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INSTRUCTIONS FOR THE SOIL DEVELOPMENT INDEX TEMPLATE--LOTUS 1-2-3

by

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ABSTRACT

The soil development index (Harden, 1982; Harden and Taylor, 1983) to quantify field properties of soils has proven to be a successful method to study rates of soil development and provides a means to quantitatively compare soil development in different climatic regimes. Three Lotus 1-2-3 templates have been designed to simplify the transition from field descriptions to the calculation of the soil development index. The first two are optional bookkeeping templates to record field descriptions of soils; the third template calculates the soil development index. The field descriptions may be copied into the index template. Data can easily be added, changed, and compared.

INTRODUCTION

Lotus 1-2-3 templates are presented to simplify the calculation of the soil development index (Harden, 1982; Harden and Taylor, 1983). To use these templates it is assumed you are familiar with the variables and the calculations of the soil development index. An understanding of Lotus 1-2-3 is required to efficiently use these templates.

COMPUTER REQUIREMENTS AND MISCELLANEOUS NOTES

These programs have been implemented on IBM PC/XT and compatible microcomputers with Lotus 1-2-3 Version 2.0, running under DOS 3.10. You should also have access to the software "Sideways" to print out the spreadsheets. General hardware requirements are (1) 640K RAM, (2) a dot matrix printer, (3) a monochrome monitor, (4) an IBM color/graphics adapter or equivalent (optional), and (5) a 8087 math co-processor chip (optional).

To use these templates it is assumed that you have a working knowledge of Lotus 1-2-3. You should be able to bring up templates, read and construct Lotus 1-2-3 equations, copy equations, and set the number of significant figures in a given range. To use it efficiently you should also be able to create windows and extract columns and create smaller data sets for statistical analyses. You may also want to create your own macros to copy calculations, however you should be aware that the macros may decrease the number of profiles that may be quantified. Also, when you use macros there will be a problem using cells that do not contain the original equations. This will occur when you select to override equations and directly enter data. If you are unfamiliar with the operation of Lotus 1-2-3 refer to the tutorial included with the Lotus 1-2-3 software package.

There are three Lotus 1-2-3 Version 2.0 templates on the disk. Before you begin, make a backup copy of the original disk. The first two templates are optional bookkeeping tools. The first template is a soil field description sheet--"fldata.wk1". Make a copy of this field description sheet using Sideways for use in the field to ensure collection of all the necessary field data. The second template is a matrix in which to transfer your field data--"fieldis.wk1". The data entries are in the same order as the field description sheet and the template that calculates the soil development index. This second template is intended to

help you compile your field data for proof reading and publication. You may add or delete columns to personalize the spreadsheet for your field data. With minor modifications, it is relatively simple to transfer the data from "fieldis.wk1" into the "index.wk1" template. Both of these templates contain sample data sets.

To use the template that calculates the soil development index--"index.wk1", you initially enter your data, or copy and modify your data from "fieldis.wk1". Then, you must copy the equations from the sample data set. You must write "@sum" equations to calculate the profile property indices for each profile. You can write these equations once for each spreadsheet and then copy them to the other properties (refer to the template and the example data set in "index.wk1"). You may choose to write your own macros to calculate these sums, but first consider the problems discussed above. Each template may contain from data for 35 to 40 soil horizons. Samples of the printed templates are shown in the appendix.

DATA ENTRY--ENTERING SOIL DESCRIPTIONS IN INDEX TEMPLATE

Standard Soil Survey Staff (1951, 1975; Birkeland, 1984; Harden, 1986) field descriptions must be followed in describing soil morphology. Soil colors are measured using the Munsell Soil Color Chart (1954) or the Japanese Soil Color book (Fujihira Industry Co., 1985). Secondary carbonate morphology must be described using the Gile and Grossman (1979, p. 139-191) and Bachman and Machette (1977) field standards.

Sample number: Create a unique number (lab number, horizon code, etc). This number may become very useful when you are doing statistical analyses, because most statistical software packages will not recognize a horizon description such as "2Btqmk1b3".

Horizon description: Enter the field designation.

Depth: Enter measurements for top and bottom of horizon in centimeters.

Thickness: Calculate; copy equation from example row.

Dry and Moist Colors: Enter as many as four dry and moist colors for each soil horizon. If no primary value (dry color #1) for dry hue, value, or chroma is recorded, missing data are assumed.

Hue:

5Y	=	0
2.5Y	=	1
10YR	=	2
7.5YR	=	3
5YR	=	4
2.5YR	=	5
10R	=	6
5R	=	7

note: extrapolate between points 8.75YR = 2.5

Value: Enter actual value.

Chroma: Enter actual chroma.

Parent Material Colors: Enter the dry and moist colors the same way you did by horizon. One dry and one moist color may be entered.

Total Texture: There are two alternative methods to calculate soil texture. One method will calculate the texture from the lab particle-size data, the second from the USDA textural class (S, LS, SL, Si, L, SCL, SiL, CL, SC, C, SiCL, or SiC). There are 14 columns involved in the calculation of total texture. If available, lab particle-size data for the horizon and parent material are entered in the first six columns. The columns are labeled "SAND", "SILT", and "CLAY" for the horizon data (lab-S, Si, or C) and the parent material data (PM-S, Si, or C). The USDA textural class will be determined for the horizon and parent material by copying the eight equations adjacent to the columns where the lab particle-size data are entered. These eight columns are labeled "HZ", "(a)", "(b)", and "(c)" under "Horizon"; and "PM" "(a)", "(b)", and "(c)" under "Parent Material". The columns labeled "(a)", "(b)", and "(c)" contain the data from the textural triangle used to calculate the textural class from the particle-size data. Because of the equation length limitations in Lotus 1-2-3, three equations are required to calculate the USDA textual class from the lab data.

If the lab particle-size data are not used, the USDA textural class must be entered in the appropriate column. You should enter the textural class for the horizon and the parent material in the columns labeled "HZ" for the horizon and "PM" for the parent material, however, this is strictly for your bookkeeping. You must enter the textual class number code that corresponds to each horizon. Type the textural class number code in the column adjacent to the "HZ" and "PM" labeled "(a)", and type "-9"'s in the following two columns in both the case of the horizon and the parent material. Note that these columns contain calculations that are used when the lab particle-size data are entered, so you lose the equation when you override the calculation by just typing in the textural class and the textural class number code. **You must** fill in the three columns adjacent to the columns labeled "HZ" and "PM" ("(a)", "(b)", and "(c)) with the textural class number code in first column and "-9" in the other columns.

Enter "-9" for missing texture data in the columns labeled "(a)", "(b)", and "(c). If there is a "-9" in all of these columns no texture value will be used for that horizon.

USDA Textural Class Number Code:

S	=	1
LS	=	2
SL, Si	=	3
L, SCL	=	4
SiL, CL, SC	=	5
C, SiCL	=	6
SiC	=	7

Structure:

Grade: Enter "9" for missing structure data in the primary grade column. If there is a "9" in this column no structure value will be used for that horizon.

massive but not cemented by secondary $CaCO_3$ or SiO_2, and single grain	0
very weak	0.5
weak (1)	1.0
weak to moderate	1.5
moderate (2)	2.0
moderate to strong	2.5
strong (3)	3.0
very strong	3.5

Kind:

platy (A, Bw, or Bj horizons)	0.5
granular and crumb	1
angular blocky, subangular blocky, and massive stage III $CaCO_3$ or SiO_2	1
prismatic, and $CaCO_3$ or SiO_2 stage IV plates	2
columnar, and stage V and VI $CaCO_3$	3

Consistence: The parent material consistence follows the consistence value for each horizon.

Dry: Enter "9" for missing dry consistence data. If there is a "9" in this column, no dry consistence value will be used for that horizon.

lo	so	sh	h	vh	eh
0	1	2	3	4	5

Moist: Enter "9" for missing moist consistence data. If there is a "9" in this column, no moist consistence value will be used for that horizon.

lo	vfr	fr	fi	vfi	efi
0	1	2	3	4	5

Wet: Enter "9" for missing wet consistence data. If there is a "9" in either the stickiness or plasticity column, no wet consistence value will be used for that horizon.

so	vss	ss	s	vs
0	0.5	1	2	3

po	vps	ps	p	vp
0	0.5	1	2	3

Clay Films: Enter "9" in the primary (1^{o}) stains column to code for missing clay film data. If there is a "9" in this column, no clay film value will be used for that horizon. Blank spaces indicate that no clay films were recognized in the field, not missing data. You may enter as many clay film descriptions as you want in either the primary (1^{o}) or secondary (2^{o}) columns for stains (co, frequency only), pores (po), clast or gravel coats, bridges (br), and ped faces (pf).

Frequency:

(v1)	(1)	(2)	(3)	(4)
very few	few	common	many	continuous
1	2	3	4	5

Thickness:

(1)	(2)	(3)
n	mk	k
1	2	3

Location (determined by column):

colloid stains	10
pores	10
clast or gravel coat	10
bridges	20
ped face	20

Secondary Carbonate: Enter the stage from 0.5 (disseminated) to 6.0, of the secondary carbonate morphology. Enter "9" for missing carbonate data. If there is a "9" in this column, no carbonate value will be used for that horizon. Blanks are assumed to equal 0 or no carbonate, not missing data.

pH: Enter lab values for the horizon and the parent material. Enter "999" for missing soil pH data. If there is a "999" in this column, no pH value will be used for that horizon.

PROGRAM OPERATION--COPY EQUATIONS TO HAVE LOTUS 1-2-3 CALCULATE THE QUANTIFIED, NORMALIZED, AND PROFILE INDEX VALUES

Copy the equations or cell entries through the property "profile pH increase", from a row in the sample data set to your data. The columns labeled profile "property" must have unique equations for each profile. Do not forget to copy the eight texture equations labeled "HZ", "PM", "(a)", "(b)", and "(c)" if you have entered lab particle-size data. If you do not mind the display of intermediate values, you can write a single equation for the profile "property". This would avoid having to go back and copy this equation for each profile. You may also choose to write a macro to perform these calculations.

Profile Property: For each profile, sum the previous column labeled "X thickness". In other words, you are summing the "normalized property X horizon thickness" for a given profile. Look at the example profile. You only need to do this for the first property, then you can copy this column to all the other profile "property" columns.

There is a problem in the sensitivity of the data to variable depths of soil descriptions. Several approaches are noted in the literature--do nothing, carry basal soil horizons to an arbitrary depth, or cut off deeper soils to a depth of the shallowest pit in a study area. If you have not described the soils you are quantifying to a horizon that you feel is as similar to the parent material as possible, you must decide at this point what approach you will take. The approach selected may vary for different study areas.

DESCRIPTION OF HOW THE QUANTIFIED VALUE IS CALCULATED FOR EACH SOIL PROPERTY

Rubification, Melanization, Color Paling, and Color Lightening: The program calculates the maximum and minimum values entered for dry and moist hue, value and chroma. If you have a **soil color component equal to "0"** (hue = 5Y, value = 0, chroma = 0) you must override the minimum calculation, and enter a 0 for the minimum in that color component. Blank spaces in the field description colors are read as "0's", so the program will not recognize an actual data entry of "0". If no primary dry (dry color #1) or moist (moist color #1) color is recorded in the field description, "999" is entered for missing data.

Before rubification, melanization, color lightening, and paling are quantified, dry and moist hue, value, and chroma are independently quantified. When **both** the maximum and minimum are greater or less than the parent material, the quantified value is equal to the difference between the parent material and the midpoint between the maximum and minimum. For color hue and value, positive quantified values indicate that the maximum and minimum are greater than the parent material, and negative values that the maximum and minimum are less than the parent material. The opposite is true in the case of color chroma. When the maximum is greater than the parent material and the minimum is less than or equal to the parent material, the maximum and minimums are handled separately. A good example of this situation is a horizon with white carbonate nodules in a red soil matrix, that has formed from in a soil with a brown parent material. Both rubification and color lightening are occurring in this horizon. The difference between the parent material and the midpoint between the parent material and the maximum would yield a positive number for hue and chroma, and a negative number for color value. The difference between the parent material and the midpoint between the parent material and the minimum would yield a negative number for hue and chroma, and a positive number for color value.

Total Texture: Total texture combines quantified texture and wet consistence. If either texture or wet consistence (either stickiness or plasticity) is missing, "999" will be entered for total texture. The parent material value for wet consistence, including stickiness and plasticity, is subtracted from the horizon value. Only increases are quantified.

Texture is quantified by counting the number of line crossings toward clay from the parent material to the horizon texture (table 1). Scan the total texture data for negative texture values, and suspect values if you are quantifying soils with parent material finer than a sandy loam. Modify the texture data to the number of "line crossings X 10" for finer parent material. You may want to create a matrix of parent material vs horizon textures or refer to table 1 to be consistent with your line crossing values.

TABLE 1: Results of textural class quantifications of line crossings between the parent material and soil horizon going in the clay direction. The **number in bold print** is the number calculated by the "index.wk1" spreadsheet, and the **number in parentheses** is the correct number, and <u>not the number</u> calculated in the spreadsheet. All calculations favor sandier soil parent materials, therefore, if you are quantifying soils derived from fine-grained deposits you <u>must</u> correct the appropriate column under quantified total texture where line crossings are quantified (texture-line Xing).

		PARENT MATERIAL										
		S	LS	SL	Si	L	SCL	CL	SiL	SC	SiCL	C	SiC
		1	2	3	3	4	4	5	5	5	6	6	7
HZ													
S	1	**0**											
LS	2	**1**	**0**			LINE CROSSING TOWARD CLAY =							
SL	3	**2**	**1**	**0**		HORIZON VALUE - PARENT MATERIAL							
Si	3	**2(4)**	**1(3)**	**0(2)**	**0**								
L	4	**3**	**2**	**1**	**1(2)**	**0**							
SCL	4	**3**	**2**	**1**	**1(3)**	**0(1)**	**0**						
CL	5	**4**	**3**	**2**	**2**	**1**	**1**	**0**					
SiL	5	**4(3)**		**3(2)**	**2(1)**	**2(1)**	**1(0)**	**1(0)**	**0**	**0**			
SC	5	**4**	**3**	**2**	**2(4)**	**1(2)**	**1**	**0(1)**	**0(3)**	**0**			
SiCL	6	**5**	**4**	**3**	**3(2)**	**2**	**2**	**1(0)**	**1**	**1(0)**	**0**		
C	6	**5**	**4**	**3**	**3**	**2**	**2**	**1**	**1(2)**	**1**	**0(1)**	**0**	
SiC	7	**6**	**5**	**4**	**4(3)**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**0**

<u>Structure</u>: The sum of the "grade" and the "kind" of the primary structure is added to one half of the sum of the secondary "grade" and "kind". If there is a "9" in the primary structure column, missing data are assumed, and "999" is entered for quantified structure.

<u>Dry Consistence</u> and <u>Moist Consistence</u>: The parent material value is subtracted from the quantified horizon value. Only increases are quantified. If there is a "9" in the dry or moist consistence column, missing data are assumed, and "999" is entered for quantified dry or moist consistence.

<u>Clay Films</u>: Stains, pores, and clast are assigned 10 points, and bridges and ped face clay films are assigned 20 points. This location value of the clay film is determined by the column in which the frequency and thickness are entered. Quantified clay film is equal to the location point value (10 or 20), plus 10 times the frequency and thickness recorded in that column. If there is a "9" in the primary (1^{o}) stains column, missing data are assumed, and "999" is entered for quantified clay films.

The primary class or class with the greatest point value is recorded in a column labeled "primary class". One half of the frequency values of the secondary clay films are added to the primary value. Immediately adjacent to the column labeled "primary class" is a column that contains either "ok" or "!!". This column is to help you check your data. If there is a "!!" in this column, there may be a secondary clay film that is equal to the maximum. If this occurs, <u>you</u> must enter one half of the sum of the secondary frequency or frequencies in either column labeled "sum of 2^{o} frequency/2" that contains a "0". Note that these columns contain calculations, the results of which are used to calculate the normalized clay film value. You lose the equation when you override the calculation by just typing in the value of one half the sum of the secondary frequencies.

Secondary carbonate: The values for quantified color lightening and color paling are summed and this value is multiplied by the carbonate stage. If there is a "999" in color lightening, in color paling, or a "9" in the carbonate stage, "999" is entered for quantified carbonate.

pH Decrease and pH Increase: The parent material value is subtracted from the quantified horizon value. Positive vales indicate a pH decrease and negative values indicate a pH increase in comparison to the parent material. If there is a "999" in the pH column, "999" is entered for quantified pH decease and pH increase.

DESCRIPTION OF HOW THE NORMALIZED VALUE IS CALCULATED FOR EACH SOIL PROPERTY

Rubification (maximum=190) and Color Paling (maximum=60): Positive (rubification) or negative (color lightening) quantified dry hue and chroma, and moist hue and chroma are summed and divided by the current maximum. If either the dry or moist color is missing, the single dry hue and chroma, or moist hue and chroma is normalized by dividing by one half of the maximum. If both dry and moist color values are missing ("999"), "999" is entered, and no rubification or color paling value is used for that horizon. This program requires that both hue and chroma be recorded to calculate rubification or color paling.

Melanization (maximum=85) and Color Lightening (maximum=80): Negative (melanization) and positive (color lightening) quantified dry and moist color values are summed and divided by the current maximum. If either dry or moist color value is missing, the single color value is normalized by dividing by one half of the maximum. If both dry and moist color values are missing ("999"), "999" is entered, and no melanization or color lightening value is used for that horizon.

Total Texture (maximum=90): The quantified value is divided by the current maximum. If the quantified value is missing ("999"), no total texture value is used for that horizon.

Structure (maximum=60): The quantified value is divided by the current maximum. If the quantified value is missing ("999"), no structure value is used for that horizon.

Dry Consistence (maximum=100) and Moist Consistence (maximum=100): The quantified value is divided by the current maximum. If the quantified value is missing ("999"), no consistence value is used for that horizon.

Clay Films (maximum=130): The maximum quantified clay film class is recognized. One half of the abundance values of all the secondary quantified clay films are added to the maximum. This total is reduced by 20 and divided by the current maximum. If the quantified value is missing ("999"), no clay film value is used for that horizon.

Secondary carbonate (maximum=240): The quantified value is divided by the current maximum. If the quantified value is missing ("999"), no consistence value is used for that horizon.

pH Decrease (maximum=3.5) and pH Increase (maximum=1.5): The quantified value is divided by the current maximum. If the quantified value is missing ("999"), no pH value is used for that horizon.

YOU CAN CALCULATE THE PROFILE INDEX IN A NUMBER OF WAYS

Look at the section on the spreadsheet that allows you to select how you want the index calculated. Type in "yes" or "no" adjacent to the properties that you want included in the calculation of the soil development index.

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APPENDIX I

Soil Field Description Sheet

SOIL FIELD DESCRIPTION SHEET

PAGE _______ OF _______

SAMPLE NO. ________________ DATE _________ TIME _________ WEATHER _____________ DESCRIBED BY ______________________________

LOCATION ____

GEOMORPHIC SURFACE/LANDFORM ____ ESTIMATED AGE ____________________

ELEVATION __________ SLOPE __________ ASPECT __________ EROSION __________ CLIMATE ________________________ PHOTOS ____________________

VEGETATION ____

HORIZON, BOUNDARY	DEPTH, CM	COLOR	(DRY)	(MOIST)	TEXTURE	STRUCTURE	CONSISTENCE	CLAY FILMS	SECONDARY CaCO3	% GRAVEL	PARENT MATERIAL & LITHOLOGY	MISCELLANEOUS -- ROOTS, PORES, SILICA, OXIDATION, CONCRETIONS, SALTS
		MATRIX				1o	DRY			Bd >26 cm		. SAMPLES
										Cb 6-26 cm		
		CARB					MOIST			Pb 60-4 mm		.
						2o				Gr 2-4 mm		
		MISC					WET					.
										TOTAL <2 mm		
												.
		MATRIX				1o	DRY			Bd		.
										Cb		
		CARB					MOIST			Pb		.
						2o				Gr		
		MISC					WET					.
										TOTAL <2 mm		
												.
		MATRIX				1o	DRY			Bd		.
										Cb		
		CARB					MOIST			Pb		.
						2o				Gr		
		MISC					WET					.
										TOTAL <2 mm		
												.
		MATRIX				1o	DRY			Bd		.
										Cb		
		CARB					MOIST			Pb		.
						2o				Gr		
		MISC					WET					.
										TOTAL <2 mm		
												.
		MATRIX				1o	DRY			Bd		.
										Cb		
		CARB					MOIST			Pb		.
						2o				Gr		
		MISC					WET					.
										TOTAL <2 mm		
												.

APPENDIX II

Soil Field Description Data Entry Template

16-Mar-88

SURFACE ELEV, M AGE	PROFILE	SAMPLE NUMBER	HORIZON	DEPTH,cm TOP	DEPTH,cm BASE	BOUNDARY	COLOR #1 MATRIX DRY	COLOR #1 MATRIX MOIST	COLOR #2 CARBONATE DRY	COLOR #2 CARBONATE MOIST
Q7	CV-1	CV-1.1	Av	0	8	as	10YR 7/3	10YR 4/4		
1500 m		CV-1.2	Btk	8	13	ab	7.5YR 5/4	7.5YR 4.5/4		
200 Ka	Taylor	CV-1.3	Bky	13	23	cb	7.5YR 6.5/4	7.5YR 5/4		
	Huckins	CV-1.4	2Btkyb	23	44	gb	7.5YR 5.5/6	7.5YR 4.5/4	10YR 8/2	10YR 7/4
		CV-1.5	2Bky1b	44	64	cw	10YR 7/3	10YR 4/3	7.5YR 8/2	7.5YR 4.5/4
		CV-1.6	2Bky2b	64	100	gs	10YR 7/3	10YR 4/3	7.5YR 8/2	10YR 5/4
		CV-1.7	2Bky3b	100	126	as	10YR 7/3	10YR 4/3	10YR 8/3	10YR 7/4
		CV-1.8	2Bky4b	126	152	as	10YR 7/3	10YR 4/2		
		CV-1.9	3Btkqb	152	250	--	7.5YR 7/4	7.5YR 4/4	7.5YR 8/2	7.5YR 7/4

NOTES:

COLOR #3 DRY	COLOR #3 MOIST	COLOR #4 DRY	COLOR #4 MOIST	TEXTURE	STRUCTURE 1o	STRUCTURE 2o	CONSISTENCE DRY	CONSISTENCE MOIST	CONSISTENCE WET
				CL	2co sbk	2t pl	sh	ND	s,ps
				L	2m pl	1m sbk	sh	ND	ss,ps
				SL	1f sbk	-	lo	ND	ss,ps
				SL	1co sbk	m	sh	ND	so,po
				LS	1co sbk	m	lo	ND	so,po
				LS	sg	-	lo	ND	so,po
				LS	2co sbk	-	sh	ND	so,po
				LS	sg	-	lo	ND	so,po
				SL	m	2co sbk	sh	ND	so,po

<-- CLAY FILMS --> 1o	2o	<------- CaCO3 --------> MATRIX	GRAVEL	% GRAVEL >2 mm	PARENT MATERIAL & LITHOLOGY	ROOTS (* MAX)
2mk po	-	dis	-	<5	eolian	1f
3mk br	-	dis	stg I	30	eolian w/ alluvium	1f
-	-	dis	stg I	50	"	2f,1m,1co *
3mk br	-	dis	stg II	80	grusy granitic	1f
-	-	dis	stg II+	80	alluvium	1f
1n br	-	dis	stg I	80	"	1f,1m
1n br	-	strg stg II	-	80	"	1f
-	-	ND	stg I-	90	"	1f,1m
3n-mk br	-	strg stg II	-	90	"	1f

PORES	SiO2	SALT MATRIX	SALT GRAVEL	MISCELLANEOUS
1vf,3m ves	-	-	-	gravel intact
2vf, 1f	-	-	-	"
ND	stg I	-	-	"
ND	-	stg I-II	-	gravel grusified
inter	-	stg I-II	-	"
inter	-	stg I-II	-	gravel intact
inter	-	stg I-II	-	"
inter	stg I	stg I-II	-	"
inter	stg III	-	-	buried soil?

APPENDIX III

Soil Development Index Template

16-Mar-88

5Y=0, 2.5Y=1, 10YR=2, 7.5YR=3,
5YR=4, 2.5YR=5, 10R=6, 5R=7

FIELD DESCRIPTION DATA ------->

Sample Number	Horizon	Depth (cm)		Thickness	SOIL COLOR Dry #1 hue	value	chroma	Moist #1 hue	value	chroma	Dry #2 hue	value	chroma
1.01	A	0	10	10	2.0	6.0	3.0	2.0	4.0	2.0			
1.02	Bt	10	25	15	2.0	5.5	3.0	2.0	4.0	3.0			
1.03	2Btqb1	25	42	17	3.0	5.0	4.0	2.0	4.0	3.0			
1.04	2Btqb2	42	56	14	3.0	5.0	4.0	3.0	4.0	4.0			
1.08	3Kqmb1	56	70	14	2.0	8.0	2.0	2.0	7.0	2.0			
1.09	4Kqmb2	70	115	45									
1.10	5Bk	115	167	52	3.0	7.0	6.0						
1.11	5Cnk	167	195	28	3.0	7.0	4.0	3.0	5.0	4.0			
1.12	5Cn	195	290	95	3.0	7.0	4.0	3.0	5.0	4.0	3.0	6.0	2.5

Moist #2 hue	value	chroma	Dry #3 hue	value	chroma	Moist #3 hue	value	chroma	Dry #4 hue	value	chroma	Moist #4 hue	value	chroma

s=1; ls=2; sl,si=3; l,scl=4; sil,cl,sc=5; c,sicl=6; sic=7

PARENT MATERIAL <-- Dry Color -->			<- Moist Color ->			TEXTURE - Lab Data - SAND % Total		SILT % Total		CLAY % Total		HZ	USDA Textural Class - Horizon (a)	(b)	(c)	PM	Parent Material (a)	(b)	(c)
hue	value	chroma	hue	value	chroma	lab-S	PM-S	lab-Si	PM-Si	lab-C	PM-C								
2.0	6.0	3.0	2.0	4.0	3.0	61.66	65.00	23.26	25.00	15.07	10.00	SL	3	-9	-9	SL	3	-9	-9
2.0	6.0	3.0	2.0	4.0	3.0	53.13	65.00	27.90	25.00	18.97	10.00	SL	3	-9	-9	SL	3	-9	-9
2.0	6.0	2.0	2.0	4.0	2.0	33.66	98.00	21.23	1.00	45.11	1.00	C	-9	6	-9	S	1	-9	-9
2.0	6.0	2.0	2.0	4.0	2.0	36.06	98.00	19.73	1.00	44.22	1.00	C	-9	6	-9	S	1	-9	-9
2.0	6.0	2.0	2.0	4.0	2.0	46.16	98.00	20.77	1.00	33.07	1.00	SCL	-9	4	-9	S	1	-9	-9
2.0	6.0	2.0	2.0	4.0	2.0	61.61	98.00	17.40	1.00	20.99	1.00	SCL	-9	4	-9	S	1	-9	-9
2.0	6.0	2.0	2.0	4.0	2.0	73.98	98.00	12.58	1.00	13.45	1.00	SL	3	-9	2	S	1	-9	-9
2.0	6.0	2.0	2.0	4.0	2.0	70.56	98.00	16.43	1.00	13.01	1.00	SL	3	-9	2	S	1	-9	-9
2.0	6.0	2.0	2.0	4.0	2.0	80.36	98.00	8.98	1.00	10.66	1.00	SL	3	-9	2	S	1	-9	-9

m; vw; w; m; s; vs	lo so sh h vh eh	so vss ss s vs	0vf 1f 2c 3m 4c
Pl; G,Cr; Ab,Sb; Pr,"K"; C	0 1 2 3 4 5	0 0.5 1 2 3	n mk k
0 0.5 1 2 3 3.5	lo vfr fr fi vfi efi	po ps p vp	1 2 3 4 5

STRUCTURE primary Grade*	primary Kind	secondary Grade	secondary Kind	CONSISTENCE < Dry > HZ*	< Dry > PM	< Moist > HZ*	< Moist > PM	<- - - Wet - - -> stkn*	stkn PM	plst*	plst PM	CLAY FILMS stains (1o)*	stains freq (2o)	bridges(1o) freq	bridges(1o) thkn	bridges(2o) freq	bridges(2o) thkn
1.0	1.0	0.0		1.0	1.0	9.0		1.0	0.0	1.0	0.0		2.0				
1.0	1.0	2.0	1.0	1.0	1.0	9.0		1.0	0.0	1.0	0.0						
2.0	1.0			2.0	0.0	9.0		2.0	0.0	2.0	0.0						
2.0	1.0			2.0	0.0	9.0		2.0	0.0	2.0	0.0						
2.0	2.0			5.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0						
0.0				4.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0						
0.0				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
0.0				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
0.0				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						

* NOTE: For missing data enter "9" for structure (1o grade), clay films (stains), dry, moist and wet consistence, and secondary carbonate; and "999" for pH.

pores(1o) freq	pores(1o) thkn	pores(2o) freq	pores(2o) thkn	ped faces(1o) freq	ped faces(1o) thkn	ped faces(2o) freq	ped faces(2o) thkn	clasts(1o) freq	clasts(1o) thkn	clasts(2o) freq	clasts(2o) thkn	CaCO3 STAGE*	pH lab*	PM
												0.0	7.25	7.96
												0.0	7.20	7.96
				3.0	2.0							0.0	7.30	7.96
				3.0	3.0							0.0	7.40	7.96
												3.5	8.15	7.96
												3.5	8.40	7.96
												2.0	8.10	7.96
												1.0	8.40	7.96
												0.0	8.40	7.96

SOIL DEVELOPMENT INDICES

DRY COLOR						MOIST COLOR					
MAX Hue	MIN Hue	MAX Value	MIN Value	MAX Chroma	MIN Chroma	MAX Hue	MIN Hue	MAX Value	MIN Value	MAX Chroma	MIN Chroma
2.0	2.0	6.0	6.0	3.0	3.0	2.0	2.0	4.0	4.0	2.0	2.0
2.0	2.0	5.5	5.5	3.0	3.0	2.0	2.0	4.0	4.0	3.0	3.0
3.0	3.0	5.0	5.0	4.0	4.0	2.0	2.0	4.0	4.0	3.0	3.0
3.0	3.0	5.0	5.0	4.0	4.0	3.0	3.0	4.0	4.0	4.0	4.0
2.0	2.0	8.0	8.0	2.0	2.0	2.0	2.0	7.0	7.0	2.0	2.0
999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
3.0	3.0	7.0	7.0	6.0	6.0	999.0	999.0	999.0	999.0	999.0	999.0
3.0	3.0	7.0	7.0	4.0	4.0	3.0	3.0	5.0	5.0	4.0	4.0
3.0	3.0	7.0	6.0	4.0	2.5	3.0	3.0	5.0	5.0	4.0	4.0

----- Quantified Colors for Rubification (+), Melanization (-),
Color Paling (-), Color Lightening (+)

Dry hue		Dry value		Dry chroma		Moist hue		Moist value		Moist chroma	
(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-10.0
0.0	0.0	0.0	-5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10.0	0.0	0.0	-10.0	20.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0
10.0	0.0	0.0	-10.0	20.0	0.0	10.0	0.0	0.0	0.0	20.0	0.0
0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0	0.0
999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0	999.0
10.0	0.0	10.0	0.0	40.0	0.0	999.0	999.0	999.0	999.0	999.0	999.0
10.0	0.0	10.0	0.0	20.0	0.0	10.0	0.0	10.0	0.0	20.0	0.0
10.0	0.0	5.0	0.0	12.5	0.0	10.0	0.0	10.0	0.0	20.0	0.0

----- RUBIFICATION ------> (maximum=190)			----- MELANIZATION ------> (maximum=85)			----- COLOR-PALING ------> (maximum=60)		
Normalized Rub	X thick	Profile Rub	Normalized Mel	X thick	Profile Mel	Normalized Pale	X thick	Profile Pale
0.00	0.00		0.00	0.00		0.17	1.67	
0.00	0.00		0.06	0.88		0.00	0.00	
0.21	3.58		0.12	2.00		0.00	0.00	
0.32	4.42		0.12	1.65		0.00	0.00	
0.00	0.00		0.00	0.00		0.00	0.00	
999.00	0.00		999.00	0.00		999.00	0.00	
0.53	27.37		0.00	0.00		0.00	0.00	
0.32	8.84		0.00	0.00		0.00	0.00	
0.28	26.25	70.46	0.00	0.00	4.53	0.00	0.00	1.67

---- COLOR-LIGHTENING ---> (maximum=80)			------- TOTAL TEXTURE ----------> (maximum=90)					
			<------ Quantified ------>					
Normalized Light	X thick	Profile Light	Texture (line Xing)	Wet Con	Total Texture	Normalized Texture	X thick	Profile Texture
0.00	0.00		0.0	20.0	20.0	0.22	2.22	
0.00	0.00		0.0	20.0	20.0	0.22	3.33	
0.00	0.00		50.0	40.0	90.0	1.00	17.00	
0.00	0.00		50.0	40.0	90.0	1.00	14.00	
0.63	8.75		30.0	0.0	30.0	0.33	4.67	
999.00	0.00		30.0	0.0	30.0	0.33	15.00	
0.25	13.00		20.0	0.0	20.0	0.22	11.56	
0.25	7.00		20.0	0.0	20.0	0.22	6.22	
0.19	17.81	46.56	20.0	0.0	20.0	0.22	21.11	95.11

---------- STRUCTURE ----------> (maximum=60)				----- DRY CONSISTENCE ----------> (maximum=100)			
Quantified Struc	Normalized Struc	X thick	Profile Struc	Quantified Dry Con	Normalized Dry Con	X thick	Profile Dry Con
20.00	0.33	3.33		0.00	0.00	0.00	
35.00	0.58	8.75		0.00	0.00	0.00	
30.00	0.50	8.50		20.00	0.20	3.40	
30.00	0.50	7.00		20.00	0.20	2.80	
40.00	0.67	9.33		50.00	0.50	7.00	
0.00	0.00	0.00		40.00	0.40	18.00	
0.00	0.00	0.00		0.00	0.00	0.00	
0.00	0.00	0.00		0.00	0.00	0.00	
0.00	0.00	0.00	36.92	0.00	0.00	0.00	31.20

---- MOIST CONSISTENCE ------------->
(maximum=100)

Quantified Mst Con	Normalized Mst Con	X thick	Profile Mst Con
999.00	999.00	0.00	
999.00	999.00	0.00	
999.00	999.00	0.00	
999.00	999.00	0.00	
20.00	0.20	2.80	
20.00	0.20	9.00	
0.00	0.00	0.00	
0.00	0.00	0.00	
0.00	0.00	0.00	11.80

---- CLAY FILMS --------->

---- CLAY FILMS --------->
(normalize: -20/130)

Quantified Clay Films: stains 1o	stains 2o	bridges 1o	bridges 2o	pores 1o	pores 2o	ped face 1o	ped face 2o	clasts 1o	clasts 2o	primary class		Sum of 2o Freqs/2		Normalized Cly Flms	X thick	Profile Cly Flms
30	0	0	0	0	0	0	0	0	0	30	ok	0	0	0.08	0.77	
0	0	0	0	0	0	0	0	0	0	0	ok	0	0	0.00	0.00	
0	0	0	0	0	0	70	0	0	0	70	ok	0	0	0.38	6.54	
0	0	0	0	0	0	80	0	0	0	80	ok	0	0	0.46	6.46	
0	0	0	0	0	0	0	0	0	0	0	ok	0	0	0.00	0.00	
0	0	0	0	0	0	0	0	0	0	0	ok	0	0	0.00	0.00	
0	0	0	0	0	0	0	0	0	0	0	ok	0	0	0.00	0.00	
0	0	0	0	0	0	0	0	0	0	0	ok	0	0	0.00	0.00	
0	0	0	0	0	0	0	0	0	0	0	ok	0	0	0.00	0.00	13.77

---- SECONDARY CARBONATE ----------> (maximum=240)				-------- pH DECREASE ----------> (maximum=3.5)				----- pH INCREASE -------> (maximum=1.5)		
Quantified Carb	Normalized Carb	X thick	Profile Carb	Quantified pH	Normalized pH dec	X thick	Profile pH dec	Normalized pH inc	X thick	Profile pH inc
0.00	0.00	0.00		0.71	0.20	2.03		0.00	0.00	
0.00	0.00	0.00		0.76	0.22	3.26		0.00	0.00	
0.00	0.00	0.00		0.66	0.19	3.21		0.00	0.00	
0.00	0.00	0.00		0.56	0.16	2.24		0.00	0.00	
175.00	0.73	10.21		-0.19	0.00	0.00		0.13	1.77	
999.00	999.00	0.00		-0.44	0.00	0.00		0.29	13.20	
40.00	0.17	8.67		-0.14	0.00	0.00		0.09	4.85	
20.00	0.08	2.33		-0.44	0.00	0.00		0.29	8.21	
0.00	0.00	0.00	21.21	-0.44	0.00	0.00	10.73	0.29	27.87	55.91

HOW DO YOU WANT TO CALCULATE THE PROFILE INDEX? YOUR CHOICES ARE THE FOLLOWING ---ALL PROPERTIES INCLUDING---	TYPE YES OR NO NEXT TO *	<******* INDEX VALUE ********** RUB-MEL WITH pH DECREASING Horizon Index (Sum normalized prop/# prop)	X thick	PROFILE INDEX (1)
(1)		0.84	0.12	1.19
RUBIFICATION, MELANIZATION AND		1.08	0.15	2.32
pH DECREASING	* yes	2.60	0.37	6.32
		2.75	0.39	5.51
(2)		1.70	0.21	2.98
COLOR PALING, COLOR LIGHTENING		0.93	0.16	7.00
AND pH INCREASING	* yes	0.75	0.09	4.87
		0.54	0.07	1.88
(3)		0.50	0.06	5.92
INCLUDE ONLY THE FOLLOWING				
RUBIFICATION (R)	* yes			
MELANIZATION (M)	* no			
COLOR-PALING (CP)	* no			
COLOR-LIGHTENING (CL)	* no			
TEXTURE (T)	* yes			
STRUCTURE (S)	* no			
DRY CONSISTENCE (DC)	* no			
MOIST CONSISTENCE (MC)	* no			
CLAY FILMS (CF)	* no			
SECONDARY CARBONATE (C)	* yes			
pH DECREASING (PD)	* no			
pH INCREASING (PI)	* yes			

<********* INDEX VALUE *********> PALE-LIGHT WITH pH INCREASING				********* INDEX VALUE - PROPERTIES SELECTED ********* RUB, TEXTURE, CARB, pH INC						
Horizon Index (Sum normalized prop/# prop)		X thick	PROFILE INDEX (2)	Sum Normalized Properties (R-S)	(DC-PI)	Count Properties (R-S)	(DC-PI)	Horizon Index	X thick	SELECTED PROFILE INDEX
0.80	0.11	1.14		0.22	0.00	2	2	0.06	0.56	
0.81	0.12	1.73		0.22	0.00	2	2	0.06	0.83	
2.08	0.30	5.06		1.21	0.00	2	2	0.30	5.14	
2.16	0.31	4.32		1.32	0.00	2	2	0.33	4.61	
2.45	0.31	4.29		0.33	0.86	2	2	0.30	4.16	
1.23	0.20	9.20		0.33	0.29	1	1	0.31	14.10	
0.57	0.07	3.68		0.75	0.26	2	2	0.25	13.11	
0.77	0.10	2.68		0.54	0.38	2	2	0.23	6.40	
0.70	0.09	8.35	40.45	0.50	0.29	2	2	0.20	18.81	67.72