

SOIL COMPACTION AND THE ONSITE SEWAGE SYSTEM

Purpose:

The purpose of this document is to provide guidance on how to address soil compaction when it is identified at a proposed soil absorption field site. This document applies to all onsite sewage system technologies (elevated and subsurface). It provides procedures that may be used to address soil compaction.

Background:

Soil compaction commonly occurs when soils are wet or moist and a force (such as the weight of tractor or backhoe) is applied to the soil surface. This force results in a compacted layer of soil that has a reduced porosity (volume of voids or air-filled space) and a reduced hydraulic conductivity (a measure of the soils ability to move water). Properly functioning onsite sewage systems rely on soil porosity to maintain an aerobic zone below the trenches by allowing air transfer through the soil profile. Properly functioning onsite sewage systems also rely on soil hydraulic conductivity to disperse effluent away from the soil absorption system. Therefore, preservation of the natural soil porosity and hydraulic conductivity is critical to proper system performance.

Soil compaction will impact the soil absorption system performance by reducing the loading rate of the soil. Rule 410 IAC 6-8.2-69 (4) Table V, and 71 (4) Table VI, both identify platy soil structure caused by soil compaction as having a soil loading rate of 0.00 gpd/ft². If the infiltrative surface of the soil absorption system is positioned in or above compacted soil, system performance will be negatively impacted by the reduced infiltration rate of the soil, resulting in premature failure.

The agricultural industry is also negatively impacted by soil compaction. Because of this, equipment has been used for decades to remediate compaction within soil profiles. However, the equipment used has performance limitations. The effective depth of remediation of compacted soils using common plow-type equipment is 24 inches below the ground surface. The construction, site improvement and building industries are also familiar with soil compaction for a variety of reasons. Due to the potential for compaction, protection of the proposed soil absorption site is the best approach when developing a property which will be utilizing an onsite sewage system.

Decision:

I. Considerations for all soil absorption field sites:

- A. When an on-site evaluation has been performed and compaction found at a proposed onsite system location the first, and optimum, approach would be to locate and use another site with suitable soils and no compaction.
- B. If another site cannot be located, then the following procedures may be implemented, if site, soil and topographic features permit. [Rule 410 IAC 6-8.2 - 69 (1), (2), (3) and 71(1), (2) (3)]

- C. A site with compacted soils to a depth greater than 22 inches is unsuitable for the application of onsite system technology.
- D. When plowing of a site in excess of 10 inches in depth becomes necessary to remediate compacted soil, the site must have suitable soil depth under the plow depth for the specific soil absorption system type being proposed for the project.
- E. No soil absorption system may have the infiltrative surface positioned within a compacted layer.

II. Considerations for subsurface soil absorption fields:

- A. A subsurface soil absorption system must have the infiltrative surface positioned 2 inches or more into natural soil below an amended compacted layer, but no deeper than 36 inches below final grade.
- B. There must be soils with a soil loading rate $> 0.25 \text{ gpd/ft}^2$ and $< 1.20 \text{ gpd/ft}^2$ to an appropriate depth beneath the proposed infiltrative surface. [Rule 410 IAC 6-8.2-69 (4), 69(5), and 69(6); Enviro-Septic Wastewater Treatment System Indiana Design and Installation Manual for Residential Systems, March 2007 revisions; Eljen Geotextile Sand Filter Indiana Design and Installation Manual for Subsurface Trench Systems, December 2010].
- C. The infiltrative surface must also be positioned at least 24 inches above a natural or modified seasonal watertable. [Rule 410 IAC 6-8.2-69(7)].
- D. The depth of the infiltrative surface is contingent on the OSS technology and the depth of compaction.

III. Considerations for subsurface drip soil absorption fields:

- A. A subsurface drip system must have the dripline positioned 2 inches or more into natural soil below an amended compacted layer. The dripline depth below original grade is typically 6 to 12 inches [Indiana Standards for Subsurface Drip Systems, December 1, 2009].
- B. The driplines must be positioned:
 - 1. For slopes ≤ 15 percent, 20 inches or more above a layer with a soil loading rate less than 0.05 gpd/ft^2 or a natural or modified seasonal watertable. [Indiana Standards for Subsurface Drip Systems, December 1, 2009].
 - 2. For slopes > 15 percent and ≤ 25 percent, 24 inches or more above a layer with a soil loading rate less than 0.05 gpd/ft^2 or a natural or modified seasonal watertable. [Indiana Standards for Subsurface Drip Systems, December 1, 2009].

IV. Considerations for elevated soil absorption fields:

- A. When an elevated soil absorption system is being proposed consideration may be given to removal of compacted soil from the site. After removal, there must be suitable soils to an appropriate depth beneath the proposed infiltrative surface. [Rule 410 IAC 6-8.2-71(4), 71(5) 71(6), 71(7), and 71(8)] Removal of the compacted soil must not result in the formation of a depression in the area of the soil absorption field or topography that would increase surface or subsurface drainage to the site [Rule 410 IAC 6-8.2-68(c), and (f), (1), (3)].

- C. When a site has been identified with compacted soils and an elevated system is being proposed with the infiltrative surface above or within the amended compacted soil the following design considerations must be applied.
1. If the soil texture of the amended layer is finer than sandy loam, a site amended by chisel plowing shall have an assigned soil load rate of 0.25 gpd/ft², or G soil class for Presby Enviro-Septic Systems,
 2. If the soil texture of the amended layer is sandy loam or coarser, a site amended by chisel plowing shall have the same assigned soil load rate for that texture and a granular structure from Table VI, *Soil Loading Rates for Above Ground Systems*, 410 IAC 6-8.2-71(4).

Procedures to Remedy Soil Compaction:

I. Identify the Boundaries of Soil Compaction / Evaluate Site

- A. All soils descriptions shall be provided by an IRSS soil scientist.
- B. Transects shall be used to characterize the extent of compaction. Descriptions along a transect shall come from borings or pits on a 10 – 25 foot spacing. A minimum of 2 pits shall be used. Pits may be hand dug with a minimum width of 18 inches and a depth at least 6 inches deeper than the depth of compaction. All pit and boring descriptions shall be done to a depth 6 inches deeper than the depth of compaction.

II. Remediation by Subsoiling:

- A. At the time of subsoiling and/or chisel plowing the soil shall be dry enough that its plastic limit will not be exceeded.
- B. When the soil compaction extends no more than 10 inches below existing grade, a chisel plow shall be used to break up the compaction. The chisel plow shall work along the contours of the site at a depth 2 inches deeper than the greatest depth of compaction identified.
- C. When the soil compaction extends more than 10 inches below existing grade, a subsoiler and a chisel plow shall be used to break up the compaction.
 1. The subsoiler will be used first and shall work at a depth 2 inches deeper than the greatest depth of compaction. Its first pass shall be perpendicular to the slope and its second pass along the contours of the site.
 2. The site shall be plowed using a chisel plow parallel to the contour of the site to a depth of seven (7) to fourteen (14) inches. If the site is suitable for a subsurface trench system (based on 410 IAC 6-8.2 and the provisions of this document), and if the subsoiler has sufficiently broken up the compaction, plowing with a chisel plow is not necessary.
- F. The area subsoiled and plowed using a chisel plow must include the dispersal area if the same limiting conditions exist in the dispersal area.

III. Remediation by Vegetation

Vegetation can be considered to remediate soil compaction. Oilseed radish, annual and perennial ryegrasses, Korean or annual Lespedeza and turf type fescues and alfalfa have all been used in the remediation of soil compaction. Oilseed radish, a taproot plant, is effective on deep compaction. Annual ryegrass, a fibrous root plant, is effective

on plow depth compaction. Perennial ryegrass, also a fibrous root plant, will replace the short lived annual ryegrass. However, remediation by vegetation may take a 2 to 4 year time frame to amend the compaction.

- A. The use of vegetation to amend compaction may only be considered for sites with a maximum depth of compaction to 22 inches.
- B. The site shall be planted in the fall with a mixture of oilseed radish and annual ryegrass, and the following spring interseeded with perennial ryegrass.
- C. In low pH sites substitute Korean Lespedeza or an annual Lespedeza for Oilseed radish and substitute a turf type fescue for perennial ryegrass.
- D. Before planting the perennial ryegrass the site must be sprayed to kill the annual ryegrass, this allows the annual ryegrass roots to die and decompose leaving macro pores to help perennial ryegrass roots get established.

IV. Evaluate After Remediation

- A. On sites with more than 10 inches of compaction, a soil scientist shall describe the condition of the previously described compacted layer after subsoiling and before chisel plowing to ensure that compaction has been amended.
- B. A minimum of 3 pits shall be used. Pits may be hand dug with a minimum size of 18 inches horizontally. All pits and descriptions shall be done to a depth 6 inches deeper than the greatest depth of compaction previously identified. All pits and descriptions shall be done after the 2 subsoiling passes and before the chisel plowing. Pits shall be placed so the soil between grooves left by subsoiler shanks can be evaluated.
- C. After the soil has been evaluated by the soil scientist, and if the compacted soil has been amended, the site shall be chisel plowed parallel to the contours of the site at a depth of approximately 7-8 inches.
- D. The soil scientist shall describe the color, texture and size of clods in inches or mm. The description shall extend from the surface to a depth 6 inches deeper than the greatest depth of previously identified compaction.
- E. Clod size must average less than 4 inches or 100 mm for the compacted soil to be considered amended.