United States Department of Agriculture
Natural Resources Conservation Service
MLRA Region 9
Temple, Texas 76501

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EXCAVATION AND PIT SAFETY PROGRAM

1. **PURPOSE**.

   a. To provide Natural Resources Conservation Service (NRCS), cooperators, and contractor personnel with guidance and an overview of the Occupational Safety and Health Administration (OSHA) excavation program requirements.

   b. To establish the policy on excavations at NRCS MLRA Region 9.

   c. To establish the training requirements for the competent person at excavation sites.

2. **APPLICABILITY**. This memorandum is for all NRCS, university, volunteer, and contractor personnel assigned to sample or examine soils in excavations.

3. **REFERENCES**.

   a. OSHA Standard 29 CFR, § 1926 (subpart P), Excavations.
   (available at website http://www.osha.gov under Laws and Regulations/Standards)

4. **EXPLANATION OF TERMS**. Explanation of terms is outlined in Appendix A.

5. **POLICY.**

   a. A competent person will be placed in charge of all excavations. Because conditions can change very quickly, the competent person will be present whenever workers are in an excavation.

   b. Underground utilities must be located and marked before excavations begin. At least 2 working days ahead register online at http://ontry.1-call.com/ (preferred) or call 811 or 1-800-DIG-TESS. Keep all emails/documentation of registration for a minimum of 1 year.

   c. Employees are not allowed in the excavation while heavy equipment is digging.

   d. For excavations less than 4 feet in depth specific requirements do not exist, however, many of the principles contained herein should be followed to ensure the safety of the employees.

   e. For excavations more than 4 feet in depth, a trench inspection checklist will be filled out. (See Appendix B.) Additional controls are not necessary if the competent person determines that there is no potential for cave-in.

   f. For excavations more than 5 feet in depth, the trench inspection checklist will be filled out (Appendix B), and the guidance given in 29 CFR 1926, subpart P, will be followed.

g. If the excavation is more than 20 feet in depth or if there is any deviation from the 29 CFR 1926, subpart P, an engineering design must be completed, and signed by a registered professional engineer. Normally most soil sample pits will be 7 feet or less in depth.

h. Most excavations performed by NRCS will be conducted in order to collect soil samples in soil that has never been disturbed. Excavations will be classified as Stable Rock, Type A, Type B, or Type C soils according to the OSHA classification.

6. **BACKGROUND.**

a. Excavation cave-ins are one of the leading causes of death in the construction industry, with about 100 people dying each year. Although accurate figures are difficult to obtain, mainly due to reporting discrepancies on death certificates (i.e., a worker trapped under water in an excavation may be listed as a drowning victim), it should be noted that Texas leads the nation in excavation fatalities.

Our agency is not immune to these types of accidents. A 1995 accident at Crowley, LA killed a NRCS technician as he attempted to rescue a landowner who was trapped by a cave-in. While in the trench, a large piece of spoil fell on him breaking his neck and trapping him also. The investigation which followed disclosed that he would have probably survived if he had been wearing a hard hat.

b. Ignorance, poor judgment, and poor attitudes regarding excavation safety are the leading causes of cave-in fatalities. Often individuals are not only ignorant of the applicability of OSHA standards, but may simply not be aware of the extreme danger they face entering unprotected excavations. Most excavations do not kill or seriously injure people; therefore, workers tend to acquire a false sense of security and a false sense of authority regarding safety issues. Statistics indicate that 9 out of 10 people covered with soil in cave-ins will die. Compliance with the OSHA standard is often bypassed due to time constraints with individuals inclined to cut corners, belief that compliance is unnecessary, or expectation that short-term operations will go undetected.

c. Good intentions do not prevent safety accidents or fatalities. The solution lies in training competent workers, incorporating safety into the thought process and practices, providing and enforcing the use of required equipment, and ensuring compliance with applicable rules, policies, and standards.

7. **RESPONSIBILITIES**.

a. The State Safety Officer in Temple will:

(1) Serve as the proponent for the excavation safety program.

(2) Assist in the training and qualification of NRCS competent person(s).

(3) Maintain a record of competent person training conducted for employees.

b. MLRA Leader, Region 9/State Soil Scientist who performs excavations will:

(1) Provide resources to procure equipment required for shoring, shielding, or sloping operations and other safety equipment where excavations are performed.

(2) Provide resources for training the competent person(s).

(3) Report all incidents involving excavations to State Safety Officer.

(4) Establish local procedures for excavations.

c. Supervisory Soil Scientists will:

(1) Ensure only trained, competent individuals are assigned the duties of a competent person at excavation operations.

(2) Enforce excavation policies and procedures along with the competent person.

d. The "competent person" will enforce all local policies and procedures as stated in the OSHA standard, and ensure compliance with 29 CFR 1926, subpart P (copy at jobsite). An excavation checklist (Appendix B) will be filled out before sampling. The competent person will also conduct inspections:

(1) Before any soil sampling is done and also daily if pit is left open for several days.

(2) As dictated by work being done in the trench.

(3) After each rain storm or other event that could increase hazards, such as a windstorm, earthquake, dramatic change in weather, etc.

(4) When there is bulging at the bottom, fissures, tension cracks, sloughing, undercutting, water seepage, or similar conditions occur.

(5) When there is a change of size, location, or placement of the spoil pile.

(6) When there is any indication of change or movement in adjacent structures.

e. The competent person in charge of the excavation will be responsible for determining whether the site is Stable Rock or soil is Type A, B, or C. Where soils are configured in layers, the soils will be classified on the basis of the weakest layer. Each layer may be classified individually if a more stable layer lies below a less stable layer, i.e., Type C soil resting on top of stable rock. Soil type can change during excavation, i.e., adding water to Type B, will change soil classification to Type C.

f. The competent person will conduct a visual test with one or more manual tests of the soil prior to and during excavation. In addition, the competent person will perform a visual test to evaluate conditions around the entire site, to include soil adjacent to excavation, any signs of vibration in the area, or any other type of workers or moving equipment in the area.

g. The competent person will have a complete and current copy of 29 CFR 1926, subpart P, and this memorandum at the job site, while work is in progress.

8. **TRAINING**.

a. The supervisor must determine excavation requirements and personnel qualifications for soil sampling operations and request training needs.

b. Training for the competent person will consist of a minimum of the following:

(1) Attending an 8 hour OSHA approved excavation safety course.

c. Individuals expected to enter excavations will follow all directions given by the competent person. The competent person will brief everyone at the jobsite about safety concerns.

d. Training will be documented on SF-182 which is placed in the National Finance Center training database, Individual Development Plan, and in the Soils Training Database.

9. **OPERATING PROCEDURES**.

a. Soil tests will be performed by the competent person in charge of the excavation using a visual test, coupled with one or more manual tests.

b. The visual test method requires the competent person to perform a physical observation of the entire excavation site, including the soil adjacent to the site, and the soil being excavated. A visual check will also be performed for any evidence of vibration in the vicinity. The competent person will:

(1) Check for crack-line openings along the failure zone that would indicate tension cracks.

(2) Check areas adjacent to the excavation for signs of other intrusions into the failure zone.

(3) Identify existing utilities.

(4) Observe the open side of the excavation for indicators of layered soil/geologic structuring.

(5) Look for signs of bulging, boiling or sloughing, as well as for signs of surface water seeping from the sides of the excavation or from the water table.

(6) Check for surcharging load limit and the spoil distance from the edge of the excavation.

c. Manual test methods

(1) Thumb penetration test. Attempt to press the thumb firmly into the soil in question. If soil can be penetrated by thumb only with great effort, it is normally Type A. If the thumb penetrates no further than the length of the nail, it is normally Type B soil. If the thumb penetrates the full length of the thumb, it is Type C soil. It should be noted that the thumb penetration is the least accurate.

(2) Dry strength test. Take a dry soil sample, if it crumbles freely or with moderate pressure into individual grains it is considered granular (Type C). If the dry soil falls into clumps, which in turn can be broken into smaller clumps, and these smaller clumps can only be broken with difficulty, it is probably clay in combination with gravel, sand or silt (Type B)

(3) Plasticity or wet thread test. Take a moist sample of soil. Mold it into a thin thread, approximately 1/8 inch in diameter by 2 inches in length, if the soil does not break when held by one end, it may be considered Type B.

(4) A pocket penetrometer or shearvane may also be used to determine the unconfined compression strength of soils.

d. Spoils (excavated material).

(1) Temporary spoils:

(a) Will be placed no closer than 2 feet from the surface edge of the excavation, measured from the nearest base of the spoil to the cut. Further distance may be required, depending on the type of material, to ensure that the temporary spoils do not fall onto the employees in the excavation.

(b) Will be placed so that it cannot accidentally run, slide or fall back into the excavation.

(2) Permanent spoils will be placed some distance from the excavation. The exact distance will be determined by the competent person.

e. Rainwater or other run-off water will be directed away from the excavation.

f. Surface crossing of trenches will not be made unless absolutely necessary. If necessary, they are permitted under the following conditions:

(1) Vehicle crossings must be designed by and installed under the supervision of a registered professional engineer.

(2) Walkways or bridges must:

(a) Have a minimum clear width of 20 inches.

(b) Be fitted with standard top and mid-rails and toe boards.

(c) Extend a minimum of 24 inches past the surface edge of the trench.

g. Ingress/egress.

(1) Trenches 4 feet or more in depth will be provided with a fixed means of ingress/egress. All sample excavations will have ramp dug at an angle that is easily traversed.

(2) If ladders are used (or other means of egress), spacing must be in such a manner that a worker does not have to travel more than 25 feet laterally to the nearest means of egress once inside the excavation.

(3) Ladders must be secure, and extend a minimum of 36 inches above the landing. Use caution if using metal ladders when electric utilities are present.

h. Employees exposed to vehicular traffic are required to wear reflective vests or other suitable garment marked with or made of reflecting or high-visibility materials.

i. Exposure to falling loads.

(1) All employees on an excavation site will wear hard hats.

(2) At no time will employees be allowed to work under raised loads, nor will employees be allowed to work under loads being lifted or moved by heavy equipment used for digging or lifting.

(3) Employees are required to stand away from any equipment that is being loaded/unloaded to avoid being struck by falling material or spillage.

j. Mobile equipment warning systems. The following measures will be implemented to prevent vehicles or animals from accidentally falling into the trench:

(1) Barricades will be installed, as necessary.

(2) Stop logs (chock barriers) will be installed if there is danger of vehicles falling into the trench.

(3) Soil will be graded away from the excavation in order to assist in channeling of run-off water if excavation is to be left open several days.

(4) Trenches will be fenced and barricaded if left open overnight.

k. Atmospheric conditions and confined spaces.

(1) Employees will not be permitted to work in hazardous and/or toxic atmospheres. Soil sampling operations rarely, if ever, will encounter these conditions. These conditions include:

(a) Less than 19.5 percent oxygen or exhaust fumes from nearby running engines are entering excavation.

(b) A combustible gas concentration greater than 10 percent of the lower explosive limit (LEL).

(c) Concentrations of hazardous substances that exceed those specified in the OSHA standard.

(2) Any such operations will be conducted in accordance with all OSHA requirements for occupational health and environmental controls for personal protective equipment and lifesaving equipment. Job hazard evaluations will be implemented to ensure any required controls, i.e., ventilation or respiratory equipment to be provided. If the trench qualifies for classification as a confined space, entry will be in compliance with OSHA standards.

(3) If the potential for a hazardous atmosphere is present, i.e., excavations near landfills or excavations adjacent to hazardous materials/pipelines (natural gas), atmospheric testing will be accomplished prior to entry.

(4) Testing frequency.

(a) Testing will be conducted before employees enter the excavation.

(b) Testing will be performed at regular intervals to ensure that the excavation remains safe.

(c) Testing will be increased if gas combustion equipment is operating in the trench.

(5) Employees required to wear respiratory protection will be trained, fit-tested and enrolled in a respiratory protection program prior to wearing a respirator.

l. Standing water and water accumulation.

(1) In general, employees will not be allowed to enter trenches that have significant accumulation of water. An exception can be made only after coordination and approval of the competent person.

(2) Water removal equipment will be used and monitored by a competent person.

(3) Employees will be removed from the trench during rainstorms.

(4) Trenches will be carefully inspected by a competent person after each rain, and before employees are permitted to re-enter the trench.

m. Benching, sloping, shoring, and shielding.

(1) Excavations performed at NRCS will be accomplished using OSHA standards as set forth in this memorandum.

(2) Sloping. (not normally used for soil sampling)

(a) Maximum allowable slopes for excavations less than 20 feet deep based on soil type and angle to the horizontal are as follows:

Soil Type	Height/Depth Ratio	Slope Angle
Stable Rock	Vertical	90 degrees
Type A	3/4:1	53 degrees
Type B	1:1	45 degrees
Type C	1 1/2: 1	34 degrees

(b) For example, a 10 feet deep trench in Type B soil would be sloped to a 45 degree angle -- 10 feet back in both directions. Total distance across a 10 feet deep trench would be 20 feet, plus the width of the bottom of the trench itself. In Type C soil, the trench would be sloped at a 34 degree angle 15 feet back in both directions, for at least 30 feet across, plus the width of the bottom of the trench itself.

(3) Benching. (not normally used for soil sampling)
There are two basic types of benching, single and multiple, which can be used in conjunction with sloping. Benching is not allowed in Type C soil.

(a) In Type B soil, the vertical height of benches must not exceed 4 feet.

(b) Benches must be below the maximum allowable slope for that soil type. For example, a 10 feet deep trench in Type B soil must be benched back 10 feet in each direction, with a maximum of a 45 degree angle.

(4) Shoring. (aluminum hydraulic system used for most soil sampling)
Shoring or shielding is used when location or depth of the cut makes sloping back to the maximum allowable slope impractical. The two basic types are timber and aluminum hydraulic. Due to cost and effort of using lumber, aluminum hydraulic is the preferred method. Hydraulic shoring provides a critical safety advantage over timber because workers do not have to enter the trench to install them. Hydraulic shoring is also light enough to be installed by one worker, they are gauge-regulated to ensure even distribution of pressure along the trench line, and can be adapted easily to various trench depths and widths. If lumber shoring is used, it must meet the requirements set forth in 29 CFR 1926, subpart P.

(a) All shoring will be installed from the top down, and removed from the bottom up.

(b) Hydraulic shoring will be checked for leaking hoses and/or cylinders, broken connections, cracked nipples, bent bases, or any other damage or defective parts. Unserviceable equipment will not be used at any time.

(c) The top cylinder of hydraulic shoring will be no more than 18 inches below the top of the excavation.

(d) The bottom of the cylinder shall be no higher than 4 feet from the bottom of the excavation. Two feet of trench wall may be exposed beneath the bottom of the rail or plywood sheeting, if used.

(e) Two vertical shores, evenly spaced, must be used to form a system. Spacing is dependant on soil type.

(f) Wales, where used, are installed no more than 2 feet from the top, no more than 4 feet from the bottom, and no more than 4 feet apart, vertically.

(g) Hydraulic shoring will be installed per instructions provided with manufacturer’s data sheet.

(5) Shielding. (not used for soil sampling except for unusual reason)
Trench boxes are different from shoring. Instead of supporting the trench face, they are intended primarily to enclose and protect workers from cave-ins.

(a) Excavation areas, between the outside of the trench box and face of the trench must be backfilled, to prevent lateral movement of the box.

(b) Shields (Trench Boxes) may not be subjected to loads exceeding those which the system was designed to withstand.

(c) Shields may be used in combination with sloping and benching.

(d) Shields must extend at least 18 inches above the surrounding area if there is sloping toward the excavation. This can be accomplished by providing a benched area adjacent to the shield.

(e) Any modifications to the shields must be approved by the manufacturer.

(f) Shields may ride above the bottom of an excavation, provided they are calculated to support the full depth of an excavation, and there is no caving under or behind the shield.

(g) Workers must enter and leave the shield in a protected manner, such as a ladder or ramp.

(h) Workers must not remain in shield while it is being moved.

APPENDIX A

EXPLANATION OF TERMS

Aluminum Hydraulic Shoring. An engineering shoring system comprised of aluminum hydraulic cylinders (cross braces), used in conjunction with vertical rails (uprights) or horizontal rails (walers). Such a system is designed specifically to support the sidewalls of an excavation and to prevent cave-ins.

Benching. A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near vertical surfaces between levels.

Cave-in. Separation of mass of soil or rock materials from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Competent Person. One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate those hazards. All competent persons will have and be able to demonstrate the following:

1. Training, experience and knowledge of soil analysis, use of protective systems, and the requirements outlined in 29 CFR 1926, subpart P.

2. Ability to detect conditions that could result in cave-ins, failures in protective systems, hazardous atmospheres, and other hazards, including those associated with confined spaces.

Excavation. Any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal.

Registered Professional Engineer. A person who is registered as a professional engineer in the state where the work is to be performed, or any state if approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

Shield (Shield System or Trench Box). A structure that is able to withstand the forces imposed on it by a cave-in and thereby protects the employees with the structure. Shields can be permanent structure or can be designed to be portable and moved along as work progresses. Also known as trench box or trench shield.

Shoring (Shoring System). A structure such as metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sloping (Sloping System). A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Soil Types:

<u>Type A</u>: Most stable. Clay, silty clay, and hardpan (resists penetration). No soil is Type A if it is fissured, is subject to vibration of any type, has been previously disturbed, or has seeping water.

Type B: Medium stability. Silt, sandy loam to medium clay and unstable dry rock; previously disturbed soils unless otherwise classified as Type C; soils that meet the requirements of Type A soil but are fissured or subject to vibration.

Type C: Least stable. Gravel, loamy sand, soft clay, submerged soil or dense, heavy unstable rock, and soil from which water is freely seeping.

Tabulated Data.   Tables and charts approved by a registered professional engineer used with a protective system. This data is available at the worksite.

Trench (Trench Excavation).   A narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet. If forms or other structures are installed or constructed in an excavation as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet or less, the excavation is also considered to be a trench.

Wales. Horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

APPENDIX C
Soil Mechanics

Soil, for trenching and excavation purposes, is defined as any material to be removed from the ground to form a hole, trench, or cavity for the purpose of working below the earth surface. Soil can be an extremely heavy material, weighing more than l00 pounds per cubic foot (pcf). A cubic yard of soil (3 ft x 3 ft x 3 ft) contains 27 cubic feet of material and could weigh more than 2,700 lbs. This is almost 1 1/2 tons or the equivalent weight of a car in a space less than the size of an average office desk. It is no surprise that the human body cannot support this heavy load without being injured. In addition, wet soil, rocky soil or rock is usually heavier.

Visualize the soil as a series of multiple columns of soil blocks, with the blocks piled one on top of the other. Each soil block weighs approximately 100 lbs and supports the weight of all the blocks above. This means the bottom block supports the vertical weight of itself and the 4 other blocks resting on it with all 500 lbs spread over a one-square-foot area (pcf). The column of soil exerts not only this vertical pressure but the horizontal force in all outward directions. The horizontal force pushing in all directions is half of the 500 lbs - or 250 pcf. Theoretically, as the weight of the column increases, there would be a tendency for the soil to compress and spread outward. However, in undisturbed soil conditions, this process is stopped by the presence of the surrounding columns pushing back with equal pressure. The hypothetical columns pressing against each other help maintain equilibrium.

Trench Failure. When soil has been excavated, this equilibrium no longer exists. The bottom block of soil may no longer be able to support its weight nor the weight of the blocks above it. At this point a wall could shear and break away from its stable position. It should be noted that cave-ins can start anywhere along the wall. Usually the first failure occurs when the bottom of the wall falls into the trench. This creates an undercut area at the base of the trench. This results in a second movement where more of the wall erodes. As the erosion of the base of the trench leaves the column unsupported, more soil is sheared off under its own weight and results in a cave-in. It is at the second and third stage that many would-be rescuers, attempting to save victims, find themselves trapped along with the first victims. Due to the uncertainty of time lapses between failures, time is a major consideration. The longer the trench is unsupported, the more potential there is for further trench collapse. Proper safety procedures save time, money and most importantly--lives.