Session 7
Septic Tank Drainfield Site Suitability and Evaluation Workshop
7-Landscapes and Site Evaluation.doc

This power point provides an introduction to the subject of landscape assessments, land forms, and topographic influences on septic drain field assessments and suitability.

Frame 1:

You'll recall that we identified five soil forming factors: starting with parent material. The soil that develops in a result of weather (or climate), living organisms, topographic variability – all working together or against each other – through time.

Irrespective of the parent material (or as in this example – bedrock) is disintegrated by the chemical and physical action of weather, climate, living organisms. Organic matter generally accumulates on the soil surface – weathering occurs at the soil surface. Bedrock may become the parent material – or the parent material may be some other mineral material deposited on top of bedrock. Horizons slowly begin to develop and become distinguishable and eventually a profile becomes evident.

What we'd like to take a look at now is how topography might influence the soil formation process, how topography might influence the soil profile that develops, and how topography comes into play when considering septic tank drain field site suitability and assessment.

Frame 2:

The example we will use is a topography common to Montana: hilltops, hillsides, footslopes, flood plains and valley fill. As this graphic illustrates, each position in the landscape has a name or a term. Each position in the landscape experiences a different set of soil-forming conditions.

In this illustration, the black line represents the land surface, while the blue line represents a possible water table or saturated zone. The red line constitutes a 'soil depth', below which is parent material.

Here we see the summit or hilltop, a convex slope – one which is pushing outward, a concave slope – one which is pushing inward, and a swale or depositional area. The deepest soils generally occur either at the summit or the swale (but not always). Soils in the convex position are generally shallow – because of erosion, rainfall runoff, and lack of vegetative cover. Soils at the concave position and swale are generally thicker, deeper due to deposition from upgradient. Additionally, these locations generally have more moisture, more vegetation, more organic matter.

However, they may also be closest to the water table or saturated zone.

Frame 3:

Illustrated here is a picture similar to the previous – with some different names: shoulder, back slope, side slope, foot slope, and toe slope. The arrows reflect the general direction of water movement in the soil in these positions on the landscape.

Frame 4:

Let's for a moment look at surface water movement and how it is influenced by topography. I am sure that much of this is obvious – either from intuition or experience. Convex slopes – those pushing outward – generally direct water outward and downward. Water movement across the surface is more likely than water movement into the soil. Generally, the water distribution pattern is 'dispersed'.

Concave slopes, on the other hand, direct water into a specific flow path – again – downward, but usually channelized. Water movement is both downward into the soil and downgradient along defined flow paths.

In the case of straight, parallel, level, or flat landscapes, water movement patterns are less well defined. Under conditions of flat and level, net water movement is either into the soil (downward) or into the atmosphere through evaporation.

Obviously, the location of a septic drain field should take into consideration the landscape features and the likely pattern and direction of surface water flow – whether from rainfall or melting snow. A septic drain field which is regularly flooded will likely result in treatment failure and periodic anaerobic conditions.

Frame 5:

Additionally, position on the landscape often provides very good clues at to the soil condition below the land surface. Topographic lines often reflect differences in parent material, soil deposition, and weathering processes. This particular slide illustrates the presence to an alluvial fan, stream terraces, and associated soil variability. Below ground the variability is equally as dramatic.

Frame 6:

The other term that is important – from the perspective of soil formation and water behavior on the landscape is aspect – the direction the land surface faces, relative to the position of the sun (or the gravitational field as a reference). A south slope aspect faces south while a north slope aspect faces north. South slope aspect is characterized as relatively more solar energy, higher soil temperatures, drying growing conditions, more evaporation. Combine this with runoff events and you likely have a drought-prone site.

On the other hand, north slope aspect is characterized as relatively less solar radiation, generally more erosion, generally wetter, more organic matter, less drying, and different vegetation.

Frame 7:

Obviously, the proximity of a water table or saturated zone affects the depth of soil formation. As illustrated here, well-drained (but not droughty) soils are likely to have more soil formation and deeper soil than poorly-drained soils.

Frame 8:

A concept which has been mentioned and which needs special attention is what is referred to as a ‘textural discontinuity’. These are abrupt changes in texture within the soil profile. These discontinuities often constitute water flow boundaries – either retarding or enhancing water flow. Later on we’ll view a video which brings the issue of textural discontinuity into perspective.

Textural discontinuities represent abrupt changes in particle size distribution and pore size distribution. Transition from a silt to a sand and gravel horizon represents a transition from a soil of many, uniformly sized fine pores and channels to a soil with (comparatively speaking) a fewer number of pores, but much larger pores. The silt soil actually holds more water but conducts at a slower rate. Additionally, because of the smaller particle size, the silt soil holds onto its water when wetted – rather than letting it flow into the gravel. Not until the silt is saturated will water flow into the gravel.

Remember – small pores fill first and drain last; large pores fill last and drain first.

Frame 9:

Here’s another example of a textural discontinuity. As you can see, immediately in the middle of this profile is a horizon which is wetter than either the horizon above or below. Interestingly, this wet horizon occurs on a droughty, south-facing slope in southeast Montana. Being able to recognize and appreciate the significance of these textural discontinuities can be a valuable aid in assessing site suitability.

Frame 10:

I’d like to introduce you to a resource which you might find interesting and informative. A Montana State University Bulletin (764), titled Soils of Montana, provides an overview of the geologic history of Montana, followed by detailed descriptions of the soil formation process at work in various landscape positions of Montana. In addition, the publication contains detailed descriptions of some of the more prominent soils of Montana.

Frame 11:

Just as a review, geologically Montana can be divided into three major areas: the mountains, the glaciated plains, and the unglaciated plains. Interestingly, the Missouri River constitutes the boundary between the glaciated and unglaciated plains. Correspondingly, glaciation has caused major alterations in the landscape north of the Missouri River, compared to south of the Missouri River. Within the mountains, the predominant geologic activities included uplife, downthrust, intermountain glaciation, erosion, outwash deposition, and valley fill.

Frame 12:

As this figure illustrates, continental glaciation and intermountain glaciation resulted in a very diverse arrangement of landforms and parent materials. Many glacial lakes were present throughout Montana, resulting in landscapes ideal for home sites. In addition, many places in western Montana still contain remnants of significant volcanic activity to the west. It is not uncommon to find volcanic ash horizons ranging from 10 to 45 centimeters thick in some of the mountain soils and valley areas of western Montana.

Frame 13:

What I'd like to do for a few minutes is take a look at some of the more prominent soils of Montana, as they occur on the Montana landscape. I've selected a few soil profiles from the Soils of Montana publication. For each profile, I've assembled a picture, a description – some narration – and a few notes. Let's start with the Amsterdam silt loam.

Amsterdam silt loam – Gallatin County. The Amsterdam series consists of very deep, well drained soils that formed in alluvium, lacustrine, or loess deposited materials mixed with volcanic ash. These soils are on alluvial fans, stream terraces and lake terraces. Slopes are 0 to 25 percent. Mean annual precipitation is about 15 inches.

Frame 14:

I'll use this slide as an example – to point out some of the nomenclature and detail of a profile description that would be of value to the site evaluator or permit reviewer. It may be a matter of the site evaluator gathering a profile description or selection of profile descriptions from Web Soil Survey (more about this later) before going to the field and then validating the profile description and documenting with a digital photo.

As you can see, the individual describing the soil identified 6 horizons in this profile. The exposure is to 66 inches – not 8 feet – but from the profile description and observation – both within the pit and on the landscape – it's obvious that there is not need to go to 8 feet. Each horizon is described by a symbol, for example Ap, B2, B2ca, C1ca. Each horizon depth is identified, along with a narrative and Munsell color description. This is followed by the texture (silt loam); structure (moderate fine and very fine granular); consistency or workability (friable); and reaction (neutral).

Frame 15:

Elloam loam and Phillips loam – Blaine County (Chinook). The Elloam and Phillips series consist of very deep, well drained soils that formed in till. These soils are on till plains. Slopes are 0 to 15 percent. Mean annual precipitation is about 13 inches.

Frame 16:

What's particularly interesting about this profile is the presence of coarse fragments and a relatively 'consolidated' subsoil or parent material. Recall that this soil is formed in glacial till – which meant the parent material was put in place and compressed-consolidated by massive overburden of ice and water. In this case, the coarse fragments are insignificant – there are neither sufficient of them to adversely and significantly affect water storage or transmission properties. Typically, the overburden water was saline, often resulting in relatively salty subsoils – contributing to salty ground water and saline seeps. The grayish brown clay in the C2cs horizon suggests relatively poor drainage, long periods of relatively wet conditions. Additionally, the comments about salinity, crystals, and gypsum indicate that the soil has not historically experienced significant leaching since deposition of the parent material.

Frame 17:

Holloway loam – Ravalli County (Hamilton). The Holloway series consists of very deep, somewhat excessively drained soils that formed in colluvium derived from argillite and quartzite rock. These soils have a large component of volcanic ash in the surface layer. Holloway soils are on mountains. Slopes are 8 to 80 percent. Mean annual precipitation is about 35 inches.

Frame 18:

In this case – the coarse fragments make a difference. The heterogenous nature – many shapes, sizes, mixed – and the broken edges indicate colluvial material, uplift or downslope erosion processes in place. The extensive nature of the coarse fragments and the mixture and contact indicates a highly transmissive soil – percolation rate – extremely high. This soil would likely result in 'treatment failure'.

Frame 19:

Loberg stony clay loam – Judith Basin (Harlowton). The Loberg series consists of very deep, well drained soils that formed in till, alluvium, or colluvial material derived from igneous, sedimentary, and metamorphosed rocks. These soils are on till plains, moraines, alluvial fans, mountains, and hills. Slopes are 2 to 65 percent. Mean annual precipitation is about 22 inches.

Frame 20:

Surprisingly, this soil is characterized (described) as well-drained, but slow permeability. The permeability factor is likely a consequence of the clay loam designation.

Frame 21:

Lambert silt loam – Richland/Yellowstone County (Billings/Sidney). The Lambert soils consist of very deep, well drained soils formed recent (within the last 10-12,000 years) alluvium on uplands, fans and terraces. These soils are moderately slowly permeable. They are on 0 to 65 percent slopes. Mean annual precipitation is about 14 inches. These soils are described as well-drained; medium to very rapid runoff; moderately slow permeability.

Frame 22:

As you can see from this slide, the soil is very uniform in texture, essentially no coarse fragments, silt loam throughout the profile. The slow permeability is a consequence of the very uniform and small size particles – silt throughout the profile.

Frame 23:

Hesper silt loam – Yellowstone County (Billings). Hesper soils are on upland plains and on terraces. They formed in uniform calcareous silt loam. The climate is cool semiarid. Mean annual precipitation ranges from 10 to 14 inches and about 8 inches falls from April through August. The reason for including this soil is the distinct mineralogy of this soil. The Hesper series is a member of the fine, montmorillonitic, mesic family of Ustollic Haplargids. Typically, these soils have silt loam A1, and heavy silty clay loam B2t horizons that have strong fine prismatic and blocky structure, and C horizons of olive silt loam that has distinct accumulation of calcium carbonate. The nomenclature of montmorillonite, or smectite, signifies a high shrink-swell clay soil with tendancies to disperse when wet.

Frame 24:
Hesper soils.

Frame 25:
Scobey loam/clay loam – Daniels County (Scobey). This is the official Montana state soil. The Scobey series consists of very deep, well drained soils that formed in till. These soils are on till plains, hills, and moraines. Slopes are 0 to 15 percent. Mean annual precipitation is about 12 inches. These soils are smectitic, well-drained, and slowly permeable. Again, having been formed in marine-influenced till and being located in areas of relatively limited rainfall, salinity is a common feature.

Frame 26:
Scobey loam/clay loam.

Frame 27:
I think I know the answer to this question. From our perspective here, what's important is that you realize that there is a diversity of soil in Montana, there is a wealth of information, and that information is both easily accessible and valuable in septic tank drain field site assessment.

Later on we'll go through some examples of how to get dialed into that information via internet. If you've already gone through the lesson in Web Soil Survey, you're either excused, you can sleep through the session, or you can be the evaluator and tell me what I'm doing wrong. In any case, you're welcomed to listen in.

Frame 28:
Questions? Comments?

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