Hydraulic and hydrological data from surface and subsurface soils across the Thames catchment, UK, 2021

Overview:

This dataset contains surface and sub-surface hydraulic and hydrological soil property data from across the Thames catchment. Soil bulk density, estimated soil porosity, volumetric soil moisture content, and soil moisture retention (to 100 cm suction) were calculated through laboratory analysis of soil samples collected at 5 depths between the surface and 100 cm depth (where practical). Surface soil infiltration rates were measured, and soil saturated hydraulic conductivity was calculated at 25 cm and 45 cm depth (where possible).

These field-scale point data were collected from 7 sites in the Thames Catchment, with three sub-groups of sites under different land use and management practices. The first land management group included three arable fields in the Cotswolds, Gloucestershire on shallow soils over limestone with no grass in rotation, herbal leys in rotation or rye and clover in rotation. The second group included two arable fields in near Wantage, Oxfordshire on free draining loamy soils over chalk with conventional management or controlled traffic. The final group included a permanent grassland and mature broadleaf woodland on slowly permeable soils over mudstone near Oxford, Oxfordshire. Data were collected in representative infield areas; trafficked areas (e.g. tramlines or animal tracks), and untrafficked margins.

Samples and measurements were taken between April 2021 and October 2021, with repeats taken before and after harvest. Soil moisture retention measurements were carried out on a subset of the sites (the three fields located in the Cotswolds).

This dataset was collected by UKCEH as part of the 'Land management in lowland catchments for integrated flood risk reduction' (LANDWISE) project. LANDWISE seeks to examine how well natural land-based measures can be used to reduce the risk of flooding for communities. LANDWISE is one of three projects comprising the Natural Environment Research Council Natural Flood Management Research Programme. The work was supported by the Natural Environment Research Council Grant NE/R004668/1. The participation and assistance of the land owners and managers is also gratefully acknowledged.

Experimental design/Sampling regime:

Research Design
This dataset was collected as part of a detailed survey for the LANDWISE project and follows on from a Broad-scale survey of soil surface properties across the Thames catchment (see related EIDC dataset). The aim of this detailed survey was to better characterise field-scale heterogeneity under different land-based Natural Flood Management (NFM) measures. Seven fields were selected from the Broad-scale survey for more detailed investigation. Fields were chosen based on their soil type and underlying geology, land-use, and management. Table 1 outlines the seven fields which are divided into three sites based on geology and soil, with two fields on mudstone, two fields on chalk, and 3 on limestone. Each site allows for comparisons between land-uses or types of management.

Table 1: Sampling strategy – survey sites, land use/management and soil/geology types.

Site and field ID	Land use	Crop rotation/vegetation	Land management (tillage, cover crops, traffic etc.)	Landwise soil type group from NSRI data (indicative)	BGS bedrock geology (indicative)	LANDWISE Broad-scale survey results (dominant hand texture, HCl)	LANDWISE Scenario modelling purpose/storyline
18_6	Grassland, permanent	Rye (mainly)	Cattle or sheep, mob grazing	Slowly permeable loamy/clayey	Mudstone, siltstone and sandstone	Texture: SaSiLo HCl: none-slight	Compare grassland and woodland (Mudstone)
44_1	Mature broadleaf woodland	Mix native broadleaf species – ash, sycamore, hawthorn	Unmanaged, low density grazing deer	Slowly permeable loamy/clayey	Mudstone, siltstone and sandstone	Texture: SiLo HCl: none	
26_1	Arable with grass	Spring 2021 grass for 2 years, spring barley prior	Conventional. Min till before grass, grass ploughed	Free draining loamy	Chalk	Texture: SiCl - SiClLo HCl: strong	Compare conventional arable with controlled traffic (Chalk)
23_5	Arable without grass	Oilseed rape, winter wheat, spring barley, spring beans, winter wheat, winter barley	Conventional, controlled traffic, min till, cover crops	Shallow	Chalk	Texture: SiCl HCl: strong	
31_3	Arable without grass	Barley, Oats, Wheat	Conventional, Conventional till	Shallow over limestone		Texture: SiLo HCl: strong	Compare conventional arable versus grass or herbal ley in rotation (Limestone)
27_2	Arable with grass (rye and clover)	Harvest 2016/17/8/19 Grass and Clover Ley, 2020 and 21 winter wheat	Conventional, No till	Shallow over limestone		Texture: SiLo - SaSiLo HCl: strong	
27_4	Arable with grass (herbal ley)	2016/17/18 Herbal Ley, 2019 – winter wheat, 2020 Peas, 2021, winter wheat	Conventional, No till	Shallow over limestone		Texture: SiLo HCl: slight-strong	

Figure 1 shows the locations of the three sites chosen for the detailed survey. Table 2 provides a summary of the seven sites and their locations.

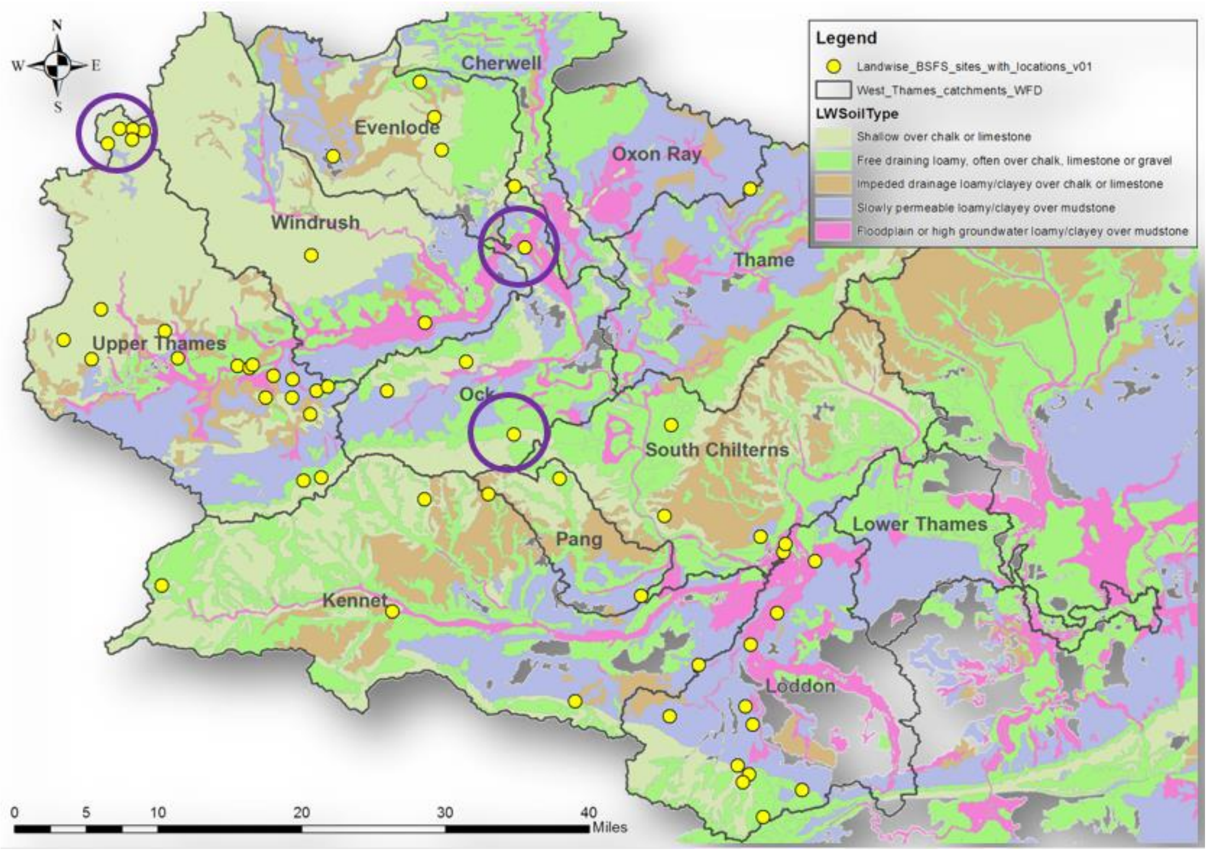

Figure 1: Selected sites for the detailed survey (circled in purple) within the Thames area. Yellow points indicate sites sampled as part of the original Broad-scale survey. The base map shows the Landwise soil types used in the site selection process. Soils Data © Cranfield University (NSRI) and for the Controller of HMSO 2022.

Table 2: Seven field sites for the LANDWISE detailed survey soil sampling and measurements. Approximate locations (Easting and Northing to the nearest 1 km) are given for the purposes of anonymity. The Site and Field ID matches the 'ID_SiteNo_FieldNo' column in the dataset.

Geology		**Soil Type**	**Land-use**	**Management**	**Site and Field ID**	**Location**
Mudstone		Slowly permeable loamy/clayey	Permanent grassland		18_6	447000, 208000
			Mature broadleaf woodland		44_1	446000, 209000
Carbonate	Chalk	Free-draining loamy	Arable	Controlled traffic	23_5	447000, 189000
				Conventional traffic	26_1	443000, 188000
	Limestone	Shallow over limestone		Herbal ley in rotation	27_4	406000, 219000
				Rye and clover in rotation	27_2	405000, 220000
				No grass in rotation	31_3	403000, 222000

Sampling Strategy

The sampling strategy of the survey was designed so that fields were sampled across multiple periods over an annual cycle. Table 3 lists the measurements made and the techniques used, along with the number of samples taken and when they were taken.

Soil properties were measured along transects within fields at several location types that were categorised into: TR (trafficked areas e.g. tramlines), IN (general infield areas), and UN (untrafficked field margins). Figure 2 shows a schematic of the sampling at the 15 locations within fields. The five IN locations were chosen to represent general infield conditions typical of the field. The five TR locations were targeted to the trafficked parts of the field, typically tramlines in arable fields, and animal/livestock tracks in grassland/woodland. The five UN locations were chosen on field margins that were uncultivated and untrafficked, avoiding within 1 metre of tree/hedge stems and animal burrows. Sampling locations were equally spaced along transects as much as possible.

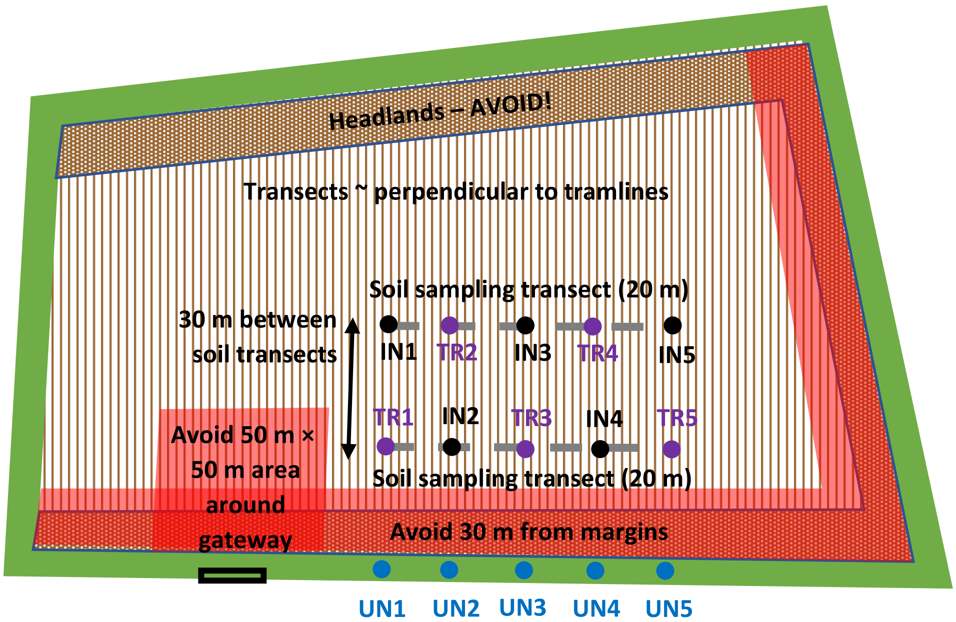

Figure 2: Schematic showing detailed survey transects and sampling locations within a typical field. IN = Infield; TR = Trafficked; UN = Untrafficked margin.

Table 3: Detailed survey measurements, techniques, and timing of sampling.

Measurement	Technique	Site type	Samples per field	No. of fields	Spring	Pre-harvest	Post-harvest
Bulk density (and inferred porosity) with depth	Volumetric soil cores and oven drying (105 °C)	Arable	50	5	April 21	NA	October 21
		Grassland	50	1	April 21	NA	October 21
		Woodland	50	1	April 21	NA	October 21
Soil moisture retention (pF 0 – pF 2)	Volumetric samples and Sandbox lab analysis	Arable	24	3 (limestone sites only)	October 21		
Soil saturated hydraulic conductivity, K_{sat} (Kfs)	Guelph Permeameter	Arable	12	5	September-October 21		
		Grassland	12	1	September-October 21		
		Woodland	12	1	September-October 21		

Measurement	Technique	Site type	Samples per field	No. of fields	Spring	Pre-harvest	Post-harvest
Soil infiltration rate, Kunsat (0.5 – 6.0 cm suction)	Mini Disk Infiltrometer	Arable	10	5	NA	July 21	September 21
		Grassland	10	1	NA	July 21	September 21
		Woodland	10	1	NA	July 21	September 21
Soil and vegetation root depth	Auger and tape measure	Arable	15	5	April 21	NA	October 21
		Grassland	15	1	April 21	NA	October 21
		Woodland	15	1	April 21	NA	October 21

Table 4 summarises which measurements were made at each location type within fields.

Table 4: Detailed survey soil measurements and sampling locations.

Soil Measurement	Sampling locations		
Bulk density (and inferred porosity)	TR1 - TR5	IN1 - IN5	-
Moisture retention	TR2 - TR4	IN2 - IN4	-
Saturated hydraulic conductivity	TR2 - TR4	IN2 - IN4	-
Infiltration rate	-	IN1 - IN5	UN1 - UN5
Soil and vegetation root depth	TR1 - TR5	IN1 - IN5	UN1 - UN5

Data collection methods:

Soil Sampling

Soil samples were collected using an Eijkelkamp 07.53.SC sample ring kit with closed ring holder and the Edelman auger and Stony auger when required. Samples were collected within representative field areas, sealed in polyethylene bags, and refrigerated the same day as collection, prior to laboratory analysis.

Soil dry bulk density and volumetric soil moisture content were calculated in the UKCEH laboratories using oven drying methods (see Analytical Methods section). Soil porosity was inferred from dry bulk density. Soil moisture retention was also calculated using an Eijkelkamp Sandbox in the UKCEH laboratories (see Analytical Methods section).

Field Measurements: Infiltration

Soil surface infiltration measurements were taken using Mini Disk Infiltrometers. The infiltrometers are made up of an upper and lower chamber (both of which are filled with water during measurements). The upper chamber controls the suction, and the lower chamber contains a volume of water that infiltrates into the soil at a rate determined by the suction. The bottom of the infiltrometer contains a porous sintered stainless-steel disk that does not allow water to leak in open air, so only allows water out when placed on a relatively level soil surface. Once the infiltrometer is placed onto the soil surface for a measurement, water leaves the lower chamber and infiltrates into the soil (the rate of which is determined by the soil properties). As the water level in the lower chamber drops over time, the rate of infiltration can be calculated by recording the water volume at regular intervals (e.g. 30 seconds for a typical silt loam).

At each location where a measurement was taken, the soil first had to be exposed where the surface was vegetated. Vegetation was carefully cleared using a hand trowel to ensure the soil remained relatively undisturbed. Reliable measurements required the soil surface to be as level as possible, so locations were chosen with this in mind. Where it was not possible to get a naturally level surface, the soil was gently brushed (avoiding any soil smearing) to create a flat surface for the infiltrometer to rest on and ensure a good contact with the porous disk.

At each site, the suction rate of the infiltrometer was selected based on knowledge of the soil type following guidance in the Mini Disk Infiltrometer manual (METER, 2021). At most sites the recommended suction rate of 2 cm was used, however on the two sites with heavier clay soils a suction rate of 0.5 cm was used due to the lower infiltration rates anticipated there. The measurement interval was also chosen based on the soil type at each site and adjusted accordingly to suit the observed rate of infiltration.

The infiltrometer was kept upright and stable during the measurement using a retort stand and clamp. The chambers were filled using tap water rather than distilled water to avoid potential changes to the ionic balance of soil water and its effects on soil properties. Before taking a measurement, the initial water volume of the lower chamber was recorded and then the infiltrometer was placed onto the soil surface whilst a timer was started. Measurements were then taken at the selected time interval. The method aimed to infiltrate at least 15 ml of water for a robust measurement, however given fieldwork time constraints this was not always practical where infiltration rates were notably slow. These measurements were still used in the dataset but were flagged during the QC process (see Quality Control section).

The recorded field data were entered into a Microsoft Excel spreadsheet (available at www.decagon.com/macro) (Decagon Devices, 2018), which was used to calculate the unsaturated hydraulic conductivity (infiltration rate). The calculations used within the spreadsheet follow the method proposed by Zhang (1997), which measures cumulative infiltration over time and fits the results using a curve function. The soil van Genuchten parameters (for different soil texture classes) required by the function were obtained from Carsel & Parrish (1988).

Field Measurements: Saturated hydraulic conductivity

Soil saturated hydraulic conductivity was measured at two depths (25 and 45 cm below ground level) using Guelph Permeameters. The Guelph Permeameter operates using the Mariotte Principle and measures the steady-state rate of water recharge into unsaturated soil from a well hole, in which a constant head of water is maintained.

Measurements of saturated hydraulic conductivity were taken at nearby but offset locations on field transects (Figure 2) to avoid errors from soil disturbance from previous measurements and sampling. Well holes for the 25 and 45 cm depth measurements were made approximately 1 metre apart to avoid interference from soil moisture saturation ‘bulbs’ created during measurements. An Edelman soil auger was initially used to excavate a well to depths of 10 and 30 cm for the 25 and 45 cm measurements respectively. To remove the remaining depth of soil from the well, a sizing auger attachment was then used to ensure a well hole of a uniform geometry (6 cm in diameter with a flat bottom). Where large stones were encountered during the augering process, new well holes were dug to avoid excessively increasing the volume of the well by removing stones from the walls of the well hole. Once the well hole was of sufficient depth and geometry, a well prep brush attachment was used roughen the walls of the well hole and scour any soil smearing that occurred during the augering process.

The Guelph Permeameter was assembled, reservoir filled with deionised water, and placed on a tripod above the well hole following the operating instructions (Soilmoisture Equipment Corp., 2012). For the measurements, the ‘two head’ method was chosen due to its higher accuracy compared to the ‘single head’ method. The two head method involved repeating measurements at two well head heights. At most field sites, measurements were carried out using well head heights of 5 and 10 cm above the base of the well. However at the two sites with more slowly permeable soils, alternative heights of either 10 and 15 cm or 15 and 20 cm were used for some measurements. Similarly, where measurements were anticipated to be slow, the inner reservoir of the permeameter (containing a smaller volume of water) was used instead of the larger combined reservoir which was used for most measurements.

To take measurements with the permeameter, the steady-state rate of fall (R) was determined by recording the reservoir water volume at regular time intervals. The rate of fall in the volume was calculated for each time interval and the measurement was only finished when there was no significant change for three consecutive time intervals.

To calculate the final saturated hydraulic conductivity values (Kfs) in the dataset, a Microsoft Excel spreadsheet (available at https://www.soilmoisture.com/Calculators) was used (Soilmoisture Equipment Corp., 2020). The calculation takes into account the observed R value from a measurement, the cross-sectional area of the reservoir used, the well head height, and the well hole radius.

Analytical methods:

Volumetric Water Content & Dry bulk density

Volumetric water content (VWC) was obtained by oven drying soil. Whilst samples were still in their bags, any large lumps of soil were broken up to aid drying. Samples were emptied into pre-weighed aluminium foil trays and then weighted to the nearest 0.1 g. The sample trays were then placed into the oven at 105 °C for approximately 36 hours (up to a maximum of 60 hours). Upon completion of drying, samples were removed from the oven in small batches and immediately weighed to the nearest 0.1 g to ensure they did not regain any moisture from the atmosphere. The following formulae (equations 1-3) were then used to calculate VWC:

$$Volumetric\ soil\ moisture\ content\ (cm^3/cm^3) = \frac{Water\ volume\ (cm^3)}{Sample\ volume\ (cm^3)} \qquad (1)$$

$$Volume\ water\ (cm^3) = \frac{(Mass\ wet\ soil\ (g) - Mass\ dry\ soil\ (g))}{Density\ water\ (g/cm^3)} \qquad (2)$$

$$Density\ water = 1\ g/cm^3 \qquad (3)$$

Dry bulk density was calculated based on the known volume of the soil core samples (100.1 cm^3) following equation 4:

$$Dry\ bulk\ density\ (g\ cm^{-3}) = \frac{Dry\ soil\ mass\ (g)}{Sample\ volume\ (cm^3)} \tag{4}$$

Estimated porosity

Soil porosity was estimated using equation 5 based on an assumed soil particle density of 2.65 g cm^{-3} for mineral soils:

$$Estimated\ porosity\ (cm^3/cm^3) = 1 - \left(\frac{Dry\ bulk\ density\ (g\ cm^{-3})}{2.65}\right) \tag{5}$$

Soil moisture retention

Soil moisture retention analysis was carried out using a Sandbox that applied a range of pressures (pF 0 to pF 2) to soil samples.

Small pieces of thin nylon cloth were attached to the base of the soil samples (still within metal rings) with rubber rings in order to separate the sandbox surface from the soil sample. Each cloth and rubber ring were weighed together before the plastic caps were removed from the core sample rings. The cloth was then attached, and the sample then weighed again.

The samples were then spaced out evenly on the sandbox surface, ensuring a gap of several centimetres between samples. Deionised water was used to supply water to the sandbox during the saturation process. The water supply contained a small addition of copper sulphate to help prevent algal growth within the sandbox and its tubing. Samples were left to saturate in the sandbox until they reached a constant mass. Saturation was assumed to have been reached when sample mass (measured using a 0.1 g precision balance) remained the same for two consecutive days. Evaporation from the sandbox was minimised by placing a tight lid over the sandbox when the samples were not being weighed.

Once all samples were saturated, the suction regulator was changed to apply a suction of 2.5 cm head for the first pF (0.4). Samples were weighed on a daily basis until they reached equilibrium (consistent mass over two consecutive days). This process was then repeated at each of the following pF values: 1, 1.5, 1.7, 1.8 and 2 (equivalent to 100 cm suction).

Nature and Units of recorded values:

Table 5 provides an overview of the variables given in the dataset.

Table 5: Descriptions of columns in the dataset, with their units of measurement provided where applicable.

Column Name	Data Type/Format	Units
ID_SiteNo	Numeric code for identification of site	NA
ID_FieldNo	Numeric code for identification of field	NA
ID_LocationCode	Alphanumeric code for identification of sampling location	NA
ID_SiteNo_FieldNo	Numeric code for identification of site and field	NA
ID_SiteNo_FieldNo_Loc	Numeric code for identification of site, field and sampling location	NA
LocationTypeObs	Text category describing sampling location	NA
OS_Grid_Sq	Text code for Ordnance Survey 100 km British National Grid squares	NA
EastingBNG_PUBLIC	Numeric 6-figure Easting value for British National Grid	m
NorthingBNG_PUBLIC	Numeric 6-figure Northing value for British National Grid	m
Date_Sample_1	Date of sample/measurement in dd/mm/yyyy format for Spring sampling campaign (April 2021)	NA
Time_Sample_1	Time of sample/measurement in hh:mm format for Spring sampling campaign (April 2021)	NA
Sample_1_Soil_Depth	Maximum depth of soil at sampling location for Spring sampling campaign (April 2021)	cm
Sample_1_Root_Depth	Maximum depth of roots at sampling location for Spring sampling campaign (April 2021)	cm
Sample_1_Horizon_1	Depth of first soil horizon at sampling location for Spring sampling campaign (April 2021)	cm
Sample_1_Horizon_2	Depth of second soil horizon at sampling location for Spring sampling campaign (April 2021)	cm
Sample_1_Horizon_3	Depth of third soil horizon at sampling location for Spring sampling campaign (April 2021)	cm
Sample_1_Depth	Depth range of soil sample/measurement for Spring sampling campaign (April 2021)	cm
Sample_1_Depth_1	Depth range of first soil sample/measurement for Spring sampling campaign (April 2021). Given in the top row for each sampling location	cm
Sample_1_Depth_2	Depth range of second soil sample/measurement for Spring sampling campaign (April 2021). Given in the top row for each sampling location	cm
Sample_1_Depth_3	Depth range of third soil sample/measurement for Spring sampling campaign (April 2021). Given in the top row for each sampling location	cm
Sample_1_Depth_4	Depth range of fourth soil sample/measurement for Spring sampling campaign (April 2021). Given in the top row for each sampling location	cm

Sample_1_Depth_5	Depth range of fifth soil sample/measurement for Spring sampling campaign (April 2021). Given in the top row for each sampling location	cm
Sample_1_VolSoilMoistMea	Volumetric soil moisture measurement of Spring sampling campaign sample (April 2021)	cm^3/cm^3
Sample_1_DryBulkDenMea	Soil dry bulk density measurement of Spring sampling campaign sample (April 2021)	g/cm^3
Sample_1_EstPorosityDeriv	Estimated soil porosity of Spring sampling campaign sample (April 2021)	cm^3/cm^3
Sample_1_notes	Text notes from field/lab observations/issues of Spring sampling campaign sample (April 2021)	NA
Date_Sample_2	Date of sample/measurement in dd/mm/yyyy format for Autumn sampling campaign (October 2021)	NA
Time_Sample_2	Time of sample/measurement in hh:mm format for Autumn sampling campaign (October 2021)	NA
Sample_2_Soil_Depth	Maximum depth of soil at sampling location for Autumn sampling campaign (October 2021)	cm
Sample_2_Root_Depth	Maximum depth of roots at sampling location for Autumn sampling campaign (October 2021)	cm
Sample_2_Horizon_1	Depth of first soil horizon at sampling location for Autumn sampling campaign (October 2021)	cm
Sample_2_Horizon_2	Depth of second soil horizon at sampling location for Autumn sampling campaign (October 2021)	cm
Sample_2_Horizon_3	Depth of third soil horizon at sampling location for Autumn sampling campaign (October 2021)	cm
Sample_2_Horizon_4	Depth of fourth soil horizon at sampling location for Autumn sampling campaign (October 2021)	cm
Sample_2_Depth	Depth range of soil sample/measurement for Autumn sampling campaign (October 2021)	cm
Sample_2_Depth_1	Depth range of first soil sample/measurement for Autumn sampling campaign (October 2021). Given in the top row for each sampling location	cm
Sample_2_Depth_2	Depth range of second soil sample/measurement for Autumn sampling campaign (October 2021). Given in the top row for each sampling location	cm
Sample_2_Depth_3	Depth range of third soil sample/measurement for Autumn sampling campaign (October 2021). Given in the top row for each sampling location	cm
Sample_2_Depth_4	Depth range of fourth soil sample/measurement for Autumn sampling campaign (October 2021). Given in the top row for each sampling location	cm
Sample_2_Depth_5	Depth range of fifth soil sample/measurement for Autumn sampling campaign (October 2021). Given in the top row for each sampling location	cm
Sample_2_VolSoilMoistMea	Volumetric soil moisture measurement of Autumn sampling campaign sample (October 2021)	cm^3/cm^3
Sample_2_DryBulkDenMea	Soil dry bulk density measurement of Autumn sampling campaign sample (October 2021)	g/cm^3
Sample_2_EstPorosityDeriv	Estimated soil porosity of Autumn sampling campaign sample (October 2021)	cm^3/cm^3

Sample_2_notes	Text notes from field/lab observations/issues of Autumn sampling campaign sample (October 2021)	NA
SMR_VWC_pF_0	Volumetric water content of soil sample at sand table suction of 0 pF	cm^3/cm^3
SMR_VWC_pF_0.4	Volumetric water content of soil sample at sand table suction of 0.4 pF	cm^3/cm^3
SMR_VWC_pF_1	Volumetric water content of soil sample at sand table suction of 1 pF	cm^3/cm^3
SMR_VWC_pF_1.5	Volumetric water content of soil sample at sand table suction of 1.5 pF	cm^3/cm^3
SMR_VWC_pF_1.7	Volumetric water content of soil sample at sand table suction of 1.7 pF	cm^3/cm^3
SMR_VWC_pF_1.8	Volumetric water content of soil sample at sand table suction of 1.8 pF	cm^3/cm^3
SMR_VWC_pF_2	Volumetric water content of soil sample at sand table suction of 2 pF	cm^3/cm^3
SMR_notes	Text notes from lab observations/issues of sample during soil moisture retention analysis	NA
Infiltrometer_1_Date	Date of infiltration measurement in dd/mm/yyyy format for pre-harvest campaign	NA
Infiltrometer_1_Time	Time of infiltration measurement in hh:mm format for pre-harvest campaign	NA
Infiltration_1_Kunsat	Infiltration measurement (unsaturated hydraulic conductivity) for pre-harvest campaign	cm/s
Infiltration_1_Kunsat_ms	Infiltration measurement (unsaturated hydraulic conductivity) for pre-harvest campaign	m/s
Infiltration_1_QC_Flag	Text code denoting Quality Control flag for Infiltration measurement of pre-harvest campaign (code meanings are given in the Supporting Documentation)	NA
Infiltration_1_notes	Text notes from field observations/issues of infiltration measurement for pre-harvest campaign	NA
Infiltrometer_2_Date	Date of infiltration measurement in dd/mm/yyyy format for post-harvest campaign	NA
Infiltrometer_2_Time	Time of infiltration measurement in hh:mm format for post-harvest campaign	NA
Infiltration_2_Kunsat	Infiltration measurement (unsaturated hydraulic conductivity) for post-harvest campaign	cm/s
Infiltration_2_Kunsat_ms	Infiltration measurement (unsaturated hydraulic conductivity) for post-harvest campaign	m/s
Infiltration_2_QC_Flag	Text code denoting Quality Control flag for Infiltration measurement of post-harvest campaign (code meanings are given in the Supporting Documentation)	NA
Infiltration_2_notes	Text notes from field observations/issues of infiltration measurement for post-harvest campaign	NA
Guelph_Permeameter_Date	Date of Guelph permeameter Kfs measurement in dd/mm/yyyy format	NA
Guelph_Permeameter_Depth	Soil depth of Guelph permeameter Kfs measurement	cm
Guelph_Permeameter_Kfs	Guelph permeameter Kfs (saturated hydraulic conductivity) measurement	cm/s
Guelph_Permeameter_Kfs_ms	Guelph permeameter Kfs (saturated hydraulic conductivity) measurement	m/s
Guelph_Permeameter_QC_Flag	Text code denoting Quality Control flag for Guelph permeameter Kfs measurement (code meanings are given in the Supporting Documentation)	NA
Guelph_Permeameter_notes	Text notes from field observations/issues of Guelph permeameter Kfs measurement	NA

Quality control:

Data underwent a quality control (QC) process to flag any potentially spurious measurements or typos. Measurements made in the field and lab were all entered into Excel spreadsheets by the person that recorded them. To ensure that typos had not been made during the data entry process, the transcribed data were checked by another individual and corrected where necessary.

Infiltration measurements underwent QC to categorise each measurement into the following flags which are stored in the 'Infiltration_1_QC_Flag' and 'Infiltration_2_QC_Flag' columns in the dataset:

- '*Good*' = Where no apparent issues with the measurement were identified.
- '*Invalid*' = Where the measurement gave values that were not physically plausible (e.g. negative values). These values have been removed from the dataset.
- '*A*' = Where the change in infiltration rate over time was observed to be notably unsteady (e.g. where plots of cumulative infiltration over time showed sudden/rapid increases).
- '*B*' = Where <15 ml water was infiltrated during the measurement (the Mini Disk infiltrometer manual states that accurate calculation requires at least 15 ml of water to be infiltrated during each measurement).
- '*C*' = Where K values of measurements were unusually high. This was determined by comparing the measured value against typical K_{sat} + 3 SD (i.e. the 99.7% upper bound of the distribution) from (Carsel & Parrish, 1988). It is important to note that datapoints with this QC flag may potentially reflect the novel soil state/management at the time of measurement.

Saturated hydraulic conductivity measurements underwent QC to categorise each measurement into the following flags which are stored in the 'Guelph_Permeameter_QC_Flag' column in the dataset:

- '*Good*' = Where no apparent issues with the measurement were identified.
- '*Invalid*' = Where measurements gave values that were not physically plausible (e.g. negative values or alpha values outside of the valid range of 0.01 - 0.5 cm^{-1}). These values have been removed from the dataset.

In addition, the 'Guelph_Permeameter_notes' column indicates whether the double head method or the average of two single head measurements was used for deriving the Kfs value for each measurement. The double head method is more accurate and is therefore provided in preference. However, sometimes the data generated physically inadmissible values using the double head method and in this case the data was instead used in two separate single head measurement calculations. The results of the two single head measurements were then averaged. More details are provided in the Guelph Permeameter operating instructions (Soilmoisture Equipment Corp., 2012).

Details of data structure:

This dataset comprises one .csv file entitled 'LANDWISE_detailed_survey_soil_data_2021_updated_v2', containing 70 columns and 380 rows. The column titles are given in Table 5 in the 'Nature and Units of recorded values' section of this documentation and appear in the .csv in the order listed in the table.

'*NA*' values within the dataset represent any missing values (e.g. where measurements were deemed invalid (also noted within the relevant notes column and QC flag column), or where measurements were not taken due to the experimental design).

Fieldwork and laboratory instrumentation:

Soil samples were collected using Eijkelkamp 07.53.SC sample ring kit with closed ring holder and the Edelman auger and Stony auger when required.

The ovens used for drying soil samples were Heraeus Function Line drying ovens (Thermo Fisher Scientific; Waltham, Massachusetts, USA). The balance used to weigh soil samples was a Precisa 2200C, s/n 49375 (Livingston, UK). The sandbox samples were weighed using a Precisa 5000D, s/n 38629. The balances used in the laboratory analyses were checked to 0.1 precision using 100 g and 200 g test weights prior to processing each batch of samples. In addition the lab balances were independently calibrated annually by Avery Weigh-Tronix.

Infiltration measurements were taken using Mini Disk Infiltrometers (Decagon Devices, Inc.; Pullman, Washington, USA).

Soil saturated hydraulic conductivity was measured using a model 2800 Guelph Permeameter (Soilmoisture Equipment Corp.; Goleta, California, USA).

Soil moisture retention analysis was carried out using a model 08.01 Eijkelkamp Sandbox (Royal Eijkelkamp; Giesbeek, The Netherlands).

Miscellaneous:

This dataset is related to the Landwise Broad-scale survey dataset entitled: 'Soil near-surface properties, vegetation observations, land use and land management information for 1800 locations across the Thames catchment, UK, 2018-2021'.

References:

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