

# Standards and Specifications for High Intensity Soil Survey for Agriculture in Illinois

July 1999



A Soil Survey Centennial Initiative

# **Standards and Specifications for High Intensity Soil Survey for Agriculture in Illinois**

## **Table of Contents**

	<b><u>Page</u></b>
• <b>INTRODUCTION</b>	<b>1</b>
• <b>SPECIAL CONSIDERATIONS</b>	<b>2</b>
• <b>STANDARDS AND SPECIFICATIONS</b>	<b>4</b>
<b>Work Plan</b>	<b>4</b>
<b>Survey Area Size</b>	<b>4</b>
<b>Map Base</b>	<b>4</b>
<b>Map Scale</b>	<b>4</b>
<b>Soil Survey Descriptive Legend</b>	<b>4</b>
<b>Identification Legend</b>	<b>4</b>
<b>Conventional and Special Symbols Legend</b>	<b>5</b>
<b>Descriptions and Classifications of the Soils</b>	<b>5</b>
<b>Map Units</b>	<b>5</b>
<b>Soil Mapping Procedure</b>	<b>6</b>
<b>Soil Survey Augmentation</b>	<b>6</b>
<b>Point Data</b>	<b>6</b>
<b>Cartographic Procedures</b>	<b>6</b>
<b>Product / Report</b>	<b>6</b>
<b>Data Sharing</b>	<b>6</b>
<b>Certification</b>	<b>6</b>
• <b>REFERENCES</b>	<b>8</b>
• <b>APPENDICES</b>	
<b>A. Guide to Map Scales and Minimum Size Delineation</b>	<b>9</b>
<b>B. Conventional and Special Symbols Legend</b>	<b>10</b>
<b>C. Example Point Data Worksheet</b>	<b>11</b>
<b>D. Contact List</b>	<b>12</b>

## **INTRODUCTION**

Soil survey is the systematic examination, description, classification, and mapping of soils in an area. Soil surveys are classified according to the type and intensity of field examination.

Different intensities of field study, different degrees of detail in mapping, different phases or levels of abstraction in defining and naming map units, and different map unit designs are the basis for differentiating five orders of soil surveys.

The soil surveys produced in Illinois through the Illinois Cooperative Soil Survey at map scales of 1:12,000, 1:15,840, and 1:20,000 are considered “2<sup>nd</sup> Order” or “intensive” soil surveys. The standards and specifications for making “2<sup>nd</sup> Order” soils surveys are well documented and presented in the Natural Resources Conservation Service’s (NRCS) National Soil Survey Handbook (NSSH) and Soil Survey Manual (SSM).

“1<sup>st</sup> Order” or “very intensive” soil surveys (“high intensity” soil survey used in this document) are more detailed and have a smaller minimum size delineation than the “2<sup>nd</sup> Order” soil surveys and use map scales larger than 1:12,000 (see Appendix A). Guidelines for making “1st Order” soil surveys are not well documented in NSSH or SSM. The standards and specifications presented in this document establish the minimum level of acceptable quality and describe the technical details required for making a high intensity soil survey for agriculture.

## **SPECIAL CONSIDERATIONS**

The soil factor equation,  $S = f(cl, o, pm, r, t, \dots)$ , identifies the five factors of soil formation and provides the basis for the soil-landscape model which is the guiding paradigm for soil survey. An appreciation and understanding of this model allows a trained and experienced soil scientist to accurately delineate soils as they occur on the landscape. The standards and specifications presented herein require that the resulting soil map be produced using the concepts of the soil-landscape model and the soil survey techniques described in the NSSH, SSM, and Soil Taxonomy. The soil survey must depict and describe how soils occur on the landscape.

The literature on site specific management for agriculture documents the fact that the relationship between crop yields and soil properties is complex. Many papers conclude that the soil properties and qualities described in soil survey map units are generally inadequate to develop site specific crop management options. These conclusions may be somewhat erroneous. While not all of the soil characteristics being measured or observed in traditional soil survey are relevant for site specific crop management, there are numerous soil properties and qualities that affect the spatial and temporal variability in crop yields that are described in soil survey. Soil physical properties such as texture, structure, depth, and soil color are highly correlated to parent material and topography and are described in soil survey. Chemical properties important to crop growth, such as soil test N, P, and K typically have a poor correlation with soil survey map units.

One of the challenges in producing a high intensity soil survey for agriculture is to provide data and information for those soil attributes that impact crop growth; that impact the movement and accumulation of water within the soil landscape; and that reflect the long term status of the soil resource. In addition to soil attributes linked to soil survey map units, point observations and point data are needed so that interpolation techniques and models may be utilized to estimate specific soil characteristics across the landscape. Spatial detail and data, information, and knowledge about soil properties should be co-related. As spatial detail increases, so should knowledge about soil properties.

Most sample strategies are designed to avoid bias through a random or probability sampling scheme. However, soil mapping is a science based on information and techniques learned through experience (tacit knowledge). Decisions on where and what to sample when producing a soil survey and collecting soil survey data are based on this tacit knowledge. The soil variability of the area, map scale, and professional judgment of the soil scientist dictate in part where and how many points will be observed. What to observe at every point will be dictated by the intended use of the data, soil variability and professional judgment.

## **STANDARDS AND SPECIFICATIONS**

These standards and specifications establish the minimum level of acceptable quality and describe the technical details required for producing a high intensity soil survey for agriculture.

### **1. Work Plan**

A work plan should be developed for each high intensity soil survey project area. The purpose and objectives of the survey, spatial and attribute data acquisition and development, completion date, and product delivery should be addressed.

### **2. Survey Area Size**

No survey area size limit is set. However, farm or field size should dictate survey area size.

### **3. Map Base**

The map base must be an aerial photograph. Orthophotography is the preferred map base. It is recommended that a detailed contour map be used to compliment the aerial photograph. (see 11. Soil Survey Augmentation)

### **4. Map Scale**

Map scale is 1:12,000 or larger, but not larger than 1:7920. The map scale should meet the needs of the soil survey user. The minimum size soil map delineations is dictated by the map scale (see to Appendix A) and should conform to the delineation of the users smallest management unit.

### **5. Soil Survey Descriptive Legend**

A descriptive legend is required for all high intensity soil surveys. It is composed of three parts: (1) Identification legend, (2) Conventional and Special symbols legend, and (3) descriptions and classification of the soils.

### **6. Identification Legend**

The identification legend lists the map unit symbols and corresponding map unit names used on the soil map. The soil survey legends used for “2nd order” soil surveys areas, as amended by the Major Land Resource Area (MLRA) soil legends, should be used as a basis for establishing the identification legend for a high intensity soil survey project. Map unit symbols and names should conform to the conventions established and used by the Illinois Cooperative Soil Survey. Any changes or additions to the MLRA legend should be coordinated with the NRCS MLRA soil survey project leader (see Appendix D).

## **7. Conventional and Special Symbols Legend**

A conventional and special symbols legend identifies the cultural, hydrographic and special symbols used on the soil map. The need for special symbols is determined by their significance to the use of the soil map. Conventional and special-symbols should conform to the guidelines and protocol established and used by the Illinois Cooperative Soil Survey. All Symbols should correspond to those listed in Appendix B. Additions to the legend should be coordinated with the NRCS MLRA Soil Survey Project Leader (see to Appendix D).

## **8. Descriptions and Classification of the Soils**

Descriptions of the taxa as they occur in the area delineated on the soil map form the primary reference for proper mapping, classification, correlation and interpretation of the soils of an area. These descriptions and a table of classification were established for “2nd Order” soil surveys and are maintained by the NRCS MLRA soil survey project leader. Soil scientists conducting high intensity soil surveys must be familiar with these descriptions and must conform to guidelines provided in the National Soil Survey Handbook, Soil Survey Manual, and Soil Taxonomy. Any changes to the established taxonomic unit descriptions, map unit descriptions, and table of classification should be coordinated with the NRCS MLRA soil survey project leader. (see Appendix D)

## **9. Map Units**

Map units are designed to meet the objectives of the high intensity soil survey as stated in the work plan. All map units in a high intensity soil survey should be consociations (complexes are allowed, if needed, to depict complexity). Delineated areas are dominantly a single taxon and similar soils. At least one-half of the pedons in each delineation are of the named soil. Most of the remainder of the delineation consists of similar inclusions. The total amount of dissimilar soils should not exceed 15 to 25 percent as described in SSM.

The minimum size map unit delineation should be identified in the work plan. It should represent the size of the smallest area that is managed for the intended land use. The map scale must accommodate legible delineations of the smallest size map unit. (see Appendix A).

## **10. Soil Mapping Procedures**

The soils in each delineation are identified by transecting or traversing the landscape and making sufficient soil observations to enable accurate soil boundary placement and to ensure precise and appropriate soil map unit composition. Soil boundaries are observed throughout their length and their placement corresponds to changes in soil properties and landscape position. At a minimum, at least two observations will be made in each delineation.

The annual “window of opportunity” for conducting high intensity soil survey for agriculture may be restricted by crop cover, snow cover, and other conditions that may obscure the soil surface and micro-topography of the area.

## **11. Soil Survey Augmentation**

Where available, detailed contour maps, color infrared aerial photography, digital elevation models (DEM's), digital orthophotography (DOQs), ground penetrating radar (GPR), electromagnetic induction (EM), electromagnetic conductivity (EC), global positioning system (GPS), larger scale (>1:7920) aerial photography, and other tools may be used to collect point data and help establish accurate line placement. Geophysical measurements should be correlated with observed and measured soil and landscape features.

## **12. Point Data**

Point data will be collected at each point of observation during the course of the soil survey or at those selected points determined by the work plan. The point data will be georeferenced and will be recorded on a point data worksheet (see Appendix C for an example).

The purpose of the survey, soil variability, map scale, and professional judgment of the soil scientist will dictate where and how many points will be observed. The kind and number of point data to be collected should be identified in the work plan. The georeferencing technique should also be identified in the work plan.

## **13. Cartographic Procedures**

Cartographic guidelines for soil map compilation, soil map finishing, and soil map digitizing outlined in National Soil Survey Handbook should be followed.

## **14. Product/Report**

High intensity soil survey report will include:

- (1) Reference to Standards and Specifications for High Intensity Soil Survey for Agriculture.
- (2) Geographic location and size of project area.
- (3) Soil map with soil identification legend and conventional and special symbols legend.
- (4) Soil attribute data, map unit descriptions, soil interpretations, and point data (per work plan). Source of all data should be documented.
- (5) Certification Statement
- (6) Signature of soil scientist and a date soil map/report was produced.

It is recommended that both hard copy and electronic copy products be produced.

## **15. Data Sharing**

With the willingness of the Certified Professional Soil Classifier and the concurrence of his/her client, the high intensity soil survey data will be provided to NRCS MLRA Soil Survey Project Leader for possible inclusion in National Soil Information System (NASIS).

## **16. Certification**

High intensity soil survey will be completed by a Certified Professional Soil Classifier certified by Illinois Soil Classifiers Association (ISCA), or by the American Registry of Certified Professional in Agronomy, Crops, and Soils (ARCPACS) or by a Registered Professional Soil Scientist registered with the National Society of Consulting Soil Scientists.

The following certification statement will be on all high intensity soil survey map products.  
**“This map product meets the technical standards of the Illinois Cooperative Soil Survey.  
It is a special purpose product produced by a Certified Professional Soil Classifier.  
There is a report that accompanies this map.”**

Should a client impose constraints on the soil scientist that preclude him or her from producing a product that meets the standards of the Illinois Cooperative Soil Survey a statement will be added to the map label indicating, **“This map product is not within the technical standards of the Illinois Cooperative Soil Survey because....”**

A high intensity soil survey will be considered a supplement to the “2nd Order” soil survey and not a replacement.

## REFERENCES

United States Department of Agriculture Handbook No. 18, 1993. Soil Survey Manual, and amendments, USDA Natural Resources Conservation Service.

<http://www.nhq.nrcs.usda.gov/BCS/soil/smanual.html>

United States Department of Agriculture, 1975. Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys, Soil Conservation Service, US Department of Agriculture Handbook 436, 754pp illus.

United States Department of Agriculture, November 1996. National Soil Survey Handbook USDA Natural Resources Conservation Service. <http://www.statlab.iastate.edu/soils/nssh>

United States Department of Agriculture, Natural Resources Conservation, 1996. Keys to Soil Taxonomy, Seventh Edition, US Government printing Office, Washington, DC

<http://www.statlab.iastae.edu/soils/keytax>

United States Department of Agriculture, National Resources Conservation Service, Field Book for Describing and Sampling Soils

[http://www.statlab.iastate.edu/soils/nssc/field\\_gd/field\\_gd.htm](http://www.statlab.iastate.edu/soils/nssc/field_gd/field_gd.htm)

United States Department of Agriculture, Natural Resources Conservation Service, Official Series Descriptions.

<http://www.statlab.iastate.edu/soils/osd>

**Standards and Specifications  
For High Intensity Soil Survey  
For Agriculture in Illinois**

**APPENDIX A**

**Guide to Map Scales and Minimum Size Delineations**

<b><u>Map Scale</u></b>	<b><u>Inches/Mile</u></b>	<b><u>Minimum Size Delineation* (acres)</u></b>	<b><u>Soil Survey Order</u></b>
<b>1:5,000</b>	<b>12.7</b>	<b>0.25</b>	<b>1<sup>st</sup> Order</b>
<b>1:7,920</b>	<b>8.00</b>	<b>0.62</b>	<b>1<sup>st</sup> Order</b>
<b>1:10,000</b>	<b>6.34</b>	<b>1.00</b>	<b>1<sup>st</sup> Order</b>
<b>1:12,000</b>	<b>5.28</b>	<b>1.43</b>	<b>1<sup>st</sup> /2<sup>nd</sup> Order</b>
<b>1:15,840</b>	<b>4.00</b>	<b>2.5</b>	<b>2<sup>nd</sup> Order</b>
<b>1:20,000</b>	<b>3.17</b>	<b>4.0</b>	<b>2<sup>nd</sup> Order</b>
<b>1:24,000</b>	<b>2.64</b>	<b>5.7</b>	<b>3<sup>rd</sup>/2<sup>nd</sup> Order</b>
<b>1:31,680</b>	<b>2.00</b>	<b>10.0</b>	<b>3<sup>rd</sup> Order</b>
<b>1:63,360</b>	<b>1.00</b>	<b>40.00</b>	<b>3<sup>rd</sup> Order</b>

**\* The “minimum size delineation” is taken as 1/16 square inch area. Cartographically, this is about the smallest area in which a symbol can be readily printed.**

**Standards and Specifications  
For High Intensity Soil Survey  
For Agriculture in Illinois**

**APPENDIX B**

**Conventional and Special Symbols Legend**

**Standards and Specifications  
For High Intensity Soil Survey  
For Agriculture in Illinois**

**APPENDIX C**

**EXAMPLE POINT DATA WORKSHEET**

Client \_\_\_\_\_  
 Property Owner \_\_\_\_\_  
 Project \_\_\_\_\_  
 Date \_\_\_\_\_  
 County \_\_\_\_\_  
 Topoquad \_\_\_\_\_  
 Observation Pt. # \_\_\_\_\_  
 Georeference \_\_\_\_\_  
 Map Unit Symbol \_\_\_\_\_  
 Map Unit Name \_\_\_\_\_  
 Land Use \_\_\_\_\_  
 Landform Position \_\_\_\_\_  
 Landform Slope \_\_\_\_\_  
 % Slope \_\_\_\_\_  
 Aspect \_\_\_\_\_  
 Thickness of A \_\_\_\_\_  
 Texture of A \_\_\_\_\_

Structure of A \_\_\_\_\_  
 Color of A \_\_\_\_\_  
 pH of A \_\_\_\_\_  
 Thickness of E \_\_\_\_\_  
 Texture of E \_\_\_\_\_  
 pH of E \_\_\_\_\_  
 Thickness of B \_\_\_\_\_  
 Texture of B \_\_\_\_\_  
 Structure of B \_\_\_\_\_  
 pH of B \_\_\_\_\_  
 Depth to 2 chroma \_\_\_\_\_  
 Depth to 2 chroma \_\_\_\_\_  
 Mottles/matrix \_\_\_\_\_  
 Observed Water Table \_\_\_\_\_  
 Drainage Class \_\_\_\_\_  
 Depth to Carbonates \_\_\_\_\_  
 Depth to Lithic/Paralithic \_\_\_\_\_

*NOTES*

Estimated Ksat \_\_\_\_\_  
 Estimated AWC \_\_\_\_\_  
 \_\_\_\_\_  
 Series \_\_\_\_\_  
 Classification \_\_\_\_\_  
 By: \_\_\_\_\_ Date: \_\_\_\_\_  
Soil Scientist

**Standards and Specifications  
For High Intensity Soil Survey  
For Agriculture in Illinois**

**APPENDIX D**

**CONTACT LIST**

American Registry of Certified Professionals  
in Agronomy, Crops and Soils (ARCPACS)  
Soil Science Society of America  
677 South Segoe Road  
Madison, WI 53711-1081  
Phone: 608/273-8080

Illinois Soil Classifiers Association, President  
2118 W. Park Ct.  
Champaign, IL 61821  
Phone: 217/353-6643

United States Department of Agriculture  
Natural Resources Conservation Service  
<http://www.il.nrcs.usda.gov>  
State Soil Scientist  
2118 W. Park Ct.  
Champaign, IL 61821  
Phone: 217/353-6643

Carbondale MLRA Soil Survey Office  
148 E. Pleasant Hill Road, Suite 105  
Carbondale, IL 62903  
Phone: 618/453-5577

Charleston MLRA Soil Survey Office  
683 Castle Drive  
Charleston, IL 61920  
Phone: 217/345-6767

Aurora MLRA Soil Survey Office  
4255 Westbrook Drive, Suite 218  
Aurora, IL 60504  
Phone: 630/851-3254

United States Department of Agriculture  
Natural Resources Conservation Service  
(continued)

Rock Falls MLRA Soil Survey Office  
Canal Plaza North  
102 East Route 30  
Rock Falls, IL 61071  
Phone: 815/625-3417

Springfield MLRA Soil Survey Office  
40 Adloff Lane, Suite 3  
Springfield, IL 62703  
Phone: 217/241-6635

Illinois Department of Transportation  
Aerial Survey Section (IDOT Map Sales)  
2300 South Dirksen Parkway, Room 005  
Springfield, IL 62764  
Phone: 217/782-0834  
Fax: 217/524-4149