California Underground Facilities
Safe Excavation Board

Item #2

Agenda Item – Staff Report

DATE: February 22, 2018

TO: Members, Underground Facilities Safe Excavation Board

FROM: Tony Marino, Executive Officer

SUBJECT: Baseline Safety Assessment

SUMMARY:

Data is important for both deciding where to spend limited resources and determining what means of regulation will be most effective in promoting safety. Existing analyses of available data, however, does not appear sufficiently targeted to inform policy decisions, and the data itself cannot always be seen as reliable. The Board will likely need to carefully examine its policy goals and determine what type and quality of data it needs to inform its progress toward those goals.

Workshop participants should be prepared to discuss the following questions:

1) What excavation safety-related data does your organization gather?
2) Does your organization view the safety requirements of the one call law as a partnership or as a series of individual obligations with individual accountabilities?
3) What are the current measures of success? What are their strengths and weaknesses?
4) Do these measures assist in policy development? *e.g.*
    a. Do these measures assist in determining what types of activities would be acceptable for a notification exemption?
    b. Do these measures help us in determining how effective our education, outreach, and compliance activities are?
5) In comparing these measures year-to-year, state-to-state, or community-to-community (in the case of pilot programs), what supporting measures do we need (such as size of the economy, housing starts, etc).
6) What are other ideas for demonstrating incremental success or failure in response to safety improvement efforts in the state?

BACKGROUND:

Excavation damage data is collected in a number of ways, though it is not generally analyzed at the state level. The investor-owned natural gas utilities submit quarterly to

the California Public Utilities Commission (CPUC) all excavation-related damages.[1] Significant excavation-related events may also be captured in electric[2] and telecommunications[3] reports to the CPUC, in hazardous liquid incidents[4] to the Office of the State Fire Marshal (OSFM), in employee accidents[5] to Cal/OSHA, and, to an extent, in fire responses[6] in the California All Incident Reporting System (CAIRS), but these reports were not designed to capture excavation-related events and are thus limited in scope and detail.

Nationally, the Pipeline and Hazardous Materials Safety Administration (PHMSA) collects damage data from distribution gas operators. While this is a subset of the incidents collected by the CPUC, PHMSA's requirement applies to operators across the country, so this data is more comparable across different states.

The Common Ground Alliance (CGA), a non-profit stakeholder group established in 2000 in response to increased congressional and regulatory attention on pipeline damage prevention, collects damage data voluntarily provided by excavators and owners of buried infrastructure, including but not limited to natural gas. CGA collects information through its electronic damage incident reporting tool (DIRT). Its dataset is more ambitious, looking not merely for damage numbers but for root causes, excavator type, work type performed, equipment used, and other information, but suffers in the unevenness of data reported.

Some state level data is collected by utilities commission and one call centers, some of which is extensive due to state reporting requirements, such as in Colorado.

DISCUSSION:

The National Academy of Public Administration, in its October 2016 report, "Performance Accountability, Evidence, And Improvement Reflections and Recommendations to the Next Administration," proclaimed that "every government organization should strive to be effective and improve, continually, on multiple dimensions," and recommended doing so by employing

"a common set of practices that, when used wisely, work remarkably well:
(1) setting outcomes-focused goals;
(2) collecting and analyzing performance data;
(3) running frequent data-rich reviews to identify what works and what needs attention;

[1] Rule 122.2 of General Order 112-F
[2] Per Resolution E-4184
[3] Per Rule 4 of General Order 133-D, following federal reporting requirements in 47 CFR § 4.9
[4] 49 CFR 195.52
[5] 8 CCR 342, following Labor Code § 6409.1
[6] Health and Safety Code § 13110.5

(4) complementing routinely collected data with independent, rigorous evaluations and other studies; and
(5) using effective communication strategies for a wide variety of purposes aimed at a wide variety of stakeholders."[7]

This theme of continual improvement is a prominent feature of the Board's 2018 Plan and the strategic objective of continual improvement found therein. Such improvement is contingent on the collection of relevant data and its effective use. Easily-obtained data, however, may not be relevant, and relevant data may not be easily available.

Existing data appears to have limited value in policy development. That reported by gas utilities to the CPUC and PHMSA are likely reliable, but it paints a broad brush and does not distinguish between the contributions of education, enforcement, or any other of the activities tied to Board strategic objectives. Analyses of data from DIRT, on the other hand, rely on much more granular information, but sometimes can draw unwarranted conclusions from it. The 2012 DIRT Report found that states with more notification exemptions had a greater number of damages per 1000 tickets than those with fewer exemptions, assuming the difference was due to excavators hitting underground infrastructure for failure to call (the numerator) and not due to the reduced number of notifications (the denominator).[8] PHMSA would, however, in its 2014 "Study on the Impact of Excavation Damage on Pipeline Safety," determine that "data and information were not sufficient to support an adequate evaluation" and that "data do not exist regarding exemptions as the cause of damage incidents."[9]

The 2016 DIRT Report would recognize the challenges in using damages per thousand ticket tickets as a measure of success. While the metric has become standard, having the benefit of being assumed largely invariant with the swings of the economy, there continues to be unease with its use for a variety of reasons, including those that change the number of tickets that are counted in the denominator (differences in state 811 notification exemptions and life and scope of tickets, one call center ticket re-transmission policies, and effectiveness of filtering unnecessary transmissions).[10]

Despite its drawbacks, the damage per thousand tickets appears to have utility, particularly in looking at a state's performance from year to year. Measuring across states, with the associated comparability problems noted above, is less useful, though it has been used to argue that enforcement of damage prevention laws against excavators is the single most important means of reducing damages.[11] A 2005 report from a PHMSA-organized stakeholder group did so using the **Figure 1** below.

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[7] Shelley H. Metzenbaum and Robert Shea, "Performance Accountability, Evidence, And Improvement Reflections and Recommendations to the Next Administration," October 2016, p. 3.
[8] DIRT Analysis & Recommendations, 2012.
[9] US DOT (PHMSA), *Study on the Impact of Excavation Damage on Pipeline Safety*, October 9, 2014, p. 9.
[10] DIRT Report, 2016.
[11] "Excavation Damage Prevention Group Report," from "Integrity Management for Gas Distribution: Report of Phase 1 Investigations," December 2005, p. 10.

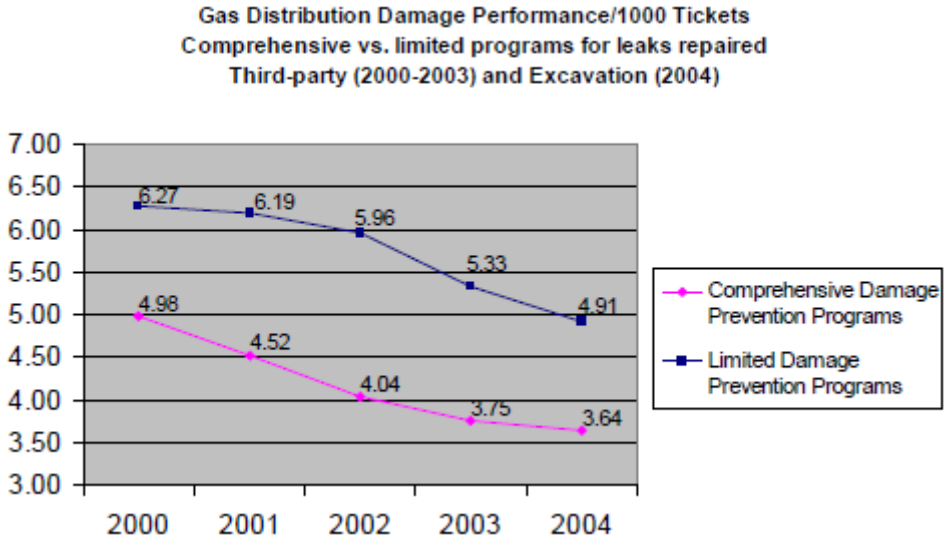

Figure 1: From [11]. An average of the damages per thousand tickets for the five states with effective enforcement compared with the average of 34 states with ineffective enforcement

What the report failed to do was identify, beyond self-platitude for training, operator qualifications, and education improvement, why damage rates (as they averaged them) dropped everywhere from 2000 to 2004. Colorado, despite still absent a statewide enforcement program, has had dramatic improvement in its damages per thousand ticket metric (**Figure 2** below).[12]

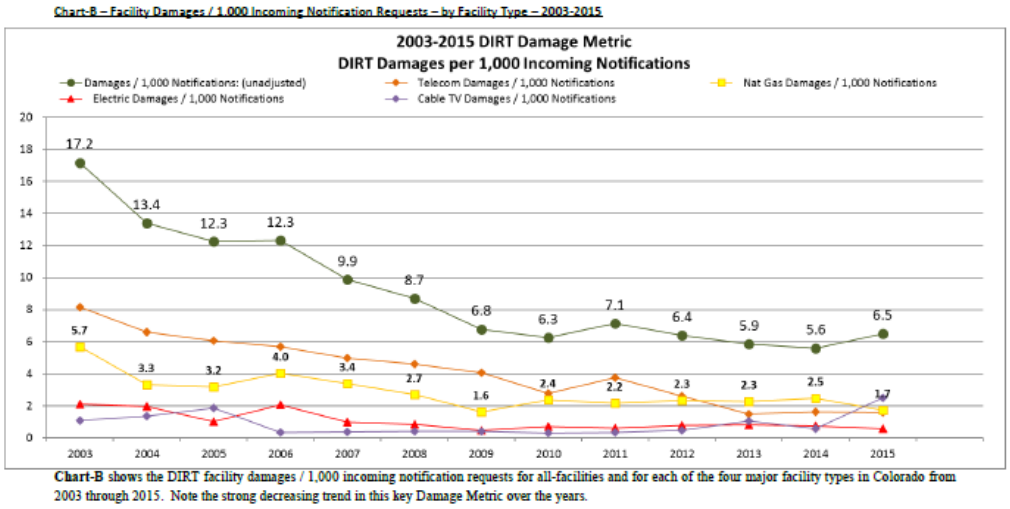

Figure 2: Chart-B from [12]. Colorado has had a significant improvement in damage per thousand tickets metric without a statewide enforcement program.

[12] Colorado 811, *Perspectives on Facility Damage - 2015*, September 19, 2016, p. 24.

In taking credit for the state's success in improving excavation safety around buried infrastructure, the Board will need to take care to account for trends outside California's borders.

Even the claim that notifying a one call center prior to excavation so that buried utilities may be marked, while universally recognized as cheap, easy, and effective, is not clearly supported by data. An oft-quoted claim is that a call to 811 will prevent a damage 99% of the time. Data from Ontario, Canada supports this, with officials estimating that a person has a 1 in 700 chance of striking a buried line with a locate. They also estimate, however, that one has a 1 in 300 chance of striking buried infrastructure without a locate.[13] According to these estimates, a person has a 99% chance of avoiding damage whether or not he or she calls. The challenge is that, while its straightforward to determine the number of digs performed with a ticket, estimates of digs performed without a ticket are more difficult to come by.

Even more troubling than the questionable statistics used in analysis of the data is the unclear but consistent biases in it. It is well-known that the breakdown of damage cause in the DIRT data varies by the reporting stakeholder. It should not be surprising that, for 2016, natural gas operators reported that 21% of the damages were caused by locating issues while excavators reported 75% for the same cause. As DIRT data is voluntarily reported, a stakeholder may spend more time and effort recording and reporting an incident that was someone else's fault. Selection bias is a compelling argument, as excavators reported only 8% of the 2016 DIRT damages.

In Colorado, however, selection bias is not at play for a similarly large disparity of root causes, as can be seen below in **Figure 3** from the state's 2015 "Perspectives on Facility Damage."[14] Excavators in Colorado notify the one call center in the case of damage, and operators are required to submit damage information to the one call center within 90 days. Given that these are relatively complete data sets, there shouldn't be significant difference in the reasons for a damage. Nonetheless, excavators in Colorado reported 63% of the time that damages were caused because facilities were unmarked, while facility owners found a lack of marking to be the cause less than 4% of the time.

[13] Jeff Hitchcock, "Alternative Locate Agreements: How Ontario Incentivizes Safe Excavation," *Damage Prevention Professional*, Fall 2017, p. 30.
[14] Colorado 811, *Perspectives on Facility Damage - 2015*, September 19, 2016, p. 12.

Table-C – DIRT Damage – Breakdown by Notification and Marking for 2015

Table-C	DIRT - Facility Owner Submited Damage Information					
TOTAL-Damaged Facility Submitted		4,773				
	%Share of Total Damages Submitted	Total Damages Submitted	# Notification Requests	% Share Notification Request	% Share No Notification Request	# No Notification Requests
#Damages with Notification Status		4,773	3,545	74.3%	25.7%	1,228
TOTAL-Facility Marking	100.0%	4,773	3,545	74.3%	25.7%	1,228
Facility Marked/Visible	40.5%	1,932	1,932	100.0%	0.0%	0
Facility Mismarked/NotCorrect	5.6%	268	268	100.0%	0.0%	0
Facility UnMarked	3.4%	162	162	100.0%	0.0%	0
Facility Marking Unknown	2.0%	96	96	100.0%	0.0%	0
Facility Marking Not Collected	48.5%	2,315	1,087	47.0%	53.0%	1,228

Table-D – Colorado 811 Damage Ticket – Breakdown by Notification and Marking for 2015

Table-D	Colorado 811 - Excavator Reported Damage Ticket					
TOTAL-Damaged Facility Tickets		9,560				
	%Share of Total Damage Tickets	Total Damage Tickets Reported	# Notification Requests	% Share Notification Request	% Share No Notification Request	# No Notification Requests
#Tickets with Notification Status		9,560	7,840	82.0%	18.0%	1,720
TOTAL-Facility Marking	100.0%	9,560	7,840	82.0%	18.0%	1,720
Facility Marked/Visible	16.2%	1,549	1,338	86.4%	13.6%	211
Facility Mismarked/NotCorrect	15.0%	1,431	1,287	89.9%	10.1%	144
Facility UnMarked	63.0%	6,019	4,834	80.3%	19.7%	1,185
Facility Marking Unknown	5.9%	561	381	67.9%	32.1%	180
Facility Marking Not Collected	0.0%	0	0	N/A	N/A	0

Figure 3: Table-C and Table-D from [14]. Comparison of root causes attributed to excavation damage as reported by excavators and facility owners from Colorado in 2015. Differences in reporting practice between excavators and facility owners, while evident in the table, do not explain the large discrepancy in opinion regarding whether an unmarked facility was the cause of damage.

Even year-to-year changes in reporting practices within the same stakeholder group can sway damage cause results. For instance, the 2016 DIRT data notes a drop in damages due to a failure to contact the one call center from 31% in 2015 to 16% in 2016—plummeting nearly 50%—as can be seen in the **Figure 4**.[15] The locator stakeholder group—the stakeholder with the most reports—reported 57% fewer damages in 2016 due to a no-call, and telecommunications facilities—the facilities for which the most damages were reported—saw a 54% drop in reports. No other stakeholder group or facility type saw such a drop. Such a change cannot be attributed to a dramatic increase or decrease in reports, either, as the number of damages reported—irrespective of cause—was largely stable from the locator group and for telecommunications facilities.

[15] From "2016 DIRT Report Interactive Analysis," http://commongroundalliance.com/dirt-2016-interactive-report

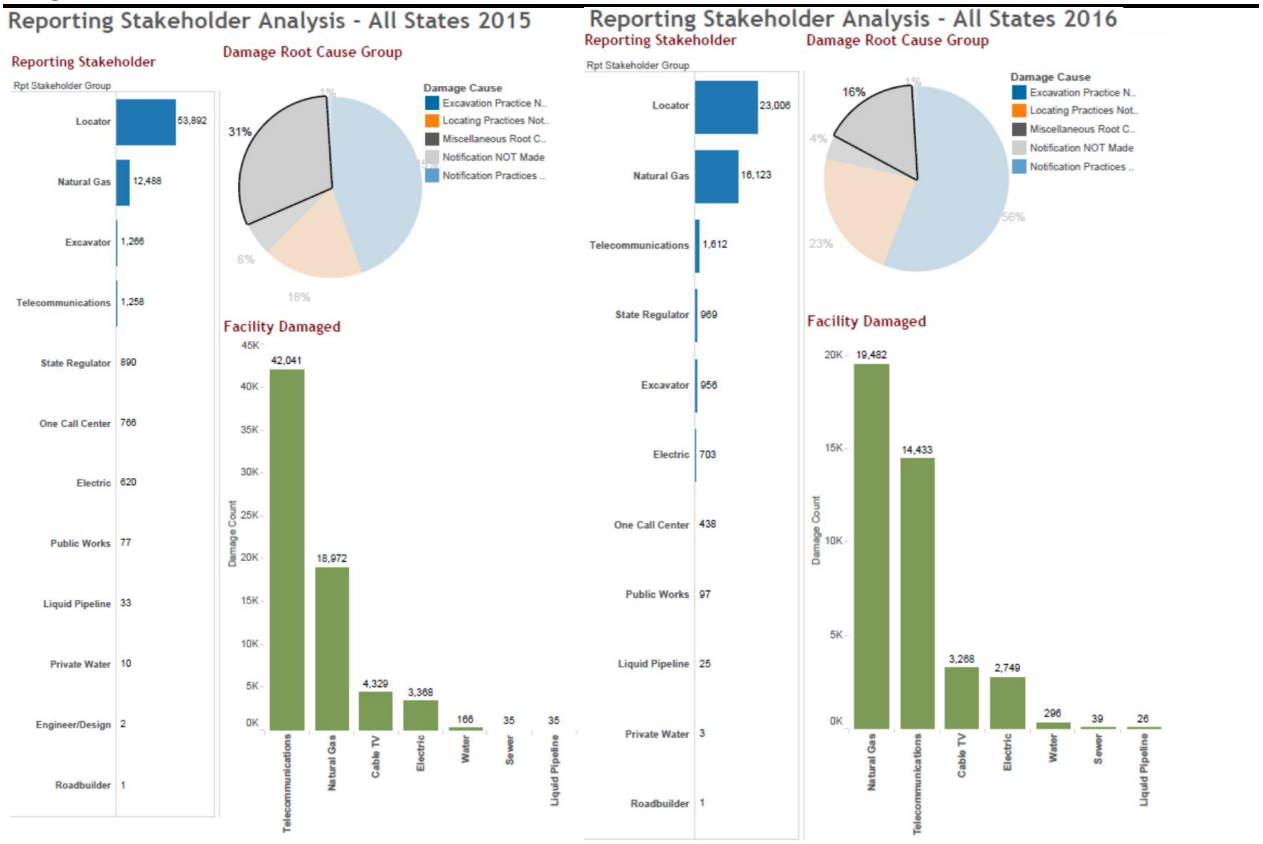

Figure 4: Drop in no-call damages from 31% in 2015 to 16% in 2016 can be traced to a change in reporting of locators of damages to telecommunications facilities. No other reporting stakeholder or type of facility demonstrates so significant a year-over-year change. All numbers in the figure are for damages associated with a failure of the excavator to contact the one call center.

Such inconsistency should not sway professionals or policymakers that the efforts to improve excavation safety over the past decades have been for naught, but they should highlight the challenge of demonstrating incremental change, whether in applying risk management techniques to argue for the addition or elimination of a risk control or in after-the-fact safety assurance analyses. The Board will likely need to identify data needs during the development phase of its policy initiatives and make that data's collection a part of the rollout of these initiatives.

The appendix describes a means of describing the system as a first step to a risk management approach.

Appendix: System description as a first step in risk management

Under even the briefest of glances at the CGA DIRT reports, one can see a number of behaviors, actors, and consequences, making difficult the determination of which actors and which behaviors contribute most to unsafe outcomes, or where the Board and industry should channel their efforts and limited resources to make the greatest impacts.

To begin to address this situation, we must first examine the possible set of circumstances.

To take as an example, we can examine the question of how 811 notification affects the likelihood of striking a subsurface installation. We can separate this into three propositions:

A) an actor contacts the regional notification center two days in advance of a proposed excavations (calls)
B) an actor excavates (digs)
C) an actor strikes a subsurface installation (strikes)

As there are two options for each proposition (True or False), and three propositions, we have $2^3 = 8$ possibilities, as seen in the table below:

#	Call	Dig	Strike	Outcome
1	T	T	T	Excavator calls, digs, & strikes
2	T	T	F	Excavator calls, digs, and doesn't strike
3	T	F	T	Excavator calls, doesn't dig, but still strikes
4	F	T	T	Excavator doesn't call, digs, and strikes
5	T	F	F	Excavator calls, doesn't dig, and doesn't strike
6	F	T	F	Excavator doesn't call, digs, and doesn't strike
7	F	F	T	Excavator doesn't call, doesn't dig, and strikes
8	F	F	F	Excavator doesn't call, doesn't dig, and doesn't strike

Of these eight outcomes, two (#3 & #7) have a probability of zero, as they both involve striking a facility without actually excavating. Another outcome (#8) is irrelevant, as it describes the condition of not participating in excavation activities at all. What remains are five relevant outcomes, and they can be described pictorially in a Venn Diagram, as in the **Figure A** below, which lists the three propositions (A = Call, B = Dig, C = Strike) and the five relevant outcomes from Table 1 (1, 2, 4, 5, 6). Outcome #8, in which no calling, digging, or striking takes place, can be imagined as the white space outside the figure.

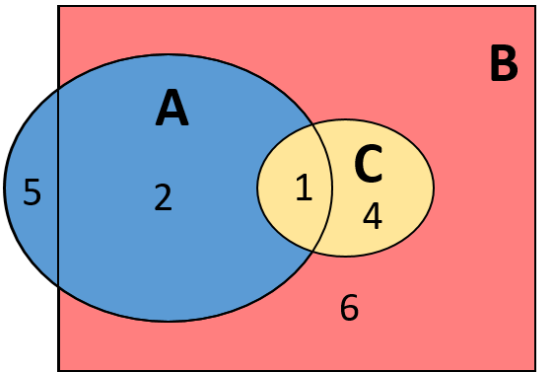

Figure A: Venn diagram describing the overlapping of call, dig, and strike propositions and the five relevant outcomes.

From this simple diagram and truth table, one can use existing data and assumptions to calculate and compare conditional probabilities. Comparing the magnitudes, for instance, between the probability of striking a buried facility given no call with the probability of striking a buried facility given a call would be the first step in deciding where to focus attention and resources in improving safety outcomes.

This example is illustrious, as it does not include the presence of other actors, such as locators, and the actions they may take, which complicate the real-world system.