

## **CHAPTER 4**

### **Locating and Marking Task Team Best Practices**

#### **4.1 CHAPTER SUMMARY**

Locating and marking is necessary before excavation can be carried out safely. Without accurate and timely location and effective marking of facilities, excavator damage to underground facilities is more likely and may have severe consequences. As part of the overall best practice identification effort, the Locating and Marking Task Team identified best practices for: (1) knowing, (2) appropriately marking, and (3) effectively communicating the location of all underground facilities in association with excavation activities. The Team reached consensus that carrying out these practices will enhance the accuracy, completeness, and timeliness of locating and marking. The Team believes that improvements in locating and marking through employment of these practices will translate directly into a lower risk of damage to facilities. The specific best practices identified by Team consensus are listed below.

1. Locators utilize available facility records at all times.
2. If a facility locator becomes aware of an error or omission, then the facility locator provides information for updating records that are in error or to add new facilities.
3. A uniform color code and set of marking symbols is adopted nationwide.
4. A single locator is used for multiple facilities.
5. Locators are properly trained. Locator training is documented.
6. Locates are performed safely.
7. A visual inspection is completed during the facility locating process.
8. Facilities are adequately marked for conditions.
9. Positive response is provided to facility locate requests.
10. Multiple facilities in the same trench are marked individually and with corridor markers.
11. Information on abandoned facilities is provided when possible.
12. When locating electro-magnetically, active/conductive locating is preferable to passive/inductive locating.

13. The facility owner/operator is identified.
14. Communication is established between all parties.
15. Documentation of work performed on a locate is maintained.
16. A damaged facility is investigated as soon as possible after occurrence of damage.
17. Forecasting/Planning for Predictable Workload Fluctuations. A plan is developed for dealing with unpredictable fluctuations.

## **4.2 BACKGROUND AND MOTIVATION**

### **4.2.1 Motivation for Locating and Marking Practices Task Team**

Each year a greater percentage of facilities placed in the field are placed underground. In 1994, Bell Communication Research estimated that total U.S. underground infrastructure totaled more than 20 million miles. This figure has likely dramatically increased in the years since.<sup>9</sup> This underground infrastructure is vulnerable to damage without careful preventive measures. Prevention of damage to underground facilities requires complete and accurate location of facilities before excavation work commences. Once facilities are located, they must be marked so that the facility locations are communicated effectively to excavators. Locating and marking is necessary before excavation can be carried out safely. Without accurate and timely location and effective marking of facilities, excavator damage to underground facilities is more likely and may have severe consequences.

### **4.2.2 Goals for Locating and Marking Practices Task Team**

The goal of the Locating and Marking Practices Task Team was to contribute to a reduction in the risk of outside damage to underground facilities. As part of the overall best practice identification effort, the Task Team undertook to identify best practices for: (1) knowing, (2) appropriately marking, and (3) effectively communicating the location of all underground facilities in association with excavation activities. The specific best practices identified by the Team were chosen by Team consensus. The Team reached a consensus that carrying out these practices will enhance the accuracy, completeness, and timeliness of locating and marking. The Team believes that improvements in locating and marking through employment of these practices will translate directly into a lower risk of damage to facilities.

### **4.2.3 Organization of Chapter**

The following section lists all Locating and Marking Task Team members and their organizations. Section 4.4 describes the process employed by the Task Team for identifying, evaluating, and selecting locating and

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<sup>9</sup> Estimate of 20 million miles used by Bell Communications Research during the National Transportation Safety Board's 1994 excavation damage prevention workshop.

marking best practices. In Section 4.5, Findings, the specific candidate practices considered by the Team are described individually, along with the Team's evaluation and consensus of which of the candidate practices constitute best practices. The information and sources employed by the Team in the discussion and evaluation of the specific practices are listed or referenced.

Section 4.6 lists issues related to best practices that the Team identified and how these issues were resolved. Also listed are issues that the Team identified that were referred to other Task Teams because they were outside the scope of locating and marking best practices.

Finally, the chapter briefly describes potential approaches for measuring the improvement that might result from wider employment of the locating and marking best practices identified by the Task Team consensus and lists suggestions for activities to be carried out following completion of the Best Practices Report.

### **4.3 TEAM MEMBERS**

The Locating and Marking Task Team included representatives from a wide spectrum of organizations involved in the prevention of damage to underground facilities. Industry segments that were represented on the Team included gas and liquid pipeline, electric, and telecommunications facility owners/operators; excavating contractors; locating companies; one-call centers; state regulatory agencies; railroads; and locating equipment vendors. Team members solicited opinions from their affiliated or sponsoring organizations, bringing diverse points of view to the discussions and evaluations in the Task Team meetings and in the background material used to support the evaluations.

Task Team members and their organizations are listed below. A brief biographical sketch of each Team member, that serves to validate their participation in the Study effort, is included in Appendix F, "Common Ground Study Team Member Biographies."

<b>Team Member</b>	<b>Representing<sup>10</sup></b>	<b>Employer</b>
L. Bradford Barringer	AGC	BRS, Incorporated
Ronald J. Boes	Gas Utilities	Indiana Gas
Dan Bradley, Co-Chairperson	NULCA	STS, Incorporated
Randy Burke, Co-Chairperson	API	Chevron Pipe Line Company
Rod Elms		UTI
Aydren D. Flowers	State Regulators	NC Dept. of Transportation
Bobby Haney	AGA	Reliant Energy-ENTEX
Kelly Hardy	OCSI	Utilities Protection Center, Inc. of Georgia
Tom Jackson	Electric Utilities	GA Power
Orlando Jerez	State Regulators	Utah Dept. of Transportation
Dan Knight	NTDPC	U S West
Keith G. Leewis	INGAA	Gas Research Institute
Joe Maresca		Vista Research, Incorporated
Gary L. McKay	Electric Utilities	Detroit Edison
Charles E. Moore	AGA	ENTEX
Bob Nighswonger		Utility Technical Services
Jerry Palmer	NULCA	RadioDetection Corporation
James Pfeiffer	NULCA	Sub-Site
Leroy Schoon	AGC	Schoon Construction, Inc.
Greg Strudwick	NUCA	Line One, Inc
Steven T. Theis	NUCA	Henkels & McCoy Contractors, Inc.
Buddy Waugh	NTDPC	GTE Network Services
Lynn Whitford	DOT	OK Dept. of Transportation
Henry Wyche	AAR	Norfolk Southern Corporation

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<sup>10</sup> See Appendix D for a detailed list of acronyms.

Others that participated in the Task Team’s discussions but did not participate in the consensus decision process include:

<b>Team Participant</b>	<b>Representing</b>	<b>Employer</b>
Mike McDonald, Linking Team Liaison	EEI/AEI	Arizona Public Service
Guy (Skip) McIntosh, Linking Team Liaison	NULCA	Byers Locate Services, LLC
John Walko, Steering Team Liaison	NULCA	Excavac Corporation

#### **4.4 BEST PRACTICE IDENTIFICATION AND EVALUATION PROCESS**

The Task Team compiled a list of candidate best practices at the initial Task Team meeting. Additional practices were added to this list as new members joined the team and as members received input from their constituent organizations. Team members that were unable to attend meetings submitted candidate practices in writing via fax or E-mail.

In the course of discussions at Task Team meetings, the Team identified issues related to locating and marking and other areas of underground damage prevention. The issues were addressed according to the following steps:

1. If the issue was related to locating and marking, then the list of candidate best practices compiled by the team was reviewed to determine if the issue was addressed by one of the practices on the list.
2. If a locating and marking issue was not addressed by a candidate best practice, then the Team defined a candidate best practice to address the issue.
3. If a locating and marking issue was addressed by a candidate best practice already on the Task Team list, then no further action was taken.
4. If the issue was primarily related to another area of damage prevention, then the issue was referred to the specific Task Team that focused on that area. Communication with the relevant Task Team was carried out by documenting the referred issues in the Locating and Marking Team meeting summaries and by the Locating and Marking Team’s Linking Team liaison.

Following the initial identification of practices and evaluation of issues, the candidate best practices were assigned to team members who served as practice advocates. The practice advocates were responsible for preparing material to support the selection of best practices. This material was distributed to the Task

Team and served as the basis for the discussion and evaluation of the practices. The candidate practices were evaluated according to the following selection criteria:

1. Probability of Damage Reduction - Does performance of the practice reduce the probability of damage to underground facilities during excavation?
2. Feasibility - Is performance of the practice feasible from a cost and technological standpoint?
3. Public Safety - Does performance of the practice promote the safety of the public?
4. Employee Safety - Does performance of the practice promote the safety of locator and excavator personnel?
5. Conformance with Existing Standards - Is the practice compatible with standards that have been established for the locating process?

Initially, group consensus was reached on seven best practices on the basis of the material already developed by the practice advocates. Provisional group consensus was reached on an additional ten best practices; however, further work was considered necessary on the definitions and descriptions of these practices in order for the provisional consensus to be maintained. Additional descriptive material was developed by the practice advocates and was subsequently reviewed by the Task Team. This review resulted in changes to the definition and description of the best practices to preserve the group consensus.

## **4.5 FINDINGS**

### **4.5.1 Consensus Best Practices**

The following sections present the best practices selected by Task Team consensus. Each practice is defined and the evaluation of the practices according to the Team's selection criteria is presented.

1. Locators utilize available facility records at all times.
2. If a facility locator becomes aware of an error or omission, then the facility locator provides information for updating records that are in error or to add new facilities.
3. A uniform color code and set of marking symbols is adopted nationwide.
4. A single locator is used for multiple facilities.
5. Locators are properly trained. Locator training is documented.
6. Locates are performed safely.
7. A visual inspection is completed during the facility locating process.
8. Facilities are adequately marked for conditions
9. Positive response is provided to facility locate requests.
10. Multiple facilities in the same trench are marked individually and with corridor markers.
11. Information on abandoned facilities is provided when possible.

12. When locating electro-magnetically, active/conductive locating is preferable to passive/inductive locating.
13. The facility owner/operator is identified.
14. Communication is established between all parties.
15. Documentation of work performed on a locate is maintained.
16. A damaged facility is investigated as soon as possible after occurrence of damage.
17. Forecasting/Planning for Predictable Workload Fluctuations. A plan is developed for dealing with unpredictable fluctuations.

**1. Locators utilize available facility records at all times.**

**Practice Description:** Facility locators use available records at all times. Facility records indicate approximate location, number of facilities and access points for buried facilities within a requested area. The use of facility owner/operator supplied records is an effective method of identifying facilities as part of the locating process.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: High.
2. Feasibility (cost): Cost will be minimal, limited to providing records to field personnel.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: Meets current accepted industry standards.

**2. If a facility locator becomes aware of an error or omission, then the facility locator provides information for updating records that are in error or to add new facilities.**

**Practice Description:** During the course of a locating activity, a locator may become aware of errors or omissions. Methods are in place to notify a facility owner/operator of that error or omission. The corrections are submitted to the appropriate person or department in a timely manner. The method of notification is determined by the facility owner/operator and includes the following information:

- Name (and company if contracted),
- Contact phone number of the individual(s) submitting change,
- Location (either address or reference points),
- Size and type of facility,
- Nature of the error or omission, and
- Sketch of the change in relation to the other facilities.

Omissions and errors may occur due to misdrawn records, changes during construction at the job site, repair or abandonment of facilities and delays in posting new records. Failure to note errors or omissions when found could result in damages to the facility at a later date.

The 1994 NTSB Excavation Damage Prevention Workshop stated: “facility operators should be required to update maps when excavation finds errors in the mapping system.”<sup>11</sup>

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes.
2. Feasibility (cost), where technologically feasible: Minimal; cost of manpower to review and update existing records.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: While not practiced as an industry standard, this would fall under the mandate of state laws requiring accurate records of underground facilities.

**3. A uniform color code and set of marking symbols is adopted nationwide.**

**Practice Description:** A national standard is adopted defining color specifications relevant to facility type. The specifications could be similar to the accepted NULCA<sup>12</sup> or APWA<sup>13</sup> standards. The December 1997 National Transportation Safety Board safety report<sup>14</sup> cites the use of the APWA/ULCC color code as the model example.

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<sup>11</sup> National Transportation Safety Board, 1995. *Proceedings of the Excavation Damage Prevention Workshop; 1994 September 8-9; Washington, DC*, Report of Proceedings NTSB/RP-95/01 (pp.177-178), Washington, DC.

<sup>12</sup> National Utility Locating Contractors Association, 1998. *Underground Facility Marking Standards*, Spooner, WI.

<sup>13</sup> American Public Works Association, 1999. *Guidelines for Uniform Temporary Marking of Underground Facilities*.

<sup>14</sup> National Transportation Safety Board, 1997. *Protecting Public Safety through Excavation Damage Prevention*, Safety Study NTSB/SS-97/01 (pp. 25-26), Washington, DC.

### **Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: High. A national standard alleviates any question of “what stands for what” for excavators working in multiple regions across the country.
2. Feasibility (cost): Minimal. Outside of public awareness education, costs are low. Most states/regions have already adopted the APWA standard.
3. Public Safety: Yes. A national standard would reduce errors associated with misinterpreting locate marks.
4. Employee Safety: Yes - indirectly. Proper interpretation of locate marks will result in a safer job site.
5. Conformity to Existing Practices: Yes. The color codes of the APWA/ULCC are widely accepted as the industry standard.

#### **4. A single locator is used for multiple facilities.**

**Practice Description:** This practice is employed when determined to be advantageous by the facility owner/operator. The use of a single locator to mark multiple facilities may provide several advantages to both the facility and the excavating communities. Among these advantages are:

- more responsive service to the excavation community,
- better communication with the excavating community (fewer points of contact),
- improved safety due to less traffic on the road,
- improved worker safety,
- reduced environmental impact, and
- maps of multiple facilities.

It should be noted that this best practice does not suggest that all facilities be located by a single locator, but rather that conditions exist in which locating multiple facilities with a single locator will reduce the likelihood of errors and resulting damage (e.g., multiple facilities with the same owner or multiple facilities that are marked with the same or similar color codes). This practice has been employed by a facility owner in Michigan to enhance safety.

The use of a single locator to locate multiple facilities is analogous to the use of one-call systems to handle locate requests from excavators. The use of a one-call system allows locate requests for multiple facilities at an excavation site to be issued through a single point of contact, simplifying communications. The use of a single locator to carry out locate requests for multiple facilities further simplifies communications, with fewer links needed between excavator and locator.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes.
2. Feasibility (cost): Lower administration, operating and exposure costs.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: Increasingly becoming the standard in practice around the industry.

**5. Locators are properly trained. Locator training is documented.**

**Practice Description:** Minimum training guidelines and practices are adopted for locator training. These guidelines and practices include the following:

- Understanding System Design/Prints/Technology
- Understanding Construction Standards and Practices for all Types of Facilities
- Equipment Training and Techniques
- Plant Recognition Training
- Theory of Locating
- Daily Operations
- Facility Owner/Excavator Relationships and Image
- Safety Procedures Per OSHA Regulations/Federal, State and Local Laws
- Written and Field Testing
- Field Training
- Annual Retesting.

The NULCA *Locator Training Standards and Practices*<sup>15</sup> represent an accepted model within the locate industry.

Documentation of all training is maintained to ensure that facility locators have been properly trained.

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<sup>15</sup> National Utility Locating Contractors Association, 1996. *Locator Training Standards and Practices*, Spooner, WI.

### Evaluation According to Selection Criteria:

1. Probability of Damage Reduction: Yes. Locating by a knowledgeable and well trained locator is less likely to lead to errors. Fewer errors, in turn, results in a lower likelihood of damages.
2. Feasibility (cost): Implementation of an effective training program; including trainers, materials and testing costs.
3. Public Safety: Yes.
4. Employee Safety: Yes, locators trained in current federal, state and local safety regulations would have a reduced risk of injury.
5. Conformance with Existing Standards: Yes, NULCA and industry standards.

## 6. Locates are performed safely.

**Practice Description:** It is the responsibility of the owner/operator and locator to establish when and how the underground facility will be identified. All hazards associated with a performing a locate are identified. Appropriate measures conforming to federal, state, local and industry standards are established. Employees are made aware of these hazards and properly trained in worker safety standards.

### A. Pre-Work Safety Considerations

1. Site Background Data. Site information is gathered to determine hazards, exposures, and/or other potential safety problems that might be encountered in connection with on-site locate work. This information may be gathered from the facility records and from visual inspection.
2. Site Familiarization. Site characteristics which could affect locate work are analyzed. Areas to be considered include:
  - a. Obstructions. The site is analyzed to determine if physical obstructions are present on the property which would make locate work unsafe. Means for working around such obstructions are defined.
  - b. Traffic. Vehicular arteries (highways, roadways, railways, etc.) at the work site are identified to determine if such traffic would pose any safety hazard to locating the site.
  - c. Physical Site Conditions. Soil conditions and other factors (such as trenches, pits, bores, standing water, etc.) that could affect the safety of the job site are identified. Methods are developed to identify and safely work around these hazards.
3. External Resources. Information is gathered about safety-related resources that might be required in the event of an accident or other problem (such as an employee illness). Information needed includes location and contact information

for nearest hospital, fire department, police department, and any other public emergency response organization. In addition, access routes and travels plans to emergency response facilities are defined.

4. Work Plan. A work plan in which procedures, employee roles, equipment requirements, time requirements, and other factors are considered is developed to define the most efficient means for safely accomplishing required locate work. This work plan considers all of the safety related information developed in connection with items #2 and #3.
5. Job Briefing. Information developed as discussed in preceding items #1 through #4 is used to conduct a job briefing prior to commencement of on site locate work. The job briefing focuses on safety aspects of the required work.

B. Locate Work Safety Considerations

1. Personnel Protection. Watchman/lookout capabilities are provided to ensure the safety of personnel in cases where locate work requires that working individuals disrupt traffic flow or otherwise occupy hazardous positions. All working individuals wear proper safety attire. Such attire provides for adequate visibility of the worker and personal protection against hazards.
2. Equipment. All equipment used in connection with locate work is suitable for the intended uses. Items such as ladders, electrical test devices, and other instruments and items are inspected from a safety perspective prior to use. Safety features such as locking devices, grounding, insulation, etc., are thoroughly inspected.
3. Exposures. In cases where locate work requires personnel to enter into spaces with potentially unsafe conditions, appropriate testing is accomplished prior to entry. During times when such spaces are occupied, adequate monitoring and/or ventilation devices are present and properly operating during occupancy.
4. Work Activities. All locate work activities are conducted with safety given first priority. All employees are thoroughly trained and briefed regarding safety measures such as minimizing exposures to potentially hazardous conditions, avoiding unnecessary risks, and giving priority to personal safety.

C. Post Work Safety Considerations

1. Termination of Work Activities. After locate work is completed, the site is restored and left in such a condition that no safety hazards associated with the locate work activities remain. All personnel and equipment utilized in connection with the work are accounted for and no unsafe conditions remain at the site. Any safety-related equipment used in connection with the work is returned/restored to pre-work status.
2. Debriefing. After completion of locate work, a debriefing safety review of work activities is conducted. This review is conducted with the objective of looking at the safety aspects of all involved work practices as necessary to see where unnecessary exposures may have occurred and where improvements could be made.

**Evaluation According to Selection Criteria:**

1. Probability of damage reduction: Minimal.
2. Feasibility (cost): Minimal - Included in employee training.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with existing standards: Meets current industry standards.

7. **A visual inspection is completed during the facility locating process.**

**Practice Description:** This inspection includes the following:

- all facilities within a facility owner/operator's service area (to evaluate the scope of the locate request),
- identification of access points,
- identification of potential hazards, and
- assurance that plant facilities shown on records match those of the site.

The primary reason for a visual inspection is to determine if there are facilities placed that are not on record. It is very important that visual inspections be completed in areas of new construction, where records may not indicate the presence of a facility. The visual inspection is necessary because the time it takes for a facility placed in the field to be placed on permanent records varies by facility owner/operator and location. Evidence of a facility not on record includes, but is not limited to, poles, dips, enclosures, pedestals (including new cables found within the pedestals), valves, meters, risers, and manholes.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes.
2. Feasibility (cost): Minimal.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: No standard set.

**8. Facilities are adequately marked for conditions.**

**Practice Description:** Facility locators match markings to the existing and expected surface conditions. Markings may include one or any combination of the following: paint, chalk, flags, stakes, brushes or offsets. All marks extend a reasonable distance beyond the bounds of the requested area.

Proper training for all facility locators includes properly identifying the varying surface and environmental conditions that exist in the field and what marking methods should be used. Conditions which may affect markings are rain, snow, vegetation, high traffic, construction, etc.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes.
2. Feasibility (cost): Cost to mark facilities will increase. However, this will be offset by the reduction in damages and in the reduction in return trips to the job site due to destroyed marks.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: Conforms to existing NULCA Standards and accepted industry standards.

**9. Positive response is provided to facility locate requests.**

**Practice Description:** All facility locate requests result in a positive response from the facility owner/operator to the excavator. A positive response may include one or more of the following: markings or documentation left at the job site, callback, fax, or automated response system.

A positive response allows the excavator to know whether all facility owners/operators have marked the requested area prior to the beginning of the excavation.

### **Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes. Any establishment or relaying of information between a locator and an excavator lessens the chances for miscommunication and, subsequently, lessens potential facility damages.
2. Feasibility (cost): The method of providing positive response may be established to be cost-effective for the specific situation involved in the locate request.
3. Public Safety: Yes. Any open lines of communication between an excavator and a locator should result in less potential for facility damages, ensuring an increased level of public safety.
4. Employee Safety: Unknown. While no direct result on a locator's level of job safety can be seen, it does not adversely affect their working environment.
5. Conformance with Existing Standards: Yes. Most states have implemented positive response systems and have made their use mandatory through legislation.

### **10. Multiple facilities in the same trench are marked individually and with corridor markers.**

**Practice Description:** In general, the number of lines marked on the surface equal the number of lines buried below. “All facilities within the same trench should be individually marked and identified. In situations where two facilities share the same color code (such as telephone and CATV) both facilities should be identified and the marks placed parallel, but with enough separation so that they may be readily identified.”<sup>16</sup> In circumstances where the total number of lines buried in the same trench by a single facility owner/operator may not be readily known, a corridor marker is used. The corridor mark indicates the width of the facility.

### **Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes, a standard for marking multiple facilities in the same trench will help eliminate excavator confusion and lessen the chances of a facility damage.
2. Feasibility (cost): Nominal.
3. Public Safety: Yes. Improved awareness of what is below the surface will reduce damages and increase public safety.
4. Employee Safety: No effect seen on employee safety.
5. Conformance with Existing Standards: Yes. Many states have adopted some method of identifying multiple facilities in the same trench.

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<sup>16</sup> National Utility Locating Contractors Association, 1998. *Underground Facility Marking Standards*, Spooner, WI.

**11. Information on abandoned facilities is provided when possible.**

**Practice Description:** When the presence of an abandoned facility within an excavation site is known, an attempt is made to locate and mark the abandoned facility. When located or exposed, all abandoned facilities are treated as live facilities. Information regarding the presence or location of an abandoned facility may not be available because of updating or deletion of records. In addition, the process of abandoning an existing facility, damage to an abandoned facility, or limited or non-existing access points may render an abandoned line non-locatable.

It should be emphasized that recommendation of this practice is *not* an endorsement of the maintenance of records for abandoned facilities.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes. The more facilities located, whether abandoned or not, lessens the chances of live facilities being damaged.
2. Feasibility (cost): Slight additional cost, offset by reduced damages and responses to damaged abandoned lines by repair crews.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: Yes. Many states already require the location of abandoned facilities.

**12. When locating electro-magnetically, active/conductive locating is preferable to passive/inductive locating.**

**Practice Description:** The preferred method of actively applying a signal onto a facility is to use direct connection. Direct connection is the process of connecting a direct lead from the transmitter to the target facility, and connecting a ground lead from the transmitter to a ground point in order to complete a circuit. This process provides the strongest signal on the line and is less likely to “bleed over” to adjacent facilities than other methods of applying a signal. This method allows a greater range of frequency and power output options. It is good practice to use the lowest frequency possible at the lowest power output possible to complete the locate.

If direct connection is not possible, use of an induction clamp (coupler) is the most effective method of applying a locate signal onto the target conductor. This method is more limiting for the choices of frequency and power outputs than direct connection. Using an induction clamp is not as effective at transmitting a signal as direct connection, can only be used within certain frequency ranges, and must use a higher power output.

The least preferred method is induction or broadcast mode on a transmitter. This usually results in a weak signal that will “bleed over” to any conductor in the area.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes. Establishing best methods of locating facilities assures greater accuracy and reduced damages.
2. Feasibility (cost): Nominal, possibly additional training of locators.
3. Public Safety: Yes.
4. Employee Safety: Yes. Proper knowledge of how to connect to a facility should reduce the risk of injury.
5. Conformance with Existing Standards: Yes. Conforms to standards and practices within the locate industry and manufactures guidelines.

**13. The facility owner/operator is identified.**

**Practice Description:** When feasible, the owner/operator of a facility is identified by markings at the time the facility is located. This practice facilitates a positive response for all facilities within the requested area.

The NULCA Marking Standards recommends “In situations where two facilities share the same color code (such as telephone or CATV) both facilities should be identified. . . .”<sup>17</sup>

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes. Establishing a positive response avoids confusion with excavator, all of which contributes to damage prevention.
2. Feasibility (cost): Nominal, slight increase in time to identify facility owner.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: Yes. Conforms to standards and practices within the locate industry.

**14. Communication is established between all parties.**

**Practice Description:** One-call centers, facility owners/operators, and excavators all have clearly defined processes to facilitate communication between all parties. If the complexity of a project or its duration is such that a clear and precise understanding of the excavation site is not easily conveyed in writing on a locate request, then a pre-location meeting is scheduled. This pre-location meeting is on-site to establish the scope of the excavation. Written agreements between the excavator(s) and the locator(s) include:

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<sup>17</sup> National Utility Locating Contractors Association, 1998. *Underground Facility Marking Standards*, Spooner, WI.

- date,
- name,
- company,
- contact numbers for all parties,
- a list of the areas to be excavated,
- a schedule for both marking and excavating the areas, and
- any follow up agreements that might be necessary.

Any changes to the areas that are to be located are in writing and include all parties responsible for the excavation and marking of the excavation sites. Locators also schedule meets if the complexity of the markings requires further explanation.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes, better communication will reduce confusion and increase cooperation between excavator and locator.
2. Feasibility (cost): Minimal; additional time spent with excavators may be offset by more even distribution of work on large projects made possible by written agreements.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: Yes, many states already have criteria established for the scheduling of meets prior to locating work areas.

**15. Documentation of work performed on a locate is maintained.**

**Practice Description:** A facility locator always documents what work was completed on a locate request. This assists in the locate process by making a locator review what was located and then verify that all facilities within the requested area were marked. Careful documentation helps ensure that there is an accurate record of the work that was performed by the locator and helps eliminate confusion over what work was requested by the excavator.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes, proper documentation establishes accountability for performing locate work accurately. If locates are accurate, the likelihood of damage is reduced.
2. Feasibility (cost): Minimal; this is currently the practice for most companies.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: Yes, locators generally perform some type of documentation.

**16. A damaged facility is investigated as soon as possible after occurrence of damage.**

**Practice Description:** Any time a damage occurs, a proper investigation is performed. This is to determine not only the responsible party but also the root cause of the damage. The information gathered from damage investigations is essential in preventing future damages.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes, information can be used to help prevent future damages.
2. Feasibility (cost): Minimal. Any cost is offset by the ability to prevent future damages.
3. Public Safety: Yes.
4. Employee Safety: Yes.
5. Conformance with Existing Standards: Yes, most locators and facility owner/operator companies perform damage investigations.

**17. Forecasting/Planning for Predictable Workload Fluctuations. A plan is developed for dealing with unpredictable fluctuations.**

**Practice Description:** Facility owners/operators and/or their representatives develop methods to sufficiently forecast and plan for future workloads in order that ticket requests may be completed in a timely manner. This will ensure that adequate personnel and equipment will be available to complete all locate requests.

It should be noted that this practice does not involve limiting the number of one-call requests from excavators.

**Evaluation According to Selection Criteria:**

1. Probability of Damage Reduction: Yes. The ability to plan for workloads means that potential shortages in equipment and manpower will be avoided and all requested locates can be completed within the prescribed time limit.
2. Feasibility (cost): Minimal (dependent on number of changes); most changes are procedural. Some cost savings may actually be achieved because of better forecasting and manpower utilization.
3. Public Safety: Yes.
4. Employee Safety: Yes. Adequate personnel to cover the workloads means the locators will not be working beyond their normal work hours. This reduces the chances of fatigue and errors.
5. Conformance with Existing Standards: Yes. Many facility owners/operators and locate companies already use forecasting to predict future manpower and equipment needs.

## **4.5.2 Candidate Practices not Adopted by Consensus**

The Task Team discussed and evaluated twenty-nine candidate best practices. Seventeen practices were designated best practices by Task Team consensus, as noted above. Four practices were combined with others in the consensus best practice list. The Team did not reach consensus that the remaining eight candidates were Locating and Marking best practices. In some of these cases, the Team concluded that the practice was more appropriate for consideration by one or more of the other Task Teams. The eight practices that did not receive Team consensus are listed below. The Team recommended these practices should be considered by a different Task Team(s). The recommended Task Team(s) to consider the practice is indicated in parentheses:

1. Mark new facilities at time of installation/construction (Excavation, Mapping);
2. Adequate hand-dig buffer zone (Excavation, Compliance);
3. Potholing when necessary (Excavation);
4. Definite size of locate request (One-Call);
5. Utilizing best available technology (e.g., locating instruments, vacuum excavating equipment, ticket tracking and management software) (Emerging Technologies);
6. Drug testing of employees (Compliance);
7. Identify facilities installed using directional boring; accurate records of type of installation (Excavation, Planning and Design, Mapping); and
8. Permanent markers (Planning and Design).

## **4.6 TASK TEAM ISSUES**

The process followed by the Task Team for identifying Locating and Marking best practices, as described in Section 4.4, included the consideration of issues at Task Team meetings. The Team determined that the following issues were either addressed by a candidate locating and marking best practice or could not be addressed by a current practice.

1. Conflicting state laws,
2. Unlocatable facilities (depth),
3. Inaccurate or no records,
4. Common grounding,
5. Fluctuating workloads,
6. Locating for design/engineering,
7. Maintenance of marks,
8. Determining life of marks,
9. Reporting depth,
10. Facilities installed with directional boring, and
11. Marking/removal of marks after damage.

In addition, the Team identified issues related to damage prevention that were more pertinent to one of the other Task Team focus areas, rather than locating and marking. Those issues are listed below, along with the Task Team(s) they relate to.

1. Lag time between construction and mapping (Mapping),
2. Facility owners/operators area definition (Mapping and One-Call),
3. Workload fluctuations (One-Call),
4. Limit to size of locate request (One-Call),
5. White-lining (Excavation),
6. Locate request clarity/standardization (One-Call),
7. Overlapping one-call center coverage (One-Call),
8. Establish plan for facility protection during construction (Planning and Design),
9. Avoid excessive depth (Planning and Design, Excavation),
10. Excavators should report to facility owners/operators any errors found in records and any new facilities (Excavation), and
11. Records need to be updated if errors are found by locators or excavators (Reporting and Evaluation, Compliance).

## **4.7 MEASURING IMPROVEMENTS**

To measure whether the best practices result in improvements, baseline statistics should be established. These baseline statistics could then be compared to changes that may occur over time as these best practices are implemented. Once a standard set of reference data has been established, methods should be in place to track, store, and report data in a useful and timely manner. All data should be reviewed at regular intervals to determine whether improvements have resulted from the best practices and, if possible, identify which best practices were most effective. These statistics could be found within the DOT, one-call centers, trade organizations, facility owner/operator company published statistics, and industry research groups.

Data that could be used for the baseline statistics and for tracking over time includes:

- U.S. Department of Transportation, Research and Special Programs Administration, Office of Pipeline Safety (damages to pipeline systems);
- Network Reliability Steering Committee (damages to fiber optic/carrier cables);
- Federal Aviation Administration (damages to air traffic control system communications cables);
- Bellcore (damages to fiber optic and carrier cables);
- One-call centers (complaints from excavators and facility owners/operators; number of recalls);
- Gas Research Institute (damages to pipeline systems); and
- Insurance Industry Data Bases (damages to gas, water, electrical, and communications systems).

## **4.8 PATH FORWARD**

The Task Team reached consensus that the following actions could be important to further promote the prevention of damage to underground facilities. Unlike the best practices included in Section 4.5, the following actions are not necessarily current practices. They represent the Task Team’s suggestions for desirable future actions.

1. It is important for the Task Team to maintain involvement to preserve the integrity and intent of this Locating and Marking chapter of the Best Practices Report.
2. Continue development and commercialization of locating technology, improving accuracy, including depth (e.g., GPR, Defense Department imaging technology, GPS).
3. Develop grants dedicated to the improvement of locating technology.
4. Improve the accuracy of records, including the use of:
  - A common data base,
  - GPS, and
  - other evolving technologies.
5. Improve the accuracy of information provided on a locate request, including the use of:
  - A common data base,
  - GPS, and
  - other evolving technologies.
6. Establish a real-time link between excavator and specific locator (e.g., radio, cell phone).
7. Develop an automated system for providing information to facility owners/operators to correct errors or omissions in facility records.
8. Promote the development and use of biodegradable marking flags and paint.
9. Promote the development and use of intelligent marking systems for underground facilities.
10. Develop and apply methods for identifying unknown infrastructure.
11. Automate documentation of locate performed (e.g., using GPS).
12. Encourage the formation of “Utility Coordinating Committees,” “Damage Prevention Committees,” etc., to improve communications among stakeholders.
13. Tie due dates for completing locates to the actual excavation start date.

## **4.9 ACKNOWLEDGMENTS**

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