Soil surveys have been completed for most parts of the United States and focus on a broad spectrum of land concerns. In 1966, the purposes of federal soil inventories through the National Cooperative Soil Survey were expanded from agricultural uses to include urban development and regional planning to serve the public. The National Cooperative Soil Survey is a partnership of the Natural Resources Conservation Service (formerly the Soil Conservation Service), University Cooperative Experiment Stations, and various federal, state, county, parish, or tribal agencies. National Cooperative Soil Survey information and standards are available on the Web at http://soils.usda.gov/survey/ and http://soildatamart.nrcs.usda.gov, as well as in various United States Department of Agriculture (USDA) paper publications.

USDA Natural Resources Conservation Service issued the publication Understanding Soil Risks and Hazards in 2004 (http://soils.usda.gov/use/risks.html). This publication expands awareness of various soil risks and hazards to human life and property and encourages city and county officials, planners, developers, and others to consider the soil in their land use decisions. Knowledge of soil landscapes, soil formation, and the various soil properties and functions provides a basis for application of the information to engineering and agricultural uses. An awareness of Soil Risks and Hazards will lead readers to further investigation of the potential problems in their area of interest, such as a site for a home, community road, or school. Locating facilities in areas with excessive risks contributes to loss of life, health, and property.

There are some limitations in using soil surveys to identify risks and hazards at specific building sites or urban uses. Soil surveys are not designed to replace site-specific evaluations. Soil surveys represent landscapes and soils as they were at the time of mapping. More recent changes related to land shaping, mining, or other human activities or to natural events are not reflected in the imagery or soil information. Problem soils with risks and hazards in areas smaller than the scale of mapping also cannot be delineated on soil maps; however, they may be mentioned in soil map unit descriptions. Information learned in one area is extrapolated to other areas. Soil surveys today generally describe the soils only to a depth of 2 meters, or about 80 inches. Earlier surveys described the soils to a shallower depth. Despite these limitations, the public can still use their local soil survey through Internet services or their local Natural Resources Conservation Service field office as a reference for scoping out potential problems.

Helping people to help the land, as well as helping people to understand soil science and its importance in land management and conservation are important goals for the USDA Natural Resources Conservation Service (NRCS). Communities and local governments work with NRCS State Offices and local USDA Service Centers to help them protect their natural resources.

To find out more about the soil in your state or county or local community, look to the National Cooperative Soil Survey Web site at http://soils.usda.gov/ and click on the Web Soil Survey. For more information about natural resources and conservation in your own backyard, contact the NRCS at http://www.nrcs.usda.gov or volunteer locally by calling 1-888-LANDCARE.

Cover Photos:
1. Shrink-well potential map of greater Tucson, Arizona.
2. High stream bank erosion along a Wisconsin stream.
3. Decomposition of a concrete channel caused by acidic runoff.
5. Top soil blowing in the wind in north-central Iowa.
Dominant Soil Orders in the U.S.

DOMINANT SOIL ORDERS

1998 Dominant Soil Orders
for STATSGO Mapunits
- ALPSOLS
- ANDISOLS
- ARIDISOLS
- ENTISOLS
- GELISOLS
- GELISOLS/SPARANGISOLS
- HAPISOLS
- HAPRISOLS
- INCEPTISOLS
- Mollisols
- ORGISOLS
- SANTISOLS
- SPARANGISOLS
- STERTISOLS
- VERTISOLS

Rock Outcrop
Native Vegetation
Waste

Dominant Soil Order/Suborder was identified as that Soil Order/Suborder which possesses the largest sum of component percentage/percent area for each STATSGO map unit. Order and Suborder concepts for each STATSGO map unit were revised according to the Soil Classification File 3/98 with projected correlation by National Soil Survey Center Soil Intro 1998 Soil Taxonomy concepts. W.E. USDA Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE USA.
Since the Dust Bowl days of the 1930s, the USDA Natural Resources Conservation Service (NRCS) has worked with landowners and numerous partners to protect our natural resources and improve the lives of our citizens. NRCS is a primary source of resource technology for practical use on the land. Our technical guides, available on the NRCS Web site, are used not only by NRCS staff, but also by private consultants and engineers, conservation districts, state agencies, federal agencies, and landowners. Over the past 70 years, our programs have expanded and changed, but our mission will always remain the same: helping people help the land so we can all benefit from productive lands and a healthy environment.

This Soils Planner for 2007 highlights the U.S. soil survey community working to help people understand soils and give them the information they need to protect themselves from risks and hazards associated with the misuse of this valuable natural resource. As farmers and land managers know, working with nature and not against it is the best way to maintain our natural resources. In August 2005, NRCS launched the U.S. Web Soil Survey. Updated and maintained online, the Web Soil Survey at http://soils.usda.gov/survey is now the single authoritative source of soil survey information for the United States. Today any farmer or rancher can sit down in the office or at the kitchen table and access soil information 24/7.

Many of the conservation practices we encourage landowners to establish focus on reducing soil erosion. Last year alone, we estimate that conservation practices prescribed by NRCS helped farmers and ranchers reduce soil erosion by more than 52 million tons. This is critical. As Hugh Hammond Bennett, the father of conservation and the agency’s first Chief said, “Out of a long list of nature’s gifts to man, none is perhaps so utterly essential to human life as soil.”

Arlen L. Lancaster
Chief, Natural Resources Conservation Service
www.nrcs.usda.gov

Soils Sustain Life
Identifying risks and hazards to human health and welfare in the natural soil environment is a high priority for the Soil Science Society of America (SSSA). Searching for solutions to maintain a productive and healthy environment is one of our most important goals. SSSA is an educational organization with more than 6,000 scientists and professionals in over 80 countries committed to the advancement of soil science. Members of SSSA are dedicated to the conservation and wise use of natural resources to produce food, feed, fiber, and biofuel crops while maintaining and improving the environment. For seven decades, SSSA has provided a professional home for soil scientists from around the world.

Public awareness is the first step in making a change in the way we use our natural resources. We look forward to our next SSSA International Annual Meeting in New Orleans, Louisiana, November 4-8, 2007, where we will be able to see first-hand the effects of overlooking soil risks and hazards (specifically subsidence in organic soils and potential flooding—see the month of May in this Planner). The well-being of everyone is dependent on caring for our soil resources and using them wisely, because soil sustains life.

Soil is the reservoir on which life on Earth depends. Soil plays a vital role in sustaining human welfare and assuring future agricultural productivity and environmental stability. The study of soil as a science has provided us with a basic understanding of the physical, chemical, and biological properties and processes essential to such a complex ecosystem.

SSSA is pleased to continue our active partnership with the USDA Natural Resources Conservation Service (NRCS) and the National Cooperative Soil Survey in producing educational materials such as the 2007 Soils Planner—Soil Risks and Hazards for our members, the public, and the science community.

Rattan Lal
President, Soil Science Society of America
www.soils.org
**Starting Web Soil Survey**

- Open the NCSS WSS site at: [http://websoilssurvey.nrcs.usda.gov](http://websoilssurvey.nrcs.usda.gov)
- Click the “Start WSS” button to begin

**Step 1**
**Define Your Area of Interest (AOI)**

- Under “Navigate By...” click on “Address” or “County” to view your area of interest (other navigation options are also available)
- Click the “View” button

**Area of Interest Interactive Map**

- Click the Zoom tool (plus sign) and drag a box to zoom in on a specific area
- Click the rectangular AOI tool to drag a box or use the polygon AOI tool to click around your specific area of interest

**Step 2**
**View and Print Your Soil Map**

- View your soil map by clicking on the “Create Printable Document” button
- Click the “View” button
- Click on the File menu and Print

**Step 3**
**Explore Your Soil Information**

- Click on the “Soil Data Explorer” tab

**Legend**

- Map Unit Name
- Acres Percent in ADI of AOI
- Jones-Shubuta association, mildly Luceda loamy fine sandy loam, 2 to 5 percent slopes

**Note:** At any time during your visit to the WSS, you can get online help by clicking on the top question mark in the upper right corner (click on the “x” button to close).
Acid sulfate soils are derived from sediments containing iron sulfides, commonly in tidal flats along seacoasts. If exposed to air, sulfides oxidize and produce sulfuric acid. Iron and other metals like aluminum are released into the environment. These processes have adverse effects on plant growth and animal life, both in the soils and in waters that come from the soils. Engineering structures may be drastically affected. Sulfuric acid and associated acid-forming salts rapidly corrode metals and concrete in buildings, channels, pipelines, and roads. The corrosion can weaken the structures and greatly reduce their expected lifespan.

Soil Taxonomy refers to the unoxidized soil materials that have potential to become exceedingly acid as sulfidic materials. These oxidized materials have a pH of 3.5 or less. When left undisturbed and saturated with water, sulfidic materials are relatively benign. In many coastal areas of the United States, sulfidic materials are near the surface or at some depth where they are easily exposed during construction activities. Dredged materials from California’s San Francisco Bay, from Baltimore Harbor in Maryland, and from the tidal Pocomoke River in Somerset County, Maryland, have all exhibited acid sulfate conditions.

Rocks are stained red by iron in the water from an acid sulfate area. The least expensive management alternative is learning to recognize sulfidic materials and avoiding their exposure and use as construction materials.
### NRCS Events


22-25 January: International Conference of Remediation of Contaminated Sediments, Savannah, GA

28 January-1 February: USDA-CSREES National Water Conference, Marriott Savannah Riverfront, Savannah, GA

29-31 January: National Technical Committee for Hydric Soils, Vicksburg, MS

31 January-3 February: International Meeting of Fire Effects on Soil Properties, Barcelona, Spain

Helping People Help the Land
Stream bank erosion destroys land and its cultural features. Additionally, it adds sediment to streams. Stream bank erosion is a dynamic process that occurs during periods of high flow and continues for a period of time after the high flows have receded. Stable streams take many decades to centuries to migrate from one valley wall to the opposite valley wall across their flood plain. The low height of the banks and the root systems of riparian vegetation typically help to maintain very low annual bank erosion rates.

When a disturbance is introduced into the watershed, the riparian corridor, or the stream itself, the equilibrium can be lost. Land-use changes upstream, such as home building, poor grazing management, or diversions of water along highways, can cause additional water to be delivered to a stream and change the balance. If more water is delivered to a stream more frequently, the alluvial channel will probably become larger in response to the increased flows. If the erosion resistance of the bank materials is greater than that of the bed materials, the stream may begin to down cut and produce deep gullies.

An area where poor grazing management has changed the extent and distribution of grass species in the watershed, causing increased runoff. The changed runoff pattern caused the channel to down cut. The higher banks are sloughing into the channel as it attempts to widen following the down cutting. The head cuts will continue to migrate upstream, creating more instability.

A stabilizing stream in Mississippi. The streambed down cut in the 1950s in response to channel straightening and removal of the riparian forest. It widened and began to build anew by 1984.
**Events**


4-8 February: National Association of Conservation Districts Annual Meeting, Los Angeles, CA; http://www.nacdnet.org

5-7 February: 4th USDA Greenhouse Gas Conference, Baltimore, MD; http://www.acsmeetings.org/carbon


*Helping People Help the Land*
Compaction is important to attain when soil material is prepared for construction, but it degrades soils for other important uses. It occurs when moist or wet soil particles are pressed together and the pore spaces between them are reduced. Adequate pore space is essential for the movement of water, air, and soil fauna through the soil. Restricted infiltration results in excessive runoff, erosion, nutrient loss, and potential water-quality problems. Compaction restricts plant roots and thus inhibits plant growth. Also, it can significantly reduce the rate of rainwater infiltration in urban areas, thus increasing the volume of stormwater runoff.

Generally, compaction is a problem within the top 24 inches of the soil. There are several signs of compaction. Discolored or poor plant growth, especially in very wet or very dry years, may reflect the poor soil-plant-water relationships of compacted soils. Excessive runoff on sloping land and ponding on nearly level land are common in compacted areas because water does not infiltrate the soil. A shallow hole may reveal lateral root growth with little, if any, penetration of roots into compacted layers. Platy, blocky, dense or massive layers indicate compaction.

Preventing soil compaction is important because all compaction is expensive to treat and deep compaction may have permanent, untreatable effects on plant growth. Soil should not be subject to traffic when it is wet. Plowing can improve water infiltration of shallow compaction. Deep compaction requires subsoiling, which refers to plowing at a depth of at least 14 inches. Deep-rooted perennials should be considered where compaction is not too severe and mechanical subsoiling is not practical.

The photo shows compaction under the wheel tracks. Notice the structure where the soil is not compacted and the lack of structure where it is. Compaction is still evident in the Oregon Trail after 150 years.

There is horizontal rooting above zone of compaction.
NRCS
Natural Resources Conservation Service

Events

2-9 March: Western Nutrient Management Conference, Salt Lake City, UT; http://isnap.oregonstate.edu/WERA_103/

11-13 March: 4th Conference on Watershed Management to Meet Water Quality and TMDL (Total Maximum Daily Load) Issues: Solutions and Impediments to Watershed Management and TMDLs, San Antonio, TX

29 March-1 April: National Science Teacher’s Association, National Conference on Science Education, St. Louis, MO

Helping People Help the Land
Second only to fire, floods are one of the most common and widespread of all natural disasters. Most communities in the United States can experience some kind of flooding after spring rains, heavy thunderstorms, or winter snow thaws. Floods can be slow or fast rising, but they generally develop over a period of days. Dam failures potentially result in the worst flooding.

Flash floods and other floods occur within all 50 States. Communities at risk are those located in low-lying areas, near water or downstream from a dam.

Soils that are subject to flooding are indicated in the tables of soil survey reports. Soils are rated for the frequency, duration and most likely period of flooding. In communities, more detailed maps are developed and maintained by city and county officials.

The Federal Insurance and Mitigation Administration’s Hazard Mapping Division maintains and updates National Flood Insurance Program maps.
### Events


**17-21 April**: Association of American Geographers Annual Meeting, San Francisco, CA

**22-25 April**: National Association of Environmental Professionals Annual Conference, Orlando, FL; [http://www.naep.org](http://www.naep.org)

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**Phases of the moon:**
- New Moon: 1
- Full Moon: 15
- First Quarter: 29
- Last Quarter: 30
Subsidence of Organic Soils —
Mississippi River Valley, New Orleans

The word “subsidence” is a general term for a lowering of the ground surface that can result from changes in soil or geologic conditions. Subsidence of organic soils is a specific concern if the soils are drained for cultivation or urban development. Organic soils have more than 30 percent organic matter; they are commonly called peats or mucks. They form in bogs or fens of northern latitudes; in flat, delta areas, such as those along the lower Mississippi River and those in the Sacramento and San Joaquin Valleys in California; and on coastal plains marginal to oceans. Source materials include reeds, sedges and grasses in marsh fens, such as those in the Florida Everglades; woody remains in swamps, such as those in Louisiana; and mosses, mostly sphagnum, in areas of cool climates. Subsidence occurs when wet organic materials are drained and exposed to air. Initial subsidence occurs when the water table is lowered, usually by pumping.

Subsidence resulting from drainage is attributed to (1) shrinkage as the material dries, (2) consolidation because of the loss of ground-water buoyancy, (3) compaction from tillage or manipulation, (4) wind erosion, (5) burning, (6) oxidation. The first three factors are responsible for initial subsidence, which occurs rapidly within three years after the water table is lowered. After the initial rapid subsidence, the rate of subsidence decreases significantly to a lower but steady rate. The susceptibility of soils to subsidence is an important consideration in areas of organic soils that are drained. If these soils are drained for community development, special foundations are needed for buildings. New Orleans was first settled on a natural levee along the Mississippi River, but with time the city extended into marshy and swampy areas. Today, homes in such areas are on pilings, and utility lines and sewer lines are similarly supported. Homes and farmland are much lower than the levees that protect them. If the soils are drained for farming, the long-term effects of subsidence, the possible destruction of land, and the possible legal implications of wetlands must be considered.
Severe damage to the test section of an aqueduct similar to the California Aqueduct. The damage was caused by shallow subsidence in an area of Panoche loam.
Permafrost takes many different forms in soils. Thin ice lenses are distributed throughout some soils. Others have massive ice in the form of large blocks and wedges.

Permafrost in many soils of Alaska is relatively warm, just below 32 degrees F. These soils are insulated by a cover of vegetation. If the vegetative cover is disturbed by wildfire or cultural practices, insulation is lost and the permafrost will begin to melt. If a soil has finer textures (silt and clay) and thin ice throughout the profile, the soil can become super-saturated and liquefy as the permafrost thaws. Such a soil will lose all strength and stability unless the melt water eventually drains off. If the soil has large blocks and wedges of ice, large voids and pits will appear in the soil as the blocks of ice melt. The resulting pitted landscape is known as thermokarst and is very disruptive to almost all land uses.
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**Events**

2-7 June: 44th Annual Meeting of Clay Minerals Society, Santa Fe, NM

3-8 June: National Cooperative Soil Survey Conference, Madison, WI

18-22 June: ESRI International Users Conference, San Diego, CA

25-30 June: 5th International Congress of the European Society for Soil Conservation, Palermo, Italy; dazzi@unipa.it

**Phases of the moon:** 8: 14: 22: 30: 4

**Helping People Help the Land**
“Wet” soils, or Hydric soils, are saturated with water or have a water table near the surface. Excess water in a soil affects nearly all soil survey interpretations for construction, farming, and other land uses. Naturally wet areas have special value as catchments and as wetland habitat.

Soil survey reports describe soil moisture status and depth to the water table. “Apparent” water tables extend below a depth of two meters. “Perched” water tables are often near the surface and are found over unsaturated zones of soil that restrict the flow of water. Hydric soils are not necessarily saturated all the time, depending upon rainfall and the source of the water. Nearly all hydric soils exhibit characteristics that persist in the soils during both wet and dry periods. The indicators of wetness are referred to as redoximorphic features because they occur by the reduction or oxidation of soil minerals such as iron, manganese, sulfur, or carbon compounds.

Drainage of potential agricultural lands was quite common as agriculture moved into wet forests and tall grass prairies. Tile lines and open drains were installed to remove excess water. Unfortunately, wetlands also were drained, and today major concerns have been expressed for restoring former wetlands for environmental and wildlife purposes. High water tables, whether apparent or perched, often cause wetness in basements and dysfunctional septic tank absorption fields. The excess wetness restricts the growth of most landscaping plants and trees.
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Phases of the moon: 7: ☄️ 14: ☾ 22: ☾ 29: ☾

August 2007

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Natural Resources Conservation Service

**Events**

9-13 July: Information Agri-culture Conference (InfoAg 2007), Springfield, IL; [www.infoag.org](http://www.infoag.org)


23-26 July: Rebuilding Sustainable Communities in Iraq: Policies, Programs and Projects, College of Public and Community Service University of Massachusetts at Boston; [www.cpcs.umb.edu/rsci](http://www.cpcs.umb.edu/rsci)

Helping People Help the Land
A saline seep is an intermittent or continuous saline water discharge, at or near the soil surface, down slope from recharge areas under dryland crop conditions. Saline seeps are different from other saline-soil conditions because of their recent and local origin, shallow water table, and sensitivity to precipitation and cropping systems.

Salts depress plant growth in one of three ways: prevention of soil water uptake by plant roots; disruption of the nutritional and metabolic processes of plants; and alteration of soil structure, permeability, and aeration.

Several types of dryland saline seeps occur throughout the northern Great Plains and in parts of the southern Great Plains. In areas of native prairie vegetation, grasses and forbs use most of the precipitation and little moisture percolates below the root zone. When permanent vegetation is removed and replaced with crops that do not use water as efficiently, the quantity of water in the subsoil increases and saline seeps occur.

Kochia (Kochia scoparia L.) is salt tolerant and an indicator plant for saline seeps on cultivated land. Also, scattered salt crystals on a dry soil surface may indicate saline conditions. Since seeps are caused by water moving below the root zone in the recharge area, there is no permanent solution to saline-seep problems unless control measures are applied to the recharge area and the area above a saline seep on the landscape. A subsurface drainage system is generally not satisfactory to correct saline seeps. Seeding a perennial crop, such as alfalfa or grasses, in the recharge area of a saline seep is commonly the quickest, most effective way to dry the deep subsoil and stop water flow to the saline seep.
### September 2007

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**Events**


**Phases of the moon:**
- New Moon: 🌙
- Waxing Crescent: 🌙
- First Quarter: 🌙
- Waxing Gibbous: 🌙
- Full Moon: 🌙
- Waning Gibbous: 🌙
- Third Quarter: 🌙
- Waning Crescent: 🌙

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*Helping People Help the Land*
Chemical Heave occurs when expansive anhydrous salts convert to their hydrated state. This mineral transition occurs with absorption of water and a consequent expansion. The reaction is stimulated by a drop in temperature, so an event can be sudden and extensive. Rapid expansion of such salt concentrations in soils can cause sudden cracking and even collapse of overlying structures unless precautions have been taken to mitigate the hazard.

The Las Vegas Wash and associated flood plains east of Las Vegas, Nevada, have areas of soils that are heavily enriched with salts. These soils support a saline meadow ecological site dominated by inland saltgrass. They are in the Land series, classified as fine-silty, mixed, superactive, thermic Typic Aquisalids. The soils have a history of chemical heave. Many saline lakebeds in the arid West have similar chemistry. Soil survey reports identify soils with concentrations of salts.

Expansive, water-soluble salts cause several million dollars in property damage annually in the Las Vegas Valley. Similar problems have been reported in California, Texas, Kansas, and Utah but are less documented. Most of the damage comes from hydration of anhydrous thenardite ($\text{Na}_2\text{SO}_4$) to mirabilite ($\text{Na}_2\text{SO}_4.10\text{H}_2\text{O}$). Both are highly soluble and easily transported in solution to low-lying, poorly drained areas where they crystallize as evaporates in the upper 6 to 12 inches of the soil.

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Scanning electron microscope images of the mineral thenardite (top) and mirabilite (bottom).

Expansive, water-soluble salts cause several million dollars in property damage annually in the Las Vegas Valley.
# Natural Resources Conservation Service

**Events**

- **5-7 September:** ECOSUD 2007 Sixth International Conference on Ecosystems and Sustainable Development, Coimbra, Portugal
- **15-19 September:** International Symposium on Air Quality and Waste Management for Agriculture, Broomfield, CO
- **17-21 September:** 35th Congress of International Association of Hydrogeologists: Groundwater and Ecosystems, Lisbon, Portugal

**Helping People Help the Land**

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**Phases of the moon:** 3: 11: 19: 26: 

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### September 2007

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Soils contribute dust to the atmosphere from natural forces, such as the wind, and from human activities, such as driving vehicles on dirt roads, cultivating fields, and shaping land. Dust is common in the drier parts of the Western United States where the plant cover is minimal and the soils are in a condition that allows them to be blown by strong winds or to become airborne by mechanical means. Some soils contribute very little dust to the air. Sands, for example, move across the soil surface with blowing winds, but the particles are too large to stay in suspension. Soil surveys report the potential for wind erosion in drier climates or areas with low bulk density soils.

Farming practices performed during periods when the soils are moist contribute little fugitive dust. Both paved and unpaved roads contribute a large amount of dust, particularly with high vehicle speeds. Ripping and land leveling contribute more fugitive dust than most farming practices.

While most particles of windblown soils are large and fall from the air quickly, the smaller particles (referred to as PM2.5) from vehicle emissions, fire, and very-fine-ground dust particles create a greater danger to human health. The smaller the particle, the deeper it can penetrate into the lungs. Consequently, PM2.5 can cause a wide variety of health problems, especially in children, the elderly, and people with preexisting respiratory or cardiovascular disease. This atmospheric dust provides a mechanism for the transport of fungal spores, pollen, and bacteria and is a source for soil-borne diseases, such as Histoplasmosis and Valley Fever.

The amount of dust can be reduced during many farm and construction operations by lower vehicle speeds. Confining tillage operations to times of the day when solar radiation is lowest and the wind is calm also can reduce the amount of dust. Irrigation is usually practiced in areas of drier climates. It may offer ways to reduce surface dust production.
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Phases of the moon: 3: ☽ 11: ☽ 19: ☽ 26: ☽

November 2007

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Events

1-5 October: USCID 4th International Conference on Irrigation and Drainage, Sacramento, CA

Helping People Help the Land
The people who die from earth collapse each year include construction workers, agricultural workers, homeowners, inspectors, professional consultants and children. Approximately 100 construction workers are killed each year in the United States. Workers' compensation claims indicate that excavation cave-ins cause approximately 1,000 work-related injuries each year. Almost all fatalities and serious injuries occur where human activities have created unstable earth conditions and where escape is difficult. Young adults and children have been killed while excavating holes in sand along beaches or stream banks.

Soil weighs approximately 3,000 pounds per cubic yard (or the comparable weight of a small automobile). This weight puts tremendous pressure on the walls of a trench. The stability of trench or excavation walls is dependent on many factors. These include the soil type, natural fissures and zones of weakness within the soil, the water content of the soil, weather conditions, the depth of the excavation, previous disturbance of the soil, surcharge loads next to the trench, and vibrations caused by equipment.

**Warning Signs of Trench Instability**
- Tension cracks forming near and parallel to the edges or on the sides of the excavation.
- Subsidence of the soils at the top edge of the excavation.
- Surface soil falling into the excavation or soil particles becoming dislodged from the sides of the excavation.
- Saturated soils occurring on the sides or bottom of the excavation, water seeping from the sides of the excavation, or ground water rising into the excavation.
- Surface water entering the pit or excavation or standing on the bottom for an extended period.
- The sides and top of the excavation being undercut by heavy equipment or falling soils.
- Lateral movement of existing protective shoring.
- Instability in areas where the pit or trench is dug out in previously excavated ground.

*Left photo: Fissures developed in a trench wall along natural zones of weakness in the soil profile. Note hand pick for scale.*

*Right photo: An adequately sloped trench.*
### November 2007 Calendar

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**Phases of the moon:** 1: ☿ 9: ☿ 17: ☿ 24: ☿

**Events**

3-7 November: American Indian Science and Engineering Society, Phoenix, AZ; [http://www.aises.org](http://www.aises.org)

4-8 November: Soil Science Society of America International Annual Meeting, New Orleans, LA; [http://www.acsmeetings.org](http://www.acsmeetings.org)

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**Reinforcement of trench excavation in Texas.**

NRCS Natural Resources Conservation Service

Helping People Help the Land
Liquefaction is a phenomenon in which the strength and stiffness of a soil are reduced by earthquake shaking or other rapid loading. Liquefaction and related phenomena have been responsible for tremendous amounts of earthquake damage around the world. Soil survey reports can be used to assess the damage that might result from soil liquefaction during an earthquake. Liquefaction occurs in soils that are very wet, where water fills most of the space between the particles. The water exerts pressure on the soil particles influencing how tightly the particles are pressed together.

Liquefied soil exerts higher pressure on construction, causing retaining walls to tilt or slide. Increased water pressure can also trigger landslides and cause the collapse of dams. If a hillside starts to slide, the soil loses its strength and flows away like a liquid. Roads may crack and split as sub-grade materials liquefy. Because liquefaction primarily occurs in saturated or nearly saturated soils, its effects are most commonly observed in low-lying areas near bodies of water, such as rivers, lakes, bays, and oceans. Upland soils that have a large percentage of silt and substantial moisture, but are not saturated, can also liquefy. The strongest amplification of shaking in an earthquake occurs in water-saturated soil and artificial fill. Loose fill is more susceptible to shaking than well-compacted fill.

Strategies That Reduce the Hazard of Liquefaction
Three strategies can reduce the hazard of liquefaction when new buildings, bridges, tunnels, or roads are designed and constructed:

- Avoid construction on soils that are susceptible to liquefaction. By characterizing the soil at a particular building site, its susceptibility to liquefaction and suitability for the desired structure can be determined.
- Design the foundation elements so that the structure can resist the effects of liquefaction.
- Mitigate the hazard of liquefaction by improving the strength, density and/or drainage in the soil.

Severe road damage caused by an earthquake in east-central Idaho.
December 2007


Events

9-14 December: American Geophysical Union Fall Meeting, San Francisco, CA

NRCS
Natural Resources Conservation Service

Helping People Help the Land
NRCS has generated maps in response to recent natural disasters along the Gulf Coast. Also, it has developed contingency maps for the Atlantic Coast. The set of 11 maps includes general and detailed maps showing the suitability of soils for such emergency measures as disposal of the carcasses of large animals.

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Maps - National Geospatial Development Center, Morgantown, West Virginia NRCS
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Our Mission:
Helping People Help the Land

Our Vision:
Productive Land
Healthy Environment

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