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Soil Fingerprint Framework for 'A' Horizon (Topsoil) Characterization and Soil Quality Monitoring in Canada

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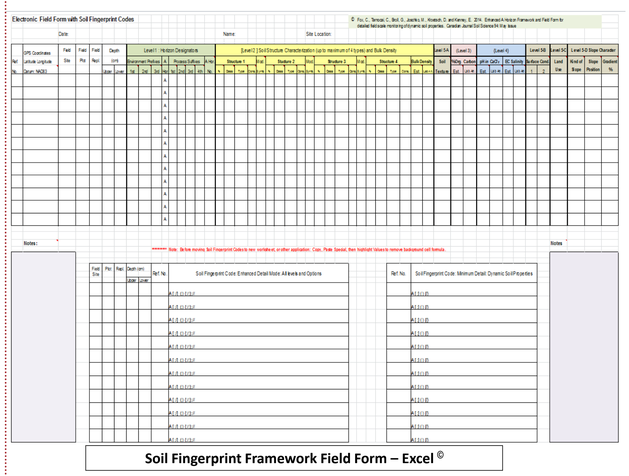
Introduction

A soil "fingerprinting" framework developed by Agriculture and Agri-Food Canada researchers and soil specialists has the capacity to describe and monitor the impacts of land management and environment on soil quality and soil quality change. This Framework provides an expanded methodology to systematically track and record the state of change in soil chemical, physical and biological characteristics in 'A' horizon soils to generate a unique descriptor analogous to the generation of a soil "fingerprint". The Framework monitors 'A' horizon characteristics that not only represent dynamic soil properties (soil structure, organic matter content) but also soil and land information (slope attributes, soil texture, land use and surface conditions) that contextualizes the information to allow comparative interpretations of soil quality changes due to beneficial management practices among different soils, or the same soils under different conditions spatially and temporally.

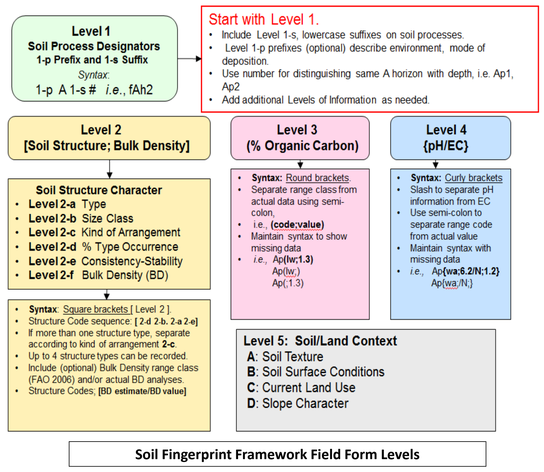
Existing taxonomic protocols for 'A' horizon suffix designators in many soil classification systems emphasize soil genetic process. By introducing additional lowercase suffix levels related to soil properties and morphology, important information can be included in the 'A' horizon designation for enhancing topsoil characterization. The 'A' Horizon Framework was developed with 5 levels of enhanced lower case suffix designators designators are defined: Level 1, Soil processes and environmental context; Level 2, Soil structure-bulk density; Level 3, Organic carbon; Level 4, pH and electrical conductivity; and, Level 5, Soil and landscape context. An electronic Field Form (currently Microsoft Excel©) based on the new Framework syntax automatically records and concatenates the soil fingerprint code in an enhanced (all Levels included) and a minimum detail mode focused on the key dynamic properties.

Interpretative products can be developed to visualize or "rate" the soil quality at a location or with time.

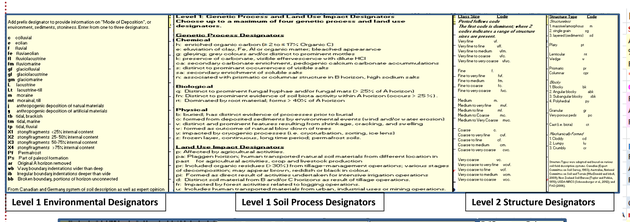
Materials & methods



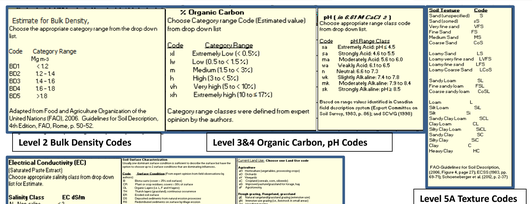
Soil Fingerprint Framework Field Form – Excel ©



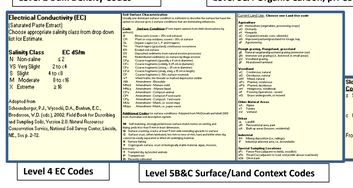
Soil Fingerprint Framework Field Form Levels



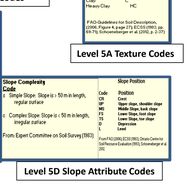
Level 1 Environmental Designators | Level 1 Soil Process Designators | Level 2 Structure Designators



Level 2 Bulk Density Codes | Level 3&4 Organic Carbon, pH Codes | Level 5A Texture Codes



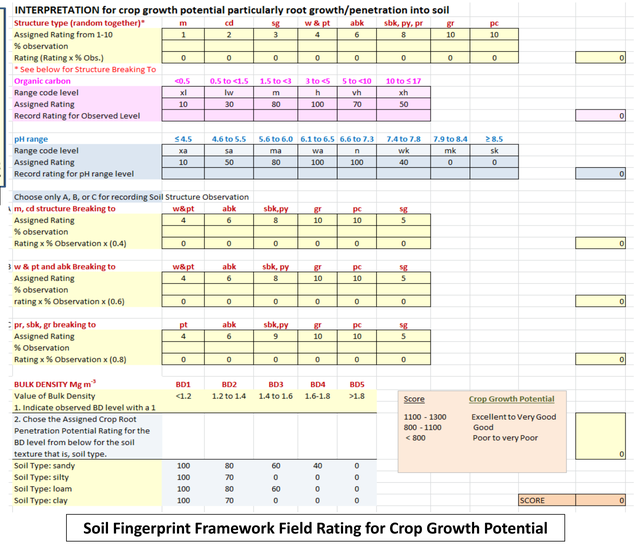
Level 4 EC Codes



Level 5B&C Surface/Land Context Codes

Level 5D Slope Attribute Codes

Soil Fingerprint Framework Field Form Level Codes



Soil Fingerprint Framework Field Rating for Crop Growth Potential

Results & discussion

Comparison Study (Since 1959) Different Crops on Same Soil Type
Conventional Tillage – Brookston Clay Loam;
Humic Gleysol (Aquolls, Humaquepts)
Woodslee, Ontario (Canada)

Sod – Permanent Cover | **Corn - Rotation** | **Corn - Continuous**

Ahp [gr +sbk;BD1] (6.0) | **Apfn[bk-sbk+py+gr;BD2](2.8)** | **Apg[cd-sbk;BD3](2.3)**

Field Site	Plot	Repl.	Depth (cm) Upper	Depth (cm) Lower	Ref. No.	Soil Fingerprint Code: Enhanced Detail Mode: All levels and Options
SOD	6	F	0	10	1	Ahp [30fm.gr2 +60fm.sbk2;BD1/0.91] CL (xh;6) {n;/VS;};TH;/aG/sL1
RC	2	F	0	10	2	Apfn [30bk2 --30sbk2+20py3+10gr;BD2/1.33] CL (m;2.8) {n;/VS;};CR;/aC/sL1
CC	3	F	0	10	3	Apg [60cd3 --40sbk2;BD3/1.49] CL (m;2.3) {n;/VS;};CR;WT/aC/sL1

Soil Fingerprint Code: Enhanced Detailed Mode: All Levels

SCORE	CROP GROWTH POTENTIAL
1100 - 1300	Excellent to Very Good
800 - 1100	Good
< 800	Poor to Very Poor

WDSOD F	SCORE	1332

SCORE	CROP GROWTH POTENTIAL
1100 - 1300	Excellent to Very Good
800 - 1100	Good
< 800	Poor to Very Poor

WD RC F	SCORE	902

SCORE	CROP GROWTH POTENTIAL
1100 - 1300	Excellent to Very Good
800 - 1100	Good
< 800	Poor to Very Poor

WD CC F	SCORE	224

Soil Fingerprint Code Ratings for Crop Growth Potential

Conclusions

- **Provides a unique soil fingerprint code incorporating dynamic soil properties**
- **Provides for adaptability to build a database to enable spatial and temporal evaluations**
- **Designed for detailed monitoring at field, plot and landscape scales**
- **Uses Taxonomic protocols from existing field description and classification systems providing consistency in terminology for undertaking interpretations of change**
- **Linking to interpretations and ratings allows for monitoring Soil fingerprint and soil quality spatially and temporally**

References

Fox, C.A., Tarnocai, C., Broll, G., Joschko, M., Kroetsch, D. and Kenney, E. 2014. Enhanced A Horizon Framework and Field Form for detailed field scale monitoring of dynamic soil properties. Can. J. Soil Sci. 2014, 94(2): 189-208, 10.4141/cjss2013-079.

Acknowledgements

- C. Tarnocai, G. Broll, M. Joschko, E. Kenney

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