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Thanks, Sue Miller

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President Tom Benusa presents a Hazleton soil profile monolith to Debra A. Buckman, professor of Environmental Technology, Penn College of Technology, at the annual meeting picnic.

Annual Meeting and Fall Technical Session Focus on Licensing and National Cooperative Soil Survey Standards

By Michael Lane

The PA Association of Professional Soil Scientists held its annual business meeting and fall technical session on October 5, 2007 at the Pennsylvania College of Technology in Williamsport.

Committee reports were followed by nominations and elections for the PAPSS Board. The Board for 2008 comprises President, Tom Benusa; Vice President, Bill Davis; Secretary, Steve Dadio; Treasurer, Laurel Mueller; and Board members at-large, Russ Losco, Michael Sowers, and Michael Lane.

Luther Smith, the Director of Certification Programs for the Soil Science Society of



America (SSSA), spoke to the membership about the process and benefits of a state-sponsored licensing program for professional soil scientists. SSSA has approximately 5000 members nationwide with about 150 members in Pennsylvania. Only 60 members in Pennsylvania currently have a professional soil scientist or soil classifier certification through the SSSA. He laid out a likely structure of a licensing board and discussed strategies for developing a professional licensing program.

Ed White coordinated the morning technical session covering the National Cooperative Soil Survey Standards. He, Tim Craul, and Chris Fabian offered a refresher on the soil orders, suborders, and diagnostic horizons typical of Pennsylvania soils. They provided guidance on the criteria for identifying major diagnostic horizons and the proper use of descriptive terms for texture, structure, consistence, and other key components of soil descriptions. Laurel Mueller distributed copies of a CD of Standards Documents, prepared for the 2006 World Congress of Soil Science by the NCSS program, including the invaluable Field Book for Describing and Sampling Soils, the Soil Survey Manual, Keys to Soil Taxonomy, and others.

The afternoon was spent at part of the off-campus research and training grounds for the Penn College of Technology. Several test pits were opened for members to apply what was learned in the morning. Special thanks to the Penn College staff and students for providing excellent facilities and insightful questions. ■

New Study Tests the Effects of Ring Diameter In Double-Ring Testing

by Chris Whitman

Double ring infiltrometer testing has become the industry standard by which saturated hydraulic conductivity (K_{sat}) is measured. Using the principles of Darcy's Law, the test aims to provide a quantitative value for the rate at which water moves through a saturated medium. In most cases, the test is used to determine wastewater application rates through the least permeable soil horizon identified in the field by a soil scientist. One of the underlying principles of the test is to measure vertical water movement, and not horizontal movement as may occur in a standard percolation test hole.

Although ASTM standards were developed for determining K_{sat} , several different methodologies and techniques are currently in use throughout Pennsylvania. Occasionally, the testing method may be determined by local soil conditions, equipment availability, or past-accepted guidelines and policy. Ring, tube, or cylinder diameter and height have varied along with these factors.

A recent study by soil scientists in China determined that the size of the rings used has an effect on the results of K_{sat} measurement. Typically, a 12" ring is nested inside a 24" ring, and water levels are kept constant manually, or by using specialized equipment. The study by scientists at the Chinese Agricultural University determined that variations in the range and standard deviation of measurements decreased with increasing inner-ring diameters. Diameters of 40 cm (15.7") or less exhibited greater variations, while diameters of 80 cm (31.5") or greater showed more consistent values. In soils with a high degree of heterogeneity, the importance of accurate testing is even greater. Multiple replications are also highly recommended to account for inherent variability. The full text of the article is available in the latest issue of the Soil Science Society of America Journal (volume 71:1667-1675). ■



PAPSS Awards Scholarship to Penn State Student

Jake Eckenrode congratulates Krystal Bealing on her \$1000 scholarship to aid in her studies of soils and environmental science. PAPSS offers annual scholarships to students in soils or related fields. Applications are available online at www.papss.org. ■

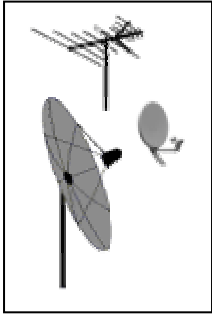
Hydrating a Soil Profile

by Laurel Mueller

Hydrating a soil profile can help the observer to overcome difficulty in interpreting redoximorphic features in very dry soil conditions. Such dry conditions can cause normally low-contrast or obscured features such as cutans (coatings or deposits of material on the surface of peds caused by translocation and deposition of clay particles on ped surfaces) or skeletans (clay depletions or uncoated sand and silt particles) to appear pale, white, or low-chroma. In practicing this technique, we should be careful to avoid harsh spraying that might obliterate the details we are trying to observe. It is best to allow time for the soil to absorb the moisture, and then to observe the soil features behind the wetted front. ■



Joe Valentine wets a profile at the October field trip.



The Earth as Ground – Part I

Grounding of Antennas

by Walter E. Grube, Jr., PhD, CPSS, SEO, WD8MNE

This author has been a licensed amateur radio operator for over 30 years, and has been interested in radio antennas and in lightning strike issues for at least that period of time. This interest has resulted in accumulation of a substantial file of reports in the areas of antenna grounding networks, lightning strike prevention, and soil-related properties which affect these two technologies

Soil as part of an electrical circuit has received academic and practical attention from the standpoints of soil chemistry and soil physics. Such circuits are important in grounding electrical supplies to homes and businesses, grounding lightning strike prevention systems, and grounding antenna systems used in radio-frequency transmission and receiving systems. The present discussion will touch only upon grounding of antennas.

Electrical conductivity of a soil mass is a major factor in the effectiveness of radio-frequency antenna structures. Soil conductivity is evaluated in relatively dry soil regions, and is heavily weighed toward evaluating the sodium cation status of the soil. The soil solution and its electrical properties have the major influence on soil electrical properties, although mineral species (a solid component) also have a noticeable contribution.

Radio-frequency implications include the broad spectrum, from simple AM broadcast through FM, television, shortwave, tactical military, cell-phone, and perhaps even low-GHz microwave communication modes. So far, not many published technical reports can be found relating soil properties to very high microwave frequencies, other than some involving ground-penetrating radar and experimental soil moisture measuring techniques. In fact, commercial ground-penetrating-radar appears to concentrate on radio frequencies within what is commonly called the “short wave” range; that area of the spectrum where one normally hears international radio broadcasts.

Review of Soil Surveys which cover a proposed antenna site can reveal areas which contain clay-rich soils having greater amounts of adsorbed ions. B-horizons which are thicker and more clay-rich can be expected to provide the better grounding for antenna signals. Perhaps more easily obtained are soils with deep, fertile, and heavily vegetated A-horizons. Indeed, A-horizons of most soils are readily amenable to enrichment with fertilizer salts and flourishing vegetation. Fertilizers enhance soil conductivity and vegetation holds both soil and plant moisture. No reports could be found which would suggest the better vegetation species or planting schemes. Considering ecological theories, a dense cover of deep-rooted grassy species may be more desirable to enhance antenna function.

As indicated above, soil moisture content has a significant impact on soil electrical conductivity. Thus wetland soils can be expected to be the most favorable locations for radio antenna performance. This concept is verified by the record that radio amateurs operating along shorelines obtain better reception and transmission propagation than those located farther inland.

Wetland soils are frequently both vegetated with woody and thick shrub species, and subject to difficulty of traversing and installing antenna wires and towers. A reasonable alternative is to install antenna systems at borders of wetlands that are accessible for construction. However this feasible alternative needs to be balanced against a potentially long run of antenna feed cable which may result in significant signal attenuation.

Desirable antenna locations on crests of hills often also contain shallow soils and numerous rock outcrops. Management of large rock outcrops is likely to be an unavailable option. In such areas, intensive management of the soil between rock outcrops can improve radio antenna performance. This would entail hand application of fertilizers on to small areas, keeping in mind the particular native vegetation already present and other ecological changes which could enhance this vegetation.

Shallow shaly or stony soils can be improved by generous applications of organic material to the surface. Barn manure, spent mushroom substrate, and bagged mulch from commercial garden centers comprise viable options to assist in maintaining soil moisture and sustaining good plant growth. “Antenna farms” which only occupy fractions of an acre allow application of small quantities of purchased organic material which may not be a financial burden. Forest soils or horticulture authorities can be consulted in these areas.

National Society of
Consulting Soil
Scientists

Annual Conference
Myrtle Beach, SC
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Many personal antenna systems are installed close to houses or above maintained lawns. Amending the soils in these areas may enhance antenna performance. Of note, however, is that many soils adjacent and nearby to houses are comprised of a mixture of soil materials obtained from nearby and disturbed by mechanical handling. Often these soils are covered by a thin mat of turf grass imported by the construction contractor. The first approach here should be to maximize the growth and fertility of the lawn grass. Soil testing for turf species is available from local University Soil Testing Laboratories, and their recommendations should be followed closely. Lawns beneath antenna arrays should also be kept well watered.

Building codes published by NEC (National Electrical Code) require interconnection of all ground wires within a building, and connection to a specified array of metal rods driven into the ground outside the building. All structural design engineers simply follow the guidelines prescribed in these Codes for how to interface wire systems with ground rods.

It is less recognized by electrical codes that soils may differ in electrical properties from place to place. The field of corrosion of metallic structures--primarily pipelines carrying oil or natural gas--does consider the properties of the soil matrix within which pipelines are buried. A large store of research studies and applied practices are published on soil/metal interactions that impact pipeline corrosion. Soil electrical conductivity is a parameter included in considering the corrosivity of soils.

Soil resistivity measurements were incorporated into field investigations searching for metal ore deposits many decades ago. Standardized measurement procedures are published to determine soil conductivity. The Miller Soil Box is a standard procedure in the soils engineering industry to determine soil resistance to electrical flow; the resistance is then arithmetically converted to conductance.

The Miller Soil Box, used for engineering tests, is basically a laboratory bench scale replication of field-scale systems which implant an array of electrodes across large fields on the scale of tens of meters. The home practitioner can set up a soil box resistivity measurement system in one's basement workbench, but the results from a small sample of perhaps a quart of soil may be of questionable value when considering a field under an antenna system extending 100-feet. The small soil box can provide general ideas regarding whether the candidate soil is more or less electrically conductive. To be most effective, the soil box should be applied to numerous samples from several soil horizons in the field which is being considered for a radio-frequency antenna system.

A field test setup utilizes the mechanics of the "Four Electrode Method," which was developed by the National Bureau of Standards (now the National Institute for Standards and Technology, NIST) and is commonly known as the Wenner 4-pin Method. The resultant resistivity is the average resistivity of the soil (electrolyte) to a depth equal to the spacing between adjacent electrodes (soil pins). The maximum depth (pin spacing) of this standard test set has been designed for 20 feet, which is recommended for standard survey.

A possible shortcoming of the common standard resistivity testing methods is that they usually apply a low frequency (up to a few hundred cycles per second) and low power. So far, no correlative studies could be found which indicate relationships between standard low-frequency testing methods and the soil conductivity at megacycle per second frequencies applied in radio communications.

Specifications for soil resistance provided in some construction contracts call for values in the range of 5-ohms to 25-ohms. Low resistance values indicate a good electrical conductor. Codes provide the definition of the procedures to be used. However, so far, little information could be found regarding the soil depths at which the soil's influence on radio wave propagation begins to lose significance.

Where one has no access to technical equipment to measure soil resistance, conductance, or related properties, but has intentions of installing an antenna with corresponding ground system for radio listening, transmitting, or related work where the antenna wires extend across several tens of feet, or more, several practical soil modifications can be implemented.

Higher soil conductivity is better than low conductivity. Addition of salts to the soil and maintaining a moist soil is practical. Table salt, which is sodium chloride, is to be discouraged, as it is the salt which most rapidly adversely influences osmotic activity in plant roots. The first approach should be application of commercial fertilizer in sufficient quantities to assure good plant growth and persistence. Lime, or calcium carbonate, may be applied at a rate required to adjust the soil pH for optimum growth of the desired plant species. This author also suggests magnesium sulfate, which is a more neutral salt which provides both high ionic activity and the

nutrient magnesium to the soil. This salt may be advantageous for spot applications, such as where ground rods are driven in to the soil. If a field is susceptible to droughtiness, consideration should be given to installing drip irrigation, possibly using roof runoff water collected in rain barrels, as this is the most water conservative.

A luxurious ground cover of vegetation, such as turf grass or thick pasture species can increase the relative conductivity of a soil area. Irrigation to supplement natural rainfall can improve the soil moisture status and thus also the soil solution which is a major electrical pathway.

The U.S. Army Communications-Electronics Command has published a 40-page "Earth Grounding Pamphlet", which is "A Guide to Proper Earth Grounding Methods and Procedures for use with Tactical Systems", available online at <http://handle.dtic.mil/100.2/ADA311375>. This is a good practical synopsis of what the man in the field should do to provide the best possible antenna and electrical ground for radio equipment for a temporary situation. However the construction practices provided are equally valuable for more permanent installations. This Guide also presents the proper various mechanical connections recommended for ground rods and other interfaces.

Practical approaches can be provided as modern reminders. These include:

- Put ground rods as deep as possible
- Use copper or copper-coated ground rods.
- If rocks are hit at shallow depths, place ground rods at an angle
- If a ground plate is buried, surround it with a few inches of clumping kitty litter and moisten well.
- Copper water pipe, if available and a pre-drilled hole can be installed
- Pack around pipe with clumping kitty litter and copper sulfate salt
- Mechanical connections(firm) to ground rods are preferred over soldering
- More metal, connected together, in the ground is better.
- Moist or wet soil is better
- Good grass or turf cover is much better than bare soil
- If soil seems poorly conductive, enhance with Epsom salts washed in with water
- Don't use table salt—(sodium chloride); road salt (calcium chloride); or water softener salt.
- Fertilizer is good (has favorable salt content)on vegetated soils (lawn, etc)

COMING SOON... Part II Grounding for Lightning Strikes

REFERENCES

- ASTM G 57-78, Method for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method
- CECOM-TR-96-2, Earth Grounding Pamphlet. U.S.Army communications-Electronics Command, CECOM Safety Office, ATTN:AMSEL-SF-SEP, Fort Monmouth, NJ 07703-5024.
- NFPA 70, NEC Article 250, Grounding.
- Chaker, V. 1996. Measuring soil Resistivity. ASTM Standardization News, April, pp 30-33.
- Ferren, W. P. 1969. The Electronics of Corrosion. Electronics World, November 1969, pp.12 - ?.
- Tusinski, J. 1969. Resistivity : Some definitions. Electronics world, November 1969, P. 6- ?.
- McPartland, J. F. Handbook of Practical Electrical Design, McGraw-Hill Book Co., New York .
- WB2GHA. 1993. Getting Grounded. Monitoring Times, March 1993. pp.40-41.
- Schoeneberger, P.J., Wysocki, D.A., Benham, E.C., and Broderson, W.D.9editors), 2002. Field book for describing and sampling soils, Version 2.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE.

This author has condensed much material gleaned from numerous sources, and solicits any additional relevant references and other publications which readers may find available. ■



Lost – 1" Blue Binder with looseleaf paper containing lists of committee members. If found, please notify any board member at the addresses listed on the front page. (Be prepared to re-volunteer.)

Web Soil Survey Usage Data – July 2007 – November 2007

The NRCS Web Soil Survey (websoilsurvey.nrcs.usda.gov) has been up and running for several months providing current soil survey mapping and interpretations. Data from the beginning of July to the end of November 2007 indicates that the public and professional communities are making use of this valuable resource.

For Pennsylvania alone, over 20,000 requests were logged to create an Area of Interest, the first step in obtaining site specific mapping information. Over 13,000 requests were filed for printable maps, and 2000 requests were made for custom soil reports. The reports ranged from typical land development criteria, such as suitability for dwellings with basements and hydrologic soil group, to more traditional agricultural criteria, such as depth to water table and nonirrigated capability class.

About one-third of the total requests were for Areas of Interest less than 25 acres, and about one-half for Areas of Interest less than 100 acres. ■

Mid-Atlantic Hydric Soils Committee

The Mid-Atlantic Hydric Soils Committee is seeking a PAPSS member to serve. If you are interested in attending committee meetings, please contact Mr. Ralph Spagnolo at the address below.

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Special Thanks to Sue Miller

by Tom Benusa

I would like to introduce all members to the most important person in the PAPSS organization, Sue Miller. Sue is the PAPSS Administrator. Sue is also the keeper of the PAPSS history, organizer of lists, and registrar of all PAPSS functions. Sue organizes the PAPSS yearly membership information and registration and the annual consultants list. Sue also takes care of the mailings to all members and outside organizations. Sue handles the registration for the PAPSS conferences and gatherings. Sue basically keeps the organization running and running. So the next time you see Sue make sure you say hello and thanks for all the hard work in keeping us organized. ■



Submit stories, news articles, announcements, website links, photographs, corrections, suggestions, or complaints to

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ASA-CSSA-SSSA International Annual Meetings Scheduled for November 1-5, 2009 Pittsburgh Pennsylvania

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