



The Engineer's Angle

Geotechnically Marginal Sites-To Dump or to Develop

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Good land is hard to find. With the demand for housing at historically high levels, what is a home developer/builder to do? More and more homebuilders are purchasing marginal lands that they would not have touched with a ten-foot pole a few years ago. Such sites include: previously mined and reclaimed sand and gravel pits or rock quarries, sites where the former improvements were demolished and buried, and former "uncontrolled landfills or stump dumps".

A large number of marginal sites are currently under development around the Washington metropolitan region. The homebuilders and developers have a fairly good handle on the cost of the sticks and bricks. However, the site development and foundation construction costs vary widely depending upon the soil conditions at the site. Unsuitable or marginal soil conditions can represent a significant cost making the development of some sites cost-prohibitive. It is very important to thoroughly define site conditions and identify the required mitigating measures to improve the soils for the proposed development and structures.

The sand and gravel mining operations often include washing of materials to remove fines. The fines-laden water is directed to ponds (wash ponds) where the fines are allowed to settle. Such wash ponds can occupy large portions of the site and may include up to 30 to 40 feet or more of essentially "peanut butter" consistency clayey and silty soils. The typical mine reclamation practices generally consist of pushing in site overburden or off-site surplus materials to raise the grades in the mined-out areas. Tree stumps, shrubs, demolition debris, topsoil and environmentally contaminated materials may be encountered within the fill in the reclaimed areas. Such reclaimed areas are generally not suitable (without improvement) for support of buildings or site infrastructures (roads, utilities, etc.) due to the potential for excessive and unacceptable differential and total settlements.

Additionally, the buried organic materials decompose and contribute to the presence of objectionable gases including methane. The presence and accumulation of methane gas within site improvements (including buildings, basements, footing excavations, utility trenches, etc.) can represent an explosion hazard. Methane is explosive when it is present

between five percent (Lower Explosive Limit, LEL) and 15 percent (Upper Explosive Limit, UEL) by volume. For sites with significant methane, remedies such as under-slab barrier and passive or active venting systems may be necessary. Options for improving marginal sites typically include: Removal and replacement of unsuitable soils, placing a surcharge load to preload and compress soft/unsuitable soils, deep dynamic compaction (DDC) to densify loose fills, and use of rammed aggregate piers or deep foundations to support structures.

Removal of unsuitable soils and replacement with structural fill is generally not cost-effective for widespread fills with thicknesses of more than 8 to 10 feet. The surcharge method entails raising the site to the proposed grades and placing several additional feet of the soils and allowing soft soils to compress (consolidate) under the weight of the fill. Surcharge method is particularly suitable for saturated fine-grained soils. Depending upon the permeability of the soils, surcharge may need to be maintained for several months to a year (waiting period). This waiting period can be reduced to a few months by installing pre-fabricated vertical drains (wick drains) at close spacing.

DDC is a method of ground improvement that involves repeatedly raising and dropping a large (generally 10 to 20 tons) weight by a crane equipped with a cable and winch. The impact energy at the ground surface results in densification of the existing fill and/or soil deposits to significant depths (20 to 40 feet or more). DDC may result in ground vibrations, noise, flying debris and dust.

The key for development of a geotechnically marginal site is to thoroughly investigate the site conditions early in the feasibility. This will allow the developer to have a more realistic handle on the site conditions, risks, and development costs.



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