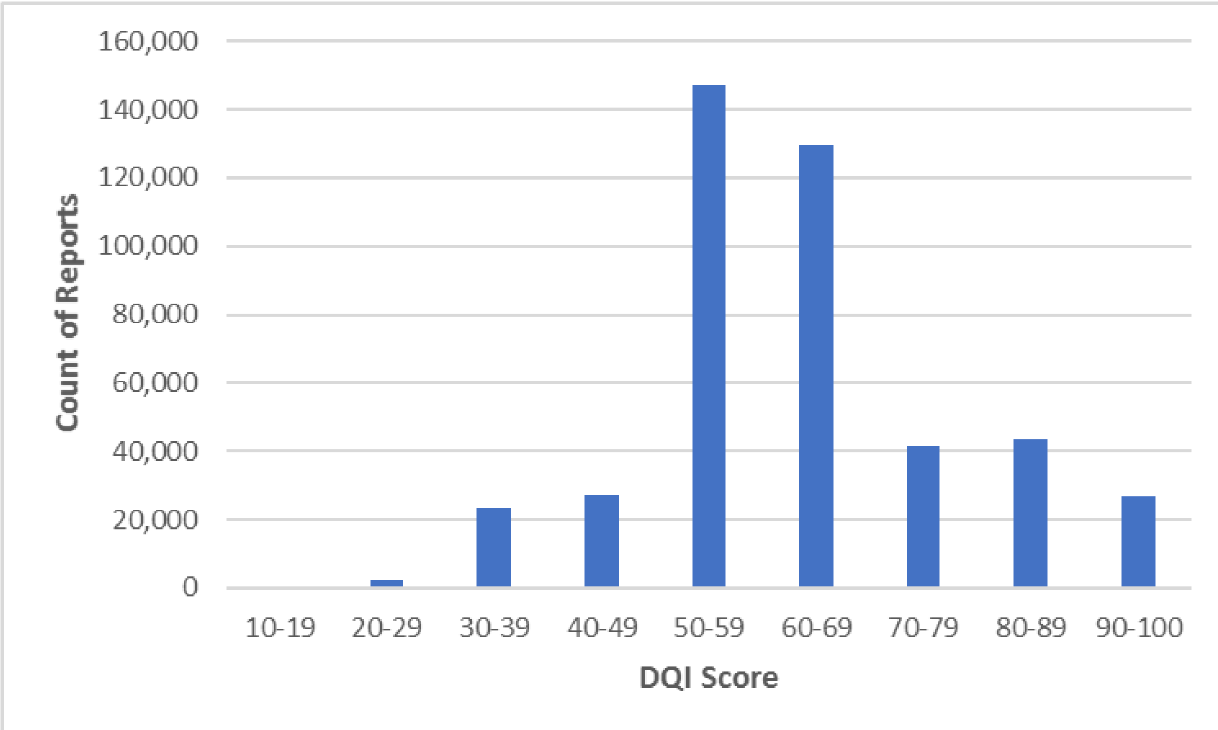


Figure 1—Number of reports by DQI

Appendix A illustrates the effect missing data has on the excavation information DIRT questions: type of excavator, equipment, and work performed. After root cause, these questions have the highest relative value to the DQI score. In conjunction with root cause, these questions help identify the who, what, how, and why of damages, and are worth 50 DQI points combined.

It is difficult to achieve a DQI score of 100 because some information may be unavailable to certain stakeholders. A facility owner may not know the duration and cost of an excavator's downtime. An excavator may not know if the type of locator was contract versus utility. These questions are worth 2.5 DQI points or less. Users with relatively high scores should not be concerned with getting to 100, but DIRT could be greatly improved by raising the scores of those below 70 into the 70s and 80s.

Estimating Total U.S. Damages

Data from the substantial reporting states is used to estimate the total number of damages for the U.S. Appendix B explains this process in detail. Those states are Colorado, Connecticut, Florida, Georgia, Illinois, Kansas, New Mexico, Pennsylvania, Texas, and Virginia.

Using data from the one call centers that submitted their outgoing transmission data to the CGA's One Call Systems International (OSCI) database (or that provided it separately), estimates for the missing one call centers were calculated and added. Table 5 presents key performance indicators generated using the prediction models. Indicators are presented for total estimated damages and transmissions for the U.S. over time. Figure 2 shows this information graphically.

Table 5—Key performance indicators for total estimated damages in the U.S., over time

	2016	2017	2018
Total Estimated Damages	416,000	439,000	509,000
Lower Bound Confidence Interval for Total Estimated Damages	201,000	270,000	230,000
Upper Bound Confidence Interval for Total Estimated Damages	1,159,000	715,000	787,000
Total Estimated Transmissions	221.9 M	234.9 M	244.3 M
Total Estimated Damages per 1,000 Transmissions	1.88	1.87	2.08
Total Estimated Damages per million dollars of construction spending (2018 $)	0.329	0.339	0.389

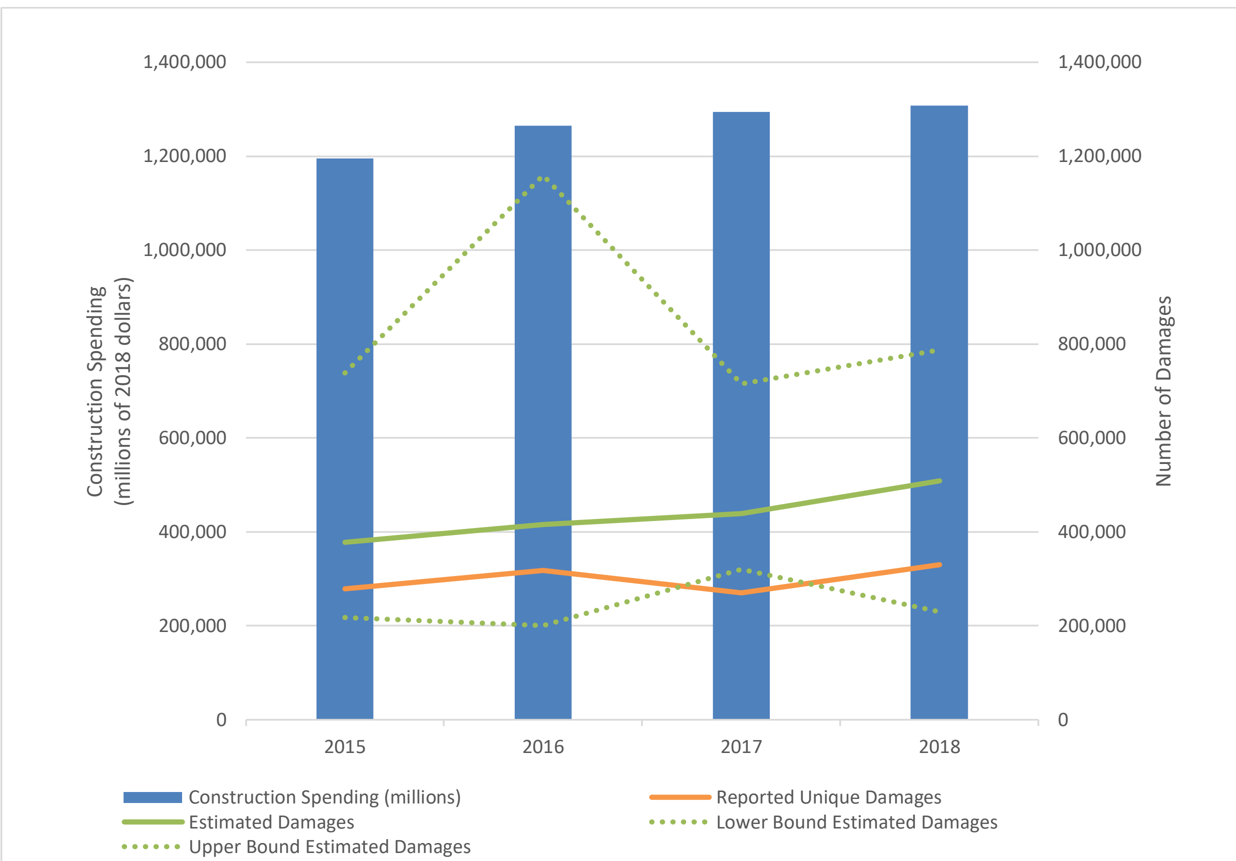


Figure 2—Comparison of DIRT-reported and estimated damages with construction spending. The source for construction spending data is https://www.census.gov/construction/c30/historical_data.html

As shown in Table 5 and Figure 2, there is variation in the number of estimated damages from year to year and an upward trend since 2015. Variation is expected, given that the estimates are based on incomplete data and the relatively low explanatory power of the models from 2017 and 2018. Despite the variation, the estimated damages are not terribly different over time; and given the range in values between the lower and upper bound estimates, one can conclude that damages are likely to be relatively the same from year to year. For the same reason (i.e., the range between the upper and lower bound estimates), the focus should be more on the trend in the data than on the specific estimated damages for any given year. Indeed, the primary objective of estimating total damages for the U.S. is to demonstrate trends over time. Within this context, the large jump in damages from 2017 to 2018 may reflect, in part, the faster rate of growth in the country's economy (e.g., economic growth in 2018 was 2.9%[5] relative to 2.2% in 2017). The consecutive years of data also allow for comparisons with other time-trend data such as construction spending.

The damages per 1,000 transmissions ratio is affected by movement in both the numerator and denominator. An increase in damages (numerator) will obviously cause it to rise, but so will a decrease in the number of transmissions (denominator). Technology advances such as internet ticket entry allow one call centers to better filter out unnecessary transmissions to operators having no buried facilities in the work area. This reduces costs and improves efficiency for the facility operators and locators. However, it also depresses the transmission total relative to how much it might otherwise rise due to increases in incoming notifications, all else being equal.

There are also several factors that make use of the damages per ticket metric problematic when making comparisons between states/provinces, facility operators, industries, etc. For example, differences in life-of-ticket, or limitations on the geographical scope of a ticket, will lead to differences in the number of incoming notices and outgoing transmissions, all else being equal. Two states could have similar damage numbers and other characteristics (such as population, density of buried utilities, or construction activity) but different damage per ticket ratios due to differences in how the denominator is tabulated. The Data Reporting and Evaluation Committee is exploring alternative metrics to measure damage prevention progress.

Date and Location of Damages

The clear majority of reported damages in 2018 occurred during the work week (Monday to Friday). Across all states, 301,687 reported damages occurred during the work week and 28,758 occurred on weekends. The same trend was observed for Canada, with 10,284 reported damages occurring during the work week and 880 on weekends.

[5] Source: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=US

Figure 3 illustrates the distribution of reported damages by month and day for 2018.

> The online DIRT Dashboard has a Calendar Heat Map page that enables filtering by variables such as state, excavator type, facility damaged, damage cause, etc.

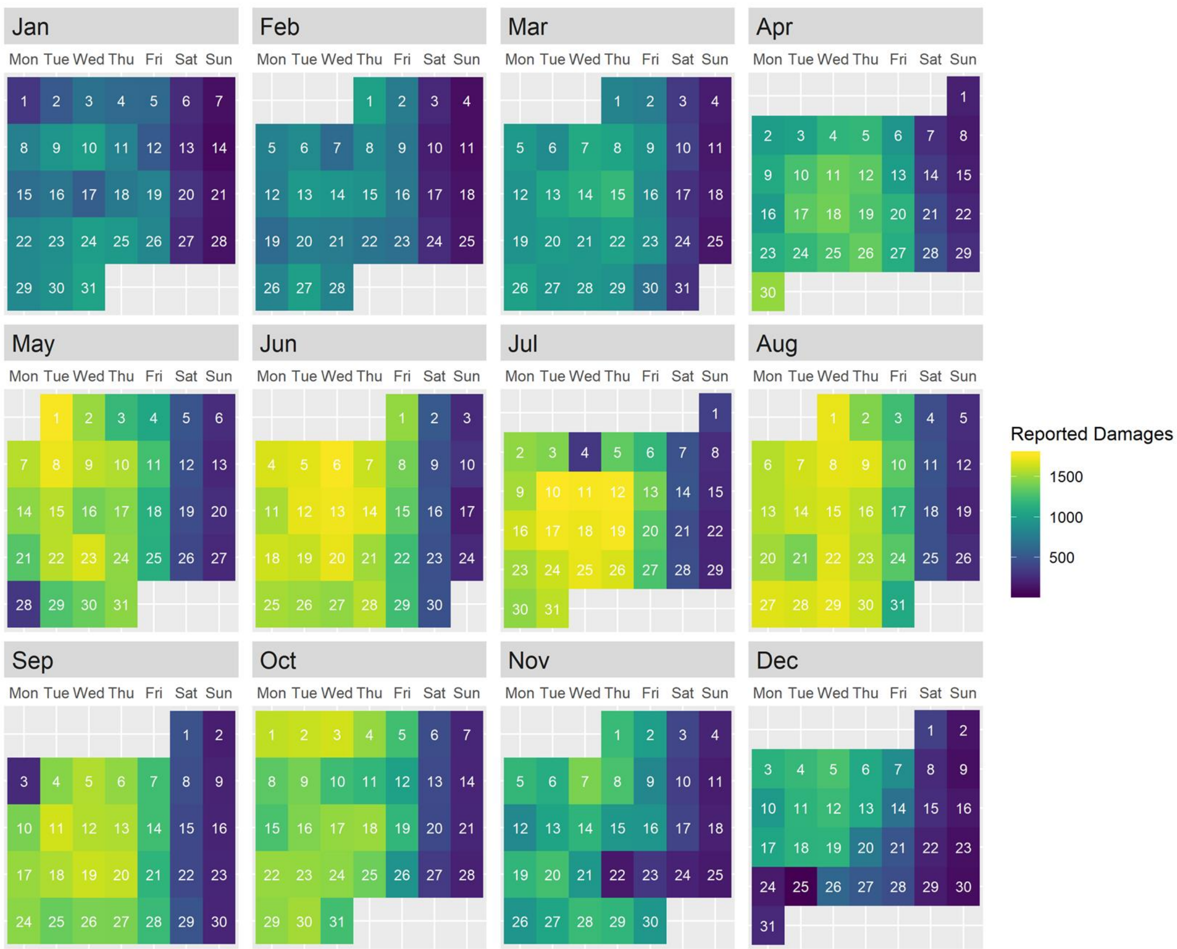


Figure 3—Heat calendar of reported damages in Canada and the U.S. by month and date, 2018

The majority of damages occur in the months of May, June, July, and August. In 2018, 43% of the reported damages occurred during these four months. The highest number of damages was reported for the month of August with 11%. For types of excavators excluding Occupants, more than 92% of damages occur on weekdays. For Occupants, it's approximately 72% weekdays and 28% weekends. Hand tools are the type of equipment for 89% of damages occurring on weekdays but 11% on weekends. For Backhoes, it's 95% of damages on weekdays and 5% on weekends.

Figure 4 displays ranges of damages by location as reported via DIRT. Because participation in DIRT is voluntary and varies by state, the damage ranges indicated may not provide a complete picture of damages and damage prevention efforts. Specifically, higher damages may indicate a higher level of voluntary reporting rather than a higher level of actual damages. As a result, Figure 4 should be interpreted as an indication of which states and provinces are providing damage reports and not an assessment of which are experiencing the most damages.

The online DIRT Dashboard has a States/Provinces page that enables filtering by variables such as one call transmissions, population, construction spending, etc.

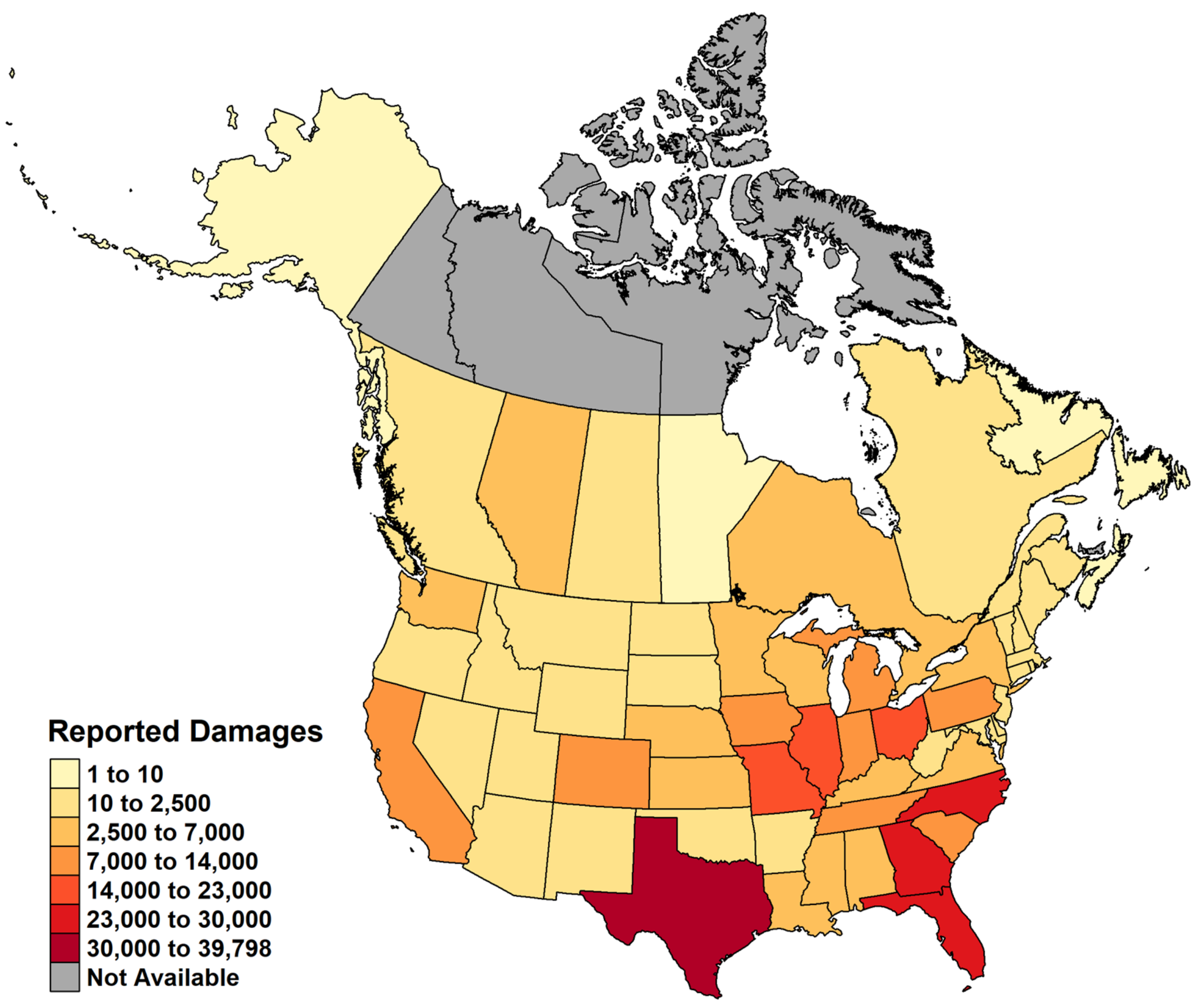


Figure 4—Map of reported damages, 2018

Event Source

As of January 1, 2018, the DIRT form was updated and what was previously referred to as “Reporting Stakeholder” was changed to “Original Source of Event Information.” Figure 5 summarizes damages for 2018 by event source for Canada and the U.S. combined. The leading event source is Locator (217,617 or 64% of events) followed by Natural Gas (56,242 or 17% of events). See Appendix C for a detailed breakdown of damages by all event sources.

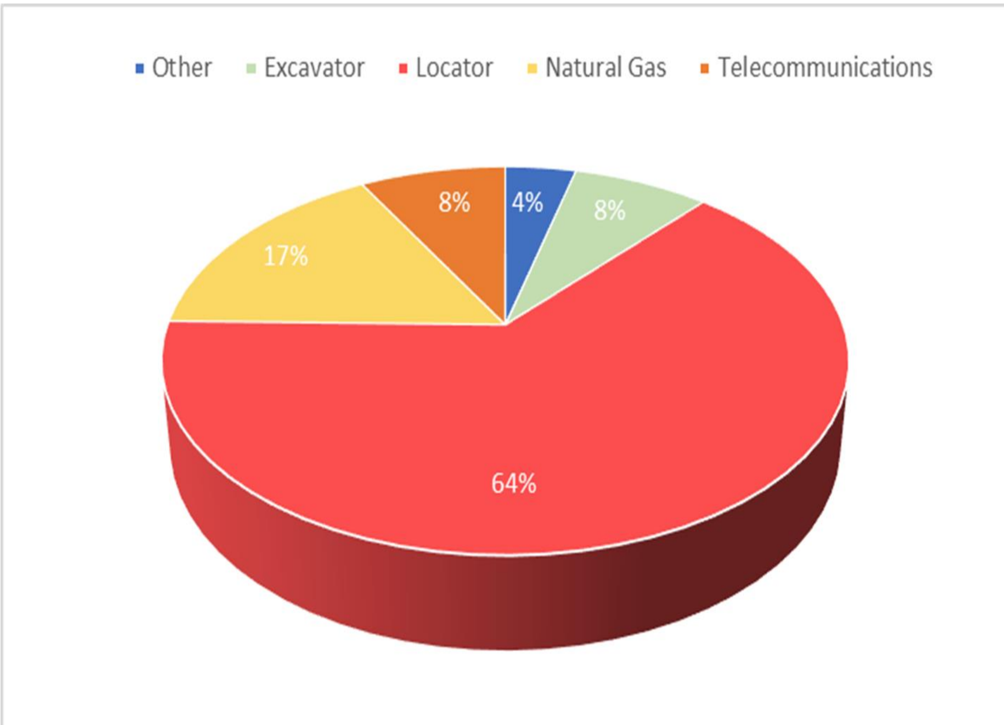


Figure 5—Reported damages by event source in Canada and the U.S., 2018

Event Source by Consistently Reporting Sources

To allow for a comparison of event sources over time, Figure 6 presents data for consistently reporting sources. As can be seen in this figure, Locator has been by far the leading source over the last three years, with year-over-year increases in the number of reported damages. Note: As part of the revision to the DIRT form effective January 1, 2018, One Call and Insurance were removed as selections.

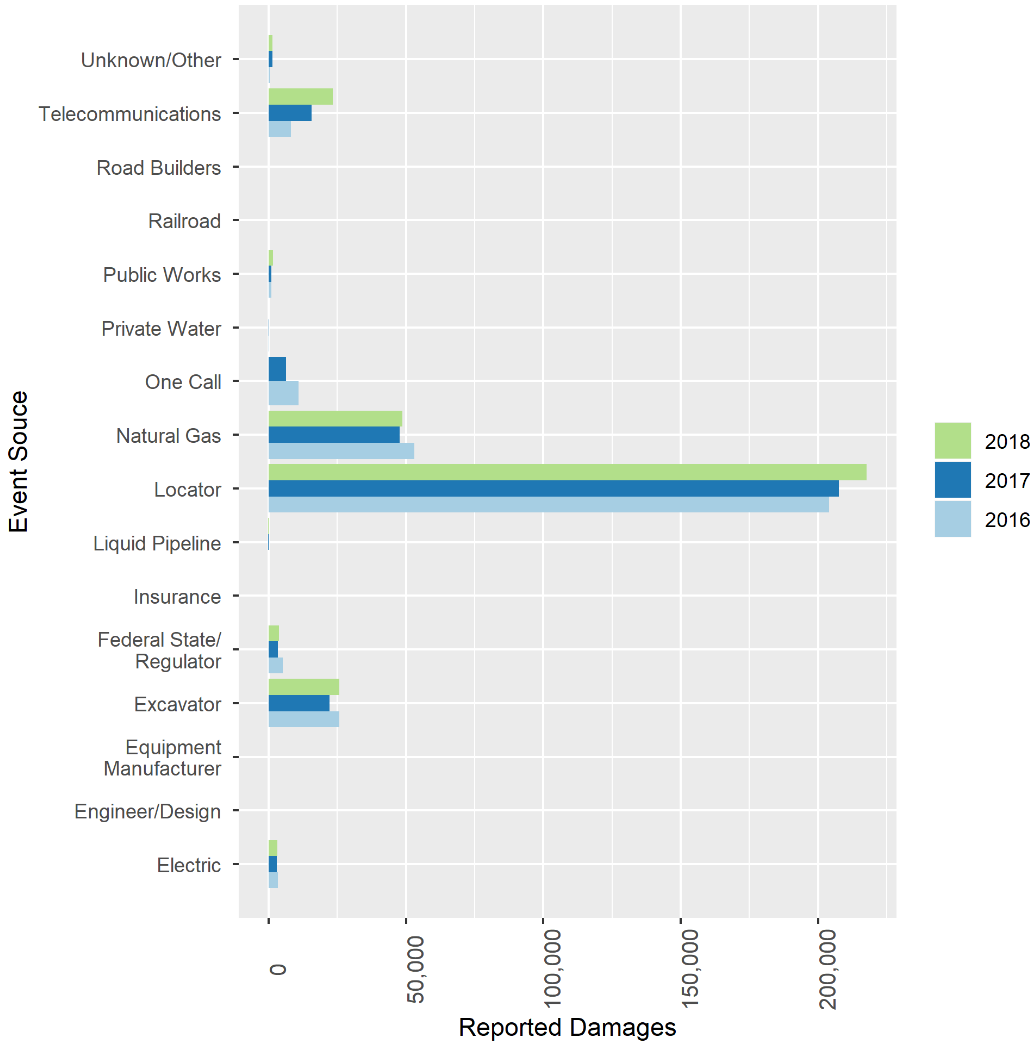


Figure 6—Reported damages by event source for consistently reporting sources in Canada and the U.S., over time

Root Cause

This section of the report presents data trends for root cause. The unknown data for root cause is relatively small (see **A Note About Unknown Data** on pages 11-12). However, for some subtopics in this section, unknown data is discussed due to its impact on the analysis. Readers should pay particular attention to whether unknown data is included or not.

Figure 7 demonstrates the breakdown of known root cause for damage events. The single most commonly listed root cause in 2018 was *No notification made to One Call Center/811* (26%). This was followed by *Improper excavation practice* (15%).

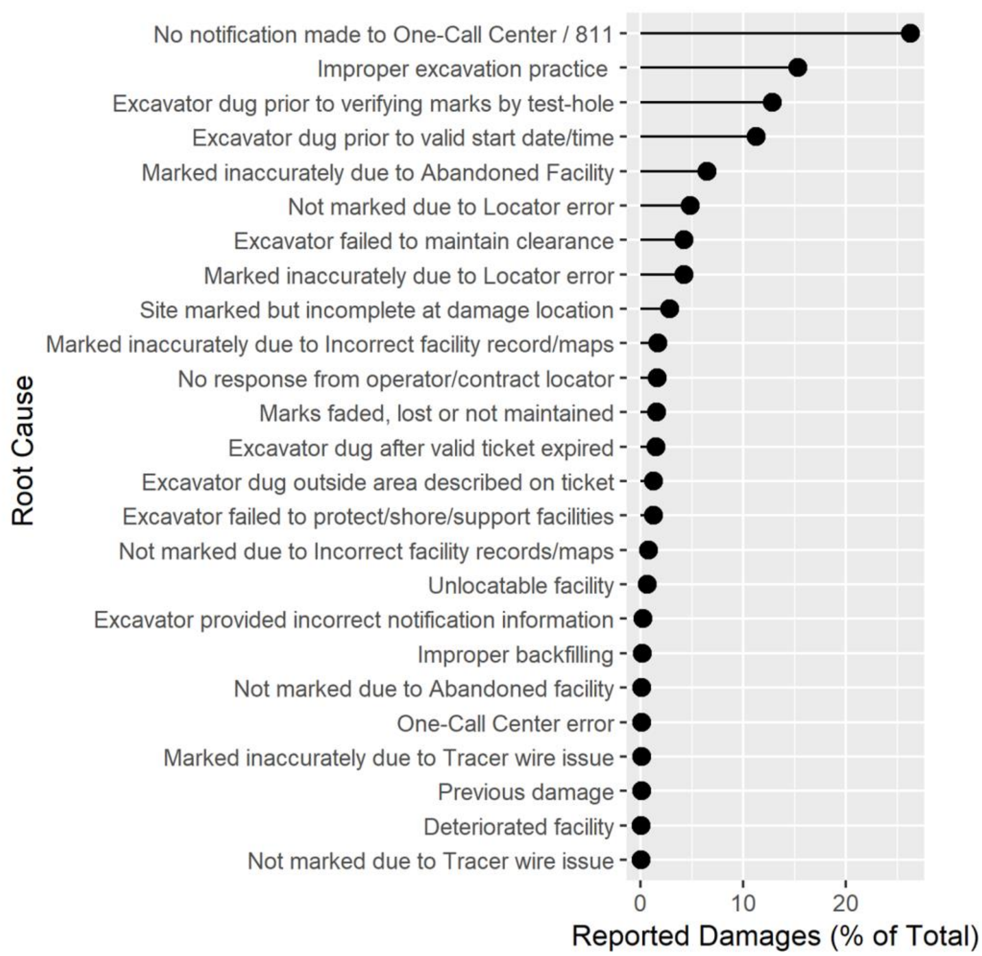


Figure 7—Reported damages by root cause, known data, in Canada and the U.S., 2018

Root Cause by Group

The Data Committee sorts the root causes into groups to provide a high-level snapshot of what went wrong in the damage prevention process. The groups are as follows:

- The process starts with the excavator providing notice of intent to dig to a one call center (i.e., calling 811). *Notification Not Made* (same as *No notification to One Call Center/811*) represents damages caused by this step not being followed.[6]
- The next step is the facility operator or contract locator accurately and timely marking the location of buried facilities. Locating Issue captures damages where this did not happen.
- Once 811 notification and marking have occurred, the next step is following careful excavating practices when digging near buried facilities. Excavation Issue captures damages where something went wrong here.
- Other Notification Issue captures situations where an 811 notification was made, but something about it was invalid.
- Miscellaneous captures damage causes that don't fit well into a notification, locating, or excavating category.
- Unknown/Other captures damages where the root cause was not collected or none of the available choices fit. In such cases, the DIRT user is required to also provide a free-text comment. Ideally this would be something relevant and useful, providing some indication of what caused the damage and why none of the available root cause choices fit.

Figure 8 shows the root cause groupings, in pie-chart form, for 2017 and 2018. *Notification Not Made*, Other Notification Issues, and Locating Issues increased from 2017 to 2018, while Excavating Issues and Miscellaneous decreased. Note that Unknown data is included here.

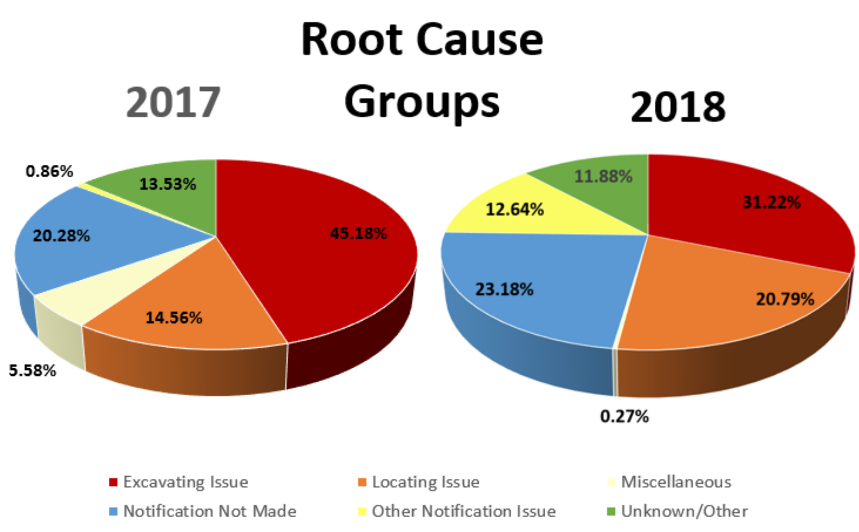


Figure 8—Root cause groupings for 2017 and 2018

[6] *Notification Not Made* is singled out–making it a group of one–because it has historically been the single leading root cause and because it is the focal point of 811 and Call Before You Dig awareness.

These shifts are due to a combination of the revamped root causes introduced in 2018 and a reshuffling of the specific root causes within the groups. In past years, the DIRT data included many entries with Unknown/Other as the root cause, with free-text comments such as dug before ticket due, dug before marks completed, dug outside state work area, and expired ticket. *Notification to the One Call Center Made But Not Sufficient* was intended to capture these situations, but it seemed many DIRT users had difficulty in determining what root cause to apply.

To address this and make it easier for DIRT users to categorize these situations, *Notification to the One Call Center Made But Not Sufficient* was replaced with three new root causes, and new Users Guide Material was published. The guidance material provides the following descriptions for the new root causes:

- **Excavator Dug Outside Area Described on Ticket:** Excavator notified one call center/811 of intent to dig, but then dug outside of work area as described on one call ticket. (Best Practice 5-1)
- **Excavator Dug Prior to Valid Start Date/Time:** Excavator notified one call center/811 of intent to dig, but then dug before the stated start date and time. Include when excavator dug before markouts completed when facility operator or locator requested delay in accordance with state regulations. Include if excavator failed to check positive response system where required. (Best Practices 5-1, 5-8)
- **Excavator Dug after Valid Ticket Expired:** Excavator notified one call center/811 of intent to dig, but state law has a "life-of-ticket" which was exceeded without renewal or renotification. Note: this should be selected for cases where a ticket renewal likely would have prevented the event. Example: Ticket is a few days beyond expiration, but marks are still visible. If marks are inaccurate, Root Cause could be a Locating Issue. If marks are accurate, the Root Cause may be an Excavating Issue, such as not pot-holing or not maintaining clearance. If state does not have a life-of-ticket, consider "marks faded or not maintained" as possible root cause. (Best Practices 5-1, 5-23)

Table 6 shows the root causes, sorted high-to-low, and color-coded to match the pie charts in Figure 8 (including unknown data). As noted above, a free-text comment is required when Unknown/Other is the chosen root cause. A free-text comment is optional when a "known" root cause is selected. The DIRT data would also have many reports with a root cause of *Excavation Practices Not Sufficient*, and a free-text comment as described above (expired ticket, dug early, dug outside stated area). When the free-text comment field is blank, there is no way to know the extent to which these types of situations were being categorized as Insufficient Excavation, but it appears that the largest contributor to the root cause group re-shuffling is that these three new root causes were formerly being categorized as Excavation Issues rather than Other Notification Issues by many DIRT users. While it's true that digging before marks are complete, or outside the stated work area, is not good practice, so is digging without any 811 notification at all. Excavation Issue is intended to capture root causes where something went wrong with the actual digging process rather than the notification process. The word “valid” is key when used in the root cause description or User Guide.

Table 6— Reported damages by root cause for 2018 (color coded by root cause group)

Root Cause	Reports	% of Total
No notification made to One Call Center / 811	79,197	23.18%
Improper excavation practice not listed elsewhere	46,117	13.50%
Root Cause not listed elsewhere	40,742	11.93%
Excavator dug prior to verifying marks by test hole (pot-hole)	38,559	11.29%
Excavator dug before valid start date/time	33,938	9.93%
Facility marked inaccurately due to locator error	12,790	3.74%
Facility marked inaccurately due to abandoned facility	19,535	5.72%
Facility not marked due to locator error	14,596	4.27%
Excavator failed to maintain clearance after verifying marks	12,808	3.75%
Site marked but incomplete at damage location	8,491	2.49%
Facility marked inaccurately due to incorrect facility record/map	5,126	1.50%
Facility not marked due to no response from operator/contract locator	4,997	1.46%
Marks faded, lost or not maintained	4,711	1.38%
Excavator dug after valid ticket expired	4,622	1.35%
Excavator dug outside area described on ticket	3,906	1.14%
Excavator failed to shore excavation/support facilities	3,889	1.14%
Facility not marked due to incorrect facility record/map	2,360	0.69%
Facility not marked do to unlocatable facility	2,020	0.59%
Excavator provided incorrect notification information	737	0.22%
Improper backfilling	601	0.18%
Facility not marked due to abandoned facility	422	0.12%
One Call Center error	411	0.12%
Facility marked inaccurately due to tracer wire	320	0.09%
Previous Damage	301	0.09%
Deteriorated Facility	212	0.06%
Facility not marked due to tracer wire issue	202	0.06%
Total	**341,610**	**100%**

The new root causes highlight the extent to which excavators digging before marks are completed contributes to damages. Beyond promoting 811 awareness and encouraging excavators to Call Before You Dig, the importance of waiting for the marks to be completed needs to be emphasized.

In the first half of 2019, the issue of increases in one call ticket volume and failure of underground facility operators to respond to locate requests in the time required by state law has been the subject of press coverage. A frequent complaint of excavators is locators not responding on time, or at all, to locate requests.[7] In addition, some reports with this root cause have free-text comments such as "did not wait full 5 days for trouble ticket" or "excavator did not allow time for trouble ticket."[8] This indicates that a lack of on-time locating is at least partially contributing to excavators commencing work before markouts are complete.

Within the Locating Issues group, *Facility Markings or Location Not Sufficient* and *Facility Was Not Located or Marked* have been replaced starting in 2018. The Data Committee recognized that DIRT users had difficulty distinguishing between them. The revamped locating root causes break down the damages further according to whether the facility was marked but done so inaccurately, or was not marked at all. In addition, abandoned facility was formerly grouped with Miscellaneous but is now grouped with Locating Issues. This accounts for much of the increase in Locating Issues and decrease in Miscellaneous.

Within the Excavation Issue group, *Improper* e*xcavation practices not listed elsewhere* is intended as a catch-all when the options within the group do not fit. Nearly three quarters of these involve first- and second-party excavators[9] where the facility operator has them locate its own facilities or proceed without a markout by their locating personnel or outside vendor.

[7] "*Facility not marked due to no response from operator/locator*" is another new, more specific root cause added to DIRT in 2018. It is intended to make it easier for excavators to report these situations.

[8] A "trouble ticket" is when a locator delays the excavators' start date because of an unusually difficult or complex locate that may require specialized equipment or personnel.

[9] First party is when a facility operator's own crews are excavating near their facilities, and second party would be a contractor hired by the facility operator.

Root Cause Group by Event Source

Figure 9 shows some significant differences in the root cause group percentages by event source (with total damages (*n* = xx) by event source labeled at the top of the figure). This number should be considered when interpreting the graph. For instance, the number of damages provided by Equipment Manufacturers, Engineer/Design, and Railroad (combined as "Other") is likely too small to draw any solid conclusions. The figure demonstrates that Natural Gas, Locators, and Telecommunications have similar distributions of root cause groups. For Excavators/Road Builders, Locating Issues are by far the most reported root cause group, whereas it is much lower for Locators. It should also be noted that unknown root data is filtered out, which for Excavators and Road Builders combined was 72% of damage reports. With unknown root causes included, locating issues would be 21% of the total for Excavators and Road Builders.

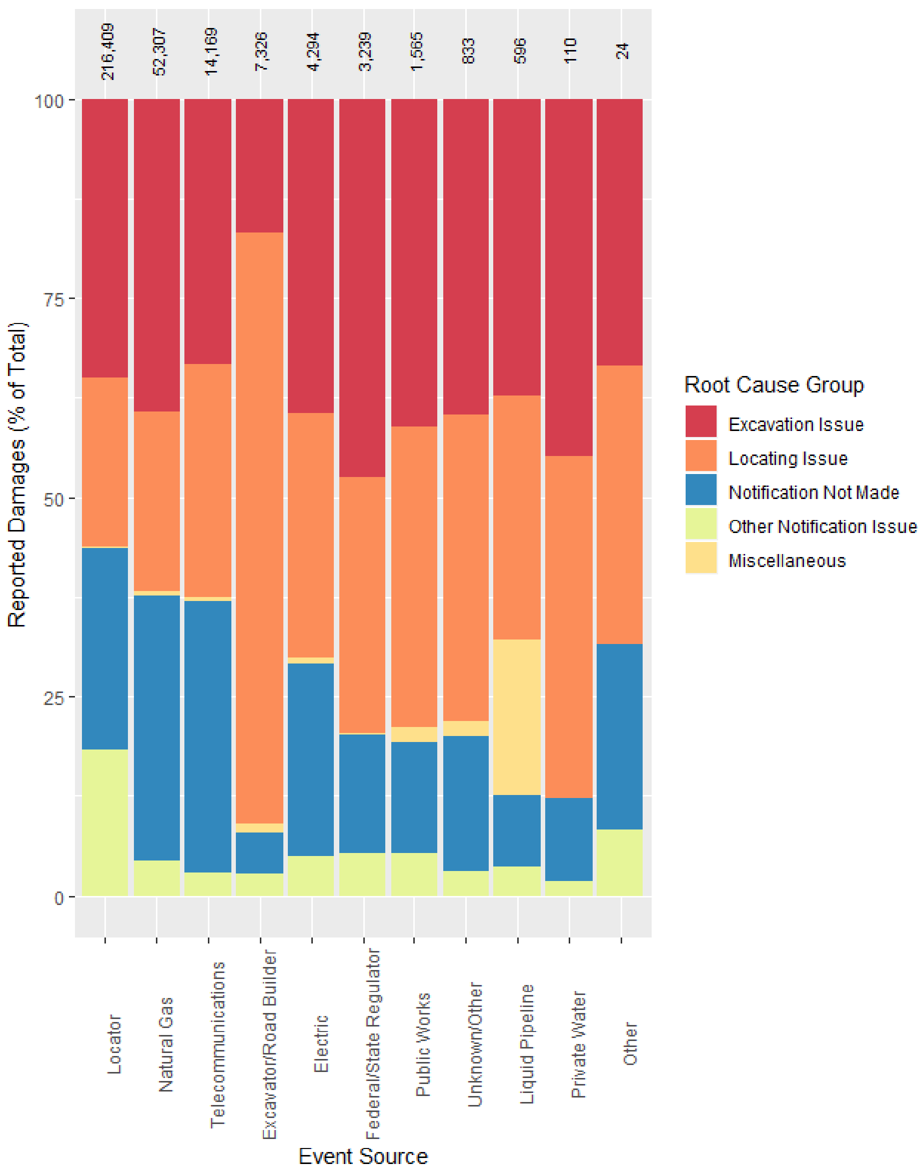


Figure 9—Root cause groups by event source, known data, in Canada and the U.S., 2018

Root Cause by Consistently Reporting Sources

Figure 10 shows the trend in damages by root cause group over time, focusing on consistently reporting sources, with unknown data included. The most frequently cited root cause groups in the last three years are Excavation Issues and *Notification Not Made*. Although Excavation Issues declined as a root cause between 2016 and 2018, *Notification Not Made* has been increasing. It is encouraging that Unknown/Other continues to trend downward. The shift from Excavation Issues to Other Notification Issues is explained by the revamped root causes introduced in 2018. There was also a shift from Miscellaneous to Locating Issues due to moving the root cause(s) associated with abandoned facilities.

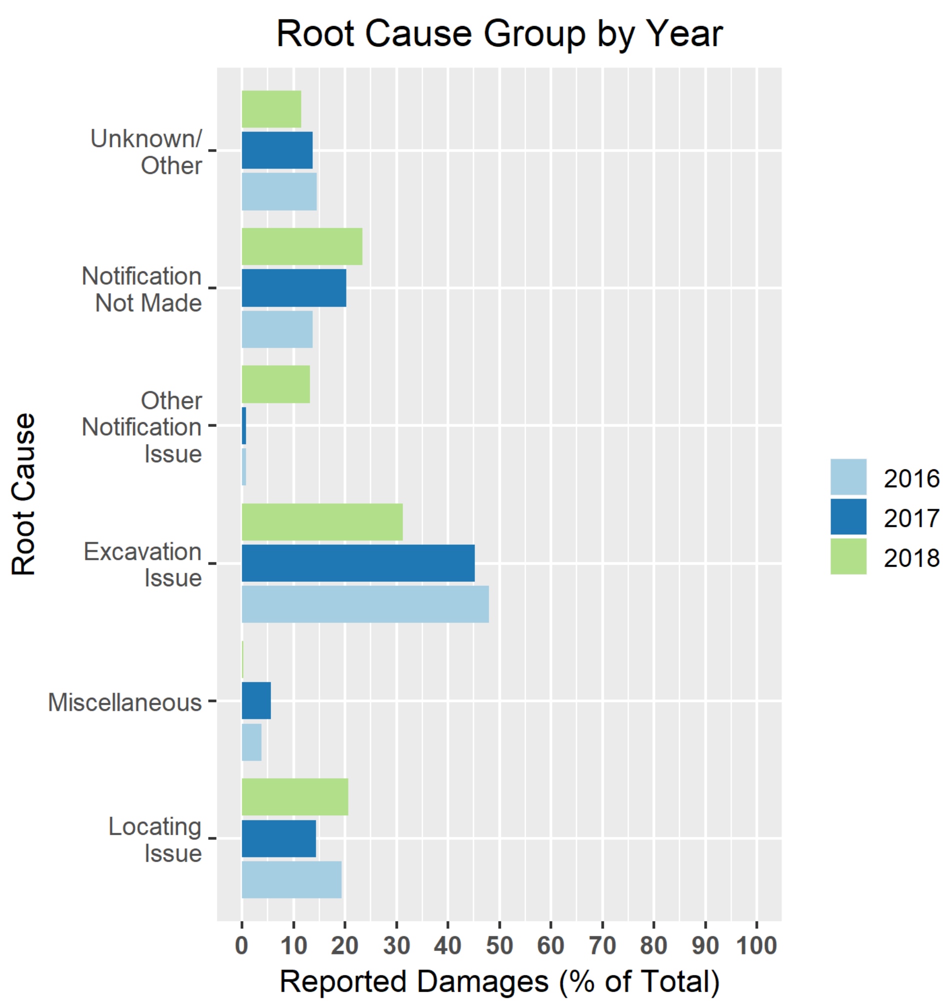


Figure 10—Root cause by group for consistently reporting sources, in Canada and the U.S., over time

Excavator Type

This section describes the type of excavator, type of work performed, and type of equipment involved in damages. Figure 11 presents damage information by excavator type that clearly demonstrates the significant involvement of Contractors (36%). The high number of unknowns stands out at 48%. This is an indication of the strength of the data for excavator type, which, when compared to root cause data, appears to be relatively more uncertain.

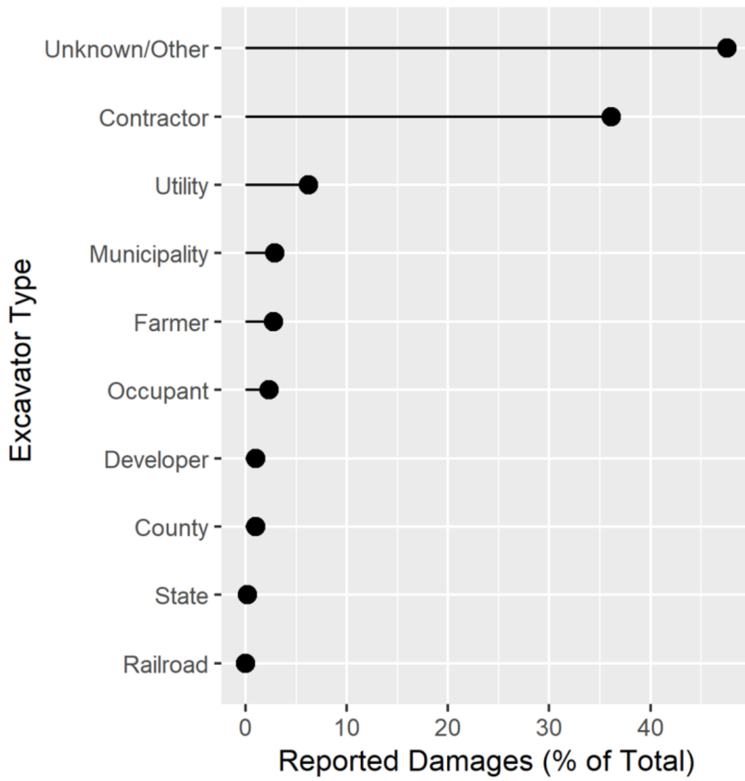


Figure 11 —Reported damages by excavator type, all reported data, in Canada and the U.S., 2018

Because of the significant contribution of unknown data to the excavator dataset, in the sections below, unknown data is included in the presentation of the data unless otherwise noted.

Excavator Type by Type of Work Performed and Equipment Used

For this section of the report, data for excavator type, work performed, and excavation type (i.e., equipment used) was cross-tabulated. Appendix A shows the top 20 combinations of excavator type, work performed, and equipment used ranked by number of reported damages. The appendix highlights the large proportion of unknown data in the excavator dataset (162,577 damages or 48% in the DIRT database are associated with an unknown excavation type). Table 7 demonstrates the top 10 combinations of work performed and equipment used, excluding combinations with one or more unknown data points. In each case, the type of excavator is contractor. The leading combinations with known data are Contractors doing Sewer or Water work using Backhoes/Trackhoes.

Table 7—Top 10 combinations of excavator, work performed, and equipment used, known data, in Canada and the U.S., 2018

Work Performed	Equipment Used	Reported Damages	% Reported Damages
Water	Backhoe/Trackhoe	6,129	1.79%
Sewer	Backhoe/Trackhoe	5,186	1.52%
Natural Gas	Backhoe/Trackhoe	3,585	1.05%
Electric	Backhoe/Trackhoe	2,745	0.80%
Bldg. Construction	Backhoe/Trackhoe	1,928	0.56%
Telecommunications	Boring	1,667	0.49%
Telecommunications	Backhoe/Trackhoe	1,538	0.45%
Fencing	Hand Tools	1,527	0.45%
Road Work	Backhoe/Trackhoe	1,484	0.43%
Telecommunications	Directional Drilling	1,365	0.40%

Figure 12 graphically demonstrates the relationship between excavator and work performed groups. See Appendix D, Table D2, for grouping definitions. The significant number of damages attributable to Contractors across a range of work performed is evident.

The online DIRT Dashboard includes a DIRT Explorer page where stakeholders can confirm these numbers and experiment with other combinations of variables.

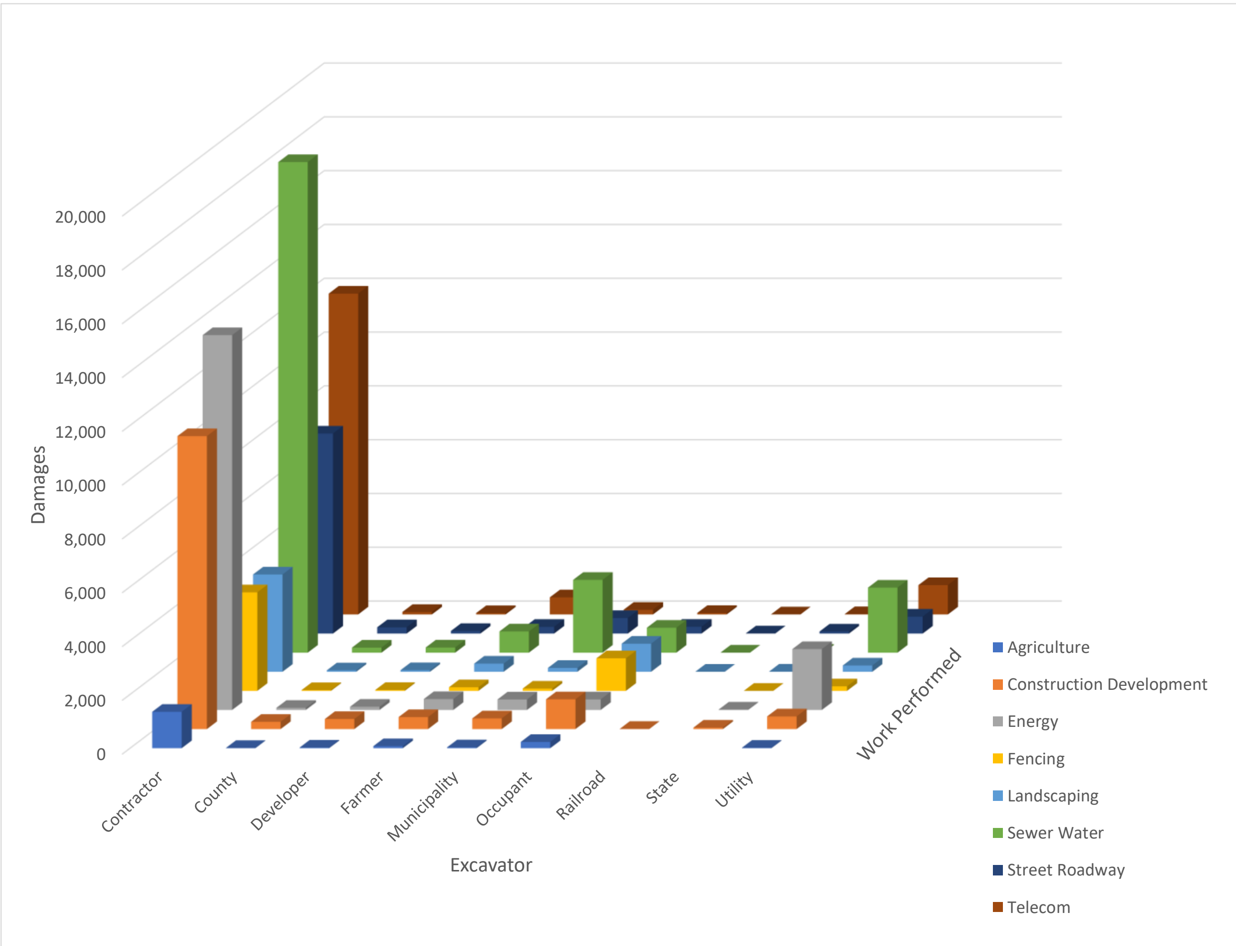


Figure 12—Reported damages by excavator and work performed in Canada and the U.S., 2018

The relationship between type of equipment used by excavators can also be examined graphically (Figure 13). A similar trend can be seen here, with a significant number of damages attributable to Contractors across a range of equipment types.

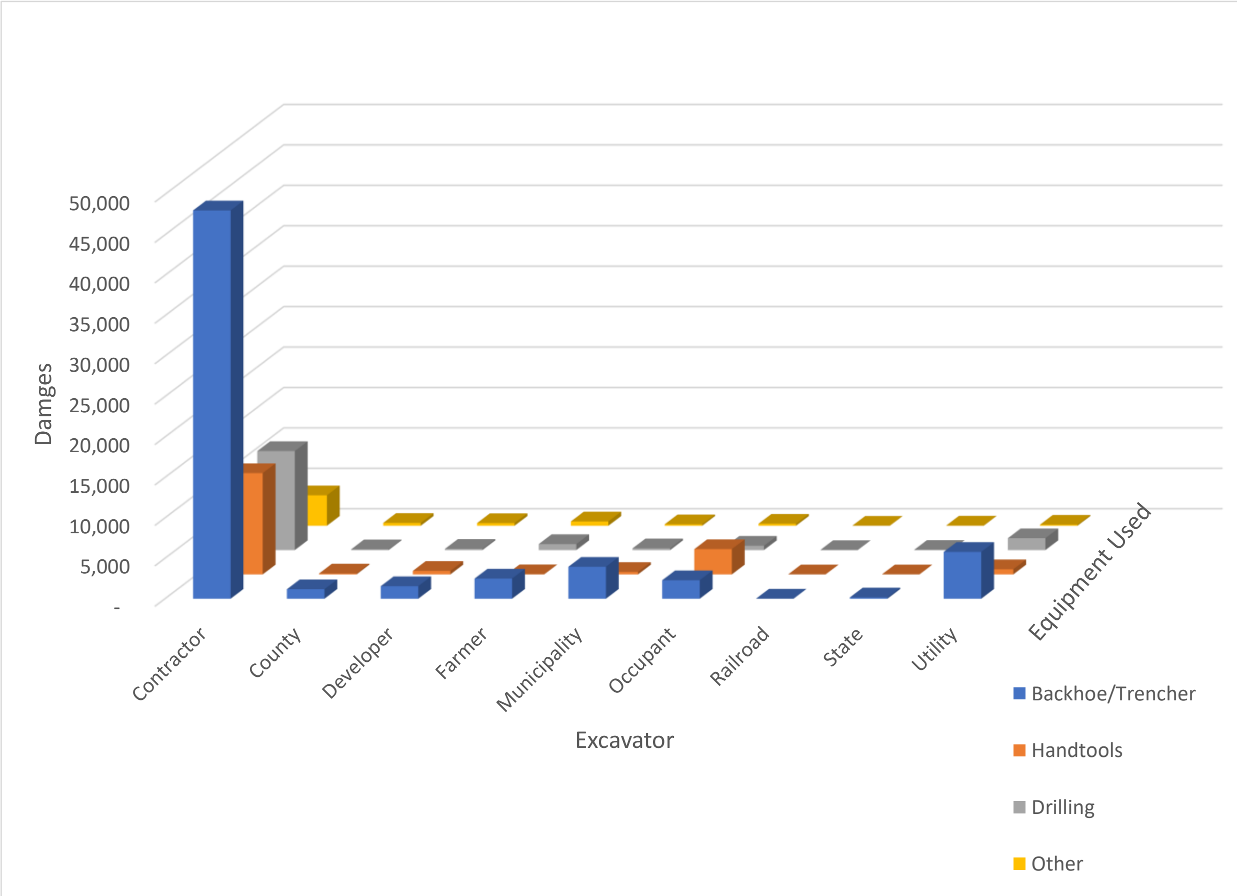


Figure 13—Reported damages by type of excavator and equipment used in Canada and the U.S., 2018

Excavator Type by Root Cause

Figure 14 shows the root cause groups by type of excavator involved. As can be seen in the figure, Excavation Issue (shown as the red bars) is the leading cause of damages for most excavator types in 2018, with the exception of Occupants where *Notification Not Made* is the leading cause of damages.

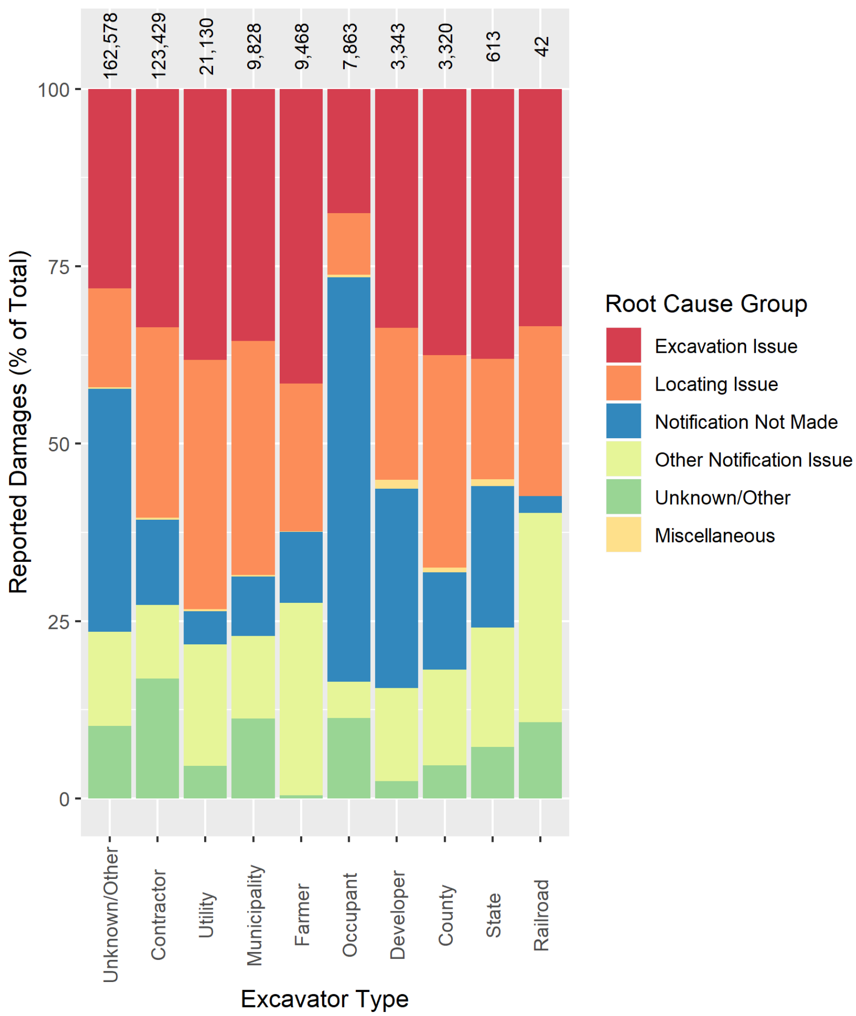


Figure 14—Root cause group by type of excavator, all reported data, in Canada and the U.S., 2018

Excavator Type by Consistently Reporting Sources

Figure 15 shows the trend in damages by excavator type over time, focusing on consistently reporting sources. Between 2016 and 2018, Contractor and Unknown/Other have remained the main excavator types, with the contribution of the unknown data increasing from 2016 to 2017 and then declining in 2018. Contractor declined from 2016 to 2017 and then increased in 2018.

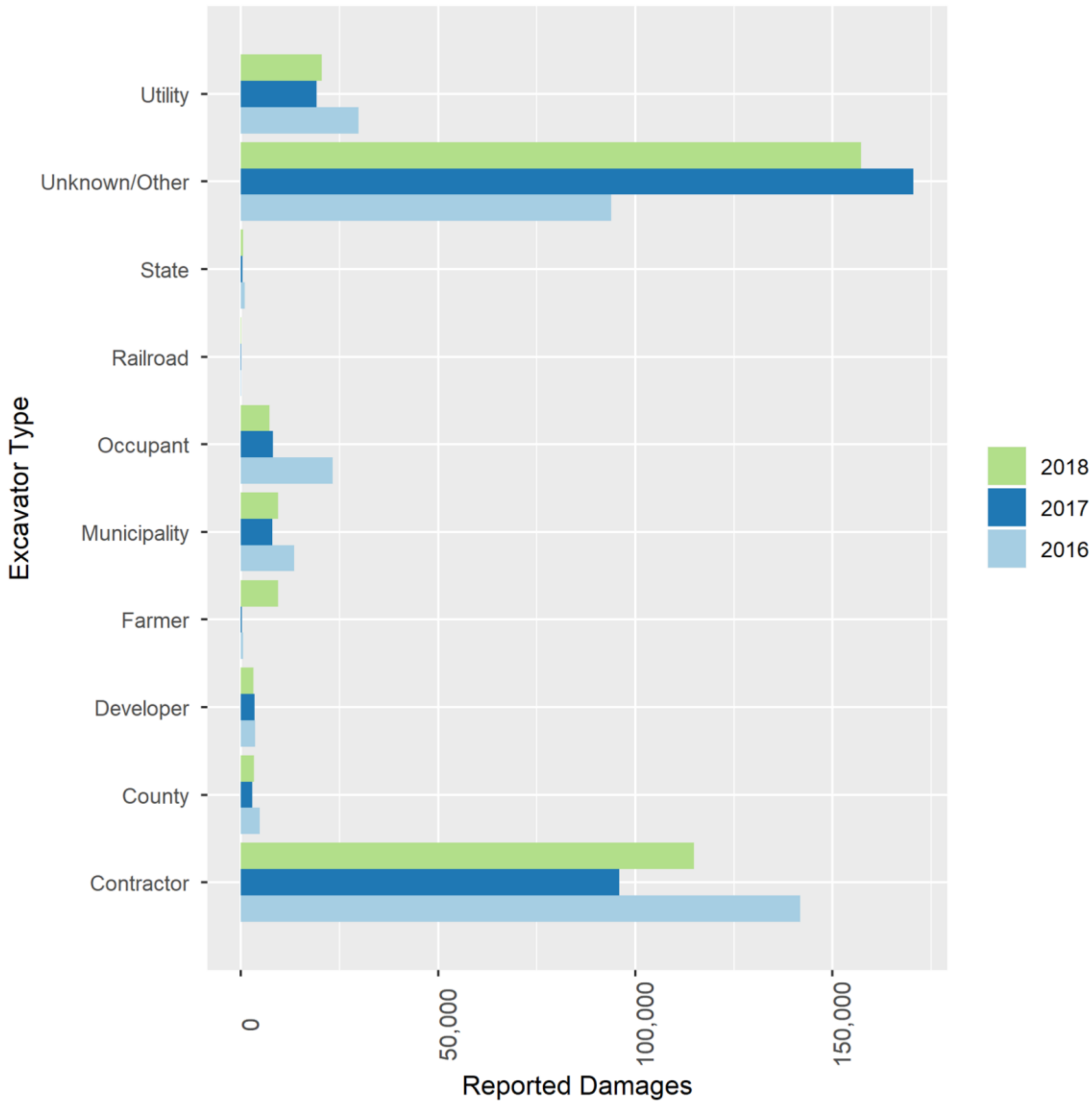


Figure 15—Reported damages by excavator type for consistently reporting sources in Canada and the U.S., 2016 to 2018

Facilities Affected and Damaged

Figure 16 shows reported damages by facility damaged for known data (unknown data is excluded due to the relatively low contribution—about 5% of all reported damages). In 2018, the leading reported damaged facility was Telecommunications (48%). This was followed by Natural Gas (28%) and Cable Television (11%).

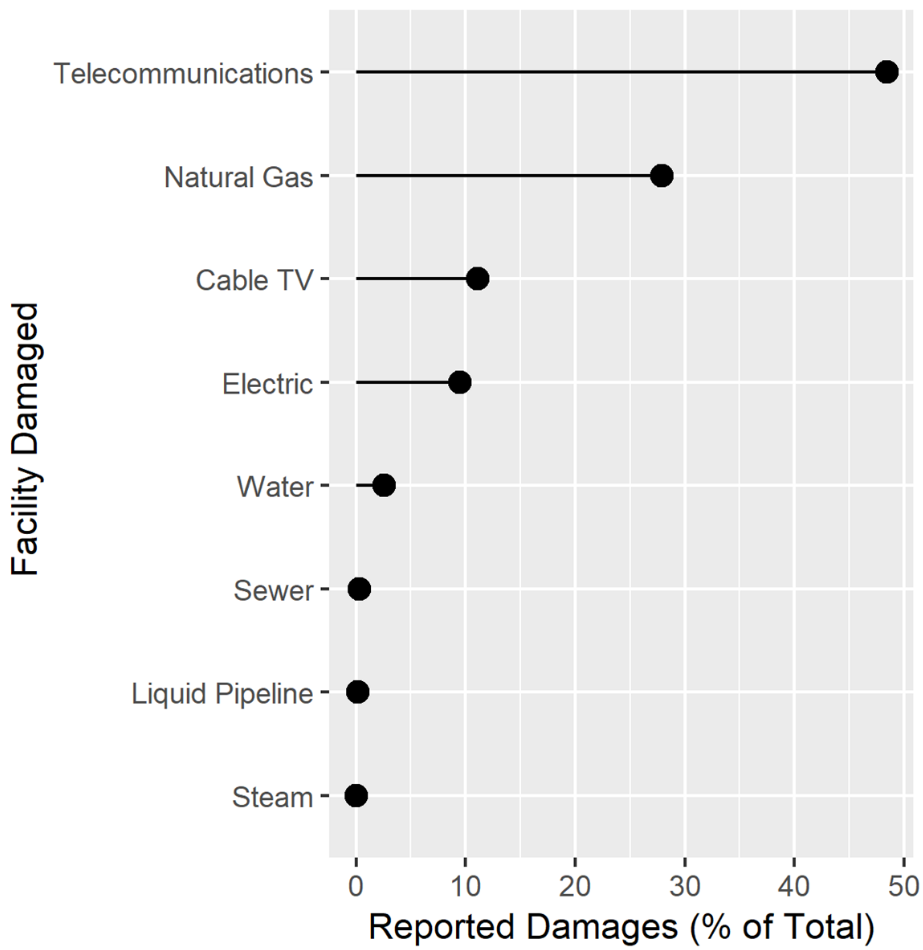


Figure 16- Reported damages by facility damaged, known data, in Canada and the U.S., 2018

The type of affected facilities includes Distribution, Service Drop, Transmission, and Gathering. Figure 17 demonstrates the relationship between facilities affected and facilities damaged. The majority of reports involve Telecommunications and Natural Gas Service/Drops and Distribution.

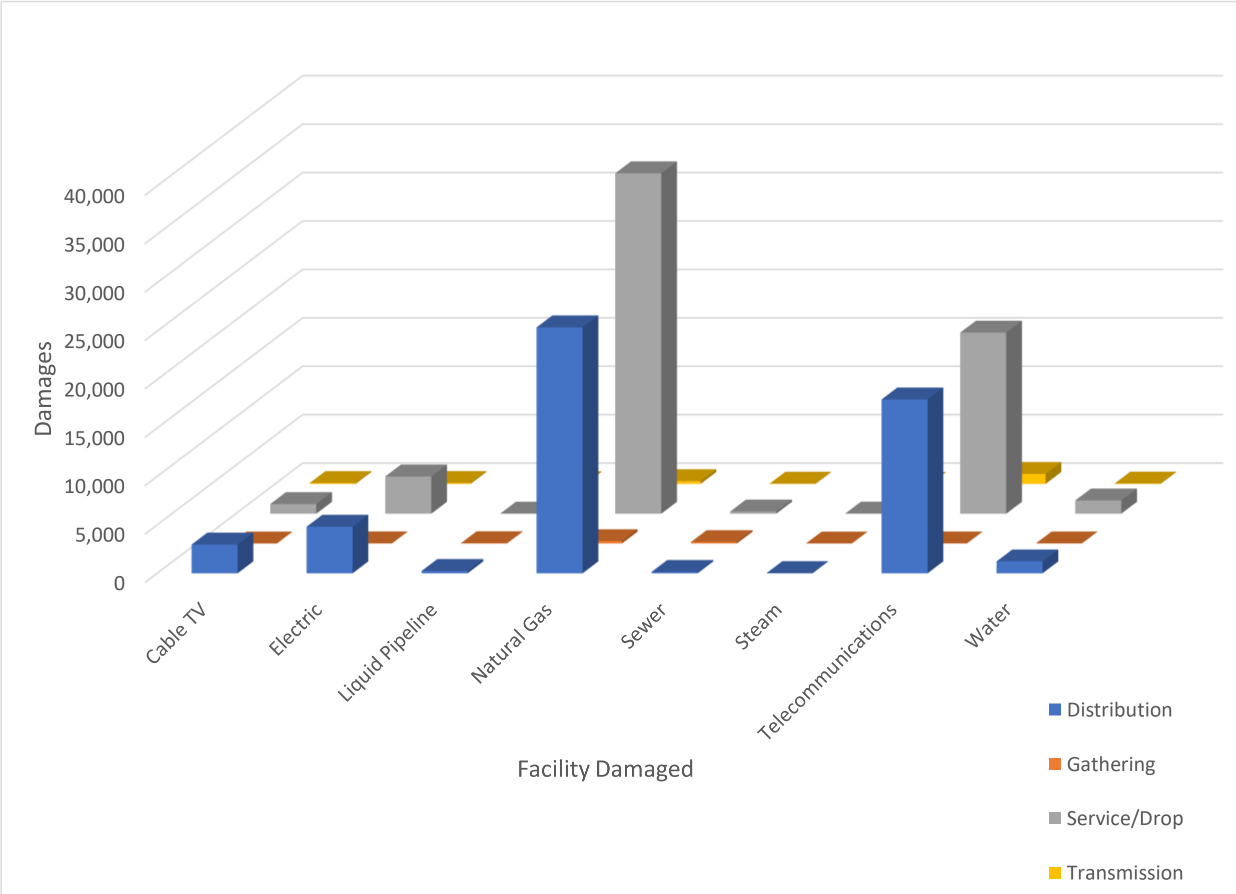


Figure 17- Reported damages by facility damaged and facility affected, known data, in Canada and the U.S., 2018

Facilities Damaged by Event Source

The leading sources of events vary by each type of facility damaged. Table 8 shows the leading event source for each type of facility damaged. The self-reporting columns indicate the level to which the matching event source (where applicable) submits the DIRT reports. Natural gas is the only one where self-reporting is the leading source. Locators are the second leading source for natural gas damages at 34%. The second leading source for water facility damages is excavators at 28%, and for steam it's telecommunications at 47%. For all other facilities damaged, the self-reporting source is the second leading source.

Table 8—Leading event sources and self-reporting level by facility damaged, known data, in Canada and the U.S., 2018

Facility Damaged	Leading Event Source	%	Self-Reporting	%
Cable TV	Locator	83%	Telecommunications	7%
Electric	Locator	72%	Electric	16%
Liquid Pipe	Regulator	71%	Liquid Pipe	19%
Natural Gas	Natural Gas	58%	Natural Gas	58%
Sewer	Excavator	59%	Public Works	22%
Steam	Excavator	51%	N/A	N/A
Telecommunications	Locator	76%	Telecommunications	16%
Water	Locator	55%	Public + Private Water	8%

Facilities Damaged by Root Cause

Figure 18 demonstrates the relationship between damaged facilities and root cause. Excavation Issues is the dominant root cause group for most damaged facilities (Natural Gas, Electric, and Water). For Sewer, Steam, and Cable TV, it is Locating Issues. For Telecommunications and Liquid Pipelines, *Notification Not Made* is the dominant root cause.

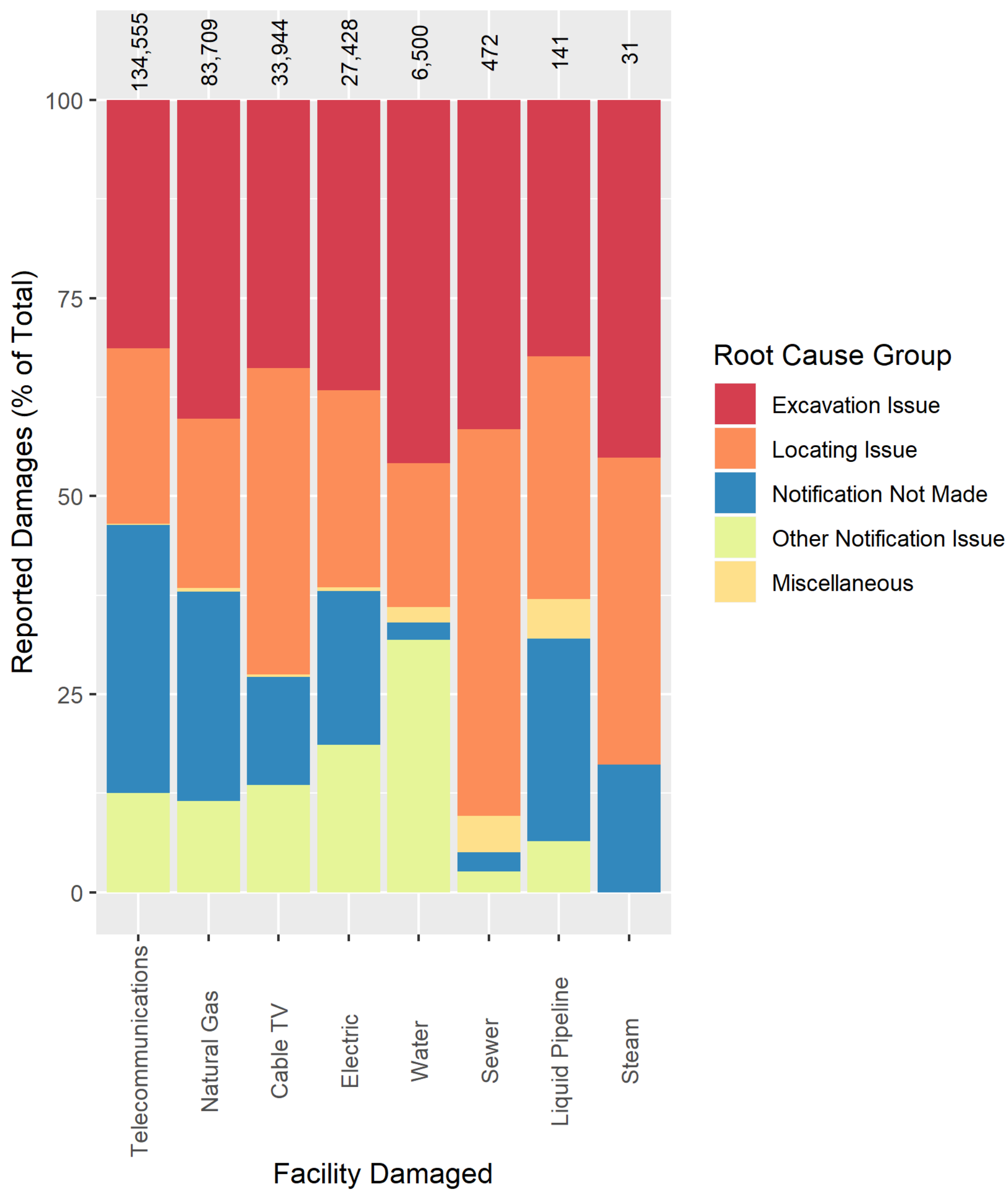


Figure 18—Root cause group by facility damaged, known data, in Canada and the U.S., 2018

Facilities Damaged for Consistently Reporting Sources

Facilities damaged for consistently reporting sources over time is presented in Figure 19. Here, known and unknown data are presented. The figure demonstrates the significant contribution of damages to Telecommunications and Natural Gas in the last three years, with an increase in reported damages to Telecommunications between 2016 and 2018 and a decrease in reported damages to Natural Gas over the same period. The decline in the contribution of unknown data between 2016 and 2018 is a promising trend.

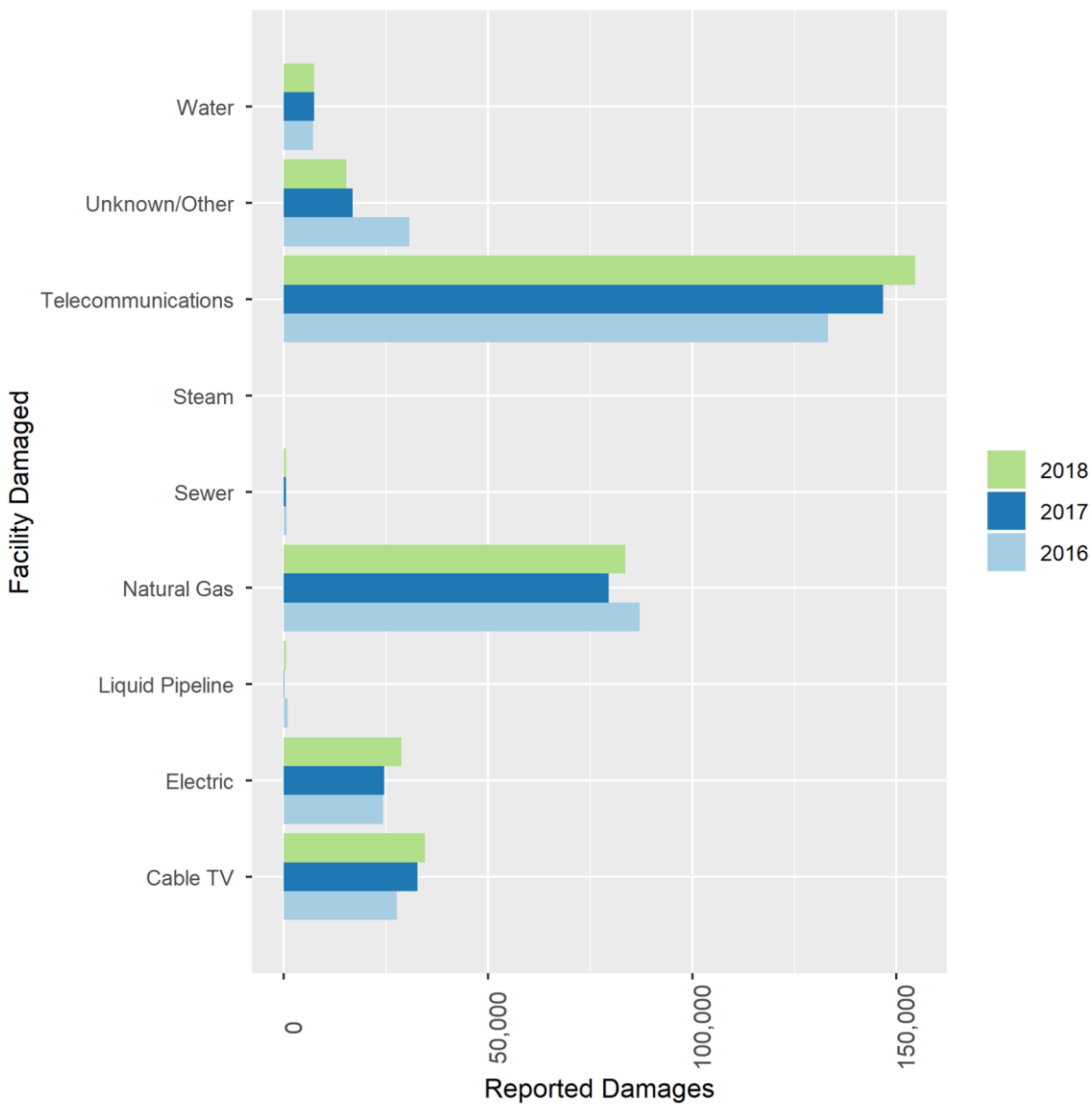


Figure 19—Reported damages by affected facilities for consistently reporting sources, in Canada and the U.S., 2016 to 2018

New DIRT Questions

Four new Yes/No questions were added to DIRT in 2018. Table 9 shows the number of reports where these questions were answered (or not) and the DQI value of these questions. The Yes, No, and Blank numbers are values reported before applying the matching/weighting process, and therefore add up to 440,749.

Table 9—New DIRT questions

Question	Yes	% Yes	No	Blank	DQI Value
Did this event involve a cross bore?	1,668	0.378%	33,700	405,381	1
Was the work area white lined?	11,433	2.594%	29,362	399,954	1
Is facility owner exempt from one call center membership?	22	0.005%	7,668	433,059	1.25
Is excavation activity and/or excavator exempt from 811 notification?	3,169	0.719%	35,349	402,231	1

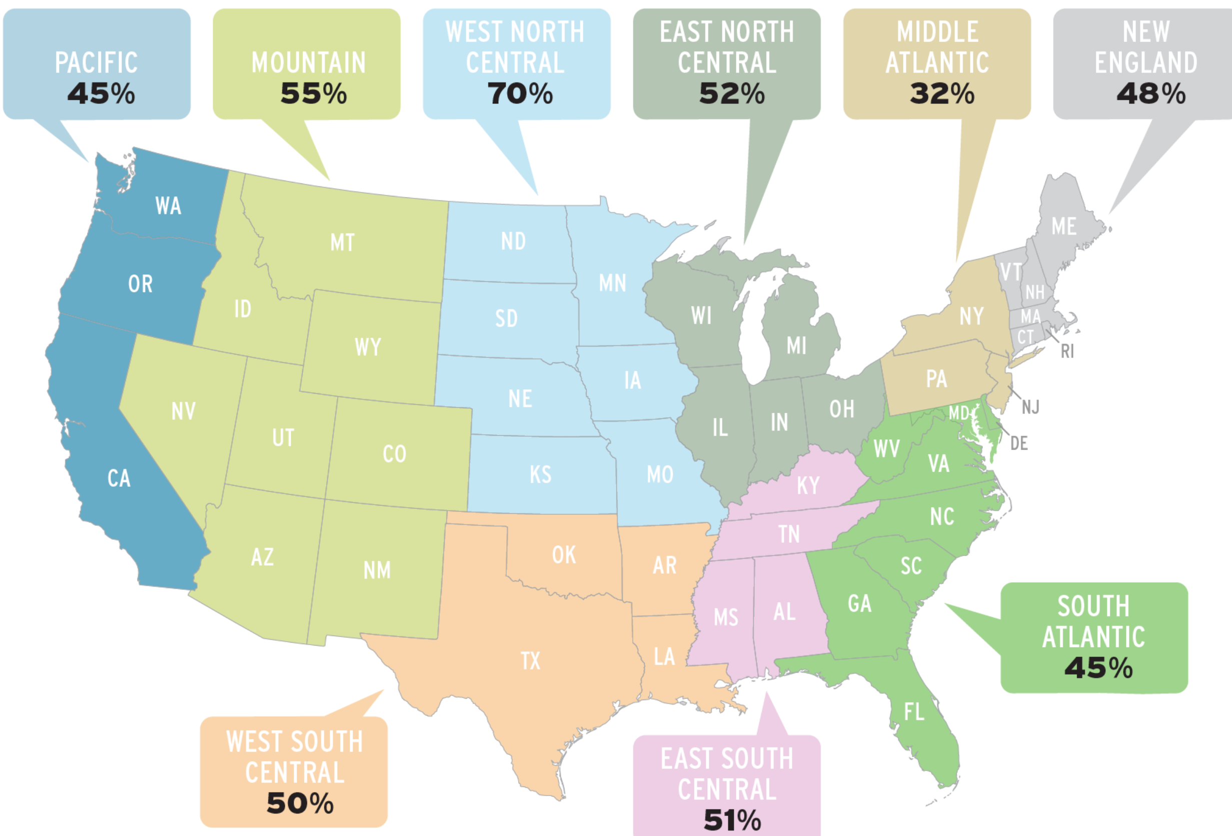
Measured depth from grade of the damaged facility was the one non-Yes/No question that was added to DIRT in 2018. Its DQI value is 2. Table 10 shows the number of reports per depth increment.

Table 10—Measured depth from grade of the damaged facility DIRT results

Depth	# Reports	% Reports
Embedded	1,104	0.25%
1 to 18 inches	21,801	4.95%
18 to 36 inches	14,113	3.20%
Over 36 inches	2,475	0.56%
Blank	401,256	91.10%

Call Before You Dig Awareness

CGA periodically conducts a national survey to test the use and awareness of Call Before You Dig (CBYD) services, including 811, across U.S. census regions. Figure 20 shows the states within each census region and the awareness level for that region. In this section, trends in 2018 DIRT data in relation to a survey conducted in June 2018 are presented. The vertical bars in Figures 21 and 22 show the percentage of damages due to *Notification Not Made* within each region, with the regions sorted high-to-low by this calculation. Figure 21 represents damages involving all excavator types, while Figure 22 is limited to Occupant excavators. Only damages with a known root cause are included (i.e., "unknown/other" are filtered out). A summary table of damages and CBYD survey results is provided in Appendix E.



Q: Are you aware of a free national phone number that people can call to have underground utility lines on their property marked prior to starting any digging project? National Average = 48%

Figure 20—Census regions used in the annual Call Before You Dig survey

Figure 21 demonstrates the trend in damages due to *Notification Not Made* in relation to awareness of CBYD services (for all excavator types). In general, an inverse relationship between awareness and damages can be observed.

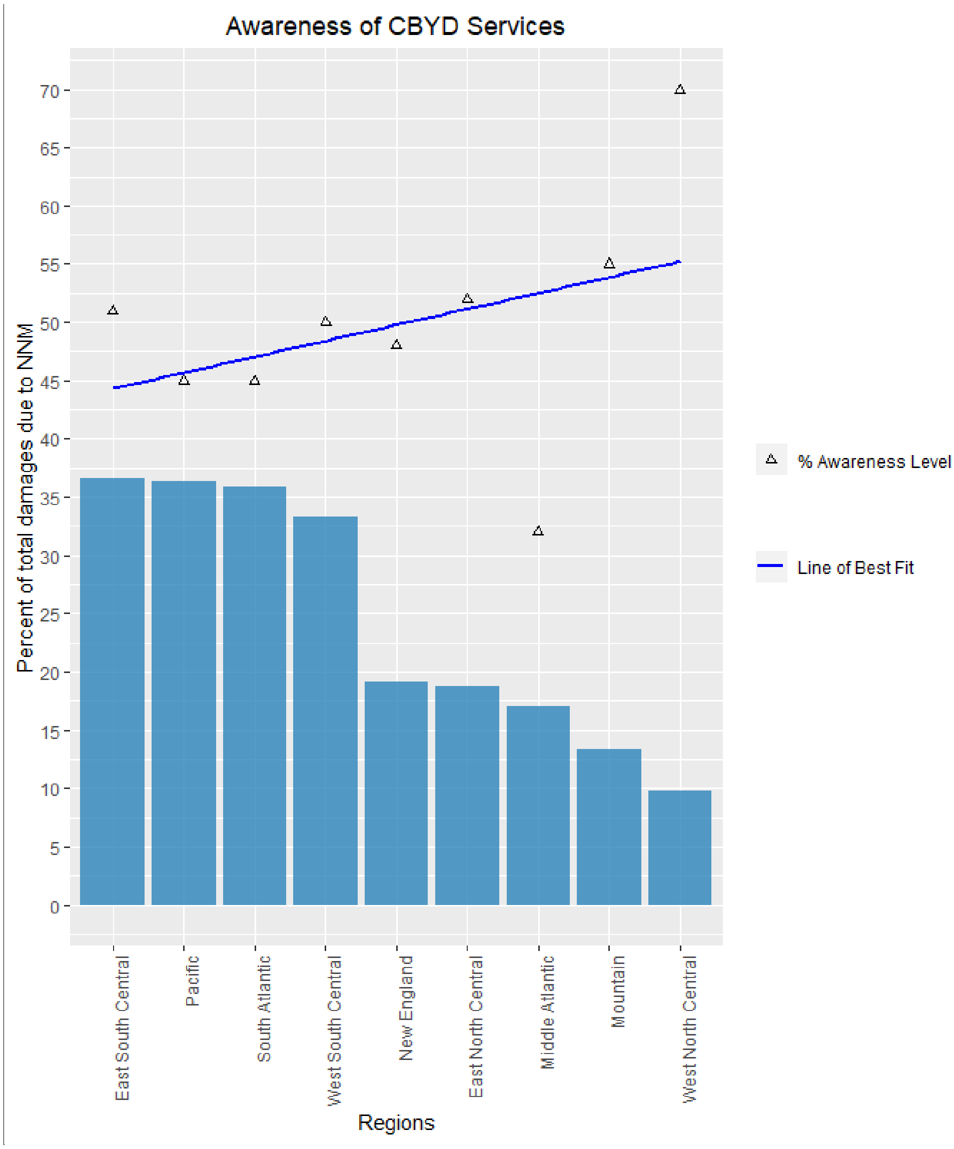


Figure 21—Awareness of CBYD services in relation to damages due to *Notification Not Made,* all excavator types

The West North Central Region has the lowest percentage damages due to *Notification Not Made* and the highest awareness of CBYD services. The same pattern is observed in the East North Central Region and Mountain Region where damages due to *Notification Not Made* are relatively low and CBYD awareness is relatively high. The Pacific and South Atlantic Regions demonstrate the same trend in the other direction. Here, high damages due to *Notification Not Made* are associated with relatively low CBYD awareness. The Middle Atlantic is an outlier to the trend observed in other census regions. However, it has a relatively high percentage of reports with unknown root cause, which may be masking a higher level of *Notification Not Made* damages, which in turn would make the vertical bar higher and perhaps moved left one or more places.

Figure 22 shows the trends in Occupant damages (the excavator type most relevant to the CBYD survey) due to *Notification Not Made* and awareness of CBYD services. Note how the percentage of damages due to *Notification Not Made* shifts upwards significantly when compared to Figure 21, which includes all excavator types.

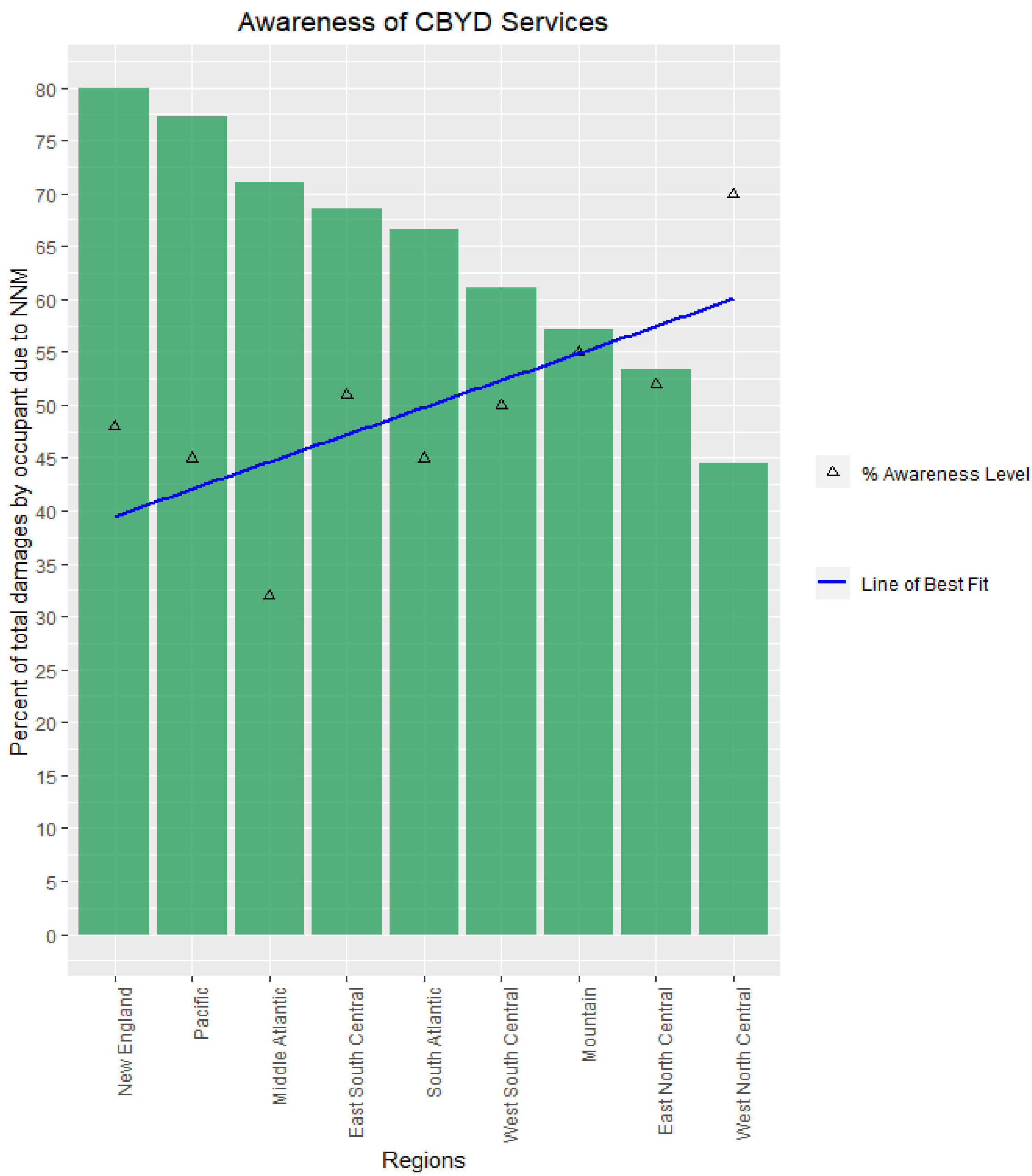


Figure 22—Awareness of CBYD services in relation to damages due to *Notification Not Made,* occupant excavators

In general, the figure above demonstrates an inverse relationship between occupant damages due to *Notification Not Made* and CBYD awareness. Regions with relatively high damages (New England, Pacific, East South Central, and Middle Atlantic) have relatively low CBYD awareness. Regions with relatively low damages (Mountain, West North Central, and East North Central) have relatively high CBYD awareness. Here again, the Middle Atlantic region could possibly be moved to the left.

Near Miss DIRT Reports

Since inception, DIRT users have been able to enter "near miss" reports in DIRT in addition to damages. Over the past 10 years, the percentage of near miss reports in the total dataset have ranged from a high of 3.29% in 2015 to a low of 0.50% in 2017, with 0.95% in 2018.

The DIRT Users Guide includes the following in the Glossary:

Near Miss: An event where a damage (as defined above) did not occur, but a clear potential for damage was identified. (BP*) Some examples include, but are not limited to the following:

a. An excavator discovers a buried facility that was not marked or not marked accurately.
b. An excavator is found digging without having notified the one call center.
c. An operator fails to respond to a locate request.
d. A one call center incorrectly entered data regarding the work site.

This Report (and the Interactive Dashboard) covers damage reports. The Data Committee plans to do a separate report on near misses with several years of combined data in order to have a more robust data set. However, here we provide a few high-level observations about the near miss data.

- The leading contributors to near miss reports are Excavators and Road Builders reporting Locating Issues and Natural Gas and Liquid Pipelines reporting excavation activity without a one call notification (*Notification Not Made*).
- Excavators and Road Builders enter better quality data (higher DQI) and complete the downtime questions more often in near miss reports than they do for damage reports.
- For Natural Gas and Liquid Pipelines, Transmission is identified as the affected facility for near miss reports in significantly higher proportion than for damage reports.

Appendix A: Excavation Information

Table A1—Top 20 combinations of excavator, work performed, and equipment used, including unknown data, in Canada and the U.S., 2018

Excavator	Work Performed	Equipment Used	Unique Damages
Unknown/Other	Unknown/Other	Unknown/Other	105,669
Contractor	Unknown/Other	Unknown/Other	33,535
Utility	Unknown/Other	Unknown/Other	10,856
Unknown/Other	Unknown/Other	Trencher	7,765
Contractor	Unknown/Other	Trencher	7,313
Contractor	Water	Backhoe/Trackhoe	6,129
Contractor	Unknown/Other	Backhoe/Trackhoe	5,266
Contractor	Sewer	Backhoe/Trackhoe	5,186
Municipality	Unknown/Other	Unknown/Other	4,344
Farmer	Unknown/Other	Unknown/Other	4,282
Contractor	Natural Gas	Backhoe/Trackhoe	3,585
Contractor	Electric	Backhoe/Trackhoe	2,745
Unknown/Other	Water	Unknown/Other	2,650
Unknown/Other	Unknown/Other	Boring	2,310
Utility	Unknown/Other	Trencher	2,125
Contractor	Unknown/Other	Hand Tools	1,941
Contractor	Bldg. Construction	Backhoe/Trackhoe	1,928
Unknown/Other	Telecommunications	Unknown/Other	1,913
Contractor	Water	Unknown/Other	1,873
Unknown/Other	Unknown/Other	Grader/Scraper	1,797

Figure A1 depicts the relative contribution of known and unknown data to reported damages by excavator, work performed, and equipment used. The circle on the left represents the percentage of damages for which all three variables (excavator, work performed, and equipment used) are unknown (31%). The center of the three circles on the right represents the portion of the reported damages where all three variables are known (22%). The intersections between two of the variables (excavator and work performed; excavator and equipment; equipment used and work performed) represent the portion of damages where two of the three variables are known (i.e., for 6% of damages, excavator and work performed are known; for 6% of damages, work performed and equipment used are known; and for 9% of damages, equipment used and excavator are known). The outer percentages (not overlapping) represent the portion of damages where only one variable is known (i.e., for 17% of damages, excavator is the only known variable; for 5% of damages, work performed is the only known variable; and for 5% of damages, equipment used is the only known variable).[10]

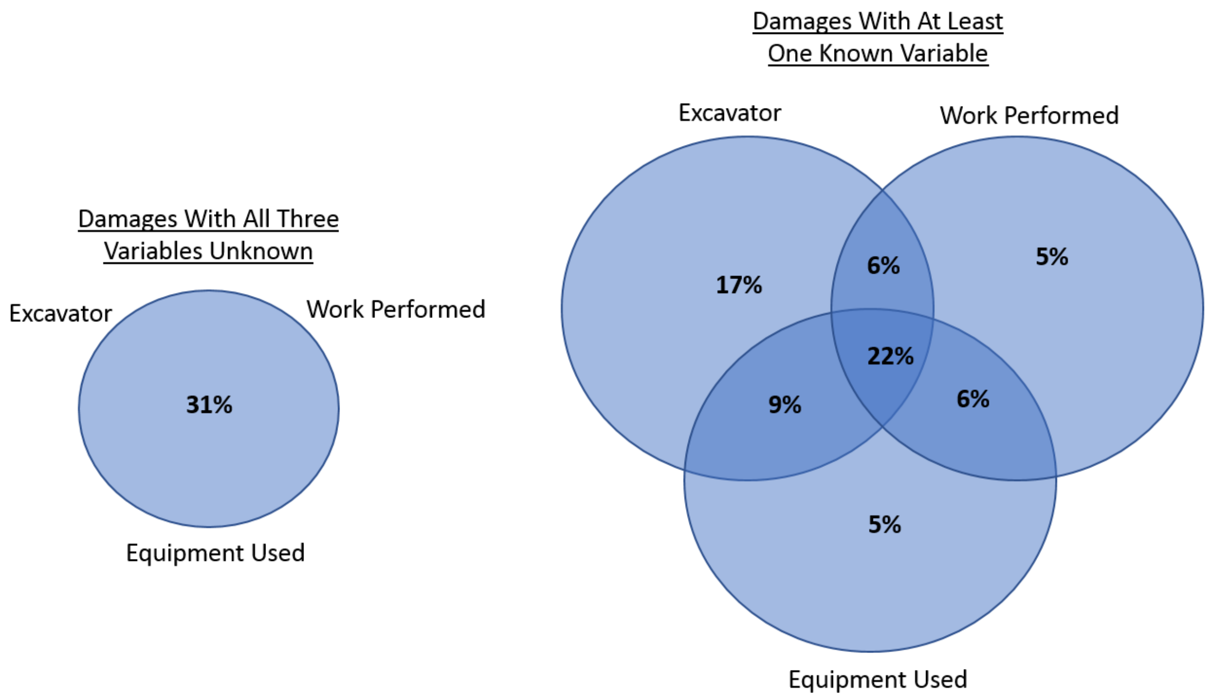


Figure A1—Percentage of damages by excavator, work performed, and equipment used, known and unknown data

[10] All the percentages add to 101% due to rounding errors.

Appendix B: Estimate of Total U.S. Damages

Green Analytics, in consultation with the Data Reporting and Evaluation Committee, developed a model to estimate the total number of facility damages in the U.S. and to provide insight into the relationships between key variables. The modeling process used is summarized in this section.

Damages reported to DIRT are voluntary and for many states under-reported. As a result, the total reported damages in the DIRT database do not reflect the actual number of damages that occur in the U.S. By relying on states that are substantially reporting actual damages, statistical methods can be used to estimate damages for the states with less adequate reporting. In this way, an estimate can be made of the total number of damages in the U.S. To start, a subset of states where damages are deemed to have been substantially reported was established. This subset was then used to develop a predictive model as outlined in the following sections.

Substantial Reporting States

This report uses the same set of substantial reporting states as in the 2017 DIRT report, which were established based on the following process. The first step was to establish a consistent method to identify a substantial reporting state. While actual damages are unknown for all states, for the purpose of guiding this assessment, a target of reporting at least 70% of actual damages was defined.

To establish whether a state meets this threshold, a certainty scoring process was employed. Damages were divided into seven groups according to the facility damaged: cable tv, electric, liquid pipeline, natural gas, sewer, telecommunications, and water. For each facility damage group, states were ranked on a scale and assigned points as follows: 'Likely or definitely substantially reporting' = 1 point, 'Maybe substantially reporting' = 0.5 points, 'Definitely not substantially reporting' = 0 points. Weightings were determined largely through expert opinion and by considering the following variables:

- Percentage reported via Virtual Private DIRT applications
- The existence of damage reporting legislation
- The combination of event sources

Points for each state were then summed across damage facility groups. The total possible score for a given state was seven points. The initial scoring was then verified through a series of one-on-one discussions with subject matter experts in the individual states. Through those discussions, several state scores were adjusted and refined. Ten states, listed below, scored more than four of the seven points. For the purpose of producing a predictive model, two cut-offs for what qualifies as a substantial reporting state were explored:

- 4 out of 7 points, capturing the top 10 states
- 4.5 out of 7 points, capturing the top 5 states

Table B1 - Substantial reporting states and their score

State	Score
Georgia	6.5
Pennsylvania	5.5
New Mexico	5.0
Illinois	4.5
Kansas	4.5
Colorado	4.0
Florida	4.0
Texas	4.0
Virginia	4.0
Connecticut	4.0

Table B2 lists the 10 substantial reporting states used for this analysis along with their reported damages over time.

Table B2—Reported damages from substantial reporting states, 2016 to 2018

State	2016	2017	2018
Colorado	12,660	6,786	12,411
Connecticut	561	562	711
Florida	10,661	21,877	26,628
Georgia	37,562	29,655	29,844
Illinois	21,293	19,256	20,702
Kansas	4,650	5,476	5,435
New Mexico	1,431	1,479	1,825
Pennsylvania	7,983	8,878	9,706
Texas	53,899	45,384	36,543
Virginia	4,273	4,877	4,862
SUBSTANTIAL REPORTING STATES TOTAL	154,974	144,230	148,667
TOTAL DIRT REPORTED DAMAGES	317,869	316,442	330,444
Reported Damages Attributed to Substantial Reporting States	49%	46%	45%

While this process yielded some excellent new insight into which states are "substantially reporting," it is possible that even these states may not be at the benchmark goal of 70% reporting. However, the process does establish a continuum of states, from low to high, of DIRT reporting that reflects damages occurring in those states. Through the process, there was a general consensus that sewer and water damages are under-reported everywhere, and natural gas and telecommunications are fairly well represented.

Statistical Method

The predictive model was built using data associated with the two cut-off levels (4 of 7 points and 4.5 of 7 points). Predictive models were developed independently for the 2015, 2016, 2017, and 2018 years. The conceptual framework assumes that damages are broadly influenced by the total number of excavations, conditions at the work site, rules governing excavation in the state, and behavior/experience/competence (Figure B1). Data for the first three categories were available; however, no data was available for behavioral/experience/competence factors.

A Poisson regression model, with standard errors adjusted for the panel data structure, was used to develop the predictive model. The Poisson regression is a generalized linear model that is typically used to understand and model count data, such as the number of damage events in a state that is contained within the DIRT database. This model yields estimates of the percentage change in damages given a range of independent (or explanatory) variables.

The modeling exercise involved running a series of Poisson models to explore which independent variables had a statistically significant influence on the count of damages in a given state and month. In general, the modeling process involved adding all potential predictor variables to an initial model. Model coefficients deemed insignificantly different from 0 by a t-test were then iteratively dropped from this initial specification. Thus, the final model used for predictive purposes included only significant coefficients.

Two different model specifications were initially run: 1) a model with linear quantitative variables and nominal variables; and 2) a model with linear and quadratic or log-normal quantitative variables as well as nominal variables. The specification with quadratic variables accounts for potential non-linear relationships. For this specification, the modeling process proceeded by first adding quadratic variables for certain quantitative predictors to the linear model independent of other quadratic variables. If the relationship was statistically significant, then the quadratic variable was considered a candidate for the final model. Though the quadratic and log-normal specifications yielded certain informative results, the analysts chose not to use them for predictive purposes because they generated unreasonable estimated damage counts.

The same procedures were used to run models for the two sets of substantial reporting states. However, in this appendix only the larger dataset of 10 states is presented because this data is more representative of all 50 states (although the trade-off is that the damage counts reported for the larger set of data may be more under-reported). Furthermore, certain estimated damage counts based on the smaller set of substantial reporting states were unreasonably large. For these reasons, the 10 states were used as the substantial reporting states in the main body of the report. However, damage estimates should still be treated as an underestimate because it is known that DIRT data used in the modeling process does not capture the actual total number of damages.

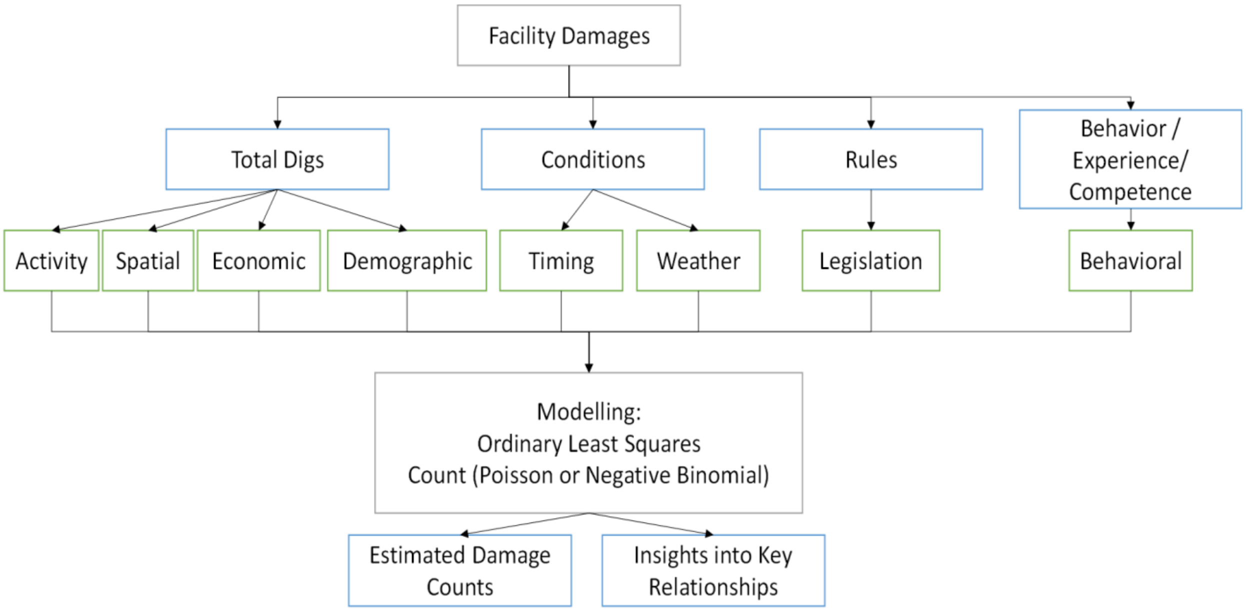


Figure B1—Conceptual framework of damage counts and possible outputs of modeling process

Data

The dependent variable in the model is the weighted damage count, rounded to the nearest integer. The dependent variable in the model is structured such that each observation represents the number of facility damages in a particular state ***s*** and month ***t***. The potential independent variables representing each data category in Figure B1 are summarized in Table B3. The analysts made efforts to match the resolution of each independent variable to that of the dependent variable. However, not all data was available on a monthly basis. For the final set of independent variables, the analysts attempted to focus on variables representing activity rather than value (e.g., number of building permits rather than the value of permits, or employment in an industry instead of its gross domestic product).

Table B3—Variables considered (Type categories correspond to those in conceptual model)

Type	Variable
Activity	▪ Total construction spending in state by month ▪ Construction employment in state by month (total and per capita) ▪ Outgoing transmissions from one call center(s) in state in the year[a] ▪ Total residential unit construction in state by month ▪ Gross domestic product for construction by state and month (per capita and total) ▪ Gross domestic product for utilities by state and month (per capita and total)
Weather[b]	▪ Mean precipitation in state by month ▪ Mean temperature in state by month
Time	▪ Rough indicators of season (Winter: Jan, Feb, Mar; Spring: Apr, May, Jun; Summer: Jul, Aug, Sep; Fall: Oct, Nov, Dec) ▪ Aggregate of rough indicators of season corresponding to spring and summer versus fall and winter (cannot enter model at same time as other season indicator variables)
Population	▪ Total population in state (2018) ▪ Population change from 2017 to 2018 ▪ Population density in state (2018)
Legislation	▪ Tolerance zone in inches ▪ Hand dig, vacuum, or soft excavation within tolerance zone (hand dig clause)
Spatial	▪ Area of state in kilometers[c]
Economic	▪ Unemployment rate in state by month ▪ Total employment in state by month ▪ Gross domestic product for all industries by state and month

[a] One Call transmissions were not reported for certain states. In these cases, a model was developed to impute the missing observations. Transmissions for certain other states were only partially reported (multiple one call centers in a state). To be conservative, the analysts did not impute these observations.

[b] Weather data were available from the NOAA National Climatic Data Center for all states except Hawaii. For Hawaii, the analysts estimated mean monthly temperature and precipitation using data from the state's weather stations.

[c] The area variable was causing unrealistic estimated damage counts for the state of Alaska in certain models for all years, so this variable was dropped from the analysis. Similar problems were encountered with the 2018 data when predicting damage counts for Washington, DC and these were caused by the population density and per capita employment variables.

Before running the models, variance inflation factors (VIFs) were calculated and used to check for high correlation between independent variables, a situation known as multi-collinearity that affects the interpretation of coefficients and can impact predictions based on the model. The VIFs indicated that multi-collinearity is a problem when all independent variables are included (Table B4). Variables with the highest VIF scores were iteratively dropped.

Table B4—Checking for multicollinearity variance inflation factors[a]

Variable	2018		2017		2016		2015	
	Initial	Reduced	Initial	Reduced	Initial	Reduced	Initial	Reduced
Total units	40							
Population	4,547		17,239		15,517		21,189	
Employment	3,174	6	14,521		16,245		25,784	
Construction employment	305		641		936		1,995	
Population change	26	5	71		232	5	385	
Construction employment per capita	27	5	62	2	74		85.72	5
Hand dig clause	15		60		50	5	47	4
Total residential unit construction	15		45		67		49	
Transmissions	16	6	44	1	22	7	24.76	3.
Tolerance interval	15		31		16	6	15	3
Unemployment rate	16	2	25	2	8	5	7	4
Population density			13	2	11	2	11	2
Total construction spending	13		12	6	19		4	3
Mean temperature	14	4	11	4	20	5	9	7
Winter (Jan, Feb, Mar.)	4	2	7	6	Omitted	5	Omitted	7
Fall (Oct, Nov, Dec.)	Omitted	Omitted	4	3	9	4	5	4
Spring (Apr, May, Jun.)	3	2	2	2	4	2	5	2
Summer (Jul, Aug, Sep.)	4	3	Omitted	Omitted	8	Omitted	7	Omitted
Mean precipitation	3	2	2	2	2	2	2	2
Mean VIF	511	4	1,929	3	1,955	4	2,919	4

[a] Rounded to the nearest integer

The analysts used a rule of thumb of a VIF score of 10 as a cut-off value for when to stop dropping variables. Although there were still some issues after removing the most collinear variables, multi-collinearity was much less of an issue. Note that different sets of data have different issues with collinearity, so the same set of variables was not used for each year.

Results

Table B5—Regression results for the final count models of facility damages

Variable	Poisson Count Coefficients[a]			
	2018	2017	2016	2015
Constant	5.117257*** (0.5495457)	4.58841*** (0.4610575)	5.146535*** (0.2155254)	8.301317*** (0.8659892)
Construction spending total				0.00000517* (0.00000306)
Population change			-0.00000383*** (0.00000146)	
Population density				-0.0042612** (0.0021191)
Transmissions	0.0000000418*** (0.00000000981)	0.0000000524*** (0.00000000819)	0.000000172*** (0.0000000372)	0.000000113*** (0.0000000141)
Spring and summer		-0.3651772** (0.1504601)	-0.2838454*** (0.0988685)	
Winter	0.002818 (0.0928489)			
Spring	-0.2659848* (0.14766)			
Summer	-0.4020203** (0.197851)			
Fall	*Base season*			
Mean temperature	0.0269653*** (0.0090757)	0.032051*** (0.0071174)	0.0268825*** (0.0051069)	0.0166688*** (0.0018208)
Total employment in construction per capita				-111559.3*** (39309.74)
Hand dig clause			-1.152784*** (0.2592687)	-1.636223*** (0.3911967)
Model statistics				
N	120			
Log pseudolikelihood	-22,112.56	-16,195.66	-7,608.79	-7,654.93
Pseudo r2	0.62	0.76	0.91	0.88

***, **, * the coefficient is significantly different from 0 at the 99%, 95%, and 90% levels of significance, respectively

[a] Coefficient with the corresponding robust standard errors in brackets

Table B5 presents the best models for the top 10 substantial reporting states for the 2015, 2016, 2017, and 2018 data. Model fit, as indicated by the pseudo R^2 measure, was best for 2016, followed closely by 2015 and then more distantly 2017 and 2018.

- The model for 2018 indicates that damages rise with increases in outgoing transmissions and a state's mean monthly temperature. Relative to the fall season, damage counts appear significantly lower for spring and summer though do not significantly differ in winter.
- For 2017, the models suggest that damages increase with increases in outgoing transmissions and the mean monthly temperature for the state—there are fewer damages in spring and summer relative to fall and winter.

- For 2016, the models also indicate that damages increase with outgoing transmissions and the mean monthly temperature for the state (similar to 2017 and 2018). However, for 2016, the results suggest that damages decrease with population declines (from 2015 to 2016), are lower for spring and summer relative to fall and winter, and are lower for states with a hand-dig clause.
- For 2015, the model suggests that damages increase with the total amount of money spent on construction, outgoing transmissions, and mean monthly temperature in the state. Damages in 2015 are lower in states with higher population density and higher per capita employment in construction and in states with a hand-dig clause.

These results are largely expected. For instance, it is sensible that damages increase with outgoing transmissions because transmissions reflect excavation activity; or that damages decrease during the spring and summer months because excavating conditions are likely better in this period relative to fall and winter. While this may seem counter to the calendar heat map, note that the calendar is highlighting that more damages happen in the summer, which is largely because there is more activity in the summer. The regression model, in contrast, is examining the relationship between variables holding all other variables constant. In other words, holding activity constant, there are fewer damages during the spring and summer. If rising temperatures extend construction seasons, given this relationship, it is reasonable to anticipate increased damages in the future, all else being equal. The negative coefficients observed for population change and construction employment per capita in the 2016 and 2015 models, respectively, are not expected.

Using these regression results, all other state total damages can be estimated by applying the value of each variable from each state and then aggregating to estimate total U.S. damages (Table B6). This process assumes that reported damages in the defined substantial reporting states approximate total actual damages in those states, and that the estimated relationships in Table B5 hold for the states not included in these models. Though there is variation from year to year and an upward trend since 2015, the estimated damages are not terribly different from 2015 to 2018. Variation is expected, given that these are estimates based on incomplete data and the explanatory power of the models from 2017 and 2018 is relatively low. However, the large jump in damages from 2017 to 2018 may reflect the faster rate of growth in the country's economy (e.g., economic growth in 2018 was 2.9% relative to 2.2% in 2017). Future analysis may consider pooling the data across years rather than running independent models for each year. This enables a more robust comparison of damages for substantial reporting states across years, although resulting estimates should still be treated with caution given the uncertainty introduced by the incomplete nature of the data.

Table B6—Estimated damage counts and upper and lower bound estimates for the U.S. (top 10 states), rounded to the nearest 1,000

Year	Estimated Total U.S. Damages	Lower Bound of Estimated Total U.S. Damages	Upper Bound of Estimated Total U.S. Damages
2018	509,000	230,000	787,000
2017	439,000	270,000	715,000
2016	416,000	201,000	1,159,000
2015	378,000	217,000	738,000

To examine the strength of the relationship between the data for the substantial reporting states and the broader DIRT database, the substantial reporting state dataset was compared with the broader database for a number of key variables. Results of that examination are presented below for event sources, root cause, excavator type, and facilities damaged. In general, the examination revealed that the substantial reporting state dataset is a strong representation of the larger DIRT database.

Event Sources for Substantial Reporting States

Table B7 illustrates the percentage of reported damages for all states in relation to those for the substantial reporting states. The data exhibits a high degree of alignment between all states and the substantial reporting states. In both cases, locator, natural gas, and excavator are the dominant event sources.

Table B7 – Reported damages for all states in relation to the substantial reporting states, 2018

Event Source	Percentage of Reported Damages—All States	Percentage of Reported Damages—Substantial Reporting States
Locator	63.70	66.08
Natural Gas	16.46	10.91
Excavator	7.66	10.68
Telecommunications	8.20	7.91
Federal/State Regulator	1.11	2.25
Electric	1.53	0.93
Unknown/Other	0.49	0.46
Liquid Pipeline	0.18	0.37
Public Works	0.59	0.36
Private Water	0.04	0.03
Road Builders	0.03	0.02
Engineer/Design	0.0043	0.0036
Railroad	0.0040	0.0010
Equipment Manufacturer	0.0024	0.0007

Root Cause for Substantial Reporting States

Root cause data for the substantial reporting states is presented in Table B8 along with root cause data for all states. As was the case with the event source data, the root cause data for the substantial reporting states is a strong representation of the dataset for all states. The percentage of damages attributed to any given root cause for all states is comparable to that for the substantial reporting states.

Table B8 – Root cause for all states in relation to the substantial reporting states, 2018

Root Cause Group	Percentage of Reported Damages—All states	Percentage of Reported Damages—Substantial Reporting States
Excavation Issue	35.46	33.57
Other Notification Issue	26.32	26.86
Locating Issue	23.55	24.22
Notification Not Made	14.36	15.03
Miscellaneous	0.31	0.32

Excavator Type for Substantial Reporting States

Table B9 presents excavator type data for all states in relation to the same data for the substantial reporting states. Here again, the distribution of damages across excavator types for the substantial reporting states is consistent with that for all states.

Table B9 – Excavator type for all states in relation to the substantial reporting states, 2018

Excavator Types	Percentage of Reported Damages—All states	Percentage of Reported Damages—Substantial Reporting States
Unknown/Other	47.59	47.51
Contractor	36.13	34.83
Utility	6.19	6.14
Farmer	2.77	5.67
Municipality	2.88	2.77
Occupant	2.30	1.34
Developer	0.98	0.92
County	0.97	0.74
State	0.18	0.07
Railroad	0.01	0.01

Facilities Damaged for Substantial Reporting States

Table B10 considers facilities damaged for substantial reporting states in relation to that for all states, demonstrating once again the strong alignment between the two datasets. In both cases, the majority of reported damages occur to telecommunications and natural gas.

Table B10—Facilities damaged for all states in relation to the substantial reporting states, 2017

Facilities Damaged	Percentage of Reported Damages—All states	Percentage of Reported Damages—Substantial Reporting States
Telecommunications	46.21	49.71
Natural Gas	26.61	22.14
Cable TV	10.58	10.43
Electric	9.05	8.86
Unknown/Other	4.61	5.31
Water	2.48	2.98
Sewer	0.29	0.47
Liquid Pipeline	0.15	0.07
Steam	0.01	0.02

Appendix C: Damages by Event Source

Table C1—Reported damages by event source, complete dataset, 2018

Event Source	Reported Damages	
	Reported Damages	Percentage of Total
Locator	217,616	63.70
Natural Gas	56,242	16.46
Telecommunications	28,010	8.20
Excavator	26,182	7.66
Electric	5,210	1.53
Federal/State Regulator	3,805	1.11
Public Works	2,019	0.59
Unknown/Other	1,661	0.49
Liquid Pipeline	613	0.18
Private Water	123	0.04
Road Builders	92	0.03
Engineer/Design	15	0.0043
Railroad	14	0.0040
Equipment Manufacturer	8	0.0024
Total Damages	341,610	

Appendix D: Groupings Used in Report

Table D1 – Root cause groupings used in this report (Damage Cause column is based on the DIRT specification for bulk uploading)

Added
Removed
Replaced

Damage Cause	Replaced with in 2018	Key	Root Cause Groups
EXBACKFILL		Improper backfilling practices	Excavation Issue
EXCLEARANCE		Failure to maintain clearance	Excavation Issue
EXHANDTOOL		Failure to use hand tools where required	Excavation Issue
EXMARKS		Marks faded or not maintained	Excavation Issue
EXSUPPORT		Failed to protect/shore support facilities	Excavation Issue
EXTESTHOLE		Failure to pothole	Excavation Issue
INSUFEX		Other Excavation practices not sufficient	Excavation Issue
BADMAP		Incorrect Facility Records/Maps	Locating Issue
INACCABAND		Marked inaccurately due to Abandoned Facility	Locating Issue
INACCBADMAP		Marked inaccurately due to Incorrect facility record/maps	Locating Issue
INACCLOCERR		Marked inaccurately due to Locator error	Locating Issue
INACCTRACEW		Marked inaccurately due to Tracer wire issue	Locating Issue
INCOMPLETE		Site marked incomplete	Locating Issue
INSUFMARKING		Facility marking or location not sufficient	Locating Issue
LOCERROR		Locator error	Locating Issue
NOMARKABAND		Not marked due to Abandoned facility	Locating Issue
NORESPLOC		No response from operator/contract locator	Locating Issue
NOTFOUND		Unlocatable facility	Locating Issue
NOTLOCATED		Facility was not located or marked	Locating Issue
TRACEWIRE		Tracer wire issue	Locating Issue
CALLCENTER		One Call Center Error	Miscellaneous
ABANDONED	NOMARKABAND, INACCABAND	Abandoned Facility	Miscellaneous
DETERIORATED		Deteriorated facility	Miscellaneous

PREVDAMAGE		Previous damage	Miscellaneous
EXBADINFO		Excavator provided incorrect notification information	Other Notification Issue
EXDUGAFTER		Excavator dug after valid ticket expired	Other Notification Issue
EXDUGBEFORE		Excavator dug prior to valid start date/time	Other Notification Issue
EXDUGOUT		Excavator dug outside area described on ticket	Other Notification Issue
INSUFCALL	EXDUGATER EXDUGBEFORE EXDUGOUT	Notification to one call center made, but not sufficient	Other Notification Issue
WRONGINFO	EXBADINFO	Wrong Information Provided	Other Notification Issue
NOLOCATEREQ		No Notification made to the one call center	Notification Not Made
NOTCOL		Data Not Collected	Unknown/Other
OTHER		Other	Unknown/Other

Table D2—Work performed groupings used in this report

Group	**Root Cause**
Agriculture	Agriculture
Construction/Development	Construction
	Site Development
	Grading
	Drainage
	Driveway
	Demolition
	Engineering
	Railroad
	Waterway
Energy	Natural Gas
	Electric
	Steam
	Liquid Pipe
Fencing	Fencing
Landscaping	Landscaping
Sewer/Water	Sewer
	Water
Street/Roadway	Roadwork
	Curb/Sidewalk
	Storm Drainage
	Milling
	Pole
	Traffic Signals
	Traffic Signs
	Street Lights
	Public Transit
Telecom	Telecommunications
	Cable TV

Appendix E: CBYD Survey Results

This appendix presents the results of the CBYD survey in relation to total reported damages due to notification not made (NNM) and damages by occupants due to notification not made by state and region. The Total Damages column excludes reports with an unknown root cause.

Region	Damages			Occupant Damages			Awareness of CBYD
	Total	Due to NNM	% Due to NNM	Total	Due to NNM	% Due to NNM	
East North Central	58,833	11,005	19	1,462	781	53	52
East South Central	21,565	7,890	37	523	359	69	51
Middle Atlantic	12,840	2,186	17	288	205	71	32
Mountain	19,207	2,556	13	721	413	57	55
New England	2,738	517	19	33	26	80	48
Pacific	14,943	5,440	36	1,749	1,351	77	45
South Atlantic	80,818	29,028	36	786	523	67	45
West North Central	39,265	3,829	10	274	122	45	70
West South Central	42,884	14,257	33	193	118	61	50

2018 CGA DIRT Analysis & Recommendations

Green Analytics

CGA's Data Reporting & Evaluation Committee

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