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Interactive comment on "Relation between hydraulic properties and plant coverage of the closed-landfill soils in Piacenza (Po Valley, Italy)" *by* C. Cassinari et al.

Anonymous Referee #1

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The manuscript presents a study carried out in a landfill site located in Northern Italy, and specifically deals with the determination of the hydraulic characteristics of the porous materials used at the site. Interestingly, the authors claim that an objective of their study is to find a correlation between the material hydraulic properties and plant coverage so as to be able to explain the presence of certain plant species in the study area. Even though the topic is intriguing and perhaps more works in the literature should tackle that matter, overall I judge that the present form of the manuscript fails to meet its major objectives. It also shows some flaws in various parts of the text, and is definitely rather weak from a scientific point of view. I also have some reservations concerning the methods employed. Therefore, I suggest the paper should be rejected

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altogether.

I have listed below a few general comments for authors' consideration and some additional and specific questions [the most significant of which are starred (*)] showing the weakness of the work.

General comments.

The title and the text refer to the words "soil" and "hydraulic properties", but I think they are rather misused in the context of the present paper. It being a landfill site, the porous material might not be a soil in the classic pedological terms. The authors should clarify that point. Attributes like "degraded" and "lack of compacted structure" are too vague and a proper characterization of the landfill porous medium should be required to better frame the outcomes of this study and the measured hydraulic properties. Concerning the "hydraulic properties", on the other hand, they are commonly referred to as the soil water retention and hydraulic conductivity functions. However, the present paper refers only to the water retention characteristic of the landfill material. Instead, determining the unsaturated hydraulic conductivity characteristics of this landfill porous material would have been an important component of the study, especially with reference to the subsequent estimation of the so-called plant-available soil-water holding capacity (as I will explain below).

Determining soil water content at "permanent wilting" might not be a real problem. It is commonly accepted that this variable can be estimated from the soil water retention function at a matric suction of about 15,000 cm (allowing for the pattern exhibited by the retention function for many soils at highest suctions). On the other hand, the "field capacity" concept poses some problems of interpretation and identification. Field capacity is often assumed as the average water content value in a uniform soil profile at which the redistribution process, following an infiltration event, proceeds so slowly that draining rates becomes virtually negligible. This variable is definitely not a constitutive soil characteristic, rather it should be viewed as a process-based parameter being de-

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termined using specifically-designed field experiments (for example, see Romano and Santini, 2002). For practical reasons and usually in large-scale or regional studies, field capacity is often associated with a specific point of the soil water retention curve, usually the water content at the matric suction of 330 cm, as an average of FC-values being associated to coarser soils (FC at 50–100 cm of suction) and finer-aggregated soils (FC at 400–600 cm of suction). However, the latter (very simplified) method can only be used if the soil profile can be considered uniform from the hydraulic viewpoint over the soil depth investigated by the root system of that specific plant type. To frame the implication of the field capacity concept and its simplified determination in a modeling perspective (like determining "available soil water"), a look should be given to the papers by Twarakavi et al. (2009) and Romano et al. (2011). If the authors would still like to employ a property-dependent criterion to estimate a "field capacity" value, I would bring to their attention the paper by Mayer and Gee (1999) who proposed an interesting, but alternative approach to estimate the field capacity value from the knowledge of the soil hydraulic conductivity function.

Specific questions.

- (*) The sentence at P.758, L.18-19, "Direct measurements of soil hydraulic properties are rarely performed because they require lengthy and costly analysis" is not always true. More importantly, this statement should be properly framed in the context of the objectives of a study and its relevant spatial extent.

- (*) P.759, L.12-14 [The relationship between volumetric water content and matric potential is the soil water retention curve, which allows to derive available water for plants by comparing the water content at the different rates of suction (negative pressure) applied]. It should be said that this provides a very simplistic view of the soil-water status in a soil profile and of the movement of soil-water in the soil-vegetation-atmosphere system. Moreover, it is not clear what the Authors mean for the words "...comparing the water content at the different rates of suction". Which suction rates are we talking about? Which suction rates are depicted in a water retention function? Please clarify.

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- (*) P.759, L.19. Again the Authors stress on the importance to get the soil hydraulic properties. However, this study refers only on the water retention function, whereas leaves the unsaturated hydraulic conductivity function, K(h), out of the investigation (but K is a key property for assessing the plant available water).

- P.760, L.24 “reconstitution method”. It is not clear. Maybe the Authors intend to say “recovering”.

- (*) The present study deals with a landfill area of about 20 hectares. Information is required about the sampling locations and strategies adopted here. It is also not clear which kind of statistical analysis (see P. 761, L. 3 and L. 7-8) enabled 11 locations to be selected as the “most representative” of the area. Why?

- Why the authors used 17 different PTFs for water retention functions? Some of the PTFs listed in Table 3 might perhaps be not relevant to the present study (e.g. the PTF of Tomasella and Hodnett since it refers to tropical soils, whereas others are specific for other parts of the world). The authors’ comment at P.766, L.22, is almost obvious. I understood that PTFs could have been developed for the administrative region where the landfill site is located. Why do not use local PTFs?

- What about the size of the undisturbed soil cores? - (*) It is well known that one gets larger uncertainties when estimating the water retention function by PTFs without measuring the oven-dry bulk density. Most of the observed variability can perhaps be explained by the local spatial variations of the bulk density values, and this might affect the above-mentioned selection of the “most representative” locations. The Authors should comment on that point and provide a measure of the uncertainty involved in their evaluations.

References cited Meyer, P.D., and G.W. Gee, 1999. Flux-based estimation of field capacity. J. Geotech. Geoenviron. Eng., ASCE, 125:595-599. Romano, N., and A. Santini, 2002. Water retention and storage: Field. In “Methods of Soil Analysis, Part 4, Physical Methods” (Dane, J.H., and G.C. Topp, eds.), pp. 721-738, SSSA

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Interactive comment on Solid Earth Discuss., 7, 757, 2015.