Soil Characterisation and Mapping for an Agricultural Environment in Federal University of Technology, Minna

[1*]Musa J.J., [2]Musa I.H., [3]Odofin A. & [1]Otache M.Y.
[1]Department of Agriculture and Bioresources Engineering, Federal University of Technology, Minna
[2]Bida-Badeggi Staple Crop Processing Zone, Farm Institute, Ministry of Agriculture and Rural Development, Bida
[3]Department of Soil Science and Land Management, Federal University of Technology, Minna
[4]Department of Agriculture and Bioresources Engineering, Federal University of Technology, Minna
[*]**Corresponding author:** johnmusa@futminna.edu.ng

Received: 25/04/2025 **Revised:** 15/05/2025 **Accepted:** 23/08/2025

The study characterised soil and mapped agricultural lands in north-central Nigeria to address the lack of detailed, geospatial soil data and classification within the agricultural environment of the Federal University of Technology, Minna, as it has been identified as obstructing sustainable land management, agricultural productivity, educational support, and research development. This process systematically involved field surveys, examinations, and laboratory analyses. This comprehensive study evaluated the soil quality, drainage, morphology, and physicochemical properties across the Federal University of Technology, Minna (FUT) Main Campus Teaching and Research Farm. By advanced techniques like gridding, soil examination, profile pit excavation, and laboratory analysis, the study delineated the farm into five distinct mapping units (FUT1, FUT2, FUT3, FUT4, and FUT5). It evaluated various soil attributes such as effective soil depth, texture, colour, drainage conditions, erosion evidence, bulk density, saturated hydraulic conductivity (Ks), and soil organic carbon content. Results showed notable variations among these units. FUT2, FUT3, and FUT5, characterised by higher slope gradients, exhibited the most susceptibility to erosion due to their soil properties and evident erosion features, whereas FUT1 and FUT4 displayed lower erosion potential with relatively stable soil properties. Soil conservation and proper land management practices should have been prioritised in the past and continue to be prioritised at present. Therefore, the soil mapping units are produced to achieve these targets and serve as a basis for further research at the study site. Ridging across the slopes at intervals will minimise soil erosion by water, and conservation tillage is encouraged.
Keywords: Agriculture, Crop, Organic Matter, Pore Space, Soil

Introduction

As a natural resource, soil constitutes the uppermost weathered and disintegrated layer of the Earth's crust, comprising various components such as mineral and organic matter, water, and air within its pore space (Regassa *et al*., 2023). Understanding its inherent characteristics is pivotal for optimising its utility in agriculture (Hou *et al*., 2020). Soil morphological and physicochemical characterisation is a critical resource that informs policy actions regarding soil management practices (Bhat *et al*., 2023).

Soil mapping units are defined areas on a map representing specific soil types or similar characteristics, providing information on properties like texture, drainage, fertility, slope, and depth (Dharumarajan *et al*., 2022), identified through field surveys and laboratory analyses, these units are crucial for agriculturists as they offer detailed insights into soil capabilities and limitations, aiding in better agricultural planning and management decision-making.

This study involves in-depth analyses to comprehend diverse soil attributes such as depth, texture, colour, drainage, structure, and consistency across distinct units within agricultural watersheds. It aims to provide comprehensive insights into soil properties and their spatial distribution, crucial for enhancing agricultural practices and land management strategies. Through soil characterisation mapping, researchers (Abdelrahman & Metwaly, 2023; Khosravani *et al*., 2023) seek to elucidate the soil's suitability for different crops, fertility, and potential limitations, thereby empowering farmers, land managers, and policymakers to make informed decisions regarding land use, crop selection, and sustainable agricultural practices.

However, Nigeria faces significant challenges related to soil degradation resulting from inappropriate land-use practices. Issues such as soil erosion, declining fertility, and compaction stem from unsustainable agricultural practices, deforestation, inadequate irrigation, and overgrazing. This degradation poses a considerable threat to agricultural productivity and the preservation of soil minerals in the region. Given its status, the Federal University of Technology (FUT) Minna should spearhead studies focused on soil characterisation mapping to assist the local communities in adopting improved farming methods. Such research endeavours hold the potential to safeguard their lands, mitigate soil degradation, and preserve essential soil nutrients, contributing significantly to sustainable agriculture and environmental conservation in the region. The study aims to characterise and map out soils for agricultural purposes in the north-central part of Nigeria.

Materials and Methods

Study area description

The Teaching and Research Farm of the Federal University of Technology Minna, Niger State, Nigeria (located in Gidan Kwanu), was used for the study. The farm occupies 200 ha between Latitude 09° 30 33.589''N to 09° 31 05.927''N and Longitude 06° 27' 02.855''E to 06° 26' 29.867''E.

Gidan Kwanu, situated in Nigeria's Guinea Savanna zone, is home to a diverse range of vegetation, including Guinea grass, spear grass, shea butter trees, locust bean trees, and mahogany. The area experiences a tropical wet and dry climate, with rainfall primarily occurring between May and October, peaking between August and September. The average annual temperatures range from 27 to 34°C, with daily temperatures exceeding 37°C during the dry season. Humidity levels range from 60 to 80% during the dry season and between 30 and 50% during the harmattan season.

Soil sampling/sample collection

Generally, 28 samples, 14 each for disturbed and undisturbed soil samples, were collected from the two (2 Nos.) profile pits in each mapping unit along the paedogenic (genetic) horizon.

Field survey

The topographic map of the FUT Minna Main Campus Teaching and Research Farm (Figure 1) was gridded on a GIS environment using a rigid grid method of soil survey. The gridding was carried out at 100m intervals in horizontal and vertical directions (Esu, 2010; Nwaloka *et al*., 2019). A total of 231 intersection points were established. The coordinates of the 231 intersection points were loaded into a differential GPS. After that, the 231 points were easily located on the farm and pegged for smooth follow-up yield soil examination and analysis.

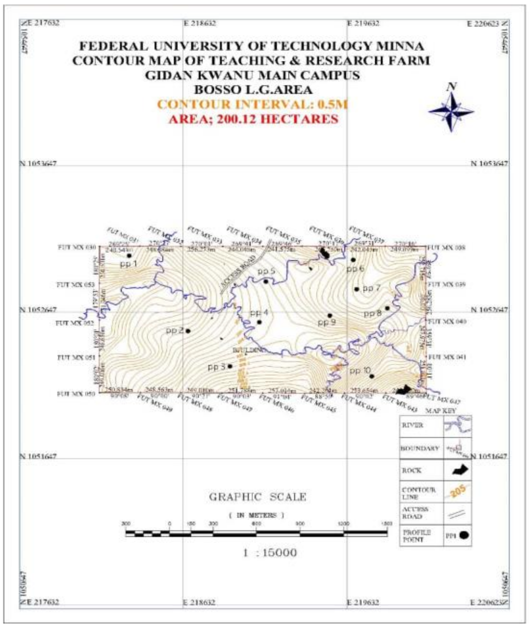

Figure 1: Map of the study location

Field soil examination/analysis

Field soil examination was conducted on the 231 pegged intersection points. At each point, a soil auger was used to collect samples at 20 cm increments to a depth of 120cm or where an impenetrable strata/limiting zone was observed. Soil samples were examined for colour with Munsell soil colour charts, texture by the feel method, Drainage condition from observed soil colour, and slope, which was calculated from the contour map generated for the farm. Pieces of evidence of erosion were also observed and recorded by physical observation for stoniness/rock outcrops, sheets, rills, and gullies.

Mapping unit delineation

The outcome from the field soil analysis was used to delineate the research farm into five mapping units (namely, FUT1, FUT2, FUT3, FUT4, and FUT5). The geographical locations of the five mapping units are presented in Table 1.

Profile pit excavation and examination

Excavation of two (2 Nos.) profile pits of size 2m x 2m x 2m in length, breadth, and depth was carried out in each mapping unit (Peter & Uweni, 2020). The profile pits were examined for morphological characteristics and described following FAO (2006) guidelines for Effective soil depth, soil colour, drainage, mottles, texture, structure, consistency (moist), horizon boundary, and erosion evidence on the field, as highlighted in Nwaloka *et al.* (2019). After this, the infiltration rate was physically analysed in situ for each profile pit using the double-ring infiltrometer.

Laboratory soil analysis of physicochemical characteristics

Undisturbed core samples were analysed for bulk density and saturated hydraulic conductivity (Zhao *et al*., 2021), while disturbed samples were used for particle size distribution, texture, and soil organic carbon using standard laboratory procedures (Wu *et al*., 2021).

Results and Discussion

Morphological characterisation

Exploratory results for soil morphological characterisation are presented in Table 1. The results from the five mapping units show effective soil depth varying from shallow to deep horizons (49 to 120 cm), indicating favourable depth for cultivation. Notably, mapping units FUT1 and FUT4 exhibited deep soils (100–114 cm) with three paedogenic horizons, indicating their capacity to store water effectively and facilitate post-rainfall percolation, consequently reducing runoff (Chidozie *et al*., 2019; Evaristo *et al*., 2019). Conversely, FUT5 featured shallower profiles (47–49 cm), which led to high water tables and increased susceptibility to waterlogging and erosion risks due to their limited water-holding capacity (Evaristo *et al*., 2019). In addition, the presence of consolidated parent material beneath FUT1, FUT2, FUT3, and FUT4 contributes to their erosion susceptibility, as these materials are nearly impermeable, as Odofin (2017) highlighted.

Furthermore, FUT5, with stones and gravel as parent materials, tends to have limited water infiltration due to the coarse nature of these materials. Surface horizons were dominated by dark brown (10YR 3/3) and very dark brown (10YR 2/2) soil colourations, signifying moderately well-drained soils with notable organic matter content, consistent with the findings of Obi *et al*. (2020) and Nsor & Akpan (2021), while sub-horizons displayed olive yellow, light olive brown, and light olive green hues, suggesting imperfectly drained conditions, aligning with the observations of Peter and Uweni (2020). Soil texture ranged from loamy sand to sandy loam in both surface and sub-horizons across all mapping units. This is consistent with the findings by Abam and Orji (2019).

Many fine mottles observed in sub-horizons indicate impeded drainage conditions. The soils exhibited a dominant structural grouping characterised by weak to moderate grade, medium-sized peds, and sub-angular shapes in the surface horizons. This can be attributed to several factors, including the low soil organic matter content observed, reduced plant root abundance, and a low clay percentage, as observed in study findings (Dengiz *et al*., 2013). Subsurface horizons displayed moderate-grade, medium-sized peds and subangular blocky shapes. Surface horizons showed a friable consistency, while sub-horizons exhibited a range from friable to firm consistency. This contrast in consistency, with a friable surface and a firmer subsurface under moist conditions, suggests potential rapid permeability, holding significance in irrigation practices. These observations align with previous studies by Lawal *et al*. (2013) who conducted a similar sequence in the Ijah-Gbagyi district of Niger State, Nigeria, as well as findings by Nwaloka *et al*. (2019) in studies conducted in Niger State and Cross River State, Nigeria, respectively.

Physicochemical characterisation

The result for physicochemical characterisation is shown in Table 3. Sand particles dominated the mineral fractions in all mapping units with an observable decreasing trend with depth (between 850 and 790 kg g^{-1}). This may be due to the parent material's high quartz content, a key constituent in granite (Abam & Orji, 2019; Ali & Jassim, 2022). The higher sand content indicates a high water intake rate and low moisture retention capacity. Observed sand dominance is attributable to geological processing involving mineral sorting (Musa *et al*., 2017). In contrast, silt particles had the lowest values among the mineral fractions, ranging between 120 and 140 kg g^{-1}.

Moderate bulk density dominated the surface horizons (1.56 to 1.60 gcm^{-3}). In subsurface bulk density values varied from moderate to high (1.55 to 1.63 gcm^{-3}). Moderate bulk density at surface horizons indicates less erosion resistance.

Moderately high saturated hydraulic conductivity (Ks) (1.58 to 2.25 cm/hr) dominated surface horizons except FUT5, with moderately low Ks (1.21 cm hr^{-1}). Soil organic carbon (SOC) shows an irregular increase and decrease with depth in all mapping units. Means for SOC were within low range (4 – 10 g kg^{-1}) (FAO, 2006). Low SOC observed in surface horizons of FUT1, FUT2, FUT3, and FUT5 (6.3 – 9.4 g kg^{-1}) may be due to grazing, bush burning, and farming practices.

Conclusion

Based on the morphological and physiochemical characterisation findings following FAO (2006) guidelines, the study concluded that soils have favourable depth for root development by plants with mean values of 109cm, 83cm, 93cm, and 101cm for mapping units FUT1, FUT2, FUT3, and FUT4 respectively, except for FUT5 (48cm) with shallow depth. Additionally, rainfall-runoff action can negatively impact the soils due to their sandy loam and loamy sand texture, with a weak to moderate structure. Generally, soil characterisation based on morphological and physicochemical properties can

provide a proper understanding of soil resources for judicious use, thereby preventing soil erosion risk.
Soil conservation practices such as contour ploughing, terracing, and constructing retention basins should be employed to mitigate the negative impact of rainfall-runoff action. Also, cover crops or grass buffer strips should be introduced to stabilise soil and minimise erosion risks, particularly in areas with sandy loam and loamy sand textures. Finally, implement measures like installing drainage systems or contouring to enhance drainage in areas with pervasive mottles, improve soil aeration, and reduce waterlogging.

References

Abam, P.O., & Orji, O.A. (2019). Morphological and physico-chemical properties of soils formed from diverse parent materials in Cross River State, Nigeria. *Journal of Applied Geology and Geophysics*, *7*(1), 1-7. https://doi.org/10.9790/0990-0701010107.

AbdelRahman, M.A., & Metwaly, M.M. (2023). Digital soil characteristics mapping for aiding site-specific management practices in the West Nile Delta, Egypt. *Discover Sustainability*, *4*(1), 47.

Ali, R.A. & Jassim, H.K. (2022). The mineralogy, geochemistry, and the origin of lower clastic unit in hussainiyat formation-western desert of IRAQ. Iraqi Bulletin of Geology and Mining, 18(1), 1-19. https://doi.org/10.5281/zenodo.7016582

Bhat, S.A., Hussain, I., & Huang, N.F. (2023). Soil suitability classification for crop selection in precision agriculture using GBRT-based hybrid DNN surrogate models. *Ecological Informatics*, *75*, 102109.

Chidozie, E.I., Ifeanyi, I.F., Johnbosco, O.M., Onyekachi, I.A., Anthony, C.C., Obinna, O.M., & Glory, M.O. (2019). Assessment of hydraulic conductivity and soil quality of similar lithology under contrasting landuse and land cover in humid tropical Nigeria. *Soil & Environment*, *38*(1). DOI: 10.25252/SE/19/61419

Dengiz, O., Kızılkaya, R., Erkoçak, A. & Durmuş, M. (2013).Variables of microbial response in natural soil aggregates for soil characterisation in different fluvial land shapes. *Geo-microbiology Journal*, 30 (2), 100-107. https://doi.org/10.1080/01490451.2011.653089

Dharumarajan, S., Kalaiselvi, B., Lalitha, M., Vasundhara, R., & Hegde, R. (2022). Defining fertility management units and land suitability analysis using digital soil mapping approach. *Geocarto International*, *37*(20), 5914-5934.

Esu, I.E. (2010). *Soil Characterisation, Classification and Survey*. Ibadan, HEBN Publishers PLC, Nigeria, pp. 73-99.

Evaristo, J., Kim, M., van Haren, J., Pangle, L.A., Harman, CJ., Troch, P. A., & McDonnell, J.J. (2019). Characterising the fluxes and age distribution of soil water, plant water, and deep percolation in a model tropical ecosystem. *Water Resources Research*, *55*(4), 3307-3327. https://doi.org/10.1029/2018WR023265

Food and Agriculture Organisation (FAO). (2006). Guidelines for soil description. Fourth edition. Food and Agricultural Organisation of the United Nations, 1–85.

Hou, D., Bolan, N.S., Tsang, D.C., Kirkham, M.B., & O'Connor, D. (2020). Sustainable soil use and management: An interdisciplinary and systematic approach. *Science of the Total Environment*, *729*, 138961.

Khosravani, P., Baghernejad, M., Moosavi, A.A., & FallahShamsi, S.R. (2023). Digital mapping to extrapolate the selected soil fertility attributes in calcareous soils of a semiarid region in Iran. *Journal of Soils and Sediments*, *23*(11), 4032-4054.

Lawal, B.A., Ojanuga, A.G., Tsado, P.A., & Mohammed, A. (2013). Characterisation, classification and agricultural potentials of soils on a toposequence in the southern Guinea savanna of Nigeria. *International Journal of Agricultural and Biosystems Engineering*, 7(5), 330-334. http://repository.futminna.edu.ng:8080/jspui/handle/123456789/8358

Musa, J.J., Anijofor, S.C., Obasa, P., & Avwevuruvwe, J.J. (2017). Effects of soil physical properties on erodibility and infiltration parameters of selected areas in Gidan Kwano. *Nigerian Journal of Technological Research.* Vol. 12 (1), 46 – 54.

Nsor, M.E., & Akpan, A.E. (2021). Characterisation and land suitability evaluation for cocoyam in Southern Nigeria. *Ghana Journal of Agricultural Science*, *56*(1), 26-47. DOI:10.4314/gjas.v56i1.3

Nwaloka, D.C., Lawal, B.A., Raji, B.A., Ezenwa, M.I.S., & Tsado, P.A. (2013). Description and Characterisation of Some Alfisols under Two Different Land-Use (Groundnut and Maize) Patterns in Chanchaga, Minna, Niger State. http://repository.futminna.edu.ng:8080/jspui/handle/123456789/13523

Obi, J.C., Udoh, I.B., Adefila, F.R., & Brownson, U.E. (2020). Numerical classification and digital mapping of coastal plain sands of Southeastern Nigeria. *Agro-Science*, *19*(2), 13–22.

Odofin, A.J. (2017). Nigerian soil resources: The neglected base of our national development. *An inaugural lecture series* 56: Federal University of Technology, Minna Nigeria. Pp 60.

Peter, K.D., & Uweni, A.S. (2020). Morphological and Physicochemical Properties of Soils

Developed from Coastal Plain Sands and Alluvium in Khana Local Government Area of Rivers State, Southern Nigeria. *African Journal of Sustainable Agricultural Development (AJSAD)*, *2714*, 4402.

Regassa, A., Kibret, K., Selassie, Y. G., Kiflu, A., & Tena, (2023). W. Soil properties. In *The Soils of Ethiopia*, pp. 111–156. Cham: Springer International Publishing.

Wu, C., Zheng, Y., Yang, H., Yang, Y., & Wu, Z. (2021) Effects of different particle sizes on the spectral prediction of soil organic matter. *Catena*, *196*, 104933.

Zhao, Y., Wang, Y., & Zhang, X. (2021). Spatial and temporal variation in soil bulk density and saturated hydraulic conductivity and its influencing factors along a 500 km transect. *Catena*, *207*, 105592.

Table 1: Description of the representative profile pits for the mapping units by Elevation, Size and Geographical location

Profile pits	Mapping units	Land area coverage (Hectare)	Elevation (metre)	Geographical location	
				Longitude	Latitude
FUT1	Pp3	61.14	196 – 218 asl	6º 26′ 05.388″	9º 31′ 01.866″
	Pp8			6º 26′ 54.608″	9º 30′ 52.612″
FUT2	Pp2	38.76	195 – 217 asl	6º 26′ 13.074″	9º 30′ 48.446″
	Pp9			6º 26′ 42.853″	9º 30′ 49.556″
FUT3	Pp4	58.66	195 – 216 asl	6º 26′ 05.388″	9º 31′ 01.866″
	Pp5			6º 26′ 26.248″	9º 30′ 55.264″
FUT4	Pp1	22.6	195 – 214 asl	6º 26′ 22.785″	9º 30′ 40.483″
	Pp7			6º 26′ 52.166″	9º 30′ 58.61″
FUT5	Pp6	18.96	198 – 215 asl	6º 26′ 47.798″	9º 31′ 04.643″
	Pp10			6º 26′ 44.556″	9º 30′ 39.114″

**Pp= Profile pits, asl= above sea level*

Table 2: Morphological characteristics of the representative mapping unit in the study site

Mapping unit/Profile pit	Profile depth (cm)	Soil colour	Mottles	Textural class	Structure G S Sh	Consistency Moist	Boundary	Slope Evidence	% of erosion
				FUT1					
Pp3	0 – 27	10YR 3/3 (DB)	7.5YR 4/6	LS	1 m abk	fr	cs	3 – 5	Sheet sign
	27 – 51	5Y 4/3 (OY)	2.5YR 4/6	LS	2 m sbk	fr	cw		
	51 – 103	5Y 6/8 (OY)	2.5YR 4/6	SL	2 m abk	fi	-		
Pp8	0 – 36	10YR 2/2 (VDB)	-	LS	1 m abk	fr	cs		
	36 – 75	5YR 4/3 (RB)	-	SL	2 m sbk	fi	cw		
	75 – 114	5YR 5/4 (LOB)	5YR 5/8	LS	2 m sbk	fi	-		
				FUT2					
Pp2	0 – 33	10YR 3/3 (DB)	-	LS	1 m sbk	fr	cs	1 – 3	Sheet sign
	33 – 62	2.5Y 4/4 (OB)	7.5YR 5/8	SL	2 m abk	fi	cw		
	62 – 101	2.5Y 5/4 (LOB)	7.5YR 5/8	LS	3 m abk	fi	-		

Pp9	0 – 20	10YR 3/2 (VDGB)5YR 3/3		SL	1 m sbk	fr	cs		
	20 – 64	5Y 6/2 (LOG)	5YR 5/8	SL	2 m sbk	fi	-		
				FUT3					
Pp4	0 – 17	10YR 2/2 (VDB)	7.5YR 5/8	LS	1 m sbk	lo	cs	1 – 3	Cracks,
	17 – 38	10YR 3/2 (DYB)	5YR 5/8	LS	1 m abk	fi	cs		stones,
	38 – 64	10YR 3/2 (VDGB)5YR 5/8		LS	2 m sbk	fr	cs		Rill/gully
	64 – 96	10YR 3/2 (VDGB)5YR 3/4		SL	2 m sbk	fr	-		
Pp5	0 – 16	10YR 2/2 (VDB)	-	LS	2 m sbk	fi	cs	5 – 10	
	16 – 41	10YR 3/4 (DYB)	-	SL	2 c abk	fi	cw		
	41 – 90	10YR 3/3 (DB)	7.5YR 4/6	LS	2 c abk	fi	-		
				FUT4					
Pp1	0 – 18	10YR 3/3 (DB)	-	LS	1 m abk	fr	cs	0 – 1	No signs
	18 – 41	2.5Y 5/6 (LOB)	5YR 4/6	LS	1 m abk	fr	cw		
	41 – 100	5Y 6/2 (LOG)	5YR 4/4	LS	2 m sbk	fi	-		
Pp7	0 – 25	10YR 3/3 (DB)	-	SL	1 m abk	fr	cs		
	25 – 75	7.5YR 4/6 (SB)	-	SL	1 m abk	fr	cw		
	75 – 102	5Y 6/2 (LOG)	5YR 5/8	SL	2 m sbk	fi	-		
				FUT5					
Pp6	0 – 18	10YR 3/3 (DB)	-	LS	2 m sbk	fr	gw	5 – 10	Cracks,
	18 – 47	10YR 3/3 (DB)	5YR 5/8	LS	2 m abk	fi	cw		stones, Rill/gully
Pp10	0 – 15	10YR 2/2 (VDB)	5YR 3/3	SL	2 m sbk	fr	gw		
	15 – 49	10yr 4/6 (DYB)	5YR 5/8	SL	2 m abk	fi	cw		

**Texture: SL= sandy loam and LS= loamy sand*
**Structure: G= grade, S= size, Sh= shape, 1= weak, 2= moderate, 3= strong, m= medium, c= coarse, gr= granular, sbk= sub-angular blocky, abk= angularblocky.*
**Consistence: lo = loose, fr = friable, fi = firm. *Boundary: a = abrupt, c = clear, g = gradual, s = smooth, w = wavy.*

Table 3: Physicochemical parameters of the soil

Mapping unit	Profile pit	Profile depth (cm)	Sand	Silt	Clay	Textural class	Pb (gcm^{-3})	Ks ($cmhr^{-1}$)	OC (gkg^{-1})
FUT1	Pp1	0 – 27	840	70	110	LS	1.59	2.23	7.80
		27 – 51	820	80	100	LS	1.61	2.59	9.00
		51 – 103	810	60	130	SL	1.56	1.58	7.50
	Pp8	0 – 36	800	100	100	LS	1.6	2.55	9.00
		36 – 75	790	90	120	SL	1.57	1.83	10.30
		75 – 114	800	120	80	LS	1.63	3.55	6.00
FUT2	Pp2	0 – 33	820	60	120	LS	1.58	1.87	7.80
		33 – 62	810	70	120	SL	1.58	1.85	7.00
		62 – 101	800	60	90	LS	1.62	3.01	8.00
	Pp9	0 – 20	800	90	110	SL	1.59	2.16	11.00
		20 – 64	800	80	120	SL	1.57	1.84	10.50
FUT3	Pp4	0 – 17	840	50	110	LS	1.66	4.45	9.30
		17 – 38	800	60	140	LS	1.61	2.59	8.70
		38 – 64	820	70	110	LS	1.59	2.22	7.90
		64 – 96	820	50	130	SL	1.57	1.59	8.00
	Pp5	0 – 16	840	50	110	LS	1.59	2.23	8.00
		16 – 41	800	60	140	SL	1.55	1.35	7.60
		41 – 90	820	70	110	LS	1.59	2.2	9.30
FUT4	Pp3	0 – 18	840	40	120	LS	1.58	1.89	10.00
		18 – 41	830	10	100	LS	1.61	2.62	8.80
		41 – 100	820	80	100	LS	1.61	2.59	8.90
	Pp7	0 – 25	810	60	130	SL	1.56	1.58	10.20
		25 – 75	810	110	120	SL	1.57	1.81	9.80
		75 – 102	790	100	110	SL	1.59	2.15	10.20
FUT5	Pp6	0 – 18	830	60	110	LS	1.2	0.35	8.60
		18 – 47	850	50	120	LS	1.41	2.67	7.80
	Pp10	0 – 15	840	40	120	SL	1.22	0.32	4.00
		15 – 49	790	90	120	SL	1.47	1.83	6.90

**Pp= profile pit, SL= sandy loam, LS= loamy sand, Pb= bulk density, Ks= saturated hydraulic conductivity, OC= organic carbon*